WATER PERMIT NO. 8212-3

Name of Applicant: **City of Yankton**

Address: **315 W Riverside Dr, Yankton SD 57078** Phone: **605 660-6704**

Amount of Water Claimed: **20.12 cfs – 6,050 acre-feet annually** Total Acres: **NA**

Source of Water Supply: **groundwater (one well)**

Water to be used for: **municipal** County: **Yankton**

Type of Waste Disposal System:

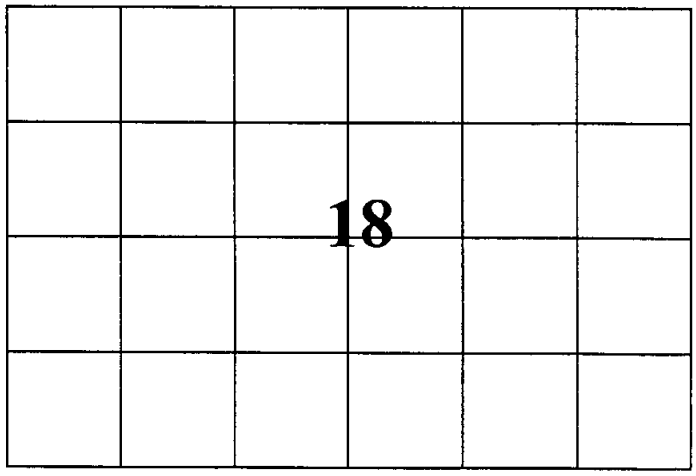
Location:

PRIORITY Date Received: **3-25-16** Application/License Fee: **$ 5,850.00**

Corrected Application Received: - Period of Annual Use: **Jan 1 – Dec 31**

Remarks:

Diversion Point: **SE 1/4 SE 1/4 Sec 18-T93N-R55W**



Land to be Irrigated: **NA**

Depth of Well: **110 feet deep**

Well Driller:

Remarks:

Type of Map: **aerial**

Prepared by:

Reviewed and the Number Assigned on: **3-28-16** By: **Karen Schlaak**

Notice of Hearing - date to intervene: _____

SD EForm - 1585LD V4
FORM 2: Application for uses other than irrigation
(type or print)

Mail to:	(office use only)
PMB 2020 DENR - Water Rights 523 E Capitol Ave Pierre, SD 57501-3182 ph. (605) 773-3352	No. 8212-3 Hydrologic Unit 10170101 Basin Missouri River Newspaper Press & Dakotan, Yankton

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Application For Permit To Appropriate Water Within The State Of South Dakota

Check use(s) of water:

- [X] Municipal
- [ ] Rural Water System
- [ ] Domestic (over 18 gpm)
- [ ] Suburban Housing
- [ ] Commercial
- [ ] Industrial
- [ ] Recreational
- [ ] Fish & Wildlife
- [ ] Other
- [ ] Institutional
- [ ] Geothermal Heat

Type of Application: (check one)

- [X] **New**
- [ ] **Vested Right** (Use predates Mar 2, 1955)
- [ ] **Future Use Reservation**
- [ ] **Place to Beneficial Use Water Reserved by Future Use Permit No.** _____
- [ ] **Amendment/Correction to Permit No.** _____

Description of amendment/correction: (i.e. change diversion point(s), add diversion point(s), change use, etc.)

1. Name to Appear on Water Permit **City of Yankton, SD**

   (check one) [X] Owner [ ] Tenant/lessee [ ] Owner's Legal Agent _____
   (name and complete address if different than above name)

   Mailing Address **315 West Riverside Drive** (Address) **Yankton** (City) **SD** (State) **57078** (Zip Code)

   Work ~~Home~~ Phone **(605) 668-5273** Cell **(605) 660-6704** Email **kgoodmanson@cityofyankton.org**

2. Amount of water claimed **20.12** *CFS or **9,030 GPM (3 Pumps Running)** **GPM **6,050 (See Calculations Attached)** ***AF
   (*Cubic Feet per Second) (**Gallons per Minute) (***Acre Feet - storage capacity of dam/dugout or annual use if applicable)

3. Source of water supply ~~**Lower James - Missouri River Alluvium**~~ Missouri : Elk Point

4. Location of point of diversion **1 well in the SE1/4 Sec. 18 T93N, R55W (See attached location description).** Lot 1 County **Yankton**
   (example - 3 wells in SW1/4 NE1/4 section 12-T104N-R53W)

   If not a public water supply (e.g. municipal), will water be used outside of the area described above? [ ] Yes [X] No

   If "Yes," where will water be used? _____
   (example - NW1/4 section 12-T104N-R53W)

5. County or counties where water will be used **Yankton**

6. Annual period during which water is to be used **All year (January through December)**

7. Give a description of the project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)

   A copy of the Collector Well Siting Study at Paddlewheel Point is attached. The project will include the construction of a new 16ft diameter horizontal collector well located near the Missouri River at Paddlewheel Point in Yankton, SD. The well will be approximately 110 ft deep with 13 screened laterals extending an average of 185 ft horizontally from the well caisson. The well will include a pump station structure designed to deliver 12 MGD (8,333 gpm). Water from the well will be delivered to the City's existing Water Treatment Plant No. 2 and a new (near future) water treatment plant.

I, **Kyle Goodmanson, Director of Environmental Services**, the applicant, certify that I have read this application, have examined the attached map, and that the matters stated are true.

2012-09

Attachments: Attach Form 2A if diversion is from a well or dugout, or if storage of water is proposed. Also, attach map and any other technical information. (see instructions)

City of Yankton, SD
Horizontal Collector Well
Location Description

Commencing at the East Quarter Corner of Section 18, Township 93 North, Range 55 West of the Fifth Principal Meridian. Thence S1 58' 02"E along the East Line of said Section 18 for a distance of 2328.15 Feet to a point on said East Line. Thence S88 01' 58"W for a distance of 131.83 Feet to the center of the proposed Well Caisson. Yankton County, South Dakota.

SOUTH DAKOTA
WATER PERMIT NO. 8212-3

Date of first receipt of application March 25, 2016.
Date of return to applicant for corrections, amendments or changes March 29, 2016.
Date of receipt of corrected application April 4, 2016.

The Chief Engineer, on behalf of the Water Management Board, issues Water Permit No. 8212-3 to the City of Yankton, 315 West Riverside Drive, Yankton SD 57078 authorizing the construction of the water use system and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 8212-3 appropriates 20.12 cubic feet of water per second (6,050 acre-feet of water annually) from one well to be completed into the Missouri:Elk Point Aquifer (110 feet deep) located in Lot 1 of the SE 1/4 Section 18-T93N-R55W. The project consists of drilling a new well with 13 screened laterals extending an average of 185 feet horizontally from the well caisson.

2. The water appropriated shall be used for the purpose of municipal use and may not exceed the amount of water needed for beneficial use.

3. The water is to be used during the following described annual period: January 1 – December 31.

4. The date of approval of Permit No. 8212-3 is June 13, 2016.

5. The date from which applicant may claim right is March 25, 2016.

6. One-fifth of the construction is to be completed on or before December 13, 2018.

7. All construction is to be completed on or before June 13, 2021.

8. Water is to be put to beneficial use on or before June 13, 2025.

9. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.

2. The well authorized by Permit No. 8212-3 shall be constructed by a licensed well driller and construction shall comply with Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28.

3. The Permit holder shall report to the Chief Engineer annually the amount of water withdrawn from the Missouri:Elk Point Aquifer.

4. Water Permit No. 8212-3 authorizes a total annual diversion of 6,050 acre feet of water.

WATER MANAGEMENT BOARD

By: Jeanne Goodman

Jeanne Goodman, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

JUN 2 1 2016
date

STATE OF SOUTH DAKOTA * GREAT SEAL * 1889

Form 2A
(Complete applicable portions only)

Supplemental Information

(type or print)

1. Well Information (check one or both as applicable) [X] Drilling new well(s) [ ] Using existing well(s)

a) If new wells, how many 1 Have test holes been drilled [X] Yes [ ] No Drilled by **Test Well - Thein Well Drilling**
Test Holes - Layne Specialty Drilling
(if yes, please provide copies of logs) **(Test Hole logs included in attached report)**

b) If existing wells, how many ___ Provide copy of log(s), if available. Drilled by _____

c) Well Depth **110 ft.** Depth to Top of Water Bearing Material **0 ft.** Depth to Water from Surface **10 ft.**

d) Distance to nearest existing domestic well:

On applicant's property **Over 1,000 ft.** On property owned by others **Over 2,000 ft.**

2. Wastewater Disposal System Information

a) Type of System (i.e. septic tank, drain field) _____

b) System Capacity (gallons) _____ Year Constructed _____

c) Connected to the City of _____ Sanitary System

3. Dugout Information

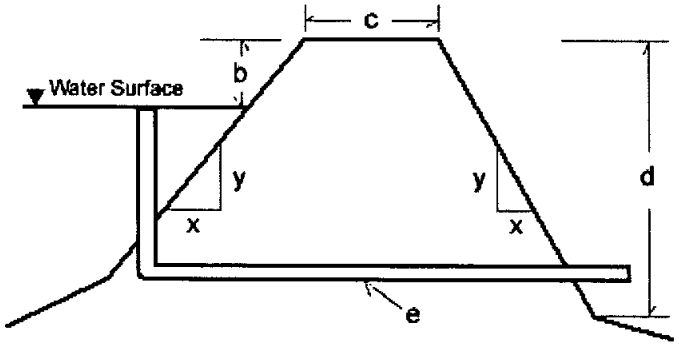
a) Surface Dimensions _____ Depth _____

b) Depth to water (ground surface to water level) _____

4. Water Storage Dams

If the proposed water use system contains one or more storage dams, please furnish the information requested below for each dam. The locations of the dams need to be shown on the map submitted with the application.

a) If a private engineering firm or government agency was involved in the design of this dam, please give their name and address:



b) Freeboard _____

c) Crest Width _____

Crest Length _____

d) Height _____

e) Primary Outlet Capacity _____

If pipe, diameter _____

f) Secondary Spillway Capacity _____

Spillway Width _____

g) X & Y Slope (e.g. 3 to 1 is a typical slope)

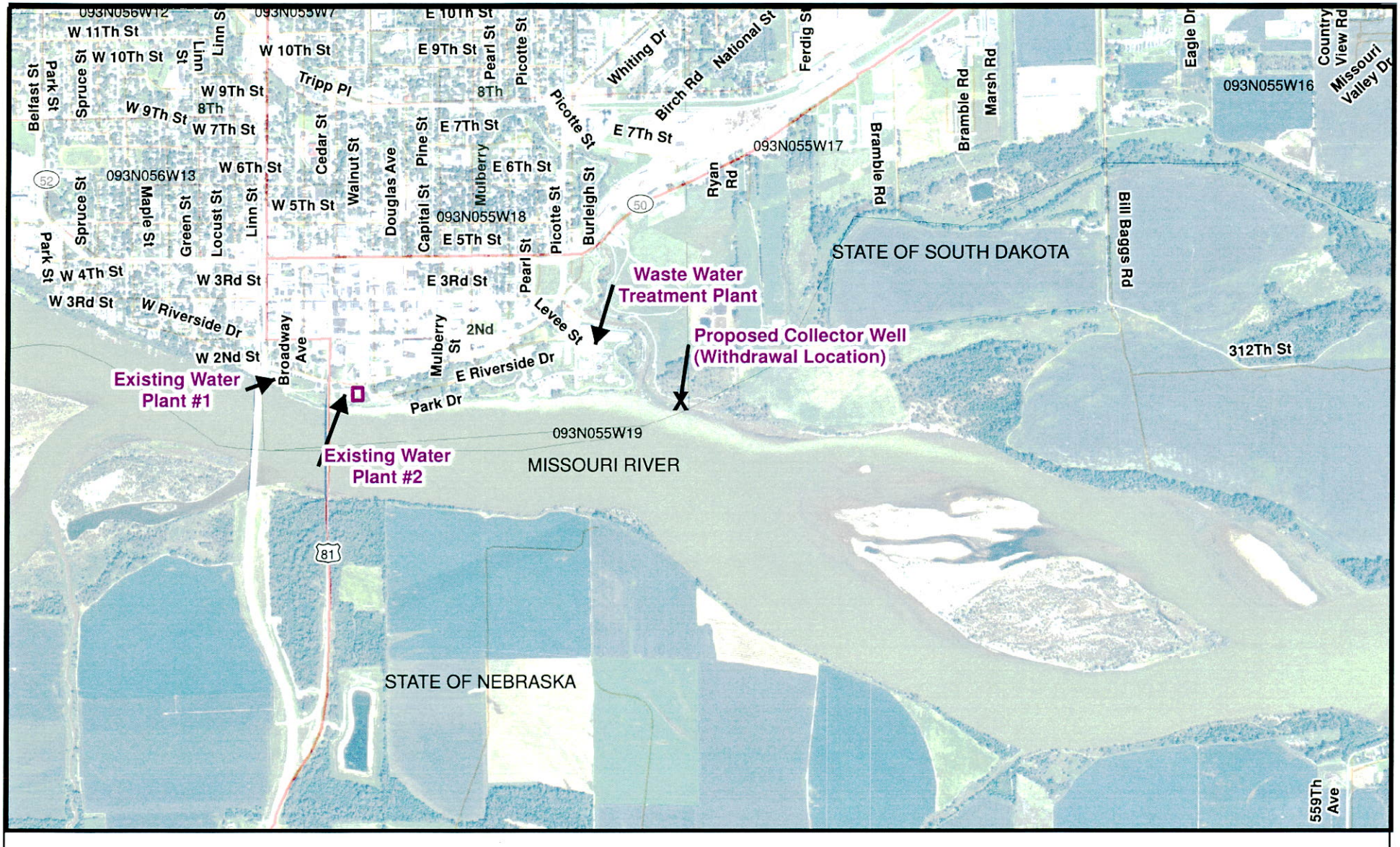
Upstream _____

Downstream _____

h) Surface Area of Impoundment _____

i) Storage _____ Acre Feet

j) Drainage Area Above Dam _____ Acres



CITY OF YANKTON SOUTH DAKOTA

N

0 750 1,500
Feet

YANKTON HORIZONTAL COLLECTOR WELL WITHDRAWAL POINT

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September 2014

Figure
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City of Yankton, SD
Water Rights Permit for New Horizontal Collector Well
Permit Application Fee Calculations

I. **Determine the Projected Maximum Day and Average Day Demands**

A. From City of Yankton Water Facility Plan 2013
- Projected Maximum Day Demand for 2035 = 10.03 MGD
- Average Annual Peaking Factor = 2.43 (Based on records from 1994-2011)
- Estimated Average Annual Water Usage for 2035 = 4.12 MGD (10.03MGD/2.43)

II. **Calculate the Pumping Capacity Required**

A. New Membrane Water Treatment Plant.
- Raw Water Pumping = 11.8 MGD
- Total Water Produced = 9.0 MGD
- Ratio of gallons of raw water pumped per gallon produced = 1.31 (11.8 MGD/9.0 MGD).

B. Existing Lime Softening Water Treatment Plants.
- Total Raw Water Pumped in 2013 = 942.09 MG.
- Total Water Treated in 2013 = 783.55 MG.
- Ratio of gallons of raw water pumped per gallon produced = 1.2 (942.09 MG/783.55 MG)

C. Determine Maximum Pumping Rate Required for 10.03 MGD Maximum Day Demand (Assume 9 MGD through new membrane treatment plant and 1 MGD through existing WTP #2).
- Max rate to new membrane plant = 11.80 MGD (9.0 MGD x 1.31)
- Max rate to existing WTP #2 = 1.2 MGD (1.0 MGD x 1.2)
- Total Required Pumping Rate = **13.0 MGD** (11.8 MGD + 1.20 MGD)

III. **Determine the annual volume in acre-ft. of water claimed** (Assume only the new membrane plant is operated to meet average day demands).
- Average annual day demand = 4.12 MGD (From I. above)
- Average day water pumped = 5.40 MGD (4.12 MGD x 1.31)
- Total annual water pumped = 1971 MG (5.40 MGD x 365 days)
- 1 Acre-ft. of water = 0.3258 MG.
- Annual volume of water used in acre-ft. **= 6,050 acre feet per year** (1971 MG/0.3258 MG/Acre-ft.)

IV. **Calculate the permit application Fee:**

• First 120 acre-ft.	$500.00
• Second 120 acre-ft.	$250.00
• Each additional 120 acre-ft. or portion there of at $100 each: {(6,050 acre-ft. – 240 acre-ft)/120 acre-ft} = 48.42 ; 49 x $100:	$4,900.00
• Fee for final inspection	$200.00
• Total Fee	**$5,850.00**

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date 3/21, 20 16

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The following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. 8212-3 to Appropriate Water, to construct and to put water to beneficial use	5650	00
Fee for Application for Permit No. _____ to Appropriate Water for Future use		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. 8212-3	200	00
Fee for Filing Transfer Form _____		
Fee for _____		
Fee for Issuing New Well Driller's License No. _____ for C.Y. _____		
Fee for Renewal of Well Driller's License No _____ for C.Y. _____		
Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____		
Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____		
(Any Other Work Provided by Law) TOTAL	5850	00

No. 07795

By Jeanne Goodman
Chief Engineer

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March 24, 2016

Mr. Eric Gronlund
SD Department of Environment and Natural Resources
PMB 2020
Water Rights Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3182

Re: Horizontal Collector Well – Water Rights
Yankton, SD
City Project No. ES-2014-05

Dear Mr. Gronlund,

Attached is an "Application for Permit to Appropriate Water within the State of South Dakota" for the City of Yankton's new Horizontal Collector Well. As you are aware a check in the amount of $5,850 for the permit application fee was mailed separately. For your reference we have also attached a copy of the "Collector Well Siting Study at Paddlewheel Point" in addition to water quality data, test well data, and monitoring well data.

Please contact me at 605-977-7760 with any questions regarding this permit application.

Sincerely,

CITY OF YANKTON, SD

Kevin F Newman

Kevin F. Newman, P.E.
Project Engineer

hdrinc.com

315 West Riverside Drive, Yankton, SD 57078
T 605.668.5273 C 605.660.6704

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PROGRAM

COLLECTOR WELL SITING STUDY AT PADDLEWHEEL POINT

PREPARED FOR:
CITY OF YANKTON, SOUTH DAKOTA

PREPARED BY:
HDR ENGINEERING, INC.

AUGUST 2014

HDR No. 223788



Table of Contents

1 Executive Summary 1-1

1.1 Purpose 1-1

1.2 Aquifer Investigation 1-1

1.3 Aquifer Parameters 1-1

1.4 Aquifer Yield 1-2

1.5 Preliminary Mechanical Capacity of Collector Wells 1-2

1.6 Anticipated Quality of Produced Water 1-3

1.7 Opinion of Probable Cost 1-3

2 Introduction 2-1

2.1 Background 2-1

2.2 Purpose 2-1

2.3 Study Area Description 2-2

2.3.1 Site Geology / Hydrogeology 2-2

3 Site Exploration 3-1

3.1 Test Hole Drilling 3-1

3.2 Selection of Test Well Location and Pilot Hole Drilling 3-1

3.3 Installation of Additional Observation Wells 3-2

3.4 Site Geology 3-3

3.4.1 Bedrock Elevation 3-3

3.4.2 Lithology 3-3

4 Aquifer Testing 4-1

4.1 Test Well Construction 4-1

4.2 Sand Point and River Stilling Well Installation 4-1

4.3 Water Level Monitoring 4-1

4.4 Pumping Test Execution 4-1

4.4.1 Stepped-rate Pumping Test 4-2

4.4.2 Constant-rate Pumping Test 4-2

4.4.3 Water Quality Sampling 4-3

5 Pumping Test Data Analysis 5-1
5.1 Explanation of Terms and Analytical Methods 5-1
5.2 Correction for Boundary Conditions 5-1
5.3 Aquifer Test Results 5-2
5.3.1 Background Monitoring and River Efficiency 5-2
5.3.2 Aquifer Analysis 5-2
6 Collector Well Yield Estimates 6-1
6.1 Collector Well Analytical Equations 6-1
6.2 Design Parameters 6-2
6.3 Test Site Conceptual Design and Yield 6-3
7 Water Quality Modeling 7-1
7.1 PHREEQC Modeling 7-1
8 Opinion of Probably Cost 8-2
8.1 Opinion of Probably Cost 8-2
9 References 9-1

Tables

Table 1 Summary of Paddlewheel Point Test Site Well Data
Table 2 Formation Sample Sieve Analysis Results
Table 3 TW-1 Variable-Rate Test Summary
Table 4 TW-1 Constant-Rate Test Summary
Table 5 TW-1 Constant-Rate Test Summary - Corrected for River Stage Changes
Table 6 Collector Well Design Parameter Summary

Figures

Figure 1 Site Map
Figure 2 Elevation of the Top of Bedrock
Figure 3 Stepped-Rate Test and Recovery
Figure 4 Constant-Rate Test and Recovery – Test Well
Figure 5 Constant-Rate Test and Recovery – Observation Wells
Figure 6 Constant-Rate Test and Recovery - Temperature

Figures Continued

Figure 7 Elevation of the Pre-Pumping Groundwater Surface
Figure 8 Water Level Drawdown at 60 Hours into Constant-Rate Pumping Test
Figure 9 Aquifer Test Analysis
Figure 10 Post 2012 Stage Curve for USGS Gage at Yankton
Figure 11 Estimated Collector Well Production Curves at 100% Efficient Well
Figure 12 Estimated Collector Well Production Curves at 80% Efficient Well

Appendices

Appendix A June 2013 Collector Well Investigation Report at Paddle Wheel Point
Appendix B Geologic Logs
Appendix C Sieve Analysis Reports
Appendix D Pumping Test Data
Appendix E Water Quality Results
Appendix F Collector Well Yield Calculations
Appendix G March 2014 Preliminary Collector Well Design Recommendations Technical Memo
Appendix H March 2014 Collector Well Water Quality Modeling Report

1 EXECUTIVE SUMMARY

1.1 PURPOSE

The City of Yankton (City) contracted HDR Engineering, Inc. (HDR) to investigate the potential to install a radial collector well in the alluvial deposits along the Missouri River to supplement the City's raw water supply. The purpose of this study is to investigate and test the alluvial aquifer at Paddlewheel Point to develop both potential yield and preliminary design considerations for a collector well, and to evaluate potential water quality expected from a collector well producing a blend of groundwater and Missouri River water. HDR subcontracted with Ranney Collector Wells (Ranney), a subdivision of the Heavy Civil Division of Layne Christensen Company, to provide collector well preliminary design review and to perform water quality modeling using the aqueous geochemical model PHREEQC.

1.2 AQUIFER INVESTIGATION

HDR conducted an initial investigation consisting of three test borings at Paddlewheel Point in May 2013 to determine the best location for more extensive aquifer testing. These test borings confirmed the presence of greater than 100-foot thickness of saturated sand and gravel alluvial aquifer at the site. Initial water samples collected at the observation wells completed at each test boring indicated the groundwater was high in total dissolved solids (over 1,800 mg/L) with high sulfate (over 1,000 mg/L), high hardness (over 1,250 mg/L as $CaCO_3$), high iron (over 4 mg/L) and high manganese (over 2.4 mg/L).

Based on the initial investigation, the test boring TH-2-13 location was selected for additional aquifer testing. A 12-inch diameter test well and three additional observation wells were installed in November / December 2013 at the TH-2-13 location; approximately 400 feet downstream of the confluence of Marne Creek with the Missouri River, and approximately 200 feet back from the river's edge at low flow conditions. The additional drilling showed the presence of greater than 110 feet of saturated sand and gravel aquifer with minimal clay layers at the test well site. In December 2013, HDR conducted a 74-hour constant-rate pumping test at 1,200 gallons per minute to ascertain aquifer parameters and develop preliminary design considerations for a collector well at this site. Water quality samples were collected from both the test well and the river to be used in PHREEQC modeling to predict quality of water produced at a collector well installed at the test location.

1.3 AQUIFER PARAMETERS

Aquifer parameters of transmissivity, saturated thickness, hydraulic conductivity and "a" distance to recharge were determined for the test site by analysis of the 74-hour pumping test. Aquifer parameters at test conditions are as follows:

Transmissivity	242,400 gpd/ft
Saturated Thickness	112.7 feet
Hydraulic Conductivity	2,151 gpd/ft^2
Water Temperature	54^0 Fahrenheit
"a" Distance	255 feet

1.4 AQUIFER YIELD

The maximum aquifer yield for a collector well constructed at the test well site was calculated on the basis of the aquifer parameters. The aquifer yield assumes a collector well with 185-foot long laterals, and was calculated based on the following four conditions for water temperature and Missouri River level flow: average summer flow, average winter flow, low summer flow, and low winter flow. The estimated maximum aquifer yields for a collector well presented below assume that the laterals are placed at 102 and 106 feet below ground surface, pumping water levels at steady state conditions are 10 feet above the laterals, the "a" distance to recharge is 750 feet for the upsized collector well, and the well has degraded to 80% of original capacity.

Average Summer Flow (32,175 cfs)	24.2 MGD
Low Winter Flow (26,500 cfs)	23.9 MGD
Average Winter Flow (16,836 cfs)	16.5 MGD
Low Winter Flow (12,000 cfs)	16.2 MGD

1.5 PRELIMINARY MECHANICAL CAPACITY OF COLLECTOR WELLS

In addition to aquifer yield, mechanical design considerations on well capacity were evaluated for this site. The mechanical capacity of the well is based on three primary parameters:

- The approach velocity to the well lateral screens. For a hydraulic conductivity of 2,151 gpd/ft^2, it is recommended to be limited to less than 0.2 ft/sec.
- The entrance velocity into the well lateral screens. The industry standard is a maximum of 2 feet per minute (0.033 ft/sec) and assumes that 50% of the screen opening is blocked.
- In-line flow velocity in the laterals. The industry standard is a maximum of 5 ft/sec for axial velocity within a well screen. Ranney recommends that it not substantially exceed 3.3 ft/sec.

Preliminary collector well mechanical design considerations for the Paddlewheel Point test site were developed by Ranney. Conceptual designs were developed for three maximum operating conditions: 12 MGD, 15 MGD and 20 MGD. Given the smaller diameter of the 10% passing fraction of the formation samples collected, Ranney recommends that a filter pack be used with the lateral screens. Mechanical capacity designs were based upon using a 0.060-inch slot size screen with a Johnson 10 inch by 12 inch MuniPak well screen (a well screen that has and inner and outer screen with a manufactured filter pack in between). In order to meet minimum mechanical design criteria, the following number of 185-foot long laterals (175 feet of screen, 10 feet of black casing) would be required:

12 MGD	8 Laterals at 30° spacing
15 MGD	10 Laterals at 30° spacing
20 MGD	13 Laterals at 30° spacing

Since the 20 MGD collector wells requires over 12 laterals, it would require two tiers of laterals; six on one tier, seven on the other.

1.6 ANTICIPATED QUALITY OF PRODUCED WATER

Ranney developed water quality projections of produced raw water based on using the aqueous geochemical model PHREEQC to model the mixing of groundwater and Missouri River water expected at the proposed collector well. Four scenarios were developed for the proposed collector well:

- Winter conditions with a pumping rate of 2 MGD, assuming produced water is a ratio of
  - 40% groundwater and 60% river water, and
  - 60% groundwater and 40% river water
- Summer conditions with a pumping rate of 12 MGD, assuming produced water is a ratio of
  - 10% groundwater and 90% river water, and
  - 30% groundwater and 70% river water

The following table presents the PHREEQC modeling results for parameters of most interest. The tabulated results are for modeling with total organic carbon (TOC) as non-reactive. TOC was also modeled as a reactive constituent (CH_20), with very little change in results except for zero TOC in the produced water for all four scenarios.

Parameter	Winter - 2 MGD 40% GW/60% SW	Winter - 2 MGD 60% GW/40% SW	Summer - 12 MGD 10% GW/90% SW	Summer - 12 MGD 30% GW/70% SW
Temperature °F	43.0	46.9	72.2	68.3
pH	7.5	7.3	7.7	7.4
Total Dissolved Solids (mg/L)	1010	1270	540	817
Total Hardness (mg/L as $CaCO_3$)	702	913	351	570
Calcium Hardness (mg/L as $CaCO_3$)	448	578	230	365
Alkalinity (mg/L)	239.7	276.0	164.5	205.4
Sulfate (mg/L)	527.2	694.8	252.4	425.2
Iron (mg/L)	1.7	2.3	0.6	1.3
Manganese (mg/L)	1.4	1.8	0.6	1.1
Total Organic Carbon (mg/L)	2.6	2.1	3.7	3.1

1.7 OPINION OF PROBABLE COST

Ranney developed the following opinion of current-day probable cost for the 12 MGD, 15 MGD and 20 MGD collector well designs. These costs include construction of the caisson, installation and development of the well laterals, and completion of a 3-day performance test at design rates.

Rate	12 MGD	15 MGD	20 MGD
Number of Ports	10	12	15
Number of Laterals	8	12	13
Average Length per Lateral	185	185	185
Probable Cost	$2,500,000	$2,900,000	$3,500,000

2 INTRODUCTION

2.1 BACKGROUND

The City of Yankton, South Dakota (City) has historically sourced its water supply from the Missouri River using two surface water intakes. As of 2011, the City's average day demand was 2.35 million gallons per day (MGD), with a historical maximum day demand of 7.69 MGD. The City projects that by 2035, it will have an average day demand of 3.5 MGD, with maximum day water demand of 10 MGD.

Missouri River bed lowering due to river degradation has been a concern that the City has dealt with by extending their two surface water intakes. In 2010, the City retired their oldest "East" surface water intake, since it was no longer practical to extend it further. Continued Missouri River channel degradation, as well as migration of the river's thalweg away from the intakes and disruptions to the water intakes during the high volume Gavins Point dam releases of 2011, has led the City to question the reliability of their surface water intakes.

To address part of the water source reliability concerns, the City installed two wells on the south side (Nebraska side) of the Missouri River to replace capacity lost when the City retired the East intake in 2010. These two wells have a total combined capacity of 4.32 MGD, which only accounts for 55% of the yield required to meet current maximum day demand.

HDR Engineering, Inc. (HDR) was retained by the City to evaluate the potential for constructing a horizontal collector well at Paddlewheel Point, just southeast of town and directly downstream of the City's river intake. It is anticipated that a collector well would need to supply the water treatment plant with 2 MGD during the lower use period in winter, and 12 MGD during peak use periods in summer.

Initial test hole drilling and hydraulic interval testing at three locations on Paddlewheel Point was conducted by HDR in May of 2013 (Figure 1). Based on this investigation, the second test hole "TH-2-13" was selected as the location for additional aquifer testing. The report on the May 2013 investigation is included at Appendix A of this report.

In November 2013, the TH-2-13 test hole site was further developed with a test well and three observation wells in addition to an observation well initially completed at TH-2-13. In December 2013, a 5-hour stepped-rate test and a constant rate consisting of 72 hours of pumping at 1,200 gallons per minute (gpm) were conducted at the TH-2-13 site. Data from this testing was used to estimate design parameters and potential yield for a collector well at this site.

2.2 PURPOSE

This report presents the methods used and results obtained from hydrogeologic investigations performed to date for the Paddlewheel Point site. Those include:

- Summary of initial test hole drilling investigation to characterize the aquifer at Paddlewheel Point
- Installation of test well and additional observation wells

- Aquifer testing to determine potential of the aquifer to induce infiltration of Missouri River water and yield water
- Estimates of potential yield for a collector well constructed at Paddlewheel Point
- Preliminary design considerations for a collector well constructed at Paddlewheel Point
- Water quality anticipated to be produced from a collector well constructed at Paddlewheel Point under 2 MGD and 12 MGD pumping scenarios
- Opinion of probable cost of construction for a collector well caisson and lateral screens

2.3 STUDY AREA DESCRIPTION

Paddlewheel Point is located immediately downstream of the confluence of Marne Creek with the Missouri River adjacent to River Mile 805, or approximately 0.8 miles downstream from the Meridian Highway Bridge (Figure 1). The Missouri River adjacent to Paddlewheel Point is shallow, and river depth gradually increases with distance into the river.

2.3.1 SITE GEOLOGY / HYDROGEOLOGY

The primary surficial aquifer at Paddelwheel Point testing site (Site) consists of Lower James-Missouri River alluvial deposits of sand and gravel with occasional fine sediment layers. Thickness of the unconsolidated sediments at the Site was found to range from approximately 110 to 140 feet, with thicker sediments to the southeast. Surface elevation at the Site is approximately 1160 feet above mean sea level NAVD 88 (msl). Depth to groundwater was approximately 10 feet below ground surface (bgs) during the investigation.

The deeper portion of the Missouri River bedrock valley trends west to east south of the Site, then turns to the northeast under the southeastern portion of the Site. This results in a thicker saturated thickness of Lower James-Missouri River alluvium under the southeast portion of the Site. Carlile Shale forms the bedrock beneath the alluvium at the Site. Under normal Missouri River flow conditions, groundwater in the Lower James-Missouri River alluvium discharges to the Missouri River (Bugliosi, 1986).

To the west of the Site, the Niobrara Formation and associated aquifer form the Yankton Ridge and underlie the western part of the City of Yankton. Lower quality water from the Niobrara Aquifer tends to discharge to the Lower James-Missouri River alluvium beneath the City of Yankton. This most likely accounts for the higher dissolved solids content in the groundwater at the Site (Bugliosi, 1986).

Paddlewheel Point is not a cutting bank of the river, and river depth gradually increases with distance into the river. During the investigation, river levels dropped 2.5 feet, which resulted in the river shore migrating 50 feet away from the Site. Where the river receded, the riverbed appeared to be lined with cobbles.

3 SITE EXPLORATION

3.1 TEST HOLE DRILLING

The alluvial aquifer at the Paddlewheel Point site was initially investigated in May of 2013 by drilling test holes at three locations, which were later converted to observation wells OW-1-13, OW-2-13 and OW-3-13 (Figure 1). HDR subcontracted with Layne Specialty Drilling Division (Layne) to drill the test holes and perform hydraulic interval testing using rotary sonic drilling method. This method allowed not only for the collection of continuous formation samples, but also limited aquifer testing at approximately 100 gallons per minute (gpm). After the test holes were completed as 2-inch diameter observation wells, they were air lift developed and water samples were collected at each location and analyzed for drinking water quality parameters.

Results of the initial drilling and testing indicated that depth to bedrock was 106 to greater than 115 feet below ground surface (bgs), with depth to bedrock increasing towards the south and east. Of the three locations, OW-2-13 presented the best potential for collector well development by having the least amount of clay or silt layers that could impede vertical infiltration, and by being located closest to the Missouri River.

Full details of this initial investigation were presented in a June 2013 report prepared by HDR for the City of Yankton, which is included as Appendix A to this report. Geologic logs for the first three bores are included in the geologic logs presented in Appendix B. A summary of test hole information and formation sample grain-size analysis is presented in Tables 1 and 2 respectively.

3.2 SELECTION OF TEST WELL LOCATION AND PILOT HOLE DRILLING

Observation well location OW-2-13 (Figure 1) was selected as the Site for more extensive aquifer testing to determine the water quality and production potential of a collector well constructed at the Site. The location for a 12-inch diameter test well was selected at approximately 48 feet west of OW-2-13. Observation well OW-2-13 was then designated as OW-50P for the aquifer testing. Thein Well Company, Inc. (Thein) of Spicer, Minnesota was retained to install the additional wells for the aquifer testing.

Thein mobilized a truck mounted mud rotary drilling rig (Schramm T300M Rotadrill) to the test well location on November 18, 2013 to drill a pilot hole. The pilot hole was located at what would be inline with a line of observations wells parallel to the Missouri River (which includes OW-50P). A 5.25-inch diameter borehole was drilled using a tri-cone bit. Wash bore samples were collected continuously over 5-foot intervals, and HDR's on-site geologist logged these samples according to observed grain size and percentages of fines, sand, and gravel. Wash bore samples typically are coarser than actual formation due to removal of the fines and fine sand by the drilling mud circulation.

The material encountered at the pilot hole is typical of the Lower James-Missouri River alluvial aquifer. Recovered samples showed the aquifer to be fine to very coarse sand with some gravel, that showed layers with finer and coarser gradations. Some minor clay layers were present at 25 to 35 feet bgs. A cobble/gravel zone was encountered at 39 to 45 feet bgs, and coarse material with 15 to 20 percent gravel was encountered from 45 to 60 feet and from 80 to 90 feet bgs. Lignite was encountered at 45 feet and

continued to come up in cuttings to total depth, however much of it could have been recirculated with the drilling mud. Of note, was that the interval from 100 to 123 feet bgs (where collector well laterals might be projected) was mostly fine to medium sand. Weathered shale bedrock was encountered at 123 feet bgs, and the bore hole was drilled to 127 feet bgs for confirmation. Wash bore samples collected on 5-foot intervals from 90 to 120 feet bgs were given to Thein for grain-size distribution analysis.

A summary of the pilot hole data is presented in Table 1. Geologic logs and driller's logs are provided in the Appendix B. Sieve results data is presented in Appendix C. Results of the sieve analyses of select wash bore samples are presented in Table 2.

3.3 INSTALLATION OF ADDITIONAL OBSERVATION WELLS

Thein drilled and installed three additional 2-inch PVC observation wells at the Site between November 19 and November 21, 2013 (Figure 2). These included:

- OW-75P – installed in the parallel to river line 76 feet upstream from the test well location.
- OW-150P – installed in the parallel to river line 158 feet downstream from the test well location.
- OW-60R – installed between the test well and the river 52 feet from the test well location.

All three wells were drilled using the Schramm T300M Rotadrill and a 6.125 inch tri-cone bit. Wash bore samples were collected on 5 –foot intervals. Wells were completed with 2-inch diameter PVC casing from above ground surface to 105 feet bgs, and with 0.010 slot PVC screen from approximately 105 to 115 feet bgs. Red Flint #40 filter sand was placed in the well annulus to two feet above the top of the screen, and the annulus was tremie grouted to surface with a bentonite grout. The well heads were completed with locking metal protective casings and concrete pads.

The formation encountered at the three observation wells as similar to that observed at the pilot hole. All three locations had gravel and cobble zones between 20 and 40 feet bgs. Minor discontinuous clay lenses were encountered in observation wells OW-75P and OW-150P. Thicker discontinuous clay lenses were encountered in observation well OW-60R at 19 to 22 feet, 32 to 33 feet, and 42 to 44 feet bgs.

Depth to weathered shale bedrock at observation wells OW-75P, OW-150P and OW-60R was encountered at 118 feet, 136 feet, and 121 feet respectively. This suggests that what was interpreted as bedrock at 115 feet bgs in OW-50P, and was described as "something hard enough to cause the drill rods to break off at 92 feet", may have been a cobble or boulder and not weathered shale bedrock.

Thein developed each observation well by air lifting until the wells were pumping water free of fines. Wash bore samples collected on 5-foot intervals from 100 to 115 feet bgs at each of the observation wells were given to Thein for grain-size distribution analysis.

A summary of the observation well data is presented in Table 1. Geologic logs and driller's logs are provided in the Appendix B. Sieve Data is presented in Appendix C. Results of the sieve analyses of select wash bore samples are presented in Table 2.

3.4 SITE GEOLOGY

Drilling logs from the three original test holes drilled in May 2103 and the additional four locations drilled in November 2013 were reviewed to characterize expected geology for the lateral footprint of a collector well constructed at the Site.

3.4.1 BEDROCK ELEVATION

Figure 2 presents an interpreted top of bedrock surface for the Site based on depth to bedrock observed at the wells. Bedrock dips to the southeast towards the middle of the Missouri River bedrock channel, with dips increasing southeast of observation well OW-50P. Overall, the bedrock surface elevation underneath the lateral footprint is expected to range from 1053 feet above mean sea level NAVD88 (msl) on the northwest to less than 1020 feet msl on the southeast.

3.4.2 LITHOLOGY

The geologic logs indicate that the aquifer is primarily fine to coarse sand with gravel, with trace to minor discontinuous clay lenses. Samples submitted for sieve analysis indicate that the alluvial formation is primarily medium sand. Coal and lignite were observed throughout the aquifer. A layer with cobbles and gravel falling between 25 and 40 feet bgs appears to be continuous across the site except at observation well OW-1-13.

Collector well laterals are expected to be placed at 100 to 105 feet bgs. At this depth interval, the material is approximately 80% medium sand (0.017 to 0.079 inches in diameter) with less than five percent fines.

4 AQUIFER TESTING

4.1 TEST WELL CONSTRUCTION

Thein mobilized a large mud rotary drilling rig (Speed Star SS15) to the test well location on December 3, 2013 to drill the test well. The test well (TW-1) was located inline with the parallel line of observation wells at the location of the test well pilot hole. An 18-inch diameter borehole was drilled to 122 feet below ground surface (bgs).

Test well TW-1 was completed with 95 feet of 12-inch diameter steel casing from three feet above ground to 92 feet bgs, and with 30 feet of 12-inch diameter stainless-steel wire-wrapped screen from a depth of 92 to 122 feet bgs. Screen slot size was a combination of 0.070 and 0.080 inch slots. Gravel pack was place in the annulus from total depth to 90 feet bgs. Bentonite grout was used to seal the annulus from 90 feet bgs to surface.

Thein developed the well by air lifting until the well pumped water free of fines. Total well development time was approximately 20 hours.

4.2 SAND POINT AND RIVER STILLING WELL INSTALLATION

In order to further define groundwater levels near the river, a sandpoint or driven well point (observation point SP-120R) was installed 104 feet from TW-1, between the test well and the river and inline with OW-60R. The sand point was installed to approximately 11 feet bgs, with top of screen at approximately 8 feet bgs. A second sand point was installed in the river approximately eight feet from the river bank to be used as a river stilling well.

4.3 WATER LEVEL MONITORING

In-Situ, Inc. brand Troll 700 datalogging pressure transducers equipped to read both water level and water temperature were installed in the test well, all of the monitoring wells, the sand point, and the river stilling well to monitor water levels during the aquifer testing. Water level drawdown in the test well and nearby observation wells was also monitored by a HDR hydrogeologist prior to, during, and following the constant-rate test manually using an electric water level tape. Thein staff monitored water levels manually in the test well throughout the testing.

Water levels were tied into elevation based on a topographic site survey. Eisenbraun & Associates surveyed all water level measuring points for Northing and Easting coordinates (NAD 83 using City of Yankton Control Network Coordinate System) and elevation (NAVD 88) on December 16, 2013. An elevation of the river surface adjacent to the site was also measured and tied in with USGS Gaging Station 06467500 upstream at the Meridian Highway Bridge.

4.4 PUMPING TEST EXECUTION

Both a 5-hour stepped-rate pumping test, and a 74-hour constant-rate pumping test were performed on TW-1 to stress the aquifer and determine degree of connection with the Missouri River. Prior to and throughout the 74-hour constant-rate pumping test, water quality samples were collected from both a tap off the pumped well discharge and the Missouri River. Pumping rate was monitored by Thein using a

pipe orifice meter. Discharge water from the pumping test was routed by irrigation pipe to the Missouri River approximately 200 feet downstream of TW-1.

4.4.1 STEPPED-RATE PUMPING TEST

A stepped-rate pumping test was performed by Thein on the test well on December 12, 2013. The test was started at noon, and consisted of five consecutively higher pumping rates of 500, 660, 830, 1030 and 1200 gallons per minute (gpm) for 60 minutes each. Water level drawdown in the test well was monitored by Thein staff prior to, during, and following the stepped-rate test both manually.

Data from the TW-1 stepped-rate test is presented in Table 3 and Figure 3. The results of the step test were used to calculate specific capacity for each step, which is the pumping rate of the well divided by the observed water level drawdown. Specific capacity typically declines with both pumping duration and increased pumping rate. The observed specific capacity of the test well varied from 73.33 gallons per minute per foot of drawdown (gpm/ft) at the second lowest pumping rate (660 gpm) to 67.76 gpm/ft at the highest pumping rate (1,200 gpm). Based on these results, a pumping rate of 1,200 gpm was selected for the 74-hour constant-rate pump test.

Stepped-rate pumping test data is presented in Appendix D.

4.4.2 CONSTANT-RATE PUMPING TEST

A 74-hour constant-rate pumping test was initiated at noon on December 16, 2013 at the Paddlewheel test site at a near constant pumping rate of 1,200 gpm. The test was run by Thein, and water level drawdown was monitored by HDR and Thein staff. The data were collected in the test well and all of the observation wells both manually and electronically in the same way as in the stepped-rate test. Water level and temperature were also monitored in the river stilling well.

At two times during the pumping test, the pump shut off due to generator issues. At 8:55 AM on December 18, 2013 the pump shut down for 45 minutes before it could be restarted. At 1:17 PM on December 18, 2013 the pump shut down for 25 minutes before it could be restarted

The pumping test was run 2.5 hours longer to compensate for the non-pumping periods. The pumping test was shut off at 2:30 PM on December 19, 2013, and aquifer recovery water levels were monitored through December 23, 2013.

A drawdown data summary for the constant-rate test is presented in Table 4 and in Figures 4 and 5. Temperature data is presented in Figure 6. Of note is that the Missouri River flow stayed fairly constant at approximately 14,000 cubic feet per second (cfs) until about 60 hours into the test. Then the stage dropped 0.2 feet for a flow of approximately 13,000 cfs. Missouri River water temperature stayed near freezing with minor temperature fluctuations of one degree Fahrenheit. The only observation well to show infiltration of colder river water towards the test well was the sand point closest to the river (OW-120R). At that location, the groundwater temperature dropped two degrees Fahrenheit throughout the constant rate test, and remained at the lower temperature throughout the test recovery period. A complete data set for the tests is provided in the report Appendix D.

Pre-pumping water level and drawdown contours of the Site after 60 hours of pumping are presented in Figures 7 and 8, respectively. The 60 hours into the test time period was used because at that point river

water level fluctuations were not expected to have impacted water levels from the pumping. Prior to the test, static water levels decreased in the direction towards the River, indicating that the aquifer was discharging to the river. After 60 hours of test pumping, an elliptical cone of depression with the long axis parallel to the River had developed. The contours show that the groundwater surface has a steeper slope on the River side of the well, indicating recharge to the well from the River.

Pumping test data is presented in Appendix D.

4.4.3 WATER QUALITY SAMPLING

One objective of the aquifer testing was to collect water quality data from the river and the test well to use in the aqueous geochemical model PHREEQC to model the mix of groundwater and Missouri River water potentially expected from a collector well constructed at the Site.

An In-Situ, Inc. brand Troll 3500 and sampling cup was used to measure water of both the Missouri River water adjacent to the Site and water produced at the test well for quality parameters of:

- temperature,
- pH,
- oxidation reduction potential,
- dissolved oxygen, and
- electrical conductivity

Water quality parameters were collected twice a day from both the river and the well during the pumping test. Of note, is that the test well water was mostly likely oxygenated by the action of pumping before it was collected from the sample tap on the discharge from the pump head. Samples from the test well also tended to cool off slightly during the parameter stabilization period.

Water quality samples were collected at 1, 25, 49 and 73 hours into pumping at the test well for the following analytes:

- total dissolved solids (TDS)
- total hardness
- calcium hardness
- alkalinity
- sulfate
- iron
- manganese
- total organic carbon (TOC)
- dissolved iron
- dissolved manganese
- dissolve organic carbon (DOC)

Water quality samples were collected at 1, 25, 49 and 73 hours into pumping at both the Missouri River adjacent to the site for only the dissolved iron, dissolved manganese, and DOC. DOC was not collected for either the river or test well at one hour into pumping due to missing sample bottles.

Water quality samples were analyzed for iron, manganese, alkalinity, total and calcium hardness, and dissolved iron and manganese at the City water treatment plant by City staff using colorimetric methods. Water quality samples for TDS, sulfate, TOC and DOC were sent to the South Dakota State Public Health Laboratory for analysis.

At the end of the constant-rate pumping test, water samples were collected to comply with the full suite of analyses required by the State of South Dakota for a new public water source. Samples were submitted to the South Dakota State Public Health Laboratory for analysis.

Results of water quality monitoring and laboratory analysis reports are presented in Appendix E.

5 PUMPING TEST DATA ANALYSIS

5.1 EXPLANATION OF TERMS AND ANALYTICAL METHODS

Aquifer coefficients of transmissivity and specific yield were calculated from the test data using methods appropriate for unconfined aquifer conditions. Transmissivity is an expression of the ability of an aquifer to transmit water. It is equal to the discharge through a unit width of an aquifer under a unit hydraulic gradient. Hydraulic conductivity is equal to the transmissivity divided by the saturated thickness of the aquifer. Hydraulic conductivity and transmissivity are governed by the size and shape of the pores between the grains comprising the aquifer, the effectiveness of interconnection between pores, and the physical properties of the fluid. The fluid properties of water vary with temperature, and the hydraulic conductivity is defined on the basis of fluid viscosity and density at a particular temperature. Coefficient of storage is the volume of water released from storage (or taken into storage) per unit of aquifer storage area per unit change in head. Specific yield is the quantity of water that a unit volume of unconfined aquifer gives up by gravity. Specific yield values range from 0.01 to 0.3 (Driscoll, 1983). Specific yield plus specific retention (i.e., the volume retained in dewatered aquifer material due to surface tension) equals the porosity of an aquifer.

A distance-drawdown analysis based on Cooper-Jacob was performed on data in all the observation wells at a selected time into pumping. This analysis was done by manually plotting drawdown at each observation well versus the log of the distance between the observation well and the pumped well. A solution is derived from a straight-line fit to the points on the graph for wells parallel to the Missouri River. Drawdown data were corrected to effective drawdown for confined aquifer conditions prior to plotting it on the graph. Typically, the distance-drawdown analysis should yield transmissivity values close to actual, and storage values that are skewed too high (Driscoll, 1986).

The distance to a line source of recharge is called the "a" distance. Calculations of the "a" distance were made from the method derived by Rorabaugh (1956) using image well theory. Rorabaugh's analysis is performed on pairs of observation wells in the direction parallel to the river, and on pairs of observation wells in the direction perpendicular to the river. The Rorabaugh "a" distance can be checked against one-half of the r_o distance (intercept of a straight-line through the data plot at zero drawdown) for wells parallel to the river on the distance-drawdown plot.

5.2 CORRECTION FOR BOUNDARY CONDITIONS

The Paddlewheel Point test site is located adjacent to the Missouri River, and is therefore subject to fluctuations in groundwater level resulting from changes in River stage and flow. The River recharges the aquifer or the aquifer discharges to the River depending on climate/weather conditions and head differential.

During the period of aquifer monitoring and testing (December 12, 2013 – December 23, 2013), no rain events occurred at the Sites. However, the gage height of the Missouri River declined 0.2 feet approximately 60 hours into the test. This condition made it necessary to correct data sets for each well using a ratio of change in aquifer at each well location per change in river stage. Water level observation

data collected in the wells and River prior to the step test and after the recovery of the constant rate test were used to determine the correction factors. These correction factors are listed in Table 5.

No boundary effects due to barrier boundaries in the aquifer or mutual interference from nearby pumping wells were detected during the aquifer testing, so no corrections of this type were necessary.

5.3 AQUIFER TEST RESULTS

5.3.1 BACKGROUND MONITORING AND RIVER EFFICIENCY

Static water levels at the Paddlewheel Point test site were monitored from December 3 through December 23, 2013. At each observation well, the water level was monitored as the River level fluctuated. A percentage factor of the change in the water level of each observation well relative to the river gage change was determined. This percentage factor was used to correct pumping test drawdown and recovery data affected by changes in the Missouri River during testing. Correction factors ranged from 0.63 for OW-120R to 0.35 for OW-3-13. The river correction factors are provided in Table 5.

5.3.2 AQUIFER ANALYSIS

Transmissivity derived from the distance-drawdown analysis is believed to better represent the actual aquifer transmissivity, and was estimated at 242,400 gpd/ft (Figure 9). With an average formation saturated thickness of 112.7 feet, the average hydraulic conductivity for the Site is 2,151 gpd/ft2 (at a water temperature of 54 degrees Fahrenheit) during testing. Analyses plots are included in the report appendices.

The site "a" distance calculated by the Rorabaugh (1956) method averaged 255 feet from available well pairs. The distance-drawdown plot shows a radius of 521 feet for wells parallel to the River. Half of that radius matches well with the Rorabaugh result. An "a" distance of 750 feet was selected for calculations of collector well yield to account for a much greater area of infiltration needed to supply the higher rate collector well.

6 COLLECTOR WELL YIELD ESTIMATES

6.1 COLLECTOR WELL ANALYTICAL EQUATIONS

The analytical solutions for unconfined groundwater flow to collector wells are based on assumptions that collector wells are partially penetrating horizontal wells, that screen laterals are line sinks, and that recharge from a river is treated as a line source (Walton, 1970). The assumptions that pertain to the source aquifer are that it is homogeneous and isotropic, infinite in extent, and the same saturated thickness throughout. The assumptions that relate to the collector design and construction are that the radial laterals lie in the same horizontal plane, are equal in length, and are oriented such that each will drain an equal section of the aquifer. It is also assumed that the laterals all produce an equal percentage of the total flow from the well. While actual aquifer conditions and collector well construction do not conform fully to the assumptions, the analytical solutions help provide an estimate of collector well yield at varying river stage and river water temperature that assist in preliminary design.

The following theoretical steady state equation by Hantush and Papadopulos (1962) is used to estimate yield for a collector well constructed at the Paddlewheel Point location. This equation assumes that the maximum drawdown of the water table is small (less than 25%) relative to the original saturated thickness, and the radius of the caisson is small compared to the length of the laterals. The equation assumes the radius of maximum drawdown to be at the face of the caisson. The drawdown in a collector well can be approximated by:

$$S_{cs} \geq \frac{Q}{2\pi K b} \ln\left[\frac{\gamma^{\gamma}}{\varepsilon^{\varepsilon}}\left[\frac{\left[\frac{b}{\pi r_w}\right]^2}{2^*\,(1-\cos\,(\pi/b)^*(2z_i + r_w))}\right]^{b/4L}\right]$$

Where:

- S_{cs} = Drawdown in the collector well caisson (L)
- Q = Discharge, gallons per day (L^3/T)
- K = Hydraulic conductivity (L/T)
- b = Saturated aquifer thickness (L)
- L = Average lateral length (L)
- a = Effective distance to line source of recharge (L)
- ε = $(2^*a-2^*r_c-L)/L$ (dimensionless)
- r_c = Radius of the caisson (L)
- γ = $2((2-r_c)/L)$ (dimensionless)
- r_w = Effective radius of laterals (L)
- z_i = Vertical position of laterals below the top of aquifer (L)

Additionally, hydraulic conductivity can be modified to account for changes in water density and viscosity that occur with changes in water temperature:

$$K = K_i*(\rho g/\mu)$$

Where:

K_i = Intrinsic permeability (L^2)
ρ = Density of water (M/L^3)
g = Acceleration of gravity at sea level 45 degree latitude (L/T^2)
μ = Viscosity of water (M/LT)

6.2 DESIGN PARAMETERS

The parameters used for the Paddlewheel Point test well site in preparing a preliminary design and estimating yield of a collector well at this location are provided in Table 6. These parameters are based on the results of the test well drilling and aquifer analyses performed at the site. The four scenarios used to calculate maximum yield are:

- Summer average river flow
- Summer minimum river flow
- Winter average river flow
- Winter minimum river flow

Every effort was made to use realistic, but conservative values for each scenario. The river hydrograph for the USGS Yankton, South Dakota gaging station was used for predictions of river stage and corresponding groundwater level fluctuations for summer average flow and winter average flow. The 2013 Missouri River Mainstem System 2013-2014 Annual Operating Plan was used to determine summer low flow and winter low flow conditions. USGS river gage readings of 32,175 cfs, 16,836 cfs, 26,500 cfs, and 12,000 cfs correspond to summer average, winter average, summer low, and winter low flows. Corresponding river stage was determined based on 2012 post high rate Gavins Point dam releases shift rating data (Figure 10).

Temperature also has a considerable affect on river recharge as a result of changes in hydraulic conductivity as water density and viscosity typically decreases with temperature. As a rule of thumb, hydraulic conductivity changes 1.5 percent for every 1°F change in water temperature. A seasonal low groundwater temperature of 42°F was used for winter, and a seasonal high groundwater temperature of 65°F was used for summer. Hydraulic conductivity values corrected for temperature ranged from 1,767 to 2,505 gpd/ft^{2}for the Site.

Maximum calculated yield is based on available drawdown with a design pumping level of ten feet above the laterals; and laterals set at seven and eleven feet above bedrock. The calculated yield is discounted to account for a 20% well loss over time. Over time, the screen laterals and the formation material surrounding the laterals will bio-foul and partially plug due to minor chemical and bacterial precipitation. Because drawdown during pumping will be greater than 25% of the original saturated thickness, drawdown values calculated from the Hantush and Papadopulos (1962) equation had to be corrected for aquifer dewatering effects.

The estimated collector production curves presented in Figure 11 and 12 illustrate yield under average summer river stage and summer groundwater temperature, and average summer river stage and summer groundwater temperature for both the 100% and 80% of original capacity conditions. Using the selected design parameters, the maximum potential yield (at 80% of original capacity) of a collector well constructed at the Site is 24.2 MGD under seasonal summer conditions, 16.5 MGD under seasonal winter conditions. Calculation spreadsheets are presented in Appendix F.

6.3 TEST SITE CONCEPTUAL DESIGN AND YIELD

In addition to aquifer yield, mechanical design considerations on well capacity were evaluated for this site. The mechanical capacity of the well is based on three primary parameters:

- The approach velocity to the well lateral screens. For a hydraulic conductivity of 2,151 gpd/ft^2, it is recommended to be limited to less than 0.2 ft/sec.
- The entrance velocity into the well lateral screens. The industry standard is a maximum of 2 feet per minute (0.033 ft/sec) and assumes that 50% of the screen opening is blocked.
- In-line flow velocity in the laterals. The industry standard is a maximum of 5 ft/sec for axial velocity within a well screen. Ranney recommends that it not substantially exceed 3.3 ft/sec.

Preliminary collector well mechanical design considerations for the Paddlewheel Point test site were developed by Ranney. Conceptual designs were developed for three maximum operating conditions: 12 MGD, 15 MGD and 20 MGD. Given the smaller diameter of the 10% passing fraction of the formation samples collected, Ranney recommends that a filter pack be used with the lateral screens. Mechanical capacity designs were based upon using a 0.060-inch slot size screen with a Johnson 10 inch by 12 inch MuniPak well screen (a well screen that has and inner and outer screen with a manufactured filter pack in between). In order to meet minimum mechanical design criteria, the following number of 185-foot long laterals (175 feet of screen, 10 feet of black casing) would be required:

12 MGD	8 Laterals at 30^0 spacing
15 MGD	10 Laterals at 30^0 spacing
20 MGD	13 Laterals at 30^0 spacing

Since the 20 MGD collector wells requires over 12 laterals, it would require two tiers of laterals; six on one tier, seven on the other. The Ranney preliminary design report is included in Appendix G.

The collector well should extend to the maximum depth possible, but the centerline of the laterals should be placed at approximately seven feet above bedrock. Bedrock is expected to be at an elevation of approximately 1038 feet msl at the TW-1 location. The depth limiting factor would be the depth to bedrock where the laterals extend to the northwest. At 185 feet northwest of TW-1, bedrock is expected to be at an elevation of approximately 1053 feet msl. The centerline of lower tier would be at 1055 feet msl, while the centerline of upper tier would be at 1059 feet msl.

Accounting for a static water level of 10 feet bgs and keeping 10 feet of water above the laterals and pump, and allowing for 20% well loss between lateral cleaning, the maximum design pumping water level used in the yield calculations is approximately 82 to 84 feet below ground, or a pumping water level elevation of 1069 feet msl.

7 WATER QUALITY MODELING

7.1 PHREEQC MODELING

Ranney developed produced water quality projects based on using the aqueous geochemical model PHREEQC to model the mixing of groundwater and Missouri River water expected at the proposed collector well. Four scenarios were developed for the proposed collector well:

- Winter conditions with a pumping rate of 2 MGD, assuming produced water is a ratio of
  - 40% groundwater and 60% river water, and
  - 60% groundwater and 40% river water
- Summer conditions with a pumping rate of 12 MGD, assuming produced water is a ratio of
  - 10% groundwater and 90% river water, and
  - 30% groundwater and 70% river water

For the model inputs, Ranney utilized water quality data collected by HDR during the initial May 2013 investigation and during the constant-rate testing for background groundwater quality and river water quality at the time of the testing. Ranney used data from the USGS river gage station at the Meridian Highway Bridge to determine seasonal water quality for the Missouri River.

The following table presents the results of the PHREEQC modeling for parameters of most interest. The tabulated results are for modeling with total organic carbon (TOC) as non-reactive. TOC was also modeled as a reactive constituent (CH_20), with very little change in results except for zero TOC in the produced water for all four scenarios.

Parameter	Winter - 2 MGD 40% GW/60% SW	Winter - 2 MGD 60% GW/40% SW	Summer - 12 MGD 10% GW/90% SW	Summer - 12 MGD 30% GW/70% SW
Temperature °F	43.0	46.9	72.2	68.3
pH	7.5	7.3	7.7	7.4
Total Dissolved Solids (mg/L)	1010	1270	540	817
Total Hardness (mg/L as $CaCO_3$)	702	913	351	570
Calcium Hardness (mg/L as $CaCO_3$)	448	578	230	365
Alkalinity (mg/L)	239.7	276.0	164.5	205.4
Sulfate (mg/L)	527.2	694.8	252.4	425.2
Iron (mg/L)	1.7	2.3	0.6	1.3
Manganese (mg/L)	1.4	1.8	0.6	1.1
Total Organic Carbon (mg/L)	2.6	2.1	3.7	3.1

Layne's water quality modeling report is included as Appendix H.

8 OPINION OF PROBABLY COST

8.1 OPINION OF PROBABLY COST

Ranney developed an opinion of current-day probable cost for the 12 MGD, 15 MGD and 20 MGD collector well designs. These costs include construction of the caisson, installation and development of the well laterals, and completion of a 3-day performance test at design rates.

Rate	12 MGD	15 MGD	20 MGD
Number of Ports	10	12	15
Number of Laterals	8	12	13
Average Length per Lateral	185	185	185
Probable Cost	$2,500,000	$2,900,000	$3,500,000

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TABLES

Table 1: Summary of Paddlewheel Point Test Site Well Data
Yankton, South Dakota

Well Name	Date Installed	City of Yankton Control: North (ft)	City of Yankton Control: East (ft)	Ground Elevation NAVD 88 (ft msl)	Top Casing Elevation NAVD 88 (ft msl)	Depth to Top of Sand (ft bgs)	Depth to Bedrock (ft bgs)	Bedrock Elevation NAVD 88 (ft msl)	Depth to Water (ft bgs)[a]	Saturated Thickness (ft)	Notes
TW-1	12/4/2013	8,327.660	60,920.469	1161.3	1164.24	0	123	1038.3	10.66	112.3	Constructed with 12-inch steel casing and 0.070" & 0.080" stainless steel continous slot screen. Well screen set from 92' to 122'. Drilled by mud rotary.
OW-1-13	5/8/2013	8,453.445	60,787.973	1159.3	1162.41	0	106	1053.3	8.39	97.6	Competed as 2-inch PVC Observation Well with screen set 90' to 100'. Drill cutting indicate sand and trace gravel. Fines layers at 18.5'-21.5' and 84'-90'. Gravel layer at 33'-36.5'. Drilled by sonic rig.
OW-3-13	5/15/2013	8,486.663	61,149.406	1159.4	1162.49	0	115	1044.4	8.26	106.7	Competed as 2-inch PVC Observation Well with screen set 100' to 110'. Drill cutting indicate sand with trace gravel. Gravelly at 25'-37' and 57'-62'. Fines layer at 37'-50'. Cobbles at 25'-31'. Drilled by sonic rig.
OW-50P (OW-2-13)	5/11/2013	8,314.594	60,967.041	1160.9	1163.63	0	> 115	> 1045.9	10.21	104.8	Competed as 2-inch PVC Observation Well with screen set 100' to 110'. Drill cutting indicate sand and trace gravel. Gravel layers at 32'-35'. Cobbles at 28'-35'. Drilled by sonic rig.
OW-75P	11/19/2013	8,348.157	60,846.998	1163.3	1166.42	0	118	1045.3	12.03	106.0	Competed as 2-inch PVC Observation Well with screen set 104' to 114'. Drill cutting indicate well graded sand and gravel with cobble layers. Fines at 23'-24' and 55'-60'. Cobbles at 35'-40'. Drilled by mud rotary.
OW-150P	11/20/2013	8,284.664	61,072.404	1160.6	1163.54	0	136	1024.6	8.61	127.4	Competed as 2-inch PVC Observation Well with screen set 105' to 115'. Drill cutting indicate sand with gravel, some cobble layers. Fines layers in 40'-44'. Cobbles from 22'-40'. Drilled by mud rotary.
OW-60R	11/21/2013	8,277.198	60,907.523	1160.9	1164.29	5	121	1039.9	9.78	111.20	Competed as 2-inch PVC Observation Well with screen set 105' to 115'. Drill cutting indicate sand and some gravel. Fines at 19'-22', 32'-33' and 42'-44'. Drilled by mud rotary.
SP-120R	12/11/2013	8,226.531	60,898.043	1152.2	1152.51	NA	NA	NA	1.91	NA	Sandpoint installed to 11 feet below ground; top of screen at 8 feet bgs.

Notes:

[a] Water levels collected on December 16, 2013

bgs = below ground surface

Table 2: Formation Sample Sieve Analysis Results
Yankton, South Dakota

Boring	Sample Type	Depth (ft bgs)	Percentage of Sample by USCS Grain Size (mm)					Grain Size (mm) Percent Retained				Grain Size (inches) Percent Retained		
			Gravel > 4.75	Coarse Sand 2.00 - 4.75	Medium Sand 0.425 - 2.00	Fine Sand 0.075 - 0.425	Fines <0.075	D10	D60	D50	C_u	D10	D60	D50
TW-1	WB	90-95	1.0	9.5	80.5	9.0	0.0	0.43	1.24	1.04	2.9	0.02	0.05	0.04
TW-1	WB	95-105	0.0	7.5	85.5	7.0	0.0	0.48	1.30	1.14	2.7	0.02	0.05	0.05
TW-1	WB	105-115	0.0	6.0	81.0	13.0	0.0	0.38	1.04	0.94	2.7	0.02	0.04	0.04
TW-1	WB	115-120	0.0	22.5	71.0	6.5	0.0	0.53	1.52	1.40	2.9	0.02	0.06	0.06
OW-60R	WB	105-110	0.0	17.0	80.0	3.0	0.0	0.69	1.47	1.35	2.1	0.03	0.06	0.05
OW-60R	WB	110-115	0.0	45.0	52.0	3.0	0.0	0.71	2.18	1.85	3.1	0.03	0.09	0.07
OW-75P	WB	100-105	0.0	7.2	83.8	9.0	0.0	0.46	1.19	1.04	2.6	0.02	0.05	0.04
OW-75P	WB	105-110	0.0	17.5	76.5	6.0	0.0	0.61	1.52	1.42	2.5	0.02	0.06	0.06
OW-75P	WB	110-115	0.0	17.5	75.5	7.0	0.0	0.56	1.50	1.35	2.7	0.02	0.06	0.05
OW-150P	WB	100-105	1.0	20.0	73.5	6.0	0.0	0.58	1.55	1.40	2.7	0.02	0.06	0.06
OW-150P	WB	105-110	1.0	13.0	80.5	6.0	0.0	0.58	1.40	1.24	2.4	0.02	0.06	0.05
OW-150P	WB	110-115	1.0	10.5	83.0	6.0	0.0	0.53	1.35	1.19	2.5	0.02	0.05	0.05
TH-1-13	Sonic	43-49	4.0	6.0	79.0	7.7	3.3	0.4	1.05	0.98	2.6	0.02	0.04	0.04
TH-1-13	Sonic	61-80	2.0	4.0	66.0	24.5	3.5	0.27	0.85	0.65	3.1	0.01	0.03	0.03
TH-1-13	Sonic	90-97	1.0	7.0	82.0	7.3	2.7	0.43	0.97	0.9	2.3	0.02	0.04	0.04
TH-1-13	Sonic	97-101	10.0	11.0	64.0	10.1	4.9	0.24	1.05	0.9	4.4	0.01	0.04	0.04
TH-1-13	Sonic	101-106	2.0	4.0	83.0	8.0	3.0	0.42	0.91	0.8	2.2	0.02	0.04	0.03
TH-2-13	Sonic	50-60	9.0	16.0	60.0	11.9	3.1	0.33	1.4	1.1	4.2	0.01	0.05	0.04
TH-2-13	Sonic	60-70	7.0	9.0	65.0	13.0	6.0	0.3	1.05	0.9	3.5	0.01	0.04	0.04
TH-2-13	Sonic	80-90	3.0	1.0	75.0	18.2	2.8	0.27	0.79	0.65	2.9	0.01	0.03	0.03
TH-2-13	Sonic	90-100	0.0	3.0	82.0	10.0	5.0	0.26	0.9	0.8	3.5	0.01	0.04	0.03
TH-2-13	Sonic	100-110	0.0	1.0	79.0	15.2	4.8	0.24	0.79	0.66	3.3	0.01	0.03	0.03
TH-3-13	Sonic	62-69	2.0	11.0	82.0	2.3	2.7	0.65	1.5	1.32	2.3	0.03	0.06	0.05
TH-3-13	Sonic	71.5-77	10.0	10.0	67.0	10.8	2.2	0.36	1.05	0.95	2.9	0.01	0.04	0.04
TH-3-13	Sonic	77-88	0.0	1.0	76.0	18.3	4.7	0.2	0.78	0.61	3.9	0.01	0.03	0.02
TH-3-13	Sonic	91-98	0.0	1.0	90.0	7.4	1.6	0.43	0.8	0.7	1.9	0.02	0.03	0.03
TH-3-13	Sonic	98-113	6.0	5.0	81.0	7.5	0.5	0.43	0.95	0.8	2.2	0.02	0.04	0.03

D10 = sieve size (I.e., grain size) where 10% of the material passes through.
D50 = sieve size (I.e., grain size) where 50% of the material passes through.
D60 = sieve size (I.e., grain size) where 60% of the material passes through.
C_u = uniformity coefficient = D60 passing/D10 passing; lower values of C_u indicate more uniform grading of sample between these limits; larger values of C_u represent less uniform grading. Cu < 2 is considered uniform, Cu > 5 is considered non-uniform.
WB = Wash Bore sample collected from representative cutting returns after ceasing drill penetration; fines can be under represented in these samples.
SS = Split Spoon sample

Table 3: TW-1 Variable-Rate Test Summary
December 12, 2013: Yankton, South Dakota

Step	Start Time	Duration (minutes)	Pumping Rate (gpm)	Depth to Water in Test Well at End of Step (ft bgs)	Observed Drawdown at End of Step (ft)	Observed Specific Capacity (gpm/ft)
SWL[a]				13.38		
1	12:00	60	500	20.31	6.94	72.05
2	13:00	60	660	22.38	9.00	73.33
3	14:00	60	830	25.10	11.73	70.76
4	15:00	60	1028	28.29	14.92	68.90
5	16:00	60	1200	31.08	17.71	67.76

Notes:

[a] Referenced static water level was measured just prior to pumping

Table 4: TW-1 Constant-Rate Test Summary
December 16-20, 2013: Yankton, South Dakota

Well Name	Distance from Pumping Well (ft)	Reference Elevation at TOC (ft above msl)	Depth to Static Water Level (ft TOC)[a]	Static Water Level Elevation (ft msl)[a]	~ 24 Hours of Pumping		~ 48 Hours of Pumping		~ 60 Hours of Pumping		~ 74 Hours of Pumping		~ 24 Hours of Recovery	
					Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)
TW-1	----	1164.28	13.60	1150.68	31.43	17.83	31.43	17.83	31.41	17.81	31.48	17.88	13.66	0.06
OW-50P	48.37	1163.65	12.94	1150.71	15.49	2.55	15.55	2.61	15.55	2.61	15.66	2.72	12.97	0.03
OW-75P	76.28	1165.87	15.15	1150.72	17.72	2.57	17.78	2.63	17.77	2.62	17.88	2.73	15.20	0.05
OW-150P	157.90	1162.27	11.55	1150.72	12.78	1.23	12.83	1.28	12.84	1.29	12.95	1.40	11.57	0.02
OW-60R	52.10	1163.77	13.17	1150.60	15.83	2.66	15.89	2.72	15.88	2.71	16.00	2.83	13.21	0.04
OW-1-13	182.69	1162.41	11.50	1150.91	13.25	1.75	13.30	1.80	13.31	1.81	13.41	1.91	11.55	0.05
OW-3-13	278.72	1162.53	11.35	1151.18	12.15	0.80	12.22	0.87	12.24	0.89	12.32	0.97	11.45	0.10
SP-120R	103.59	1152.51	2.22	1150.29	2.65	0.43	2.71	0.49	2.73	0.51	2.84	0.62	2.28	0.06
River	175	1149.70	0.00	1149.70	0.02	0.02	0.04	0.04	0.04	0.04	0.20	0.20	-0.17	-0.17

Notes:

[a] Static water levels referenced were measured just prior to test

[b] Water levels have been corrected to account for river fluctuation effects

Table 5: TW-1 Constant-Rate Test Summary - Corrected for River Stage Changes
December 16-20, 2013: Yankton, South Dakota

Well Name	Distance from Pumping Well (ft)	Reference Grade Elevation (ft above msl)	Depth to Static Water Level (ft TOC)[a]	Static Water Level Elevation (ft msl)[a]	~ 24 Hours of Pumping		~ 48 Hours of Pumping		~ 60 Hours of Pumping		~ 74 Hours of Pumping		~ 24 Hours of Recovery		River change correction factor (ft/ft)
					Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	Depth to Water Level (ft TOC)[b]	Observed Change from Static (ft)	
TW1	----	1164.28	13.60	1150.68	31.42	17.82	31.41	17.81	31.39	17.79	31.37	17.77	13.75	0.15	0.53
OW-50P	48.37	1163.65	12.94	1150.71	15.48	2.54	15.53	2.59	15.53	2.59	15.55	2.61	13.06	0.12	0.53
OW-75P	76.28	1165.87	15.15	1150.72	17.71	2.56	17.76	2.61	17.75	2.60	17.78	2.63	15.29	0.14	0.50
OW-150P	157.90	1162.27	11.55	1150.72	12.77	1.22	12.81	1.26	12.82	1.27	12.84	1.29	11.66	0.11	0.55
OW-60R	52.10	1163.77	13.17	1150.60	15.82	2.65	15.87	2.70	15.86	2.69	15.89	2.72	13.30	0.13	0.54
OW-1-13	182.69	1162.41	11.50	1150.91	13.24	1.74	13.28	1.78	13.29	1.79	13.32	1.82	11.63	0.13	0.46
OW-3-13	278.72	1162.53	11.35	1151.18	12.14	0.79	12.21	0.86	12.23	0.88	12.25	0.90	11.51	0.16	0.35
SP-120R	103.59	1152.51	2.22	1150.29	2.64	0.42	2.68	0.46	2.70	0.48	2.71	0.49	2.39	0.17	0.63
River	175	1149.70	0.00	1149.70	0.02	0.02	0.04	0.04	0.04	0.04	0.20	0.20	-0.17	-0.17	1.00

Notes:

[a] Static water levels referenced were measured just prior to test

[b] Water levels have been corrected to account for river fluctuation effects

Table 6: Collector Well Design Parameter Summary
Yankton, South Dakota

Parameter	Summer Average Flow	Summer Minimum Flow	Winter Average Flow	Winter Minimum Flow
Grade Elevation (ft msl)	1161	1161	1161	1161
Bedrock Elevation (ft msl)	1038	1038	1038	1038
Top of Sand Elevation (ft. msl)	1161	1161	1161	1161
Elevation of Lower Laterals Centerline (ft. msl)	1055	1055	1055	1055
Elevation of Upper Laterals Centerline (ft. msl)	1059	1059	1059	1059
Inside Diameter of Caisson (ft)	16	16	16	16
Saturated Thickness (ft)	115.2	114.6	113.3	112.6
Missouri River Flow (cfs)	32,175	26,500	16,836	12,000
Static Water Level (ft.msl)	1153.2	1152.6	1151.3	1150.6
Produced Water Temperature (F)	65	65	42	42
Hydraulic Conductivity (gpd/ft^2; temperature corrected)	2505	2505	1767	1767
Radius of Lateral (ft)	0.42	0.42	0.42	0.42
Design Distance to Line Source of Recharge (ft)	750	750	750	750
Average Lateral Length (ft)	185	185	185	185
Minimum Design Pumping Level (ft msl)	1069	1069	1069	1069
Calculated Maximum Yield (gpd)**	24,213,600	23,938,560	16,456,320	16,233,120
Calculated Maximum Yield (gpm)**	16,815	16,624	11,428	11,273
Number of Laterals	14	14	13	13
Estimated Maximum Flow Per Lateral (gpm)	1,201	1,187	879	867
Calculated Average In-Line Flow Velocity (ft/sec)	4.91	4.85	3.59	3.54

Notes:

** Assumes 20% well degradation

FIGURES

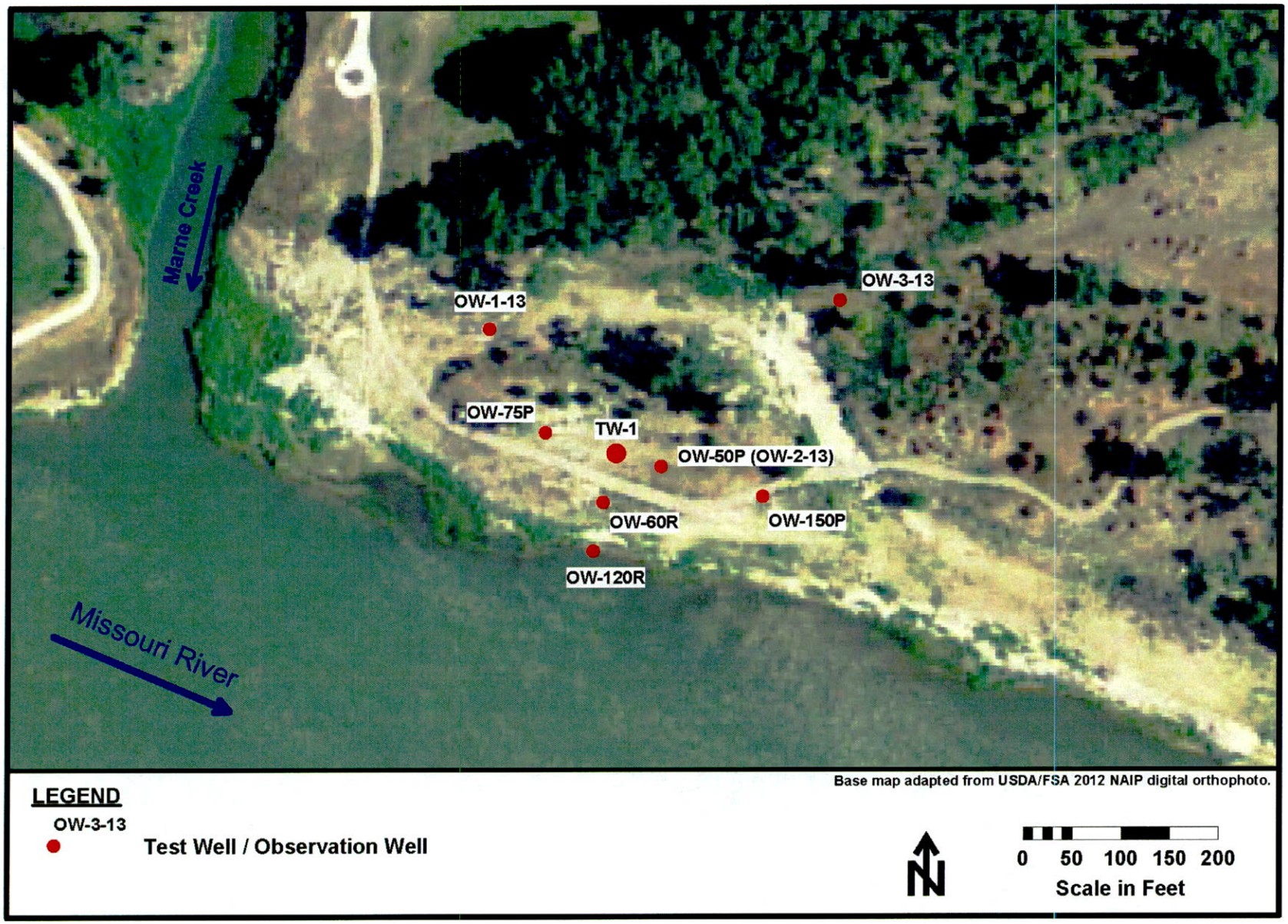


FIGURE 1: Site Map

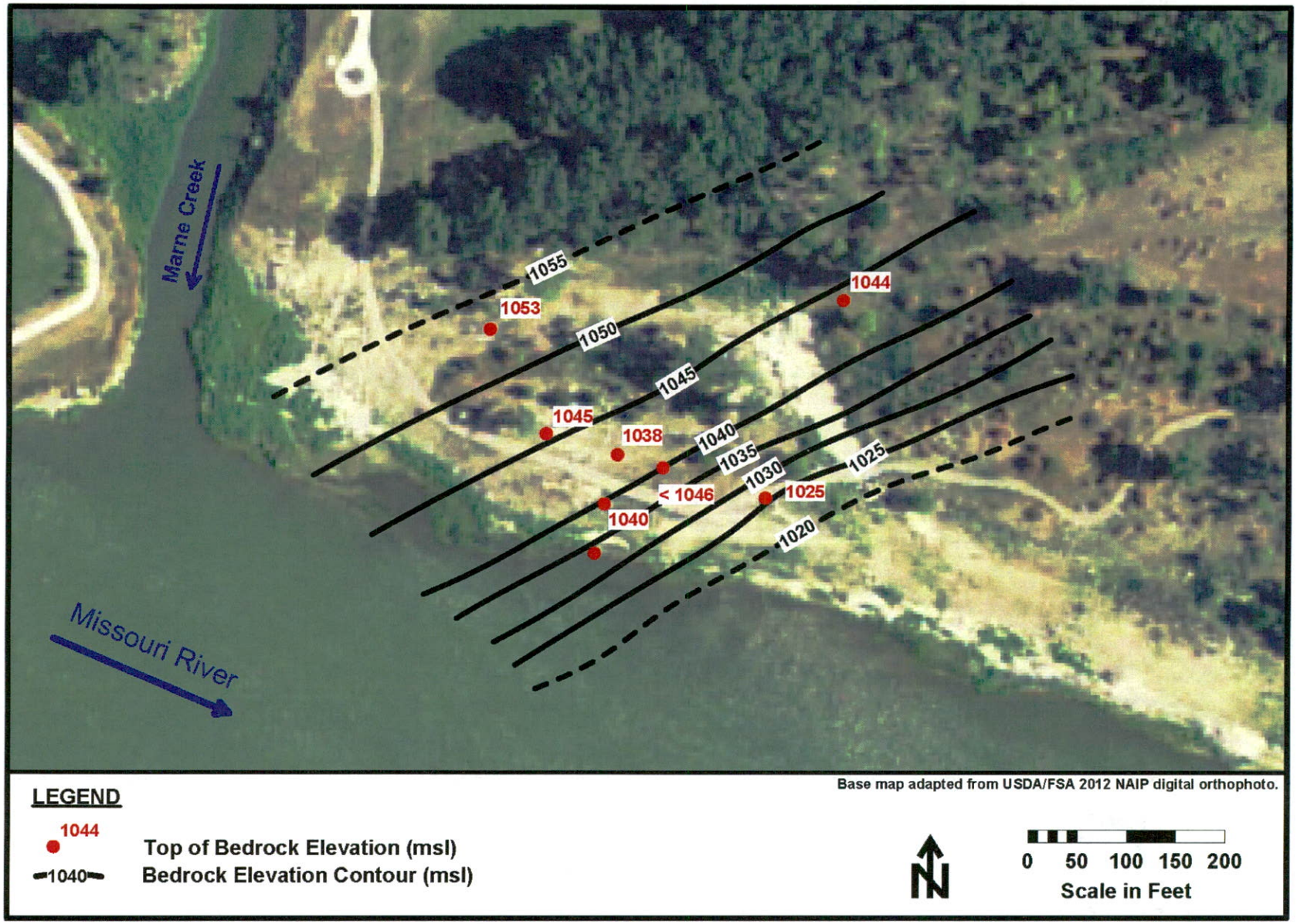


FIGURE 2: Elevation of the Top of Bedrock

FIGURE 3: Stepped Rate Test and Recovery
December 12, 2013
Yankton Collector Well Study: Yankton, SD

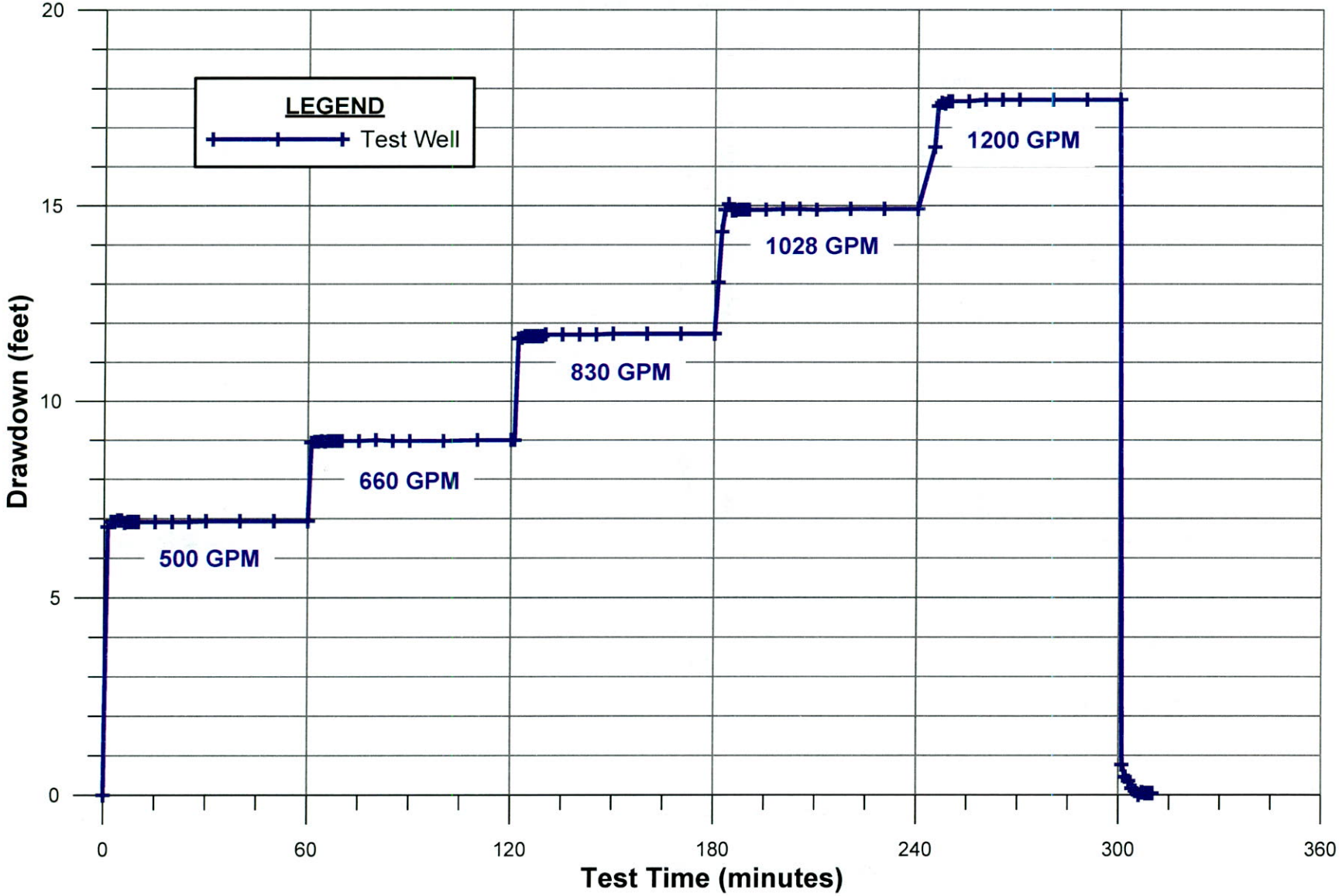


FIGURE 4: Constant-Rate Test and Recovery - Test Well
December 16 - 20, 2013
Yankton Collector Well Study: Yankton, SD

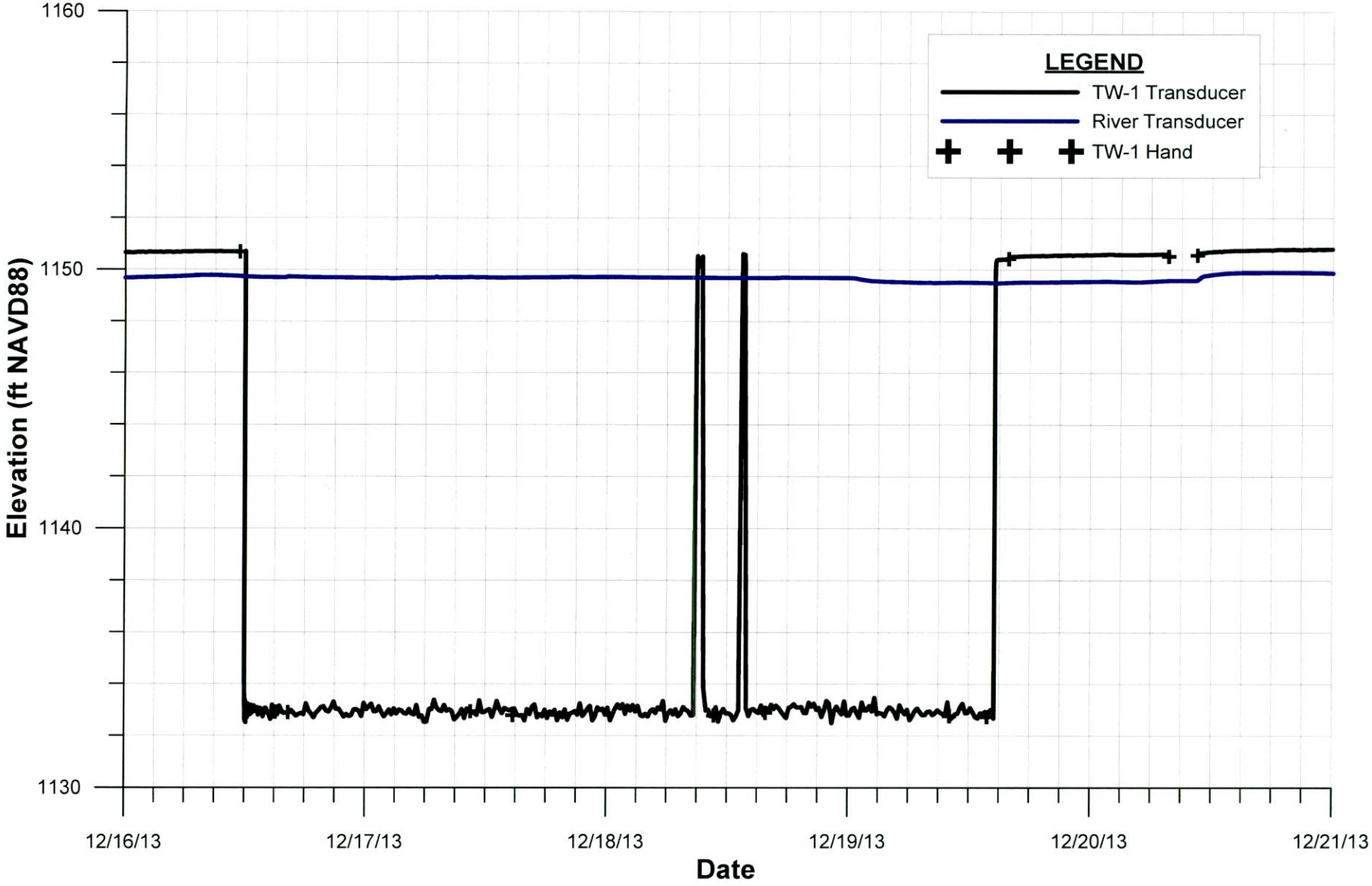


FIGURE 5: Constant-Rate Test and Recovery - Observation Wells
December 16 - 20, 2013
Yankton Collector Well Study: Yankton, SD

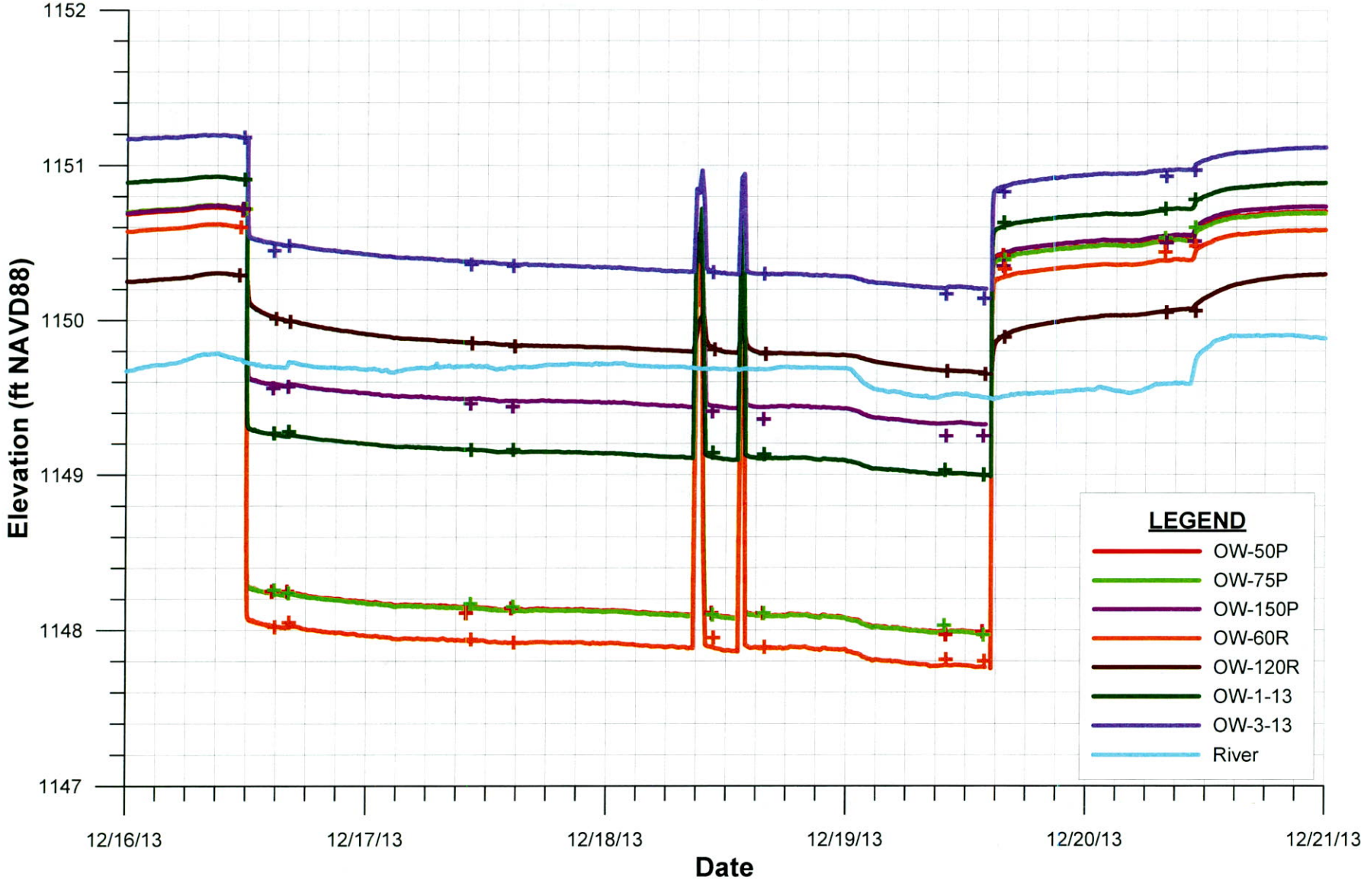
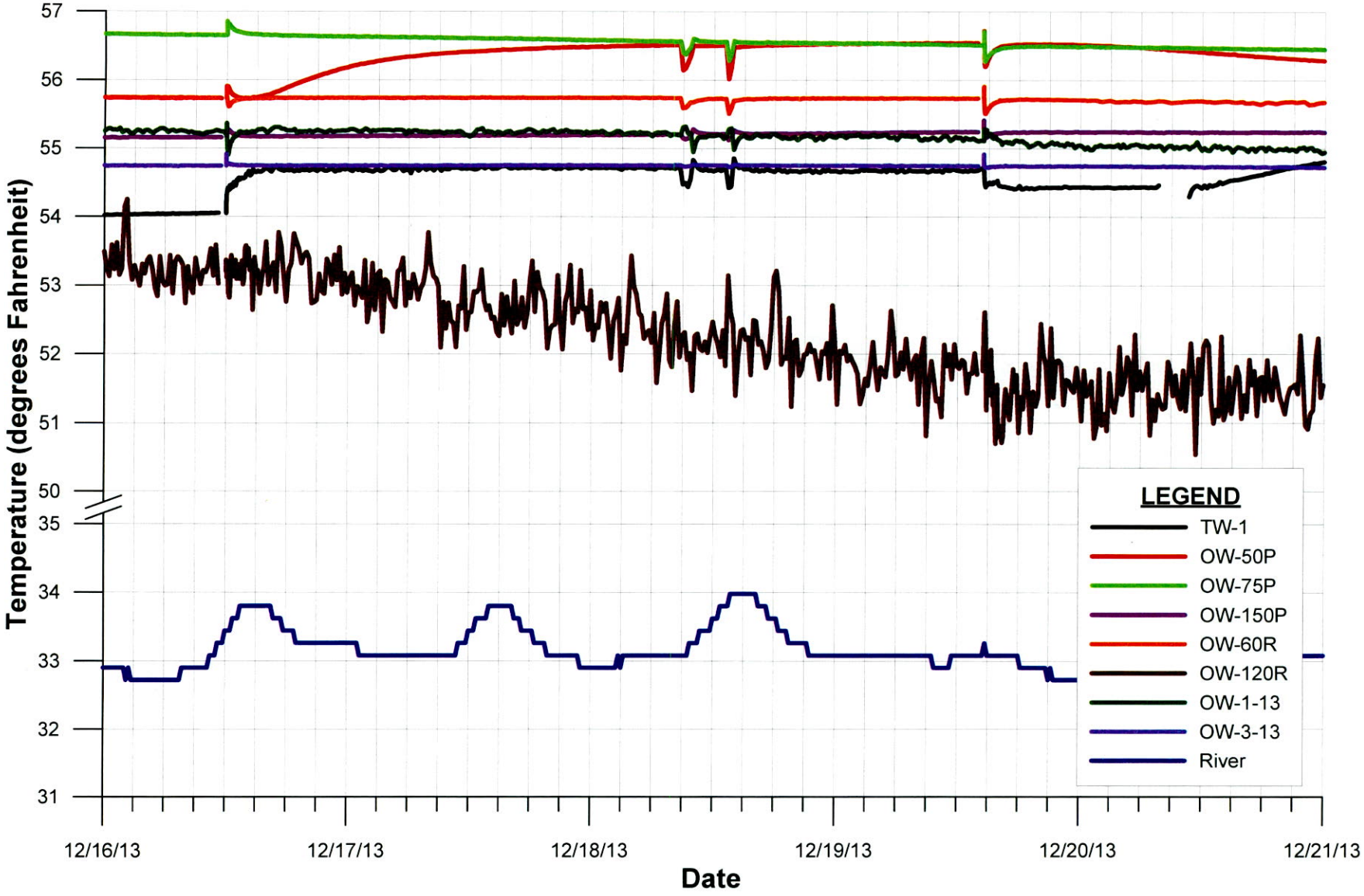


FIGURE 6: Constant-Rate Test and Recovery - Temperature
December 16 - 20, 2013
Yankton Collector Well Study: Yankton, SD



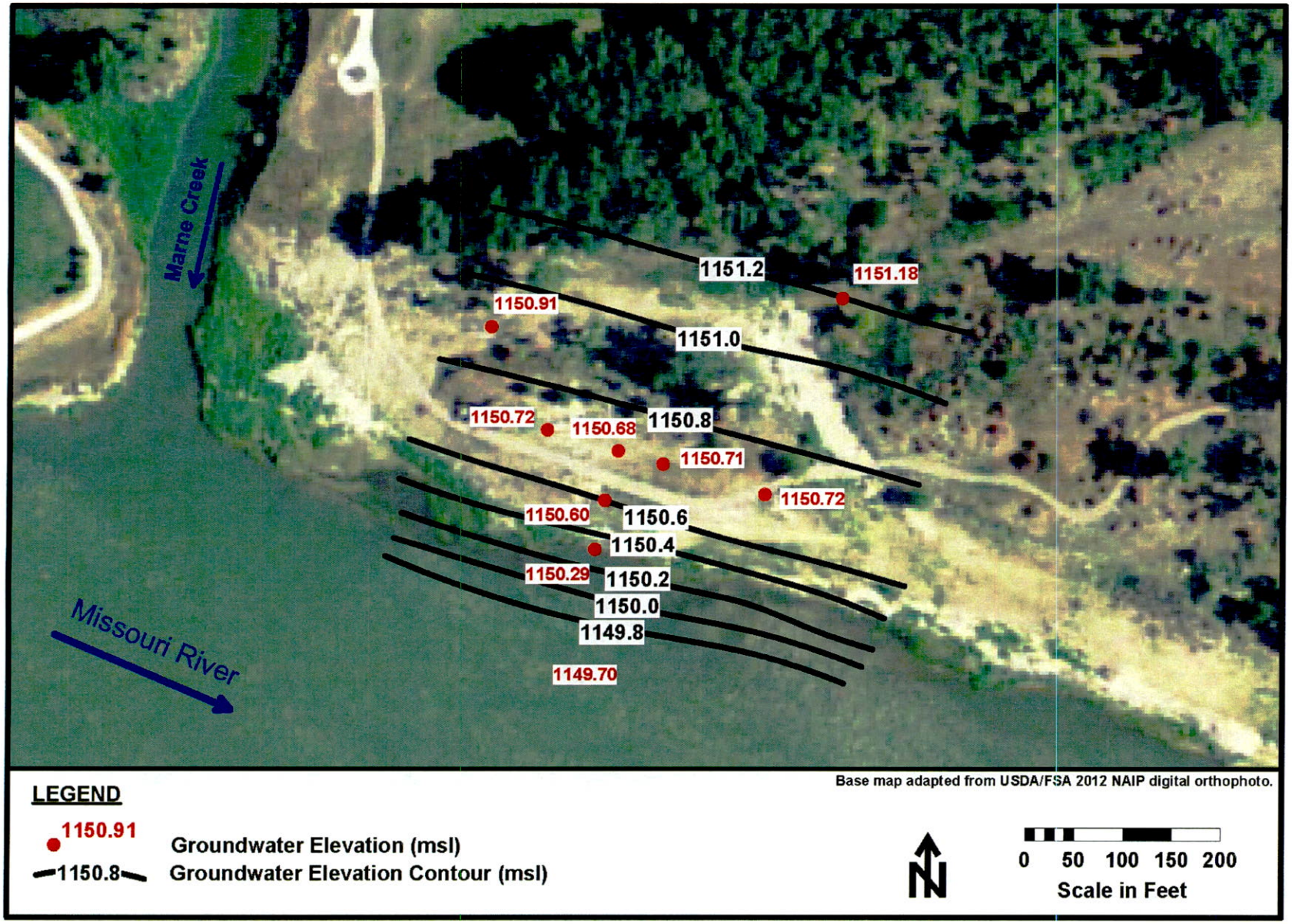


FIGURE 7: Elevation of the Pre-Pumping Groundwater Surface

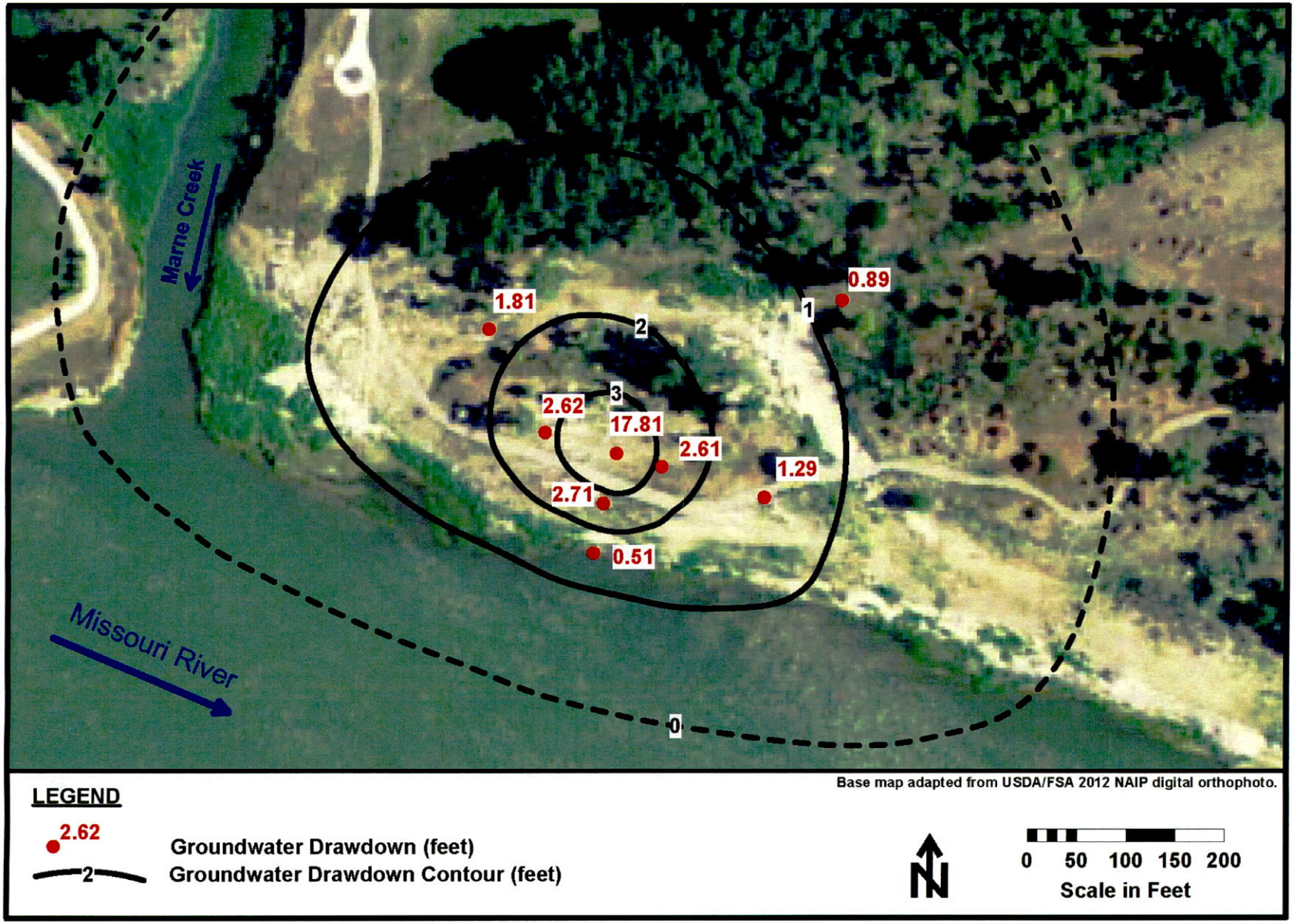
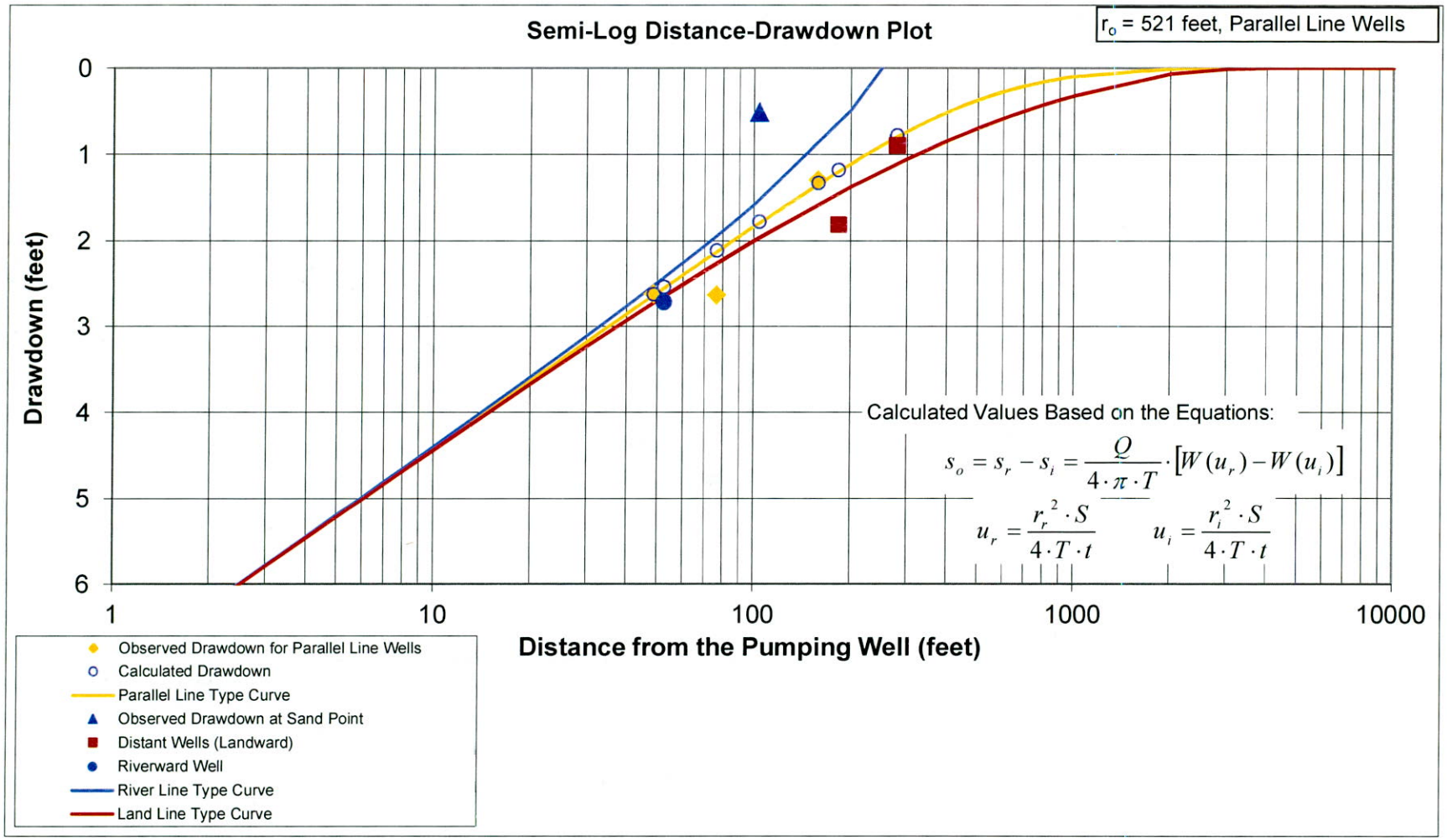


FIGURE 8: Water Level Drawdown at 60 Hours into Constant-Rate Pumping Test

FIGURE 9: Aquifer Test Analysis
Theis Method with Image Well to Evaluate Recharge Boundary



Well:	TW-1	**Job:**	City of Yankton, South Dakota			**Job No. :**	
Estimated Parameters:							
Transmissivity =	242,400 gal/day/ft		**Storativity =**	0.10	**Effective Distance to Recharge =**		255 ft

FIGURE 10: Post 2012 Stage Curve for USGS Gage at Yankton

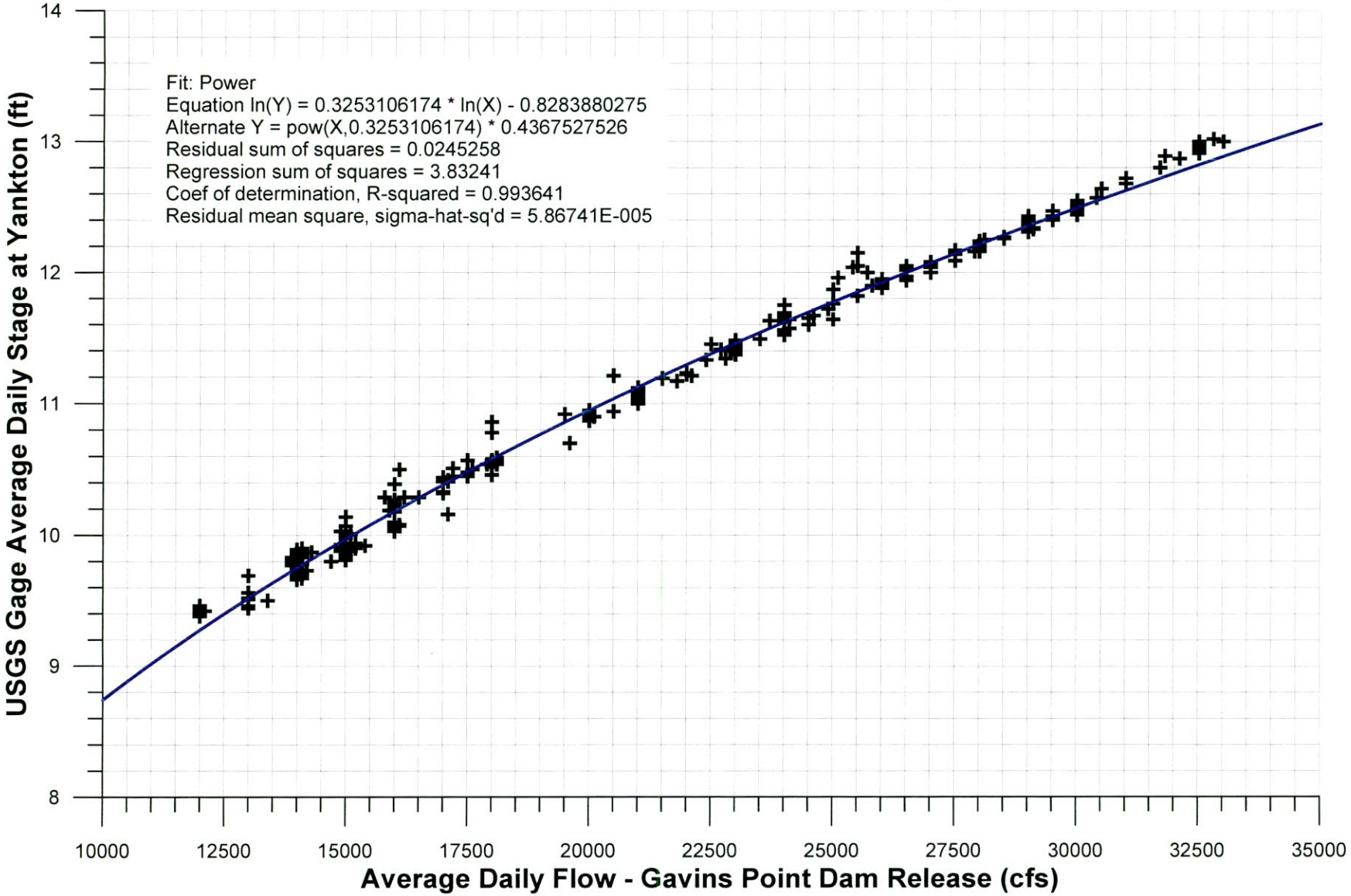


FIGURE 11: Estimated Collector Well Production Curves at 100% Efficient Well Paddlewheel Point: Yankton, South Dakota

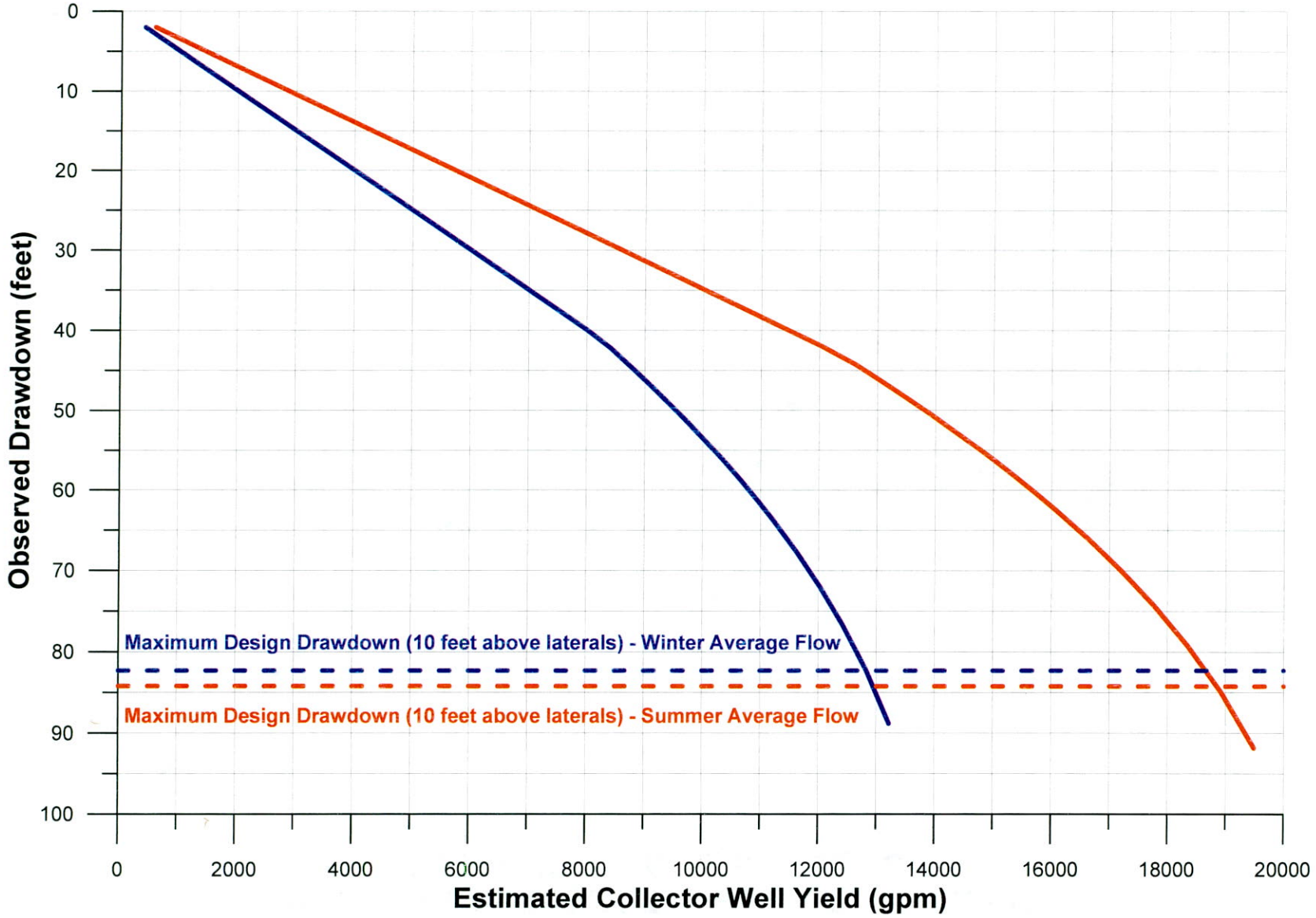
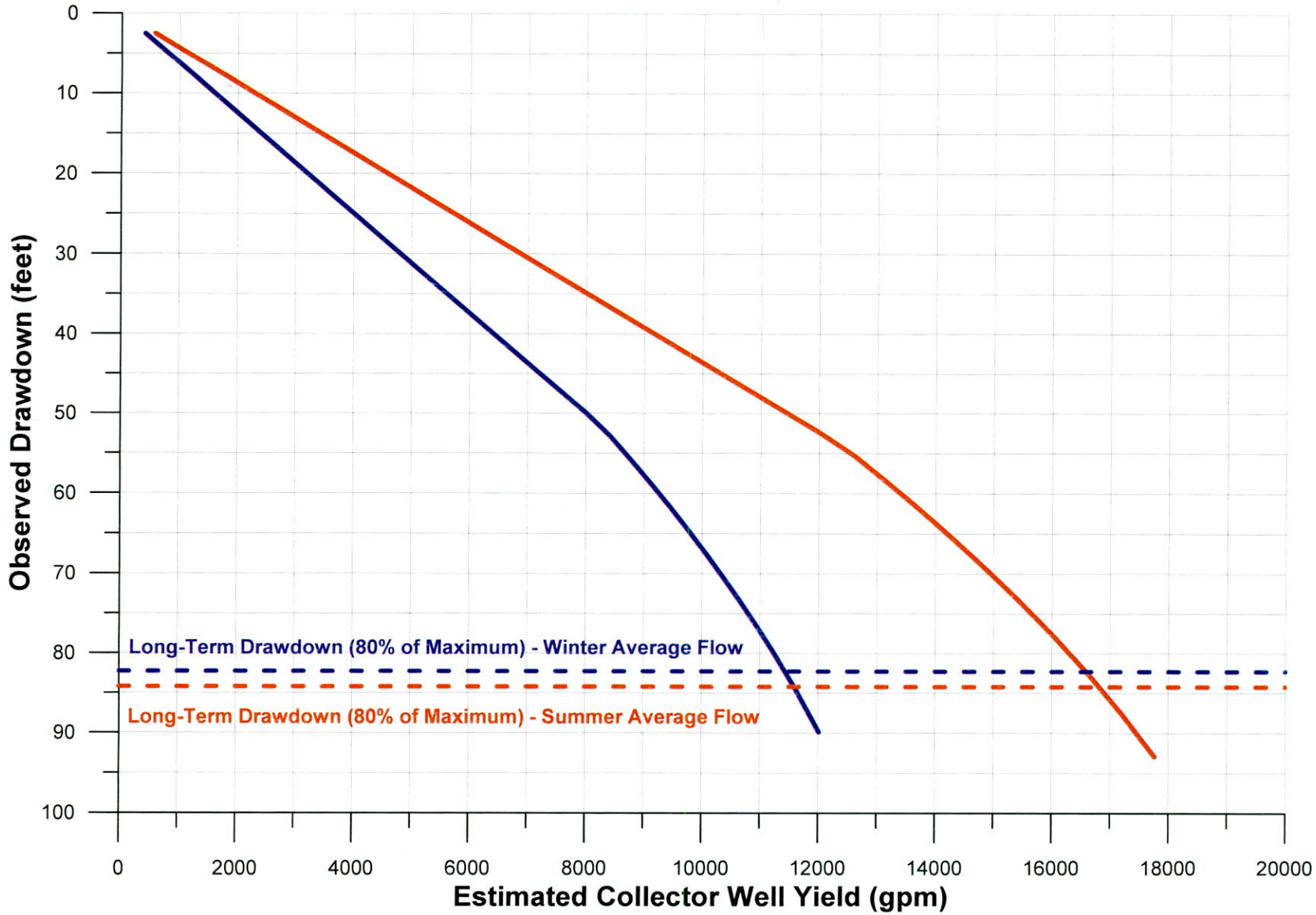


FIGURE 12: Estimated Collector Well Production Curves at 80% Efficient Well Paddlewheel Point: Yankton, South Dakota



APPENDIX A

June 2013 Collector Well Investigation Report

at Paddle Wheel Point

CITY OF YANKTON

COLLECTOR WELL INVESTIGATION REPORT AT PADDLE WHEEL POINT

Prepared for

City of Yankton, South Dakota

Prepared by
HDR Engineering, Inc.

June 2013

TABLE OF CONTENTS

	Page
Introduction	1
Field Activities	1
TH-1-13	2
TH-2-13	3
TH-3-13	3
Estimate of Aquifer Properties	4
Horizontal Collector Well Yield Estimate	4
Water Quality	6
Summary	7
References	8

LIST OF TABLES

Table 1	Test Boring Information Summary
Table 2	Grain Size Analysis Summary
Table 3	Monitoring Well Construction Details
Table 4	Hydraulic Interval Test Results
Table 5	Groundwater Quality Analytical Results
Table 6	Estimate of Collector Well Water Quality

LIST OF FIGURES

Figure 1	Test Boring Locations
Figure 2	Preliminary Estimate; Collector Well Drawdown vs Yield

APPENDICES

Appendix A	Boring Logs
Appendix B	Photos
Appendix C	Grain Size Laboratory Report
Appendix D	Field Notes
Appendix E	Hydraulic Interval Testing Data
Appendix F	Projected Collector Well Yield Calculation Sheet
Appendix G	Water Quality Analytical Laboratory Reports

CITY OF YANKTON
COLLECTOR WELL INVESTIGATION REPORT

INTRODUCTION

The City of Yankton is evaluating the potential to install a collector well in the alluvial deposits along the Missouri River to supplement its raw water supply. HDR Engineering, Inc. (HDR) was contracted to perform the evaluation. HDR subcontracted with Layne Specialty Drilling Division (Layne) to drill test borings and perform hydraulic interval testing at potential collector well sites. The test borings are located in a City-owned, lightly wooded natural area known as Paddle Wheel Point, adjacent to the Missouri River. This memorandum presents the results of the collector well evaluation.

FIELD ACTIVITIES

In order to evaluate the hydraulic character of the alluvial deposits, a total of three (3) test borings (designated TH-1-13 through TH-3-13) were drilled by Layne using rotasonic drilling technology, under the supervision of an HDR hydrogeologist. The approximate locations of the test borings are presented in Figure 1. Each boring was advanced until bedrock was encountered. Continuous core samples were collected and provided by Layne for lithologic logging by the HDR hydrogeologist. Selected samples from the lower portions of each boring were retained by HDR for grain size analysis. Detailed boring logs of the materials encountered during drilling are included in Appendix A. Photographs of the alluvial deposits are provided in Appendix B. A summary of information on the borings is presented in Table 1. The grain size laboratory report is presented in Appendix C, and a summary of the grain size analysis results is presented in Table 2.

A hydraulic interval pumping test was conducted at each of the three borings. The vertical interval tested was selected by the HDR hydrogeologist on the basis of the drilling and sampling results. Upon reaching the total completion depth of the test boring, the outer drill casing was pulled back to the bottom of the interval to be tested, and a temporary 10-foot length of well screen (4-inch diameter, wire-wrapped continuous slot) was installed in the selected interval using the pullback method. The screen slot size was selected based on the grain size of the formation materials, with 0.040-inch and 0.060-inch slot screens utilized during the testing. Development of the test interval was accomplished by air lifting for up to two hours after which the water produced was visibly clear and contained little or no sediment. A temporary pump capable of pumping up to 110 gallons per minute (gpm) was then installed in the casing and hydraulic interval testing performed. An in-line electromagnetic flowmeter was used to measure the pumping rates during the testing. The selected interval was pumped for two (2) hours, with the pumping period divided into four (4) steps of thirty (30) minutes duration. During each step, the pumping was maintained at a constant rate. Depths to water were measured to the nearest

0.01-foot in the casing prior to and during the pumping period. The elapsed time of pumping to the nearest minute and the pumping rate associated with each water level measurement were recorded in a field logbook (copies of HDR's field notes are contained in Appendix D). During each step of the pumping period, water level measurements in the test boring were made at approximately the following schedule:

- Every 1 minute for 0 to 10 minutes from the start of the step; and
- Every 2 minutes after 10 minutes from the start of the step.

Summaries of the hydraulic interval testing results for each test boring are presented in Appendix E, including calculations of specific capacity and well efficiency.

During the hydraulic interval testing, water samples were collected at the end of the pumping period for laboratory analysis of drinking water quality indicator parameters, volatile organic compounds (VOCs) and other organic compounds. Only clean, laboratory-supplied containers and preservatives were used. Samples were packed on ice in coolers and given to City of Yankton water treatment plant personnel for delivery to the State of South Dakota Department of Health laboratory in Pierre, South Dakota, and Midwest Laboratories in Omaha, Nebraska.

Following completion of interval testing, the borings were converted to 2-inch diameter PVC observation wells. Details of the observation well construction are summarized in Table 3 and described in the field notes in Appendix D. Each observation well was installed with 10 feet of machine slotted PVC well screen. Following installation each well was developed by pumping until the water produced was relatively clear and contained little or no sediment. The tops of the observation wells were completed with 4-inch square steel protective casings with lockable lids. The protective casings extend approximately 3 feet above ground surface.

TEST BORING TH-1-13

Test boring TH-1-13 was drilled about 300 feet east of Marne Creek and 300 feet north of the Missouri River (Figure 1). TH-1-13 was drilled to a depth of 110 feet, encountering weathered shale bedrock at 106.5 feet. A general summary of the materials encountered during the drilling is presented below:

Depth in Feet		
From	To	Description
0	18.5	Sand and silty sand
18.5	21.5	Medium stiff clay
21.5	84	Sand with trace gravel
84	90	Very stiff silt
90	106.5	Sand with trace gravel
106.5	110	Weathered shale bedrock

Following the drilling of TH-1-13, a temporary well screen (0.060-inch slot openings) was set between depths of 90 and 100 feet for hydraulic interval testing. TH-1-13 was pumped at rates of 30, 61, 82, and 101 gpm, with the drawdown at the end of the 4th step being 4.06 feet

equating to a specific capacity of 25 gallons per minute per foot (gpm/ft) of drawdown. The results of the drilling and hydraulic interval testing indicated a favorable location for a collector well. Following completion of the interval test, the boring was converted to an observation well.

TEST BORING TH-2-13

Test boring TH-2-13 was drilled about 600 feet east of Marne Creek and 90 feet north of the Missouri River (Figure 1). TH-2-13 was drilled to a depth of 115 feet, encountering hard material (assumed to be weathered shale bedrock) at 115 feet. A general summary of the materials encountered during the drilling is presented below:

Depth in Feet		
From	To	Description
0	32	Sand with trace gravel
32	50	Sand, gravel, cobbles
50	90	Sand with trace gravel, few clay lenses
90	115	Sand with trace gravel
115	-	Weathered shale bedrock (assumed)

Following the drilling of TH-2-13, a temporary well screen (0.040-inch slot openings) was set between depths of 100 and 110 feet for hydraulic interval testing. TH-2-13 was pumped at rates of 37, 60, 82, and 101 gpm, with the drawdown at the end of the 4th step being 3.86 feet equating to a specific capacity of 26 gpm/ft. The results of the drilling hydraulic interval testing indicated a favorable location for a collector well. Following completion of the interval test, the boring was converted to an observation well.

TH-3-13 RESULTS

Test boring TH-3-13 was drilled about 900 feet east of Marne Creek and 400 feet north of the Missouri River (Figure 1). TH-3-13 was drilled to a depth of 120 feet, encountering weathered shale bedrock at 115 feet. A general summary of the materials encountered during the drilling is presented below:

Depth in Feet		
From	To	Description
0	37	Sand with trace gravel
37	50	Clay and silty sand
50	88	Sand with trace gravel
88	90.5	Fine sand and clay lenses
90.5	115	Sand with trace gravel
115	120	Weathered shale bedrock

Following the drilling of TH-3-13, a temporary well screen (0.040-inch slot openings) was set between depths of 100 and 110 feet for hydraulic interval testing. TH-3-13 was pumped at rates of 25, 57, 86, and 104 gpm, with the drawdown at the end of the 4th step being 4.44 feet

equating to a specific capacity of 23 gpm/ft. The results of the drilling and hydraulic interval testing indicated a favorable location for a collector well. Following completion of the interval test, the boring was converted to an observation well.

ESTIMATION OF AQUIFER PROPERTIES

Estimates of aquifer hydraulic conductivity and transmissivity were made using two different methods, including calculations using the grain size results and analysis of the hydraulic interval tests. Hydraulic conductivity estimates based on grain size analyses are included in Table 2. The geometric means of the hydraulic conductivity values from each test boring are approximately 400 ft/day (TH-1), 260 ft/day (TH-2), and 510 ft/day (TH-3). These values correspond with textbook values for clean sand given by Freeze and Cherry (1979), which reasonably matches the materials observed and collected in the field. Assuming a saturated thickness of 99 feet observed at TH-1, the transmissivity of the aquifer ranges from 190,000-375,000 gallons per day per foot (gpd/ft).

Estimates of hydraulic conductivity and transmissivity based on the hydraulic interval testing are presented in Table 4. The observed specific capacity values from the hydraulic interval tests were adjusted to account for partial penetration and well efficiency and the adjusted values were utilized to calculate the aquifer hydraulic conductivity and transmissivity. Due to the short duration of the hydraulic interval tests and because they are single well pumping tests, the results for the aquifer parameters should be considered as approximate and are intended primarily to allow comparison of the test boring locations. The method utilized to adjust for the well screen only partially penetrating the saturated thickness of the aquifer is based on the assumption that the aquifer is homogeneous and isotropic. Since at all of the sites tested the aquifer materials were somewhat heterogeneous, the partial penetration adjustment probably results in an over estimate of the transmissivity and hydraulic conductivity values. Without the partial penetration adjustment, the transmissivity and hydraulic conductivity values are likely underestimated. The transmissivity and hydraulic conductivity values were calculated both with and without the partial penetration adjustment and the results are reported in Table 4 as a range of values, with the true values of transmissivity and hydraulic conductivity likely being between the ranges of values presented. Calculated hydraulic conductivity ranges include 65-330 ft/day (TH-1), 75-370 ft/day (TH-2), and 70-420 ft/day (TH-3). Transmissivity estimates range from approximately 50,000-310,000 gpd/ft. These results display good agreement with the values calculated from the grain size analyses.

HORIZONTAL COLLECTOR WELL YIELD ESTIMATES

The yield of a horizontal collector well is a function of design (number and length of laterals), aquifer hydraulics (transmissivity, storativity, saturated thickness and areal extent) and recharge. As such, a design detail level estimate of the yield of a horizontal collector well requires the aquifer parameters obtained from an extended aquifer pumping test. However, a preliminary estimate of the potential yield from a collector well was developed using the results of the test drilling and hydraulic interval testing program.

Based on the test drilling results, it appears that either TH-2 or TH-3 is a suitable location for the construction of a horizontal collector well. Given the quantity and quality of the water desired, it is necessary to locate the collector well as close to the river as possible to maximize induced infiltration for optimal yield and maximize the percentage of river water to optimize water quality.

The theoretical drawdown under steady-state pumping conditions in a collector well near a stream is calculated using the following equation developed by Hantush and Papadopulos (1962):

$$s_{cs} \geq \left(\frac{Q}{2\pi Kb}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}(2z_i + r_w)\right)}\right)^{\frac{b}{4\ell}}\right]$$

Where:

s_{cs}	=	Drawdown in collector well, ft
Q	=	Yield of collector, gpd
K	=	Hydraulic Conductivity, gpd/ft^2
b	=	Saturated thickness of aquifer, ft
Γ	=	$(2\ (a - r_c))/l$
a	=	Effective distance to a line of recharge, ft
l	=	Average length of laterals, ft
r_c	=	Radius of collector caisson, ft
ε	=	$(2a - r_c - l)/l$
r_w	=	Effective radius of each lateral, ft
z_i	=	Depth of lateral below static water level, ft

As shown in the equation above, the yield of a collector well is proportional to the drawdown in the caisson. Using TH-3 as an example, the centerline of the collector well laterals would be located at a depth of 100 feet bgs to leave room for the bottom plug (minimum 3 to 4 foot thickness) and the jacking equipment (centerline of 3 feet above plug). This lateral depth results in approximately 85 feet of water column overlying the top of the collector well laterals. The minimum pumping level was assumed to be ten (10) feet above the centerline of the laterals, meaning the drawdown in the caisson was set equal to 70 feet. The effective distance to recharge boundary was assumed to equal 750 feet based on the geometry of the Missouri River and the location of TH-3.

The aquifer parameters used in the calculation of the collector well yield were obtained from the hydraulic interval tests performed in the three test borings (see Table 3). For the TH-3 site, a range of collector well yields were calculated based on the range of transmissivity values determined from the hydraulic interval testing. Using the range of aquifer transmissivity values, the yield of collector well installed at TH-2 or TH-3 is between 4 and 24 MGD. A projected well yield calculation sheet is included in Appendix F. Using the geometric mean of the calculated aquifer transmissivity values (122,000 gpd/ft), the yield of a horizontal collector well installed at TH-2 or TH-3 is estimated to be approximately 10 MGD. According to Domenico and Schwartz

(1990), if a number of aquifer-testing results are available, the geometric mean of the results should be used to calculate the average hydraulic conductivity. Given our experience with the hydrogeology of the Missouri River near Yankton, it is our opinion that an aquifer transmissivity of 122,000 gpd/ft is a reasonable estimate, given the geology encountered at the TH-3 site. Figure 2 presents a plot of the estimated pumping rate and drawdown response in a horizontal collector well constructed near the TH-3 location.

WATER QUALITY

Laboratory water quality analytical results are summarized in Table 5. Lab reports are contained in Appendix G. All parameters reported from all three sampling points are below the Safe Drinking Water Act (SDWA) Primary Drinking Water Standards. However, as discussed below, several constituents exceed the Secondary Drinking Water Standards.

The Primary Drinking Water Standards are mandatory water quality standards for drinking water contaminants. These are enforceable standards defined as "maximum contaminant levels" or "MCLs." MCLs represent the maximum allowable concentration of the contaminant and established to protect the public against consuming drinking water that present a risk to human health.

In addition, EPA established the Secondary Drinking Water Standards as non-mandatory water quality Standards. The "secondary maximum contaminant levels" or "SMCLs" are not enforced by EPA or DENR. The SMCLs are set primarily for aesthetics. Compounds that exceed the SMCL may cause the water to appear cloudy, colored, or taste or smell bad. Secondary contaminants are set to provide guidance on the maximum concentration where most people will not find the compound to be noticeable.

Inorganic Constituents

Inorganic constituents of the well water sampled are high in concentrations of dissolved solids. The majority of the dissolved solids consists of hardness, iron, manganese, and sulfate. These parameters exceed the Secondary Drinking Water Standards.

Organic Constituents

The organic constituents analyzed are those regulated compounds as part of the SDWA Primary Drinking Water Act. All VOCs, pesticides, herbicides and other organic compounds that were analyzed were reported as non-detectable in the samples collected.

Projected Collector Well Water Quality

Water quality at these test boring sites will change with time if continuous pumping at sufficient rates to induce infiltration from the Missouri River. Collector wells constructed along the Missouri River basin have demonstrated the change in water quality over time as river water infiltrates into the well system. We estimate that the ration of river water to groundwater will range from 75% river water / 25% groundwater to over 90% river water / 10% groundwater. The

variation depends on the distance the collector well is constructed from the river. The closer the collector well is to the river the greater influence of river water.

Table 6 summarizes water quality data as assume in the Facility Plan compared to the estimated collector well quality at various river water to groundwater ratios. These estimates suggest that the final water quality from a collector well located on Paddle Wheel Point will be similar to the estimated water quality presented in the Facility Plan.

SUMMARY/RECOMMENDATIONS

The TH-2 and TH-3 sites have favorable conditions for the construction of a horizontal collector well. The 10 MGD calculation presented above is an estimate of the horizontal collector well yield based on estimated aquifer parameters determined from a short, single well pumping test. Refinement of these estimates should be performed by conducting a detailed 72-hr aquifer pumping test, which includes several observation wells. The objectives of the pumping test are to improve our estimation of hydraulic conductivity and transmissivity, and obtain estimates of aquifer properties not identified during the hydraulic interval testing including storativity, areal extent, and recharge boundaries (e.g., river effects).

The groundwater quality is very high in dissolved solids, hardness, iron, manganese and sulfate. For a collector well operating in the vicinity of TH-2 or TH-3, induced river water will dilute these compounds and are anticipated to be representative of the estimated water quality used in the Facility Plan.

Although either TH-2 or TH-3 appears to be good candidate locations for a horizontal collector well, it is our recommendation that a test well be constructed at the location of TH-2 based on the proximity of this location compared to TH-3. It is generally recommended to locate a horizontal collector well as close to the river as possible to maximize induced infiltration for optimal yield and maximize the percentage of river water to optimize water quality. A detailed 72-hour aquifer pumping test should be performed at the test well location to improve the characterization of the aquifer transmissivity and to quantify the degree of interconnection between the aquifer and the Missouri River. Three to six monitoring wells should be installed in close proximity to the test well to collect the necessary drawdown data for the aquifer test analysis. Water levels in the newly installed observation wells at TH-1, TH-2, and TH-3 should be monitored using pressure transducers during the aquifer pumping test.

REFERENCES

Domenico, P.A. and F.W. Schwartz, 1990. Physical and Chemical Hydrogeology, John Wiley & Sons, New York, p. 67.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater, Prentice-Hall, Inc., Englewood Cliffs, NJ, 604 p.

Hantush, M.S. and Papadopoulos, I.S., 1962. Flow of Ground Water to Collector Wells. J. Hydraulics Division, American Society of Civil Engineers, 88 HY5, pp. 221-244.

TABLES

TABLE 1
Test Boring Information Summary
Collector Well Investigation
City of Yankton, South Dakota

Test Boring ID	Date Drilled	Total Depth Drilled (feet)	Depth to Bedrock (feet)	Observation Well Screened Interval Depths (feet)	Hydraulic Interval Test Screened Interval Depths (feet)
TH-1-13	5/8/2013	110	106.5	90 - 100	90 - 100
TH-2-13	5/15/2013	115	115	99.5 - 109.5	100 - 110
TH-3-13	5/11/2013	120	115	100 - 110	100 - 110

TABLE 2
Grain Size Analyses Summary
Collector Well Investigation
City of Yankton, South Dakota

Test Boring ID	Depth Interval (feet)	Size Fractions [1]			Effective Grain Size [2]			Uniformity Coefficient [3]	Hydraulic Conductivity Hazen Formula [4]			
		Gravel (%)	Sand (%)	Silt/Clay (%)	D_{10} (mm)	D_{50} (mm)	D_{60} (mm)		(m/s)	(gpd/ft^2)	ft/day	
TH-1-13	43-49	10.0%	86.8%	3.2%	0.40	0.98	1.05	2.6	1.92E-03	4,070	544	
TH-1-13	61-80	6.0%	90.6%	3.4%	0.27	0.65	0.85	3.1	8.75E-04	1,854	248	
TH-1-13	90-97	8.0%	89.4%	2.6%	0.43	0.90	0.97	2.3	2.17E-03	4,595	614	
TH-1-13	97-101	21.0%	74.1%	4.9%	0.24	0.90	1.05	4.4	6.91E-04	1,465	196	
TH-1-13	101-106	6.0%	91.1%	2.9%	0.42	0.80	0.91	2.2	2.12E-03	4,487	600	
											440	arithmetic mean
											396	geomean
TH-2-13	50-60	25.0%	72.0%	3.0%	0.33	1.10	1.40	4.3	1.27E-03	2,687	359	
TH-2-13	60-70	16.0%	78.2%	5.8%	0.30	0.90	1.05	3.5	1.08E-03	2,289	306	
TH-2-13	80-90	4.0%	93.3%	2.7%	0.27	0.65	0.79	2.9	8.75E-04	1,854	248	
TH-2-13	90-100	3.0%	92.1%	4.9%	0.26	0.80	0.90	3.5	8.11E-04	1,720	230	
TH-2-13	100-110	1.0%	94.3%	4.7%	0.24	0.66	0.79	3.3	6.91E-04	1,465	196	
											268	arithmetic mean
											262	geomean
TH-3-13	62-69	13.0%	84.4%	2.6%	0.65	1.32	1.50	2.3	5.07E-03	10,747	1,437	
TH-3-13	71.5-77	20.0%	77.9%	2.1%	0.36	0.95	1.05	2.9	1.56E-03	3,297	441	
TH-3-13	77-88	1.0%	94.4%	4.6%	0.20	0.61	0.78	3.9	4.80E-04	1,017	136	
TH-3-13	91-98	1.0%	97.5%	1.5%	0.43	0.70	0.80	1.9	2.22E-03	4,703	629	
TH-3-13	98-113	11.0%	88.6%	0.4%	0.43	0.80	0.95	2.2	2.22E-03	4,703	629	
											654	arithmetic mean
											509	geomean

Notes:

1) Size Fractions based on Wentworth Classification System:
   - Gravel = material between 2 mm and 64 mm
   - Sand = material between 1/16 mm and 2 mm
   - Silt and or Clay = material less than 1/16 mm

2) Effective Grain Sizes:
   - D_{10} = 10% passing grain size
   - D_{50} = 50% passing grain size
   - D_{60} = 60% passing grain size

3) Coefficient of Uniformity is ratio of D_{60} size to D_{10} size.

4) Hazen formula is applicable for materials with D_{10} grain size must be >0.1mm and < 3mm.

TABLE 3
Monitoring Well Construction Details
Collector Well Investigation
City of Yankton, South Dakota

Monitoring Well ID	TH-1-13	TH-2-13	TH-3-13
Date Installed	5/9/2013	5/16/2013	5/13/2013
Bottom of Well Depth (feet)	100	109.5	110
Screened Interval Depth (feet)	90 - 100	99.5 - 109.5	100 - 110
Filter Pack Interval Depth (feet)	88 - 100	97 - 109.5	98 - 110
Bentonite Seal Interval Depth (feet)	85 - 88	94 - 97	96 - 98
Grouted Interval Depth (feet)	~1 - 85	~1 - 94	~1 - 96
Materials:			
Screen/Casing Material	2-inch dia. Schedule 40 PVC		
Screen Slot Openings	0.010-inch, mill slot		
Filter Pack Material	#10-20 silica sand		
Bentonite Seal	3/8-inch bentonite chips		
Surface Completion	4-inch dia. steel stick-up casing w/ concrete pad		

TABLE 4
Hydraulic Interval Test Results
Collector Well Investigation
City of Yankton, South Dakota

Test Boring ID	Screen Slot Size (inches)	Screen Setting Depth (feet)	Static Depth to Water Below Ground Surface (feet)	Estimated Saturated Aquifer Thickness (feet)	Step	Observed Drawdown at End of Pumping Step (feet)	Pumping Rate at End of Step (gpm)	Observed Specific Capacity at End of Step (gpm/ft)	Partial Penetration Correction (1)	Laminar Flow Loss (2) (%)	Estimated Transmissivity (3) (gpd/ft)	Estimated Hydraulic Conductivity (4) (ft/day)
TH-1-13	0.060	90 - 100	7.61	99	1	0.97	29.7	30.6	0.20	93.9%	49,000 - 245,000	65 - 330
					2	2.25	61.2	27.2	0.20	83.4%		
					3	3.04	81.5	26.8	0.20	82.2%		
					4	4.06	101.0	24.9	0.20	76.3%		
TH-2-13	0.040	100 - 110	9.32	105	1	1.12	37.0	33.0	0.20	90.0%	55,000 - 275,000	75 - 370
					2	1.98	59.5	30.1	0.20	81.9%		
					3	2.95	82.0	27.8	0.20	75.7%		
					4	3.86	101.1	26.2	0.20	71.4%		
TH-3-13	0.040	100 - 110	7.84	107	1	0.75	24.5	32.7	0.20	94.2%	52,000 - 313,000	70 - 420
					2	2.14	57.3	26.8	0.20	77.2%		
					3	3.52	86.1	24.5	0.20	70.5%		
					4	4.44	104.0	23.4	0.20	67.6%		

Notes:

1) Partial Penetration Correction Factor:

$$X = L\left(1+7\sqrt{\frac{r}{2bL}}\cos\frac{\pi L}{2}\right)$$ (Kozeny, 1933)

2) Laminar Flow Loss estimated by comparing observed specific capacity to theoretical maximum specific capacity.

3) Transmissivity based on the equation below for an unconfined aquifer, as a range of values without and with partial penetration adjustment:

$$T = \frac{1500\ Q/s}{XE}$$ (Driscoll, 1986)

4) Hydraulic conductivity based on estimates of transmissivity and saturated aquifer thickness, as a range of values without and with partial penetration adjustment.

Table 5

Grouindwater Quality Analytical Results

Collector Well Investigation

City of Yankton, South Dakota

Parameter	Units	TH-1-13	TH-2-13	TH-3-13	MCL	SMCL
Physical Parameters						
Total Dissolved Solids	mg/L	1,918	1,875	1,829		500
pH		6.98	7.14	7.58		6.5-8.5
Conductivity	umho/cm	2,200	2,170	2,120		
Langlier Index		0.33	0.52	0.92		
Silicon	ug/L	23.0	21.4	23.4		
Cations						
Calcium	mg/L	349	350	322		
Magnesium	mg/L	118	126	115		
Hardness	mg/L as CaCO3	1,360	1,390	1,280		
Sodium	mg/L	44.2	52.2	51		
Potassium	mg/L	12.3	13.8	12.1		
Iron	mg/L	4.39	4.04	3.99		0.3
Manganese	mg/L	2.42	2.88	3.04		0.05
Ammonia	mg/L as N	<0.05	<0.05	<0.05		
Anions						
Alkalinity-M	mg/L as CaCO3	340	363	357		
Alkalinity-P	mg/L as CaCO3	0	0	0		
Bicarbonate	mg/L	415	443	436		
Carbonate	mg/L	0	0	0		
Chloride	mg/L	27	21	18		250
Sulfate	mg/L	1,090	1,020	1,010		250
Nitrate	mg/L as N	<0.2	<0.2	<0.2	10	
Nitrite	mg/L as N	<0.02	<0.02	<0.02	1	
Fluoride	mg/L	0.31	0.32	0.29	4	2
Metals						
Antimony	ug/L	<0.2	<0.2	<0.2	0.6	
Aluminum	ug/L	17	33.3	5		20
Arsenic	mg/L	0.006	0.003	0.005	0.1	
Barium	ug/L	13	21.4	12.1	2000	
Beryllium	ug/L	<0.2	<0.2	<0.2	4	
Cadmium	ug/L	<0.2	<0.2	<0.2	5	
Chromium (total)	ug/L	10.4	4.5	5.5	100	
Copper	mg/L	<0.02	<0.02	<0.02	TT	1
Lead	ug/L	0.3	0.3	<0.1	TT	

Table 5

Grouindwater Quality Analytical Results

Collector Well Investigation

City of Yankton, South Dakota

Parameter	Units	TH-1-13	TH-2-13	TH-3-13	MCL	SMCL
Mercury	ug/L	<0.1	<0.1	<0.1	2	
Molybdenum	ug/L	1.6	1.7	1.8		
Nickel	ug/L	19.8	20.9	19		
Selenium	ug/L	1.2	1.4	1.3	50	
Silver	ug/L		<1.0	<1.0		100
Thallium	ug/L	<0.1	<0.1	<0.1	2	
Zinc	ug/L	27.1	20.2	22.4		5000
Radionuclieds						
Uranium	ug/L	2.4	2	2.3	30	
Organic Compounds						
TOC	mg/L as C	1.05	1.01	1.09		
Total Trihalomethanes	ug/L	<2.00	<2.01	<2.02		
Alachlor	ug/L	<0.440	<0.440	<0.440	2	
Aldicarb sulfoxide	ug/L	<1.00	<1.00	<1.00		
Aldicarb sulfoxide	ug/L	<1.00	<1.00	<1.00		
Aldicarb sulfoxide	ug/L	<1.00	<1.00	<1.00		
Aldrin	ug/L	<0.100	<0.100	<0.100		
Aroclor 1016	ug/L	<0.080	<0.080	<0.080		
Aroclor 1221	ug/L	<0.100	<0.100	<0.100		
Aroclor 1232	ug/L	<0.100	<0.100	<0.100		
Aroclor 1242	ug/L	<0.100	<0.100	<0.100		
Aroclor 1248	ug/L	<0.100	<0.100	<0.100		
Aroclor 1254	ug/L	<0.100	<0.100	<0.100		
Aroclor 1260	ug/L	<0.100	<0.100	<0.100		
Atrazine	ug/L	<0.220	<0.220	<0.220	3	
Benzene	ug/L	<0.500	<0.500	<0.500	5	
Benzo(a)pyrene	ug/L	<0.200	<0.200	<0.200	0.2	
Bis(2-ethylhexyl)Adipate	ug/L	<1.32	<1.33	<1.34	400	
Bis(2-ethylhexyl)Phthalate	ug/L	<1.32	<1.33	<1.34	6	
Bromobenzene	ug/L	<0.500	<0.500	<0.500		
Bromochloromethane	ug/L	<0.500	<0.500	<0.500		
Bromodichloromethane	ug/L	<0.500	<0.500	<0.500		
Bromoform	ug/L	<0.500	<0.500	<0.500		
Bromomethane	ug/L	<0.500	<0.500	<0.500		
Butachlor	ug/L	<0.500	<0.500	<0.500		
N-Butylbenzene	ug/L	<0.500	<0.500	<0.500		

Table 5

Grouindwater Quality Analytical Results

Collector Well Investigation

City of Yankton, South Dakota

Parameter	Units	TH-1-13	TH-2-13	TH-3-13	MCL	SMCL
sec-Butylbenzene	ug/L	<0.500	<0.500	<0.500		
tert-Butylbenzene	ug/L	<0.500	<0.500	<0.500		
Carbaryl	ug/L	<2.00	<2.01	<2.02		
Carbofuran	ug/L	<1.98	<1.98	<1.98	40	
Carbon Tetrachloride	ug/L	<0.500	<0.500	<0.500	5	
Chlordane	ug/L	<0.440	<0.440	<0.440	2	
Chlorobenzene	ug/L	<0.500	<0.500	<0.500	100	
Chloroethane	ug/L	<0.500	<0.500	<0.500		
Chloroform	ug/L	<0.500	<0.500	<0.500		
Cloromethane	ug/L	<0.500	<0.500	<0.500		
2-Chlorotoluene	ug/L	<0.500	<0.500	<0.500		
4-Chlorotoluene	ug/L	<0.500	<0.500	<0.500		
2,4-D	ug/L	<1.00	<1.00	<1.00	70	
Dibromochloromethane	ug/L	<0.500	<0.500	<0.500		
1,2-Dibromo-3-Chloropropane	ug/L	<0.04	<0.04	<0.04	0.2	
1,2-Dibromoethane	ug/L	<0.02	<0.02	<0.02		
1,2-Dibromoethane	ug/L	<0.500	<0.500	<0.500		
Dicamba	ug/L	<1.00	<1.00	<1.00		
1,3-Dichlorobenzene	ug/L	<0.500	<0.500	<0.500		
o-Dichlorobenzene	ug/L	<0.500	<0.500	<0.500	600	
p-Dichlorobenzene	ug/L	<0.500	<0.500	<0.500	75	
Dichlorodifluoromethane	ug/L	<0.500	<0.500	<0.500		
1,1-Dichloroethane	ug/L	<0.500	<0.500	<0.500		
1,1-Dichloroethylene	ug/L	<0.500	<0.500	<0.500	7	
1,2-Dichloroethane	ug/L	<0.500	<0.500	<0.500	5	
cis-1,2-Dichloroethylene	ug/L	<0.500	<0.500	<0.500	7	
cis-1,3-Dichloropropene	ug/L	<0.500	<0.500	<0.500		
trans-1,2-Dichloroethylene	ug/L	<0.500	<0.500	<0.500	100	
trans-1,3-Dichlroopropene	ug/L	<0.500	<0.500	<0.500		
Dibromomethane	ug/L	<0.500	<0.500	<0.500		
1,1-Dichloropropene	ug/L	<0.500	<0.500	<0.500		
1,2-Dichloropropane	ug/L	<0.500	<0.500	<0.500	5	
1,3-Dichloropropane	ug/L	<0.500	<0.500	<0.500		
2,2-Dichloropropane	ug/L	<0.500	<0.500	<0.500		
Dieldrin	ug/L	<0.500	<0.500	<0.500		
Dilapon	ug/L	<10.0	<10.1	<10.2		
Dinoseb	ug/L	<1.00	<1.00	<1.00		
Diquat	ug/L	<0.88	<0.88	<0.88		

Table 5

Grouindwater Quality Analytical Results

Collector Well Investigation

City of Yankton, South Dakota

Parameter	Units	TH-1-13	TH-2-13	TH-3-13	MCL	SMCL
Endothal	ug/L	<19.8	<19.9	<19.10	100	
Endrin	ug/L	<0.100	<0.100	<0.100	2	
Ethylbenzene	ug/L	<0.500	<0.500	<0.500	700	
Glyphosate	ug/L	<13.2	<13.3	<13.4	700	
Heptachlor	ug/L	<0.400	<0.400	<0.400	0.4	
Heptachlor epoxide	ug/L	<0.100	<0.100	<0.100	0.2	
Hexachlorobenzene	ug/L	<0.220	<0.220	<0.220	1	
Hexachlorobutadiene	ug/L	<0.500	<0.500	<0.500		
Hexachlorocyclopentadiene	ug/L	<0.220	<0.220	<0.220	50	
3-Hydroxycarbofuran	ug/L	<2.00	<2.00	<2.00		
Isoproply-Toluene	ug/L	<0.500	<0.500	<0.500		
Isopropylbenzene	ug/L	<0.500	<0.500	<0.500		
Lindane	ug/L	<0.100	<0.100	<0.100	0.2	
Metholmyl	ug/L	<2.00	<2.00	<2.00		
Methoxychlor	ug/L	<0.220	<0.221	<0.222	40	
Methylene Chloride	ug/L	<0.500	<0.500	<0.500		
Metolachlor	ug/L	<0.500	<0.500	<0.500		
Metribuzin	ug/L	>0.500	>0.501	>0.502		
MTBE	ug/L	<0.500	<0.500	<0.500		
Naphthalene	ug/L	<0.500	<0.500	<0.500		
N-Propylbenzene	ug/L	<0.500	<0.500	<0.500		
Oxamyl	ug/L	<2.00	<2.00	<2.00	200	
Pentachlorophenol	ug/L	<0.500	<0.501	<0.502	1	
Picloram	ug/L	<1.00	<1.00	<1.00	500	
Propachlor	ug/L	<0.500	<0.500	<0.500		
Simazine	ug/L	<0.150	<0.150	<0.150	4	
Styrene	ug/L	<0.500	<0.500	<0.500	100	
1,1,1,2-Tetrachloroethane	ug/L	<0.500	<0.500	<0.500		
1,1,2,2-Tetrachloroethane	ug/L	<0.500	<0.500	<0.500		
Tetrachloroethylene	ug/L	<0.500	<0.500	<0.500	5	
1,2,3-Trichlorobenzene	ug/L	<0.500	<0.500	<0.500		
1,2,3-Trichloropropane	ug/L	<0.500	<0.500	<0.500		
1,2,4-Trichlorobenzene	ug/L	<0.500	<0.500	<0.500	70	
1,2,4-Trimethylbenzene	ug/L	<0.500	<0.500	<0.500		
1,1,1-Trichloroethane	ug/L	<0.500	<0.500	<0.500	200	
1,1,2-Trichoroethane	ug/L	<0.500	<0.500	<0.500	5	
1,3,5-Trimethylbenzene	ug/L	<0.500	<0.500	<0.500		
Toluene	ug/L	<0.500	<0.500	<0.500		

Table 5

Grouindwater Quality Analytical Results

Collector Well Investigation

City of Yankton, South Dakota

Parameter	Units	TH-1-13	TH-2-13	TH-3-13	MCL	SMCL
2,4,5-TP	ug/L	<1.00	<1.00	<1.00	50	
Toxaphene	ug/L	<0.100	<0.100	<0.100	3	
Trichloroethylene	ug/L	<0.500	<0.500	<0.500		
Trichlorofluoromethane	ug/L	<0.500	<0.500	<0.500		
Vinyl Cloride	ug/L	<0.500	<0.500	<0.500	2	
m,p-Xylene	ug/L	<0.500	<0.500	<0.500		
o-Xylene	ug/L	<0.500	<0.500	<0.500		
Xylenes (Total)	ug/L	<0.500	<0.500	<0.500	10	

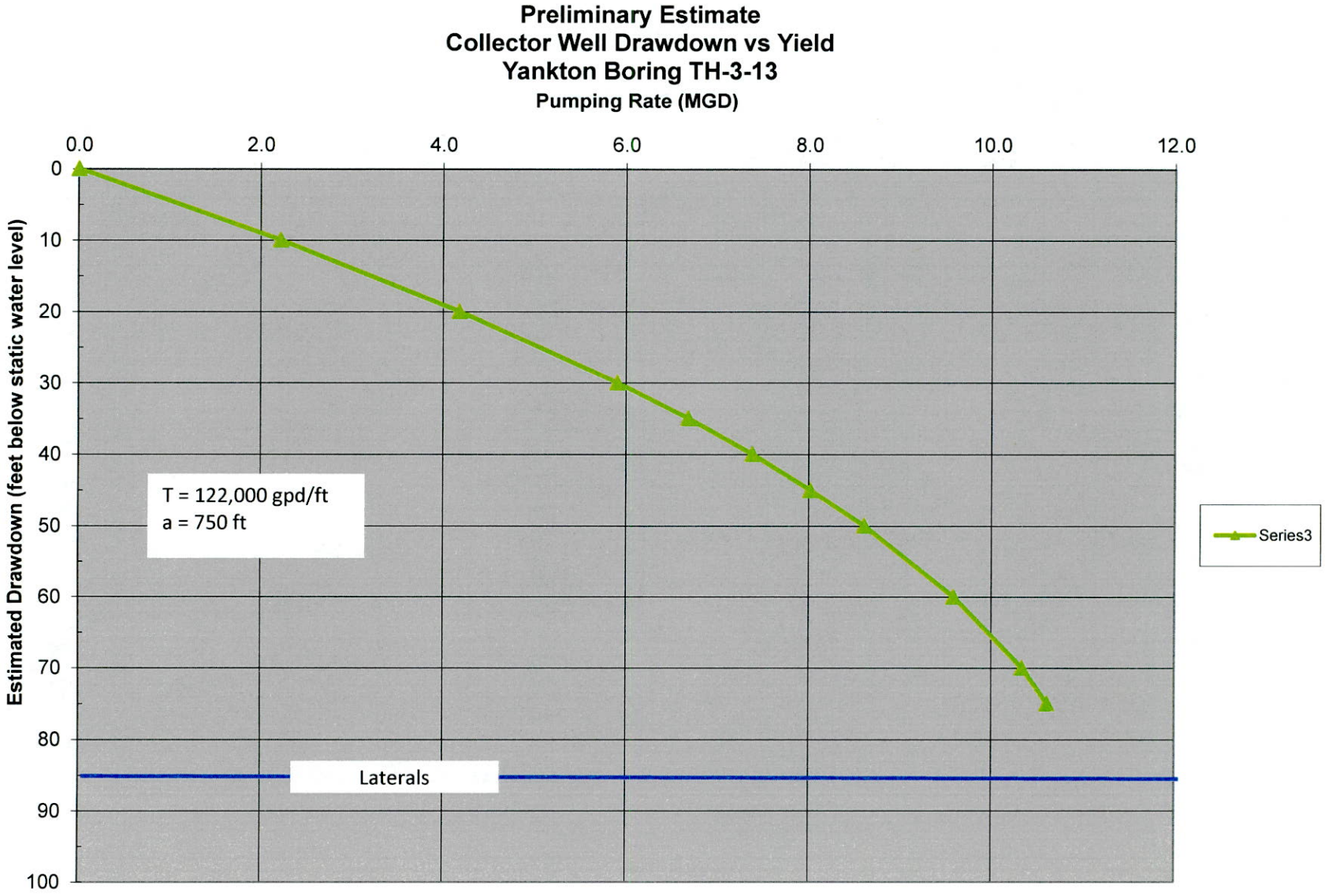
Table 6
Estimate of Collector Well Water Quality
Collector Well Investigation
Yankton, South Dakota

Parameter	Missouri River	Nebraska Wells	Facility Plan Estimate Collector Well	Test Well TH-3-13	Blend Ratio (River% : Groundwater%) 75% : 25%	80% : 20%	90% : 10%	Units
Physical Data								
pH	8.72	7.34	7.4	7.58	8.10	8.17	8.36	s.u.
Total Dissolved Solids	448	989	720	1829	793.25	724.2	586.1	mg/L
Silicon		35.9		23.4				mg/L
Inorganic Compounds								
Anions								
Alkalinity-M	167	449	300	357	215	205	186	mg/L as CaCO3
Alkalinity-P	3	0	0	0	0	0	1	mg/L as CaCO3
Chloride	13	140	68	18	14.25	14	13.5	mg/L
Sulfate	192	375	204	1010	396.5	355.6	273.8	mg/L
Fluoride	0.51	0.43	0.3	0.29	0.46	0.47	0.49	mg/L
Nitrate				<0.2				mg/L as N
Nitrite				<0.02				mg/L as N
Cations								
Total Hardness	278	706	482	1278	528	478	378	mg/L as CaCO3
Calcium Hardness	188	500	338	805	342	311	249	mg/L as CaCO3
Calcium	75	200	135	322	137	124	100	mg/L
Magnesium	22	50	35	115	45	41	31	mg/L
Sodium	69	42.4	55	51	65	65	67	mg/L
Potassium	4.8	12.5	8.6	12.1	7	6	6	mg/L
Iron	0.3	9.15	4.7	3.99	1.2	1.0	0.7	mg/L
Manganese	0.04	1.41	0.7	3.04	0.79	0.64	0.34	mg/L
Ammonia	0	0.59	0.3	<0.05	<0.05	<0.05	<0.05	mg/L as N
Organic Compounds								
TOC	4.3	3.4	3.8	1.09	3.4975	3.658	3.979	mg/L

FIGURES

Figure 1
Test Boring Locations
Collector Well Investigation
City of Yankton, South Dakota




Preliminary Estimate
Collector Well Drawdown vs Yield
Yankton Boring TH-3-13
Pumping Rate (MGD)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
Estimated Drawdown (feet below static water level)
0
10
20
30
40
50
60
70
80
90
100
T = 122,000 gpd/ft
a = 750 ft
Laterals
Series3

APPENDIX A

BORING LOGS

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-1-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 1 Recovery: 75%		5 10		0-1': Loose, slightly moist, light brown, fine to medium, poorly graded sand (SP) with trace silt. 1-8': Loose, slightly moist, orange-tan, fine to medium, poorly graded sand (SP) with trace coarse sand, rounded. 8-9': Trace fine gravel, moist. 9-11': With some silt, orange-brown, slightly moist.	▼ ▽	Drilling with small amount of water - from City hydrant.
Core 2 Recovery: 100%		15 20	2" Schedule 40 PVC Monitoring Well Screen: 90-100' w/ 0.010" mill slot	11-14': Loose, moist, orange-tan, fine to coarse, well graded sand (SW), rounded. 14-16': With some fine gravel, rounded. 16-18.5': Loose, moist, gray-brown, fine silty sand (SM). 18.5-21.5': Medium stiff, slightly moist, gray-brown, highly plastic clay (CH).		Color change. Clay.
Core 3 Recovery: 50%		25 30		21.5-30': Medium dense, wet, light brown, fine to medium, poorly graded sand (SP) with trace coarse sand and trace fine to coarse, rounded gravel.		Coal at 29.5'.
Core 4 Recovery: 75%	TH-1-13 30-40' (Not Submitted)	35 40		30-33': Medium dense, wet, gray-brown, fine, poorly graded sand (SP) with trace medium to coarse sand. 33-36.5': Medium dense, wet, black-brown, rounded, fine to coarse, well graded gravel (GW) with fine to coarse sand, trace coal. 36.5-39.5': Medium dense, wet, orange-brown, coarse, poorly graded sand (SP) and f-c gravel, trace f-m sand. 39.5-40': Brown, highly plastic clay.		Bird egg gravel.

Water Level			Logged By:	Drilled/Sampled By:
While Drilling:	After Drilling:	Hours After:	Adam Kessler	Julius Coke
~11'	7.6'	20	Date Started: 5/7/2013	Date Completed: 5/8/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-1-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
				40-42.5': Medium dense, wet, orange-brown, fine to coarse, well graded sand (SW) with trace silt.		
Core 5 Recovery: 100%	TH-1-13 43-49' (Submitted)	45		42.5-47': Medium dense, wet, orange-brown, medium to coarse, well graded sand (SW) with trace fine sand, coarse rounded gravel, and silt. 47-49': With some fine sand.		
		50		49-51': M. dense, wet, brown-black, f-m with trace coarse, poorly graded sand (SP) with trace f-c, rounded gravel, coal.		
Core 6 Recovery: 60%	TH-1-13 51-56' (Not Submitted)	55		51-56': Medium dense, wet, orange-brown, fine to coarse, well graded sand (SW) with trace fine, rounded gravel.		
	TH-1-13 56-61' (Not Submitted)	60	2" Schedule 40 PVC Monitoring Well Screen: 90-100' w/ 0.010" mill slot	56-61': Medium dense, wet, orange-brown, fine to medium, poorly graded sand (SP) with trace fine to coarse, rounded gravel.		
Core 7 Recovery: 60%	TH-1-13 61-80' (Submitted)	65		61-80': Medium dense, wet, gray-brown, fine to coarse, well graded sand (SW) with trace fine to coarse, rounded gravel. 65-70': With multiple 1" dense, fine silty sand lenses.		Sample is falling out the bottom - ask Layne to install flapper bit.
Core 8 Recovery: 0%		70 75 80		(76-80' recovered in next core run)		No recovery using the flapper bit. Measured 4' of sample in core barrel before removing from hole. Sample still fell out.

Water Level			Logged By:	Drilled/Sampled By:
			Adam Kessler	Julius Coke
While Drilling:	After Drilling:	Hours After:	Date Started:	Date Completed:
~11'	7.6'	20	5/7/2013	5/8/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-1-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 9 Recovery: 100%		85	2" Schedule 40 PVC Monitoring Well Screen: 90-100' w/ 0.010" mill slot	80-84': Dense, wet, gray-brown, fine to medium with trace coarse, pooly graded sand (SP) with trace fine, rounded gravel.		Switch back to standard bit - no flapper door. Drill to 85' only and recover some 70-80' sample.
Core 10 Recovery: 100%		90		84-90': Very stiff, slightly moist, gray-black silt (ML) with 1/4" black clay laminations, some very fine sand.		
Core 11 Recovery: 100%	TH-1-13 90-97' (Submitted)	95		90-97': Dense, wet, gray-brown, medium to coarse with some fine, well graded sand (SW).		Slight organic odor.
	TH-1-13 97-101' (Submitted)	100		97-101': With trace fine to coarse, rounded gravel. Slightly finer than above, SW.		
Core 12 Recovery: 100%	TH-1-13 101-106' (Submitted)	105		101-106.5': Dense, wet, gray, fine to medium with some coarse, well graded sand (SW) with trace fine, rounded gravel.		Slight organic odor, a bit heavier than above.
		110		106.5': Hard, slightly moist, gray clay - weathered shale, layering intact.		Weathered shale bedrock, 106.5'.
		115		Bottom of Boring @ 110'		
		120				

Water Level			Logged By:	Drilled/Sampled By:
While Drilling:	After Drilling:	Hours After:	Adam Kessler	Julius Coke
~11'	7.6'	20	Date Started: 5/7/2013	Date Completed: 5/8/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-2-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
				0-0.6': Soft, dry, brown, fine to medium silty sand (SM) and woody organics.		8" Topsoil.
Core 1 Recovery: 50%		5		0.6-7': Loose, dry, light brown, fine to medium, poorly graded sand (SP).		
				7': Becomes moist.	▽	
		10		10': Becomes wet, with trace coarse sand and fine, rounded gravel.	▼	
Core 2 Recovery: 50%		15	2" Schedule 40 PVC Monitoring Well			
		20	Screen: 99.5-109.5' w/ 0.010" mill slot	21-25': Grades to fine to coarse sand (SW), but primarily medium sand.		
Core 3 Recovery: 80%		25		25-28': With trace coarse, rounded gravel.		
				28-31': Grades to fine to medium with trace coarse sand (SP), trace cobbles.		
		30		31-32': Grades to m-c sand (SP) and fine, rounded gravel.		Cobbles felt by driller, interfering with recovery.
Core 4 Recovery: 60%		35		32-35': Loose, wet, brown, rounded, fine to coarse, well graded gravel (GW) with some cobbles.		
				35-40': Loose, wet, brown, fine to coarse, well graded sand (SW) with some fine to coarse gravel, trace cobbles, some silt.		Possible boulder at 35'.
		40		Trace silt at 38'. Stiff, gray, medium plastic clay in bottom of sampler.		

Water Level			Logged By:	Drilled/Sampled By:
			Adam Kessler	Julius Coke
While Drilling:	After Drilling:	Hours After:	Date Started:	Date Completed:
~7'	9.3'	5	5/13/2013	5/15/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-2-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 5 Recovery: 20%	TH-2-13 40-50' (Not Submitted)	45		40-50': Medium dense, wet, orangish-brown, medium to coarse, poorly graded sand (SP) with trace fine sand, some fine to coarse, rounded gravel, and trace cobbles.		Got 10% recovery on first try, 40-50'. Get another 10% on second try using flapper bit.
Core 6 Recovery: 100%	TH-2-13 50-60' (Submitted)	50 55	2" Schedule 40 PVC Monitoring Well	50-57': Medium dense, wet, orangish-brown, fine to coarse, well graded sand (SW) with trace fine, rounded gravel. 57-59.5': With trace silt.		
Core 7 Recovery: 60%	TH-2-13 60-70' (Submitted)	60 65	Screen: 99.5-109.5' w/ 0.010" mill slot	59.5-80': Medium dense, wet, gray-brown, fine to coarse, well graded sand (SW) with trace silt, trace fine to medium gravel, trace cobbles, and occassional 1" dry, gray clay lenses.		Color change at 59.5'.
Core 8 Recovery: 0%		70 75 80				Hard drilling - possible boulder. No recovery.

Water Level			Logged By:	Drilled/Sampled By:
While Drilling:	After Drilling:	Hours After:	Adam Kessler	Julius Coke
~7'	9.3'	5	Date Started: 5/13/2013	Date Completed: 5/15/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-2-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 9 Recovery: 100%	TH-2-13 80-90' (Submitted)	85		80-90': Medium dense, wet, gray-brown, medium, poorly graded sand (SP) with some fine and coarse sand, trace fine, rounded gravel, and occassional 1-2" gray-black silty clay lenses.		
Core 10 Recovery: 60%	TH-2-13 90-100' (Submitted)	90 95	2" Schedule 40 PVC Monitoring Well Screen: 99.5-109.5' w/ 0.010" mill slot	No clay/silt lenses below 90'. 97.5-99.5': Some lightly consolidated, dense, fine to medium sand with trace silt.		Got no recovery on first try, 90-100'. Get 60% on second try using flapper bit.
Core 11 Recovery: 80%	TH-2-13 100-110' (Submitted)	100 105		100-115': With trace coarse sand.		Got no recovery on first try, 100-110'. Get 80% on second try using flapper bit.
Core 12 Recovery: 0%		110 115		Refusal at 115' - bedrock likely.		No recovery. Something hard at 115' caused drill rods to break off at 92'.
		120				

Water Level			Logged By:	Drilled/Sampled By:
			Adam Kessler	Julius Coke
While Drilling:	After Drilling:	Hours After:	Date Started:	Date Completed:
~7'	9.3'	5	5/13/2013	5/15/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-3-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 1 Recovery: 70%		0 5 10		0-1': Wood, roots, fine to medium sand, silt. 1-2.5': Loose, slightly moist, brown, f-m sand (SP). 2.5-4': Soft, slightly moist, brown with rusty orange mottling, clayey silt (ML). 4-10': Loose, slightly moist, orangish-brown, fine, poorly graded sand (SP) with trace medium to coarse sand and fine, rounded gravel.	▼ ▽	
Core 2 Recovery: 80%		15 20	2" Schedule 40 PVC Monitoring Well Screen: 100-110' w/ 0.010" mill slot	10-14': With some medium sand, moist. 14-17.5': Loose, wet, brown, fine to coarse, well graded sand (SW) with trace fine to coarse, rounded gravel. 17.5-19': Loose, wet, orangish-brown, medium to coarse, poorly graded sand (SP). 19-21.5': Medium dense, wet, gray-brown, fine poorly graded sand (SP) with some silt, trace coal.		
Core 3 Recovery: 100%		25 30		21.5-25': Medium dense, wet, gray-brown, fine to medium, poorly graded sand (SP). 25-31': Medium dense, wet, orangish-brown, medium to coarse, well graded sand (SW) and fine to coarse, rounded gravel (GW). Trace cobbles, rounded, 3-4".		
Core 4 Recovery: 100%		35 40		31-33': Becomes fine to coarse sand (SW) and fine coarse gravel (GW). 33-37': Medium dense, wet, orangish-brown, fine to coarse, well graded sand (SW) with some fine, rounded gravel. 37-38.5': Medium stiff, slightly moist, gray-brown, medium to highly plastic clay (CL). 38.5-40': Medium dense, wet, orangish-brown, fine to medium silty sand (SM).		Clay, 37-38.5'.

Water Level			Logged By:	Drilled/Sampled By:
			Adam Kessler	Julius Coke
While Drilling:	After Drilling:	Hours After:	Date Started:	Date Completed:
~10'	7.8'	4	5/10/2013	5/11/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-3-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 5 Recovery: 0%		45		40-47.5': SAME: Medium dense, wet, orangish-brown, fine to medium silty sand (SM). 47.5-50': Becomes brown, less silt.		
Core 6 Recovery: 100%	TH-3-13 50-55' (Not Submitted)	50 55		50-55': Medium dense, wet, orangish-brown, fine to coarse, well graded sand (SW) with some silt, trace fine to coarse, rounded gravel. 55-57': Occassional 1" hard, light gray clay lenses.		Possible boulder at 55' - solid rock in core.
Core 7 Recovery: 50%	TH-3-13 62-69' (Submitted)	60 65	2" Schedule 40 PVC Monitoring Well Screen: 100-110' w/ 0.010" mill slot	57-62': Medium dense, wet, orangish-brown, medium to coarse, poorly graded sand (SP) and fine to coarse gravel. 59.5-60': Hard, gray, weathered shale (boulder?) 62-66': Medium dense, wet, gray-brown, coarse, poorly graded sand (SP) with some medium sand and trace fine, rounded gravel. 66-71.5': Medium dense, wet, gray-brown, fine to coarse, well graded sand (SW) with trace silt.		Color change, 62'.
Core 8 Recovery: 100%	TH-3-13 71.5-77' (Submitted)	70 75 80		69': 6", hard, gray, weathered shale (boulder), broken up. 71.5-73.5': Medium dense, wet, gray-brown, medium to coarse, poorly graded sand (SP) with some fine gravel. 73.5-77': Medium dense, wet, gray-brown, fine to coarse, well graded sand (SW) with trace fine to coarse gravel. 77-80': Grades down to fine to medium sand with some coarse (SW).		Coarse, 71.5-73.5'.

Water Level			Logged By:	Drilled/Sampled By:
While Drilling:	After Drilling:	Hours After:	Adam Kessler	Julius Coke
~10'	7.8'	4	Date Started: 5/10/2013	Date Completed: 5/11/2013

HDR

Boring Log

Project Name	Project No.	Drilling Company
City of Yankton Collector Well	196897	Layne

Boring No	Location	Drilling Rig Type and Drilling Method
TH-3-13	Paddle Wheel Point	Layne "LS-1" Sonic, Track-Mounted; 6-inch Core; 8-inch Drill

Core No.	Sample No.	Depth (feet)	Completion	Description (USCS)	Elevation (feet)	Remarks
Core 9 Recovery: 100%	TH-3-13 77-88' (Submitted)	85		80-82': SAME: Medium dense, wet, gray-brown, fine to medium with some coarse, well graded sand (SW). 82-88': Becomes dense, slightly finer.		
		90		88-90.5': Dense, wet, gray-brown, fine, poorly graded sand (SP) with some silt and thin, gray-black clay lenses.		
Core 10 Recovery: 80%	TH-3-13 91-98' (Submitted)	95	2" Schedule 40 PVC Monitoring Well Screen: 100-110' w/ 0.010" mill slot	90.5-98': Dense, wet, gray-brown, rounded to sub-rounded, medium, poorly graded sand (SP) with some fine sand.		No recovery on first try, 90-100'. Get 80% on second try using flapper bit.
Core 11 Recovery: 100%	TH-3-13 98-113' (Submitted)	100 105 110		98-113': Dense, wet, gray-brown, fine to coarse, well graded sand (SW) with trace fine to coarse, rounded gravel. Sand is mostly medium. 110': 2" gray-black weathered shale.		
Core 12 Recovery: 50%	113-115' (Not Submitted)	115 120		113-115': Dense, wet, gray-brown, m-c, poorly graded sand (SP) and f-c, rounded gravel (GW). Few cobbles. 115-120': Hard, gray-black, slightly moist, weathered shale bedrock. Bottom of Boring @ 120'.		Some rock in sampler; most was not recovered. Driller felt rock at 115'.

Water Level			Logged By:	Drilled/Sampled By:
While Drilling:	After Drilling:	Hours After:	Date Started:	Date Completed:
~10'	7.8'	4	5/10/2013	5/11/2013

Adam Kessler

Julius Coke

APPENDIX B

PHOTOS



Photo 1. TH-1-13: Core Samples from 40-80 feet bgs. Sample bag labels denote the depth of the bottom of the core.



Photo 2. TH-1-13: Core Samples from 90-110 feet bgs. Weathered shale bedrock at 106.5-110 feet bgs. Sample bag labels denote the depth of the bottom of the core.

HDR Engineering, Inc.

Photographs
Collector Well Investigation
City of Yankton, South Dakota

Date
May 2013

Figure
1



Photo 3. TH-2-13: Core Samples from 80-110 feet bgs. Sample bag labels denote the depth of the bottom of the core.



Photo 4. TH-2-13: Poorly graded medium sand at 109-110 feet bgs.

HDR Engineering, Inc.

Photographs
Collector Well Investigation
City of Yankton, South Dakota

Date
May 2013

Figure
2



Photo 5. TH-3-13: Core Samples from 80-115 feet bgs. Sample bag labels denote the depth of the bottom of the core.



Photo 6. TH-3-13: Primarily medium sand at 102-104 feet bgs.

HDR Engineering, Inc.

Photographs
Collector Well Investigation
City of Yankton, South Dakota

Date
May 2013

Figure
3

APPENDIX C

GRAIN SIZE LABORATORY REPORT

AMERICAN ENGINEERING TESTING, INC.

American Engineering Testing, Inc.
601 E. 48th St. N.
Sioux Falls, SD 57104
Phone: 605-332-5371|Toll Free: 800-972-6364
Email: bcard@amengtest.com
www.amengtest.com

Material Test Report

Report No: MAT:32-01051-W3-S1
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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Lab Supervisor

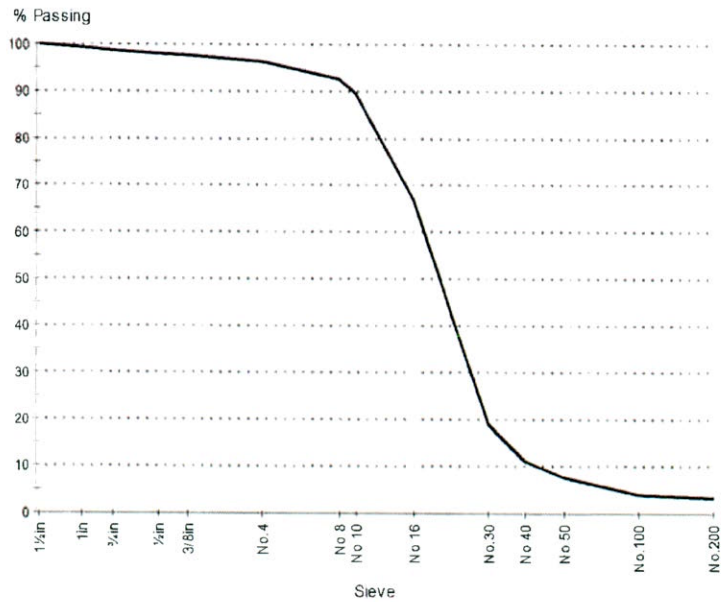
Sample Details

Sample ID	32-01051-W3-S1
Field Sample ID	TH-1-13, 43'-49'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-1-13, 43'-49'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	99	
¾in (19.0mm)	99	
½in (12.5mm)	98	
3/8in (9.5mm)	98	
No.4 (4.75mm)	96	
No.8 (2.36mm)	93	
No.10 (2.0mm)	90	
No.16 (1.18mm)	67	
No.30 (600µm)	19	
No.40 (425µm)	11	
No.50 (300µm)	8	
No.100 (150µm)	4	
No.200 (75µm)	3.3	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S6
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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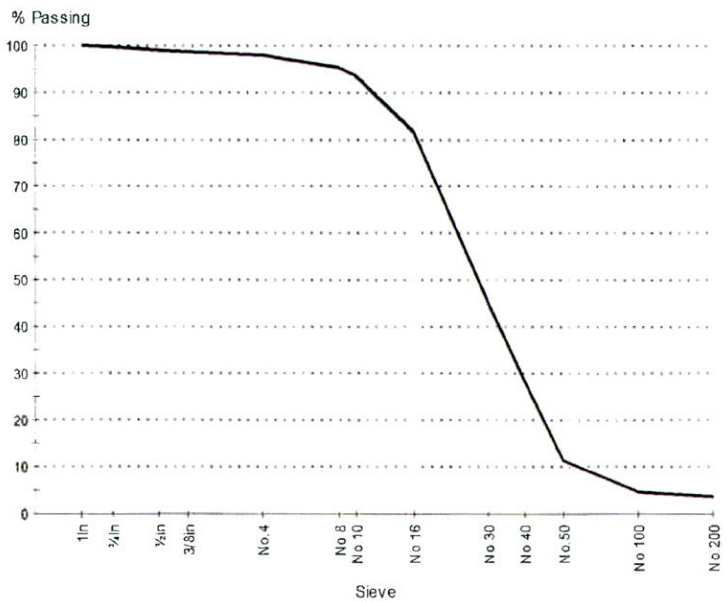
Sample Details

Sample ID	32-01051-W2-S6
Field Sample ID	TH-1-13, 61'-80'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-1-13, 61'-80'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
1in (25.0mm)	100	
¾in (19.0mm)	100	
½in (12.5mm)	99	
3/8in (9.5mm)	99	
No.4 (4.75mm)	98	
No.8 (2.36mm)	95	
No.10 (2.0mm)	94	
No.16 (1.18mm)	82	
No.30 (600µm)	45	
No.40 (425µm)	28	
No.50 (300µm)	11	
No.100 (150µm)	5	
No.200 (75µm)	3.5	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W1-S1
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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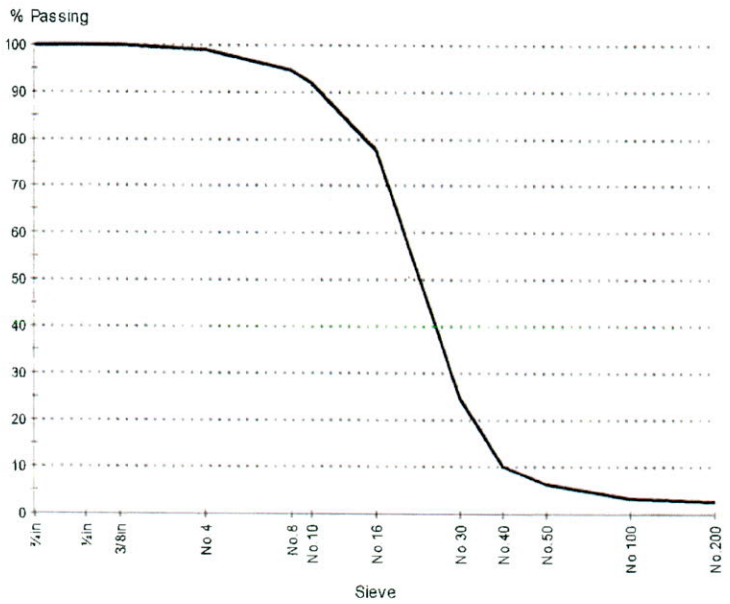
Sample Details

Sample ID	32-01051-W1-S1
Field Sample ID	TH-1-13, 90'-97'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-1-13, 90'-97'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	99	
No.8 (2.36mm)	95	
No.10 (2.0mm)	92	
No.16 (1.18mm)	78	
No.30 (600µm)	25	
No.40 (425µm)	10	
No.50 (300µm)	6	
No.100 (150µm)	3	
No.200 (75µm)	2.7	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S3
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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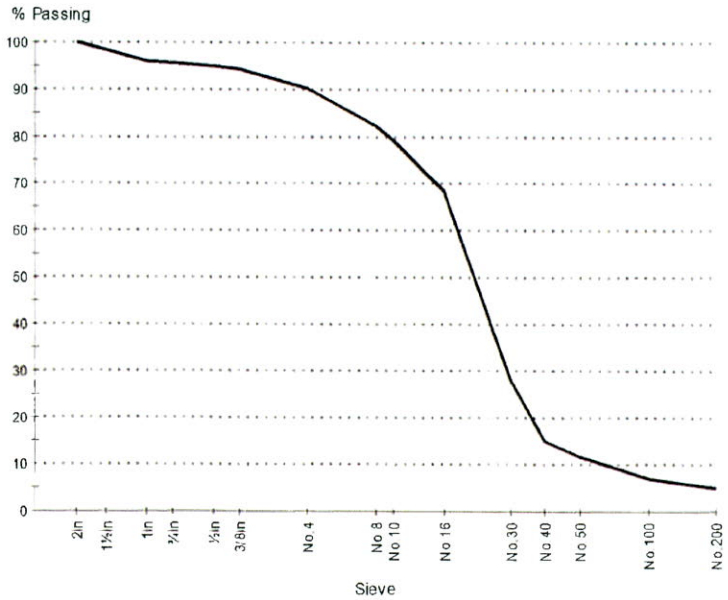
Sample Details

Sample ID	32-01051-W2-S3
Field Sample ID	TH-1-13, 97'-101'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-1-13, 97'-101'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
2in (50.0mm)	100	
1½in (37.5mm)	98	
1in (25.0mm)	96	
¾in (19.0mm)	96	
½in (12.5mm)	95	
3/8in (9.5mm)	94	
No.4 (4.75mm)	90	
No.8 (2.36mm)	82	
No.10 (2.0mm)	79	
No.16 (1.18mm)	68	
No.30 (600µm)	28	
No.40 (425µm)	15	
No.50 (300µm)	12	
No.100 (150µm)	7	
No.200 (75µm)	4.9	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S5
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
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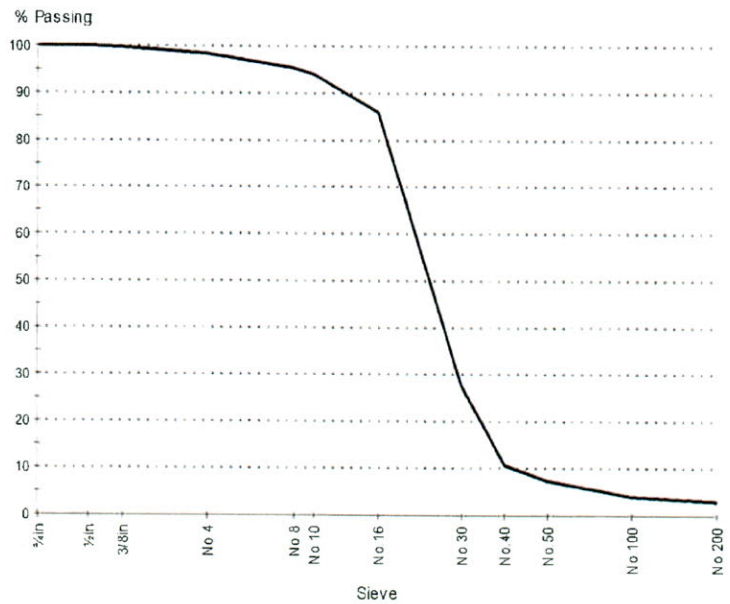
Sample Details

Sample ID	32-01051-W2-S5
Field Sample ID	TH-1-13, 101'-106'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-1-13, 101'-106'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	98	
No.8 (2.36mm)	95	
No.10 (2.0mm)	94	
No.16 (1.18mm)	86	
No.30 (600µm)	28	
No.40 (425µm)	11	
No.50 (300µm)	7	
No.100 (150µm)	4	
No.200 (75µm)	3.0	

Comments

N/A

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Material Test Report

Report No: MAT.32-01051-W4-S1
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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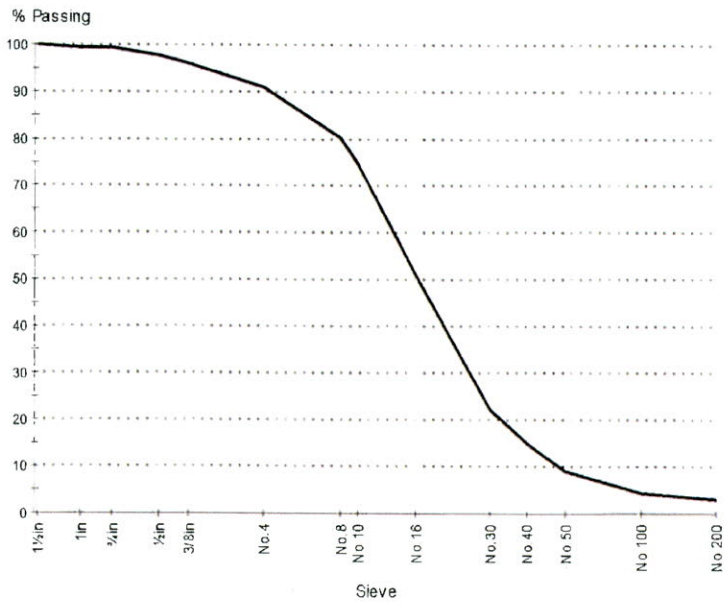
Sample Details

Sample ID	32-01051-W4-S1
Field Sample ID	TH-2-13, 50'-60'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-2-13, 50'-60'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	99	
¾in (19.0mm)	99	
½in (12.5mm)	98	
3/8in (9.5mm)	96	
No.4 (4.75mm)	91	
No.8 (2.36mm)	80	
No.10 (2.0mm)	75	
No.16 (1.18mm)	51	
No.30 (600µm)	22	
No.40 (425µm)	15	
No.50 (300µm)	9	
No.100 (150µm)	4	
No.200 (75µm)	3.1	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W4-S2
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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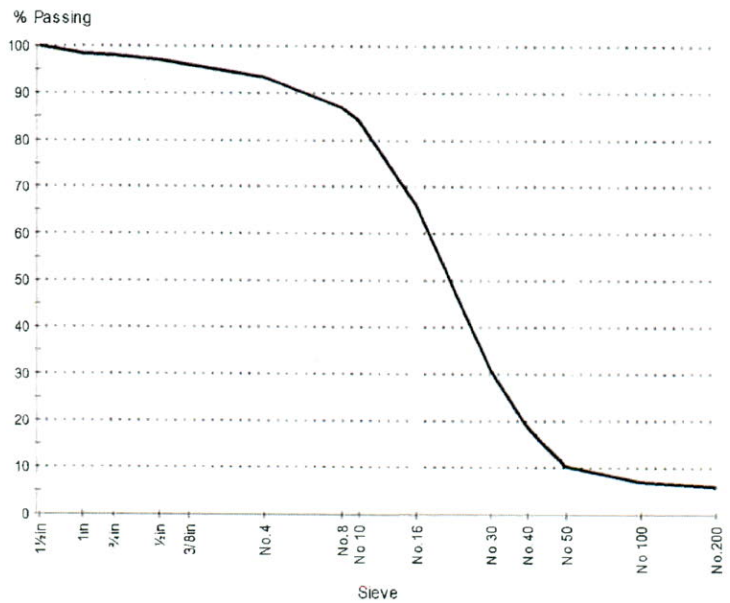
Sample Details

Sample ID	32-01051-W4-S2
Field Sample ID	TH-2-13, 60'-70'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-2-13, 60'-70'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	98	
¾in (19.0mm)	98	
½in (12.5mm)	97	
3/8in (9.5mm)	96	
No.4 (4.75mm)	93	
No.8 (2.36mm)	87	
No.10 (2.0mm)	84	
No.16 (1.18mm)	66	
No.30 (600µm)	31	
No.40 (425µm)	19	
No.50 (300µm)	10	
No.100 (150µm)	7	
No.200 (75µm)	6.0	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W4-S3
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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Lab Supervisor

Sample Details

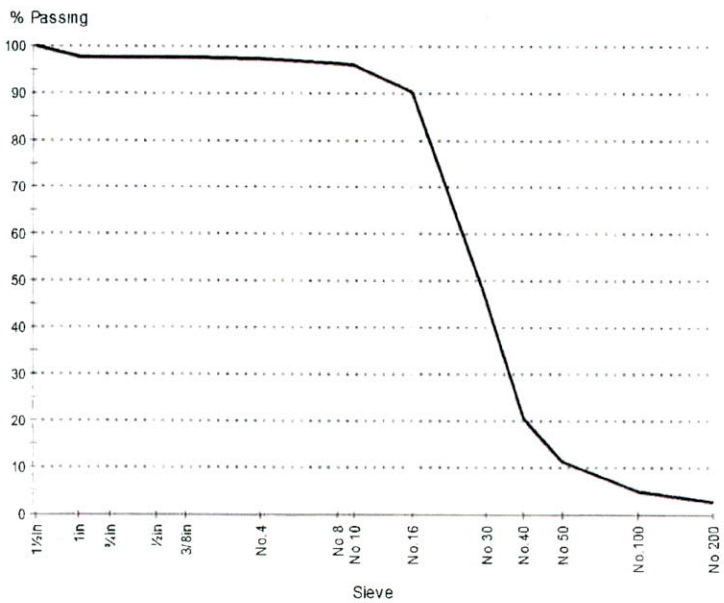
Sample ID	32-01051-W4-S3
Field Sample ID	TH-2-13, 80'-90'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-2-13, 80'-90'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution

Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013



Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	98	
¾in (19.0mm)	98	
½in (12.5mm)	98	
3/8in (9.5mm)	98	
No.4 (4.75mm)	97	
No.8 (2.36mm)	96	
No.10 (2.0mm)	96	
No.16 (1.18mm)	90	
No.30 (600µm)	46	
No.40 (425µm)	21	
No.50 (300µm)	11	
No.100 (150µm)	5	
No.200 (75µm)	2.8	

Comments

N/A

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Material Test Report

Report No: MAT 32-01051-W4-S4
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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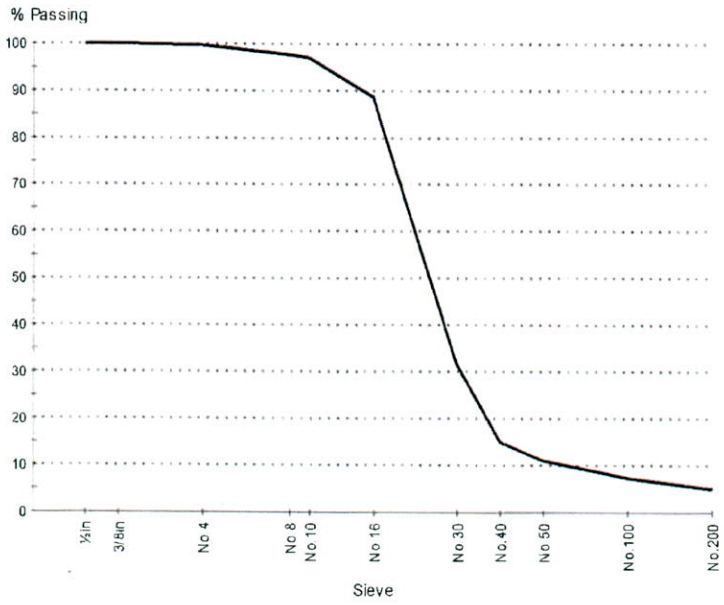
Sample Details

Sample ID	32-01051-W4-S4
Field Sample ID	TH-2-13, 90'-100'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-2-13, 90'-100'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.8 (2.36mm)	98	
No.10 (2.0mm)	97	
No.16 (1.18mm)	89	
No.30 (600µm)	32	
No.40 (425µm)	15	
No.50 (300µm)	11	
No.100 (150µm)	7	
No.200 (75µm)	5.0	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W4-S5
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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Lab Supervisor

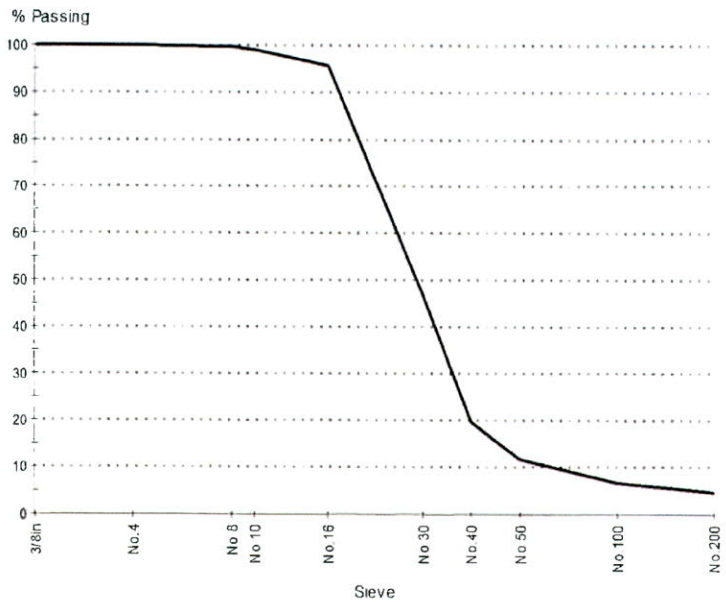
Sample Details

Sample ID	32-01051-W4-S5
Field Sample ID	TH-2-13, 100'-110'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-2-13, 100'-110'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.8 (2.36mm)	100	
No.10 (2.0mm)	99	
No.16 (1.18mm)	96	
No.30 (600µm)	47	
No.40 (425µm)	20	
No.50 (300µm)	12	
No.100 (150µm)	7	
No.200 (75µm)	4.8	

Comments

N/A

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Material Test Report

Report No: MAT.32-01051-W3-S2
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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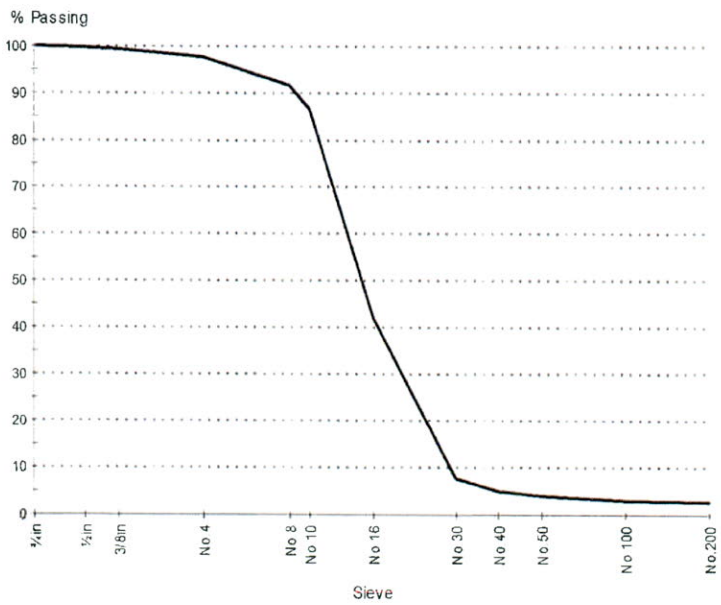
Sample Details

Sample ID	32-01051-W3-S2
Field Sample ID	TH-3-13, 62'-69'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-3-13, 62'-69'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	99	
No.4 (4.75mm)	98	
No.8 (2.36mm)	92	
No.10 (2.0mm)	87	
No.16 (1.18mm)	42	
No.30 (600µm)	8	
No.40 (425µm)	5	
No.50 (300µm)	4	
No.100 (150µm)	3	
No.200 (75µm)	2.7	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S2
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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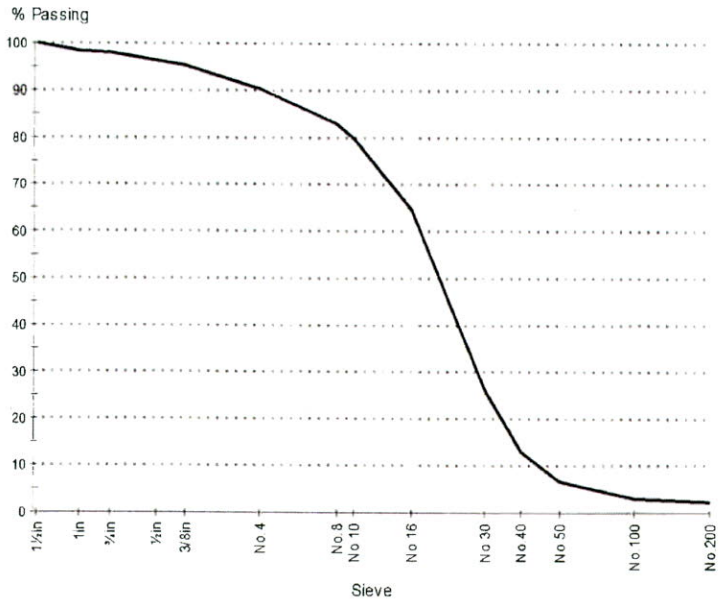
Sample Details

Sample ID	32-01051-W2-S2
Field Sample ID	TH-3-13, 71.5'-77'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-3-13, 71.5'-77'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	98	
¾in (19.0mm)	98	
½in (12.5mm)	96	
3/8in (9.5mm)	95	
No.4 (4.75mm)	90	
No.8 (2.36mm)	83	
No.10 (2.0mm)	80	
No.16 (1.18mm)	65	
No.30 (600µm)	26	
No.40 (425µm)	13	
No.50 (300µm)	7	
No.100 (150µm)	3	
No.200 (75µm)	2.2	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W4-S6
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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Lab Supervisor

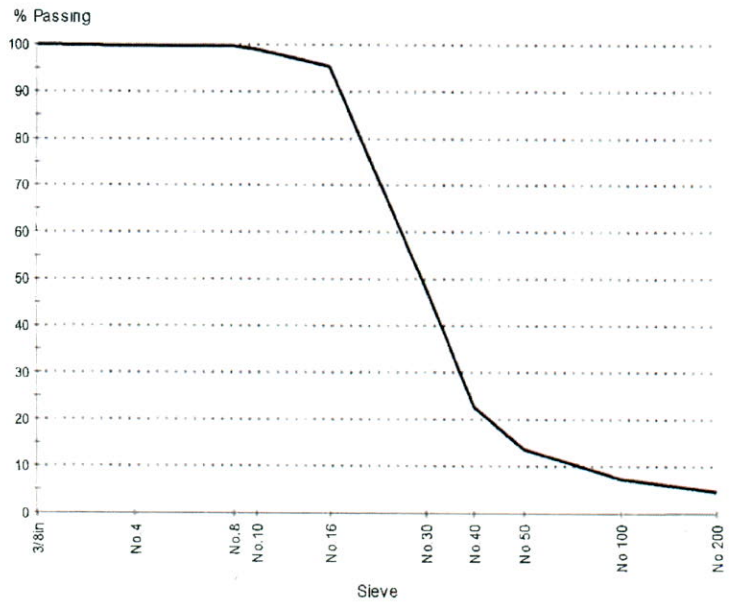
Sample Details

Sample ID	32-01051-W4-S6
Field Sample ID	TH-3-13, 77'-88'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-3-13, 77'-88'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/20/2013

Sieve Size	% Passing	Limits
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.8 (2.36mm)	100	
No.10 (2.0mm)	99	
No.16 (1.18mm)	95	
No.30 (600µm)	48	
No.40 (425µm)	23	
No.50 (300µm)	14	
No.100 (150µm)	7	
No.200 (75µm)	4.7	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S1
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
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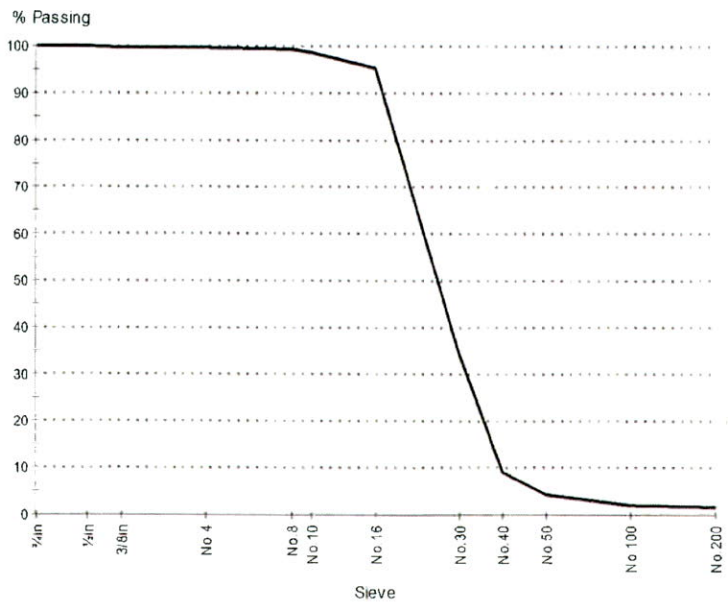
Sample Details

Sample ID	32-01051-W2-S1
Field Sample ID	TH-3-13, 91'-98'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-3-13, 91'-98'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.8 (2.36mm)	99	
No.10 (2.0mm)	99	
No.16 (1.18mm)	95	
No.30 (600µm)	34	
No.40 (425µm)	9	
No.50 (300µm)	4	
No.100 (150µm)	2	
No.200 (75µm)	1.6	

Comments

N/A

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Material Test Report

Report No: MAT:32-01051-W2-S4
Issue No: 1

Client: CHRISTENSEN, LAYNE
CC: LAYNE CHRISTENSEN

Project: 32-01051
YANKTON COLLECTOR WELL INVESTIGATION

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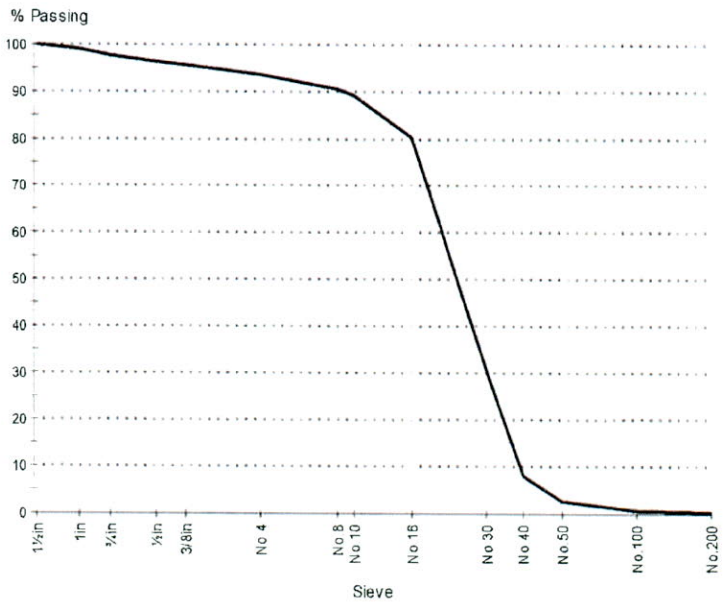
Sample Details

Sample ID	32-01051-W2-S4
Field Sample ID	TH-3-13, 98'-113'
Date Sampled	
Source	BORING
Material	
Specification	COLLECTOR WELL INVESTIGATION
Sampling Method	BORING
Sampling Location	TH-3-13, 98'-113'

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/18/2013

Sieve Size	% Passing	Limits
1½in (37.5mm)	100	
1in (25.0mm)	99	
¾in (19.0mm)	98	
½in (12.5mm)	96	
3/8in (9.5mm)	96	
No.4 (4.75mm)	94	
No.8 (2.36mm)	91	
No.10 (2.0mm)	89	
No.16 (1.18mm)	80	
No.30 (600µm)	31	
No.40 (425µm)	8	
No.50 (300µm)	3	
No.100 (150µm)	1	
No.200 (75µm)	0.5	

Comments

N/A

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APPENDIX D

FIELD NOTES

(140) City of Yankton 5/6/13

1430 Adam Kessler onsite at City of Yankton, SD Water Treatment Plant. Meet Michelle Carter (HDR - Sioux Falls), Ray Tweedy, and Randy Jorgenson (City).

Pick up sample bottles from State DoH Lab and Midwest Labs (City had 12 bottles)

1515 We check out the drilling site down by the Missouri River. Ground is fresh sand from the last flood, loose sand, little stabilizing vegetation.

Three locations are flagged. A TransCanada petroleum pipeline passes 125 feet west of westernmost boring. They need to be contacted before driving across the pipeline.

1525 HDR off site

1830 Layne (drilling company) arrives. They call me and I come down to the Visitor Center near the drilling site to meet them. They have a retrasonz truck rig. 1500 gal water tank on a truck and 300 gal. water tote.

Julius Cake is the driller, plus one helper.

1928 HDR off site

5/7/13 (141)

0702 HDR on site at City of Yankton Visitor Center.

0705 Layne on site

Personnel: Adam Kessler - HDR
Julius Cake, Ciden Gonzalez - Layne

Rig is a Layne-built LS (Layne Sonic) track-mounted sonic rig. I call Joe at TransCanada.

0750 Randy Jorgensen (City) helps Ciden and I get waters (1,500 gal tank) from a fire hydrant near the WTP

0759 Back at Visitor Center. Julius says Joe from TransCanada came by and approved the equipment for crossing the petroleum pipeline.

1004 Joe Mueller (TransCanada) stopped by for a few minutes to check on things - were good to go.

Weather: Mostly sunny, 50°, light wind (72° today)

1025 Begin drilling at TH-1-13 (western boring)

1215 The 10' core sampler (6" dia) snapped off during to 30-40' run. Top of sampler is at 30'. Retrieved all drill stem.

1318 Retrieve 10' core sampler using a tapered bit (like a nail punch). Resume drilling at 40'

5/7/13

1430-1440 Ray and Randy (City) stop by to see how things are going. We have drilled to 52'

1710 Had only 60% recovery from 50-70', so we switched over to a bit with a flapper door. Did not work. no recovery from 70-80'. Layne measured 4' of material in the core barrel before removing from the hole, but it all fell out. The flapper probably did not close. We are likely still in the fine to coarse sand that started higher up.

Switch back to a standard bit with no flapper. Begins to rain, windy.

1900 Recovered the 76-80' interval while drilling to 85'. Still in fine sand. Very stiff silt at 84.2'

Have drilled to 90'. Quit for the day.

1905 HDR off site Layne puts up orange cones.

END OF DAY

5/8/13

0715 HDR on site on Paddle Wheel Point, Yankton, SD. Layne is onsite, setting rig, starting up. At 90'

Personnel: Adam Kessler - HDR
Julius Coke, Oiden Gonzalez - Layne

Weather: 55°, rain, light wind.

0905 I call Heather Ramig at Midwest Labs. We can add silica, bromide, boron, and odor to their list of analysis. We have the right bottles and preservatives. They cannot do odor or foaming agents, or corrosivity. Corrosivity is a calculation using alkalinity and pH, so the State Drill lab should be able to do that. Odor requires a glass bottle, which we don't have.

1000 Driller to 110'. Driller think we hit bedrock at 108'. Broke a pin on the rig tooling - need to replace. Threads also stripped on drill head.

Ray and Randy (City) stop out to see how things are going; they leave at 10:23.

1140 Rig is fixed. Begin pulling 100-110' core barrel.

1230 Hit weathered shale bedrock at 106.5'. Stop drilling. Select the 40-50' interval for the step-drawdown test.

1315 Select grain size samples: all are composites of the selected intervals, in 1-gal. baggies.
TH-1-13: ~~30-40'~~, 43-49', ~~51-56'~~, ~~56-61'~~, 61-80'.

1338 I ask Layne to stop pulling casing out after I spoke with Luca DeAngelis (HDR), who said we'd probably want to test the deeper sands (90-106.5'). Waiting to hear back from Luca.

1350 Luca confirmed that we want to test the deepest coarse material above bedrock. Layne has pulled outer casing back to 100'. We will test the 90-100' interval, which is mostly medium to coarse sand.

1432 Select more grain size samples from the deep sands: 1-gal baggies
TH-1-13: 90-97', 97-101', 101-106'

1456 The screen to be used for step test is 10' long, 4.7" OD, with 0.06" continuous slot.

1530-1540 Ray and Randy (City) stop by. I tell them we will likely be collecting a water sample in the morning.

1550 Layne has set the screen at 90-100' and pulled back the outer casing. Now they are trying to disconnect the inner rods from the top of the screen

so they can force air down for development.

1620 Start developing the screened interval with compressed air. Discharge is muddy/v. cloudy. The air is going in above the screen, so the discharge rate is pretty low, maybe 5-10 gpm.

1700 Discharge has cleared significantly, now is cloudy. Rate is up to about 10-15 gpm.

1715 I had Layne cut the air for a minute and surge the hole. Discharge became muddy/v. cloudy for a few minutes after turning air back on. Stayed medium cloudy for ~10 minutes. Will continue surging process.

1740 Discharge is mostly clear after 3 surges. Rate still about 15 gpm. Stop development.

We will set the pump (3.5" Grundfos) in the morning.

1750 HDR off site.

END OF DAY

5/9/13

0713 HDR on site at Paddle Wheel Point, Yankton, SD

Personnel: Adam Kessler - HDR
Julius Cake, Otaen Gonzalez - Layne

Weather: Cloudy, windy, 50°, sprinkles (65° max)

Layne is starting to remove inner rods from the hole; will be attaching pump to the end of the rods

0825 The 3.5" Grundfos submersible pump is set with intake at 80', well screen is 90-100'.

0830 SWL= 8.75' BTOC, TOC is 1.1' above ground.
0834 SWL= 8.71'

0839 Pump on, STEP #1: 30 gpm - TH-1-13
0840 Pump rate fluctuates - starts at 65 gpm, achieve 30 gpm at 0840, by closing valve on meter

0841	9.68'	Q= 30 gpm
0842	9.68'	Q= 30.3 gpm
0843	9.68'	Q= 30.1 gpm
0844	9.68'	Q= 29.7 gpm
0845	9.68'	Q= 29.8 gpm
0846	9.68'	Q= 29.7 gpm
0847	9.68'	Q= 29.7 gpm
0848	9.68'	Q= 29.7 gpm
0849	9.68'	Q= 29.8 gpm
0850	9.68'	Q= 29.7 gpm
0852	9.68'	Q= 29.7 gpm

5/9/13

0854	9.68'	Q= 29.7 gpm
0856	9.68'	Q= 29.6 gpm
0858	9.68'	Q= 29.6 gpm
0900	9.68'	Q= 29.7 gpm
0902	9.68'	Q= 29.7 gpm
0904	9.68'	Q= 29.7 gpm
0906	9.68'	Q= 29.7 gpm
0908	9.68'	Q= 29.7 gpm
0909	STEP #2: 60 gpm	
0910	10.71'	Q= 58.5 gpm. Adjust valve
0911	10.81'	Q= 63.2 gpm
0912	10.95'	Q= 61.4 gpm. Final valve adjustment
0913	10.96'	Q= 63.3 gpm
0914	10.96'	Q= 63.4 gpm
0915	10.96'	Q= 63.1 gpm
0916	10.96'	Q= 63.0 gpm
0917	10.96'	Q= 62.9 gpm
0918	10.96'	Q= 63.2 gpm
0919	10.96'	Q= 63.1 gpm
0921	10.96'	Q= 63.2 gpm
0923	10.96'	Q= 61.9 gpm
0925	10.96'	Q= 62.9 gpm
0927	10.96'	Q= 63.3 gpm
0929	10.96'	Q= 63.2 gpm
0931	10.96'	Q= 62.2 gpm
0933	10.96'	Q= 62.8 gpm
0935	10.96'	Q= 62.4 gpm
0938	10.96'	Q= 61.2 gpm
0939	STEP #3: 80 gpm	
0940	11.75'	Q= 81.4 gpm. Final valve adjustment
0941	11.73'	Q= 75.1 gpm

5/9/13

0942	11.76'	Q=88.3 gpm
0943	11.75'	Q=84.5 gpm
0944	11.75'	Q=78.2 gpm
0945	11.75'	Q=75.2 gpm
0946	11.75'	Q=78.2 gpm
0947	11.75'	Q=82.5 gpm
0948	11.75'	Q=79.4 gpm
0949	11.75'	Q=82.9 gpm
0951	11.75'	Q=80.0 gpm
0953	11.75'	Q=80.8 gpm
0955	11.75'	Q=81.6 gpm
0957	11.75'	Q=82.6 gpm
0959	11.75'	Q=80.2 gpm
1007	11.75'	Q=82.3 gpm
1008	11.75'	Q=81.5 gpm
1009	STEP #4: Max Pump Rate	
1010	12.78'	Q= 90-117 gpm
1011	12.77'	Q=85-113 gpm
1012	12.77'	Q=98.0 gpm
1013	12.77'	Q=100.9 gpm
1014	12.77'	Q=105.2 gpm
1015	12.77'	Q=106.3 gpm
1016	12.77'	Q=94.7 gpm
1017	12.77'	Q=103.5 gpm
1018	12.77'	Q=102.8 gpm
1019	12.77'	Q=105.1 gpm
1021	12.77'	Q=102.5 gpm
1023	12.77'	Q=98.3 gpm
1025	12.78'	Q=99.6 gpm
1027	12.77'	Q=101.5 gpm

1029	12.77'	Q=101.7 gpm
1031	12.77'	Q=103.4 gpm
1033	12.77'	Q=101.3 gpm
1035	12.77'	Q=102.1 gpm
1038	12.77'	Q=101.8 gpm
1039	Pump OFF	
1040	8.75'	
1041	8.75'	
1042	8.75'	
1043	8.75'	
1044	8.75'	
1045	8.71'	100% recovery
1046	8.71'	

1050 Turn pump back on at low rate to collect water quality sample. Lowest rate is 12.0 gpm. This is going to be the sample rate.

1110 Collect water quality sample: from 90-100' depth

TH-1-13

To State Dept. of Health Lab:
- Common Ions (all)
- Inorganics (all)
- VOCs, SOCs, TOC, Ammonia, MTBE
- Radionuclides

To Midwest Labs (Omaha):
- UV254, Bromide, Boron, H_2S, Silica, Strontium, Chromium 6, Color

Samples are clear, no odor.

1146 Ray and Randy (City) stop by to take the water samples for both laboratories. They plan to courier the State lab samples today at 3:00 pm for late night arrival in Pierre, SD. They will keep the Midwest Labs samples on ice for now.

Layne is pulling the temporary well screen.

1331 Screen is pulled. Formation ~~material is at~~ ~~changed to~~ 86', some pulled up into the casing, which is at 90'. Will need to drill outer casing back down to 100' and clean out the hole in order to set a monitoring well to 100'.

1405 Layne drilled casing back to 100' and used high pressure water to push slough back into the formation - clean down to 100'.

1710 Finish installing TH-1-13 monitoring well with screen from 90-100 feet. Outer casing was withdrawn as backfill materials were added.

1733 Layne is cleaning out hoses and will move some equipment to the next boring location.

1736 Idle off site.

END OF DAY

MONITORING WELL TH-1-13:

Materials:

1 - 10'x2" Schedule 40 PVC well screen w/ bottom cap

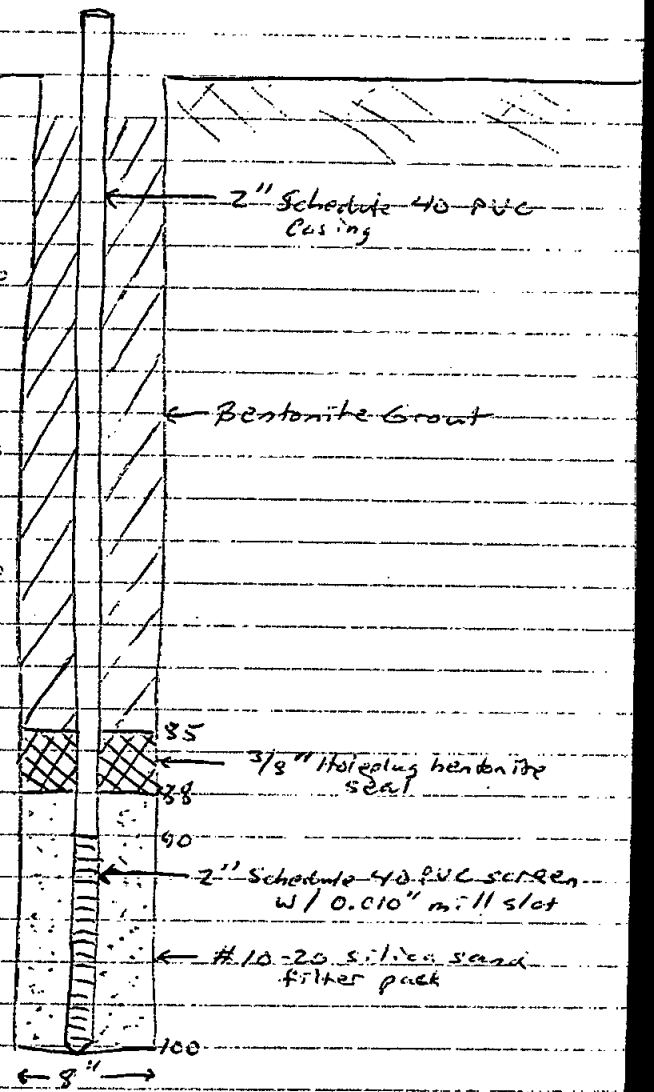
9 - 10'x2" Schedule 40 PVC threaded casing

1 - 3'x2" Schedule 40 PVC threaded casing

5 - 50 lb. bags #10-20 Filter Sil silica sand

1 - 50 lb. bag 3/8" Holeplug bentonite chips

4 + 50 lb. bags Baroid Quik Grout bentonite



0732 HDR on site. Layne is setting up on location TH-3-13, which is the eastern boring.

Personnel: Adam Kessler - HDR
Julius Coke, Oscar Gonzalez - Layne

Weather: Mostly cloudy, 50°, light wind (65° today)

0810 Start drilling TH-3-13

0830 Driller to 10'. Layne stops to go install 12V submersible pump in monitoring well TH-1-13 for development.

0840 - 0850 Ray Tweedy and Kyle Goodmansen (City) stop by to see how things are going. Not drilling at the moment, Layne is at TH-1-13.

0900 Resume drilling at TH-3-13. Development pump is set in the bottom of TH-1-13, and running at about 7 gpm.

0925 Have drilled 20'. Rig blew a hydraulic brake chamber on the left tracks parking brake. Leak is contained on plastic. Layne has absorptive pads for the spill. Stop drilling.

1025 I surged the screen at TH-1-13 with the pump. Discharge gets very cloudy, gray-brown each time.

1027 Randy and Sage (City) drop off a jug to fill at TH-1-13

1042 Collect 1-gal sample of clear TH-1-13 water for City.

1047 Layne pulls development pump from TH-1-13. They are making progress on the brake chamber leak.

1105 Leak fixed. Continue drilling TH-3-13. Randy (City) picks up the TH-1-13 water sample for their use.

1300 No recovery on the 40-50 foot sample run. Will try to recover some on the next interval.

1345 Solid rock (6") in core at 55'. Possible boulder.

1350 - 1415 Layne stops drilling to change some clamp pads to better grab the casing / drill stem.

1445 Steve Quail (HDR) stops by for a visit.

1545 Steve Quail off site. Layne has just drilled to 80'. Steve said we can move the TH-2-13 location if we feel it is worthwhile. I suggest getting closer to the river, closer to where the collector well lateral screen might go. Steve agrees we could do that. He also stated that Luca DeAngelis (HDR) originally proposed these borings to be closer to the rivers.

(154)

5/10/13

1720 Layne decides to stop drilling for the day. Have drilled and recovered samples to 90'.

1730 Layne off site

1756 I collect 3 grain size samples : 1-gal bags
TH-3-13 : 62-69', 7165-77', 77-88'

1800 HDR off site

END OF DAY

5/11/13

(155)

0720 HDR on site on Paddle Wheel Point, Yankton, SD
Layne is on site

Personnel : Adam Kessler - HDR
Julius Coke, Oiden Gonzalez - Layne

Weather : Sunny, 45°, light wind (65° today)

0755 Layne runs out of water. I call Sage (City WTP). He can meet Layne at the five hydrant at ~8:15.

0835 Oiden is back with a tank of water (1500 gal.)

0930 No recovery in the 90-100' sample. Driller thinks the sample fell out just as they pulled above the water table (suction effect). Will put a flapper bit on - material is at 92' inside the outer casing and could be recovered.

1015 Recovered 80% of the 90-100' interval using the flapper bit. In medium sand (SP) now.

1212 Drilled TH-3-13 to 120'. HST weathered shale bedrock at ~115'. Some of the rock fell out of the sampler, and driller noted feeling rock at 115'. Outer casing has been advanced to 110', so we will set the temporary screen in the sand from 100-110'.

Collect soil samples: 50-55', 91-98', 98-113', and 113-115'.

5/11/13

1342 Set temporary well screen at 100-110'. Pulled back outer casing to 100'. Put inner rods back in to 90' (10' above screen) for airlift development.

1413 Start airlift development on temporary screen. Discharge very muddy, gray-brown, ~5-10 gpm.

1423 Discharge clears significantly, still very cloudy. Rate is ~10 gpm. Some sand.

1446 Stop compressor for 1 minute, restart to surge screen.

1451 Discharge becomes sl. muddy / very cloudy 5 minutes after restarting air. Discharge is ~10-15 gpm.

1504 Stop compressor for 1 minute, restart. Discharge had cleared.

1509 Discharge becomes sl. muddy 5 minutes after restart, not as dirty as the last surge. Some sand.

1523 Discharge cloudy. Stop compressor for 1 minute, restart.

1528 Discharge becomes very cloudy 5 minutes after restart. Rate is ~10-15 gpm. Some sand.

1534 Stop airlift development. Discharge became slightly cloudy with trace sand.

5/11/13

1610 Rods removed from hole. Attaching pump to rods.

1623 3.5" Grundfos submersible pump is set at 30'.

1625 SWL = 8.37' BTOC. TOC is 0.7' above ground.

1629 SWL = 8.37'

1630 Pump ON, STEP #1: 30 gpm - TH-3-13

1631	11.01'	Q = 30.4
1632	11.02'	Q = 29.2 Final value adjustment
1633	10.99'	Q = 28.5
1634	11.01'	Q = 28.3
1635	11.00'	Q = 28.3
1636	10.98'	Q = 28.4
1637	10.99'	Q = 28.5
1638	11.00'	Q = 28.4
1639	10.92'	Q = 28.4
1640	10.92'	Q = 28.3
1642	10.93'	Q = 28.2
1644	10.92'	Q = 28.3
1646	10.93'	Q = 28.1
1648	10.92'	Q = 28.1
1650	10.92'	Q = 28.2
1652	10.93'	Q = 28.2
1654	10.95'	Q = 28.1
1656	10.92'	Q = 28.1
1659	10.93'	Q = 28.1

1700 STEP #2: 60 gpm

1701	13.13'	Q = 61.6
1702	13.15'	Q = 60.2
1703	13.15'	Q = 61.3

5/11/13

1704 Water levels come up. Flow meter on the fitz- suddenly reads 121 gpm, then 0 gpm.

1709 12.05' Q= ? 20-100 gpm on flow meter

1710 11.82' Q= ? Lot of fine sand in discharge - likely affected the flow meter.

1714 Open valve up full to flush sand out.

1715 Stop pump.

1716 8.73'

1717 8.42'

1718 8.38'

1728 Verified flow meter now working - ran clean water through it from water tank. Meter responded to valve adjustments. I suggest trying a well screen with a smaller slot size. Layne is going to check what they have.

1752 Layne has a 0.020" and 0.040" slot screen. I look at the sand we are in, which is primarily medium sand around 1mm, and select the 0.040" slot screen, which is 1mm. The screen will likely make a bit of fine and some medium sand at first, then be ok.

Layne starts to pull the pump, then will try to pull the 0.060" slot screen from the hole.

1855 Screen is pulled. No sand in screen, meaning it was getting pumped out as fast as it came through. Stop for the day. HDR off site

5/12/13

0725 HDR on site at Paddle Wheel Point, Yankton, SD. Layne is on site, at TH-3-13.

Personnel: Adam Kessler - HDR
Julius Coke, Orden Gonzalez - Layne

Weather: 34°, sunny, light wind (65° today)

0815 Begin advancing outer casing back to 110' so the 100-110' interval can be screened and tested.

0957 Installed 0.040" slot screen from ~100-110', but sand heaved just before installation, preventing screen from going down all the way. Pulled screen, and cleaning out hole again using high-pressure water.

1109 Got 0.040" slot screen installed from 100-110', pulled back outer casing to 100', and set drill rods at 90' for airlift development.

1122 Start airlifting temporary 0.040" slot screen at TH-3-13.

1126 Discharge is muddy, with small amount of fine sand, no medium sand.

1134 Discharge clears significantly, now cloudy to very cloudy with trace fine sand, ~10 gpm.

1143 Discharge cloudy. Stop compressor for 1 minute, restart.

1153 Trace fine sand in muddiest discharge.

5/12/13

1203 Discharge cloudy. Stop compressor 1 minute, restart.

1207 Discharge v. cloudy / muddy.

1218 Discharge cloudy. Stop compressor 1 minute, restart.

1222 Discharge v. cloudy. Trace fine sand

1242 Discharge sl. cloudy. Few grains of fine sand in a 1-gal. sample Stop airlift development

1319 Installed 3.5" Grundfos pump to 30', attached to rods. Set up 2" discharge hose and flow meter. Valve is on the ~~back~~ downstream side of the flow meter.

1322 SWL = 8.24' BTOC, TOC is 0.4' above ground

1323 Pump on. STEP #1 : 30 gpm - TH-3-13

1326 Rate fluctuates from 20-100 gpm in first minute. Adjust.

1327 8.95' Q=26.1 gpm

1328 8.93' Q=23.8 gpm. Open valve

1329 9.00' Q=26.7

1330 9.00' Q=25.2

1331 8.99' Q=24.8

1332 8.99' Q=24.6

1333 8.99' Q=24.6

1334 8.99' Q=24.6

1335 8.99' Q=24.6

1337 8.99' Q=24.5

5/12/13

1339 8.99' Q=24.5 Discharge clear, no sand.

1341 8.99' Q=24.6

1343 8.99' Q=24.5

1345 8.99' Q=24.6

1347 8.99' Q=24.5

1349 8.99' Q=24.5

1351 8.99' Q=24.5

1354 8.99' Q=24.5

1355 STEP #2: 60 gpm

1356 10.36' Q=58.2

1357 10.37' Q=57.9

1358 10.37' Q=57.8

1359 10.37' Q=57.4

1400 10.37' Q=57.4

1401 10.37' Q=57.5

1402 10.37' Q=57.4

1403 10.37' Q=57.5

1404 10.38' Q=57.4

1405 10.38' Q=57.3

1407 10.38' Q=57.5 Discharge clear, no sand.

1409 10.38' Q=57.4

1411 10.38' Q=57.5

1413 10.38' Q=57.5

1415 10.38' Q=57.3

1417 10.38' Q=57.4

1419 10.38' Q=57.5

1421 10.38' Q=57.4

1424 10.38' Q=57.3

1425 STEP #3: 80 gpm

1426 11.73' Q=85.5

1427	11.74'	Q=85.2 gpm
1428	11.74'	Q=85.7
1429	11.75'	Q=85.8
1430	11.75'	Q=85.9
1431	11.75'	Q=85.9
1432	11.75'	Q=85.9
1433	11.75'	Q=85.8
1434	11.76'	Q=85.7
1435	11.76'	Q=85.8
1437	11.76'	Q=85.8
1439	11.76'	Q=85.8 Discharge clear, no sand
1441	11.75'	Q=85.8
1443	11.76'	Q=85.6
1445	11.76'	Q=85.2
1447	11.76'	Q=85.9
1449	11.76'	Q=85.7
1451	11.76'	Q=85.8
1454	11.76'	Q=86.1
1455	STEP #4: max pump rate - valve wide open	
1456	12.66'	Q=103.7
1457	12.67'	Q=103.7
1458	12.67'	Q=103.9
1459	12.67'	Q=103.6
1500	12.67'	Q=103.6
1501	12.67'	Q=103.7
1502	12.67'	Q=103.6
1503	12.68'	Q=103.5
1504	12.68'	Q=103.7
1505	12.68'	Q=104.2
1507	12.69'	Q=103.9

1509	12.69'	Q=103.8 gpm. Discharge clear, no sand
1511	12.68'	Q=103.7
1513	12.68'	Q=103.4
1515	12.69'	Q=103.5
1517	12.68'	Q=103.6
1519	12.68'	Q=103.6
1521	12.68'	Q=103.4
1524	12.68'	Q=104.0
1525	Pump off.	
1526	8.23'	100% recovery
1527	8.20'	Water level came back above SWL
1528	8.19'	
1529	8.19'	
1530	8.19'	

1540 Turn pump back on at 12 gpm to collect water quality sample

1550 Collect water quality sample: from 100-110' depth

TH-3-13

To State Dept of Health Lab:
- Common Ions (all)
- Inorganics (all)
- VOCs, SOCs, TOC, Ammonia, MTBE
- Radionuclides

To Midwest Labs (Omaha):
- UV254, Bromide, Boron, H_2S, Silica, Strontium, Chromium 6, Color

Samples are clear, no odor.

Samples are on ice in coolers for now.

(164)

5/12/13

1612 Layne starts pulling the pump.

1706 Screen is pulled. There is ~12" of fine sand in the bottom.

1730 Installed casing back to 110', and pushed formation material to ~108'. Need to finish pushing the formation out in the morning. Layne needs to do weekly paperwork. Stop for the day.

1740 HOR off site.

END OF DAY

5/13/13

(165)

0715 HOR on site at Paddle Wheel Point, Yankton, SD. Layne is on site.

Personnel: Adam Kessler - HOR
Julius Coke, Orden Gonzalez - Layne

Weather: Partly cloudy, 58°, light winds (88° today)

0730 Orden goes to City water plant to get water (1,500 gal tank). Julius is preparing to install the monitoring well at TH-3-13.

0753 Orden returns with full water tank. Layne can finish cleaning out the borehole to 110' now. Outer casing is already at 110'.

0820 The rig is not building air pressure, although Julius says the compressor is running. He shuts down; needs to call somebody about the problem and for some paperwork. Julius said the compressor has done this before.

0845 Ray and Randy (City) come by to pick up the TH-3-13 sample. We agree it would be best to send the TH-1-13 Midwest Labs bottles in today due to holding times. The TH-3-13 Midwest Labs bottles will be held by the City, and the State lab coolers will be courier-delivered today/tonight.

0856 Julius returns to site.

0915 Compresser fixed. Resume clean-out at borehole

0935 Borehole is clean down to 110'. Begin installing monitoring well.

1224 Installed monitoring well TH-3-13, with 0.010" slot screen from 100-110'. Grout is within 1 ft of the surface, then will be topped off with bentonite chips after it settles.

Layne will now start repairing the brake chamber on the rig - may take 3-4 hours after given a chance to cool down a bit.

1235 HDR off site.

1547 HDR on site. Check on rig progress. Julius is putting it back together now, should be another hour or so.

1620 Kyle Goodmenson (City) & Steve Quesl (HDR) on site.

1630 Rig is fixed. Move to TH-2-13.

1700 HDR, City off site.

1851 I visit site. Layne is gone, but has drilled to 10' at TH-2-13 (core recovered).

MONITORING WELL TH-3-13:

Materials:

1 - 10' x 2" Schedule 40 PVC wellscreen w/ bottom cap.

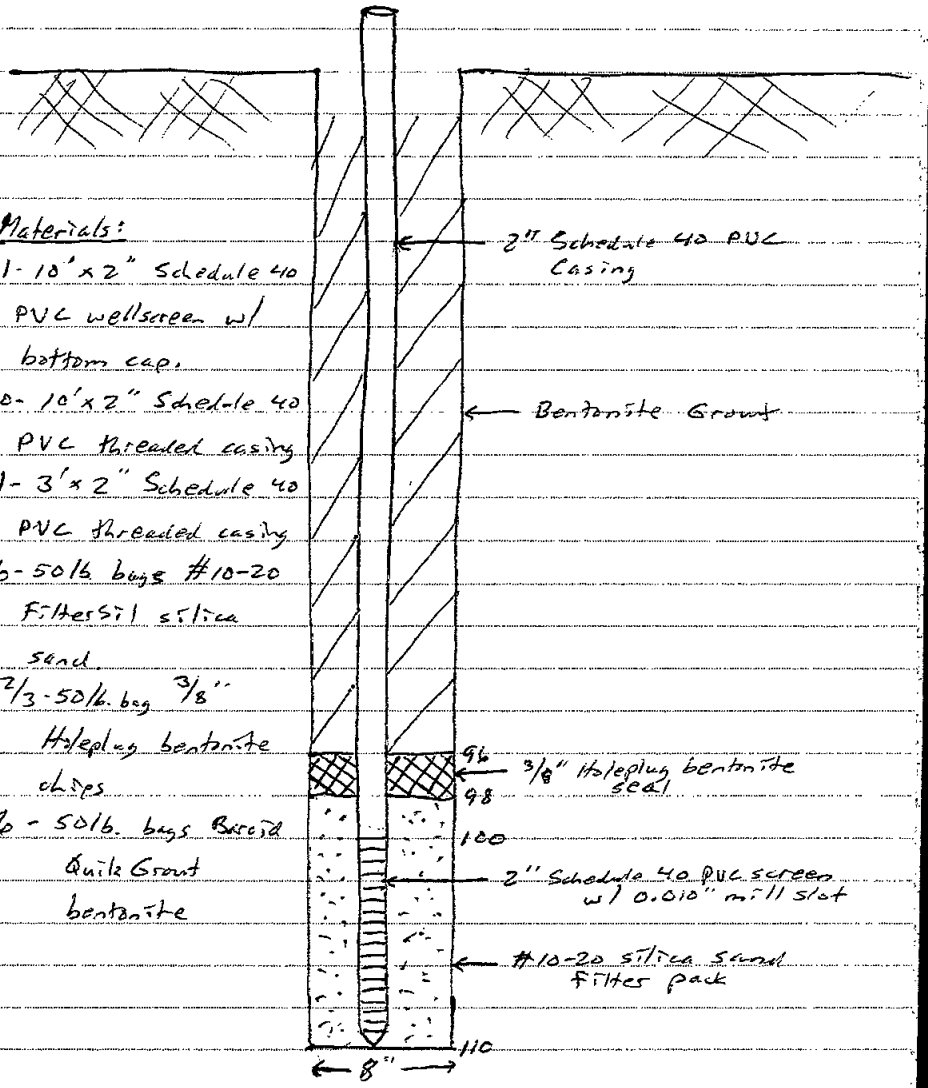
10 - 10' x 2" Schedule 40 PVC threaded casing

1 - 3' x 2" Schedule 40 PVC threaded casing

6 - 50lb bags #10-20 Filtersil silica sand.

2/3 - 50lb bag 3/8" Holeplug bentonite chips

6 - 50lb. bags Baroid Quik Grout bentonite



0708 HDR on site at Paddle Wheel Point, Yankton, SD
Layne just arrived on site.

Personnel: Adam Kessler - HDR
Julius Cole, Oiden Gonzalez - Layne

Weather: 64°, light wind, sunny (93° today)

0725 Layne installs and starts 12V submersible pump in MW TH-3-13 for development. Surge well with pump. Discharge becomes gray-brown, highly turbid. Discharge is ~5 gpm

0733 Resume drilling at TH-2-13 (drilled to 10' yesterday).

0757 I surge the screen with the pump at TH-3-13. Discharge became very cloudy, not nearly as turbid as last surge.

0840 Surge MW TH-3-13 with the pump. Discharge becomes cloudy.

0940 Cobbles and possible boulders in the 30-50 foot zone. Drillers is "double drilling" the sampler back down to try and pick up some of what falls out. Doesn't require tripping, just lift and go back.

0942 Randy (City) comes out to fill a 1-gal jug with MW TH-3-13 water for the City's use. Water is clear.

0945 Oiden shuts off pump in MW-TH-3-13. Development complete.

1110 Just recovered the 40-50' sample. Went back in with a flapper bit to try and recover more material - only got 20% total recovery. Coarse material - sand, gravel, cobbles.

1128 Oiden leaves to fill water tank. Julius is drilling to 60', then shuts down to wait for water before drilling down outer casing.

1302 Just advanced outer casing to 70'. Rig overheats. Shut down for a while to let hydraulics cool.

1345 Resume drilling.

1441 Shut down again. Overheating. An auxiliary mud pump switch is worn out and sometimes comes on without wanting it to, and that causes the rig to "dead head" and it shuts itself down before the drill head overheats and fails.

1506 Back up and running. Advancing outer casing to 80' now.

1513 Advanced casing to 77'. Rig shuts down again.

1543 Collect soil samples from TH-2-13: 1-gal baggies 40-50', 50-60'

1558 Resume drilling.

5/14/13

1622 Pulled out the 70-80' sample but only 1/2 of the core barrel came out. The other half was unthreaded during installation of the outer casing and stayed in the hole. Hard drilling at ~71' likely made the core barrel wander a bit, then the outer casing rubbed the core barrel enough to unthread it.

1720 Retrieved bottom half of core barrel. Sample fell out - no recovery from 70-80'.

1851 Sampled to 90'. In mostly medium sand with occasional 1-2" silty clay lenses. Layne decides to stop for the day.

1855 HDR off site

END OF DAY

5/15/13

0720 HDR on site at Paddlewheel Point, Yankton, SD. Layne is on site at TH-2-13

Personnel: Adam Kessler - HDR
Julius Cole, Biden Gonzalez - Layne

Weather: Partly cloudy, 59°, light wind (78° today)

0830 No recovery from 90-100', going back down with flapper bit to try and recover some of what fell out.

0905 Recover 60% of the 90-100' interval using flapper bit. Mostly medium sand still, no clay lenses. Some lightly cemented fine sand with trace silt at 97.5 - 99.5'.

0930 Collect soil samples from TH-2-13: Ziploc baggies 60-70', 80-90', 90-100'

1010 The 100-110' sample fell out immediately after picking rods up 10'. I ask Layne to try and recover some material with a flapper bit, which means they have to trip everything out, back in, then back out. This is an important interval, though.

1112 Recover 80% of the 100-110' interval, using flapper bit. Mostly medium sand and some fine sand.

1155 Drilled to 115' and core barrel started bouncing on something, maybe cobbles, maybe rock. Could not drill past 115'. Pulling sampler to check condition of core barrel. Sample fell out immediately after lifting 5 feet, so there will be no recovery on this attempt.

1210 Rods broke at 92', twisted right off about 2' below a joint. Layne starts a retrieval attempt

1255 Layne retrieved the broken rod and the rest of the string, including core barrel. No recovery from 110-115'. I decide set the temporary screen from 100-110', and presume it was rock at 115' that caused the rods to break.

Will use the 0.040-inch slot screen in the medium sand from 100-110' (some fine sand)

0805 Collect soil sample from TH-2-13: 1-gal. baggie -100-110'

1411 Randy (City) stopped by to see how things are going.

1413 Temporary 0.040-inch slot screen is installed from 100-110', outer casing pulled back to 100' to expose the screen, and rods installed back to 90' for air-lift development

1438 Start airlift development at TH-2-13.

1442 Discharge muddy, gray-brown, ~10 gpm

1449 Discharge clears significantly - very cloudy, ~10-15 gpm

1500 Discharge cloudy. Shut down compressor for 1 minute, restart.

1503 Discharge becomes slightly muddy; highly turbid. Trace sand

1518 Compressor stops running, overheated

1519 Compressor on.

1523 Discharge becomes highly turbid. Trace fine sand.

1524 Compressor stops again.

1535 Compressor on. Discharge still highly turbid.

1538 Compressor stops again. Julius calls the rental company.

1557 Compressor on. Discharge highly turbid. Trace fine sand

1616 Discharge clear, no sand. Shut down for 1 minute, restart.

1619 Discharge becomes very cloudy.

1627 Discharge slightly cloudy, trace sand, ~15-20 gpm

1635 Discharge clear, no sand.

1636 Stop development

1707 Installed 3.5" Grundfos pump to 30', on end of drill rods, in TH-2-13

1709 SWL: 9.68' BTOC, TOC is 0.3' above ground.

1711 SWL: 9.62', water level rising

1712 SWL: 9.62'

1714 SWL: 9.62'

1715 Pump on. STEP #1: 30 gpm - TH-2-13

1716 10.50' Q = 34.1 gpm

1717 10.75' Q = 36.8

1718 10.74' Q = 36.8

1719 10.74' Q = 37.1

5/15/13

1720	10.74'	Q=37.2 gpm	
1721	10.74'	Q=37.2 gpm	
1722	10.74'	Q=37.3	
1723	10.74'	Q=37.3	
1724	10.74'	Q=37.2	
1725	10.74'	Q=37.1	
1727	10.74'	Q=37.0	
1729	10.74'	Q=37.1	Discharge clear, no sand.
1731	10.74'	Q=37.1	
1733	10.74'	Q=37.1	
1735	10.74'	Q=37.1	
1737	10.74'	Q=37.1	
1739	10.74'	Q=37.0	
1741	10.74'	Q=37.1	
1744	10.74'	Q=37.0	
1745	STEP #2: 60 gpm		
1746	11.59'	Q=59.6	
1747	11.59'	Q=59.7	
1748	11.59'	Q=59.5	
1749	11.59'	Q=59.4	
1750	11.59'	Q=59.5	
1751	11.59'	Q=59.5	
1752	11.60'	Q=59.4	
1753	11.60'	Q=59.5	
1754	11.60'	Q=59.5	
1755	11.60'	Q=59.0	
1757	11.60'	Q=59.5	
1759	11.60'	Q=59.4	Discharge clear, no sand.
1801	11.60'	Q=59.6	
1803	11.60'	Q=59.4	

5/15/13

1805	11.60'	Q=59.4 gpm	
1807	11.60'	Q=59.5 gpm	
1809	11.60'	Q=59.5	
1811	11.60'	Q=59.7	
1814	11.60'	Q=59.5	
1815	STEP #3: 80 gpm		
1816	12.55'	Q=82.6	
1817	12.55'	Q=81.9	
1818	12.56'	Q=82.3	
1819	12.56'	Q=82.0	
1820	12.56'	Q=81.8	
1821	12.57'	Q=81.9	
1822	12.57'	Q=81.4	
1823	12.57'	Q=82.2	
1824	12.57'	Q=82.2	
1825	12.56'	Q=81.5	
1827	12.56'	Q=81.6	
1829	12.56'	Q=82.0	Disdarge clear, trace sand.
1831	12.56'	Q=82.2	
1833	12.56'	Q=82.5	
1835	12.57'	Q=82.0	
1837	12.57'	Q=82.0	
1839	12.57'	Q=82.5	
1841	12.57'	Q=82.0	
1844	12.57'	Q=82.0	
1845	STEP #4: max pump rate		
1846	13.46'	Q=100.5	
1847	13.47'	Q=101.6	
1848	13.47'	Q=101.9	
1849	13.48'	Q=101.5	

5/15/13

1850	13.48'	Q=101.7 gpm
1851	13.48'	Q=101.4
1852	13.48'	Q=101.5
1853	13.47'	Q=101.0
1854	13.47'	Q=101.2
1855	13.48'	Q=100.8
1857	13.47'	Q=101.5
1859	13.47'	Q=101.0 Discharge clear, no sand
1901	13.47'	Q=102.4
1903	13.47'	Q=101.3
1905	13.47'	Q=101.8
1907	13.47'	Q=101.6
1909	13.48'	Q=101.8
1911	13.48'	Q=101.3
1914	13.48'	Q=101.1
1915	Pump OFF	
1916	9.66'	
1917	9.64'	
1918	9.62'	100% recovery
1919	9.62'	
1920	9.62'	

1925 Turn pump back on at 5 gpm to collect water quality sample.

1940 Collect water quality sample : from 100-110' depth
TH-2-13

To State Dept. of Health Lab:
- Common Ions (all)
- Inorganics (all)
- VOCs, SOCs, TOC, Ammonia, MBE

5/16/13

- Radionuclides

To Midwest Labs (Omaha):
- UV254, Bromide, Boron, H_2S, Silica, Strontium, Chromium 6, Color

Samples are clear, no odor. Samples are on ice in coolers, for now.

1953 HOR off Site

END OF DAY

0730 HDR on site at Paddle Wheel Point, Yankton, SD
Layne is on site at TH-2-13

Personnel: Adam Kessler - HDR
Julius Cake, Oden Gonzalez - Layne

Weather: Partly cloudy, 58°, light wind (78° today)

0752 Oden goes to get water.

0829 Layne removes the Grundfos pump from TH-2-13.

0903 Layne removes temporary screen from TH-2-13 by running drill rods back down to 100' and threading into screen, pulling out.

0935 Layne drills outer casing back to 110' and flushes out the hole to set the monitoring well.

0950 Randy and Jason (City) come by to take the TH-2-13 water sample coolers for State DoH Lab and Midwest Labs. They will drop the Midwest Labs cooler overnight, and courier the State lab cooler tonight.

1010-1030 Steve Quail (HDR) stops by to pick up all of the soil samples - will deliver to lab in Sioux Falls, SD, for grain size analysis.

List of grain size samples collected:

TH-1-13	TH-2-13	TH-3-13
30-40'	40-50'	50-55'
* 43-49'	* 50-60'	* 62-69'
51-56'	* 60-70'	* 71.5-77'
56-61'	* 80-90'	* 77-88'
* 61-80'	* 90-100'	* 91-98'
* 90-97'	* 100-110'	* 98-113'
* 97-101'		113-115'
* 101-106'		

* Submitted for 1st analysis

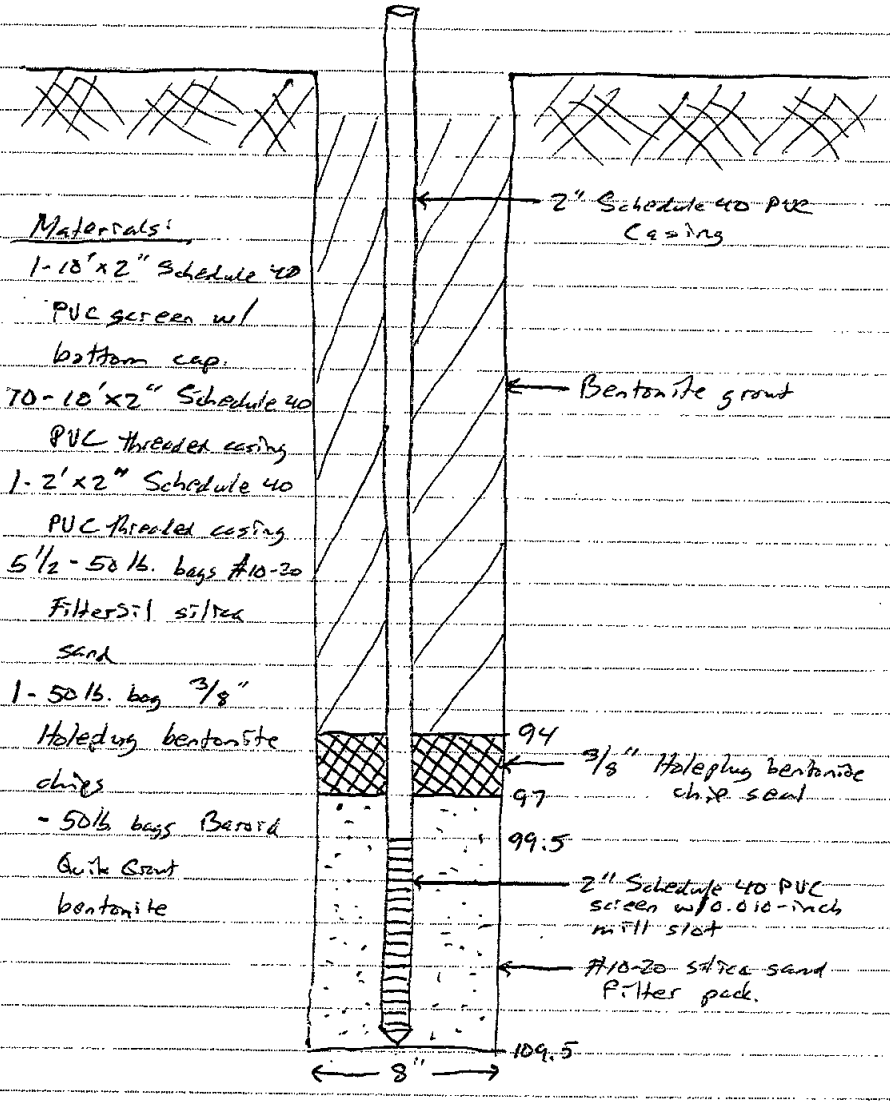
1040 Layne has installed monitoring well TH-2-13 except for the grout. Screen is 0.010-inch slot from 99.5-109.5', 2" PVC. Filter pack is #10-20 silica sand, bentonite seal is bentonite chips.

1103 HDR off site. Drive to Minneapolis.

END OF DAY

5/16/13

MONITORING WELL TH-2-13:



Materials:

1-10'x2" Schedule 40 PVC screen w/ bottom cap.

70-10'x2" Schedule 40 PVC threaded casing

1-2'x2" Schedule 40 PVC threaded casing

5 1/2 - 50 lb. bags #10-20 Filter Sil silica sand

1-50 lb. bag 3/8" Holeplug bentonite chips

- 50 lb bags Baroid Quik Grout bentonite

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APPENDIX E

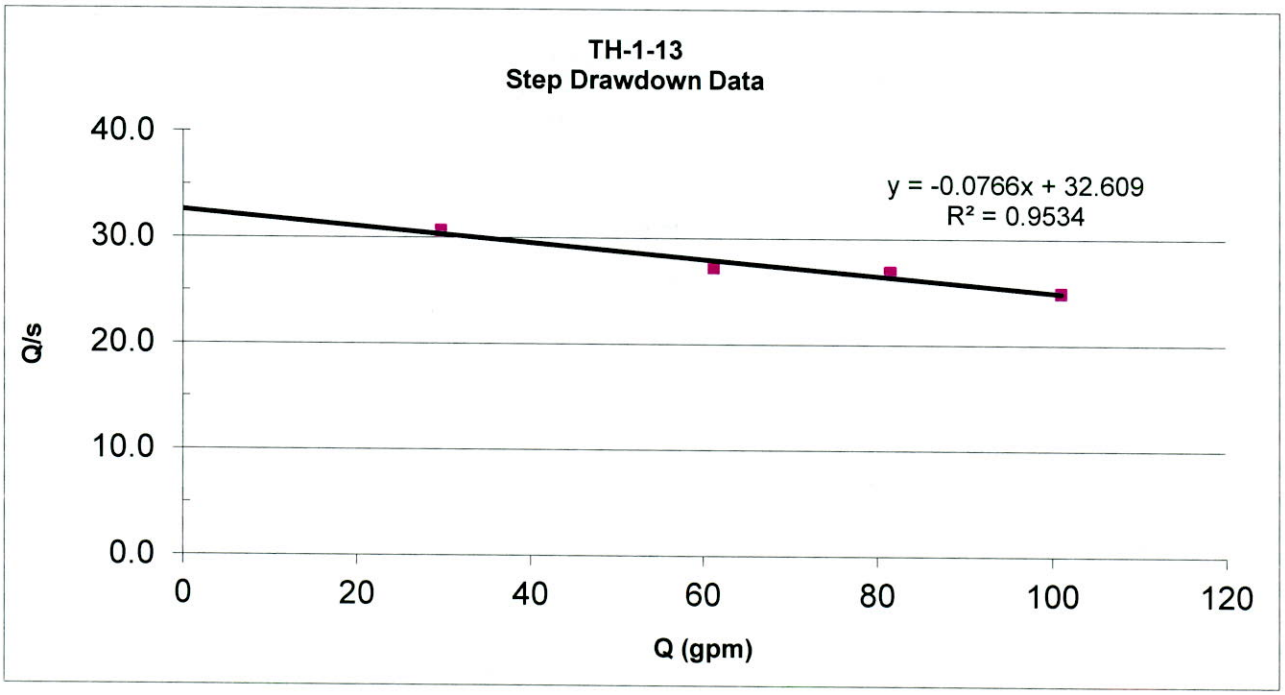
HYDRAULIC INTERVAL TESTING DATA

City of Yanton Collector Well Investigation
Test Boring #1
Hydraulic Interval Test Data and Analysis

Project: City of Yankton Collector Well Investigation
Well: TH-1-13
Location: Yankton, SD
Date: 5/9/2013

Stepped Rate Drawdown Data

Step	Pumping Rate (gpm)	Static Water Level (ft below TOC)	Pumping Water Level (ft below TOC)	Observed Drawdown (feet)	Specific Capacity Q/s (gpm/ft)	Y intercept (maximum theroretical specific capacity)	% Efficiency
1	29.7	9.32	10.29	0.97	30.6	32.6	93.9%
2	61.2		11.57	2.25	27.2		83.4%
3	81.5		12.36	3.04	26.8		82.2%
4	101.0		13.38	4.06	24.9		76.3%

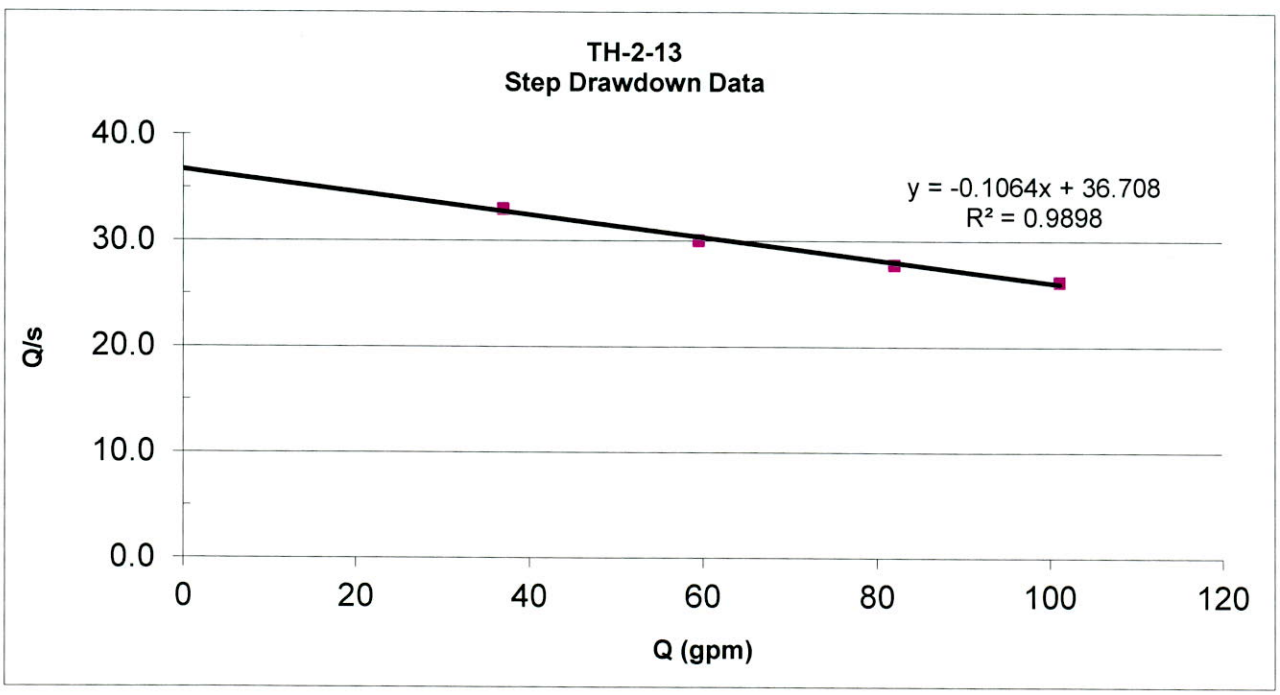


City of Yanton Collector Well Investigation
Test Boring #2
Hydraulic Interval Test Data and Analysis

Project: City of Yankton Collector Well Investigation
Well: TH-2-13
Location: Yankton, SD
Date: 5/15/2013

Stepped Rate Drawdown Data

Step	Pumping Rate (gpm)	Static Water Level (ft below TOC)	Pumping Water Level (ft below TOC)	Observed Drawdown (feet)	Specific Capacity Q/s (gpm/ft)	Y intercept (maximum theroretical specific capacity)	% Efficiency
1	37	9.32	10.44	1.12	33.0	36.7	90.0%
2	59.5		11.30	1.98	30.1		81.9%
3	82		12.27	2.95	27.8		75.7%
4	101.1		13.18	3.86	26.2		71.4%

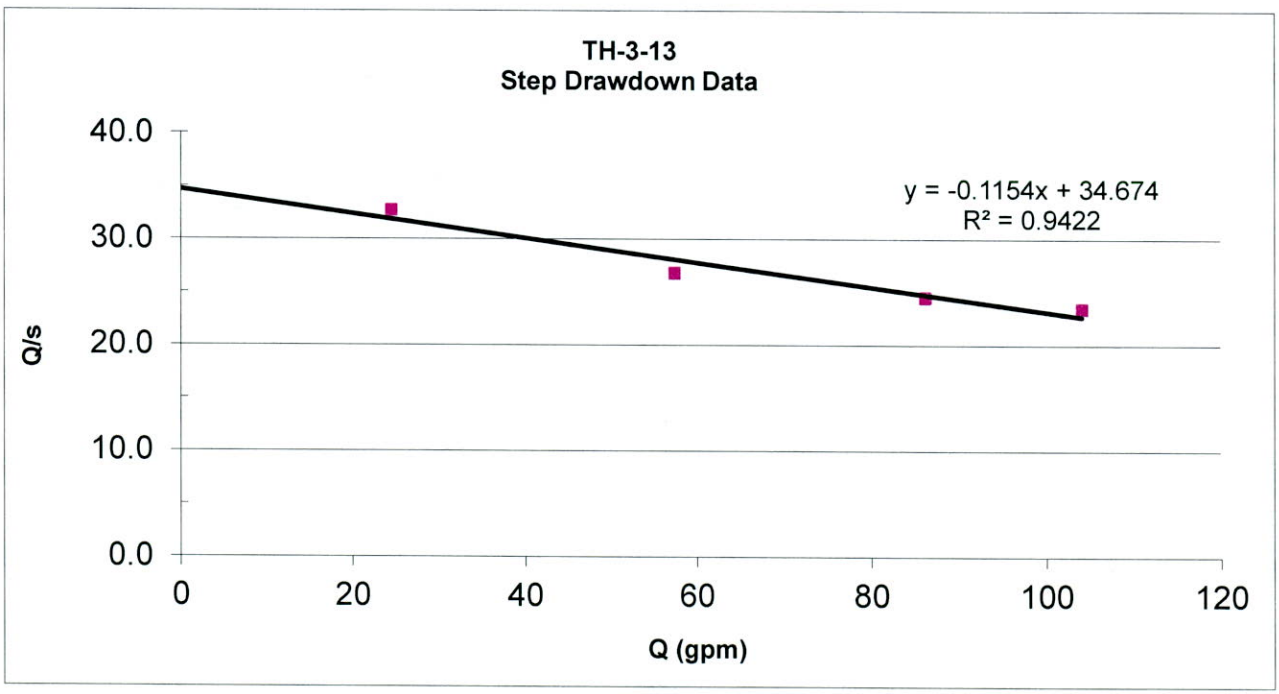


City of Yanton Collector Well Investigation
Test Boring #3
Hydraulic Interval Test Data and Analysis

Project: City of Yankton Collector Well Investigation
Well: TH-3-13
Location: Yankton, SD
Date: 5/12/2013

Stepped Rate Drawdown Data

Step	Pumping Rate (gpm)	Static Water Level (ft below TOC)	Pumping Water Level (ft below TOC)	Observed Drawdown (feet)	Specific Capacity Q/s (gpm/ft)	Y intercept (maximum theroretical specific capacity)	% Efficiency
1	24.5	7.84	8.59	0.75	32.7	34.7	94.2%
2	57.3		9.98	2.14	26.8		77.2%
3	86.1		11.36	3.52	24.5		70.5%
4	104.0		12.28	4.44	23.4		67.6%



APPENDIX F

PROJECTED COLLECTOR WELL YIELD CALCULATION SHEET

Projected Well Yield Calculation Sheet

SITE NAME: City of Yankton- TH-3-13 Site

Collector Well Yield Calculation Sheet

Hantush and Papadopulous

$$s_{cs} \geq \left(\frac{Q}{2\pi Kb}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}\left(2z_i+r_w\right)\right)}\right)^{\frac{b}{4\ell}}\right]$$

Calulation Input Parameter

Term	Description	VALUE		
s	Design Drawdown in Caison (below static water level, ft)	70		
	Well Efficiency (percent)	90		
T	Coefficient of transmissivity (ft2/day);	Variable	static water level (ft bgs)	15
T	Aquifer Transmissivity (gal/day/foot)	Variable		
Q	YIELD of collector, ft3/day	Solved For	water column thickness	
K	Hydraulic Conductivity, ft/day	Variable	saturated aquifer thickness (ft)	95
b	Saturated thickness of aquifer, ft	95	depth to laterals (ft bgs)	100
Γ	= (2 (a - rc))/l	7.3	available dd above laterals (ft)	85
a	Effective distance to a line of recharge, ft	750	depth to bedrock (ft bgs)	110
l	Average length of laterals, ft	200		
r_c	Radius of collector caisson, ft	20		
ε	= (2a - rc - l)/l	6.4		
r_w	Effective Radius of each lateral, ft	0.5		
z_i	Depth of lateral below static water level, ft	85		

Summary of Potential Well Yield at TH-3-13

Scenario (Hydraulic Conductivity)	Saturated Thickness	Hydraulic Conductivity, (ft/day)	Aquifer Transmissivity (gal/day/foot)	Collector Well Yield (mgd)
Minimum	95	70	49,742	4
Geometric Mean		172	122,223	9.8
Maximum		423	300,584	24

APPENDIX G

WATER QUALITY ANALYTICAL LABORATORY REPORTS

APPENDIX G-1

TH-1-13

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 5/10/2013
Time Rcvd: 0659
Date Coll: 5/9/2013
Time Coll: 1110
Spec Type: DRINKING WAT

Coll By: ADAM KESSLER
Source Name TH-1-13
Source Sampled: BOREHOLE 90-100'
Telephone Numb* 6685272
Temp when rec'd 9 C

Final Results

EDB and DBCP	1,2-Dibromoethane	<0.02 ug/L
	1,2-Dibromo-3-Chloropropane	<0.04 ug/L

< compound analyzed for but not detected.
Results determined by EPA Method 504.1.

Chlorinated Acids	Dalapon	<10.0 ug/L
	Dicamba	<1.00 ug/L
	2,4-D	<1.00 ug/L
	Pentachlorophenol	<0.500 ug/L
	2,4,5-TP	<1.00 ug/L
	Dinoseb	<1.00 ug/L
	Picloram	<1.00 ug/L

< compound analyzed for but not detected.
Chlorinated Acid results determined by EPA method 515.1.

Glyphosate	Glyphosate	<13.2 ug/L

< compound analyzed for but not detected.
Glyphosate results determined by EPA method 547.

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Endothall	Endothall	<19.8 ug/L

< compound analyzed for but not detected.
Endothall results determined by EPA method 548.1

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

ORGANIC COMPOUNDS-525.2

Hexachlorocyclopentadiene	<0.220 ug/L
Propachlor	<0.500 ug/L
Hexachlorobenzene	<0.220 ug/L
Simazine	<0.150 ug/L
Atrazine	<0.220 ug/L
Lindane	<0.100 ug/L
Metribuzin	<0.500 ug/L
Alachlor	<0.440 ug/L
Heptachlor	<0.400 ug/L
Metolachlor	<0.500 ug/L
Aldrin	<0.100 ug/L
Heptachlor epoxide	<0.100 ug/L
Chlordane	<0.440 ug/L
Butachlor	<0.500 ug/L
Dieldrin	<0.500 ug/L
Endrin	<0.100 ug/L
Bis (2-ethylhexyl) Adipate	<1.32 ug/L
Methoxychlor	<0.220 ug/L
Bis (2-ethylhexyl) Phthalate	<1.32 ug/L
Benzo(a)pyrene	<0.200 ug/L
Toxaphene	<0.100
Aroclor 1016	<0.080
Aroclor 1221	<0.100
Aroclor 1232	<0.100
Aroclor 1242	<0.100
Aroclor 1248	<0.100
Aroclor 1254	<0.100
Aroclor 1260	<0.100

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Organohalide results determined by EPA method 525.2.
PCB results determined by EPA Method 505.

N-Methylcarbamates	Aldicarb sulfone	<1.00 ug/L
	Aldicarb sulfoxide	<1.00 ug/L
	Oxamyl	<2.00 ug/L
	Methomyl	<2.00 ug/L
	3-Hydroxycarbofuran	<2.00 ug/L
	Aldicarb	<1.00 ug/L
	Carbofuran	<1.98 ug/L
	Carbaryl	<2.00 ug/L

< compound analyzed for but not detected.
Carbamate results determined by EPA method 531.1.

Diquat	Diquat	<0.88 ug/L

< compound analyzed for but not detected.
Diquat results determined by EPA method 549.2

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

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YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Volatile Organic Compounds	CHLOROFORM	<0.500 ug/L
	BROMODICHLOROMETHANE	<0.500 ug/L
	DIBROMOCHLOROMETHANE	<0.500 ug/L
	BROMOFORM	<0.500 ug/L
	TOTAL TRIHALOMETHANES	<2.00 ug/L
	TRICHLOROETHYLENE	<0.500 ug/L
	CARBON TETRACHLORIDE	<0.500 ug/L
	1,1,1-TRICHLOROETHANE	<0.500 ug/L
	VINYL CHLORIDE	<0.500 ug/L
	1,2-DICHLOROETHANE	<0.500 ug/L
	BENZENE	<0.500 ug/L
	1,1-DICHLOROETHYLENE	<0.500 ug/L
	PARA-DICHLOROBENZENE	<0.500 ug/L
	O-DICHLOROBENZENE	<0.500 ug/L
	cis-1,2-DICHLOROETHYLENE	<0.500 ug/L
	trans-1,2-DICHLOROETHYLENE	<0.500 ug/L
	1,2-DICHLOROPROPANE	<0.500 ug/L
	ETHYLBENZENE	<0.500 ug/L
	Chlorobenzene	<0.500 ug/L
	STYRENE	<0.500 ug/L

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

TETRACHLOROETHYLENE	<0.500 ug/L
TOLUENE	<0.500 ug/L
m,p-XYLENE	<0.500 ug/L
o-XYLENE	<0.500 ug/L
TOTAL XYLENES	<0.500 ug/L
DICHLORODIFLUOROMETHANE	<0.500 ug/L
Chloromethane	<0.500 ug/L
Bromomethane	<0.500 ug/L
Chloroethane	<0.500 ug/L
Trichlorofluoromethane	<0.500 ug/L
Methylene Chloride	<0.500 ug/L
1,1-Dichloroethane	<0.500 ug/L
2,2-Dichloropropane	<0.500 ug/L
Bromochloromethane	<0.500 ug/L
Dibromomethane	<0.500 ug/L
cis-1,3-Dichloropropene	<0.500 ug/L
trans-1,3-Dichloropropene	<0.500 ug/L
1,1,2-Trichloroethane	<0.500 ug/L
1,3-Dichloropropane	<0.500 ug/L
1,2-Dibromoethane	<0.500 ug/L
1,1,1,2-Tetrachloroethane	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

	<0.500 ug/L
1,1,2,2-Tetrachloroethane	<0.500 ug/L
Isopropylbenzene	<0.500 ug/L
Bromobenzene	<0.500 ug/L
1,2,3-Trichloropropane	<0.500 ug/L
N-Propylbenzene	<0.500 ug/L
2-Chlorotoluene	<0.500 ug/L
4-Chlorotoluene	<0.500 ug/L
1,3,5-Trimethylbenzene	<0.500 ug/L
tert-Butylbenzene	<0.500 ug/L
1,2,4-Trimethylbenzene	<0.500 ug/L
sec-Butylbenzene	<0.500 ug/L
1,3-Dichlorobenzene	<0.500 ug/L
isopropyl-Toluene	<0.500 ug/L
N-Butylbenzene	<0.500 ug/L
1,2-Dibromo-3-Chloropropane	<0.500 ug/L
1,2,4-Trichlorobenzene	<0.500 ug/L
naphthalene	<0.500 ug/L
Hexachlorobutadiene	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001811
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

		<0.500 ug/L
1,2,3-Trichlorobenzene		
		<0.500 ug/L
1,1-Dichloropropene		
		<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

MTBE	MTBE	<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

APPENDIX G-2

TH-2-13

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 5/17/2013 Coll By: ADAM KESSLER
Time Rcvd: 0657 Remarks: BOREHOLE
Date Coll: 5/15/2013 Source Name TH-2-13
Time Coll: 1940 Temp when rec'd 5 C
Spec Type: DRINKING WAT Type of Sample: RAW

Final Results

EDB and DBCP	1,2-Dibromoethane	<0.02 ug/L
	1,2-Dibromo-3-Chloropropane	<0.04 ug/L

< compound analyzed for but not detected.
Results determined by EPA Method 504.1.

Chlorinated Acids	Dalapon	<10.0 ug/L
	Dicamba	<1.00 ug/L
	2,4-D	<1.00 ug/L
	Pentachlorophenol	<0.500 ug/L
	2,4,5-TP	<1.00 ug/L
	Dinoseb	<1.00 ug/L
	Picloram	<1.00 ug/L

< compound analyzed for but not detected.
Chlorinated Acid results determined by EPA method 515.1.

Glyphosate	Glyphosate	<13.2 ug/L

< compound analyzed for but not detected.
Glyphosate results determined by EPA method 547.

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Endothall	Endothall	<19.8 ug/L

< compound analyzed for but not detected.
Endothall results determined by EPA method 548.1
(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

ORGANIC COMPOUNDS-525.2	Hexachlorocyclopentadiene	<0.220 ug/L
	Propachlor	<0.500 ug/L
	Hexachlorobenzene	<0.220 ug/L
	Simazine	<0.150 ug/L
	Atrazine	<0.220 ug/L
	Lindane	<0.100 ug/L
	Metribuzin	<0.500 ug/L
	Alachlor	<0.440 ug/L
	Heptachlor	<0.400 ug/L
	Metolachlor	<0.500 ug/L
	Aldrin	<0.100 ug/L
	Heptachlor epoxide	<0.100 ug/L
	Chlordane	<0.440 ug/L
	Butachlor	<0.500 ug/L
	Dieldrin	<0.500 ug/L
	Endrin	<0.100 ug/L
	Bis (2-ethylhexyl) Adipate	<1.32 ug/L
	Methoxychlor	<0.220 ug/L
	Bis (2-ethylhexyl) Phthalate	<1.32 ug/L
	Benzo(a)pyrene	<0.200 ug/L
	Toxaphene	<0.100
	Aroclor 1016	<0.080
	Aroclor 1221	<0.100
	Aroclor 1232	<0.100
	Aroclor 1242	<0.100
	Aroclor 1248	<0.100
	Aroclor 1254	<0.100
	Aroclor 1260	<0.100

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Organohalide results determined by EPA method 525.2.
PCB results determined by EPA Method 505.

N-Methylcarbamates	Aldicarb sulfone	<1.00 ug/L
	Aldicarb sulfoxide	<1.00 ug/L
	Oxamyl	<2.00 ug/L
	Methomyl	<2.00 ug/L
	3-Hydroxycarbofuran	<2.00 ug/L
	Aldicarb	<1.00 ug/L
	Carbofuran	<1.98 ug/L
	Carbaryl	<2.00 ug/L

< compound analyzed for but not detected.
Carbamate results determined by EPA method 531.1.

Diquat	Diquat	<0.88 ug/L

< compound analyzed for but not detected.
Diquat results determined by EPA method 549.2

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Volatile Organic Compounds	CHLOROFORM	<0.500 ug/L
	BROMODICHLOROMETHANE	<0.500 ug/L
	DIBROMOCHLOROMETHANE	<0.500 ug/L
	BROMOFORM	<0.500 ug/L
	TOTAL TRIHALOMETHANES	<2.00 ug/L
	TRICHLOROETHYLENE	<0.500 ug/L
	CARBON TETRACHLORIDE	<0.500 ug/L
	1,1,1-TRICHLOROETHANE	<0.500 ug/L
	VINYL CHLORIDE	<0.500 ug/L
	1,2-DICHLOROETHANE	<0.500 ug/L
	BENZENE	<0.500 ug/L
	1,1-DICHLOROETHYLENE	<0.500 ug/L
	PARA-DICHLOROBENZENE	<0.500 ug/L
	O-DICHLOROBENZENE	<0.500 ug/L
	cis-1,2-DICHLOROETHYLENE	<0.500 ug/L
	trans-1,2-DICHLOROETHYLENE	<0.500 ug/L
	1,2-DICHLOROPROPANE	<0.500 ug/L
	ETHYLBENZENE	<0.500 ug/L
	Chlorobenzene	<0.500 ug/L
	STYRENE	<0.500 ug/L

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:

Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

TETRACHLOROETHYLENE	<0.500 ug/L
TOLUENE	<0.500 ug/L
m,p-XYLENE	<0.500 ug/L
o-XYLENE	<0.500 ug/L
TOTAL XYLENES	<0.500 ug/L
DICHLORODIFLUOROMETHANE	<0.500 ug/L
Chloromethane	<0.500 ug/L
Bromomethane	<0.500 ug/L
Chloroethane	<0.500 ug/L
Trichlorofluoromethane	<0.500 ug/L
Methylene Chloride	<0.500 ug/L
1,1-Dichloroethane	<0.500 ug/L
2,2-Dichloropropane	<0.500 ug/L
Bromochloromethane	<0.500 ug/L
Dibromomethane	<0.500 ug/L
cis-1,3-Dichloropropene	<0.500 ug/L
trans-1,3-Dichloropropene	<0.500 ug/L
1,1,2-Trichloroethane	<0.500 ug/L
1,3-Dichloropropane	<0.500 ug/L
1,2-Dibromoethane	<0.500 ug/L
1,1,1,2-Tetrachloroethane	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

	<0.500 ug/L
1,1,2,2-Tetrachloroethane	<0.500 ug/L
Isopropylbenzene	<0.500 ug/L
Bromobenzene	<0.500 ug/L
1,2,3-Trichloropropane	<0.500 ug/L
N-Propylbenzene	<0.500 ug/L
2-Chlorotoluene	<0.500 ug/L
4-Chlorotoluene	<0.500 ug/L
1,3,5-Trimethylbenzene	<0.500 ug/L
tert-Butylbenzene	<0.500 ug/L
1,2,4-Trimethylbenzene	<0.500 ug/L
sec-Butylbenzene	<0.500 ug/L
1,3-Dichlorobenzene	<0.500 ug/L
isopropyl-Toluene	<0.500 ug/L
N-Butylbenzene	<0.500 ug/L
1,2-Dibromo-3-Chloropropane	<0.500 ug/L
1,2,4-Trichlorobenzene	<0.500 ug/L
naphthalene	<0.500 ug/L
Hexachlorobutadiene	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC002084
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

		<0.500 ug/L
1,2,3-Trichlorobenzene		
		<0.500 ug/L
1,1-Dichloropropene		
		<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

MTBE	MTBE	<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

APPENDIX G-3

TH-3-13

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 5/14/2013
Time Rcvd: 0703
Date Coll: 5/12/2013
Time Coll: 1550
Spec Type: DRINKING WAT

Coll By: ADAM KESSLER
Source Name TH-3-13
Telephone Numb* 6685272
Temp when rec'd 2 C
Type of Sample: BOREHOLE

Final Results

EDB and DBCP	1,2-Dibromoethane	<0.02 ug/L
	1,2-Dibromo-3-Chloropropane	<0.04 ug/L

< compound analyzed for but not detected.
Results determined by EPA Method 504.1.

Chlorinated Acids	Dalapon	<10.0 ug/L
	Dicamba	<1.00 ug/L
	2,4-D	<1.00 ug/L
	Pentachlorophenol	<0.500 ug/L
	2,4,5-TP	<1.00 ug/L
	Dinoseb	<1.00 ug/L
	Picloram	<1.00 ug/L

< compound analyzed for but not detected.
Chlorinated Acid results determined by EPA method 515.1.

Glyphosate	Glyphosate	<13.2 ug/L

< compound analyzed for but not detected.
Glyphosate results determined by EPA method 547.

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Endothall	Endothall	<19.8 ug/L

< compound analyzed for but not detected.
Endothall results determined by EPA method 548.1

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

ORGANIC COMPOUNDS-525.2

Hexachlorocyclopentadiene	<0.220 ug/L
Propachlor	<0.500 ug/L
Hexachlorobenzene	<0.220 ug/L
Simazine	<0.150 ug/L
Atrazine	<0.220 ug/L
Lindane	<0.100 ug/L
Metribuzin	<0.500 ug/L
Alachlor	<0.440 ug/L
Heptachlor	<0.400 ug/L
Metolachlor	<0.500 ug/L
Aldrin	<0.100 ug/L
Heptachlor epoxide	<0.100 ug/L
Chlordane	<0.440 ug/L
Butachlor	<0.500 ug/L
Dieldrin	<0.500 ug/L
Endrin	<0.100 ug/L
Bis (2-ethylhexyl) Adipate	<1.32 ug/L
Methoxychlor	<0.220 ug/L
Bis (2-ethylhexyl) Phthalate	<1.32 ug/L
Benzo(a)pyrene	<0.200 ug/L
Toxaphene	<0.100
Aroclor 1016	<0.080
Aroclor 1221	<0.100
Aroclor 1232	<0.100
Aroclor 1242	<0.100
Aroclor 1248	<0.100
Aroclor 1254	<0.100
Aroclor 1260	<0.100

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

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YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Organohalide results determined by EPA method 525.2.
PCB results determined by EPA Method 505.

N-Methylcarbamates	Aldicarb sulfone	<1.00 ug/L
	Aldicarb sulfoxide	<1.00 ug/L
	Oxamyl	<2.00 ug/L
	Methomyl	<2.00 ug/L
	3-Hydroxycarbofuran	<2.00 ug/L
	Aldicarb	<1.00 ug/L
	Carbofuran	<1.98 ug/L
	Carbaryl	<2.00 ug/L

< compound analyzed for but not detected.
Carbamate results determined by EPA method 531.1.

Diquat	Diquat	<0.88 ug/L

< compound analyzed for but not detected.
Diquat results determined by EPA method 549.2

(continued)

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Volatile Organic Compounds	CHLOROFORM	<0.500 ug/L
	BROMODICHLOROMETHANE	<0.500 ug/L
	DIBROMOCHLOROMETHANE	<0.500 ug/L
	BROMOFORM	<0.500 ug/L
	TOTAL TRIHALOMETHANES	<2.00 ug/L
	TRICHLOROETHYLENE	<0.500 ug/L
	CARBON TETRACHLORIDE	<0.500 ug/L
	1,1,1-TRICHLOROETHANE	<0.500 ug/L
	VINYL CHLORIDE	<0.500 ug/L
	1,2-DICHLOROETHANE	<0.500 ug/L
	BENZENE	<0.500 ug/L
	1,1-DICHLOROETHYLENE	<0.500 ug/L
	PARA-DICHLOROBENZENE	<0.500 ug/L
	O-DICHLOROBENZENE	<0.500 ug/L
	cis-1,2-DICHLOROETHYLENE	<0.500 ug/L
	trans-1,2-DICHLOROETHYLENE	<0.500 ug/L
	1,2-DICHLOROPROPANE	<0.500 ug/L
	ETHYLBENZENE	<0.500 ug/L
	Chlorobenzene	<0.500 ug/L
	STYRENE	<0.500 ug/L

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

TETRACHLOROETHYLENE	<0.500 ug/L
TOLUENE	<0.500 ug/L
m,p-XYLENE	<0.500 ug/L
o-XYLENE	<0.500 ug/L
TOTAL XYLENES	<0.500 ug/L
DICHLORODIFLUOROMETHANE	<0.500 ug/L
Chloromethane	<0.500 ug/L
Bromomethane	<0.500 ug/L
Chloroethane	<0.500 ug/L
Trichlorofluoromethane	<0.500 ug/L
Methylene Chloride	<0.500 ug/L
1,1-Dichloroethane	<0.500 ug/L
2,2-Dichloropropane	<0.500 ug/L
Bromochloromethane	<0.500 ug/L
Dibromomethane	<0.500 ug/L
cis-1,3-Dichloropropene	<0.500 ug/L
trans-1,3-Dichloropropene	<0.500 ug/L
1,1,2-Trichloroethane	<0.500 ug/L
1,3-Dichloropropane	<0.500 ug/L
1,2-Dibromoethane	<0.500 ug/L
1,1,1,2-Tetrachloroethane	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/30/2013

Submitter copy to:

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

	<0.500 ug/L
1,1,2,2-Tetrachloroethane	<0.500 ug/L
Isopropylbenzene	<0.500 ug/L
Bromobenzene	<0.500 ug/L
1,2,3-Trichloropropane	<0.500 ug/L
N-Propylbenzene	<0.500 ug/L
2-Chlorotoluene	<0.500 ug/L
4-Chlorotoluene	<0.500 ug/L
1,3,5-Trimethylbenzene	<0.500 ug/L
tert-Butylbenzene	<0.500 ug/L
1,2,4-Trimethylbenzene	<0.500 ug/L
sec-Butylbenzene	<0.500 ug/L
1,3-Dichlorobenzene	<0.500 ug/L
isopropyl-Toluene	<0.500 ug/L
N-Butylbenzene	<0.500 ug/L
1,2-Dibromo-3-Chloropropane	<0.500 ug/L
1,2,4-Trichlorobenzene	<0.500 ug/L
naphthalene	<0.500 ug/L
Hexachlorobutadiene	

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 5/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC001853
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

		<0.500 ug/L
	1,2,3-Trichlorobenzene	
		<0.500 ug/L
	1,1-Dichloropropene	
		<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

MTBE	MTBE	<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

APPENDIX B

Geologic Logs

Bore Hole Logs for Paddlewheel Point Collector Well Hydrogeologic Investigation

TH 1-13 (OW-1-13) Drilled 5/8/13

From:	To:	Description
0	18.5	Sand and silty sand
18.5	21.5	Medium stiff clay
21.5	84	Sand with trace gravel, 33' to 39.5' much coarser, clay at 39.5' to 40'
84	90	Very stiff silt
90	106.5	Sand with trace gravel
106.5	110	Weather shale bedrock

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 90 to 100 feet below ground*

TH 2-13 (OW-P50) Drilled 5/15/13

From:	To:	Description
0	32	Sand with trace gravel
32	50	Sand, gravel, cobbles. Coarser at 32' to 40'.
50	90	Sand with trace gravel, few 1 ' to 2 ' thick clay lenses
90	115	Sand with trace gravel
115	--	Refusal - weather shale bedrock (assumed)

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 99.5 to 109.5 feet below ground*

TH 3-13 (OW-3-13) Drilled 5/11/13

From:	To:	Description
0	37	Sand with trace gravel. Coarser at 25' to 33'.
37	50	Silty sand, clay at 37' to 38.5'.
50	88	Sand with trace gravel. Coarser at 57' to 62'. 6-inch boulders at 59.5' and 69'.
88	90.5	Fine sand with clay lenses
90.5	115	Sand with trace gravel. Coarser at 113' to 115'.
115	120	Weather shale bedrock

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 100 to 110 feet below ground*

TW-1 Drilled 11/18/13

From:	To:	Description
0	30	Tan very fine to coarse sand, 10% fine gravel. Clay lenses in 25' to 30'.
30	39	Tan very fine to very coarse sand, trace clay. Some lignite.
39	45	Brown gravel with 40% fine to coarse sand, cobbles
45	60	Brown very fine to coarse sand, 15% gravel. Gravel sized pieces of lignite.
60	80	Brown fine to coarse sand with lignite.
80	90	Brown fine to coarse sand, 20% gravel.
90	123	Brown fine to coarse sand (mostly fine to medium) with lignite.
123	127	Dark gray weathered shale

Notes: *Completed as 12-in steel test well with 0.070 & 0.080 slot screen from 92 to 122 feet below ground*

OW-75P Drilled 11/19/13

From:	To:	Description
0	25	Brown fine to very coarse sand, 15% small gravel. Sandy clay lense at 23'.
25	40	Brown fine to very coarse sand, 25% gravel and cobbles. Taking a lot of water.
40	60	Brown fine sand to small gravel, 25% gravel (rock chips), trace clay balls.
60	90	Brown fine to coarse sand, 20% is very coarse sand and small gravel, trace clay.
90	95	Brown very fine to medium sand, some coarse.
95	100	Dark brown fine to very coarse sand.
100	105	Brown very fine to medium sand, some coarse.
105	118	Dark brown very fine to very coarse sand.
118	133	Dark gray weathered shale

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 104 to 114 feet below ground*

OW-150P Drilled 11/20/13

From:	To:	Description
0	22	Brown very fine to very coarse sand
22	40	Brown very fine to very coarse sand, 20% gravel and cobbles. Clay balls at 35'.
40	44	Dark brown very fine to coarse sand, 20% brownish-black silt.
44	65	Brown very fine to very coarse sand, 30% gravel and cobbles. Trace grey clay balls.
65	85	Brown very fine to very coarse sand, 10% gravel. Clay lenses in 70' to 75' and 80' to 85', coal.
85	100	Dark brown very fine to very coarse sand, 10% small gravel, trace clay balls, coal.
100	125	Dark brown very fine to very coarse sand, trace small gravel, coal.
125	136	Dark brown very fine to very coarse sand, 10% small gravel, trace clay balls, coal.
136	140	Dark gray weathered shale

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 105 to 115 feet below ground*

OW-60R Drilled 11/21/13

From:	To:	Description
0	3	Brown fine to medium sand
3	5	Brown sandy clay
5	19	Brown fine sand to small gravel, 15% angular gravel.
19	22	Black organic clay
22	32	Brown fine sand to small gravel, 15% angular gravel.
32	33	Gray clay
33	42	Brown very fine to very coarse sand. Mostly coarse, clean.
42	44	Gray clay
44	60	Brown very fine to very coarse sand, 10% gravel.
60	90	Brown very fine to coarse sand, 5% gravel, trace clay, coal.
90	115	Brown very fine to very coarse sand, 5% gravel, coal. Trace clay balls in 90' to 100'.
115	121	Gray fine sand to small gravel, trace clay balls.
121	125	Dark gray weathered shale

Notes: *Completed as 2-in PVC observation well with 0.010 slot screen from 105 to 115 feet below ground*

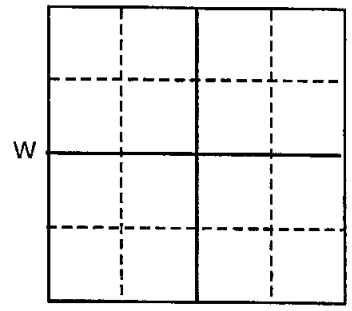
SD EForm - 1621LD V1

SOUTH DAKOTA WATER WELL COMPLETION REPORT 11-02

Location SW ¼ SW ¼ Sec 17 Twp 93N Rg 55W

County Yankton

Please mark well location with an "X"



Well Completion Date
November 20, 2013

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?
50.0 ft. from sewer (identify source)

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☑ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:
Rotary

CASING DATA: ☐ Steel ☑ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	105.0 FT	6.13 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Bentonite	7	Lb/gal	0.0 Ft	103.0 Ft
		Lb/gal	Ft	Ft

Describe grouting procedure
tremie piped

SCREEN: ☐ Perforated pipe ☑ Manufactured
Diameter 2.00 Inches Length 10.0 Feet
Material PVC
Slot Size .010 Set From 105.0 Feet to 115.0 Feet
Other information

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No
If so, what material?
Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?
☐ Yes, How?
Lab to which water quality sample sent for analysis
☑ No, Why Not? no samples taken

Well Owner: City of Yankton
Business Name:
Address: 416 Walnut St
City, State, Zip: Yankton SD 57078

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand & cobblestone layers	0	136
Gray shale	136	140

STATIC WATER LEVEL 11.0 FEET
If flowing: closed in pressure PSI
GPM flow through Inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced flow rate GPM
Can well be completely shut in?

WELL TEST DATA:
☐ Pumped Describe: no test pumping has been done
☐ Bailed
☐ Other
Pumping Level Below Land Surface
Ft. After Hrs. pumped GPM
Ft. After Hrs. pumped GPM
If pump installed, pump rate: GPM

REMARKS
GPS: N 42 51.963
W 97 22.632

OB2-East

This well was drilled under license # 475 and this report is true and accurate.
Drilling firm: Thein Well Co., Inc.
Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date:

SD EForm - 1621LD V1

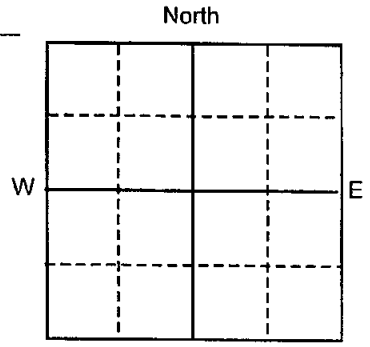
SOUTH DAKOTA WATER WELL COMPLETION REPORT

11- 02

Location SW ¼ SW ¼ Sec 17 Twp 93N Rg 55W

County Yankton

Please mark well location with an "X"



Well Completion Date

November 19, 2013

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?

50.0 ft. from sewer (identify source)

PROPOSED USE:

☐ Domestic/Stock ☐ Municipal ☐ Business ☑ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Rotary

CASING DATA: ☐ Steel ☑ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	104.0 FT	6.13 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Bentonite	9	Lb/gal	0.0 Ft	102.0 Ft
		Lb/gal	Ft	Ft

Describe grouting procedure

tremie piped

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 2.00 Inches Length 10.0 Feet

Material PVC

Slot Size .010 Set From 104.0 Feet to 114.0 Feet

Other information

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No

If so, what material?

Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?

☐ Yes, How?

Lab to which water quality sample sent for analysis

☑ No, Why Not? no samples taken

Well Owner: City of Yankton

Business Name:

Address: 416 Walnut St

City, State, Zip: Yankton SD 57078

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand & cobblestone layers	0	118
Gray shale	118	133

STATIC WATER LEVEL 14.0 FEET

If flowing: closed in pressure PSI

GPM flow through Inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced flow rate GPM

Can well be completely shut in?

WELL TEST DATA:

☐ Pumped Describe: no test pumping has been done

☐ Bailed

☐ Other

Pumping Level Below Land Surface

Ft. After Hrs. pumped GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

REMARKS

GPS: N 42 51.975
W 97 22.68

OB1-West

This well was drilled under license # 475 and this report is true and accurate.

Drilling firm: Thein Well Co., Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date:

SD EForm - 1621LD V1

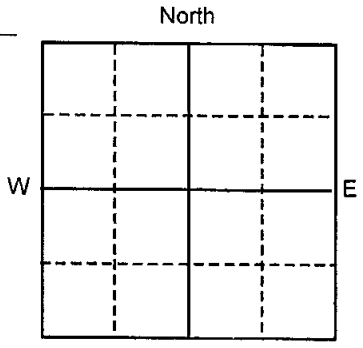
SOUTH DAKOTA WATER WELL COMPLETION REPORT

11- 02

Location SW ¼ SW ¼ Sec 17 Twp 93N Rg 55W

County Yankton

Please mark well location with an "X"



Well Completion Date

November 21, 2013

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?

50.0 ft. from sewer (identify source)

PROPOSED USE:

☐ Domestic/Stock ☐ Municipal ☐ Business ☑ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Rotary

CASING DATA: ☐ Steel ☑ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	105.0 FT	6.13 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Bentonite	8	Lb/gal	0.0 Ft	100.0 Ft
		Lb/gal	Ft	Ft

Describe grouting procedure

tremie piped

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 2.00 Inches Length 10.0 Feet

Material PVC

Slot Size .010 Set From 105.0 Feet to 115.0 Feet

Other information

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No

If so, what material?

Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?

☐ Yes, How?

☑ No, Why Not? no samples taken

Lab to which water quality sample sent for analysis

n/a

Well Owner: City of Yankton

Business Name:

Address: 416 Walnut St

City, State, Zip: Yankton SD 57078

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand	0	3
Gray clay	3	4
Tan clay	4	5
Sand	5	32
Gray clay	32	33
Sand	33	42
Gray clay	42	44
Sand	44	121
Gray shale	121	125

STATIC WATER LEVEL 12.0 FEET

If flowing: closed in pressure PSI

GPM flow through Inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced flow rate GPM

Can well be completely shut in?

WELL TEST DATA:

☐ Pumped Describe: no test pumping has been done
☐ Bailed
☐ Other

Pumping Level Below Land Surface

Ft. After Hrs. pumped GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

REMARKS

GPS: N 42 51.962
W 97 22.669

OB1-South

This well was drilled under license # 475 and this report is true and accurate.

Drilling firm: Thein Well Co., Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date:

SD EForm - 1621LD V1

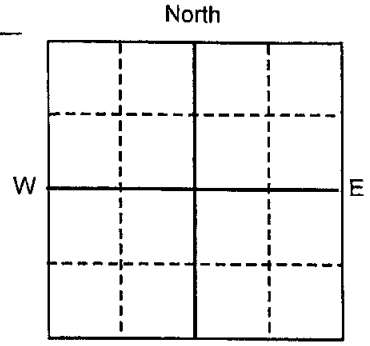
SOUTH DAKOTA WATER WELL COMPLETION REPORT

11- 02

Location SW ¼ SW ¼ Sec 17 Twp 93N Rg 55W

County Yankton

Please mark well location with an "X"



Well Completion Date

December 16, 2013

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?

50.0 ft. from sewer (identify source)

PROPOSED USE:

☐ Domestic/Stock ☐ Municipal ☐ Business ☑ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Rotary

CASING DATA: ☑ Steel ☐ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	12.00 IN	0.0 FT	92.0 FT	18.00 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Bentonite	36	Lb/gal	0.0 Ft	90.0 Ft
		Lb/gal	Ft	Ft

Describe grouting procedure

tremie piped

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 12.00 Inches Length 30.0 Feet

Material stainless steel

Slot Size Set From 92.0 Feet to 122.0 Feet

Other information slot size: .070 & .080

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No

If so, what material?

Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?

☑ Yes, How? chlorinated

☐ No, Why Not?

Lab to which water quality sample sent for analysis

n/a

Well Owner: City of Yankton

Business Name:

Address: 416 Walnut St

City, State, Zip: Yankton SD 57078

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand	0	123
Gray shale	123	127

STATIC WATER LEVEL 14.0 FEET

If flowing: closed in pressure PSI

GPM flow through Inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced flow rate GPM

Can well be completely shut in?

WELL TEST DATA:

☑ Pumped Describe:

☐ Bailed

☐ Other

Pumping Level Below Land Surface

32.0 Ft. After 72.0 Hrs. pumped 1,200.0 GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

REMARKS

GPS: N 42 51.969
W 97 22.667

This well was drilled under license # 475 and this report is true and accurate.

Drilling firm: Thein Well Co., Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

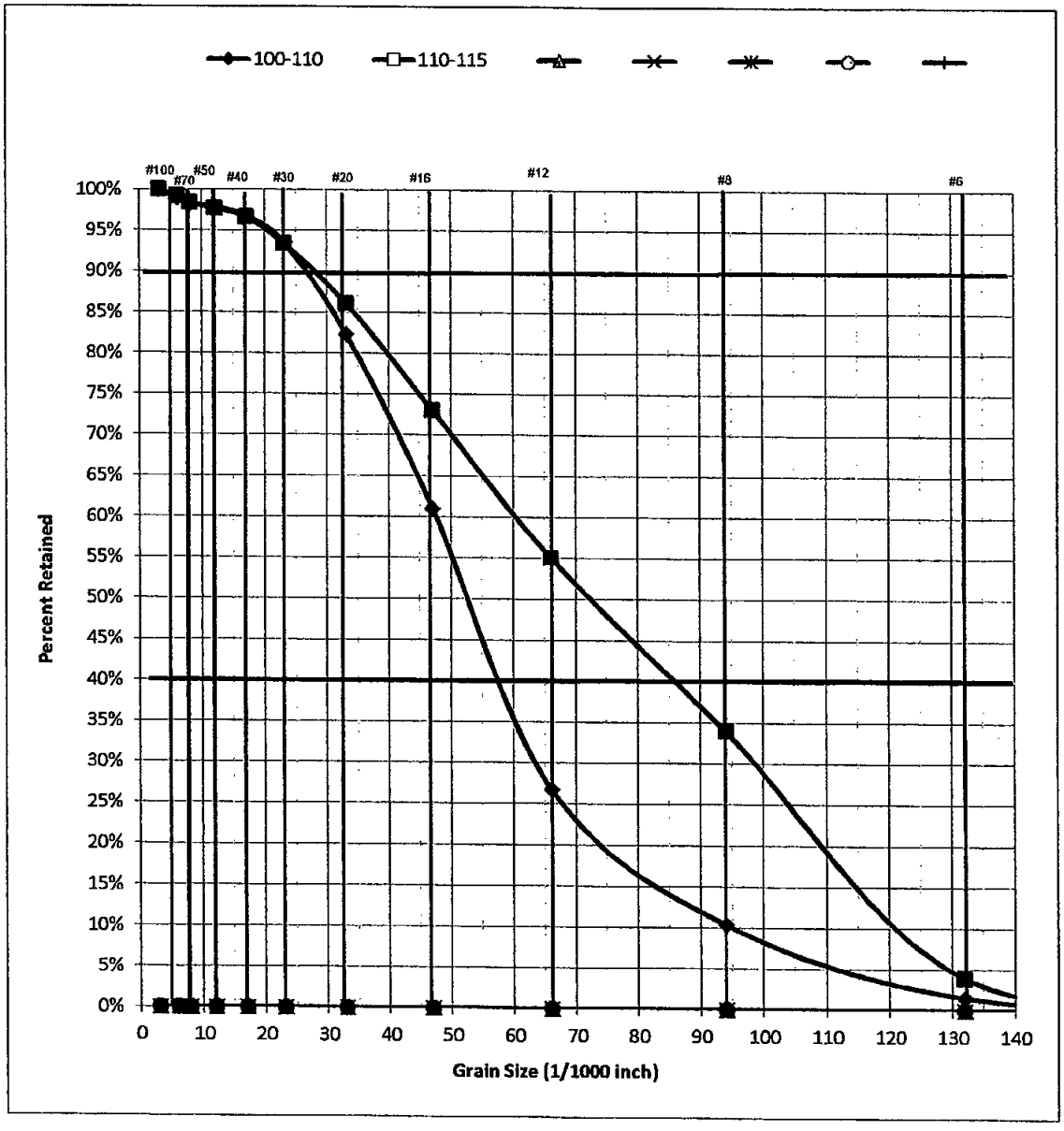
Date:

APPENDIX C

Sieve Analysis Reports

Johnson Screens
651-636-3900

SAND ANALYSIS



Job Name Yankton OW - 1S
Location Yankton, SD
Driller Thein Well

Casing ϕ
Screen ϕ

Recommended Slot Size
Recommended Gravel Pack

Sample ID 112513-1
Analyzed by: Al Smith, 651-638-3160
Date: 11/25/2013

Yield 1000 GPM
SWL (ft) 15'

Based exclusively on the samples provided by the contractor, a sieve analysis graph and suggested screen slot size is provided as requested. Since numerous construction considerations and site circumstances influence successful well completion, Johnson Screens assumes no responsibility for final well performance nor awareness of local regulations pertaining to well installations.

#NAME?

Send Samples to 1950 Old Highway 8, New Brighton, MN 55112

OW-15

Sample Identification

Cummulative Percent Retained

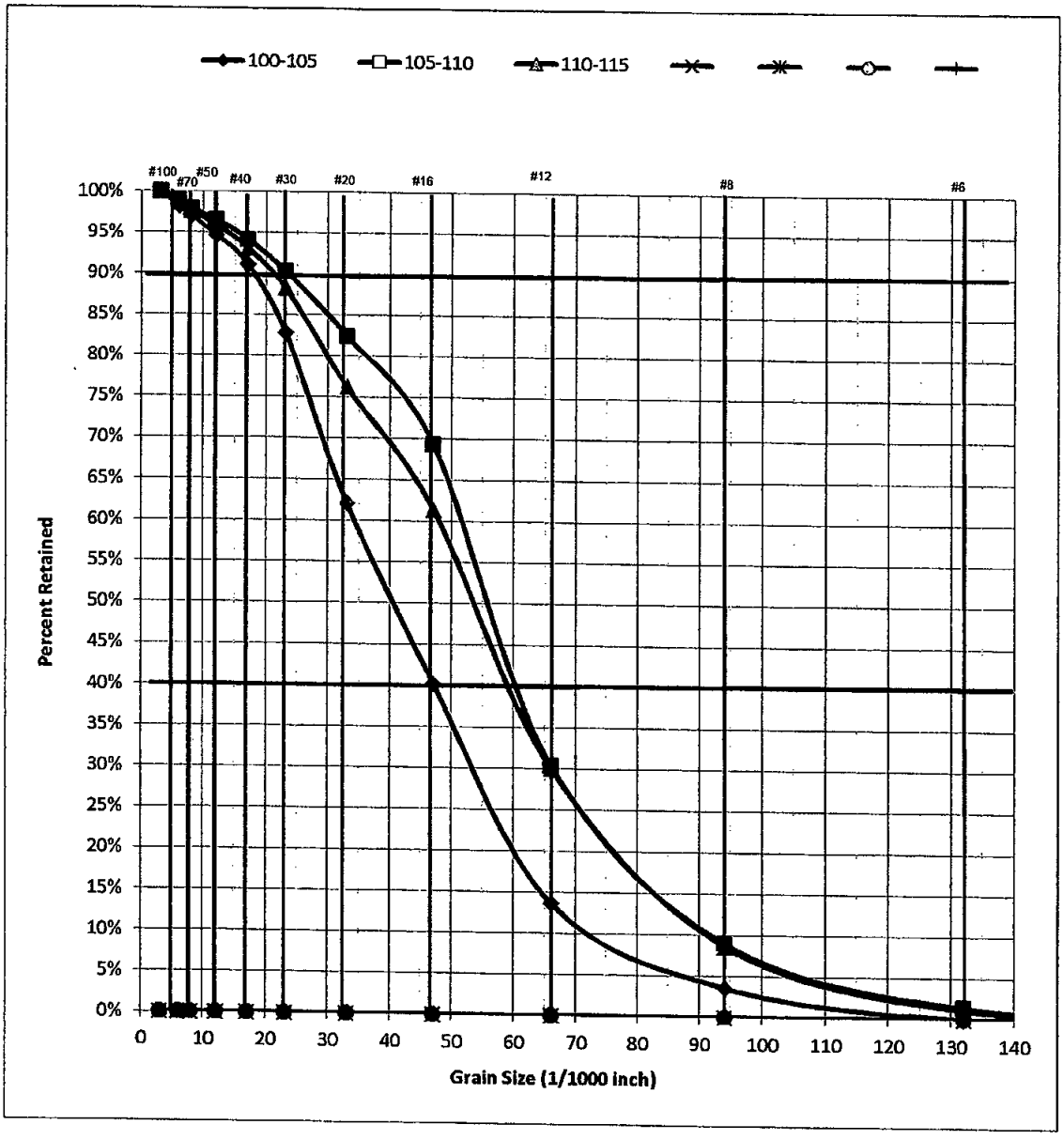
US Sieve	IN	100-105 105-110		100-110		110-115		
		Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum % Ret
200	3	464	100%	560	100%	0	#DIV/0!	0
100	6	459	99%	555	99%	0	#DIV/0!	0
70	8	456	98%	551	98%	0	#DIV/0!	0
50	12	454	98%	547	98%	0	#DIV/0!	0
40	17	449	97%	541	97%	0	#DIV/0!	0
30	23	434	94%	523	93%	0	#DIV/0!	0
20	33	382	82%	482	86%	0	#DIV/0!	0
16	47	283	61%	409	73%	0	#DIV/0!	0
12	66	124	27%	308	55%	0	#DIV/0!	0
8	94	48	10%	190	34%	0	#DIV/0!	0
6	132	7	2%	22	4%	0	#DIV/0!	0
4	185	0	0%	2	0%	0	#DIV/0!	
3/8"	375	0	0%	0	0%	0	#DIV/0!	
1/2"	500		0%		0%		#DIV/0!	
3/4"	750		0%		0%		#DIV/0!	
1"	1000		0%		0%		#DIV/0!	

40 pct	#NAME?		#NAME?	#NAME?	#NAME?
70 pct	#NAME?		#NAME?	#NAME?	#NAME?
3x70	#NAME?		#NAME?	#NAME?	#NAME?
4x70	#NAME?		#NAME?	#NAME?	#NAME?
5x70	#NAME?		#NAME?	#NAME?	#NAME?
6x70	#NAME?		#NAME?	#NAME?	#NAME?

	90pct	#NAME?	#NAME?	#NAME?
	20pct	#NAME?	#NAME?	#NAME?
	100x50pct	#NAME?	#NAME?	#NAME?
	R	#NAME?	#NAME?	#NAME?
Permeability	K	#NAME?	#NAME?	#NAME?
Aquifer thickness	T			
Capacity	C	#NAME?	#NAME?	#NAME?
Total Capacity	#NAME?			
Yield				
Req'd drawdown	#NAME?			

Johnson Screens
651-636-3900

SAND ANALYSIS



Job Name Yankton OW - 1W
Location Yankton, SD
Driller Thein Well

Sample ID 112513-1
Analyzed by: Al Smith, 651-638-3160
Date: 11/25/2013

Casing ϕ
Screen ϕ

Yield 1000 GPM
SWL (ft) 15'

Recommended Slot Size
Recommended Gravel Pack

Based exclusively on the samples provided by the contractor, a sieve analysis graph and suggested screen slot size is provided as requested. Since numerous construction considerations and site circumstances influence successful well completion, Johnson Screens assumes no responsibility for final well performance nor awareness of local regulations pertaining to well installations.

#NAME?

Send Samples to 1950 Old Highway 8, New Brighton, MN 55112

OW-1W

Sample Identification
Cummulative Percent Retained

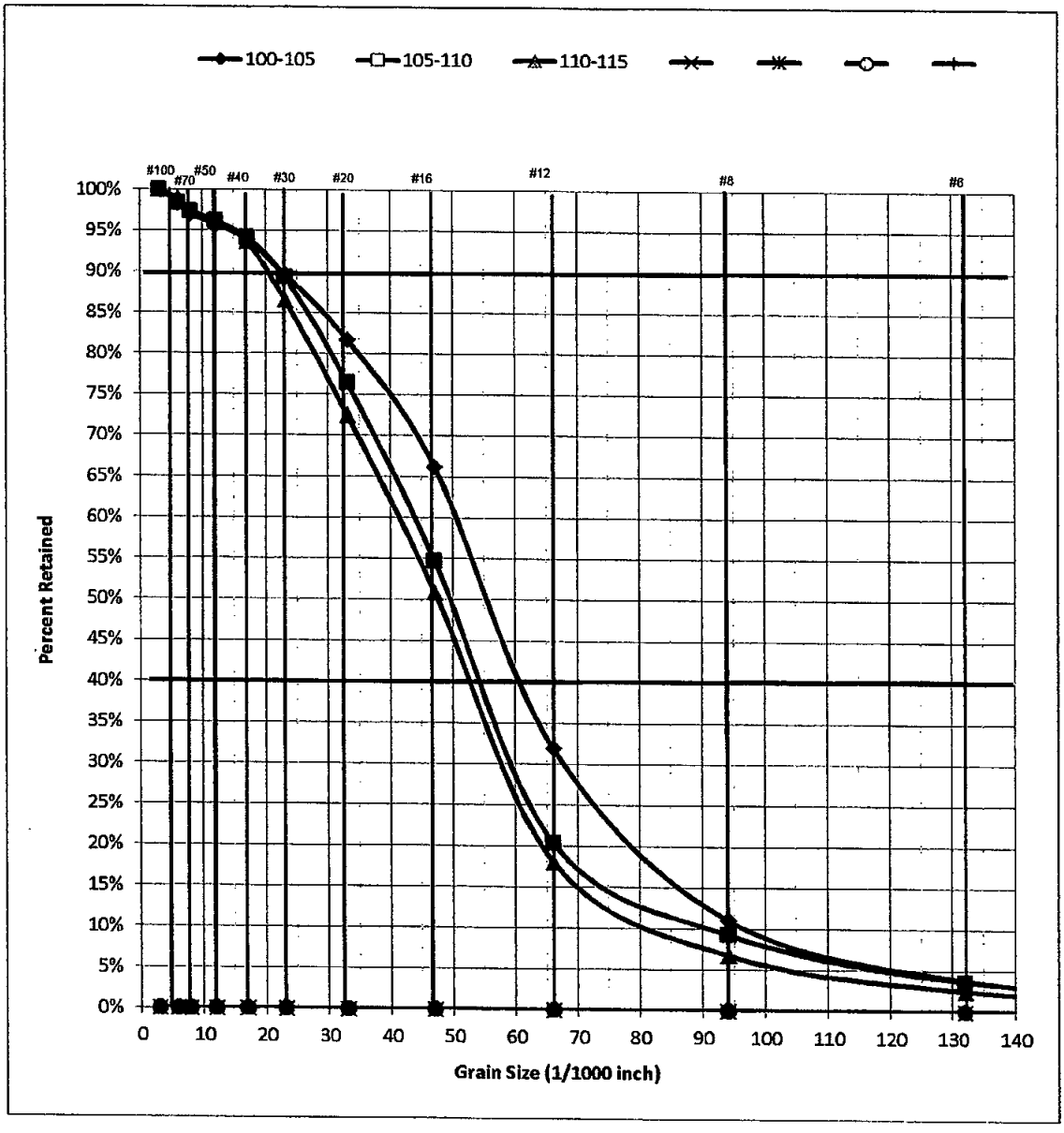
US Sieve	IN	100-105		105-110		110-115		
		Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum % Ret
200	3	169	100%	290	100%	290	100%	0
100	6	166	98%	287	99%	286	99%	0
70	8	164	97%	284	98%	283	98%	0
50	12	160	95%	280	97%	278	96%	0
40	17	154	91%	273	94%	270	93%	0
30	23	140	83%	262	90%	256	88%	0
20	33	105	62%	239	82%	221	76%	0
16	47	68	40%	201	69%	178	61%	0
12	66	23	14%	88	30%	87	30%	0
8	94	6	4%	26	9%	25	9%	0
6	132	0	0%	4	1%	3	1%	0
4	185	0	0%	0	0%	0	0%	
3/8"	375	0	0%	0	0%	0	0%	
1/2"	500		0%		0%		0%	
3/4"	750		0%		0%		0%	
1"	1000		0%		0%		0%	

40 pct	#NAME?		#NAME?	#NAME?	#NAME?
70 pct	#NAME?		#NAME?	#NAME?	#NAME?
3x70	#NAME?		#NAME?	#NAME?	#NAME?
4x70	#NAME?		#NAME?	#NAME?	#NAME?
5x70	#NAME?		#NAME?	#NAME?	#NAME?
6x70	#NAME?		#NAME?	#NAME?	#NAME?

	90pct	#NAME?	#NAME?	#NAME?
	20pct	#NAME?	#NAME?	#NAME?
	100x50pct	#NAME?	#NAME?	#NAME?
	R	#NAME?	#NAME?	#NAME?
Permeability	K	#NAME?	#NAME?	#NAME?
Aquifer thickness	T			
Capacity	C	#NAME?	#NAME?	#NAME?
Total Capacity	#NAME?			
Yield				
Req'd drawdown	#NAME?			

Johnson Screens
651-636-3900

SAND ANALYSIS



Job Name Yankton OW - 2E
Location Yankton, SD
Driller Thein Well

Sample ID 112513-1
Analyzed by: Al Smith, 651-638-3160
Date: 11/25/2013

Casing ϕ
Screen ϕ

Yield 1000 GPM
SWL (ft) 15'

Recommended Slot Size
Recommended Gravel Pack

Based exclusively on the samples provided by the contractor, a sieve analysis graph and suggested screen slot size is provided as requested. Since numerous construction considerations and site circumstances influence successful well completion, Johnson Screens assumes no responsibility for final well performance nor awareness of local regulations pertaining to well installations.

#NAME?

Send Samples to 1950 Old Highway 8, New Brighton, MN 55112

OW-2E

Sample Identification
Cummulative Percent Retained

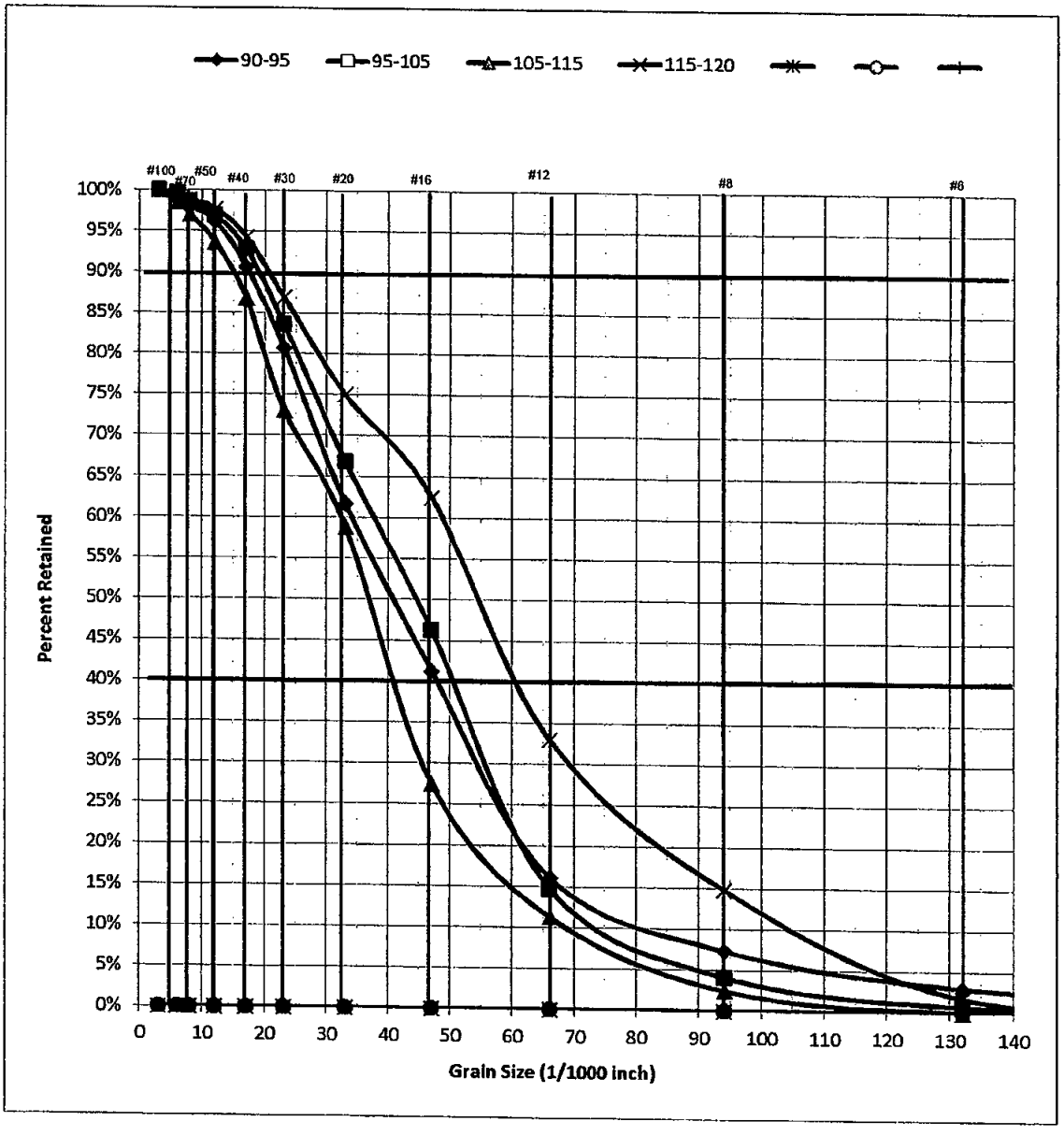
US Sieve	IN	100-105		105-110		110-115		
		Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum % Ret
200	3	426	100%	497	100%	444	100%	0
100	6	419	98%	489	98%	439	99%	0
70	8	413	97%	484	97%	433	98%	0
50	12	408	96%	478	96%	426	96%	0
40	17	400	94%	468	94%	416	94%	0
30	23	382	90%	444	89%	384	86%	0
20	33	348	82%	380	76%	322	73%	0
16	47	282	66%	272	55%	226	51%	0
12	66	136	32%	101	20%	80	18%	0
8	94	47	11%	46	9%	30	7%	0
6	132	16	4%	18	4%	11	2%	0
4	185	3	1%	6	1%	3	1%	
3/8"	375	0	0%	0	0%	0	0%	
1/2"	500		0%		0%		0%	
3/4"	750		0%		0%		0%	
1"	1000		0%		0%		0%	

40 pct	#NAME?		#NAME?	#NAME?	#NAME?
70 pct	#NAME?		#NAME?	#NAME?	#NAME?
3x70	#NAME?		#NAME?	#NAME?	#NAME?
4x70	#NAME?		#NAME?	#NAME?	#NAME?
5x70	#NAME?		#NAME?	#NAME?	#NAME?
6x70	#NAME?		#NAME?	#NAME?	#NAME?

	90pct	#NAME?	#NAME?	#NAME?
	20pct	#NAME?	#NAME?	#NAME?
	100x50pct	#NAME?	#NAME?	#NAME?
	R	#NAME?	#NAME?	#NAME?
Permeability	K	#NAME?	#NAME?	#NAME?
Aquifer thickness	T			
Capacity	C	#NAME?	#NAME?	#NAME?
Total Capacity	#NAME?			
Yield				
Req'd drawdown	#NAME?			

Johnson Screens
651-636-3900

SAND ANALYSIS



Job Name Yankton TW
Location Yankton, SD
Driller Thein Well

Sample ID 112513-1
Analyzed by: Al Smith, 651-638-3160
Date: 11/25/2013

Casing ϕ 12"
Screen ϕ 12" Pipe Size

Yield 1000 GPM
SWL (ft) 15'

Recommended Slot Size 80 Slot From 90' - 120'
Recommended Gravel Pack #90 Well Slot Red Flint

Based exclusively on the samples provided by the contractor, a sieve analysis graph and suggested screen slot size is provided as requested. Since numerous construction considerations and site circumstances influence successful well completion, Johnson Screens assumes no responsibility for final well performance nor awareness of local regulations pertaining to well installations.

#NAME?

Send Samples to 1950 Old Highway 8, New Brighton, MN 55112

TW

Sample Identification

Cummulative Percent Retained

US Sieve	IN	90-95		95-105 (95-100 / 100-105)		105-115 (105-110 / 110-115)		115-120		
		Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum Wt	Cum %Ret	Cum % Ret	Cum %Ret	Cum % Ret
200	**3**	342	100%	292	100%	204	100%	176	100%	0
100	**6**	338	99%	291	100%	201	99%	175	99%	0
70	**8**	335	98%	288	99%	198	97%	174	99%	0
50	**12**	329	96%	283	97%	191	94%	172	98%	0
40	**17**	310	91%	271	93%	177	87%	166	94%	0
30	**23**	276	81%	244	84%	149	73%	153	87%	0
20	**33**	211	62%	195	67%	120	59%	132	75%	0
16	**47**	141	41%	135	46%	56	27%	110	63%	0
12	**66**	55	16%	43	15%	23	11%	58	33%	0
8	**94**	25	7%	12	4%	5	2%	26	15%	0
6	**132**	10	3%	2	1%	0	0%	3	2%	0
4	**185**	4	1%	0	0%	0	0%		0%	0
3/8"	**375**	0	0%	0	0%	0	0%		0%	0
1/2"	**500**		0%		0%		0%		0%	
3/4"	**750**		0%		0%		0%		0%	
1"	**1000**		0%		0%		0%		0%	

40 pct	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
70 pct	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
3x70	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
4x70	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
5x70	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
6x70	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?

	90pct	#NAME?	#NAME?	#NAME?	#NAME?
	20pct	#NAME?	#NAME?	#NAME?	#NAME?
	100x50pct	#NAME?	#NAME?	#NAME?	#NAME?
	R	#NAME?	#NAME?	#NAME?	#NAME?
Permeability	K	#NAME?	#NAME?	#NAME?	#NAME?
Aquifer thickness	T				
Capacity	C	#NAME?	#NAME?	#NAME?	#NAME?
Total Capacity	#NAME?				
Yield					
Req'd drawdown	#NAME?				

APPENDIX D

Pumping Test Data

THEIN WELL
P.O. BOX 778, 11355 HWY. 71 NE (ACROSS FROM RINGO LAKE)
SPICER, MINNESOTA 56288 • (320) 796-2111
www.theinwell.com • E-mail: theinwell@tds.net

WELLS ~ PUMPS
SALES ~ SERVICE

Since 1893

Drawdown/Recovery Measurements

Driller: Date: 12/12/13

Owner: City of Yankton

Well No: 12" test well Static Water Level: 13' 4½" Time Start:

Measurements taken from top of casing, top of casing is 32" above grade.

Pumping Test						Recovery Measurement			
Time	Time in Minutes	Pumping Level	Draw Down	GPM	Sand	Time	Time in Minutes	Water Level	Recovery
12:00 PM	0	13' 4½"				5:00 PM	0		
12:01 PM	0.5	20' 2"		500		5:01 PM	0.5	14' 1¾"	
12:02 PM	0.75	20' 3½"				5:02 PM	0.75	13' 10"	
12:03 PM	1	20' 3½"				5:03 PM	1	13' 8¾"	
12:04 PM	2	20' 4"				5:04 PM	2	13' 6½"	
12:05 PM	3	20' 4"				5:05 PM	3	13' 5¾"	
12:06 PM	4	20' 3¼"				5:06 PM	4	13' 4½"	
12:07 PM	5	20' 3½"				5:07 PM	5	13' 5¼"	
12:08 PM	8	20' 3½"				5:08 PM	6	13' 5"	
12:09 PM	9	20' 3½"				5:09 PM	7	13' 5"	
12:10 PM	10	20' 3½"				5:10 PM	8	13' 5"	
12:15 PM	20	20' 3½"				5:20 PM	9		
12:20 PM	30	20'3½"				5:30 PM	10		
12:25 PM	40	20' 3½"					12		
12:30 PM	50	20' 3¾"					14		
12:40 PM	60	20' 3¾"					16		
12:50 PM	90	20' 3¾"					18		
1:00 PM	120	20' 3¾"		660			20		
1:01 PM	150	22' 3¾"					25		
1:02 PM	180	22' 4"					30		
1:03 PM	210	22' 4"					35		
1:04 PM	240	22' 4¼"					40		
1:05 AM	270	22' 4"					45		
1:06 PM	300	22' 4¼"					50		
1:07 PM	360	22' 4¼"					55		
1:08 PM	420	22' 4¼"					60		
1:09 PM	480	22' 4¼"					90		
1:10 PM	540	22' 4¼"					120		
1:15 PM	600	22' 4¼"					150		
1:20 PM	720	22' 4½"					180		
1:25 PM	780	22' 4¼"					210		
1:30 PM	840	22"4¼"					240		
1:40 PM	900	22' 4¼"					270		
1:50 AM	960	22' 4½"					300		
2:00 PM	1020	22' 4½"		830			360		
2:01 PM	1080	22' 4½"					420		
2:02 PM	1140	24' 11¾"					480		
2:03 PM	1200	25' 0"					540		
2:04 PM	1260	25' ½"					600		
2:05 PM	1320	25' ½"							

2:06 PM	1380	25' ½"							
2:07 PM	1440	25' ½"							
2:08 PM		25' ½"							
2:09 PM		25' ½"							
2:10 PM		25' 1"							
2:15 PM		25' 1"							
2:20 PM		25' 1"							
2:25 PM		25' 1"							
2:30 PM		25' 1¼"							
2:40 PM		25' 1¼"							
2:50 PM		25' 1¼"							
3:00 PM		25' 1¼"							
3:01 PM		26' 5"		1028					
3:02 PM		27' 8½"							
3:03 PM		28' 3¼"							
3:04 PM		28' 5"							
3:05 PM		28' 3"							
3:06 PM		28' 3"							
3:07 PM		28' 3¼"							
3:08 PM		28' 3¼"							
3:09 PM		28' 3¼"							
3:10 PM		28' 3¼"							
3:15 PM		28' 3¼"							
3:20 PM		28' 3½"							
3:25 PM		28' 3½"							
3:30 PM		28' 3¼"							
3:40 PM		28' 3½"							
3:50 PM		28' 3½"							
4:00 PM		28' 3½"							
4:05 PM		29' 10½"		1200					
4:06 PM		30' 11"							
4:07 PM		31' 0"							
4:08 PM		30' 11¾"							
2:09 PM		31' ½"							
4:10 PM		31' ½"							
4:15 PM		31' ½"							
4:20 PM		31' 1"							
4:25 PM		31' 1"							
4:30 PM		31' 1"							
4:40 PM		31' 1"							
4:50 PM		31' 1"							
5:00 PM		31' 1"							

THEIN WELL
P.O. BOX 778, 11355 HWY. 71 NE (ACROSS FROM RINGO LAKE)
SPICER, MINNESOTA 56288 • (320) 796-2111
www.theinwell.com • E-mail: theinwell@tds.net

WELLS ~ PUMPS
SALES ~ SERVICE

Since 1893

Drawdown/Recovery Measurements

Driller:

Date: 12/16/13

Owner: City of Yankton

Well No: 12" test well

Static Water Level: 13' 7½" Time Start: 12:00

Measurements taken from top of casing, top of casing is 32" above grade.

Pumping Test						Recovery Measurement			
Time	Time in Minutes	Pumping Level	Draw Down	GPM	Sand	Time	Time in Minutes	Water Level	Recovery
12:00 PM	0	13' 7½"		1200		2:30 PM	0	31' 5¾"	
12:01 PM	0.5	30' 8"		1200			0.5		
12:02 PM	0.75	31' 1"		1200			0.75		
12:03 PM	1	31' 2"		1200		2:31 PM	1	14' 11"	
12:04 PM	2	31' 2½"		1200		2:32 PM	2	14' 2"	
12:05 PM	3	31' 2½"		1200		2:33 PM	3		
12:06 PM	4	31' 2¾"		1200		2:34 PM	4		
12:07 PM	5	31' 3"		1200		2:35 PM	5	13' 1½"	
12:08 PM	8	31' 3½"		1200		2:36 PM	6	13' 11"	
12:09 PM	9	31' 3½"		1200		2:37 PM	7	13' 10¾"	
12:10 PM	10	31' 3"		1200		2:38 PM	8	13' 10¼"	
12:15 PM	20	31' 4"		1200		2:39 PM	9	13' 10¾"	
12:20 PM	30	31' 4½"		1200		2:40 PM	10	13' 10½"	
12:25 PM	40	31' 4½"		1200		14:50	12	13' 10½"	
12:30 PM	50	31' 4"		1200		15:00	14	13' 10¼"	
12:40 PM	60	31' 3¾"		1200		15:10	16		
12:50 PM	90	31' 3¾"		1200		15:20	18		
1:00 PM	120	31' 4"		1200		15:30	20	13' 10½"	
1:30 PM	150	31' 4"		1200		15:40	25	13' 10½"	
2:00 PM	180	31' 3¾"		1200		15:50	30	13' 10¼"	
2:30 PM	210	31' 4½"		1200		16:00	35	13' 10¾"	
3:00 PM	240	31' 4½"		1200		16:10	40	13' 10¼"	
4:00 PM	270	31' 5"		1200		16:20	45	13' 10½"	
5:00 PM	300	31' 4½"		1200		16:30	50	13' 10¼"	
6:00 PM	360	31' 4¾"		1200		16:40	55	13' 10½"	
7:00 PM	420	31' 5"		1200		16:50	60	13' 10¼"	
8:00 PM	480	31' 4½"		1200		17:00	90	13' 10½"	
9:00 PM	540	31' 5"		1200			120		
10:00 PM	600	31' 5"		1200			150		
11:00 PM	720	31' 6"		1200		7:30 AM	180	13' 9¼"	
12:00 AM	780	31' 4½"		1200			210		
1:00 AM	840	31' 5"		1200			240		
2:00 AM	900	31' 5"		1200			270		
3:00 AM	960	31' 4½"		1200			300		
4:00 AM	1020	31' 5"		1200			360		
5:00 AM	1080	31' 5"		1200			420		
6:00 AM	1140	31' 4¾"		1200			480		
7:00 AM	1200	31' 4½"		1200			540		
8:00 AM	1260	31' 4½"		1200			600		
9:00 AM	1320	31' 4½"		1200					

10:00 AM	1380	31' 4¾"		1200					
11:00 AM	1440	31' 5 "		1200					
12:00 PM		31' 5½"		1200					
1:00 PM		31' 5¾"		1200					
2:00 PM		31' 6"		1200					
3:00 PM		31' 6"		1200					
4:00 PM		31' 4¾"		1200					
5:00 PM		31' 5½"		1200					
6:00 PM		31' 5¼"		1200					
7:00 PM		31' 5½"		1200					
8:00 PM		31' 6"		1200					
9:00 PM		31' 5½"		1200					
10:00 PM		31' 6"		1200					
11:00 PM		31' 5½"		1200					
12:00 AM		31' 4½"		1200					
1:00 AM		31' 5"		1200					
2:00 AM		31' 5¼"		1200					
3:00 AM		31' 5"		1200					
4:00 AM		31' 5½"		1200					
5:00 AM		31' 5"		1200					
6:00 AM		31' 5½"		1200					
7:00 AM		31' 5½"		1200					
8:00 AM		31' 5¼"		1200					
9:00 AM				1200					
10:00 AM		31' 5"		1200					
11:00 AM		31' 4½"		1200					
12:00 PM		31' 5½"		1200					
1:00 PM		31' 6"		1200					
2:00 PM		31' 4½"		1200					
3:00 PM		31' 5¼"		1200					
4:00 PM		31' 5½"		1200					
5:00 PM		31' 4½"		1200					
6:00 PM		31' 4½"		1200					
7:00 PM		31' 4¼"		1200					
8:00 PM		31' 4½"		1200					
9:00 PM		31' 5¼"		1200					
10:00 PM		31' 5¼"		1200					
11:00 PM		31' 4½"		1200					
12:00 AM		31' 5¼"		1200					
1:00 AM		31' 4¼"		1200					
2:00 AM		31' 5"		1200					
3:00 AM		31' 4¾"		1200					
4:00 AM		31' 5"		1200					
5:00 AM		31' 5"		1200					
6:00 AM		31' 5½"		1200					
7:00 AM		31' 5½"		1200					
8:00 AM		31' 5½"		1200					
9:00 AM		31' 5¼"		1200					
10:00 AM		31' 5¼"		1200					
11:00 AM		31' 5"		1200					
12:00 PM		31' 5¼"		1200					
1:00 PM		31' 5½"		1200					

2:00 PM		31' 6"		1200					

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/3/2013	15:48	-22812				11.51					
12/3/2013	15:55	-22805					13.27				
12/3/2013	16:03	-22797			15.04						
12/3/2013	16:24	-22776							11.37		
12/3/2013	16:30	-22770		12.83							
12/3/2013	16:34	-22766								12.34	
12/5/2013	11:38	-15862							11.36		
12/5/2013	11:45	-15855								12.35	
12/5/2013	11:50	-15850				11.42					
12/5/2013	11:53	-15847		12.79							
12/5/2013	11:56	-15844					12.98				
12/5/2013	12:00	-15840		14.97							
12/6/2013	14:03	-14277							10.99		
12/6/2013	14:09	-14271								12.08	
12/6/2013	14:12	-14268				11.05					
12/6/2013	14:14	-14266					12.58				
12/6/2013	14:16	-14264			14.61						
12/6/2013	14:18	-14262		12.4							
12/12/2013	11:50	-5770	13.34								
12/12/2013	11:58	-5762					12.97				
12/12/2013	11:59	-5761						2.03			
12/12/2013	12:55	-5705						2.13			
12/12/2013	12:56	-5704					14.07				
12/12/2013	12:58	-5702	20.27								
12/12/2013	13:08	-5692						2.1			
12/12/2013	13:55	-5645	22.34								
12/12/2013	13:56	-5644					14.4				
12/12/2013	13:57	-5643						2.2			
12/12/2013	14:31	-5609					14.77				
12/12/2013	14:52	-5588								12.79	

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/12/2013	14:55	-5585	25.09								
12/12/2013	14:57	-5583					14.77				
12/12/2013	14:57	-5583						2.22			
12/12/2013	15:16	-5564		14.88							
12/12/2013	15:23	-5557				12.4					
12/12/2013	15:36	-5544			17.12						
12/12/2013	15:52	-5528					15.2				
12/12/2013	15:52	-5528						2.31			
12/12/2013	15:58	-5522	28.25								
12/12/2013	16:30	-5490					15.58				
12/12/2013	16:30	-5490						2.37			
12/12/2013	16:30	-5490	30.04								
12/12/2013	17:08	-5452									2.33
12/12/2013	17:10	-5450					13.08				
12/12/2013	17:15	-5445	13.46								
12/12/2013	17:55	-5405							11.4		
12/16/2013	11:15	-45						2.22			
12/16/2013	11:20	-40					13.17				
12/16/2013	11:27	-33	13.56								
12/16/2013	11:31	-29		12.94							
12/16/2013	11:35	-25				11.55					
12/16/2013	11:40	-20								12.47	
12/16/2013	11:45	-15							11.5		
12/16/2013	11:50	-10			15.15						
12/16/2013	14:35	155		15.4							
12/16/2013	14:39	159				12.71					
12/16/2013	14:43	163								13.2	
12/16/2013	14:47	167							13.14		
12/16/2013	14:51	171			17.61						
12/16/2013	14:54	174					15.75				

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/16/2013	14:57	177						2.5			
12/16/2013	15:06	186	31.33								
12/16/2013	16:07	247		15.4							
12/16/2013	16:09	249				12.7					
12/16/2013	16:12	252								13.17	
12/16/2013	16:15	255							13.13		
12/16/2013	16:17	257			17.63						
12/16/2013	16:19	259					15.72				
12/16/2013	16:20	260						2.52			
12/16/2013	16:23	263	31.34								
12/17/2013	10:00	1320		15.54							
12/17/2013	10:22	1342				12.81					
12/17/2013	10:24	1344								13.29	
12/17/2013	10:27	1347							13.25		
12/17/2013	10:28	1348			17.7						
12/17/2013	10:30	1350					15.83				
12/17/2013	10:31	1351						2.66			
12/17/2013	10:33	1353	31.30								
12/17/2013	14:31	1591		15.51							
12/17/2013	14:35	1595				12.83					
12/17/2013	14:38	1598								13.3	
12/17/2013	14:41	1601							13.25		
12/17/2013	14:43	1603			17.72						
12/17/2013	14:45	1605	31.45								
12/17/2013	14:46	1606					15.85				
12/17/2013	14:47	1607						2.68			
12/17/2013	14:51	1611									2.33
12/18/2013	10:33	2073		15.54							
12/18/2013	10:34	2074				12.86					
12/18/2013	10:37	2077								13.34	

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/18/2013	10:40	2080							13.27		
12/18/2013	10:41	2081			17.77						
12/18/2013	10:43	2083	31.46								
12/18/2013	10:45	2085					15.82				
12/18/2013	10:47	2087						2.7			
12/18/2013	10:51	2091									2.33
12/18/2013	15:41	3101		15.54							
12/18/2013	15:42	3102				12.91					
12/18/2013	15:45	3105								13.35	
12/18/2013	15:48	3108							13.28		
12/18/2013	15:49	3109			17.76						
12/18/2013	15:51	3111	31.35								
12/18/2013	15:53	3113					15.88				
12/18/2013	15:54	3114						2.73			
12/19/2013	9:53	4193			17.84						
12/19/2013	9:55	4195							13.38		
12/19/2013	9:57	4197								13.48	
12/19/2013	9:59	4199				13.02					
12/19/2013	10:00	4200		15.68							
12/19/2013	10:02	4202					15.96				
12/19/2013	10:04	4204						2.84			
12/19/2013	10:06	4206									2.57
12/19/2013	10:07	4207	31.48								
12/19/2013	13:41	4421		15.66							
12/19/2013	13:42	4422				13.02					
12/19/2013	13:45	4425								13.51	
12/19/2013	13:47	4427							13.41		
12/19/2013	13:48	4428			17.9						
12/19/2013	13:50	4430	31.51								
12/19/2013	13:52	4432					15.97				

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/19/2013	13:53	4433						2.86			
12/19/2013	15:37	4537		13.23							
12/19/2013	15:39	4539				11.92					
12/19/2013	15:41	4541								12.82	
12/19/2013	15:43	4543							11.78		
12/19/2013	15:45	4545			15.48						
12/19/2013	15:47	4547					13.44				
12/19/2013	15:48	4548						2.62			
12/19/2013	15:50	4550	13.82								
12/20/2013	7:42	5508	13.72								
12/20/2013	7:50	5510		13.14							
12/20/2013	7:51	5511					13.33				
12/20/2013	7:53	5513			15.34						
12/20/2013	7:54	5514							11.69		
12/20/2013	7:57	5517								12.72	
12/20/2013	7:59	5519				11.77					
12/20/2013	8:02	5522						2.46			
12/20/2013	10:33	5673	13.68								
12/20/2013	10:45	5685		13.14							
12/20/2013	10:47	5687				11.76					
12/20/2013	10:50	5690								12.68	
12/20/2013	10:52	5692							11.63		
12/20/2013	10:54	5694			15.27						
12/20/2013	10:56	5696					13.29				
12/20/2013	10:57	5697						2.45			
12/23/2013	11:00	10020		12.58							
12/23/2013	11:04	10024				11.25					
12/23/2013	11:06	10026								12.29	
12/23/2013	11:11	10031							11.2		
12/23/2013	11:12	10032			14.82						

MANUAL WATER LEVEL READINGS

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 3, 2013 to December 23, 2013

Date	Time	Constant Rate Elasped Test Time (Min)	TW (ft TOC)	OW-P50 (ft TOC)	OW-P75 (ft TOC)	OW-P150 (ft TOC)	OW-R60 (ft TOC)	OW-R120 (ft TOC)	OW-1-13 (ft TOC)	OW-3-13 (ft TOC)	River Stilling Well (ft TOC)
12/23/2013	11:15	10035	13.19								
12/23/2013	11:17	10037					12.81				
12/23/2013	11:18	10038						1.85			

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/12/2013 14:00						7.342			12/12/2013 14:00	
12/12/2013 14:15						7.315			12/12/2013 14:15	
12/12/2013 14:30						7.296			12/12/2013 14:30	
12/12/2013 14:45						7.283			12/12/2013 14:45	
12/12/2013 15:00					9.730	7.268			12/12/2013 15:00	
12/12/2013 15:15					9.308	7.236			12/12/2013 15:15	
12/12/2013 15:30					9.303	7.219			12/12/2013 15:30	
12/12/2013 15:45					9.294	7.207			12/12/2013 15:45	
12/12/2013 16:00		12.661	9.293	16.057	9.292	7.194		17.709	12/12/2013 16:00	
12/12/2013 16:15		12.314	8.952	15.902	8.934	7.167		17.616	12/12/2013 16:15	
12/12/2013 16:30		12.317	8.948	15.896	8.932	7.149		17.611	12/12/2013 16:30	
12/12/2013 16:45		12.311	8.947	15.896	8.931	7.135		17.604	12/12/2013 16:45	
12/12/2013 17:00		12.315	8.947	15.899	8.933	7.128		17.604	12/12/2013 17:00	
12/12/2013 17:15		14.709	11.344	16.980	11.423	7.279		18.231	12/12/2013 17:15	
12/12/2013 17:30	27.039	14.712	11.347	16.983	11.424	7.294		18.234	12/12/2013 17:30	
12/12/2013 17:45	27.035	14.715	11.350	16.985	11.428	7.300		18.238	12/12/2013 17:45	
12/12/2013 18:00	27.042	14.716	11.351	16.986	11.429	7.303	13.218	18.236	12/12/2013 18:00	2.862
12/12/2013 18:15	27.041	14.717	11.351	16.990	11.426	7.305	13.219	18.239	12/12/2013 18:15	2.862
12/12/2013 18:30	27.016	14.716	11.348	16.987	11.428	7.305	13.219	18.236	12/12/2013 18:30	2.858
12/12/2013 18:45	27.027	14.714	11.348	16.987	11.426	7.304	13.220	18.235	12/12/2013 18:45	2.863
12/12/2013 19:00	27.042	14.712	11.346	16.987	11.425	7.303	13.218	18.238	12/12/2013 19:00	2.855
12/12/2013 19:15	27.034	14.710	11.344	16.985	11.424	7.305	13.217	18.237	12/12/2013 19:15	2.857
12/12/2013 19:30	27.021	14.711	11.343	16.985	11.423	7.301	13.217	18.239	12/12/2013 19:30	2.858
12/12/2013 19:45	27.025	14.711	11.344	16.982	11.423	7.303	13.219	18.233	12/12/2013 19:45	2.860
12/12/2013 20:00	27.034	14.708	11.344	16.984	11.421	7.303	13.218	18.231	12/12/2013 20:00	2.858
12/12/2013 20:15	27.032	14.709	11.341	16.983	11.423	7.299	13.218	18.237	12/12/2013 20:15	2.859
12/12/2013 20:30	27.017	14.710	11.342	16.983	11.423	7.298	13.216	18.235	12/12/2013 20:30	2.857
12/12/2013 20:45	27.020	14.707	11.342	16.980	11.421	7.297	13.216	18.234	12/12/2013 20:45	2.860
12/12/2013 21:00	27.024	14.707	11.341	16.981	11.421	7.299	13.217	18.232	12/12/2013 21:00	2.856
12/12/2013 21:15	27.031	14.709	11.339	16.979	11.419	7.296	13.214	18.233	12/12/2013 21:15	2.856

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/12/2013 21:30	27.018	14.708	11.338	16.979	11.417	7.296	13.213	18.227	12/12/2013 21:30	2.855
12/12/2013 21:45	27.020	14.703	11.338	16.978	11.418	7.296	13.209	18.226	12/12/2013 21:45	2.848
12/12/2013 22:00	27.027	14.703	11.336	16.976	11.416	7.292	13.213	18.230	12/12/2013 22:00	2.856
12/12/2013 22:15	27.023	14.703	11.333	16.974	11.414	7.291	13.211	18.225	12/12/2013 22:15	2.848
12/12/2013 22:30	27.026	14.700	11.334	16.974	11.413	7.290	13.209	18.223	12/12/2013 22:30	2.851
12/12/2013 22:45	27.021	14.703	11.333	16.974	11.415	7.287	13.211	18.225	12/12/2013 22:45	2.854
12/12/2013 23:00	27.022	14.700	11.333	16.975	11.414	7.288	13.210	18.223	12/12/2013 23:00	2.851
12/12/2013 23:15	27.023	14.701	11.335	16.976	11.414	7.291	13.210	18.221	12/12/2013 23:15	2.852
12/12/2013 23:30	27.024	14.699	11.334	16.975	11.412	7.290	13.211	18.225	12/12/2013 23:30	2.852
12/12/2013 23:45	27.013	14.700	11.334	16.974	11.413	7.289	13.209	18.221	12/12/2013 23:45	2.850
12/13/2013 0:00	27.022	14.700	11.333	16.972	11.412	7.287	13.207	18.224	12/13/2013 0:00	2.853
12/13/2013 0:15	27.013	14.701	11.334	16.975	11.414	7.287	13.210	18.225	12/13/2013 0:15	2.857
12/13/2013 0:30	27.016	14.700	11.333	16.973	11.412	7.289	13.207	18.223	12/13/2013 0:30	2.855
12/13/2013 0:45	27.020	14.701	11.334	16.976	11.415	7.290	13.211	18.224	12/13/2013 0:45	2.862
12/13/2013 1:00	27.030	14.701	11.334	16.975	11.414	7.288	13.210	18.219	12/13/2013 1:00	2.862
12/13/2013 1:15	27.026	14.700	11.332	16.975	11.413	7.290	13.209	18.223	12/13/2013 1:15	2.862
12/13/2013 1:30	27.020	14.700	11.333	16.973	11.414	7.290	13.209	18.225	12/13/2013 1:30	2.861
12/13/2013 1:45	27.012	14.698	11.333	16.974	11.413	7.288	13.209	18.220	12/13/2013 1:45	2.865
12/13/2013 2:00	27.017	14.699	11.332	16.974	11.412	7.288	13.206	18.222	12/13/2013 2:00	2.866
12/13/2013 2:15	27.016	14.699	11.332	16.971	11.411	7.289	13.208	18.222	12/13/2013 2:15	2.860
12/13/2013 2:30	27.013	14.697	11.329	16.970	11.411	7.288	13.204	18.220	12/13/2013 2:30	2.866
12/13/2013 2:45	27.017	14.698	11.330	16.970	11.410	7.286	13.206	18.219	12/13/2013 2:45	2.862
12/13/2013 3:00	27.015	14.696	11.329	16.970	11.410	7.284	13.206	18.215	12/13/2013 3:00	2.864
12/13/2013 3:15	27.023	14.696	11.329	16.971	11.409	7.285	13.203	18.214	12/13/2013 3:15	2.859
12/13/2013 3:30	27.011	14.695	11.327	16.969	11.410	7.285	13.201	18.217	12/13/2013 3:30	2.863
12/13/2013 3:45	27.011	14.696	11.329	16.971	11.410	7.287	13.205	18.215	12/13/2013 3:45	2.864
12/13/2013 4:00	27.007	14.695	11.328	16.969	11.409	7.285	13.202	18.213	12/13/2013 4:00	2.862
12/13/2013 4:15	27.016	14.696	11.328	16.969	11.409	7.284	13.205	18.214	12/13/2013 4:15	2.862
12/13/2013 4:30	27.008	14.696	11.331	16.968	11.408	7.286	13.206	18.218	12/13/2013 4:30	2.863
12/13/2013 4:45	27.006	14.696	11.328	16.969	11.409	7.284	13.205	18.215	12/13/2013 4:45	2.866

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/13/2013 5:00	27.008	14.695	11.325	16.969	11.408	7.285	13.201	18.211	12/13/2013 5:00	2.863
12/13/2013 5:15	27.013	14.694	11.328	16.969	11.409	7.286	13.202	18.214	12/13/2013 5:15	2.864
12/13/2013 5:30	27.000	14.695	11.326	16.967	11.407	7.282	13.201	18.216	12/13/2013 5:30	2.862
12/13/2013 5:45	27.007	14.695	11.328	16.970	11.407	7.284	13.201	18.215	12/13/2013 5:45	2.866
12/13/2013 6:00	27.009	14.695	11.327	16.970	11.408	7.282	13.199	18.214	12/13/2013 6:00	2.873
12/13/2013 6:15	27.018	14.695	11.328	16.970	11.410	7.284	13.202	18.214	12/13/2013 6:15	2.871
12/13/2013 6:30	27.007	14.696	11.330	16.973	11.413	7.283	13.202	18.216	12/13/2013 6:30	2.872
12/13/2013 6:45	27.004	14.695	11.329	16.971	11.409	7.285	13.201	18.214	12/13/2013 6:45	2.877
12/13/2013 7:00	27.003	14.697	11.329	16.973	11.411	7.286	13.204	18.215	12/13/2013 7:00	2.876
12/13/2013 7:15	27.006	14.697	11.329	16.972	11.411	7.287	13.204	18.216	12/13/2013 7:15	2.874
12/13/2013 7:30	27.014	14.697	11.328	16.970	11.409	7.283	13.204	18.212	12/13/2013 7:30	2.874
12/13/2013 7:45	27.016	14.696	11.327	16.971	11.411	7.286	13.203	18.214	12/13/2013 7:45	2.878
12/13/2013 8:00	27.000	14.694	11.326	16.970	11.408	7.284	13.201	18.214	12/13/2013 8:00	2.876
12/13/2013 8:15	27.009	14.692	11.325	16.967	11.406	7.285	13.200	18.212	12/13/2013 8:15	2.869
12/13/2013 8:30	27.000	14.692	11.324	16.967	11.405	7.281	13.200	18.210	12/13/2013 8:30	2.868
12/13/2013 8:45	27.015	14.692	11.324	16.968	11.405	7.281	13.200	18.209	12/13/2013 8:45	2.869
12/13/2013 9:00	27.002	14.692	11.323	16.966	11.405	7.282	13.196	18.209	12/13/2013 9:00	2.866
12/13/2013 9:15	27.004	14.691	11.322	16.967	11.404	7.279	13.197	18.203	12/13/2013 9:15	2.866
12/13/2013 9:30	27.002	14.690	11.322	16.965	11.402	7.278	13.196	18.203	12/13/2013 9:30	2.864
12/13/2013 9:45	27.010	14.689	11.318	16.964	11.403	7.279	13.195	18.206	12/13/2013 9:45	2.863
12/13/2013 10:00	27.002	14.688	11.321	16.963	11.401	7.276	13.193	18.207	12/13/2013 10:00	2.860
12/13/2013 10:15	27.018	14.704	11.335	16.979	11.420	7.282	13.208	18.214	12/13/2013 10:15	2.923
12/13/2013 10:30	27.029	14.708	11.341	16.985	11.425	7.293	13.216	18.216	12/13/2013 10:30	2.919
12/13/2013 10:45	27.022	14.711	11.341	16.985	11.425	7.296	13.212	18.219	12/13/2013 10:45	2.918
12/13/2013 11:00	27.020	14.706	11.341	16.984	11.423	7.299	13.213	18.215	12/13/2013 11:00	2.912
12/13/2013 11:15	27.020	14.702	11.335	16.982	11.420	7.295	13.209	18.211	12/13/2013 11:15	2.899
12/13/2013 11:30	27.013	14.698	11.334	16.977	11.417	7.296	13.206	18.215	12/13/2013 11:30	2.896
12/13/2013 11:45	27.010	14.694	11.329	16.973	11.413	7.291	13.204	18.212	12/13/2013 11:45	2.891
12/13/2013 12:00	27.001	14.696	11.327	16.969	11.411	7.286	13.203	18.208	12/13/2013 12:00	2.877
12/13/2013 12:15	27.009	14.697	11.327	16.970	11.408	7.286	13.202	18.209	12/13/2013 12:15	2.879

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/13/2013 12:30	26.987	14.690	11.322	16.966	11.405	7.285	13.195	18.204	12/13/2013 12:30	2.879
12/13/2013 12:45	26.998	14.689	11.321	16.964	11.402	7.281	13.194	18.205	12/13/2013 12:45	2.872
12/13/2013 13:00	27.006	14.687	11.319	16.965	11.402	7.281	13.193	18.204	12/13/2013 13:00	2.872
12/13/2013 13:15	27.008	14.683	11.319	16.962	11.401	7.276	13.192	18.205	12/13/2013 13:15	2.870
12/13/2013 13:30	27.003	14.684	11.314	16.960	11.397	7.277	13.192	18.197	12/13/2013 13:30	2.866
12/13/2013 13:45	26.995	14.682	11.314	16.957	11.396	7.274	13.190	18.196	12/13/2013 13:45	2.859
12/13/2013 14:00	26.996	14.679	11.310	16.953	11.393	7.271	13.188	18.198	12/13/2013 14:00	2.854
12/13/2013 14:15	26.993	14.676	11.309	16.955	11.390	7.268	13.184	18.191	12/13/2013 14:15	2.851
12/13/2013 14:30	26.990	14.677	11.306	16.950	11.389	7.270	13.185	18.195	12/13/2013 14:30	2.852
12/13/2013 14:45	26.985	14.674	11.307	16.951	11.387	7.267	13.183	18.194	12/13/2013 14:45	2.845
12/13/2013 15:00	26.986	14.671	11.307	16.947	11.387	7.267	13.181	18.189	12/13/2013 15:00	2.848
12/13/2013 15:15	26.991	14.670	11.306	16.946	11.386	7.266	13.180	18.190	12/13/2013 15:15	2.847
12/13/2013 15:30	26.977	14.666	11.302	16.944	11.384	7.263	13.176	18.186	12/13/2013 15:30	2.841
12/13/2013 15:45	26.988	14.667	11.304	16.942	11.383	7.260	13.179	18.186	12/13/2013 15:45	2.840
12/13/2013 16:00	26.977	14.665	11.299	16.943	11.380	7.259	13.175	18.187	12/13/2013 16:00	2.840
12/13/2013 16:15	26.990	14.666	11.300	16.945	11.381	7.257	13.176	18.184	12/13/2013 16:15	2.839
12/13/2013 16:30	26.990	14.672	11.301	16.946	11.381	7.259	13.177	18.184	12/13/2013 16:30	2.846
12/13/2013 16:45	26.981	14.668	11.302	16.945	11.382	7.258	13.179	18.187	12/13/2013 16:45	2.848
12/13/2013 17:00	26.997	14.670	11.299	16.948	11.387	7.261	13.182	18.186	12/13/2013 17:00	2.855
12/13/2013 17:15	26.986	14.668	11.301	16.948	11.386	7.262	13.179	18.190	12/13/2013 17:15	2.862
12/13/2013 17:30	26.992	14.670	11.300	16.948	11.385	7.260	13.180	18.185	12/13/2013 17:30	2.854
12/13/2013 17:45	26.982	14.671	11.301	16.949	11.387	7.263	13.179	18.188	12/13/2013 17:45	2.859
12/13/2013 18:00	27.002	14.671	11.302	16.949	11.385	7.262	13.180	18.187	12/13/2013 18:00	2.855
12/13/2013 18:15	26.992	14.671	11.302	16.949	11.386	7.263	13.180	18.190	12/13/2013 18:15	2.864
12/13/2013 18:30	26.992	14.669	11.301	16.946	11.385	7.260	13.178	18.188	12/13/2013 18:30	2.857
12/13/2013 18:45	26.988	14.668	11.299	16.947	11.385	7.261	13.179	18.186	12/13/2013 18:45	2.858
12/13/2013 19:00	26.988	14.668	11.299	16.949	11.385	7.261	13.179	18.186	12/13/2013 19:00	2.867
12/13/2013 19:15	26.990	14.669	11.300	16.947	11.386	7.260	13.180	18.183	12/13/2013 19:15	2.862
12/13/2013 19:30	26.987	14.668	11.298	16.947	11.384	7.262	13.178	18.187	12/13/2013 19:30	2.861
12/13/2013 19:45	26.994	14.669	11.300	16.947	11.386	7.261	13.179	18.186	12/13/2013 19:45	2.865

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/13/2013 20:00	26.977	14.670	11.300	16.948	11.387	7.261	13.180	18.187	12/13/2013 20:00	2.870
12/13/2013 20:15	26.987	14.670	11.300	16.949	11.389	7.263	13.179	18.184	12/13/2013 20:15	2.871
12/13/2013 20:30	26.994	14.671	11.301	16.949	11.387	7.262	13.179	18.187	12/13/2013 20:30	2.873
12/13/2013 20:45	26.987	14.671	11.302	16.949	11.388	7.262	13.179	18.187	12/13/2013 20:45	2.872
12/13/2013 21:00	26.991	14.669	11.301	16.948	11.385	7.261	13.177	18.185	12/13/2013 21:00	2.867
12/13/2013 21:15	26.986	14.670	11.300	16.947	11.385	7.263	13.177	18.184	12/13/2013 21:15	2.864
12/13/2013 21:30	26.999	14.667	11.297	16.945	11.385	7.262	13.177	18.184	12/13/2013 21:30	2.865
12/13/2013 21:45	26.979	14.667	11.297	16.943	11.381	7.260	13.175	18.179	12/13/2013 21:45	2.863
12/13/2013 22:00	26.961	14.665	11.295	16.944	11.386	7.260	13.177	18.183	12/13/2013 22:00	2.857
12/13/2013 22:15	26.976	14.665	11.295	16.942	11.381	7.259	13.175	18.176	12/13/2013 22:15	2.853
12/13/2013 22:30	26.979	14.664	11.293	16.942	11.380	7.256	13.175	18.182	12/13/2013 22:30	2.856
12/13/2013 22:45	26.981	14.663	11.295	16.942	11.379	7.258	13.173	18.181	12/13/2013 22:45	2.857
12/13/2013 23:00	26.979	14.662	11.292	16.940	11.380	7.257	13.171	18.174	12/13/2013 23:00	2.855
12/13/2013 23:15	26.983	14.661	11.292	16.938	11.378	7.255	13.171	18.175	12/13/2013 23:15	2.852
12/13/2013 23:30	26.986	14.661	11.291	16.938	11.377	7.253	13.170	18.179	12/13/2013 23:30	2.855
12/13/2013 23:45	26.985	14.660	11.291	16.939	11.377	7.253	13.169	18.174	12/13/2013 23:45	2.854
12/14/2013 0:00	26.977	14.662	11.291	16.939	11.377	7.254	13.170	18.176	12/14/2013 0:00	2.855
12/14/2013 0:15	26.973	14.664	11.292	16.938	11.378	7.255	13.169	18.173	12/14/2013 0:15	2.855
12/14/2013 0:30	26.982	14.661	11.293	16.940	11.379	7.254	13.170	18.174	12/14/2013 0:30	2.860
12/14/2013 0:45	26.984	14.664	11.294	16.942	11.378	7.255	13.173	18.178	12/14/2013 0:45	2.862
12/14/2013 1:00	26.983	14.663	11.293	16.940	11.379	7.255	13.173	18.180	12/14/2013 1:00	2.858
12/14/2013 1:15	26.982	14.664	11.293	16.941	11.380	7.254	13.172	18.178	12/14/2013 1:15	2.863
12/14/2013 1:30	26.986	14.664	11.295	16.942	11.380	7.257	13.171	18.173	12/14/2013 1:30	2.864
12/14/2013 1:45	26.993	14.666	11.296	16.942	11.381	7.256	13.172	18.178	12/14/2013 1:45	2.867
12/14/2013 2:00	26.982	14.662	11.296	16.943	11.382	7.257	13.172	18.177	12/14/2013 2:00	2.871
12/14/2013 2:15	26.990	14.664	11.297	16.943	11.383	7.256	13.176	18.176	12/14/2013 2:15	2.871
12/14/2013 2:30	26.990	14.666	11.296	16.944	11.382	7.260	13.177	18.175	12/14/2013 2:30	2.873
12/14/2013 2:45	26.987	14.666	11.298	16.945	11.384	7.245	13.174	18.178	12/14/2013 2:45	2.877
12/14/2013 3:00	26.990	14.668	11.298	16.946	11.386	7.261	13.175	18.180	12/14/2013 3:00	2.874
12/14/2013 3:15	26.983	14.665	11.296	16.943	11.383	7.261	13.177	18.178	12/14/2013 3:15	2.876

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/14/2013 3:30	26.988	14.662	11.295	16.941	11.382	7.260	13.173	18.174	12/14/2013 3:30	2.871
12/14/2013 3:45	26.988	14.666	11.295	16.943	11.382	7.260	13.173	18.175	12/14/2013 3:45	2.875
12/14/2013 4:00	26.978	14.661	11.294	16.941	11.380	7.258	13.172	18.177	12/14/2013 4:00	2.872
12/14/2013 4:15	26.978	14.662	11.293	16.942	11.381	7.257	13.172	18.176	12/14/2013 4:15	2.870
12/14/2013 4:30	26.986	14.660	11.294	16.941	11.379	7.255	13.171	18.169	12/14/2013 4:30	2.872
12/14/2013 4:45	26.982	14.660	11.292	16.941	11.380	7.257	13.172	18.176	12/14/2013 4:45	2.869
12/14/2013 5:00	26.983	14.660	11.291	16.940	11.381	7.255	13.171	18.174	12/14/2013 5:00	2.869
12/14/2013 5:15	26.974	14.661	11.292	16.939	11.377	7.256	13.173	18.171	12/14/2013 5:15	2.866
12/14/2013 5:30	26.976	14.659	11.289	16.940	11.378	7.256	13.170	18.173	12/14/2013 5:30	2.867
12/14/2013 5:45	26.973	14.657	11.289	16.938	11.378	7.255	13.168	18.173	12/14/2013 5:45	2.865
12/14/2013 6:00	26.982	14.658	11.290	16.937	11.377	7.256	13.167	18.173	12/14/2013 6:00	2.864
12/14/2013 6:15	26.974	14.655	11.288	16.936	11.375	7.254	13.165	18.170	12/14/2013 6:15	2.865
12/14/2013 6:30	26.976	14.656	11.289	16.937	11.372	7.253	13.166	18.166	12/14/2013 6:30	2.862
12/14/2013 6:45	26.972	14.656	11.287	16.936	11.375	7.253	13.164	18.168	12/14/2013 6:45	2.866
12/14/2013 7:00	26.977	14.655	11.287	16.935	11.375	7.254	13.165	18.170	12/14/2013 7:00	2.863
12/14/2013 7:15	26.976	14.656	11.288	16.936	11.375	7.253	13.168	18.168	12/14/2013 7:15	2.864
12/14/2013 7:30	26.976	14.656	11.288	16.938	11.375	7.252	13.170	18.167	12/14/2013 7:30	2.865
12/14/2013 7:45	26.975	14.656	11.287	16.936	11.374	7.253	13.167	18.166	12/14/2013 7:45	2.864
12/14/2013 8:00	26.973	14.655	11.290	16.936	11.377	7.253	13.167	18.171	12/14/2013 8:00	2.870
12/14/2013 8:15	26.979	14.658	11.290	16.937	11.375	7.252	13.165	18.166	12/14/2013 8:15	2.876
12/14/2013 8:30	26.988	14.657	11.290	16.936	11.375	7.254	13.167	18.170	12/14/2013 8:30	2.868
12/14/2013 8:45	26.986	14.658	11.290	16.938	11.376	7.253	13.168	18.169	12/14/2013 8:45	2.869
12/14/2013 9:00	26.980	14.657	11.289	16.938	11.377	7.253	13.166	18.170	12/14/2013 9:00	2.870
12/14/2013 9:15	26.971	14.656	11.289	16.939	11.378	7.255	13.167	18.165	12/14/2013 9:15	2.871
12/14/2013 9:30	26.977	14.657	11.290	16.939	11.378	7.255	13.167	18.166	12/14/2013 9:30	2.873
12/14/2013 9:45	26.982	14.660	11.290	16.939	11.379	7.252	13.168	18.166	12/14/2013 9:45	2.873
12/14/2013 10:00	26.981	14.659	11.289	16.939	11.378	7.255	13.168	18.171	12/14/2013 10:00	2.873
12/14/2013 10:15	27.011	14.681	11.311	16.962	11.400	7.266	13.185	18.183	12/14/2013 10:15	2.933
12/14/2013 10:30	27.002	14.676	11.308	16.959	11.400	7.271	13.182	18.176	12/14/2013 10:30	2.924
12/14/2013 10:45	27.002	14.677	11.311	16.957	11.399	7.276	13.185	18.178	12/14/2013 10:45	2.920

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/14/2013 11:00	26.995	14.676	11.309	16.956	11.399	7.279	13.183	18.178	12/14/2013 11:00	2.919
12/14/2013 11:15	26.992	14.674	11.305	16.955	11.395	7.275	13.182	18.176	12/14/2013 11:15	2.913
12/14/2013 11:30	26.994	14.673	11.303	16.955	11.393	7.274	13.180	18.180	12/14/2013 11:30	2.905
12/14/2013 11:45	26.994	14.672	11.305	16.956	11.391	7.274	13.178	18.180	12/14/2013 11:45	2.899
12/14/2013 12:00	26.984	14.669	11.301	16.949	11.389	7.268	13.178	18.172	12/14/2013 12:00	2.902
12/14/2013 12:15	26.981	14.668	11.301	16.951	11.388	7.270	13.177	18.174	12/14/2013 12:15	2.897
12/14/2013 12:30	26.997	14.669	11.299	16.947	11.388	7.269	13.176	18.177	12/14/2013 12:30	2.896
12/14/2013 12:45	26.988	14.663	11.296	16.946	11.383	7.266	13.174	18.173	12/14/2013 12:45	2.884
12/14/2013 13:00	26.982	14.662	11.295	16.943	11.383	7.266	13.174	18.174	12/14/2013 13:00	2.888
12/14/2013 13:15	26.981	14.664	11.294	16.941	11.383	7.264	13.170	18.169	12/14/2013 13:15	2.886
12/14/2013 13:30	26.983	14.659	11.292	16.942	11.382	7.264	13.168	18.167	12/14/2013 13:30	2.877
12/14/2013 13:45	26.980	14.660	11.292	16.940	11.379	7.264	13.167	18.169	12/14/2013 13:45	2.884
12/14/2013 14:00	26.990	14.660	11.291	16.938	11.377	7.260	13.167	18.164	12/14/2013 14:00	2.884
12/14/2013 14:15	26.984	14.658	11.289	16.939	11.376	7.259	13.167	18.163	12/14/2013 14:15	2.875
12/14/2013 14:30	26.981	14.656	11.290	16.937	11.376	7.255	13.165	18.168	12/14/2013 14:30	2.876
12/14/2013 14:45	26.977	14.655	11.288	16.937	11.378	7.256	13.166	18.167	12/14/2013 14:45	2.881
12/14/2013 15:00	26.981	14.656	11.286	16.935	11.373	7.255	13.163	18.165	12/14/2013 15:00	2.869
12/14/2013 15:15	26.975	14.654	11.285	16.937	11.376	7.254	13.164	18.162	12/14/2013 15:15	2.869
12/14/2013 15:30	26.976	14.653	11.285	16.933	11.373	7.252	13.163	18.164	12/14/2013 15:30	2.867
12/14/2013 15:45	26.972	14.653	11.285	16.934	11.373	7.249	13.162	18.161	12/14/2013 15:45	2.861
12/14/2013 16:00	26.969	14.653	11.284	16.932	11.374	7.251	13.160	18.163	12/14/2013 16:00	2.865
12/14/2013 16:15	26.978	14.651	11.284	16.933	11.371	7.253	13.161	18.163	12/14/2013 16:15	2.861
12/14/2013 16:30	26.973	14.652	11.284	16.932	11.371	7.252	13.159	18.161	12/14/2013 16:30	2.860
12/14/2013 16:45	26.975	14.652	11.283	16.931	11.371	7.248	13.159	18.161	12/14/2013 16:45	2.860
12/14/2013 17:00	26.976	14.649	11.281	16.928	11.369	7.249	13.159	18.157	12/14/2013 17:00	2.859
12/14/2013 17:15	26.968	14.646	11.278	16.926	11.367	7.247	13.158	18.160	12/14/2013 17:15	2.854
12/14/2013 17:30	26.971	14.645	11.279	16.928	11.367	7.249	13.156	18.159	12/14/2013 17:30	2.854
12/14/2013 17:45	26.974	14.646	11.277	16.925	11.366	7.247	13.155	18.156	12/14/2013 17:45	2.856
12/14/2013 18:00	26.964	14.646	11.277	16.926	11.366	7.246	13.155	18.153	12/14/2013 18:00	2.854
12/14/2013 18:15	26.951	14.644	11.277	16.922	11.365	7.247	13.157	18.158	12/14/2013 18:15	2.857

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/14/2013 18:30	26.959	14.644	11.275	16.924	11.363	7.245	13.154	18.157	12/14/2013 18:30	2.854
12/14/2013 18:45	26.965	14.646	11.274	16.922	11.365	7.244	13.154	18.151	12/14/2013 18:45	2.852
12/14/2013 19:00	26.967	14.643	11.272	16.922	11.361	7.244	13.152	18.150	12/14/2013 19:00	2.850
12/14/2013 19:15	26.960	14.641	11.273	16.921	11.361	7.242	13.151	18.153	12/14/2013 19:15	2.849
12/14/2013 19:30	26.964	14.638	11.269	16.920	11.360	7.240	13.152	18.153	12/14/2013 19:30	2.847
12/14/2013 19:45	26.957	14.639	11.271	16.921	11.358	7.239	13.152	18.148	12/14/2013 19:45	2.843
12/14/2013 20:00	26.955	14.638	11.269	16.919	11.357	7.240	13.150	18.152	12/14/2013 20:00	2.845
12/14/2013 20:15	26.969	14.639	11.270	16.918	11.359	7.239	13.150	18.152	12/14/2013 20:15	2.846
12/14/2013 20:30	26.957	14.639	11.270	16.919	11.359	7.240	13.149	18.148	12/14/2013 20:30	2.847
12/14/2013 20:45	26.965	14.639	11.267	16.919	11.357	7.239	13.149	18.151	12/14/2013 20:45	2.845
12/14/2013 21:00	26.968	14.638	11.268	16.916	11.357	7.238	13.148	18.147	12/14/2013 21:00	2.846
12/14/2013 21:15	26.959	14.638	11.268	16.916	11.357	7.235	13.148	18.151	12/14/2013 21:15	2.841
12/14/2013 21:30	26.961	14.636	11.268	16.915	11.354	7.236	13.149	18.145	12/14/2013 21:30	2.840
12/14/2013 21:45	26.963	14.637	11.264	16.916	11.354	7.235	13.146	18.147	12/14/2013 21:45	2.840
12/14/2013 22:00	26.962	14.635	11.265	16.916	11.355	7.233	13.147	18.145	12/14/2013 22:00	2.839
12/14/2013 22:15	26.958	14.635	11.266	16.917	11.355	7.235	13.145	18.150	12/14/2013 22:15	2.841
12/14/2013 22:30	26.956	14.638	11.267	16.918	11.356	7.235	13.148	18.150	12/14/2013 22:30	2.845
12/14/2013 22:45	26.962	14.638	11.268	16.917	11.357	7.237	13.148	18.149	12/14/2013 22:45	2.847
12/14/2013 23:00	26.962	14.638	11.268	16.918	11.356	7.238	13.148	18.150	12/14/2013 23:00	2.850
12/14/2013 23:15	26.959	14.638	11.266	16.915	11.356	7.238	13.148	18.145	12/14/2013 23:15	2.845
12/14/2013 23:30	26.961	14.636	11.267	16.916	11.356	7.236	13.147	18.144	12/14/2013 23:30	2.849
12/14/2013 23:45	26.960	14.632	11.265	16.915	11.355	7.237	13.146	18.147	12/14/2013 23:45	2.848
12/15/2013 0:00	26.956	14.638	11.268	16.918	11.358	7.236	13.149	18.149	12/15/2013 0:00	2.847
12/15/2013 0:15	26.965	14.637	11.265	16.917	11.356	7.235	13.146	18.147	12/15/2013 0:15	2.853
12/15/2013 0:30	26.957	14.639	11.269	16.918	11.357	7.239	13.147	18.149	12/15/2013 0:30	2.850
12/15/2013 0:45	26.960	14.637	11.270	16.918	11.359	7.236	13.148	18.148	12/15/2013 0:45	2.851
12/15/2013 1:00	26.954	14.638	11.269	16.918	11.357	7.237	13.150	18.150	12/15/2013 1:00	2.852
12/15/2013 1:15	26.962	14.639	11.271	16.920	11.360	7.238	13.149	18.148	12/15/2013 1:15	2.857
12/15/2013 1:30	26.959	14.636	11.267	16.920	11.357	7.237	13.146	18.145	12/15/2013 1:30	2.856
12/15/2013 1:45	26.962	14.639	11.268	16.918	11.358	7.238	13.147	18.144	12/15/2013 1:45	2.856

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/15/2013 2:00	26.954	14.636	11.269	16.923	11.358	7.239	13.149	18.145	12/15/2013 2:00	2.858
12/15/2013 2:15	26.959	14.641	11.270	16.921	11.361	7.239	13.150	18.151	12/15/2013 2:15	2.860
12/15/2013 2:30	26.970	14.641	11.272	16.921	11.360	7.239	13.150	18.143	12/15/2013 2:30	2.863
12/15/2013 2:45	26.968	14.641	11.272	16.921	11.363	7.240	13.150	18.149	12/15/2013 2:45	2.866
12/15/2013 3:00	26.970	14.643	11.271	16.922	11.363	7.242	13.150	18.144	12/15/2013 3:00	2.869
12/15/2013 3:15	26.966	14.641	11.272	16.922	11.363	7.241	13.150	18.148	12/15/2013 3:15	2.869
12/15/2013 3:30	26.962	14.639	11.271	16.921	11.362	7.241	13.151	18.149	12/15/2013 3:30	2.865
12/15/2013 3:45	26.974	14.643	11.271	16.921	11.361	7.242	13.151	18.150	12/15/2013 3:45	2.866
12/15/2013 4:00	26.959	14.641	11.271	16.921	11.362	7.243	13.152	18.143	12/15/2013 4:00	2.863
12/15/2013 4:15	26.957	14.643	11.271	16.921	11.362	7.242	13.151	18.147	12/15/2013 4:15	2.866
12/15/2013 4:30	26.969	14.642	11.271	16.921	11.361	7.243	13.149	18.144	12/15/2013 4:30	2.869
12/15/2013 4:45	26.961	14.646	11.275	16.926	11.365	7.242	13.152	18.151	12/15/2013 4:45	2.867
12/15/2013 5:00	26.962	14.643	11.272	16.925	11.361	7.242	13.150	18.144	12/15/2013 5:00	2.863
12/15/2013 5:15	26.970	14.636	11.270	16.917	11.359	7.242	13.147	18.145	12/15/2013 5:15	2.862
12/15/2013 5:30	26.965	14.638	11.271	16.921	11.361	7.240	13.149	18.147	12/15/2013 5:30	2.866
12/15/2013 5:45	26.972	14.642	11.271	16.920	11.361	7.239	13.151	18.147	12/15/2013 5:45	2.862
12/15/2013 6:00	26.968	14.642	11.270	16.921	11.361	7.242	13.150	18.147	12/15/2013 6:00	2.864
12/15/2013 6:15	26.957	14.637	11.270	16.919	11.360	7.241	13.149	18.145	12/15/2013 6:15	2.869
12/15/2013 6:30	26.956	14.637	11.271	16.918	11.359	7.241	13.148	18.142	12/15/2013 6:30	2.867
12/15/2013 6:45	26.962	14.640	11.269	16.920	11.360	7.242	13.148	18.142	12/15/2013 6:45	2.863
12/15/2013 7:00	26.968	14.637	11.272	16.923	11.362	7.241	13.150	18.147	12/15/2013 7:00	2.867
12/15/2013 7:15	26.966	14.638	11.270	16.920	11.362	7.242	13.149	18.141	12/15/2013 7:15	2.869
12/15/2013 7:30	26.962	14.643	11.272	16.921	11.362	7.242	13.149	18.143	12/15/2013 7:30	2.868
12/15/2013 7:45	26.958	14.641	11.272	16.923	11.363	7.246	13.151	18.143	12/15/2013 7:45	2.867
12/15/2013 8:00	26.958	14.643	11.272	16.922	11.363	7.244	13.148	18.142	12/15/2013 8:00	2.873
12/15/2013 8:15	26.960	14.644	11.273	16.923	11.363	7.245	13.150	18.148	12/15/2013 8:15	2.878
12/15/2013 8:30	26.961	14.646	11.276	16.926	11.364	7.247	13.152	18.143	12/15/2013 8:30	2.877
12/15/2013 8:45	26.968	14.643	11.272	16.922	11.364	7.243	13.147	18.144	12/15/2013 8:45	2.877
12/15/2013 9:00	26.964	14.643	11.273	16.921	11.360	7.242	13.151	18.146	12/15/2013 9:00	2.870
12/15/2013 9:15	26.969	14.640	11.268	16.919	11.361	7.240	13.147	18.144	12/15/2013 9:15	2.867

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/15/2013 9:30	26.957	14.637	11.267	16.919	11.359	7.240	13.145	18.138	12/15/2013 9:30	2.860
12/15/2013 9:45	26.955	14.639	11.268	16.917	11.358	7.241	13.145	18.142	12/15/2013 9:45	2.858
12/15/2013 10:00	26.963	14.631	11.262	16.915	11.356	7.238	13.142	18.142	12/15/2013 10:00	2.860
12/15/2013 10:15	26.932	14.630	11.265	16.916	11.355	7.234	13.143	18.139	12/15/2013 10:15	2.851
12/15/2013 10:30	26.950	14.636	11.264	16.915	11.353	7.236	13.142	18.141	12/15/2013 10:30	2.851
12/15/2013 10:45	26.958	14.633	11.263	16.912	11.356	7.234	13.142	18.141	12/15/2013 10:45	2.853
12/15/2013 11:00	26.954	14.636	11.265	16.914	11.356	7.237	13.143	18.137	12/15/2013 11:00	2.858
12/15/2013 11:15	26.963	14.632	11.267	16.915	11.357	7.237	13.142	18.137	12/15/2013 11:15	2.860
12/15/2013 11:30	26.969	14.639	11.271	16.920	11.359	7.240	13.148	18.143	12/15/2013 11:30	2.871
12/15/2013 11:45	26.950	14.638	11.269	16.919	11.360	7.239	13.148	18.142	12/15/2013 11:45	2.864
12/15/2013 12:00	26.974	14.641	11.273	16.923	11.364	7.244	13.150	18.145	12/15/2013 12:00	2.877
12/15/2013 12:15	26.969	14.647	11.275	16.923	11.366	7.246	13.150	18.146	12/15/2013 12:15	2.878
12/15/2013 12:30	26.974	14.640	11.275	16.925	11.366	7.245	13.152	18.142	12/15/2013 12:30	2.881
12/15/2013 12:45	26.977	14.646	11.277	16.926	11.368	7.247	13.154	18.142	12/15/2013 12:45	2.885
12/15/2013 13:00	26.973	14.645	11.279	16.927	11.368	7.250	13.153	18.149	12/15/2013 13:00	2.881
12/15/2013 13:15	26.977	14.646	11.276	16.929	11.365	7.249	13.151	18.146	12/15/2013 13:15	2.885
12/15/2013 13:30	26.975	14.647	11.279	16.928	11.369	7.249	13.154	18.144	12/15/2013 13:30	2.887
12/15/2013 13:45	26.971	14.647	11.279	16.931	11.372	7.248	13.156	18.145	12/15/2013 13:45	2.893
12/15/2013 14:00	26.976	14.646	11.277	16.927	11.368	7.251	13.152	18.143	12/15/2013 14:00	2.887
12/15/2013 14:15	26.979	14.646	11.276	16.928	11.366	7.250	13.153	18.147	12/15/2013 14:15	2.887
12/15/2013 14:30	26.970	14.648	11.278	16.927	11.369	7.251	13.153	18.143	12/15/2013 14:30	2.884
12/15/2013 14:45	26.972	14.650	11.280	16.930	11.368	7.251	13.153	18.149	12/15/2013 14:45	2.887
12/15/2013 15:00	26.970	14.651	11.277	16.929	11.368	7.251	13.154	18.145	12/15/2013 15:00	2.888
12/15/2013 15:15	26.977	14.644	11.276	16.928	11.369	7.251	13.152	18.148	12/15/2013 15:15	2.883
12/15/2013 15:30	26.972	14.643	11.276	16.927	11.367	7.250	13.152	18.142	12/15/2013 15:30	2.883
12/15/2013 15:45	26.980	14.659	11.290	16.941	11.383	7.260	13.165	18.150	12/15/2013 15:45	2.919
12/15/2013 16:00	26.983	14.654	11.284	16.936	11.376	7.261	13.160	18.151	12/15/2013 16:00	2.910
12/15/2013 16:15	26.970	14.655	11.284	16.934	11.376	7.259	13.160	18.152	12/15/2013 16:15	2.905
12/15/2013 16:30	26.979	14.652	11.285	16.932	11.374	7.256	13.158	18.152	12/15/2013 16:30	2.905
12/15/2013 16:45	26.978	14.648	11.281	16.937	11.375	7.257	13.156	18.149	12/15/2013 16:45	2.896

PRESSURE TRANSDUCER WATER LEVEL DATA

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December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/15/2013 17:00	26.975	14.646	11.279	16.927	11.368	7.257	13.154	18.148	12/15/2013 17:00	2.886
12/15/2013 17:15	26.967	14.641	11.275	16.928	11.365	7.253	13.151	18.144	12/15/2013 17:15	2.878
12/15/2013 17:30	26.960	14.638	11.272	16.920	11.361	7.250	13.148	18.138	12/15/2013 17:30	2.875
12/15/2013 17:45	26.973	14.640	11.269	16.918	11.360	7.247	13.145	18.138	12/15/2013 17:45	2.871
12/15/2013 18:00	26.957	14.639	11.268	16.918	11.356	7.244	13.144	18.134	12/15/2013 18:00	2.862
12/15/2013 18:15	26.962	14.633	11.265	16.918	11.357	7.241	13.143	18.135	12/15/2013 18:15	2.864
12/15/2013 18:30	26.959	14.632	11.264	16.916	11.356	7.239	13.141	18.134	12/15/2013 18:30	2.855
12/15/2013 18:45	26.965	14.631	11.264	16.915	11.354	7.238	13.140	18.138	12/15/2013 18:45	2.860
12/15/2013 19:00	26.953	14.632	11.263	16.914	11.350	7.238	13.140	18.136	12/15/2013 19:00	2.853
12/15/2013 19:15	26.947	14.628	11.259	16.913	11.352	7.236	13.137	18.130	12/15/2013 19:15	2.851
12/15/2013 19:30	26.958	14.628	11.261	16.910	11.351	7.235	13.137	18.136	12/15/2013 19:30	2.852
12/15/2013 19:45	26.942	14.628	11.261	16.914	11.351	7.235	13.137	18.131	12/15/2013 19:45	2.849
12/15/2013 20:00	26.947	14.626	11.259	16.910	11.351	7.235	13.137	18.130	12/15/2013 20:00	2.848
12/15/2013 20:15	26.960	14.628	11.259	16.907	11.348	7.234	13.136	18.133	12/15/2013 20:15	2.847
12/15/2013 20:30	26.954	14.630	11.259	16.909	11.351	7.234	13.136	18.129	12/15/2013 20:30	2.853
12/15/2013 20:45	26.969	14.626	11.256	16.911	11.344	7.232	13.135	18.132	12/15/2013 20:45	2.843
12/15/2013 21:00	26.960	14.627	11.256	16.908	11.345	7.228	13.134	18.131	12/15/2013 21:00	2.843
12/15/2013 21:15	26.952	14.622	11.255	16.906	11.346	7.230	13.134	18.130	12/15/2013 21:15	2.840
12/15/2013 21:30	26.946	14.621	11.252	16.904	11.344	7.229	13.132	18.129	12/15/2013 21:30	2.842
12/15/2013 21:45	26.937	14.622	11.255	16.904	11.343	7.229	13.130	18.125	12/15/2013 21:45	2.841
12/15/2013 22:00	26.945	14.623	11.254	16.903	11.343	7.229	13.130	18.124	12/15/2013 22:00	2.833
12/15/2013 22:15	26.945	14.619	11.248	16.901	11.341	7.228	13.129	18.124	12/15/2013 22:15	2.837
12/15/2013 22:30	26.934	14.622	11.247	16.902	11.340	7.224	13.127	18.127	12/15/2013 22:30	2.831
12/15/2013 22:45	26.950	14.619	11.251	16.899	11.340	7.225	13.128	18.126	12/15/2013 22:45	2.830
12/15/2013 23:00	26.942	14.617	11.245	16.898	11.338	7.223	13.126	18.126	12/15/2013 23:00	2.825
12/15/2013 23:15	26.946	14.617	11.247	16.901	11.338	7.222	13.127	18.122	12/15/2013 23:15	2.823
12/15/2013 23:30	26.942	14.616	11.247	16.895	11.337	7.222	13.125	18.119	12/15/2013 23:30	2.827
12/15/2013 23:45	26.934	14.615	11.241	16.895	11.334	7.218	13.125	18.118	12/15/2013 23:45	2.826
12/16/2013 0:00	26.945	14.611	11.244	16.894	11.336	7.218	13.123	18.118	12/16/2013 0:00	2.820
12/16/2013 0:15	26.946	14.612	11.244	16.895	11.335	7.218	13.124	18.121	12/16/2013 0:15	2.823

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 0:30	26.946	14.616	11.245	16.896	11.334	7.217	13.124	18.121	12/16/2013 0:30	2.825
12/16/2013 0:45	26.934	14.615	11.245	16.900	11.337	7.218	13.127	18.119	12/16/2013 0:45	2.827
12/16/2013 1:00	26.944	14.617	11.249	16.899	11.339	7.220	13.125	18.119	12/16/2013 1:00	2.835
12/16/2013 1:15	26.958	14.618	11.249	16.905	11.343	7.222	13.129	18.122	12/16/2013 1:15	2.840
12/16/2013 1:30	26.952	14.621	11.253	16.901	11.344	7.221	13.131	18.127	12/16/2013 1:30	2.840
12/16/2013 1:45	26.963	14.622	11.253	16.904	11.345	7.225	13.131	18.127	12/16/2013 1:45	2.847
12/16/2013 2:00	26.944	14.622	11.255	16.907	11.345	7.222	13.131	18.126	12/16/2013 2:00	2.848
12/16/2013 2:15	26.961	14.624	11.253	16.907	11.346	7.226	13.130	18.125	12/16/2013 2:15	2.850
12/16/2013 2:30	26.966	14.626	11.256	16.910	11.349	7.228	13.135	18.127	12/16/2013 2:30	2.856
12/16/2013 2:45	26.957	14.626	11.259	16.911	11.350	7.228	13.136	18.127	12/16/2013 2:45	2.858
12/16/2013 3:00	26.964	14.629	11.259	16.912	11.351	7.230	13.136	18.129	12/16/2013 3:00	2.861
12/16/2013 3:15	26.957	14.629	11.258	16.912	11.350	7.233	13.137	18.125	12/16/2013 3:15	2.860
12/16/2013 3:30	26.968	14.629	11.259	16.911	11.350	7.232	13.136	18.129	12/16/2013 3:30	2.860
12/16/2013 3:45	26.950	14.630	11.261	16.914	11.353	7.233	13.136	18.132	12/16/2013 3:45	2.860
12/16/2013 4:00	26.961	14.631	11.260	16.915	11.354	7.235	13.139	18.132	12/16/2013 4:00	2.864
12/16/2013 4:15	26.965	14.632	11.262	16.915	11.356	7.234	13.139	18.129	12/16/2013 4:15	2.868
12/16/2013 4:30	26.968	14.633	11.262	16.916	11.356	7.236	13.139	18.131	12/16/2013 4:30	2.870
12/16/2013 4:45	26.950	14.635	11.263	16.917	11.356	7.238	13.140	18.128	12/16/2013 4:45	2.870
12/16/2013 5:00	26.964	14.634	11.265	16.918	11.356	7.239	13.141	18.129	12/16/2013 5:00	2.873
12/16/2013 5:15	26.967	14.637	11.262	16.920	11.359	7.239	13.141	18.133	12/16/2013 5:15	2.878
12/16/2013 5:30	26.960	14.636	11.266	16.921	11.360	7.241	13.143	18.131	12/16/2013 5:30	2.881
12/16/2013 5:45	26.975	14.639	11.268	16.924	11.363	7.243	13.145	18.139	12/16/2013 5:45	2.892
12/16/2013 6:00	26.975	14.641	11.269	16.925	11.366	7.247	13.147	18.138	12/16/2013 6:00	2.892
12/16/2013 6:15	26.973	14.644	11.274	16.926	11.365	7.247	13.149	18.138	12/16/2013 6:15	2.901
12/16/2013 6:30	26.973	14.646	11.276	16.929	11.370	7.245	13.150	18.140	12/16/2013 6:30	2.905
12/16/2013 6:45	26.975	14.649	11.280	16.933	11.372	7.255	13.153	18.138	12/16/2013 6:45	2.910
12/16/2013 7:00	26.989	14.654	11.283	16.939	11.375	7.256	13.155	18.142	12/16/2013 7:00	2.921
12/16/2013 7:15	26.981	14.652	11.285	16.938	11.378	7.260	13.157	18.143	12/16/2013 7:15	2.921
12/16/2013 7:30	26.986	14.655	11.282	16.938	11.380	7.263	13.159	18.145	12/16/2013 7:30	2.926
12/16/2013 7:45	26.976	14.656	11.288	16.941	11.381	7.266	13.159	18.147	12/16/2013 7:45	2.930

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 8:00	26.991	14.655	11.289	16.942	11.383	7.269	13.160	18.142	12/16/2013 8:00	2.929
12/16/2013 8:15	26.986	14.656	11.289	16.943	11.383	7.269	13.159	18.144	12/16/2013 8:15	2.928
12/16/2013 8:30	26.993	14.658	11.288	16.942	11.383	7.270	13.161	18.146	12/16/2013 8:30	2.931
12/16/2013 8:45	26.988	14.656	11.285	16.942	11.382	7.271	13.161	18.144	12/16/2013 8:45	2.930
12/16/2013 9:00	26.984	14.658	11.288	16.947	11.383	7.272	13.162	18.143	12/16/2013 9:00	2.937
12/16/2013 9:15	26.986	14.655	11.286	16.942	11.384	7.272	13.161	18.142	12/16/2013 9:15	2.933
12/16/2013 9:30	26.995	14.656	11.285	16.939	11.379	7.270	13.160	18.147	12/16/2013 9:30	2.927
12/16/2013 9:45	26.979	14.656	11.287	16.942	11.380	7.270	13.160	18.145	12/16/2013 9:45	2.921
12/16/2013 10:00	26.975	14.650	11.277	16.937	11.376	7.269	13.154	18.144	12/16/2013 10:00	2.916
12/16/2013 10:15	26.981	14.651	11.279	16.936	11.374	7.265	13.153	18.138	12/16/2013 10:15	2.911
12/16/2013 10:30	26.977	14.647	11.275	16.932	11.371	7.265	13.150	18.140	12/16/2013 10:30	2.909
12/16/2013 10:45	26.978	14.645	11.274	16.931	11.371	7.262	13.150	18.140	12/16/2013 10:45	2.908
12/16/2013 11:00	26.978	14.645	11.276	16.933	11.367	7.260	13.147	18.136	12/16/2013 11:00	2.897
12/16/2013 11:15	26.975	14.639	11.268	16.925	11.363	7.258	13.146	18.130	12/16/2013 11:15	2.898
12/16/2013 11:30		14.638	11.269	16.923			13.143	18.130	12/16/2013 11:30	2.895
12/16/2013 11:45			11.263				13.143		12/16/2013 11:45	2.879
12/16/2013 12:00	26.997	14.632	11.253	16.920	11.353	7.250	13.136	18.124	12/16/2013 12:00	2.877
12/16/2013 12:00	26.966	14.632	11.254	16.924	11.354	7.249	13.135	18.130	12/16/2013 12:15	2.870
12/16/2013 12:00	26.983	14.632	11.253	16.922	11.355	7.247	13.137	18.126	12/16/2013 12:30	2.868
12/16/2013 12:00	26.970	14.629	11.253	16.921	11.356	7.249	13.136	18.128	12/16/2013 12:45	2.868
12/16/2013 12:00	26.980	14.629	11.253	16.921	11.357	7.246	13.133	18.125	12/16/2013 13:00	2.858
12/16/2013 12:00	26.975	14.630	11.250	16.924	11.356	7.248	13.136	18.128	12/16/2013 13:15	2.864
12/16/2013 12:00	26.970	14.628	11.258	16.923	11.350	7.247	13.135	18.122	12/16/2013 13:30	2.851
12/16/2013 12:00	26.959	14.632	11.255	16.921	11.352	7.246	13.134	18.126	12/16/2013 13:45	2.852
12/16/2013 12:00	26.980	14.629	11.250	16.922	11.352	7.245	13.137	18.126	12/16/2013 14:00	2.849
12/16/2013 12:00	26.976	14.632	11.253	16.921	11.352	7.245	13.134	18.125	12/16/2013 14:15	2.853
12/16/2013 12:00	26.975	14.630	11.252	16.921	11.349	7.246	13.136	18.124	12/16/2013 14:30	2.849
12/16/2013 12:00	26.976	14.631	11.253	16.919	11.353	7.244	13.136	18.126	12/16/2013 14:45	2.846
12/16/2013 12:00	26.963	14.629	11.252	16.919	11.353	7.244	13.134	18.123	12/16/2013 15:00	2.848
12/16/2013 12:00	26.980	14.628	11.252	16.919	11.355	7.246	13.135	18.122	12/16/2013 15:15	2.848

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 12:00	26.970	14.623	11.251	16.919	11.354	7.245	13.133	18.127	12/16/2013 15:30	2.844
12/16/2013 12:00	26.983	14.622	11.249	16.923	11.350	7.247	13.136	18.125	12/16/2013 15:45	2.842
12/16/2013 12:00	25.651	14.614	11.248	16.916	11.341	7.245	13.136	18.129	12/16/2013 16:00	2.844
12/16/2013 12:00	20.255	14.607	11.246	16.922	11.335	7.246	13.134	18.127	12/16/2013 16:15	2.880
12/16/2013 12:00	22.988	14.589	11.245	16.917	11.327	7.247	13.133	18.126	12/16/2013 16:30	2.877
12/16/2013 12:00	21.474	14.570	11.238	16.921	11.307	7.246	13.131	18.126	12/16/2013 16:45	2.878
12/16/2013 12:00	22.428	14.556	11.228	16.918	11.289	7.245	13.131	18.127	12/16/2013 17:00	2.870
12/16/2013 12:00	24.786	14.537	11.217	16.919	11.281	7.247	13.133	18.127	12/16/2013 17:15	2.866
12/16/2013 12:00	27.100	14.522	11.210	16.919	11.258	7.244	13.131	18.124	12/16/2013 17:30	2.862
12/16/2013 12:00	24.583	14.504	11.198	16.918	11.235	7.246	13.130	18.124	12/16/2013 17:45	2.860
12/16/2013 12:00	24.464	14.473	11.188	16.917	11.204	7.245	13.127	18.127	12/16/2013 18:00	2.858
12/16/2013 12:00	21.659	14.432	11.167	16.916	11.163	7.244	13.125	18.126	12/16/2013 18:15	2.854
12/16/2013 12:00	20.236	14.380	11.141	16.915	11.111	7.244	13.120	18.126	12/16/2013 18:30	2.852
12/16/2013 12:00	19.428	14.315	11.109	16.915	11.050	7.244	13.118	18.126	12/16/2013 18:45	2.848
12/16/2013 12:00	18.716	14.252	11.074	16.910	10.987	7.244	13.111	18.126	12/16/2013 19:00	2.847
12/16/2013 12:00	17.596	14.183	11.036	16.909	10.919	7.246	13.103	18.125	12/16/2013 19:15	2.846
12/16/2013 12:00	16.530	14.103	10.992	16.905	10.848	7.245	13.094	18.124	12/16/2013 19:30	2.844
12/16/2013 12:00	16.381	14.020	10.938	16.900	10.758	7.247	13.081	18.121	12/16/2013 19:45	2.846
12/16/2013 12:00	15.481	13.945	10.890	16.890	10.687	7.245	13.068	18.119	12/16/2013 20:00	2.842
12/16/2013 12:00	14.943	13.856	10.826	16.882	10.596	7.243	13.052	18.119	12/16/2013 20:15	2.843
12/16/2013 12:00	14.369	13.774	10.762	16.873	10.510	7.244	13.030	18.120	12/16/2013 20:30	2.845
12/16/2013 12:00	13.956	13.701	10.691	16.862	10.434	7.245	13.012	18.118	12/16/2013 20:45	2.845
12/16/2013 12:00	13.264	13.630	10.623	16.851	10.354	7.246	12.988	18.117	12/16/2013 21:00	2.842
12/16/2013 12:00	13.001	13.570	10.551	16.837	10.290	7.247	12.960	18.114	12/16/2013 21:15	2.841
12/16/2013 12:00	12.948	13.519	10.469	16.823	10.228	7.245	12.931	18.112	12/16/2013 21:30	2.838
12/16/2013 12:00	12.772	13.480	10.401	16.804	10.178	7.247	12.901	18.109	12/16/2013 21:45	2.838
12/16/2013 12:00	12.595	13.450	10.335	16.788	10.144	7.247	12.870	18.106	12/16/2013 22:00	2.840
12/16/2013 12:00	12.657	13.423	10.271	16.767	10.116	7.246	12.842	18.102	12/16/2013 22:15	2.841
12/16/2013 12:00	12.317	13.401	10.215	16.750	10.088	7.247	12.811	18.100	12/16/2013 22:30	2.837
12/16/2013 12:00	12.446	13.370	10.167	16.733	10.060	7.245	12.783	18.095	12/16/2013 22:45	2.841

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 12:00	12.119	13.327	10.116	16.712	10.026	7.247	12.753	18.091	12/16/2013 23:00	2.838
12/16/2013 12:00	12.104	13.283	10.074	16.689	9.979	7.247	12.722	18.078	12/16/2013 23:15	2.832
12/16/2013 12:00	12.476	13.229	10.027	16.669	9.926	7.246	12.690	18.073	12/16/2013 23:30	2.832
12/16/2013 12:00	11.821	13.177	9.992	16.654	9.878	7.245	12.658	18.068	12/16/2013 23:45	2.831
12/16/2013 12:00	11.761	13.138	9.952	16.632	9.835	7.247	12.626	18.057	12/17/2013 0:00	2.827
12/16/2013 12:00	11.980	13.115	9.909	16.611	9.799	7.247	12.586	18.051	12/17/2013 0:15	2.835
12/16/2013 12:00	11.957	13.098	9.869	16.590	9.774	7.246	12.559	18.039	12/17/2013 0:30	2.831
12/16/2013 12:00	11.887	13.081	9.831	16.570	9.749	7.247	12.528	18.033	12/17/2013 0:45	2.836
12/16/2013 12:00	11.882	13.055	9.789	16.549	9.729	7.246	12.497	18.022	12/17/2013 1:00	2.829
12/16/2013 12:00	11.730	13.018	9.761	16.530	9.695	7.247	12.468	18.013	12/17/2013 1:15	2.828
12/16/2013 12:00	11.304	12.977	9.722	16.509	9.655	7.245	12.436	18.003	12/17/2013 1:30	2.819
12/16/2013 12:00	11.482	12.948	9.683	16.488	9.619	7.246	12.405	17.991	12/17/2013 1:45	2.823
12/16/2013 12:00	11.547	12.931	9.663	16.468	9.597	7.245	12.376	17.980	12/17/2013 2:00	2.829
12/16/2013 12:00	11.413	12.909	9.626	16.448	9.575	7.247	12.347	17.967	12/17/2013 2:15	2.813
12/16/2013 12:00	11.335	12.879	9.595	16.428	9.553	7.245	12.316	17.956	12/17/2013 2:30	2.811
12/16/2013 12:00	11.564	12.850	9.568	16.408	9.514	7.242	12.285	17.944	12/17/2013 2:45	2.810
12/16/2013 12:00	11.337	12.826	9.532	16.389	9.493	7.245	12.256	17.932	12/17/2013 3:00	2.819
12/16/2013 12:00	11.517	12.808	9.505	16.369	9.470	7.242	12.231	17.918	12/17/2013 3:15	2.820
12/16/2013 12:00	11.272	12.779	9.477	16.347	9.439	7.243	12.202	17.906	12/17/2013 3:30	2.823
12/16/2013 12:00	11.049	12.754	9.449	16.328	9.411	7.241	12.173	17.893	12/17/2013 3:45	2.829
12/16/2013 12:01	11.458	12.734	9.419	16.309	9.391	7.240	12.148	17.878	12/17/2013 4:00	2.832
12/16/2013 12:01	11.311	12.714	9.395	16.289	9.369	7.238	12.121	17.863	12/17/2013 4:15	2.833
12/16/2013 12:01	10.898	12.693	9.371	16.271	9.346	7.236	12.095	17.852	12/17/2013 4:30	2.836
12/16/2013 12:01	11.072	12.665	9.344	16.252	9.320	7.235	12.065	17.836	12/17/2013 4:45	2.836
12/16/2013 12:01	11.188	12.643	9.319	16.230	9.301	7.233	12.039	17.822	12/17/2013 5:00	2.841
12/16/2013 12:01	11.234	12.623	9.295	16.214	9.274	7.230	12.017	17.810	12/17/2013 5:15	2.840
12/16/2013 12:01	11.054	12.604	9.267	16.197	9.253	7.230	11.994	17.796	12/17/2013 5:30	2.841
12/16/2013 12:01	11.296	12.583	9.246	16.178	9.230	7.226	11.967	17.780	12/17/2013 5:45	2.841
12/16/2013 12:01	10.964	12.562	9.182	16.162	9.210	7.227	11.946	17.766	12/17/2013 6:00	2.838
12/16/2013 12:01	11.085	12.543	9.193	16.141	9.186	7.225	11.922	17.754	12/17/2013 6:15	2.839

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 12:01	10.993	12.528	9.182	16.124	9.167	7.220	11.896	17.735	12/17/2013 6:30	2.845
12/16/2013 12:01	11.067	12.504	9.157	16.111	9.147	7.219	11.877	17.727	12/17/2013 6:45	2.842
12/16/2013 12:01	10.786	12.487	9.133	16.092	9.127	7.214	11.856	17.712	12/17/2013 7:00	2.869
12/16/2013 12:02	10.815	12.473	9.115	16.076	9.113	7.211	11.835	17.699	12/17/2013 7:15	2.841
12/16/2013 12:02	10.605	12.450	9.094	16.056	9.088	7.208	11.812	17.687	12/17/2013 7:30	2.846
12/16/2013 12:02	10.586	12.441	9.079	16.041	9.076	7.204	11.796	17.674	12/17/2013 7:45	2.850
12/16/2013 12:02	11.383	12.423	9.058	16.029	9.060	7.201	11.775	17.661	12/17/2013 8:00	2.848
12/16/2013 12:02	11.154	12.405	9.041	16.014	9.041	7.196	11.759	17.650	12/17/2013 8:15	2.856
12/16/2013 12:02	10.728	12.391	9.027	16.000	9.025	7.195	11.742	17.640	12/17/2013 8:30	2.846
12/16/2013 12:02	10.393	12.375	9.004	15.987	9.011	7.189	11.723	17.624	12/17/2013 8:45	2.843
12/16/2013 12:03	10.830	12.367	8.996	15.972	8.999	7.187	11.709	17.616	12/17/2013 9:00	2.852
12/16/2013 12:03	10.959	12.353	8.976	15.964	8.986	7.180	11.694	17.605	12/17/2013 9:15	2.848
12/16/2013 12:03	10.641	12.342	8.963	15.951	8.969	7.176	11.680	17.596	12/17/2013 9:30	2.850
12/16/2013 12:03	11.164	12.329	8.951	15.940	8.957	7.171	11.669	17.585	12/17/2013 9:45	2.850
12/16/2013 12:03	10.771	12.316	8.942	15.928	8.947	7.168	11.654	17.574	12/17/2013 10:00	2.850
12/16/2013 12:04	10.787	12.304	8.928	15.917	8.932	7.164	11.638	17.563	12/17/2013 10:15	2.850
12/16/2013 12:04	10.785	12.295	8.917	15.909	8.920	7.157	11.629	17.557	12/17/2013 10:30	2.858
12/16/2013 12:04	11.012	12.285	8.910	15.899	8.909	7.154	11.622	17.550	12/17/2013 10:45	2.849
12/16/2013 12:05	11.103	12.274	8.896	15.892	8.902	7.148	11.609	17.545	12/17/2013 11:00	2.845
12/16/2013 12:05	10.541	12.266	8.889	15.882	8.892	7.142	11.601	17.539	12/17/2013 11:15	2.854
12/16/2013 12:05	10.805	12.260	8.879	15.876	8.890	7.135	11.592	17.532	12/17/2013 11:30	2.845
12/16/2013 12:05	10.316	12.254	8.875	15.870	8.883	7.132	11.585	17.527	12/17/2013 11:45	2.849
12/16/2013 12:06	11.149	12.249	8.867	15.864	8.874	7.127	11.579	17.521	12/17/2013 12:00	2.854
12/16/2013 12:06	11.017	12.241	8.858	15.859	8.867	7.122	11.573	17.515	12/17/2013 12:15	2.843
12/16/2013 12:07	10.432	12.240	8.858	15.854	8.867	7.119	11.569	17.514	12/17/2013 12:30	2.840
12/16/2013 12:07	10.501	12.233	8.851	15.850	8.861	7.114	11.563	17.507	12/17/2013 12:45	2.835
12/16/2013 12:07	10.842	12.230	8.851	15.846	8.855	7.110	11.560	17.503	12/17/2013 13:00	2.828
12/16/2013 12:08	10.664	12.225	8.839	15.844	8.848	7.108	11.555	17.502	12/17/2013 13:15	2.835
12/16/2013 12:08	10.650	12.223	8.839	15.840	8.845	7.105	11.551	17.499	12/17/2013 13:30	2.839
12/16/2013 12:09	10.566	12.222	8.836	15.838	8.850	7.099	11.549	17.498	12/17/2013 13:45	2.831

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 12:10	10.276	12.221	8.837	15.838	8.843	7.096	11.545	17.497	12/17/2013 14:00	2.842
12/16/2013 12:10	10.696	12.216	8.833	15.834	8.843	7.095	11.545	17.494	12/17/2013 14:15	2.845
12/16/2013 12:11	10.636	12.218	8.826	15.835	8.842	7.092	11.544	17.489	12/17/2013 14:30	2.844
12/16/2013 12:11	10.582	12.219	8.828	15.831	8.839	7.089	11.542	17.490	12/17/2013 14:45	2.838
12/16/2013 12:12	10.714	12.216	8.826	15.831	8.840	7.085	11.540	17.494	12/17/2013 15:00	2.847
12/16/2013 12:13	10.754	12.212	8.825	15.830	8.836	7.087	11.539	17.488	12/17/2013 15:15	2.847
12/16/2013 12:14	10.764	12.214	8.823	15.828	8.837	7.084	11.535	17.486	12/17/2013 15:30	2.845
12/16/2013 12:15	10.830	12.207	8.824	15.825	8.834	7.079	11.534	17.486	12/17/2013 15:45	2.849
12/16/2013 12:15	10.723	12.210	8.823	15.826	8.833	7.077	11.535	17.485	12/17/2013 16:00	2.845
12/16/2013 12:16	10.779	12.203	8.820	15.827	8.829	7.076	11.534	17.485	12/17/2013 16:15	2.843
12/16/2013 12:17	10.460	12.204	8.819	15.824	8.829	7.075	11.533	17.485	12/17/2013 16:30	2.844
12/16/2013 12:18	10.689	12.208	8.819	15.826	8.833	7.073	11.532	17.480	12/17/2013 16:45	2.848
12/16/2013 12:19	10.689	12.205	8.820	15.820	8.833	7.070	11.533	17.484	12/17/2013 17:00	2.848
12/16/2013 12:21	10.625	12.207	8.821	15.823	8.829	7.072	11.533	17.478	12/17/2013 17:15	2.854
12/16/2013 12:22	10.730	12.207	8.819	15.821	8.832	7.072	11.530	17.481	12/17/2013 17:30	2.853
12/16/2013 12:23	11.008	12.200	8.816	15.820	8.825	7.067	11.530	17.478	12/17/2013 17:45	2.857
12/16/2013 12:25	10.781	12.204	8.812	15.819	8.828	7.065	11.528	17.478	12/17/2013 18:00	2.860
12/16/2013 12:26	10.632	12.205	8.814	15.821	8.826	7.066	11.530	17.483	12/17/2013 18:15	2.861
12/16/2013 12:28	10.618	12.196	8.813	15.820	8.825	7.063	11.527	17.480	12/17/2013 18:30	2.861
12/16/2013 12:29	10.703	12.199	8.816	15.821	8.825	7.062	11.529	17.480	12/17/2013 18:45	2.858
12/16/2013 12:31	10.615	12.200	8.812	15.819	8.825	7.057	11.526	17.481	12/17/2013 19:00	2.861
12/16/2013 12:33	10.701	12.199	8.814	15.815	8.822	7.057	11.526	17.476	12/17/2013 19:15	2.859
12/16/2013 12:35	10.577	12.194	8.811	15.814	8.823	7.055	11.525	17.478	12/17/2013 19:30	2.862
12/16/2013 12:37	10.811	12.199	8.813	15.814	8.823	7.054	11.522	17.474	12/17/2013 19:45	2.860
12/16/2013 12:39	10.610	12.197	8.811	15.812	8.829	7.054	11.524	17.477	12/17/2013 20:00	2.860
12/16/2013 12:42	10.956	12.191	8.807	15.813	8.818	7.050	11.520	17.476	12/17/2013 20:15	2.867
12/16/2013 12:44	10.633	12.197	8.817	15.815	8.821	7.048	11.521	17.471	12/17/2013 20:30	2.868
12/16/2013 12:47	10.688	12.202	8.807	15.815	8.825	7.046	11.528	17.471	12/17/2013 20:45	2.866
12/16/2013 12:50	10.791	12.197	8.812	15.816	8.822	7.046	11.524	17.469	12/17/2013 21:00	2.866
12/16/2013 12:53	10.836	12.194	8.808	15.808	8.818	7.040	11.520	17.470	12/17/2013 21:15	2.865

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 12:56	10.756	12.193	8.805	15.811	8.817	7.036	11.519	17.467	12/17/2013 21:30	2.863
12/16/2013 12:59	10.927	12.192	8.802	15.812	8.818	7.039	11.517	17.473	12/17/2013 21:45	2.864
12/16/2013 13:03	10.701	12.186	8.805	15.808	8.811	7.035	11.519	17.468	12/17/2013 22:00	2.862
12/16/2013 13:06	10.855	12.192	8.805	15.804	8.810	7.034	11.515	17.467	12/17/2013 22:15	2.865
12/16/2013 13:10	10.711	12.185	8.801	15.807	8.811	7.031	11.517	17.463	12/17/2013 22:30	2.859
12/16/2013 13:15	10.728	12.189	8.804	15.806	8.815	7.029	11.512	17.468	12/17/2013 22:45	2.865
12/16/2013 13:19	10.863	12.184	8.796	15.801	8.807	7.027	11.511	17.464	12/17/2013 23:00	2.871
12/16/2013 13:24	10.568	12.183	8.799	15.799	8.806	7.021	11.511	17.463	12/17/2013 23:15	2.861
12/16/2013 13:29	10.678	12.183	8.797	15.797	8.808	7.018	11.509	17.461	12/17/2013 23:30	2.869
12/16/2013 13:34	10.832	12.179	8.798	15.800	8.807	7.017	11.510	17.457	12/17/2013 23:45	2.865
12/16/2013 13:40	10.818	12.178	8.792	15.796	8.801	7.014	11.507	17.455	12/18/2013 0:00	2.865
12/16/2013 13:46	10.736	12.178	8.793	15.796	8.802	7.012	11.505	17.457	12/18/2013 0:15	2.864
12/16/2013 13:52	10.503	12.173	8.791	15.793	8.800	7.007	11.505	17.454	12/18/2013 0:30	2.864
12/16/2013 13:59	10.643	12.173	8.790	15.794	8.802	7.006	11.505	17.453	12/18/2013 0:45	2.869
12/16/2013 14:06	10.840	12.171	8.787	15.793	8.794	7.000	11.501	17.453	12/18/2013 1:00	2.871
12/16/2013 14:13	10.816	12.170	8.788	15.793	8.796	6.998	11.500	17.454	12/18/2013 1:15	2.867
12/16/2013 14:21	10.647	12.172	8.786	15.791	8.799	6.995	11.500	17.450	12/18/2013 1:30	2.870
12/16/2013 14:30	10.581	12.166	8.786	15.794	8.793	6.993	11.500	17.448	12/18/2013 1:45	2.870
12/16/2013 14:38	10.396	12.168	8.784	15.788	8.793	6.991	11.497	17.448	12/18/2013 2:00	2.859
12/16/2013 14:48	10.959	12.164	8.778	15.791	8.791	6.986	11.492	17.445	12/18/2013 2:15	2.860
12/16/2013 14:58	10.498	12.165	8.779	15.787	8.790	6.985	11.496	17.443	12/18/2013 2:30	2.859
12/16/2013 15:08	10.731	12.163	8.776	15.786	8.784	6.979	11.491	17.441	12/18/2013 2:45	2.856
12/16/2013 15:19	10.580	12.165	8.776	15.784	8.786	6.975	11.491	17.440	12/18/2013 3:00	2.855
12/16/2013 15:31	10.927	12.156	8.771	15.782	8.779	6.973	11.486	17.436	12/18/2013 3:15	2.853
12/16/2013 15:44	10.742	12.160	8.772	15.778	8.782	6.968	11.484	17.433	12/18/2013 3:30	2.850
12/16/2013 15:57	10.640	12.159	8.767	15.776	8.778	6.964	11.482	17.430	12/18/2013 3:45	2.853
12/16/2013 16:11	10.652	12.174	8.781	15.792	8.793	6.965	11.497	17.440	12/18/2013 4:00	2.850
12/16/2013 16:26	10.655	12.169	8.779	15.787	8.788	6.962	11.492	17.435	12/18/2013 4:15	2.851
12/16/2013 16:41	10.754	12.167	8.777	15.786	8.786	6.959	11.488	17.434	12/18/2013 4:30	2.847
12/16/2013 16:56	10.647	12.167	8.772	15.784	8.786	6.957	11.487	17.431	12/18/2013 4:45	2.847

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/16/2013 17:11	10.536	12.166	8.770	15.781	8.785	6.953	11.485	17.429	12/18/2013 5:00	2.851
12/16/2013 17:26	10.601	12.160	8.767	15.777	8.779	6.946	11.481	17.429	12/18/2013 5:15	2.845
12/16/2013 17:41	10.645	12.155	8.763	15.777	8.772	6.945	11.480	17.424	12/18/2013 5:30	2.848
12/16/2013 17:56	10.584	12.156	8.765	15.772	8.772	6.943	11.477	17.420	12/18/2013 5:45	2.845
12/16/2013 18:11	11.010	12.147	8.755	15.766	8.765	6.938	11.474	17.417	12/18/2013 6:00	2.845
12/16/2013 18:26	10.736	12.147	8.753	15.765	8.765	6.934	11.471	17.414	12/18/2013 6:15	2.846
12/16/2013 18:41	10.622	12.144	8.753	15.765	8.765	6.931	11.468	17.412	12/18/2013 6:30	2.848
12/16/2013 18:56	10.465	12.144	8.754	15.761	8.763	6.929	11.467	17.411	12/18/2013 6:45	2.848
12/16/2013 19:11	10.649	12.140	8.749	15.760	8.759	6.924	11.463	17.409	12/18/2013 7:00	2.845
12/16/2013 19:26	10.753	12.137	8.749	15.759	8.759	6.924	11.461	17.406	12/18/2013 7:15	2.849
12/16/2013 19:41	10.870	12.134	8.745	15.753	8.753	6.918	11.458	17.402	12/18/2013 7:30	2.847
12/16/2013 19:56	10.898	12.136	8.743	15.752	8.753	6.915	11.461	17.403	12/18/2013 7:45	2.846
12/16/2013 20:11	10.731	12.135	8.743	15.752	8.751	6.915	11.458	17.402	12/18/2013 8:00	2.841
12/16/2013 20:26	10.693	12.134	8.742	15.751	8.748	6.912	11.458	17.399	12/18/2013 8:15	2.841
12/16/2013 20:41	10.841	12.131	8.741	15.751	8.751	6.908	11.456	17.402	12/18/2013 8:30	2.842
12/16/2013 20:56	11.082	12.128	8.737	15.748	8.744	6.906	11.452	17.395	12/18/2013 8:45	2.838
12/16/2013 21:11	10.791	12.131	8.738	15.748	8.748	6.903	11.451	17.396	12/18/2013 9:00	2.837
12/16/2013 21:26	10.812	12.128	8.735	15.744	8.748	6.899	11.451	17.391	12/18/2013 9:15	2.837
12/16/2013 21:41	10.661	12.123	8.734	15.741	8.743	6.898	11.447	17.390	12/18/2013 9:30	2.833
12/16/2013 21:56	10.499	12.119	8.732	15.741	8.740	6.899	11.444	17.392	12/18/2013 9:45	2.835
12/16/2013 22:11	10.603	12.120	8.728	15.739	8.738	6.894	11.444	17.388	12/18/2013 10:00	2.834
12/16/2013 22:26	10.519	12.121	8.727	15.738	8.739	6.894	11.442	17.387	12/18/2013 10:15	2.832
12/16/2013 22:41	10.557	12.118	8.727	15.742	8.741	6.890	11.441	17.385	12/18/2013 10:30	2.836
12/16/2013 22:56	10.777	12.120	8.727	15.738	8.739	6.887	11.441	17.384	12/18/2013 10:45	2.837
12/16/2013 23:11	10.785	12.115	8.720	15.732	8.731	6.884	11.434	17.385	12/18/2013 11:00	2.835
12/16/2013 23:26	10.724	12.113	8.722	15.733	8.729	6.883	11.437	17.379	12/18/2013 11:15	2.833
12/16/2013 23:41	10.517	12.114	8.718	15.732	8.732	6.882	11.434	17.377	12/18/2013 11:30	2.833
12/16/2013 23:56	11.029	12.108	8.720	15.731	8.727	6.876	11.432	17.377	12/18/2013 11:45	2.835
12/17/2013 0:11	10.787	12.109	8.713	15.731	8.725	6.876	11.431	17.374	12/18/2013 12:00	2.834
12/17/2013 0:26	10.896	12.106	8.713	15.725	8.725	6.874	11.430	17.372	12/18/2013 12:15	2.828

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/17/2013 0:41	11.001	12.106	8.710	15.724	8.721	6.871	11.428	17.372	12/18/2013 12:30	2.829
12/17/2013 0:56	10.701	12.110	8.715	15.723	8.727	6.870	11.428	17.370	12/18/2013 12:45	2.830
12/17/2013 1:11	10.713	12.105	8.714	15.725	8.724	6.866	11.425	17.366	12/18/2013 13:00	2.833
12/17/2013 1:26	10.898	12.102	8.707	15.716	8.717	6.866	11.421	17.362	12/18/2013 13:15	2.825
12/17/2013 1:41	10.678	12.097	8.708	15.715	8.720	6.864	11.420	17.365	12/18/2013 13:30	2.832
12/17/2013 1:56	10.505	12.096	8.705	15.716	8.718	6.862	11.420	17.361	12/18/2013 13:45	2.835
12/17/2013 2:11	10.631	12.097	8.707	15.718	8.716	6.861	11.416	17.365	12/18/2013 14:00	2.836
12/17/2013 2:26	10.776	12.099	8.703	15.716	8.716	6.857	11.416	17.360	12/18/2013 14:15	2.832
12/17/2013 2:41	10.584	12.089	8.698	15.709	8.707	6.852	11.414	17.358	12/18/2013 14:30	2.832
12/17/2013 2:56	10.819	12.089	8.693	15.711	8.707	6.854	11.411	17.355	12/18/2013 14:45	2.831
12/17/2013 3:11	10.615	12.087	8.697	15.708	8.705	6.851	11.412	17.354	12/18/2013 15:00	2.828
12/17/2013 3:26	10.773	12.091	8.698	15.713	8.706	6.849	11.411	17.353	12/18/2013 15:15	2.836
12/17/2013 3:41	10.736	12.091	8.701	15.712	8.708	6.848	11.411	17.353	12/18/2013 15:30	2.831
12/17/2013 3:56	10.639	12.093	8.698	15.710	8.712	6.848	11.415	17.357	12/18/2013 15:45	2.831
12/17/2013 4:11	10.610	12.092	8.699	15.708	8.708	6.849	11.412	17.353	12/18/2013 16:00	2.830
12/17/2013 4:26	10.799	12.090	8.701	15.707	8.709	6.847	11.411	17.350	12/18/2013 16:15	2.831
12/17/2013 4:41	10.620	12.087	8.695	15.707	8.705	6.845	11.411	17.350	12/18/2013 16:30	2.834
12/17/2013 4:56	10.582	12.091	8.701	15.709	8.706	6.844	11.408	17.352	12/18/2013 16:45	2.838
12/17/2013 5:11	10.953	12.089	8.695	15.707	8.711	6.844	11.411	17.349	12/18/2013 17:00	2.839
12/17/2013 5:26	10.488	12.090	8.699	15.711	8.706	6.844	11.407	17.352	12/18/2013 17:15	2.845
12/17/2013 5:41	10.553	12.085	8.696	15.705	8.707	6.843	11.407	17.347	12/18/2013 17:30	2.846
12/17/2013 5:56	10.291	12.083	8.692	15.704	8.704	6.841	11.406	17.348	12/18/2013 17:45	2.845
12/17/2013 6:11	10.306	12.087	8.693	15.707	8.706	6.841	11.408	17.348	12/18/2013 18:00	2.847
12/17/2013 6:26	10.802	12.085	8.694	15.701	8.707	6.839	11.406	17.345	12/18/2013 18:15	2.846
12/17/2013 6:41	10.787	12.087	8.697	15.702	8.705	6.839	11.405	17.345	12/18/2013 18:30	2.842
12/17/2013 6:56	11.155	12.085	8.693	15.704	8.703	6.835	11.404	17.340	12/18/2013 18:45	2.846
12/17/2013 7:11	10.851	12.083	8.690	15.698	8.699	6.833	11.400	17.341	12/18/2013 19:00	2.841
12/17/2013 7:26	10.743	12.088	8.689	15.698	8.706	6.834	11.405	17.343	12/18/2013 19:15	2.842
12/17/2013 7:41	10.715	12.084	8.693	15.698	8.711	6.834	11.398	17.336	12/18/2013 19:30	2.841
12/17/2013 7:56	10.955	12.086	8.687	15.695	8.704	6.833	11.399	17.337	12/18/2013 19:45	2.841

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/17/2013 8:11	10.724	12.082	8.688	15.699	8.697	6.829	11.398	17.335	12/18/2013 20:00	2.842
12/17/2013 8:26	10.790	12.079	8.689	15.695	8.701	6.831	11.398	17.335	12/18/2013 20:15	2.844
12/17/2013 8:41	10.725	12.081	8.688	15.694	8.701	6.828	11.397	17.333	12/18/2013 20:30	2.841
12/17/2013 8:56	10.391	12.082	8.691	15.696	8.696	6.828	11.399	17.336	12/18/2013 20:45	2.842
12/17/2013 9:11	10.482	12.078	8.686	15.691	8.701	6.827	11.398	17.331	12/18/2013 21:00	2.843
12/17/2013 9:26	10.615	12.078	8.689	15.694	8.696	6.826	11.395	17.329	12/18/2013 21:15	2.840
12/17/2013 9:41	10.794	12.078	8.684	15.695	8.695	6.824	11.394	17.330	12/18/2013 21:30	2.839
12/17/2013 9:56	10.442	12.076	8.684	15.692	8.695	6.825	11.394	17.331	12/18/2013 21:45	2.840
12/17/2013 10:11	10.814	12.078	8.684	15.693	8.695	6.824	11.395	17.329	12/18/2013 22:00	2.839
12/17/2013 10:26	10.815	12.076	8.685	15.694	8.689	6.824	11.394	17.329	12/18/2013 22:15	2.840
12/17/2013 10:41	10.677	12.076	8.686	15.697	8.694	6.821	11.395	17.329	12/18/2013 22:30	2.839
12/17/2013 10:56	10.642	12.071	8.684	15.692	8.696	6.821	11.391	17.326	12/18/2013 22:45	2.839
12/17/2013 11:11	10.568	12.075	8.684	15.700	8.694	6.819	11.391	17.325	12/18/2013 23:00	2.839
12/17/2013 11:26	11.137	12.072	8.682	15.692	8.697	6.819	11.392	17.327	12/18/2013 23:15	2.838
12/17/2013 11:41	10.678	12.073	8.684	15.694	8.697	6.819	11.389	17.322	12/18/2013 23:30	2.837
12/17/2013 11:56	10.678	12.071	8.679	15.688	8.693	6.820	11.389	17.324	12/18/2013 23:45	2.837
12/17/2013 12:11	10.753	12.070	8.678	15.689	8.686	6.819	11.387	17.320	12/19/2013 0:00	2.838
12/17/2013 12:26	10.795	12.068	8.674	15.686	8.685	6.814	11.385	17.323	12/19/2013 0:15	2.833
12/17/2013 12:41	10.490	12.066	8.671	15.687	8.687	6.816	11.381	17.323	12/19/2013 0:30	2.828
12/17/2013 12:56	10.763	12.067	8.678	15.682	8.689	6.811	11.379	17.317	12/19/2013 0:45	2.810
12/17/2013 13:11	11.111	12.060	8.670	15.677	8.684	6.810	11.377	17.315	12/19/2013 1:00	2.790
12/17/2013 13:26	10.813	12.060	8.671	15.679	8.683	6.808	11.379	17.313	12/19/2013 1:15	2.778
12/17/2013 13:41	10.633	12.057	8.670	15.678	8.680	6.807	11.379	17.315	12/19/2013 1:30	2.757
12/17/2013 13:56	10.836	12.061	8.670	15.682	8.685	6.811	11.380	17.313	12/19/2013 1:45	2.741
12/17/2013 14:11	10.789	12.063	8.670	15.679	8.680	6.809	11.379	17.312	12/19/2013 2:00	2.731
12/17/2013 14:26	10.746	12.057	8.673	15.681	8.681	6.807	11.378	17.312	12/19/2013 2:15	2.722
12/17/2013 14:41	10.804	12.059	8.668	15.681	8.683	6.807	11.378	17.310	12/19/2013 2:30	2.714
12/17/2013 14:56	10.820	12.062	8.665	15.682	8.681	6.805	11.378	17.309	12/19/2013 2:45	2.703
12/17/2013 15:11	10.590	12.062	8.669	15.676	8.680	6.803	11.383	17.309	12/19/2013 3:00	2.701
12/17/2013 15:26	10.544	12.065	8.667	15.679	8.681	6.806	11.379	17.309	12/19/2013 3:15	2.696

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/17/2013 15:41	10.566	12.061	8.667	15.680	8.682	6.804	11.377	17.312	12/19/2013 3:30	2.695
12/17/2013 15:56	10.357	12.057	8.665	15.675	8.679	6.805	11.379	17.313	12/19/2013 3:45	2.694
12/17/2013 16:11	10.795	12.060	8.666	15.677	8.681	6.802	11.379	17.305	12/19/2013 4:00	2.686
12/17/2013 16:26	10.601	12.064	8.671	15.680	8.685	6.803	11.381	17.307	12/19/2013 4:15	2.682
12/17/2013 16:41	10.892	12.062	8.668	15.679	8.684	6.800	11.380	17.307	12/19/2013 4:30	2.687
12/17/2013 16:56	10.980	12.064	8.673	15.679	8.685	6.803	11.381	17.307	12/19/2013 4:45	2.689
12/17/2013 17:11	10.476	12.067	8.672	15.680	8.686	6.801	11.381	17.308	12/19/2013 5:00	2.684
12/17/2013 17:26	10.608	12.063	8.670	15.684	8.686	6.799	11.380	17.306	12/19/2013 5:15	2.684
12/17/2013 17:41	10.518	12.066	8.670	15.683	8.687	6.801	11.380	17.308	12/19/2013 5:30	2.678
12/17/2013 17:56	10.775	12.062	8.671	15.679	8.685	6.800	11.380	17.304	12/19/2013 5:45	2.673
12/17/2013 18:11	10.446	12.063	8.669	15.683	8.685	6.801	11.380	17.303	12/19/2013 6:00	2.668
12/17/2013 18:26	10.707	12.059	8.668	15.678	8.681	6.799	11.379	17.306	12/19/2013 6:15	2.668
12/17/2013 18:41	10.575	12.059	8.668	15.677	8.683	6.801	11.379	17.301	12/19/2013 6:30	2.663
12/17/2013 18:56	10.768	12.061	8.670	15.681	8.684	6.798	11.378	17.301	12/19/2013 6:45	2.659
12/17/2013 19:11	10.363	12.062	8.669	15.680	8.684	6.800	11.381	17.301	12/19/2013 7:00	2.658
12/17/2013 19:26	10.672	12.060	8.669	15.679	8.683	6.798	11.377	17.305	12/19/2013 7:15	2.657
12/17/2013 19:41	10.481	12.061	8.670	15.676	8.684	6.796	11.377	17.299	12/19/2013 7:30	2.656
12/17/2013 19:56	10.788	12.060	8.667	15.677	8.685	6.797	11.376	17.302	12/19/2013 7:45	2.654
12/17/2013 20:11	10.373	12.064	8.668	15.678	8.683	6.797	11.379	17.302	12/19/2013 8:00	2.660
12/17/2013 20:26	10.624	12.059	8.669	15.678	8.686	6.798	11.376	17.298	12/19/2013 8:15	2.647
12/17/2013 20:41	10.661	12.057	8.668	15.677	8.680	6.797	11.377	17.299	12/19/2013 8:30	2.646
12/17/2013 20:56	10.725	12.062	8.668	15.676	8.683	6.797	11.378	17.298	12/19/2013 8:45	2.647
12/17/2013 21:11	10.579	12.060	8.669	15.675	8.685	6.797	11.376	17.297	12/19/2013 9:00	2.648
12/17/2013 21:26	11.026	12.063	8.670	15.678	8.685	6.796	11.377	17.295	12/19/2013 9:15	2.649
12/17/2013 21:41	10.528	12.063	8.665	15.674	8.683	6.795	11.372	17.295	12/19/2013 9:30	2.657
12/17/2013 21:56	10.656	12.053	8.666	15.674	8.678	6.792	11.375	17.298	12/19/2013 9:45	2.660
12/17/2013 22:11	10.808	12.058	8.666	15.673	8.678	6.793	11.372	17.298	12/19/2013 10:00	2.665
12/17/2013 22:26	10.923	12.059	8.665	15.671	8.674	6.792	11.371	17.292	12/19/2013 10:15	2.665
12/17/2013 22:41	10.355	12.056	8.662	15.675	8.683	6.794	11.371	17.291	12/19/2013 10:30	2.667
12/17/2013 22:56	10.518	12.057	8.667	15.673	8.676	6.794	11.373	17.294	12/19/2013 10:45	2.673

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/17/2013 23:11	10.865	12.056	8.665	15.675	8.679	6.792	11.372	17.293	12/19/2013 11:00	2.673
12/17/2013 23:26	10.755	12.052	8.664	15.669	8.673	6.792	11.371	17.290	12/19/2013 11:15	2.671
12/17/2013 23:41	10.818	12.053	8.660	15.669	8.680	6.791	11.369	17.295	12/19/2013 11:30	2.671
12/17/2013 23:56	10.578	12.053	8.662	15.668	8.676	6.790	11.371	17.292	12/19/2013 11:45	2.667
12/18/2013 0:11	10.858	12.054	8.662	15.673	8.678	6.791	11.370	17.293	12/19/2013 12:00	2.674
12/18/2013 0:26	10.363	12.054	8.665	15.668	8.681	6.791	11.371	17.288	12/19/2013 12:15	2.666
12/18/2013 0:41	10.601	12.056	8.662	15.673	8.680	6.791	11.371	17.289	12/19/2013 12:30	2.661
12/18/2013 0:56	10.830	12.053	8.664	15.668	8.677	6.790	11.367	17.288	12/19/2013 12:45	2.657
12/18/2013 1:11	10.982	12.053	8.662	15.668	8.680	6.790	11.368	17.292	12/19/2013 13:00	2.659
12/18/2013 1:26	10.826	12.052	8.661	15.668	8.674	6.790	11.368	17.288	12/19/2013 13:15	2.657
12/18/2013 1:41	10.991	12.052	8.661	15.672	8.673	6.788	11.365	17.286	12/19/2013 13:30	2.652
12/18/2013 1:56	10.611	12.050	8.657	15.667	8.673	6.788	11.366	17.285	12/19/2013 13:45	2.650
12/18/2013 2:11	10.941	12.049	8.658	15.666	8.670	6.787	11.362	17.286	12/19/2013 14:00	2.647
12/18/2013 2:26	10.738	12.047	8.655	15.665	8.670	6.785	11.362	17.283	12/19/2013 14:15	2.646
12/18/2013 2:41	10.960	12.044	8.655	15.661	8.671	6.783	11.362	17.283	12/19/2013 14:30	2.641
12/18/2013 2:56	10.708	12.044	8.651	15.663	8.666	6.782	11.358	17.279	12/19/2013 14:45	2.637
12/18/2013 3:11	10.928	12.040	8.649	15.660	8.666	6.783	11.359	17.278	12/19/2013 15:00	2.649
12/18/2013 3:26	10.567	12.039	8.649	15.657	8.662	6.781	11.357	17.277	12/19/2013 15:15	2.644
12/18/2013 3:41	10.521	12.043	8.651	15.656	8.662	6.780	11.357	17.276	12/19/2013 15:30	2.651
12/18/2013 3:56	10.619	12.042	8.652	15.655	8.664	6.780	11.359	17.275	12/19/2013 15:45	2.655
12/18/2013 4:11	10.510	12.040	8.649	15.654	8.664	6.779	11.355	17.275	12/19/2013 16:00	2.657
12/18/2013 4:26	10.724	12.038	8.644	15.657	8.657	6.778	11.355	17.278	12/19/2013 16:15	2.658
12/18/2013 4:41	10.800	12.036	8.646	15.655	8.658	6.775	11.352	17.275	12/19/2013 16:30	2.669
12/18/2013 4:56	10.641	12.036	8.645	15.656	8.657	6.775	11.352	17.273	12/19/2013 16:45	2.662
12/18/2013 5:11	10.868	12.030	8.644	15.651	8.659	6.776	11.350	17.275	12/19/2013 17:00	2.671
12/18/2013 5:26	10.785	12.036	8.645	15.649	8.658	6.772	11.348	17.269	12/19/2013 17:15	2.673
12/18/2013 5:41	11.117	12.035	8.643	15.651	8.656	6.774	11.348	17.268	12/19/2013 17:30	2.670
12/18/2013 5:56	10.342	12.034	8.642	15.648	8.651	6.773	11.349	17.267	12/19/2013 17:45	2.675
12/18/2013 6:11	10.626	12.034	8.640	15.648	8.654	6.772	11.347	17.268	12/19/2013 18:00	2.676
12/18/2013 6:26	10.757	12.030	8.639	15.647	8.657	6.771	11.348	17.269	12/19/2013 18:15	2.670

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/18/2013 6:41	10.586	12.031	8.642	15.651	8.659	6.770	11.346	17.265	12/19/2013 18:30	2.675
12/18/2013 6:56	10.791	12.034	8.639	15.645	8.654	6.769	11.345	17.264	12/19/2013 18:45	2.672
12/18/2013 7:11	10.527	12.031	8.638	15.645	8.650	6.769	11.347	17.267	12/19/2013 19:00	2.676
12/18/2013 7:26	10.635	12.030	8.640	15.649	8.651	6.767	11.345	17.266	12/19/2013 19:15	2.678
12/18/2013 7:41	10.878	12.027	8.640	15.644	8.653	6.766	11.347	17.266	12/19/2013 19:30	2.679
12/18/2013 7:56	10.780	12.026	8.636	15.644	8.654	6.767	11.341	17.265	12/19/2013 19:45	2.674
12/18/2013 8:11	10.729	12.027	8.632	15.640	8.643	6.766	11.341	17.261	12/19/2013 20:00	2.681
12/18/2013 8:26	10.553	12.023	8.636	15.640	8.649	6.764	11.341	17.265	12/19/2013 20:15	2.678
12/18/2013 8:41	10.566	12.026	8.630	15.644	8.646	6.766	11.340	17.262	12/19/2013 20:30	2.679
12/18/2013 8:56	28.293	14.319	10.912	16.612	11.030	6.857	12.791	17.799	12/19/2013 20:45	2.676
12/18/2013 9:11	27.902	14.180	10.683	16.510	10.862	6.952	12.615	17.773	12/19/2013 21:00	2.686
12/18/2013 9:26	28.281	14.460	11.066	16.747	11.175	6.986	12.954	17.917	12/19/2013 21:15	2.686
12/18/2013 9:41	11.627	12.640	9.444	16.228	9.334	6.997	12.087	17.728	12/19/2013 21:30	2.688
12/18/2013 9:56	10.743	12.049	8.656	15.663	8.668	6.837	11.363	17.285	12/19/2013 21:45	2.687
12/18/2013 10:11	10.779	12.037	8.645	15.654	8.657	6.802	11.352	17.271	12/19/2013 22:00	2.691
12/18/2013 10:26	10.524	12.032	8.642	15.649	8.655	6.797	11.349	17.272	12/19/2013 22:15	2.688
12/18/2013 10:41	10.592	12.029	8.638	15.646	8.652	6.787	11.343	17.264	12/19/2013 22:30	2.689
12/18/2013 10:56	10.878	12.023	8.634	15.647	8.645	6.780	11.343	17.257	12/19/2013 22:45	2.693
12/18/2013 11:11	10.313	12.019	8.630	15.644	8.642	6.771	11.339	17.259	12/19/2013 23:00	2.694
12/18/2013 11:26	10.655	12.019	8.629	15.642	8.640	6.768	11.338	17.252	12/19/2013 23:15	2.697
12/18/2013 11:41	10.812	12.016	8.624	15.639	8.632	6.763	11.332	17.257	12/19/2013 23:30	2.696
12/18/2013 11:56	10.628	12.016	8.623	15.639	8.629	6.760	11.333	17.250	12/19/2013 23:45	2.695
12/18/2013 12:11	10.649	12.016	8.622	15.634	8.633	6.762	11.332	17.250	12/20/2013 0:00	2.699
12/18/2013 12:26	10.578	12.009	8.621	15.634	8.630	6.757	11.329	17.250	12/20/2013 0:15	2.702
12/18/2013 12:41	10.364	12.008	8.619	15.631	8.626	6.758	11.326	17.249	12/20/2013 0:30	2.697
12/18/2013 12:56	10.527	12.004	8.619	15.632	8.628	6.756	11.328	17.247	12/20/2013 0:45	2.696
12/18/2013 13:11	10.745	12.009	8.617	15.634	8.624	6.758	11.329	17.247	12/20/2013 1:00	2.702
12/18/2013 13:26	28.372	14.412	11.020	16.707	11.126	6.894	12.903	17.869	12/20/2013 1:15	2.714
12/18/2013 13:41	28.338	14.438	11.049	16.733	11.154	6.958	12.933	17.895	12/20/2013 1:30	2.715
12/18/2013 13:56	10.840	12.049	8.658	15.659	8.667	6.815	11.362	17.271	12/20/2013 1:45	2.708

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/18/2013 14:11	10.535	12.035	8.649	15.651	8.657	6.789	11.351	17.258	12/20/2013 2:00	2.707
12/18/2013 14:26	10.777	12.034	8.641	15.647	8.647	6.778	11.345	17.254	12/20/2013 2:15	2.702
12/18/2013 14:41	10.811	12.028	8.643	15.642	8.648	6.768	11.344	17.252	12/20/2013 2:30	2.698
12/18/2013 14:56	10.708	12.029	8.639	15.642	8.653	6.764	11.342	17.249	12/20/2013 2:45	2.694
12/18/2013 15:11	10.658	12.031	8.636	15.640	8.648	6.758	11.337	17.249	12/20/2013 3:00	2.690
12/18/2013 15:26	10.948	12.024	8.637	15.640	8.644	6.756	11.337	17.249	12/20/2013 3:15	2.691
12/18/2013 15:41	10.569	12.022	8.636	15.641	8.647	6.757	11.339	17.249	12/20/2013 3:30	2.687
12/18/2013 15:56	10.841	12.022	8.632	15.640	8.648	6.756	11.338	17.249	12/20/2013 3:45	2.685
12/18/2013 16:11	10.697	12.022	8.634	15.640	8.648	6.758	11.341	17.245	12/20/2013 4:00	2.680
12/18/2013 16:26	10.974	12.021	8.632	15.644	8.645	6.754	11.340	17.250	12/20/2013 4:15	2.677
12/18/2013 16:41	10.807	12.020	8.631	15.642	8.647	6.753	11.337	17.247	12/20/2013 4:30	2.677
12/18/2013 16:56	10.941	12.024	8.633	15.643	8.647	6.752	11.341	17.247	12/20/2013 4:45	2.681
12/18/2013 17:11	10.847	12.022	8.634	15.646	8.646	6.755	11.339	17.248	12/20/2013 5:00	2.686
12/18/2013 17:26	10.701	12.022	8.635	15.646	8.652	6.755	11.339	17.245	12/20/2013 5:15	2.689
12/18/2013 17:41	10.568	12.024	8.631	15.645	8.642	6.753	11.338	17.250	12/20/2013 5:30	2.690
12/18/2013 17:56	10.462	12.022	8.632	15.645	8.647	6.750	11.340	17.250	12/20/2013 5:45	2.698
12/18/2013 18:11	10.853	12.026	8.634	15.639	8.646	6.751	11.338	17.249	12/20/2013 6:00	2.707
12/18/2013 18:26	10.897	12.033	8.643	15.648	8.655	6.751	11.343	17.249	12/20/2013 6:15	2.711
12/18/2013 18:41	10.996	12.031	8.640	15.649	8.654	6.750	11.342	17.249	12/20/2013 6:30	2.716
12/18/2013 18:56	10.878	12.027	8.638	15.644	8.654	6.750	11.341	17.249	12/20/2013 6:45	2.725
12/18/2013 19:11	10.869	12.030	8.638	15.646	8.652	6.750	11.341	17.248	12/20/2013 7:00	2.734
12/18/2013 19:26	10.887	12.028	8.639	15.646	8.651	6.750	11.342	17.248	12/20/2013 7:15	2.731
12/18/2013 19:41	10.658	12.025	8.638	15.641	8.652	6.748	11.342	17.243	12/20/2013 7:30	2.733
12/18/2013 19:56	10.658	12.026	8.640	15.645	8.655	6.748	11.343	17.246	12/20/2013 7:45	2.738
12/18/2013 20:11	11.061	12.031	8.639	15.646	8.649	6.748	11.340	17.241	12/20/2013 8:00	2.734
12/18/2013 20:26	10.901	12.021	8.632	15.637	8.643	6.748	11.338	17.239	12/20/2013 8:15	2.738
12/18/2013 20:41	11.020	12.018	8.630	15.640	8.642	6.749	11.334	17.239	12/20/2013 8:30	2.736
12/18/2013 20:56	10.781	12.017	8.626	15.639	8.638	6.746	11.331	17.242	12/20/2013 8:45	2.739
12/18/2013 21:11	10.854	12.014	8.626	15.638	8.641	6.744	11.329	17.239	12/20/2013 9:00	2.744
12/18/2013 21:26	10.500	12.012	8.621	15.635	8.633	6.745	11.327	17.237	12/20/2013 9:15	2.736

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/18/2013 21:41	10.750	12.025	8.635	15.641	8.646	6.745	11.335	17.243	12/20/2013 9:30	2.741
12/18/2013 21:56	11.131	12.023	8.633	15.636	8.647	6.745	11.335	17.242	12/20/2013 9:45	2.743
12/18/2013 22:11	11.023	12.016	8.630	15.637	8.640	6.745	11.333	17.237	12/20/2013 10:00	2.736
12/18/2013 22:26	10.260	12.017	8.627	15.636	8.641	6.743	11.331	17.235	12/20/2013 10:15	2.736
12/18/2013 22:41	10.734	12.016	8.628	15.632	8.639	6.742	11.329	17.239	12/20/2013 10:30	2.736
12/18/2013 22:56	10.911	12.012	8.627	15.633	8.638	6.741	11.330	17.236	12/20/2013 10:45	2.815
12/18/2013 23:11	10.734	12.017	8.625	15.634	8.638	6.740	11.327	17.234	12/20/2013 11:00	2.893
12/18/2013 23:26	10.600	12.016	8.624	15.631	8.635	6.742	11.327	17.233	12/20/2013 11:15	2.922
12/18/2013 23:41	11.113	12.011	8.621	15.630	8.637	6.742	11.328	17.234	12/20/2013 11:30	2.940
12/18/2013 23:56	10.560	12.008	8.626	15.632	8.641	6.741	11.325	17.233	12/20/2013 11:45	2.953
12/19/2013 0:11	10.559	12.002	8.612	15.628	8.623	6.737	11.318	17.232	12/20/2013 12:00	2.964
12/19/2013 0:26	10.805	11.998	8.611	15.624	8.625	6.738	11.320	17.230	12/20/2013 12:15	2.975
12/19/2013 0:41	10.862	11.995	8.604	15.619	8.616	6.734	11.313	17.226	12/20/2013 12:30	2.987
12/19/2013 0:56	10.652	11.995	8.604	15.615	8.612	6.734	11.310	17.221	12/20/2013 12:45	3.006
12/19/2013 1:11	10.469	11.994	8.601	15.611	8.611	6.729	11.307	17.216	12/20/2013 13:00	3.016
12/19/2013 1:26	11.071	11.984	8.593	15.602	8.604	6.722	11.301	17.213	12/20/2013 13:15	3.019
12/19/2013 1:41	10.763	11.968	8.582	15.593	8.589	6.718	11.293	17.205	12/20/2013 13:30	3.026
12/19/2013 1:56	10.758	11.966	8.580	15.589	8.587	6.713	11.287	17.203	12/20/2013 13:45	3.030
12/19/2013 2:11	10.935	11.962	8.570	15.582	8.578	6.708	11.283	17.196	12/20/2013 14:00	3.031
12/19/2013 2:26	10.716	11.957	8.566	15.577	8.575	6.705	11.276	17.198	12/20/2013 14:15	3.041
12/19/2013 2:41	11.254	11.948	8.560	15.573	8.564	6.700	11.271	17.194	12/20/2013 14:30	3.048
12/19/2013 2:56	10.606	11.953	8.564	15.570	8.572	6.697	11.272	17.190	12/20/2013 14:45	3.043
12/19/2013 3:11	10.663	11.953	8.565	15.572	8.572	6.693	11.272	17.191	12/20/2013 15:00	3.049
12/19/2013 3:26	10.634	11.950	8.563	15.569	8.568	6.692	11.270	17.190	12/20/2013 15:15	3.046
12/19/2013 3:41	10.530	11.949	8.559	15.567	8.565	6.689	11.267	17.189	12/20/2013 15:30	3.044
12/19/2013 3:56	10.767	11.949	8.556	15.566	8.564	6.685	11.266	17.188	12/20/2013 15:45	3.046
12/19/2013 4:11	10.882	11.943	8.555	15.560	8.564	6.685	11.264	17.186	12/20/2013 16:00	3.044
12/19/2013 4:26	10.811	11.939	8.557	15.562	8.566	6.681	11.268	17.185	12/20/2013 16:15	3.048
12/19/2013 4:41	10.662	11.944	8.554	15.562	8.560	6.679	11.264	17.181	12/20/2013 16:30	3.046
12/19/2013 4:56	10.439	11.943	8.553	15.561	8.562	6.678	11.264	17.184	12/20/2013 16:45	3.045

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 5:11	10.960	11.945	8.556	15.561	8.561	6.675	11.264	17.179	12/20/2013 17:00	3.049
12/19/2013 5:26	10.753	11.935	8.551	15.557	8.558	6.672	11.259	17.178	12/20/2013 17:15	3.050
12/19/2013 5:41	10.609	11.938	8.548	15.554	8.553	6.671	11.261	17.179	12/20/2013 17:30	3.046
12/19/2013 5:56	10.789	11.935	8.544	15.552	8.552	6.669	11.258	17.174	12/20/2013 17:45	3.046
12/19/2013 6:11	10.380	11.931	8.544	15.551	8.549	6.666	11.256	17.174	12/20/2013 18:00	3.047
12/19/2013 6:26	10.538	11.930	8.540	15.547	8.546	6.663	11.251	17.172	12/20/2013 18:15	3.047
12/19/2013 6:41	10.732	11.924	8.542	15.546	8.548	6.662	11.253	17.167	12/20/2013 18:30	3.052
12/19/2013 6:56	10.832	11.928	8.541	15.545	8.547	6.659	11.253	17.170	12/20/2013 18:45	3.052
12/19/2013 7:11	10.696	11.926	8.538	15.541	8.543	6.657	11.248	17.169	12/20/2013 19:00	3.050
12/19/2013 7:26	10.577	11.919	8.535	15.541	8.540	6.656	11.247	17.166	12/20/2013 19:15	3.050
12/19/2013 7:41	10.578	11.926	8.536	15.540	8.541	6.653	11.247	17.162	12/20/2013 19:30	3.047
12/19/2013 7:56	10.708	11.923	8.535	15.537	8.542	6.649	11.247	17.165	12/20/2013 19:45	3.048
12/19/2013 8:11	10.725	11.918	8.531	15.537	8.540	6.650	11.243	17.163	12/20/2013 20:00	3.052
12/19/2013 8:26	10.581	11.922	8.527	15.534	8.529	6.646	11.240	17.161	12/20/2013 20:15	3.052
12/19/2013 8:41	10.647	11.917	8.527	15.536	8.531	6.645	11.241	17.160	12/20/2013 20:30	3.052
12/19/2013 8:56	10.771	11.919	8.527	15.533	8.531	6.646	11.237	17.159	12/20/2013 20:45	3.052
12/19/2013 9:11	10.683	11.914	8.525	15.533	8.531	6.643	11.235	17.158	12/20/2013 21:00	3.046
12/19/2013 9:26	10.619	11.919	8.529	15.534	8.533	6.641	11.239	17.159	12/20/2013 21:15	3.048
12/19/2013 9:41	10.553	11.920	8.528	15.535	8.534	6.640	11.239	17.155	12/20/2013 21:30	3.045
12/19/2013 9:56	11.079	11.916	8.531	15.535	8.537	6.640	11.242	17.155	12/20/2013 21:45	3.045
12/19/2013 10:11	10.396	11.914	8.532	15.538	8.536	6.640	11.245	17.167	12/20/2013 22:00	3.041
12/19/2013 10:26	10.494	11.920	8.534	15.538	8.534	6.640	11.241	17.165	12/20/2013 22:15	3.041
12/19/2013 10:41	10.615	11.922	8.532	15.537	8.534	6.638	11.242	17.164	12/20/2013 22:30	3.035
12/19/2013 10:56	10.636	11.920	8.535	15.539	8.539	6.638	11.240	17.165	12/20/2013 22:45	3.037
12/19/2013 11:11	10.873	11.921	8.533	15.540	8.538	6.637	11.242	17.168	12/20/2013 23:00	3.039
12/19/2013 11:26	11.021	11.921	8.531	15.541	8.538	6.635	11.240	17.166	12/20/2013 23:15	3.038
12/19/2013 11:41	10.656	11.924	8.534	15.539	8.534	6.637	11.242	17.164	12/20/2013 23:30	3.032
12/19/2013 11:56	10.663	11.920	8.530	15.537	8.535	6.636	11.240	17.163	12/20/2013 23:45	3.031
12/19/2013 12:11	10.856	11.918	8.530	15.536	8.534	6.635	11.236	17.160	12/21/2013 0:00	3.030
12/19/2013 12:26	10.684	11.918	8.528	15.535	8.532	6.634	11.238	17.162	12/21/2013 0:15	3.032

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 12:41	10.495	11.917	8.524	15.531	8.529	6.631	11.236	17.154	12/21/2013 0:30	3.038
12/19/2013 12:56	10.448	11.912	8.524	15.529	8.525	6.630	11.234	17.156	12/21/2013 0:45	3.056
12/19/2013 13:11	10.656	11.909	8.522	15.529	8.524	6.630	11.233	17.151	12/21/2013 1:00	3.071
12/19/2013 13:26	10.620	11.910	8.523	15.527	8.526	6.627	11.232	17.155	12/21/2013 1:15	3.094
12/19/2013 13:41	10.710	11.909	8.522	15.527	8.526	6.628	11.232	17.154	12/21/2013 1:30	3.111
12/19/2013 13:56	10.586	11.904	8.517	15.528	8.524	6.626	11.229	17.153	12/21/2013 1:45	3.119
12/19/2013 14:11	10.773		8.517				11.230		12/21/2013 2:00	3.134
12/19/2013 14:30	10.663	11.907	8.519	15.525	8.521	6.627	11.226	17.150	12/21/2013 2:15	3.140
12/19/2013 14:30	10.765	11.906	8.517	15.525	8.524	6.627	11.226	17.151	12/21/2013 2:30	3.152
12/19/2013 14:30	10.743	11.903	8.518	15.525	8.522	6.624	11.227	17.151	12/21/2013 2:45	3.159
12/19/2013 14:30	10.816	11.906	8.518	15.524	8.525	6.623	11.227	17.153	12/21/2013 3:00	3.170
12/19/2013 14:30	10.669	11.905	8.520	15.523	8.521	6.624	11.227	17.148	12/21/2013 3:15	3.179
12/19/2013 14:30	10.529	11.902	8.517	15.522	8.522	6.625	11.225	17.150	12/21/2013 3:30	3.186
12/19/2013 14:30	10.754	11.899	8.519	15.523	8.522	6.623	11.224	17.149	12/21/2013 3:45	3.196
12/19/2013 14:30	10.539	11.904	8.518	15.521	8.521	6.624	11.225	17.150	12/21/2013 4:00	3.192
12/19/2013 14:30	10.649	11.901	8.518	15.520	8.520	6.624	11.224	17.150	12/21/2013 4:15	3.201
12/19/2013 14:30	10.669	11.903	8.520	15.521	8.520	6.622	11.226	17.149	12/21/2013 4:30	3.197
12/19/2013 14:30	10.621	11.901	8.518	15.521	8.521	6.623	11.223	17.149	12/21/2013 4:45	3.199
12/19/2013 14:30	10.442	11.900	8.519	15.523	8.523	6.623	11.226	17.149	12/21/2013 5:00	3.208
12/19/2013 14:30	10.821	11.903	8.518	15.522	8.522	6.623	11.226	17.146	12/21/2013 5:15	3.207
12/19/2013 14:30	11.025	11.900	8.520	15.521	8.517	6.623	11.226	17.148	12/21/2013 5:30	3.208
12/19/2013 14:30	10.725	11.897	8.519	15.521	8.519	6.622	11.227	17.152	12/21/2013 5:45	3.216
12/19/2013 14:30	10.811	11.901	8.520	15.522	8.521	6.620	11.227	17.149	12/21/2013 6:00	3.219
12/19/2013 14:30	10.501	11.903	8.519	15.520	8.518	6.622	11.226	17.150	12/21/2013 6:15	3.222
12/19/2013 14:30	10.733	11.900	8.519	15.522	8.516	6.624	11.225	17.150	12/21/2013 6:30	3.219
12/19/2013 14:30	10.608	11.903	8.522	15.519	8.517	6.623	11.225	17.149	12/21/2013 6:45	3.227
12/19/2013 14:30	10.789	11.911	8.524	15.520	8.516	6.623	11.224	17.150	12/21/2013 7:00	3.225
12/19/2013 14:30	10.731	11.918	8.529	15.520	8.518	6.623	11.224	17.149	12/21/2013 7:15	3.229
12/19/2013 14:30	10.644	11.927	8.533	15.520	8.520	6.622	11.222	17.148	12/21/2013 7:30	3.231
12/19/2013 14:30	11.827	11.936	8.537	15.521	8.527	6.623	11.225	17.149	12/21/2013 7:45	3.235

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 14:30	12.143	11.949	8.547	15.520	8.534	6.623	11.222	17.149	12/21/2013 8:00	3.241
12/19/2013 14:30	12.375	11.961	8.555	15.518	8.544	6.624	11.224	17.147	12/21/2013 8:15	3.242
12/19/2013 14:30	11.527	11.986	8.569	15.519	8.557	6.622	11.225	17.149	12/21/2013 8:30	3.247
12/19/2013 14:30	13.327	12.015	8.587	15.518	8.574	6.621	11.225	17.148	12/21/2013 8:45	3.246
12/19/2013 14:30	14.498	12.055	8.613	15.521	8.607	6.621	11.229	17.149	12/21/2013 9:00	3.243
12/19/2013 14:30	15.868	12.102	8.637	15.524	8.643	6.623	11.228	17.149	12/21/2013 9:15	3.240
12/19/2013 14:30	17.156	12.153	8.672	15.526	8.684	6.620	11.233	17.149	12/21/2013 9:30	3.245
12/19/2013 14:30	18.525	12.217	8.707	15.529	8.738	6.622	11.239	17.150	12/21/2013 9:45	3.242
12/19/2013 14:30	19.896	12.295	8.753	15.532	8.810	6.622	11.246	17.151	12/21/2013 10:00	3.239
12/19/2013 14:30	21.013	12.364	8.798	15.537	8.875	6.622	11.256	17.147	12/21/2013 10:15	3.253
12/19/2013 14:30	22.129	12.456	8.856	15.542	8.961	6.619	11.267	17.152	12/21/2013 10:30	3.244
12/19/2013 14:30	23.066	12.547	8.918	15.550	9.053	6.619	11.278	17.149	12/21/2013 10:45	3.249
12/19/2013 14:30	23.845	12.636	8.983	15.558	9.147	6.620	11.295	17.148	12/21/2013 11:00	3.247
12/19/2013 14:30	24.511	12.731	9.055	15.567	9.246	6.621	11.315	17.153	12/21/2013 11:15	3.246
12/19/2013 14:30	25.083	12.823	9.137	15.577	9.350	6.623	11.337	17.155	12/21/2013 11:30	3.257
12/19/2013 14:30	25.560	12.910	9.218	15.590	9.453	6.622	11.367	17.156	12/21/2013 11:45	3.259
12/19/2013 14:30	25.910	12.982	9.296	15.608	9.545	6.622	11.394	17.160	12/21/2013 12:00	3.253
12/19/2013 14:30	26.182	13.039	9.372	15.625	9.625	6.621	11.425	17.161	12/21/2013 12:15	3.256
12/19/2013 14:30	26.403	13.083	9.443	15.646	9.690	6.621	11.458	17.166	12/21/2013 12:30	3.254
12/19/2013 14:30	26.553	13.120	9.509	15.665	9.740	6.622	11.492	17.172	12/21/2013 12:45	3.251
12/19/2013 14:30	26.676	13.141	9.565	15.686	9.773	6.621	11.529	17.175	12/21/2013 13:00	3.242
12/19/2013 14:30	26.763	13.164	9.616	15.708	9.803	6.623	11.562	17.181	12/21/2013 13:15	3.266
12/19/2013 14:30	26.854	13.199	9.661	15.729	9.828	6.622	11.597	17.187	12/21/2013 13:30	3.243
12/19/2013 14:30	26.903	13.238	9.704	15.752	9.864	6.620	11.629	17.194	12/21/2013 13:45	3.241
12/19/2013 14:30	26.962	13.289	9.746	15.771	9.906	6.622	11.663	17.197	12/21/2013 14:00	3.233
12/19/2013 14:30	27.028	13.339	9.785	15.793	9.958	6.621	11.695	17.205	12/21/2013 14:15	3.238
12/19/2013 14:30	27.087	13.382	9.825	15.816	10.007	6.622	11.729	17.216	12/21/2013 14:30	3.228
12/19/2013 14:30	27.117	13.413	9.867	15.837	10.055	6.621	11.765	17.222	12/21/2013 14:45	3.224
12/19/2013 14:30	27.153	13.432	9.906	15.857	10.084	6.623	11.798	17.234	12/21/2013 15:00	3.223
12/19/2013 14:30	27.216	13.447	9.941	15.875	10.106	6.623	11.832	17.243	12/21/2013 15:15	3.222

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 14:30	27.244	13.474	9.978	15.900	10.129	6.621	11.864	17.253	12/21/2013 15:30	3.220
12/19/2013 14:30	27.281	13.511	10.012	15.921	10.163	6.623	11.893	17.264	12/21/2013 15:45	3.218
12/19/2013 14:30	27.319	13.552	10.046	15.941	10.198	6.625	11.925	17.276	12/21/2013 16:00	3.219
12/19/2013 14:30	27.363	13.580	10.078	15.960	10.237	6.623	11.959	17.288	12/21/2013 16:15	3.219
12/19/2013 14:30	27.383	13.601	10.110	15.981	10.260	6.628	11.985	17.298	12/21/2013 16:30	3.214
12/19/2013 14:30	27.426	13.622	10.142	16.003	10.285	6.628	12.017	17.314	12/21/2013 16:45	3.220
12/19/2013 14:30	27.442	13.651	10.172	16.022	10.313	6.627	12.046	17.327	12/21/2013 17:00	3.217
12/19/2013 14:30	27.479	13.678	10.204	16.042	10.345	6.628	12.077	17.341	12/21/2013 17:15	3.216
12/19/2013 14:30	27.512	13.704	10.232	16.063	10.370	6.628	12.107	17.354	12/21/2013 17:30	3.218
12/19/2013 14:30	27.522	13.725	10.261	16.082	10.393	6.630	12.133	17.366	12/21/2013 17:45	3.221
12/19/2013 14:30	27.569	13.751	10.288	16.103	10.422	6.632	12.161	17.381	12/21/2013 18:00	3.218
12/19/2013 14:31	27.588	13.775	10.314	16.123	10.448	6.631	12.190	17.393	12/21/2013 18:15	3.213
12/19/2013 14:31	27.622	13.793	10.340	16.147	10.474	6.632	12.216	17.409	12/21/2013 18:30	3.215
12/19/2013 14:31	27.624	13.816	10.366	16.165	10.497	6.635	12.245	17.421	12/21/2013 18:45	3.220
12/19/2013 14:31	27.666	13.840	10.394	16.183	10.522	6.634	12.272	17.436	12/21/2013 19:00	3.215
12/19/2013 14:31	27.676	13.862	10.418	16.204	10.545	6.637	12.298	17.452	12/21/2013 19:15	3.212
12/19/2013 14:31	27.705	13.883	10.441	16.220	10.568	6.638	12.323	17.464	12/21/2013 19:30	3.215
12/19/2013 14:31	27.739	13.905	10.468	16.239	10.590	6.638	12.348	17.479	12/21/2013 19:45	3.219
12/19/2013 14:31	27.758	13.925	10.494	16.257	10.616	6.641	12.373	17.494	12/21/2013 20:00	3.212
12/19/2013 14:31	27.777	13.944	10.515	16.274	10.634	6.643	12.396	17.505	12/21/2013 20:15	3.210
12/19/2013 14:31	27.797	13.967	10.540	16.295	10.654	6.646	12.421	17.522	12/21/2013 20:30	3.214
12/19/2013 14:31	27.816	13.985	10.563	16.310	10.675	6.648	12.443	17.533	12/21/2013 20:45	3.210
12/19/2013 14:31	27.843	14.004	10.581	16.329	10.697	6.652	12.466	17.549	12/21/2013 21:00	3.208
12/19/2013 14:31	27.868	14.021	10.602	16.346	10.718	6.654	12.486	17.564	12/21/2013 21:15	3.209
12/19/2013 14:32	27.893	14.041	10.623	16.362	10.739	6.656	12.506	17.575	12/21/2013 21:30	3.212
12/19/2013 14:32	27.900	14.059	10.644	16.379	10.756	6.660	12.529	17.588	12/21/2013 21:45	3.205
12/19/2013 14:32	27.913	14.076	10.660	16.388	10.770	6.665	12.548	17.602	12/21/2013 22:00	3.210
12/19/2013 14:32	27.936	14.093	10.678	16.409	10.789	6.668	12.566	17.613	12/21/2013 22:15	3.213
12/19/2013 14:32	27.950	14.108	10.700	16.423	10.805	6.674	12.585	17.622	12/21/2013 22:30	3.215
12/19/2013 14:32	27.972	14.122	10.716	16.437	10.820	6.675	12.606	17.637	12/21/2013 22:45	3.214

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 14:32	27.989	14.135	10.731	16.446	10.836	6.680	12.620	17.649	12/21/2013 23:00	3.212
12/19/2013 14:33	28.006	14.150	10.746	16.464	10.851	6.683	12.636	17.660	12/21/2013 23:15	3.218
12/19/2013 14:33	28.009	14.162	10.762	16.476	10.864	6.688	12.652	17.666	12/21/2013 23:30	3.219
12/19/2013 14:33	28.024	14.176	10.774	16.488	10.880	6.694	12.665	17.676	12/21/2013 23:45	3.225
12/19/2013 14:33	28.039	14.187	10.789	16.495	10.893	6.699	12.680	17.690	12/22/2013 0:00	3.216
12/19/2013 14:33	28.045	14.199	10.800	16.506	10.904	6.704	12.691	17.700	12/22/2013 0:15	3.217
12/19/2013 14:34	28.061	14.210	10.813	16.515	10.913	6.706	12.704	17.705	12/22/2013 0:30	3.216
12/19/2013 14:34	28.070	14.220	10.821	16.530	10.923	6.712	12.714	17.712	12/22/2013 0:45	3.218
12/19/2013 14:34	28.090	14.227	10.833	16.535	10.933	6.718	12.724	17.723	12/22/2013 1:00	3.222
12/19/2013 14:35	28.077	14.235	10.843	16.543	10.946	6.722	12.734	17.726	12/22/2013 1:15	3.216
12/19/2013 14:35	28.099	14.244	10.853	16.553	10.957	6.727	12.742	17.734	12/22/2013 1:30	3.222
12/19/2013 14:35	28.099	14.254	10.862	16.557	10.960	6.734	12.752	17.741	12/22/2013 1:45	3.228
12/19/2013 14:35	28.117	14.258	10.869	16.565	10.969	6.739	12.760	17.746	12/22/2013 2:00	3.230
12/19/2013 14:36	28.122	14.265	10.872	16.568	10.974	6.744	12.768	17.753	12/22/2013 2:15	3.234
12/19/2013 14:36	28.124	14.269	10.878	16.576	10.981	6.748	12.772	17.759	12/22/2013 2:30	3.237
12/19/2013 14:37	28.134	14.275	10.884	16.578	10.984	6.752	12.779	17.759	12/22/2013 2:45	3.233
12/19/2013 14:37	28.140	14.284	10.888	16.583	10.989	6.756	12.783	17.762	12/22/2013 3:00	3.229
12/19/2013 14:37	28.154	14.283	10.894	16.586	10.994	6.763	12.786	17.769	12/22/2013 3:15	3.231
12/19/2013 14:38	28.135	14.284	10.898	16.593	10.996	6.766	12.791	17.774	12/22/2013 3:30	3.224
12/19/2013 14:38	28.149	14.289	10.900	16.594	10.999	6.769	12.794	17.770	12/22/2013 3:45	3.231
12/19/2013 14:39	28.146	14.291	10.902	16.596	11.002	6.774	12.797	17.773	12/22/2013 4:00	3.228
12/19/2013 14:40	28.157	14.294	10.903	16.596	11.004	6.780	12.799	17.774	12/22/2013 4:15	3.219
12/19/2013 14:40	28.148	14.295	10.906	16.599	11.007	6.783	12.801	17.779	12/22/2013 4:30	3.229
12/19/2013 14:41	28.151	14.297	10.911	16.600	11.008	6.785	12.803	17.779	12/22/2013 4:45	3.230
12/19/2013 14:41	28.155	14.297	10.910	16.602	11.008	6.790	12.805	17.782	12/22/2013 5:00	3.227
12/19/2013 14:42	28.163	14.301	10.911	16.602	11.012	6.793	12.806	17.786	12/22/2013 5:15	3.223
12/19/2013 14:43	28.145	14.304	10.913	16.603	11.010	6.797	12.807	17.783	12/22/2013 5:30	3.213
12/19/2013 14:44	28.153	14.304	10.915	16.604	11.014	6.799	12.809	17.783	12/22/2013 5:45	3.218
12/19/2013 14:45	28.166	14.306	10.917	16.606	11.013	6.801	12.809	17.786	12/22/2013 6:00	3.224
12/19/2013 14:45	28.170	14.303	10.915	16.611	11.014	6.803	12.809	17.783	12/22/2013 6:15	3.220

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 14:46	28.170	14.306	10.918	16.607	11.014	6.806	12.811	17.789	12/22/2013 6:30	3.219
12/19/2013 14:47	28.163	14.307	10.919	16.610	11.015	6.809	12.811	17.786	12/22/2013 6:45	3.213
12/19/2013 14:48	28.167	14.307	10.919	16.609	11.017	6.811	12.811	17.786	12/22/2013 7:00	3.215
12/19/2013 14:49	28.172	14.311	10.921	16.611	11.019	6.814	12.815	17.792	12/22/2013 7:15	3.220
12/19/2013 14:51	28.164	14.310	10.923	16.611	11.019	6.816	12.816	17.789	12/22/2013 7:30	3.219
12/19/2013 14:52	28.168	14.311	10.922	16.616	11.022	6.820	12.816	17.789	12/22/2013 7:45	3.214
12/19/2013 14:53	28.173	14.312	10.922	16.614	11.021	6.822	12.816	17.790	12/22/2013 8:00	3.218
12/19/2013 14:55	28.167	14.313	10.925	16.618	11.021	6.825	12.817	17.793	12/22/2013 8:15	3.219
12/19/2013 14:56	28.173	14.313	10.927	16.615	11.022	6.829	12.819	17.795	12/22/2013 8:30	3.221
12/19/2013 14:58	28.163	14.315	10.927	16.616	11.028	6.826	12.821	17.801	12/22/2013 8:45	3.218
12/19/2013 14:59	28.163	14.316	10.927	16.621	11.028	6.833	12.824	17.801	12/22/2013 9:00	3.225
12/19/2013 15:01	28.171	14.316	10.927	16.620	11.030	6.834	12.823	17.803	12/22/2013 9:15	3.229
12/19/2013 15:03	28.166	14.319	10.930	16.619	11.025	6.837	12.824	17.798	12/22/2013 9:30	3.229
12/19/2013 15:05	28.165	14.320	10.930	16.619	11.031	6.838	12.825	17.799	12/22/2013 9:45	3.232
12/19/2013 15:07	28.167	14.316	10.930	16.624	11.030	6.840	12.827	17.804	12/22/2013 10:00	3.231
12/19/2013 15:09	28.176	14.321	10.932	16.627	11.032	6.842	12.826	17.804	12/22/2013 10:15	3.235
12/19/2013 15:12	28.176	14.322	10.934	16.620	11.031	6.845	12.828	17.800	12/22/2013 10:30	3.235
12/19/2013 15:14	28.172	14.324	10.933	16.623	11.032	6.845	12.830	17.806	12/22/2013 10:45	3.229
12/19/2013 15:17	28.176	14.324	10.934	16.628	11.033	6.850	12.830	17.803	12/22/2013 11:00	3.241
12/19/2013 15:20	28.172	14.323	10.933	16.629	11.035	6.853	12.831	17.811	12/22/2013 11:15	3.245
12/19/2013 15:23	28.181	14.327	10.939	16.629	11.035	6.855	12.834	17.811	12/22/2013 11:30	3.240
12/19/2013 15:26	28.180	14.329	10.939	16.632	11.038	6.858	12.833	17.808	12/22/2013 11:45	3.242
12/19/2013 15:29	28.166	14.328	10.941	16.634	11.038	6.859	12.835	17.810	12/22/2013 12:00	3.238
12/19/2013 15:33	28.187	14.329	10.938	16.631	11.038	6.861	12.836	17.814	12/22/2013 12:15	3.240
12/19/2013 15:36	28.184	14.329	10.941	16.631	11.039	6.864	12.837	17.815	12/22/2013 12:30	3.336
12/19/2013 15:40	28.166	14.331	10.941	16.637	11.042	6.867	12.838	17.816	12/22/2013 12:45	3.326
12/19/2013 15:45	28.178	14.334	10.945	16.638	11.043	6.869	12.840	17.818	12/22/2013 13:00	3.328
12/19/2013 15:49	28.190	14.335	10.946	16.640	11.046	6.861	12.844	17.816	12/22/2013 13:15	3.308
12/19/2013 15:54	28.273	14.336	10.949	16.643	11.047	6.872	12.845	17.817	12/22/2013 13:30	3.295
12/19/2013 15:59	28.271	14.338	10.949	16.644	11.047	6.876	12.845	17.821	12/22/2013 13:45	3.279

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 16:04	28.274	14.339	10.951	16.645	11.050	6.880	12.846	17.821	12/22/2013 14:00	3.265
12/19/2013 16:10	28.273	14.341	10.954	16.641	11.049	6.883	12.847	17.824	12/22/2013 14:15	3.257
12/19/2013 16:16	28.278	14.341	10.952	16.647	11.051	6.885	12.852	17.823	12/22/2013 14:30	3.249
12/19/2013 16:22	28.279	14.341	10.957	16.650	11.055	6.887	12.851	17.828	12/22/2013 14:45	3.243
12/19/2013 16:29	28.281	14.346	10.958	16.652	11.056	6.889	12.855	17.830	12/22/2013 15:00	3.231
12/19/2013 16:36	28.287	14.351	10.960	16.658	11.059	6.896	12.856	17.835	12/22/2013 15:15	3.231
12/19/2013 16:43	28.288	14.351	10.960	16.660	11.061	6.897	12.860	17.834	12/22/2013 15:30	3.226
12/19/2013 16:51	28.292	14.356	10.967	16.661	11.062	6.899	12.860	17.835	12/22/2013 15:45	3.224
12/19/2013 17:00	28.301	14.355	10.970	16.661	11.065	6.904	12.864	17.836	12/22/2013 16:00	3.216
12/19/2013 17:08	28.300	14.356	10.972	16.664	11.068	6.904	12.864	17.842	12/22/2013 16:15	3.218
12/19/2013 17:18	28.299	14.359	10.970	16.664	11.068	6.909	12.863	17.839	12/22/2013 16:30	3.213
12/19/2013 17:28	28.303	14.359	10.973	16.665	11.068	6.913	12.867	17.845	12/22/2013 16:45	3.214
12/19/2013 17:38	28.301	14.361	10.976	16.667	11.071	6.915	12.869	17.843	12/22/2013 17:00	3.213
12/19/2013 17:49	28.305	14.362	10.978	16.669	11.071	6.917	12.869	17.845	12/22/2013 17:15	3.215
12/19/2013 18:01	28.301	14.364	10.975	16.670	11.074	6.922	12.871	17.847	12/22/2013 17:30	3.218
12/19/2013 18:14	28.305	14.365	10.980	16.673	11.076	6.924	12.875	17.853	12/22/2013 17:45	3.212
12/19/2013 18:27	28.308	14.367	10.982	16.674	11.076	6.927	12.873	17.851	12/22/2013 18:00	3.213
12/19/2013 18:41	28.315	14.370	10.984	16.679	11.079	6.929	12.879	17.851	12/22/2013 18:15	3.216
12/19/2013 18:56	28.308	14.375	10.984	16.679	11.080	6.933	12.879	17.855	12/22/2013 18:30	3.209
12/19/2013 19:11	28.324	14.375	10.985	16.680	11.083	6.935	12.880	17.857	12/22/2013 18:45	3.207
12/19/2013 19:26	28.305	14.377	10.991	16.683	11.087	6.938	12.885	17.862	12/22/2013 19:00	3.209
12/19/2013 19:41	28.312	14.376	10.992	16.684	11.086	6.941	12.884	17.864	12/22/2013 19:15	3.206
12/19/2013 19:56	28.321	14.379	10.996	16.686	11.090	6.944	12.887	17.861	12/22/2013 19:30	3.204
12/19/2013 20:11	28.324	14.381	10.996	16.688	11.091	6.947	12.889	17.867	12/22/2013 19:45	3.202
12/19/2013 20:26	28.333	14.381	10.994	16.687	11.092	6.948	12.888	17.867	12/22/2013 20:00	3.203
12/19/2013 20:41	28.326	14.385	10.999	16.692	11.095	6.953	12.894	17.873	12/22/2013 20:15	3.203
12/19/2013 20:56	28.324	14.389	11.000	16.693	11.098	6.954	12.894	17.867	12/22/2013 20:30	3.205
12/19/2013 21:11	28.331	14.389	11.005	16.696	11.098	6.955	12.898	17.871	12/22/2013 20:45	3.209
12/19/2013 21:26	28.335	14.392	11.004	16.696	11.100	6.961	12.897	17.876	12/22/2013 21:00	3.216
12/19/2013 21:41	28.336	14.392	11.004	16.699	11.102	6.961	12.901	17.872	12/22/2013 21:15	3.209

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/19/2013 21:56	28.338	14.394	11.009	16.702	11.103	6.967	12.899	17.876	12/22/2013 21:30	3.217
12/19/2013 22:11	28.320	14.396	11.005	16.702	11.105	6.967	12.904	17.881	12/22/2013 21:45	3.225
12/19/2013 22:26	28.342	14.396	11.007	16.702	11.106	6.969	12.903	17.882	12/22/2013 22:00	3.226
12/19/2013 22:41	28.336	14.396	11.010	16.702	11.105	6.971	12.903	17.883	12/22/2013 22:15	3.235
12/19/2013 22:56	28.342	14.403	11.013	16.707	11.109	6.974	12.907	17.882	12/22/2013 22:30	3.243
12/19/2013 23:11	28.333	14.400	11.012	16.708	11.110	6.978	12.906	17.886	12/22/2013 22:45	3.250
12/19/2013 23:26	28.347	14.402	11.014	16.709	11.111	6.977	12.908	17.883	12/22/2013 23:00	3.253
12/19/2013 23:41	28.344	14.403	11.018	16.711	11.115	6.977	12.910	17.890	12/22/2013 23:15	3.261
12/19/2013 23:56	28.342	14.404	11.018	16.711	11.114	6.980	12.911	17.887	12/22/2013 23:30	3.266
12/20/2013 0:11	28.342	14.410	11.021	16.712	11.117	6.983	12.910	17.890	12/22/2013 23:45	3.274
12/20/2013 0:26	28.354	14.407	11.020	16.714	11.118	6.985	12.911	17.889	12/23/2013 0:00	3.282
12/20/2013 0:41	28.350	14.409	11.021	16.712	11.118	6.986	12.915	17.894	12/23/2013 0:15	3.285
12/20/2013 0:56	28.350	14.410	11.021	16.717	11.120	6.987	12.917	17.893	12/23/2013 0:30	3.296
12/20/2013 1:11	28.358	14.410	11.023	16.718	11.121	6.988	12.915	17.896	12/23/2013 0:45	3.306
12/20/2013 1:26	28.353	14.413	11.028	16.720	11.124	6.995	12.918	17.894	12/23/2013 1:00	3.312
12/20/2013 1:41	28.368	14.415	11.029	16.723	11.123	6.993	12.920	17.898	12/23/2013 1:15	3.317
12/20/2013 1:56	28.368	14.417	11.027	16.720	11.125	6.996	12.922	17.897	12/23/2013 1:30	3.332
12/20/2013 2:11	28.363	14.413	11.028	16.720	11.124	6.997	12.920	17.896	12/23/2013 1:45	3.343
12/20/2013 2:26	28.347	14.414	11.027	16.719	11.122	6.997	12.921	17.894	12/23/2013 2:00	3.351
12/20/2013 2:41	28.357	14.413	11.027	16.718	11.120	6.996	12.917	17.897	12/23/2013 2:15	3.367
12/20/2013 2:56	28.350	14.412	11.028	16.719	11.119	6.998	12.920	17.895	12/23/2013 2:30	3.376
12/20/2013 3:11	28.353	14.414	11.025	16.718	11.120	6.997	12.917	17.898	12/23/2013 2:45	3.387
12/20/2013 3:26	28.350	14.417	11.026	16.718	11.120	6.996	12.917	17.897	12/23/2013 3:00	3.400
12/20/2013 3:41	28.351	14.413	11.021	16.719	11.121	6.999	12.916	17.898	12/23/2013 3:15	3.408
12/20/2013 3:56	28.351	14.412	11.025	16.718	11.124	6.997	12.919	17.895	12/23/2013 3:30	3.423
12/20/2013 4:11	28.352	14.411	11.027	16.718	11.121	6.999	12.918	17.897	12/23/2013 3:45	3.421
12/20/2013 4:26	28.343	14.413	11.021	16.718	11.119	6.997	12.916	17.897	12/23/2013 4:00	3.427
12/20/2013 4:41	28.355	14.413	11.022	16.718	11.121	7.000	12.919	17.897	12/23/2013 4:15	3.443
12/20/2013 4:56	28.352	14.413	11.025	16.720	11.122	6.999	12.919	17.896	12/23/2013 4:30	3.450
12/20/2013 5:11	28.353	14.412	11.026	16.717	11.123	7.001	12.919	17.899	12/23/2013 4:45	3.463

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/20/2013 5:26	28.360	14.416	11.026	16.721	11.125	7.003	12.922	17.900	12/23/2013 5:00	3.467
12/20/2013 5:41	28.367	14.418	11.030	16.725	11.128	7.004	12.923	17.899	12/23/2013 5:15	3.476
12/20/2013 5:56	28.371	14.423	11.033	16.728	11.130	7.006	12.927	17.903	12/23/2013 5:30	3.487
12/20/2013 6:11	28.361	14.426	11.036	16.731	11.136	7.010	12.931	17.910	12/23/2013 5:45	3.490
12/20/2013 6:26	28.370	14.430	11.043	16.736	11.136	7.012	12.932	17.909	12/23/2013 6:00	3.502
12/20/2013 6:41	28.365	14.432	11.045	16.737	11.140	7.013	12.935	17.915	12/23/2013 6:15	3.514
12/20/2013 6:56	28.376	14.434	11.046	16.739	11.142	7.018	12.937	17.913	12/23/2013 6:30	3.523
12/20/2013 7:11	28.374	14.436	11.048	16.743	11.147	7.020	12.939	17.916	12/23/2013 6:45	3.526
12/20/2013 7:26	28.370	14.438	11.051	16.743	11.148	7.021	12.941	17.915	12/23/2013 7:00	3.530
12/20/2013 7:41	28.413	14.439	11.051	16.745	11.148	7.023	12.940	17.921	12/23/2013 7:15	3.533
12/20/2013 7:56	0.055	14.442	11.050	16.748	11.146	7.027	12.947	17.915	12/23/2013 7:30	3.537
12/20/2013 8:11	1.157	14.443	11.052	16.747	11.146	7.029	12.951	17.922	12/23/2013 7:45	3.548
12/20/2013 8:26	1.368	14.444	11.056	16.749	11.149	7.028	12.949	17.920	12/23/2013 8:00	3.556
12/20/2013 8:41	1.273	14.446	11.058	16.752	11.156	7.032	12.952	17.921	12/23/2013 8:15	3.558
12/20/2013 8:56	1.318	14.453	11.064	16.754	11.157	7.033	12.955	17.925	12/23/2013 8:30	3.563
12/20/2013 9:11	1.351	14.453	11.065	16.754	11.157	7.034	12.956	17.925	12/23/2013 8:45	3.562
12/20/2013 9:26	1.310	14.446	11.063	16.750	11.153	7.036	12.951	17.923	12/23/2013 9:00	3.568
12/20/2013 9:41	1.281	14.452	11.059	16.753	11.156	7.038	12.953	17.921	12/23/2013 9:15	3.572
12/20/2013 9:56	1.174	14.449	11.056	16.751	11.151	7.037	12.951	17.921	12/23/2013 9:30	3.565
12/20/2013 10:11	0.077	14.447	11.056	16.753	11.150	7.042	12.950	17.924	12/23/2013 9:45	3.562
12/20/2013 10:26	1.168	14.448	11.059	16.750	11.148	7.038	12.950	17.921	12/23/2013 10:00	3.549
12/20/2013 10:41	17.629	14.458	11.065	16.762	11.162	7.044	12.961	17.931	12/23/2013 10:15	3.541
12/20/2013 10:56	17.719	14.504	11.113	16.813	11.218	7.068	13.005	17.960	12/23/2013 10:30	3.537
12/20/2013 11:11	17.727	14.518	11.125	16.822	11.230	7.080	13.014	17.967	12/23/2013 10:45	3.520
12/20/2013 11:26	17.740	14.528	11.131	16.832	11.238	7.091	13.022	17.977	12/23/2013 11:00	3.588
12/20/2013 11:41	17.759	14.538	11.142	16.843	11.249	7.104	13.031	17.983	12/23/2013 11:15	3.573
12/20/2013 11:56	17.753	14.541	11.149	16.851	11.255	7.112	13.036	17.987		
12/20/2013 12:11	17.771	14.550	11.157	16.858	11.262	7.121	13.044	17.991		
12/20/2013 12:26	17.766	14.559	11.162	16.862	11.265	7.129	13.049	18.001		
12/20/2013 12:41	17.779	14.566	11.171	16.872	11.278	7.138	13.057	18.003		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/20/2013 12:56	17.765	14.571	11.177	16.876	11.284	7.147	13.062	18.005		
12/20/2013 13:11	17.794	14.576	11.182	16.881	11.289	7.155	13.066	18.012		
12/20/2013 13:26	17.794	14.580	11.185	16.887	11.293	7.161	13.073	18.013		
12/20/2013 13:41	17.795	14.584	11.193	16.890	11.299	7.169	13.074	18.018		
12/20/2013 13:56	17.801	14.589	11.192	16.896	11.303	7.174	13.080	18.021		
12/20/2013 14:11	17.805	14.591	11.198	16.897	11.307	7.182	13.083	18.025		
12/20/2013 14:26	17.812	14.596	11.201	16.901	11.310	7.187	13.085	18.027		
12/20/2013 14:41	17.805	14.599	11.206	16.903	11.313	7.191	13.087	18.029		
12/20/2013 14:56	17.814	14.600	11.205	16.907	11.314	7.198	13.088	18.034		
12/20/2013 15:11	17.814	14.604	11.211	16.909	11.320	7.201	13.090	18.035		
12/20/2013 15:26	17.809	14.600	11.209	16.910	11.316	7.202	13.092	18.035		
12/20/2013 15:41	17.818	14.601	11.209	16.912	11.316	7.208	13.091	18.035		
12/20/2013 15:56	17.828	14.601	11.208	16.913	11.319	7.211	13.094	18.036		
12/20/2013 16:11	17.829	14.608	11.211	16.913	11.319	7.213	13.094	18.039		
12/20/2013 16:26	17.821	14.609	11.215	16.916	11.324	7.216	13.099	18.039		
12/20/2013 16:41	17.823	14.610	11.215	16.917	11.324	7.220	13.097	18.041		
12/20/2013 16:56	17.831	14.609	11.214	16.918	11.323	7.222	13.100	18.042		
12/20/2013 17:11	17.831	14.610	11.216	16.919	11.326	7.226	13.101	18.044		
12/20/2013 17:26	17.829	14.616	11.219	16.921	11.328	7.230	13.102	18.045		
12/20/2013 17:41	17.836	14.616	11.222	16.921	11.329	7.231	13.104	18.047		
12/20/2013 17:56	17.824	14.616	11.223	16.922	11.331	7.233	13.106	18.048		
12/20/2013 18:11	17.836	14.615	11.223	16.923	11.332	7.236	13.106	18.053		
12/20/2013 18:26	17.847	14.620	11.224	16.926	11.334	7.239	13.109	18.051		
12/20/2013 18:41	17.848	14.619	11.226	16.926	11.334	7.240	13.108	18.052		
12/20/2013 18:56	17.845	14.619	11.227	16.927	11.336	7.242	13.109	18.054		
12/20/2013 19:11	17.845	14.619	11.228	16.929	11.337	7.243	13.114	18.054		
12/20/2013 19:26	17.841	14.622	11.229	16.931	11.338	7.246	13.111	18.056		
12/20/2013 19:41	17.841	14.623	11.231	16.932	11.340	7.248	13.115	18.059		
12/20/2013 19:56	17.850	14.625	11.231	16.932	11.338	7.250	13.116	18.059		
12/20/2013 20:11	17.854	14.627	11.234	16.934	11.342	7.250	13.117	18.059		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/20/2013 20:26	17.843	14.625	11.231	16.933	11.340	7.251	13.119	18.060		
12/20/2013 20:41	17.844	14.627	11.234	16.936	11.341	7.252	13.117	18.060		
12/20/2013 20:56	17.839	14.628	11.234	16.936	11.343	7.255	13.120	18.063		
12/20/2013 21:11	17.850	14.628	11.233	16.936	11.341	7.258	13.120	18.062		
12/20/2013 21:26	17.848	14.625	11.235	16.935	11.341	7.256	13.117	18.063		
12/20/2013 21:41	17.860	14.628	11.235	16.935	11.344	7.259	13.116	18.064		
12/20/2013 21:56	17.845	14.628	11.238	16.937	11.343	7.259	13.120	18.064		
12/20/2013 22:11	17.841	14.628	11.234	16.937	11.340	7.260	13.118	18.064		
12/20/2013 22:26	17.857	14.629	11.235	16.937	11.341	7.261	13.121	18.064		
12/20/2013 22:41	17.857	14.630	11.234	16.938	11.344	7.260	13.119	18.067		
12/20/2013 22:56	17.856	14.630	11.233	16.938	11.345	7.261	13.121	18.066		
12/20/2013 23:11	17.854	14.630	11.237	16.937	11.343	7.262	13.119	18.067		
12/20/2013 23:26	17.861	14.630	11.234	16.937	11.343	7.263	13.120	18.065		
12/20/2013 23:41	17.856	14.629	11.236	16.937	11.345	7.261	13.120	18.067		
12/20/2013 23:56	17.859	14.631	11.234	16.937	11.345	7.265	13.122	18.068		
12/21/2013 0:11	17.860	14.632	11.237	16.940	11.344	7.264	13.122	18.068		
12/21/2013 0:26	17.855	14.632	11.237	16.941	11.346	7.263	13.124	18.069		
12/21/2013 0:41	17.868	14.639	11.247	16.949	11.354	7.270	13.129	18.076		
12/21/2013 0:56	17.875	14.646	11.255	16.955	11.362	7.275	13.138	18.080		
12/21/2013 1:11	17.873	14.653	11.257	16.960	11.368	7.279	13.143	18.082		
12/21/2013 1:26	17.885	14.660	11.268	16.969	11.376	7.286	13.147	18.088		
12/21/2013 1:41	17.885	14.668	11.273	16.975	11.383	7.293	13.152	18.093		
12/21/2013 1:56	17.896	14.673	11.279	16.981	11.390	7.297	13.158	18.097		
12/21/2013 2:11	17.897	14.677	11.281	16.984	11.394	7.301	13.162	18.100		
12/21/2013 2:26	17.891	14.683	11.287	16.991	11.399	7.306	13.163	18.102		
12/21/2013 2:41	17.913	14.689	11.292	16.994	11.404	7.311	13.171	18.107		
12/21/2013 2:56	17.915	14.695	11.297	17.001	11.412	7.319	13.177	18.113		
12/21/2013 3:11	17.913	14.700	11.305	17.008	11.416	7.323	13.180	18.116		
12/21/2013 3:26	17.930	14.706	11.309	17.011	11.421	7.329	13.188	18.119		
12/21/2013 3:41	17.911	14.708	11.312	17.015	11.425	7.333	13.189	18.124		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

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12/21/2013 3:56	17.929	14.709	11.314	17.017	11.428	7.339	13.193	18.123		
12/21/2013 4:11	17.924	14.713	11.316	17.020	11.433	7.343	13.195	18.127		
12/21/2013 4:26	17.938	14.715	11.318	17.024	11.430	7.345	13.196	18.127		
12/21/2013 4:41	17.928	14.717	11.321	17.023	11.435	7.348	13.198	18.130		
12/21/2013 4:56	17.946	14.720	11.321	17.026	11.436	7.351	13.198	18.132		
12/21/2013 5:11	17.942	14.723	11.325	17.029	11.440	7.356	13.199	18.134		
12/21/2013 5:26	17.946	14.725	11.329	17.029	11.443	7.357	13.203	18.136		
12/21/2013 5:41	17.946	14.726	11.331	17.033	11.445	7.363	13.206	18.138		
12/21/2013 5:56	17.954	14.728	11.333	17.036	11.448	7.368	13.207	18.138		
12/21/2013 6:11	17.956	14.730	11.337	17.038	11.449	7.373	13.210	18.140		
12/21/2013 6:26	17.961	14.731	11.336	17.036	11.449	7.373	13.209	18.141		
12/21/2013 6:41	17.957	14.731	11.336	17.037	11.447	7.374	13.211	18.139		
12/21/2013 6:56	17.959	14.735	11.337	17.040	11.451	7.378	13.212	18.142		
12/21/2013 7:11	17.953	14.739	11.342	17.046	11.457	7.383	13.216	18.146		
12/21/2013 7:26	17.955	14.740	11.346	17.047	11.458	7.384	13.219	18.149		
12/21/2013 7:41	17.965	14.745	11.347	17.052	11.464	7.389	13.220	18.152		
12/21/2013 7:56	17.971	14.747	11.351	17.054	11.464	7.390	13.223	18.154		
12/21/2013 8:11	17.971	14.747	11.352	17.056	11.468	7.393	13.225	18.156		
12/21/2013 8:26	17.973	14.749	11.353	17.056	11.470	7.396	13.226	18.155		
12/21/2013 8:41	17.977	14.750	11.354	17.057	11.470	7.399	13.224	18.158		
12/21/2013 8:56	17.972	14.754	11.356	17.060	11.473	7.402	13.229	18.160		
12/21/2013 9:11	17.977	14.755	11.359	17.060	11.474	7.403	13.231	18.162		
12/21/2013 9:26	17.970	14.754	11.357	17.059	11.471	7.405	13.228	18.161		
12/21/2013 9:41	17.984	14.755	11.359	17.060	11.473	7.406	13.231	18.162		
12/21/2013 9:56	17.986	14.760	11.362	17.065	11.478	7.409	13.236	18.167		
12/21/2013 10:11	17.984	14.753	11.360	17.064	11.476	7.411	13.234	18.165		
12/21/2013 10:26	17.968	14.762	11.365	17.067	11.479	7.412	13.238	18.168		
12/21/2013 10:41	17.989	14.754	11.363	17.064	11.476	7.414	13.235	18.167		
12/21/2013 10:56	17.999	14.763	11.365	17.069	11.480	7.415	13.238	18.167		
12/21/2013 11:11	17.991	14.757	11.367	17.070	11.476	7.415	13.236	18.169		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/21/2013 11:26	17.993	14.762	11.369	17.073	11.484	7.420	13.240	18.170		
12/21/2013 11:41	18.001	14.762	11.367	17.074	11.484	7.418	13.242	18.173		
12/21/2013 11:56	17.983	14.765	11.371	17.074	11.486	7.425	13.244	18.174		
12/21/2013 12:11	17.998	14.768	11.373	17.077	11.490	7.426	13.246	18.180		
12/21/2013 12:26	18.002	14.767	11.374	17.076	11.488	7.428	13.245	18.175		
12/21/2013 12:41	17.997	14.767	11.374	17.078	11.488	7.430	13.243	18.175		
12/21/2013 12:56	18.006	14.768	11.374	17.077	11.484	7.432	13.246	18.178		
12/21/2013 13:11	18.005	14.767	11.373	17.076	11.487	7.428	13.246	18.179		
12/21/2013 13:26	17.998	14.767	11.374	17.076	11.490	7.432	13.247	18.183		
12/21/2013 13:41	17.993	14.768	11.373	17.078	11.489	7.430	13.247	18.182		
12/21/2013 13:56	18.003	14.766	11.374	17.075	11.486	7.430	13.246	18.180		
12/21/2013 14:11	18.001	14.763	11.368	17.073	11.484	7.426	13.242	18.177		
12/21/2013 14:26	17.993	14.764	11.370	17.073	11.486	7.429	13.243	18.181		
12/21/2013 14:41	17.986	14.763	11.369	17.071	11.482	7.430	13.240	18.176		
12/21/2013 14:56	17.996	14.764	11.370	17.072	11.483	7.428	13.245	18.181		
12/21/2013 15:11	18.005	14.765	11.370	17.074	11.482	7.431	13.242	18.179		
12/21/2013 15:26	18.002	14.761	11.367	17.073	11.481	7.428	13.242	18.176		
12/21/2013 15:41	18.000	14.761	11.367	17.070	11.479	7.431	13.240	18.179		
12/21/2013 15:56	17.998	14.761	11.367	17.070	11.477	7.427	13.240	18.176		
12/21/2013 16:11	17.994	14.762	11.369	17.072	11.480	7.428	13.242	18.178		
12/21/2013 16:26	17.993	14.763	11.366	17.072	11.480	7.430	13.241	18.179		
12/21/2013 16:41	18.001	14.764	11.371	17.073	11.483	7.429	13.244	18.180		
12/21/2013 16:56	18.003	14.764	11.372	17.074	11.483	7.430	13.245	18.180		
12/21/2013 17:11	17.998	14.766	11.372	17.073	11.484	7.431	13.245	18.183		
12/21/2013 17:26	17.996	14.768	11.373	17.074	11.486	7.433	13.246	18.182		
12/21/2013 17:41	18.003	14.768	11.373	17.077	11.484	7.432	13.247	18.182		
12/21/2013 17:56	17.982	14.768	11.372	17.075	11.487	7.434	13.246	18.185		
12/21/2013 18:11	17.995	14.767	11.370	17.076	11.485	7.433	13.245	18.184		
12/21/2013 18:26	17.999	14.768	11.374	17.076	11.486	7.432	13.247	18.185		
12/21/2013 18:41	18.006	14.767	11.373	17.075	11.487	7.431	13.247	18.184		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/21/2013 18:56	18.008	14.768	11.373	17.076	11.487	7.435	13.248	18.183		
12/21/2013 19:11	18.003	14.768	11.373	17.077	11.488	7.434	13.249	18.187		
12/21/2013 19:26	17.992	14.770	11.374	17.078	11.489	7.435	13.248	18.186		
12/21/2013 19:41	18.003	14.770	11.374	17.079	11.488	7.436	13.249	18.187		
12/21/2013 19:56	17.996	14.770	11.375	17.080	11.488	7.437	13.250	18.188		
12/21/2013 20:11	17.996	14.769	11.374	17.079	11.486	7.436	13.249	18.189		
12/21/2013 20:26	17.998	14.770	11.375	17.079	11.489	7.433	13.249	18.188		
12/21/2013 20:41	18.005	14.770	11.376	17.079	11.487	7.434	13.249	18.187		
12/21/2013 20:56	17.990	14.769	11.375	17.079	11.486	7.435	13.249	18.188		
12/21/2013 21:11	18.000	14.772	11.375	17.077	11.487	7.436	13.249	18.188		
12/21/2013 21:26	18.000	14.770	11.373	17.077	11.486	7.434	13.249	18.186		
12/21/2013 21:41	17.993	14.768	11.373	17.079	11.484	7.436	13.250	18.190		
12/21/2013 21:56	18.006	14.770	11.378	17.079	11.489	7.434	13.250	18.191		
12/21/2013 22:11	17.993	14.772	11.377	17.081	11.489	7.436	13.252	18.191		
12/21/2013 22:26	17.999	14.773	11.377	17.081	11.490	7.437	13.252	18.191		
12/21/2013 22:41	18.006	14.773	11.379	17.082	11.489	7.439	13.254	18.193		
12/21/2013 22:56	18.012	14.773	11.378	17.084	11.492	7.439	13.253	18.193		
12/21/2013 23:11	18.017	14.777	11.382	17.084	11.493	7.440	13.254	18.193		
12/21/2013 23:26	18.015	14.776	11.382	17.085	11.495	7.442	13.255	18.196		
12/21/2013 23:41	18.014	14.777	11.383	17.086	11.495	7.442	13.256	18.196		
12/21/2013 23:56	18.005	14.777	11.382	17.087	11.496	7.444	13.258	18.196		
12/22/2013 0:11	18.012	14.781	11.382	17.088	11.497	7.444	13.257	18.199		
12/22/2013 0:26	18.007	14.780	11.385	17.089	11.496	7.443	13.259	18.198		
12/22/2013 0:41	18.013	14.779	11.385	17.088	11.499	7.445	13.259	18.197		
12/22/2013 0:56	18.020	14.781	11.387	17.090	11.497	7.445	13.260	18.200		
12/22/2013 1:11	18.019	14.783	11.386	17.091	11.495	7.447	13.259	18.200		
12/22/2013 1:26	18.016	14.784	11.390	17.090	11.500	7.446	13.263	18.200		
12/22/2013 1:41	18.014	14.781	11.389	17.092	11.499	7.447	13.264	18.202		
12/22/2013 1:56	18.024	14.786	11.390	17.096	11.505	7.450	13.264	18.203		
12/22/2013 2:11	18.022	14.788	11.393	17.095	11.505	7.453	13.265	18.203		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/22/2013 2:26	18.021	14.789	11.392	17.098	11.503	7.452	13.266	18.205		
12/22/2013 2:41	18.015	14.788	11.392	17.096	11.507	7.449	13.266	18.204		
12/22/2013 2:56	18.028	14.786	11.391	17.095	11.503	7.453	13.268	18.205		
12/22/2013 3:11	18.024	14.789	11.392	17.096	11.506	7.454	13.268	18.206		
12/22/2013 3:26	18.026	14.789	11.392	17.097	11.506	7.454	13.266	18.205		
12/22/2013 3:41	18.020	14.783	11.392	17.095	11.502	7.455	13.267	18.206		
12/22/2013 3:56	18.034	14.789	11.394	17.099	11.504	7.453	13.267	18.206		
12/22/2013 4:11	18.018	14.792	11.391	17.097	11.504	7.454	13.267	18.207		
12/22/2013 4:26	18.006	14.790	11.393	17.098	11.504	7.454	13.264	18.207		
12/22/2013 4:41	18.025	14.792	11.393	17.100	11.506	7.455	13.268	18.208		
12/22/2013 4:56	18.027	14.790	11.396	17.103	11.510	7.455	13.269	18.209		
12/22/2013 5:11	18.028	14.788	11.390	17.097	11.505	7.454	13.267	18.207		
12/22/2013 5:26	18.022	14.788	11.391	17.096	11.504	7.454	13.267	18.208		
12/22/2013 5:41	18.022	14.789	11.393	17.096	11.502	7.455	13.266	18.207		
12/22/2013 5:56	18.033	14.789	11.393	17.096	11.506	7.455	13.264	18.209		
12/22/2013 6:11	18.022	14.787	11.392	17.095	11.506	7.455	13.264	18.207		
12/22/2013 6:26	18.022	14.788	11.392	17.094	11.504	7.454	13.267	18.207		
12/22/2013 6:41	18.020	14.789	11.390	17.099	11.505	7.453	13.267	18.208		
12/22/2013 6:56	18.024	14.790	11.391	17.096	11.505	7.455	13.264	18.209		
12/22/2013 7:11	18.024	14.790	11.389	17.098	11.504	7.453	13.266	18.208		
12/22/2013 7:26	18.034	14.788	11.393	17.097	11.506	7.455	13.267	18.208		
12/22/2013 7:41	18.030	14.785	11.393	17.097	11.505	7.457	13.266	18.210		
12/22/2013 7:56	18.025	14.789	11.393	17.098	11.506	7.454	13.268	18.210		
12/22/2013 8:11	18.031	14.791	11.394	17.099	11.508	7.456	13.269	18.212		
12/22/2013 8:26	18.030	14.791	11.396	17.100	11.509	7.457	13.271	18.211		
12/22/2013 8:41	18.030	14.795	11.397	17.102	11.511	7.457	13.272	18.211		
12/22/2013 8:56	18.026	14.793	11.399	17.102	11.505	7.458	13.270	18.212		
12/22/2013 9:11	18.031	14.796	11.399	17.105	11.510	7.459	13.273	18.214		
12/22/2013 9:26	18.036	14.799	11.402	17.105	11.515	7.460	13.275	18.217		
12/22/2013 9:41	18.031	14.794	11.402	17.104	11.512	7.460	13.274	18.214		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/22/2013 9:56	18.041	14.798	11.400	17.105	11.517	7.462	13.274	18.216		
12/22/2013 10:11	18.039	14.799	11.402	17.107	11.514	7.463	13.277	18.217		
12/22/2013 10:26	18.032	14.797	11.402	17.107	11.515	7.466	13.276	18.219		
12/22/2013 10:41	18.039	14.800	11.404	17.109	11.518	7.466	13.278	18.218		
12/22/2013 10:56	18.046	14.801	11.405	17.111	11.518	7.463	13.280	18.220		
12/22/2013 11:11	18.042	14.808	11.407	17.122	11.521	7.471	13.280	18.220		
12/22/2013 11:26	18.035	14.804	11.407	17.110	11.518	7.467	13.279	18.224		
12/22/2013 11:41	18.034	14.799	11.403	17.111	11.521	7.464	13.279	18.220		
12/22/2013 11:56	18.035	14.800	11.408	17.112	11.521	7.468	13.283	18.222		
12/22/2013 12:11	18.049	14.804	11.412	17.113	11.522	7.469	13.281	18.220		
12/22/2013 12:26	18.046	8.107	11.420	17.122	11.533	7.469	13.290	18.227		
12/22/2013 12:41	18.070	14.828	11.444	17.149	11.559	7.491	13.312	18.245		
12/22/2013 12:56	18.081	14.828	11.442	17.148	11.560	7.493	13.311	18.244		
12/22/2013 13:11	18.071	14.824	11.438	17.142	11.552	7.495	13.307	18.243		
12/22/2013 13:26	18.070	14.817	11.433	17.140	11.549	7.497	13.304	18.239		
12/22/2013 13:41	18.065	14.815	11.427	17.133	11.541	7.493	13.300	18.239		
12/22/2013 13:56	18.060	14.801	11.423	17.130	11.535	7.487	13.291	18.231		
12/22/2013 14:11	18.063	14.803	11.420	17.126	11.531	7.486	13.293	18.231		
12/22/2013 14:26	18.060	14.801	11.419	17.122	11.529	7.484	13.290	18.232		
12/22/2013 14:41	18.059	14.800	11.416	17.122	11.533	7.484	13.290	18.228		
12/22/2013 14:56	18.048	14.794	11.413	17.116	11.523	7.485	13.286	18.230		
12/22/2013 15:11	18.052	14.791	11.411	17.114	11.525	7.476	13.284	18.226		
12/22/2013 15:26	18.049	14.790	11.410	17.113	11.520	7.475	13.280	18.225		
12/22/2013 15:41	18.038	14.787	11.406	17.111	11.519	7.473	13.280	18.224		
12/22/2013 15:56	18.043	14.786	11.405	17.111	11.516	7.472	13.280	18.222		
12/22/2013 16:11	18.028	14.787	11.404	17.109	11.517	7.472	13.280	18.224		
12/22/2013 16:26	18.040	14.787	11.404	17.108	11.515	7.470	13.278	18.222		
12/22/2013 16:41	18.053	14.786	11.403	17.108	11.511	7.467	13.276	18.222		
12/22/2013 16:56	18.043	14.785	11.404	17.107	11.514	7.466	13.277	18.223		
12/22/2013 17:11	18.033	14.786	11.402	17.107	11.515	7.468	13.279	18.222		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/22/2013 17:26	18.034	14.786	11.403	17.105	11.513	7.467	13.278	18.222		
12/22/2013 17:41	18.035	14.786	11.403	17.107	11.514	7.466	13.278	18.222		
12/22/2013 17:56	18.045	14.787	11.403	17.109	11.514	7.465	13.277	18.222		
12/22/2013 18:11	18.043	14.787	11.404	17.108	11.514	7.466	13.277	18.223		
12/22/2013 18:26	18.035	14.785	11.402	17.107	11.514	7.465	13.276	18.222		
12/22/2013 18:41	18.040	14.789	11.398	17.106	11.512	7.464	13.274	18.220		
12/22/2013 18:56	18.038	14.783	11.401	17.106	11.510	7.463	13.274	18.221		
12/22/2013 19:11	18.029	14.784	11.401	17.103	11.512	7.463	13.274	18.220		
12/22/2013 19:26	18.036	14.784	11.398	17.104	11.511	7.463	13.275	18.221		
12/22/2013 19:41	18.036	14.785	11.400	17.103	11.509	7.463	13.275	18.220		
12/22/2013 19:56	18.035	14.785	11.399	17.102	11.511	7.461	13.274	18.220		
12/22/2013 20:11	18.044	14.786	11.400	17.104	11.511	7.460	13.274	18.219		
12/22/2013 20:26	18.041	14.785	11.400	17.105	11.511	7.461	13.275	18.221		
12/22/2013 20:41	18.044	14.787	11.401	17.105	11.513	7.461	13.276	18.219		
12/22/2013 20:56	18.042	14.786	11.401	17.108	11.515	7.461	13.274	18.221		
12/22/2013 21:11	18.036	14.785	11.402	17.106	11.511	7.461	13.277	18.221		
12/22/2013 21:26	18.039	14.789	11.401	17.109	11.512	7.466	13.279	18.224		
12/22/2013 21:41	18.037	14.791	11.405	17.112	11.517	7.467	13.282	18.224		
12/22/2013 21:56	18.047	14.795	11.411	17.117	11.519	7.469	13.284	18.227		
12/22/2013 22:11	18.049	14.797	11.413	17.118	11.522	7.472	13.285	18.231		
12/22/2013 22:26	18.047	14.799	11.414	17.121	11.531	7.475	13.289	18.233		
12/22/2013 22:41	18.062	14.806	11.421	17.126	11.533	7.481	13.292	18.235		
12/22/2013 22:56	18.059	14.809	11.423	17.127	11.535	7.482	13.294	18.236		
12/22/2013 23:11	18.061	14.810	11.425	17.129	11.538	7.485	13.298	18.237		
12/22/2013 23:26	18.049	14.815	11.429	17.133	11.543	7.487	13.299	18.239		
12/22/2013 23:41	18.063	14.816	11.431	17.138	11.543	7.491	13.302	18.240		
12/22/2013 23:56	18.072	14.819	11.435	17.141	11.549	7.494	13.303	18.245		
12/23/2013 0:11	18.081	14.825	11.439	17.143	11.554	7.497	13.308	18.248		
12/23/2013 0:26	18.070	14.827	11.443	17.148	11.557	7.498	13.311	18.249		
12/23/2013 0:41	18.098	14.832	11.445	17.149	11.561	7.504	13.316	18.252		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/23/2013 0:56	18.084	14.834	11.448	17.155	11.565	7.509	13.319	18.254		
12/23/2013 1:11	18.098	14.838	11.454	17.158	11.565	7.512	13.322	18.255		
12/23/2013 1:26	18.086	14.843	11.459	17.162	11.573	7.515	13.325	18.258		
12/23/2013 1:41	18.102	14.848	11.465	17.167	11.579	7.519	13.331	18.261		
12/23/2013 1:56	18.107	14.854	11.466	17.176	11.584	7.524	13.333	18.266		
12/23/2013 2:11	18.104	14.859	11.475	17.181	11.589	7.530	13.341	18.272		
12/23/2013 2:26	18.109	14.865	11.479	17.184	11.598	7.535	13.346	18.274		
12/23/2013 2:41	18.115	14.869	11.484	17.189	11.602	7.542	13.351	18.278		
12/23/2013 2:56	18.130	14.876	11.491	17.196	11.608	7.545	13.355	18.283		
12/23/2013 3:11	18.124	14.881	11.497	17.202	11.614	7.552	13.361	18.284		
12/23/2013 3:26	18.138	14.889	11.497	17.207	11.620	7.559	13.365	18.290		
12/23/2013 3:41	18.132	14.891	11.505	17.210	11.620	7.563	13.366	18.292		
12/23/2013 3:56	18.148	14.895	11.507	17.214	11.626	7.568	13.371	18.294		
12/23/2013 4:11	18.151	14.897	11.513	17.218	11.633	7.573	13.374	18.298		
12/23/2013 4:26	18.170	14.903	11.519	17.224	11.637	7.580	13.374	18.300		
12/23/2013 4:41	18.141	14.909	11.525	17.228	11.646	7.583	13.383	18.305		
12/23/2013 4:56	18.168	14.914	11.526	17.234	11.650	7.590	13.388	18.307		
12/23/2013 5:11	18.161	14.917	11.532	17.238	11.651	7.596	13.391	18.312		
12/23/2013 5:26	18.170	14.921	11.536	17.241	11.658	7.601	13.398	18.313		
12/23/2013 5:41	18.171	14.926	11.538	17.244	11.663	7.608	13.400	18.318		
12/23/2013 5:56	18.177	14.930	11.545	17.252	11.669	7.612	13.405	18.321		
12/23/2013 6:11	18.189	14.937	11.551	17.256	11.671	7.620	13.408	18.324		
12/23/2013 6:26	18.196	14.940	11.557	17.260	11.677	7.625	13.413	18.327		
12/23/2013 6:41	18.197	14.945	11.558	17.265	11.680	7.629	13.416	18.331		
12/23/2013 6:56	18.190	14.946	11.560	17.267	11.682	7.634	13.417	18.331		
12/23/2013 7:11	18.207	14.949	11.564	17.269	11.688	7.637	13.420	18.335		
12/23/2013 7:26	18.204	14.955	11.568	17.276	11.688	7.643	13.424	18.339		
12/23/2013 7:41	18.203	14.958	11.571	17.281	11.695	7.647	13.431	18.340		
12/23/2013 7:56	18.205	14.963	11.573	17.283	11.698	7.653	13.432	18.345		
12/23/2013 8:11	18.209	14.968	11.580	17.287	11.701	7.657	13.436	18.347		

PRESSURE TRANSDUCER WATER LEVEL DATA

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (ft above sensor)	OW-50P (ft above sensor)	OW-75P (ft above sensor)	OW-150P (ft above sensor)	OW-60R (ft above sensor)	SP-120R (ft above sensor)	OW-1-13 (ft above sensor)	OW-3-13 (ft above sensor)	Date / Time	River (ft above sensor)
12/23/2013 8:26	18.220	14.969	11.580	17.290	11.709	7.661	13.440	18.348		
12/23/2013 8:41	18.215	14.971	11.586	17.294	11.708	7.666	13.440	18.351		
12/23/2013 8:56	18.216	14.974	11.591	17.296	11.716	7.672	13.447	18.353		
12/23/2013 9:11	18.231	14.978	11.593	17.297	11.718	7.675	13.447	18.355		
12/23/2013 9:26	18.225	14.975	11.589	17.297	11.715	7.677	13.444	18.354		
12/23/2013 9:41	18.215	14.973	11.588	17.295	11.712	7.675	13.442	18.354		
12/23/2013 9:56	18.223	14.973	11.584	17.294	11.709	7.677	13.446	18.355		
12/23/2013 10:11	18.227	14.972	11.589	17.289	11.706	7.675	13.439	18.353		
12/23/2013 10:26	18.203	14.965	11.582	17.288	11.705	7.678	13.437	18.352		
12/23/2013 10:41	18.227	14.964	11.579	17.286	11.700	7.674	13.435	18.351		
12/23/2013 10:56	18.236	14.987	11.597	17.305	11.722	7.681	13.455	18.362		
12/23/2013 11:11	18.246	14.990	11.598	17.308	11.724	7.688	13.453	18.365		
12/23/2013 11:26	18.250	14.984	11.584	17.304	11.718	7.689	13.451	18.362		
12/23/2013 11:41				17.300			13.446	18.360		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/12/2013 14:00						55.352			12/12/2013 14:00	
12/12/2013 14:15						55.306			12/12/2013 14:15	
12/12/2013 14:30						55.219			12/12/2013 14:30	
12/12/2013 14:45						55.079			12/12/2013 14:45	
12/12/2013 15:00					55.736	54.777			12/12/2013 15:00	
12/12/2013 15:15					55.793	54.510			12/12/2013 15:15	
12/12/2013 15:30					55.777	54.681			12/12/2013 15:30	
12/12/2013 15:45					55.771	54.716			12/12/2013 15:45	
12/12/2013 16:00		56.055	56.757	55.100	55.761	54.438		54.738	12/12/2013 16:00	
12/12/2013 16:15		56.167	56.837	55.147	55.789	54.522		54.747	12/12/2013 16:15	
12/12/2013 16:30		56.126	56.831	55.148	55.782	54.896		54.744	12/12/2013 16:30	
12/12/2013 16:45		56.110	56.818	55.140	55.769	54.076		54.745	12/12/2013 16:45	
12/12/2013 17:00		56.095	56.819	55.139	55.765	54.760		54.742	12/12/2013 17:00	
12/12/2013 17:15		55.633	56.500	55.029	55.540	54.969		54.709	12/12/2013 17:15	
12/12/2013 17:30	54.266	55.818	56.589	55.059	55.605	55.090		54.718	12/12/2013 17:30	
12/12/2013 17:45	54.245	55.940	56.649	55.089	55.653	54.918		54.726	12/12/2013 17:45	
12/12/2013 18:00	54.221	56.009	56.681	55.099	55.683	54.387	55.179	54.724	12/12/2013 18:00	47.381
12/12/2013 18:15	54.207	56.064	56.713	55.108	55.712	54.627	55.325	54.729	12/12/2013 18:15	48.083
12/12/2013 18:30	54.193	56.113	56.726	55.117	55.719	54.870	55.362	54.736	12/12/2013 18:30	47.930
12/12/2013 18:45	54.183	56.133	56.743	55.121	55.725	54.751	55.380	54.739	12/12/2013 18:45	48.485
12/12/2013 19:00	54.161	56.142	56.753	55.123	55.734	54.136	55.417	54.736	12/12/2013 19:00	48.627
12/12/2013 19:15	54.153	56.163	56.755	55.126	55.736	53.693	55.396	54.732	12/12/2013 19:15	47.713
12/12/2013 19:30	54.142	56.172	56.761	55.128	55.736	54.671	55.374	54.737	12/12/2013 19:30	47.633
12/12/2013 19:45	54.136	56.189	56.767	55.127	55.740	53.799	55.377	54.738	12/12/2013 19:45	48.451
12/12/2013 20:00	54.125	56.197	56.769	55.121	55.736	54.181	55.394	54.737	12/12/2013 20:00	48.385
12/12/2013 20:15	54.113	56.200	56.773	55.132	55.732	54.282	55.410	54.737	12/12/2013 20:15	48.241
12/12/2013 20:30	54.113	56.213	56.773	55.130	55.738	54.442	55.433	54.732	12/12/2013 20:30	48.611
12/12/2013 20:45	54.101	56.213	56.779	55.133	55.739	54.429	55.418	54.733	12/12/2013 20:45	48.326
12/12/2013 21:00	54.096	56.218	56.777	55.129	55.738	54.100	55.420	54.739	12/12/2013 21:00	48.478
12/12/2013 21:15	54.084	56.215	56.778	55.133	55.745	53.914	55.410	54.738	12/12/2013 21:15	48.779

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/12/2013 21:30	54.085	56.220	56.780	55.131	55.736	53.983	55.415	54.735	12/12/2013 21:30	48.780
12/12/2013 21:45	54.080	56.221	56.782	55.125	55.742	54.203	55.419	54.739	12/12/2013 21:45	47.731
12/12/2013 22:00	54.077	56.227	56.782	55.127	55.741	53.719	55.420	54.743	12/12/2013 22:00	48.586
12/12/2013 22:15	54.071	56.230	56.781	55.123	55.740	53.669	55.416	54.740	12/12/2013 22:15	48.238
12/12/2013 22:30	54.064	56.228	56.785	55.133	55.744	54.053	55.427	54.744	12/12/2013 22:30	48.586
12/12/2013 22:45	54.064	56.231	56.787	55.127	55.737	53.827	55.400	54.736	12/12/2013 22:45	48.761
12/12/2013 23:00	54.061	56.229	56.780	55.127	55.741	54.185	55.407	54.742	12/12/2013 23:00	48.522
12/12/2013 23:15	54.059	56.227	56.785	55.128	55.744	53.764	55.400	54.739	12/12/2013 23:15	48.915
12/12/2013 23:30	54.054	56.230	56.781	55.135	55.742	53.654	55.393	54.739	12/12/2013 23:30	48.673
12/12/2013 23:45	54.052	56.231	56.783	55.127	55.742	54.159	55.415	54.738	12/12/2013 23:45	49.060
12/13/2013 0:00	54.047	56.229	56.785	55.129	55.747	53.896	55.380	54.744	12/13/2013 0:00	48.518
12/13/2013 0:15	54.046	56.228	56.786	55.129	55.742	53.680	55.413	54.735	12/13/2013 0:15	48.467
12/13/2013 0:30	54.044	56.228	56.785	55.127	55.743	53.753	55.436	54.743	12/13/2013 0:30	48.746
12/13/2013 0:45	54.041	56.225	56.780	55.132	55.737	53.890	55.387	54.739	12/13/2013 0:45	48.944
12/13/2013 1:00	54.040	56.223	56.784	55.133	55.741	53.865	55.406	54.738	12/13/2013 1:00	49.283
12/13/2013 1:15	54.035	56.223	56.784	55.131	55.739	53.769	55.385	54.738	12/13/2013 1:15	49.392
12/13/2013 1:30	54.040	56.229	56.779	55.130	55.744	54.411	55.393	54.739	12/13/2013 1:30	49.280
12/13/2013 1:45	54.040	56.226	56.784	55.131	55.740	54.105	55.405	54.737	12/13/2013 1:45	48.402
12/13/2013 2:00	54.028	56.227	56.786	55.129	55.738	54.106	55.410	54.742	12/13/2013 2:00	48.161
12/13/2013 2:15	54.029	56.223	56.787	55.130	55.743	54.154	55.396	54.738	12/13/2013 2:15	48.569
12/13/2013 2:30	54.029	56.218	56.783	55.126	55.738	54.335	55.386	54.743	12/13/2013 2:30	48.593
12/13/2013 2:45	54.028	56.223	56.779	55.124	55.741	53.834	55.382	54.742	12/13/2013 2:45	48.773
12/13/2013 3:00	54.020	56.217	56.787	55.128	55.741	54.013	55.367	54.738	12/13/2013 3:00	49.208
12/13/2013 3:15	54.020	56.217	56.783	55.127	55.742	53.783	55.400	54.738	12/13/2013 3:15	49.051
12/13/2013 3:30	54.019	56.216	56.781	55.128	55.743	53.637	55.405	54.743	12/13/2013 3:30	48.668
12/13/2013 3:45	54.016	56.216	56.785	55.128	55.740	53.678	55.405	54.738	12/13/2013 3:45	48.934
12/13/2013 4:00	54.018	56.209	56.779	55.131	55.742	53.486	55.417	54.742	12/13/2013 4:00	49.290
12/13/2013 4:15	54.015	56.208	56.784	55.126	55.736	54.014	55.429	54.739	12/13/2013 4:15	49.312
12/13/2013 4:30	54.012	56.207	56.784	55.125	55.740	53.574	55.380	54.738	12/13/2013 4:30	49.133
12/13/2013 4:45	54.011	56.206	56.779	55.132	55.742	53.679	55.386	54.744	12/13/2013 4:45	49.394

PRESSURE TRANSDUCER WATER TEMPERATURE

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December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/13/2013 5:00	54.007	56.200	56.789	55.131	55.740	53.110	55.385	54.738	12/13/2013 5:00	49.505
12/13/2013 5:15	54.008	56.197	56.785	55.127	55.736	54.014	55.399	54.744	12/13/2013 5:15	49.230
12/13/2013 5:30	54.007	56.197	56.786	55.129	55.742	54.106	55.386	54.739	12/13/2013 5:30	49.657
12/13/2013 5:45	54.003	56.191	56.782	55.125	55.742	53.824	55.376	54.739	12/13/2013 5:45	49.693
12/13/2013 6:00	53.998	56.190	56.785	55.131	55.741	53.531	55.409	54.738	12/13/2013 6:00	48.844
12/13/2013 6:15	53.994	56.191	56.784	55.132	55.741	53.288	55.410	54.742	12/13/2013 6:15	49.473
12/13/2013 6:30	54.002	56.188	56.780	55.128	55.739	53.408	55.402	54.742	12/13/2013 6:30	49.484
12/13/2013 6:45	54.003	56.184	56.785	55.123	55.742	53.320	55.418	54.742	12/13/2013 6:45	49.603
12/13/2013 7:00	54.001	56.185	56.785	55.129	55.737	53.482	55.411	54.744	12/13/2013 7:00	48.965
12/13/2013 7:15	53.993	56.179	56.784	55.129	55.738	53.438	55.408	54.741	12/13/2013 7:15	49.553
12/13/2013 7:30	53.995	56.177	56.781	55.134	55.740	53.194	55.430	54.746	12/13/2013 7:30	49.063
12/13/2013 7:45	53.990	56.173	56.777	55.128	55.736	53.753	55.391	54.743	12/13/2013 7:45	49.652
12/13/2013 8:00	53.986	56.174	56.776	55.129	55.738	53.752	55.419	54.746	12/13/2013 8:00	48.684
12/13/2013 8:15	53.989	56.164	56.784	55.129	55.734	53.868	55.395	54.742	12/13/2013 8:15	48.549
12/13/2013 8:30	53.991	56.166	56.776	55.133	55.740	53.874	55.394	54.743	12/13/2013 8:30	49.439
12/13/2013 8:45	53.985	56.161	56.779	55.128	55.745	53.275	55.388	54.739	12/13/2013 8:45	48.707
12/13/2013 9:00	53.980	56.161	56.778	55.131	55.737	53.926	55.355	54.746	12/13/2013 9:00	49.520
12/13/2013 9:15	53.982	56.154	56.777	55.129	55.735	53.430	55.374	54.741	12/13/2013 9:15	48.722
12/13/2013 9:30	53.980	56.155	56.778	55.136	55.739	53.153	55.369	54.740	12/13/2013 9:30	49.014
12/13/2013 9:45	53.982	56.149	56.780	55.135	55.743	53.705	55.380	54.742	12/13/2013 9:45	49.239
12/13/2013 10:00	53.982	56.146	56.781	55.127	55.738	53.926	55.379	54.746	12/13/2013 10:00	49.540
12/13/2013 10:15	53.980	56.141	56.779	55.134	55.739	53.841	55.365	54.745	12/13/2013 10:15	48.800
12/13/2013 10:30	53.978	56.138	56.775	55.127	55.738	53.223	55.373	54.744	12/13/2013 10:30	48.066
12/13/2013 10:45	53.980	56.139	56.778	55.128	55.738	53.509	55.364	54.744	12/13/2013 10:45	48.702
12/13/2013 11:00	53.973	56.137	56.773	55.129	55.743	53.649	55.357	54.739	12/13/2013 11:00	49.140
12/13/2013 11:15	53.974	56.127	56.768	55.129	55.742	53.653	55.366	54.744	12/13/2013 11:15	48.858
12/13/2013 11:30	53.973	56.124	56.771	55.133	55.744	53.435	55.378	54.740	12/13/2013 11:30	48.670
12/13/2013 11:45	53.976	56.121	56.779	55.132	55.742	53.486	55.397	54.742	12/13/2013 11:45	49.061
12/13/2013 12:00	53.971	56.122	56.774	55.126	55.742	53.798	55.361	54.744	12/13/2013 12:00	49.913
12/13/2013 12:15	53.975	56.118	56.772	55.132	55.741	53.554	55.388	54.747	12/13/2013 12:15	49.288

PRESSURE TRANSDUCER WATER TEMPERATURE

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December 12, 2013 to December 23, 2013

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12/13/2013 12:30	53.969	56.110	56.775	55.128	55.742	53.011	55.382	54.743	12/13/2013 12:30	49.764
12/13/2013 12:45	53.970	56.116	56.772	55.129	55.742	53.154	55.374	54.740	12/13/2013 12:45	49.263
12/13/2013 13:00	53.973	56.111	56.774	55.129	55.738	53.660	55.375	54.748	12/13/2013 13:00	49.788
12/13/2013 13:15	53.968	56.103	56.770	55.128	55.744	53.571	55.386	54.743	12/13/2013 13:15	49.800
12/13/2013 13:30	53.969	56.099	56.772	55.130	55.742	53.285	55.386	54.744	12/13/2013 13:30	49.887
12/13/2013 13:45	53.972	56.093	56.773	55.128	55.746	53.748	55.406	54.743	12/13/2013 13:45	48.791
12/13/2013 14:00	53.974	56.092	56.777	55.129	55.742	53.651	55.391	54.740	12/13/2013 14:00	48.999
12/13/2013 14:15	53.969	56.090	56.772	55.130	55.738	53.739	55.379	54.738	12/13/2013 14:15	49.800
12/13/2013 14:30	53.962	56.086	56.763	55.134	55.742	53.438	55.397	54.748	12/13/2013 14:30	49.958
12/13/2013 14:45	53.967	56.085	56.767	55.131	55.741	53.469	55.399	54.744	12/13/2013 14:45	49.876
12/13/2013 15:00	53.967	56.081	56.772	55.131	55.738	53.359	55.399	54.738	12/13/2013 15:00	48.774
12/13/2013 15:15	53.963	56.076	56.771	55.125	55.742	53.397	55.409	54.745	12/13/2013 15:15	48.183
12/13/2013 15:30	53.968	56.073	56.766	55.131	55.742	53.288	55.391	54.744	12/13/2013 15:30	48.218
12/13/2013 15:45	53.965	56.070	56.769	55.130	55.742	53.472	55.390	54.748	12/13/2013 15:45	48.396
12/13/2013 16:00	53.962	56.063	56.769	55.133	55.739	53.151	55.391	54.746	12/13/2013 16:00	48.446
12/13/2013 16:15	53.963	56.063	56.767	55.133	55.742	53.861	55.379	54.748	12/13/2013 16:15	48.563
12/13/2013 16:30	53.960	56.060	56.767	55.131	55.743	53.489	55.403	54.741	12/13/2013 16:30	49.640
12/13/2013 16:45	53.958	56.054	56.767	55.130	55.738	53.437	55.401	54.743	12/13/2013 16:45	50.039
12/13/2013 17:00	53.956	56.052	56.764	55.129	55.736	54.049	55.386	54.745	12/13/2013 17:00	50.154
12/13/2013 17:15	53.962	56.049	56.767	55.132	55.735	53.349	55.370	54.747	12/13/2013 17:15	49.881
12/13/2013 17:30	53.962	56.047	56.771	55.129	55.743	53.304	55.382	54.747	12/13/2013 17:30	48.496
12/13/2013 17:45	53.961	56.040	56.766	55.135	55.735	53.528	55.362	54.744	12/13/2013 17:45	48.304
12/13/2013 18:00	53.956	56.041	56.770	55.131	55.743	53.453	55.353	54.743	12/13/2013 18:00	48.596
12/13/2013 18:15	53.956	56.032	56.765	55.128	55.742	53.417	55.370	54.744	12/13/2013 18:15	48.384
12/13/2013 18:30	53.951	56.034	56.767	55.123	55.739	53.740	55.337	54.748	12/13/2013 18:30	48.379
12/13/2013 18:45	53.956	56.026	56.767	55.128	55.743	53.651	55.340	54.747	12/13/2013 18:45	48.307
12/13/2013 19:00	53.956	56.023	56.761	55.131	55.738	53.471	55.382	54.748	12/13/2013 19:00	48.248
12/13/2013 19:15	53.951	56.023	56.767	55.130	55.739	53.734	55.384	54.744	12/13/2013 19:15	48.168
12/13/2013 19:30	53.956	56.021	56.762	55.130	55.742	53.395	55.399	54.744	12/13/2013 19:30	48.331
12/13/2013 19:45	53.954	56.016	56.762	55.129	55.736	53.296	55.393	54.748	12/13/2013 19:45	48.430

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/13/2013 20:00	53.950	56.014	56.759	55.133	55.742	53.592	55.373	54.752	12/13/2013 20:00	48.448
12/13/2013 20:15	53.952	56.005	56.764	55.131	55.741	53.167	55.381	54.744	12/13/2013 20:15	48.300
12/13/2013 20:30	53.952	56.011	56.762	55.134	55.736	53.146	55.392	54.750	12/13/2013 20:30	48.222
12/13/2013 20:45	53.948	56.008	56.761	55.133	55.739	53.397	55.382	54.744	12/13/2013 20:45	48.263
12/13/2013 21:00	53.950	56.001	56.761	55.131	55.742	53.978	55.376	54.746	12/13/2013 21:00	48.228
12/13/2013 21:15	53.948	55.996	56.764	55.134	55.739	53.094	55.359	54.747	12/13/2013 21:15	48.268
12/13/2013 21:30	53.950	55.998	56.761	55.138	55.740	52.980	55.354	54.745	12/13/2013 21:30	47.983
12/13/2013 21:45	53.947	55.994	56.764	55.133	55.737	53.426	55.315	54.743	12/13/2013 21:45	48.503
12/13/2013 22:00	53.947	55.989	56.762	55.133	55.741	52.982	55.335	54.741	12/13/2013 22:00	48.244
12/13/2013 22:15	53.942	55.989	56.765	55.131	55.743	53.127	55.332	54.744	12/13/2013 22:15	48.190
12/13/2013 22:30	53.948	55.987	56.758	55.127	55.742	53.615	55.362	54.746	12/13/2013 22:30	48.140
12/13/2013 22:45	53.947	55.981	56.764	55.131	55.742	53.120	55.377	54.743	12/13/2013 22:45	48.371
12/13/2013 23:00	53.944	55.983	56.754	55.126	55.741	53.243	55.358	54.740	12/13/2013 23:00	48.337
12/13/2013 23:15	53.952	55.980	56.759	55.129	55.741	53.426	55.366	54.746	12/13/2013 23:15	48.230
12/13/2013 23:30	53.943	55.973	56.761	55.132	55.738	54.054	55.384	54.750	12/13/2013 23:30	48.035
12/13/2013 23:45	53.946	55.969	56.756	55.139	55.744	53.221	55.381	54.743	12/13/2013 23:45	48.435
12/14/2013 0:00	53.947	55.966	56.758	55.132	55.739	53.548	55.339	54.746	12/14/2013 0:00	48.390
12/14/2013 0:15	53.943	55.965	56.752	55.135	55.742	53.097	55.368	54.739	12/14/2013 0:15	48.397
12/14/2013 0:30	53.945	55.960	56.757	55.135	55.742	53.714	55.319	54.749	12/14/2013 0:30	48.592
12/14/2013 0:45	53.948	55.961	56.754	55.134	55.739	53.690	55.352	54.738	12/14/2013 0:45	48.102
12/14/2013 1:00	53.943	55.953	56.753	55.130	55.737	53.132	55.342	54.746	12/14/2013 1:00	47.953
12/14/2013 1:15	53.947	55.951	56.755	55.136	55.742	53.343	55.372	54.747	12/14/2013 1:15	48.351
12/14/2013 1:30	53.948	55.952	56.756	55.132	55.736	53.659	55.371	54.742	12/14/2013 1:30	48.458
12/14/2013 1:45	53.950	55.957	56.750	55.132	55.742	53.053	55.391	54.744	12/14/2013 1:45	48.721
12/14/2013 2:00	53.946	55.949	56.752	55.132	55.742	53.558	55.379	54.744	12/14/2013 2:00	48.907
12/14/2013 2:15	53.943	55.947	56.755	55.132	55.741	53.870	55.375	54.746	12/14/2013 2:15	48.507
12/14/2013 2:30	53.943	55.945	56.754	55.130	55.740	53.252	55.352	54.743	12/14/2013 2:30	48.452
12/14/2013 2:45	53.946	55.943	56.753	55.132	55.739	54.035	55.377	54.745	12/14/2013 2:45	48.513
12/14/2013 3:00	53.947	55.936	56.755	55.135	55.742	54.338	55.357	54.745	12/14/2013 3:00	48.506
12/14/2013 3:15	53.948	55.934	56.754	55.138	55.740	53.513	55.364	54.746	12/14/2013 3:15	48.303

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/14/2013 3:30	53.943	55.934	56.750	55.135	55.742	52.952	55.361	54.747	12/14/2013 3:30	48.275
12/14/2013 3:45	53.948	55.938	56.754	55.131	55.738	52.940	55.376	54.744	12/14/2013 3:45	48.273
12/14/2013 4:00	53.944	55.926	56.750	55.129	55.742	52.560	55.347	54.743	12/14/2013 4:00	48.324
12/14/2013 4:15	53.946	55.924	56.750	55.134	55.741	53.195	55.393	54.744	12/14/2013 4:15	48.323
12/14/2013 4:30	53.945	55.921	56.749	55.135	55.740	53.027	55.404	54.743	12/14/2013 4:30	48.348
12/14/2013 4:45	53.940	55.921	56.752	55.135	55.744	53.299	55.370	54.743	12/14/2013 4:45	48.584
12/14/2013 5:00	53.940	55.921	56.748	55.136	55.737	53.214	55.377	54.747	12/14/2013 5:00	48.181
12/14/2013 5:15	53.946	55.914	56.746	55.135	55.737	53.481	55.381	54.747	12/14/2013 5:15	48.069
12/14/2013 5:30	53.941	55.918	56.746	55.131	55.741	53.218	55.376	54.744	12/14/2013 5:30	48.277
12/14/2013 5:45	53.941	55.915	56.747	55.134	55.740	53.141	55.360	54.741	12/14/2013 5:45	48.402
12/14/2013 6:00	53.944	55.910	56.745	55.129	55.738	53.379	55.375	54.746	12/14/2013 6:00	48.355
12/14/2013 6:15	53.945	55.906	56.746	55.126	55.738	53.177	55.348	54.744	12/14/2013 6:15	48.272
12/14/2013 6:30	53.940	55.906	56.749	55.136	55.739	53.658	55.330	54.746	12/14/2013 6:30	48.198
12/14/2013 6:45	53.942	55.905	56.743	55.135	55.741	52.927	55.330	54.750	12/14/2013 6:45	48.364
12/14/2013 7:00	53.945	55.899	56.748	55.135	55.738	53.427	55.352	54.748	12/14/2013 7:00	47.935
12/14/2013 7:15	53.940	55.897	56.746	55.135	55.740	53.620	55.344	54.741	12/14/2013 7:15	48.048
12/14/2013 7:30	53.941	55.898	56.743	55.135	55.735	53.583	55.346	54.746	12/14/2013 7:30	48.082
12/14/2013 7:45	53.945	55.893	56.744	55.131	55.735	53.102	55.345	54.742	12/14/2013 7:45	48.347
12/14/2013 8:00	53.949	55.892	56.743	55.131	55.742	53.160	55.361	54.749	12/14/2013 8:00	48.230
12/14/2013 8:15	53.945	55.890	56.738	55.135	55.736	53.527	55.362	54.744	12/14/2013 8:15	48.305
12/14/2013 8:30	53.946	55.892	56.743	55.140	55.736	53.366	55.315	54.747	12/14/2013 8:30	48.748
12/14/2013 8:45	53.947	55.882	56.741	55.133	55.739	53.607	55.345	54.745	12/14/2013 8:45	48.342
12/14/2013 9:00	53.943	55.885	56.743	55.131	55.740	53.385	55.369	54.748	12/14/2013 9:00	48.298
12/14/2013 9:15	53.945	55.879	56.743	55.136	55.736	53.409	55.356	54.743	12/14/2013 9:15	48.447
12/14/2013 9:30	53.950	55.882	56.743	55.135	55.742	53.367	55.340	54.743	12/14/2013 9:30	48.363
12/14/2013 9:45	53.942	55.873	56.738	55.135	55.735	53.871	55.323	54.744	12/14/2013 9:45	48.431
12/14/2013 10:00	53.952	55.874	56.743	55.135	55.740	53.563	55.345	54.747	12/14/2013 10:00	48.469
12/14/2013 10:15	53.946	55.873	56.739	55.129	55.734	53.286	55.345	54.748	12/14/2013 10:15	48.369
12/14/2013 10:30	53.946	55.873	56.741	55.135	55.739	53.448	55.331	54.748	12/14/2013 10:30	48.205
12/14/2013 10:45	53.945	55.870	56.734	55.133	55.736	53.290	55.352	54.744	12/14/2013 10:45	48.253

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/14/2013 11:00	53.945	55.871	56.736	55.138	55.738	53.175	55.347	54.746	12/14/2013 11:00	48.371
12/14/2013 11:15	53.951	55.865	56.738	55.135	55.736	53.293	55.335	54.748	12/14/2013 11:15	48.467
12/14/2013 11:30	53.951	55.865	56.737	55.135	55.741	53.467	55.313	54.742	12/14/2013 11:30	48.337
12/14/2013 11:45	53.942	55.861	56.740	55.140	55.737	53.554	55.326	54.744	12/14/2013 11:45	48.479
12/14/2013 12:00	53.944	55.865	56.733	55.139	55.741	53.833	55.273	54.743	12/14/2013 12:00	48.279
12/14/2013 12:15	53.947	55.863	56.733	55.133	55.737	53.626	55.275	54.744	12/14/2013 12:15	48.456
12/14/2013 12:30	53.949	55.854	56.732	55.140	55.738	53.874	55.281	54.749	12/14/2013 12:30	48.598
12/14/2013 12:45	53.950	55.858	56.738	55.135	55.736	53.575	55.283	54.748	12/14/2013 12:45	48.425
12/14/2013 13:00	53.951	55.855	56.737	55.141	55.742	53.492	55.308	54.738	12/14/2013 13:00	48.298
12/14/2013 13:15	53.946	55.854	56.733	55.136	55.741	53.266	55.297	54.747	12/14/2013 13:15	48.341
12/14/2013 13:30	53.957	55.855	56.740	55.141	55.741	54.312	55.305	54.747	12/14/2013 13:30	48.473
12/14/2013 13:45	53.951	55.850	56.737	55.135	55.737	54.530	55.316	54.745	12/14/2013 13:45	48.376
12/14/2013 14:00	53.951	55.843	56.732	55.141	55.740	53.708	55.301	54.744	12/14/2013 14:00	48.596
12/14/2013 14:15	53.946	55.846	56.734	55.138	55.742	53.178	55.333	54.747	12/14/2013 14:15	48.368
12/14/2013 14:30	53.952	55.843	56.732	55.137	55.740	53.356	55.327	54.750	12/14/2013 14:30	48.575
12/14/2013 14:45	53.956	55.840	56.734	55.137	55.742	53.303	55.319	54.746	12/14/2013 14:45	48.605
12/14/2013 15:00	53.953	55.839	56.735	55.141	55.735	53.644	55.324	54.744	12/14/2013 15:00	48.887
12/14/2013 15:15	53.956	55.840	56.732	55.138	55.738	53.577	55.302	54.750	12/14/2013 15:15	48.517
12/14/2013 15:30	53.950	55.840	56.726	55.137	55.737	53.310	55.332	54.741	12/14/2013 15:30	49.494
12/14/2013 15:45	53.952	55.839	56.731	55.135	55.742	53.175	55.330	54.747	12/14/2013 15:45	49.316
12/14/2013 16:00	53.954	55.834	56.728	55.135	55.740	53.361	55.319	54.745	12/14/2013 16:00	49.755
12/14/2013 16:15	53.955	55.830	56.727	55.143	55.742	53.254	55.327	54.744	12/14/2013 16:15	49.536
12/14/2013 16:30	53.953	55.835	56.729	55.135	55.737	53.380	55.327	54.748	12/14/2013 16:30	49.807
12/14/2013 16:45	53.954	55.829	56.729	55.143	55.742	53.131	55.285	54.744	12/14/2013 16:45	49.832
12/14/2013 17:00	53.952	55.831	56.725	55.142	55.742	53.451	55.332	54.743	12/14/2013 17:00	50.115
12/14/2013 17:15	53.959	55.830	56.730	55.141	55.742	53.793	55.297	54.744	12/14/2013 17:15	49.955
12/14/2013 17:30	53.956	55.825	56.731	55.143	55.738	53.543	55.281	54.744	12/14/2013 17:30	50.039
12/14/2013 17:45	53.954	55.825	56.726	55.137	55.734	53.572	55.291	54.744	12/14/2013 17:45	49.981
12/14/2013 18:00	53.959	55.824	56.729	55.138	55.737	53.466	55.290	54.744	12/14/2013 18:00	50.117
12/14/2013 18:15	53.957	55.825	56.722	55.138	55.741	53.162	55.279	54.744	12/14/2013 18:15	50.053

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/14/2013 18:30	53.959	55.821	56.721	55.141	55.739	53.148	55.280	54.745	12/14/2013 18:30	49.872
12/14/2013 18:45	53.957	55.819	56.726	55.137	55.739	53.246	55.311	54.744	12/14/2013 18:45	50.049
12/14/2013 19:00	53.962	55.821	56.726	55.142	55.742	52.963	55.310	54.740	12/14/2013 19:00	49.977
12/14/2013 19:15	53.957	55.816	56.722	55.140	55.738	53.803	55.307	54.744	12/14/2013 19:15	50.025
12/14/2013 19:30	53.962	55.819	56.723	55.144	55.742	53.141	55.337	54.740	12/14/2013 19:30	49.818
12/14/2013 19:45	53.960	55.814	56.723	55.141	55.742	52.730	55.308	54.738	12/14/2013 19:45	50.075
12/14/2013 20:00	53.961	55.817	56.722	55.141	55.737	53.432	55.279	54.748	12/14/2013 20:00	50.209
12/14/2013 20:15	53.965	55.812	56.720	55.140	55.739	53.168	55.246	54.743	12/14/2013 20:15	49.959
12/14/2013 20:30	53.964	55.812	56.722	55.138	55.735	53.042	55.235	54.745	12/14/2013 20:30	49.801
12/14/2013 20:45	53.971	55.814	56.720	55.143	55.740	53.102	55.285	54.744	12/14/2013 20:45	49.950
12/14/2013 21:00	53.966	55.808	56.720	55.141	55.740	53.456	55.325	54.746	12/14/2013 21:00	49.960
12/14/2013 21:15	53.965	55.807	56.718	55.144	55.741	53.445	55.345	54.744	12/14/2013 21:15	49.786
12/14/2013 21:30	53.966	55.807	56.714	55.138	55.734	53.231	55.359	54.745	12/14/2013 21:30	49.842
12/14/2013 21:45	53.968	55.806	56.716	55.145	55.739	53.322	55.352	54.744	12/14/2013 21:45	49.839
12/14/2013 22:00	53.960	55.807	56.723	55.142	55.741	53.246	55.329	54.748	12/14/2013 22:00	49.752
12/14/2013 22:15	53.961	55.804	56.724	55.146	55.740	53.628	55.322	54.741	12/14/2013 22:15	49.478
12/14/2013 22:30	53.968	55.801	56.716	55.141	55.736	53.719	55.320	54.743	12/14/2013 22:30	49.819
12/14/2013 22:45	53.969	55.800	56.718	55.141	55.739	53.084	55.327	54.742	12/14/2013 22:45	49.727
12/14/2013 23:00	53.968	55.806	56.721	55.142	55.739	53.516	55.297	54.750	12/14/2013 23:00	49.928
12/14/2013 23:15	53.968	55.800	56.714	55.146	55.740	52.935	55.311	54.741	12/14/2013 23:15	49.809
12/14/2013 23:30	53.968	55.795	56.714	55.137	55.739	53.268	55.303	54.742	12/14/2013 23:30	49.712
12/14/2013 23:45	53.968	55.800	56.719	55.140	55.736	53.337	55.305	54.743	12/14/2013 23:45	49.420
12/15/2013 0:00	53.972	55.799	56.714	55.144	55.736	53.492	55.324	54.747	12/15/2013 0:00	49.738
12/15/2013 0:15	53.969	55.795	56.715	55.141	55.736	53.480	55.322	54.750	12/15/2013 0:15	49.850
12/15/2013 0:30	53.971	55.796	56.718	55.145	55.734	53.647	55.323	54.745	12/15/2013 0:30	49.759
12/15/2013 0:45	53.970	55.795	56.716	55.146	55.736	53.790	55.325	54.739	12/15/2013 0:45	49.848
12/15/2013 1:00	53.970	55.795	56.714	55.142	55.736	52.916	55.307	54.742	12/15/2013 1:00	49.620
12/15/2013 1:15	53.977	55.794	56.714	55.143	55.740	53.328	55.325	54.746	12/15/2013 1:15	49.551
12/15/2013 1:30	53.976	55.794	56.713	55.147	55.734	53.343	55.314	54.741	12/15/2013 1:30	49.623
12/15/2013 1:45	53.974	55.790	56.714	55.143	55.736	53.335	55.287	54.740	12/15/2013 1:45	49.621

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/15/2013 2:00	53.974	55.789	56.712	55.145	55.730	52.726	55.291	54.746	12/15/2013 2:00	49.784
12/15/2013 2:15	53.974	55.791	56.710	55.142	55.735	53.381	55.335	54.745	12/15/2013 2:15	49.957
12/15/2013 2:30	53.977	55.794	56.708	55.142	55.741	53.612	55.303	54.745	12/15/2013 2:30	50.004
12/15/2013 2:45	53.980	55.790	56.708	55.141	55.732	53.481	55.285	54.745	12/15/2013 2:45	49.643
12/15/2013 3:00	53.975	55.788	56.709	55.141	55.736	53.551	55.279	54.750	12/15/2013 3:00	49.699
12/15/2013 3:15	53.975	55.783	56.709	55.144	55.736	53.524	55.277	54.748	12/15/2013 3:15	49.645
12/15/2013 3:30	53.971	55.793	56.706	55.145	55.731	52.965	55.284	54.745	12/15/2013 3:30	49.763
12/15/2013 3:45	53.976	55.786	56.707	55.144	55.742	53.376	55.293	54.749	12/15/2013 3:45	49.889
12/15/2013 4:00	53.973	55.787	56.709	55.144	55.735	53.033	55.291	54.746	12/15/2013 4:00	49.874
12/15/2013 4:15	53.974	55.786	56.705	55.142	55.739	53.825	55.287	54.744	12/15/2013 4:15	49.653
12/15/2013 4:30	53.978	55.781	56.706	55.143	55.736	53.465	55.291	54.745	12/15/2013 4:30	49.621
12/15/2013 4:45	53.977	55.778	56.708	55.146	55.736	53.373	55.301	54.745	12/15/2013 4:45	49.684
12/15/2013 5:00	53.979	55.782	56.706	55.146	55.736	53.058	55.283	54.741	12/15/2013 5:00	49.805
12/15/2013 5:15	53.980	55.780	56.702	55.146	55.736	53.050	55.289	54.743	12/15/2013 5:15	49.828
12/15/2013 5:30	53.976	55.780	56.704	55.142	55.735	53.273	55.295	54.738	12/15/2013 5:30	49.573
12/15/2013 5:45	53.980	55.777	56.703	55.145	55.734	53.488	55.307	54.745	12/15/2013 5:45	49.534
12/15/2013 6:00	53.982	55.781	56.707	55.148	55.736	53.434	55.285	54.744	12/15/2013 6:00	49.717
12/15/2013 6:15	53.980	55.780	56.700	55.144	55.744	52.899	55.219	54.739	12/15/2013 6:15	49.345
12/15/2013 6:30	53.986	55.775	56.710	55.145	55.737	53.490	55.218	54.745	12/15/2013 6:30	49.404
12/15/2013 6:45	53.985	55.777	56.707	55.147	55.736	53.541	55.238	54.744	12/15/2013 6:45	49.243
12/15/2013 7:00	53.980	55.777	56.705	55.149	55.737	53.460	55.272	54.744	12/15/2013 7:00	49.325
12/15/2013 7:15	53.987	55.780	56.704	55.146	55.735	53.371	55.272	54.745	12/15/2013 7:15	49.446
12/15/2013 7:30	53.984	55.775	56.700	55.148	55.736	52.975	55.283	54.746	12/15/2013 7:30	49.289
12/15/2013 7:45	53.984	55.776	56.701	55.146	55.736	53.094	55.299	54.752	12/15/2013 7:45	49.367
12/15/2013 8:00	53.986	55.771	56.700	55.146	55.735	53.428	55.324	54.745	12/15/2013 8:00	49.372
12/15/2013 8:15	53.985	55.771	56.701	55.149	55.733	53.037	55.280	54.743	12/15/2013 8:15	49.417
12/15/2013 8:30	53.987	55.776	56.702	55.151	55.742	53.219	55.237	54.749	12/15/2013 8:30	49.455
12/15/2013 8:45	53.989	55.771	56.697	55.146	55.735	53.215	55.293	54.741	12/15/2013 8:45	49.469
12/15/2013 9:00	53.990	55.773	56.699	55.146	55.735	53.498	55.315	54.748	12/15/2013 9:00	49.333
12/15/2013 9:15	53.992	55.771	56.695	55.147	55.736	53.528	55.327	54.743	12/15/2013 9:15	49.223

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/15/2013 9:30	53.988	55.774	56.700	55.149	55.734	53.297	55.327	54.742	12/15/2013 9:30	49.243
12/15/2013 9:45	53.986	55.767	56.693	55.148	55.733	52.911	55.311	54.744	12/15/2013 9:45	49.486
12/15/2013 10:00	53.986	55.775	56.701	55.148	55.740	53.461	55.268	54.742	12/15/2013 10:00	49.354
12/15/2013 10:15	53.990	55.777	56.696	55.145	55.733	52.873	55.273	54.742	12/15/2013 10:15	49.219
12/15/2013 10:30	53.991	55.767	56.703	55.146	55.733	53.238	55.276	54.747	12/15/2013 10:30	49.506
12/15/2013 10:45	53.992	55.766	56.696	55.145	55.736	53.498	55.267	54.744	12/15/2013 10:45	49.370
12/15/2013 11:00	53.986	55.767	56.698	55.147	55.738	53.223	55.290	54.745	12/15/2013 11:00	49.704
12/15/2013 11:15	53.993	55.768	56.695	55.148	55.742	53.310	55.289	54.740	12/15/2013 11:15	49.609
12/15/2013 11:30	53.996	55.768	56.696	55.151	55.740	53.313	55.253	54.741	12/15/2013 11:30	49.409
12/15/2013 11:45	53.997	55.767	56.694	55.146	55.733	53.467	55.300	54.744	12/15/2013 11:45	49.315
12/15/2013 12:00	53.993	55.760	56.695	55.146	55.736	53.624	55.299	54.746	12/15/2013 12:00	49.776
12/15/2013 12:15	53.992	55.764	56.690	55.146	55.736	53.247	55.305	54.747	12/15/2013 12:15	49.458
12/15/2013 12:30	53.996	55.760	56.692	55.148	55.733	53.363	55.291	54.747	12/15/2013 12:30	49.280
12/15/2013 12:45	53.993	55.761	56.696	55.152	55.735	53.003	55.264	54.743	12/15/2013 12:45	49.597
12/15/2013 13:00	53.998	55.761	56.693	55.150	55.734	53.143	55.245	54.749	12/15/2013 13:00	49.537
12/15/2013 13:15	53.999	55.761	56.693	55.154	55.739	53.128	55.255	54.745	12/15/2013 13:15	49.251
12/15/2013 13:30	54.000	55.764	56.692	55.145	55.741	52.948	55.258	54.748	12/15/2013 13:30	49.388
12/15/2013 13:45	54.000	55.760	56.693	55.149	55.736	53.508	55.257	54.748	12/15/2013 13:45	49.393
12/15/2013 14:00	53.996	55.762	56.690	55.152	55.738	53.235	55.266	54.743	12/15/2013 14:00	49.501
12/15/2013 14:15	54.000	55.759	56.690	55.149	55.741	53.180	55.301	54.746	12/15/2013 14:15	49.470
12/15/2013 14:30	54.003	55.761	56.688	55.153	55.732	53.745	55.291	54.747	12/15/2013 14:30	49.437
12/15/2013 14:45	54.003	55.758	56.688	55.149	55.733	53.388	55.278	54.742	12/15/2013 14:45	49.291
12/15/2013 15:00	54.003	55.760	56.690	55.152	55.739	53.448	55.291	54.747	12/15/2013 15:00	49.237
12/15/2013 15:15	54.009	55.758	56.689	55.149	55.734	53.093	55.297	54.745	12/15/2013 15:15	49.255
12/15/2013 15:30	54.003	55.759	56.689	55.153	55.733	53.293	55.269	54.744	12/15/2013 15:30	49.257
12/15/2013 15:45	54.000	55.757	56.686	55.146	55.737	53.149	55.270	54.749	12/15/2013 15:45	49.196
12/15/2013 16:00	54.001	55.753	56.689	55.149	55.734	53.595	55.244	54.742	12/15/2013 16:00	49.107
12/15/2013 16:15	53.999	55.753	56.694	55.147	55.731	53.212	55.241	54.745	12/15/2013 16:15	49.376
12/15/2013 16:30	54.005	55.759	56.691	55.149	55.737	54.020	55.257	54.739	12/15/2013 16:30	49.173
12/15/2013 16:45	54.005	55.754	56.683	55.153	55.731	53.395	55.230	54.744	12/15/2013 16:45	49.171

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/15/2013 17:00	54.008	55.750	56.688	55.150	55.735	53.027	55.241	54.746	12/15/2013 17:00	49.046
12/15/2013 17:15	54.009	55.753	56.686	55.155	55.736	53.199	55.264	54.742	12/15/2013 17:15	48.949
12/15/2013 17:30	54.007	55.752	56.689	55.149	55.736	53.079	55.240	54.744	12/15/2013 17:30	48.948
12/15/2013 17:45	54.009	55.753	56.687	55.151	55.736	53.309	55.279	54.740	12/15/2013 17:45	49.152
12/15/2013 18:00	54.014	55.752	56.683	55.150	55.735	53.104	55.269	54.747	12/15/2013 18:00	48.941
12/15/2013 18:15	54.010	55.753	56.681	55.149	55.739	53.039	55.261	54.747	12/15/2013 18:15	48.944
12/15/2013 18:30	54.012	55.747	56.688	55.149	55.730	52.914	55.261	54.744	12/15/2013 18:30	48.921
12/15/2013 18:45	54.011	55.747	56.681	55.156	55.736	53.164	55.226	54.748	12/15/2013 18:45	49.047
12/15/2013 19:00	54.015	55.752	56.678	55.152	55.736	53.863	55.253	54.741	12/15/2013 19:00	49.033
12/15/2013 19:15	54.012	55.748	56.679	55.158	55.736	53.834	55.288	54.744	12/15/2013 19:15	48.970
12/15/2013 19:30	54.012	55.753	56.684	55.155	55.736	53.536	55.298	54.744	12/15/2013 19:30	48.734
12/15/2013 19:45	54.012	55.749	56.679	55.149	55.736	53.659	55.291	54.743	12/15/2013 19:45	48.583
12/15/2013 20:00	54.016	55.752	56.675	55.152	55.731	53.323	55.319	54.746	12/15/2013 20:00	48.808
12/15/2013 20:15	54.019	55.747	56.676	55.156	55.733	53.588	55.297	54.740	12/15/2013 20:15	48.926
12/15/2013 20:30	54.018	55.749	56.676	55.150	55.736	53.499	55.273	54.747	12/15/2013 20:30	49.120
12/15/2013 20:45	54.019	55.753	56.681	55.153	55.736	52.878	55.261	54.742	12/15/2013 20:45	49.142
12/15/2013 21:00	54.018	55.748	56.680	55.158	55.735	53.145	55.242	54.744	12/15/2013 21:00	49.265
12/15/2013 21:15	54.014	55.746	56.681	55.155	55.738	53.303	55.171	54.750	12/15/2013 21:15	49.575
12/15/2013 21:30	54.019	55.746	56.676	55.156	55.734	53.045	55.196	54.741	12/15/2013 21:30	49.267
12/15/2013 21:45	54.022	55.746	56.674	55.156	55.732	52.630	55.205	54.743	12/15/2013 21:45	49.462
12/15/2013 22:00	54.021	55.746	56.678	55.157	55.736	53.745	55.219	54.740	12/15/2013 22:00	49.772
12/15/2013 22:15	54.021	55.746	56.673	55.152	55.732	53.361	55.233	54.743	12/15/2013 22:15	49.823
12/15/2013 22:30	54.020	55.742	56.674	55.151	55.739	53.438	55.256	54.746	12/15/2013 22:30	49.846
12/15/2013 22:45	54.025	55.745	56.677	55.153	55.737	53.297	55.213	54.740	12/15/2013 22:45	49.623
12/15/2013 23:00	54.023	55.746	56.676	55.146	55.734	52.975	55.249	54.744	12/15/2013 23:00	49.610
12/15/2013 23:15	54.028	55.741	56.676	55.155	55.736	53.160	55.255	54.740	12/15/2013 23:15	49.880
12/15/2013 23:30	54.025	55.746	56.675	55.158	55.736	53.609	55.276	54.744	12/15/2013 23:30	50.000
12/15/2013 23:45	54.022	55.742	56.672	55.155	55.735	53.406	55.264	54.740	12/15/2013 23:45	49.753
12/16/2013 0:00	54.019	55.744	56.673	55.154	55.739	53.490	55.249	54.746	12/16/2013 0:00	49.767
12/16/2013 0:15	54.024	55.737	56.667	55.151	55.734	53.255	55.279	54.737	12/16/2013 0:15	49.787

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 0:30	54.023	55.738	56.668	55.153	55.730	53.129	55.290	54.740	12/16/2013 0:30	49.725
12/16/2013 0:45	54.022	55.741	56.670	55.159	55.733	53.589	55.268	54.743	12/16/2013 0:45	49.859
12/16/2013 1:00	54.026	55.744	56.668	55.158	55.731	53.232	55.270	54.740	12/16/2013 1:00	49.627
12/16/2013 1:15	54.030	55.740	56.668	55.151	55.733	53.622	55.266	54.741	12/16/2013 1:15	49.403
12/16/2013 1:30	54.026	55.742	56.668	55.147	55.733	53.149	55.294	54.744	12/16/2013 1:30	49.718
12/16/2013 1:45	54.028	55.742	56.668	55.153	55.736	53.250	55.229	54.747	12/16/2013 1:45	49.570
12/16/2013 2:00	54.033	55.743	56.666	55.153	55.733	54.143	55.259	54.743	12/16/2013 2:00	49.458
12/16/2013 2:15	54.027	55.738	56.665	55.152	55.733	54.253	55.256	54.745	12/16/2013 2:15	49.407
12/16/2013 2:30	54.031	55.739	56.665	55.160	55.730	53.348	55.220	54.740	12/16/2013 2:30	49.718
12/16/2013 2:45	54.029	55.741	56.665	55.158	55.739	53.079	55.209	54.739	12/16/2013 2:45	49.562
12/16/2013 3:00	54.035	55.741	56.662	55.158	55.734	53.288	55.241	54.747	12/16/2013 3:00	49.563
12/16/2013 3:15	54.028	55.735	56.662	55.158	55.733	53.141	55.267	54.739	12/16/2013 3:15	49.404
12/16/2013 3:30	54.032	55.735	56.663	55.155	55.731	52.992	55.253	54.743	12/16/2013 3:30	49.415
12/16/2013 3:45	54.035	55.735	56.662	55.157	55.730	53.310	55.224	54.745	12/16/2013 3:45	49.429
12/16/2013 4:00	54.038	55.739	56.661	55.152	55.730	53.167	55.262	54.736	12/16/2013 4:00	49.541
12/16/2013 4:15	54.039	55.742	56.664	55.153	55.730	53.365	55.264	54.745	12/16/2013 4:15	49.598
12/16/2013 4:30	54.034	55.741	56.661	55.155	55.731	53.417	55.238	54.741	12/16/2013 4:30	49.709
12/16/2013 4:45	54.037	55.738	56.666	55.154	55.732	53.245	55.219	54.744	12/16/2013 4:45	49.429
12/16/2013 5:00	54.035	55.738	56.661	55.158	55.735	52.959	55.250	54.744	12/16/2013 5:00	49.582
12/16/2013 5:15	54.043	55.740	56.667	55.157	55.736	52.838	55.268	54.741	12/16/2013 5:15	49.724
12/16/2013 5:30	54.038	55.732	56.655	55.154	55.727	53.421	55.288	54.744	12/16/2013 5:30	49.719
12/16/2013 5:45	54.043	55.737	56.658	55.153	55.728	53.066	55.289	54.741	12/16/2013 5:45	49.640
12/16/2013 6:00	54.035	55.736	56.655	55.156	55.731	52.993	55.268	54.741	12/16/2013 6:00	49.693
12/16/2013 6:15	54.040	55.733	56.657	55.153	55.730	53.015	55.232	54.740	12/16/2013 6:15	49.246
12/16/2013 6:30	54.040	55.738	56.656	55.155	55.733	53.438	55.258	54.744	12/16/2013 6:30	49.336
12/16/2013 6:45	54.046	55.737	56.656	55.155	55.733	52.877	55.264	54.738	12/16/2013 6:45	49.409
12/16/2013 7:00	54.040	55.734	56.660	55.156	55.724	53.345	55.241	54.740	12/16/2013 7:00	49.266
12/16/2013 7:15	54.040	55.738	56.661	55.156	55.729	53.416	55.252	54.735	12/16/2013 7:15	49.420
12/16/2013 7:30	54.042	55.741	56.661	55.160	55.727	53.375	55.261	54.742	12/16/2013 7:30	49.063
12/16/2013 7:45	54.042	55.733	56.656	55.157	55.734	53.296	55.253	54.741	12/16/2013 7:45	49.205

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 8:00	54.045	55.735	56.652	55.156	55.731	52.737	55.245	54.744	12/16/2013 8:00	49.200
12/16/2013 8:15	54.043	55.736	56.654	55.156	55.732	53.275	55.227	54.744	12/16/2013 8:15	48.925
12/16/2013 8:30	54.043	55.739	56.655	55.158	55.736	52.986	55.241	54.745	12/16/2013 8:30	48.648
12/16/2013 8:45	54.048	55.736	56.657	55.160	55.728	52.882	55.227	54.740	12/16/2013 8:45	49.433
12/16/2013 9:00	54.045	55.729	56.656	55.157	55.736	53.396	55.219	54.745	12/16/2013 9:00	49.074
12/16/2013 9:15	54.046	55.732	56.659	55.158	55.730	53.180	55.222	54.744	12/16/2013 9:15	49.142
12/16/2013 9:30	54.050	55.729	56.654	55.158	55.733	53.018	55.208	54.742	12/16/2013 9:30	49.170
12/16/2013 9:45	54.048	55.732	56.653	55.158	55.734	53.216	55.206	54.744	12/16/2013 9:45	49.402
12/16/2013 10:00	54.049	55.729	56.654	55.166	55.735	53.189	55.230	54.738	12/16/2013 10:00	49.599
12/16/2013 10:15	54.046	55.737	56.655	55.158	55.731	53.297	55.230	54.742	12/16/2013 10:15	49.629
12/16/2013 10:30	54.053	55.730	56.655	55.160	55.731	53.532	55.236	54.743	12/16/2013 10:30	49.305
12/16/2013 10:45	54.050	55.730	56.650	55.157	55.732	53.138	55.246	54.742	12/16/2013 10:45	49.559
12/16/2013 11:00	54.053	55.732	56.655	55.157	55.732	53.589	55.264	54.744	12/16/2013 11:00	49.362
12/16/2013 11:15	54.053	55.735	56.651	55.161	55.733	53.023	55.253	54.742	12/16/2013 11:15	49.552
12/16/2013 11:30		55.729	56.650	55.157			55.240	54.741	12/16/2013 11:30	49.676
12/16/2013 11:45			56.650				55.242		12/16/2013 11:45	49.502
12/16/2013 12:00	54.049	55.730	56.655	55.159	55.733	53.200	55.187	54.744	12/16/2013 12:00	49.736
12/16/2013 12:00	54.089	55.770	56.690	55.199	55.768	53.241	55.225	54.781	12/16/2013 12:15	49.502
12/16/2013 12:00	54.116	55.788	56.725	55.225	55.791	53.261	55.248	54.807	12/16/2013 12:30	49.255
12/16/2013 12:00	54.128	55.812	56.737	55.239	55.808	53.276	55.264	54.820	12/16/2013 12:45	49.382
12/16/2013 12:00	54.144	55.819	56.756	55.248	55.824	53.293	55.277	54.835	12/16/2013 13:00	49.299
12/16/2013 12:00	54.156	55.830	56.768	55.256	55.835	53.301	55.288	54.843	12/16/2013 13:15	49.623
12/16/2013 12:00	54.161	55.842	56.779	55.271	55.842	53.311	55.299	54.850	12/16/2013 13:30	49.639
12/16/2013 12:00	54.176	55.847	56.823	55.276	55.852	53.314	55.306	54.856	12/16/2013 13:45	49.259
12/16/2013 12:00	54.175	55.855	56.823	55.286	55.855	53.322	55.313	54.868	12/16/2013 14:00	49.081
12/16/2013 12:00	54.191	55.856	56.828	55.284	55.865	53.330	55.314	54.874	12/16/2013 14:15	49.280
12/16/2013 12:00	54.186	55.868	56.828	55.297	55.872	53.328	55.323	54.874	12/16/2013 14:30	49.145
12/16/2013 12:00	54.198	55.869	56.827	55.297	55.875	53.342	55.324	54.883	12/16/2013 14:45	49.332
12/16/2013 12:00	54.202	55.873	56.825	55.305	55.874	53.336	55.328	54.886	12/16/2013 15:00	49.103
12/16/2013 12:00	54.197	55.878	56.832	55.303	55.879	53.343	55.336	54.886	12/16/2013 15:15	48.791

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 12:00	54.202	55.881	56.835	55.307	55.884	53.342	55.340	54.893	12/16/2013 15:30	49.006
12/16/2013 12:00	54.207	55.885	56.835	55.311	55.889	53.346	55.338	54.892	12/16/2013 15:45	49.178
12/16/2013 12:00	54.213	55.885	56.839	55.320	55.895	53.352	55.340	54.899	12/16/2013 16:00	48.595
12/16/2013 12:00	54.215	55.887	56.837	55.317	55.891	53.352	55.345	54.900	12/16/2013 16:15	48.732
12/16/2013 12:00	54.214	55.892	56.838	55.319	55.896	53.356	55.355	54.903	12/16/2013 16:30	48.713
12/16/2013 12:00	54.221	55.896	56.839	55.324	55.898	53.353	55.351	54.903	12/16/2013 16:45	48.592
12/16/2013 12:00	54.220	55.897	56.839	55.321	55.900	53.356	55.358	54.909	12/16/2013 17:00	48.749
12/16/2013 12:00	54.221	55.902	56.844	55.330	55.899	53.363	55.355	54.910	12/16/2013 17:15	48.517
12/16/2013 12:00	54.224	55.903	56.850	55.333	55.906	53.366	55.356	54.912	12/16/2013 17:30	48.549
12/16/2013 12:00	54.227	55.904	56.849	55.330	55.901	53.368	55.361	54.911	12/16/2013 17:45	48.814
12/16/2013 12:00	54.224	55.907	56.850	55.328	55.908	53.370	55.367	54.915	12/16/2013 18:00	48.665
12/16/2013 12:00	54.210	55.889	56.837	55.315	55.889	53.349	55.341	54.900	12/16/2013 18:15	48.402
12/16/2013 12:00	54.203	55.884	56.824	55.313	55.886	53.341	55.339	54.893	12/16/2013 18:30	48.485
12/16/2013 12:00	54.193	55.871	56.813	55.299	55.878	53.330	55.327	54.880	12/16/2013 18:45	48.570
12/16/2013 12:00	54.183	55.866	56.803	55.291	55.861	53.326	55.321	54.873	12/16/2013 19:00	48.440
12/16/2013 12:00	54.179	55.858	56.803	55.288	55.862	53.320	55.315	54.869	12/16/2013 19:15	48.239
12/16/2013 12:00	54.176	55.856	56.797	55.281	55.857	53.307	55.309	54.864	12/16/2013 19:30	48.168
12/16/2013 12:00	54.164	55.845	56.788	55.272	55.847	53.298	55.308	54.849	12/16/2013 19:45	48.382
12/16/2013 12:00	54.161	55.847	56.783	55.271	55.848	53.304	55.299	54.853	12/16/2013 20:00	48.123
12/16/2013 12:00	54.162	55.840	56.776	55.266	55.841	53.300	55.291	54.845	12/16/2013 20:15	47.844
12/16/2013 12:00	54.149	55.836	56.768	55.263	55.834	53.293	55.296	54.841	12/16/2013 20:30	48.199
12/16/2013 12:00	54.156	55.835	56.773	55.260	55.831	53.287	55.291	54.838	12/16/2013 20:45	48.071
12/16/2013 12:00	54.125	55.830	56.761	55.257	55.829	53.263	55.284	54.839	12/16/2013 21:00	48.117
12/16/2013 12:00	54.163	55.827	56.756	55.249	55.820	53.297	55.278	54.828	12/16/2013 21:15	47.821
12/16/2013 12:00	54.182	55.823	56.756	55.247	55.819	53.308	55.273	54.831	12/16/2013 21:30	48.212
12/16/2013 12:00	54.164	55.820	56.751	55.245	55.814	53.287	55.277	54.826	12/16/2013 21:45	47.791
12/16/2013 12:00	54.154	55.820	56.749	55.245	55.814	53.278	55.273	54.822	12/16/2013 22:00	48.355
12/16/2013 12:00	54.151	55.815	56.743	55.239	55.814	53.274	55.273	54.817	12/16/2013 22:15	47.667
12/16/2013 12:00	54.145	55.810	56.744	55.239	55.812	53.269	55.269	54.816	12/16/2013 22:30	47.932
12/16/2013 12:00	54.145	55.815	56.745	55.237	55.810	53.272	55.266	54.815	12/16/2013 22:45	47.964

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 12:00	54.143	55.808	56.738	55.238	55.807	53.267	55.261	54.814	12/16/2013 23:00	47.555
12/16/2013 12:00	54.143	55.813	56.739	55.233	55.806	53.264	55.261	54.814	12/16/2013 23:15	47.714
12/16/2013 12:00	54.150	55.806	56.740	55.228	55.796	53.261	55.257	54.809	12/16/2013 23:30	47.654
12/16/2013 12:00	54.151	55.805	56.736	55.226	55.807	53.257	55.255	54.814	12/16/2013 23:45	47.695
12/16/2013 12:00	54.153	55.805	56.736	55.222	55.805	53.261	55.254	54.805	12/17/2013 0:00	47.765
12/16/2013 12:00	54.155	55.806	56.730	55.220	55.799	53.260	55.254	54.806	12/17/2013 0:15	47.688
12/16/2013 12:00	54.156	55.806	56.733	55.227	55.794	53.260	55.251	54.799	12/17/2013 0:30	47.891
12/16/2013 12:00	54.157	55.802	56.729	55.225	55.793	53.256	55.249	54.799	12/17/2013 0:45	47.543
12/16/2013 12:00	54.161	55.802	56.727	55.220	55.794	53.257	55.249	54.800	12/17/2013 1:00	47.671
12/16/2013 12:00	54.161	55.799	56.729	55.222	55.792	53.252	55.247	54.798	12/17/2013 1:15	47.677
12/16/2013 12:00	54.161	55.801	56.726	55.217	55.792	53.255	55.249	54.797	12/17/2013 1:30	47.399
12/16/2013 12:00	54.168	55.799	56.727	55.220	55.790	53.252	55.248	54.796	12/17/2013 1:45	47.457
12/16/2013 12:00	54.171	55.798	56.730	55.216	55.787	53.254	55.242	54.794	12/17/2013 2:00	47.633
12/16/2013 12:00	54.175	55.801	56.727	55.216	55.786	53.248	55.239	54.792	12/17/2013 2:15	48.050
12/16/2013 12:00	54.188	55.797	56.725	55.210	55.783	53.247	55.237	54.791	12/17/2013 2:30	48.411
12/16/2013 12:00	54.183	55.798	56.727	55.210	55.779	53.246	55.235	54.792	12/17/2013 2:45	47.777
12/16/2013 12:00	54.179	55.798	56.728	55.213	55.781	53.246	55.236	54.786	12/17/2013 3:00	47.766
12/16/2013 12:00	54.188	55.801	56.727	55.213	55.779	53.246	55.236	54.789	12/17/2013 3:15	47.530
12/16/2013 12:00	54.198	55.803	56.726	55.206	55.774	53.245	55.235	54.784	12/17/2013 3:30	47.887
12/16/2013 12:00	54.197	55.807	56.726	55.212	55.772	53.237	55.232	54.781	12/17/2013 3:45	47.342
12/16/2013 12:01	54.203	55.807	56.732	55.210	55.772	53.238	55.231	54.783	12/17/2013 4:00	47.751
12/16/2013 12:01	54.209	55.807	56.720	55.207	55.770	53.243	55.224	54.779	12/17/2013 4:15	47.755
12/16/2013 12:01	54.210	55.808	56.732	55.209	55.766	53.242	55.222	54.778	12/17/2013 4:30	47.636
12/16/2013 12:01	54.219	55.810	56.727	55.209	55.768	53.234	55.216	54.778	12/17/2013 4:45	46.879
12/16/2013 12:01	54.224	55.819	56.733	55.212	55.760	53.233	55.218	54.770	12/17/2013 5:00	46.768
12/16/2013 12:01	54.229	55.816	56.733	55.209	55.759	53.234	55.209	54.780	12/17/2013 5:15	46.842
12/16/2013 12:01	54.232	55.822	56.734	55.205	55.761	53.236	55.200	54.773	12/17/2013 5:30	46.783
12/16/2013 12:01	54.241	55.826	56.741	55.207	55.756	53.238	55.196	54.774	12/17/2013 5:45	46.752
12/16/2013 12:01	54.247	55.828	56.741	55.208	55.752	53.242	55.193	54.776	12/17/2013 6:00	46.701
12/16/2013 12:01	54.253	55.831	56.740	55.205	55.744	53.246	55.189	54.775	12/17/2013 6:15	46.660

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 12:01	54.255	55.835	56.746	55.210	55.746	53.249	55.177	54.769	12/17/2013 6:30	46.569
12/16/2013 12:01	54.264	55.837	56.739	55.209	55.742	53.252	55.174	54.772	12/17/2013 6:45	46.886
12/16/2013 12:01	54.266	55.842	56.749	55.215	55.740	53.264	55.168	54.770	12/17/2013 7:00	46.787
12/16/2013 12:02	54.279	55.845	56.752	55.218	55.736	53.276	55.161	54.767	12/17/2013 7:15	45.710
12/16/2013 12:02	54.280	55.857	56.755	55.219	55.736	53.276	55.158	54.766	12/17/2013 7:30	45.208
12/16/2013 12:02	54.286	55.856	56.759	55.222	55.736	53.286	55.147	54.769	12/17/2013 7:45	45.181
12/16/2013 12:02	54.297	55.865	56.764	55.220	55.727	53.296	55.141	54.768	12/17/2013 8:00	45.106
12/16/2013 12:02	54.306	55.870	56.767	55.228	55.728	53.304	55.130	54.768	12/17/2013 8:15	44.542
12/16/2013 12:02	54.308	55.872	56.775	55.231	55.726	53.310	55.118	54.774	12/17/2013 8:30	44.583
12/16/2013 12:02	54.313	55.875	56.777	55.233	55.719	53.301	55.118	54.774	12/17/2013 8:45	44.535
12/16/2013 12:03	54.318	55.874	56.780	55.234	55.723	53.283	55.105	54.768	12/17/2013 9:00	44.559
12/16/2013 12:03	54.329	55.880	56.783	55.235	55.713	53.246	55.098	54.763	12/17/2013 9:15	44.297
12/16/2013 12:03	54.333	55.886	56.786	55.241	55.710	53.210	55.090	54.771	12/17/2013 9:30	44.320
12/16/2013 12:03	54.337	55.891	56.792	55.249	55.707	53.171	55.077	54.775	12/17/2013 9:45	44.536
12/16/2013 12:03	54.341	55.891	56.794	55.240	55.704	53.141	55.068	54.768	12/17/2013 10:00	44.690
12/16/2013 12:04	54.348	55.892	56.800	55.240	55.697	53.118	55.058	54.770	12/17/2013 10:15	44.789
12/16/2013 12:04	54.353	55.898	56.804	55.252	55.693	53.129	55.044	54.774	12/17/2013 10:30	44.928
12/16/2013 12:04	54.357	55.898	56.804	55.258	55.692	53.146	55.027	54.774	12/17/2013 10:45	45.041
12/16/2013 12:05	54.362	55.898	56.810	55.261	55.689	53.180	55.011	54.774	12/17/2013 11:00	45.055
12/16/2013 12:05	54.366	55.898	56.809	55.266	55.677	53.219	54.997	54.767	12/17/2013 11:15	45.037
12/16/2013 12:05	54.367	55.904	56.813	55.264	55.671	53.253	54.980	54.775	12/17/2013 11:30	45.040
12/16/2013 12:05	54.375	55.902	56.815	55.265	55.665	53.258	54.968	54.772	12/17/2013 11:45	45.060
12/16/2013 12:06	54.379	55.903	56.809	55.265	55.659	53.264	54.953	54.777	12/17/2013 12:00	45.144
12/16/2013 12:06	54.385	55.897	56.815	55.268	55.659	53.281	54.938	54.774	12/17/2013 12:15	45.157
12/16/2013 12:07	54.388	55.902	56.814	55.267	55.652	53.320	54.930	54.774	12/17/2013 12:30	45.146
12/16/2013 12:07	54.393	55.898	56.818	55.273	55.650	53.329	54.919	54.777	12/17/2013 12:45	45.201
12/16/2013 12:07	54.402	55.900	56.816	55.274	55.642	53.318	54.909	54.774	12/17/2013 13:00	45.195
12/16/2013 12:08	54.411	55.894	56.810	55.271	55.641	53.270	54.907	54.778	12/17/2013 13:15	45.287
12/16/2013 12:08	54.408	55.892	56.813	55.270	55.634	53.224	54.899	54.774	12/17/2013 13:30	45.358
12/16/2013 12:09	54.417	55.893	56.813	55.267	55.631	53.170	54.902	54.776	12/17/2013 13:45	45.105

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 12:10	54.419	55.892	56.808	55.274	55.624	53.135	54.910	54.772	12/17/2013 14:00	45.062
12/16/2013 12:10	54.405	55.885	56.810	55.274	55.621	53.142	54.916	54.776	12/17/2013 14:15	45.068
12/16/2013 12:11	54.402	55.884	56.811	55.263	55.617	53.136	54.917	54.774	12/17/2013 14:30	44.999
12/16/2013 12:11	54.404	55.880	56.807	55.272	55.612	53.007	54.920	54.775	12/17/2013 14:45	44.954
12/16/2013 12:12	54.395	55.876	56.806	55.266	55.609	52.905	54.928	54.771	12/17/2013 15:00	45.046
12/16/2013 12:13	54.392	55.876	56.802	55.268	55.611	52.880	54.944	54.772	12/17/2013 15:15	44.990
12/16/2013 12:14	54.394	55.867	56.802	55.262	55.613	52.939	54.956	54.772	12/17/2013 15:30	44.944
12/16/2013 12:15	54.398	55.865	56.795	55.257	55.611	53.080	54.971	54.773	12/17/2013 15:45	44.923
12/16/2013 12:15	54.388	55.855	56.793	55.262	55.613	53.090	54.980	54.771	12/17/2013 16:00	44.722
12/16/2013 12:16	54.389	55.853	56.790	55.252	55.615	53.030	55.004	54.771	12/17/2013 16:15	44.549
12/16/2013 12:17	54.388	55.843	56.790	55.254	55.616	52.909	55.012	54.773	12/17/2013 16:30	44.832
12/16/2013 12:18	54.403	55.837	56.780	55.252	55.625	52.843	55.026	54.767	12/17/2013 16:45	44.494
12/16/2013 12:19	54.447	55.831	56.779	55.251	55.624	52.816	55.035	54.768	12/17/2013 17:00	44.410
12/16/2013 12:21	54.454	55.828	56.779	55.242	55.638	52.842	55.042	54.769	12/17/2013 17:15	44.368
12/16/2013 12:22	54.442	55.820	56.769	55.244	55.642	52.879	55.052	54.764	12/17/2013 17:30	44.326
12/16/2013 12:23	54.419	55.821	56.766	55.239	55.649	52.938	55.069	54.761	12/17/2013 17:45	44.240
12/16/2013 12:25	54.408	55.813	56.771	55.242	55.653	53.021	55.077	54.766	12/17/2013 18:00	44.188
12/16/2013 12:26	54.412	55.807	56.756	55.233	55.654	53.144	55.089	54.764	12/17/2013 18:15	44.291
12/16/2013 12:28	54.429	55.803	56.759	55.230	55.660	53.311	55.091	54.758	12/17/2013 18:30	44.396
12/16/2013 12:29	54.443	55.798	56.749	55.228	55.662	53.397	55.094	54.762	12/17/2013 18:45	44.356
12/16/2013 12:31	54.469	55.795	56.747	55.223	55.666	53.436	55.105	54.764	12/17/2013 19:00	44.273
12/16/2013 12:33	54.469	55.791	56.746	55.221	55.672	53.383	55.117	54.759	12/17/2013 19:15	44.321
12/16/2013 12:35	54.451	55.784	56.740	55.216	55.672	53.271	55.128	54.757	12/17/2013 19:30	44.415
12/16/2013 12:37	54.435	55.778	56.738	55.212	55.678	53.257	55.136	54.761	12/17/2013 19:45	44.309
12/16/2013 12:39	54.430	55.777	56.728	55.210	55.682	53.237	55.146	54.757	12/17/2013 20:00	44.310
12/16/2013 12:42	54.492	55.775	56.729	55.205	55.686	53.164	55.155	54.753	12/17/2013 20:15	44.319
12/16/2013 12:44	54.503	55.771	56.721	55.204	55.689	53.129	55.159	54.758	12/17/2013 20:30	44.320
12/16/2013 12:47	54.488	55.762	56.720	55.210	55.689	53.200	55.170	54.756	12/17/2013 20:45	44.262
12/16/2013 12:50	54.457	55.760	56.717	55.208	55.691	53.264	55.165	54.755	12/17/2013 21:00	44.227
12/16/2013 12:53	54.472	55.759	56.710	55.201	55.698	53.220	55.165	54.756	12/17/2013 21:15	44.167

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 12:56	54.451	55.753	56.713	55.198	55.700	53.368	55.177	54.755	12/17/2013 21:30	44.174
12/16/2013 12:59	54.481	55.748	56.707	55.192	55.706	53.310	55.182	54.752	12/17/2013 21:45	44.146
12/16/2013 13:03	54.539	55.748	56.707	55.191	55.700	53.096	55.195	54.756	12/17/2013 22:00	44.137
12/16/2013 13:06	54.526	55.741	56.702	55.189	55.705	53.234	55.213	54.744	12/17/2013 22:15	44.127
12/16/2013 13:10	54.559	55.738	56.696	55.185	55.709	53.176	55.225	54.751	12/17/2013 22:30	44.105
12/16/2013 13:15	54.566	55.737	56.696	55.186	55.715	53.099	55.242	54.753	12/17/2013 22:45	44.040
12/16/2013 13:19	54.538	55.735	56.691	55.185	55.713	53.093	55.241	54.749	12/17/2013 23:00	44.048
12/16/2013 13:24	54.551	55.731	56.685	55.181	55.715	53.308	55.240	54.745	12/17/2013 23:15	44.021
12/16/2013 13:29	54.567	55.733	56.685	55.183	55.715	53.165	55.231	54.754	12/17/2013 23:30	44.104
12/16/2013 13:34	54.563	55.730	56.681	55.179	55.713	53.359	55.225	54.750	12/17/2013 23:45	44.094
12/16/2013 13:40	54.556	55.725	56.681	55.179	55.720	53.015	55.231	54.749	12/18/2013 0:00	44.120
12/16/2013 13:46	54.568	55.731	56.679	55.176	55.719	53.090	55.229	54.752	12/18/2013 0:15	44.138
12/16/2013 13:52	54.577	55.734	56.674	55.173	55.720	53.537	55.232	54.746	12/18/2013 0:30	44.127
12/16/2013 13:59	54.624	55.727	56.674	55.180	55.722	53.578	55.240	54.744	12/18/2013 0:45	44.130
12/16/2013 14:06	54.625	55.733	56.669	55.175	55.726	53.289	55.222	54.743	12/18/2013 1:00	44.125
12/16/2013 14:13	54.667	55.728	56.668	55.180	55.721	53.533	55.232	54.743	12/18/2013 1:15	44.099
12/16/2013 14:21	54.600	55.729	56.669	55.171	55.722	53.218	55.234	54.745	12/18/2013 1:30	44.063
12/16/2013 14:30	54.624	55.736	56.666	55.175	55.730	53.360	55.246	54.747	12/18/2013 1:45	44.046
12/16/2013 14:38	54.687	55.745	56.663	55.175	55.726	52.638	55.240	54.743	12/18/2013 2:00	44.107
12/16/2013 14:48	54.653	55.740	56.663	55.175	55.726	53.410	55.237	54.746	12/18/2013 2:15	43.983
12/16/2013 14:58	54.650	55.741	56.661	55.171	55.730	53.210	55.256	54.746	12/18/2013 2:30	43.999
12/16/2013 15:08	54.669	55.746	56.662	55.170	55.728	53.218	55.276	54.747	12/18/2013 2:45	43.999
12/16/2013 15:19	54.652	55.755	56.661	55.168	55.730	52.873	55.272	54.748	12/18/2013 3:00	43.947
12/16/2013 15:31	54.664	55.759	56.651	55.170	55.728	53.100	55.283	54.746	12/18/2013 3:15	44.410
12/16/2013 15:44	54.691	55.769	56.657	55.174	55.729	53.273	55.264	54.743	12/18/2013 3:30	43.747
12/16/2013 15:57	54.704	55.777	56.659	55.172	55.732	53.636	55.225	54.744	12/18/2013 3:45	43.726
12/16/2013 16:11	54.690	55.779	56.653	55.170	55.728	53.008	55.244	54.742	12/18/2013 4:00	43.742
12/16/2013 16:26	54.657	55.796	56.651	55.173	55.729	53.228	55.279	54.744	12/18/2013 4:15	43.949
12/16/2013 16:41	54.711	55.813	56.657	55.174	55.736	53.332	55.305	54.745	12/18/2013 4:30	43.796
12/16/2013 16:56	54.751	55.827	56.651	55.174	55.736	52.901	55.309	54.742	12/18/2013 4:45	43.737

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/16/2013 17:11	54.698	55.836	56.649	55.172	55.734	53.771	55.308	54.748	12/18/2013 5:00	44.227
12/16/2013 17:26	54.679	55.856	56.642	55.167	55.730	53.583	55.280	54.747	12/18/2013 5:15	43.816
12/16/2013 17:41	54.671	55.867	56.646	55.175	55.734	53.142	55.281	54.740	12/18/2013 5:30	43.736
12/16/2013 17:56	54.687	55.888	56.644	55.181	55.731	52.760	55.256	54.744	12/18/2013 5:45	43.740
12/16/2013 18:11	54.676	55.903	56.642	55.177	55.736	53.221	55.261	54.750	12/18/2013 6:00	43.801
12/16/2013 18:26	54.686	55.916	56.646	55.173	55.735	53.328	55.257	54.744	12/18/2013 6:15	43.777
12/16/2013 18:41	54.662	55.933	56.643	55.175	55.736	53.754	55.279	54.743	12/18/2013 6:30	44.060
12/16/2013 18:56	54.681	55.947	56.642	55.174	55.735	53.639	55.224	54.741	12/18/2013 6:45	43.733
12/16/2013 19:11	54.668	55.959	56.642	55.176	55.738	53.531	55.247	54.744	12/18/2013 7:00	43.703
12/16/2013 19:26	54.689	55.976	56.641	55.178	55.736	53.319	55.240	54.744	12/18/2013 7:15	43.680
12/16/2013 19:41	54.678	55.987	56.640	55.174	55.734	53.442	55.245	54.749	12/18/2013 7:30	43.689
12/16/2013 19:56	54.686	56.001	56.643	55.176	55.730	53.483	55.243	54.746	12/18/2013 7:45	43.643
12/16/2013 20:11	54.672	56.016	56.640	55.177	55.736	53.395	55.258	54.743	12/18/2013 8:00	43.718
12/16/2013 20:26	54.690	56.027	56.640	55.177	55.736	52.736	55.232	54.748	12/18/2013 8:15	43.549
12/16/2013 20:41	54.688	56.041	56.640	55.172	55.730	52.750	55.250	54.744	12/18/2013 8:30	43.590
12/16/2013 20:56	54.668	56.052	56.636	55.175	55.739	52.783	55.267	54.749	12/18/2013 8:45	43.542
12/16/2013 21:11	54.693	56.064	56.634	55.178	55.734	53.165	55.257	54.744	12/18/2013 9:00	43.781
12/16/2013 21:26	54.693	56.077	56.636	55.170	55.730	52.916	55.243	54.744	12/18/2013 9:15	43.606
12/16/2013 21:41	54.673	56.090	56.637	55.184	55.738	52.874	55.231	54.743	12/18/2013 9:30	43.864
12/16/2013 21:56	54.672	56.095	56.636	55.181	55.736	53.383	55.243	54.745	12/18/2013 9:45	43.800
12/16/2013 22:11	54.692	56.112	56.638	55.177	55.735	53.291	55.265	54.739	12/18/2013 10:00	43.539
12/16/2013 22:26	54.699	56.123	56.632	55.174	55.736	53.012	55.239	54.747	12/18/2013 10:15	43.514
12/16/2013 22:41	54.661	56.130	56.633	55.179	55.735	53.442	55.248	54.744	12/18/2013 10:30	43.549
12/16/2013 22:56	54.678	56.146	56.635	55.176	55.735	53.073	55.255	54.739	12/18/2013 10:45	43.507
12/16/2013 23:11	54.676	56.158	56.634	55.179	55.739	53.553	55.254	54.746	12/18/2013 11:00	43.669
12/16/2013 23:26	54.711	56.165	56.631	55.176	55.737	52.863	55.260	54.746	12/18/2013 11:15	43.534
12/16/2013 23:41	54.688	56.173	56.634	55.176	55.733	53.176	55.255	54.750	12/18/2013 11:30	43.600
12/16/2013 23:56	54.711	56.180	56.635	55.180	55.738	52.894	55.262	54.746	12/18/2013 11:45	43.669
12/17/2013 0:11	54.683	56.193	56.630	55.176	55.735	53.096	55.279	54.744	12/18/2013 12:00	43.900
12/17/2013 0:26	54.667	56.205	56.637	55.179	55.737	53.183	55.279	54.742	12/18/2013 12:15	43.623

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/17/2013 0:41	54.734	56.212	56.630	55.176	55.735	52.704	55.267	54.749	12/18/2013 12:30	43.538
12/17/2013 0:56	54.683	56.219	56.626	55.177	55.736	52.986	55.248	54.745	12/18/2013 12:45	43.557
12/17/2013 1:11	54.692	56.230	56.630	55.180	55.734	52.921	55.246	54.748	12/18/2013 13:00	43.562
12/17/2013 1:26	54.668	56.231	56.632	55.189	55.730	52.815	55.261	54.741	12/18/2013 13:15	43.608
12/17/2013 1:41	54.686	56.239	56.632	55.176	55.735	53.367	55.287	54.751	12/18/2013 13:30	43.755
12/17/2013 1:56	54.676	56.248	56.633	55.175	55.738	52.461	55.267	54.743	12/18/2013 13:45	43.968
12/17/2013 2:11	54.668	56.253	56.626	55.181	55.738	52.689	55.238	54.745	12/18/2013 14:00	43.810
12/17/2013 2:26	54.657	56.257	56.628	55.181	55.739	53.324	55.263	54.747	12/18/2013 14:15	43.837
12/17/2013 2:41	54.682	56.269	56.632	55.182	55.736	52.637	55.251	54.744	12/18/2013 14:30	43.738
12/17/2013 2:56	54.691	56.275	56.631	55.179	55.736	53.159	55.266	54.742	12/18/2013 14:45	43.831
12/17/2013 3:11	54.666	56.280	56.627	55.183	55.736	53.208	55.263	54.751	12/18/2013 15:00	43.816
12/17/2013 3:26	54.674	56.288	56.625	55.184	55.738	52.318	55.267	54.747	12/18/2013 15:15	43.882
12/17/2013 3:41	54.704	56.293	56.626	55.181	55.738	53.084	55.265	54.744	12/18/2013 15:30	43.835
12/17/2013 3:56	54.737	56.299	56.627	55.176	55.736	53.046	55.268	54.738	12/18/2013 15:45	43.829
12/17/2013 4:11	54.710	56.302	56.622	55.177	55.733	52.813	55.264	54.747	12/18/2013 16:00	43.794
12/17/2013 4:26	54.680	56.311	56.626	55.182	55.737	52.752	55.258	54.747	12/18/2013 16:15	43.730
12/17/2013 4:41	54.685	56.316	56.620	55.187	55.735	52.680	55.268	54.744	12/18/2013 16:30	43.725
12/17/2013 4:56	54.726	56.321	56.624	55.182	55.739	53.203	55.267	54.745	12/18/2013 16:45	43.635
12/17/2013 5:11	54.716	56.324	56.626	55.180	55.736	53.237	55.269	54.744	12/18/2013 17:00	43.671
12/17/2013 5:26	54.668	56.329	56.626	55.185	55.731	53.401	55.256	54.746	12/18/2013 17:15	43.538
12/17/2013 5:41	54.682	56.334	56.623	55.181	55.734	52.698	55.211	54.745	12/18/2013 17:30	43.585
12/17/2013 5:56	54.697	56.341	56.619	55.179	55.738	53.043	55.261	54.748	12/18/2013 17:45	43.594
12/17/2013 6:11	54.636	56.345	56.621	55.187	55.739	52.810	55.232	54.745	12/18/2013 18:00	43.584
12/17/2013 6:26	54.724	56.344	56.625	55.185	55.733	53.163	55.262	54.744	12/18/2013 18:15	43.530
12/17/2013 6:41	54.714	56.348	56.621	55.180	55.736	53.013	55.261	54.750	12/18/2013 18:30	43.402
12/17/2013 6:56	54.673	56.352	56.617	55.185	55.737	52.790	55.246	54.748	12/18/2013 18:45	43.437
12/17/2013 7:11	54.705	56.359	56.620	55.178	55.739	52.953	55.246	54.739	12/18/2013 19:00	43.397
12/17/2013 7:26	54.723	56.364	56.622	55.183	55.742	53.033	55.242	54.746	12/18/2013 19:15	43.386
12/17/2013 7:41	54.684	56.368	56.620	55.179	55.735	53.242	55.244	54.746	12/18/2013 19:30	43.357
12/17/2013 7:56	54.709	56.369	56.620	55.185	55.736	53.774	55.230	54.746	12/18/2013 19:45	43.343

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/17/2013 8:11	54.711	56.379	56.617	55.188	55.740	53.328	55.233	54.746	12/18/2013 20:00	43.340
12/17/2013 8:26	54.676	56.378	56.614	55.179	55.737	53.133	55.243	54.743	12/18/2013 20:15	43.344
12/17/2013 8:41	54.723	56.381	56.620	55.181	55.736	53.099	55.239	54.744	12/18/2013 20:30	43.328
12/17/2013 8:56	54.715	56.384	56.619	55.187	55.739	52.986	55.245	54.746	12/18/2013 20:45	43.287
12/17/2013 9:11	54.672	56.387	56.617	55.185	55.742	52.091	55.230	54.747	12/18/2013 21:00	43.271
12/17/2013 9:26	54.711	56.389	56.613	55.183	55.738	52.754	55.219	54.750	12/18/2013 21:15	43.287
12/17/2013 9:41	54.694	56.391	56.615	55.187	55.739	52.365	55.243	54.750	12/18/2013 21:30	43.249
12/17/2013 9:56	54.693	56.401	56.612	55.187	55.740	52.741	55.235	54.753	12/18/2013 21:45	43.255
12/17/2013 10:11	54.723	56.402	56.617	55.187	55.736	52.488	55.240	54.748	12/18/2013 22:00	43.225
12/17/2013 10:26	54.715	56.405	56.612	55.189	55.741	52.439	55.231	54.746	12/18/2013 22:15	43.224
12/17/2013 10:41	54.723	56.405	56.611	55.187	55.736	52.095	55.244	54.743	12/18/2013 22:30	43.203
12/17/2013 10:56	54.713	56.410	56.610	55.184	55.738	52.700	55.251	54.747	12/18/2013 22:45	43.203
12/17/2013 11:11	54.700	56.411	56.609	55.193	55.733	52.659	55.237	54.751	12/18/2013 23:00	43.176
12/17/2013 11:26	54.711	56.415	56.608	55.186	55.737	53.277	55.199	54.744	12/18/2013 23:15	43.164
12/17/2013 11:41	54.699	56.413	56.613	55.191	55.734	52.348	55.193	54.748	12/18/2013 23:30	43.140
12/17/2013 11:56	54.711	56.416	56.613	55.191	55.738	52.602	55.170	54.745	12/18/2013 23:45	43.178
12/17/2013 12:11	54.702	56.419	56.612	55.184	55.742	52.608	55.186	54.745	12/19/2013 0:00	43.127
12/17/2013 12:26	54.691	56.418	56.609	55.187	55.738	52.911	55.227	54.749	12/19/2013 0:15	43.130
12/17/2013 12:41	54.695	56.423	56.612	55.189	55.739	52.897	55.274	54.748	12/19/2013 0:30	43.099
12/17/2013 12:56	54.717	56.420	56.605	55.186	55.738	52.948	55.277	54.750	12/19/2013 0:45	43.128
12/17/2013 13:11	54.739	56.424	56.608	55.190	55.744	53.231	55.293	54.750	12/19/2013 1:00	43.167
12/17/2013 13:26	54.706	56.423	56.607	55.188	55.741	52.778	55.231	54.752	12/19/2013 1:15	43.177
12/17/2013 13:41	54.724	56.428	56.603	55.187	55.738	52.634	55.249	54.744	12/19/2013 1:30	43.185
12/17/2013 13:56	54.736	56.433	56.608	55.187	55.743	52.702	55.244	54.746	12/19/2013 1:45	43.162
12/17/2013 14:11	54.701	56.434	56.610	55.192	55.737	52.513	55.236	54.752	12/19/2013 2:00	43.227
12/17/2013 14:26	54.703	56.436	56.602	55.187	55.738	52.532	55.207	54.751	12/19/2013 2:15	43.166
12/17/2013 14:41	54.705	56.439	56.606	55.190	55.736	52.320	55.242	54.747	12/19/2013 2:30	43.181
12/17/2013 14:56	54.730	56.438	56.604	55.188	55.736	52.260	55.232	54.750	12/19/2013 2:45	43.208
12/17/2013 15:11	54.736	56.447	56.605	55.199	55.742	52.870	55.204	54.750	12/19/2013 3:00	43.193
12/17/2013 15:26	54.742	56.445	56.611	55.193	55.736	52.414	55.234	54.754	12/19/2013 3:15	43.184

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/17/2013 15:41	54.733	56.444	56.606	55.191	55.740	52.833	55.248	54.755	12/19/2013 3:30	43.168
12/17/2013 15:56	54.708	56.443	56.608	55.189	55.737	52.540	55.252	54.753	12/19/2013 3:45	43.179
12/17/2013 16:11	54.709	56.447	56.604	55.190	55.737	52.299	55.215	54.751	12/19/2013 4:00	43.177
12/17/2013 16:26	54.730	56.450	56.602	55.189	55.736	53.065	55.220	54.753	12/19/2013 4:15	43.194
12/17/2013 16:41	54.708	56.452	56.606	55.187	55.742	52.427	55.233	54.750	12/19/2013 4:30	43.171
12/17/2013 16:56	54.711	56.453	56.606	55.184	55.737	52.515	55.241	54.756	12/19/2013 4:45	43.187
12/17/2013 17:11	54.722	56.456	56.600	55.191	55.744	52.821	55.244	54.754	12/19/2013 5:00	43.153
12/17/2013 17:26	54.710	56.457	56.599	55.184	55.738	52.383	55.257	54.750	12/19/2013 5:15	43.182
12/17/2013 17:41	54.718	56.460	56.599	55.190	55.736	52.584	55.280	54.750	12/19/2013 5:30	43.167
12/17/2013 17:56	54.714	56.458	56.602	55.193	55.736	53.034	55.275	54.750	12/19/2013 5:45	43.158
12/17/2013 18:11	54.726	56.457	56.596	55.193	55.739	53.360	55.262	54.749	12/19/2013 6:00	43.161
12/17/2013 18:26	54.727	56.463	56.600	55.197	55.739	52.611	55.239	54.754	12/19/2013 6:15	43.187
12/17/2013 18:41	54.715	56.462	56.606	55.191	55.740	53.194	55.221	54.747	12/19/2013 6:30	43.161
12/17/2013 18:56	54.720	56.464	56.594	55.192	55.737	52.980	55.235	54.750	12/19/2013 6:45	43.173
12/17/2013 19:11	54.705	56.470	56.601	55.187	55.738	52.910	55.260	54.751	12/19/2013 7:00	43.159
12/17/2013 19:26	54.710	56.474	56.599	55.189	55.739	52.759	55.243	54.756	12/19/2013 7:15	43.152
12/17/2013 19:41	54.717	56.475	56.598	55.192	55.736	52.079	55.249	54.749	12/19/2013 7:30	43.183
12/17/2013 19:56	54.739	56.474	56.598	55.190	55.736	52.355	55.267	54.750	12/19/2013 7:45	43.168
12/17/2013 20:11	54.712	56.472	56.591	55.190	55.736	52.416	55.281	54.750	12/19/2013 8:00	43.155
12/17/2013 20:26	54.699	56.475	56.596	55.190	55.736	52.428	55.233	54.750	12/19/2013 8:15	43.151
12/17/2013 20:41	54.707	56.475	56.591	55.192	55.741	53.148	55.235	54.755	12/19/2013 8:30	43.136
12/17/2013 20:56	54.701	56.478	56.592	55.188	55.742	52.462	55.258	54.751	12/19/2013 8:45	43.156
12/17/2013 21:11	54.726	56.481	56.593	55.192	55.737	52.065	55.251	54.750	12/19/2013 9:00	43.106
12/17/2013 21:26	54.725	56.478	56.590	55.188	55.736	52.752	55.273	54.749	12/19/2013 9:15	43.120
12/17/2013 21:41	54.709	56.484	56.595	55.193	55.740	52.910	55.254	54.758	12/19/2013 9:30	43.106
12/17/2013 21:56	54.711	56.482	56.586	55.193	55.736	53.299	55.243	54.756	12/19/2013 9:45	43.109
12/17/2013 22:11	54.721	56.486	56.588	55.197	55.742	52.447	55.242	54.752	12/19/2013 10:00	43.068
12/17/2013 22:26	54.722	56.481	56.580	55.195	55.739	52.655	55.246	54.750	12/19/2013 10:15	43.119
12/17/2013 22:41	54.729	56.480	56.591	55.196	55.744	52.608	55.245	54.750	12/19/2013 10:30	43.143
12/17/2013 22:56	54.705	56.487	56.584	55.191	55.737	53.222	55.241	54.750	12/19/2013 10:45	43.146

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/17/2013 23:11	54.717	56.486	56.585	55.201	55.736	52.651	55.211	54.756	12/19/2013 11:00	43.198
12/17/2013 23:26	54.741	56.481	56.586	55.196	55.739	52.675	55.248	54.748	12/19/2013 11:15	43.160
12/17/2013 23:41	54.717	56.486	56.584	55.191	55.738	52.347	55.224	54.753	12/19/2013 11:30	43.145
12/17/2013 23:56	54.709	56.490	56.582	55.195	55.737	52.927	55.236	54.755	12/19/2013 11:45	43.175
12/18/2013 0:11	54.722	56.490	56.585	55.198	55.742	52.197	55.243	54.750	12/19/2013 12:00	43.187
12/18/2013 0:26	54.716	56.492	56.581	55.199	55.737	52.420	55.244	54.754	12/19/2013 12:15	43.157
12/18/2013 0:41	54.713	56.492	56.587	55.201	55.741	52.380	55.234	54.753	12/19/2013 12:30	43.117
12/18/2013 0:56	54.716	56.495	56.585	55.199	55.737	52.750	55.259	54.752	12/19/2013 12:45	43.207
12/18/2013 1:11	54.720	56.488	56.587	55.194	55.738	52.616	55.240	54.754	12/19/2013 13:00	43.224
12/18/2013 1:26	54.710	56.492	56.580	55.199	55.737	52.738	55.212	54.750	12/19/2013 13:15	43.186
12/18/2013 1:41	54.725	56.494	56.579	55.194	55.737	52.353	55.209	54.750	12/19/2013 13:30	43.205
12/18/2013 1:56	54.717	56.499	56.578	55.195	55.743	51.932	55.215	54.755	12/19/2013 13:45	43.223
12/18/2013 2:11	54.713	56.498	56.584	55.195	55.742	52.476	55.232	54.753	12/19/2013 14:00	43.187
12/18/2013 2:26	54.719	56.502	56.580	55.199	55.740	52.605	55.255	54.748	12/19/2013 14:15	43.204
12/18/2013 2:41	54.704	56.500	56.581	55.193	55.739	52.814	55.251	54.753	12/19/2013 14:30	43.204
12/18/2013 2:56	54.689	56.502	56.582	55.196	55.744	51.761	55.221	54.747	12/19/2013 14:45	43.608
12/18/2013 3:11	54.718	56.500	56.579	55.202	55.742	52.271	55.201	54.753	12/19/2013 15:00	43.772
12/18/2013 3:26	54.714	56.503	56.576	55.200	55.741	52.147	55.222	54.755	12/19/2013 15:15	43.844
12/18/2013 3:41	54.726	56.503	56.576	55.198	55.743	52.790	55.226	54.752	12/19/2013 15:30	43.920
12/18/2013 3:56	54.714	56.502	56.576	55.204	55.741	53.433	55.232	54.749	12/19/2013 15:45	43.941
12/18/2013 4:11	54.706	56.504	56.571	55.198	55.736	52.992	55.235	54.753	12/19/2013 16:00	43.978
12/18/2013 4:26	54.726	56.504	56.575	55.200	55.737	52.865	55.209	54.751	12/19/2013 16:15	44.022
12/18/2013 4:41	54.722	56.509	56.571	55.199	55.735	52.589	55.242	54.754	12/19/2013 16:30	44.230
12/18/2013 4:56	54.723	56.504	56.571	55.201	55.742	52.550	55.225	54.756	12/19/2013 16:45	44.086
12/18/2013 5:11	54.726	56.508	56.570	55.200	55.742	52.220	55.227	54.750	12/19/2013 17:00	44.260
12/18/2013 5:26	54.704	56.507	56.570	55.204	55.742	52.301	55.226	54.751	12/19/2013 17:15	44.374
12/18/2013 5:41	54.703	56.508	56.573	55.204	55.736	52.343	55.204	54.760	12/19/2013 17:30	44.481
12/18/2013 5:56	54.707	56.515	56.574	55.200	55.741	52.163	55.178	54.754	12/19/2013 17:45	44.516
12/18/2013 6:11	54.693	56.507	56.572	55.204	55.738	52.596	55.219	54.750	12/19/2013 18:00	44.502
12/18/2013 6:26	54.721	56.507	56.572	55.197	55.742	51.582	55.235	54.752	12/19/2013 18:15	44.520

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/18/2013 6:41	54.722	56.511	56.567	55.204	55.745	51.977	55.230	54.756	12/19/2013 18:30	44.552
12/18/2013 6:56	54.726	56.511	56.567	55.201	55.737	52.442	55.236	54.753	12/19/2013 18:45	44.643
12/18/2013 7:11	54.713	56.518	56.568	55.205	55.735	52.578	55.237	54.750	12/19/2013 19:00	44.596
12/18/2013 7:26	54.721	56.512	56.566	55.206	55.739	52.879	55.222	54.753	12/19/2013 19:15	44.652
12/18/2013 7:41	54.711	56.516	56.571	55.207	55.736	51.911	55.184	54.752	12/19/2013 19:30	44.614
12/18/2013 7:56	54.718	56.514	56.567	55.205	55.736	51.812	55.208	54.747	12/19/2013 19:45	44.625
12/18/2013 8:11	54.705	56.516	56.563	55.206	55.732	52.420	55.206	54.759	12/19/2013 20:00	44.673
12/18/2013 8:26	54.730	56.518	56.565	55.208	55.736	52.767	55.197	54.757	12/19/2013 20:15	44.621
12/18/2013 8:41	54.708	56.512	56.570	55.206	55.736	51.951	55.193	54.756	12/19/2013 20:30	44.637
12/18/2013 8:56	54.478	56.143	56.397	55.154	55.591	52.262	55.312	54.741	12/19/2013 20:45	44.589
12/18/2013 9:11	54.498	56.172	56.375	55.137	55.597	52.313	55.321	54.735	12/19/2013 21:00	44.536
12/18/2013 9:26	54.439	56.260	56.436	55.150	55.634	51.915	55.219	54.742	12/19/2013 21:15	44.520
12/18/2013 9:41	54.558	56.355	56.479	55.170	55.677	52.010	55.219	54.742	12/19/2013 21:30	44.589
12/18/2013 9:56	54.832	56.510	56.604	55.282	55.674	51.472	54.950	54.774	12/19/2013 21:45	44.642
12/18/2013 10:11	54.773	56.503	56.592	55.251	55.691	52.262	55.095	54.764	12/19/2013 22:00	44.631
12/18/2013 10:26	54.714	56.500	56.575	55.234	55.702	52.295	55.160	54.758	12/19/2013 22:15	44.701
12/18/2013 10:41	54.690	56.500	56.571	55.228	55.707	52.081	55.163	54.757	12/19/2013 22:30	44.730
12/18/2013 10:56	54.680	56.503	56.571	55.220	55.714	52.046	55.164	54.757	12/19/2013 22:45	44.791
12/18/2013 11:11	54.698	56.506	56.566	55.219	55.719	52.178	55.165	54.756	12/19/2013 23:00	44.813
12/18/2013 11:26	54.677	56.504	56.566	55.214	55.725	52.017	55.187	54.756	12/19/2013 23:15	44.835
12/18/2013 11:41	54.682	56.508	56.561	55.213	55.725	52.267	55.183	54.756	12/19/2013 23:30	44.849
12/18/2013 11:56	54.669	56.508	56.561	55.211	55.722	52.468	55.181	54.754	12/19/2013 23:45	44.937
12/18/2013 12:11	54.681	56.511	56.558	55.213	55.729	52.273	55.190	54.756	12/20/2013 0:00	44.905
12/18/2013 12:26	54.696	56.509	56.556	55.210	55.728	52.142	55.198	54.751	12/20/2013 0:15	45.004
12/18/2013 12:41	54.675	56.512	56.558	55.211	55.733	51.956	55.187	54.755	12/20/2013 0:30	44.965
12/18/2013 12:56	54.699	56.512	56.561	55.214	55.722	52.345	55.142	54.754	12/20/2013 0:45	44.958
12/18/2013 13:11	54.692	56.502	56.561	55.207	55.725	51.825	55.170	54.756	12/20/2013 1:00	44.908
12/18/2013 13:26	54.425	56.014	56.279	55.123	55.510	53.146	55.283	54.729	12/20/2013 1:15	44.890
12/18/2013 13:41	54.446	56.183	56.376	55.147	55.595	52.607	55.296	54.732	12/20/2013 1:30	44.896
12/18/2013 13:56	54.857	56.480	56.575	55.268	55.701	52.441	54.982	54.768	12/20/2013 1:45	44.905

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/18/2013 14:11	54.755	56.484	56.560	55.246	55.703	51.401	55.085	54.764	12/20/2013 2:00	45.043
12/18/2013 14:26	54.717	56.488	56.557	55.238	55.709	51.958	55.151	54.760	12/20/2013 2:15	45.179
12/18/2013 14:41	54.733	56.494	56.553	55.228	55.714	52.335	55.176	54.754	12/20/2013 2:30	45.126
12/18/2013 14:56	54.698	56.497	56.554	55.220	55.722	52.358	55.192	54.756	12/20/2013 2:45	45.092
12/18/2013 15:11	54.701	56.501	56.552	55.222	55.724	52.209	55.159	54.752	12/20/2013 3:00	45.044
12/18/2013 15:26	54.702	56.504	56.550	55.216	55.725	52.238	55.147	54.755	12/20/2013 3:15	45.170
12/18/2013 15:41	54.679	56.503	56.549	55.216	55.722	51.694	55.152	54.755	12/20/2013 3:30	45.187
12/18/2013 15:56	54.672	56.504	56.546	55.216	55.720	52.493	55.182	54.756	12/20/2013 3:45	45.753
12/18/2013 16:11	54.702	56.506	56.550	55.220	55.727	52.476	55.207	54.755	12/20/2013 4:00	46.243
12/18/2013 16:26	54.664	56.510	56.549	55.216	55.728	52.136	55.191	54.755	12/20/2013 4:15	45.959
12/18/2013 16:41	54.685	56.511	56.547	55.216	55.726	52.184	55.171	54.752	12/20/2013 4:30	45.215
12/18/2013 16:56	54.674	56.514	56.545	55.219	55.729	52.040	55.183	54.758	12/20/2013 4:45	46.306
12/18/2013 17:11	54.708	56.515	56.559	55.222	55.725	51.797	55.183	54.756	12/20/2013 5:00	46.302
12/18/2013 17:26	54.681	56.516	56.551	55.220	55.737	51.906	55.171	54.753	12/20/2013 5:15	45.147
12/18/2013 17:41	54.675	56.511	56.551	55.220	55.729	52.391	55.215	54.756	12/20/2013 5:30	45.101
12/18/2013 17:56	54.660	56.519	56.549	55.222	55.736	53.118	55.213	54.755	12/20/2013 5:45	45.249
12/18/2013 18:11	54.697	56.516	56.547	55.217	55.731	53.215	55.188	54.752	12/20/2013 6:00	45.113
12/18/2013 18:26	54.689	56.520	56.543	55.222	55.730	52.910	55.171	54.752	12/20/2013 6:15	45.104
12/18/2013 18:41	54.667	56.516	56.552	55.216	55.734	51.846	55.146	54.750	12/20/2013 6:30	45.067
12/18/2013 18:56	54.683	56.521	56.550	55.219	55.732	51.956	55.165	54.750	12/20/2013 6:45	45.049
12/18/2013 19:11	54.652	56.518	56.553	55.219	55.739	51.933	55.147	54.749	12/20/2013 7:00	45.070
12/18/2013 19:26	54.677	56.522	56.550	55.222	55.730	52.525	55.145	54.748	12/20/2013 7:15	45.064
12/18/2013 19:41	54.671	56.522	56.548	55.219	55.728	51.239	55.154	54.752	12/20/2013 7:30	44.984
12/18/2013 19:56	54.673	56.522	56.543	55.219	55.733	52.173	55.163	54.756	12/20/2013 7:45	45.070
12/18/2013 20:11	54.671	56.523	56.553	55.221	55.734	52.208	55.123	54.751	12/20/2013 8:00	45.068
12/18/2013 20:26	54.657	56.525	56.543	55.222	55.723	51.687	55.154	54.750	12/20/2013 8:15	46.053
12/18/2013 20:41	54.675	56.528	56.548	55.222	55.736	51.772	55.173	54.750	12/20/2013 8:30	46.272
12/18/2013 20:56	54.670	56.525	56.549	55.224	55.735	51.992	55.182	54.754	12/20/2013 8:45	45.785
12/18/2013 21:11	54.677	56.524	56.546	55.216	55.735	51.999	55.195	54.753	12/20/2013 9:00	46.052
12/18/2013 21:26	54.685	56.528	56.538	55.225	55.731	52.145	55.175	54.749	12/20/2013 9:15	46.032

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/18/2013 21:41	54.647	56.524	56.549	55.220	55.740	52.032	55.165	54.755	12/20/2013 9:30	45.624
12/18/2013 21:56	54.679	56.529	56.545	55.222	55.731	52.054	55.118	54.747	12/20/2013 9:45	45.863
12/18/2013 22:11	54.662	56.529	56.541	55.228	55.737	51.853	55.149	54.750	12/20/2013 10:00	45.626
12/18/2013 22:26	54.650	56.533	56.538	55.227	55.732	51.632	55.168	54.750	12/20/2013 10:15	45.911
12/18/2013 22:41	54.690	56.534	56.543	55.221	55.736	52.039	55.134	54.752	12/20/2013 10:30	45.611
12/18/2013 22:56	54.668	56.531	56.543	55.225	55.733	52.006	55.161	54.752	12/20/2013 10:45	45.706
12/18/2013 23:11	54.698	56.529	56.543	55.215	55.735	52.159	55.193	54.750	12/20/2013 11:00	45.334
12/18/2013 23:26	54.670	56.531	56.547	55.228	55.738	51.644	55.184	54.751	12/20/2013 11:15	45.458
12/18/2013 23:41	54.673	56.536	56.543	55.217	55.732	52.708	55.166	54.748	12/20/2013 11:30	45.444
12/18/2013 23:56	54.675	56.533	56.543	55.223	55.735	52.183	55.160	54.750	12/20/2013 11:45	45.469
12/19/2013 0:11	54.663	56.535	56.540	55.227	55.738	51.273	55.188	54.748	12/20/2013 12:00	45.532
12/19/2013 0:26	54.657	56.538	56.536	55.228	55.732	52.046	55.189	54.744	12/20/2013 12:15	45.494
12/19/2013 0:41	54.680	56.531	56.538	55.230	55.740	52.008	55.184	54.750	12/20/2013 12:30	45.518
12/19/2013 0:56	54.667	56.532	56.541	55.228	55.736	52.132	55.156	54.750	12/20/2013 12:45	45.501
12/19/2013 1:11	54.669	56.541	56.543	55.235	55.733	51.898	55.183	54.750	12/20/2013 13:00	45.543
12/19/2013 1:26	54.661	56.538	56.543	55.227	55.736	51.980	55.188	54.750	12/20/2013 13:15	45.530
12/19/2013 1:41	54.663	56.537	56.543	55.235	55.736	51.891	55.189	54.758	12/20/2013 13:30	45.583
12/19/2013 1:56	54.676	56.535	56.540	55.234	55.738	51.819	55.191	54.750	12/20/2013 13:45	45.583
12/19/2013 2:11	54.667	56.534	56.546	55.230	55.732	51.710	55.207	54.750	12/20/2013 14:00	45.588
12/19/2013 2:26	54.698	56.537	56.540	55.234	55.735	51.278	55.171	54.750	12/20/2013 14:15	45.919
12/19/2013 2:41	54.681	56.538	56.537	55.232	55.735	51.410	55.172	54.749	12/20/2013 14:30	45.246
12/19/2013 2:56	54.688	56.536	56.543	55.234	55.737	51.641	55.178	54.753	12/20/2013 14:45	46.035
12/19/2013 3:11	54.681	56.538	56.540	55.231	55.738	51.543	55.170	54.752	12/20/2013 15:00	45.631
12/19/2013 3:26	54.685	56.541	56.542	55.231	55.733	51.852	55.193	54.751	12/20/2013 15:15	46.086
12/19/2013 3:41	54.685	56.539	56.535	55.234	55.731	52.175	55.200	54.752	12/20/2013 15:30	45.759
12/19/2013 3:56	54.681	56.539	56.541	55.235	55.737	51.774	55.175	54.750	12/20/2013 15:45	45.619
12/19/2013 4:11	54.673	56.538	56.540	55.233	55.734	51.486	55.181	54.750	12/20/2013 16:00	45.671
12/19/2013 4:26	54.667	56.541	56.536	55.236	55.742	51.808	55.188	54.743	12/20/2013 16:15	46.207
12/19/2013 4:41	54.693	56.539	56.538	55.232	55.731	51.729	55.198	54.755	12/20/2013 16:30	45.937
12/19/2013 4:56	54.660	56.541	56.535	55.236	55.735	51.666	55.195	54.753	12/20/2013 16:45	45.510

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 5:11	54.704	56.541	56.537	55.235	55.735	51.989	55.159	54.758	12/20/2013 17:00	45.633
12/19/2013 5:26	54.678	56.545	56.538	55.239	55.736	52.631	55.159	54.751	12/20/2013 17:15	46.199
12/19/2013 5:41	54.695	56.540	56.533	55.239	55.738	52.284	55.170	54.746	12/20/2013 17:30	46.208
12/19/2013 5:56	54.654	56.535	56.537	55.238	55.736	51.681	55.127	54.744	12/20/2013 17:45	45.892
12/19/2013 6:11	54.673	56.538	56.532	55.239	55.731	51.712	55.171	54.750	12/20/2013 18:00	46.770
12/19/2013 6:26	54.699	56.541	56.531	55.241	55.733	52.021	55.199	54.755	12/20/2013 18:15	45.752
12/19/2013 6:41	54.658	56.543	56.526	55.233	55.736	51.779	55.181	54.748	12/20/2013 18:30	46.087
12/19/2013 6:56	54.668	56.536	56.534	55.239	55.738	52.222	55.184	54.749	12/20/2013 18:45	45.985
12/19/2013 7:11	54.686	56.542	56.530	55.242	55.736	51.872	55.182	54.748	12/20/2013 19:00	45.552
12/19/2013 7:26	54.674	56.542	56.526	55.242	55.738	51.632	55.172	54.753	12/20/2013 19:15	46.088
12/19/2013 7:41	54.674	56.545	56.529	55.243	55.737	51.901	55.184	54.750	12/20/2013 19:30	45.393
12/19/2013 7:56	54.668	56.541	56.531	55.237	55.738	51.984	55.184	54.748	12/20/2013 19:45	45.718
12/19/2013 8:11	54.675	56.541	56.526	55.241	55.737	51.273	55.128	54.749	12/20/2013 20:00	45.746
12/19/2013 8:26	54.674	56.541	56.530	55.241	55.737	51.997	55.118	54.750	12/20/2013 20:15	45.927
12/19/2013 8:41	54.677	56.547	56.529	55.244	55.733	52.233	55.150	54.751	12/20/2013 20:30	45.499
12/19/2013 8:56	54.657	56.550	56.532	55.239	55.734	50.813	55.129	54.749	12/20/2013 20:45	45.964
12/19/2013 9:11	54.665	56.542	56.532	55.243	55.736	51.546	55.141	54.751	12/20/2013 21:00	45.876
12/19/2013 9:26	54.686	56.543	56.528	55.234	55.732	51.897	55.164	54.749	12/20/2013 21:15	46.194
12/19/2013 9:41	54.673	56.546	56.526	55.242	55.736	51.623	55.150	54.750	12/20/2013 21:30	45.699
12/19/2013 9:56	54.674	56.548	56.530	55.242	55.732	51.321	55.119	54.751	12/20/2013 21:45	45.827
12/19/2013 10:11	54.680	56.547	56.530	55.244	55.733	51.363	55.137	54.747	12/20/2013 22:00	45.811
12/19/2013 10:26	54.654	56.547	56.524	55.244	55.738	51.087	55.174	54.750	12/20/2013 22:15	46.112
12/19/2013 10:41	54.701	56.547	56.522	55.245	55.737	52.135	55.188	54.750	12/20/2013 22:30	46.064
12/19/2013 10:56	54.683	56.547	56.519	55.244	55.733	51.827	55.173	54.750	12/20/2013 22:45	46.179
12/19/2013 11:11	54.680	56.548	56.520	55.244	55.735	51.997	55.116	54.747	12/20/2013 23:00	45.836
12/19/2013 11:26	54.707	56.547	56.521	55.250	55.740	51.634	55.142	54.748	12/20/2013 23:15	45.534
12/19/2013 11:41	54.689	56.541	56.524	55.246	55.729	52.143	55.175	54.745	12/20/2013 23:30	45.699
12/19/2013 11:56	54.681	56.547	56.519	55.250	55.732	51.831	55.157	54.756	12/20/2013 23:45	45.605
12/19/2013 12:11	54.675	56.546	56.522	55.246	55.733	51.789	55.164	54.747	12/21/2013 0:00	45.458
12/19/2013 12:26	54.668	56.547	56.522	55.243	55.736	51.914	55.115	54.750	12/21/2013 0:15	45.736

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 12:41	54.679	56.553	56.521	55.251	55.735	51.878	55.161	54.747	12/21/2013 0:30	46.188
12/19/2013 12:56	54.668	56.551	56.520	55.245	55.738	51.439	55.141	54.749	12/21/2013 0:45	45.873
12/19/2013 13:11	54.686	56.550	56.523	55.250	55.732	51.713	55.135	54.750	12/21/2013 1:00	45.933
12/19/2013 13:26	54.675	56.547	56.514	55.247	55.733	51.717	55.153	54.746	12/21/2013 1:15	45.607
12/19/2013 13:41	54.678	56.548	56.517	55.248	55.734	52.012	55.126	54.747	12/21/2013 1:30	45.574
12/19/2013 13:56	54.683	56.548	56.514	55.246	55.736	51.704	55.109	54.749	12/21/2013 1:45	45.681
12/19/2013 14:11	54.710		56.515				55.118		12/21/2013 2:00	45.442
12/19/2013 14:30	54.697	56.552	56.518	55.250	55.736	51.755	55.113	54.746	12/21/2013 2:15	45.473
12/19/2013 14:30	54.740	56.582	56.556	55.281	55.772	51.788	55.153	54.782	12/21/2013 2:30	46.363
12/19/2013 14:30	54.761	56.609	56.585	55.310	55.796	51.815	55.169	54.808	12/21/2013 2:45	45.703
12/19/2013 14:30	54.778	56.627	56.601	55.327	55.809	51.831	55.193	54.820	12/21/2013 3:00	45.610
12/19/2013 14:30	54.790	56.638	56.620	55.339	55.831	51.847	55.198	54.838	12/21/2013 3:15	45.780
12/19/2013 14:30	54.807	56.647	56.626	55.349	55.837	51.850	55.211	54.849	12/21/2013 3:30	45.828
12/19/2013 14:30	54.815	56.657	56.641	55.358	55.843	51.860	55.225	54.856	12/21/2013 3:45	46.011
12/19/2013 14:30	54.825	56.664	56.650	55.362	55.855	51.872	55.228	54.864	12/21/2013 4:00	45.698
12/19/2013 14:30	54.831	56.669	56.655	55.371	55.859	51.875	55.230	54.868	12/21/2013 4:15	45.733
12/19/2013 14:30	54.836	56.675	56.658	55.372	55.869	51.880	55.238	54.872	12/21/2013 4:30	46.444
12/19/2013 14:30	54.838	56.683	56.664	55.381	55.869	51.882	55.246	54.877	12/21/2013 4:45	45.366
12/19/2013 14:30	54.843	56.688	56.670	55.384	55.872	51.886	55.251	54.884	12/21/2013 5:00	46.173
12/19/2013 14:30	54.852	56.693	56.677	55.389	55.875	51.895	55.251	54.890	12/21/2013 5:15	45.676
12/19/2013 14:30	54.852	56.693	56.678	55.391	55.878	51.891	55.257	54.892	12/21/2013 5:30	45.900
12/19/2013 14:30	54.854	56.698	56.685	55.397	55.889	51.897	55.265	54.893	12/21/2013 5:45	46.251
12/19/2013 14:30	54.854	56.700	56.684	55.401	55.892	51.900	55.268	54.897	12/21/2013 6:00	46.150
12/19/2013 14:30	54.856	56.703	56.689	55.397	55.893	51.902	55.263	54.903	12/21/2013 6:15	45.643
12/19/2013 14:30	54.863	56.706	56.696	55.408	55.896	51.909	55.271	54.903	12/21/2013 6:30	45.635
12/19/2013 14:30	54.866	56.713	56.694	55.408	55.900	51.904	55.272	54.904	12/21/2013 6:45	45.644
12/19/2013 14:30	54.865	56.710	56.697	55.408	55.901	51.908	55.273	54.907	12/21/2013 7:00	46.271
12/19/2013 14:30	54.873	56.710	56.699	55.406	55.901	51.908	55.276	54.909	12/21/2013 7:15	45.804
12/19/2013 14:30	54.874	56.714	56.702	55.417	55.904	51.910	55.279	54.917	12/21/2013 7:30	45.640
12/19/2013 14:30	54.875	56.722	56.703	55.416	55.908	51.914	55.282	54.916	12/21/2013 7:45	45.714

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 14:30	54.874	56.722	56.705	55.417	55.908	51.917	55.283	54.916	12/21/2013 8:00	45.147
12/19/2013 14:30	54.875	56.724	56.712	55.417	55.909	51.919	55.285	54.920	12/21/2013 8:15	45.586
12/19/2013 14:30	54.860	56.701	56.687	55.401	55.896	51.898	55.270	54.904	12/21/2013 8:30	45.847
12/19/2013 14:30	54.853	56.698	56.685	55.397	55.890	51.894	55.262	54.891	12/21/2013 8:45	46.719
12/19/2013 14:30	54.841	56.688	56.673	55.391	55.876	51.882	55.251	54.878	12/21/2013 9:00	46.412
12/19/2013 14:30	54.835	56.686	56.666	55.384	55.872	51.867	55.245	54.876	12/21/2013 9:15	46.476
12/19/2013 14:30	54.832	56.682	56.661	55.375	55.866	51.869	55.244	54.876	12/21/2013 9:30	46.766
12/19/2013 14:30	54.820	56.673	56.656	55.370	55.857	51.860	55.237	54.866	12/21/2013 9:45	46.159
12/19/2013 14:30	54.815	56.665	56.638	55.359	55.844	51.852	55.230	54.857	12/21/2013 10:00	45.230
12/19/2013 14:30	54.820	56.665	56.643	55.361	55.848	51.850	55.226	54.859	12/21/2013 10:15	45.616
12/19/2013 14:30	54.808	56.655	56.636	55.351	55.837	51.844	55.219	54.853	12/21/2013 10:30	45.335
12/19/2013 14:30	54.802	56.652	56.626	55.352	55.837	51.840	55.218	54.842	12/21/2013 10:45	45.973
12/19/2013 14:30	54.798	56.651	56.625	55.344	55.831	51.839	55.212	54.844	12/21/2013 11:00	45.664
12/19/2013 14:30	54.795	56.649	56.622	55.342	55.830	51.831	55.210	54.838	12/21/2013 11:15	45.367
12/19/2013 14:30	54.790	56.640	56.613	55.343	55.825	51.826	55.213	54.837	12/21/2013 11:30	45.360
12/19/2013 14:30	54.788	56.638	56.616	55.337	55.823	51.824	55.202	54.834	12/21/2013 11:45	45.918
12/19/2013 14:30	54.782	56.636	56.609	55.335	55.822	51.829	55.202	54.828	12/21/2013 12:00	45.434
12/19/2013 14:30	54.781	56.632	56.608	55.334	55.819	51.824	55.201	54.831	12/21/2013 12:15	45.379
12/19/2013 14:30	54.772	56.631	56.609	55.332	55.817	51.815	55.199	54.820	12/21/2013 12:30	45.660
12/19/2013 14:30	54.771	56.630	56.601	55.321	55.813	51.815	55.196	54.820	12/21/2013 12:45	45.470
12/19/2013 14:30	54.777	56.627	56.601	55.325	55.810	51.815	55.192	54.821	12/21/2013 13:00	46.070
12/19/2013 14:30	54.759	56.625	56.597	55.316	55.807	51.810	55.192	54.816	12/21/2013 13:15	46.639
12/19/2013 14:30	54.768	56.623	56.593	55.316	55.805	51.805	55.190	54.812	12/21/2013 13:30	46.258
12/19/2013 14:30	54.759	56.619	56.595	55.322	55.798	51.809	55.182	54.815	12/21/2013 13:45	46.639
12/19/2013 14:30	54.763	56.614	56.596	55.316	55.805	51.802	55.181	54.808	12/21/2013 14:00	46.470
12/19/2013 14:30	54.755	56.613	56.596	55.312	55.797	51.802	55.183	54.808	12/21/2013 14:15	46.202
12/19/2013 14:30	54.757	56.612	56.585	55.307	55.799	51.798	55.182	54.810	12/21/2013 14:30	45.878
12/19/2013 14:30	54.751	56.608	56.585	55.312	55.789	51.795	55.185	54.805	12/21/2013 14:45	45.740
12/19/2013 14:30	54.748	56.605	56.581	55.308	55.793	51.791	55.177	54.802	12/21/2013 15:00	45.777
12/19/2013 14:30	54.741	56.602	56.581	55.309	55.791	51.793	55.184	54.803	12/21/2013 15:15	45.787

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 14:30	54.738	56.600	56.577	55.302	55.787	51.790	55.177	54.800	12/21/2013 15:30	45.794
12/19/2013 14:30	54.735	56.601	56.575	55.302	55.783	51.788	55.177	54.797	12/21/2013 15:45	45.821
12/19/2013 14:30	54.728	56.597	56.573	55.303	55.783	51.784	55.177	54.800	12/21/2013 16:00	45.815
12/19/2013 14:30	54.725	56.590	56.568	55.302	55.778	51.785	55.179	54.795	12/21/2013 16:15	45.841
12/19/2013 14:30	54.722	56.585	56.567	55.296	55.777	51.782	55.180	54.793	12/21/2013 16:30	45.830
12/19/2013 14:30	54.711	56.585	56.570	55.297	55.776	51.777	55.176	54.793	12/21/2013 16:45	45.875
12/19/2013 14:30	54.711	56.580	56.563	55.297	55.770	51.773	55.173	54.787	12/21/2013 17:00	45.873
12/19/2013 14:30	54.705	56.571	56.557	55.291	55.767	51.771	55.178	54.793	12/21/2013 17:15	45.824
12/19/2013 14:30	54.698	56.570	56.553	55.292	55.762	51.770	55.178	54.791	12/21/2013 17:30	45.832
12/19/2013 14:30	54.694	56.571	56.548	55.291	55.760	51.770	55.177	54.787	12/21/2013 17:45	45.849
12/19/2013 14:30	54.690	56.556	56.543	55.285	55.755	51.775	55.177	54.786	12/21/2013 18:00	46.370
12/19/2013 14:31	54.686	56.550	56.532	55.286	55.752	51.778	55.182	54.787	12/21/2013 18:15	46.621
12/19/2013 14:31	54.676	56.545	56.531	55.283	55.741	51.786	55.179	54.783	12/21/2013 18:30	47.098
12/19/2013 14:31	54.671	56.536	56.528	55.280	55.743	51.790	55.181	54.779	12/21/2013 18:45	45.922
12/19/2013 14:31	54.665	56.521	56.519	55.281	55.736	51.793	55.183	54.776	12/21/2013 19:00	45.774
12/19/2013 14:31	54.656	56.514	56.516	55.281	55.732	51.799	55.183	54.781	12/21/2013 19:15	45.775
12/19/2013 14:31	54.647	56.502	56.509	55.270	55.726	51.814	55.180	54.778	12/21/2013 19:30	46.052
12/19/2013 14:31	54.638	56.497	56.505	55.268	55.715	51.825	55.183	54.775	12/21/2013 19:45	46.783
12/19/2013 14:31	54.634	56.477	56.491	55.266	55.709	51.836	55.181	54.774	12/21/2013 20:00	45.964
12/19/2013 14:31	54.631	56.470	56.483	55.265	55.706	51.852	55.183	54.773	12/21/2013 20:15	45.879
12/19/2013 14:31	54.619	56.454	56.475	55.264	55.698	51.868	55.184	54.767	12/21/2013 20:30	45.797
12/19/2013 14:31	54.614	56.439	56.466	55.259	55.689	51.881	55.190	54.767	12/21/2013 20:45	45.692
12/19/2013 14:31	54.608	56.427	56.456	55.262	55.681	51.892	55.189	54.759	12/21/2013 21:00	45.762
12/19/2013 14:31	54.602	56.408	56.446	55.255	55.669	51.913	55.193	54.768	12/21/2013 21:15	45.858
12/19/2013 14:32	54.594	56.388	56.441	55.246	55.662	51.934	55.191	54.763	12/21/2013 21:30	46.832
12/19/2013 14:32	54.578	56.377	56.420	55.250	55.652	51.953	55.198	54.763	12/21/2013 21:45	47.355
12/19/2013 14:32	54.573	56.362	56.408	55.242	55.645	51.981	55.201	54.759	12/21/2013 22:00	46.203
12/19/2013 14:32	54.572	56.343	56.398	55.239	55.635	52.003	55.203	54.759	12/21/2013 22:15	45.767
12/19/2013 14:32	54.557	56.337	56.389	55.237	55.625	52.026	55.205	54.758	12/21/2013 22:30	46.158
12/19/2013 14:32	54.551	56.324	56.375	55.232	55.616	52.043	55.203	54.757	12/21/2013 22:45	46.912

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 14:32	54.544	56.308	56.363	55.234	55.604	52.072	55.207	54.754	12/21/2013 23:00	46.751
12/19/2013 14:33	54.540	56.294	56.353	55.223	55.602	52.089	55.216	54.753	12/21/2013 23:15	46.944
12/19/2013 14:33	54.533	56.284	56.350	55.215	55.589	52.122	55.216	54.752	12/21/2013 23:30	46.691
12/19/2013 14:33	54.524	56.269	56.334	55.213	55.583	52.152	55.219	54.749	12/21/2013 23:45	47.064
12/19/2013 14:33	54.518	56.266	56.327	55.213	55.571	52.185	55.222	54.751	12/22/2013 0:00	46.858
12/19/2013 14:33	54.509	56.253	56.316	55.205	55.564	52.221	55.218	54.746	12/22/2013 0:15	45.647
12/19/2013 14:34	54.502	56.242	56.309	55.204	55.561	52.269	55.224	54.740	12/22/2013 0:30	46.692
12/19/2013 14:34	54.494	56.235	56.303	55.196	55.549	52.313	55.225	54.742	12/22/2013 0:45	45.963
12/19/2013 14:34	54.488	56.230	56.295	55.198	55.549	52.359	55.229	54.744	12/22/2013 1:00	45.468
12/19/2013 14:35	54.486	56.219	56.292	55.189	55.538	52.400	55.233	54.738	12/22/2013 1:15	46.066
12/19/2013 14:35	54.483	56.214	56.286	55.185	55.535	52.438	55.231	54.739	12/22/2013 1:30	46.979
12/19/2013 14:35	54.472	56.214	56.280	55.179	55.536	52.466	55.237	54.741	12/22/2013 1:45	46.939
12/19/2013 14:35	54.474	56.209	56.280	55.180	55.525	52.498	55.237	54.737	12/22/2013 2:00	45.464
12/19/2013 14:36	54.463	56.209	56.278	55.175	55.523	52.532	55.238	54.734	12/22/2013 2:15	45.692
12/19/2013 14:36	54.461	56.202	56.274	55.175	55.519	52.537	55.237	54.734	12/22/2013 2:30	47.223
12/19/2013 14:37	54.463	56.206	56.272	55.165	55.523	52.554	55.244	54.730	12/22/2013 2:45	46.893
12/19/2013 14:37	54.456	56.199	56.273	55.165	55.518	52.573	55.244	54.726	12/22/2013 3:00	47.151
12/19/2013 14:37	54.451	56.200	56.274	55.167	55.520	52.591	55.244	54.734	12/22/2013 3:15	46.174
12/19/2013 14:38	54.452	56.203	56.280	55.159	55.518	52.603	55.252	54.731	12/22/2013 3:30	46.366
12/19/2013 14:38	54.445	56.202	56.277	55.163	55.516	52.610	55.250	54.731	12/22/2013 3:45	45.890
12/19/2013 14:39	54.445	56.203	56.280	55.165	55.512	52.595	55.255	54.726	12/22/2013 4:00	45.902
12/19/2013 14:40	54.444	56.207	56.281	55.162	55.514	52.579	55.258	54.728	12/22/2013 4:15	45.881
12/19/2013 14:40	54.439	56.211	56.280	55.163	55.515	52.547	55.259	54.729	12/22/2013 4:30	45.772
12/19/2013 14:41	54.448	56.215	56.286	55.160	55.519	52.501	55.261	54.726	12/22/2013 4:45	46.047
12/19/2013 14:41	54.456	56.217	56.290	55.164	55.518	52.459	55.268	54.722	12/22/2013 5:00	45.774
12/19/2013 14:42	54.457	56.217	56.296	55.163	55.524	52.411	55.269	54.724	12/22/2013 5:15	46.036
12/19/2013 14:43	54.457	56.217	56.292	55.171	55.532	52.307	55.266	54.727	12/22/2013 5:30	46.103
12/19/2013 14:44	54.457	56.229	56.301	55.164	55.530	52.216	55.275	54.721	12/22/2013 5:45	45.760
12/19/2013 14:45	54.464	56.234	56.304	55.169	55.541	52.187	55.278	54.721	12/22/2013 6:00	46.462
12/19/2013 14:45	54.470	56.242	56.309	55.165	55.540	52.129	55.268	54.727	12/22/2013 6:15	45.722

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 14:46	54.465	56.247	56.314	55.172	55.540	51.973	55.260	54.727	12/22/2013 6:30	47.203
12/19/2013 14:47	54.473	56.259	56.313	55.175	55.552	51.670	55.244	54.725	12/22/2013 6:45	46.151
12/19/2013 14:48	54.472	56.269	56.321	55.173	55.555	51.452	55.242	54.729	12/22/2013 7:00	45.480
12/19/2013 14:49	54.472	56.275	56.327	55.175	55.555	51.308	55.231	54.730	12/22/2013 7:15	45.757
12/19/2013 14:51	54.476	56.281	56.336	55.181	55.566	51.191	55.229	54.728	12/22/2013 7:30	45.696
12/19/2013 14:52	54.482	56.288	56.338	55.182	55.568	51.358	55.216	54.730	12/22/2013 7:45	45.818
12/19/2013 14:53	54.485	56.298	56.343	55.181	55.577	51.520	55.203	54.726	12/22/2013 8:00	45.880
12/19/2013 14:55	54.490	56.309	56.350	55.186	55.584	51.569	55.198	54.726	12/22/2013 8:15	46.693
12/19/2013 14:56	54.497	56.314	56.353	55.184	55.587	51.569	55.195	54.729	12/22/2013 8:30	45.585
12/19/2013 14:58	54.490	56.325	56.362	55.190	55.592	51.430	55.187	54.725	12/22/2013 8:45	45.420
12/19/2013 14:59	54.494	56.332	56.363	55.196	55.598	51.409	55.191	54.734	12/22/2013 9:00	45.921
12/19/2013 15:01	54.503	56.338	56.371	55.196	55.603	51.580	55.194	54.729	12/22/2013 9:15	45.679
12/19/2013 15:03	54.506	56.351	56.379	55.195	55.608	51.586	55.210	54.735	12/22/2013 9:30	45.956
12/19/2013 15:05	54.501	56.360	56.379	55.201	55.614	51.428	55.214	54.732	12/22/2013 9:45	46.421
12/19/2013 15:07	54.505	56.372	56.384	55.202	55.619	51.413	55.219	54.738	12/22/2013 10:00	46.746
12/19/2013 15:09	54.484	56.380	56.397	55.203	55.625	51.643	55.215	54.731	12/22/2013 10:15	45.799
12/19/2013 15:12	54.489	56.393	56.403	55.204	55.639	51.757	55.200	54.737	12/22/2013 10:30	46.138
12/19/2013 15:14	54.498	56.393	56.408	55.208	55.642	51.837	55.188	54.738	12/22/2013 10:45	46.018
12/19/2013 15:17	54.499	56.404	56.407	55.208	55.645	52.062	55.166	54.737	12/22/2013 11:00	45.575
12/19/2013 15:20	54.485	56.415	56.412	55.214	55.648	51.805	55.161	54.739	12/22/2013 11:15	45.527
12/19/2013 15:23	54.490	56.422	56.425	55.216	55.655	51.735	55.156	54.738	12/22/2013 11:30	46.486
12/19/2013 15:26	54.514	56.430	56.423	55.215	55.662	51.646	55.149	54.740	12/22/2013 11:45	45.912
12/19/2013 15:29	54.509	56.444	56.428	55.217	55.669	51.266	55.165	54.741	12/22/2013 12:00	46.426
12/19/2013 15:33	54.501	56.447	56.438	55.222	55.669	51.288	55.171	54.740	12/22/2013 12:15	45.598
12/19/2013 15:36	54.517	56.452	56.439	55.221	55.674	51.264	55.153	54.734	12/22/2013 12:30	45.823
12/19/2013 15:40	54.505	56.462	56.446	55.224	55.680	50.971	55.165	54.739	12/22/2013 12:45	45.766
12/19/2013 15:45	54.519	56.466	56.451	55.227	55.684	50.700	55.146	54.743	12/22/2013 13:00	45.844
12/19/2013 15:49	54.535	56.473	56.455	55.228	55.686	51.030	55.134	54.739	12/22/2013 13:15	45.938
12/19/2013 15:54	54.485	56.477	56.452	55.227	55.692	51.554	55.129	54.740	12/22/2013 13:30	46.259
12/19/2013 15:59	54.464	56.488	56.460	55.229	55.699	50.800	55.123	54.742	12/22/2013 13:45	45.970

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 16:04	54.455	56.487	56.464	55.228	55.713	50.932	55.115	54.746	12/22/2013 14:00	45.982
12/19/2013 16:10	54.454	56.501	56.471	55.232	55.701	50.904	55.100	54.744	12/22/2013 14:15	45.965
12/19/2013 16:16	54.449	56.500	56.475	55.230	55.705	50.952	55.059	54.745	12/22/2013 14:30	45.973
12/19/2013 16:22	54.446	56.505	56.476	55.236	55.707	50.714	55.095	54.745	12/22/2013 14:45	46.007
12/19/2013 16:29	54.449	56.508	56.485	55.238	55.709	50.820	55.095	54.741	12/22/2013 15:00	46.007
12/19/2013 16:36	54.445	56.510	56.477	55.244	55.706	51.275	55.094	54.756	12/22/2013 15:15	45.988
12/19/2013 16:43	54.439	56.511	56.483	55.240	55.713	51.495	55.104	54.748	12/22/2013 15:30	46.029
12/19/2013 16:51	54.432	56.515	56.486	55.237	55.713	51.378	55.084	54.744	12/22/2013 15:45	45.957
12/19/2013 17:00	54.432	56.517	56.485	55.239	55.707	51.153	55.098	54.744	12/22/2013 16:00	45.905
12/19/2013 17:08	54.422	56.516	56.485	55.236	55.715	51.046	55.076	54.743	12/22/2013 16:15	45.886
12/19/2013 17:18	54.424	56.521	56.490	55.241	55.714	51.411	55.072	54.748	12/22/2013 16:30	45.859
12/19/2013 17:28	54.409	56.524	56.494	55.244	55.716	51.780	55.106	54.747	12/22/2013 16:45	45.895
12/19/2013 17:38	54.413	56.526	56.493	55.241	55.718	51.462	55.124	54.748	12/22/2013 17:00	45.850
12/19/2013 17:49	54.425	56.528	56.490	55.240	55.718	51.695	55.116	54.747	12/22/2013 17:15	45.859
12/19/2013 18:01	54.458	56.527	56.496	55.239	55.722	50.860	55.101	54.742	12/22/2013 17:30	45.823
12/19/2013 18:14	54.408	56.525	56.497	55.240	55.721	51.386	55.118	54.746	12/22/2013 17:45	45.851
12/19/2013 18:27	54.414	56.531	56.493	55.245	55.719	51.208	55.089	54.745	12/22/2013 18:00	45.978
12/19/2013 18:41	54.433	56.532	56.503	55.238	55.725	51.857	55.072	54.741	12/22/2013 18:15	46.018
12/19/2013 18:56	54.417	56.528	56.501	55.241	55.721	51.577	55.023	54.739	12/22/2013 18:30	45.835
12/19/2013 19:11	54.426	56.534	56.498	55.245	55.718	50.864	55.042	54.742	12/22/2013 18:45	45.932
12/19/2013 19:26	54.413	56.529	56.499	55.242	55.717	51.461	55.056	54.739	12/22/2013 19:00	45.939
12/19/2013 19:41	54.421	56.531	56.498	55.242	55.721	51.246	55.087	54.743	12/22/2013 19:15	45.655
12/19/2013 19:56	54.436	56.530	56.501	55.242	55.718	51.386	55.084	54.742	12/22/2013 19:30	45.917
12/19/2013 20:11	54.431	56.530	56.503	55.245	55.715	52.441	55.048	54.748	12/22/2013 19:45	46.208
12/19/2013 20:26	54.428	56.531	56.503	55.247	55.718	51.999	55.034	54.740	12/22/2013 20:00	45.644
12/19/2013 20:41	54.435	56.529	56.503	55.248	55.717	51.840	55.052	54.743	12/22/2013 20:15	45.691
12/19/2013 20:56	54.428	56.531	56.506	55.240	55.718	51.256	55.074	54.748	12/22/2013 20:30	45.777
12/19/2013 21:11	54.432	56.531	56.500	55.240	55.715	52.377	55.099	54.740	12/22/2013 20:45	46.138
12/19/2013 21:26	54.434	56.526	56.501	55.244	55.714	51.371	55.064	54.742	12/22/2013 21:00	46.800
12/19/2013 21:41	54.432	56.529	56.497	55.247	55.718	51.894	55.087	54.745	12/22/2013 21:15	46.001

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/19/2013 21:56	54.431	56.527	56.498	55.247	55.714	51.906	55.052	54.749	12/22/2013 21:30	45.729
12/19/2013 22:11	54.430	56.532	56.499	55.245	55.716	51.855	55.059	54.748	12/22/2013 21:45	45.849
12/19/2013 22:26	54.449	56.530	56.496	55.239	55.714	51.267	55.039	54.744	12/22/2013 22:00	45.913
12/19/2013 22:41	54.445	56.526	56.497	55.241	55.715	51.621	55.084	54.749	12/22/2013 22:15	45.789
12/19/2013 22:56	54.428	56.529	56.501	55.245	55.711	51.602	55.058	54.744	12/22/2013 22:30	45.903
12/19/2013 23:11	54.438	56.529	56.495	55.242	55.712	51.499	55.068	54.744	12/22/2013 22:45	45.895
12/19/2013 23:26	54.438	56.523	56.503	55.247	55.713	51.451	55.013	54.745	12/22/2013 23:00	46.028
12/19/2013 23:41	54.437	56.524	56.490	55.250	55.713	51.798	55.046	54.747	12/22/2013 23:15	45.774
12/19/2013 23:56	54.437	56.521	56.492	55.243	55.714	51.560	55.052	54.746	12/22/2013 23:30	45.539
12/20/2013 0:11	54.437	56.519	56.493	55.244	55.712	51.029	55.034	54.741	12/22/2013 23:45	45.406
12/20/2013 0:26	54.439	56.522	56.498	55.242	55.710	51.764	54.992	54.750	12/23/2013 0:00	45.667
12/20/2013 0:41	54.439	56.519	56.504	55.246	55.704	51.395	55.027	54.744	12/23/2013 0:15	45.826
12/20/2013 0:56	54.438	56.518	56.500	55.244	55.707	51.465	54.982	54.744	12/23/2013 0:30	45.653
12/20/2013 1:11	54.429	56.513	56.500	55.244	55.710	51.605	54.986	54.744	12/23/2013 0:45	45.567
12/20/2013 1:26	54.433	56.513	56.493	55.240	55.707	50.779	55.035	54.744	12/23/2013 1:00	45.768
12/20/2013 1:41	54.431	56.514	56.497	55.245	55.707	50.948	55.037	54.745	12/23/2013 1:15	45.559
12/20/2013 1:56	54.433	56.510	56.489	55.245	55.690	51.780	55.058	54.743	12/23/2013 1:30	45.568
12/20/2013 2:11	54.433	56.511	56.496	55.249	55.688	50.969	55.036	54.743	12/23/2013 1:45	45.544
12/20/2013 2:26	54.433	56.511	56.487	55.245	55.695	51.136	55.033	54.745	12/23/2013 2:00	45.559
12/20/2013 2:41	54.439	56.509	56.490	55.244	55.701	50.891	55.041	54.740	12/23/2013 2:15	45.548
12/20/2013 2:56	54.436	56.511	56.490	55.247	55.704	51.723	55.043	54.747	12/23/2013 2:30	45.543
12/20/2013 3:11	54.429	56.505	56.494	55.247	55.693	51.287	55.030	54.744	12/23/2013 2:45	45.560
12/20/2013 3:26	54.426	56.500	56.490	55.248	55.684	51.160	55.043	54.745	12/23/2013 3:00	45.522
12/20/2013 3:41	54.433	56.500	56.489	55.246	55.684	51.393	55.063	54.743	12/23/2013 3:15	45.518
12/20/2013 3:56	54.436	56.498	56.493	55.242	55.686	52.106	55.013	54.741	12/23/2013 3:30	45.491
12/20/2013 4:11	54.434	56.493	56.490	55.247	55.688	51.421	55.066	54.744	12/23/2013 3:45	45.232
12/20/2013 4:26	54.439	56.492	56.490	55.245	55.690	51.597	55.020	54.748	12/23/2013 4:00	45.373
12/20/2013 4:41	54.432	56.494	56.490	55.241	55.689	51.954	55.025	54.743	12/23/2013 4:15	45.443
12/20/2013 4:56	54.436	56.492	56.485	55.244	55.689	51.856	55.053	54.746	12/23/2013 4:30	45.385
12/20/2013 5:11	54.442	56.490	56.487	55.245	55.700	51.115	55.054	54.738	12/23/2013 4:45	45.399

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/20/2013 5:26	54.435	56.486	56.487	55.248	55.697	52.285	55.067	54.741	12/23/2013 5:00	45.417
12/20/2013 5:41	54.437	56.486	56.484	55.246	55.690	51.483	55.059	54.742	12/23/2013 5:15	45.428
12/20/2013 5:56	54.435	56.483	56.486	55.247	55.694	51.748	55.034	54.743	12/23/2013 5:30	45.420
12/20/2013 6:11	54.443	56.483	56.482	55.245	55.684	51.481	55.046	54.741	12/23/2013 5:45	45.407
12/20/2013 6:26	54.439	56.479	56.484	55.239	55.678	51.677	55.027	54.738	12/23/2013 6:00	45.405
12/20/2013 6:41	54.433	56.477	56.487	55.240	55.685	51.869	55.021	54.742	12/23/2013 6:15	45.346
12/20/2013 6:56	54.440	56.474	56.485	55.241	55.685	50.825	55.053	54.737	12/23/2013 6:30	45.350
12/20/2013 7:11	54.434	56.474	56.484	55.248	55.689	51.348	55.035	54.740	12/23/2013 6:45	45.389
12/20/2013 7:26	54.436	56.466	56.479	55.242	55.695	51.035	55.034	54.740	12/23/2013 7:00	45.383
12/20/2013 7:41	54.469	56.470	56.479	55.239	55.701	51.426	55.052	54.740	12/23/2013 7:15	45.368
12/20/2013 7:56	34.688	56.462	56.486	55.243	55.699	51.295	55.037	54.742	12/23/2013 7:30	45.313
12/20/2013 8:11	25.416	56.473	56.489	55.238	55.697	51.207	54.975	54.746	12/23/2013 7:45	45.316
12/20/2013 8:26	21.482	56.460	56.490	55.246	55.690	51.232	55.021	54.738	12/23/2013 8:00	45.281
12/20/2013 8:41	19.904	56.450	56.484	55.247	55.680	51.890	55.048	54.742	12/23/2013 8:15	45.287
12/20/2013 8:56	20.526	56.453	56.482	55.244	55.672	51.743	55.047	54.741	12/23/2013 8:30	46.419
12/20/2013 9:11	20.702	56.451	56.481	55.248	55.677	51.402	55.004	54.741	12/23/2013 8:45	47.037
12/20/2013 9:26	20.240	56.448	56.483	55.245	55.678	51.691	55.034	54.744	12/23/2013 9:00	47.642
12/20/2013 9:41	19.361	56.443	56.480	55.244	55.684	51.332	55.010	54.736	12/23/2013 9:15	47.345
12/20/2013 9:56	18.090	56.443	56.479	55.245	55.685	51.210	55.027	54.745	12/23/2013 9:30	46.781
12/20/2013 10:11	34.018	56.438	56.481	55.245	55.692	51.762	55.040	54.738	12/23/2013 9:45	46.833
12/20/2013 10:26	33.178	56.439	56.484	55.245	55.689	51.182	55.039	54.740	12/23/2013 10:00	47.046
12/20/2013 10:41	54.300	56.433	56.483	55.247	55.696	51.657	54.998	54.740	12/23/2013 10:15	46.977
12/20/2013 10:56	54.402	56.432	56.479	55.237	55.695	52.159	55.034	54.741	12/23/2013 10:30	45.956
12/20/2013 11:11	54.446	56.429	56.477	55.244	55.696	51.655	55.047	54.735	12/23/2013 10:45	46.070
12/20/2013 11:26	54.467	56.427	56.474	55.239	55.701	50.542	55.102	54.736	12/23/2013 11:00	46.381
12/20/2013 11:41	54.450	56.420	56.479	55.238	55.699	51.934	55.028	54.738	12/23/2013 11:15	46.255
12/20/2013 11:56	54.426	56.423	56.479	55.241	55.700	51.428	54.980	54.736		
12/20/2013 12:11	54.471	56.418	56.479	55.242	55.693	52.106	55.015	54.730		
12/20/2013 12:26	54.431	56.413	56.468	55.245	55.688	52.201	54.980	54.735		
12/20/2013 12:41	54.476	56.406	56.473	55.243	55.691	52.130	54.974	54.737		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/20/2013 12:56	54.455	56.409	56.478	55.247	55.683	51.345	55.027	54.741		
12/20/2013 13:11	54.473	56.403	56.473	55.244	55.681	50.998	55.055	54.734		
12/20/2013 13:26	54.480	56.402	56.476	55.247	55.684	51.200	55.022	54.741		
12/20/2013 13:41	54.520	56.399	56.471	55.241	55.688	51.102	55.046	54.736		
12/20/2013 13:56	54.493	56.398	56.477	55.244	55.692	52.258	54.998	54.740		
12/20/2013 14:11	54.509	56.393	56.473	55.245	55.698	51.046	55.016	54.735		
12/20/2013 14:26	54.524	56.391	56.474	55.240	55.695	51.193	55.029	54.737		
12/20/2013 14:41	54.540	56.387	56.472	55.243	55.692	51.660	55.009	54.736		
12/20/2013 14:56	54.542	56.390	56.471	55.245	55.685	51.142	54.951	54.737		
12/20/2013 15:11	54.549	56.390	56.469	55.243	55.681	51.478	54.998	54.736		
12/20/2013 15:26	54.548	56.378	56.472	55.242	55.681	51.817	55.028	54.738		
12/20/2013 15:41	54.557	56.377	56.471	55.241	55.687	51.687	55.018	54.738		
12/20/2013 15:56	54.568	56.374	56.467	55.243	55.691	51.066	55.015	54.732		
12/20/2013 16:11	54.575	56.372	56.468	55.242	55.671	51.411	54.994	54.737		
12/20/2013 16:26	54.584	56.371	56.467	55.241	55.668	51.172	54.962	54.740		
12/20/2013 16:41	54.593	56.364	56.464	55.245	55.670	51.918	55.006	54.740		
12/20/2013 16:56	54.602	56.364	56.469	55.245	55.675	51.556	55.010	54.736		
12/20/2013 17:11	54.606	56.355	56.465	55.244	55.667	51.756	54.965	54.732		
12/20/2013 17:26	54.615	56.358	56.470	55.243	55.659	51.111	55.010	54.736		
12/20/2013 17:41	54.621	56.354	56.468	55.245	55.649	51.649	55.023	54.735		
12/20/2013 17:56	54.627	56.352	56.467	55.246	55.662	51.670	55.020	54.739		
12/20/2013 18:11	54.644	56.350	56.464	55.240	55.677	51.329	54.972	54.738		
12/20/2013 18:26	54.646	56.349	56.468	55.245	55.683	51.915	55.025	54.734		
12/20/2013 18:41	54.655	56.343	56.467	55.244	55.676	51.480	55.002	54.731		
12/20/2013 18:56	54.665	56.343	56.462	55.245	55.670	51.341	54.980	54.734		
12/20/2013 19:11	54.676	56.336	56.463	55.247	55.662	51.808	54.977	54.735		
12/20/2013 19:26	54.684	56.335	56.462	55.245	55.669	51.587	55.002	54.739		
12/20/2013 19:41	54.693	56.333	56.467	55.244	55.678	51.381	54.997	54.740		
12/20/2013 19:56	54.701	56.334	56.466	55.241	55.684	51.260	54.991	54.738		
12/20/2013 20:11	54.715	56.327	56.466	55.240	55.689	51.135	55.012	54.738		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/20/2013 20:26	54.716	56.326	56.466	55.242	55.687	51.393	54.979	54.738		
12/20/2013 20:41	54.728	56.319	56.460	55.246	55.692	51.507	54.995	54.732		
12/20/2013 20:56	54.730	56.320	56.460	55.244	55.688	51.529	54.992	54.741		
12/20/2013 21:11	54.741	56.317	56.461	55.246	55.678	51.558	54.966	54.730		
12/20/2013 21:26	54.743	56.316	56.461	55.244	55.683	51.432	55.016	54.734		
12/20/2013 21:41	54.753	56.309	56.462	55.243	55.689	52.275	55.012	54.735		
12/20/2013 21:56	54.760	56.313	56.464	55.251	55.693	51.677	55.028	54.732		
12/20/2013 22:11	54.765	56.308	56.460	55.246	55.674	50.967	54.983	54.729		
12/20/2013 22:26	54.771	56.300	56.461	55.249	55.647	50.915	55.016	54.732		
12/20/2013 22:41	54.778	56.305	56.455	55.251	55.650	51.141	55.021	54.732		
12/20/2013 22:56	54.793	56.301	56.463	55.244	55.652	51.193	54.974	54.733		
12/20/2013 23:11	54.786	56.297	56.460	55.250	55.665	51.924	54.986	54.731		
12/20/2013 23:26	54.798	56.294	56.460	55.250	55.673	52.232	54.967	54.727		
12/20/2013 23:41	54.806	56.295	56.456	55.245	55.677	51.377	54.935	54.730		
12/20/2013 23:56	54.812	56.291	56.455	55.243	55.679	51.551	54.950	54.728		
12/21/2013 0:11	54.815	56.293	56.458	55.247	55.681	51.568	54.949	54.735		
12/21/2013 0:26	54.824	56.286	56.454	55.244	55.688	51.489	54.975	54.732		
12/21/2013 0:41	54.823	56.281	56.455	55.247	55.670	51.877	54.999	54.733		
12/21/2013 0:56	54.828	56.280	56.455	55.247	55.667	51.427	54.977	54.728		
12/21/2013 1:11	54.835	56.278	56.450	55.251	55.655	51.578	54.999	54.732		
12/21/2013 1:26	54.839	56.277	56.451	55.249	55.659	51.493	54.972	54.732		
12/21/2013 1:41	54.851	56.277	56.453	55.248	55.665	51.283	54.954	54.733		
12/21/2013 1:56	54.855	56.269	56.457	55.245	55.660	51.449	54.975	54.731		
12/21/2013 2:11	54.857	56.269	56.452	55.244	55.660	51.977	54.984	54.731		
12/21/2013 2:26	54.864	56.270	56.450	55.248	55.651	51.669	54.985	54.726		
12/21/2013 2:41	54.870	56.263	56.451	55.245	55.644	52.675	54.975	54.726		
12/21/2013 2:56	54.867	56.258	56.455	55.251	55.653	52.151	54.949	54.730		
12/21/2013 3:11	54.883	56.263	56.457	55.242	55.658	51.306	55.004	54.730		
12/21/2013 3:26	54.877	56.254	56.449	55.245	55.656	52.260	55.002	54.729		
12/21/2013 3:41	54.887	56.252	56.450	55.248	55.662	51.409	55.003	54.730		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/21/2013 3:56	54.885	56.249	56.446	55.245	55.654	51.537	55.013	54.727		
12/21/2013 4:11	54.892	56.250	56.450	55.250	55.652	51.733	55.022	54.727		
12/21/2013 4:26	54.895	56.242	56.448	55.250	55.655	51.664	54.994	54.726		
12/21/2013 4:41	54.908	56.245	56.444	55.245	55.652	52.076	55.025	54.731		
12/21/2013 4:56	54.905	56.243	56.450	55.245	55.637	51.561	55.047	54.730		
12/21/2013 5:11	54.911	56.241	56.449	55.254	55.640	50.997	54.998	54.729		
12/21/2013 5:26	54.914	56.245	56.451	55.251	55.650	51.199	54.968	54.727		
12/21/2013 5:41	54.917	56.240	56.445	55.251	55.641	51.664	54.976	54.731		
12/21/2013 5:56	54.917	56.239	56.446	55.252	55.642	51.498	54.965	54.728		
12/21/2013 6:11	54.919	56.233	56.449	55.250	55.647	51.180	54.991	54.727		
12/21/2013 6:26	54.927	56.231	56.444	55.253	55.649	51.770	54.974	54.728		
12/21/2013 6:41	54.923	56.228	56.448	55.248	55.658	51.422	54.974	54.731		
12/21/2013 6:56	54.929	56.227	56.449	55.254	55.658	51.822	54.919	54.729		
12/21/2013 7:11	54.937	56.226	56.440	55.254	55.644	51.292	54.960	54.729		
12/21/2013 7:26	54.929	56.226	56.444	55.250	55.632	50.712	54.950	54.733		
12/21/2013 7:41	54.937	56.224	56.444	55.252	55.624	51.656	54.980	54.729		
12/21/2013 7:56	54.937	56.218	56.449	55.243	55.630	50.806	54.974	54.728		
12/21/2013 8:11	54.941	56.219	56.444	55.249	55.625	51.613	55.031	54.732		
12/21/2013 8:26	54.946	56.219	56.439	55.248	55.618	51.057	54.971	54.728		
12/21/2013 8:41	54.952	56.209	56.444	55.251	55.618	51.199	54.968	54.733		
12/21/2013 8:56	54.950	56.214	56.438	55.247	55.630	51.014	54.975	54.728		
12/21/2013 9:11	54.953	56.210	56.440	55.246	55.640	51.797	54.939	54.732		
12/21/2013 9:26	54.959	56.210	56.438	55.254	55.652	51.687	54.914	54.729		
12/21/2013 9:41	54.957	56.206	56.438	55.254	55.646	51.373	54.974	54.726		
12/21/2013 9:56	54.960	56.203	56.438	55.246	55.649	51.978	54.995	54.726		
12/21/2013 10:11	54.964	56.202	56.444	55.248	55.655	51.740	54.981	54.727		
12/21/2013 10:26	54.963	56.203	56.436	55.252	55.657	51.851	54.986	54.726		
12/21/2013 10:41	54.972	56.198	56.438	55.247	55.651	51.447	54.978	54.727		
12/21/2013 10:56	54.972	56.195	56.433	55.250	55.650	51.314	54.895	54.733		
12/21/2013 11:11	54.972	56.195	56.440	55.254	55.640	51.775	54.885	54.724		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/21/2013 11:26	54.977	56.196	56.436	55.249	55.633	51.382	54.897	54.726		
12/21/2013 11:41	54.979	56.193	56.437	55.248	55.635	51.015	54.953	54.726		
12/21/2013 11:56	54.984	56.191	56.437	55.250	55.636	52.083	54.929	54.725		
12/21/2013 12:11	54.984	56.185	56.435	55.247	55.643	52.060	54.944	54.728		
12/21/2013 12:26	54.990	56.183	56.432	55.256	55.651	51.454	54.948	54.725		
12/21/2013 12:41	54.989	56.183	56.432	55.251	55.654	51.432	54.971	54.725		
12/21/2013 12:56	54.990	56.183	56.432	55.249	55.649	50.811	54.950	54.729		
12/21/2013 13:11	54.991	56.183	56.434	55.251	55.632	51.443	54.941	54.723		
12/21/2013 13:26	54.994	56.178	56.436	55.256	55.619	50.917	54.916	54.732		
12/21/2013 13:41	54.997	56.173	56.432	55.249	55.615	51.661	54.923	54.726		
12/21/2013 13:56	55.002	56.177	56.432	55.256	55.612	51.159	54.910	54.730		
12/21/2013 14:11	55.005	56.171	56.432	55.253	55.591	51.077	54.963	54.726		
12/21/2013 14:26	55.008	56.174	56.435	55.250	55.602	52.558	54.962	54.727		
12/21/2013 14:41	55.010	56.171	56.432	55.250	55.603	51.729	54.937	54.726		
12/21/2013 14:56	55.012	56.173	56.435	55.252	55.601	51.849	54.892	54.725		
12/21/2013 15:11	55.018	56.169	56.432	55.255	55.609	51.807	54.877	54.730		
12/21/2013 15:26	55.014	56.170	56.434	55.256	55.608	52.170	54.920	54.724		
12/21/2013 15:41	55.017	56.164	56.426	55.253	55.601	51.264	54.944	54.727		
12/21/2013 15:56	55.022	56.161	56.426	55.254	55.607	50.867	54.932	54.721		
12/21/2013 16:11	55.026	56.165	56.426	55.256	55.624	51.133	54.915	54.726		
12/21/2013 16:26	55.029	56.163	56.428	55.256	55.636	51.271	54.948	54.730		
12/21/2013 16:41	55.031	56.154	56.432	55.256	55.646	51.591	54.975	54.727		
12/21/2013 16:56	55.033	56.153	56.426	55.253	55.659	51.175	54.938	54.721		
12/21/2013 17:11	55.035	56.153	56.433	55.251	55.650	50.766	54.920	54.717		
12/21/2013 17:26	55.033	56.155	56.427	55.258	55.642	51.665	54.943	54.723		
12/21/2013 17:41	55.037	56.149	56.429	55.254	55.633	51.612	54.941	54.725		
12/21/2013 17:56	55.032	56.150	56.426	55.254	55.637	51.732	54.923	54.726		
12/21/2013 18:11	55.039	56.148	56.429	55.255	55.627	52.540	54.963	54.726		
12/21/2013 18:26	55.039	56.149	56.423	55.256	55.629	51.867	54.923	54.726		
12/21/2013 18:41	55.045	56.147	56.425	55.251	55.642	51.473	54.921	54.723		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/21/2013 18:56	55.045	56.142	56.424	55.256	55.642	51.501	54.945	54.722		
12/21/2013 19:11	55.045	56.143	56.427	55.251	55.643	51.396	54.934	54.723		
12/21/2013 19:26	55.047	56.144	56.421	55.251	55.637	51.750	54.937	54.726		
12/21/2013 19:41	55.050	56.138	56.429	55.257	55.629	51.575	54.930	54.724		
12/21/2013 19:56	55.050	56.148	56.426	55.250	55.624	51.543	54.925	54.726		
12/21/2013 20:11	55.054	56.135	56.420	55.250	55.618	50.915	54.938	54.726		
12/21/2013 20:26	55.057	56.136	56.425	55.256	55.616	51.615	54.958	54.726		
12/21/2013 20:41	55.062	56.136	56.426	55.253	55.620	51.432	54.938	54.726		
12/21/2013 20:56	55.061	56.132	56.422	55.254	55.614	51.504	54.959	54.721		
12/21/2013 21:11	55.061	56.129	56.423	55.254	55.608	51.398	54.932	54.719		
12/21/2013 21:26	55.054	56.131	56.420	55.255	55.613	51.129	54.914	54.721		
12/21/2013 21:41	55.064	56.128	56.422	55.252	55.617	51.688	54.959	54.721		
12/21/2013 21:56	55.065	56.125	56.421	55.253	55.632	52.003	54.952	54.723		
12/21/2013 22:11	55.069	56.122	56.421	55.252	55.618	51.640	54.945	54.722		
12/21/2013 22:26	55.067	56.122	56.419	55.251	55.616	51.184	54.926	54.723		
12/21/2013 22:41	55.066	56.123	56.417	55.259	55.636	50.800	54.944	54.721		
12/21/2013 22:56	55.069	56.121	56.420	55.256	55.635	51.572	54.986	54.721		
12/21/2013 23:11	55.069	56.124	56.416	55.251	55.638	52.032	54.974	54.723		
12/21/2013 23:26	55.072	56.119	56.415	55.256	55.637	51.746	54.909	54.721		
12/21/2013 23:41	55.072	56.121	56.413	55.260	55.623	51.055	54.900	54.721		
12/21/2013 23:56	55.075	56.113	56.413	55.256	55.615	50.945	54.938	54.722		
12/22/2013 0:11	55.080	56.118	56.418	55.254	55.610	51.203	54.920	54.719		
12/22/2013 0:26	55.081	56.113	56.415	55.252	55.625	51.489	54.884	54.721		
12/22/2013 0:41	55.077	56.112	56.412	55.257	55.627	51.602	54.890	54.723		
12/22/2013 0:56	55.085	56.110	56.418	55.256	55.624	51.650	54.885	54.719		
12/22/2013 1:11	55.081	56.112	56.418	55.260	55.626	50.746	54.910	54.724		
12/22/2013 1:26	55.081	56.107	56.415	55.256	55.613	51.920	54.886	54.721		
12/22/2013 1:41	55.081	56.107	56.415	55.256	55.624	51.523	54.885	54.720		
12/22/2013 1:56	55.081	56.100	56.415	55.255	55.629	50.876	54.902	54.722		
12/22/2013 2:11	55.076	56.103	56.415	55.258	55.613	51.646	54.922	54.721		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/22/2013 2:26	55.076	56.104	56.415	55.261	55.592	51.406	54.875	54.716		
12/22/2013 2:41	55.084	56.101	56.411	55.257	55.567	51.358	54.892	54.722		
12/22/2013 2:56	55.080	56.102	56.407	55.256	55.572	51.735	54.933	54.724		
12/22/2013 3:11	55.081	56.099	56.411	55.254	55.583	51.584	54.920	54.719		
12/22/2013 3:26	55.082	56.097	56.408	55.253	55.594	51.528	54.903	54.724		
12/22/2013 3:41	55.080	56.096	56.410	55.258	55.617	51.221	54.936	54.720		
12/22/2013 3:56	55.085	56.095	56.409	55.255	55.618	52.129	54.950	54.722		
12/22/2013 4:11	55.081	56.095	56.408	55.256	55.616	52.540	54.974	54.723		
12/22/2013 4:26	55.082	56.091	56.412	55.260	55.611	52.318	54.959	54.720		
12/22/2013 4:41	55.081	56.090	56.408	55.251	55.606	51.405	54.924	54.718		
12/22/2013 4:56	55.081	56.089	56.409	55.258	55.577	51.702	54.915	54.721		
12/22/2013 5:11	55.089	56.085	56.408	55.257	55.585	51.734	54.913	54.721		
12/22/2013 5:26	55.085	56.085	56.408	55.254	55.592	51.039	54.926	54.719		
12/22/2013 5:41	55.086	56.085	56.407	55.256	55.606	51.915	54.923	54.717		
12/22/2013 5:56	55.089	56.086	56.408	55.256	55.618	51.058	54.921	54.723		
12/22/2013 6:11	55.087	56.081	56.406	55.259	55.607	51.719	54.942	54.719		
12/22/2013 6:26	55.086	56.083	56.404	55.258	55.609	52.172	54.879	54.719		
12/22/2013 6:41	55.093	56.079	56.405	55.261	55.611	51.714	54.920	54.717		
12/22/2013 6:56	55.086	56.080	56.408	55.254	55.613	51.168	54.918	54.721		
12/22/2013 7:11	55.093	56.074	56.405	55.257	55.600	51.441	54.951	54.719		
12/22/2013 7:26	55.090	56.079	56.404	55.259	55.602	51.245	54.968	54.714		
12/22/2013 7:41	55.092	56.076	56.405	55.256	55.618	51.587	54.942	54.721		
12/22/2013 7:56	55.093	56.079	56.406	55.258	55.613	51.442	54.949	54.721		
12/22/2013 8:11	55.092	56.077	56.407	55.256	55.616	51.409	54.909	54.718		
12/22/2013 8:26	55.090	56.071	56.401	55.262	55.593	51.392	54.876	54.723		
12/22/2013 8:41	55.090	56.073	56.404	55.258	55.597	51.289	54.925	54.722		
12/22/2013 8:56	55.100	56.067	56.400	55.256	55.601	51.426	54.870	54.717		
12/22/2013 9:11	55.096	56.071	56.405	55.258	55.601	52.391	54.901	54.715		
12/22/2013 9:26	55.094	56.071	56.401	55.254	55.603	52.453	54.875	54.721		
12/22/2013 9:41	55.100	56.067	56.404	55.256	55.601	51.740	54.853	54.720		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/22/2013 9:56	55.096	56.068	56.402	55.252	55.601	51.785	54.912	54.716		
12/22/2013 10:11	55.096	56.063	56.397	55.254	55.592	51.432	54.942	54.718		
12/22/2013 10:26	55.094	56.066	56.394	55.256	55.591	51.630	54.919	54.721		
12/22/2013 10:41	55.101	56.067	56.397	55.255	55.588	51.644	54.947	54.719		
12/22/2013 10:56	55.100	56.062	56.399	55.257	55.597	51.478	54.955	54.713		
12/22/2013 11:11	55.098	56.061	56.400	55.258	55.590	51.465	54.950	54.717		
12/22/2013 11:26	55.100	56.063	56.395	55.259	55.600	51.123	54.925	54.717		
12/22/2013 11:41	55.103	56.065	56.394	55.258	55.601	51.814	54.885	54.718		
12/22/2013 11:56	55.097	56.065	56.392	55.257	55.590	52.347	54.873	54.723		
12/22/2013 12:11	55.101	56.058	56.398	55.256	55.583	51.088	54.911	54.723		
12/22/2013 12:26	55.098	55.663	56.397	55.255	55.587	51.597	54.887	54.721		
12/22/2013 12:41	55.099	56.023	56.392	55.256	55.588	51.090	54.895	54.717		
12/22/2013 12:56	55.097	56.038	56.391	55.254	55.591	51.983	54.913	54.721		
12/22/2013 13:11	55.101	56.051	56.393	55.261	55.601	51.579	54.900	54.716		
12/22/2013 13:26	55.103	56.046	56.389	55.255	55.587	51.117	54.929	54.717		
12/22/2013 13:41	55.100	56.046	56.395	55.259	55.592	51.709	54.885	54.720		
12/22/2013 13:56	55.102	56.051	56.390	55.261	55.592	51.326	54.880	54.716		
12/22/2013 14:11	55.102	56.047	56.393	55.260	55.585	51.887	54.911	54.716		
12/22/2013 14:26	55.105	56.049	56.397	55.259	55.591	51.546	54.899	54.714		
12/22/2013 14:41	55.101	56.049	56.389	55.259	55.599	51.332	54.891	54.717		
12/22/2013 14:56	55.103	56.044	56.393	55.258	55.589	51.354	54.862	54.714		
12/22/2013 15:11	55.104	56.044	56.391	55.255	55.577	51.512	54.924	54.711		
12/22/2013 15:26	55.105	56.046	56.389	55.255	55.586	51.857	54.938	54.719		
12/22/2013 15:41	55.100	56.046	56.394	55.259	55.570	51.310	54.916	54.718		
12/22/2013 15:56	55.108	56.047	56.388	55.261	55.576	51.096	54.907	54.715		
12/22/2013 16:11	55.104	56.045	56.387	55.253	55.595	51.764	54.887	54.713		
12/22/2013 16:26	55.100	56.041	56.390	55.256	55.603	51.507	54.927	54.714		
12/22/2013 16:41	55.098	56.043	56.388	55.258	55.587	52.070	54.951	54.714		
12/22/2013 16:56	55.105	56.042	56.389	55.254	55.588	51.485	54.890	54.718		
12/22/2013 17:11	55.104	56.039	56.386	55.258	55.600	51.424	54.831	54.716		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/22/2013 17:26	55.108	56.041	56.385	55.257	55.604	51.773	54.845	54.721		
12/22/2013 17:41	55.111	56.038	56.388	55.256	55.607	52.054	54.910	54.712		
12/22/2013 17:56	55.111	56.038	56.388	55.257	55.599	51.518	54.935	54.712		
12/22/2013 18:11	55.110	56.035	56.388	55.258	55.581	51.296	54.866	54.714		
12/22/2013 18:26	55.111	56.035	56.384	55.258	55.586	51.238	54.873	54.711		
12/22/2013 18:41	55.109	56.038	56.389	55.260	55.594	51.108	54.916	54.710		
12/22/2013 18:56	55.105	56.031	56.386	55.258	55.599	51.575	54.857	54.719		
12/22/2013 19:11	55.111	56.034	56.383	55.256	55.607	51.586	54.885	54.714		
12/22/2013 19:26	55.112	56.031	56.383	55.251	55.595	51.575	54.866	54.716		
12/22/2013 19:41	55.111	56.029	56.379	55.255	55.577	51.401	54.939	54.719		
12/22/2013 19:56	55.107	56.029	56.386	55.262	55.577	51.182	54.932	54.713		
12/22/2013 20:11	55.112	56.029	56.376	55.253	55.574	51.244	54.872	54.713		
12/22/2013 20:26	55.107	56.029	56.381	55.257	55.571	50.695	54.867	54.716		
12/22/2013 20:41	55.106	56.026	56.376	55.259	55.582	50.605	54.882	54.709		
12/22/2013 20:56	55.108	56.027	56.383	55.259	55.593	51.926	54.865	54.714		
12/22/2013 21:11	55.111	56.024	56.380	55.255	55.589	50.985	54.916	54.715		
12/22/2013 21:26	55.111	56.027	56.380	55.258	55.571	51.626	54.856	54.716		
12/22/2013 21:41	55.106	56.023	56.379	55.252	55.580	51.689	54.849	54.721		
12/22/2013 21:56	55.110	56.024	56.379	55.262	55.583	51.134	54.861	54.713		
12/22/2013 22:11	55.105	56.023	56.381	55.259	55.575	51.536	54.873	54.711		
12/22/2013 22:26	55.111	56.024	56.377	55.259	55.572	51.820	54.888	54.715		
12/22/2013 22:41	55.111	56.026	56.375	55.256	55.568	51.263	54.891	54.718		
12/22/2013 22:56	55.111	56.023	56.379	55.251	55.575	52.035	54.877	54.715		
12/22/2013 23:11	55.113	56.023	56.375	55.257	55.583	52.108	54.896	54.718		
12/22/2013 23:26	55.107	56.020	56.376	55.258	55.596	51.721	54.913	54.714		
12/22/2013 23:41	55.111	56.021	56.374	55.256	55.593	51.797	54.939	54.716		
12/22/2013 23:56	55.106	56.018	56.375	55.256	55.575	52.287	54.964	54.710		
12/23/2013 0:11	55.105	56.018	56.371	55.258	55.567	51.845	54.908	54.711		
12/23/2013 0:26	55.105	56.017	56.376	55.256	55.560	51.379	54.912	54.714		
12/23/2013 0:41	55.106	56.018	56.371	55.254	55.581	51.860	54.849	54.714		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/23/2013 0:56	55.107	56.016	56.374	55.254	55.579	51.130	54.880	54.719		
12/23/2013 1:11	55.111	56.014	56.376	55.255	55.571	51.535	54.866	54.714		
12/23/2013 1:26	55.106	56.011	56.370	55.262	55.559	51.457	54.872	54.715		
12/23/2013 1:41	55.110	56.015	56.373	55.261	55.575	51.391	54.840	54.715		
12/23/2013 1:56	55.111	56.013	56.372	55.252	55.583	51.219	54.849	54.714		
12/23/2013 2:11	55.106	56.011	56.373	55.262	55.583	50.848	54.829	54.713		
12/23/2013 2:26	55.109	56.013	56.369	55.258	55.567	51.948	54.864	54.716		
12/23/2013 2:41	55.102	56.012	56.372	55.252	55.572	50.886	54.878	54.711		
12/23/2013 2:56	55.099	56.010	56.371	55.251	55.572	51.969	54.868	54.717		
12/23/2013 3:11	55.106	56.010	56.367	55.260	55.595	50.997	54.827	54.713		
12/23/2013 3:26	55.105	56.009	56.367	55.254	55.598	51.103	54.861	54.711		
12/23/2013 3:41	55.101	56.010	56.367	55.259	55.583	51.435	54.848	54.715		
12/23/2013 3:56	55.105	56.005	56.366	55.256	55.567	51.712	54.841	54.712		
12/23/2013 4:11	55.095	56.004	56.370	55.257	55.560	51.233	54.853	54.714		
12/23/2013 4:26	55.105	56.005	56.367	55.254	55.576	51.359	54.874	54.709		
12/23/2013 4:41	55.100	56.008	56.365	55.256	55.584	51.278	54.900	54.707		
12/23/2013 4:56	55.100	56.006	56.360	55.258	55.575	51.510	54.875	54.715		
12/23/2013 5:11	55.100	56.003	56.365	55.258	55.578	51.519	54.828	54.713		
12/23/2013 5:26	55.100	56.000	56.362	55.251	55.584	51.702	54.854	54.709		
12/23/2013 5:41	55.097	56.003	56.364	55.259	55.567	51.520	54.917	54.712		
12/23/2013 5:56	55.095	56.001	56.365	55.258	55.559	51.806	54.873	54.718		
12/23/2013 6:11	55.095	56.002	56.363	55.260	55.561	51.695	54.842	54.705		
12/23/2013 6:26	55.097	56.003	56.360	55.253	55.578	52.049	54.799	54.714		
12/23/2013 6:41	55.102	56.002	56.357	55.254	55.589	51.523	54.830	54.711		
12/23/2013 6:56	55.092	55.999	56.359	55.252	55.574	51.206	54.858	54.709		
12/23/2013 7:11	55.094	55.999	56.366	55.254	55.568	50.647	54.839	54.716		
12/23/2013 7:26	55.094	55.994	56.361	55.256	55.566	51.002	54.808	54.715		
12/23/2013 7:41	55.088	55.993	56.356	55.254	55.559	51.296	54.832	54.711		
12/23/2013 7:56	55.091	55.994	56.362	55.255	55.566	51.741	54.858	54.714		
12/23/2013 8:11	55.087	55.996	56.356	55.251	55.571	50.813	54.856	54.713		

PRESSURE TRANSDUCER WATER TEMPERATURE

Paddlewheel Point Aquifer Testing: Yankton, South Dakota

December 12, 2013 to December 23, 2013

Date / Time	TW1 (°F)	OW-50P (°F)	OW-75P (°F)	OW-150P (°F)	OW-60R (°F)	SP-120R (°F)	OW-1-13 (°F)	OW-3-13 (°F)	Date / Time	River (°F)
12/23/2013 8:26	55.094	55.990	56.356	55.254	55.571	51.284	54.794	54.712		
12/23/2013 8:41	55.096	55.997	56.358	55.256	55.565	51.301	54.820	54.713		
12/23/2013 8:56	55.085	55.993	56.357	55.257	55.562	51.492	54.778	54.709		
12/23/2013 9:11	55.086	55.987	56.360	55.259	55.554	51.171	54.805	54.713		
12/23/2013 9:26	55.087	55.989	56.357	55.256	55.548	50.767	54.829	54.714		
12/23/2013 9:41	55.085	55.988	56.358	55.253	55.556	50.778	54.849	54.711		
12/23/2013 9:56	55.087	55.987	56.356	55.256	55.559	52.117	54.845	54.710		
12/23/2013 10:11	55.089	55.989	56.356	55.257	55.551	51.452	54.809	54.706		
12/23/2013 10:26	55.081	55.989	56.351	55.256	55.554	51.299	54.861	54.710		
12/23/2013 10:41	55.083	55.982	56.355	55.253	55.554	50.825	54.877	54.714		
12/23/2013 10:56	55.081	55.982	56.350	55.252	55.555	51.017	54.795	54.709		
12/23/2013 11:11	55.086	55.988	56.354	55.254	55.571	51.209	54.801	54.714		
12/23/2013 11:26	55.075	55.986	56.359	55.256	55.554	51.802	54.897	54.717		
12/23/2013 11:41				55.291			54.832	54.714		

APPENDIX E

Water Quality Results

SUMMARY OF WATER QUALITY RESULTS FOR PADDLEWHEEL POINT AQUIFER TESTING
December 16, 2013

TEST WELL (Pump test started at 12:00 on 12/16/13)

Parameter	Date	Time	Result	Unit
TDS	12/16/2013	12:30	1888	mg/l
Total Hardness	12/16/2013	13:15	1300	mg/l
Ca Hardness	12/16/2013	13:15	850	mg/l
Alkalinity	12/16/2013	13:15	340	mg/l
Sulfate	12/16/2013	13:15	1040	mg/l
Iron	12/16/2013	13:15	2.41	mg/l
Manganese	12/16/2013	13:15	3.17	mg/l
TOC	12/16/2013	12:30	0.905	mg/l
Dissolved Iron	12/16/2013	13:15	2.26	mg/l
Dissolved Manganese	12/16/2013	13:15	2.74	mg/l
DOC	NA	NA	NA	NA
Temperature	12/16/2013	13:15	53.73	Degrees F
pH	12/16/2013	13:15	7.13	pH units
Dissovled Oxygen	12/16/2013	13:15	7.84	mg/l
ORP	12/16/2013	13:15	0.02	V
EC	12/16/2013	13:15	1620	uS/cm
Temperature	12/16/2013	16:00	54.06	Degrees F
pH	12/16/2013	16:00	7.11	pH units
Dissovled Oxygen	12/16/2013	16:00	5.28	mg/l
ORP	12/16/2013	16:00	-0.01	V
EC	12/16/2013	16:00	1631	uS/cm

RIVER

Parameter	Date	Time	Result	Unit
Dissolved Fe	12/16/2013	13:15	0.03	mg/l
Dissolved Mn	12/16/2013	13:15	0.364	mg/l
DOC	NA	NA	NA	NA
Temperature	12/16/2013	12:55	35.33	Degrees F
pH	12/16/2013	12:55	7.8	pH units
Dissovled Oxygen	12/16/2013	12:55	13.91	mg/l
ORP	12/16/2013	12:55	0.22	V
EC	12/16/2013	12:55	508.5	uS/cm

SUMMARY OF WATER QUALITY RESULTS FOR PADDLEWHEEL POINT AQUIFER TESTING
December 17, 2013

TEST WELL

Parameter	Date	Time	Result	Unit
TDS	12/17/2013	13:20	1790	mg/l
Total Hardness	12/17/2013	13:30	1268	mg/l
Ca Hardness	12/17/2013	13:30	840	mg/l
Alkalinity	12/17/2013	13:30	348	mg/l
Sulfate	12/17/2013	13:30	1010	mg/l
Iron	12/17/2013	13:30	2.41	mg/l
Manganese	12/17/2013	13:30	2.71	mg/l
TOC	12/17/2013	13:20	0.792	mg/l
Dissolved Fe	12/17/2013	13:30	2.36	mg/l
Dissolved Mn	12/17/2013	13:30	2.61	mg/l
DOC	12/17/2013	13:30	1.09	mg/l
Temperature	12/17/2013	9:30	53.99	Degrees F
pH	12/17/2013	9:30	7.03	pH units
Dissovled Oxygen	12/17/2013	9:30	3.11	mg/l
ORP	12/17/2013	9:30	0.02	V
EC	12/17/2013	9:30	1616	uS/cm
Temperature	12/17/2013	14:15	53.2	Degrees F
pH	12/17/2013	14:15	7.03	pH units
Dissovled Oxygen	12/17/2013	14:15	4.58	mg/l
ORP	12/17/2013	14:15	-0.00	V
EC	12/17/2013	14:15	1562	uS/cm

RIVER

Parameter	Date	Time	Result	Unit
Dissolved Fe	12/17/2013	13:45	0.07	mg/l
Dissolved Mn	12/17/2013	13:45	0.224	mg/l
DOC	12/17/2013	13:45	3.54	mg/l
Temperature	12/17/2013	9:45	33.19	Degrees F
pH	12/17/2013	9:45	7.98	pH units
Dissovled Oxygen	12/17/2013	9:45	12.8	mg/l
ORP	12/17/2013	9:45	0.01	V
EC	12/17/2013	9:45	498.9	uS/cm
Temperature	12/17/2013	14:10	35.83	Degrees F
pH	12/17/2013	14:10	8.32	pH units
Dissovled Oxygen	12/17/2013	14:10	13.82	mg/l
ORP	12/17/2013	14:10	0.09	V
EC	12/17/2013	14:10	510.1	uS/cm

SUMMARY OF WATER QUALITY RESULTS FOR PADDLEWHEEL POINT AQUIFER TESTING
December 18, 2013

TEST WELL

Parameter	Date	Time	Result	Unit
TDS	12/18/2013	12:20	1798	mg/l
Total Hardness	12/18/2013	12:30	1248	mg/l
Ca Hardness	12/18/2013	12:30	838	mg/l
Alkalinity	12/18/2013	12:30	356	mg/l
Sulfate	12/18/2013	12:20	986	mg/l
Iron	12/18/2013	12:30	2.3	mg/l
Manganese	12/18/2013	12:30	2.81	mg/l
TOC	12/18/2013	12:30	0.759	mg/l
Dissolved Fe	12/18/2013	12:30	2.3	mg/l
Dissolved Mn	12/18/2013	12:30	2.3	mg/l
DOC	12/18/2013	12:30	0.76	mg/l
Temperature	12/18/2013	10:22	53.1	Degrees F
pH	12/18/2013	10:22	6.94	pH units
Dissovled Oxygen	12/18/2013	10:22	4.69	mg/l
ORP	12/18/2013	10:22	0.08	V
EC	12/18/2013	10:22	1569	uS/cm
Temperature	12/18/2013	13:12	55.3	Degrees F
pH	12/18/2013	13:12	7.01	pH units
Dissovled Oxygen	12/18/2013	13:12	3.77	mg/l
ORP	12/18/2013	13:12	0.04	V
EC	12/18/2013	13:12	1630	uS/cm

RIVER

Parameter	Date	Time	Result	Unit
Dissolved Fe	12/18/2013	12:45	0.04	mg/l
Dissolved Mn	12/18/2013	12:45	0.4	mg/l
DOC	12/18/2013	12:45	3.88	mg/l
Temperature	12/18/2013	10:27	35.64	Degrees F
pH	12/18/2013	10:27	7.86	pH units
Dissovled Oxygen	12/18/2013	10:27	12.91	mg/l
ORP	12/18/2013	10:27	0.08	V
EC	12/18/2013	10:27	524.1	uS/cm
Temperature	12/18/2013	13:18	36.77	Degrees F
pH	12/18/2013	13:18	8.28	pH units
Dissovled Oxygen	12/18/2013	13:18	13.21	mg/l
ORP	12/18/2013	13:18	0.04	V
EC	12/18/2013	13:18	510.2	uS/cm

SUMMARY OF WATER QUALITY RESULTS FOR PADDLEWHEEL POINT AQUIFER TESTING
December 19, 2013

TEST WELL

Parameter	Date	Time	Result	Unit
TDS	12/19/2013	11:25	1816	mg/l
Total Hardness	12/19/2013	12:30	1260	mg/l
Ca Hardness	12/19/2013	12:30	820	mg/l
Alkalinity	12/19/2013	12:30	354	mg/l
Sulfate	12/19/2013	11:25	954	mg/l
Iron	12/19/2013	12:30	2.5	mg/l
Manganese	12/19/2013	12:30	2.12	mg/l
TOC	12/19/2013	12:30	0.700	mg/l
Dissolved Fe	12/19/2013	12:30	2.5	mg/l
Dissolved Mn	12/19/2013	12:30	2.2	mg/l
DOC	12/19/2013	12:20	0.84	mg/l
Temperature	12/19/2013	13:06	47.05	Degrees F
pH	12/19/2013	13:06	7.34	pH units
Dissovled Oxygen	12/19/2013	13:06	6.25	mg/l
ORP	12/19/2013	13:06	0.03	V
EC	12/19/2013	13:06	1419	uS/cm

RIVER

Parameter	Date	Time	Result	Unit
Dissolved Fe	12/19/2013	12:40	0.11	mg/l
Dissolved Mn	12/19/2013	12:40	0.83	mg/l
DOC	12/19/2013	12:40	3.67	mg/l
Temperature	12/19/2013	13:19	34.58	Degrees F
pH	12/19/2013	13:19	7.87	pH units
Dissovled Oxygen	12/19/2013	13:19	7.89	mg/l
ORP	12/19/2013	13:19	0.02	V
EC	12/19/2013	13:19	530.1	uS/cm

SUMMARY OF WATER QUALITY RESULTS FOR PADDLEWHEEL POINT AQUIFER TESTING
December 19, 2013

TEST WELL

Parameter	Date	Time	Result	Unit
Pesticides	12/19/2013	11:50	ND	
Disinfection Byproducts	12/19/2013	11:30	ND	
VOC's	12/19/2013	11:20	ND	
Silver	12/19/2013	11:35	< 1.0	ug/l
Thallium	12/19/2013	11:35	< 0.1	ug/l
Zinc	12/19/2013	11:35	12.8	ug/l
Uranium	12/19/2013	11:35	2.8	ug/l
Silicon	12/19/2013	11:35	15300	ug/l
Cyanide	12/19/2013	11:35	< 0.010	mg/l
Potassium	12/19/2013	11:35	11.4	mg/l
Sodium	12/19/2013	11:35	47.0	mg/l
Aluminum	12/19/2013	11:35	< 0.1	ug/l
Antimony	12/19/2013	11:35	< 0.2	ug/l
Arsenic	12/19/2013	11:35	0.005	mg/l
Barium	12/19/2013	11:35	8.5	ug/l
Beryllium	12/19/2013	11:35	< 0.2	ug/l
Cadmium	12/19/2013	11:35	< 0.2	ug/l
Chromium	12/19/2013	11:35	< 0.2	ug/l
Copper	12/19/2013	11:35	< 0.02	mg/l
Lead	12/19/2013	11:35	0.04	ug/l
Mercury	12/19/2013	11:35	0.2	ug/l
Molybdenum	12/19/2013	11:35	1.0	ug/l
Nickel	12/19/2013	11:35	15.9	ug/l
Nitrate (as N)	12/19/2013	11:35	0.4	mg/l
Nitrite	12/19/2013	11:35	< 0.02	mg/l
Selenium	12/19/2013	11:35	2.4	ug/l

* Mercury result most likely caused by tungsten oxide contaminaton - tungsten was found in sample.

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SD STATE PUBLIC HEALTH LABORATORY

615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:

Date: 12/19/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007536
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source

YANKTON/CITY WATER

Date Rcvd:	12/17/2013	Site Location:	PUMP DISCHARGE
Time Rcvd:	0705	Source Name	MISSOURI RIVER ALLUVIUM
Date Coll:	12/16/2013		
Time Coll:	1230	Source Sampled:	WELL
Spec Type:	WATER	Source:	WELL
Coll By:	DOUG HANEY	Tap Location:	PUMP DISCHARGE
Date Built:	12-6-13	Telephone Numb*	6685272
Field Comments	TEST WELL	Treatment:	NONE
Field Temp	57.7 F	Type of Sample:	RAW
Field pH:	7.13	Well Depth:	120
Location	PUMP DISCHARGE		medium water
Remarks:	TEST WELL		

Final Results

SOLIDS, TOTAL DISS.	1888 mg/L
Standard Method 2540C	
Sulfate	1040 mg/L

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:

Date: 12/24/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007569
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source

YANKTON/CITY WATER

Date Rcvd: 12/18/2013
Time Rcvd: 0718
Date Coll: 12/17/2013
Time Coll: 1320
Spec Type: WATER
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 53.2 F
Field pH: 7.1

Remarks: TEST WELL
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP DISCHARGE
Telephone Numb* 6685272
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

SOLIDS, TOTAL DISS.	1790 mg/L
Standard Method 2540C	
Sulfate	1010 mg/L

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: ** DUPLICATE REPORT ** Date: 12/30/2013

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007804
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/19/2013
Time Rcvd: 0656
Date Coll: 12/18/2013
Time Coll: 1220
Spec Type: WATER
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 55.3 F
Field pH: 7.0

Remarks: TEST WELL
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP DISCHARGE
Telephone Numb* 6685272
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

SOLIDS, TOTAL DISS.	1798 mg/L
Standard Method 2540C	
Sulfate	986 mg/L

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615 East Fourth Street PIERRE, SD 57501-1700

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Date: 12/30/2013

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YANKTON, SD 57078-0176

Spec #: E13EC007642
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/20/2013
Time Rcvd: 0705
Date Coll: 12/19/2013
Time Coll: 1125
Spec Type: WATER
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 47.0 F
Field pH: 7.3

Remarks: TEST WELL
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP DISCHARGE
Telephone Numb* 6685272
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

SOLIDS, TOTAL DISS.	1816 mg/L
Standard Method 2540C	
Sulfate	954 mg/L

From: Klein, Beverly [Beverly.Klein@SDSTATE.EDU]
Sent: December 23, 2013 7:15 PM
To: Ray Tweedy
Subject: results

WATER & ENVIRONMENTAL ENGINEERING RESEARCH CENTER

SCEH 112 PO Box 2219 Brookings, SD 57007 605-688-6308

Ray Tweedy
City of Yankton
Water Plant #2
105 W Riverside Dr
Yankton, SD 57078
rtweedy@cityofyankton.org

Sample #	Date Sampled	Sample Type	TOC Method: St Meth 5310 B mg organic C/L	DOC Method: St Meth 5310 C mg organic C/L	Ultraviolet Absorbance at 254 nm Method: Std Meth 5910B /cm^{-1}	SUVA L/mg-m
09-46201		test well 12/17/13	0.792			
09-46202		trt	2.46	2.1	0.022	1.05
09-46203		raw	3.05	2.88	0.057	1.98
09-46204		test well 12/16/13	0.905			
		test well 12/18/13	0.759			
		test well 12/19/13	0.700			

Temperature on receipt in lab: 7°C

Beverly Klein
Senior Chemist
12/23/13

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:

Date: 1/22/2014

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007565
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd:	12/18/2013	Remarks:	TEST WELL FILTERED
Time Rcvd:	0710	Source Name	MISSOURI RIVER ALLUVIUM
Date Coll:	12/17/2013		
Time Coll:	1330	Tap Location:	PUMP DISCHARGE
Coll By:	DOUG HANEY	Telephone Numb*	6685272
Date Built:	12-6-13	Treatment:	0.45 MICRON FILTER
Field Temp	53.2 F	Type of Sample:	RAW
Field pH:	7.1	Well Depth:	120

Final Results

DOC	1.09 mg organic C/L

Testing completed by WEERC using SM5310C

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615 East Fourth Street PIERRE, SD 57501-1700

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PO BOX 176
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YANKTON, SD 57078-0176

Spec #: E13EC007566
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/18/2013	Field pH: 8.3
Time Rcvd: 0708	Remarks: MISSOURI RIVER
Date Coll: 12/17/2013	Tap Location: GRAB SAMPLE
Time Coll: 1345	Telephone Numb* 6685272
Coll By: DOUG HANEY	Treatment: 0.45 MICRON FILTER
Field Temp 35.8 F	Type of Sample: RAW

Final Results

DOC	3.54 mg organic C/L

Testing completed by WEERC using SM5310C

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/22/2014

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007605
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/19/2013
Time Rcvd: 0702
Date Coll: 12/18/2013
Time Coll: 1230
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 55.3 F
Field pH: 7.0

Remarks: TEST WELL FILTERED
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP DISCHARGE
Telephone Numb* 6685272
Treatment: 0.45 MICRON FILTER
Type of Sample: RAW
Well Depth: 120

Final Results

DOC	0.76 mg organic C/L

Testing completed by WEERC using SM5310C

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PO BOX 176
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YANKTON, SD 57078-0176

Spec #: E13EC007606
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/19/2013
Time Rcvd: 0701
Date Coll: 12/18/2013
Time Coll: 1245
Coll By: DOUG HANEY
Field Temp 36.8 F
Field pH: 8.3

Remarks: MISSOURI RIVER FILTERED
Source Name MISSOURI RIVER
Tap Location: GRAB SAMPLE
Telephone Numb* 6685272
Treatment: 0.45 MICRON FILTER
Type of Sample: RAW

Final Results

DOC	3.88 mg organic C/L

Testing completed by WEERC using SM5310C

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Date: 1/24/2014

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007637
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source

YANKTON/CITY WATER

Date Rcvd:	12/20/2013	Remarks:	TEST WELL FILTERED
Time Rcvd:	0722	Source Name	MISSOURI RIVER ALLUVIUM
Date Coll:	12/19/2013		
Time Coll:	1220	Tap Location:	PUMP HOUSE
Coll By:	DOUG HANEY	Telephone Numb*	6685272
Date Built:	12-6-13	Treatment:	0.45 MICRON FILTER
Field Temp	47 F	Type of Sample:	RAW
Field pH:	7.3	Well Depth:	120

Final Results

DOC	0.84 mg organic C/L

Testing completed by WEERC using SM5310C

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

* Page 1 of 1*
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PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007638
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd:	12/20/2013	Remarks:	RIVER FILTERED
Time Rcvd:	0719	Source Name	MISSOURI RIVER
Date Coll:	12/19/2013	Tap Location:	GRAB SAMPLE
Time Coll:	1240	Telephone Numb*	6685272
Coll By:	DOUG HANEY	Treatment:	0.45 MICRON FILTER
Date Built:	12-6-13	Type of Sample:	RAW
Field Temp	34.6 F	Well Depth:	120
Field pH:	7.9		

Final Results

DOC	3.67 mg organic C/L

Testing completed by WEERC using SM5310C

********** CONFIDENTIAL LABORATORY REPORTS **********
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615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:
Date: 1/30/2014

YANKTON, CITY OF-0423
PO BOX 176
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YANKTON, SD 57078-0176

Spec #: E13EC007643
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd:	12/20/2013	Remarks:	TEST WELL
Time Rcvd:	0716	Source Name	MISSOURI RIVER ALLUVIUM
Date Coll:	12/19/2013		
Time Coll:	1135	Source Sampled:	WELL
Spec Type:	WATER	Source:	WELL
Coll By:	DOUG HANEY	Tap Location:	PUMP DISCHARGE
Date Built:	12-6-13	Telephone Numb*	6685272
Field Temp	47 F	Treatment:	NONE
Field pH:	7.3	Type of Sample:	RAW
Location	PUMP DISCHARGE	Well Depth:	120

Final Results

ALUMINUM		<1.0	ug/L	
ANTIMONY		<0.2	ug/L	
Arsenic		0.005	mg/L	
Barium		8.5	ug/L	
Beryllium		<0.2	ug/L	
Cadmium		<0.2	ug/L	
Chromium		<0.2	ug/L	
Copper		<0.02	mg/L	
Lead		0.4	ug/L	
EPA Method 200.8				
Mercury, Total		0.2	ug/L	
Mercury result is likely caused by Tungsten Oxide contamination When screen with Total Qaunt Method; Tungsten was found in sample.				
MOLYBDENUM		1.0	ug/L	
Nickel		15.9	ug/L	
Nitrate	Nitrate-N	0.4	mg/L	Limit: 10.0
Nitrite		<0.02	mg/L	Limit: 1.00
Selenium		2.4	ug/L	

(continued)

Submitter copy to:

Date: 1/30/2014

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YANKTON, SD 57078-0176

Spec #: E13EC007643
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Silver	<1.0 ug/L
Thallium	<0.1 ug/L
Zinc	12.8 ug/L
Uranium	2.8 ug/L
SILICON	15300 ug/L
EPA Method 200.8	
CYANIDE, Total	<0.010 mg/L
Testing completed by MTL using Kelada 01	
Potassium	11.4 mg/L
Sodium	47.0 mg/L

********** CONFIDENTIAL LABORATORY REPORTS **********
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615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/6/2014

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PO BOX 176
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YANKTON, SD 57078-0176

Spec #: E13EC007640
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/20/2013
Time Rcvd: 0704
Date Coll: 12/19/2013
Time Coll: 1120
Spec Type: DRINKING WAT
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 47.0 F
Field pH: 7.3

Remarks: TEST WELL
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP DISCHARGE
Telephone Numb* 6685272
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

Volatile Organic Compounds	CHLOROFORM	<0.500 ug/L
	BROMODICHLOROMETHANE	<0.500 ug/L
	DIBROMOCHLOROMETHANE	<0.500 ug/L
	BROMOFORM	<0.500 ug/L
	TOTAL TRIHALOMETHANES	<2.00 ug/L
	TRICHLOROETHYLENE	<0.500 ug/L
	CARBON TETRACHLORIDE	<0.500 ug/L
	1,1,1-TRICHLOROETHANE	<0.500 ug/L
	VINYL CHLORIDE	<0.500 ug/L
	1,2-DICHLOROETHANE	<0.500 ug/L
	BENZENE	<0.500 ug/L
	1,1-DICHLOROETHYLENE	<0.500 ug/L
	PARA-DICHLOROBENZENE	

(continued)

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615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/6/2014

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410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007640
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

	<0.500 ug/L
O-DICHLOROBENZENE	
	<0.500 ug/L
cis-1,2-DICHLOROETHYLENE	
	<0.500 ug/L
trans-1,2-DICHLOROETHYLENE	
	<0.500 ug/L
1,2-DICHLOROPROPANE	
	<0.500 ug/L
ETHYLBENZENE	<0.500 ug/L
Chlorobenzene	<0.500 ug/L
STYRENE	<0.500 ug/L
TETRACHLOROETHYLENE	
	<0.500 ug/L
TOLUENE	<0.500 ug/L
m,p-XYLENE	<0.500 ug/L
o-XYLENE	<0.500 ug/L
TOTAL XYLENES	<0.500 ug/L
DICHLORODIFLUOROMETHANE	
	<0.500 ug/L
Chloromethane	<0.500 ug/L
Bromomethane	<0.500 ug/L
Chloroethane	<0.500 ug/L
Trichlorofluoromethane	
	<0.500 ug/L
Methylene Chloride	
	<0.500 ug/L
1,1-Dichloroethane	
	<0.500 ug/L
2,2-Dichloropropane	
	<0.500 ug/L
Bromochloromethane	
	<0.500 ug/L

(continued)

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PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007640
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Dibromomethane	<0.500 ug/L
cis-1,3-Dichloropropene	<0.500 ug/L
trans-1,3-Dichloropropene	<0.500 ug/L
1,1,2-Trichloroethane	<0.500 ug/L
1,3-Dichloropropane	<0.500 ug/L
1,2-Dibromoethane	<0.500 ug/L
1,1,1,2-Tetrachloroethane	<0.500 ug/L
1,1,2,2-Tetrachloroethane	<0.500 ug/L
Isopropylbenzene	<0.500 ug/L
Bromobenzene	<0.500 ug/L
1,2,3-Trichloropropane	<0.500 ug/L
N-Propylbenzene	<0.500 ug/L
2-Chlorotoluene	<0.500 ug/L
4-Chlorotoluene	<0.500 ug/L
1,3,5-Trimethylbenzene	<0.500 ug/L
tert-Butylbenzene	<0.500 ug/L
1,2,4-Trimethylbenzene	<0.500 ug/L
sec-Butylbenzene	<0.500 ug/L

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/6/2014

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007840
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

	<0.500 ug/L
1,3-Dichlorobenzene	
	<0.500 ug/L
isopropyl-Toluene	
	<0.500 ug/L
N-Butylbenzene	<0.500 ug/L
1,2-Dibromo-3-Chloropropane	
	<0.500 ug/L
1,2,4-Trichlorobenzene	
	<0.500 ug/L
naphthalene	<0.500 ug/L
Hexachlorobutadiene	
	<0.500 ug/L
1,2,3-Trichlorobenzene	
	<0.500 ug/L
1,1-Dichloropropene	
	<0.500 ug/L

Results for VOC analysis determined by EPA method 524.2.

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to:
Date: 1/6/2014

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007639
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd:	12/20/2013	Source Name	MISSOURI RIVER ALLUVIUM
Time Rcvd:	0707		
Date Coll:	12/19/2013	Source Sampled:	WELL
Time Coll:	1130	Tap Location:	PUMP DISCHARGE
Coll By:	DOUG HANEY	Temp when rec'd	6 C
Date Built:	12-6-13	Treatment:	NONE
Field Comments	TEST WELL	Type of Sample:	RAW
Field Temp	47.0 F	Well Depth:	120
Field pH:	7.3		

Final Results

Trihalomethane analysis	CHLOROFORM	<0.500	ug/L
	BROMODICHLOROMETHANE	<0.500	ug/L
	DIBROMOCHLOROMETHANE	<0.500	ug/L
	BROMOFORM	<0.500	ug/L
	TOTAL TRIHALOMETHANES	<0.500	ug/L

Trihalomethane results obtained using EPA method 524.2.

(continued)

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/6/2014

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PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007639
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Haloacetic Acids	Chloroacetic acid	<2.0 ug/L
	Dichloroacetic acid	<1.0 ug/L
	Trichloroacetic acid	<1.0 ug/L
	Bromoacetic acid	<1.0 ug/L
	Dibromoacetic acid	<1.0 ug/L
	Total Haloacetic acids	<4.50 ug/L

Results for HAA analysis determined by EPA method 552.2
Results confirmed by dual column.

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Submitter copy to: Date: 1/3/2014

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007636
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/20/2013
Time Rcvd: 0710
Date Coll: 12/19/2013
Time Coll: 1150
Spec Type: DRINKING WAT
Coll By: DOUG HANEY
Date Built: 12-6-13
Field Temp 47.0 F
Field pH: 7.3

Remarks: TEST WELL
Source Name MISSOURI RIVER ALLUVIUM
Tap Location: PUMP HOUSE
Telephone Numb* 6685272
Temp when rec'd 7 C
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

EDB and DBCP	1,2-Dibromoethane	<0.02 ug/L
	1,2-Dibromo-3-Chloropropane	<0.04 ug/L

< compound analyzed for but not detected.
Results determined by EPA Method 504.1.

Chlorinated Acids	Dalapon	<10.0 ug/L
	Dicamba	<1.00 ug/L
	2,4-D	<1.00 ug/L
	Pentachlorophenol	<0.500 ug/L
	2,4,5-TP	<1.00 ug/L
	Dinoseb	<1.00 ug/L
	Picloram	<1.00 ug/L

< compound analyzed for but not detected.
Chlorinated Acid results determined by EPA method 515.1.

(continued)

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/3/2014

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PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007636
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Glyphosate	Glyphosate	<13.2 ug/L

< compound analyzed for but not detected.
Glyphosate results determined by EPA method 547.

Endothall	Endothall	<19.8 ug/L

< compound analyzed for but not detected.
Endothall results determined by EPA method 548.1

(continued)

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SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/3/2014

Submitter copy to:

YANKTON,CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007636
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

ORGANIC COMPOUNDS-525.2

Hexachlorocyclopentadiene	<0.220 ug/L
Propachlor	<0.500 ug/L
Hexachlorobenzene	<0.220 ug/L
Simazine	<0.150 ug/L
Atrazine	<0.220 ug/L
Lindane	<0.100 ug/L
Metribuzin	<0.500 ug/L
Alachlor	<0.440 ug/L
Heptachlor	<0.400 ug/L
Metolachlor	<0.500 ug/L
Aldrin	<0.100 ug/L
Heptachlor epoxide	<0.100 ug/L
Chlordane	<0.440 ug/L
Butachlor	<0.500 ug/L
Dieldrin	<0.500 ug/L
Endrin	<0.100 ug/L
Bis (2-ethylhexyl) Adipate	<1.32 ug/L
Methoxychlor	<0.220 ug/L
Bis (2-ethylhexyl) Phthalate	<1.32 ug/L
Benzo(a)pyrene	<0.200 ug/L
Toxaphene	<0.100
Aroclor 1016	<0.080
Aroclor 1221	<0.100
Aroclor 1232	<0.100
Aroclor 1242	<0.100
Aroclor 1248	<0.100
Aroclor 1254	<0.100
Aroclor 1260	<0.100

(continued)

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 1/3/2014

Submitter copy to:

YANKTON, CITY OF-0423
PO BOX 176
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007636
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Organohalide results determined by EPA method 525.2.
PCB results determined by EPA Method 505.

N-Methylcarbamates	Aldicarb sulfone	<1.00 ug/L
	Aldicarb sulfoxide	<1.00 ug/L
	Oxamyl	<2.00 ug/L
	Methomyl	<2.00 ug/L
	3-Hydroxycarbofuran	<2.00 ug/L
	Aldicarb	<1.00 ug/L
	Carbofuran	<1.98 ug/L
	Carbaryl	<2.00 ug/L

< compound analyzed for but not detected.
Carbamate results determined by EPA method 531.1.

Diquat	Diquat	<0.88 ug/L

< compound analyzed for but not detected.
Diquat results determined by EPA method 549.2

********** CONFIDENTIAL LABORATORY REPORTS **********
SD STATE PUBLIC HEALTH LABORATORY
615 East Fourth Street PIERRE, SD 57501-1700

Date: 5/2/2014

Submitter copy to:

YANKTON,CITY OF-0423
PO BOX 178
410-416 WALNUT
YANKTON, SD 57078-0176

Spec #: E13EC007641
Subm #:
Lab: ENV CHEMISTRY
Tel #: (605)773-3368

Source
YANKTON/CITY WATER

Date Rcvd: 12/20/2013
Time Rcvd: 0708
Date Coll: 12/19/2013
Time Coll: 1116
Spec Type: WATER
Coll By: DOUG HANEY
Date Built: 12-6-13

Remarks: TEST WELL
Source Sampled: WELL
Tap Location: PUMP DISCHARGE
Treatment: NONE
Type of Sample: RAW
Well Depth: 120

Final Results

Radium-226	<0.3 +/- 0.2 pCi/L
radium-228	<1.0 +/-0.4 pCi/L
Gross Alpha	6.0 +/-2.8 pCi/L
Gross Beta	10.9 +/-2.3 pCi/L

APPENDIX F

Collector Well Yield Calculations

$$s_{cs} \geq \left(\frac{Q}{2\pi Kb}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}\left(2z_i+r_w\right)\right)}\right)^{\frac{b}{4L}}\right]$$

Hantush and Papadopulous, 1962

Hantush M.S., I.S.Papadopulus, 1962. Flow of ground water to collector wells, ASCE, Hydraul. Div., 88, 5.

Condition for formula validity
L>0.5b rw<b/2PI

Scs	2	Drawdown in collector well (ft)
Q	826,736	Yield of collector (gpd)
K	2505	Hydraulic Conductivity (gpd/ft^2)
b	115.2	Saturated thickness of aquifer (ft)
Γ	8.021621622	2* ((a-rc)/L)
a	750	Effective distance to a line of recharge (ft)
t	0	Time (days)
L	185	Average length of laterals (ft)
rc	8	Radius of collector caisson (ft)
ε	7.021621622	(2a-drc-L)L
rw	0.42	Effective radius of each lateral (ft)
zi	94.2	Depth of lateral below static water level (ft)
g	9.81	Acceleration of gravity at sea level 45 degree latitude (m/s^2)
ρ	998.545	Density of water (Kg/m^3)
μ	0.0010555	Viscosity of water (Kg/ms)
Ki	1.27E-10	Intrinsic Permeability (m^2)

			(gal/day/ft)	ft²/d
T			288,576	38839.25

K	0.001181427	(m/s)
K	0.003876072	(ft/s)
K	334.8926442	(ft/day)
K	2504.996978	(gpd/ft^2)
Scs(2*pi*K*b)	3626348.592	
(b/(pi * rw))^2	7622.661457	
(2* zi + rw)	188.82	
2*(1 - cos(pi/b)*(2* zi + rw))	1.153774974	
(b/(pi * rw))^2/2*(1 - cos(pi/b)*(2* zi + rw))	6606.71416	
a28 ^(b/4l)	3.932591412	
Γ = 2 (a - rc)/L	8.021621622	
Γ^Γ	17932836.75	
ε = (2a - 2rc - L)/L	7.021621622	
ε^ε	877734.7818	
Γ^Γ/ε^ε	20.43081477	
	80.34604672	
LN	4.38634289	
Q (gal/day)	**826,736**	

MGD	gpm	ft3/day
0.8	574	111,270

Well Design Considerations

Ground Surface Elev	1161
Depth to Water	7.8
Static Water Level	1153.2
Depth to Bedrock	120
Bedrock Elevation	1038
Saturated Thickness of Aquifer	115.2
Elevation of Laterals	1059
Lowest Pumping Water Level	1069
Max Available Drawdown	84.2

$$s_{cs} \geq \left(\frac{Q}{2\pi K b}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}\left(2z_i+r_w\right)\right)}\right)^{\frac{b}{4L}}\right]$$

Hantush and Papadopulous, 1962

Hantush M.S., I.S.Papadopulus, 1962. Flow of ground water to collector wells, ASCE, Hydraul. Div., 88, 5.

Condition for formula validity
L>0.5b rw<b/2PI

Scs	2	Drawdown in collector well (ft)
Q	824,345	Yield of collector (gpd)
K	2505	Hydraulic Conductivity (gpd/ft^2)
b	114.6	Saturated thickness of aquifer (ft)
Γ́	8.021621622	2* ((a-rc)/L)
a	750	Effective distance to a line of recharge (ft)
t	0	Time (days)
L	185	Average length of laterals (ft)
rc	8	Radius of collector caisson (ft)
ε	7.021621622	(2a-drc-L)L
rw	0.42	Effective radius of each lateral (ft)
zi	93.6	Depth of lateral below static water level (ft)
g	9.81	Acceleration of gravity at sea level 45 degree latitude (m/s^2)
ρ	998.545	Density of water (Kg/m^3)
μ	0.0010555	Viscosity of water (Kg/ms)
Ki	1.27E-10	Intrinsic Permeability (m^2)

K	0.001181427	(m/s)
K	0.003876072	(ft/s)
K	334.8926442	(ft/day)
K	2504.996978	(gpd/ft^2)

Scs(2*pi*K*b)	3607461.36
(b/(pi * rw))^2	7543.465511
(2* zi + rw)	187.62
2*(1 - cos(pi/b)*(2* zi + rw))	1.164548124
(b/(pi * rw))^2/2*(1 - cos(pi/b)*(2* zi + rw))	6477.590196
a28 ^(b/4l)	3.892727757
Γ́ = 2 (a - rc)/L	8.021621622
Γ́^Γ́	17932836.75
ε = (2a - 2rc - L)/L	7.021621622
ε^ε	877734.7818
Γ́^Γ́/ε^ε	20.43081477
	79.53159977
LN	4.376154424
Q (gal/day)	**824,345**

	MGD	gpm	ft3/day
	0.8	572	110,948

	(gal/day/ft)	ft²/d
T	287,073	38636.97

Well Design Considerations

Ground Surface Elev	1161
Depth to Water	8.4
Static Water Level	1152.6
Depth to Bedrock	120
Bedrock Elevation	1038
Saturated Thickness of Aquifer	114.6
Elevation of Laterals	1059
Lowest Pumping Water Level	1069
Max Available Drawdown	83.6

$$s_{cs} \geq \left(\frac{Q}{2\pi K b}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}\left(2z_i+r_w\right)\right)}\right)^{\frac{b}{4L}}\right]$$

Hantush and Papadopulous, 1962

Hantush M.S., I.S.Papadopulus, 1962. Flow of ground water to collector wells, ASCE, Hydraul. Div., 88, 5.

Condition for formula validity
L>0.5b rw<b/2PI

Scs	2	Drawdown in collector well (ft)
Q	577,652	Yield of collector (gpd)
K	1767	Hydraulic Conductivity (gpd/ft^2)
b	113.3	Saturated thickness of aquifer (ft)
Γ	8.021621622	2* ((a-rc)/L)
a	750	Effective distance to a line of recharge (ft)
t	0	Time (days)
L	185	Average length of laterals (ft)
rc	8	Radius of collector caisson (ft)
ε	7.021621622	(2a-drc-L)L
rw	0.42	Effective radius of each lateral (ft)
zi	92.3	Depth of lateral below static water level (ft)
g	9.81	Acceleration of gravity at sea level 45 degree latitude (m/s^2)
ρ	999.942	Density of water (Kg/m^3)
μ	0.0014988	Viscosity of water (Kg/ms)
Ki	1.27E-10	Intrinsic Permeability (m^2)

K	0.00083316	(m/s)
K	0.002733465	(ft/s)
K	236.1714144	(ft/day)
K	1766.56218	(gpd/ft^2)

Scs(2*pi*K*b)	2515177.865
(b/(pi * rw))^2	7373.293022
(2* zi + rw)	185.02
2*(1 - cos(pi/b)*(2* zi + rw))	1.188384731
(b/(pi * rw))^2/2*(1 - cos(pi/b)*(2* zi + rw))	6204.466305
a28 ^(b/4l)	3.80797247
Γ = 2 (a - rc)/L	8.021621622
Γ^Γ	17932836.75
ε = (2a - 2rc - L)/L	7.021621622
ε^ε	877734.7818
Γ^Γ/ε^ε	20.43081477
	77.7999802
LN	4.354141177
Q (gal/day)	**577,652**

	MGD	gpm	ft3/day
	0.6	401	77,746

	(gal/day/ft)	ft²/d
T	200,151	26938.29

Well Design Considerations

Ground Surface Elev	1161
Depth to Water	9.7
Static Water Level	1151.3
Depth to Bedrock	120
Bedrock Elevation	1038
Saturated Thickness of Aquifer	113.3
Elevation of Laterals	1059
Lowest Pumping Water Level	1069
Max Available Drawdown	82.3

$$s_{cs} \geq \left(\frac{Q}{2\pi Kb}\right) \mathrm{Ln}\left[\frac{\Gamma^{\Gamma}}{\varepsilon^{\varepsilon}}\left(\frac{\left(\frac{b}{\pi r_w}\right)^2}{2\left(1-\cos\frac{\pi}{b}\left(2z_i+r_w\right)\right)}\right)^{\frac{b}{4L}}\right]$$

Hantush and Papadopulous, 1962

Hantush M.S., I.S.Papadopulus, 1962. Flow of ground water to collector wells, ASCE, Hydraul. Div., 88, 5.

Condition for formula validity
L>0.5b rw<b/2PI

Scs	2	Drawdown in collector well (ft)
Q	575,645	Yield of collector (gpd)
K	1767	Hydraulic Conductivity (gpd/ft^2)
b	112.6	Saturated thickness of aquifer (ft)
Γ̇	8.021621622	2* ((a-rc)/L)
a	750	Effective distance to a line of recharge (ft)
t	0	Time (days)
L	185	Average length of laterals (ft)
rc	8	Radius of collector caisson (ft)
ε	7.021621622	(2a-drc-L)L
rw	0.42	Effective radius of each lateral (ft)
zi	91.6	Depth of lateral below static water level (ft)
g	9.81	Acceleration of gravity at sea level 45 degree latitude (m/s^2)
ρ	999.942	Density of water (Kg/m^3)
μ	0.0014988	Viscosity of water (Kg/ms)
Ki	1.27E-10	Intrinsic Permeability (m^2)

K	0.00083316	(m/s)
K	0.002733465	(ft/s)
K	236.1714144	(ft/day)
K	1766.56218	(gpd/ft^2)

Scs(2*pi*K*b)	2499638.372
(b/(pi * rw))^2	7282.465818
(2* zi + rw)	183.62
2*(1 - cos(pi/b)*(2* zi + rw))	1.201506953
(b/(pi * rw))^2/2*(1 - cos(pi/b)*(2* zi + rw))	6061.11001
a28 ^(b/4l)	3.7632348
Γ̇ = 2 (a - rc)/L	8.021621622
Γ̇^Γ̇	17932836.75
ε = (2a - 2rc - L)/L	7.021621622
ε^ε	877734.7818
Γ̇^Γ̇/ε^ε	20.43081477
	76.88595315
LN	4.342323196
Q (gal/day)	**575,645**

	MGD	gpm	ft3/day
	0.6	400	77,476

		(gal/day/ft)	ft²/d	
T		198,915	26771.86	

Well Design Considerations

Ground Surface Elev	1161
Depth to Water	10.4
Static Water Level	1150.6
Depth to Bedrock	120
Bedrock Elevation	1038
Saturated Thickness of Aquifer	112.6
Elevation of Laterals	1059
Lowest Pumping Water Level	1069
Max Available Drawdown	81.6

APPENDIX G

March 2014 Preliminary Collector Well Design Recommendations Technical Memo

WATER MINERAL ENERGY

MEMORANDUM

TO: Steven Quail and Luca DeAngelis, HDR Engineering, Inc.
FROM: Brad Gamble, Ranney Collector Wells
RE: Preliminary Collector Well Design Recommendations
12 MGD, 15 MGD and 20 MGD designs
City of Yankton, South Dakota
DATE: March 28, 2014

Item 7 of the Scope of Services in the Subconsultant's agreement for the Yankton project includes the task of preparing a conceptual design for the proposed Paddle Wheel Point collector well caisson and laterals. This memorandum presents our preliminary design recommendations and the technical basis for these recommendations.

For the purposes of preliminary design, it is assumed that the proposed collector well will be located at the TW-1 test well location. It is understood that the expected water demand for the collector well is 2 million gallons per day (MGD) during the winter and 12 MGD during the summer. Based on the aquifer testing results, the Paddle Wheel Point site should be capable of yielding at least 20 MGD under normal conditions. Preliminary designs, are presented here for maximum sustained collector well yields of 12, 15 and 20 MGD.

Collector Well Caisson Design

In order to provide adequate room for installation of the collector well laterals and for pump installation, a 16 foot inside diameter (ID), 19 foot outside diameter (OD) caisson is recommended. This caisson diameter is satisfactory for the 12, 15 and 20 MGD designs. However, it might be advantageous to increase the caisson ID to 20 feet for the 20 MGD design.

The reported top of bedrock elevations in the borings and wells at the Paddle Wheel Point site vary from a minimum of 1024.6 feet to a maximum of 1053.3 feet. The bedrock elevation at TW-1 was reported as 1038.3 feet and the bedrock elevations reported for the wells adjacent to TW-1 (OW-2-13, OW-75P and OW-60R) vary from 1039.9 feet to 1045.9 feet. In order to ensure that the bedrock is not encountered during lateral projection, the recommended minimum centerline elevation for the laterals is 1055 feet. To facilitate lateral installation, the caisson floor elevation should be at approximately 1052 feet, 3 feet below the lateral centerline elevation. The minimum recommended plug thickness for the bottom of the caisson is 4 feet so the caisson shoe elevation should be at approximately

1048 feet, 7 feet below the minimum lateral centerline elevation. It is understood that the planned top of caisson elevation is 1168.2 feet or 2.5 feet above the high water level at this location during the 2011 flood event. This would give an overall caisson length of 120.2 feet.

Well Screen Design

The borings installed using rotasonic methods (TH-1-13, TH-2-13, TH-3-13) likely provide lithologic samples that are the most representative of the formation grain size distribution. Samples from the rotasonic boring TW-2-13 (OW-50P), the closest to the TW-1 location, show the aquifer materials to be comprised mainly of medium sand. It is generally recommended that a filter pack be installed around the well screens when the effective grain size of the 10% passing material (D_{10} size) is less than 0.25 millimeters (mm) (< 0.010 inches) and the coefficient of uniformity (D_{60}/D_{10}) is less than 3 (Williams, 1981). The D_{10} values from the TW-2-13 samples generally decrease downward from 0.33 mm to 0.24 mm, and the uniformity coefficient values are between 2.9 and 4.2. The ground surface elevation at TH-2-13 is 1160.9 feet. The recommended lateral elevation of 1055 feet is at a depth of 105.9 feet. The TH-2-13 sample submitted for grain size analysis from 100-110 feet has a D_{10} value of 0.24 mm and a uniformity coefficient value of 3.3. Given these results, it is recommended that the lateral well screens be installed with a filter pack or that pre-packed well screens, such as Johnson MuniPak screens, be utilized.

The slot sizes utilized for the collector well screens should be based on formation samples obtained during the lateral installation process. For the purposes of determining the required amount of well screen needed, it is assumed that most of the formation material will be similar to that found in the TH-2-13 10-110 foot sample. The D_{30} grain size (the effective grain size at 30% passing) in the TH-2-13 100-110 foot sample is 0.48 mm (0.019 inch). It is recommended that the D_{30} of the filter pack be 4 to 6 times the D_{30} of the formation sample and that the screen slot size be 90% of the D_{10} of the filter pack material (Williams, 1981). 4 times the D_{30} of the TH-2-13 100-110 foot sample is 1.9 mm (0.076 inch) so the filter pack should have a D_{30} of about 2 mm (0.080 inch). For a filter pack with a D_{30} of 2 mm and a uniformity coefficient of 1.5, the D_{10} size of the filter pack would be 1.7 mm. The recommended screen slot size is 90% of this value or 1.6 mm (0.060 inch).

For the purposes of determining the number and lengths of the laterals it is assumed that Johnson 10 inch by 12 inch MuniPak well screen will be utilized. This well screen has an inner and outer screen with a manufactured filter pack material between the screens. The approximate OD of the outer screen is 12.78 inches, the approximate OD of the inner screen is 10.75

inches and the approximate ID of the inner screen is 10.09 inches. The approximate ID of the screen fittings is 9.89 inches.

Ranney generally recommends a sufficient number of laterals so that the average sustained in-line water velocity within the laterals does not substantially exceed approximately 1 meter per second (m/sec) or about 3.3 feet per second (ft/sec). The in-line velocity is determined from the following equation:

$$V_l = \frac{Q}{N \times \pi \left[\frac{ID}{2}\right]^2}$$

Where: V_l = average in-line velocity (m/sec or ft/sec)
Q = pumping rate of the well (m^3/sec or ft^3/sec)
ID = inside diameter of well screen (m or ft)
N = number of laterals

Using this equation, it was determined that reasonable values for in-line velocity could be achieved using eight (8) laterals for 12 MGD, ten (10 laterals for 15 MGD and thirteen 13 laterals for 20 MGD. The average in-line flow velocity values through the minimum ID of 9.89 inches for the selected pumping rates and number of laterals are as follows:

Average In-line Flow Velocities		
12 MGD with 8 Laterals	15 MGD with 10 Laterals	20 MGD with 13 Laterals
1.33 m/s 4.35 ft/sec	1.33 m/sec 4.35 ft/sec	1.36 m/sec 4.46 ft/sec

Given that the collector well will likely not generally be operated at the maximum rates, and that the ID of the inner screen is slightly larger than the ID of the fittings, these are considered to be acceptable values for the average in-line velocities.

Williams (1981) presents a recommendation that a well be designed such that the velocity of the water approaching the well screens should be limited to the following:

$$V_a < \sqrt{K}/_{220}$$

Where: V_a = the approach velocity in feet per minute (ft/min)
K = the hydraulic conductivity in the aquifer (gal/day/ft^2)

Assuming that the hydraulic conductivity of the aquifer is 2,210 gal/day/ft^2, the recommended upper limit of the approach velocity from the equation above is 0.2 ft/min.

The minimum length of screen needed to achieve the recommended approach velocity can be determined from the following equation:

$$L_{min} = \frac{Q}{OF \times \pi \times D \times V_a}$$

Where: L_{min} = the minimum screen length (ft)
OF = open fraction of the screen accounting for joints and couplings
D = the diameter at which the approach velocity is determined (ft)
V_a = the approach velocity (ft/min)

Calculating the minimum screen lengths for the selected pumping rates for an approach velocity of 0.2 ft/min at a diameter of 16 inches (the OD of the projection pipe) and assuming that the screen couplings make up 5% of the screen length gives the following results:

Minimum Screen Length based on Approach Velocity		
12 MGD with 8 Laterals	15 MGD with 10 Laterals	20 MGD with 13 Laterals
1322 ft total 165 ft per lateral	1638 ft total 164 ft per lateral	2203 ft total 169 ft per lateral

Based on these results it is recommended that a design length for the well screens be 175 feet for the 12, 15 and 20 MGD designs to ensure that the water approach velocity does not exceed the recommended limit. It is recommended that the laterals be designed with 10 feet of blank casing at the caisson end of the laterals, giving a design lateral length of 185 feet. The 12 MGD design would have a total of 1480 feet of lateral and 1400 feet of well screen. The 15 MGD design would have a total of 1850 feet of lateral and 1750 feet of well screen, and the 20 MGD design would have a total of 2275 feet of lateral and 2405 feet of well screen.

Ranney generally recommends for collector well design that the well screen entrance velocity be limited to 1.0 ft/min assuming no blockage of the well screen slot openings. For a slot opening of 0.060 inches, the Johnson MuniPak screen has an open area of 46% or 1.29 ft^2 per foot of screen. The screen entrance velocity is given by the equation:

$$V_e = \frac{Q}{A \times L \times OF}$$

Where: V_e = the screen entrance velocity (ft/min)
Q = the pumping rate (ft^3/min)
A = screen open area (ft^2/ft)
L = total length of well screen (ft)
OF = open fraction of the screen accounting for joints and couplings

Assuming that the screen couplings make up 5% of the screen length, with 0.060 inch slot screen the average entrance velocity values for the selected pumping rates and recommended screen lengths are as follows:

Screen Entrance Velocity		
12 MGD 1400 ft screen	15 MGD 1750 ft screen	20 MGD 2275 ft screen
0.65 ft/min	0.65 ft/min	0.67 ft/min

These results indicate that the criteria for screen entrance velocity can be met with the recommended screen lengths even if somewhat smaller screen slot openings need to be utilized to match the formation materials.

For the 12 MGD design, it is recommended that the 8 laterals be oriented at radial spacings of 30° so that they are within an arc of 210° around the circumference of the collector well caisson as depicted in Figure 1. The middle laterals should be placed on the river side of the caisson. This orientation will help to maximize the collector well yield and enhance the quality of the water produced from the collector well. It is recommended that 2 spare ports be installed on the landward side of the caisson which could be utilized if there is difficulty in installing one or more of the other laterals.

For the 15 MGD design, it is recommended that the 10 laterals be oriented at radial spacings of 30° so that they are within an arc of 270° around the circumference of the collector well caisson as depicted in Figure 2. There is room for 2 spare ports on the landward side of the caisson installed at the same 30° radial spacing.

For the 20 MGD design, there is insufficient room around the perimeter of the caisson to install all 13 laterals on the same level. For the preliminary design it is recommended that the laterals be installed in two tiers with a minimum vertical separation of 4 feet between the upper and lower tiers. It is recommended that 7 of the laterals be placed on a lower tier with a

centerline elevation of 1055 feet. The remaining 6 laterals be should be placed in an upper tier at an elevation of 1059 feet. It is recommended that the laterals be oriented at radial spacings of 40°. At this spacing, the lower tier of 7 laterals are within an arc of 240° around the circumference of the collector well caisson as depicted in Figure 3. The ports for the upper tier are rotated 20° from the lower tier laterals so that in plan view the upper tier laterals are half way between the lower tier laterals. It is recommended that 2 spare ports be installed on the landward side of the caisson in the upper tier of laterals.

When the collector well would be operated below the maximum design rates, it is possible that there could be some improvement in water quality by closing off laterals on the side of the caisson away from the river. The river water quality is generally better than the ambient ground water quality. Utilizing the laterals closest to the river could help increase the proportion of water derived from the river that is produced by the collector well. With the recommended design, 2 laterals are sufficient to produce 2 MGD without exceeding the recommended design criteria for approach, entrance and in-line velocities.

Opinion of Collector Well Construction Costs

The basis for an opinion of probable cost of a horizontal collector well designed for 12 MGD is as follows:

Caisson ID	16 feet
Caisson OD	19 feet
Grade elevation	1161.3 ft (near TW-1)
Cutting Shoe Elevation	1048 ft
Top of Caisson	1168.2 ft
Overall Length	120.2 feet
Number of Ports	10
Number of Laterals	8
Lateral Design	10-inch by 12-inch stainless steel wire-wrapped MuniPak, with glass beads
Average lateral Length	185 feet
Total screen footage	1400 lineal feet
Total lateral footage	1480 lineal feet
3-day performance test at 12 MGD	

The basis for an opinion of probable cost of a horizontal collector well for a yield of 15 MGD is as follows:

Caisson ID	16 feet
Caisson OD	19 feet

Grade elevation	1161.3 ft (near TW-1)
Cutting Shoe Elevation	1048 ft
Top of Caisson	1168.2 ft
Overall Length	120.2 feet
Number of Ports	12
Number of Laterals	12
Lateral Design	10-inch by 12-inch stainless steel wire-wrapped MuniPak, with glass beads
Average lateral Length	185 feet
Total screen footage	1850 lineal feet
Total lateral footage	1750 lineal feet
3-day performance test at 15 MGD	

The basis for an opinion of probable cost of a horizontal collector well for a yield of 20 MGD is as follows:

Caisson ID	16 feet
Caisson OD	19 feet
Grade elevation	1161.3 ft (near TW-1)
Cutting Shoe Elevation	1048 ft
Top of Caisson	1168.2 ft
Overall Length	120.2 feet
Number of Ports	15
Number of Laterals	13
Lateral Design	10-inch by 12-inch stainless steel wire-wrapped MuniPak, with glass beads
Average lateral Length	185 feet
Total screen footage	2275 lineal feet
Total lateral footage	2405 lineal feet
3-day performance test at 20 MGD	

Estimated present-day costs to construct the caisson, install and develop the laterals and complete a 3-day performance test at the design rates are as follows:

Opinion of Probable Cost		
12 MGD	15 MGD	20 MGD
$2,500,00	$2,900,000	$3,500,000

These cost estimates are based upon pricing of recent similar horizontal collector wells and knowledge of general site conditions. Costs do not include bonding and assumes the access road is completed by others.

Reference:

Williams, E.B., 1981. Fundamental Concepts of Well Design, *Ground Water*, Volume 19, Number 5, pages 527-542.

Attachments:
Figures 1, 2 and 3



Layne Ranney Collector Wells

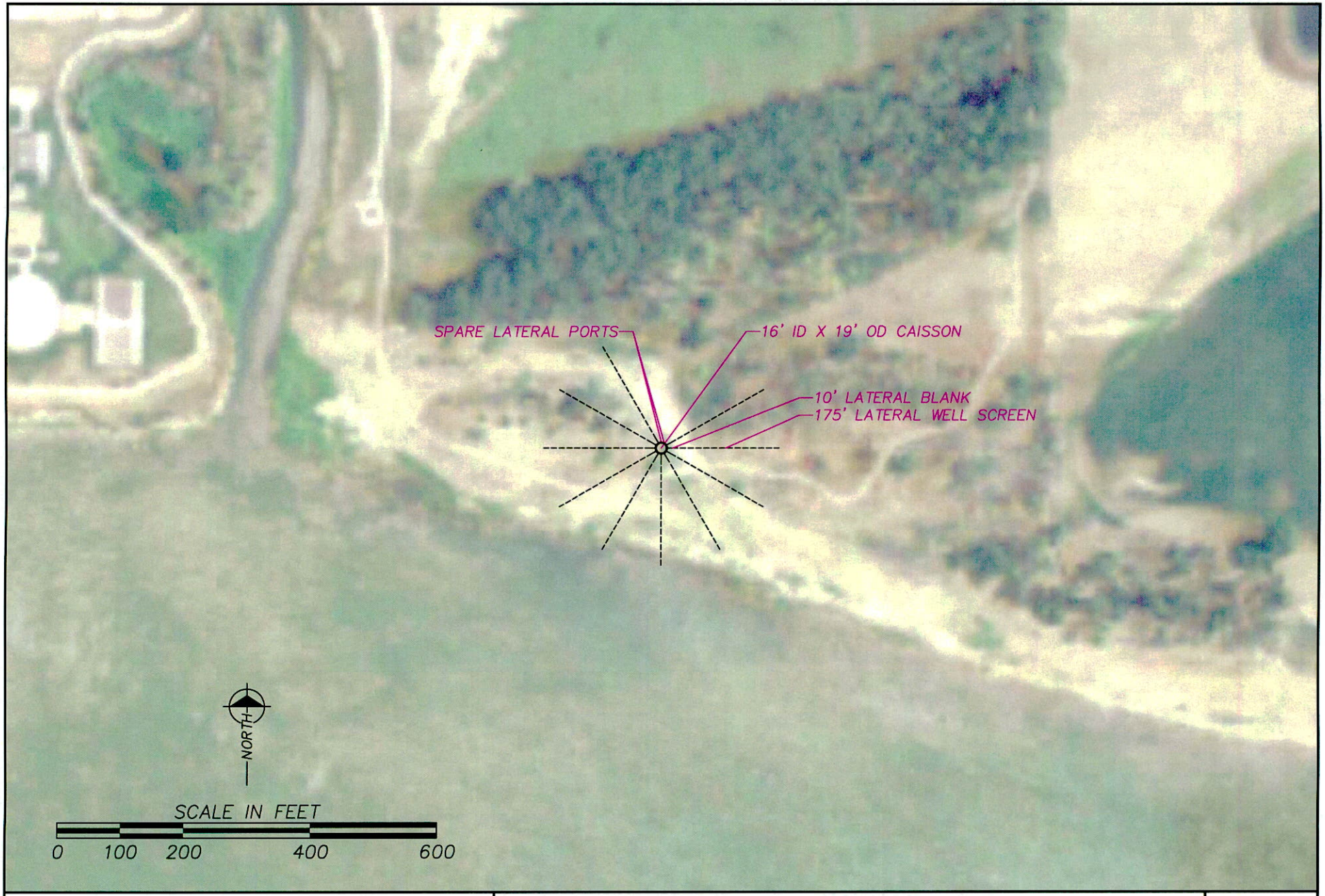
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PRELIMINARY COLLECTOR WELL LATERAL ORIENTATION – FOR 12 MGD

PADDLE WHEEL POINT SITE
CITY OF YANKTON, SOUTH DAKOTA

FIGURE 1

PROJECT NUMBER	DATE	FILE NAME	SCALE
27651	03/26/2014	27651-02	1" = 200'



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PRELIMINARY COLLECTOR WELL LATERAL ORIENTATION – FOR 15 MGD

PADDLE WHEEL POINT SITE
CITY OF YANKTON, SOUTH DAKOTA

FIGURE 2

PROJECT NUMBER	DATE	FILE NAME	SCALE
27651	03/26/2014	27651-02	1" = 200'



Layne
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PRELIMINARY COLLECTOR WELL LATERAL ORIENTATION – FOR 20 MGD

PADDLE WHEEL POINT SITE
CITY OF YANKTON, SOUTH DAKOTA

FIGURE 3

PROJECT NUMBER	DATE	FILE NAME	SCALE
27651	03/26/2014	27651-03	1" = 200'

APPENDIX H

March 2014 Collector Well Water Quality Modeling Report

DRAFT

Water Quality Modeling Report
Collector Well Investigation
City of Yankton, South Dakota

PREPARED BY

Layne Heavy Civil
Columbus, Ohio

Layne®
Ranney Collector Wells

PREPARED FOR

HDR ENGINEERING, INC.

SIOUX FALLS, SOUTH DAKOTA

MARCH 28, 2014

TABLE OF CONTENTS

PAGE

1 INTRODUCTION 1

1.1 SCOPE OF WORK 1

1.2 LIMITATIONS 1

2 WATER QUALITY DATA 1

3 ESTIMATING RIVER CONTRIBUTION TO WELL PRODUCTION 3

4 GEOCHEMICAL MODELING 5

5 SUMMARY AND CONCLUSIONS 8

6 REFERENCES 9

LIST OF FIGURES (REAR OF REPORT)

FIGURE 1 – Mean Daily River Water Temperatures – Missouri River at Yankton, South Dakota

FIGURE 2 – Dissolved Oxygen Content with Respect to Water Temperature – Missouri River at Yankton, South Dakota

FIGURE 3 – Missouri River Hardness – Missouri River Gavins Point and Yankton, South Dakota

FIGURE 4 – Potentiometric Surface Map – Non-Pumping Conditions December 16, 2013

LIST OF TABLES (REAR OF REPORT)

TABLE 1 – Water Quality Data

TABLE 2 – Estimated Representative Water Quality Data for Geochemical Modeling

TABLE 3 – PHREEQC Water Chemistry Modeling Results - TOC as a Non-Reactive Compound

TABLE 4 – PHREEQC Water Chemistry Modeling Results - TOC as CH_2O

TABLE 5 – PHREEQC Saturation Index Results - TOC as a Non-Reactive Compound

TABLE 6 – PHREEQC Saturation Index Results - TOC as CH_2O

LIST OF APPENDICES (REAR OF REPORT)

APPENDIX A – PHREEQC Input files

1 INTRODUCTION

Ranney Collector Wells (Ranney), a division of Layne Heavy Civil (Layne) was contracted to assist HDR Engineering, Inc. (HDR) in the siting studies for a potential collector well for the City of Yankton, South Dakota. The studies focus on an area within South Dakota and adjacent to the Missouri River referred to as Paddle Wheel Point.

1.1 SCOPE OF WORK

Task 6 of the Description of Subconsultant's Services is an evaluation of extracted water quality from the collector well at various mixing ratios of Missouri River water and ambient ground water. The evaluation includes use of an aqueous geochemical model (PHREEQC) to look at concentrations water quality parameters including hardness, sulfate, iron, and manganese under various mixing scenarios as determined by evaluation of the aquifer testing results.

1.2 LIMITATIONS

This report was prepared for the exclusive use of HDR and the City of Yankton, South Dakota. This report was prepared for the specific application of developing a ground water supply using horizontal collector well technology. Ranney makes no warranty, whether expressed or implied, as to the actual water supply or quality available. Conclusions reached in this report are based upon the objective data made available to Ranney at the time this work was performed and the accuracy of the report depends upon the accuracy of these data. Ranney's responsibility is to apply its hydrogeology expertise, and collector well experience to provide an opinion regarding the development of water supplies of adequate capacity from horizontal collector wells developed in the alluvial aquifer along the Missouri River.

2 WATER QUALITY DATA

The water quality data utilized for the geochemical modeling were based on data obtained from the preliminary HDR collector well investigation report (HDR, June 2013), from data provided by HDR from the December 2013 aquifer testing activities and from other available sources. The June 2013 HDR report presented ground water quality from samples obtained at test holes TH-1-13, TH-2-13 and TH-3-13 and also presented estimates of the major anion and cation concentrations in the Missouri River. Historical Missouri River water quality data were also obtained from the U.S. Geological Survey (USGS, 2014), and from a Master of Science thesis prepared by Brittni Stephens-Yates (2012).

During the December 2013 aquifer testing activities, water samples were obtained from the test pumping well (TW-1) and from the Missouri River. Laboratory analysis was conducted on samples obtained from TW 1 for selected metals, alkalinity, sulfate, pesticides, volatile organic compounds, disinfection byproducts, total and calcium hardness, total and dissolved organic carbon, total and dissolved iron and total and dissolved manganese. Samples from TW-1 were analyzed in the field for pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential (ORP). The

samples from the Missouri were analyzed in the field for specific conductance, dissolved oxygen, and ORP, and were also analyzed for dissolved iron, dissolved manganese and dissolved organic carbon. The water quality data obtained from the preliminary HDR report and from the December 2013 aquifer testing activities are summarized in Table 1. The ground water and surface water data were evaluated to determine representative values for the water quality parameters utilized as input for the geochemical model. The selected representative values are presented in Table 2.

The water quality data obtained during the aquifer testing activities provides information on the background ground water quality and information on the river water quality at the time of the testing. Data from other sources was utilized to determine how the river water quality changes on a seasonal basis. Dissolved oxygen concentrations, water temperature, specific conductance data for the Missouri River for the period from March 2006 through September 2009 are available from the USGS river gage station 06467500 located at Yankton about ¾ mile upstream of the Paddle Wheel Point site. Water temperature data is available for this station for some dates after 2009. Figure 1 shows the available Missouri River water temperature data from March 2006 to the beginning of 2014. As shown in Figure 1, the river water temperature varies seasonally from near freezing in the winter to over 80° F in the summer. Based on data from this gage for the period from 2006 to 2011 the average water temperature for the winter months is 32.3° F (0.2° C), and the average water temperature for the summer months is 74.2° F (23.4° C).

Dissolved oxygen concentrations are dependent on water temperature with colder water able to contain more dissolved oxygen than warmer water. The relation between water temperature and dissolved oxygen in the Missouri River at Yankton is shown in Figure 2. Also plotted on Figure 2 are the Missouri River dissolved oxygen measurements with respect to the temperature measurements that were made during the December 2013 aquifer testing. As shown, the dissolved oxygen concentrations from the aquifer testing are consistent with the river gage data with the exception of a measurement from December 19th that had a dissolved oxygen concentration of 7.89 milligrams per liter (mg/l) at a water temperature of 1.4° C (34.6° F). The average of the December 2013 river dissolved oxygen measurements, excluding the 12/19 measurement, is 13.3 mg/l, and this value is considered to be representative of the winter dissolved oxygen concentration. Based on the data shown in Figure 2, a value of 8.0 mg/l is considered to be representative of the river dissolved oxygen concentration during the summer months.

Water hardness data from Stephens-Yates (2012) for the Missouri River at Gavins Point and from the Yankton intake raw water are presented in Figure 3. As shown, the total hardness in the Missouri River typically varies from about 200 to 300 mg/l as calcium carbonate ($CaCO_3$). Data from other sites indicates that the river hardness concentrations tend to vary seasonally with higher hardness values more likely during the winter months and lower hardness values more likely during the summer months. The hardness concentration for the Missouri River from the 2013 HDR report of 278 mg/l total hardness and 188 mg/l calcium hardness are considered to be representative of the typical winter hardness

values. Based on the data depicted in Figure 3, a value of 240 mg/l as total hardness is considered to be a conservative estimate of the typical Missouri River total hardness during the summer months.

To estimate the typical summer concentrations of the other parameters used in the geochemical model, it was assumed that the concentrations of the other parameters, except sodium and dissolved oxygen, would vary proportionally with the change in the total hardness concentration (from 278 mg/l to 240 mg/l). As discussed above, the dissolved oxygen for summer conditions was assumed to be 8.0 mg/l. With the other parameters adjusted proportionally, the geochemical model was used to estimate a sodium concentration that would give a charge balance between the anions and cations in the input parameters. This resulted in a sodium concentration of 40 mg/l, whereas if the sodium concentration was adjusted proportionally to the hardness it would have been assigned a concentration of 60 mg/l.

The ground water dissolved oxygen concentrations measured in the field from well TW-1 appear anomalously high given the dissolved iron and manganese concentrations in the samples. For the geochemical modeling, it was assumed that there was no dissolved oxygen in the ground water and that the iron was in a reduced state. Oxidation-reduction potential (ORP) was measured in the field during the December 2013 aquifer testing activities. Values of pe (negative log of the activity of electrons in the solution) were calculated based on the measured ORP values and these pe values were used for the initial input for the geochemical models. However, the model calculated pe values are substantially different than the field determined values. Because OPR is known to be difficult to accurately measure in the field, it was decided to utilize the model determined pe values for model input for subsequent geochemical model runs.

3 ESTIMATING THE RIVER CONTRIBUTION TO WELL PRODUCTION

A well located in an alluvial aquifer adjacent to a river will produce water that is a mixture of water that has been in the aquifer as ground water for a considerable period of time and water derived from induced infiltration from the river that has been in the aquifer for only a short period of time. The water obtained from induced infiltration will have quality that approaches the river water quality. In order to determine the water quality produced from the well, it is necessary to determine the proportion of water from ground water and the proportion derived from river water.

For the geochemical modeling, two different scenarios for the collector well production were evaluated:

- Winter conditions with a pumping rate of 2 million gallons per day (MGD); and
- Summer conditions with a pumping rate of 12 MGD.

The amount of water moving through a specified width of an aquifer can be determined from Darcy's Law as follows:

$$Q = T * I * W$$

Where:

Q = the flow rate through the aquifer (gallons per day)
T = the aquifer transmissivity (gallons per day per foot, gpd/ft)
I = the hydraulic gradient in the aquifer (feet/feet)
W = the width of the aquifer being considered (feet)

Figure 4 depicts the potentiometric surface at the aquifer test site under non-pumping conditions on December 16, 2013. From the location of wells OW-3-13 to OW-150P there is a change in head of 0.5 foot over a distance of 205 feet giving a hydraulic gradient of 0.002 ft/ft. The aquifer transmissivity based on the results of the aquifer pumping test is approximately 232,000 gpd/ft. Given a pumping rate of 2 MGD, it is estimated that the width of the aquifer away from the river that would contribute water to the well is approximately 1,600 feet, and given a pumping rate of 12 MGD it is estimated that the width of the aquifer away from the river that would contribute water to the well is approximately 2,300 feet. Using these values and the above equation, it is estimated that the amount of ground water that would enter the collector well would be as follows:

Q = 232,000 gpd/ft * 0.002 ft/ft * 1,600 ft = 905,560 gpd = 629 gallons per minute (gpm)

Q = 232,000 gpd/ft * 0.002 ft/ft * 2,300 ft = 1,301,740 gpd = 904 gallons per minute (gpm)

The proportion of the water produced from the well that is derived from ground water at pumping rates of 2 MGD and 12 MGD would be as follows:

For 2 MGD: 905,560 gpd / 2,000,000 gpd = 0.45
45% derived from ground water and 55% derived from river water

For 12 MGD: 1,301,740 gpd / 12,000,000 gpd = 0.11
11% derived from ground water and 89% derived from river water

Based on these results, for the purposes of the geochemical modeling, it is assumed that at a pumping rate of 2 MGD the sources of the water from the proposed collector well will be in the ranges of:

40% ground water and 60% river water; to
60% ground water and 40% river water.

At a pumping rate of 12 MGD it is assumed that the sources of the water from the proposed collector well will be in the ranges of

10% ground water and 90% river water; to
30% ground water and 70% river water.

These proportions are consistent with observed water quality from wells in production that are installed in the alluvial aquifer along the Missouri River and at other similar locations.

4 GEOCHEMICAL MODELING

The U.S. Geological Survey aqueous geochemical model PHREEQC version 3.1.1 was utilized for the geochemical modeling for the proposed Yankton collector well. PHREEQC is a computer program for simulating chemical reactions and transport processes in natural or contaminated water (Parkhurst, D.L., and Appelo, C.A.J., 2013).

The specific water quality parameters evaluated by the geochemical modeling include:

- temperature;
- pH;
- total dissolved solids (TDS);
- total and calcium hardness;
- alkalinity;
- sulfate;
- iron;
- manganese; and
- total organic carbon (TOC).

PHREEQC was utilized to evaluate simple mixing models of the ground water and river water. The mixing models calculate the theoretical equilibrium concentrations of the combined constituents included in the input parameters. The mixing models do not consider reactions between the water and solid components of the aquifer and do not consider the time that it takes for the water to move through the aquifer or time that it might take for the equilibrium concentrations to be reached. The mixing models also do not consider that the river water quality changes gradually over the seasons. The scenarios for which the mixing models were performed are as follows:

- winter conditions with the collector well pumping rate at 2 MGD
    - 40% ground water to 60% river water
    - 60% ground water to 40% river water
- summer conditions with the collector well pumping rate at 12 MGD.
    - 10% ground water to 90% river water
    - 30% ground water to 70% river water

The PHREEQC input values (Table 2) utilized the representative ground water concentrations based on the samples obtained from the test pumping well and observation wells at the site for both the winter and summer scenarios. The representative river water concentrations for the winter scenarios were based on the available data and sampling data obtained during the aquifer testing. The representative river water concentrations for the summer scenarios were estimated based on the assumed reduction in hardness as discussed in Section 2. The PHREEQC input files utilized for the mixing models are presented in Appendix A.

Total organic carbon (TOC) was modeled in two different ways in the mixing models. Organic carbon in the river water could be in the form of complex compounds such as humic and fulvic acids that have very large molecular weights and contain hydrogen, oxygen, nitrogen and sulfur in addition to carbon. It is difficult to predict how such compounds might react as they move through the aquifer. The first modeling approach used in the mixing models was to enter the TOC as a non-reactive compound. This represents the most conservative estimate of the amount of TOC that could move from the river to the well. The second modeling approach was to add the simple compound CH_2O as an analog for the TOC. The CH_2O was added as a reactant so that the moles of carbon in the CH_2O were equivalent to the moles of carbon in the TOC for the representative input concentrations. In this modeling approach the CH_2O can react with the other constituents in the water mixtures and can be decomposed by oxidation reactions. Neither modeling approach considers potential reactions between the TOC and solid components of the aquifer, nor do they consider the amount of time that might be needed for chemical equilibrium to be reached.

The PHREEQC mixing model results with TOC as a non-reactive compound are presented in Table 3. With the exception of pH, these mix results are all the simple proportional combinations of the ground water and river water input values. The initial ground water concentrations exceed the secondary maximum contaminant levels (SMCLs) for TDS (SMCL = 500 mg/l), iron (SMCL = 0.3 mg/l), manganese (SMCL = 0.05 mg/l) and sulfate (SMCL = 250 mg/l). SMCLs are set primarily for aesthetic reasons (issues of taste, odor, appearance, staining) and are not generally associated with health effects. The initial river water concentrations do not exceed the SMCLs for TDS, iron, and sulfate, but the manganese in the river water exceeds the SMCL. The mixtures show that the water quality produced by the collector well would be better than the initial ground water concentrations, but would still exceed SMCLs for TDS, iron, manganese and sulfate. The 12 MGD summer conditions scenario result has an estimated sulfate concentration slightly above the SMCL at 252 mg/l and TDS slightly above the SMCL at 540 mg/l. One item of note in the simulations with TOC as a non-reactive compound is that the resulting mixtures contain dissolved oxygen. This results in the iron being present in an oxidized state (ferric iron with valence +3). In this form, the iron would be insoluble and would precipitate in the aquifer. If chemical equilibrium was reached, the water from the collector well would not contain dissolved iron.

The PHREEQC mixing model results with TOC as a reactive compound are presented in Table 4. These results indicate that the TOC is not in chemical equilibrium with the other components included as input parameters. This is especially true with regard to the dissolved oxygen and TOC in the river water. The dissolved oxygen concentrations in the river water exceed the amounts needed to oxidize all of the TOC. This suggests that there is a continuous source of TOC to the river and/or that the organic carbon is in a form that does not oxidize quickly enough for equilibrium conditions to be reached. In the mixing model results with TOC as a reactive compound, at equilibrium all of the TOC is converted to carbon dioxide or carbonates. In the summer scenarios, which have lower initial dissolved oxygen concentrations, and in the winter scenario with 60% ground water, all of the dissolved oxygen is consumed in the reaction with the TOC. In these instances, the iron is present in the reduced form (ferric iron with valence +2), and the iron would remain soluble, and would be present as dissolved iron in the water produced from the

collector well. In the winter scenario with 40% ground water, the model result shows that there is 0.8 mg/l dissolved oxygen and the iron is in the oxidized form.

The model results do not include potential interactions with solid phase components in the aquifer or microbial induced water quality changes. The PHREEQC results indicate the model calculated equilibrium conditions and do not include the time that might be necessary to reach equilibrium conditions. The model results also do not account for the potential for bacteria to affect the water quality. It is likely that the actual chemical quality of the water produced by the collector well will be intermediate between the solutions with TOC non-reactive and TOC reactive. There will likely be some oxidation of organic matter as it moves through the aquifer and subsequent reduction in dissolved oxygen concentrations. Alternatively, there might be components in the aquifer that are subject to oxidization that are not accounted for in the model. These components could consume oxygen and reduce the amount of organic carbon that can be oxidized and could also affect the oxidation state of components such as iron.

The PHREEQC results include calculated saturation indices (SI) for a number of mineral types. The SI values indicate whether or not the water composition is potentially in chemical equilibrium with the minerals. If the SI value for a mineral is less than 0 and the mineral is present in the aquifer, the mineral could dissolve, but not precipitate. If the SI value is greater than 0, the mineral could precipitate, but not dissolve. If the SI value is approximately 0, the mineral could dissolve or precipitate to maintain equilibrium. A mineral cannot dissolve if it is not present in the aquifer materials. The SI values calculated by the PHREEQC mixing models assuming TOC is non-reactive are presented in Table 5, and the SI values calculated by the PHREEQC mixing models assuming TOC is reactive are presented in Table 6. The SI values for calcite ($CaCO_3$) and iron hydroxide ($Fe(OH)_3$) give some indication of the potential for lime and iron to precipitate from the water produced by the collector well. This is of concern because of the potential for lime and iron to precipitate in the slot openings of the well screens and reduce the well efficiency. For all of the scenarios except the summer conditions with 90% river water and reactive TOC, the calculated SI values for calcite are positive, varying from 0.08 to 0.37, indicating a potential for lime precipitation. For the scenario with summer conditions, 90% river water and reactive TOC, the calcite SI value is -0.03, which indicates that the water is close to equilibrium for this mineral with a slight potential for calcite to dissolve. The SI values for iron hydroxide are positive, varying from 2.78 to 4.14, for all of the scenarios which result in some dissolved oxygen remaining in the water produced from the collector well. This includes all of the scenarios that assume non-reactive TOC and the winter conditions 60% river water with reactive TOC. Under these scenarios there is the potential for iron to precipitate from the water from the collector well. For the other scenarios with reactive TOC that indicate all of the dissolved oxygen being consumed, the SI values for iron hydroxide are negative, varying from -4.58 to -5.21. Under these scenarios iron would not be likely to precipitate from the water from the collector well.

5 SUMMARY AND CONCLUSIONS

Ranney Collector Wells was contracted to assist HDR Engineering, Inc. (HDR) in the siting studies for a potential collector well for the City of Yankton, South Dakota. The studies focus on the Paddle Wheel Point site adjacent to the Missouri River. Water produced from a well at this location would be a mixture of the background ground water and water derived from induced infiltration from the river. To estimate the water quality of this mixture of water, Ranney utilized the geochemical model PHREEQC to calculate equilibrium concentrations of selected water quality components.

HDR obtained water samples from observation wells and a test pumping well at the Paddle Wheel Point site and from the Missouri River. The analysis results from these samples and data from additional sources were utilized to determine representative concentrations for the water quality components that were utilized as inputs for the PHREEQC model.

Based on the aquifer parameters determined from the detailed aquifer testing conducted by HDR and the non-pumping hydraulic gradient, estimates were made on the proportions of ground water and river water that would be produced from the proposed collector well. Estimates were made for the assumed winter pumping rate of 2 MGD and the assumed summer pumping rate of 12 MGD. At the 2 MGD pumping rate it is estimated that 40% to 60% of the water produced from the collector well would be derived from river water. At the 12 MGD pumping rate it is estimated that 70% to 90% of the water from the collector well would be derived from river water.

PHREEQC model runs were conducted for the expected ranges of source water mixtures for winter and summer conditions and also with TOC as a non-reactive component and as a reactive component of the water. The results of all of the modeled scenarios indicate that the induced infiltration of river water results in a substantial improvement in the quality of the water that would be produced from the collector well. However, the results indicate that the water from the collector well would likely still exceed the SMCLs for TDS, manganese and sulfate. The results indicate that the iron concentrations in the water produced from the collector well could be affected by the reaction between the dissolved oxygen and the TOC. If the oxygen is not consumed by reaction with the organic carbon, the iron could be oxidized and precipitate out of the water, resulting in low iron concentrations in the water produced from the collector well. If the oxygen is depleted by reaction with the TOC (or other oxidizable components in the aquifer), iron could be present in the water produced by the collector well at concentrations that would exceed the SMCL.

The SI values from the PHREEQC model runs indicate that there would likely be some potential from lime precipitation from the water produced by the collector well. The SI results indicate that the potential for iron precipitation will depend on the dissolved oxygen concentration in the water produced from the collector well.

The PHREEQC model results represent the theoretical equilibrium concentrations of the constituents included in the input parameters. The model results do not consider the time that might be required for equilibrium conditions to be reached. The model results also do not include potential interactions

between the water and solid components of the aquifer, nor do they include potential bacterial interactions with the water.

6 REFERENCES

HDR Engineering, Inc., June 2013. City of Yankton Collector Well Investigation Report at Paddle Wheel Point, Prepared for: the City of Yankton, South Dakota, Prepared by: HDR Engineering, Inc., Sioux Falls, South Dakota.

Parkhurst, D.L., and Appelo, C.A.J., 2013. Description of input and examples for PHREEQC version 3—A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations: U.S. Geological Survey Techniques and Methods, book 6, chap. A43, 497 p., available at http://pubs.usgs.gov/tm/06/a43.

U.S. Geological Survey (USGS), 2014. Internet Web Site: USGS 06467500 MISSOURI R AT YANKTON, SD, http://waterdata.usgs.gov/nwis/nwisman/?site_no=06467500&agency_cd=USGS, accessed 3/18/2014.

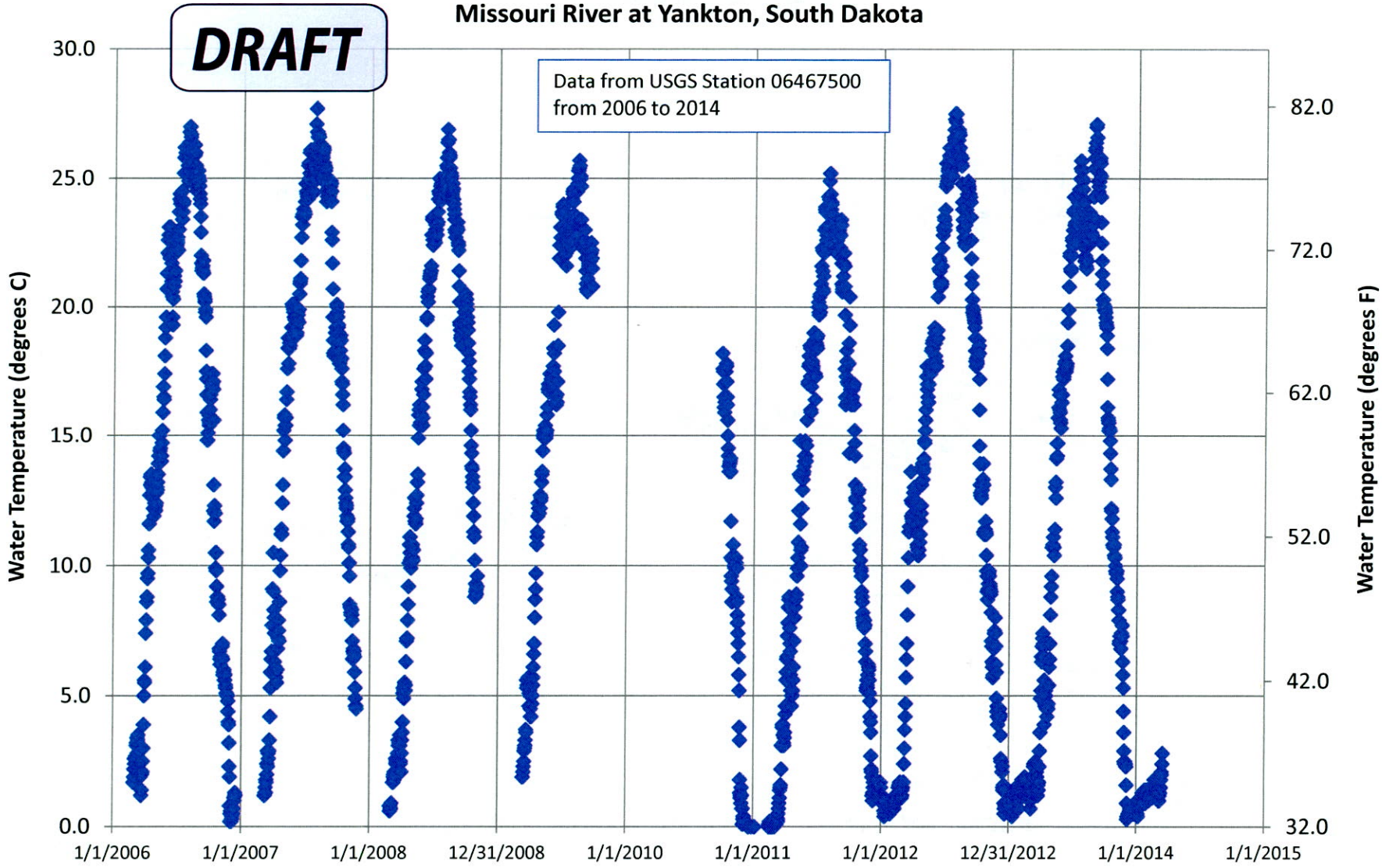
Stephens-Yates, Brittni, 2012. Impacts of DBP Precursor Removal and Disinfection Modifications on D/DBP Rule Compliance at Missouri River Water Treatment Facilities, A thesis for the degree Masters of Science Major in Civil Engineering, South Dakota State University.

FIGURES

FIGURE 1

Mean Daily River Water Temperatures

Missouri River at Yankton, South Dakota



File: Missouri River DO SC at Yankton SD.xlsx Print Date: 3/21/2014

FIGURE 2

Dissolved Oxygen Content with Respect to Water Temperature
Missouri River at Yankton, South Dakota

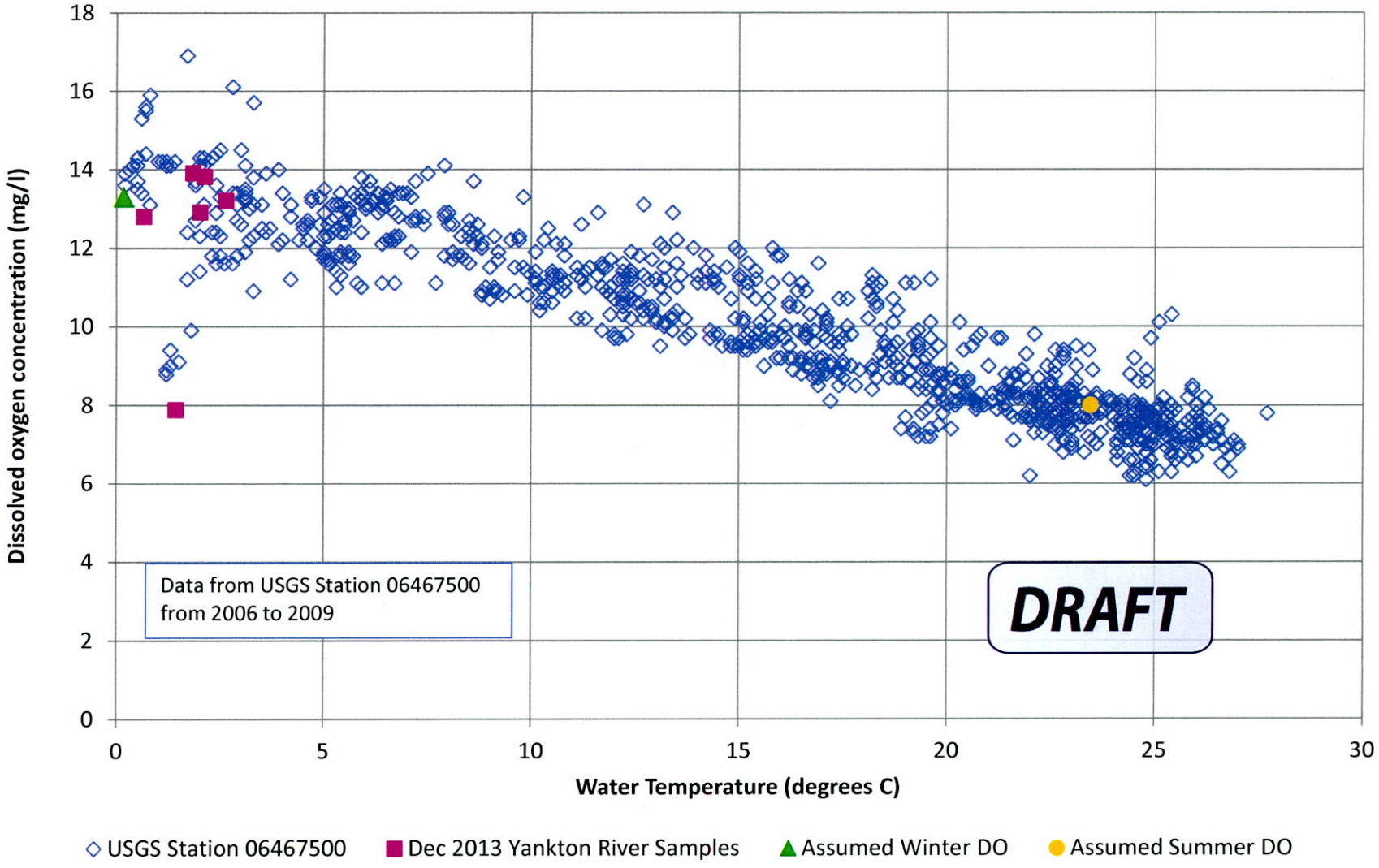
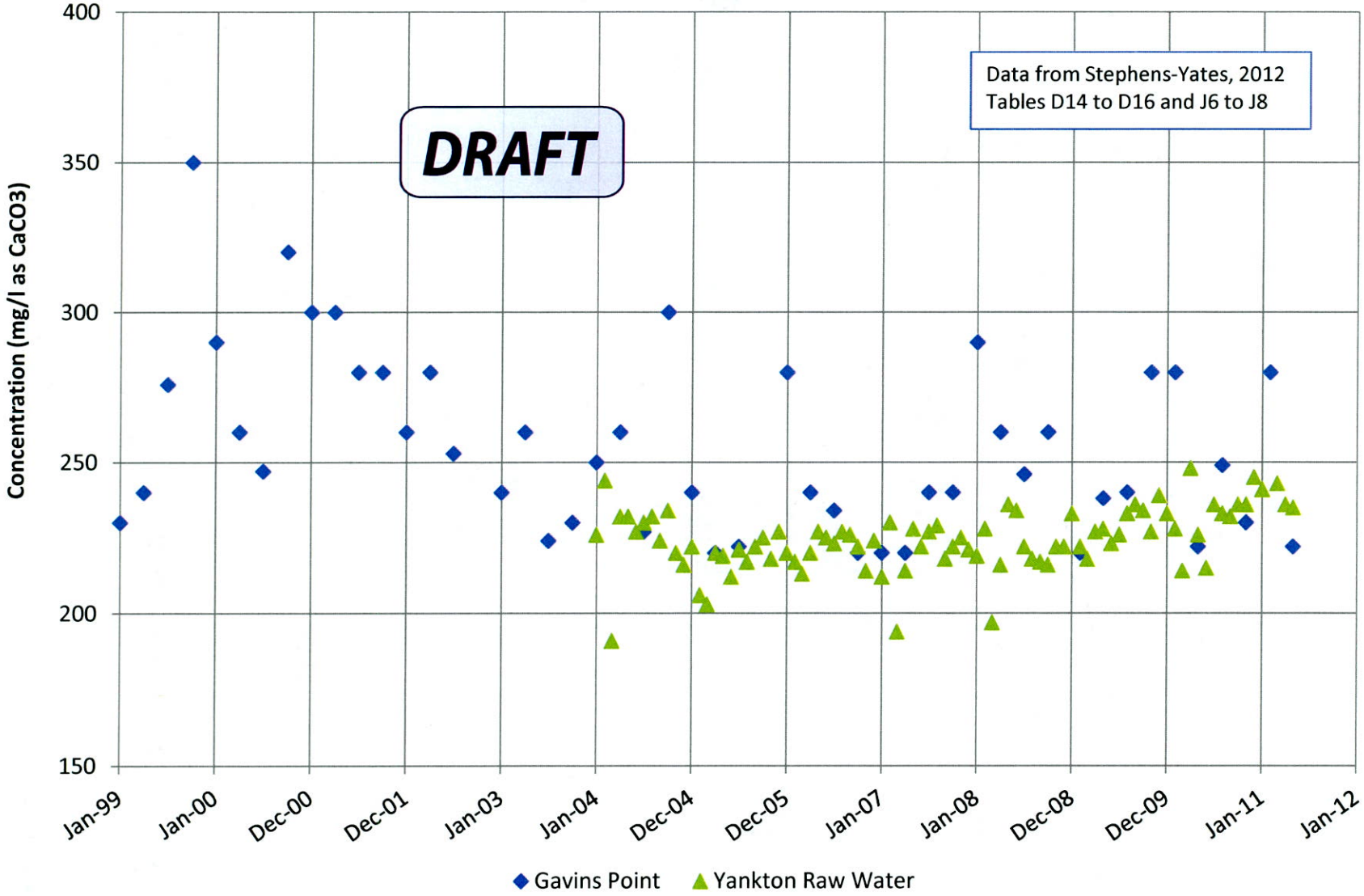


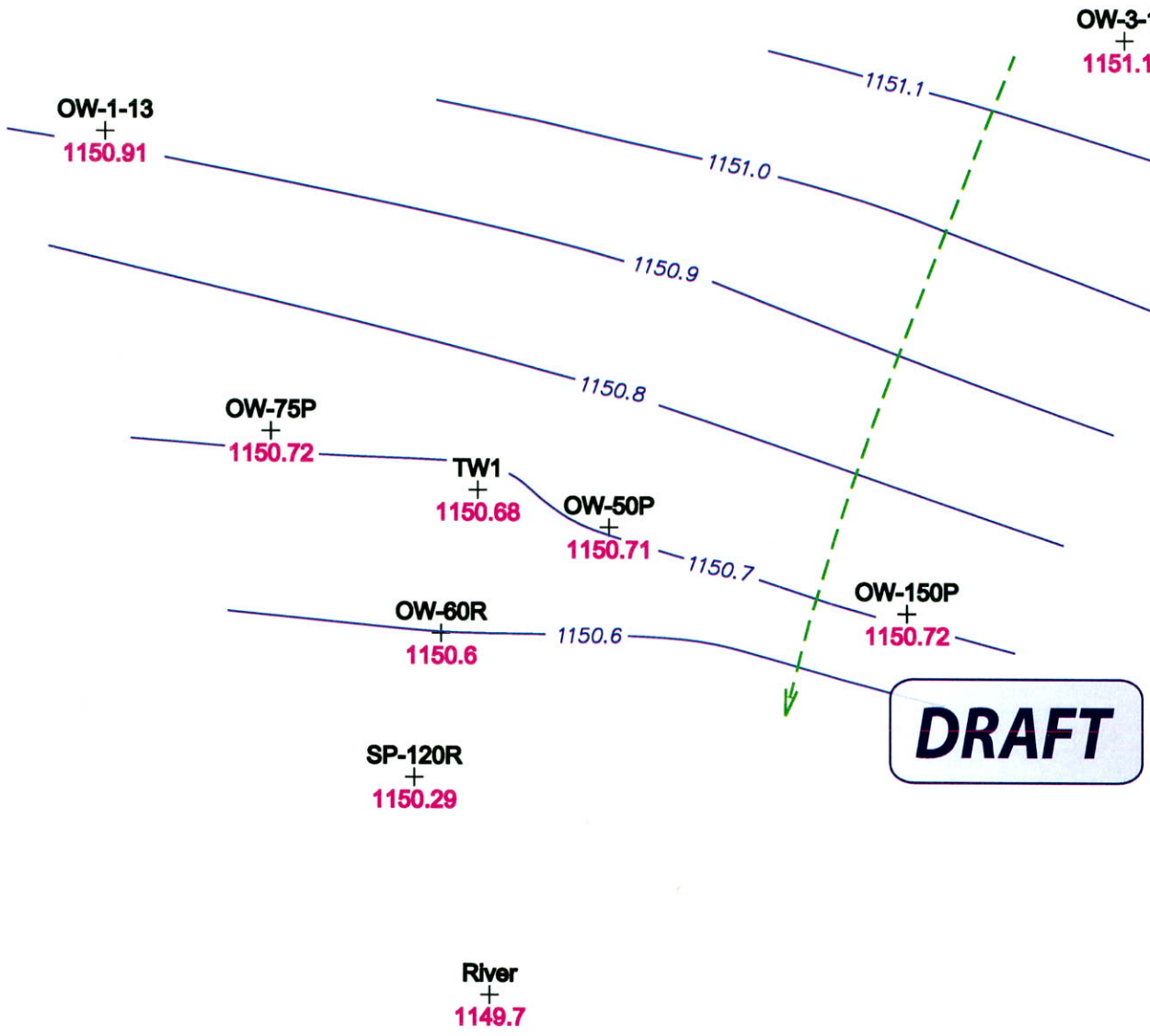
FIGURE 3

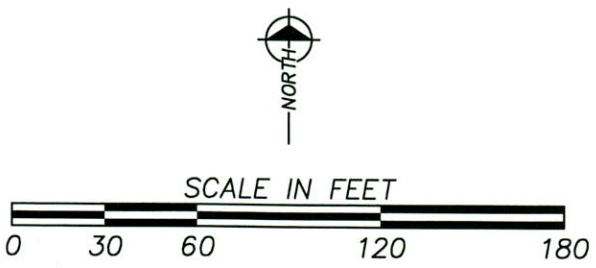
Missouri River Hardness

Missouri River at Gavins Point and Yankton, South Dakota



File: Missouri River WQ Data.xlsx Print Date: 3/21/2014





LEGEND:

OW-1-13	WELL LOCATION AND ID NUMBER
1150.91	WATER ELEVATION (FEET)
—1150.6—	POTENTIOMETRIC SURFACE CONTOUR (CONTOUR INTERVAL 0.1 FOOT)
← - - -	FLOW LINE

Layne Ranney Collector Wells
6360 HUNTLEY RD
COLUMBUS, OHIO 43229
(614) 888-6263 / FAX (614) 888-9208

POTENTIOMETRIC SURFACE MAP

NON-PUMPING CONDITIONS DECEMBER 16, 2013
PADDLE WHEEL POINT SITE
CITY OF YANKTON, SOUTH DAKOTA

FIGURE 4

PROJECT NUMBER	DATE	FILE NAME	SCALE
27651	03/19/2014	27651-01	1" = 60'

TABLES

TABLE 1

Water Quality Data

City of Yankton, South Dakota Collector Well Investigation

DRAFT

Parameter	unit	Ground Water Quality						River Water Quality			
		TH-1-13 (HDR Report Table 5)	TH-2-13 (HDR Report Table 5)	TH-3-13 (HDR Report Table 5)	TW-1 (Dec-2013 Aquifer Testing)			Missouri River (HDR Report Table 6)	Missouri River (Dec-2013 Aquifer Testing)		
					Minimum	Maximum	Average		Minimum	Maximum	Average
Temperature Fahrenheit	deg. F				47.0	55.3	54.7		33.2	36.8	35.2
Temperature Celcius	deg. C				8.3	12.9	12.6		0.7	2.7	1.8
pH (SU)	SU	6.98	7.14	7.58	6.94	7.34	7.1	8.72	7.8	8.3	8.0
Specific Conductance	uS/cm	2200	2170	2120	1419	1631	1578		499	530	514
Oxidation Reduction Potential (ORP)	Volts				-0.01	0.08	0.03		0.01	0.22	0.08
Dissolved Oxygen (mg/l)	mg/l				3.11	7.84	5.1		7.89	13.91	12.4
Total Dissolve Solids	mg/l	1918	1875	1829	1790	1888	1823	448			
Alkalinity M (as $CaCO_3$)	mg/l	340	363	357	340	356	350	167			
Alkalinity P (as $CaCO_3$)	mg/l	0	0	0				3			
Bicarbonate	mg/L	415	443	436			427	204			
Carbonate	mg/L	0	0	0				1.8			
Total Hardness (as $CaCO_3$)	mg/l	1360	1390	1280	1248	1300	1269	278			
Calcium Hardness (as $CaCO_3$)	mg/l				820	850	837	188			
Calcium	mg/l	349	350	322			335	75			
Magnesium	mg/l	118	126	115			105	22			
Sodium	mg/l	44.2	52.2	51			47	69			
Potassium	mg/l	12.3	13.8	12.1			11.4	4.8			
Dissolved Iron	mg/l				2.26	2.50	2.4		0.03	0.11	0.06
Total Iron	mg/l	4.39	4.04	3.99	2.3	2.5	2.4	0.3			
Dissolved Manganese	mg/l				2.2	2.74	2.5		0.224	0.83	0.4
Total Manganese	mg/l	2.42	2.88	3.04	2.12	3.17	2.7	0.04			
Chloride	mg/l	27	21	18				13			
Fluoride	mg/l	0.31	0.32	0.29				0.51			
Sulfate	mg/l	1090	1020	1010	954	1040	998	192			
Ammonia	mg/l	<0.05	<0.05	<0.05				0			
Nitrate (as N)	mg/l	<0.2	<0.2	<0.2			0.4				
Nitrite (as N)	mg/l	<0.02	<0.02	<0.02			< 0.02				
Aluminum	mg/l	0.017	0.0333	0.005			<0.0001				
Arsenic	mg/l	0.006	0.003	0.005			0.005				
Barium	mg/l	0.013	0.0214	0.0121			0.0085				
Chromium (total)	mg/l	0.0104	0.0045	0.0055			<0.0002				
Lead	mg/l	0.0003	0.0003	<0.0001			0.00004				
Mercury	mg/l	<0.0001	<0.0001	<0.0001			0.0002				
Molybdenum	mg/l	0.0016	0.0017	0.0018			0.001				
Nickel	mg/l	0.0198	0.0209	0.019			0.0159				
Selenium	mg/l	0.0012	0.0014	0.0013			0.0024				
Silicon	mg/l	23	21.4	23.4			15.3				
Uranium	mg/l	0.0024	0.002	0.0023			0.0028				
Zinc	mg/l	0.0271	0.0202	0.0224			0.0128				
Dissolved Organic Carbon (DOC)	mg/l				0.76	1.09	0.9		3.55	3.88	3.7
Total Organic Carbon (TOC)	mg/l	1.05	1.01	1.09	0.70	0.905	0.8	4.3			

TABLE 2

Estimated Representative Water Quality Data for Geochemical Modeling
City of Yankton, South Dakota Collector Well Investigation

DRAFT

Parameter	unit	Ground Water Concentrations	River Water Concentrations Winter Conditions	River Water Concentrations Summer Conditions
Temperature Fahrenheit	degrees F	54.7	35.2	74.2
Temperature Celsius	degrees C	12.6	1.8	23.4
pH	SU	7.2	8.36	8.1
Specific Conductance	uS/cm	2017.5	514	
Oxidation Reduction Potential (ORP-Eh)	Volts	0.02	0.05	
ORP-pe (from field Eh)		0.353	0.916	
ORP-pe (calculated by PHREEQC)		-2.343	14.399	12.686
Dissolved Oxygen (mg/l)	mg/l	0	13.3	8.0
Total Dissolve Solids	mg/l	1874	448	
Alkalinity (as $CaCO_3$)	mg/l	352.5	167	144
Total Hardness (as $CaCO_3$)	mg/l	1269	278	240
Calcium	mg/l	336	75	65
Magnesium	mg/l	118	22	19
Sodium	mg/l	48.6	69	40
Potassium	mg/l	12.4	4.8	4.1
Dissolved Iron	mg/l	3.7		
Total Iron	mg/l		0.3	0.26
Dissolved Manganese	mg/l	2.5	0.4	0.35
Total Manganese	mg/l	2.76		
Chloride	mg/l	22	13	11.2
Fluoride	mg/l	0.31	0.51	0.44
Sulfate	mg/l	1030	192	166
Dissolved Organic Carbon (DOC)	mg/l	0.90	3.7	4
Total Organic Carbon (TOC)	mg/l	0.99	4.3	

TABLE 3

PHREEQC Water Chemistry Modeling Results - TOC as a Non-Reactive Compound

City of Yankton, South Dakota Collector Well Investigation

DRAFT

Winter Conditions, Pumping 2 MGD

Proportion of Ground Water	Proportion of River Water	pH	Temperature	Alkalinity	Calcium	Magnesium	Ferrous Iron (Fe^{+2})	Ferric Iron (Fe^{+3})	Total Iron	Manganese	Potassium	Sodium	Chloride	Sulfate	Dissolved Oxygen	Total Organic Carbon	Total Dissolved Solids	Total Hardness	Calcium Hardness
(percent)	(percent)	(SU)	(degrees F)	(mg/l as $CaCO_3$)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l as $CaCO_3$)	(mg/l as $CaCO_3$)
0%	100%	8.4	35.2	167.0	75.0	22.0	0.0	0.3	0.3	0.4	4.8	69.0	13.0	192.0	13.3	3.7	491	279	187
100%	0%	7.2	54.7	352.0	336.0	118.0	3.7	0.0	3.7	2.8	12.4	49.0	22.0	1030.0	0.0	1.0	1791	1336	839
40%	**60%**	7.5	43.0	239.7	179.4	60.4	0.0	1.7	1.7	1.4	7.8	61.0	16.6	527.2	7.8	2.6	1010	702	448
60%	**40%**	7.3	46.9	276.0	231.6	79.6	0.0	2.3	2.3	1.8	9.4	57.0	18.4	694.8	5.0	2.1	1270	913	578

Summer Conditions Pumping 12 MGD

Proportion of Ground Water	Proportion of River Water	pH	Temperature	Alkalinity	Calcium	Magnesium	Ferrous Iron (Fe^{+2})	Ferric Iron (Fe^{+3})	Iron	Manganese	Potassium	Sodium	Chloride	Sulfate	Dissolved Oxygen	Total Organic Carbon	Total Dissolved Solids	Total Hardness	Calcium Hardness
(percent)	(percent)	(SU)	(degrees F)	(mg/l as $CaCO_3$)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l as $CaCO_3$)	(mg/l as $CaCO_3$)
0%	100%	8.1	74.1	144.0	65.0	19.0	0.0	0.3	0.3	0.3	4.1	40.0	11.2	166.0	8.0	4.0	401	242	162
100%	0%	7.2	54.7	352.0	336.0	118.0	3.7	0.0	3.7	2.8	12.4	49.0	22.0	1030.0	0.0	1.0	1791	1336	839
10%	**90%**	7.7	72.2	164.5	92.1	28.9	0.0	0.6	0.6	0.6	4.9	40.9	12.3	252.4	7.1	3.7	540	351	230
30%	**70%**	7.4	68.3	205.4	146.3	48.7	0.0	1.3	1.3	1.1	6.6	42.7	14.4	425.2	5.4	3.1	817	570	365

TABLE 4

PHREEQC Water Chemistry Modeling Results - TOC as CH_2O

City of Yankton, South Dakota Collector Well Investigatior

DRAFT

Winter Conditions, Pumping 2 MGD

Proportion of Ground Water	Proportion of River Water	pH	Temperature	Alkalinity	Calcium	Magnesium	Ferrous Iron (Fe^{+2})	Ferric Iron (Fe^{+3})	Total Iron	Manganese	Potassium	Sodium	Chloride	Sulfate	Dissolved Oxygen	Total Organic Carbon as CH_2O	Total Dissolved Solids	Total Hardness	Calcium Hardness
(percent)	(percent)	(SU)	(degrees F)	(mg/l as $CaCO_3$)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l as $CaCO_3$)	(mg/l as $CaCO_3$)
0%	100%	8.4	35.2	167.0	75.0	22.0	0.0	0.3	0.3	0.4	4.8	69.0	13.0	192.0	13.3	3.7	491	279	187
100%	0%	7.2	54.7	352.0	336.0	118.0	3.7	0.0	3.7	2.8	12.4	49.0	22.0	1030.0	0.0	1.0	1791	1336	839
40%	**60%**	7.3	43.0	239.7	179.4	60.4	0.0	1.7	1.7	1.4	7.8	61.0	16.6	527.2	0.8	0.0	1003	702	448
60%	**40%**	7.3	46.9	278.4	231.6	79.6	2.3	0.0	2.3	1.8	9.4	57.0	18.4	694.5	0.0	0.0	1266	913	578

Summer Conditions Pumping 12 MGD

Proportion of Ground Water	Proportion of River Water	pH	Temperature	Alkalinity	Calcium	Magnesium	Ferrous Iron (Fe^{+2})	Ferric Iron (Fe^{+3})	Iron	Manganese	Potassium	Sodium	Chloride	Sulfate	Dissolved Oxygen	Total Organic Carbon as CH_2O	Total Dissolved Solids	Total Hardness	Calcium Hardness
(percent)	(percent)	(SU)	(degrees F)	(mg/l as $CaCO_3$)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l as $CaCO_3$)	(mg/l as $CaCO_3$)
0%	100%	8.1	74.1	144.0	65.0	19.0	0.0	0.3	0.3	0.3	4.1	40.0	11.2	166.0	8.0	3.7	401	242	162
100%	0%	7.2	54.7	352.0	336.0	118.0	3.7	0.0	3.7	2.8	12.4	49.0	22.0	1030.0	0.0	1.0	1791	1336	839
10%	**90%**	7.3	72.2	169.1	92.1	28.9	0.6	0.0	0.6	0.6	4.9	40.9	12.3	248.5	0.0	0.0	531	351	230
30%	**70%**	7.2	68.3	210.7	146.3	48.7	1.3	0.0	1.3	1.1	6.6	42.7	14.4	421.2	0.0	0.0	811	570	365

TABLE 5

PHREEQC Saturation Index Results - TOC as a Non-Reactive Compound

City of Yankton, South Dakota Collector Well Investigation

DRAFT

Mineral/Compound		Ground Water	River Water Winter Conditions	River Water Summer Conditions	Winter Conditions Mix 60% River Water 40% Ground Water	Winter Conditions Mix 40% River Water 60% Ground Water	Summer Conditions Mix 90% River Water 10% Ground Water	Summer Conditions Mix 70% River Water 30% Ground Water
		Saturation Index Values						
Anhydrite	CaSO4	-0.77	-1.86	-1.77	-1.21	-1.03	-1.52	-1.23
Aragonite	CaCO3	0.26	0.47	0.42	0.1	0.12	0.22	0.12
Calcite	CaCO3	0.41	0.63	0.56	0.26	0.28	0.37	0.26
CH4(g)	CH4	-13.02	-156.12	-142.89	-151.95	-150.07	-142.97	-143.51
CO2(g)	CO2	-1.71	-3.21	-2.87	-2.17	-1.96	-2.47	-2.08
Dolomite	CaMg(CO3)2	0.53	0.7	0.92	0.09	0.18	0.54	0.32
Fe(OH)3(a)	Fe(OH)3	-3.65	3.86	2.36	4.14	4.09	2.78	3.17
FeS(ppt)	FeS	-6.48	-160.84	-147.8	-155.08	-152.92	-147.06	-146.88
Fluorite	CaF2	-1.56	-1.29	-1.79	-1.29	-1.36	-1.71	-1.62
Goethite	FeOOH	1.78	8.85	8.19	9.31	9.35	8.57	8.89
Gypsum	CaSO4:2H2O	-0.33	-1.3	-1.45	-0.7	-0.54	-1.19	-0.87
H2(g)	H2	-9.74	-45.54	-41.55	-44.6	-44.1	-41.71	-42.01
H2O(g)	H2O	-1.84	-2.15	-1.54	-2.02	-1.96	-1.57	-1.63
H2S(g)	H2S	-12.09	-156.3	-143.28	-151.19	-149.18	-142.89	-143
Halite	NaCl	-7.6	-7.6	-7.92	-7.59	-7.59	-7.88	-7.81
Hausmannite	Mn3O4	-25.75	11.49	11.49	8.32	7.86	10.11	8.76
Hematite	Fe2O3	5.51	19.59	18.39	20.53	20.63	19.14	19.76
Jarosite-K	KFe3(SO4)2(OH)6	-18.09	-1.41	-3.4	3.31	4.03	-0.82	1.59
Mackinawite	FeS	-5.75	-160.11	-147.07	-154.35	-152.19	-146.32	-146.14
Manganite	MnOOH	-10.89	8.49	5.88	6.87	6.43	5.54	5.32
Melanterite	FeSO4:7H2O	-4.74	-17.52	-17.36	-14.86	-14.38	-16.13	-15.01
O2(g)	O2	-68.15	-0.7	-0.72	-0.89	-1.05	-0.78	-0.91
Pyrite	FeS2	-1.96	-264.43	-242.96	-254.62	-251.01	-241.65	-241.21
Pyrochroite	Mn(OH)2	-5.61	-4.12	-4.73	-5.28	-5.47	-5.15	-5.52
Pyrolusite	MnO2:H2O	-24.15	11.19	10.34	9.89	9.59	9.9	9.48
Rhodochrosite	MnCO3	0.76	0.61	0.58	0.56	0.61	0.55	0.55
Siderite	FeCO3	0.62	-11.16	-10.58	-9.41	-9.02	-9.82	-9.16
Sulfur	S	-8.46	-117	-107.73	-112.78	-111.25	-107.2	-107.02
Sylvite	KCl	-7.71	-8.22	-8.46	-7.96	-7.87	-8.35	-8.16

SI < 0, a mineral could dissolve, but not precipitate.

SI > 0, a mineral could precipitate, but not dissolve.

SI ~ 0, mineral could dissolve or precipitate to maintain equilibrium.

TABLE 6

PHREEQC Saturation Index Results - TOC as CH_2O

City of Yankton, South Dakota Collector Well Investigation

DRAFT

Mineral/Compound		Ground Water	River Water Winter Conditions	River Water Summer Conditions	Winter Conditions Mix 60% River Water 40% Ground Water	Winter Conditions Mix 40% River Water 60% Ground Water	Summer Conditions Mix 90% River Water 10% Ground Water	Summer Conditions Mix 70% River Water 30% Ground Water
		Saturation Index Values						
Anhydrite	CaSO4	-0.78	-1.86	-1.78	-1.21	-1.03	-1.53	-1.23
Aragonite	CaCO3	0.25	-0.31	-0.28	-0.07	0.06	-0.18	-0.04
Calcite	CaCO3	0.41	-0.15	-0.14	0.08	0.22	-0.03	0.11
CH4(g)	CH4	-4.9	-154.13	-4.25	-149.79	-5.98	-4.41	-4.58
CO2(g)	CO2	-1.7	-2.39	-2.12	-1.99	-1.89	-2.03	-1.91
Dolomite	CaMg(CO3)2	0.52	-0.87	-0.49	-0.25	0.07	-0.27	0.02
Fe(OH)3(a)	Fe(OH)3	-4.71	3.7	-5.5	4.06	-4.58	-5.21	-5
FeS(ppt)	FeS	1.6	-158.08	0.91	-152.58	0.56	1.18	1.37
Fluorite	CaF2	-1.56	-1.29	-1.78	-1.29	-1.36	-1.7	-1.62
Goethite	FeOOH	0.72	8.69	0.33	9.23	0.68	0.58	0.72
Gypsum	CaSO4:2H2O	-0.34	-1.29	-1.46	-0.7	-0.54	-1.19	-0.87
H2(g)	H2	-7.72	-45.25	-7.08	-44.1	-8.09	-7.17	-7.32
H2O(g)	H2O	-1.84	-2.15	-1.54	-2.02	-1.96	-1.57	-1.63
H2S(g)	H2S	-3.96	-153.53	-3.94	-148.86	-5.04	-3.93	-3.93
Halite	NaCl	-7.6	-7.6	-7.92	-7.59	-7.59	-7.88	-7.81
Hausmannite	Mn3O4	-27.83	6.91	-26.93	6.83	-28.5	-26.78	-26.86
Hematite	Fe2O3	3.39	19.27	2.67	20.37	3.3	3.16	3.43
Jarosite-K	KFe3(SO4)2(OH)6	-21.25	0.52	-24.82	3.59	-21.79	-23.54	-22.44
Mackinawite	FeS	2.33	-157.35	1.65	-151.85	1.29	1.92	2.11
Manganite	MnOOH	-11.93	6.92	-12.67	6.29	-11.69	-12.51	-12.33
Melanterite	FeSO4:7H2O	-4.77	-15.93	-6.53	-14.35	-4.92	-6.02	-5.52
O2(g)	O2	-72.21	-1.29	-69.67	-1.88	-73.06	-69.84	-70.29
Pyrite	FeS2	12.22	-259.18	10.62	-250.28	10.6	11.02	11.43
Pyrochroite	Mn(OH)2	-5.63	-5.55	-6.04	-5.61	-5.59	-5.94	-5.83
Pyrolusite	MnO2:H2O	-26.19	9.46	-25.45	9.06	-26.53	-25.42	-25.52
Rhodochrosite	MnCO3	0.76	0	0.01	0.41	0.56	0.2	0.41
Siderite	FeCO3	0.58	-10.36	-0.45	-9.07	0.38	-0.11	0.19
Sulfur	S	-2.36	-114.52	-2.86	-110.94	-3.11	-2.77	-2.64
Sylvite	KCl	-7.71	-8.22	-8.46	-7.96	-7.87	-8.35	-8.16

SI < 0, a mineral could dissolve, but not precipitate.

SI > 0, a mineral could precipitate, but not dissolve.

SI ~ 0, mineral could dissolve or precipitate to maintain equilibrium.

APPENDIX A

PHREEQC INPUT FILES

```
#
TITLE Winter Conditions Mixing Model, TOC as non-reactive species
#
#
SOLUTION_MASTER_SPECIES
Toc          Toc       0.0     Toc              12.0111

SOLUTION_SPECIES
    Toc   = Toc
    log_k           0.0

SELECTED_OUTPUT
    -file                 0Winter_Mixes_selected_out.txt
    -distance             false
    -time                 false
    -temperature          true
    -charge_balance       true
    -percent_error        true
    -totals               Alkalinity  Ca  Mg  Fe(2) Fe(3) Fe Mn(2) Mn(3) Mn K  Na  Cl S(6)
O(0) C Toc

SOLUTION 1 Missouri River Test Conditions
    temp      1.8
    pH        8.4
    pe        14.399
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 167
    Ca        75
    Cl        13
    F         0.51
    Fe        0.3
    K         4.8
    Mg        22
    Mn        0.4
    Na        69
    O(0)      13.3
    S(6)      192
    Toc       3.7
    -water    1 # kg

END

SOLUTION 2 Yankton Assumed Background Ground Water Quality
    temp      12.6
    pH        7.2
    pe        -2.343
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 352
    Ca        336
    Cl        22
    F         0.31
    Fe(2)     3.7
    K         12.4
    Mg        118
    Mn        2.8
    Na        49
    S(6)      1030
    Toc       1.0
    -water    1 # kg

END

Mix 10
```

DRAFT

```
#
TITLE Summer Conditions Mixing Model, TOC as non-reactive species
#
#
SOLUTION_MASTER_SPECIES
Toc          Toc       0.0     Toc              12.0111

SOLUTION_SPECIES
    Toc    = Toc
    log_k           0.0

SELECTED_OUTPUT
    -file                0Summer_Mixes_selected_out.txt
    -distance            false
    -time                false
    -temperature         true
    -charge_balance      true
    -percent_error       true
    -totals              Alkalinity  Ca  Mg  Fe(2) Fe(3) Fe Mn(2) Mn(3) Mn K  Na  Cl S(6)
O(0) C Toc

SOLUTION 1 Missouri River Assumed Summer Water Quality
    temp      23.4
    pH        8.1
    pe        12.686
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 144
    Ca        65
    Cl        11.2
    F         0.44
    Fe        0.26
    K         4.1
    Mg        19
    Mn        0.35
    Na        40
    O(0)      8
    S(6)      166
    Toc       4.0
    -water    1 # kg
END

SOLUTION 2 Yankton Assumed Background Ground Water Quality
    temp      12.6
    pH        7.2
    pe        -2.343
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 352
    Ca        336
    Cl        22
    F         0.31
    Fe(2)     3.7
    K         12.4
    Mg        118
    Mn        2.8
    Na        49
    S(6)      1030
    Toc       1.0
    -water    1 # kg

END

Mix 10
    1  .9
```

DRAFT

```
#
TITLE Winter Conditions Mixing Model, TOC as CH2O
#
#
SELECTED_OUTPUT
    -file                  0Winter_Mixes_with_C_reaction_selected_out.txt
    -distance              false
    -time                  false
    -temperature           true
    -charge_balance        true
    -percent_error         true
    -totals                Alkalinity  Ca  Mg  Fe(2) Fe(3) Fe Mn(2) Mn(3) Mn K  Na  Cl S(6)
O(0) C C(4) C(-4)

SOLUTION 1 Missouri River Water Test Conditions
    temp      1.8
    pH        8.4
    pe        14.399
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 167 as CaCO3
    Ca        75
    Cl        13
    F         0.51
    Fe        0.3
    K         4.8
    Mg        22
    Mn        0.4
    Na        69
    O(0)      13.3
    S(6)      192
    -water    1 # kg

REACTION 1
      CH2O 1
      3.08e-4 moles  # for 3.7 mg/l organic carbon

SAVE solution 1

END


SOLUTION 2 Yankton Assumed Background Ground Water Quality
    temp      12.6
    pH        7.2
    pe        -2.343
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 352
    Ca        336
    Cl        22
    F         0.31
    Fe(2)     3.7
    K         12.4
    Mg        118
    Mn        2.8
    Na        49
    S(6)      1030
    -water    1 # kg

REACTION 2
      CH2O 1
      8.326e-5 moles  # for 1.0 mg/l organic carbon

SAVE solution 2
```

DRAFT

```
#
TITLE Summer Conditions Mixing Model, TOC as CH2O
#
#
SELECTED_OUTPUT
    -file                  0Summer_Mixes_with_C_reaction_selected_out.txt
    -distance              false
    -time                  false
    -temperature           true
    -charge_balance        true
    -percent_error         true
    -totals                Alkalinity  Ca  Mg  Fe(2) Fe(3) Fe Mn(2) Mn(3) Mn K  Na  Cl S(6)
O(0) C C(4) C(-4)

SOLUTION 1 Missouri River Assumed Summer Water Quality
    temp      23.4
    pH        8.1
    pe        12.686
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 144
    Ca        65
    Cl        11.2
    F         0.44
    Fe        0.26
    K         4.1
    Mg        19
    Mn        0.35
    Na        40
    O(0)      8
    S(6)      166
    -water    1 # kg

REACTION 1
      CH2O 1
      3.33e-4 moles  # for 4.0 mg/l organic carbon

SAVE solution 1

END


SOLUTION 2 Yankton Assumed Background Ground Water Quality
    temp      12.6
    pH        7.2
    pe        -2.343
    redox     pe
    units     mg/kgw
    density   1
    Alkalinity 352
    Ca        336
    Cl        22
    F         0.31
    Fe(2)     3.7
    K         12.4
    Mg        118
    Mn        2.8
    Na        49
    S(6)      1030
    -water    1 # kg

REACTION 2
      CH2O 1
      8.326e-5 moles  # for 1.0 mg/l organic carbon

SAVE solution 2
```

DRAFT

Schlaak, Karen

From: Newman, Kevin <Kevin.Newman@hdrinc.com>
Sent: Tuesday, March 15, 2016 5:56 PM
To: Gronlund, Eric
Cc: Schlaak, Karen
Subject: RE: Water Appropriation Permit for Yankton Horizontal Collector Well

Eric,

I wanted to check and see if you have received the Water Rights Permit Application for Yankton's new horizontal collector well? The City indicated they mailed the application a few weeks ago.

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 **M** 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

From: Gronlund, Eric [mailto:Eric.Gronlund@state.sd.us]
Sent: Tuesday, December 15, 2015 2:15 PM
To: Newman, Kevin
Cc: Schlaak, Karen
Subject: FW: Water Appropriation Permit for Yankton Horizontal Collector Well

Kevin:

Did the city of Yankton ever formally file this application. We now have received well completion reports for a horizontal well that was completed. What is the status of this project and the water right permit application as I don't find a water right permit in place.

Eric Gronlund
Water Rights Program, DENR
605 773-3352
Eric.gronlund@state.sd.us

From: Newman, Kevin [mailto:Kevin.Newman@hdrinc.com]
Sent: Monday, April 06, 2015 10:02 AM
To: Gronlund, Eric
Subject: Water Appropriation Permit for Yankton Horizontal Collector Well

Eric,

I had emailed you back in September of 2014 regarding the Water Rights Permit application for the City of Yankton's new horizontal collector well. The City of Yankton will be submitting the application this week. A copy of the application is attached. The City of Yankton will be submitting a hard copy of the application to you along with a check for the permit

application fee. Based on our emails from last September we have calculated the permit application fee using the estimated annual volume of water used in acre-ft. A copy of our calculations is included in the attached permit application. Would you please review and let me know if the calculated fee of $5,850 looks correct.

Along with the application we will include a copy of Volume 3 of 3 of the Horizontal Collector Well Construction Project Manual, with includes a copy of the "Collector Well Siting Study At Paddlewheel Point". Water quality data, Test Well Data, and Monitoring Well Data are included with this study.

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 **M** 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

From: Gronlund, Eric [mailto:Eric.Gronlund@state.sd.us]
Sent: Monday, September 22, 2014 10:37 AM
To: Newman, Kevin
Subject: RE: Water Appropriation Permit for Yankton Horizontal Collector Well

DENR does not have a preference. If the 2035 WTP Facility Plan is the best information available it seems appropriate to use that number. Eric

---

From: Newman, Kevin [mailto:Kevin.Newman@hdrinc.com]
Sent: Monday, September 22, 2014 10:32 AM
To: Gronlund, Eric
Cc: McMath, Genny
Subject: RE: Water Appropriation Permit for Yankton Horizontal Collector Well

Eric,

Do you prefer we use the 60% general rule of thumb to calculate the annual volume and fee or could we use the estimated annual water usage for the year 2035 from the WTP Facility Plan?

If I use the numbers from the WTP Facility Plan, the annual volume would be approximately 40% of the max pumping rate.

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 **M** 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

From: Gronlund, Eric [mailto:Eric.Gronlund@state.sd.us]
Sent: Thursday, September 11, 2014 9:23 AM
To: Newman, Kevin
Cc: McMath, Genny
Subject: RE: Water Appropriation Permit for Yankton Horizontal Collector Well

Kevin:

DENR reviewed the plans submitted to DENR Division of Financial & Technical Services. Based on that review, it has been determined that a new water right permit will need to be obtained since there is a groundwater component. Below are comments on the draft application emailed to me.

Item No. 2 – in addition to the diversion rate listed, the annual volume in acre feet will need to be provided. As stated in previous email a general rule of thumb is a 60% pump rate when calculating the conversion.

The fee will be based on the volume in ac-ft since it will be less expensive. Fee will be based on ac-ft in units of 120 ac-ft annually (1st 120 ac-ft = $500, 2nd 120 ac-ft = $250, each add'l 120 ac-ft = $100 and add a $200 licensing fee).

Legal descriptions near the Missouri River can be difficult due to accretion land and/or not uniform sized sections. Often legals do not follow standard quarter section designations but instead "lots" or some other designation. Please check the legal description for the proposed well location carefully.

Can you provide "Volume 3" of the plans when submitting the water permit application?

Finally, a temporary discharge permit and temporary water use permit was submitted for this project presumably for test pumping. The discharge permit is being handled by the Surface Water Quality Program while the temporary use permit is a water rights issue. The start date on the submitted application is after the first of the year. Just so you know by statute temporary use permits automatically expire on December 31st so issuing a temporary use permit at this time would be useless and we'll wait until after the first of the year to do so.

Let me know if you have questions.

Eric Gronlund
Water Rights Program, DENR
605 773-3352
Eric.gronlund@state.sd.us

From: Newman, Kevin [mailto:Kevin.Newman@hdrinc.com]
Sent: Tuesday, September 09, 2014 1:53 PM
To: Gronlund, Eric
Subject: Water Appropriation Permit for Yankton Horizontal Collector Well

Hi Eric,

See the attached draft Application for Permit to Appropriate Water for the City of Yankton's new Horizontal Collector Well Project I discussed with you this morning. The firm capacity of the new collector well was designed for 12 MGD (8,333 gpm). At this pumping capacity I calculate that the fee is $11,850. I wanted to confirm that is correct, before we submit.

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 M 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

Gronlund, Eric

From: Gronlund, Eric
Sent: Tuesday, March 29, 2016 10:59 AM
To: 'kgoodmanson@cityofyankton.org'; Newman, Kevin (Kevin.Newman@hdrinc.com)
Cc: Schlaak, Karen
Subject: water permit application for city of Yankton
Attachments: T93NR55Wplat.pdf

Gentleman:

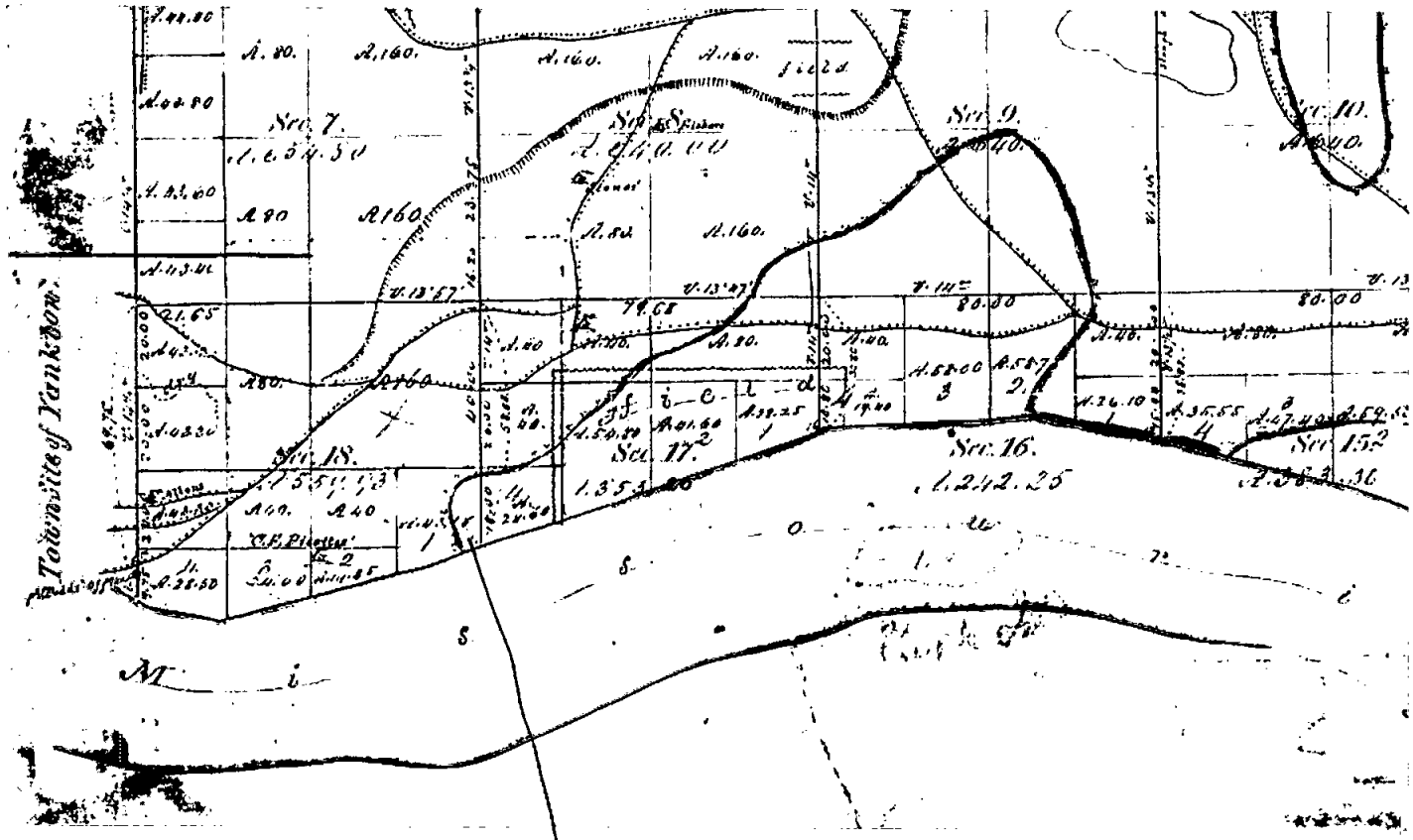
The Water Rights Program received the water permit application filed by the city of Yankton.

The location of the collector well is described in the application as the SE ¼ Section 18, T93N, R55W. Legal descriptions along the Missouri River are often complicated since there are not full sized sections. I looked at the plat image from the original survey approved in 1861. A copy is attached. This plat shows the well location to be located in Lot 1, Section 18, T93N, R55W. Please check the deed for the well site and let DENR know how the well site is legally described. When we get to the public notice, DENR wants to make sure it is correct so that the permit has proper legal standing.

The city of Yankton holds two water rights from the Missouri River (Nos. 985-3 for 10 cfs & 1978-3 for 8.44 cfs) that I assume is the city's current primary water supply. If this recent application is approved, what will occur to the direct Missouri River water source? Will it 1) continue to be use is some capacity; 2) be abandoned; or 3) be maintained for standby purposes?

Thanks

Eric Gronlund
Water Rights Program, DENR
605 773-3352
Eric.gronlund@state.sd.us


Sec. 7.
Sec. 18.
Sec. 17.
Sec. 16.
Sec. 9.
Sec. 10.
Sec. 15.
Township of Yankton
A. 80.
A. 160.
A 90
A 40
25%
approx. collector well location

zoom view

Gronlund, Eric

From: Newman, Kevin <Kevin.Newman@hdrinc.com>
Sent: Monday, April 04, 2016 12:08 PM
To: Gronlund, Eric
Cc: Schlaak, Karen
Subject: RE: water permit application for city of Yankton

Eric,

On the last page of the permit application we emailed you, the following description was included. Did you see that page?

City of Yankton, SD
Horizontal Collector Well
Location Description

Commencing at the East Quarter Corner of Section 18, Township 93 North, Range 55 West of the Fifth Principal Meridian. Thence S1 58' 02"E along the East Line of said Section 18 for a distance of 2328.15 Feet to a point on said East Line. Thence S88 01' 58"W for a distance of 131.83 Feet to the center of the proposed Well Caisson. Yankton County, South Dakota.

Our description right now does not include Lot 1 in the description, but the well is in Lot 1. We described the location starting from the East Quarter of Section 18. We can add Lot 1 to the description by including at the end "Also located in Lot 1).

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 **M** 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

From: Gronlund, Eric [mailto:Eric.Gronlund@state.sd.us]
Sent: Monday, April 04, 2016 8:36 AM
To: Newman, Kevin
Cc: Schlaak, Karen
Subject: RE: water permit application for city of Yankton

Kevin:

So the deed for this property where the well is to be located says the SE ¼ Section 18, T93N, R55W? Does it include a Lot 1 in the description?

Eric

From: Newman, Kevin [mailto:Kevin.Newman@hdrinc.com]
Sent: Friday, April 01, 2016 11:19 AM
To: Gronlund, Eric; 'kgoodmanson@cityofyankton.org'
Cc: Schlaak, Karen
Subject: RE: water permit application for city of Yankton

Eric,

We checked the location description again and it is correct. Do you want us to revise it to include "Lot 1"?

As far as the current water supply, the City will need to continue to use the existing surface water supply until the new water plant is completed and operational. Once the new water plant is operational, they would start to reduce the usage from the surface water intake.

Thank you,

Kevin F. Newman, PE
Project Manager

HDR
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108
D 605.977.7760 **M** 605.214.4955
kevin.newman@hdrinc.com

hdrinc.com/follow-us

From: Gronlund, Eric [mailto:Eric.Gronlund@state.sd.us]
Sent: Tuesday, March 29, 2016 10:59 AM
To: 'kgoodmanson@cityofyankton.org'; Newman, Kevin
Cc: Schlaak, Karen
Subject: water permit application for city of Yankton

Gentleman:

The Water Rights Program received the water permit application filed by the city of Yankton.

The location of the collector well is described in the application as the SE ¼ Section 18, T93N, R55W. Legal descriptions along the Missouri River are often complicated since there are not full sized sections. I looked at the plat image from the original survey approved in 1861. A copy is attached. This plat shows the well location to be located in Lot 1, Section 18, T93N, R55W. Please check the deed for the well site and let DENR know how the well site is legally described. When we get to the public notice, DENR wants to make sure it is correct so that the permit has proper legal standing.

The city of Yankton holds two water rights from the Missouri River (Nos. 985-3 for 10 cfs & 1978-3 for 8.44 cfs) that I assume is the city's current primary water supply. If this recent application is approved, what will occur to the direct Missouri River water source? Will it 1) continue to be use is some capacity; 2) be abandoned; or 3) be maintained for standby purposes?

Thanks

Eric Gronlund
Water Rights Program, DENR
605 773-3352
Eric.gronlund@state.sd.us

DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

denr.sd.gov

RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT APPLICATION NO. 8212-3, City of Yankton

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Water Permit Application No. 8212-3, City of Yankton, c/o Kyle Goodmanson, Director of Environmental Services, 315 West Riverside Drive, Yankton SD 57078.

The Chief Engineer is recommending APPROVAL of Application No. 8212-3 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use, 4) it is in the public interest with the following qualifications:

1. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.

2. The well authorized by Permit No. 8212-3 shall be constructed by a licensed well driller and construction shall comply with Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28.

3. The Permit holder shall report to the Chief Engineer annually the amount of water withdrawn from the Missouri:Elk Point Aquifer.

4. Water Permit No. 8212-3 authorizes a total annual diversion of 6,050 acre feet of water.

See report on application for additional information.

Jeanne Goodman, Chief Engineer
May 25, 2016

NOTE: The city of Yankton holds Water Right Nos. 985-3 and 1978-3 from the Missouri River as their primary water supply. Upon completion and full development of the well proposed by Water Permit Application No. 8212-3, if the city stops using the Missouri River source, the existing water rights can become subject to cancellation due to abandonment and/or forfeiture for nonuse. However, there is an exception to nonuse of water if the Missouri River water supply is maintained for fire protection or standby purposes and the diversion works are maintained in working condition for immediate use upon demand.

Report of the Chief Engineer
Water Permit 8212-3
City of Yankton
May 10, 2016

Water Permit Application No. 8212-3 proposes to appropriate water at a maximum diversion rate of 20.12 cubic feet per second (cfs) and a maximum annual diversion of 6,050 acre-feet per year from one well to be completed in the Elk Point management unit of the Missouri aquifer. The proposed well location is Lot 1 of SE ¼ Section 18 T93N-R55W for municipal use by the City of Yankton. The proposed well design is for a collector well with 13 screened laterals extending an average of 185 feet horizontally from the well caisson.

Aquifer: Elk Point Management unit of the Missouri aquifer

Aquifer Characteristics and Hydrogeology

The Elk Point management unit of the Missouri aquifer underlies portions of Clay, Union, and Yankton counties (Hedges et al., 1982 and 1985). It is comprised primarily of glacial outwash consisting of fine sand to coarse gravel underlying alluvium on the floodplain of the Missouri River. Much of the floodplain alluvium is permeable and forms a single aquifer where the outwash underlies the floodplain (Stephens, 1967). Elsewhere the management unit underlies glacial till (Niehus, 1994; Bugliosi, 1986; and Stephens, 1967). The management unit can be found under both water table and artesian conditions (Stephens, 1967). The management unit has an area of about 219,100 acres and contains an estimated 3,287,100 acre-feet of recoverable water (Hedges, 1982). Groundwater movement in the management unit is generally southeast toward the Missouri River (Stephens, 1967). The Elk Point management unit of the Missouri aquifer is hydraulically connected to the Missouri River along its southern boundary, the Lower Vermillion Missouri aquifer, the Big Sioux River, the Vermillion River, and the Lower James Missouri aquifer (Niehus, 1994; Bugliosi, 1986; and Stephens, 1967). The proposed well location for this application is located near the mapped border between this management unit and the Lower James Missouri aquifer. The Elk Point management unit of the Missouri aquifer typically underlies the Missouri River flood plain, and the Lower James Missouri aquifer underlies the area above the floodplain with the mapped boundary between the two management units typically matching the bluff created by the Missouri River trench (Hedges et al., 1982).

As part of the evaluation of this project HDR Engineering, Inc. conducted an extensive investigation of the proposed well site. The proposed well site for this application is located approximately 200 feet from the Missouri River. The area of the proposed well site for this application is under unconfined conditions (HDR, 2014). Aquifer materials in the area of the proposed well site ranged from about 110 to 136 feet thick with the top of the aquifer materials occurring at approximately ground surface (HDR, 2014). During the study, the static water level at the proposed water site was about ten feet below grade (HDR, 2014). The lithologic logs for the proposed well site indicated that in the area the management unit consists of fine to coarse sand with gravel with trace to minor discontinuous clay lenses (HDR, 2014).

South Dakota Codified Law (SDCL) 46-2A-9

Pursuant to SDCL 46-2A-9, a permit to appropriate water may be issued only if there is a reasonable probability that there is unappropriated water available for the applicant's proposed use, that the proposed diversion can be developed without unlawful impairment of existing rights and that the proposed use is a beneficial use and in the public interest. This report will address the availability of unappropriated water and existing rights from the aquifer that are pertinent to this application.

Water Availability

Water Permit Application No. 8212-3 proposes to appropriate water from the Elk Point management unit of the Missouri aquifer for municipal use. The probability of unappropriated water being available from an aquifer can be evaluated by considering SDCL 46-6-3.1 which requires "No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source." If the source of the water is older or lower than the Greenhorn Formation and the application is for a water distribution system defined pursuant to SDCL 46-1-6 (17), the Board need not consider the recharge/withdrawal issue. Here, a water distribution system is involved, but the Elk Point management unit of the Missouri aquifer is not older or lower than the Greenhorn Formation, therefore the withdrawal/recharge issue must be considered.

Hydraulic Budget

Recharge

Recharge to the Missouri: Elk Point occurs by infiltration of precipitation, seepage from rivers/streams, and leakage from other aquifers (Bugliosi, 1986). Hedges et al. (1985) estimated that recharge to the management unit was approximately 3.8 inches per year, based on observation well data. Utilizing this information and the area of the management unit, average annual natural recharge can be estimated at 69,382 acre-feet. Stonesifer (2013) estimated induced recharge to the management unit from the Missouri River due to the operation of the Lewis and Clark Water Treatment System to be at least 22,582 acre-feet per year. This results in an estimated average annual recharge of 91,964 acre-feet per year. Additionally, Stonesifer (2013) notes the further potential for induced recharge to the management unit from the Missouri, Vermillion, James, and Big Sioux Rivers.

Withdrawals

Withdrawals from the Elk Point management unit of the Missouri aquifer includes well withdrawals, outflow to the Missouri and Big Sioux Rivers, and evapotranspiration in locations where the water in the management unit is at water table conditions and near the land's surface

(Niehus, 1994; Bugliosi, 1986; and Stephens, 1967). Withdrawals from the Elk Point management unit of the Missouri aquifer as of June 10, 2013, were extensively examined in Stonesifer (2013), which estimated average annual withdrawals at 81,108 acre-feet per year. Therefore, Stonesifer (2013) estimated that average annual recharge exceeded average annual withdrawal by 10,856 acre-feet.

The water availability for this application can be evaluated considering the water permits issued since June 10, 2013, in conjunction with the water availability analysis of Stonesifer (2013). There have been 34 water permits issued, two reinstated permits (7074A-3 and 7009A-3) and one pending application in the management unit since Stonesifer (2013). There are also two deferred applications for the management unit. These water permits/rights/applications are summarized in Table 1, along with the amount of water appropriated for each permit in the case of irrigation permits and the annual volume for non-irrigation permits limited by an annual volume.

Table 1: Water Rights/Permits Issued Since Stonesifer (2013) for the Elk Point Management Unit of the Missouri Aquifer (Water Rights, 2016a)

Irrigation						
Permit No.	Name	Status	Use	Rate (cfs)	Acres	Appropriation (ac-ft/yr)
7848-3	MISSOURI VALLEY FARMS INC	PE	IRR	3.04	213.0	426.0
7856-3	MIKE & STEVE ALLARD	PE	IRR	1.78	129.3	258.6
7895-3	TODD HANSON	PE	IRR	1.89	180.0	360.0
7898-3	JAMES ORR	PE	IRR	1.56	132.0	264.0
7899-3	JUSTIN ORR	PE	IRR	1.56	97.0	194.0
7904-3	CRAIG S MCINERNEY	PE	IRR	1.78	160.0	320.0
7933-3	DOUGLAS G BYE	PE	IRR	0.89	90.0	180.0
7936-3	DONALD JOHNSON	PE	IRR	1.39	83.0	166.0
7938-3	RUSSELL M HALL	PE	IRR	0	53.0	106.0
7941-3	JOSEPH F CHICOINE	PE	IRR	1	37.7	75.4
7074A-3	CALVIN HANSON	PE	IRR	1.78	162.0	324.0
7951-3	ALLEN PACE	PE	IRR	1.78	150.0	300.0
7955-3	KARL M SCHENK	PE	IRR	1.78	140.0	280.0
7971-3	BARRY VAN OSDEL	PE	IRR	1.11	68.0	136.0
7980-3	FRANCIS HEINE	PE	IRR	0	5.0	10.0
7987-3	FRANCIS M ARMSTRONG LIVING TRUST	PE	IRR	1.78	102.0	204.0
8010-3	RYAN RUSHER	PE	IRR	0.1	2.5	5.0
8016-3	AMELIA BERTRAND TRUST	PE	IRR	1.67	66.0	132.0
8022-3	REDWOOD SOUTH DAKOTA HOLDINGS LLP	PE	IRR	1.91	134.0	268.0
8023-3	REDWOOD SOUTH DAKOTA HOLDINGS LLP	PE	IRR	4.14	290.0	580.0
8024-3	REDWOOD SOUTH DAKOTA HOLDINGS LLP	PE	IRR	3.36	235.2	470.4
8025-3	REDWOOD SOUTH DAKOTA HOLDINGS LLP	PE	IRR	3.82	267.2	534.4
8029-3	DAKOTA DUNES COMM IMPROVEMENT DISTRICT	PE	IRR	0.78	17.8	35.6
7009A-3	ROGER D HANSON	PE	IRR	1.78	120.0	240.0
8040-3	HEINE ELECTRIC & IRRIGATION INC	PE	IRR & COM	0.33	3.0	6.0
8079-3	MELVIN & LARRY DONNELLY	PE	IRR	1.78	160.0	320.0
8080-3	LARRY & MELVIN DONNELLY	PE	IRR	1.78	160.0	320.0
8175-3	GAYVILLE-VOLIN SCHOOL DISTRICT 63-1	PE	IRR	0.058	4.0	8.0
8176-3	CALVIN & MARY HANSON	LC	IRR	1.113	31.0	62.0
8177-3	D A OLSON & SONS	PE	IRR	1.23	62.0	124.0
8181-3	MARC T BERNARD	PE	IRR	0.89	40.0	80.0
8192-3	STOP DROP LOCK INC	PE	IRR	2.22	152.0	304.0
8202-3	GERALD BENJAMIN	PE	IRR	1.89	132.0	264.0
8204-3	DOUGLAS BYE	PA	IRR	0.89	70.0	140.0
Total					3748.7	7497.4
Non-Irrigation						
Permit No.	Name	Status	Use	Rate (cfs)	Acres	Annual Volume (ac-ft)
5749-3	STOCKMENS LIVESTOCK	DF	COM	0.03		
5750-3	STOCKMENS LIVESTOCK	DF	COM	0.09		
8031-3	DAKOTA PROTEIN CONVERSION INC	PE	COM	0.22		
8069-3	CIMPLS LLC	PE	COM	0.44		452*
8147-3	DOUG LAFLEUR	PE	COM/LCO	1		160

LC=Water Rights, PE= Water Permit, PA=Pending Application DF=deferred application, COM=commercial, IRR= irrigation, LCO=live stock confinement operation

*total when combined with Water Right No. 5616-3

For new irrigation permits the average annual pumping can be estimated in a similar manner to Stonesifer (2013), where the average ratio of pumpage to appropriation from developed appropriations was applied to new appropriations, and developed appropriations were considered to be permits authorized prior to 2006. In Stonesifer (2013) this percentage was 13.7%. In updating the pumpage to appropriations ratio to reflect additional irrigation data collected since Stonesifer (2013), developed appropriations were considered to be those past their five year construction period in a similar manner to Mathiowetz (2014). With the inclusion of the irrigation data from 2014 the updated percentage of pumpage to appropriation for developed appropriations is 13.8%. By applying this percentage of pumpage to developed appropriation to the irrigation permits issued and pending applications since June 10, 2013, the

average annual withdrawal from these appropriations can be estimated to be about 1,035 acre-feet.

Historically, water use by non-irrigation appropriations limited by instantaneous diversion rate has been less than 60% of full time pumping at the permitted authorize diversion rate. For water rights/permits limited to an annual diversion rate, full use of that annual rate is assumed for the estimation of average annual withdrawal. The water permit for Cimpl's LLC limits the total annual volume of both Water Right No. 5616-3 and Water Permit No. 8069-3 to 452 acre-feet. The hydraulic budget for the Elk Point management unit of the Missouri aquifer prepared by Stonesifer (2013) considered the appropriation associated with Water Right No. 5616-3 to be 191 acre-feet per year. This would result in an additional appropriation from the management unit of 261 acre-feet per year. Water Permit No. 8040-3 is for both irrigation and commercial use, the diversion rate for this permit appears to be more reflective of the need (for commercial use) to fill their water trucks in a timely manner rather than actual water use (Water Rights, 2014). The 2015 Irrigation Questionnaire for Water Permit No. 8040-3 also reported their commercial use for March 2015 to October 2015 totaled about 0.5 acre-feet. To estimate the water use from the commercial portion of this permit the highest reported monthly water use was used to estimate an average annual water use for the commercial portion of this permit as 1.5 acre-feet per year (Water Rights, 2015-2016). Therefore the annual withdrawal for non-irrigation appropriations since Stonesifer (2013) and the two deferred applications can be estimated at 761 acre-feet.

Balance

In considering new appropriations since June 10, 2013, the two deferred applications, two reinstated permits, and the one pending application the average annual withdrawal associated with them is estimated to be 1,796 acre-feet. When examining this estimated average annual withdrawal in conjunction with the hydraulic budget analysis in Stonesifer (2013) average annual withdrawals are estimated to be about 82,704 acre-feet. When compared with recharge, estimated average annual recharge to the aquifer exceeds this by 9,060 acre-feet. Therefore there is a reasonable probability that water is available to meet the needs of this application. Additionally, based on the estimated induced recharge percentages for the summer and winter pumping scenarios included in HDR Engineering, Inc. (2014), this permit, if approved, will likely contribute at least 63 percent of pumpage or at full development at least 3,811 acre-feet of induced recharge per year to the management unit.

Observation Wells

In determining the availability of unappropriated water for a permit application Administrative Rule 74:02:05:07 requires the Water Management Board to rely on the record of observation well measurements, in addition to other data, to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated annual recharge. When considered together observation wells can offer insight into the overall hydraulic conditions in an

aquifer, and when considered singularly or in spatial groups, can offer insights into localized hydraulic conditions.

The Water Rights Program monitors 37 observation wells in the Elk Point management unit of the Missouri aquifer. The nearest observation well to the proposed well location that this application proposes to utilize is observation well YA-57D located approximately 5.1 miles to the east northeast (hydrograph shown in Figure 1). Hydrographs for observation wells YA-79H and YA-78J are shown in Figure 2 and Figure 3.

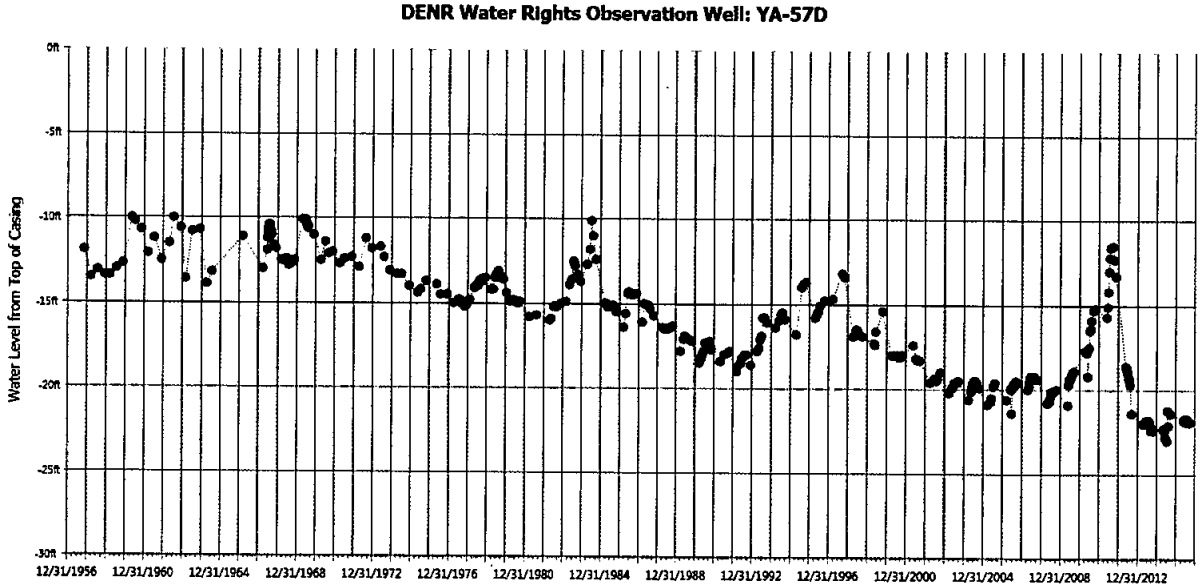


Figure 1: Observation Well Hydrograph YA-57D (Water Rights, 2016b)

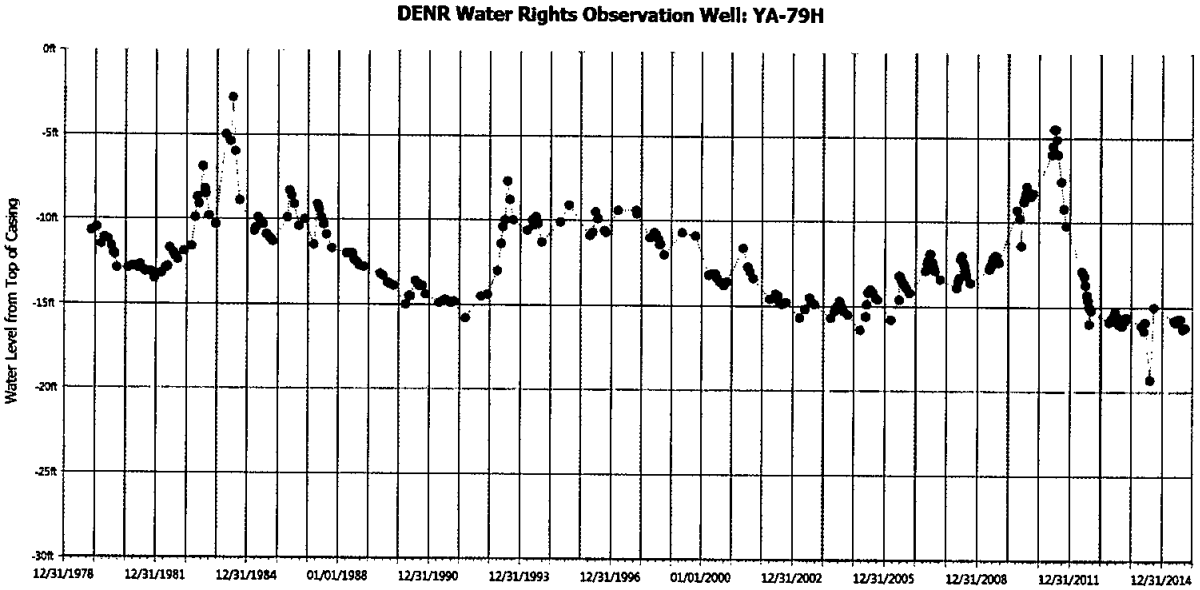


Figure 2: Observation Well Hydrograph YA-79H located about 6.0 miles to the northeast of the proposed well location (Water Rights, 2016b)

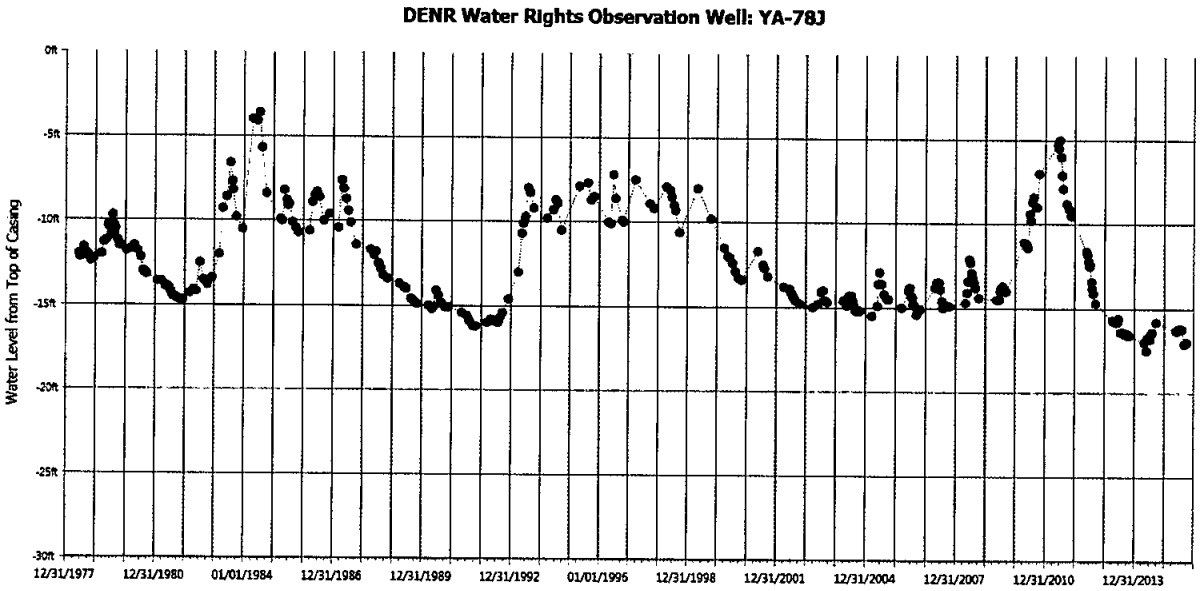


Figure 3: Observation Well Hydrograph YA-78J located about 7.3 miles to the east northeast (Water Rights, 2016b)

The observation well hydrographs show cyclic periods based on the effect of climatic conditions on the management unit. Increases in water levels occur during wetter periods (when recharge exceeds discharge), and decreases in water levels occur during drier periods (when discharge exceeds withdrawals). Additionally, Stephens (1967) notes the close relation of the water table under the floodplain to Missouri River water levels and the lowering of the water table in response to the closure of Gavins Point Dam. Furthermore, Iles (1979) notes that the ongoing entrenchment of the Missouri River below the Gavins Point Dam is also tied to lowering water table levels in the aquifer, and this has been linked by Goodman (2007) to the declining water levels in observation wells in this aquifer near the Missouri River. The hydrograph for the Missouri River at the USGS gaging station near Yankton, SD, is shown in Figure 4. By examining Figure 4, the relationship between trends in the Missouri River water levels and trends in the water levels in the observation wells can be observed. Additionally, the effect of the entrenchment of the Missouri River on water levels within the aquifer can be observed in these hydrographs. Furthermore, the impact of the Missouri River on water levels within the management unit can also be noted in Figure 4 by the correspondence of increases in water levels in the management unit with water levels increases in the Missouri River (most notably during the summer 2011 flood event). At the current level of development the temporal effects of pumping are masked by the strong hydraulic connection between the management unit and the Missouri River and the impacts of climatic conditions on the aquifer. This shows that the management unit is dominated by natural conditions, and water is available for capture. Therefore, there is a reasonable probability that there is water available to support this application.

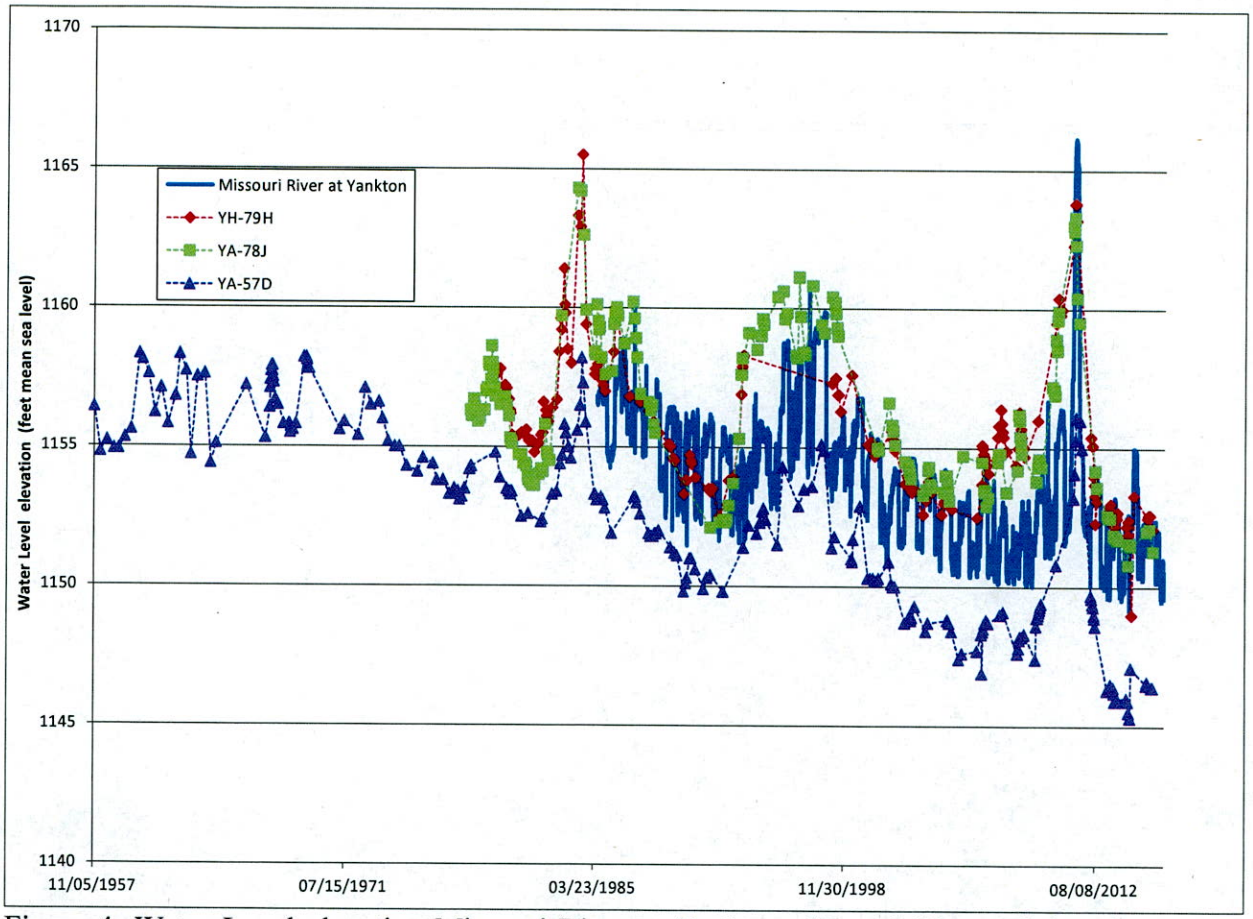


Figure 4: Water Level elevation Missouri River at Yankton, SD and Water Rights observation wells YA-79H, YA-78J, and YA-57D (Water Rights, 2016b and USGS, 2016)

Existing Users

The diversion points for groundwater water rights/permits in the vicinity of the well site for this application are shown in Figure 5. The water rights/permits completed into this management unit with the nearest diversion points to the proposed well location for this application are Water Right Nos. 5616-3, 5953-3, and 8069-3 located approximately 0.6 miles to the north of the proposed well location for this application.

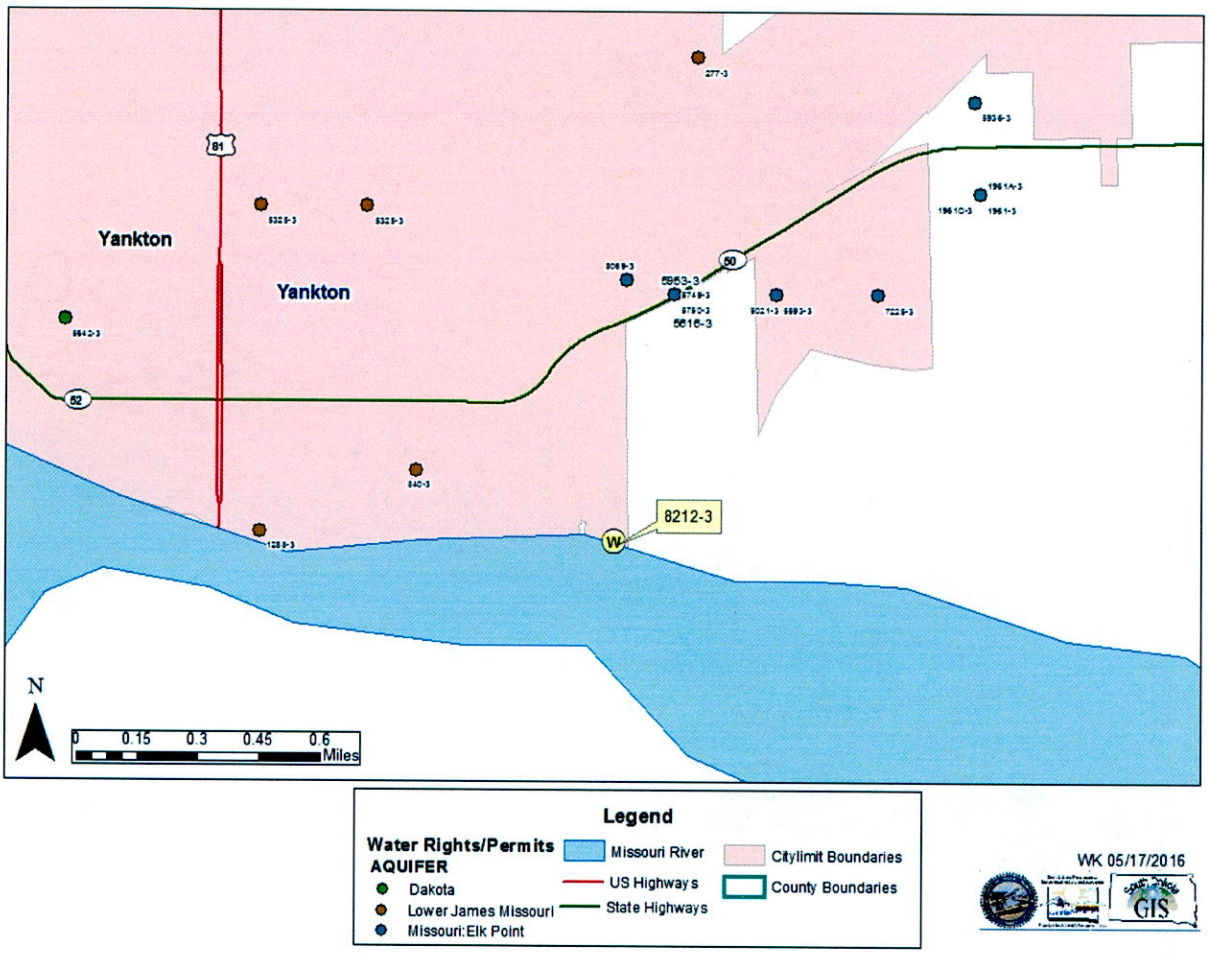


Figure 5: Diversion points for groundwater water rights/permits in the area of the proposed well location for this application (Water Rights, 2016a)

There are several well completion reports on file with the SDDENR-Water Rights Program within one mile of the well location for this application, most of which are likely completed into this management unit (Water Rights Program, 2016). The Water Rights Program Observation Wells YA-79H, YA-78J, and YA-57D are all within a mile of at least one or more high capacity irrigation wells completed into the management unit. The hydrographs for these wells show very little if any impact from the pumping of these wells, and instead show a correlation between the Missouri River and water levels in the management unit. Additionally the proposed well location for this application has about 100 feet of saturated thickness and is in close proximity to a recharge boundary. Therefore, this permit, if approved, is not expected to adversely impact existing water rights/permits with adequate wells or nearby adequate domestic wells. The Water Management Board has defined an adversely impacted domestic well as "a well in which the pump intake was set at least 20 feet below the top of the aquifer at the time of construction or, if the aquifer is less than 20 feet thick, is as near to the bottom of the aquifer as is practical and the water level of the aquifer has declined to a level that the pump will no longer deliver sufficient water for the well owner's needs."

Conclusions

1. Water Permit Application No. 8212-3 proposes to appropriate water at a maximum diversion rate of 20.12 cubic feet per second (cfs) and a maximum annual diversion rate of 6,050 acre-feet per year from one well to be completed in the Elk Point management unit of the Missouri aquifer in Lot 1 of SE ¼ Section 18 T93N-R55W.

2. The proposed well design is for a collector well with 13 screened laterals extending an average of 185 feet horizontally from the well caisson.

3. There is a reasonable probability that there is unappropriated water available to meet the requested appropriation of this application.

4. There is a reasonable probability that the appropriation and the diversion point this application proposes to use will not adversely impact existing water rights/permits with adequate wells.

Whitney Kilts
SDDENR-Water Rights Program

Approved by

Ken Buhler
SDDENR-Water Rights Program

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PROGRAM

AFFIDAVIT OF PUBLICATION

YANKTON DAILY PRESS AND DAKOTAN

CITY OF YANKTON
PO BOX 176
YANKTON SD 57078

STATE OF SOUTH DAKOTA
COUNTY OF YANKTON

KELLY HERTZ, BEING FIRST DULY SWORN ON OATH DEPOSES AND SAYS THAT (S)HE IS THE MANAGING EDITOR OF YANKTON MEDIA INC, A CORPORATION, THE PRINTER AND THE PUBLISHER OF THE YANKTON DAILY PRESS AND DAKOTAN, A LEGAL DAILY NEWSPAPER PUBLISHED AND CIRCULATED IN THE CITY OF YANKTON, SAID COUNTY AND STATE, AND ONE OF THE OFFICIAL NEWSPAPERS OF THE SAID COUNTY OF FACTS STATED IN THIS AFFIDAVIT; THAT THE ANNEXED 6+3 NOTICE OF APPLICATIO

TAKEN FROM THE PAPER, IN WHICH IT WAS LAST PUBLISHED IN THE NEWSPAPER ON THE 3rd DAY OF June, 2016
THAT THE FULL AMOUNT OF THE FEE CHARGED FOR THE PUBLICATION OF SAID NOTICE TO WIT $27.50 ENSURES TO THE BENEFITS OF THE PUBLISHER OF SAID NEWSPAPER AND THAT NO AGREEMENT AND UNDERSTANDING FOR THE DIVISION THEREOF HAS BEEN MADE WITH ANY OTHER PERSON, AND THAT NO PART THEREOF HAS BEEN AGREED TO BE PAID TO ANY PERSON WHOMSOEVER.

PUBLISHED ON: 06/03/2016

FILED ON: 06/03/2016

SUBSCRIBED AND SWORN TO BEFORE ME THIS 3rd DAY OF June, 2016

NOTARY PUBLIC, SOUTH DAKOTA
MY COMMISSION EXPIRES 08/19/2021

Ad text : 6+3

NOTICE OF APPLICATION NO. 8212-3 to Appropriate Water

Notice is given that the City of Yankton, c/o Kyle Goodmanson, Director of Environmental Services, 315 West Riverside Dr, Yankton SD 57078 has filed an application for a water permit to appropriate 20.12 cubic feet of water per second (6,050 acre-feet of water annually) from one well to be completed into the Missouri:Elk Point Aquifer (110 feet deep) located in Lot 1 of the SE 1/4 Section 18-T93N-R55W for municipal use. The proposed project consists of drilling a new well with 13 screened laterals extending an average of 185 feet horizontally from the well caisson.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 8212-3 with qualifications because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. The Chief Engineers recommendation with qualifications, the application, and staff report are available at http://denr.sd.gov/public or contact Eric Gronlund for this information, or other information, at the Water Rights Program address provided below.

Any person interested in opposing or supporting this application or recommendation must file a written petition with BOTH the applicant and Chief Engineer. The applicant must file a petition if contesting the Chief Engineer's recommendation. The Chief Engineer's address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501 (605-773-3352) and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by June 13, 2016.

The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained.

If the applicant does not contest the recommendation of the Chief Engineer and no petition to oppose the application is received, the Chief Engineer shall act on the application pursuant to the recommendation with no hearing held before the Water Management Board. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider this application. Notice of the hearing will be given to the applicant and any person filing a petition.

Steven M. Pirner, Secretary, Department of Environment and Natural Resources.
Published once at the total approximate cost of $27.50.

Schlaak, Karen

From: Schlaak, Karen
Sent: Wednesday, May 25, 2016 8:53 AM
To: 'Tera Schmidt'
Subject: FW: 8212-3, City of Yankton
Attachments: 8212-3publicnov2015.short1.docx; FORM8.FRM.doc

Attached is a notice to be published on June 3, 2016.

The City of Yankton, c/o Kyle Goodmanson, 315 W Riverside Dr, Yankton SD 57078 (605 668-5273) has been notified to contact you to authorize publication and arrange for payment.

Please send the affidavit or return the attached Proof of Publication form ASAP.

Let me know if you have questions. Please acknowledge receipt of this email.

Karen Schlaak
Water Rights Program
523 E Capitol Ave
Pierre SD 57501
Phone: 605 773-3352

DEPARTMENT of ENVIRONMENT and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
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denr.sd.gov

NOTE: TO BE SURE OF PUBLICATION ON THE CORRECT DATES, CONTACT THE NEWSPAPER(S) RIGHT AWAY.

May 25, 2016

City of Yankton
Kyle Goodmanson, Director of Environmental Services
315 West Riverside Dr
Yankton SD 57078

Dear Mr. Goodmanson:

Water Permit Application No. 8212-3 for municipal use has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice has been sent to the Press & Dakotan printed at Yankton SD (Ph # 605-665-7811). You will need to contact the newspaper(s) and authorize publication of this notice. For your information, a copy of the notice, the recommendation of the Chief Engineer and report on the application are enclosed. Please review the notice prior to publication and notify this office, if you have any corrections or questions.

Be sure to contact the above newspaper(s) to authorize publication of your Notice and to arrange for payment. Early contact with the paper(s) can eliminate delays. Upon receiving authorization from you, the publisher has been instructed to publish your notice. The newspaper has also been instructed to send us the Proof of Publication. We must receive Proof of Publication before action can be taken on the application.

Sincerely,

Eric Gronlund
Natural Resources Engineer
(605) 773-3352

enclosures

NOTE: If you plan to contest any part of the Chief Engineer's recommendation, you must file a petition pursuant to the procedures outlined in the attached notice of hearing. The Water Management Board will then consider your concerns during a hearing on the application.

Instruction to Newspaper - Publish the Notice on June 3, 2016. The applicant is responsible for payment.

NOTICE OF APPLICATION NO. 8212-3 to Appropriate Water

Notice is given that the City of Yankton, c/o Kyle Goodmanson, Director of Environmental Services, 315 West Riverside Dr, Yankton SD 57078 has filed an application for a water permit to appropriate 20.12 cubic feet of water per second (6,050 acre-feet of water annually) from one well to be completed into the Missouri:Elk Point Aquifer (110 feet deep) located in Lot 1 of the SE 1/4 Section 18-T93N-R55W for municipal use. The proposed project consists of drilling a new well with 13 screened laterals extending an average of 185 feet horizontally from the well caisson.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 8212-3 with qualifications because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. The Chief Engineer's recommendation with qualifications, the application, and staff report are available at http://denr.sd.gov/public or contact Eric Gronlund for this information, or other information, at the Water Rights Program address provided below.

Any person interested in opposing or supporting this application or recommendation must file a written petition with BOTH the applicant and Chief Engineer. The applicant must file a petition if contesting the Chief Engineer's recommendation. The Chief Engineer's address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501 (605-773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by June 13, 2016.

The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained.

If the applicant does not contest the recommendation of the Chief Engineer and no petition to oppose the application is received, the Chief Engineer shall act on the application pursuant to the recommendation with no hearing held before the Water Management Board. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider this application. Notice of the hearing will be given to the applicant and any person filing a petition.

Steven M. Pirner, Secretary, Department of Environment and Natural Resources. Published once at the total approximate cost of_____.

DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

denr.sd.gov

JUN 2 1 2016

City of Yankton
Kyle Goodmanson – Director of Environmental Services
315 W Riverside Dr
Yankton SD 57078

Dear Mr. Goodmanson:

Enclosed is Water Permit No. 8212-3 authorizing construction of the water diversion system and beneficial use of the water, not exceeding the limits as specified in the Water Permit.

Form 10, *Notice of Completion of Works and Application of Water to Beneficial Use*, is enclosed. Please return this completed form after you have finished the system and have put the water to beneficial use. An investigation can then be scheduled so the water license may be issued, thus completing the acquisition of a water right.

An informational sheet *?Common Water Right Questions?* is also enclosed. This sheet is intended to answer some of the questions associated with obtaining and keeping a water right.

Sincerely,

Jeanne Goodman

Jeanne Goodman, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

Form 12

Report of Examination of Works and/or Application of Water to Beneficial Use For Permit No. 8212-3

I have this day, **August 28, 2019**, made a thorough examination of the water use system constructed by **City of Yankton, 105 W. Riverside Dr., Yankton, SD 57078**, holder of Permit No. **8212-3**, bearing the priority of **March 25, 2016,** authorizing the diversion of **20.12** cu. ft. per second of the waters of **groundwater (Missouri: Elk Point Aquifer)** for **municipal use** in **Yankton** County.

Inspection contact: **Sage Chytka**

A. Works used to divert the water:

Well Information:

1) Well Drilling Firm: **Layne Christensen Co.**
2) No. of Wells **1**
3) Depth(s) **114** feet
4) Well log is available **Yes**

Casing:

1) Diameter **240** inches
2) Length **114** feet
3) Type **Reinforced Concrete**

Screen:

1) Type **Stainless Steel**
2) Diameter **12** inches
3) Length **2,280** feet
4) Static water level **10.1** feet

Pump: Three Pumps

1) Make **Peerless**
2) Model **24MA**
3) Capacity **4,200** GPM

Motor: Three Motors

1) Make **US Motors**
2) Model No. **7226 BCBH Q2**
3) Horsepower rating **200** hp

B. Works used to transport water to place of use:

1)	Type **Ductile Iron Pipe**	Size **24** inches	Length **35** feet
2)	Type **PVC**	Size **24** inches	Length **5,645** feet

C. Works used to apply water to beneficial use:

1) **City of Yankton Water Treatment Plant**

D. Compliance with Permit Requirements:

1) Permit qualifications being abided by **Yes**
2) Irrigation Questionnaires checked to determine if permit owner started irrigation by the end of construction period **Flow records have been sent to DENR**
3) Exceptions to compliance are: **None**

E. Condition and Location:

1. The system is in **good** condition with the point(s) of diversion located as follows:

   The well is 110 feet west and 310 feet north of the southeast corner of Section 18-T93N-R55W (Latitude 42.866200, Longitude -97.377722 – SE1/4 of the SE1/4).

2. The works are capable of diverting and conveying to the place of use **20.12** cu. ft. per second of water which is to be used for **municipal purposes**. Water has been put to beneficial use to the maximum extent at **the City of Yankton Water Treatment Plant,** and the license should be issued for **20.12** cfs.
3. All structures, wells and lands on map **Yes**

F. Comments or other permit(s) associated with the project: The well is a horizontal collector well with a 20 foot diameter reinforced concrete caisson. It has thirteen horizontal laterals with a total of 2,280 feet of stainless steel screen. Only two of the laterals are in use at this time. As demands increase, additional laterals will be used. Also, there are three pumps in the well house and there is piping set up for a future fourth pump. All of the pumps and motors are identical and are set up with variable speed drives. All the pumps can be used at one time if necessary, however, with variable speed drives the City can control the flow to restrict it to the permitted rate of 20.12 cfs.

Keith DeJong
Water Rights Inspector
DENR, Water Rights Program

Date report completed: **September 3, 2019**

8212-3

SD EForm - 1621LD V1

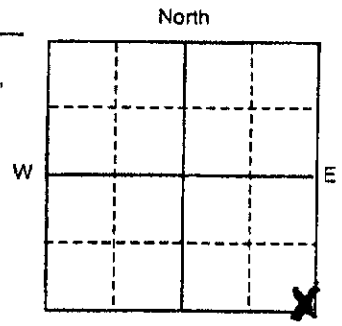
SOUTH DAKOTA WATER WELL COMPLETION REPORT

11-02

Location SE ¼ SE ¼ Sec 18 Twp 93N Rg 55W

County Yankton

Please mark well location with an "X"



Well Completion Date
10/1/2015

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?
ft. from (identify source)

Well Owner: City of Yankton, SD
Business Name:
Address: 416 Walnut St
City, State, Zip: Yankton, SD 57078

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand and Gravel, tan	0	30
Sand, tan	30	39
Gravel, sand & cobbles, brown	39	45
Sand and Gravel, brown	45	60
Sand, brown	60	80
Sand and Gravel, brown	80	90
Sand, brown	90	114

PROPOSED USE: ☐ Domestic/Stock ☑ Municipal ☐ Business ☐ Test holes ☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING: Open-ended caisson sinking Hydraulic lateral projection

CASING DATA: ☐ Steel ☐ Plastic ☑ Other
If other describe: Reinforced Concrete

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
____ LB/FT	240 IN	0 FT	114 FT	246 IN
____ LB/FT	____ IN	____ FT	____ FT	____ IN
____ LB/FT	____ IN	____ FT	____ FT	____ IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
bentonite	552	____ Lb/gal	0 Ft	114 Ft
		____ Lb/gal	____ Ft	____ Ft

Describe grouting procedure: Pumped through grout ports during caisson sinking.

SCREEN: ☐ Perforated pipe ☑ Manufactured
Diameter 12 Inches Length 2,280 Feet
Material Stainless Steel
Slot Size 0.050" Set From 101.7 Feet to 105.7 Feet
Other information: Screen installed horizontally
(to p. 1004)

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No
If so, what material?
Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?
☑ Yes. How? 200ppm Na hypochlorite ☐ No. Why Not?
Lab to which water quality sample sent for analysis: South Dakota Public Health Laboratory

STATIC WATER LEVEL 10.1 FEET
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ Inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced flow rate ____ GPM
Can well be completely shut in?

WELL TEST DATA:
☑ Pumped Describe: 72 hr constant-rate pumping test
☐ Bailed
☐ Other
Pumping Level Below Land Surface
31 Ft. After 72 Hrs. pumped 13,900 GPM
____ Ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate: ____ GPM

REMARKS
Horizontal Collector Well Installed at TW-1 location
Missouri : Elk Point

This well was drilled under license # 513 and this report is true and accurate.
Drilling firm: Layne
Signature of License Representative: Bradley Hamm
Signature of Well Owner or Equitable Property Holder:
Date: 11/18/15

RECEIVED
DEC 11 2015
WATER PROGRAMS

8212-3

SD EForm - 1311LD V1

Form 10

NOTICE OF COMPLETION OF WORKS AND APPLICATION OF WATER TO BENEFICIAL USE

Date 8/29/19

MAIL TO: PMB 2020
DENR - Water Rights Program
523 E Capitol Ave
Pierre, SD 57501-3182
ph. (605) 773-3352

FROM: City of Yankton
(name)
105 West Riverside Dr
(address)
Yankton (city) SD (state) 57078 (zip) 605-668-5272 (phone)

I have completed the construction of the water use system and I have put the water to beneficial use to the maximum extent it is going to be used.

Water Permit No. 8212-3 states that the water use system is to be constructed by May 2017 ~~8/29/19~~ (date), and water is to be put to beneficial use by October 2017 (date)

The water use system was completed on October 2017 (date)

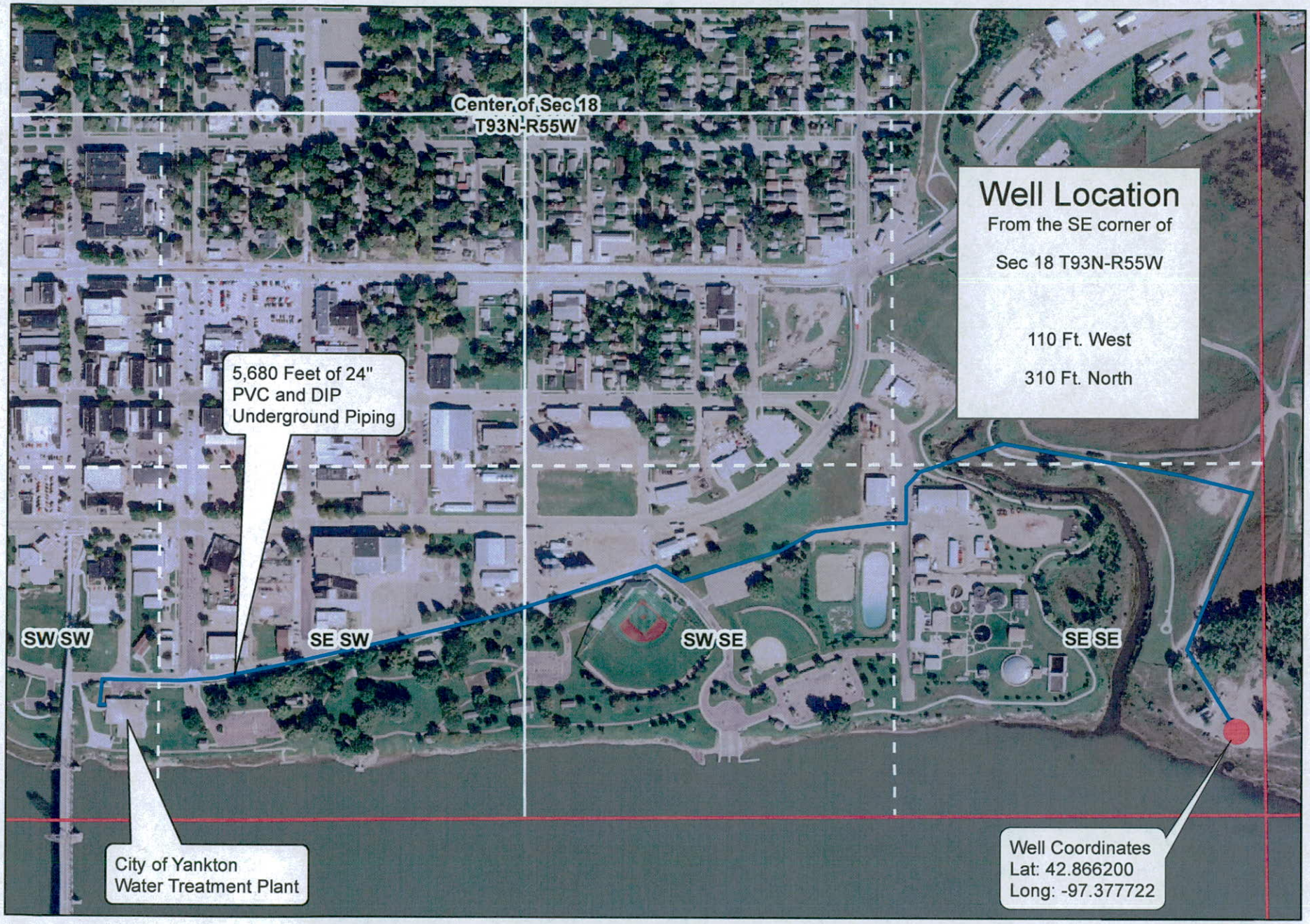
Applying the water to beneficial use was completed on October 2017 (date)

You may schedule an investigation so that the water license may be issued.

Dave Duff

2010-01

Water Right No. 8212-3



0 165 330 660 990 1,320 Feet

SCALE

N

Keith DeJong

Keith DeJong, PE
Staff Engineer
September 3, 2019

DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3182
http://denr.sd.gov

FEB 2 7 2020

8212-3

Kyle Goodmanson, Director of Environmental Services
City of Yankton
PO Box 176
Yankton SD 57078

Dear Sir:

Enclosed is Water License No. 8212-3. This is the final water right document completing your process of obtaining a Water Right. Included with your license is a map prepared by the staff engineer who conducted the field investigation.

For your information SDCL 46-6-27 requires that if in the future, the owner of an existing well, constructs a replacement well and does not plan to use the old well, the old well is considered abandoned and must be plugged. Also, any well that is being used or is not considered abandoned must be valved and controlled, if flowing, or sealed and capped so that no leaking occurs either underground or at the surface.

As long as you use the water beneficially, as stated in the Water License, the State Water Laws provide that you have a continuing right to use the water. If you have any questions, please contact our office.

Sincerely,

Jeanne Goodman

Jeanne Goodman, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

STATE OF SOUTH DAKOTA
WATER LICENSE NO. 8212-3

(1) The City of Yankton, 305 W Riverside Drive, Yankton SD 57078 made Application No. 8212-3, March 25, 2016 for a water permit to divert 20.12 cubic feet of water per second (6,050 acre feet of water annually) from ground water, one well (Missouri Elk Point Aquifer), Yankton County, South Dakota for municipal purposes. Permit No. 8212-3, with a priority date of March 25, 2016 was approved June13, 2016 and issued to the applicant for diversion of water with construction of the described water supply system to be completed on or before June 13, 2021 and for the application to beneficial use of water on or before June 13, 2025.

The Permit holder submitted a "Notice of Completion of Works and Application of Water to Beneficial Use" on August 28, 2019. The "Notice" stated the water use system was completed and the water placed to beneficial use in October 2017.

(2) It is certified that the permit holder has complied with the provisions of South Dakota State Law relating to completion of the water supply system and is entitled to divert 20.12 cubic feet of water per second for beneficial use. The well is located:

- 110'W and 310'N of the SE corner of Section 18, T93N, R55W (SE ¼ SE ¼)
  Latitude 42.866200, Longitude -97.377722

(3) The permit holder has complied with the provisions of South Dakota State Law relating to the application of water to beneficial use.

(4) Pursuant to South Dakota Water Law 46-5-30.1 the City of Yankton, 305 W Riverside Drive, Yankton SD 57078 the holder and/or owner of Water Right No. 8212-3 is issued a license to appropriate water, the right to use 20.12 cubic feet of water per second (6,050 acre feet annually) from ground water, one well (Missouri Elk Point Aquifer) with a priority date of March 25, 2016 from the location specified in (2) of this license for municipal purposes.

This license is subject to South Dakota Water Law, any limitations or conditions listed in Water Right No. 8212-3 and subject to the following qualifications:

- The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.

- The well authorized by Permit No. 8212-3 shall be constructed by a licensed well driller and construction shall comply with the Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28. ***The well was drilled in October 2015 by Layne Christensen Co. A copy of the well completion report is on file with the Water Rights Program.***

Continued

- The Water Right holder shall report to the Chief Engineer annually the amount of water withdrawn from the Missouri: Elk Point Aquifer.

- Water Right No. 8212-3 authorizes a total annual diversion of 6,050 acre feet of water.

Jeanne Goodman

Jeanne Goodman, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

FEB 2 7 2020
date