

WATER PERMIT NO. 2633B-2

Name of Applicant: Southern Black Hills Water System

Address: 26858 Hwy 385, Hot Springs SD 57747

Phone: 605 745-4669

Amount of Water Claimed: 0.67 cfs – 480 AF

Total Acres: NA

Source of Water Supply: groundwater (2 wells)

Water to be used for: rural water system use

County: Custer

Type of Waste Disposal System:

Location: 5 miles north of Hot Springs

PRIORITY Date Received: 5-14-18

Application/License Fee: \$ 300

Corrected Application Received:

Period of Annual Use: Jan 1 – Dec 31

Remarks: Serves users in Custer, Fall River and Pennington Counties

Diversion Point: N 1/2 SE 1/4 Sec 24-T6S-R5E

Land to be Irrigated: NA

Depth of Well: 883

Well Driller: Taylor Drilling

Remarks:

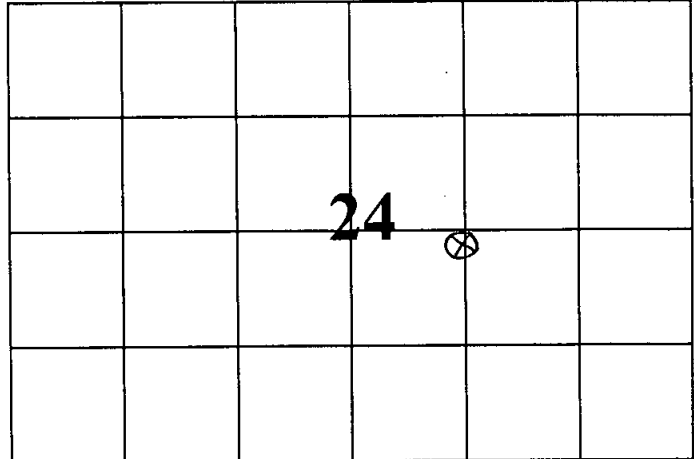
Type of Map: aerial

Prepared by:

Reviewed and the Number Assigned on: 5-14-18

By: Karen Schlaak

Notice of Hearing - date to intervene: _____



SOUTH DAKOTA
WATER PERMIT NO. 2633B-2

Date of first receipt of application May 14, 2018.

The Water Management Board approved Water Permit No. 2633B-2 on July 12, 2018 for Southern Black Hills Water System, 26858 Hwy 385, Hot Springs SD 57747 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. 2633B-2 amends Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually at a maximum pump rate of 0.67 cubic feet of water per second from one well to be completed into the Madison Aquifer located in the SE 1/4 SE 1/4 Section 35-T5S-R6E. This authorizes the point of diversion be transferred to two Madison Aquifer wells (883 and 923 feet deep) located in the N 1/2 SE 1/4 Section 24-T6S-R5E which is approximately 6 miles southwest of the original well location. The second well will be a monitoring well but also, if needed, serve as an emergency backup well. This site is located approximately five miles north of Hot Springs.
2. The water appropriated shall be used for the purpose of a rural water system serving users in Custer, Fall River and Pennington counties 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 from which applicant may claim right is June 20, 2008 (established by Permit No. 2633-2).
5. All construction is to be completed on or before July 12, 2023.
6. Water is to be put to beneficial use on or before July 12, 2027.
7. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. In accordance with SDCL 46-1-14 and 46-2A-20, Permit No. 2633B-2 is issued for a twenty year term. Pursuant to SDCL 46-2A-21, the twenty year term may be deleted at any time during the twenty year period or following its expiration. If the twenty year term is not deleted at the end of the term, the permit may either be cancelled or amended with a new term limitation of up to twenty years. Permit No. 2633B-2 may also be cancelled for nonconstruction, forfeiture, abandonment or three permit violations pursuant to SDCL 46-1-12, 46-5-37.1 and ARSD 74:02:01:37.
2. The wells 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 withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
3. Southern Black Hills Water System shall report to the Chief Engineer annually the amount of water withdrawn from the Madison aquifer.

(continued)

4. Water Permit Nos. 2633-2, 2633A-2, and 2633B-2, combined appropriate up to 484 acre feet of water annually.
5. Southern Black Hills Water System under this permit shall control withdrawals from the well so there is not a significant effect on the water flow from Beaver Creek Springs or a significant adverse effect on the water quality and character in Beaver Creek Springs.

WATER MANAGEMENT BOARD

By: _____

Jeanne Goodman

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

SEP 04 2018

date



Mail to: DENR - Water Rights 523 E Capitol Ave Pierre, SD 57501-3182 ph. (605) 773-3352	No. <u>2633B-2</u> (office use only) Hydrologic Unit <u>10120109</u>
	Basin <u>Upper Cheyenne</u>
	Newspaper <u>Hot Springs Star</u> <u>Custer County Chronicle</u> <u>Rapid City Journal</u>

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

Check use(s) of water:

☐ Municipal	☐ Water Distribution System	☐ Recreational	☐ Institutional
☒ Rural Water System	☐ Commercial	☐ Fish & Wildlife	☐ Geothermal
☐ Domestic (over 18 gpm)	☐ Industrial	☐ Other _____	

Type of Application: (check one)

☐ 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. <u>2633A-2</u>		

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

Transfer of diversion point to 2 wells in the N 1/4, SE 1/4, Section
24-T6S-R5E, Custer County

1. Name to Appear on Water Permit Southern Black Hills Water System
Mailing Address 2665E Highway 355 Hot Springs SD 57747
(Address) (City) (State) (Zip Code)
Phone 605.745.4469 Mobile _____ Email sblh@goldenwest.net

2. Amount of water claimed .67 *CFS or 300 **GPM and 484 ***AF or _____ Gallons
Flow rate and volume are both required. (*Cubic Feet per Second) (**Gallons per Minute) (***)Acre Feet - storage capacity of dam/dugout or annual use)

3. Source of water supply Madison Aquifer

4. Location of point of diversion transfer from well in the SE 1/4 of S35 county Custer
(example - 3 wells in SW 1/4 NE 1/4 section 12-T104N-R53W) T6S, R5E

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

If "Yes," where will water be used? new location: N 1/4 SE 1/4 Sec 24-T6S-R5E
(example - NW 1/4 section 12-T104N-R53W)

5. County or counties where water will be used Fall River, Custer and Pennington Counties

6. Annual period during which water is to be used January 1 to December 31

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)

Please see attached sheet.

I, Don Peterson Manager, the applicant, certify under
Name of Person Title (if applicable)

penalty of perjury that I have read this application, examined the attached map, and that the matters stated are true. I further certify, if acting on behalf of an entity or individual other than myself, that I am authorized to submit this application.

Project Description

Water Permit # 2633A-2 is for the Southern Black Hills Water System ("SBHWS"), a regional/rural water system. This application is to transfer the point of diversion of South Dakota Water Permit # 2633A-2 from the current diversion point located in the SE ¼ of S35, T5S, R6E, Custer County South Dakota to what is known as the Casey well site which consists of two wells in the N1/2, SE1/4, S24, T6S, R5E, Custer County South Dakota. The SBHWS currently holds South Dakota Water Permit #2633A-2, authorizing appropriation of 484 acre feet annually at a maximum diversion rate of .67 cfs (300 gpm) from the Madison Aquifer. SBHWS seeks to change the point of diversion for this diversion rate and volume to the Casey well site, also from the Madison Aquifer.

The SBHWS Engineering Report has previously been submitted to the South Dakota Department of Environment & Natural Resources regarding the proposed new location. A report with the results of a pump test conducted at the new proposed point of diversion (known as the Casey well), dated January 3, 2018, was previously mailed to Mr. Adam Mathiowetz of the Water Rights Program. A monitoring well (MW-1), constructed in 2017, will serve as an emergency backup/standby well. Two figures showing well locations are attached, as are the well logs for the two wells.

Supplemental Information

(type or print)

1. Well Information (check one or both as applicable) ☐ Drilling new well(s) ☒ Using existing well(s)

a) If new wells, how many ____ Have test holes been drilled ☐ Yes ☐ No Drilled by ____
(if yes, please provide copies of logs)

b) If existing wells, how many 2 Provide copy of log(s), if available. Drilled by Taylor Drilling,

For either Existing or Proposed Wells:

Alexander Drilling, Inc.

c) Well Depth (required) 883 Depth to Top of Water Bearing Material 811 Depth to Water from Surface 402

d) Distance to nearest domestic well on applicant's property 129 feet (m.w.) Property owned by others 25 miles

2. Wastewater Disposal System Information

a) Type of System (i.e. septic tank, drain field) Holding tank is pumped and waste water

b) System Capacity (gallons) ____ Year Constructed ____
hauled off-site

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)

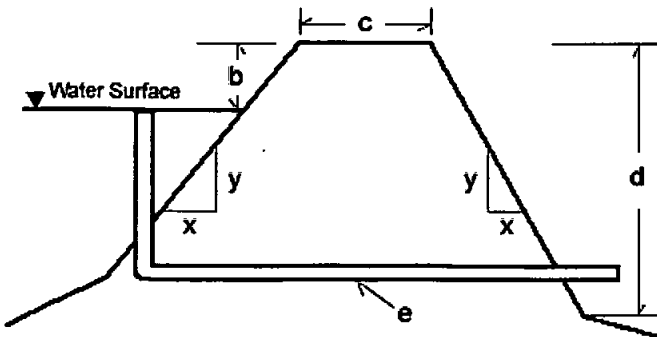
Upstream ____

Downstream ____

h) Surface Area of Impoundment ____

i) Storage ____ Acre Feet

j) Drainage Area Above Dam ____ Acres

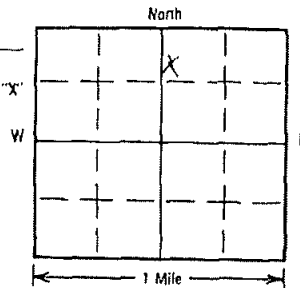


SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

Location NW 1/4 NE 1/4 Sec 24 Twp 6S Rg 5ECounty Custer

Please mark well location with an "X"

Well Completion Date May 1994

LOCATION:

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.) >1500 ft. from septic tank (identify source).

PROPOSED USE:

☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Air Rotary

CASING DATA:

☒ Steel ☐ Plastic ☐ Other

If other describe _____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
<u>23</u> LB/FT	<u>7</u> IN	<u>0</u> FT	<u>873</u> FT	<u>8 3/4</u> IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
<u>Cement</u>	<u>120</u>	<u>14</u> lb./gal	<u>0</u> ft	<u>873</u> ft
		lb./gal	ft	ft

Describe grouting procedure pressure grouted through casingSCREEN: ☐ Perforated pipe ☐ Manufactured

Diameter _____ IN Length _____ FEET

Material _____

Slot Size _____ Set From _____ Feet to _____ 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 chlorine solution
☐ NO. Why Not? _____Laboratory _____ for water quality analysis Pump not set yetWell Owner: Dennis Casey

Business Name: _____

Address: 233255 S. Airport Rd
Rapid City SD 57701

WELL LOG:

FORMATION	DEPTH	
	FROM	TO
Red clay	0	10
gravel	10	17
red shale	17	87
limestone	87	111
red shale	111	220
red shaley ss	220	250
red ss	250	304
buff LS	304	310
red shale	310	315
yellow red ss	315	378
yellow red limestone	378	433
purple shale	433	442
limestone red to purple ss	442	587
lavender to buff limestone	587	795
red to purple shale	795	811
white limestone w/shale-filled caves	811	883

STATIC WATER LEVEL 418 Feet

If flowing: closed in pressure _____ PSI

GPM flow _____ through _____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other _____

Reduced Flowrate _____ GPM

Can well be completely shut in? _____

WELL TEST DATA:

☐ PumpedDescribe: Air Developed☐ Bailed☒ Other

Pumping Level Below Land Surface

800 ft After 2 Hrs pumped 200 GPM

_____ ft After _____ Hrs pumped _____ GPM

If pump installed, pump rate _____ GPM

REMARKS

This well was drilled under license # 331

And this report is true and accurate.

Drilling firm: Taylor Drilling

Signature of License Representative: _____

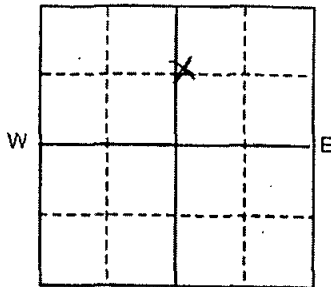
Signature of Well Owner or Equitable Property Holder: Ralph TaylorDate: 6/24/94

SOUTH DAKOTA WATER WELL COMPLETION REPORT

11-02

Location NE 1/4 NW 1/4 Sec 24 Twp 6S Rg 5ECounty Custer

North

Please mark well
location with an "X"

Well Completion Date

7/21/17

1 Mile

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

PROPOSED USE:

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

METHOD OF DRILLING:

Rotary Downhole Hammer

CASING DATA:

☒ Steel ☐ Plastic ☐ Other
 If other describe 863' of 7" OD Steel

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
<u>17</u> LB/FT	<u>7"</u> IN	<u>0</u> FT	<u>923</u> FT	<u>8.75</u> IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
<u>Portland II</u>	<u>125</u>	<u>Lb/gal</u>	<u>863</u> Ft	<u>0</u> Ft
<u>w/2% benton</u>		<u>Lb/gal</u>	<u>Ft</u>	<u>Ft</u>

Describe grouting procedure
through casing

SCREEN:

☐ Perforated pipe ☐ Manufactured

Diameter _____ Inches Length _____ Feet

Material _____

Slot Size _____ Set From _____ Feet to _____ 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? w/chlorine solution☐ No, Why Not? _____Lab to which water
quality sample sent for analysis _____

Well Owner: _____

Business Name: Southern Black Hills Water SystemsAddress: 26858 Highway 385City, State, Zip: Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH	
	FROM	TO
Cemented Gravel	0	15
Spearfish shale	15	100
Minnekahta limestone	100	135
Opeche shale	135	225
Minnelusa	225	825
Madison white limestone shale	825	923
filled caves		

STATIC WATER LEVEL

407 FEET

If flowing: closed in pressure _____ PSI

GPM flow 300+ through _____ Inch pipeControlled by ☐ Valve ☐ Reducers ☐ Other _____

Reduced flow rate _____ GPM

Can well be completely shut in? _____

WELL TEST DATA:

☒ Pumped Describe: w/air☐ Bailed☐ Other _____

Pumping Level Below Land Surface

_____ Ft. After _____ Hrs. pumped _____ GPM

_____ Ft. After _____ Hrs. pumped _____ GPM

If pump installed, pump rate: _____ GPM

REMARKS

Madison 1MThis well was drilled under license # 324 and this
report is true and accurate.Drilling firm: Alexander Drilling Inc.

Signature of License Representative: _____

Signature of Well Owner or Equitable Property Holder: _____

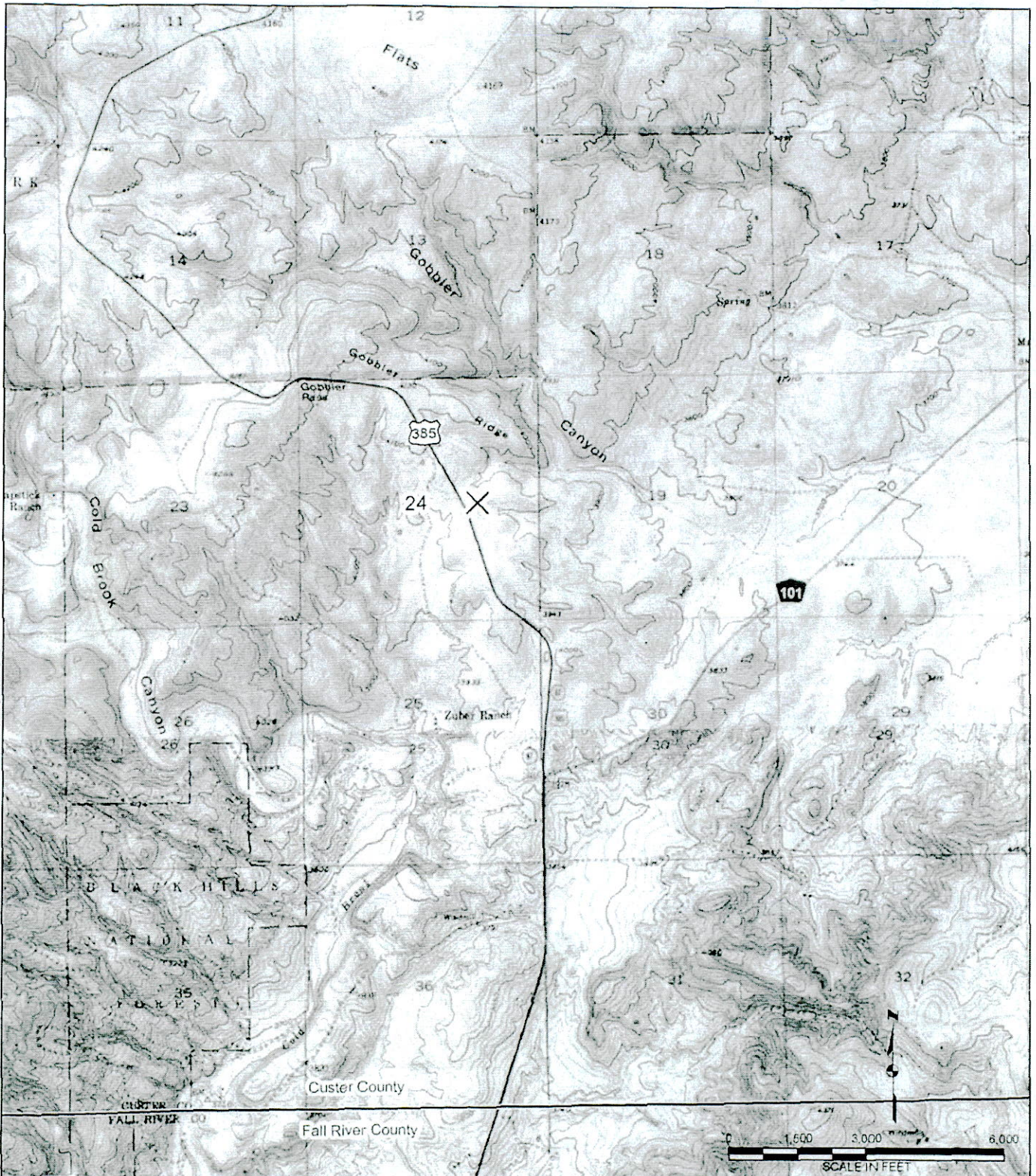
Date: 7-27-17

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JUL 31 2017

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D:\GIS\SBH\SBH_Casey_Diversion.mxd Created By: Kurlen Last Edited By: stefanm 3/14/2018 12:14:55 PM NAD 1983 UTM Zone 13N



Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed

X Diversion Point (Casey Well)



WSP USA, Inc.
140 East Hinks Lane
Suite 126
Sioux Falls, SD 57104
TEL: +1 605 334 6000
FAX: +1 605 334 1850

SOUTHERN BLACK HILLS WATER SYSTEM LOCATION OF DIVERSION POINT

NORTH 1/2 OF THE SOUTHEAST 1/4 OF SECTION
24, TOWNSHIP 6 SOUTH, RANGE 5 EAST

Path: D:\GIS\SBH\SBH_Casey_Diversion.mxd

Date: 14 Mar 2018

FIGURE 1

D:\GIS\SBH\SBH_Casey_MW1.mxd Created By: Karen Last Edited By: stefandm 3/14/2018 4:49:40 PM NAD 1983 2011 UTM Zone 13N



-  Observation Well
-  Casey Well (Pumping Well)

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



WSP USA, Inc.
140 East Hinks Lane
Suite 126
Sioux Falls, SD 57104
TEL: +1 605.334.6000
FAX: +1 605.334.1850

SOUTHERN BLACK HILLS WATER SYSTEM DETAILED LOCATION OF CASEY WELL AND MW-1

NORTH 1/2 OF THE SOUTHEAST 1/4 OF SECTION
24, TOWNSHIP 6 SOUTH, RANGE 5 EAST

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date May 14

, 20 18

RECEIVED OF Gunderson, Palmer, Nelson & Ashmore LLP PO Box 8045 Rapid City, SD 57709-8045

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

Fee for Application for Permit No. _____ to Appropriate Water, to construct and to put water to beneficial use	100	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. _____	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	300 00

No. 08661

By Jeanne Goodman
Chief Engineer vm



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MAY 14 2018

WATER RIGHTS
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506 Sixth Street
Post Office Box 8045
Rapid City, South Dakota 57709
Main: (605) 342-1078
Fax: (605) 342-9503

www.gpna.com

Email: mnaasz@gpna.com
Direct Dial: (605) 719-3424

May 11, 2018

Mr. Eric Gronlund
South Dakota Department of Environmental &
Natural Resources
Water Rights Program
523 E. Capitol Avenue
Pierre, SD 57501-3182

Re: Trailer Well Permit Application/Casey Well
GPNA File No. 07653.0014

Dear Mr. Gronlund:

Enclosed is an Application to Amend/Correct Water Permit #2633A-2 on behalf of the Southern Black Hills Water System ("SBHWS"). Also enclosed is a check in the amount of \$300.00 for this application, as we discussed on the telephone.

SBHWS is requesting that the point of diversion of Water Permit #2633A-2 be transferred to two wells located in the N1/2, SE1/4, Section 24-T6S-R5E, Custer County ("Casey well"). Water Permit #2633A-2 appropriates 484 acre feet of water annually at a maximum diversion rate of .67 cfs (300 gpm) from the Madison Aquifer. SBHWS requests the transfer of this appropriation for the same annual volume at the same maximum diversion rate, from the same groundwater source, the Madison Aquifer.

The requested new point of diversion is an existing well, constructed in 1994 for Mr. Dennis Casey. The Casey well and property the well is located on are now owned by SBHWS. In July 2017, SBHWS constructed a monitoring well ("MW-1") at a location 129 feet west of the Casey well. Two figures are attached to the application, showing the location of the two wells. Should this transfer be granted, the Casey well will be utilized to supply the SBHWS. MW-1 will be utilized primarily as a groundwater elevation monitoring well. It will also, if needed, serve as an emergency backup well.

SBHWS recently filed an application for a new appropriation of water at the Casey well for the same diversion authority and annual volume from the Madison Aquifer. After discussing the needs of the SBHWS, and the permits currently in place, the SBHWS concluded that it would be more efficient to apply to move the point of diversion from Water Permit #2633A-2 to the Casey well without currently seeking additional appropriation authority from the Madison Aquifer.

GUNDERSON | PALMER | NELSON | ASHMORE LLP

Attorneys licensed to practice in South Dakota, North Dakota, Nebraska, Wyoming, and Montana

The pending new application at the Casey well is for the same diversion authority as Water Permit #2633A-2 and also requests to appropriate from the Madison Aquifer. It is the intention of SBHWS that should the amendment to Water Permit #2633A-2 be granted, and the diversion point for that permit transferred to the Casey well, the SBHWS will withdraw its application for a new appropriation at the Casey well. With that understanding, SBHWS requests that the application for the new appropriation at the Casey well (which application was received by the Water Rights Program on March 26, 2018) be held in abeyance until the application to Amend/Correct Water Permit #2633A-2 has been finally determined.

Thank you for your assistance. If you have any questions or need additional information, please contact Talbot Wiczorek or me, at (605) 342-1078, or Don Peterson, Manager, Southern Black Hills Water System at (605) 745-4669.

Sincerely,

A handwritten signature in black ink, appearing to read 'M. Naasz', with a long horizontal flourish extending to the right.

Matthew E. Naasz

MEN:jkg
Enclosures

LEGGETTE, BRASHEARS & GRAHAM, INC.

PROFESSIONAL GROUNDWATER AND ENVIRONMENTAL ENGINEERING SERVICES

140 East Hinks Lane, Suite 126
Sioux Falls, SD 57104
605-334-6000
FAX 605-334-1850
www.lbgweb.com

February 6, 2017

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FEB 13 2017

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Mr. Jeffrey C. Hughes, Hydrologist
National Park Service
Water Resources Division
Natural Resources Stewardship and Science Directorate
1201 Oakridge Drive, Suite 250
Fort Collins, CO 80525

RE: Report Transmittal
Southern Black Hills Water System, Inc.
Trailer Well Step-Rate Pumping Test

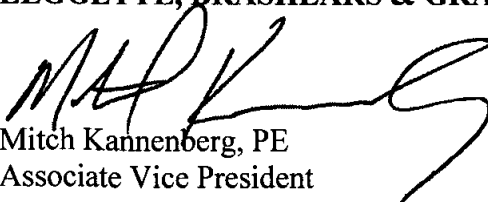
Dear Mr. Hughes:

Attached for your information and review is a report presenting the results of a step-rate pumping test for a Madison aquifer well owned by Southern Black Hills Water System, Inc. I would welcome the opportunity to discuss this report with you.

Copies of this report are also being provided to Mr. William Eldridge of the United States Geological Survey, and Ms. Jeanne Goodman of the South Dakota Department of Environment & Natural Resources.

Thank you for your consideration.

Sincerely,
LEGGETTE, BRASHEARS & GRAHAM, INC.


Mitch Kannenberg, PE
Associate Vice President

Enclosure: Trailer Well Step-Rate Pumping Test Report

Pc: Mr. Don Peterson – Southern Black Hills Water System, Inc., Hot Springs, SD (9 copies)
Ms. Jeanne Goodman, P.E. – DENR, Pierre, SD
Mr. William Eldridge – USGS, Rapid City, SD

RECEIVED

FEB 13 2017

**WATER RIGHTS
PROGRAM**

**TRAILER WELL STEP-RATE PUMPING TEST
SOUTHERN BLACK HILLS WATER SYSTEM**

HOT SPRINGS, SOUTH DAKOTA

Prepared For:

Southern Black Hills Water System
26858 Highway 385
Hot Springs, SD 57747

February 6, 2017

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater and Environmental Engineering Services
140 East Hinks Lane, Suite 126
Sioux Falls, SD 57104
(605) 334-6000

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(at end of report)

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- 2 Water Quality Monitoring Data – SBHWS Trailer Well Step-Rate Test
- 3 Water Quality Analytical Results – SBHWS Trailer Well

LIST OF FIGURES
(at end of report)

Figure

- 1 Well Location Map & Vicinity Geologic Map
- 2 Kaiser Well Water Level Elevations & Trend Line
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- 4 Background Water Level Data & Atmospheric Pressure
- 5 Depth to Water versus Time, SBHWS Trailer Well Step-Rate Test
- 6 Drawdown versus Elapsed Time, SBHWS Trailer Well Step-Rate Test

LIST OF APPENDICES
(at end of report)

Appendices

- A South Dakota Water Well Completion Reports/Well Logs
- B Trailer Well Step-Rate Test Data Sheet
- C Kaiser Well Water Level versus Atmospheric Pressure
- D Water Quality Analytical Report

TRAILER WELL STEP-RATE PUMPING TEST SOUTHERN BLACK HILLS WATER SYSTEM

HOT SPRINGS, SOUTH DAKOTA

1.0 PURPOSE AND BACKGROUND INFORMATION

The purpose of this report is to provide the results of a Step-Rate Pumping Test (Step-Rate Test) conducted on the Southern Black Hills Water System (SBHWS) Trailer well. The purpose of the Step-Rate Test was to provide information regarding the potential yield of the well, and to provide information regarding the well water quality. The Leggette, Brashears & Graham, Inc. (LBG) proposal for this work, dated May 26, 2016, was authorized by SBHWS on May 26, 2016.

All elevations in this report are referenced to mean sea level in the National American Vertical Datum of 1988 (NAVD88). Time is referenced in this report utilizing the 24-hour format (also known as “military” time).

1.1 Project Location, Trailer Well Information and Temporary Permit

The Trailer well is located on SBHWS property located approximately 4½ miles north of Hot Springs, in the southwest quarter of Section 24, Township 6 South, Range 5 East, Custer County, South Dakota. The well location is shown in a geologic map of the vicinity (Figure 1), along with the location of Wind Cave mapped passages and the location of Beaver Creek Springs. Also shown in Figure 1 are the locations of other Madison aquifer wells in the vicinity, including the SBHWS Streeter well.

The SBHWS Trailer well was constructed by Taylor Drilling for Mr. Dennis Casey, the former owner of the SBHWS property. The well depth is 883 feet (ft), and it is completed in the upper 72 ft of the Madison aquifer. A copy of the well completion report is provided in Appendix A.

The South Dakota Department of Environment & Natural Resources (DENR) issued a temporary permit to use public waters for testing purposes, and authorized discharge from the well under the South Dakota Surface Water Discharge System General Permit for Temporary

Discharge Activities in South Dakota. These two authorizations are collectively referred to in this report as the “Temporary Permit.”

The Temporary Permit authorized pumping at the rates of 100, 150 and 200 gallons per minute (gpm) for three hours each step, for a total of nine hours. Monitoring and reporting conducted relative to the Temporary Permit are discussed in a later section of the report.

1.2 National Park Service Kaiser Well and DENR Observation Well

The United States Geological Survey (USGS), on behalf of the National Park Service (NPS), monitored water levels in a domestic well referred to as the Kaiser well. The Kaiser well is located approximately ½-mile (~2,800 ft) northwest of the Trailer well (Figure 1). The Kaiser well is a domestic well originally constructed by Bice and Taylor Drilling for Mr. Lester Kaiser in 1977. The well depth is 780 ft and it is completed in the upper 90 ft of the Madison aquifer. Water levels in the well were monitored by the USGS with a data-logging pressure transducer and manual measurements collected utilizing an electronic water-level indicator. The USGS also monitored atmospheric pressure at the Kaiser well utilizing a data-logging barometric pressure transducer. The water-level data were provided to LBG by the USGS (William Eldridge, Personal Communication, 2016). A copy of the well log is provided in Appendix A.

The DENR maintains a Madison aquifer observation well called CU-91A. CU-91A is located approximately 2.3 miles (~12,300 ft) east of the Trailer well (Figure 1). The well is equipped with a data recorder that logs and records the water level in the well. CU-91A is 1,165 ft deep and is completed in the upper 115 ft of the Madison aquifer. A copy of the well log is provided in Appendix A. The water-level data from CU-91A were provided to LBG by the DENR (Ken Buhler, Personal Communication, 2016).

A summary of construction details and other information regarding the Trailer well, the Kaiser well, and CU-91A is provided in Table 1. Also shown in Table 1 is the radial (straight-line) distance of the two observation wells from the Trailer well, and the water level elevation data for the three wells prior to initiating pumping for the Step-Rate Test. The water-level elevation in the Trailer well was 3,658.28 ft, and the water-level elevation in the Kaiser well was 3,658.37 ft (0.09 feet higher than the Trailer well water-level elevation). These elevations are from water-level measurements taken at 06:30 on September 8, 2016. The water-level elevation

at CU-91A was 3,659.90 ft, which is 1.62 ft higher than the water level elevation at the Trailer well. The water-level elevation measurement for CU-91A was recorded at 0:00 on September 8, 2016.

2.0 STEP-RATE TEST PUMPING PERIOD

The Step-Rate Test was conducted in the Trailer well on September 8, 2016, at three different pumping rates. Pumping for Step 1 was initiated at 07:00, Step 2 was initiated at 10:00, and Step 3 was initiated at 13:00. Pumping was discontinued at 16:00.

Alexander Drilling, Inc. (Alexander) furnished and installed a 6-inch diameter submersible pump and 60 horsepower (hp) motor, along with the wellhead connections, discharge piping, in-line totalizing flow meter, and electric power generator utilized to power the pump. The pump intake was at 830 ft below top of casing.

Alexander installed a sounding tube for water-level measurements. In the Step-Rate Test planning stage, the “Well Test Data” reported on the South Dakota Water Well Completion Report (see Appendix A) indicated a pumping level of 800 ft at a pumping rate of 200 gpm. The static (non-pumping) water level was 418 ft. This information was interpreted as an actual pumping level (as opposed to the level at which air was being applied to the well during air-lift pumping), and a water-level change during pumping of nearly 400 ft was thought possible. Data-logging pressure transducers capable of accurate pressure measurements over that range of values are not readily available. Consequently, a 1,000-foot electronic water-level indicator was rented for the purpose of measuring water-levels in the Trailer well. Water-level measurements were made relative to the top of the sounding tube, which was 28.75 inches (2.396 ft above ground surface). The static water level measured in the Trailer well at 06:30, prior to the start of the Step-Rate Test, was 401.89 ft below the top of the sounding tube, which is equivalent to 399.49 ft below ground surface (ft bgs). Specific references to depth to water in the Trailer well in the remainder of this report are relative to the top of the sounding tube.

2.1 Madison Aquifer Water Level Trends Before and After Step-Rate Test

Monitoring of water levels in the Kaiser well was initiated by the USGS on August 5, 2016, approximately one month prior to the Step-Rate Test. The Kaiser well water-level elevation data for the period of August 5, 2016 through September 22, 2016, are shown graphically in Figure 2. The water level varied from a high of 3,658.67 ft to a low of 3,658.15 ft over this period. The difference between the high and low value is 0.52 ft. The average depth to water in the Kaiser well over this period was approximately 462 ft. Also shown in Figure 2 is a linear regression trend line for the water-level elevation data.

The water-level elevations in DENR observation well CU-91A measured over the same time period (August 5, 2016 to September 22, 2016) are shown in Figure 3. The water level varied from a high of 3,660.24 ft to a low of 3,659.42 ft over this period. The difference between the high and low value is 0.82 ft. A linear regression trend line is also shown in Figure 3. The Madison aquifer potentiometric head (height water will rise in an open well) at CU-91A is above the ground surface (it is a flowing well). The average distance between the top of casing and the water level in the well during this period was approximately 12½ ft.

The overall water-level trend in both observation wells over the indicated time period is decreasing. The frequent minor variations in the water level elevations are due to changes in atmospheric pressure. Changes in atmospheric pressure instantaneously induce changes in water level in a confined aquifer, with increasing pressure resulting in increasing depth to water, and vice versa. More information regarding water levels in these two observation wells is provided in a later section of this report.

2.2 Step-Rate Test Pumping and Recovery

Pumping from the Trailer well was initiated at 07:00, and the first five minutes or so of pumping were spent adjusting the flow control valve to get the pumping rate set to the first step of 100 gpm. The well was pumped at approximately 100 gpm for three hours.

The pumping rate was increased to 150 gpm for Step 2, and the well was pumped at approximately 150 gpm for three hours. Due to the minimal drawdown observed in the well, LBG called the DENR and requested permission to increase the maximum pumping rate over what was previously approved for the Temporary Permit. The DENR granted permission to

increase the pumping rate. Therefore, at the start of Step 3 at 13:00, the flow control valve was opened completely. The maximum pumping rate achieved was 270 gpm, and that was the pumping rate maintained for Step 3.

Pumping was stopped, and recovery began at 16:00. The water level rose very rapidly in the well, making an accurate measurement difficult. The water level initially recovered to a level that was higher than the static level measured prior to initiating pumping. The depth to water returned to static (401.89 ft) within 90 seconds after pumping was stopped, and then briefly stabilized at 401.81 ft (again, higher than the static level) within four minutes of pumping cessation. At 26 minutes after pumping was stopped, the water elevation began slowly decreasing. This recovery pattern is unusual, and is discussed further in the *Summary and Discussion* section of this report. Recovery was measured at frequent intervals for a period of two hours after pumping was stopped, reaching a depth to water of 401.88 ft two hours after pumping had ceased. The depth to water the next morning, approximately 15 hours after pumping stopped, was 402.07 ft.

The drawdown and recovery data are tabulated in a Step-Rate Test data sheet. The Step-Rate Test data sheet is provided in Appendix B.

2.3 Step-Rate Test Flow Rate and Discharge Monitoring

Water pumped from the Trailer well was discharged via steel piping and flexible hose onto erosion control devices (anchored plastic tarps) at a location approximately 20 ft south of the well. The discharged water flowed overland a distance of approximately 100 ft to a shallow depression on the SBHWS property, then flowed east and southeast in a shallow, vegetated drainage-way that is the beginning of a minor, un-named tributary to Beaver Creek. The discharge was visually monitored by LBG, and by Wind Cave National Park personnel, and no damage due to erosion occurred along the discharge path. The Madison aquifer at the Trailer well is confined, and the top of the aquifer is approximately 800 feet below ground surface. Consequently, discharge to the ground surface during the Step-Rate Test was not anticipated to recharge the pumped aquifer.

The flow meter provided by Alexander was a new, 3-inch Hersey turbine flow meter. It was installed in accordance with the manufacturer's recommendations for minimum lengths of

straight piping upstream and downstream of the meter. While there was some minimal flow variation (generally within 1 to 2 gpm), the flow rate throughout each of the three steps remained stable. The flow rate data are provided in the Step-Rate Test data sheets provided in Appendix B.

The discharged water pH, temperature, conductivity, and oxygen reduction potential (ORP) was monitored frequently during the Step-Rate Test. The data are shown in Table 2, along with the time of measurement, flow rate at time of measurement, and the approximate cumulative amount of water that had been discharged from the well at the time of measurement. The pH varied from 7.44 to 7.79. The pH limits in the Temporary Permit are from 6.5 to 9.0; therefore, the discharge water pH was in compliance with the Temporary Permit pH limits.

The temperature was approximately 59 to 61 degrees Fahrenheit. The conductivity was approximately 445 micromhos per centimeter (umhos/cm), and the ORP was generally from 40 to 70 millivolts. These water quality parameters remained relatively consistent throughout the duration of the Step-Rate Test.

2.4 Step-Rate Test Data – Qualitative Analysis

The data obtained during the Step-Rate Test include drawdown data (decreasing water levels due to pumping) and recovery data (increasing water levels after pumping had ceased) measured over time. The drawdown and recovery data collected from the Trailer well during the Step-Rate Test do not follow the pattern typically exhibited by a pumping well. When pumping is initiated in a well, the water level typically decreases and continues to decrease the entire time that pumping continues. While the rate of decrease will often slow with time, the water level will continue to decrease. This pattern was not observed in the Trailer well Step-Rate Test.

During Step 1, the magnitude of drawdown actually decreased as pumping continued. For example, at eight minutes into Step 1, the drawdown was 0.53 ft. An hour after Step 1 was initiated, the water-level elevation had increased, and the corresponding drawdown had decreased to 0.39 ft. This uncharacteristic pattern occurred throughout the Step-Rate Test, although the degree of variance was not as great during Step 2.

For this reason, the data from the Kaiser well were examined for background Madison aquifer water-level trends. As indicated previously, the overall water-level trend during the period of August 5, 2016 to September 22, 2016, in both the Kaiser well (Figure 2) and CU-91A

(Figure 3) was decreasing. The frequency of water-level measurements made by the data-recorder in CU-91A is three times daily, which is not enough to utilize for a background water level trend correction. However, the frequency of water-level measurement in the Kaiser well is suitable for use in calculating a background water-level trend correction.

Figure 4 is “zoomed into” the time period of the Step-Rate Test, and shows the water-level in the Kaiser well, in feet above the top of the transducer (which was installed by the USGS at a depth of approximately 19½ ft below water surface in the well) versus time. Also shown in Figure 4 is the start of each Step (07:00, 10:00, 13:00), the end of pumping at 16:00, and the atmospheric pressure.

In general, the water-level in the Kaiser well was decreasing for the first 40 minutes of pumping at the Trailer well, then increasing from 07:42 to 14:13, then decreasing after 14:13. The decreasing trend generally continued for the remainder of the Step-Rate Test, and continued until mid-morning on September 9, 2016. The magnitude of water-level change shown in Figure 4 is small, with the difference between the high and low of 0.25 feet (~3 inches).

The atmospheric pressure measured at the Kaiser well during the Step-Rate Test is also shown in Figure 4. As indicated previously, the atmospheric pressure has an effect on water levels in a confined aquifer. This is clearly shown in Figure 4, with the water level decreasing as atmospheric pressure rises, and vice versa. The data shown in Figure 4 indicate that the water-level variations in the Kaiser well are due to atmospheric pressure. There is no evidence that pumping at the Trailer well had any effect on the water level at the Kaiser well, at least no effect that is not masked by the effect of atmospheric pressure variations. A similar graph showing the relationship between the water level in the Kaiser well and the atmospheric pressure, for the period from August 5, 2016 to September 22, 2016, is provided in Appendix C.

Based on the above information, the Trailer well water-level data were corrected for the background water-level trends observed in the Kaiser Well. Linear trends were approximated for the rising and falling portions of the background Kaiser well water-level data, and these trends were used to correct the water levels observed in the Trailer well. Both the original and corrected data are presented in the depth to water versus time graph for the Step-Rate Test shown in Figure 5.

The drawdown versus time data are plotted on Figure 6. The maximum drawdown (corrected) measured during Step 1 was 0.53 ft which represents a specific capacity for Step 1 of approximately 189 gpm/ft. The maximum drawdown (corrected) measured during Step 2 was 0.83 ft which represents a specific capacity for Step 2 of approximately 181 gpm/ft. The maximum drawdown (corrected) measured during Step 3 was 2.82 ft, which represents a specific capacity for Step 3 of approximately 96 gpm/ft.

LBG attempted a quantitative analysis of the Trailer well drawdown versus time data. However, due to the un-usual pattern of drawdown (with drawdown decreasing with time after the initiation of each of the three Steps), the values for transmissivity (T) varied widely, and no value could be generated with confidence. No pumping-induced drawdown was definitively observed at either observation well, thereby making the determination of storativity (S) impossible. This is discussed further in the *Summary and Discussion* section of this report.

2.5 Yield Estimate for the Trailer Well

The results from the Step-Rate Test indicate that the Trailer well is completed in a portion of the Madison aquifer that likely has a high T and a high S, which would be conducive to a high capacity well. The high T and S are consistent with a well completed in a cavernous portion of the Madison aquifer.

The yield of the Trailer well is primarily limited by the casing size (7-inch), which limits the maximum pump size to six inches. Another limiting factor is friction losses associated with the submersible pump drop pipe. Friction losses decrease with increasing drop pipe diameter. The Trailer well drop pipe diameter is three inches, and friction losses could be reduced by replacing the 3-inch diameter drop pipe with larger (perhaps 6-inch) diameter drop pipe. It is unknown if the well plumbness and alignment is suitable for 6-inch diameter drop pipe.

LBG estimated the well yield under a variety of total dynamic head assumptions, including friction losses with varying drop pipe diameter, friction losses associated with various fittings, and the change in elevation from the pumping level to the ground surface. These assumptions were incorporated into a review of the performance characteristics of submersible pumps as reported by a variety of submersible pump manufacturers. Depending on the system

total dynamic head, it is likely that the maximum yield of the Trailer well is approximately 320 gpm to 370 gpm.

3.0 WATER QUALITY SAMPLE ANALYTICAL RESULTS

A select list of water quality parameters was developed collaboratively by LBG and SBHWS. A water quality sample was collected after approximately 8¼ hours of pumping (just prior to the cessation of pumping). The water quality sample was submitted to Midcontinent Testing Laboratories, Inc. of Rapid City, SD, for analysis of physical properties, metals, non-metals, radionuclides, and total coliform bacteria. The results are provided in Table 3, and the laboratory analytical report is provided in Appendix D. None of the water quality parameters measured in the water quality sample exceed the applicable maximum contaminant level (MCL) or secondary MCL, and the water quality as shown in Table 3 appears suitable for use by SBHWS.

4.0 SUMMARY AND DISCUSSION

The Trailer well Step-Rate Test data indicate that the well is completed in a portion of the Madison aquifer that has a high T and a high S. The specific capacity of the Trailer well corroborates this, with a specific capacity of approximately 100 gpm/ft at a pumping rate of 270 gpm.

It is not known why the drawdown data are so markedly different than the drawdown data that would normally be expected during a pumping test. The observed Madison aquifer background water level trend likely influences the drawdown, but does not fully explain the anomalous pattern of observed drawdown, particularly for Step 1 and Step 3.

One possible explanation for the anomalous pattern of drawdown observed in the Trailer well during the Step-Rate Test relates to well development. Well development, which generally consists of flushing the wellbore and area near the wellbore, repairs the damage to the formation caused by drilling and drilling fluids (drilling mud), and increases the near-well permeability.

While the well was likely developed immediately after construction, it may not have been fully developed. It is LBG's understanding that the Trailer well was originally equipped with a 5 hp, 4-inch diameter pump, which likely did not pump at a rate much more than 10 to 20 gpm. Pumping at the rates achieved with the larger pump utilized for the Step-Rate Test may have resulted in additional development occurring simultaneously with the Step-Rate Test, thereby increasing the well efficiency and the near-well permeability.

The Madison aquifer background water-levels were decreasing (after reaching a transient high on September 8, 2016 at 14:12) during the recovery period after the Step-Rate Test. These background water level trends, along with the minimal amount of drawdown produced by pumping, do explain the Step-Rate Test recovery data.

A quantitative determination of T requires "curve-matching" with varying analytical solutions to the observed drawdown versus time curve. However, due to the uncharacteristic pattern of drawdown observed during the Step-Rate Test, curve-matching for the Trailer well drawdown data is highly subjective, and different analytical solutions and matched curves produced widely varying values for T.

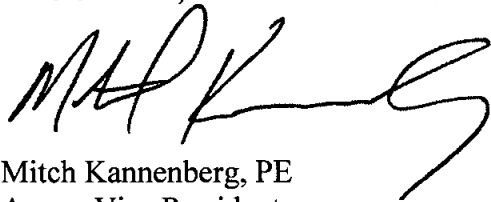
The S could not be determined because the pumping at the Trailer well did not influence the water levels at the observation wells (Kaiser and CU-91A). If it is assumed that the value of S, due to the known intersection of the well with caverns, is in the range of 0.01 to 0.001 (which is not an unreasonable assumption for this well, given the information from the Trailer and Kaiser well logs, and given the nearby presence of Wind Cave), the T can be estimated using the Theis equation and the results from the Step-Rate Test. Utilizing an S of 0.01 to 0.001, LBG estimated a T value ranging from approximately 200,000 to 250,000 gallons per day per foot (gpd/ft), or approximately 27,000 to 33,000 feet-squared per day (ft²/day). While these T&S values are not unrealistic for a karstic aquifer, they are rough estimates only, and may contain a wide margin of error.

The likely well yield, depending on the total dynamic head as influenced by friction losses due to drop pipe and fittings, the elevation head (~400 ft), and the SBHWS distribution system pressure, is likely in the range of 320 gpm to 370 gpm. The water quality appears suitable for SBHWS use.

The purpose of the Step-Rate Test was to provide information regarding the well yield and water quality, and the results suggest that the Madison aquifer in this area is highly productive. An aquifer pumping test could be designed to provide more definitive values for T and S, including the use of a transducer in the Trailer well. The installation of a nearby observation well, one located on the SBHWS property, would significantly improve the T and S values generated from a subsequent aquifer pumping test.

This report was prepared by:

LEGGETTE, BRASHEARS & GRAHAM, INC.

A handwritten signature in black ink, appearing to read 'MK' followed by a stylized flourish.

Mitch Kannenberg, PE
Assoc. Vice President
Project Manager

This report was reviewed by:

A handwritten signature in black ink, appearing to read 'M. Plante'.

Michael C. Plante
Associate

TABLES

Table 1. Pumping and Observation Well Summary - SBHWS Trailer Well Step-Rate Test

Well Name	Top of Casing Elevation (ft)	Land Surface Elevation (ft)	Radial Distance from Pumping Well (ft)	9/8/16 Distance to Water from Reference Point (ft)	9/8/16 Water Level Elevation (ft)	Total Well Depth (ft)	Top of Madison Limestone (ft bgs)	Elevation of Top of Madison Limestone (ft)	Elevation of Bottom of Well (ft)	Well Dia. (in)	Date Drilled
Trailer Well	4060.17	4057.77	0.0	401.89	3658.28	883	811	3246.77	3174.8	7	June 1994
Kaiser Well	4121.56	4120.80	2772.3	462.43	3658.37	780	690	3430.80	3340.8	5.5	April 1977
CU-91A	3647.14	3644.93	12302.0	-12.76	3659.90	1165	1050	2594.93	2479.9	5.5	October 1991

NOTES:

Reference point is top of casing for Trailer well and CU-91A, and ground surface for Kaiser well.

ft = feet

ft bgs = feet below ground surface

in = inches

DIA = diameter

Elevations shown are from measurements taken prior to initiating pumping at the Trailer well.

Elevations relative to National Geodetic Vertical Datum of 1988.

Negative distance indicates water level is above the reference point (flowing well).

Table 2. Water Quality Monitoring Data - SBHSW Trailer Well Step-Rate Test

Time	pH (s.u.)	Temperature (°F)	Conductivity (umhos/cm)	ORP (mV)	Pumping Rate (gpm)	Approximate Gallons Discharged
7:40:00	7.58	59.52	495	70.6	101	4,340
8:01:00	7.58	59.97	463	53.5	99	6,550
8:30:00	7.54	61.18	415	46.8	98	9,010
8:55:00	7.48	60.93	444	53.8	98	11,670
9:40:00	7.44	61.32	444	44.3	98	16,150
10:15:00	7.57	60.98	443	47.7	150	
10:35:00		60.94	443		150	23,090
10:40:00	7.60	60.35	443	54.1	149	
11:15:00	7.70	61.50	447	59.7	149	29,370
11:55:00	7.68	61.18	448	59.2	149	34,150
12:25:00	7.64	60.48	444	56.6	149	40,700
13:19:00	7.68	59.04	443	40.5	270	51,045
13:29:00	7.70	58.87	443	47.2	270	52,930
13:48:00	7.76	59.07	442	50.1	270	57,895
14:00:00	7.78	59.09	441	57.5	270	61,500
14:34:00	7.70	59.25	441	59.2	270	67,980
14:50:00	7.78	59.25	440	63.1	270	74,830
15:05:00	7.70	59.07	441	65.9	270	78,830
15:31:00	7.79	59.23	440	68.7	270	84,830

NOTES:

Test conducted on September 8, 2016.

s.u. = standard units

°F = degrees Fahrenheit

umhos/cm = micro Mhos per centimeter

gpm = gallons per minute

mV = millivolts

Table 3. Water Quality Analytical Results - SBHWS Trailer Well

Analyte	Trailer Well (sample date September 8, 2016)	Units	MCL	Secondary MCL
PHYSICAL PROPERTIES				
Electrical Conductivity	432	umhos/cm		
Hardness	12.0	grains/gallon		
Total Dissolved Solids	235	mg/L		500
Total Suspended Solids	<10.0	mg/L		
RADIONUCLIDES				
Gross Alpha	6.86	pCi/L	15	
Gross Beta	5.54	pCi/L	See Notes	
Radium 226	0.493	pCi/L		
Radium 228	<1.00	pCi/L		
Combined Radium (226 + 228)	<1.493	pCi/L	5	
Uranium, Total	0.005	mg/L	0.030	
BACTERIA				
Total Coliform	Absent	MPN/100 ml		
E. coli	Absent	MPN/100 ml		
NON-METALLICS				
Total Alkalinity (as CaCO ₃)	197	mg/L		
Bicarbonate	241	mg/L		
Carbonate	0.00	mg/L		
Chloride	8.33	mg/L		250
Fluoride	0.396	mg/L	4	2
Ammonia-Nitrogen as N	<0.050	mg/L		
Nitrate as N	0.543	mg/L	10	
Nitrite as N	<0.050	mg/L	1	
Sulfate	17.5	mg/L		250
Total Organic Carbon	0.532	mg/L		
METALS, TOTAL				
Arsenic - Total	0.007	mg/L	0.010	
Barium - Total	0.184	mg/L	2	
Chromium - Total	<0.001	mg/L	0.1	
Iron - Total	0.062	mg/L		0.3
Manganese - Total	<0.010	mg/L		0.05
Selenium - Total	<0.005	mg/L	0.05	
METALS, DISSOLVED				
Calcium - Dissolved	51.0	mg/L		
Magnesium - Dissolved	18.8	mg/L		
Potassium - Dissolved	2.97	mg/L		
Sodium - Dissolved	12.0	mg/L		

NOTES:

MCL = EPA maximum contaminant level

mg/L = milligrams per liter

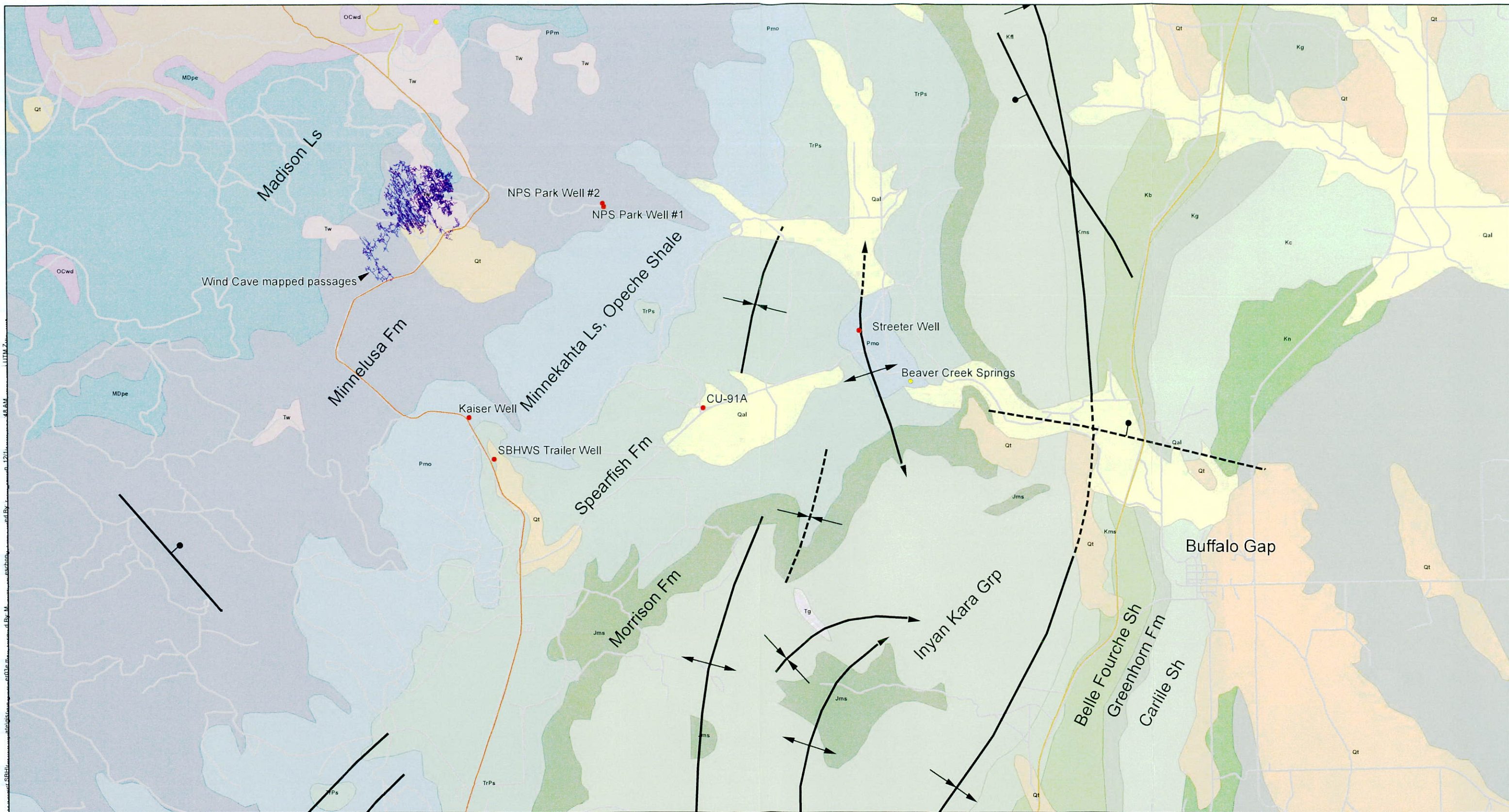
MPN/100 ml = Most Probable Number per 100 milliliters

pCi/L = picocuries per liter

umhos/cm = micro Mhos per centimeter

The MCL for gross beta emitters is 4 millirems per year. In South Dakota, 50 pCi/L is used as a screening level. If the screening level is exceeded, additional information is required to determine if the beta particles and photon emitters concentration exceeds the MCL.

FIGURES



Source: Geologic Map of South Dakota, General Map 10, Martin et al, 2004, accessed from South Dakota Geological Survey <http://arcgis.sd.gov/server/sdgis/Data.aspx#>



0 0.5 1 2
Miles

Legend

- Fault
- Fold
- Well Location



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SOUTHERN BLACK HILLS WATER SYSTEM HOT SPRINGS, SOUTH DAKOTA

WELL LOCATION MAP & VICINITY GEOLOGIC MAP

FILE:	G3custer03e.mxd	DATE:	Nov 16	FIGURE:	1
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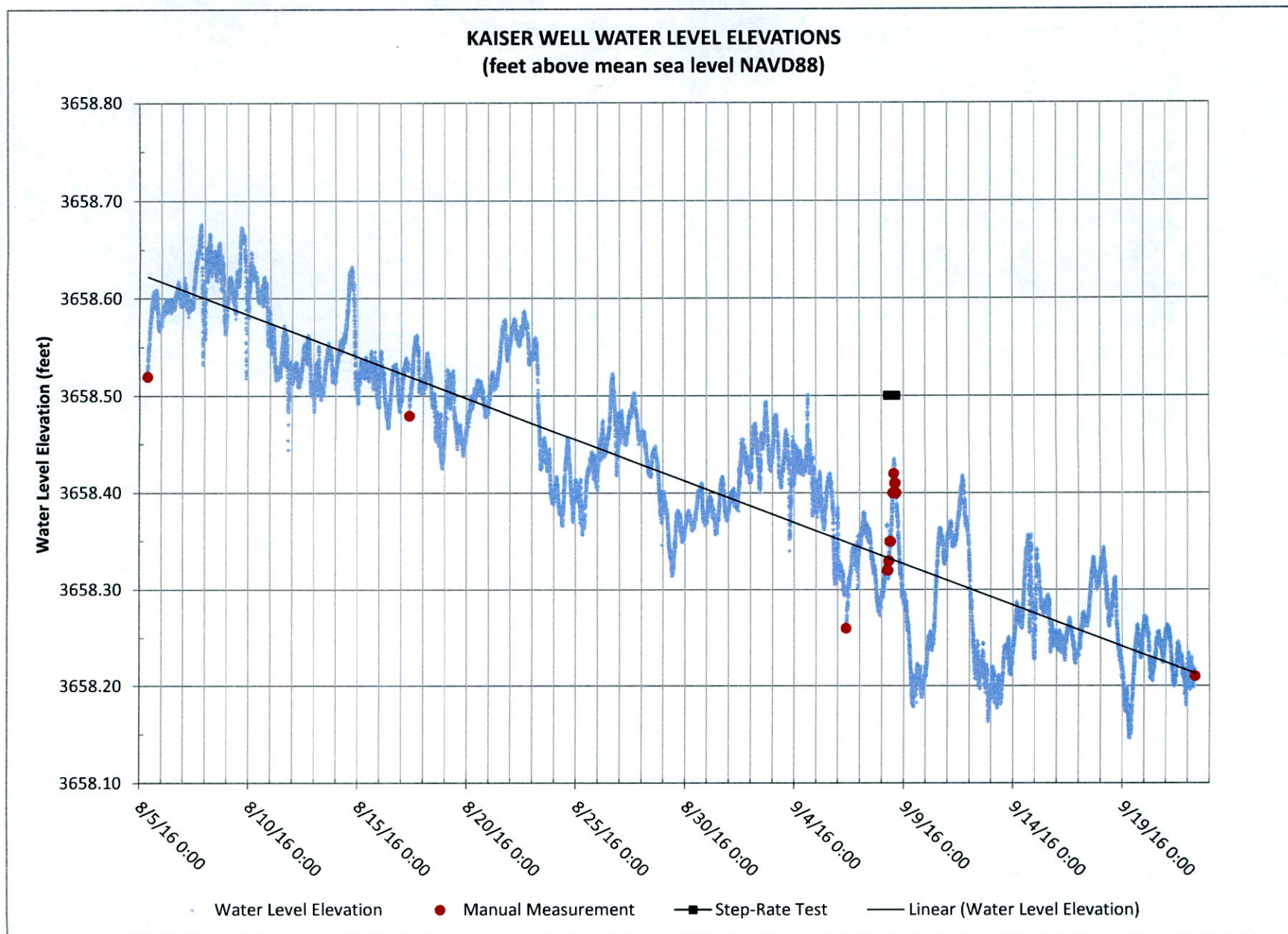


FIGURE 2. KAISER WELL WATER LEVEL ELEVATIONS & TREND LINE
(modified from Eldridge, Personal Communication, 2016)

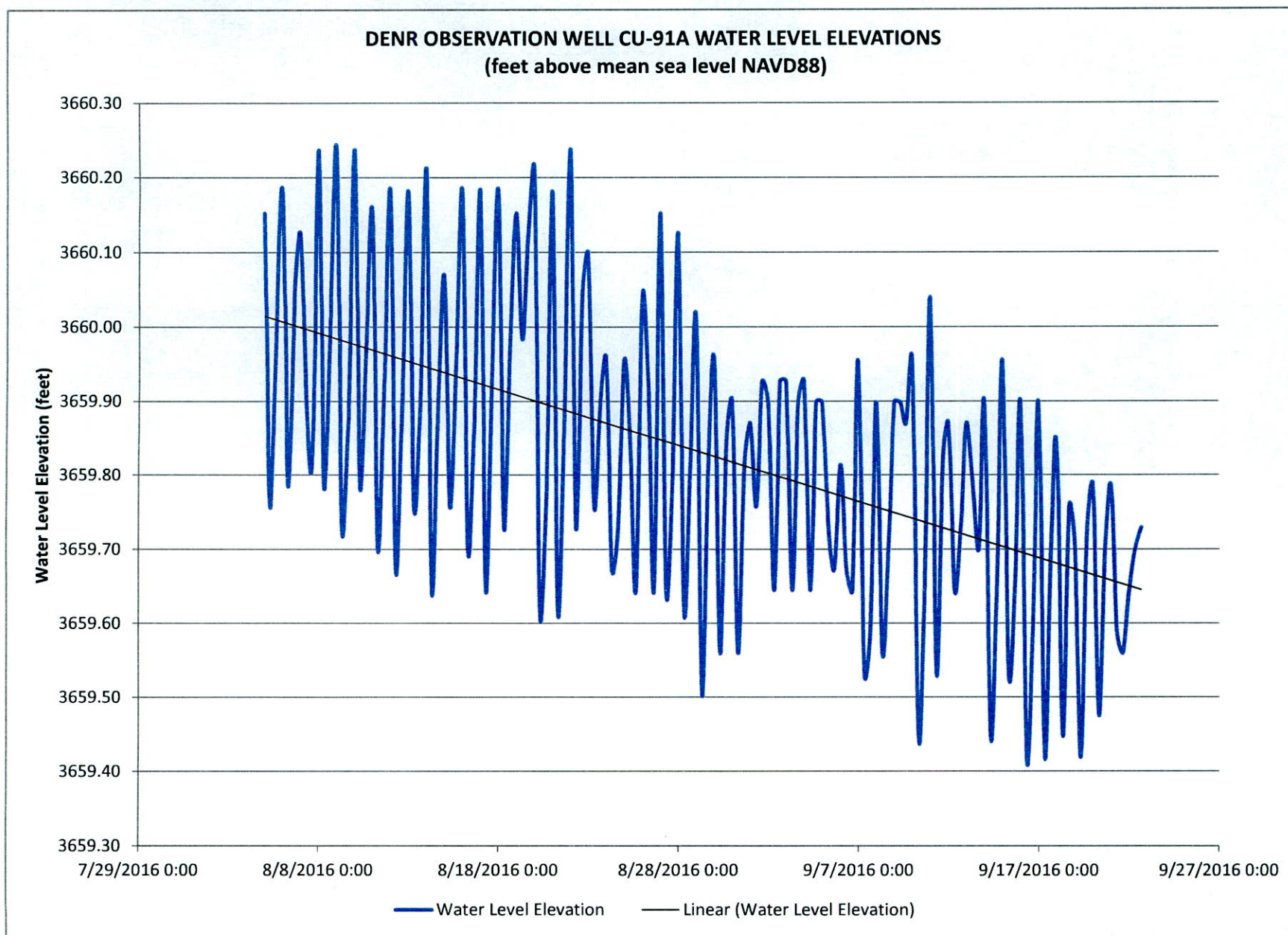


FIGURE 3. CU-91A WATER LEVEL ELEVATIONS & TREND LINE
(modified from Buhler, Personal Communication, 2016)

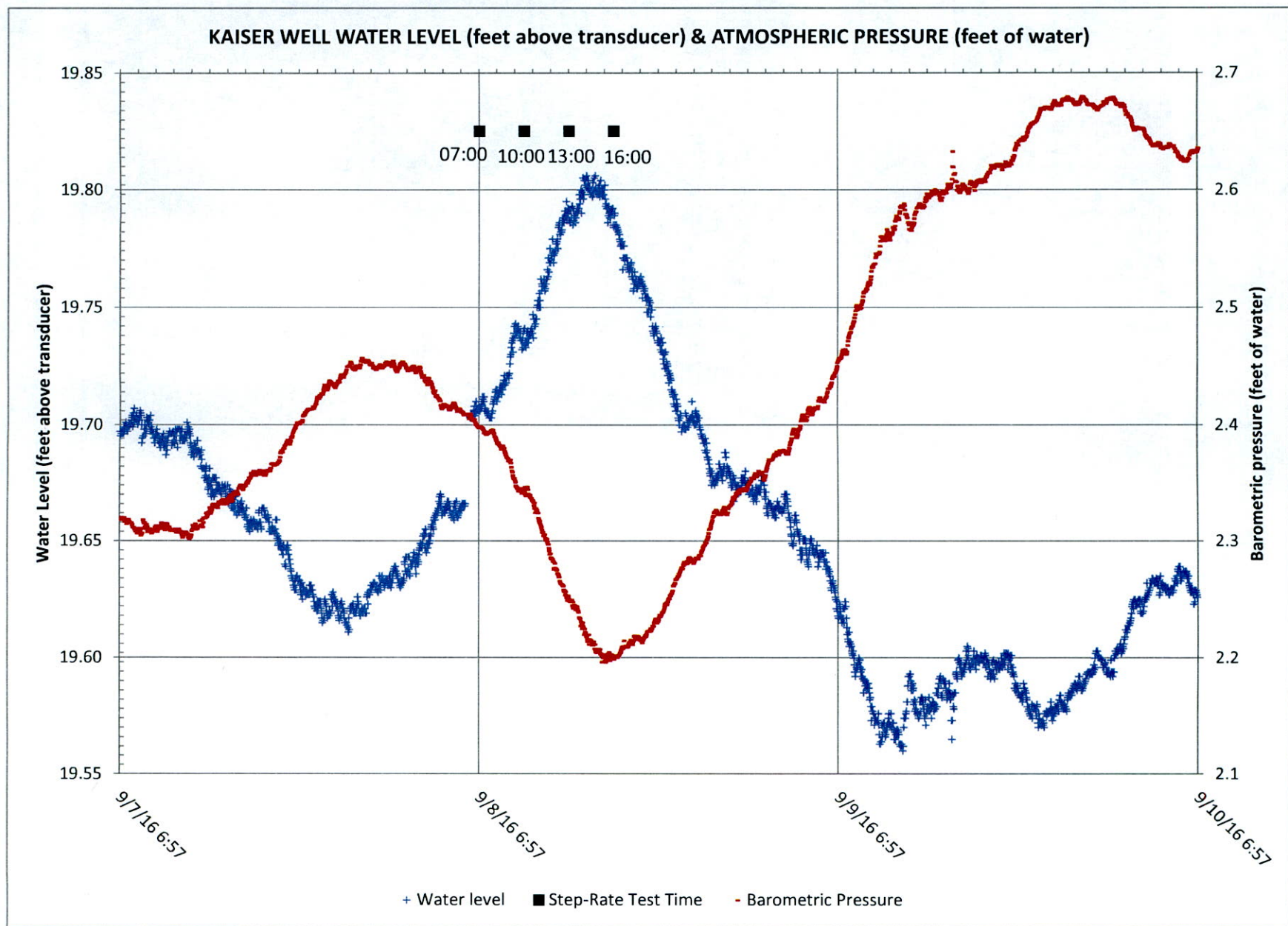
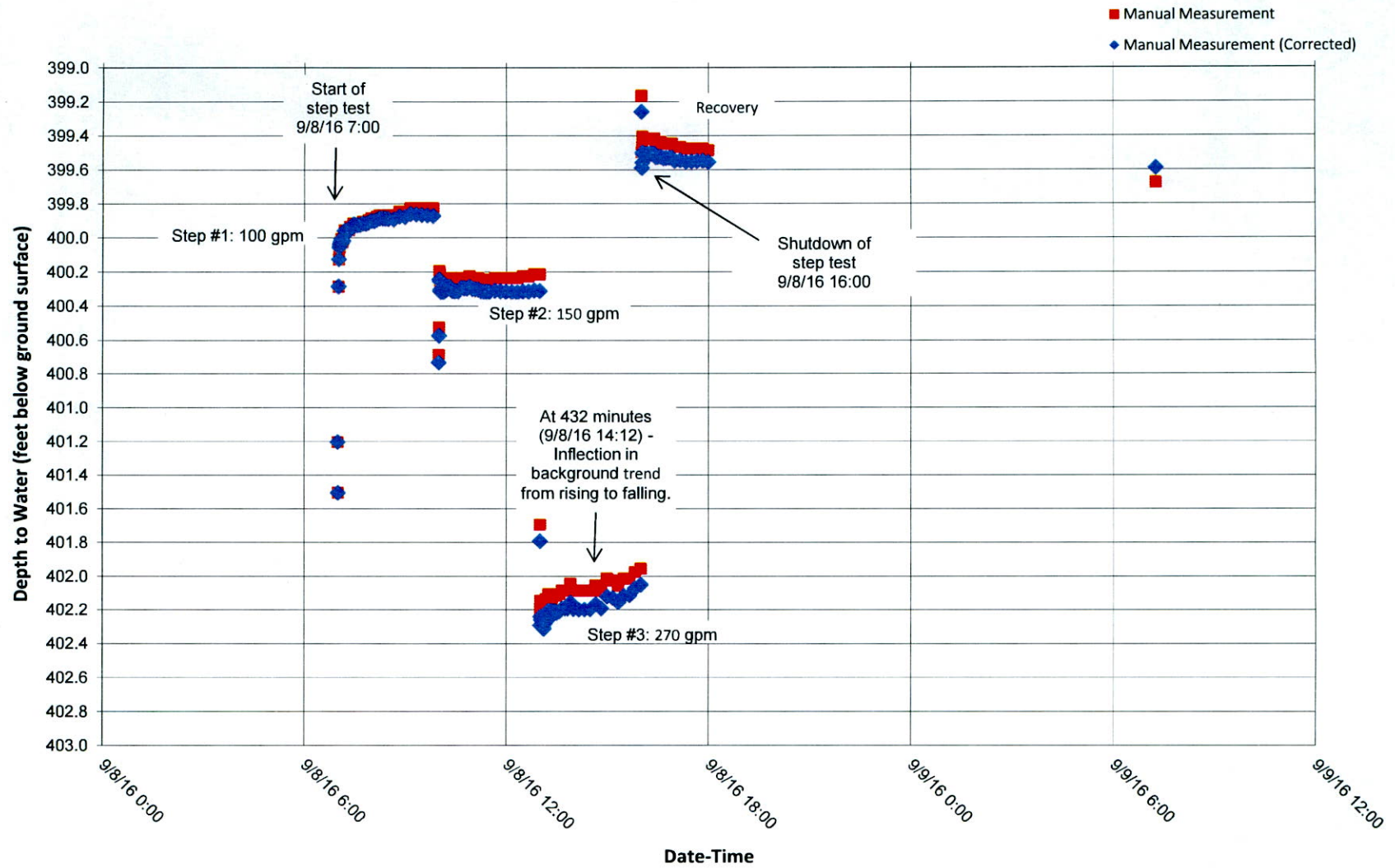


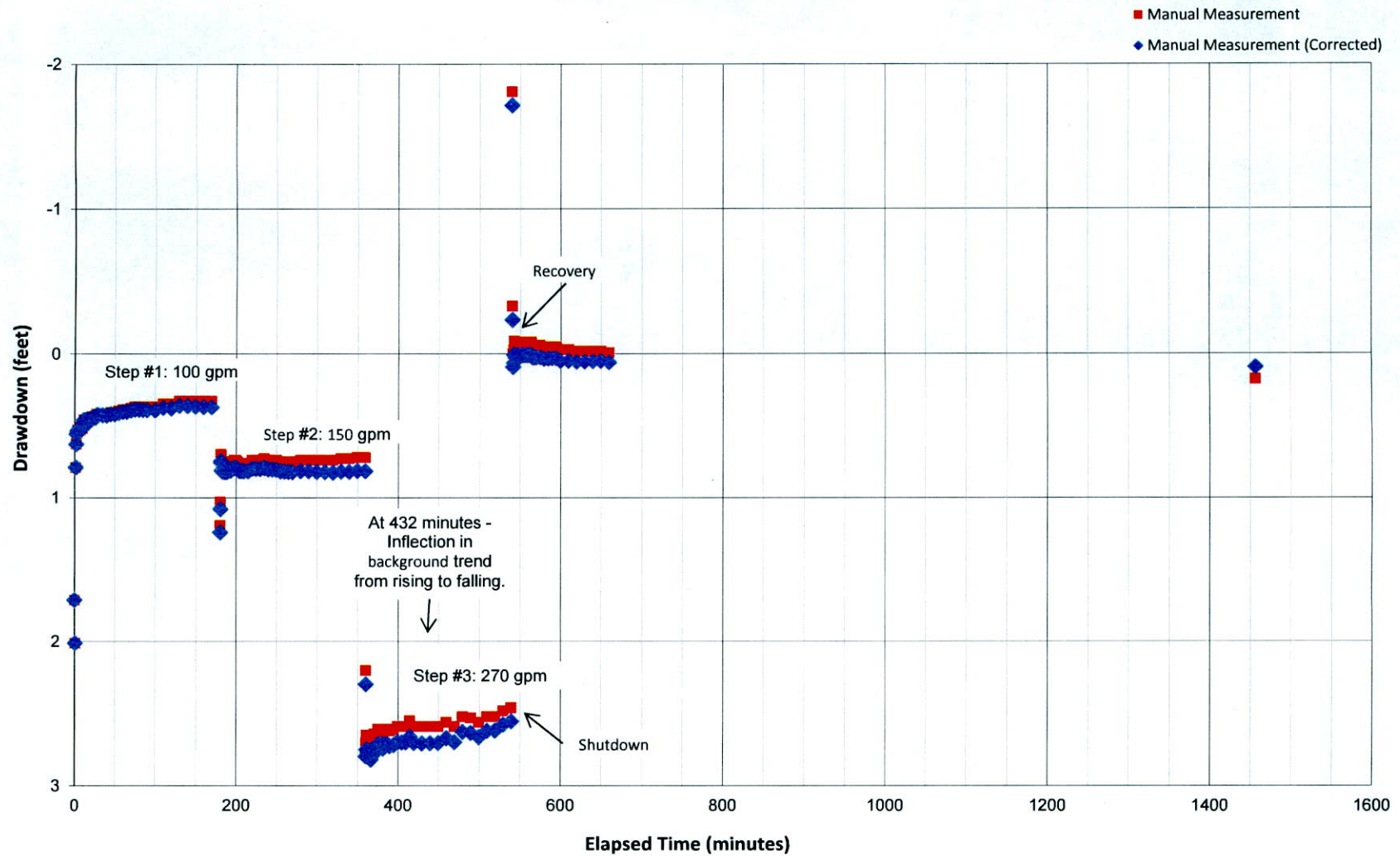
FIGURE 4. BACKGROUND WATER LEVEL DATA & ATMOSPHERIC PRESSURE
(modified from Eldridge, Personal Communication, 2016)

SBHWS TRAILER WELL STEP-RATE TEST SEPTEMBER 2016



**FIGURE 5. DEPTH TO WATER VERSUS TIME
SBHWS TRAILER WELL STEP-RATE TEST**

**SBHWS TRAILER WELL STEP-RATE TEST
SEPTEMBER 2016**



**FIGURE 6. DRAWDOWN VERSUS ELAPSED TIME
SBHWS TRAILER WELL STEP-RATE TEST**

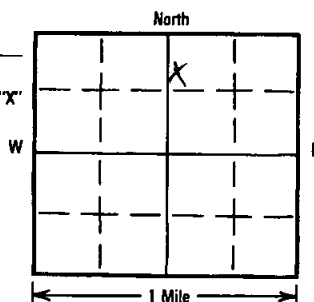
APPENDIX A

SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

Location NW 1/4 NE 1/4 Sec 24 Twp 65 Rg 5ECounty Custer

Please mark well location with an "X"

Well Completion Date May 1994

LOCATION:

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.) >1500 ft. from septic tank (identify source).

PROPOSED USE:

☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Air Rotary

CASING DATA:

☒ Steel ☐ Plastic ☐ Other

If other describe _____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
<u>23</u> LB/FT	<u>7</u> IN	<u>0</u> FT	<u>823</u> FT	<u>8 3/4</u> IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
<u>Cement</u>	<u>120</u>	<u>14</u> lb./gal	<u>0</u> ft	<u>823</u> ft
_____	_____	_____ lb./gal	_____ ft	_____ ft

Describe grouting procedure pressure grouted through casingSCREEN: ☐ Perforated pipe ☐ Manufactured

Diameter _____ IN Length _____ FEET

Material _____

Slot Size _____ Set From _____ Feet to _____ 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? X YES, How: chlorine solution
 _____ NO, Why Not? _____Laboratory _____ for water quality analysis pump not set yetWell Owner: Dennis Casey

Business Name: _____

Address: 233255 S. Airport Rd
Rapid City SD 57701

WELL LOG:

FORMATION	DEPTH	
	FROM	TO
Red clay	0	10
gravel	10	17
red shale	17	87
limestone	87	111
red shale	111	220
red shaley ss	220	250
red ss	250	304
buff LS	304	310
red shale	310	315
yellow + red ss	315	378
yellow + red limestone	378	433
purple shale	433	442
limestone red to purple some ss	442	587
lavender to buff limestone some white ss	587	795
red to purple shale	795	811
white Limestone w/ shale-filled caves	811	883

STATIC WATER LEVEL 418 Feet

If flowing: closed in pressure _____ PSI

GPM flow _____ through _____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other _____

Reduced Flowrate _____ GPM

Can well be completely shut in? _____

WELL TEST DATA:

☐ Pumped Describe: _____
☐ Bailed Air Developed
☒ Other _____

Pumping Level Below Land Surface

800 ft. After 2 Hrs. pumped 200 GPM

_____ ft. After _____ Hrs. pumped _____ GPM

If pump installed, pump rate _____ GPM

REMARKS

This well was drilled under license # 331

And this report is true and accurate.

Drilling firm Taylor Drilling

Signature of License Representative: _____

Signature of Well Owner or Equitable Property Holder: Ralph Taylor

Signature of Well Owner or Equitable Property Holder: _____

Date: 6/24/94

Lester Kaiser
Hot Springs, S.D.
300 GNL 2400 FWL

Sc. Labeled

65-5E-211600W

4-13-77

Custer

24-6S-5E

Total Depth 780'
715' - 5 1/2" O.D. - Casing

Static 475'
50 GPM @ 700'

J.D. #33114103281601

0-12 red shale and gyp
12-40 minnekahta limestone
40-140 red shale
140-215 red sandstone (fine)
215-225 yellow sandstone (very soft)
225-314 white and light red limestone
314-385 red sandstone w/some hard layers
385-395 purple shale (middle marker)
395-420 mostly red sandstone (soft) w/yellow limestone
420-425 hard yellow sandstone
425-432 red sandstone
432-437 shale red
437-585 yellow limestone and red sandstone changing back and forth OVER

1st 4110
- 175
3635

50 gpm / (700 - 475) = .22
gpm/ft.

585-685 quite hard fractured multi-colored limestone
685-690 purple shale
690-780 madisonn limestone fractured
775-777 cave
777-780 honeycombed

BICE AND TAYLOR DRILLING, INC.

1220 Creek Drive

Rapid City, South Dakota 57701



VSGS Chem and cell 81278
for command time logs and slopes & directions

show is just ... 16 South ...
to land ... Hot Park, east side of road

WATER RIGHTS

Location B333

Location NWNW NWNW

Section: 21

T. 6S

R. 6E

Test Hole:

Well: CU-91A

Land Owner: 7-11 RANCH

County: CUSTER

Date: START 18SEP91
FINISH 17OCT91

Elevation: 3640 T

E-Log: GAMMA/CAL, RES
NUETRON, SP, CBL

Samples: 10'
NOT BAGGED

Drilling Company: BICE DRILLING

Project: WATER RIGHTS

Geologist: J. GOODMAN, L. HEDGES, K. BUHLER

Rotary: AIR, MUD

Auger:

Driller: F. CONWAY

Thickness	Lithologic Description	From - to Feet
234	SILTSTONE, RED, LOTS OF GYPSUM ESPECIALLY FROM 60' - 130' (SPEARFISH)	07 234
46	LIMESTONE, LAVENDER TO CREAM COLOR, HARD, PRODUCED ABOUT 30 GPM (MINNEKAHTA)	234 280
150	SILTSTONE, RED, DARK RED TO PURPLE, VERY SANDY 388' E-LOG INDICATES OPECHE-MINNELUSA CONTACT ABOUT 380', CALL MADE FROM DRILL LOG TO BE 430' (OPECHE)	280 430
620	SANDSTONE, LIMESTONE, DOLOMITE, MOSTLY FINE, WHITE TO BROWN TO RED, MOSTLY SAND TO 490, INTERBEDDED, OIL SHOWS AT 775' AND 811' (MINNELUSA)	430 1050
115	LIMESTONE, DOLOMITIC, WHITE TO BUFF, NON TO MICRA CRYSTALLINE, HARD (MADISON)	1050 1165
	TO 1165'	
	SET 1135' 5 1/2" OD .276 WALL STEEL	
	7 1/8" HOLE TO 1140', 4 3/4" HOLE FROM 1140' TO 1165'	
	"OPEN HOLE" COMPLETION	
	GROUTED WITH 185 SKS, SQUEEZED 20 SKS, TOPPED OFF 34 SKS CEMENT	
	WELL PRODUCED 22 GPM	
	W/L-11' BLMP (22OCT91) T-14°C AT 21'	
	* FOR ADDITIONAL GEOLOGIC INFO SEE BH FALL 91 FIELDBOOK	

TRAILER WELL STEP-RATE DATA SHEET
SBHWS

Stickup (feet) = 2.395 Note: this is stickup to the top of the PVC sounding tube.

Date	Time	Date-Time	Elapsed Time (min)	Q/s Elapsed Time (min)	Totalizer (gallons)	Totalizer Flow Rate Dial (gpm)	Totalizer Sweep Flow Rate (gpm)	Depth to Water (ft. Toc)	Depth to Water (ft. Sounding Tube)	Depth to Water (ft. bg)	Corrected Depth to Water (ft. bg)	Drawdown (ft)	Corrected Drawdown for Trend in Kaiser Well (ft)	Recovery (%)	Specific Capacity Q/s (gpm/ft)	Rossum Sand Tester (mL)	Comments
9/8/2016	6:30:00				0		0		401.89	399.49							
9/8/2016	7:00:00	9/8/2016 7:00	0														Start Step 1
9/8/2016	7:00:30	9/8/2016 7:00	0.5						403.60	401.20	401.20	1.71	1.71				Adjusting Flow Rate
9/8/2016	7:01:00	9/8/2016 7:01	1						403.80	401.50	401.50	2.01	2.01				Adjusting Flow Rate
9/8/2016	7:02:00	9/8/2016 7:02	2						402.68	400.28	400.28	0.79	0.79				Adjusting Flow Rate
9/8/2016	7:02:30	9/8/2016 7:02	2.5						402.52	400.12	400.12	0.63	0.63				Adjusting Flow Rate
9/8/2016	7:03:00	9/8/2016 7:03	3						402.45	400.05	400.05	0.56	0.56				Adjusting Flow Rate
9/8/2016	7:03:30	9/8/2016 7:03	3.5						402.44	400.04	400.05	0.55	0.55				Adjusting Flow Rate
9/8/2016	7:04:00	9/8/2016 7:04	4						402.43	400.03	400.04	0.54	0.54				Adjusting Flow Rate
9/8/2016	7:04:30	9/8/2016 7:04	4.5						402.42	400.02	400.03	0.53	0.53				Adjusting Flow Rate
9/8/2016	7:05:00	9/8/2016 7:05	5						402.42	400.02	400.03	0.53	0.53				Adjusting Flow Rate
9/8/2016	7:06:00	9/8/2016 7:06	6				103										
9/8/2016	7:07:00	9/8/2016 7:07	7						402.40	400.00	400.01	0.51	0.51		196.08		
9/8/2016	7:08:00	9/8/2016 7:08	8						402.42	400.02	400.03	0.53	0.53		188.68		
9/8/2016	7:09:00	9/8/2016 7:09	9						402.41	400.01	400.02	0.52	0.52		192.31		
9/8/2016	7:10:00	9/8/2016 7:10	10						402.41	400.01	400.02	0.52	0.52		182.31		
9/8/2016	7:12:00	9/8/2016 7:12	12				99		402.35	399.95	399.95	0.46	0.46		217.39		
9/8/2016	7:14:00	9/8/2016 7:14	14						402.35	399.95	399.96	0.46	0.46		217.39		
9/8/2016	7:16:00	9/8/2016 7:16	16						402.35	399.95	399.96	0.46	0.46		217.39		
9/8/2016	7:18:00	9/8/2016 7:18	18						402.35	399.95	399.96	0.46	0.46		217.39		
9/8/2016	7:20:00	9/8/2016 7:20	20		2,445		99		402.35	399.95	399.96	0.46	0.47		217.39		
9/8/2016	7:22:00	9/8/2016 7:22	22						402.33	399.93	399.94	0.44	0.45		227.27		
9/8/2016	7:24:00	9/8/2016 7:24	24						402.33	399.93	399.94	0.44	0.45		227.27		
9/8/2016	7:26:00	9/8/2016 7:26	26						402.33	399.93	399.94	0.44	0.45		227.27		
9/8/2016	7:28:00	9/8/2016 7:28	28						402.31	399.91	399.92	0.42	0.43		238.10		
9/8/2016	7:30:00	9/8/2016 7:30	30		3,125		99		402.31	399.91	399.92	0.42	0.43		238.10		
9/8/2016	7:35:00	9/8/2016 7:35	35						402.31	399.91	399.92	0.42	0.43		238.10		
9/8/2016	7:40:00	9/8/2016 7:40	40						402.31	399.91	399.92	0.42	0.43		238.10		
9/8/2016	7:45:00	9/8/2016 7:45	45				101		402.30	399.90	399.92	0.41	0.42		243.90		
9/8/2016	7:46:00	9/8/2016 7:46	46		4,830												
9/8/2016	7:50:00	9/8/2016 7:50	50						402.30	399.90	399.92	0.41	0.42		243.90		
9/8/2016	7:55:00	9/8/2016 7:55	55		5,660		99		402.29	399.89	399.91	0.40	0.41		250.00		
9/8/2016	8:00:00	9/8/2016 8:00	60						402.28	399.88	399.90	0.39	0.41		256.41		
9/8/2016	8:05:00	9/8/2016 8:05	65						402.28	399.88	399.90	0.39	0.41		256.41		
9/8/2016	8:10:00	9/8/2016 8:10	70						402.27	399.87	399.88	0.38	0.40		263.16		
9/8/2016	8:15:00	9/8/2016 8:15	75						402.26	399.86	399.88	0.37	0.39		270.27		
9/8/2016	8:20:00	9/8/2016 8:20	80				98		402.26	399.86	399.89	0.37	0.39		270.27		
9/8/2016	8:25:00	9/8/2016 8:25	85		8,610				402.26	399.86	399.88	0.37	0.39		270.27		
9/8/2016	8:30:00	9/8/2016 8:30	90				98		402.26	399.86	399.88	0.37	0.39		270.27		
9/8/2016	8:40:00	9/8/2016 8:40	100		10,110				402.26	399.86	399.88	0.37	0.40		270.27		
9/8/2016	8:50:00	9/8/2016 8:50	110						402.24	399.84	399.87	0.35	0.38		285.71		
9/8/2016	9:00:00	9/8/2016 9:00	120						402.24	399.84	399.86	0.35	0.38		285.71		
9/8/2016	9:07:00	9/8/2016 9:07	127		12,750		98		402.22	399.82	399.86	0.33	0.36		303.03		
9/8/2016	9:10:00	9/8/2016 9:10	130						402.22	399.82	399.86	0.33	0.37		303.03		
9/8/2016	9:20:00	9/8/2016 9:20	140		14,090		98		402.22	399.82	399.86	0.33	0.37		303.03		
9/8/2016	9:30:00	9/8/2016 9:30	150						402.22	399.82	399.87	0.33	0.37		303.03		
9/8/2016	9:40:00	9/8/2016 9:40	160						402.22	399.82	399.87	0.33	0.37		303.03		
9/8/2016	9:50:00	9/8/2016 9:50	170		17,140		98		402.22	399.82	399.87	0.33	0.38		303.03		
9/8/2016	10:00:00	9/8/2016 10:00	180														Step 2 - Increase Flow Rate
9/8/2016	10:00:30	9/8/2016 10:00	180.5						403.08	400.68	400.73	1.18	1.24				Adjusting Flow Rate
9/8/2016	10:01:00	9/8/2016 10:01	181						402.82	400.52	400.57	1.03	1.08				Adjusting Flow Rate
9/8/2016	10:01:30	9/8/2016 10:01	181.5						402.59	400.19	400.24	0.70	0.75				Adjusting Flow Rate
9/8/2016	10:02:00	9/8/2016 10:02	182						402.60	400.20	400.25	0.71	0.76				Adjusting Flow Rate
9/8/2016	10:02:30	9/8/2016 10:02	182.5						402.55	400.25	400.30	0.76	0.81				Adjusting Flow Rate
9/8/2016	10:03:00	9/8/2016 10:03	183						402.66	400.26	400.31	0.77	0.82				Adjusting Flow Rate
9/8/2016	10:03:30	9/8/2016 10:03	183.5						402.66	400.26	400.31	0.77	0.82				Adjusting Flow Rate
9/8/2016	10:04:00	9/8/2016 10:04	184						402.66	400.26	400.31	0.77	0.82				Adjusting Flow Rate
9/8/2016	10:04:30	9/8/2016 10:04	184.5				150		402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:05:00	9/8/2016 10:05	185						402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:06:00	9/8/2016 10:06	186				150		402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:07:00	9/8/2016 10:07	187						402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:08:00	9/8/2016 10:08	188						402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:09:00	9/8/2016 10:09	189				150		402.66	400.26	400.31	0.77	0.82		194.61		
9/8/2016	10:10:00	9/8/2016 10:10	190						402.65	400.25	400.31	0.76	0.81		197.37		
9/8/2016	10:11:00	9/8/2016 10:11	191						402.65	400.25	400.31	0.76	0.81		197.37		
9/8/2016	10:12:00	9/8/2016 10:12	192						402.65	400.25	400.31	0.76	0.81		197.37		
9/8/2016	10:13:00	9/8/2016 10:13	193		19,850		150		402.65	400.25	400.31	0.76	0.81		197.37		
9/8/2016	10:14:00	9/8/2016 10:14	194						402.64	400.24	400.30	0.75	0.80		200.00		

TRAILER WELL STEP-RATE DATA SHEET
SBHWS

Date	Time	Date-Time	Elapsed Time (min)	Q/s Elapsed Time (min)	Totalizer (gallons)	Totalizer Flow Rate Dial (gpm)	Totalizer Sweep Flow Rate (gpm)	Depth to Water (ft. Toc)	Depth to Water (ft. Sounding Tube)	Depth to Water (ft. bg)	Corrected Depth to Water (ft. bg)	Drawdown (ft)	Corrected Drawdown for Trend in Kaiser Well (ft)	Recovery (%)	Specific Capacity Q/s (gpm/ft)	Rossum Sand tester (mL)	Comments
9/8/2016	10:16:00	9/8/2016 10:16	196						402.64	400.24	400.30	0.75	0.80		200.00		
9/8/2016	10:18:00	9/8/2016 10:18	198						402.63	400.23	400.28	0.74	0.78		202.70		
9/8/2016	10:20:00	9/8/2016 10:20	200		20,820		150		402.63	400.23	400.28	0.74	0.78		202.70		
9/8/2016	10:22:00	9/8/2016 10:22	202						402.64	400.24	400.30	0.75	0.80		200.00		
9/8/2016	10:24:00	9/8/2016 10:24	204						402.65	400.25	400.31	0.76	0.81		197.37		
9/8/2016	10:26:00	9/8/2016 10:26	206						402.65	400.25	400.31	0.76	0.82		197.37		
9/8/2016	10:28:00	9/8/2016 10:28	208		22,350		150		402.65	400.25	400.31	0.76	0.82		197.37		
9/8/2016	10:30:00	9/8/2016 10:30	210						402.65	400.25	400.31	0.76	0.82		197.37		
9/8/2016	10:35:00	9/8/2016 10:35	215						402.65	400.25	400.31	0.76	0.82		197.37		
9/8/2016	10:40:00	9/8/2016 10:40	220						402.63	400.23	400.29	0.74	0.80		202.70		
9/8/2016	10:45:00	9/8/2016 10:45	225				149		402.63	400.23	400.29	0.74	0.80		202.70		
9/8/2016	10:50:00	9/8/2016 10:50	230						402.63	400.23	400.30	0.74	0.80		202.70		
9/8/2016	10:55:00	9/8/2016 10:55	235						402.62	400.22	400.29	0.73	0.79		205.48		
9/8/2016	11:00:00	9/8/2016 11:00	240						402.63	400.23	400.30	0.74	0.80		202.70		
9/8/2016	11:05:00	9/8/2016 11:05	245						402.63	400.23	400.30	0.74	0.81		202.70		
9/8/2016	11:10:00	9/8/2016 11:10	250						402.63	400.23	400.30	0.74	0.81		202.70		
9/8/2016	11:15:00	9/8/2016 11:15	255						402.64	400.24	400.31	0.75	0.82		200.00		
9/8/2016	11:20:00	9/8/2016 11:20	260						402.64	400.24	400.31	0.75	0.82		200.00		
9/8/2016	11:25:00	9/8/2016 11:25	265						402.64	400.24	400.32	0.75	0.82		200.00		
9/8/2016	11:30:00	9/8/2016 11:30	270						402.64	400.24	400.32	0.75	0.82		200.00		
9/8/2016	11:36:00	9/8/2016 11:36	276		32,000		149										
9/8/2016	11:40:00	9/8/2016 11:40	280						402.63	400.23	400.31	0.74	0.82		202.70		
9/8/2016	11:50:00	9/8/2016 11:50	290						402.63	400.23	400.31	0.74	0.82		202.70		
9/8/2016	12:00:00	9/8/2016 12:00	300						402.63	400.23	400.31	0.74	0.82		202.70		
9/8/2016	12:10:00	9/8/2016 12:10	310						402.63	400.23	400.32	0.74	0.82		202.70		
9/8/2016	12:20:00	9/8/2016 12:20	320						402.63	400.23	400.32	0.74	0.83		202.70		
9/8/2016	12:30:00	9/8/2016 12:30	330						402.62	400.22	400.31	0.73	0.82		205.48		
9/8/2016	12:40:00	9/8/2016 12:40	340		42,110		149		402.62	400.22	400.32	0.73	0.82		205.48		
9/8/2016	12:50:00	9/8/2016 12:50	350						402.61	400.21	400.31	0.72	0.81		208.33		
9/8/2016	13:00:00	9/8/2016 13:00	360						402.61	400.21	400.31	0.72	0.82				Step 3 - Adjust to Max Flow Rate
9/8/2016	13:00:30	9/8/2016 13:00	360.5						404.09	401.69	401.78	2.20	2.30				
9/8/2016	13:01:00	9/8/2016 13:01	361				265		404.59	402.19	402.29	2.70	2.80		100.00		
9/8/2016	13:01:30	9/8/2016 13:01	361.5						404.54	402.14	402.24	2.65	2.75		101.89		
9/8/2016	13:02:00	9/8/2016 13:02	362						404.59	402.19	402.29	2.70	2.80		100.00		
9/8/2016	13:02:30	9/8/2016 13:02	362.5				265		404.59	402.19	402.29	2.70	2.80		100.00		
9/8/2016	13:03:00	9/8/2016 13:03	363						404.56	402.16	402.26	2.67	2.77		101.12		
9/8/2016	13:03:30	9/8/2016 13:03	363.5						404.56	402.16	402.26	2.67	2.77		101.12		
9/8/2016	13:04:00	9/8/2016 13:04	364						404.58	402.18	402.28	2.69	2.79		100.37		
9/8/2016	13:04:30	9/8/2016 13:04	364.5						404.59	402.19	402.29	2.70	2.80		100.00		
9/8/2016	13:05:00	9/8/2016 13:05	365						404.60	402.20	402.30	2.71	2.81		99.63		
9/8/2016	13:06:00	9/8/2016 13:06	366						404.60	402.20	402.30	2.71	2.81		99.63		
9/8/2016	13:07:00	9/8/2016 13:07	367				267		404.61	402.21	402.31	2.72	2.82		99.26		
9/8/2016	13:08:00	9/8/2016 13:08	368						404.54	402.14	402.24	2.65	2.75		101.89		
9/8/2016	13:09:00	9/8/2016 13:09	369						404.56	402.16	402.26	2.68	2.78		100.37		
9/8/2016	13:10:00	9/8/2016 13:10	370		47,100		268		404.54	402.14	402.24	2.65	2.75		101.89		
9/8/2016	13:11:00	9/8/2016 13:11	371						404.53	402.13	402.23	2.64	2.74		102.27		
9/8/2016	13:12:00	9/8/2016 13:12	372						404.56	402.16	402.26	2.67	2.77		101.12		
9/8/2016	13:13:00	9/8/2016 13:13	373						404.53	402.13	402.23	2.64	2.74		102.27		
9/8/2016	13:14:00	9/8/2016 13:14	374						404.53	402.13	402.23	2.64	2.74		102.27		
9/8/2016	13:16:00	9/8/2016 13:16	376						404.50	402.10	402.21	2.61	2.71		103.45		
9/8/2016	13:18:00	9/8/2016 13:18	378				270		404.51	402.11	402.22	2.62	2.72		103.05		
9/8/2016	13:20:00	9/8/2016 13:20	380		50,060				404.50	402.10	402.21	2.61	2.71		103.45		
9/8/2016	13:22:00	9/8/2016 13:22	382				270		404.53	402.13	402.24	2.64	2.74		102.27		
9/8/2016	13:24:00	9/8/2016 13:24	384						404.50	402.10	402.21	2.61	2.71		103.45		
9/8/2016	13:26:00	9/8/2016 13:26	386						404.50	402.10	402.21	2.61	2.71		103.45		
9/8/2016	13:28:00	9/8/2016 13:28	388						404.50	402.10	402.21	2.61	2.71		103.45		
9/8/2016	13:30:00	9/8/2016 13:30	390						404.51	402.11	402.22	2.62	2.72		103.05		
9/8/2016	13:35:00	9/8/2016 13:35	395		54,270		270		404.50	402.10	402.21	2.61	2.72		103.45		
9/8/2016	13:40:00	9/8/2016 13:40	400						404.48	402.08	402.19	2.59	2.70		104.25		
9/8/2016	13:45:00	9/8/2016 13:45	405						404.48	402.08	402.19	2.59	2.70		104.25		
9/8/2016	13:50:00	9/8/2016 13:50	410						404.48	402.08	402.19	2.59	2.70		104.25		
9/8/2016	13:55:00	9/8/2016 13:55	415						404.44	402.04	402.16	2.55	2.66		105.88		
9/8/2016	14:00:00	9/8/2016 14:00	420						404.46	402.06	402.20	2.59	2.70		104.25		
9/8/2016	14:10:00	9/8/2016 14:10	430		63,880		270		404.46	402.06	402.20	2.59	2.71		104.25		
9/8/2016	14:20:00	9/8/2016 14:20	440						404.48	402.08	402.20	2.59	2.70		104.25		
9/8/2016	14:30:00	9/8/2016 14:30	450						404.48	402.08	402.20	2.59	2.70		104.25		
9/8/2016	14:40:00	9/8/2016 14:40	460		71,790		270		404.45	402.05	402.16	2.56	2.67		105.47		
9/8/2016	14:50:00	9/8/2016 14:50	470						404.46	402.06	402.19	2.59	2.70		104.25		
9/8/2016	15:00:00	9/8/2016 15:00	480						404.41	402.01	402.12	2.52	2.63		107.14		
9/8/2016	15:10:00	9/8/2016 15:10	490						404.42	402.02	402.13	2.53	2.63		106.72		
9/8/2016	15:20:00	9/8/2016 15:20	500						404.45	402.05	402.16	2.56	2.66		105.47		

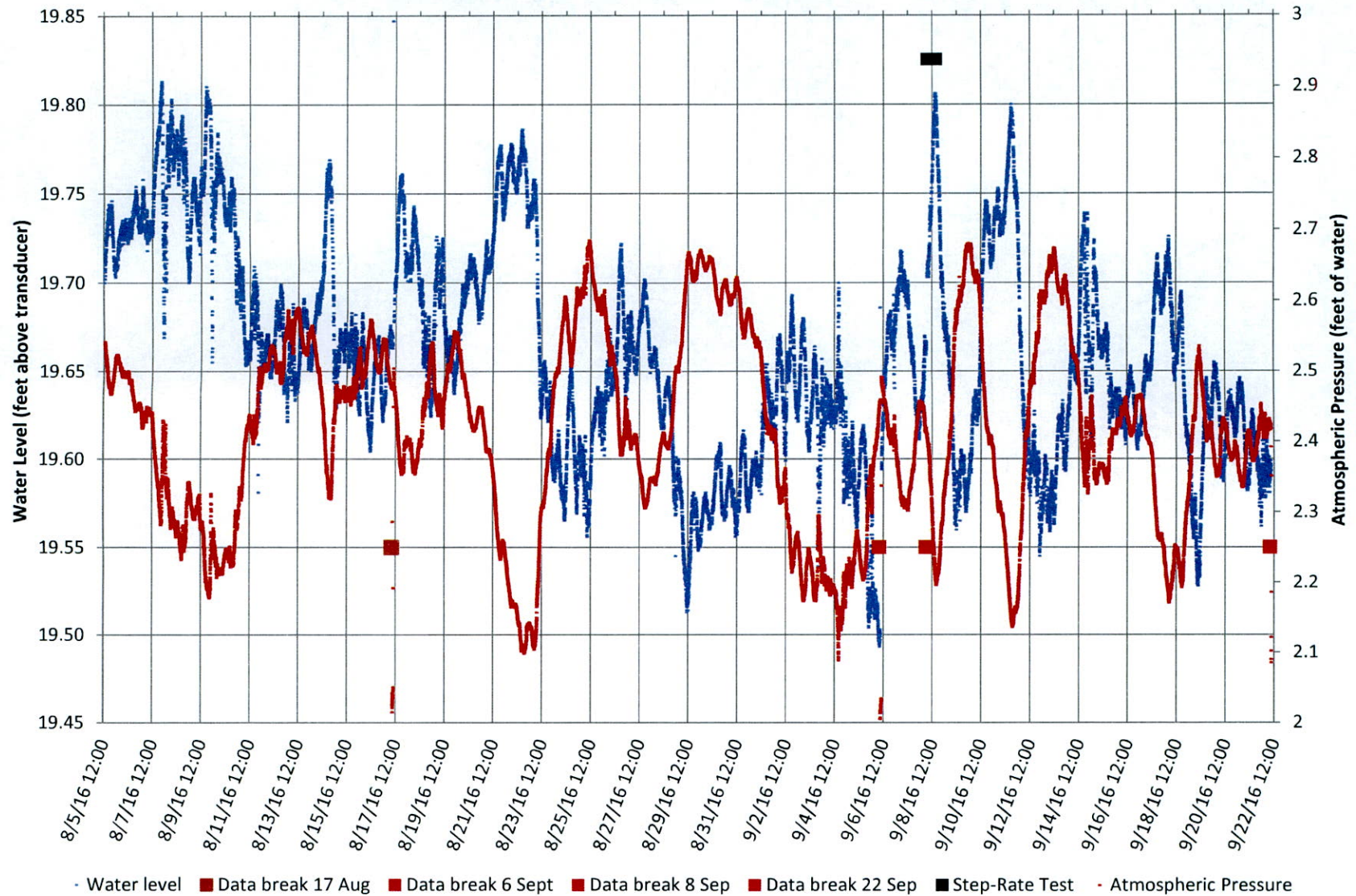
TRAILER WELL STEP-RATE DATA SHEET
SBHWS

Date	Time	Date-Time	Elapsed Time (min)	O/s Elapsed Time (min)	Totalizer (gallons)	Totalizer Flow Rate Dial (gpm)	Totalizer Sweep Flow Rate (gpm)	Depth to Water (ft. Toc)	Depth to Water (ft. Sounding Tube)	Depth to Water (ft. bg)	Corrected Depth to Water (ft. bg)	Drawdown (ft)	Corrected Drawdown for Trend In Kaiser Well (ft)	Recovery (%)	Specific Capacity Q/s (gpm/ft)	Rossum Sand tester (mL)	Comments
9/8/2016	15:30:00	9/8/2016 15:30	510						404.41	402.01	402.11	2.52	2.62		107.14		
9/8/2016	15:40:00	9/8/2016 15:40	520		88,110		270		404.41	402.01	402.11	2.52	2.62		107.14		
9/8/2016	15:50:00	9/8/2016 15:50	530						404.37	401.97	402.07	2.48	2.58		108.87		
9/8/2016	16:00:00	9/8/2016 16:00	540						404.35	401.95	402.05	2.46	2.55		109.76		
9/8/2016	16:00:30	9/8/2016 16:00	540.5		92,952		0		400.08	397.68	397.78	-1.81	-1.72				
9/8/2016	16:01:00	9/8/2016 16:01	541		92,952		0		401.56	399.16	399.26	-0.33	-0.24				
9/8/2016	16:01:30	9/8/2016 16:01	541.5		92,952		0		401.89	399.49	399.59	0.00	0.09				
9/8/2016	16:02:00	9/8/2016 16:02	542		92,952		0		401.89	399.49	399.59	0.00	0.09				
9/8/2016	16:02:30	9/8/2016 16:02	542.5		92,952		0		401.86	399.46	399.56	-0.03	0.06				
9/8/2016	16:03:00	9/8/2016 16:03	543		92,952		0		401.80	399.40	399.50	-0.09	0.00				
9/8/2016	16:03:30	9/8/2016 16:03	543.5		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:04:00	9/8/2016 16:04	544		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:04:30	9/8/2016 16:04	544.5		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:05:00	9/8/2016 16:05	545		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:06:00	9/8/2016 16:06	546		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:07:00	9/8/2016 16:07	547		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:08:00	9/8/2016 16:08	548		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:09:00	9/8/2016 16:09	549		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:10:00	9/8/2016 16:10	550		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:11:00	9/8/2016 16:11	551		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:12:00	9/8/2016 16:12	552		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:13:00	9/8/2016 16:13	553		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:14:00	9/8/2016 16:14	554		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:16:00	9/8/2016 16:16	556		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:18:00	9/8/2016 16:18	558		92,952		0		401.81	399.41	399.51	-0.08	0.01				
9/8/2016	16:20:00	9/8/2016 16:20	560		92,952		0		401.81	399.41	399.50	-0.08	0.01				
9/8/2016	16:22:00	9/8/2016 16:22	562		92,952		0		401.81	399.41	399.50	-0.08	0.01				
9/8/2016	16:24:00	9/8/2016 16:24	564		92,952		0		401.81	399.41	399.50	-0.08	0.01				
9/8/2016	16:26:00	9/8/2016 16:26	566		92,952		0		401.83	399.43	399.52	-0.09	0.03				
9/8/2016	16:28:00	9/8/2016 16:28	568		92,952		0		401.83	399.43	399.52	-0.06	0.03				
9/8/2016	16:30:00	9/8/2016 16:30	570		92,952		0		401.83	399.43	399.52	-0.06	0.03				
9/8/2016	16:35:00	9/8/2016 16:35	575		92,952		0		401.83	399.43	399.52	-0.06	0.03				
9/8/2016	16:40:00	9/8/2016 16:40	580		92,952		0		401.84	399.44	399.53	-0.05	0.04				
9/8/2016	16:45:00	9/8/2016 16:45	585		92,952		0		401.84	399.44	399.53	-0.05	0.04				
9/8/2016	16:50:00	9/8/2016 16:50	590		92,952		0		401.84	399.44	399.53	-0.05	0.03				
9/8/2016	16:55:00	9/8/2016 16:55	595		92,952		0		401.84	399.44	399.53	-0.05	0.03				
9/8/2016	17:00:00	9/8/2016 17:00	600		92,952		0		401.86	399.46	399.55	-0.03	0.05				
9/8/2016	17:10:00	9/8/2016 17:10	610		92,952		0		401.86	399.46	399.54	-0.03	0.05				
9/8/2016	17:20:00	9/8/2016 17:20	620		92,952		0		401.87	399.47	399.55	-0.02	0.06				
9/8/2016	17:30:00	9/8/2016 17:30	630		92,952		0		401.87	399.47	399.55	-0.02	0.06				
9/8/2016	17:40:00	9/8/2016 17:40	640		92,952		0		401.87	399.47	399.55	-0.02	0.05				
9/8/2016	17:50:00	9/8/2016 17:50	650		92,952		0		401.87	399.47	399.55	-0.02	0.05				
9/8/2016	18:00:00	9/8/2016 18:00	660		92,952		0		401.88	399.48	399.56	-0.01	0.06				
9/9/2016	7:17:00	9/9/2016 7:17	1457		92,952		0		402.07	399.67	399.59	0.16	0.10				Date: 9-9-16 (day after pump test)

Enter new data above this row.

Notes:

KAISER WELL WATER LEVEL VERSUS ATMOSPHERIC PRESURE
(modified from Eldridge, Personal Communication, 2016)





MIDCONTINENT
TESTING LABORATORIES, INC.

Page 1 of 2

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 — www.thechemistrylab.com

Sample Site: SBHWSI Trailer Well
Project Name: Trailer Well Pump Test
Sampled: 09/08/16 at 03:45 PM
by Mitch Kannenberg

Sample Matrix: Water

Lab ID#: 20160909501
Received: 09/09/16 at 11:00 AM
by Bob Miller
Account: 9448 - Southern Black Hills Water System

DON PETERSON
SOUTHERN BLACK HILLS WATER
26858 US HWY 385
HOT SPRINGS, SD 57747

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Electrical Conductivity	432	µmhos/cm	1	0.400	5.00	SM 2510B	JAM	09/13/16
Hardness	12.0	grains/gal	1			SM 2340 B	JMH	09/14/16
Total Dissolved Solids	235	mg/L	100ml	23.2	50.0	SM 2540 C	TMN	09/12/16
Total Suspended Solids	< 10.0	mg/L	100ml	1.81	10.0	SM 2540 D	TMN	09/12/16
Non-Metallics								
Alkalinity (CaCO3)	197	mg/L	1	0.268	10.0	SM 2320 B	JAM	09/13/16
Bicarbonate	241	mg/L	1	0.327	10.0	SM 2320 B	JAM	09/13/16
Carbonate	0.00	mg/L	1	0.134	5.00	SM 2320 B	JAM	09/13/16
Chloride (Cl-)	8.33	mg/L	1	0.129	0.500	SM 4500-Cl E	BLL	09/09/16
Fluoride	0.396	mg/L	1	0.003	0.050	SM 4500 F-C	EJF	09/12/16
Nitrogen, Ammonia (NH3)	< 0.050	mg/L	1	0.003	0.050	SM 4500-NH3 D	JAM	09/13/16
Nitrogen, Nitrate (NO3)	0.543	mg/L	1	0.019	0.050	SM 4500-NO3 F	BLL	09/09/16
Nitrogen, Nitrite (NO2)	< 0.050	mg/L	1	0.003	0.050	SM 4500-NO2 B	BLL	09/09/16
Sulfate (SO4)	17.5	mg/L	1	0.301	1.00	SM 4500-SO4 E	BLL	09/09/16
Total Organic Carbon	0.532	mg/L	1	0.036	0.200	SM 5310 C	JEP	09/13/16
Metals - Dissolved								
Calcium (Ca)	51.0	mg/L	2	0.043	2.00	SM 3111 B	TMS	09/12/16
Magnesium (Mg)	18.8	mg/L	1	0.039	0.500	SM 3111 B	TMS	09/12/16
Potassium (K)	2.97	mg/L	1	0.011	0.500	SM 3111 B	TMS	09/12/16
Sodium (Na)	12.0	mg/L	1	0.141	0.500	SM 3111 B	TMS	09/12/16
Metals - Total								
Arsenic (As)	0.007	mg/L	10	0.00087	0.005	EPA 200.8	TNA	09/13/16
Barium (Ba)	0.184	mg/L	10	0.00021	0.005	EPA 200.8	TNA	09/13/16
Chromium (Cr)	< 0.001	mg/L	10	0.00009	0.001	EPA 200.8 DRC	TNA	09/13/16
Iron (Fe)	0.062	mg/L	10	0.002	0.050	EPA 200.8	TNA	09/13/16
Manganese (Mn)	< 0.010	mg/L	10	0.00004	0.010	EPA 200.8	TNA	09/13/16
Selenium (Se)	< 0.005	mg/L	10	0.001	0.005	EPA 200.8	TNA	09/13/16
Uranium (U)	0.005	mg/L	10	0.00009	0.001	EPA 200.8	TNA	09/13/16

Report of Analysis for: **Southern Black Hills Water System**
Trailer Well

Sample Site: **SBHWSI**

Page 2 of 2

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date
Bacteria							
E. coli	Absent		1			SM 9223 B (P/A)	JMH 09/09/16
Total Coliform	Absent		1			SM 9223 B (P/A)	JMH 09/09/16
Radiological							
Gross Alpha	6.86	pCi/L	1			EPA 900.0	EJF 10/12/16
Gross Beta	5.54	pCi/L	1			EPA 900.0	EJF 10/13/16
Radium-226	0.493	pCi/L	1			MC Radium-226	EJF 10/22/16
Radium-228	< 1.00	pCi/L	1			MC Radium-228	EJF 10/22/16
Precision Data							
Gross Alpha precision	± 0.477	pCi/L	1			MC - Gross Alpha precision	EJF 10/12/16
Gross Beta precision	± 0.656	pCi/L	1			MC - Gross Beta precision	EJF 10/13/16
Radium-226 precision	± 0.148	pCi/L	1			MC-Radium 226 precision	EJF 10/22/16
Radium-228 precision	± 0.00	pCi/L	1			MC-Radium 228 precision	EJF 10/22/16
MDA Data							
Gross Alpha MDA	0.964	pCi/L	1			MC - Gross Alpha MDA	EJF 10/12/16
Gross Beta MDA	1.86	pCi/L	1			MC - Gross Beta MDA	EJF 10/13/16
Radium-226 MDA	0.306	pCi/L	1			MC - Radium 226 MDA	EJF 10/22/16
Radium-228 MDA	0.033	pCi/L	1			MC - Radium 228 MDA	EJF 10/22/16

Quality Control Data

Parameter	Result	Limits	DF	Method	Analyst/Date
Total Metals - Internal Std					
Bismuth (Bi)	88.4 %	(60.0 - 125.0) %	10	EPA 200.8	TNA 09/13/16
Germanium (Ge72)	86.0 %	(60.0 - 125.0) %	10	EPA 200.8	TNA 09/13/16
Germanium (Ge74)	89.3 %	(60.0 - 125.0) %	10	EPA 200.8 DRC	TNA 09/13/16
Indium (In)	84.8 %	(60.0 - 125.0) %	10	EPA 200.8	TNA 09/13/16
Scandium (Sc)	85.4 %	(60.0 - 125.0) %	10	EPA 200.8	TNA 09/13/16

Report Approved By:



Report Approved On: 10/27/2016 2:17:13 PM



2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Lab Numbers: 20160909501

QC Sample Report

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Spike								
TDS	0913208	1140	165	1000	100ml	97.5 %	(88.06) - (117.9)	SM 2540 C
TSS	0913208	51.0	-1.00	50.0	100ml	104.0 %	(79.16) - (120.9)	SM 2540 D
Alkalinity	0909501	303	197	106	1	100.0 %	(91.79) - (101.0)	SM 2320 B
Chloride	0909207	8.93	3.87	5.00	1	101.2 %	(86.07) - (111.2)	SM 4500-Cl E
Fluoride	0909501	0.785	0.396	0.400	1	97.3 %	(84.43) - (111.9)	SM 4500 F-C
Fluoride	0912211	2.96	2.01	1.00	1	95.3 %	(84.43) - (111.9)	SM 4500 F-C
N, Ammonia	0912109	0.411	< 0.050	0.400	1	102.8 %	(87.21) - (112.7)	SM 4500-NH3 D
N, Ammonia	0912909	0.468	0.085	0.400	1	95.8 %	(87.21) - (112.7)	SM 4500-NH3 D
N, Ammonia	0909501	0.388	< 0.050	0.400	1	97.0 %	(87.21) - (112.7)	SM 4500-NH3 D
N, Nitrate	0908921	0.769	0.372	0.400	1	99.3 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrate	0908205	4.38	2.72	0.400	4	103.3 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrate	0908101	0.834	0.437	0.400	1	99.3 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrate	0909202	0.848	0.436	0.400	1	103.0 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrate	0909301	0.391	< 0.050	0.400	1	97.8 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrate	0908850	0.387	< 0.050	0.400	1	96.8 %	(88.40) - (107.8)	SM 4500-NO3 F
N, Nitrite	0909501	0.401	0.001	0.400	1	100.0 %	(94.70) - (103.9)	SM 4500-NO2 B
N, Nitrite	0909202	0.417	0.026	0.400	1	97.8 %	(94.70) - (103.9)	SM 4500-NO2 B
N, Nitrite	0908921	0.391	0.002	0.400	1	97.3 %	(94.70) - (103.9)	SM 4500-NO2 B
N, Nitrite	0908850	0.393	0.00	0.400	1	98.3 %	(94.70) - (103.9)	SM 4500-NO2 B
Sulfate	0908919	658	474	19.2	10	105.8 %	(90.19) - (110.6)	SM 4500-SO4 E
Sulfate	0909208	1360	1000	19.2	20	104.9 %	(90.19) - (110.6)	SM 4500-SO4 E
TOC	0909501	2.51	0.532	2.00	1	98.7 %	(81.15) - (118.7)	SM 5310 C
Arsenic - D	0913301	0.261	0.007	0.025	10	101.5 %	(89.13) - (112.8)	EPA 200.8
Barium - D	0913301	0.278	0.033	0.025	10	97.8 %	(89.84) - (105.5)	EPA 200.8
Calcium - D	0912109	54.2	43.9	10.0	1	102.8 %	(79.78) - (120.1)	SM 3111 B
Calcium - D	0909501	154	51.0	10.0	10	103.2 %	(79.78) - (120.1)	SM 3111 B
Chromium - D	0913301	0.239	< 0.001	0.025	10	95.4 %	(85.17) - (103.2)	EPA 200.8 DRC
Iron - D	0913301	1.27	< 0.050	0.125	10	101.3 %	(85.03) - (107.7)	EPA 200.8
Magnesium - D	0912109	30.4	20.6	10.0	1	98.3 %	(81.47) - (110.1)	SM 3111 B
Magnesium - D	0909501	28.5	18.8	10.0	1	96.5 %	(81.47) - (110.1)	SM 3111 B
Manganese - D	0913301	0.242	< 0.010	0.025	10	96.9 %	(88.54) - (106.9)	EPA 200.8
Potassium - D	0909501	5.86	2.97	3.00	1	96.3 %	(84.98) - (115.1)	SM 3111 B
Selenium - D	0913301	1.22	< 0.005	0.125	10	97.5 %	(90.45) - (111.8)	EPA 200.8
Sodium - D	0909501	16.9	12.0	5.00	1	96.6 %	(80.77) - (122.0)	SM 3111 B
Uranium - D	0913301	0.253	0.002	0.025	10	100.4 %	(89.70) - (114.3)	EPA 200.8
Arsenic - T	0908903	0.240	0.007	0.025	10	93.0 %	(79.85) - (116.8)	EPA 200.8
Barium - T	0908903	0.246	< 0.005	0.025	10	98.5 %	(88.10) - (111.3)	EPA 200.8
Calcium - T	0912201	21.1	11.3	10.0	1	98.0 %	(82.85) - (114.4)	SM 3111 B

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Spike								
Calcium - T	0912202	227	119	10.0	10	108.3 %	(82.85) - (114.4)	SM 3111 B
Chromium - T	0908903	0.234	0.004	0.025	10	92.2 %	(86.28) - (109.9)	EPA 200.8 DRC
Iron - T	0908903	1.20	< 0.050	0.125	10	96.0 %	(74.13) - (117.9)	EPA 200.8
Magnesium - T	0912202	37.9	28.4	10.0	1	94.8 %	(80.47) - (110.9)	SM 3111 B
Magnesium - T	0912201	12.8	1.86	10.0	1	109.2 %	(80.47) - (110.9)	SM 3111 B
Manganese - T	0908903	0.242	< 0.010	0.025	10	96.9 %	(83.35) - (115.7)	EPA 200.8
Potassium - T	0912202	4.76	1.90	3.00	1	95.3 %	(80.59) - (117.3)	SM 3111 B
Potassium - T	0912201	3.96	1.05	3.00	1	97.0 %	(80.59) - (117.3)	SM 3111 B
Selenium - T	0908903	1.14	0.007	0.125	10	90.8 %	(79.81) - (117.9)	EPA 200.8
Sodium - T	0912201	10.8	5.29	5.00	1	109.6 %	(83.81) - (119.0)	SM 3111 B
Sodium - T	0912202	25.9	21.3	5.00	1	93.2 %	(83.81) - (119.0)	SM 3111 B
Uranium - T	0908903	0.259	< 0.001	0.025	10	103.7 %	(82.38) - (126.8)	EPA 200.8
Uranium - T	0913103	0.369	0.112	0.025	10	102.6 %	(82.38) - (126.8)	EPA 200.8
Arsenic - TR	0913103	0.257	< 0.005	0.025	10	102.6 %	(92.26) - (110.1)	EPA 200.8
Barium - TR	0913103	0.294	0.049	0.025	10	98.4 %	(88.38) - (106.1)	EPA 200.8
Chromium - TR	0913103	0.237	< 0.001	0.025	10	94.7 %	(82.65) - (107.4)	EPA 200.8 DRC
Iron - TR	0913103	1.28	0.083	0.125	10	96.1 %	(88.97) - (104.0)	EPA 200.8
Manganese - TR	0913103	0.237	< 0.010	0.025	10	94.7 %	(88.04) - (109.9)	EPA 200.8
Selenium - TR	0913103	1.37	0.006	0.125	10	108.8 %	(87.97) - (117.7)	EPA 200.8
Gross Alpha	0816604	15.3	5.43	10.0	1	98.3 %	(71.02) - (145.8)	EPA 900.0
Gross Alpha	0909501	16.3	6.86	10.0	1	94.7 %	(70.34) - (146.0)	EPA 900.0
Gross Beta	0816604	13.5	3.34	10.0	1	101.5 %		EPA 900.0
Gross Beta	0909501	14.1	5.54	10.0	1	85.3 %		EPA 900.0

Matrix Spike Duplicate

Alkalinity	0909501	304	303		1	0.329%	(-1.774) - (2.997)	SM 2320 B
Chloride	0909207	8.54	8.93		1	-4.46%	(-7.284) - (7.940)	SM 4500-Cl E
Fluoride		2.92	2.96		1	-1.22%	(-6.444) - (7.437)	SM 4500 F-C
Fluoride		0.760	0.785		1	-3.24%	(-6.444) - (7.437)	SM 4500 F-C
N, Ammonia	0912909	0.460	0.468		1	-1.72%	(-9.278) - (10.52)	SM 4500-NH3 D
N, Ammonia	0912109	0.402	0.411		1	-2.21%	(-9.278) - (10.52)	SM 4500-NH3 D
N, Nitrate	0909202	0.857	0.848		1	1.06%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrate	0908921	0.780	0.769		1	1.42%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrate	0909301	0.399	0.391		1	2.03%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrate	0908850	0.379	0.387		1	-2.09%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrate	0908205	4.45	4.38		4	1.77%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrate	0908101	0.807	0.834		1	-3.29%	(-7.441) - (6.442)	SM 4500-NO3 F
N, Nitrite	0908850	0.399	0.393		1	1.52%	(-7.070) - (5.425)	SM 4500-NO2 B
N, Nitrite	0908921	0.392	0.391		1	0.255%	(-7.070) - (5.425)	SM 4500-NO2 B
N, Nitrite	0909501	0.394	0.401		1	-1.76%	(-7.070) - (5.425)	SM 4500-NO2 B
N, Nitrite	0909202	0.413	0.417		1	-0.964%	(-7.070) - (5.425)	SM 4500-NO2 B
Sulfate	0909208	1360	1360		20	-0.490%	(-3.454) - (2.855)	SM 4500-SO4 E
Sulfate	0908919	656	658		10	-0.245%	(-3.454) - (2.855)	SM 4500-SO4 E
TOC	0909501	2.55	2.51		1	1.58%	(-6.978) - (6.646)	SM 5310 C
Arsenic - D	0913301	0.259	0.261		10	-0.770%	(-8.552) - (8.089)	EPA 200.8
Barium - D	0913301	0.282	0.278		10	1.40%	(-3.892) - (2.868)	EPA 200.8

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Matrix Spike Duplicate								
Calcium - D	0912109	54.9	54.2		1	1.30%	(-7.434) - (6.359)	SM 3111 B
Calcium - D	0909501	156	154		10	1.00%	(-7.434) - (6.359)	SM 3111 B
Chromium - D	0913301	0.237	0.239		10	-0.588%	(-3.148) - (3.288)	EPA 200.8 DRC
Iron - D	0913301	1.27	1.27		10	-0.126%	(-4.357) - (3.497)	EPA 200.8
Magnesium - D	0909501	28.9	28.5		1	1.50%	(-6.642) - (4.632)	SM 3111 B
Magnesium - D	0912109	30.5	30.4		1	0.197%	(-6.642) - (4.632)	SM 3111 B
Manganese - D	0913301	0.240	0.242		10	-1.03%	(-5.978) - (5.373)	EPA 200.8
Potassium - D	0909501	5.91	5.86		1	0.850%	(-4.448) - (4.830)	SM 3111 B
Selenium - D	0913301	1.23	1.22		10	0.596%	(-5.500) - (4.785)	EPA 200.8
Sodium - D	0909501	17.0	16.9		1	0.473%	(-5.630) - (6.416)	SM 3111 B
Uranium - D	0913301	0.247	0.253		10	-2.33%	(-2.730) - (2.866)	EPA 200.8
Arsenic - T	0908903	0.236	0.240		10	-1.44%	(-9.269) - (10.07)	EPA 200.8
Barium - T	0908903	0.252	0.246		10	2.10%	(-9.452) - (11.64)	EPA 200.8
Calcium - T	0912201	21.1	21.1		1	0.189%	(-7.561) - (7.755)	SM 3111 B
Calcium - T	0912202	227	227		10	-0.110%	(-7.561) - (7.755)	SM 3111 B
Chromium - T	0908903	0.236	0.234		10	0.545%	(-7.941) - (8.998)	EPA 200.8 DRC
Iron - T	0908903	1.22	1.20		10	1.70%	(-9.874) - (10.72)	EPA 200.8
Magnesium - T	0912202	39.2	37.9		1	3.38%	(-4.683) - (3.185)	SM 3111 B X
- Recovery was within 10% of expected value								
Magnesium - T	0912201	13.0	12.8		1	1.94%	(-4.683) - (3.185)	SM 3111 B
Manganese - T	0908903	0.239	0.242		10	-1.33%	(-11.02) - (11.33)	EPA 200.8
Potassium - T	0912202	4.82	4.76		1	1.25%	(-4.885) - (3.729)	SM 3111 B
Potassium - T	0912201	4.03	3.96		1	1.75%	(-4.885) - (3.729)	SM 3111 B
Selenium - T	0908903	1.11	1.14		10	-2.47%	(-10.69) - (10.93)	EPA 200.8
Sodium - T	0912202	26.8	25.9		1	3.19%	(-7.431) - (8.692)	SM 3111 B
Sodium - T	0912201	10.8	10.8		1	0.463%	(-7.431) - (8.692)	SM 3111 B
Uranium - T	0908903	0.256	0.259		10	-1.05%	(-6.476) - (6.506)	EPA 200.8
Uranium - T	0913103	0.370	0.369		10	0.420%	(-6.476) - (6.506)	EPA 200.8
Arsenic - TR	0913103	0.266	0.257		10	3.47%	(-8.777) - (8.739)	EPA 200.8
Barium - TR	0913103	0.290	0.294		10	-1.42%	(-3.782) - (4.193)	EPA 200.8
Chromium - TR	0913103	0.235	0.237		10	-0.776%	(-4.235) - (3.892)	EPA 200.8 DRC
Iron - TR	0913103	1.28	1.28		10	-0.476%	(-4.273) - (4.145)	EPA 200.8
Manganese - TR	0913103	0.240	0.237		10	1.47%	(-4.314) - (4.549)	EPA 200.8
Selenium - TR	0913103	1.39	1.37		10	1.48%	(-6.156) - (6.310)	EPA 200.8
Gross Alpha		10.4	9.74		1	6.77%		EPA 900.0
Gross Beta		10.8	9.58		1	12.2 %		EPA 900.0
Radium-226		5.43	4.47		1	19.3 %		MC Radium-226
Radium-228		6.17	5.11		1	18.9 %		MC Radium-228
Duplicate								
Conductivity	0909810	1360	1350		1	0.148%	(-0.7668) - (0.6316)	SM 2510B
Conductivity	0909501	432	432		1	0.00%	(-0.7668) - (0.6316)	SM 2510B
Conductivity	0912101	530	530		1	0.00%	(-0.7668) - (0.6316)	SM 2510B
TDS	0913203	199	200		100ml	-0.501%	(-7.494) - (9.365)	SM 2540 C
TSS	0912909	< 4.00	< 4.00		250ml	0.00%	(-14.69) - (19.89)	SM 2540 D
TSS	0913203	< 10.0	< 10.0		100ml	0.00%	(-14.69) - (19.89)	SM 2540 D

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Duplicate								
Sulfate	0908919	473	474		10	-0.169%	(-4.815) - (3.706)	SM 4500-SO4 E
Sulfate	0909208	1000	988		20	1.24%	(-4.815) - (3.706)	SM 4500-SO4 E
Initial Calibration Verification								
Conductivity		512	499		1	2.61%	(-15.70) - (9.988)	SM 2510B
Chloride		23.8	25.0		1	-4.68%	(-11.61) - (14.50)	SM 4500-Cl E
Fluoride		0.384	0.400		1	-4.00%	(-6.018) - (5.918)	SM 4500 F-C
N, Ammonia		0.378	0.400		1	-5.50%	(-8.702) - (6.687)	SM 4500-NH3 D
N, Nitrate		1.00	1.00		1	0.400%	(-5.468) - (6.848)	SM 4500-NO3 F
N, Nitrite		1.01	1.00		1	0.800%	(-2.988) - (3.498)	SM 4500-NO2 B
Sulfate		51.9	50.0		1	3.82%	(0.8475) - (7.388)	SM 4500-SO4 E
TOC		9.67	10.0		1	-3.35%	(-11.11) - (6.044)	SM 5310 C
Arsenic - D		0.051	0.050		1	1.32%	(-5.244) - (6.276)	EPA 200.8
Barium - D		0.051	0.050		1	2.34%	(-4.788) - (6.386)	EPA 200.8
Chromium - D		0.052	0.050		1	3.94%	(-8.178) - (8.320)	EPA 200.8 DRC
Iron - D		0.271	0.250		1	8.23%	(-6.288) - (7.732)	EPA 200.8 X
- Recovery was within 10% of expected value								
Manganese - D		0.050	0.050		1	0.00%	(-2.640) - (6.522)	EPA 200.8
Selenium - D		0.243	0.250		1	-2.80%	(-5.054) - (3.933)	EPA 200.8
Uranium - D		0.051	0.050		1	2.58%	(-10.61) - (7.432)	EPA 200.8
Continuing Calibration Verification								
Conductivity		510	499		1	2.20%	(-5.618) - (3.791)	SM 2510B
TDS		994	1000		100ml	-0.600%	(-15.58) - (10.08)	SM 2540 C
TSS		49.0	50.0		100ml	-2.00%	(-22.90) - (13.10)	SM 2540 D
Alkalinity		103	106		1	-2.45%	(-11.50) - (3.971)	SM 2320 B
Alkalinity		103	106		1	-2.75%	(-11.50) - (3.971)	SM 2320 B
Chloride		24.1	25.0		1	-3.56%	(-11.90) - (12.76)	SM 4500-Cl E
Chloride		23.4	25.0		1	-6.36%	(-11.90) - (12.76)	SM 4500-Cl E
Fluoride		0.967	1.00		1	-3.30%	(-7.857) - (5.223)	SM 4500 F-C
Fluoride		3.07	3.00		1	2.47%	(-7.857) - (5.223)	SM 4500 F-C
Fluoride		0.090	0.100		1	-10.0%	(-7.857) - (5.223)	SM 4500 F-C X
- Recovery was within 10% of expected value								
Fluoride		0.466	0.500		1	-6.80%	(-7.857) - (5.223)	SM 4500 F-C
N, Ammonia		1.00	1.00		1	0.400%	(-10.88) - (6.787)	SM 4500-NH3 D
N, Ammonia		0.487	0.500		1	-2.60%	(-10.88) - (6.787)	SM 4500-NH3 D
N, Ammonia		0.968	1.00		1	-3.20%	(-10.88) - (6.787)	SM 4500-NH3 D
N, Ammonia		0.097	0.100		1	-3.00%	(-10.88) - (6.787)	SM 4500-NH3 D
N, Nitrate		0.975	1.00		1	-2.50%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrate		1.02	1.00		1	2.20%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrate		1.01	1.00		1	1.10%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrate		1.00	1.00		1	0.300%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrate		0.997	1.00		1	-0.300%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrate		0.991	1.00		1	-0.900%	(-6.125) - (8.755)	SM 4500-NO3 F
N, Nitrite		1.01	1.00		1	0.700%	(-1.555) - (5.315)	SM 4500-NO2 B
N, Nitrite		1.02	1.00		1	2.10%	(-1.555) - (5.315)	SM 4500-NO2 B

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Continuing Calibration Verification								
N, Nitrite		1.02	1.00		1	1.50%	(-1.555) - (5.315)	SM 4500-NO2 B
N, Nitrite		1.02	1.00		1	2.20%	(-1.555) - (5.315)	SM 4500-NO2 B
Sulfate		51.9	50.0		1	3.78%	(0.7099) - (8.308)	SM 4500-SO4 E
Sulfate		52.3	50.0		1	4.52%	(0.7099) - (8.308)	SM 4500-SO4 E
TOC		9.91	10.0		1	-0.920%	(-7.784) - (4.211)	SM 5310 C
TOC		9.91	10.0		1	-0.900%	(-7.784) - (4.211)	SM 5310 C
Arsenic - D		0.051	0.050		1	1.38%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.048	0.050		1	-4.16%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.049	0.050		1	-3.02%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.047	0.050		1	-5.26%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.048	0.050		1	-3.50%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.048	0.050		1	-4.46%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.049	0.050		1	-2.12%	(-7.847) - (3.315)	EPA 200.8
Arsenic - D		0.049	0.050		1	-3.04%	(-7.847) - (3.315)	EPA 200.8
Barium - D		0.050	0.050		1	-0.620%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.049	0.050		1	-2.32%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.048	0.050		1	-4.20%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.050	0.050		1	0.720%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.049	0.050		1	-1.28%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.050	0.050		1	-0.220%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.048	0.050		1	-3.30%	(-10.08) - (5.170)	EPA 200.8
Barium - D		0.049	0.050		1	-1.58%	(-10.08) - (5.170)	EPA 200.8
Calcium - D		25.4	25.0		1	1.72%	(-0.3736) - (7.290)	SM 3111 B
Calcium - D		25.8	25.0		1	3.04%	(-0.3736) - (7.290)	SM 3111 B
Calcium - D		25.4	25.0		1	1.72%	(-0.3736) - (7.290)	SM 3111 B
Chromium - D		0.047	0.050		1	-6.70%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.049	0.050		1	-1.84%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.047	0.050		1	-5.66%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.049	0.050		1	-2.78%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.049	0.050		1	-1.78%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.048	0.050		1	-4.86%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.050	0.050		1	-0.880%	(-10.59) - (4.101)	EPA 200.8 DRC
Chromium - D		0.048	0.050		1	-3.26%	(-10.59) - (4.101)	EPA 200.8 DRC
Iron - D		0.245	0.250		1	-1.91%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.252	0.250		1	0.876%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.251	0.250		1	0.560%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.241	0.250		1	-3.45%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.245	0.250		1	-1.86%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.243	0.250		1	-2.91%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.242	0.250		1	-3.30%	(-14.69) - (7.940)	EPA 200.8
Iron - D		0.238	0.250		1	-4.99%	(-14.69) - (7.940)	EPA 200.8
Magnesium - D		25.0	25.0		1	-0.040%	(-8.110) - (8.402)	SM 3111 B
Magnesium - D		24.1	25.0		1	-3.60%	(-8.110) - (8.402)	SM 3111 B
Magnesium - D		26.2	25.0		1	4.72%	(-8.110) - (8.402)	SM 3111 B
Manganese - D		0.048	0.050		1	-3.30%	(-4.932) - (2.160)	EPA 200.8
Manganese - D		0.048	0.050		1	-4.14%	(-4.932) - (2.160)	EPA 200.8

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method	
Continuing Calibration Verification									
Manganese - D		0.049	0.050		1	-2.16%	(-4.932) - (2.160)	EPA 200.8	
Manganese - D		0.050	0.050		1	-0.800%	(-4.932) - (2.160)	EPA 200.8	
Manganese - D		0.049	0.050		1	-1.20%	(-4.932) - (2.160)	EPA 200.8	
Manganese - D		0.047	0.050		1	-5.18%	(-4.932) - (2.160)	EPA 200.8	X
- Recovery was within 10% of expected value									
Manganese - D		0.048	0.050		1	-4.44%	(-4.932) - (2.160)	EPA 200.8	
Manganese - D		0.048	0.050		1	-3.84%	(-4.932) - (2.160)	EPA 200.8	
Potassium - D		4.91	5.00		1	-1.80%	(-12.57) - (10.01)	SM 3111 B	
Potassium - D		4.94	5.00		1	-1.20%	(-12.57) - (10.01)	SM 3111 B	
Potassium - D		4.97	5.00		1	-0.600%	(-12.57) - (10.01)	SM 3111 B	
Selenium - D		0.238	0.250		1	-4.75%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.237	0.250		1	-5.25%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.238	0.250		1	-4.93%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.249	0.250		1	-0.432%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.233	0.250		1	-6.91%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.233	0.250		1	-6.74%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.242	0.250		1	-3.40%	(-7.226) - (4.695)	EPA 200.8	
Selenium - D		0.237	0.250		1	-5.20%	(-7.226) - (4.695)	EPA 200.8	
Sodium - D		15.5	15.0		1	3.53%	(-7.363) - (8.369)	SM 3111 B	
Sodium - D		15.5	15.0		1	3.07%	(-7.363) - (8.369)	SM 3111 B	
Sodium - D		15.1	15.0		1	0.600%	(-7.363) - (8.369)	SM 3111 B	
Uranium - D		0.050	0.050		1	0.840%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.048	0.050		1	-3.54%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.051	0.050		1	2.30%	(-10.20) - (1.623)	EPA 200.8	X
- Recovery was within 10% of expected value									
Uranium - D		0.050	0.050		1	0.180%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.050	0.050		1	-0.960%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.049	0.050		1	-1.54%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.050	0.050		1	-0.020%	(-10.20) - (1.623)	EPA 200.8	
Uranium - D		0.051	0.050		1	1.54%	(-10.20) - (1.623)	EPA 200.8	
Radium-226		10400	10200		1	2.04%	(-7.826) - (5.961)	MC Radium-226	
Radium-228		10400	10300		1	1.37%	(-12.38) - (6.909)	MC Radium-228	
Lab Fortified Blank									
Gross Alpha		9.74	0.00	10.0	1	97.4 %	(79.40) - (123.4)	EPA 900.0	
Gross Beta		9.58	0.00	10.0	1	95.8 %		EPA 900.0	
Radium-226		4.47	0.533	4.00	1	98.5 %	(86.93) - (130.5)	MC Radium-226	
Radium-228		5.11	0.699	5.00	1	88.2 %	(69.61) - (146.8)	MC Radium-228	
Initial Calibration Blank									
Conductivity		0.400	0.00		1	0.4	(0.0067) - (1.023)	SM 2510B	
Alkalinity		2.62	0.00		1	2.62	(-0.2739) - (5.500)	SM 2320 B	
Chloride		-0.280	0.00		1	0.28	(-0.1125) - (0.7235)	SM 4500-Cl E	
Fluoride		0.006	0.00		1	0.006	(0.0052) - (0.0070)	SM 4500 F-C	
N, Ammonia		0.019	0.00		1	0.0194	(0.0127) - (0.0238)	SM 4500-NH3 D	
N, Nitrate		-0.024	0.00		1	0.024	(-0.0122) - (0.0179)	SM 4500-NO3 F	X
- Blank value is less than half of the reporting limit									

Parameter	Lab#	QC Value	Smp Value Spike	DF	Result	Limits	Method
Initial Calibration Blank							
N, Nitrite		0.003	0.00	1	0.003	(-0.0086) - (0.0157)	SM 4500-NO2 B
Sulfate		1.52	0.00	1	1.52	(0.9666) - (1.767)	SM 4500-SO4 E
TOC		-0.030	0.00	1	-0.03	(-0.2884) - (0.4645)	SM 5310 C
Continuing Calibration Blank							
Conductivity		0.400	0.00	1	0.4	(-0.1415) - (0.9915)	SM 2510B
TDS		7.00	0.00	100ml	7	(-16.40) - (9.600)	SM 2540 C
TSS		-2.00	0.00	100ml	-2	(-7.787) - (2.587)	SM 2540 D
Alkalinity		2.74	0.00	1	2.74	(0.1320) - (4.579)	SM 2320 B
Chloride		-0.320	0.00	1	0.32	(-0.0536) - (0.6896)	SM 4500-Cl E
Chloride		-0.340	0.00	1	0.34	(-0.0536) - (0.6896)	SM 4500-Cl E
Fluoride		0.007	0.00	1	0.007	(0.0025) - (0.0091)	SM 4500 F-C
Fluoride		0.006	0.00	1	0.006	(0.0025) - (0.0091)	SM 4500 F-C
N, Ammonia		0.017	0.00	1	0.0169	(0.0126) - (0.0218)	SM 4500-NH3 D
N, Ammonia		0.020	0.00	1	0.0198	(0.0126) - (0.0218)	SM 4500-NH3 D
N, Ammonia		0.016	0.00	1	0.0161	(0.0126) - (0.0218)	SM 4500-NH3 D
N, Nitrate		-0.027	0.00	1	0.027	(-0.0126) - (0.0233)	SM 4500-NO3 F X
- Blank value is less than half of the reporting limit							
N, Nitrate		-0.020	0.00	1	0.02	(-0.0126) - (0.0233)	SM 4500-NO3 F
N, Nitrate		-0.022	0.00	1	0.022	(-0.0126) - (0.0233)	SM 4500-NO3 F
N, Nitrate		-0.016	0.00	1	0.016	(-0.0126) - (0.0233)	SM 4500-NO3 F
N, Nitrate		-0.020	0.00	1	0.02	(-0.0126) - (0.0233)	SM 4500-NO3 F
N, Nitrate		-0.026	0.00	1	0.026	(-0.0126) - (0.0233)	SM 4500-NO3 F X
- Blank value is less than half of the reporting limit							
N, Nitrite		0.004	0.00	1	0.004	(-0.0047) - (0.0102)	SM 4500-NO2 B
N, Nitrite		0.00	0.00	1	0	(-0.0047) - (0.0102)	SM 4500-NO2 B
N, Nitrite		0.00	0.00	1	0	(-0.0047) - (0.0102)	SM 4500-NO2 B
N, Nitrite		0.00	0.00	1	0	(-0.0047) - (0.0102)	SM 4500-NO2 B
Sulfate		1.58	0.00	1	1.58	(0.2956) - (2.750)	SM 4500-SO4 E
Sulfate		1.22	0.00	1	1.22	(0.2956) - (2.750)	SM 4500-SO4 E
TOC		-0.019	0.00	1	-0.019	(-0.1950) - (0.3041)	SM 5310 C
TOC		0.109	0.00	1	0.109	(-0.1950) - (0.3041)	SM 5310 C
Arsenic - D		0.000	0.00	1	0.00005	(0.0000) - (0.0001)	EPA 200.8
Barium - D		0.000	0.00	1	0.00003	(0.0000) - (0.0001)	EPA 200.8
Calcium - D		0.020	0.00	1	0.02	(-0.2218) - (0.2548)	SM 3111 B
Calcium - D		-0.010	0.00	1	-0.01	(-0.2218) - (0.2548)	SM 3111 B
Calcium - D		0.020	0.00	1	0.02	(-0.2218) - (0.2548)	SM 3111 B
Chromium - D		0.000	0.00	1	0.00002	(0.0000) - (0.0001)	EPA 200.8 DRC
Iron - D		0.000	0.00	1	0.00028	(-0.0001) - (0.0004)	EPA 200.8
Magnesium - D		0.010	0.00	1	0.01	(-0.0898) - (0.1101)	SM 3111 B
Magnesium - D		0.020	0.00	1	0.02	(-0.0898) - (0.1101)	SM 3111 B
Magnesium - D		0.020	0.00	1	0.02	(-0.0898) - (0.1101)	SM 3111 B
Manganese - D		0.000	0.00	1	0.00003	(0.0000) - (0.0001)	EPA 200.8
Potassium - D		-0.010	0.00	1	-0.01	(-0.0497) - (0.0137)	SM 3111 B
Potassium - D		-0.010	0.00	1	-0.01	(-0.0497) - (0.0137)	SM 3111 B
Potassium - D		-0.010	0.00	1	-0.01	(-0.0497) - (0.0137)	SM 3111 B

Parameter	Lab#	QC Value	Smp Value	Spike	DF	Result	Limits	Method
Continuing Calibration Blank								
Selenium - D		0.000	0.00		1	0.0002	(-0.0002) - (0.0004)	EPA 200.8
Sodium - D		0.040	0.00		1	0.04	(-0.0488) - (0.0746)	SM 3111 B
Sodium - D		0.020	0.00		1	0.02	(-0.0488) - (0.0746)	SM 3111 B
Sodium - D		0.040	0.00		1	0.04	(-0.0488) - (0.0746)	SM 3111 B
Uranium - D		0.000	0.00		1	0.00003	(0.0000) - (0.0001)	EPA 200.8
Lab Reagent Blank								
Gross Alpha		0.183	0.00		1	0.183	(-0.6553) - (0.7947)	EPA 900.0
Gross Beta		-0.929	0.00		1	-0.929		EPA 900.0
Radium-226		0.533	0.00		1	0.5332	(-0.5586) - (1.005)	MC Radium-226
Radium-228		0.699	0.00		1	0.6993	(-0.9232) - (1.585)	MC Radium-228

Approved By: 

Approved On: 10/27/2016 02:17 PM



2381 S. Plaza Dr. • P.O. Box 3388 • Rapid City, SD 57709
(605) 348-0111 • www.TheChemistryLab.com

CHAIN OF CUSTODY RECORD

Company	SOUTHERN BLACK HILLS WATER SYSTEM
Project Name / Mgr.	TRAILER WELL PUMP MITCH KANNENBERG
Project Number	
Sampled by	Signature: <i>[Signature]</i>
Sampled by	Print: MITCH KANNENBERG

PRESERVED WITH	✓	none	none	none	none	none	none
FILTERED (Y/N)	✓	none	none	none	none	none	none
REFRIGERATED (Y/N)	✓	none	none	none	none	none	none
ANALYSES REQUESTED	list in comments	As, Ba, Cr, Fe	Total	Mn, Se, U	Caliform	e-coli	P/A
	analyse	TOC	Ammonia	*Radiological	Hardness	calculated	

FOR LAB USE ONLY	
Seal Intact (Y/N)/Number	IV Hand
Sample Condition	Good
Temperature of Container	3.9°C
REQUESTED TURN AROUND	
STANDARD	RUSH

	SAMPLE NAME	DATE	TIME	MATRIX	NO. OF CONTAINERS									COMMENTS	LAB #
1	S3HWS1 TRAILER WELL	9-8-16	15:45	Water	6	1	1	1	1	1	1				26160909501
2														*Radiological tests Gross Alpha	
3														Gross Beta, Radium 226 & 228	
4														collected in gallon cube and	
5														preserved at lab within 5 days of collection	
6															
7														Mineral Bottle analytes-no chemical preservative	
8														Conductivity, TDS, TSS	
9														Alkalinity, Bicarbonate, Carbonate	
10														chloride, sulfate, fluoride	
11														nitrate, nitrite (within 48hrs)	
12														Calcium, Magnesium, Potassium, Sodium	

RELINQUISHED BY (Signature)	COMPANY NAME	DATE	TIME	RECEIVED BY (Signature)	COMPANY NAME	DATE	TIME
<i>[Signature]</i>	SCB	9-9-16	11:00	<i>[Signature]</i>	RET	9/9/16	11:00
BILLING ADDRESS:							
26858 Hwy 385							
Hot Springs, SD 57747							



SAMPLE RECEIPT CHECKLIST

Company Name Southern Black Hills Water System Inc. Date/Time Received 09/09/16 11:00
Project Trailer Well Sump Test Received by Robert Miller
Lab Number(s) 20160909501 Carrier Name Hand Delivered

Yes	No	<u>UNPACKING</u>	Initials
☒	☐	1. Shipping container in good condition?	
☐	☒	2. Custody seals present on shipping container? Condition: Intact Broken	
☒	☐	3. <u>(ice)</u> Blue Ice (circle one) present in shipping container?	
☐	☒	Container(s) Temp. 1. <u>3.7°C</u> 2. _____ 3. _____ 4. _____	
☐	☒	4. Bottles broken and/or leaking? (Photograph broken bottles.)	
☐	☒	5. Custody seals on sample bottles? Condition: Intact Broken	

Yes	No	<u>LABELING</u>	Initials
☒	☐	6. Chain of custody Present?	
☒	☐	7. Chain of custody includes signatures, dates, and times when relinquished and received?	
☒	☐	8. Chain of custody agrees with bottle count?	
☒	☐	9. Chain of custody agrees with labels?	
☒	☐	10. Samples received within holding times?	
☒	☐	11. Samples in proper container?	
☒	☐	12. Sufficient sample volume for indicated tests?	

<u>PRESERVATIVE</u>					
Yes	No	Initials	Yes	No	Initials
☒	☐	13. Metals bottle(s) pH < 2? <u>EF.</u>	☒	☐	17. TOC bottle(s) pH < 2? <u>EF.</u>
☐	☐	14. Nutrient bottle(s) pH < 2? _____	☐	☐	18. Oil & Grease bottle(s) pH < 2? _____
☐	☐	15. Cyanide bottle(s) pH > 12? _____	☐	☐	19. Volatiles pH < 2? _____
☐	☐	16. Sulfide bottle(s) pH > 9? _____			

COMMENTS: _____



RECEIVED

MAR 07 2018

WATER RIGHTS
PROGRAM

March 05, 2018

Mr. Adam Mathiowetz
Water Rights Program
SD Department of Environment & Natural Resources
523 E. Capitol Avenue
Pierre, SD 57501

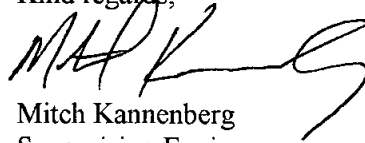
**Subject: Report Transmittal
Southern Black Hills Water System
Casey Well Constant-Rate Aquifer Pumping Test Report**

Dear Mr. Mathiowetz:

Enclosed is a copy of the Casey Well Constant-Rate Aquifer Pumping Test Report, dated January 3, 2018, that was prepared for Southern Black Hills Water System.

Please call me at (605) 334-6000 if you have any questions or need additional information.

Kind regards,



Mitch Kannenberg
Supervising Engineer

H:\data\wp\hydro\SBH\DENR report transmittal

MK/kk

Encl.

cc: Casey Well Constant-Rate Aquifer Pumping Test Report, dated January 3, 2018
Don Peterson w/o enclosure

WSP USA
Formerly
Leggette, Brashears & Graham
140 East Hinks Lane, Suite 126
Sioux Falls, SD 57104

Tel.: +1 605-334-6000
wsp.com

**CASEY WELL CONSTANT-RATE AQUIFER PUMPING TEST
SOUTHERN BLACK HILLS WATER SYSTEM**

HOT SPRINGS, SOUTH DAKOTA

Prepared For:

Southern Black Hills Water System
26858 Highway 385
Hot Springs, SD 57747

January 3, 2018

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater and Environmental Engineering Services
140 East Hinks Lane, Suite 126
Sioux Falls, SD 57104
(605) 334-6000

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- B Barometric Pressure and Precipitation
- C Qualitative Analysis Plots – Constant-Rate Test
- D Quantitative Analysis Plots – Constant-Rate Test
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CASEY WELL CONSTANT-RATE AQUIFER PUMPING TEST SOUTHERN BLACK HILLS WATER SYSTEM

HOT SPRINGS, SOUTH DAKOTA

1.0 PURPOSE AND BACKGROUND INFORMATION

The purpose of this report is to provide the results of a constant-rate aquifer pumping test (test) conducted on the Southern Black Hills Water System (SBHWS) Casey well. SBHWS is considering applying for a permit to appropriate water from the Madison aquifer at a withdrawal rate of 300 gallons per minute (gpm), utilizing the Casey well as the diversion point. The purpose of the test was to provide information regarding the aquifer characteristics of the Madison aquifer at the project site (Site) and to provide information regarding the suitability of the Casey well as a potential water supply well for the SBHWS. All elevations in this report are referenced to mean sea level in the North American Vertical Datum of 1988 (NAVD88).

The test was conducted utilizing the Casey well as the pumping well, and the test was conducted at an average pumping rate of 267 gallons per minute (gpm), from 9:06 am, Monday, October 23, 2017 to 8:05 am, Friday, October 27, 2017. For the purposes of this report, the test consisted of three different periods; the background period (time prior to initiating pumping), the pumping period (the total time the Casey well was being pumped), and the recovery period (the time after pumping from the Casey well was discontinued).

The total duration of the pumping period was approximately 95 hours (5,699 minutes). The pumping period was originally planned to be 72 hours, but was extended an additional day when a water level deflection beginning at approximately 4,000 minutes (67 hours) into the pumping period of the test was identified. The deflection, which was believed to be due to a relatively fast moving weather front resulting in a rapid increase in barometric pressure, was steeper than other barometric pressure-induced water level deflections observed during the test. Consequently, after consultation with SBHWS, it was decided to extend the pumping period by one day to confirm that the deflection in the water level curve was the result of barometric pressure changes and not an aquifer boundary condition.

1.1 Observation Wells, Calcite Lake and Water Level Monitoring Periods

LBG monitored the water levels in the Casey well (pumping well) and in the SBHWS monitoring well MW-1 during the test. The United States Geological Survey (USGS) and the

National Park Service (NPS) monitored water levels in two wells owned by the NPS (the Kaiser well and NPS Well #2) during the test. These four wells are all completed in the Madison aquifer. The radial distances from the Casey well to the three observation wells are 129 feet (MW-1), 2,772 feet (Kaiser well), and 15,488 feet (NPS Well #2). A summary of the pumping and observation wells is provided in Table 1 and the locations are shown in Figure 1. Copies of well construction and geologic logs (well logs) for the four wells are provided in Appendix A. The logs of the Casey well, MW-1 and the Kaiser well all have references to caves at the top of the Madison Limestone, which is indicative of the significant volume of solution openings within the top of the Madison aquifer in the Site vicinity.

It was intended to utilize the South Dakota Department of Environment & Natural Resource (DENR) Madison aquifer observation well CU-91A (also shown in Figure 1) as an observation well during the test. However, the data-logging pressure transducer (transducer) in CU-91A malfunctioned, and as of this report date, no water level data after September 26, 2017, are available from CU-91A.

The NPS conducts long-term water level monitoring of a flooded passageway of Wind Cave called Calcite Lake. The NPS provided LBG links to the Calcite Lake water level data (Jeff Hughes, NPS, personal communication, 2017), and the data from Calcite Lake were also reviewed as part of the test analysis.

1.2 Monitoring and Test Pumping Equipment

The four wells were equipped with data-logging pressure transducers (transducer). The Casey well and MW-1 were monitored with dedicated 30 pounds per square inch-gauge (psig) Telog transducers and the water level data were downloaded daily by LBG during the test. Manual water level measurements were collected by LBG throughout the test in the Casey well and MW-1 to validate the transducer measurements. The transducer in MW-1 functioned properly during all three of the test periods (background, pumping and recovery). The transducer in the Casey well functioned properly during the background and recovery periods; however, during the pumping period the water level data from the Casey well transducer vary by as much as 1.86 feet. This is believed to be due to electromagnetic interference due to the operation of the submersible pump. While the Casey well transducer data collected during the pumping period of

the test are “noisy,” the water level data collected manually by LBG from the well during the pumping period are accurate.

The Kaiser well, Calcite Lake and NPS Well #2 are equipped with dedicated transducers installed by the USGS on behalf of the NPS. The water level data from the Kaiser well were provided to LBG by the USGS. The water level data from Calcite Lake and NPS Well #2 were obtained by downloading the data from the NPS website following links to the data as provided to LBG by the NPS (Jeff Hughes, NPS, personal communication, 2017). No manual measurements of water levels in the Kaiser well, NPS Well #2, and Calcite Lake were made by the USGS or NPS during the pumping period of the test.

Transducers in the Casey well, MW-1 and the Kaiser well collected and recorded water level measurements at a 1-minute sample rate. The transducer in NPS Well #2 collected and recorded water-level measurements at a 1-hour sample rate, and the transducer in Calcite Lake collected and recorded water level measurements at a 12-hour sample rate.

The submersible pump utilized for the test had been previously installed in the Casey well for a step-rate aquifer test conducted in September 2016 (LBG, 2017). The pump is a 60-horsepower stainless steel submersible pump manufactured by Grundfos. The pump is 6-inches in diameter, has 17 stages, and a 3-inch diameter national pipe thread (NPT) outlet. The pump model number is 230S600-17.

1.3 Water Discharge During the Test

An application for the temporary use and discharge of water under the *South Dakota General Permit for Temporary Discharge Activities* was submitted by SBHWS to the DENR. The temporary use and discharge permit was granted and assigned Permit Number SDG071328. Permit reporting requirements for the temporary discharge permit included gallons discharged, laboratory analysis of total suspended solids (TSS), field measurements of pH, visual inspection for sheen, and if a sheen was observed, laboratory analysis for total petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes.

Water pumped from the Casey well was diverted from the wellhead via approximately 10 feet of 3-inch diameter steel pipe that included an in-line totalizing flow meter, a flow-control valve, and a sample port. Downstream of the sample port, the water was discharged into flexible hose at a location approximately 140 feet southeast of the well (Figure 2). Erosion control

measures, including anchored tarps and straw bales, were utilized to limit erosion by the well discharge.

The discharged water flowed east and southeast in a shallow, vegetated drainage-way that is the beginning of a minor, un-named tributary to Beaver Creek. The top of the Madison aquifer is greater than 800 feet below the ground surface at the Site; consequently, the discharge from the Casey well was not anticipated to recharge the aquifer. The well discharge was visually monitored periodically every day of the test to confirm that erosion was not occurring at the discharge location and to check for sheen as required by the temporary discharge permit.

There was no sheen observed in the water discharged from the well. LBG completed discharge monitoring reports (DMR), submitted them to SBHWS, and SBHWS signed and forwarded the DMRs to the DENR. DMRs were submitted for October 2017 and November 2017. The well discharge monitoring data collected during the pumping period of the test and provided in the October 2017 DMR indicated the volume and quality of water discharged during the test was in compliance with the requirements of the temporary discharge permit.

1.4 Water Level Data, Barometric Pressure and Precipitation

Barometric pressure and precipitation data were obtained from Weather Underground for Hot Springs, SD (Station KSDHOTSP14) and from the National Oceanic and Atmospheric Administration (NOAA) data for weather station WBAN:94032 (Custer County Airport). Additionally, the NPS provided barometric pressure data collected near Calcite Lake and NPS Well #2 (Jeff Hughes, NPS, personal communication, 2017).

The groundwater elevations measured in the Casey well, MW-1, the Kaiser well, and NPS Well #2 during the background period, pumping period, and recovery period of the test are shown in Figure 3. Also shown in Figure 3 is the barometric pressure measured at the Hot Springs station.

The data shown in Figure 3 indicate that the water levels in the Casey well and the three observation wells fluctuate with changes in barometric pressure. When the barometric pressure increases, the water levels decrease, when the barometric pressure decreases, the water levels increase. The barometric pressure had a notable effect on the groundwater elevations measured in the four wells during the background, pumping, and recovery periods of the test.

The top of the Madison aquifer at the Site is approximately 810 feet below the ground surface, and precipitation received in the Site vicinity during the approximately three-week period before, during and after the test would not likely measurably recharge the aquifer. The precipitation data obtained from the previously referenced Hot Springs and Custer weather stations indicate that there was no precipitation received in Hot Springs during the week before pumping was started, there was no precipitation in Hot Springs (nor at the Site) during the pumping period, and there was no precipitation received in Hot Springs for approximately one week after pumping was shutdown. There was some precipitation measured at the Custer weather station, however, the precipitation received at Custer is not believed to have impacted the groundwater elevations in the four wells during the pumping period of the test. The barometric pressure and precipitation data during the background, pumping and recovery periods of the test are provided in Appendix B.

1.5 Well Discharge Rate Measurements

The discharge flow rate from the Casey well during the test was measured and recorded using an inline totalizing flow meter provided by Alexander Drilling. The pumping rate remained constant during the four days of pumping. A graph showing the measured pumping rate versus elapsed pumping time is provided in Appendix C.

1.6 Qualitative Analysis

A qualitative analysis of the test data was completed for all four wells by constructing water level-versus-time data plots. The water level-versus-time data plots were examined and evaluated to determine if drawdown attributable to pumping from the Casey well had occurred, and to identify data for which a quantitative evaluation could be completed for the purpose of determining aquifer parameters. The plots were also reviewed to identify abnormal data resulting from natural background conditions, malfunctioning transducers, or aquifer boundary conditions. The aquifer response to pumping, barometric pressure changes, radial distances from the pumping wells, and observation well construction were considered in the qualitative analysis.

Drawdown directly attributable to pumping from the Casey well was only observed in the Casey well. All water levels in all four wells were influenced by changes in barometric pressure, as were the water levels in Calcite Lake. The water level changes measured in MW-1, the Kaiser well, NPS Well #2, and Calcite Lake, during all three test periods (background, pumping, and

recovery)), appear to be due solely to changes in barometric pressure. It was confirmed during the qualitative analysis of the data that the water level deflection observed in the Casey well near the end of the third day of the pumping period was due to a relatively rapid increase in the barometric pressure, and was not caused by a boundary condition. Depth to water, drawdown, and recovery data are plotted versus time in graphs utilized for the qualitative analysis. The graphs are provided in Appendix C.

The maximum drawdown measured in the Casey well during the pumping period was approximately 2.4 feet (near the end of the pumping period), with a corresponding pumping water level of approximately 404 feet below ground surface. This maximum drawdown corresponds to a specific capacity of approximately 111 gallons per minute per foot of drawdown (gpm/ft).

Water level recovery in the Casey well after pumping shutdown took less than 5 minutes to reach near pre-pumping static conditions. In fact, water levels recovered to approximately 0.10 ft *above* pre-pumping static levels.

Groundwater elevation data for the four wells and Calcite Lake, measured at four distinct time periods (before, during and after the pumping period of the test), are provided in Table 2. Also provided in Table 2 is the groundwater elevation measured at CU-91A on September 26, 2017.

The groundwater elevation data in Table 2 suggest a groundwater gradient from the southeast to northwest, with the highest elevation (3,659.54 feet) measured at CU-91A on September 26, 2017 (the only groundwater elevation data available from this well during the time period of the test). A groundwater elevation measurement (from the transducer) taken on September 26, 2017, in the NPS Well #2 (3656.06 feet) is approximately 3½ feet lower than the groundwater elevation measured at CU-91A. A groundwater elevation measurement (from the transducer) taken on September 26, 2017, at Calcite Lake (3635.69 feet) is over 23 feet lower than the elevation in CU-91A. While no elevation data are available on September 26, 2017, for the Casey well and MW-1, the elevation data from one day later (September 27) are 3656.10 feet, and 3656.13 feet, respectively, which are nearly equal to the groundwater elevation measured in NPS Well #2. The transducer was installed in the Kaiser well on October 9, 2017; consequently, no groundwater elevation data are available for the Kaiser well in September.

The static groundwater elevations at the Casey well, MW-1, the Kaiser well, and NPS Well #2 are essentially equal, and are generally between 3,656 feet and 3,656.7 feet during September and October of 2017. The relative difference in the groundwater elevations between the four wells and Calcite Lake during the period from September 27 to November 2 is shown in the groundwater elevation-versus-time graph provided in Figure 4. It is apparent that, with the exception of the Casey well during the pumping period, there is little change with time in the Madison aquifer groundwater elevations in the four wells and Calcite Lake during this period. The groundwater elevation at Calcite Lake (~3,635.5 feet) is approximately 21 feet lower than the groundwater elevation at the Casey well, MW-1, the Kaiser well, and NPS Well #2 (which are all essentially at the same groundwater elevation of approximately 3,656 feet). The NPS (Jeff Hughes, personal correspondence, 2017) indicated that the groundwater elevation data for Calcite Lake may be in error by as much as a few feet due to difficulties in surveying in the cave.

The difference in groundwater elevations between the four wells monitored during the test (Casey, Kaiser, NPS #2, and MW-1) and CU-91A is not due to local differences in the land surface elevations at the wells, as the land surface elevation at CU-91A is lower than the land surface elevation at the four wells (Figure 1). While a complete discussion of the flow system of the Madison aquifer in the southern Black Hills is beyond the scope of this report, the groundwater elevations in the wells shown in Table 2 likely reflect the Madison aquifer head as transmitted from the limestone plateau recharge area on the western flanks of the Black Hills.

1.7 Constant-Rate Test – Quantitative Analysis

Water level data from the Casey well, MW-1, and the Kaiser well were corrected for barometric pressure due to the small amount of observed water level change. This type of correction removes the effects of barometric pressure on the water level data for the purpose of making any detectable pumping influences more visible in the datasets. Barometric efficiency, which can be described as the ratio of water level change to barometric pressure change, was calculated for the Casey well and Kaiser well by plotting the change in background water levels versus the change in barometric pressure, and applying a least-squares “best-fit line” (linear regression) to the data. The slope of the line is the barometric efficiency, which was determined to be approximately 30%. The barometric efficiency was multiplied by barometric pressure changes observed during the pumping period, and used to correct the water level data from the

Casey well, MW-1, and Kaiser well. This correction removed the effect of barometric pressure on the water levels and produced data that approximates the water level surface as it would look if it was not influenced by barometric pressure changes. The barometric efficiency-corrected data indicates that the Casey well was the only well in which drawdown attributable to pumping was observed. Barometric efficiency calculations were not completed for NPS Well #2 due to its greater distance from the Casey well and lack of observed water level changes attributable to pumping from the Casey well. Graphs showing the barometric efficiency analysis for the Casey well and the Kaiser well are provided in Appendix C.

Although aquifer parameters of both transmissivity (T) and storativity (S) were anticipated to be determined with this test, only T was determined by analyzing the drawdown-versus-time data from the Casey well using Aqtesolv for Windows Pro (Version 4.51). The aquifer parameter S is not valid for pumping-well data; therefore, since drawdown was only observed in the Casey well, S could not be calculated. Based on the qualitative analyses and assuming the required assumptions for the specific solutions were met, the Moench (1984) solution for a fractured aquifer was applied to the uncorrected and barometric-corrected test data for the Casey well. The use of other equivalent porous media solutions is precluded since the water level in the Casey well actually recovered during the pumping period of the test. The recovery during the test is also slightly problematic for the Moench (1984) solution; therefore, a best fit curve was approximated through the drawdown-versus-time datasets. Lastly, the lack of site-specific fracture information (such as fracture opening size, fracture length and fractured slab-block thickness) also makes the application of the Moench (1984) solution, or other fractured aquifer solutions, problematic. The Madison aquifer in the project vicinity is known to be fractured and has extensive solution openings, and the groundwater flow in the solution openings essentially behaves as conduit flow, thereby precluding the aquifer test solutions based on standard porous media. For the Madison aquifer at the Casey well, the Moench solution is believed to be the most applicable solution available for the test data. Due to the rapid water level recovery (less than 5 minutes after four days of pumping), a recovery solution was not applied.

The T for the Madison aquifer at the Casey well as determined from the drawdown-versus-elapsed time analyses is approximately 98,000 feet square per day (ft^2/day), or approximately 733,000 gallons per day per foot (gpd/ft). This T value is based on an assumed

aquifer thickness of 72 feet (the thickness of the Madison Limestone penetrated by the Casey well), and the Moench (1984) solution-derived hydraulic conductivity (K) of approximately 1,360 feet/day. Plots illustrating the Moench (1984) solutions for T from the test data are provided in Appendix D.

Another estimate of T, utilizing the empirical relationship in Driscoll (1986) where specific capacity (111 gpm/ft in Casey well) is multiplied by 2,000 (for a confined aquifer), results in a T of 29,700 ft²/day (222,000 gpd/ft).

The drawdown in the Casey well was influenced by water level changes induced by barometric pressure fluctuations, thereby complicating the use of curve-matching solutions for T. LBG's best estimate is that the T of the Madison aquifer at the Casey well likely ranges from approximately 30,000 ft²/day (~224,000 gpd/ft) to nearly 100,000 ft²/day (~750,000 gpd/ft). The T of the Madison aquifer in the Black Hills is known to vary greatly, with published T values (Carter, et. al., 2001) ranging from less than 1 ft²/day (~7.5 gpd/ft) to 56,000 ft²/day (~419,000 gpd/ft). While the low end of LBG's T estimate for the Casey well is within the range of T values reported by Carter et. al. (2001), the high end of the estimated range of T values for the Casey well is greater than the high end of the range reported for the Madison aquifer by Carter et. al. (2001). These T values estimated for the Casey well from the test data, while appearing relatively high, are reasonably consistent with T values expected for a confined karst aquifer located in an area where there are many large deformational features, such as the geologic folds and faults shown in Figure 5. These large scale deformational features produced extensive fracturing, resulting in the later development of extensive solution openings (as evidenced by Wind Cave).

No drawdown directly attributable to pumping from the Casey well was observed in any of the three observation wells, thereby precluding the determination of a site-specific value for S. Published values of S for the Madison aquifer range from 10⁻⁵ to 10⁻³ (Long and Putnam, 2002). Due to the likely extensive amount of solution openings in the project vicinity, the value of S at the Site could potentially be greater than 10⁻³.

2.0 WATER QUALITY ANALYTICAL RESULTS

Water samples collected from the Casey well on October 26, 2017, (near the end of the four-day pumping period) were submitted to MidContinent Testing Laboratories, Rapid City, SD. The water quality data for the October 26, 2017, sample are summarized in Table 3. Also shown in Table 3 are the water quality data obtained from the sample collected during the step-rate test conducted on September 8, 2016. None of the parameters measured in either of the samples (step-rate test sample and constant-rate test sample) exceed primary maximum contaminant levels (MCLs) or secondary MCLs. Additionally, total coliform and e. coli bacteria were absent.

Field water quality parameters, including temperature, specific conductance, dissolved oxygen (DO), pH, and oxidation reduction potential (ORP), were monitored frequently during the test with the use of a flow cell and YSI multimeter. The pH varied from 7.79 to 8.60, and remained within the pH limits of the temporary discharge permit. The temperature varied from approximately 52 to 59 degrees Fahrenheit (11.1 to 15 degrees Celsius), and was likely somewhat influenced by changes in the air temperature affecting the glass wall of the flow cell. The specific conductance varied from approximately 374 micro mhos per centimeter ($\mu\text{mhos/cm}$) to 411 $\mu\text{mhos/cm}$, which compares favorably with the laboratory measured electrical conductivity. The DO concentrations ranged from 4.9 milligrams per liter (mg/L) to 6.67 mg/L, and the ORP concentration ranged from 168.6 milli volts (mV) to 252.70 mV. These water quality parameters remained relatively consistent throughout the duration of the test, and a table providing the data measured during the test is provided in Appendix E.

3.0 SUMMARY AND CONCLUSIONS

The purpose of the test was to provide information regarding the suitability of the Casey well to serve as a groundwater supply for the SBHWS. A withdrawal rate from the Casey well of 300 gpm is being considered. In support of that purpose, the test was conducted to obtain data with which to determine the aquifer properties of the Madison aquifer at the Site.

The specific capacity of the Casey well, after pumping continuously at the rate of 267 gpm for 95 hours, was approximately 111 gpm/ft. The maximum drawdown observed during

pumping for four days was approximately 2.4 feet. Water levels in the Casey well recovered to 0.1 feet above the static water level within 5 minutes of pumping shutdown.

The estimated T of the Madison aquifer at the Site, as determined from the analysis of the test data, is from approximately 30,000 ft²/day (~224,000 gpd/ft) to nearly 100,000 ft²/day (~750,000 gpd/ft). The higher end of this range of T values is greater than the highest value of T reported in the range of Madison aquifer T values published by Carter, et. al. (2001). The estimated S (from literature) ranges from 10⁻⁵ to 10⁻³ and it is possible that, due to the regionally extensive network of solution openings, the S could be higher than 10⁻³.

These T and S values could be used with traditional porous media groundwater flow equations, such as Theis (1935), to estimate distance-drawdown or time-drawdown data at various locations around the Casey well. However, because the Madison aquifer in the Site vicinity has extensive solution openings and is likely dominated by conduit flow, the drawdown and time estimates produced utilizing traditional porous-media solutions may not be valid.

No drawdown attributable to pumping from the Casey well was observed in MW-1, even though the MW-1 log indicates the presence of “shale-filled caves” in the Madison aquifer at a similar depth interval of the Madison aquifer at the Casey well. This may be due to poor hydraulic connection between MW-1 and the Casey well, perhaps due to incomplete development of MW-1, exacerbated by the high T and S of the aquifer. Drawdown directly attributable to pumping from the Casey well was also not observed in the Kaiser well, nor in NPS Well #2, nor in Calcite Lake.

The Madison aquifer water in the vicinity of the Casey well is of good quality, with no parameters exceeding the primary MCLs or secondary MCLs. Additionally, total coliform and e. coli bacteria were absent.

The aquifer test data indicate that the Casey well is suitable for use as an SBHWS water supply well at a pumping rate of approximately 300 gpm. The Madison aquifer properties at the Site determined from the test data indicated that the Casey well is capable of providing good quality water at an approximate withdrawal rate of 300 gpm.

The aquifer is dominated by conduit flow due to the large amount of fractures and solution openings in the Madison aquifer in the project vicinity; consequently, predicting drawdown at other locations due to pumping at the Site is more complicated than what is typically accomplished through standard porous media aquifer test solutions such as Theis

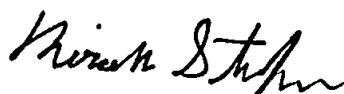
(1935). With the installation of MW-1 by SBHWS, and with the monitoring network maintained by the NPS (Kaiser Well, NPS Well #2, Calcite Lake) and the DENR observation well (CU-91A), there is a good monitoring network in place to provide for the long-term monitoring of the Madison aquifer response to proposed SBHWS withdrawals from the Site. The SBHWS proposed utilization of the Casey well as a groundwater supply is a beneficial use of groundwater resources that is in the public interest. The relatively high range of estimated T values for the Casey well, the likely relatively larger value of S (relative to typical published values for a confined aquifer), both of which are due to the extensive solution cavities in the Madison aquifer in the Site vicinity, along with the rapid recovery of the aquifer to pumping, and the good water quality, indicate that there is a reasonable probability that unappropriated water is available for the proposed withdrawals of 300 gpm. The test data also indicate that the proposed withdrawal rate of 300 gpm is unlikely to unlawfully impair existing water rights.

This report was prepared by:

LEGGETTE, BRASHEARS & GRAHAM, INC.

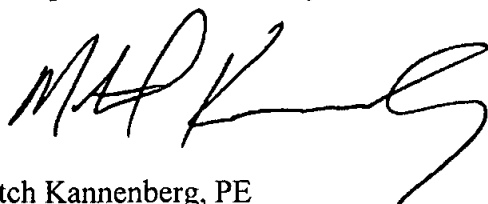


Michael C. Plante
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Project Manager

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TABLES

Table 1. Pumping and Observation Well Summary

Well Name	Latitude	Longitude	UTM Zone 13 NAD83 X (meters)	UTM Zone 13 NAD83 Y (meters)	Distance to Pumping Well (ft)	Reference Point Elevation (ft)	Approx. Land Surface Elevation (ft)	Approx. Static Water Level (ft bgs)	Total Well Depth (ft)	Elevation of Bottom of Well (ft)	Well Diameter (inch)	Top of Open Hole or Screen (ft bgs)	Bottom of Open Hole or Screen (ft bgs)	Top of Madison Limestone (ft bgs)	Elevation of Top of Madison Limestone (ft)	Madison Thickness Penetrated (ft)	Date Drilled
Casey Well	43.51362236	-103.46639059	623956.54	4818996.62	0	4058.51*	4057.69	402	883	3174.7	7	873	883	811	3246.69	72	June 1994
MW-1	43.51358600	-103.46686700	623918.10	4818991.88	129	4063.75	4062.28	406	923	3139.3	7	863	923	825	3237.28	98	July 21 2017
Kaiser Well	43.52018028	-103.47168866	623514.93	4819717.07	2,772	4121.56	4120.80	465	780	3340.8	5.5	715	780	690	3430.80	90	April 1977
Calcite Lake	43.54859000	-103.47997000	622787.97	4822860.01	13,242	na	na	na	na	na	na	na	na	na	na	na	na
NPS Well No. 2	43.55277000	-103.44365300	625713.00	4823378.52	15,488	na	3827.00	177	681	3146.0	7	521-607, 660-681		429	3398.00	256	October 16, 2001

Notes:
ft = feet
ft bgs = feet below ground surface
Approx. = approximate
UTM = Universal Transverse Mercator
NAD83 = North American Datum of 1983
Elevations reference North American Vertical Datum of 1988 (NAVD88).
* = Sounding tube was cut (shortened) by Alexander Drilling sometime after the September 2016 step-rate test

Table 2. Groundwater Elevations

Well	Distance to Pumping Well (ft)	Date	Approximate Time	Reference Point Elevation (ft)	Depth to Water (ft)	Groundwater Elevation (ft)	Barometric Pressure Trend	Comment
Casey Well	0	9/27/2017	12:00	4058.51	402.41	3656.10	slightly decreasing	26 days before startup
Casey Well	0	10/17/2017	0:00	4058.51	402.37	3656.14	decreasing	6 days before startup
Casey Well	0	10/26/2017	10:06	4058.51	405.03	3653.48	steeply increasing	22 hours before shutdown, manual measurement (due to transducer drift)
Casey Well	0	10/27/2017	16:00	4058.51	402.39	3656.12	decreasing	8 hours after shutdown
MW-1	129	9/27/2017	14:50	4063.75	407.62	3656.13	slightly decreasing	26 days before startup
MW-1	129	10/17/2017	0:00	4063.75	407.63	3656.12	decreasing	6 days before startup
MW-1	129	10/26/2017	10:00	4063.75	407.82	3655.93	steeply increasing	22 hours before shutdown
MW-1	129	10/27/2017	16:00	4063.75	407.70	3656.05	decreasing	8 hours after shutdown
Kaiser Well	2772	10/17/2017	0:00	4121.56	464.84	3656.72	decreasing	6 days before startup
Kaiser Well	2772	10/26/2017	10:00	4121.56	465.04	3656.52	steeply increasing	22 hours before shutdown
Kaiser Well	2772	10/27/2017	16:00	4121.56	464.90	3656.66	decreasing	8 hours after shutdown
NPS Well No. 2	15488	9/26/2017	0:00	NA	NA	3656.06	increasing	27 days before startup
NPS Well No. 2	15488	10/17/2017	0:00	NA	NA	3656.01	decreasing	6 days before startup
NPS Well No. 2	15488	10/26/2017	10:00	NA	NA	3655.79	steeply increasing	22 hours before shutdown
NPS Well No. 2	15488	10/27/2017	16:00	NA	NA	3655.92	decreasing	8 hours after shutdown
CU-91A*	12302	9/26/2017	NA	3647.14	-12.40	3659.54	increasing	27 days before startup
Calcite Lake	13242	9/26/2017	0:00	NA	NA	3635.69	increasing	27 days before startup
Calcite Lake	13242	10/17/2017	0:00	NA	NA	3635.59	decreasing	6 days before startup
Calcite Lake	13242	10/26/2017	10:00	NA	NA	3635.51	steeply increasing	22 hours before shutdown
Calcite Lake	13242	10/27/2017	16:00	NA	NA	3635.50	decreasing	8 hours after shutdown

Notes:

* There is only one groundwater elevation measurement available from this well during the month prior to and subsequent to the aquifer pumping test.

ft= feet

startup - pumping from the Casey well at the rate of 267 gallons per minute initiated at 9:06 AM on 10/23/2017

shutdown - pumping from the Casey well stopped at 8:05 AM on 10/27/2017

NA = Not available

Table 3. Water Quality Analytical Results - Casey Well

Analyte	Casey Well September 8, 2016	Casey Well October 26, 2017	Units	MCL	Secondary MCL
PHYSICAL PROPERTIES					
Electrical Conductivity	432	440	umhos/cm		
Hardness	205.2*	196	mg/L		
Total Dissolved Solids	235	238	mg/L		500
Total Suspended Solids	<10.0	<4.00	mg/L		
RADIONUCLIDES					
Gross Alpha	6.86	NA	pCi/L	15	
Gross Beta	5.54	NA	pCi/L	See Notes	
Radium 226	0.493	NA	pCi/L		
Radium 228	<1.00	NA	pCi/L		
Combined Radium (226 + 228)	<1.493	NA	pCi/L	5	
Uranium, Total	0.005	NA	mg/L	0.030	
BACTERIA					
Total Coliform	Absent	Absent	MPN/100 ml		
E. coli	Absent	Absent	MPN/100 ml		
NON-METALLICS					
Total Alkalinity (as CaCO ₃)	197	196	mg/L		
Bicarbonate	241	239	mg/L		
Carbonate	0.00	0.00	mg/L		
Chloride	8.33	11.2	mg/L		250
Fluoride	0.396	0.423	mg/L	4	2
Ammonia-Nitrogen as N	<0.050	<0.050	mg/L		
Nitrate as N	0.543	0.542	mg/L	10	
Nitrite as N	<0.050	<0.050	mg/L	1	
Sulfate	17.5	19.1	mg/L		250
Total Organic Carbon	0.532	<0.200	mg/L		
METALS, TOTAL					
Arsenic - Total	0.007	0.008	mg/L	0.010	
Barium - Total	0.184	0.178	mg/L	2	
Chromium - Total	<0.001	<0.001	mg/L	0.1	
Iron - Total	0.062	<0.050	mg/L		0.3
Manganese - Total	<0.010	<0.010	mg/L		0.05
Mercury - Total	NA	<0.0002	mg/L	0.002	
Selenium - Total	<0.005	<0.005	mg/L	0.05	
METALS, DISSOLVED					
Calcium - Dissolved	51.0	48.1	mg/L		
Magnesium - Dissolved	18.8	18.4	mg/L		
Potassium - Dissolved	2.97	2.96	mg/L		
Sodium - Dissolved	12.0	11.0	mg/L		

NOTES:

* = result converted from grains/gallon using the conversion of 1 grains/gallon = 17.1 mg/L

MCL = EPA maximum contaminant level

mg/L = milligrams per liter

MPN/100 ml = Most Probable Number per 100 milliliters

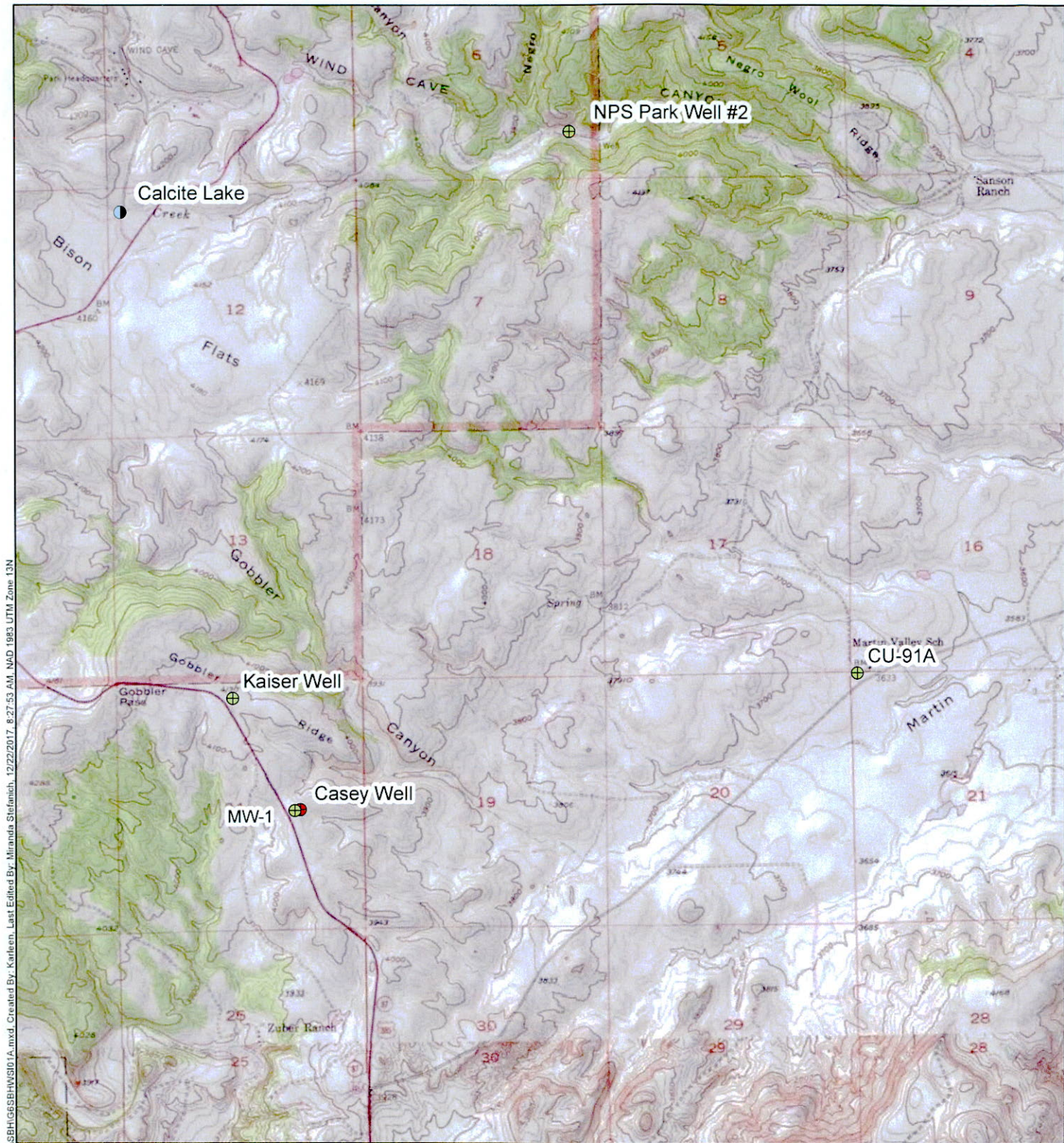
pCi/L = picocuries per liter

umhos/cm = micro Mhos per centimeter

The MCL for gross beta emitters is 4 millirems per year. In South Dakota, 50 pCi/L is used as a screening level. If the screening level is exceeded, additional information is required to determine if the beta particles and photon emitters concentration exceeds the MCL.

NA = not analyzed

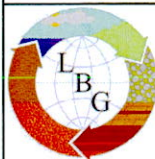
FIGURES



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- Casey Well (Pumping Well)
- ⊕ Observation Well
- Wind Cave Underground Pool

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SOUTHERN BLACK HILLS WATER SYSTEM, INC.

CASEY WELL CONSTANT-RATE PUMPING TEST

LOCATION OF CASEY WELL, MW-1, KAISER WELL, CALCITE LAKE,
 NPS WELL #2 AND CU-91A (DENR OBSERVATION WELL)

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Date: 22 Dec 2017

FIGURE: 1

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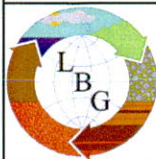


-  Observation Well
-  Casey Well (Pumping Well)
-  Discharge Flow Direction

Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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Feet



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SOUTHERN BLACK HILLS WATER SYSTEM, INC.
CASEY WELL CONSTANT-RATE PUMPING TEST

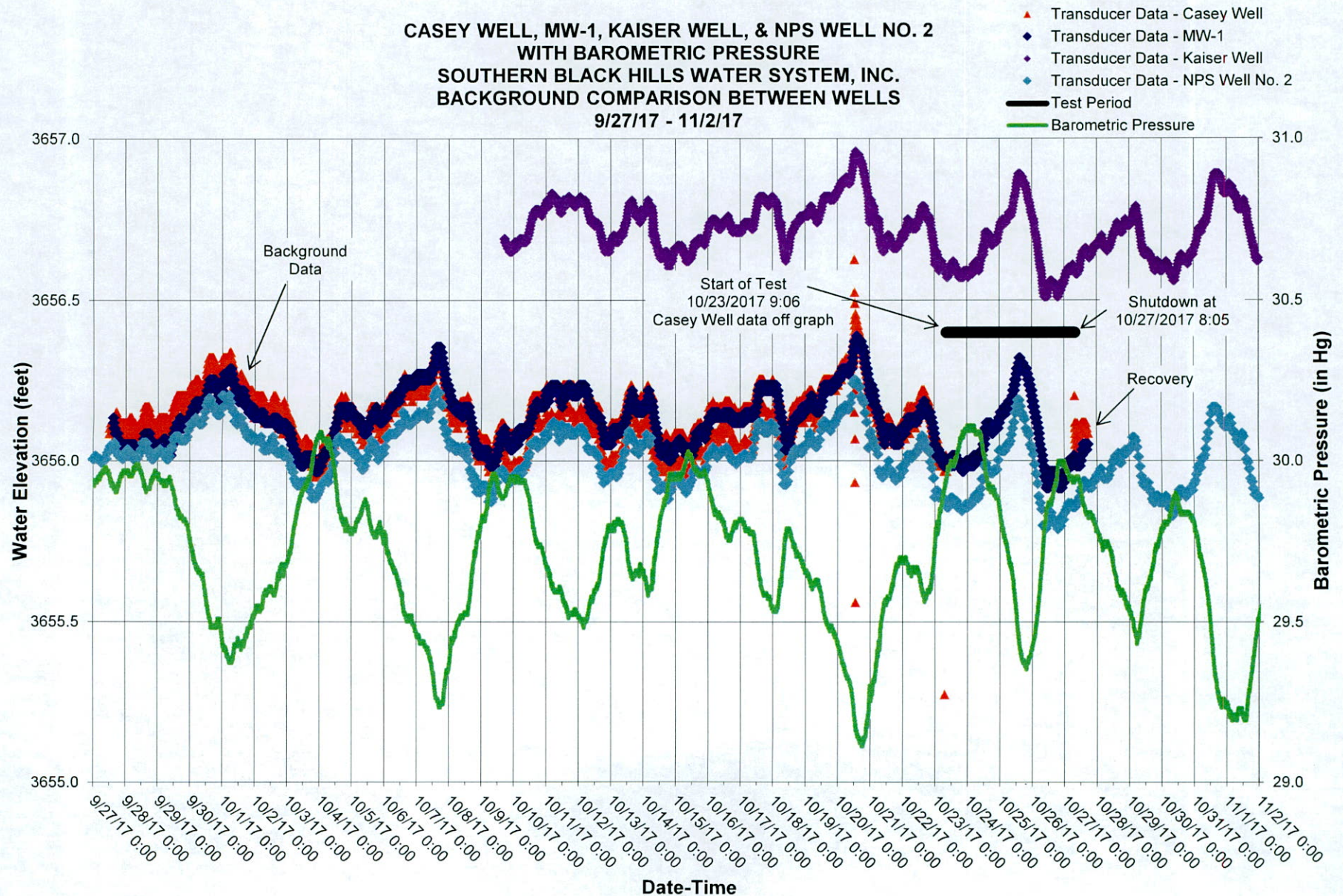
DETAILED LOCATION OF CASEY WELL AND MW-1

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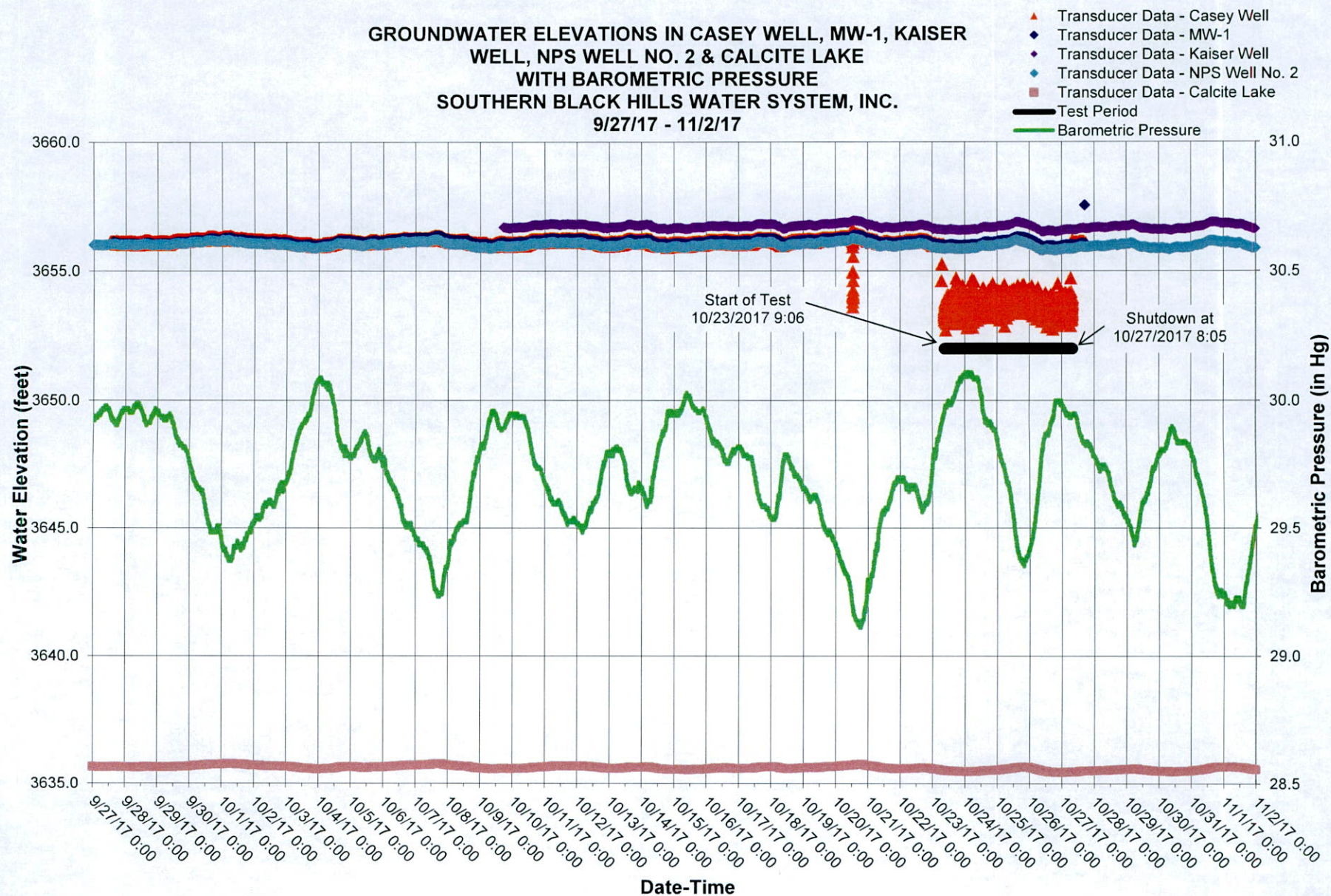
Date: 04 Dec 2017

FIGURE: 2

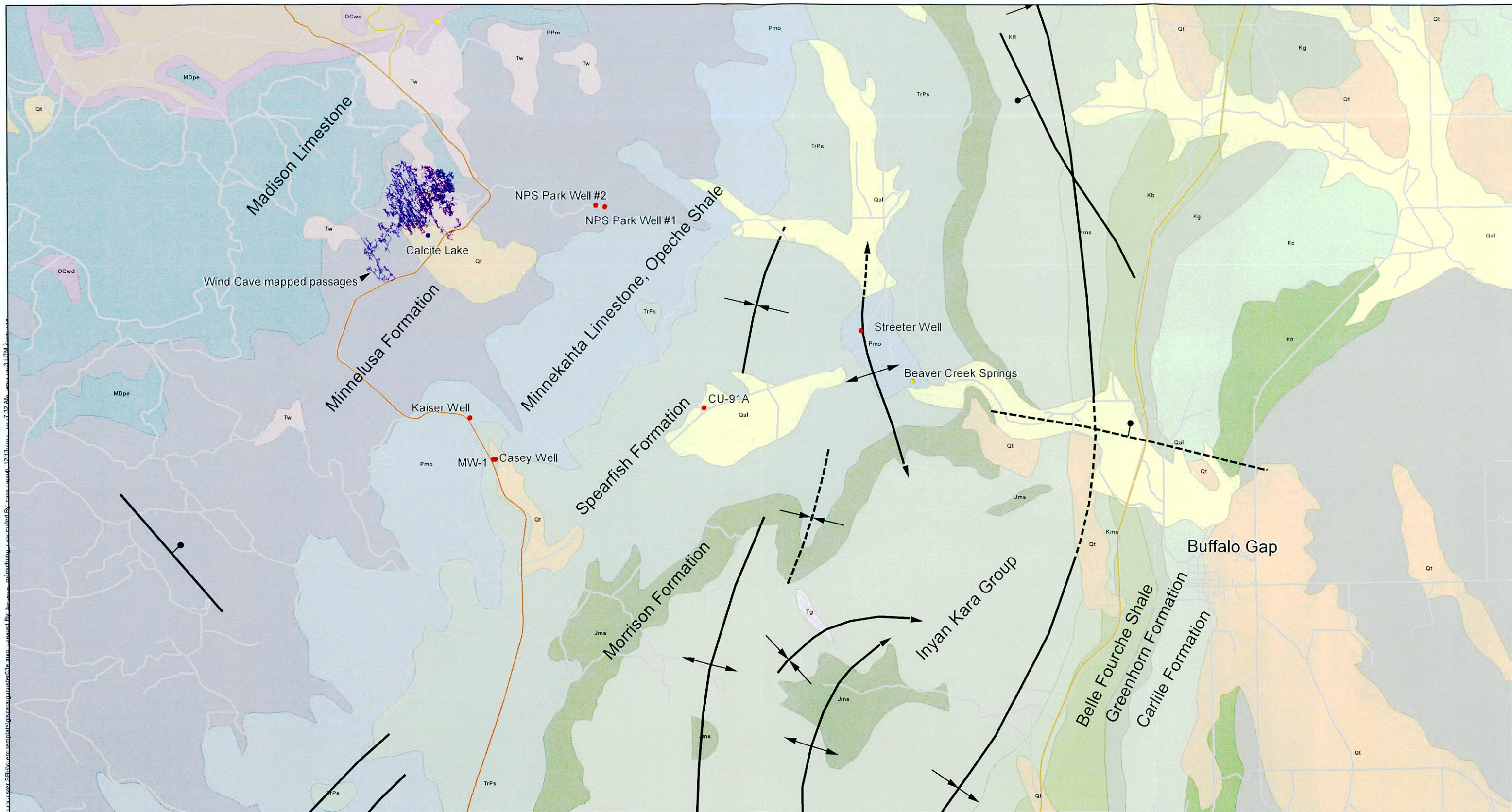
**CASEY WELL, MW-1, KAISER WELL, & NPS WELL NO. 2
WITH BAROMETRIC PRESSURE
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
BACKGROUND COMPARISON BETWEEN WELLS
9/27/17 - 11/2/17**



**FIGURE 3. GROUNDWATER ELEVATIONS (WELLS) VERSUS
BAROMETRIC PRESSURE**



**FIGURE 4. GROUNDWATER ELEVATION COMPARISON BETWEEN
WELLS AND CALCITE LAKE**



Source: Geologic Map of South Dakota, General Map 10, Martin et al, 2004, accessed from South Dakota Geological Survey <http://arcgis.sd.gov/server/sdgis/Data.aspx#>



- Legend**
- Fault
 - Fold
 - Well Location
 - NPS = National Park Service



Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
 Professional Groundwater and
 Environmental Engineering Services
 140 East Hinks Lane, Suite 126
 Sioux Falls, SD 57104
 (605) 334-6000

SOUTHERN BLACK HILLS WATER SYSTEM

HOT SPRINGS, SOUTH DAKOTA

WELL LOCATION MAP & VICINITY GEOLOGIC MAP

FILE: GIS/Custer SBH/G3custer03e.mxd DATE: 12/13/2017 FIGURE: 5

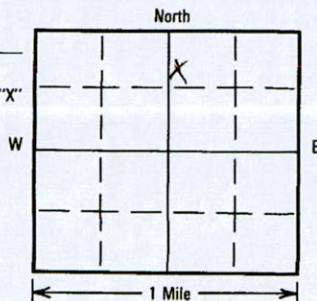
APPENDIX A.
Well Logs

SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

Location NW 1/4 NE 1/4 Sec 24 Twp 6S Rg 5ECounty Custer

Please mark well location with an "X"

Well Completion Date May 1994

LOCATION:

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.) >1500 ft. from septic tank (identify source).

PROPOSED USE:

☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:

Air Rotary

CASING DATA:

☒ Steel ☐ Plastic ☐ Other

If other describe _____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
<u>23 LB/FT</u>	<u>7 IN</u>	<u>0 FT</u>	<u>873 FT</u>	<u>8 3/4 IN</u>
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
<u>Cement</u>	<u>120</u>	<u>14 lb./gal</u>	<u>0 ft</u>	<u>873 ft</u>
_____	_____	_____ lb./gal	_____ ft	_____ ft

Describe grouting procedure pressure grouted through casingSCREEN: ☐ Perforated pipe ☐ Manufactured

Diameter _____ IN Length _____ FEET

Material _____

Slot Size _____ Set From _____ Feet to _____ 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: chlorine solution
☐ NO, Why Not? _____Laboratory _____ for water quality analysis pump not set yetWell Owner: Dennis Casey

Business Name: _____

Address: 233255 S. Airport Rd
Rapid City SD 57701

WELL LOG:

FORMATION	DEPTH	
	FROM	TO
Red clay	0	10
gravel	10	17
red shale	17	87
limestone	87	111
red shale	111	220
red shaley ss	220	250
red ss	250	304
buff LS	304	310
red shale	310	315
yellow + red ss	315	378
yellow + red limestone	378	433
purple shale	433	442
limestone red to purple some ss	442	587
lavender to buff limestone some white ss	587	795
red to purple shale	795	811
white Limestone w/shale-filled caves	811	883

STATIC WATER LEVEL 418 Feet

If flowing: closed in pressure _____ PSI

GPM flow _____ through _____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other _____

Reduced Flowrate _____ GPM

Can well be completely shut in? _____

WELL TEST DATA:

☐ Pumped Describe: _____
☐ Bailed _____
☒ Other Air Developed

Pumping Level Below Land Surface

800 ft. After 2 Hrs. pumped 200 GPM

_____ ft. After _____ Hrs. pumped _____ GPM

If pump installed, pump rate _____ GPM

REMARKS

This well was drilled under license # 331

And this report is true and accurate.

Drilling firm Taylor Drilling

Signature of License Representative:

Ralph Taylor

Signature of Well Owner or Equitable Property Holder:

Date: 6/24/94

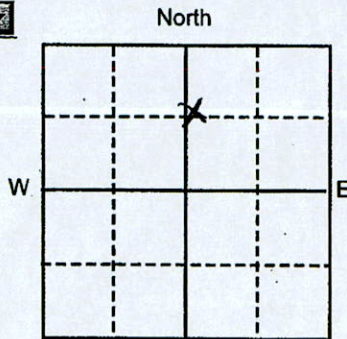
SOUTH DAKOTA WATER WELL COMPLETION REPORT

11-02

MW-1

Location NE ¼ NW ¼ Sec 24 Twp 6S Rg 5E

County Custer

Please mark well
location with an "X"

Well Completion Date

7/21/17

1 Mile

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

PROPOSED USE:

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

METHOD OF DRILLING:

Rotary Downhole Hammer

CASING DATA:

☒ Steel ☐ Plastic ☐ Other
 If other describe 863' of 7" OD Steel

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
17 LB/FT	7" IN	0 FT	923 FT	8.75 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Portland II	125	Lb/gal	863 Ft	0 Ft
w/2% benton		Lb/gal	Ft	Ft

Describe grouting procedure through casing

SCREEN:

☐ Perforated pipe ☐ Manufactured
 Diameter _____ Inches Length _____ Feet
 Material _____
 Slot Size _____ Set From _____ Feet to _____ 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? w/chlorine solution

☐ No, Why Not?

Lab to which water quality sample sent for analysis

Well Owner:

Business Name: Southern Black Hills Water Systems

Address: 26858 Highway 385

City, State, Zip: Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH	
	FROM	TO
Cemented Gravel	0	15
Spearfish shale	15	100
Minnekahta limestone	100	135
Opeche shale	135	225
Minnelusa	225	825
Madison white limestone shale	825	923
filled caves		

STATIC WATER LEVEL 407 FEET

If flowing: closed in pressure _____ PSI

GPM flow 300+ through _____ Inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other _____

Reduced flow rate _____ GPM

Can well be completely shut in?

WELL TEST DATA:

☒ Pumped Describe: w/air
☐ Bailed
☐ Other

Pumping Level Below Land Surface

_____ Ft. After _____ Hrs. pumped _____ GPM

_____ Ft. After _____ Hrs. pumped _____ GPM

If pump installed, pump rate: _____ GPM

REMARKS

Madison AM

This well was drilled under license # 324 and this report is true and accurate.

Drilling firm: Alexander Drilling Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date: 7-27-17

RECEIVED

JUL 31 2017

WATER RIGHTS
PROGRAM

Lester Kaiser
Hot Springs, S.D.
300 GNL 2400 FWL

Scheduled

4-13-77

6S-5E-24600W

Custer

Kaiser Well

24-6S-5E

Total Depth 780'
715' 5 1/2" O.D. Casing

Static 475'
50 GPM @ 700'

IP. 43311410328160

0-12 red shale and gyp
12-40 minnekahta limestone
40-140 red shale
140-215 red sandstone (fine)
215-225 yellow sandstone (very soft)
225-314 white and light red limestone
314-385 red sandstone w/some hard layers
385-395 purple shale (middle marker)
395-420 mostly red sandstone (soft) w/yellow limestone
420-425 hard yellow sandstone
425-432 red sandstone
432-437 shale red
437-585 yellow limestone and red sandstone changing back and forth
OVER

1st 4110

- 475

3635

50 gpm / (700 - 475) = .22
gpm/ft

585-685 quite hard fractured multi-colored limestone
685-690 purple shale
690-780 madison limestone fractured
775-777 cave
777-780 honeycombed

BICE AND TAYLOR DRILLING, INC.

1220 Creek Drive

Rapid City, South Dakota 57701



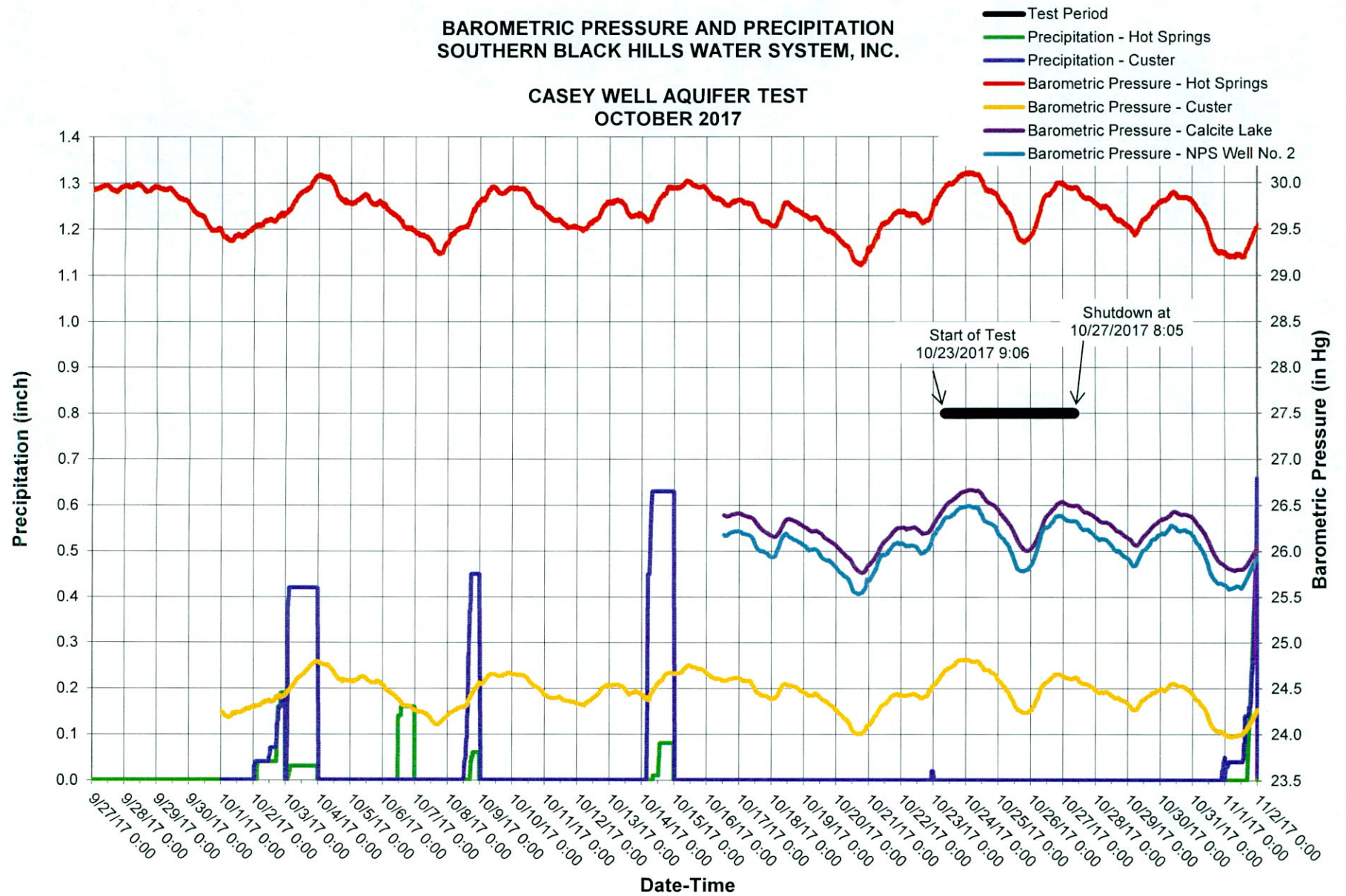
USGS chem anal call 8/1978
for comment there ions and isotopes & tracers

This well is just east of the south entrance
to Wind Cave Nat Park, east side of road

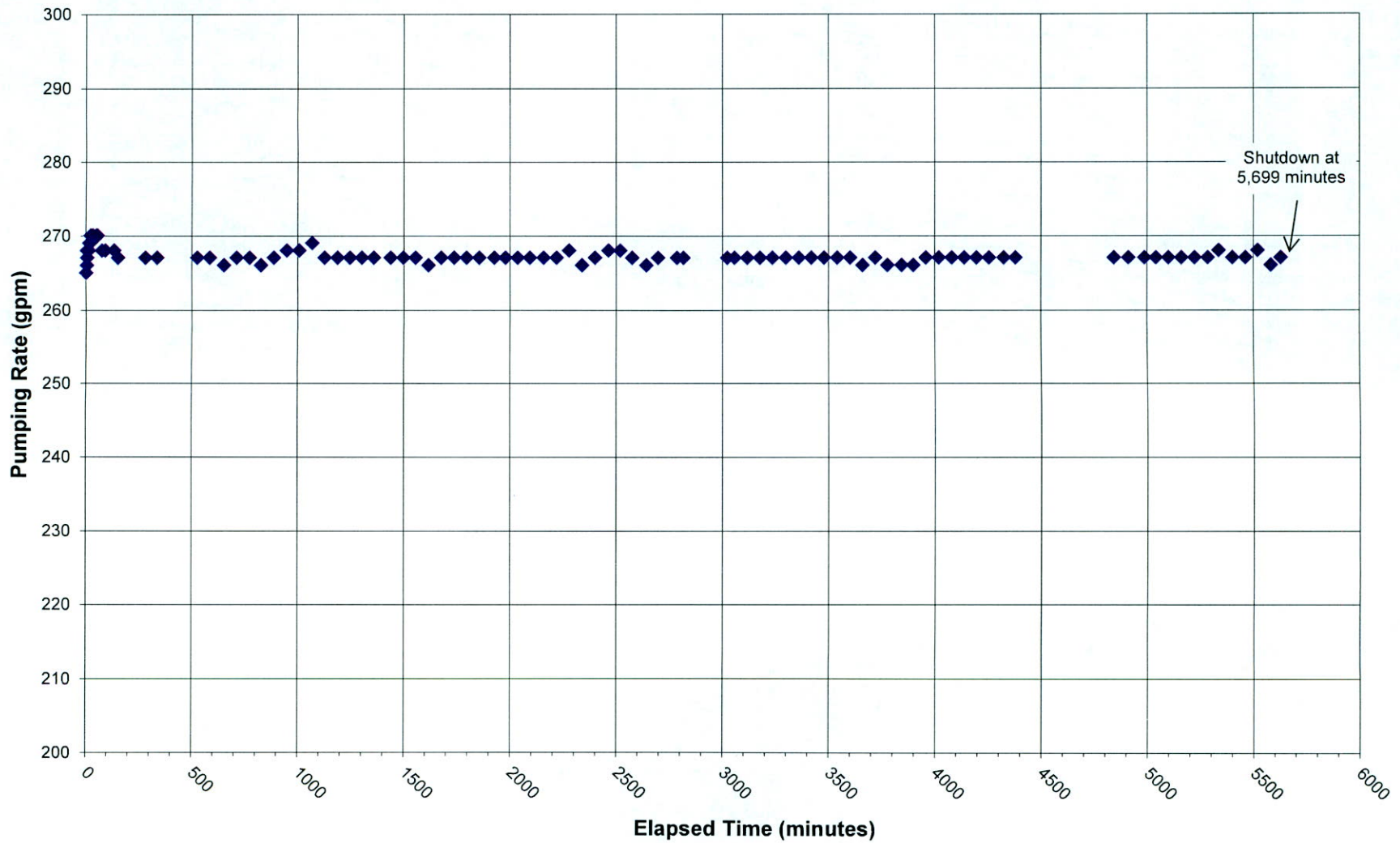
APPENDIX B
Barometric Pressure and Precipitation

BAROMETRIC PRESSURE AND PRECIPITATION SOUTHERN BLACK HILLS WATER SYSTEM, INC.

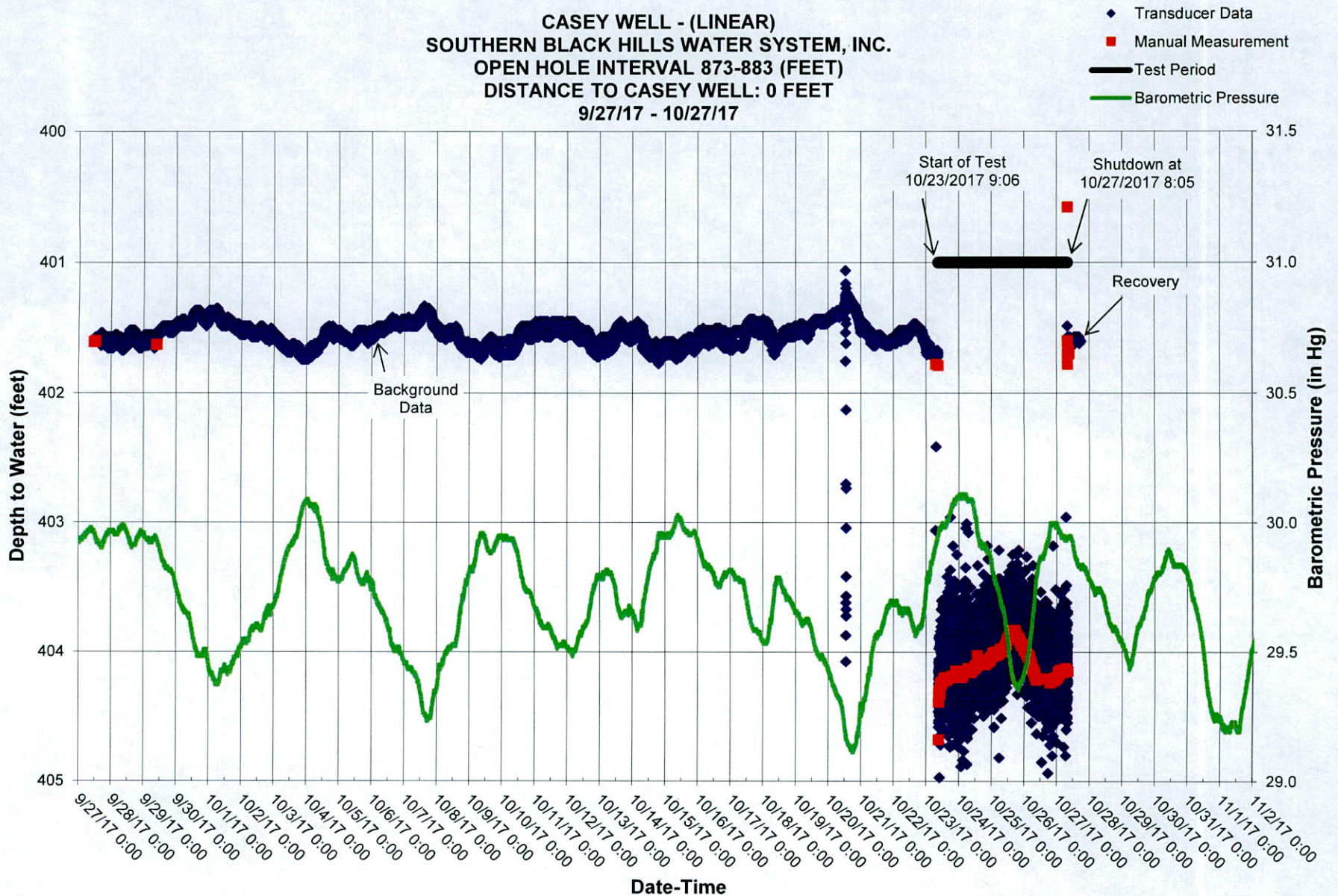
CASEY WELL AQUIFER TEST OCTOBER 2017



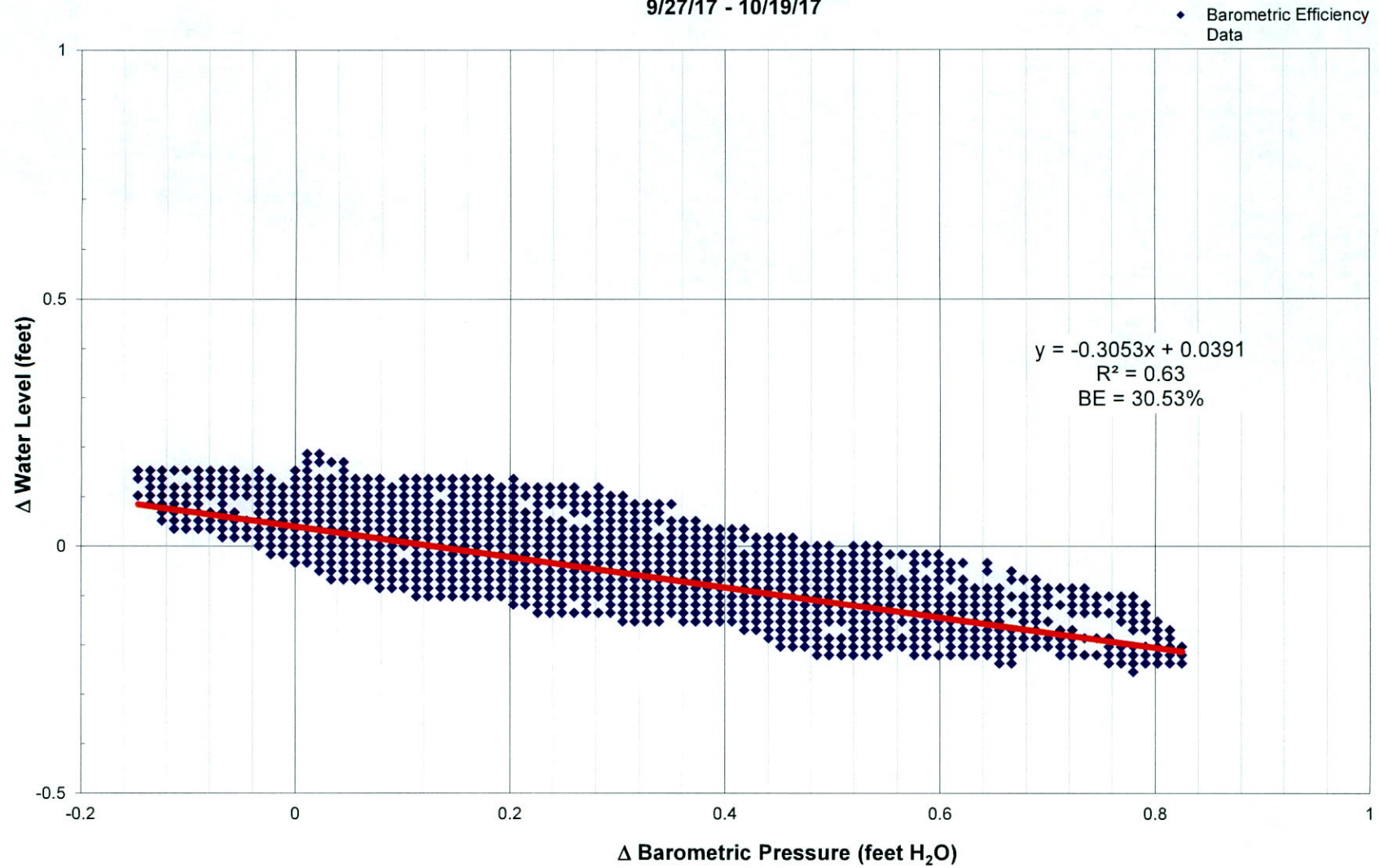
**CASEY WELL
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
FLOW RATE DATA VERSUS ELAPSED TIME - AQUIFER TEST
10/23/17 - 10/27/17**



CASEY WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 873-883 (FEET)
DISTANCE TO CASEY WELL: 0 FEET
9/27/17 - 10/27/17

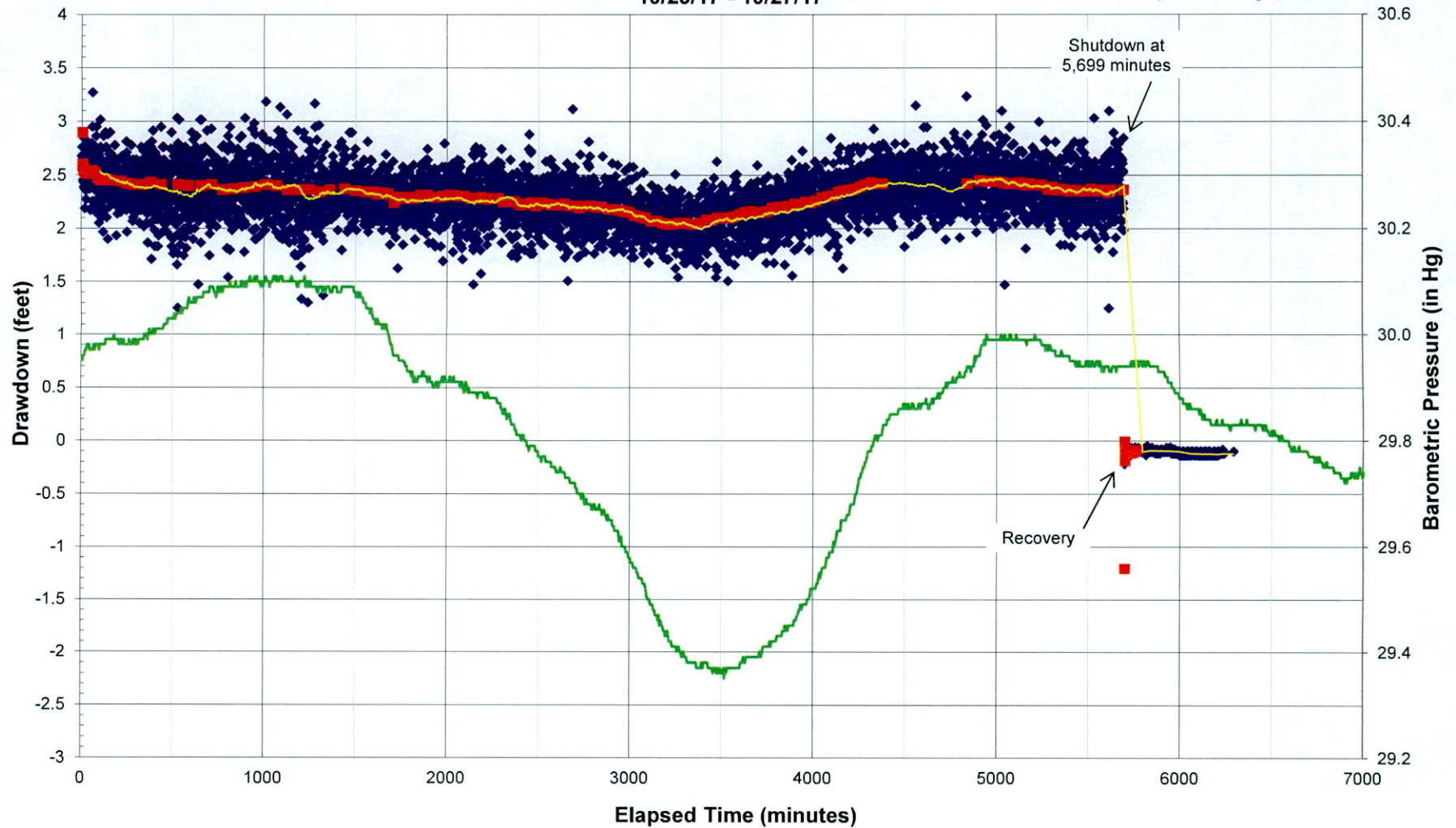


CASEY WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
BAROMETRIC EFFICIENCY
9/27/17 - 10/19/17



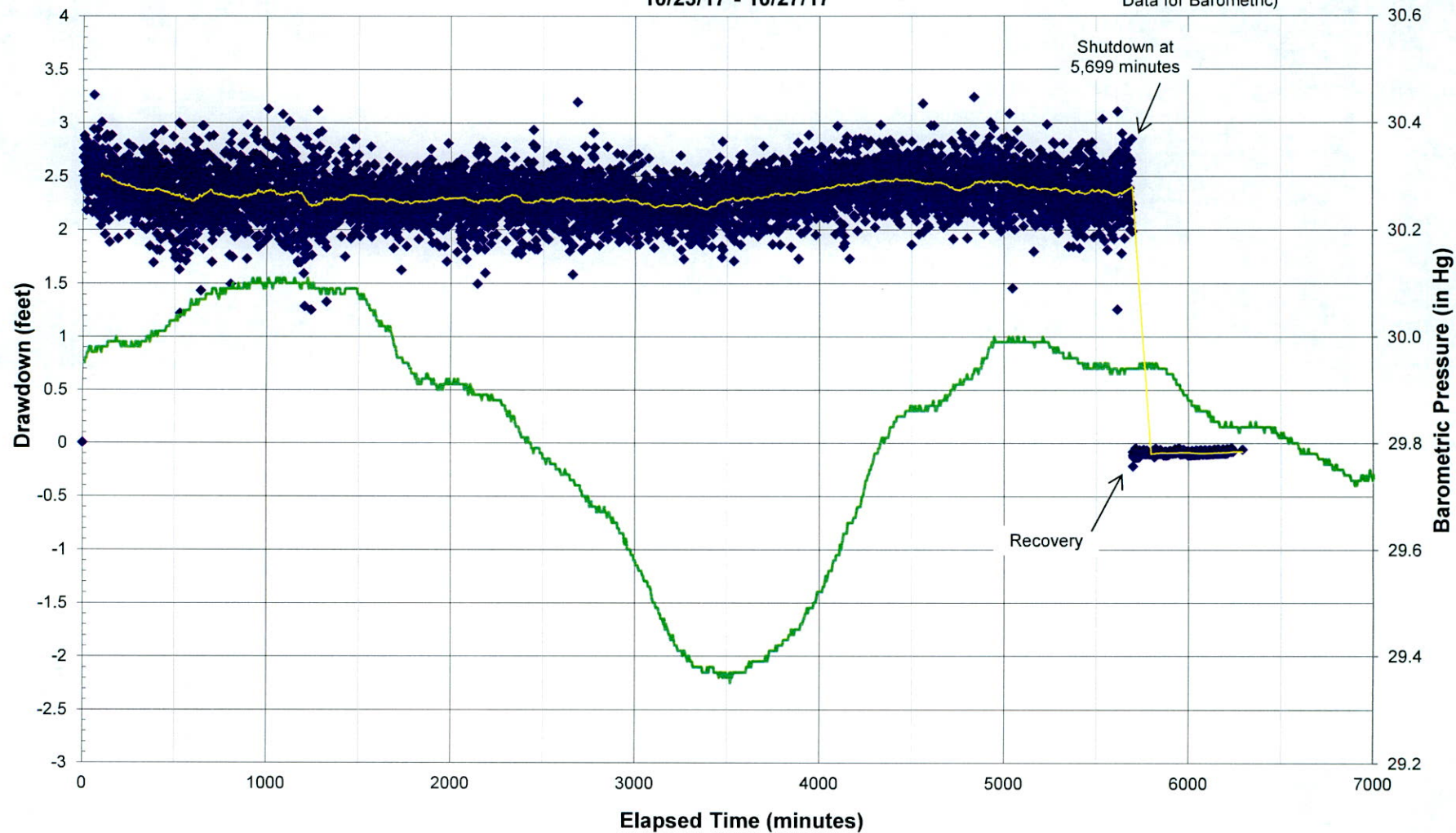
CASEY WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 873-883 (FEET)
DISTANCE TO CASEY WELL: 0 FEET
10/23/17 - 10/27/17

- ◆ Transducer Data
- Manual Measurement
- Barometric Pressure
- 100 per. Mov. Avg. (Transducer Data)

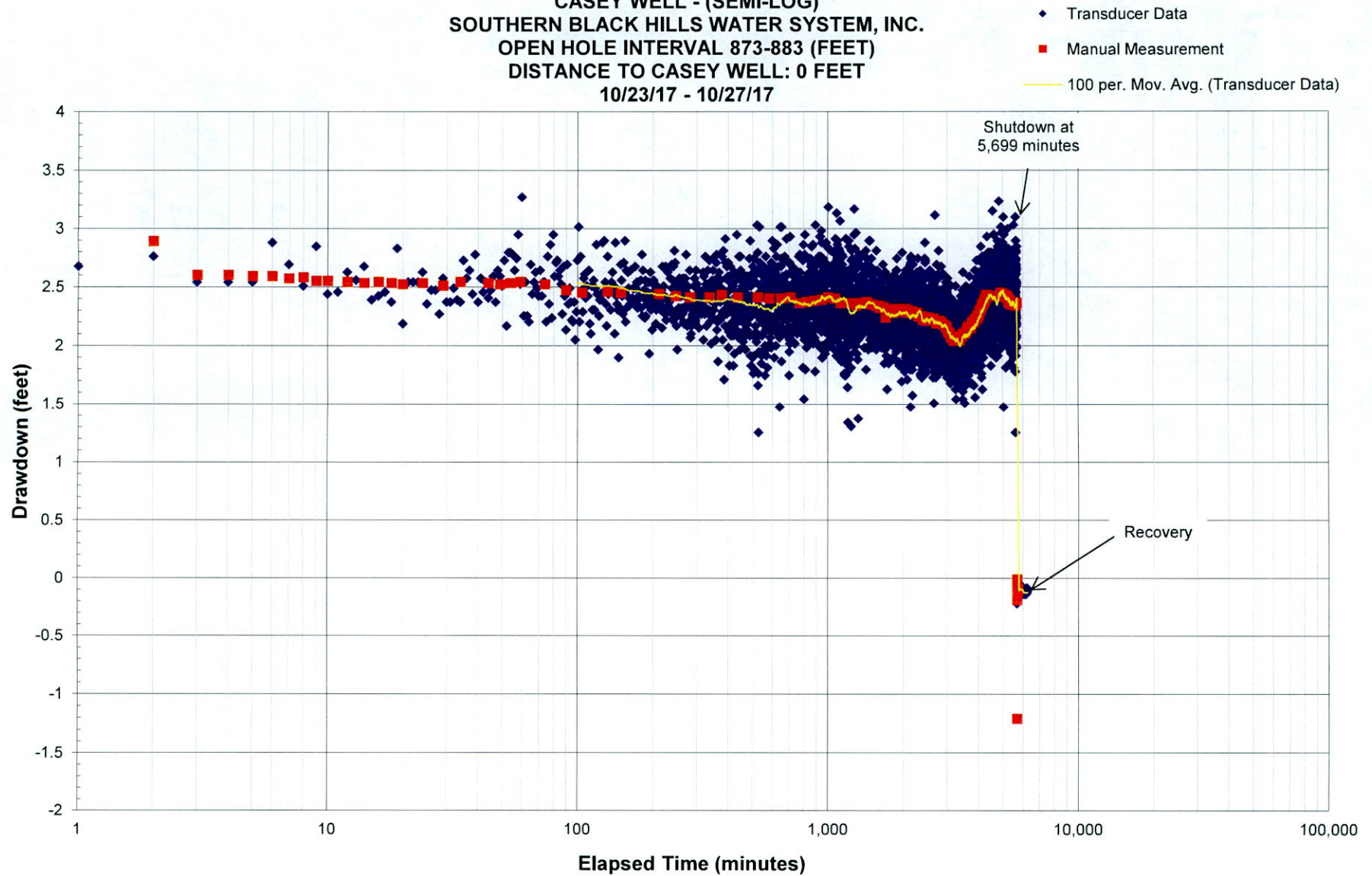


**CASEY WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 873-883 (FEET)
DISTANCE TO CASEY WELL: 0 FEET
10/23/17 - 10/27/17**

- ◆ Corrected Transducer Data for Barometric
- Barometric Pressure
- 100 per. Mov. Avg. (Corrected Transducer Data for Barometric)

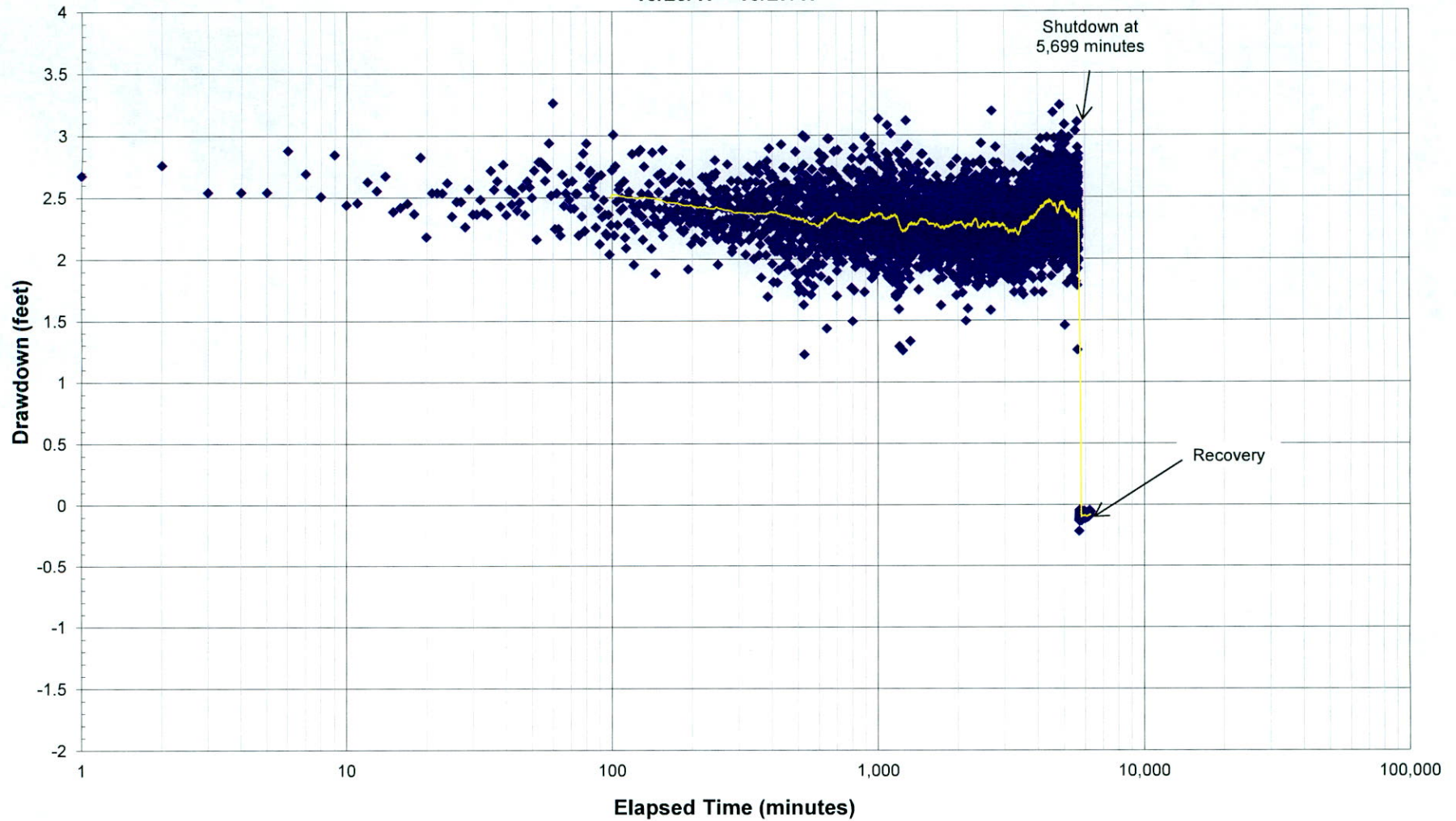


**CASEY WELL - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 873-883 (FEET)
DISTANCE TO CASEY WELL: 0 FEET
10/23/17 - 10/27/17**

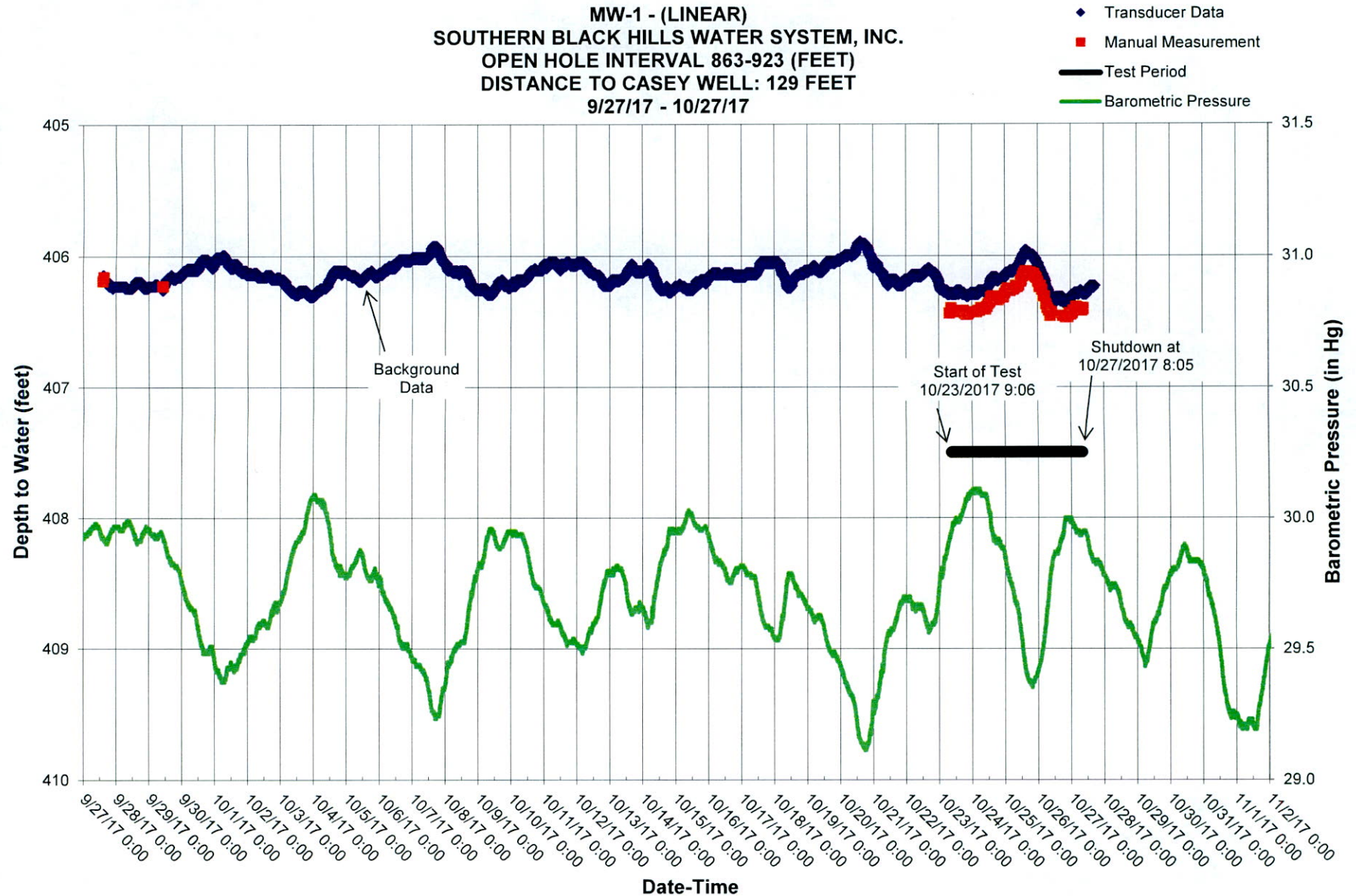


**CASEY WELL - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 873-883 (FEET)
DISTANCE TO CASEY WELL: 0 FEET
10/23/17 - 10/27/17**

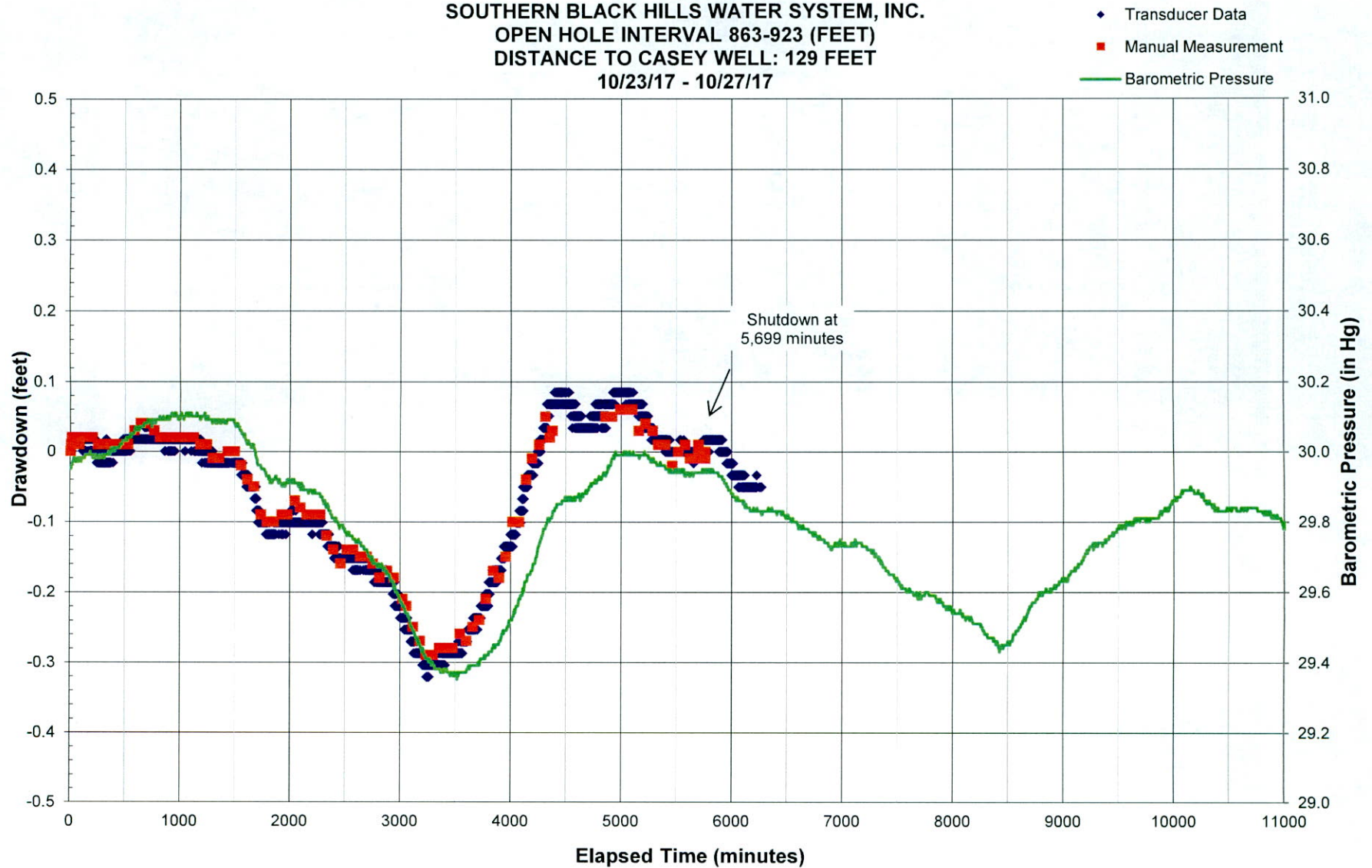
- ◆ Corrected Transducer Data for Barometric
- 100 per. Mov. Avg. (Corrected Transducer Data for Barometric)



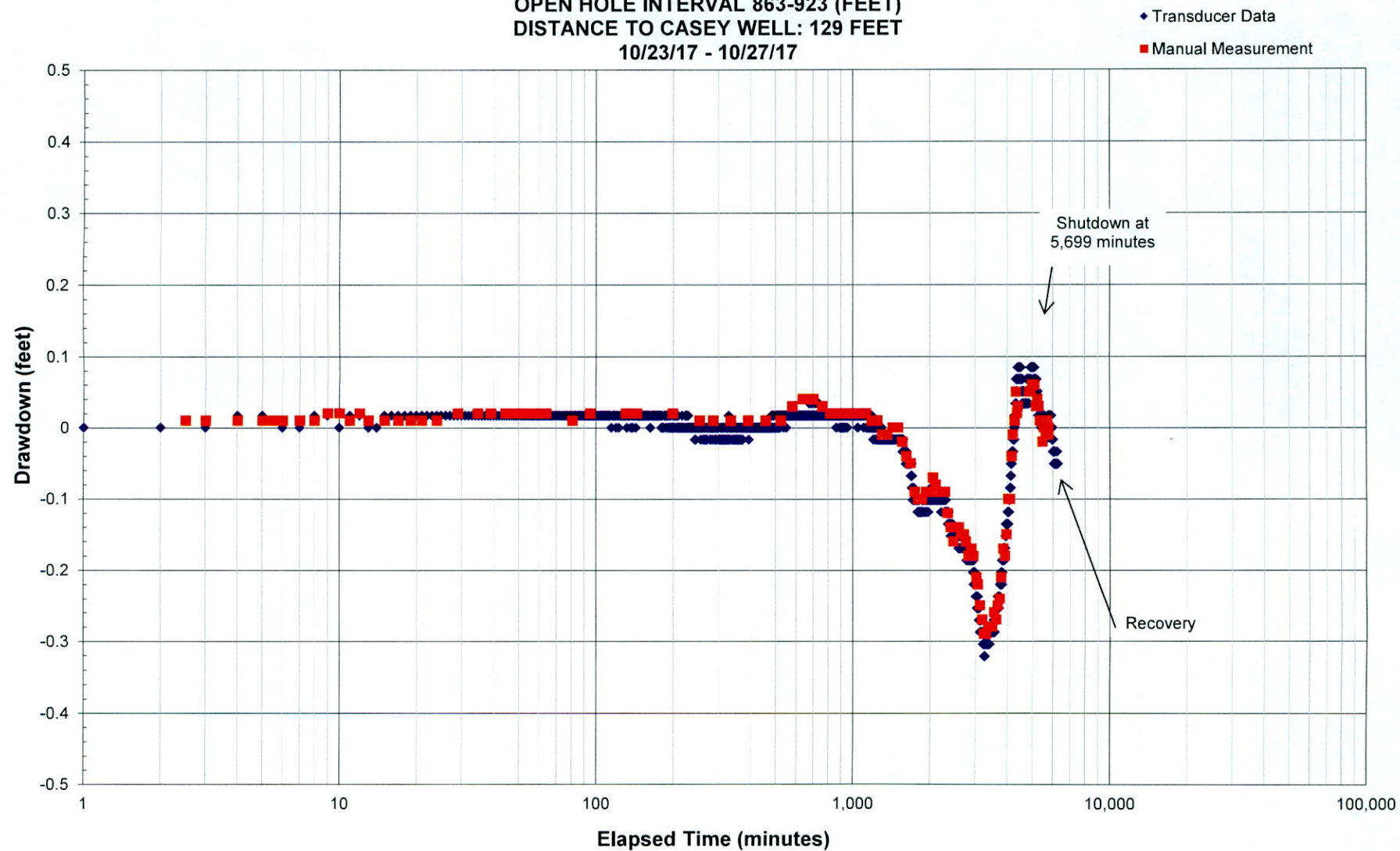
MW-1 - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 863-923 (FEET)
DISTANCE TO CASEY WELL: 129 FEET
9/27/17 - 10/27/17



MW-1 - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 863-923 (FEET)
DISTANCE TO CASEY WELL: 129 FEET
10/23/17 - 10/27/17

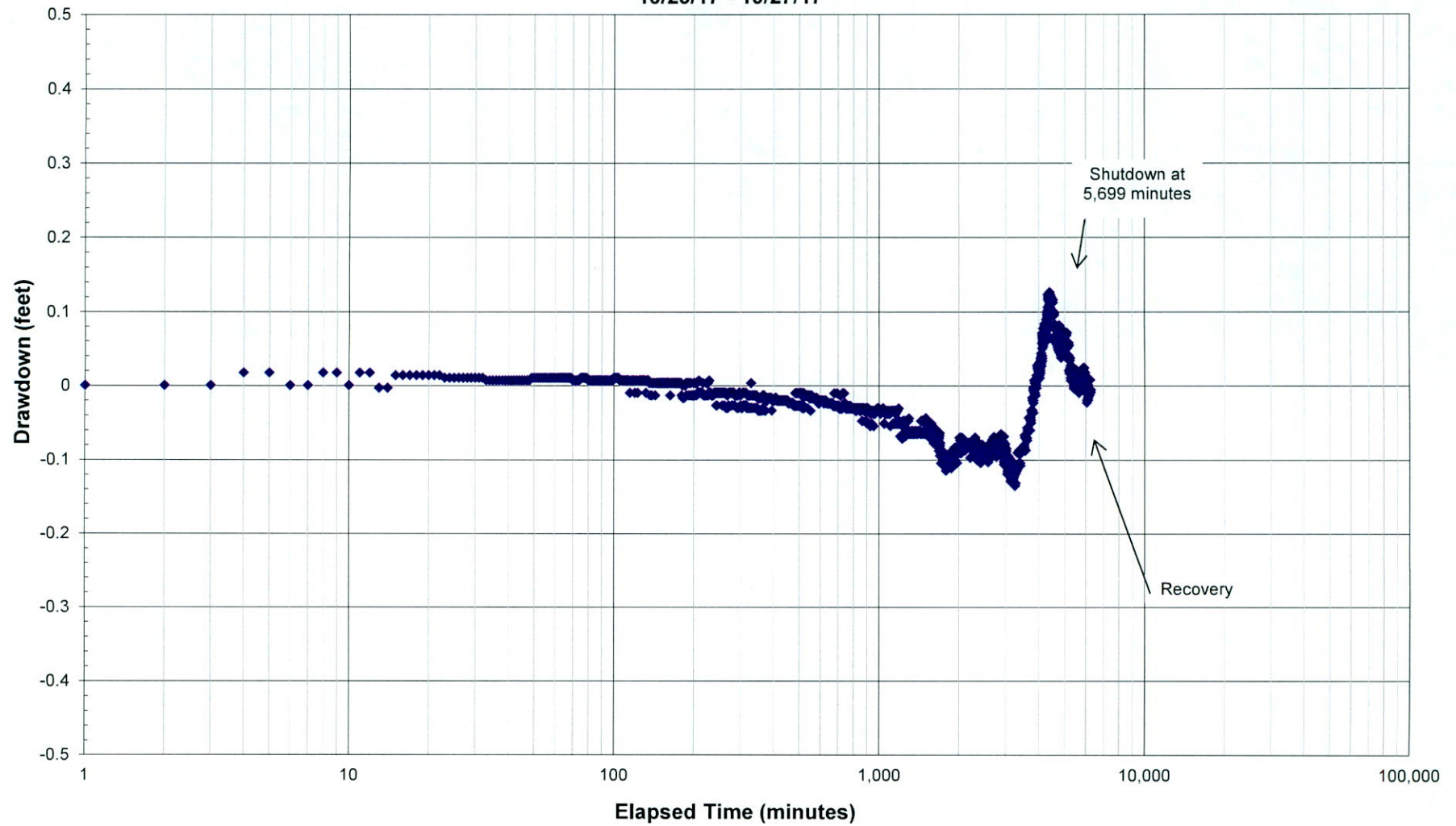


**MW-1 - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 863-923 (FEET)
DISTANCE TO CASEY WELL: 129 FEET
10/23/17 - 10/27/17**

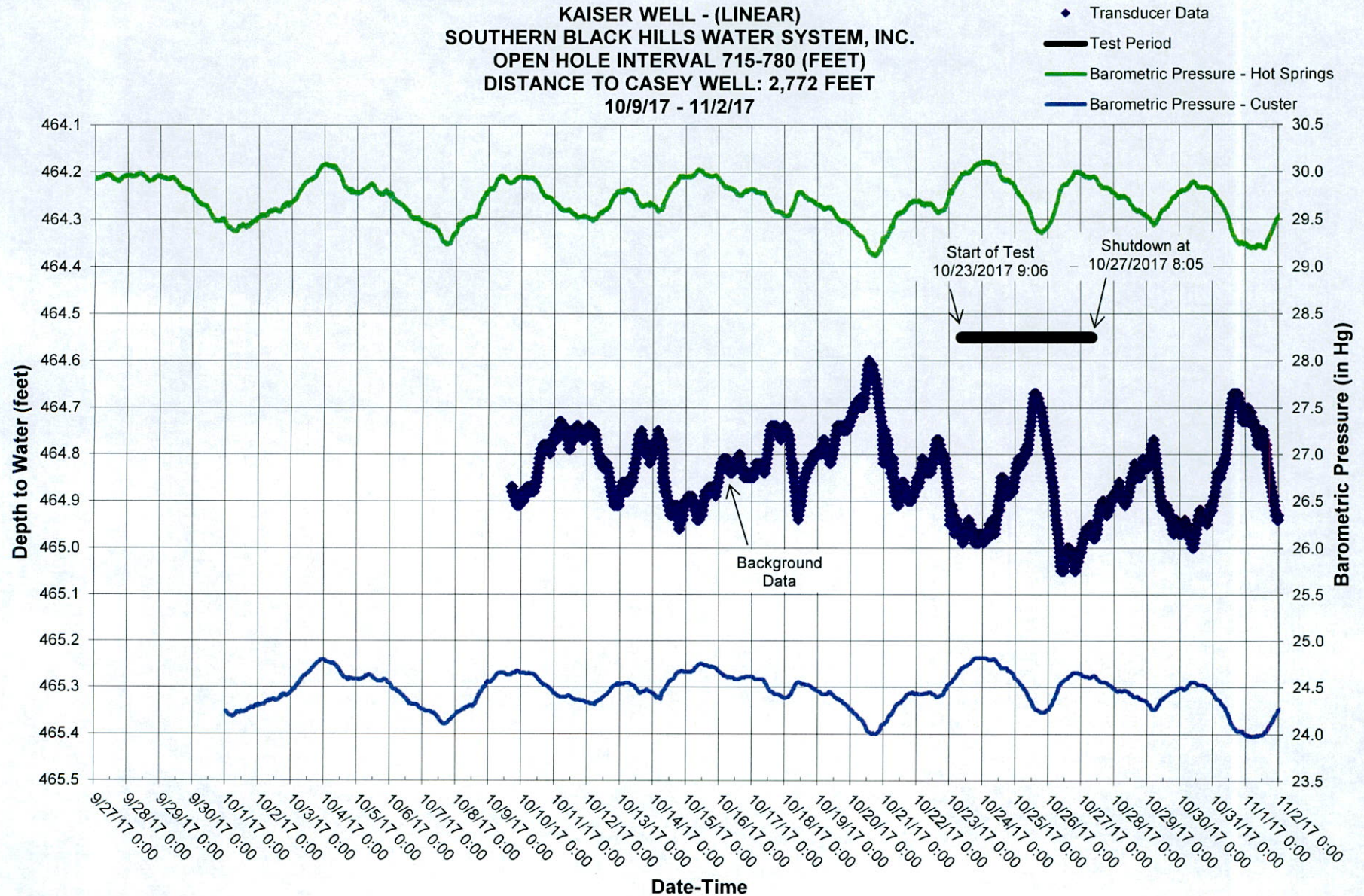


MW-1 - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 863-923 (FEET)
DISTANCE TO CASEY WELL: 129 FEET
10/23/17 - 10/27/17

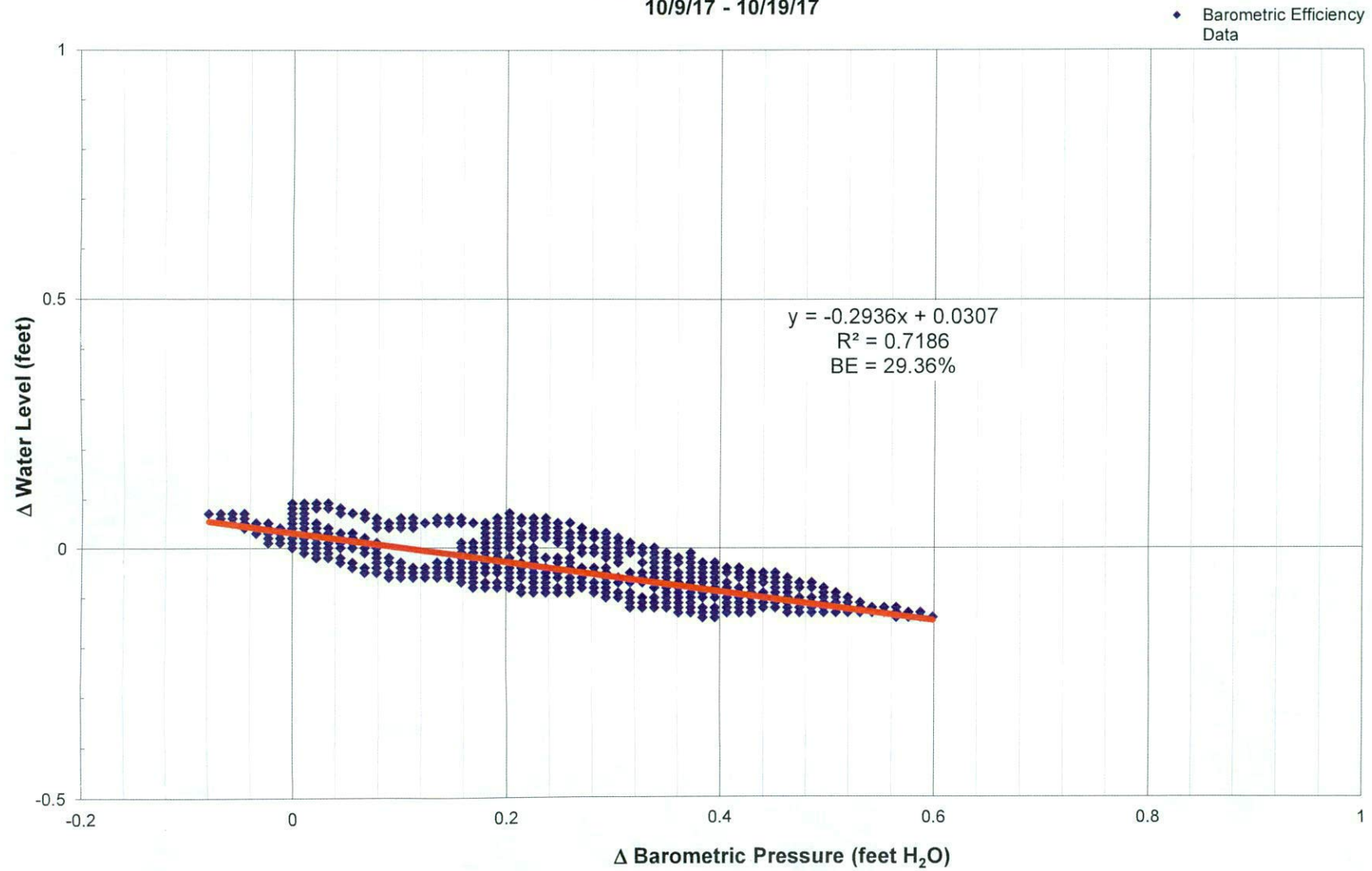
◆ Corrected Transducer Data for Barometric



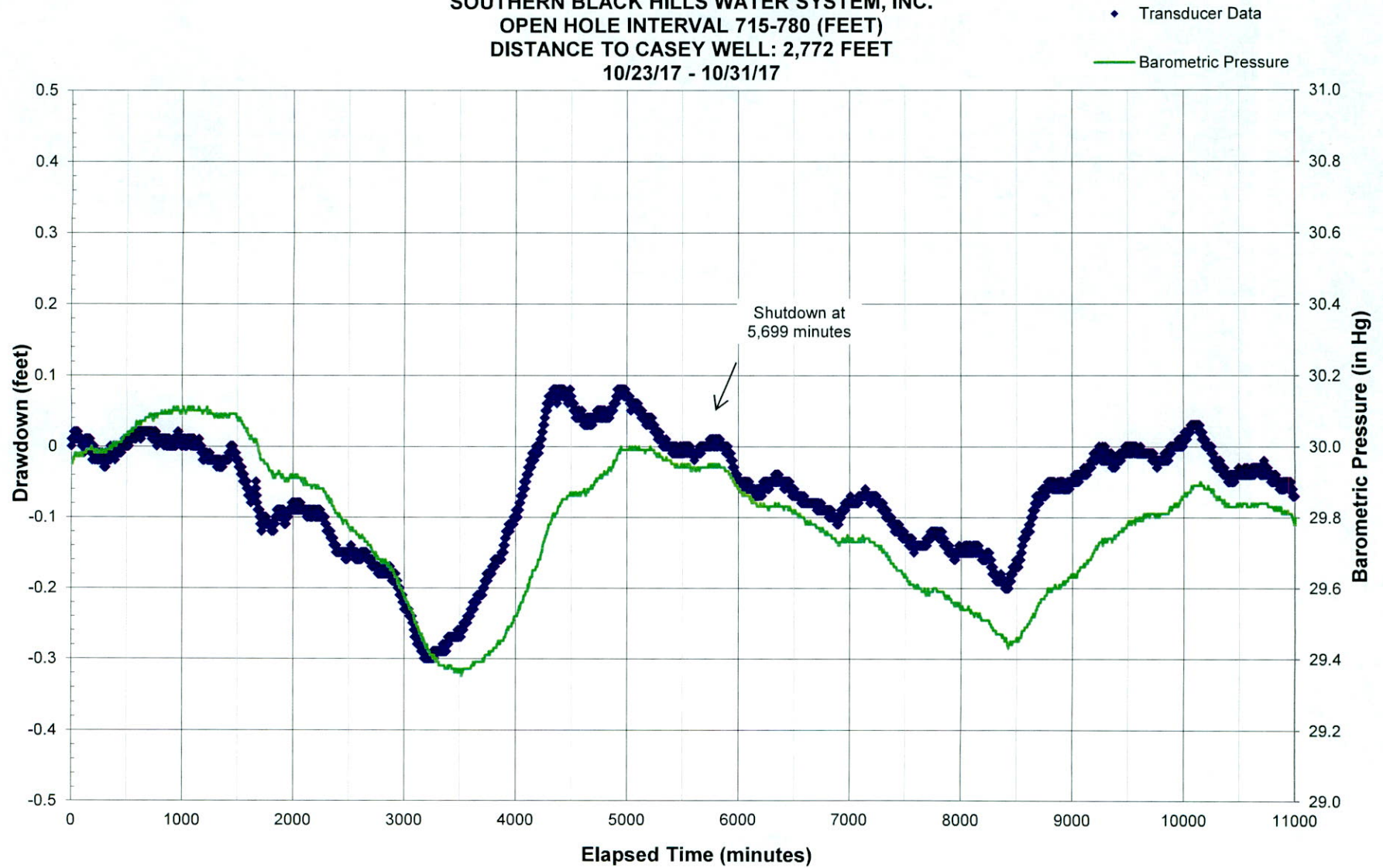
**KAISER WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 715-780 (FEET)
DISTANCE TO CASEY WELL: 2,772 FEET
10/9/17 - 11/2/17**



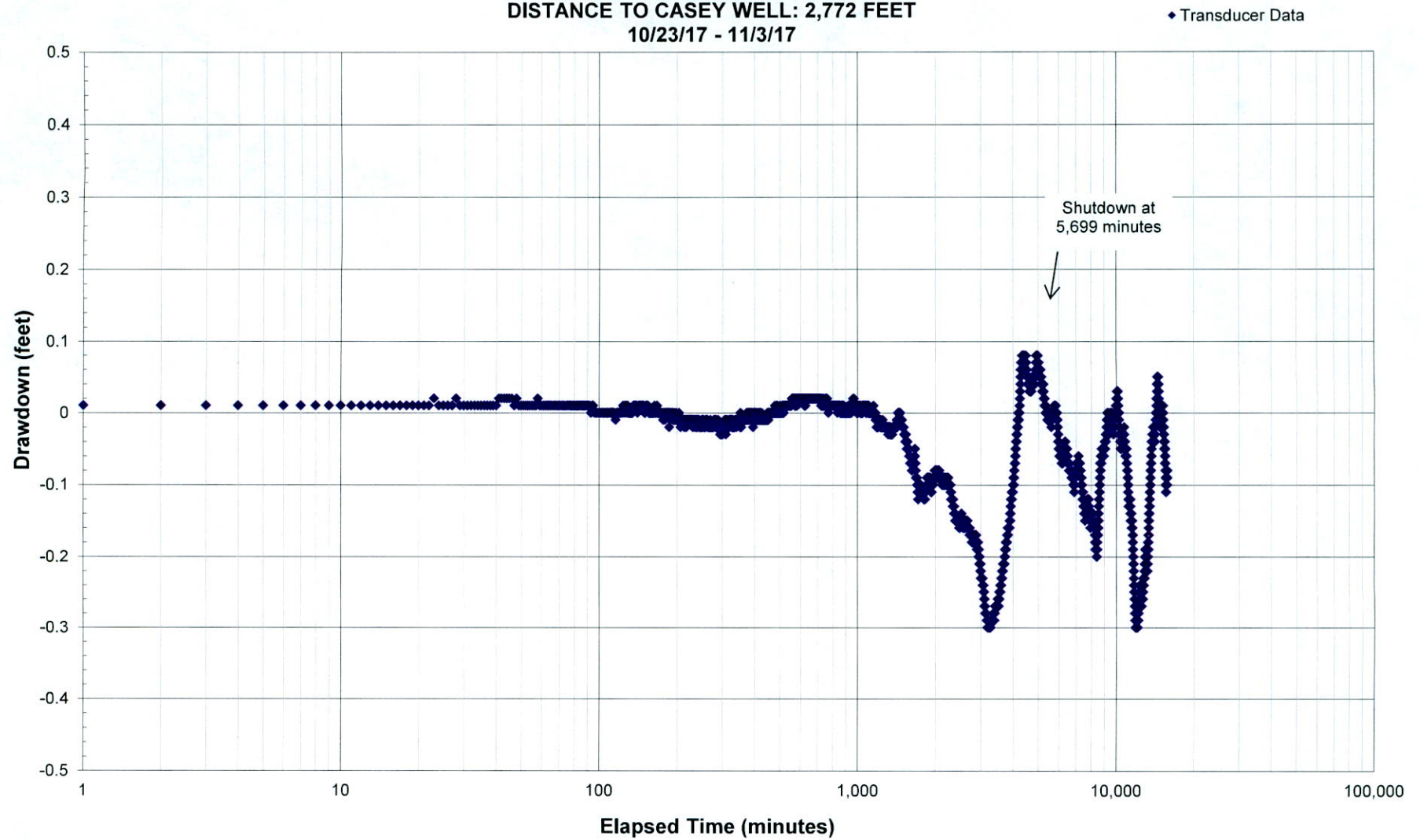
KAISER WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
BAROMETRIC EFFICIENCY
10/9/17 - 10/19/17



**KAISER WELL - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 715-780 (FEET)
DISTANCE TO CASEY WELL: 2,772 FEET
10/23/17 - 10/31/17**

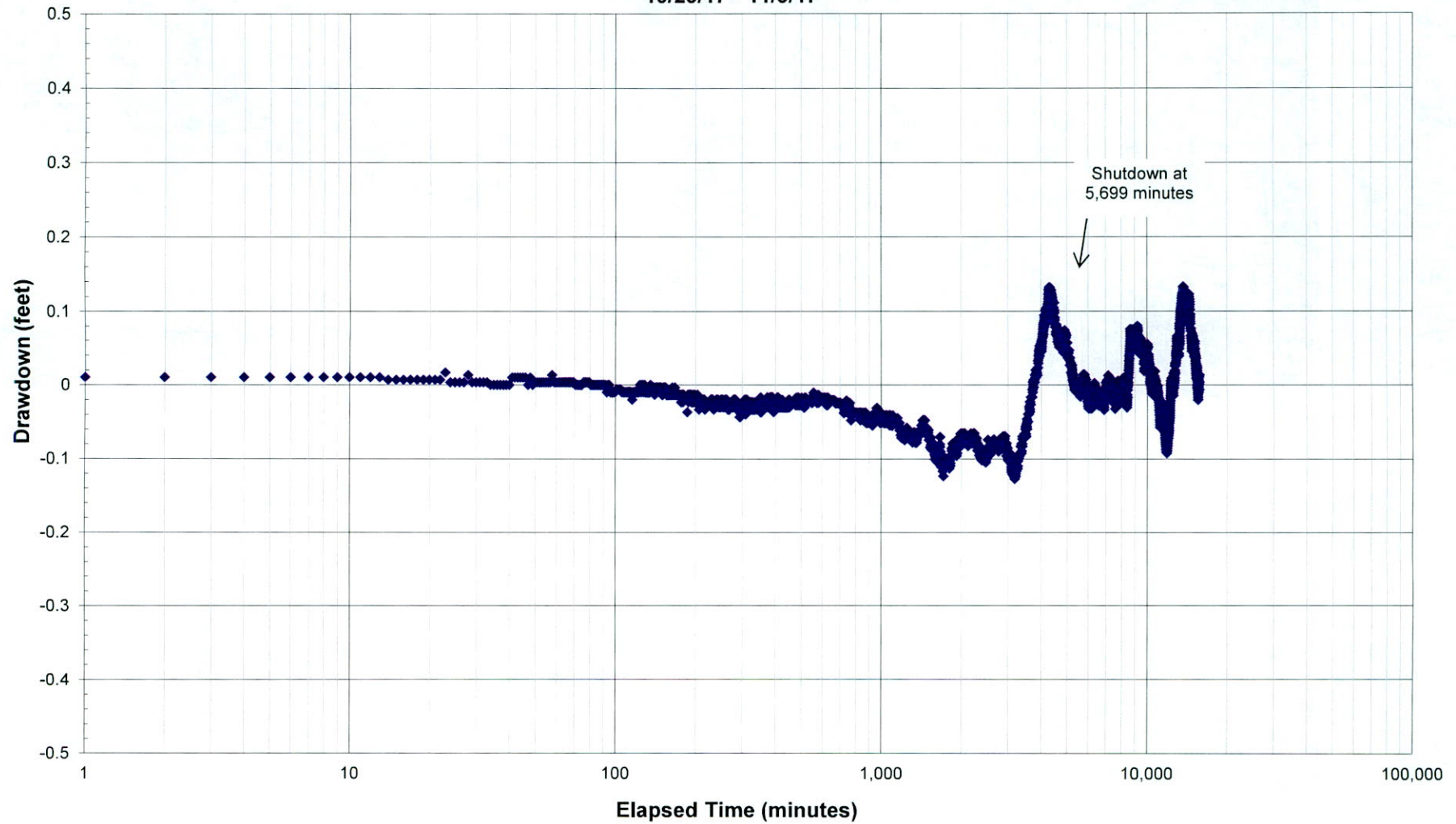


**KAISER WELL - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 715-780 (FEET)
DISTANCE TO CASEY WELL: 2,772 FEET
10/23/17 - 11/3/17**



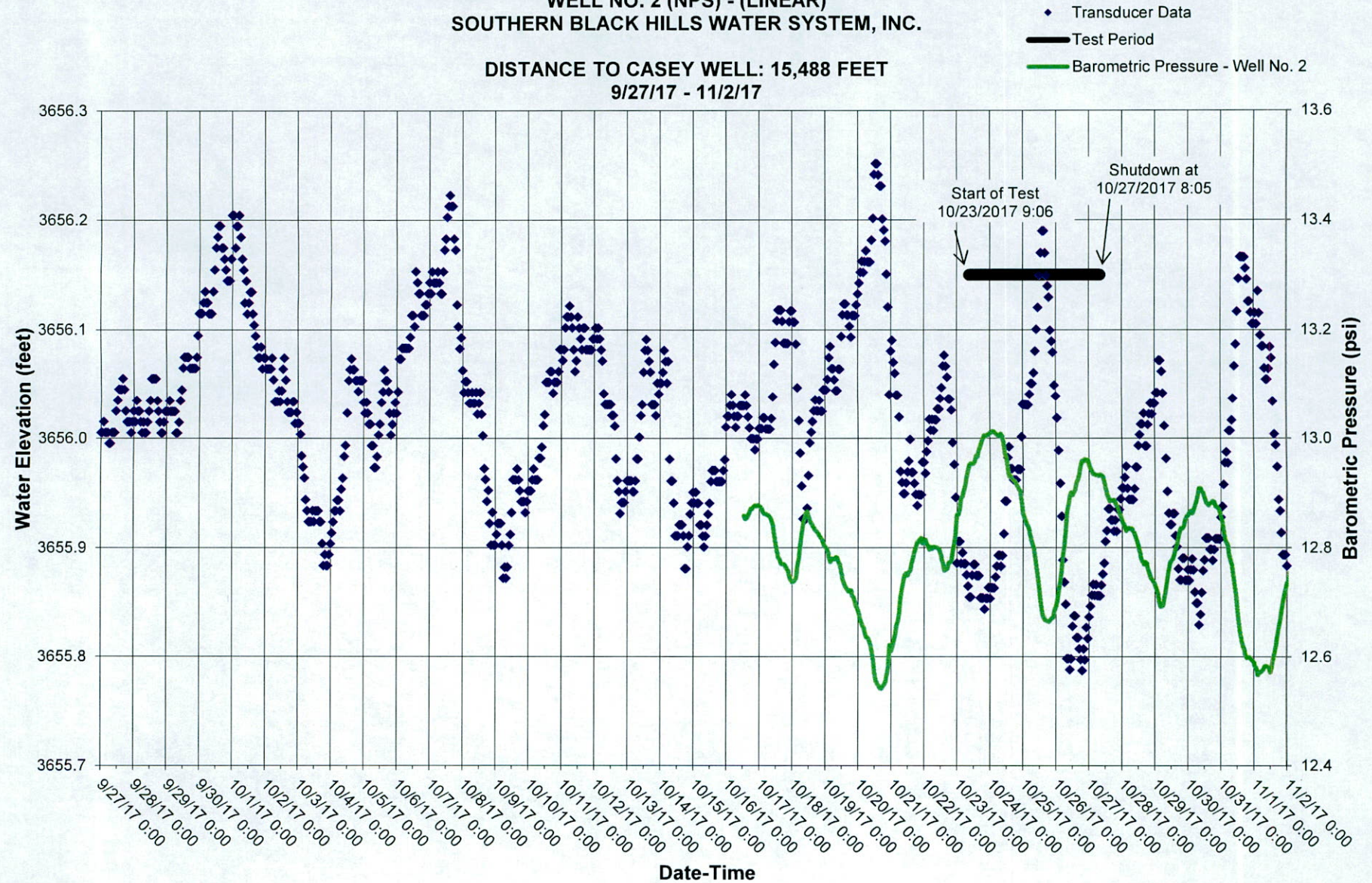
**KAISER WELL - (SEMI-LOG)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.
OPEN HOLE INTERVAL 715-780 (FEET)
DISTANCE TO CASEY WELL: 2,772 FEET
10/23/17 - 11/3/17**

◆ Transducer Data
Corrected for Barometric



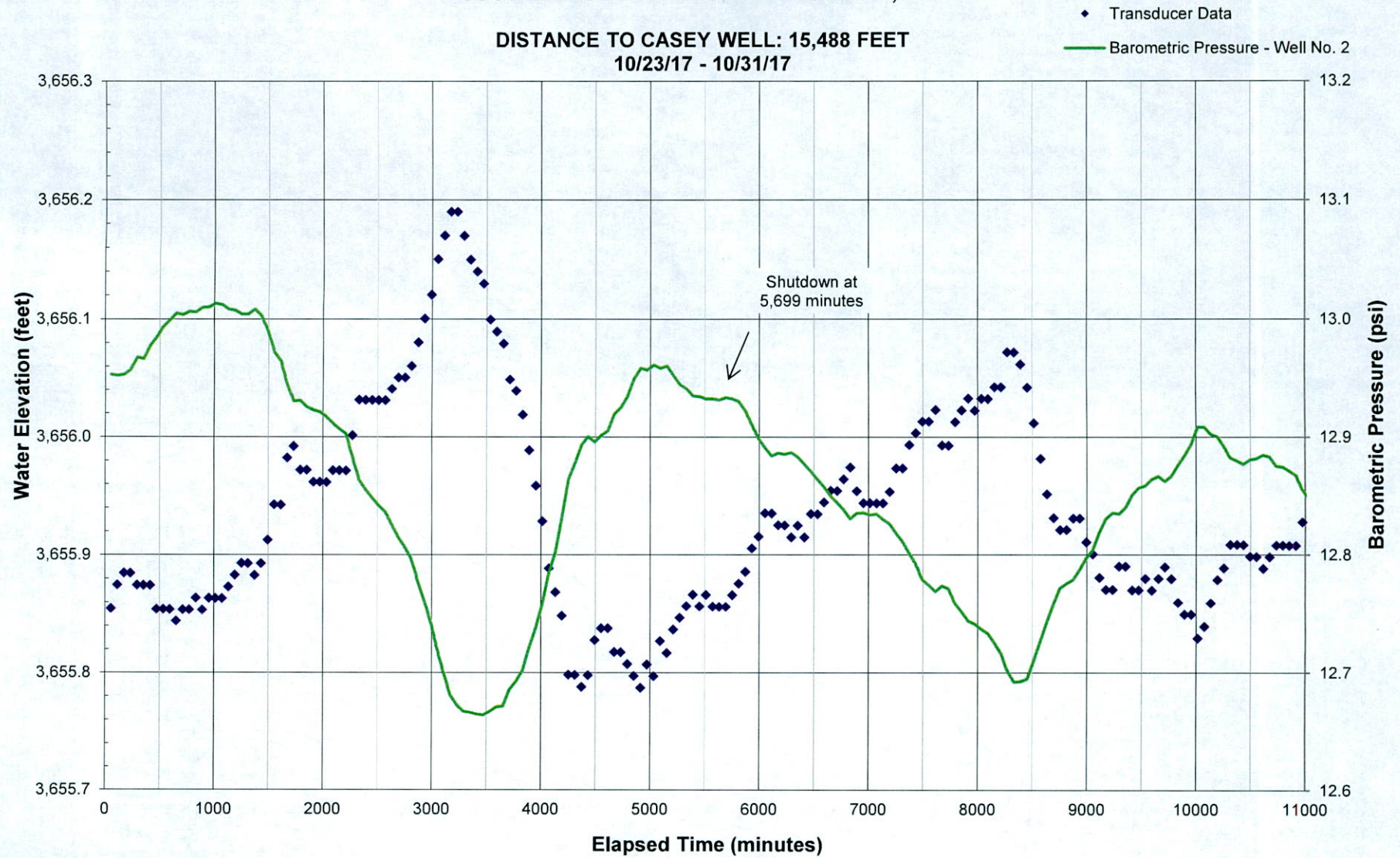
WELL NO. 2 (NPS) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.

DISTANCE TO CASEY WELL: 15,488 FEET
9/27/17 - 11/2/17



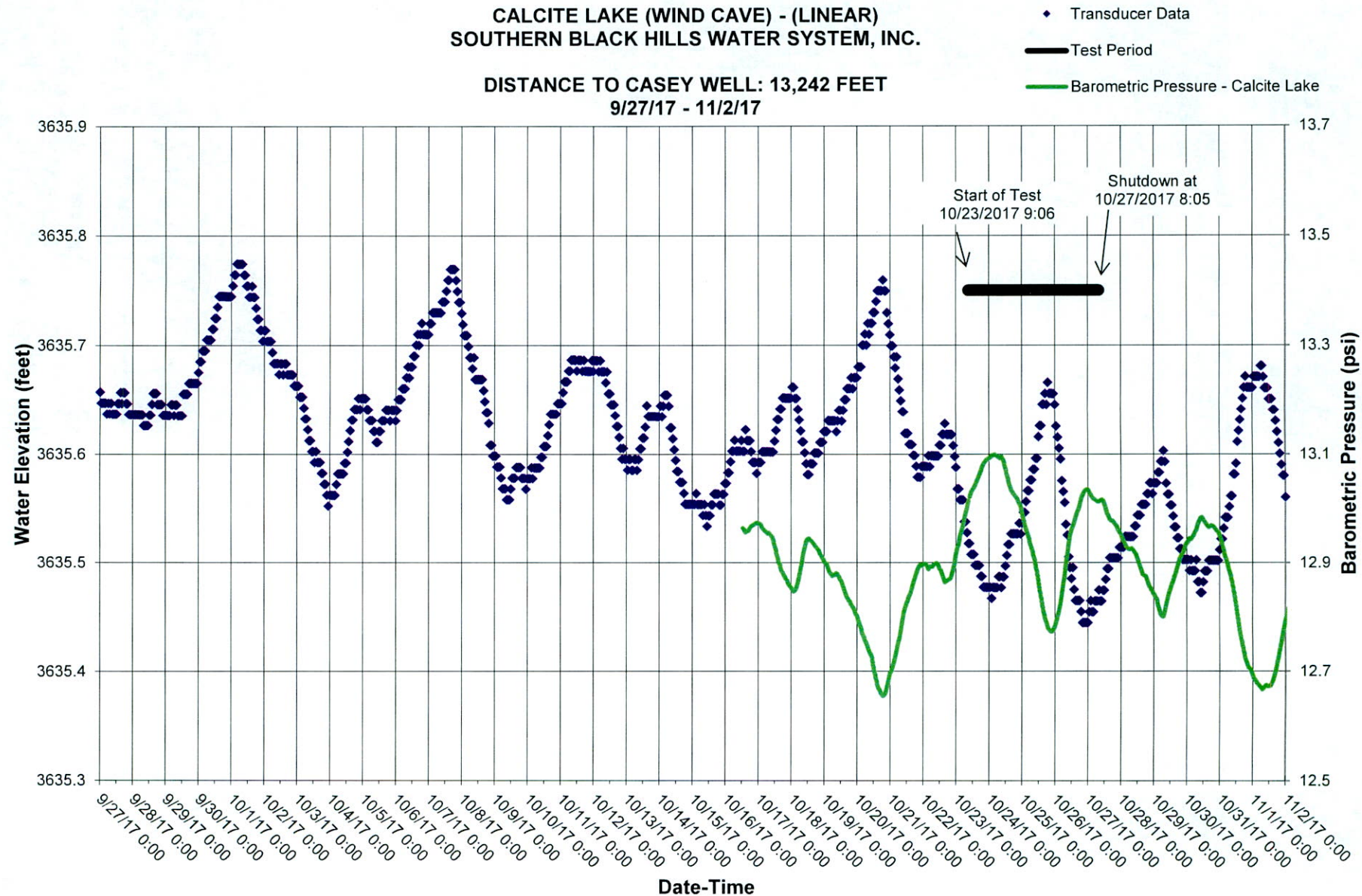
WELL NO. 2 (NPS) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.

DISTANCE TO CASEY WELL: 15,488 FEET
10/23/17 - 10/31/17



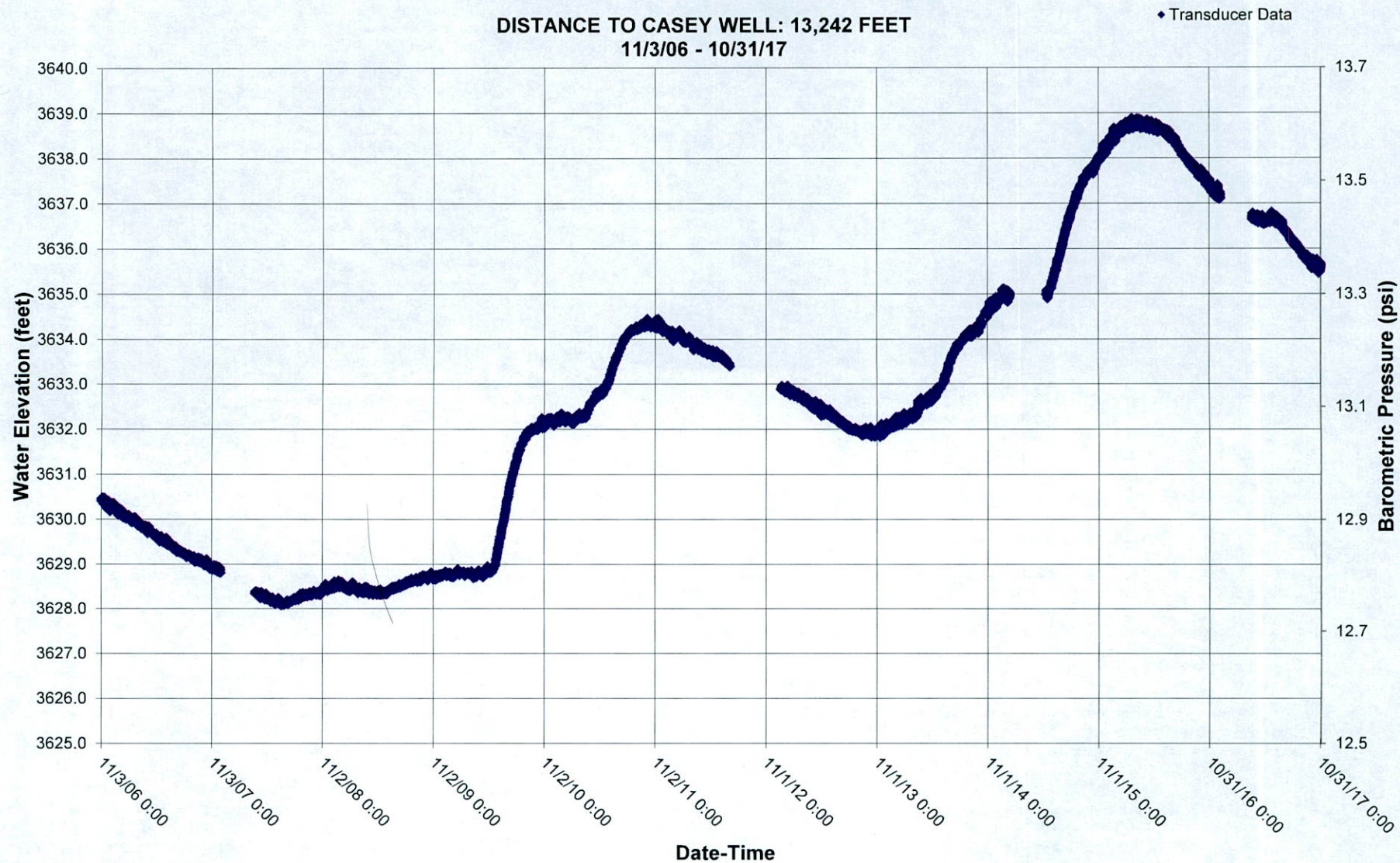
**CALCITE LAKE (WIND CAVE) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.**

**DISTANCE TO CASEY WELL: 13,242 FEET
9/27/17 - 11/2/17**



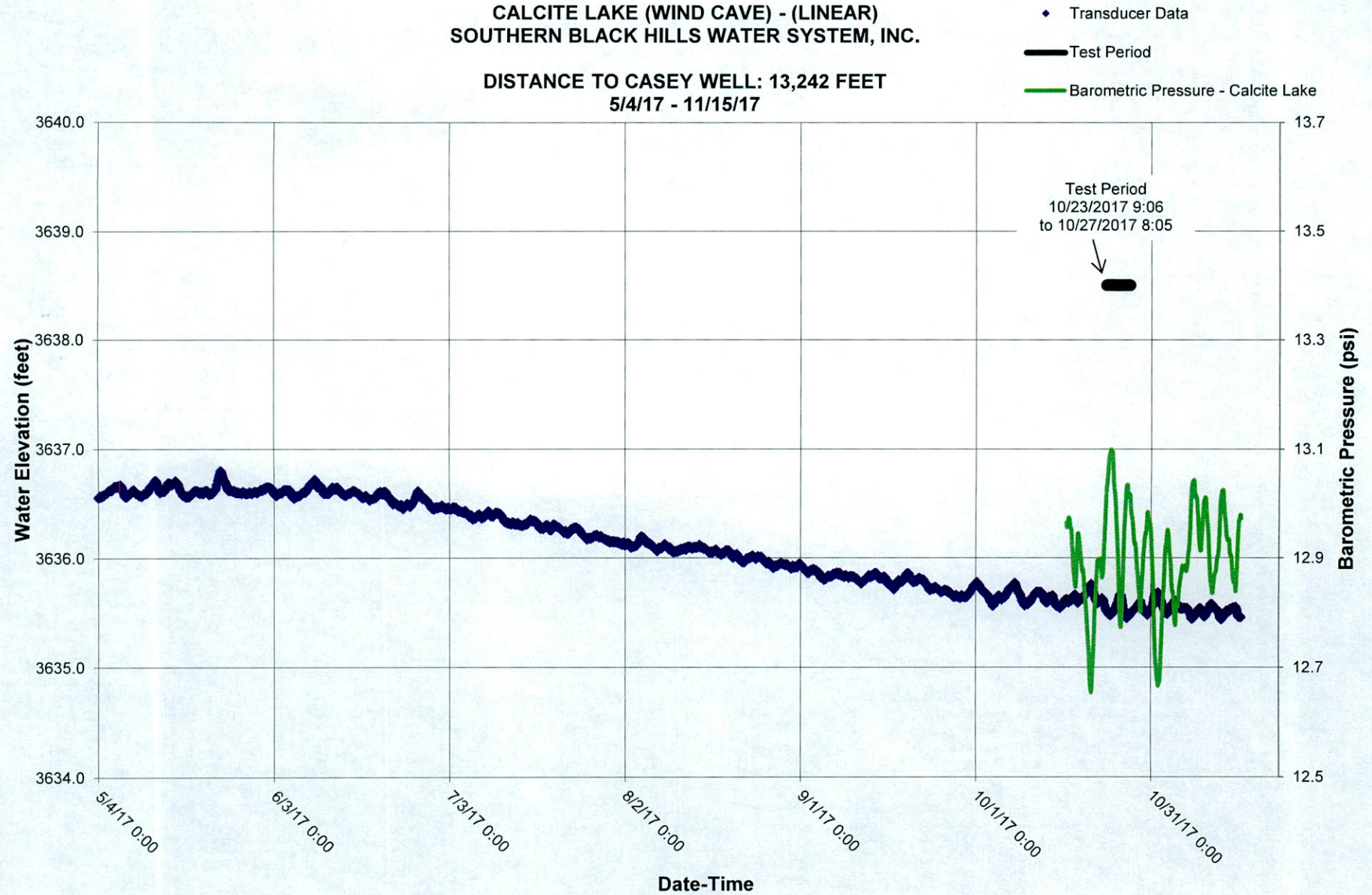
**CALCITE LAKE (WIND CAVE) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.**

**DISTANCE TO CASEY WELL: 13,242 FEET
11/3/06 - 10/31/17**



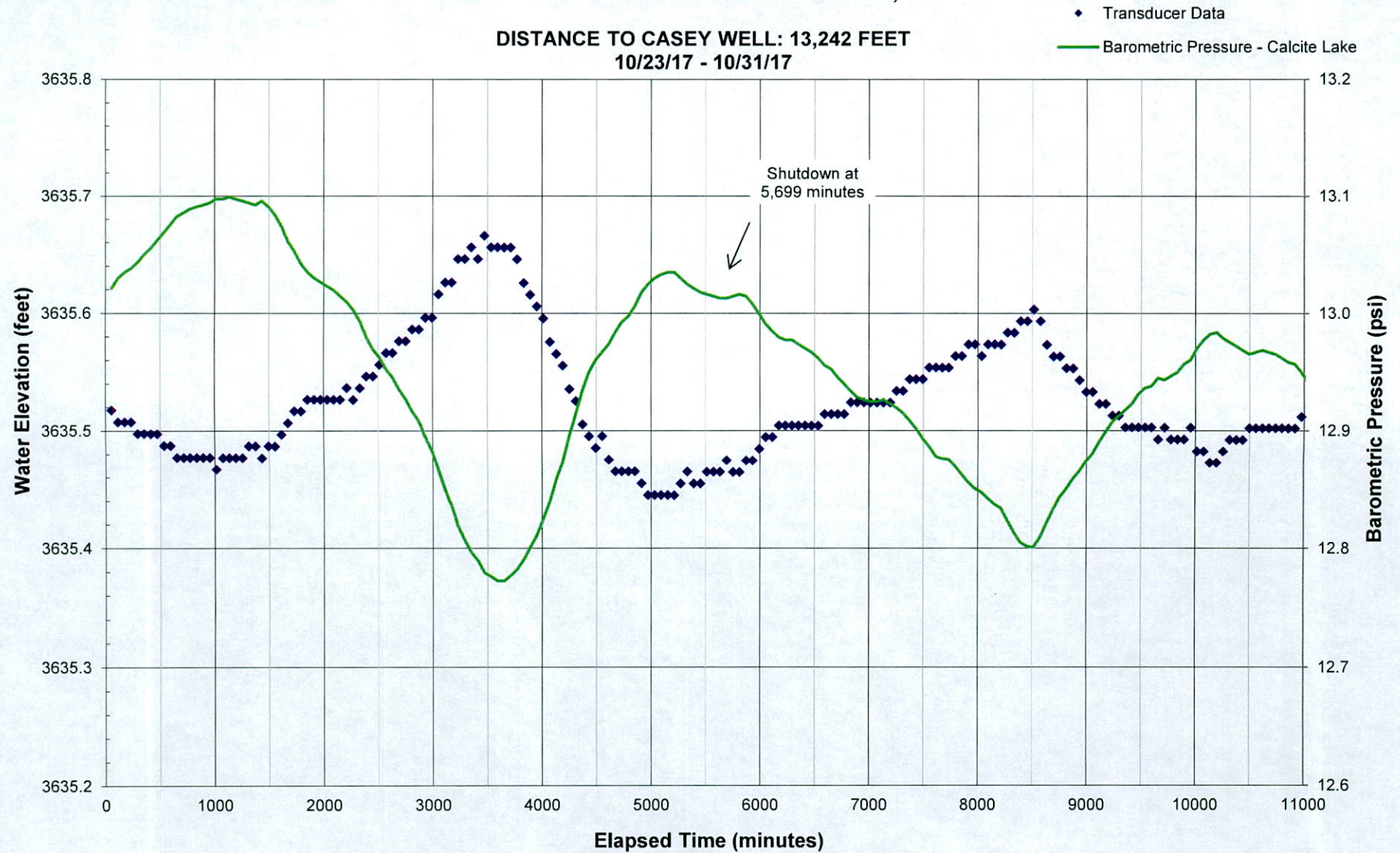
**CALCITE LAKE (WIND CAVE) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.**

**DISTANCE TO CASEY WELL: 13,242 FEET
5/4/17 - 11/15/17**

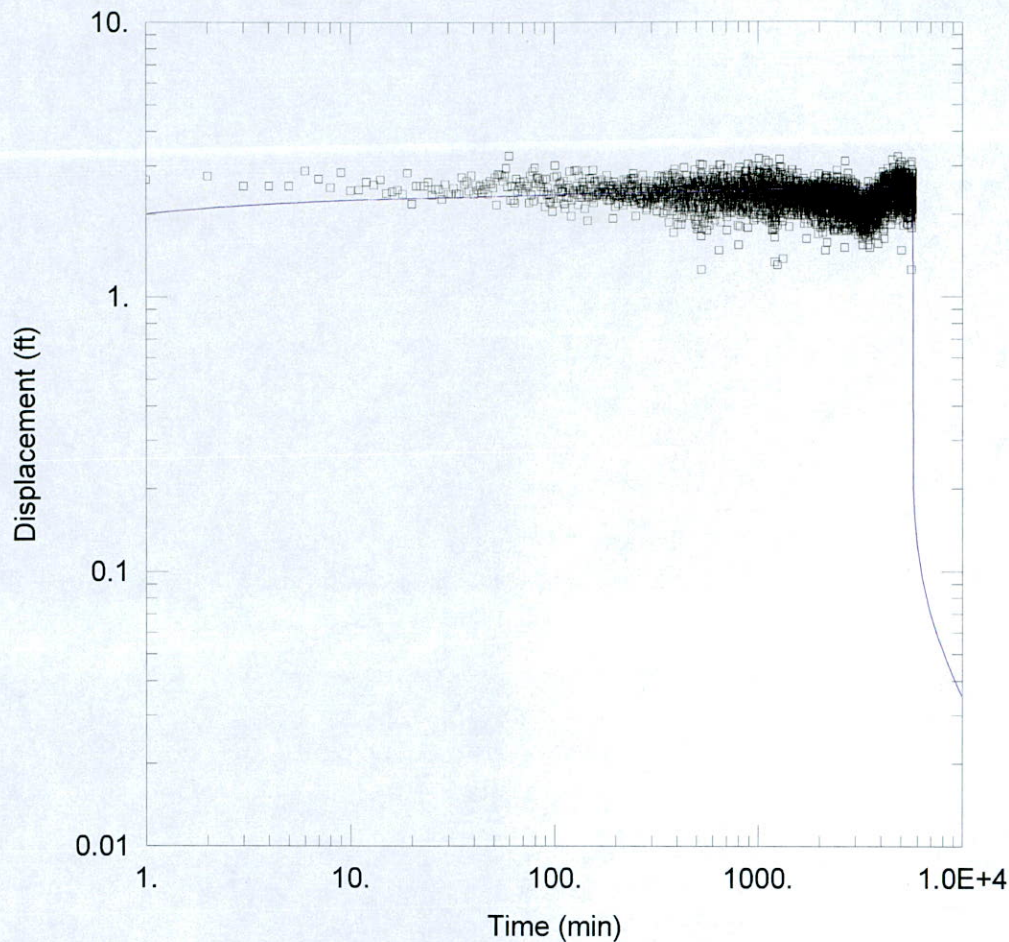


**CALCITE LAKE (WIND CAVE) - (LINEAR)
SOUTHERN BLACK HILLS WATER SYSTEM, INC.**

**DISTANCE TO CASEY WELL: 13,242 FEET
10/23/17 - 10/31/17**



APPENDIX D
Quantitative Analysis Plots – Constant-
Rate Test



WELL TEST ANALYSIS

Data Set: S:\Tech\Southern Black Hills\2017 Pump Test\Aqtesolv\Casey Well Moench.aqt
 Date: 12/04/17 Time: 11:42:26

PROJECT INFORMATION

Company: LBG
 Client: Southern Black Hills
 Test Well: Casey Well
 Test Date: 10/23/17 - 10/27/17

AQUIFER DATA

Saturated Thickness: 72. ft Slab Block Thickness: 72. ft

WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)
Casey Well	0	0	Casey Well	0	0

SOLUTION

Aquifer Model: Fractured

Solution Method: Moench w/slab blocks

K = 1362.6 ft/day

Ss = 0.01188 ft⁻¹

K' = 1.44 ft/day

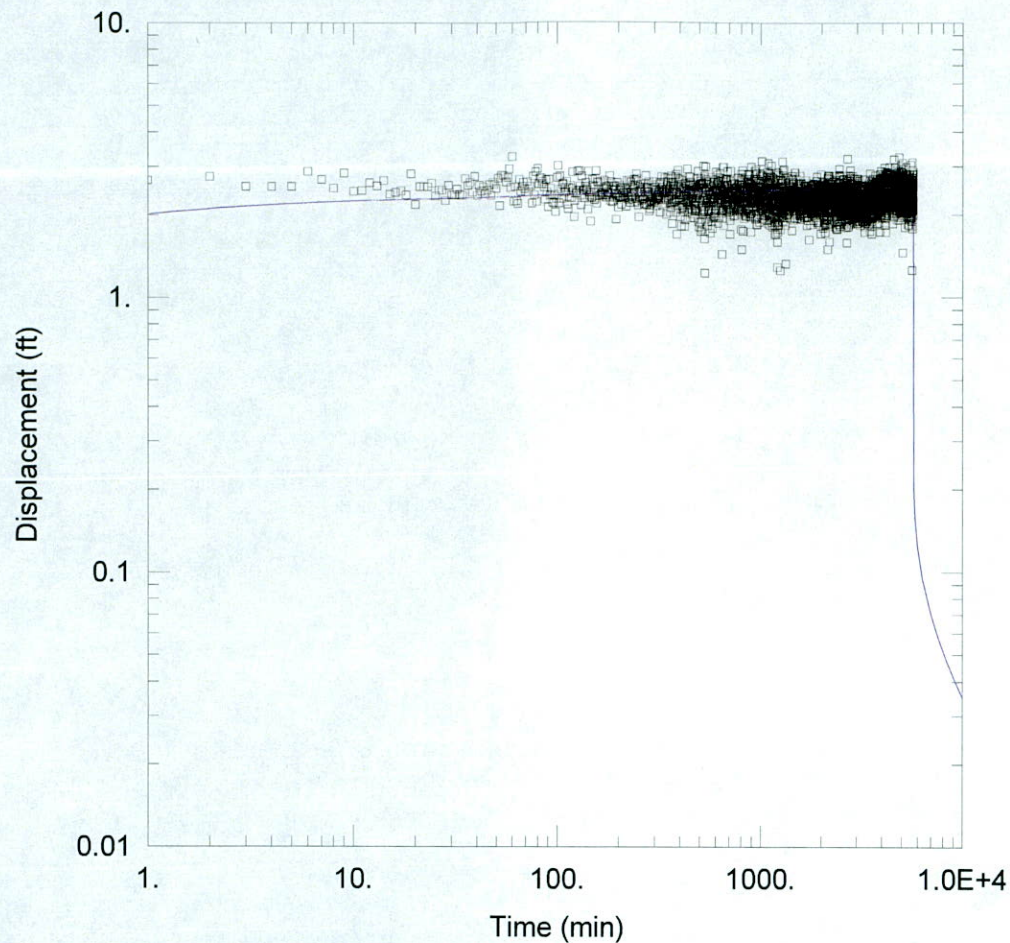
Ss' = 0.001 ft⁻¹

Sw = 0.

Sf = 0.

r(w) = 0.292 ft

r(c) = 0.292 ft



WELL TEST ANALYSIS

Data Set: S:\...\Casey Well Moench with baro corrected data.aqt

Date: 12/04/17

Time: 11:42:51

PROJECT INFORMATION

Company: LBG

Client: Southern Black Hills

Test Well: Casey Well

Test Date: 10/23/17 - 10/27/17

AQUIFER DATA

Saturated Thickness: 72. ft

Slab Block Thickness: 72. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Casey Well	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ Casey Well	0	0

SOLUTION

Aquifer Model: Fractured

Solution Method: Moench w/slab blocks

K = 1362.6 ft/day

Ss = 0.01188 ft⁻¹

K' = 1.44 ft/day

Ss' = 0.001 ft⁻¹

Sw = 0.

Sf = 0.

r(w) = 0.292 ft

r(c) = 0.292 ft

APPENDIX E
Casey Well Constant-Rate Aquifer Test
Field Water Quality

**CASEY WELL CONSTANT-RATE AQUIFER PUMPING TEST
FIELD WATER QUALITY RESULTS**

Date	Time	Totalizer	Temperature (°C)	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH (SU)	ORP (mV)
10/23/2017	13:23	163840	14.83	400	6.17	7.79	168.6
10/23/2017	14:02	174555	14.35	392	4.90	8.04	182.8
10/23/2017	14:43	185767	14.43	389	5.30	8.19	179.7
10/23/2017	15:32	198400	14.30	374	5.21	8.19	189.0
10/23/2017	16:23	212767	13.42	374	4.92	8.26	198.6
10/23/2017	16:48	218300	14.43	383	5.41	8.15	200.8
10/23/2017	17:52	236367	14.20	404	5.46	8.34	212.4
10/23/2017	18:51	252067	14.07	402	5.55	8.37	220.4
10/23/2017	20:04	269660	14.06	401	5.45	8.35	227.2
10/23/2017	20:57	285567	14.02	400	5.63	8.44	228.6
10/23/2017	22:03	301667	14.06	400	5.37	8.37	232.1
10/23/2017	22:57	315966	14.08	400	5.80	8.46	232.0
10/23/2017	23:58	332167	13.99	400	5.75	8.44	234.6
10/24/2017	1:00	348668	14.21	403	5.56	8.39	237.1
10/24/2017	1:58	364168	14.14	403	5.71	8.33	241.5
10/24/2017	2:59	380469	14.16	402	5.72	8.26	246.5
10/24/2017	4:03	396167	13.90	399	5.80	8.23	250.1
10/24/2017	5:02	413368	13.93	399	5.72	8.28	248.2
10/24/2017	5:58	428267	14.04	401	5.69	8.26	250.0
10/24/2017	6:54	443367	13.76	398	5.71	8.24	252.7
10/24/2017	7:45	457867	13.87	399	5.86	8.32	248.7
10/24/2017	9:02	478267	13.91	403	5.70	8.15	214.6
10/24/2017	10:04	495367	14.06	403	5.95	8.41	203.2
10/24/2017	11:02	510767	14.26	405	6.08	8.44	201.1
10/24/2017	12:02	526166	14.43	407	6.16	8.27	203.3
10/24/2017	13:02	542767	14.58	407	6.06	8.22	203.5
10/24/2017	14:03	558767	14.81	409	6.19	8.25	202.3
10/24/2017	15:02		14.67	409	6.31	8.26	205.9
10/24/2017	16:02	590367	14.17	404	6.16	8.25	212.4
10/24/2017	17:13	608867	13.77	400	6.19	8.27	219.9
10/24/2017	21:11	623167	12.42	386	6.38	8.29	237.3
10/24/2017	22:00	687467	12.36	386	6.45	8.41	237.5
10/24/2017	23:09		12.05	383	6.46	8.34	240.5
10/25/2017	0:09	719366	12.22	384	6.51	8.37	240.5
10/25/2017	1:10		12.03	383	6.49	8.37	243.0
10/25/2017	2:15	752868	12.04	383	6.42	8.37	245.6
10/25/2017	3:08	767268	12.33	386	6.31	8.48	241.7
10/25/2017	4:05	782367	12.17	384	6.23	8.52	238.8
10/25/2017	5:17	800366	11.92	382	6.22	8.44	241.6
10/25/2017	6:07	814967	11.34	377	6.26	8.45	245.3
10/25/2017	7:02		11.20	376	6.27	8.46	247.1
10/25/2017	8:03	846867	12.88	392	6.12	8.53	236.6
10/25/2017	9:11	864867	14.10	404	6.00	8.60	206.6
10/25/2017	10:19	880767	14.84	411	6.46	8.58	208.0
10/25/2017	11:35		14.87	409	6.53	8.40	213.6
10/25/2017	12:01	911167	14.87	409	6.46	8.22	203.5
10/25/2017	13:06	926967	15.09	410	6.57	8.30	210.3
10/25/2017	14:06	943467	15.11	410	6.59	8.23	204.4
10/25/2017	15:05	958467	15.06	411	6.60	8.20	201.6
10/25/2017	16:07	975167	14.91	409	6.67	8.32	213.3
10/25/2017	17:07	991367	14.78	410	5.82	8.26	218.6
10/25/2017	18:07	1006967	14.66	408	5.73	8.32	226.9
10/25/2017	19:10	1023467	14.62	408	6.00	8.32	232.6
10/25/2017	20:11	1039967	14.60	407	6.20	8.43	231.9
10/25/2017	21:12	1055767	14.56	407	6.08	8.36	234.1
10/25/2017	22:10	1071466	14.54	407	6.20	8.37	235.4
10/25/2017	23:09	1087267	14.57	407	6.36	8.42	235.5
10/26/2017	0:07	1102566	14.56	407	6.16	8.46	234.6
10/26/2017	1:16	1120566	14.60	407	6.16	8.42	234.1
10/26/2017	2:08	1134766	14.59	407	6.26	8.48	234.4
10/26/2017	3:07	1150567	14.63	408	6.35	8.53	233.5
10/26/2017	4:14	1166867	14.60	407	6.39	8.49	234.6
10/26/2017	5:09	1182767	14.52	407	6.45	8.50	235.2
10/26/2017	6:08	1198666	14.50	407	6.52	8.50	236.1
10/26/2017	7:05	1213667	14.43	406	6.48	8.48	237.7
10/26/2017	7:32	1229667	14.33	405	6.50	8.48	238.4

NOTES:

µmhos/cm: micro mhos per centimeter
 °C: degrees Celsius
 mg/L: milligrams per liter
 SU: standard units
 mV: milli volts

REPORT TO THE CHIEF ENGINEER
ON
WATER PERMIT APPLICATION NO. 2633B-2
SOUTHERN BLACK HILLS WATER SYSTEM
C/O DON PETERSON, MANAGER
JUNE 14, 2018

Water Permit Application No. 2633B-2 proposes to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually (ac-ft/yr.) at a maximum diversion rate of 0.67 cubic feet of water per second (cfs) from one well to be completed into the Madison aquifer located in the SE ¼ SE ¼ Sec. 35-T5S-R6E in Custer County. Application No. 2633B-2 requests the point of diversion be transferred to two Madison aquifer wells (883 feet and 923 feet deep) located in the N ½ SE ¼ Sec. 24-T6S-R5E approximately six miles southwest of the original well location. These well sites are approximately five miles north of Hot Springs, SD. The second well will be a monitoring well, but will also, if needed, serve as an emergency backup well. Southern Black Hills Water System serves customers in Custer, Fall River, and Pennington Counties. The amendment to Water Permit No. 2633A-2 can be made pursuant to South Dakota Codified Law 46-5-30.4.

HISTORY

The applicant has previously submitted Application No. 2788-2 for a new appropriation of 480 ac-ft/yr. using the wells Application No. 2633B-2 proposes to use. The applicant had engineering firm Leggette, Brahsears & Graham (LBG), now known as WSP USA, perform and analyze an aquifer pumping test to determine the viability of the wells and potential for impacts on existing users of the Madison aquifer in the area. After review of Application No. 2788-2 and the aquifer pump test data by DENR-Water Rights staff, the applicant submitted Application No. 2633B-2 to transfer the diversion point and annual pumping volume authorized by Water Permit No. 2633A-2 to the location described in Application No. 2633B-2. Water Permit No. 2633A-2 had yet to be developed at its current location, and the applicant had already received an extension of time to develop the permit there. Application No. 2788-2 is being held in abeyance pending approval of this application. If Application No. 2633B-2 is approved, Application No. 2788-2 will be withdrawn by the applicant. There has been a history of disagreement in the area regarding the development of the Madison aquifer in the southern Black Hills area for use by rural water systems.

AQUIFER: Madison (MDSN)

Aquifer Characteristics:

The Madison aquifer is a regional scale aquifer underlying portions of Montana, Nebraska, North Dakota, South Dakota, Wyoming, and Canada (Peterson, 1984). The Madison aquifer is contained within the Madison Limestone, locally known as the Pahasapa Limestone and the Englewood Limestone. The Madison aquifer underlies approximately 19,116,160 acres and contains an estimated 644,827,200 ac-ft of recoverable water in storage in western South Dakota (Allen et al, 1985), and underlies approximately 5,362 square miles and contains an estimated 51,512,300 ac-ft of recoverable water in storage in eastern South Dakota (Hedges et al, 1982).

Long and others (2012) stated the Madison aquifer is a “mature karst aquifer” that contains fractures and “solution-enlarged” cavities. The upper portion of the Madison Limestone (the Pahasapa Limestone) generally has higher permeability due to the presence of more fractures and solution cavities than the lower portion (Englewood Limestone) (Green, 1993). The average porosity of the Madison is estimated to be 1 percent, and the effective porosity from which recoverable water can be obtained by wells is assumed to be 5 percent (Rahn, 1979). The Madison Limestone is estimated to be 300 feet thick in this area (Carter and Redden, 1999a and 1999b). The Madison aquifer is generally considered an excellent aquifer in terms of its potential to supply good quality water to relatively productive wells especially near the outcrop of the formation. The wells the applicant intends to use are located approximately 2.5 miles southwest of the nearest portion of Madison Limestone outcrop (Strobel et al, 1999).

At the wells the applicant proposes to use, the top of the Madison aquifer ranges from 811 to 825 feet below ground surface. The static water level of the “Casey well”, as it is called in the constant-rate aquifer pumping test report prepared by Legette, Brashears, and Graham (LBG) (2018), at the time of completion, May 1994, was 418 feet below ground surface. The back up well, called “MW-1” by LBG (2018), had a static water level of 407 feet below ground surface at the time of completion in July 2017. The Madison aquifer is confined at the location of the wells the applicant proposes to use.

AQUIFER PUMPING TEST

METHODOLOGY REVIEW

An aquifer pumping test was performed by engineering firm Legette, Brahsears & Graham (LBG), now known as WSP USA, using both of the wells the applicant intends to use (Casey well and MW-1) for this application from October 23 through October 27, 2017 (LBG, 2018). The results of this aquifer pumping test are being used by the applicant as a foundation and justification for this application. The aquifer pumping test included aquifer water level monitoring for a period before the Casey well was pumped, known as the background period in the report, and monitoring of the water levels in the pumped well and monitoring wells after cessation of pumping, known as the recovery period in the report. Total pumping time was approximately 95 hours instead of the intended 72 hours. The pumping period was extended due to a water level deflection that was measured after 67 hours of pumping. It was determined the deflection was caused by a fast moving weather front that caused a rapid increase in barometric pressure and not an aquifer boundary condition. The Casey well was pumped at an average rate of 267 gallons per minute (gpm) for the duration of the pumping portion of the test (LBG, 2018). This application is for 0.67 cfs which is 300 gpm.

The Casey well, the well pumped for the aquifer test, and MW-1, the closest monitoring well for the test, are owned by Southern Black Hills Water System. The Kaiser well and NPS Well No. 2 well mentioned in the LBG’s (2018) report are owned by the National Park Service. Based on well completion reports, all four wells are completed into the Madison aquifer. The water levels of Calcite Lake in Wind Cave are monitored by the National Park Service, and that water level data was also considered as part of LBG’s (2018) aquifer pumping test report. A vast majority of Wind Cave including Calcite Lake is within the Madison Limestone (Long et al, 2012). The data-logger data from DENR-Observation well CU-91A, completed into the Madison aquifer, was also going to be considered for the pumping test. However, there was a malfunction with the

data collection, and no data was recorded during the aquifer test period. Barometric pressure data was obtained for use in determining the effects of and appropriately correcting for changes in barometric pressure that could cause fluctuations of the water level as measured in the wells.

The pumped well and three monitoring wells were equipped with data-logging pressure transducers. Manual measurements were also taken at the Casey well and MW-1. The National Park Service maintains long-term water level monitoring of Calcite Lake in Wind Cave. The methodology and equipment used to measure water levels for this aquifer pumping test as well as how the aquifer pumping test was conducted are consistent with standard operating procedures and methods as set forth by the American Water Works Association (AWWA) (1998), United States Environmental Protection Agency (Osborne, 1993), Fetter (1980), and Driscoll (1986) amongst many others. The aquifer pumping test as conducted by LBG is accepted by the DENR-Water Rights Program.

The water level and time data collected during the whole of the aquifer pumping test (the background period, the pumping period, and the recovery period) was analyzed using Aqtesolv (LBG, 2018). The Moench (1984) solution for a fractured aquifer was the analysis method used for the barometric-corrected data and the uncorrected data (LBG, 2018). The Moench (1984) solution is used by several software packages used for calculating aquifer characteristics and estimating drawdown based on aquifer pumping test data. This includes Aqtesolv (2018), which was used by LBG (2018) for their report and is a commonly used and accepted software package for analyzing aquifer pumping test data. The methods and software used by LBG for analysis of the aquifer pumping test data is acceptable by the DENR-Water Rights Program.

TEST DATA ANALYSIS REVIEW

The primary purposes of this constant-rate aquifer pumping test was to determine the aquifer characteristics of the Madison aquifer at the well location and provide information regarding the suitability of the Casey well as a potential water supply well for Southern Black Hills Water System (LBG, 2018). The maximum drawdown measured in the Casey well, the pumped well, was 2.4 feet near the end of the pumping period. The water level in the Casey well recovered to 0.1 feet above pre-pumping static levels within five minutes after shutting down pumping. After reviewing all of the data and accounting for barometric pressure changes, it was determined no drawdown caused by pumping the Casey well was measured in any of the monitoring wells. Monitoring wells MW-1, the Kaiser well, and NPS Well No. 2 are 129 feet, 2,722 feet, and 15,488 feet away from the Casey well. Figure 1 is a map of the project area including the wells the applicant intends to use, the wells used for monitoring the water levels during the aquifer pumping test, and Madison aquifer water rights/permits and observation wells along with the boundaries of Wind Cave National Park. Table 1 is a list of the water rights/permits shown in Figure 1.

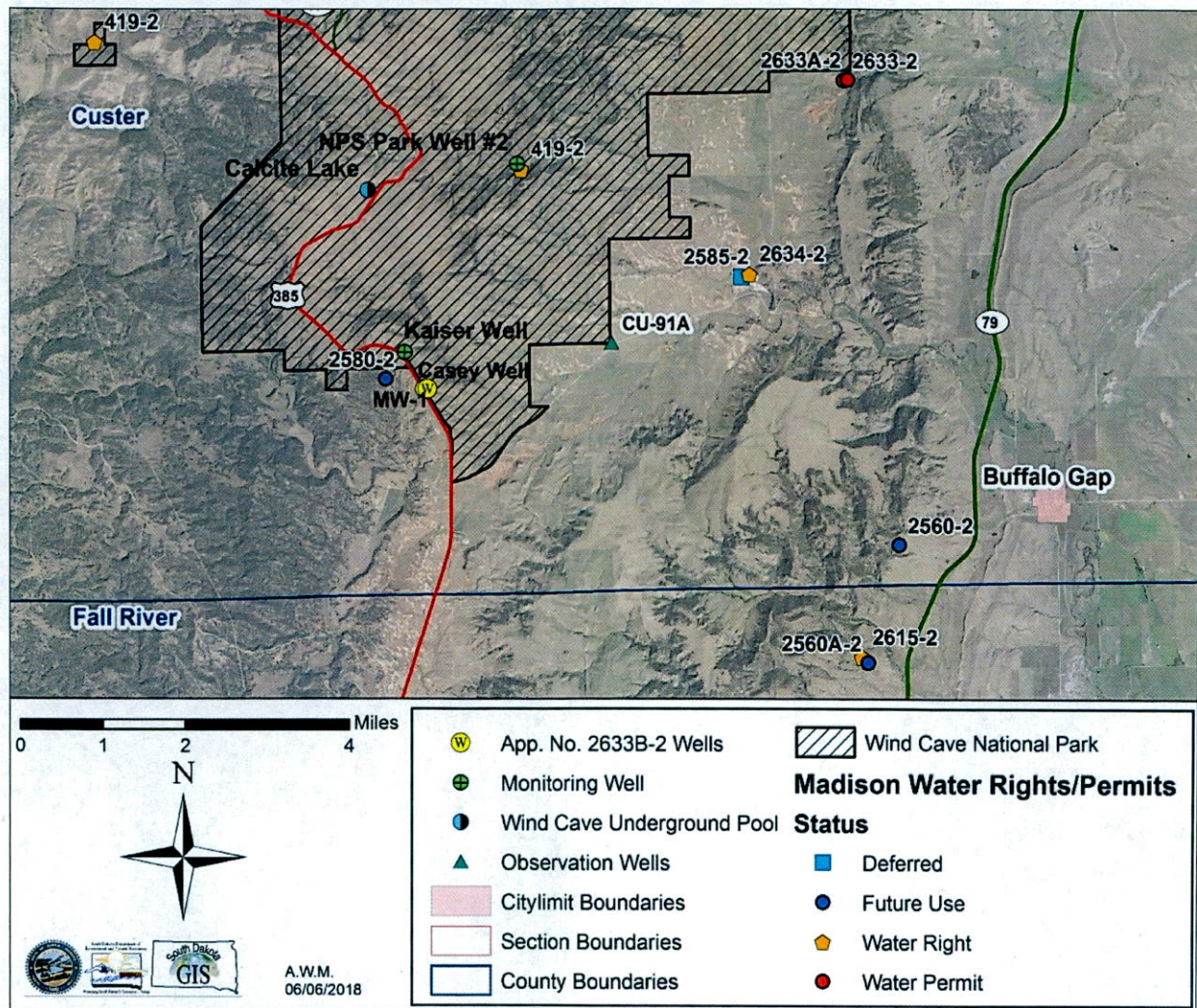


Figure 1- Map of project area included Madison aquifer water rights/permits, future use permits, and deferred application (Water Rights, 2018b), proposed wells and water level monitoring sites used for the aquifer pumping test (LBG, 2018), and Madison aquifer observation well (Water Rights, 2018a)

Table 1- Water rights/permits, future use permits, and deferred applications shown in Figure 1 (Water Rights, 2018b)

PERMIT NO.	NAME	COUNTY	STATUS	USE	CFS	ACRES	PERMITTED VOLUME (AC-FT)
419-2	WIND CAVE NATIONAL PARK	CU	LC	COM /IRR	0.15	6	18
2560-2	FALL RIVER WATER USERS DISTRICT	FR	FU	RWS	N/A	N/A	358
2560A-2	FALL RIVER WATER USERS DISTRICT	FR	FU	RWS	N/A	N/A	0
2580-2	SOUTHERN BLACK HILLS WATER SYSTEM	FR	FU	RWS	N/A	N/A	1,474
2585-2	SOUTHERN BLACK HILLS WATER SYSTEM	CU	DF	RWS	2.67	N/A	1,600
2615-2	FALL RIVER WATER USERS DISTRICT	FR	LC	RWS	0.07	N/A	42
2633-2	SOUTHERN BLACK HILLS WATER SYSTEM	CU	PE	RWS	0.67	N/A	484
2633A-2	SOUTHERN BLACK HILLS WATER SYSTEM	CU	PE	RWS	N/A	N/A	N/A
2634-2	STREETER FAMILY LIMITED PARTNERSHIP	CU	LC	RWS	0.243	N/A	N/A
CU= Custer, FR= Fall River, LC= Water Rights, FU= Future Use, DF= Deferred, PE, Water Permit, COM= Commercial, IRR= Irrigation, RWS= Rural Water System							

A site specific aquifer transmissivity, T , was determined to be approximately 98,000 ft^2/day based on the water level measurements recorded during the aquifer pumping test and calculated using the Moench (1984) solution. Using the empirical relationship between specific capacity, gpm produced from a pumped well per foot of drawdown in that well (Driscoll, 1986), the specific capacity of the Casey well during the aquifer pumping test, 111 gpm/ft, yielded a transmissivity of approximately 29,700 ft^2/day . These two transmissivity values are different because they method used to calculate them are different, even though they were calculated from the same data set. Published transmissivity values as listed in Carter and others (2001a) shows transmissivity values for the Madison aquifer can range from near zero to 56,000 ft^2/day . LBG (2018) stated while the larger transmissivity value calculated from the pumping test appears relatively high when compared to published transmissivity values for the Madison aquifer that transmissivity value is “reasonably consistent with transmissivity values for a confined karst aquifer located in an area where there are many large deformational features”. While the transmissivity value calculated from the aquifer pumping test exceeds currently published values for Madison aquifer transmissivity, the potential for significant fractures and solution cavities in the area of the Casey well and the physics of water flow through a karst aquifer like the Madison aquifer means the transmissivity value (98,000 ft^2/day) as calculated is reasonable.

Storativity, also known as storage coefficient or coefficient of storage, of an aquifer is a measure of how much water can be released from an aquifer per unit surface area per unit reduction of hydraulic head of the aquifer. Because no drawdown that could be attributed to pumping the Casey well was measured in any of the three monitoring wells, a storativity was not determined. Storativity is not valid for a pumping well and thus requires measureable drawdown in at least one monitoring well to be calculated. Long and Putnam (2002) published storativity values for the Madison aquifer ranging from 1.4×10^{-5} to 2×10^{-3} . LBG (2018) stated that based on the recorded water levels during the pumping test and the likely extensive solution cavities in the Madison aquifer in this area, the storativity could potentially be greater than 2×10^{-3} . Based on the data collected during the aquifer pumping test, it is reasonable to assume the storativity of the Madison aquifer at the Casey well site is near or greater than 2×10^{-3} .

LBG (2018) reported the water quality samples taken from the Casey well show the water is of good quality with no parameters exceeding the primary or secondary MCLs (maximum contaminant level). Additionally, total coliform and e. coli bacteria were absent from the water samples. The water samples were sent to MidContinent Testing Laboratories in Rapid City to be tested for drinking water quality parameters. MidContinent Testing Laboratories is certified for testing drinking water quality parameters. Based on the analysis of the data collected during the aquifer pumping test, LBG (2018) concluded the water from the Madison aquifer is of good quality to be used by Southern Black Hills Water System, there is a reasonable probability unappropriated water is available for use by Southern Black Hills Water System, and that at the location of the Casey well and MW-1 a diversion can be made at a maximum instantaneous diversion rate of 300 gpm (0.67 cfs) without unlawfully impairing existing water rights.

SOUTH DAKOTA CODIFIED LAW (SDCL) 46-2A-12 AND 46-5-30.4

An existing water right/permit may be amended pursuant to SDCL 46-2A-12 and 46-5-30.4 to change use, point of diversion, or other changes so long as the changes do not increase the rate of diversion, increase the volume of water appropriated under the original water right/permit, and only if the change does not unlawfully impair existing rights, is a beneficial use and is in the public interest. This application is to amend Water Permit No. 2633A-2 to change the point of diversion and add an additional well. Therefore, water availability does not need to be considered. However in recognition of the controversy involving development of the Madison aquifer for rural water systems in the southern Black Hills area, the availability of unappropriated water will be included in this report.

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 this 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 effects on existing rights from the aquifer that are pertinent to this application.

WATER AVAILABILITY

This application proposes to appropriate water from the Madison aquifer. The probability of unappropriated water available from the 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. An application may be approved, however, for withdrawals of groundwater from any groundwater formation older than or stratigraphically lower than the greenhorn formation in excess of the average estimated annual recharge for use by water distribution systems.”

The Madison aquifer is stratigraphically lower/older than the Greenhorn Formation and the applicant is a water distribution system as defined in SDCL 46-1-6(17). Therefore, a comparison of average annual recharge and average annual withdrawals from the Madison aquifer does not need to be performed for this application. However, the availability of unappropriated water will be included in this report in recognition of the history of controversy involving development of the Madison aquifer for rural water system use.

Hydrologic Budget

Recharge

The Madison aquifer is recharged through infiltration of precipitation and through streamflow losses on the outcrop area. Carter and others (2001a) estimated the combined average annual recharge through streamflow losses and precipitation to the Madison and Minnelusa Aquifers to be 249,211 ac-ft/yr. They went on to say that about 55 percent (137,066 ac-ft/yr.) of the recharge went to the Madison aquifer and 45 percent (112,145 ac-ft/yr.) entered the Minnelusa aquifer (Carter et al, 2001a). Carter and others (2001a) stated that both aquifers received approximately the same precipitation recharge, but the Madison aquifer presumably received a slightly higher percentage of streamflow loss recharge due to its outcrop area being upgradient of the Minnelusa Formation's outcrop area.

Withdrawals:

Discharge from the Madison aquifer occurs through pumping of wells, and flow from headwater and artesian springs (Carter et al, 2001a). There are 151 water rights/permits authorized to withdraw water from the Madison aquifer, 8 future use permits reserving water from the Madison aquifer, 1 deferred application (Deferred Application No. 2585-2 for Southern Black Hills Water System), and 3 applications held in abeyance (Application No. 2685-2 for Powertech (USA) Inc, Application No. 1971-1 for DC Booth Fish Hatchery, and Application No. 2788-2 for Southern Black Hills Water System) that propose to use water from the Madison aquifer.

The majority of the water use is for non-irrigation purposes. Historically, the average annual water use by non-irrigation appropriations limited by instantaneous diversion rate has been less than 60 percent of full time pumping at the permitted diversion rate. The estimated average annual use by appropriations limited only by maximum diversion rate is less than 23,000 ac-ft/yr.

There are also water rights/permits limited by an annual volume. It is assumed that permits limited by an annual volume will eventually develop the full volume. Appropriations limited by an annual volume are estimated to pump approximately 20,850 ac-ft/yr., which includes the use authorized by Water Permit No. 2366A-2. Future use permits reserve 12,189 ac-ft/yr. Deferred Application No. 2585-2 for Southern Black Hills Water System was deferred for the assessment of the potential impacts to Beaver Creek and the cave pools of Wind Cave National Park. If Deferred Application No. 2585-2 were to be approved it would be limited to pumping a maximum of 1,600 ac-ft/yr. Combined, the estimated average annual non-irrigation pumpage plus future use reservation and the deferred appropriation volume is 57,639 ac-ft/yr.

Application No. 1971-1 is held in abeyance per the request of the U.S. Fish and Wildlife Service. If it were to be approved, Application No. 1971-1 would be limited to pumping 3,226 ac-ft/yr. Application No. 2685-2 for Powertech (USA) Inc is held in abeyance at the request of the applicant while the applicant completes the required federal permitting process. If approved as is, Application No. 2685-2 would be limited to pumping 888.8 ac-ft/yr. Application No. 2788-3 is held in abeyance per the request of the applicant pending approval of this application. If this application is approved, Application No. 2788-2 will be withdrawn. Application No. 2788-2 proposes to appropriate 480 ac-ft/yr. In total, the Madison aquifer applications held in abeyance propose to appropriate 4,594.8 ac-ft/yr.

There are 32 water rights/permits that include irrigation as a permitted water use. Kilts (2017) thoroughly examined the historic irrigation use from the Madison aquifer. Kilts (2017) calculated the estimated average annual use for irrigation purposes to be 1,035.7 ac-ft/yr. Since completion of Kilts' (2017) review, more irrigation data has not become available. However, Water Permit No. 2773-2 for Arrowhead Country Club has been approved for the irrigation of 100 acres. Assuming the maximum application rate, two feet of water on each acre, Water Permit No. 2773-2 will pump 200 ac-ft/yr. The sum of the potential use under Water Permit No. 2773-2, and the historic average annual irrigation use is 1,235.7 ac-ft/yr.

Carter and others (2001b) estimated average domestic and livestock water use from the Madison aquifer during water years 1987 to 1996 at about 2.25 percent of well withdrawals. This relatively small percentage is likely due to the high cost of constructing a Madison aquifer well except near the outcrop, and that once away from the outcrop area there are typically other overlying aquifers. Using Carter and others (2001b) estimated percentage of total pumping, domestic use from the Madison aquifer is expected to be less than 1,300 ac-ft/yr.

Hydrologic Budget

Carter and others (2001a) estimated the average annual recharge to the Madison aquifer to be 137,066 ac-ft/yr. The estimated non-irrigation appropriative use plus future use reservations plus potential use by a deferred application, and the applications held in abeyance water use is expected to be less than 62,300 ac-ft/yr. The average annual irrigation use plus maximum potential use of a new water permit is 1,235.7 ac-ft/yr. Domestic use from the Madison aquifer is expected to be less than 1,300 ac-ft/yr. That is a total of 64,835.7 ac-ft/yr., which is less than half of the estimated average annual recharge. This shows that on the whole the Madison aquifer is a huge resource that can likely sustain additional appropriation.

Localized Hydrologic Budget

Carter and others (2001b) developed hydrologic budgets for the Madison and Minnelusa aquifers combined in the Black Hills area for water years 1987 to 1996, and broke down both aquifers into nine sub-areas based on hydraulic flow paths to minimize flow across boundaries. The well sites proposed by this application are located in sub-area 7, as is the well site authorized by Water Permit No. 2633A-2 (Carter et al, 2001b). The hydrologic budget for this subarea was balanced from 1987-1996, by estimating the outflow from the subarea was through artesian springflow (9.6 cfs on average), groundwater outflow (0.9 cfs on average), or well withdrawals (0.1 cfs on average) (Carter et al, 2001b). The estimates used for well withdrawals show the aquifer was relatively untapped at the time the report was written. There has been some development since then. The current estimate for well withdrawals would likely be in the range of 0.5 to 1 cfs based on the current level of appropriative development in this sub-area (Water Rights, 2018b). Currently, there are future use permits reserving up to 1,832 ac-ft/yr. for this sub-area. It should be noted Future Use Permit No. 2580-2 reserves a total of 1,474 ac-ft/yr. at four sites with only one of the sites in sub-area 7 as described in Carter and others (2001b). There is also a Deferred Application No. 2585-2 which applied for a total of 1,600 ac-ft/yr. from this sub-area.

Changes to the hydrologic budget in this sub-area (i.e. an increase in well withdrawals) will result in a change of the dynamic equilibrium of the sub-area. In short, a change of one component requires an equal change of one or more other components of the hydrologic budget. That means an increase in well withdrawals would require inducing more Madison groundwater inflow or reducing Madison groundwater outflow or reducing artesian springflow or some combination thereof. Streamflow and precipitation recharge are independent of the other components and development would not directly affect either. It can be assumed that with a very subtle change in the hydraulic gradient at either the inflow zone of the sub-area, which is within approximately two miles of the well sites, or the outflow area would establish a new dynamic equilibrium with unmeasurable impacts to the amount of water in storage or the artesian springflow. Development of this application is expected to induce more groundwater inflow and have minimal impact on the localized hydrologic budget.

Observation Well Data:

Administrative Rule of South Dakota Section 74:02:05:07 requires that the Water Management Board shall rely upon 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 average annual recharge of the aquifer.

The DENR-Water Rights Program monitors 25 observation wells completed into the Madison aquifer (Water Rights, 2018a). Figures 2, 3, 4, and 5 show the hydrographs for CU-91A, FR-95A, FR-92A, and CU-93A, respectively. Observation wells CU-91A, FR-95A, FR-92A, and CU-93A are 2.3 miles east, 5.7 miles south, 13 miles southwest, and 16.3 miles northeast of the wells this application proposes to use.

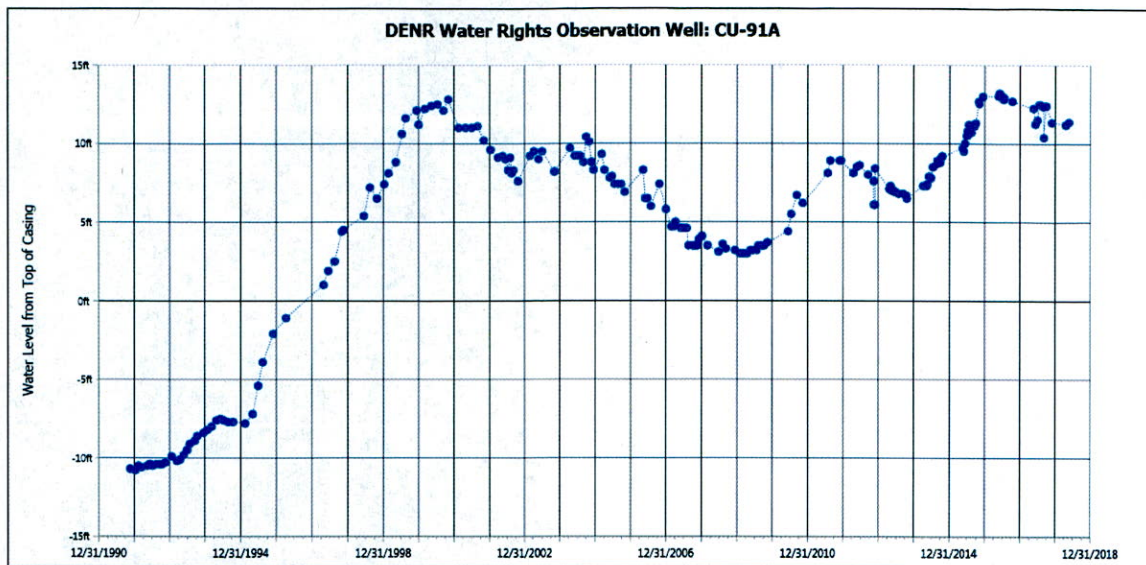


Figure 2- Hydrograph for DENR observation well CU-91A, located approximately 2.3 miles east of the applicant's well sites (Water Rights, 2018a)

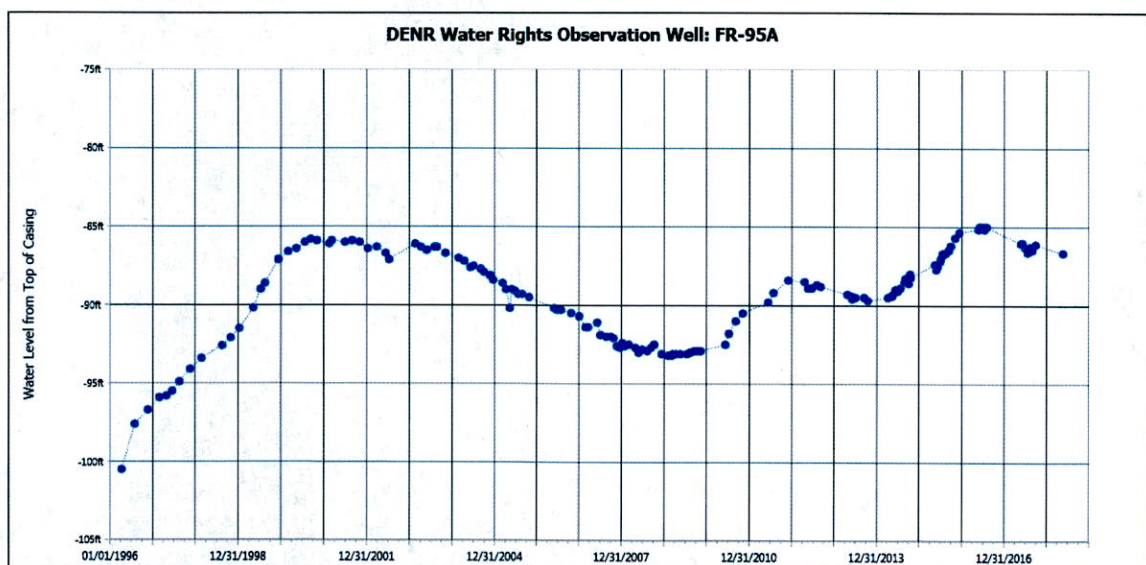


Figure 3- Hydrograph for DENR observation well FR-95A, located approximately 5.7 miles south of the applicant's well sites (Water Rights, 2018a)

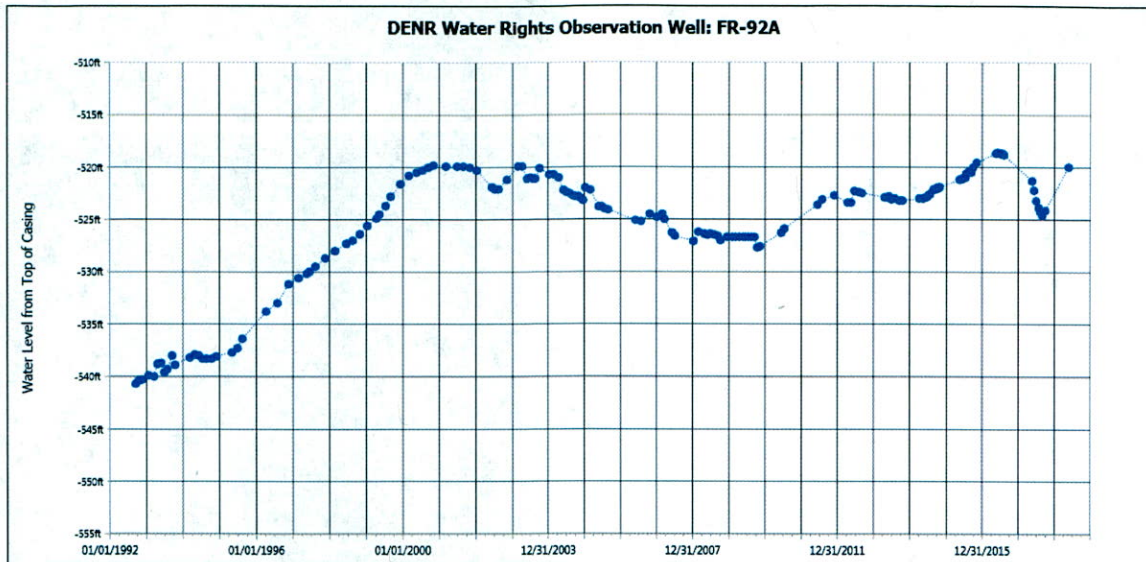


Figure 4- Hydrograph for DENR observation well FR-92A, located approximately 13 miles southwest of the applicant's well sites (Water Rights, 2018a)

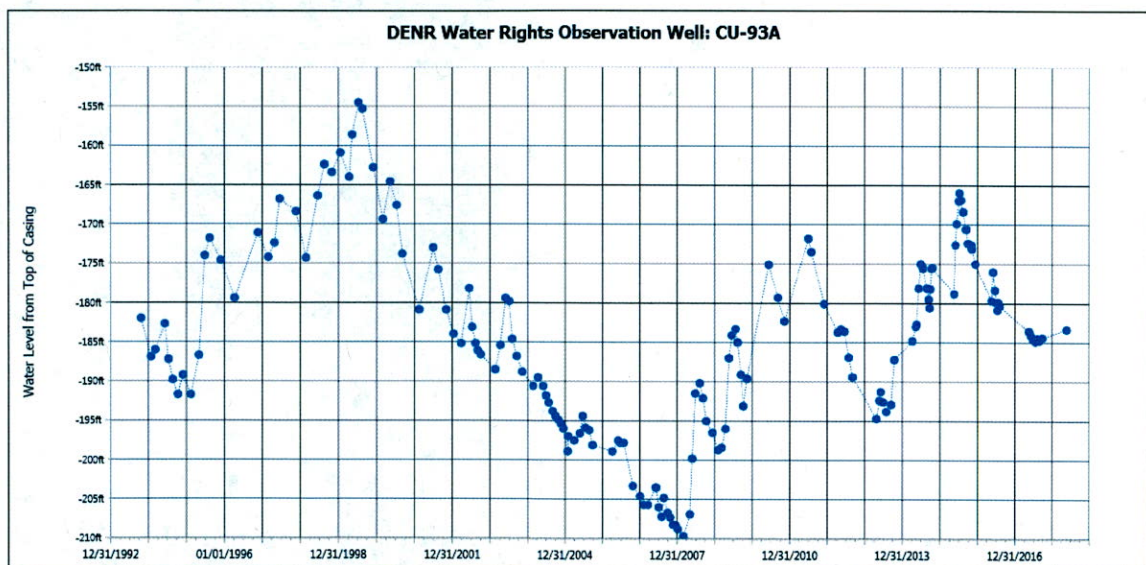


Figure 5- Hydrograph for DENR observation well CU-93A, located approximately 16.3 miles northeast of the applicant's well sites (Water Rights, 2018a)

These four hydrographs are representative of the hydrographs for the other DENR Madison aquifer observation wells. The hydrographs show the aquifer's response to climatic condition and clearly demonstrates the aquifer receives recharge. The water levels rise during wetter periods and slowly decline during drier periods. Any effects on the water levels of the aquifer caused by pumping are temporal. Overall, the effects of climatic conditions dominate changes in water levels in the Madison aquifer. This means recharge to and natural discharge from the aquifer significantly exceeds well withdrawals. Recognizing natural discharge along with recharge can be captured for pumping, the observation well data document there is unappropriated water available for this proposed appropriation. The observation well data supports the hydrologic budget data.

EFFECTS ON EXISTING WATER RIGHTS

Water right/permit wells and domestic wells completed into aquifers that are stratigraphically above or below the Madison aquifer are not expected to be affected by Madison aquifer withdrawals because the lower Minnelusa Formation and the lower Madison Limestone generally serve as upper and lower confining units for the Madison aquifer, respectively. As shown in Figure 6, the closest water right/permit, future use permit, or deferred application is Future Use Permit No. 2580-2 for Southern Black Hills Water System. Future Use Permit No. 2580-2 reserves a total of 1,474 ac-ft/yr. to be put to use at up to four locations for Southern Black Hills Water System (Water Rights, 2018b). This location is called the Gobbler Pass Site (Buhler, 2006) and it is approximately 0.5 miles west of the Casey and MW-1 well sites. The next closest water right/permit diversion point is a well authorized by Water Right No. 419-2 for Wind Cave National Park which is approximately 2.9 miles northeast of the Casey and MW-1 well sites (Water Rights, 2018b). There are also a number of domestic wells on file within two miles of the Casey and MW-1 well sites that appear to be completed into the Madison aquifer (Water Rights, 2018c).

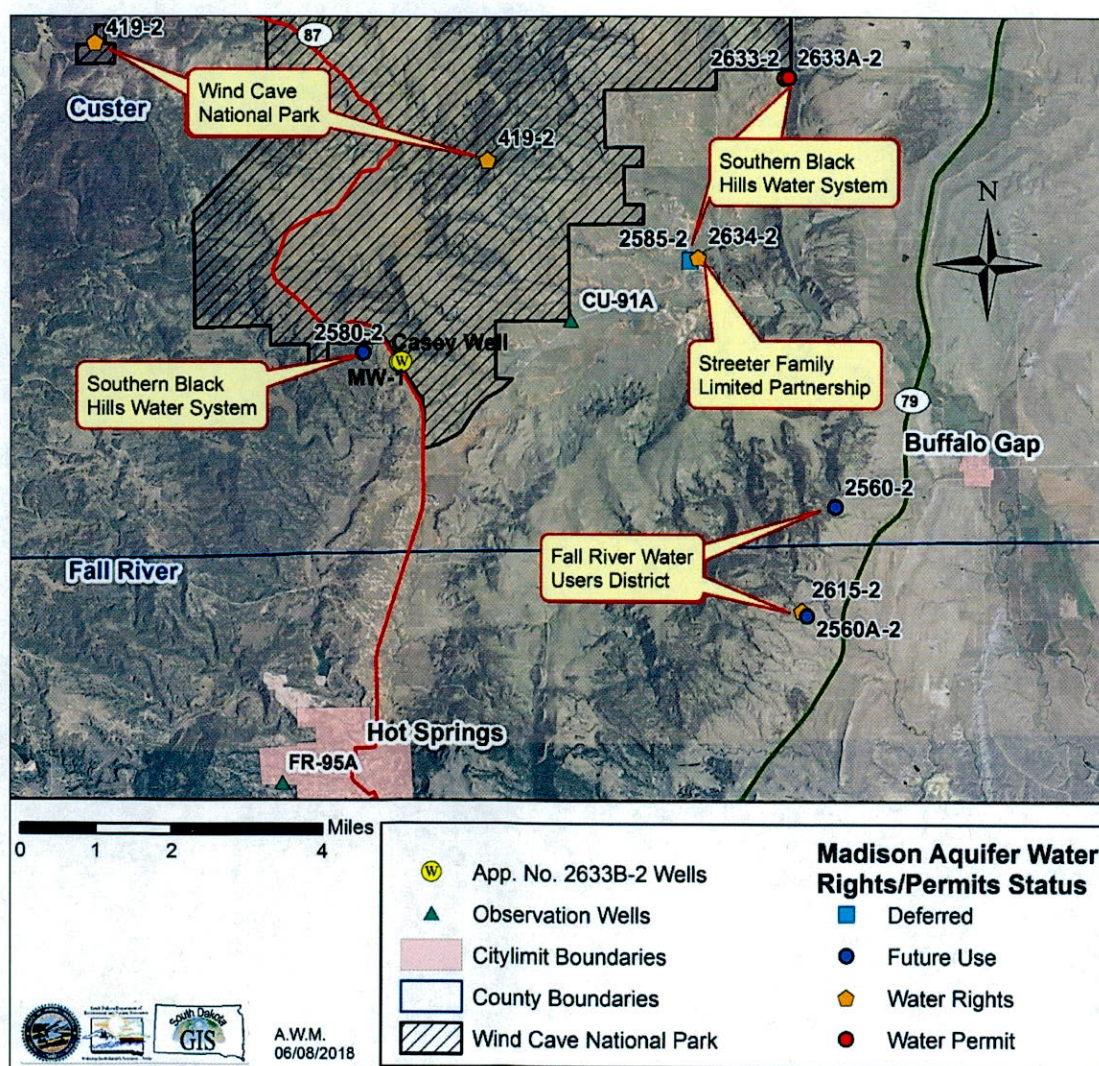


Figure 6- Map of project area with Madison aquifer water rights/permits including status and permit holder (Water Rights, 2018b) and observation wells (Water Rights, 2018a)

At the proposed well site, the Madison aquifer is under confined conditions. Generally, that means the water level of the aquifer can be subject to fairly significant fluctuations in water level caused by natural conditions (see Figures 2, 3, 4, and 5). While the drawdown created by pumping a well completed into a confined aquifer may extend a considerable distance from the pumped well, the aquifer pumping test conducted by Leggette, Brashears & Graham (LBG, 2018) showed that pumping the Casey Well at 267 gallons per minute (gpm) for approximately 95 hours produced no measureable drawdown in a monitoring well 129 feet away. However, the aquifer characteristics of the Madison aquifer can vary considerably within a short distance (Greene, 1993). This means drawdown caused by pumping a well may not necessarily be the same in all directions from the pumped well and longer term pumping (i.e. years) may cause measureable drawdown in nearby wells completed into the Madison aquifer.

While the Theis equation is primarily for use in determining drawdown in a porous media (i.e. sand and gravel) aquifer, it can provide some insight into potential drawdown caused by pumping a well completed into the Madison aquifer (a karst limestone). Assuming a transmissivity of 29,700 ft²/day, a storativity of 10⁻⁵, and diversion rate of 0.67 cfs, the estimated drawdown 129 feet away from the pumping well after one year of continuous pumping is estimated to be 2.19 feet and after 10 years of continuous pumping the drawdown 129 feet away from the pumped well increases to 2.55 feet (Utah Division of Water Rights, 2018). The transmissivity used in the estimate is the lower of the two values calculated by LBG (2018) and the storativity is on the low end of published values listed by Long and Putnam (2002). The drawdown estimates from the Theis equation show that drawdown is likely not to be significant and not likely to unlawfully impair adequate domestic wells or adequate wells for existing water rights/permits. Furthermore, the Theis equation drawdown estimates are significantly less than the historic amplitude of water level changes as shown in the Madison aquifer hydrographs in Figures 2, 3, 4, and 5.

At Casey and MW-1 well sites, there was more than 400 feet of artesian head pressure at the time of completion for each well. South Dakota Codified Law (SDCL) 46-6-6.1 does not necessarily protect artesian head pressure as a means of delivery, and the Water Management Board has recognized that to place water to maximum beneficial use, a certain amount of drawdown may occur. In order to balance interests between irrigation use and delivery of water by artesian head pressure, the Water Management Board defined an “adversely impacted domestic well” in Administrative Rule of South Dakota (ARSD) 74:02:04:20(7) 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”.

The Water Management Board considered the delivery of water by artesian head pressure versus maximum beneficial use of water issue for Water Right No. 2313-2 for Coca-Cola Bottling Company of the Black Hills. The Water Management Board adopted Findings of Facts and Conclusions of Law that noted reservation of artesian head pressure for delivery of water would be inconsistent with SDCL 46-1-4 which states, “general welfare requires that the water

resources of the state be put to beneficial use to the fullest extent of which they are capable...” (Water Rights, 1995). Furthermore, the Water Management Board found if increased cost or decreased production as a result of impacts on artesian head pressure by legitimate users is to be considered an adverse impact it would also be in conflict with SDCL 46-1-4 (Water Rights, 1995). With that in mind, some existing well owners may need to lower their pumps to accommodate for deeper water levels. However, when considering the statute (SDCL 46-6-6.1), rule (ARSD 74:02:04:20(7)), the artesian head pressure, the distance between appropriative wells, and lack of measurable drawdown in the monitoring wells as shown by the data collected by LBG (2018) during the aquifer pumping test, well interference from this proposed diversion is not expected to cause an adverse impact. Furthermore, it should be noted that DENR-Water Rights Program Madison aquifer observation wells located in areas with large capacity municipal Madison aquifer wells (i.e.: Rapid City, Spearfish, and Sturgis) show drawdown from pumping has never been adverse. The drawdown has ranged from a few feet to tens of feet (Water Rights, 2018a). When this is considered against the natural amplitude of water level changes in the Madison aquifer (several tens of feet), it shows this proposed diversion is not likely to unlawfully impact existing users.

BENEFICIAL USE

The Water Management Board has determined in the past that use of water by a rural water system is a beneficial use.

PUBLIC INTEREST CONCERNS

Artesian Springs

The water from several springs in the southern Black Hills area contains geochemical and isotopic characteristics of the Madison aquifer (Whalen, 1994). Rahn and Gries (1973) classified these springs as Type 2 and stated the springs of this type do not dry up but serve as points of permanent discharge from the carbonate aquifer. Hot Brook Spring, Beaver Creek Spring, and Evans Plunge Spring are the large springs nearest to the wells the applicant intends to use. All are four to six miles away from the wells this application proposes to use. Some or most of the source water for these three springs is from the Madison aquifer (Naus et al, 2001).

The discharge rate of Beaver Creek Spring as measured by National Park Service staff is shown in Figure 7. Figure 7 shows that the discharge rate at Beaver Creek spring has varied from 8.46 to 16.2 cfs of the period of record (July 2009 through November 2016). The total amplitude of 7.74 cfs is more than 11 times greater than the maximum instantaneous diversion rate authorized by Water Permit No. 2633A-2 and proposed by this application (0.67 cfs).

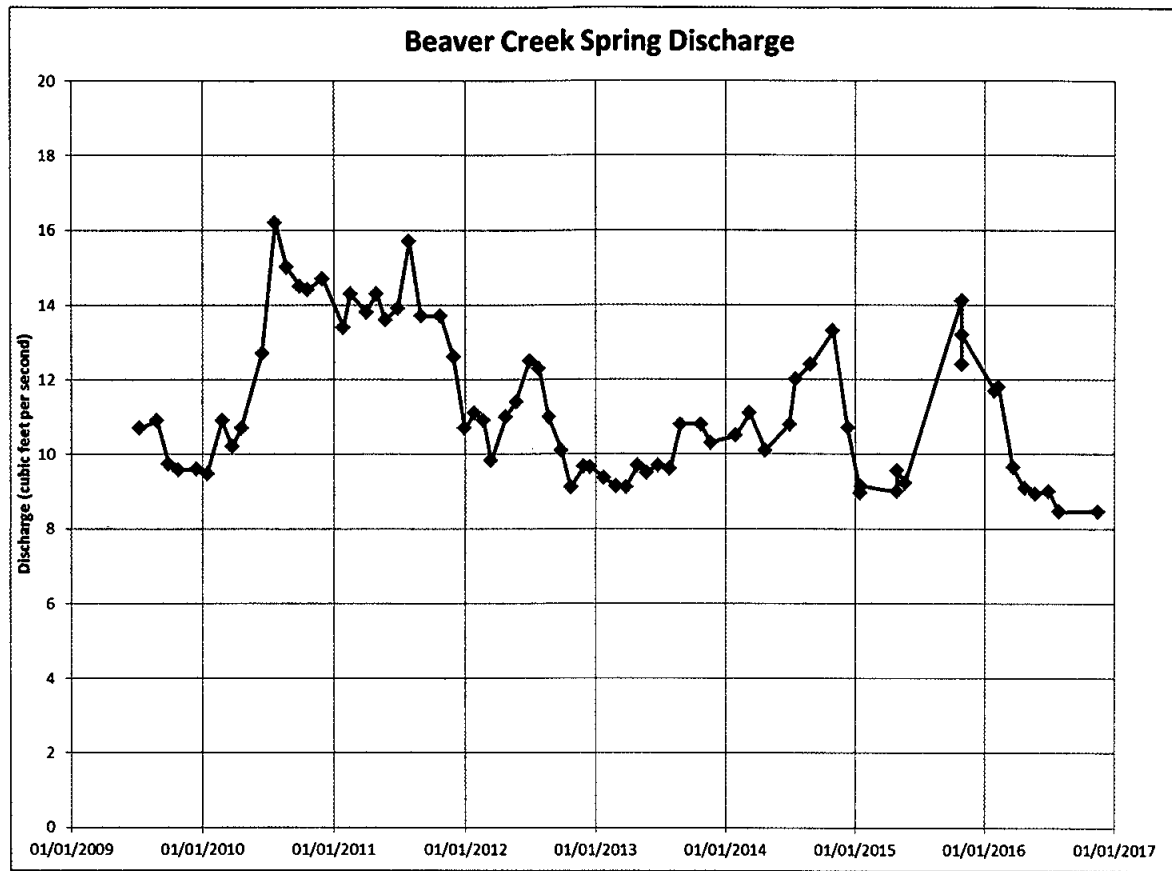


Figure 7- Beaver Creek Spring discharge measurement (NPS Continuous Water Data, 2018)

When considering Future Use Permit No. 2560-2 for Fall River Water User District, the Water Management Board accepted South Dakota Water Law does not protect artesian head pressure as a means of diversion and determined that well interference resulting in decreased discharge from these “artesian” springs could probably not be considered an adverse impact. However, the Board did recognize the “public interest” issues of decreased base flows in area streams that could result from decreased spring discharge as a result of well interference. The approval of Future Use Permit No. 2560-2 included a qualification that stated:

“At such time as definite plans are made to construct works and put the water reserved by this permit to beneficial use, specific application of all or any part of the reserved water must be submitted and approved prior to construction of facilities pursuant to SDCL 46-5-38.1 with particular attention given to the flows of Beaver [Creek] Spring, Cascade Springs and Hot Springs.” (Water Rights, 2018b)

The location of intended use for Future Use Permit No. 2560-2 is approximately three miles south of Beaver Creek Spring. Subsequently during consideration and eventual deferral of Application No. 2585-2 for Southern Black Hills Water System, the Water Management Board adopted a conclusion of law (No. 11) which states in part “The only protection South Dakota law provides when considering an application for an underground water permit for flow from an artesian spring is under the public interest criteria.” (Water Rights, 2018b).

The applicant's wells are approximately five miles west of Beaver Creek Spring. A fairly large change in the hydraulic gradient in the vicinity of a spring would be necessary to significantly affect the groundwater flow rates and consequently the spring's discharge. Given the distance between the applicants wells and the nearby springs (4 to 6 miles), the minimal drawdown expected from pumping this proposed diversion based on the aquifer pumping test, and the relatively low diversion rate requested by the applicant (0.67 cfs), it is unlikely that any drawdown caused by pumping this proposed diversion would have a measureable impact on spring discharge.

Wind Cave National Park

In the past, the National Park Service has intervened in matters of water permit applications from the Madison aquifer in the southern Black Hills area. Their primary concern was the potential effects on water levels of lakes and pools in Wind Cave that are hydraulically connected to the Madison aquifer caused by pumping new and existing water rights/permits. Buhler (2014) addressed the potential impacts from pumping the diversion proposed by Water Permit No. 2730-2. He noted that even though there was already development of Madison aquifer water rights/permits in the area the water levels in the lakes and pools within the park changed in a matter similar to the nearest DENR observation well, CU-91A (see Figure 2), which was following changes in climatic conditions. He noted that because of the distance, approximately 13 miles, and the natural fluctuation of the water level of the Madison aquifer as reflected in the water level of the lakes and pools, pumping authorized under Water Permit No. 2730-2 was not expected to impact the water level of the lakes and pools. The well sites for this application are approximately 2.5 miles southeast from the lakes and pools in Wind Cave National Park. A hydrograph of water elevation data for Calcite Lake in Wind Cave taken by an automatic recorder and manual readings along with the hydrograph for DENR observation well CU-91A is shown in Figure 8. The maximum amplitude of water level change in Calcite Lake and CU-91A across the respective periods of record is 21.27 and 24.02 feet, respectively. Furthermore, the water levels in the observation well and the cave pool follow the same shape. The changes in water level in the cave pool and the observation well are clearly controlled by climatic conditions and not by the effects of pumping. The analysis of the aquifer pumping test data, which included water levels from a lake in Wind Cave, show it is unlikely there will be any issues caused by pumping this proposed diversion.

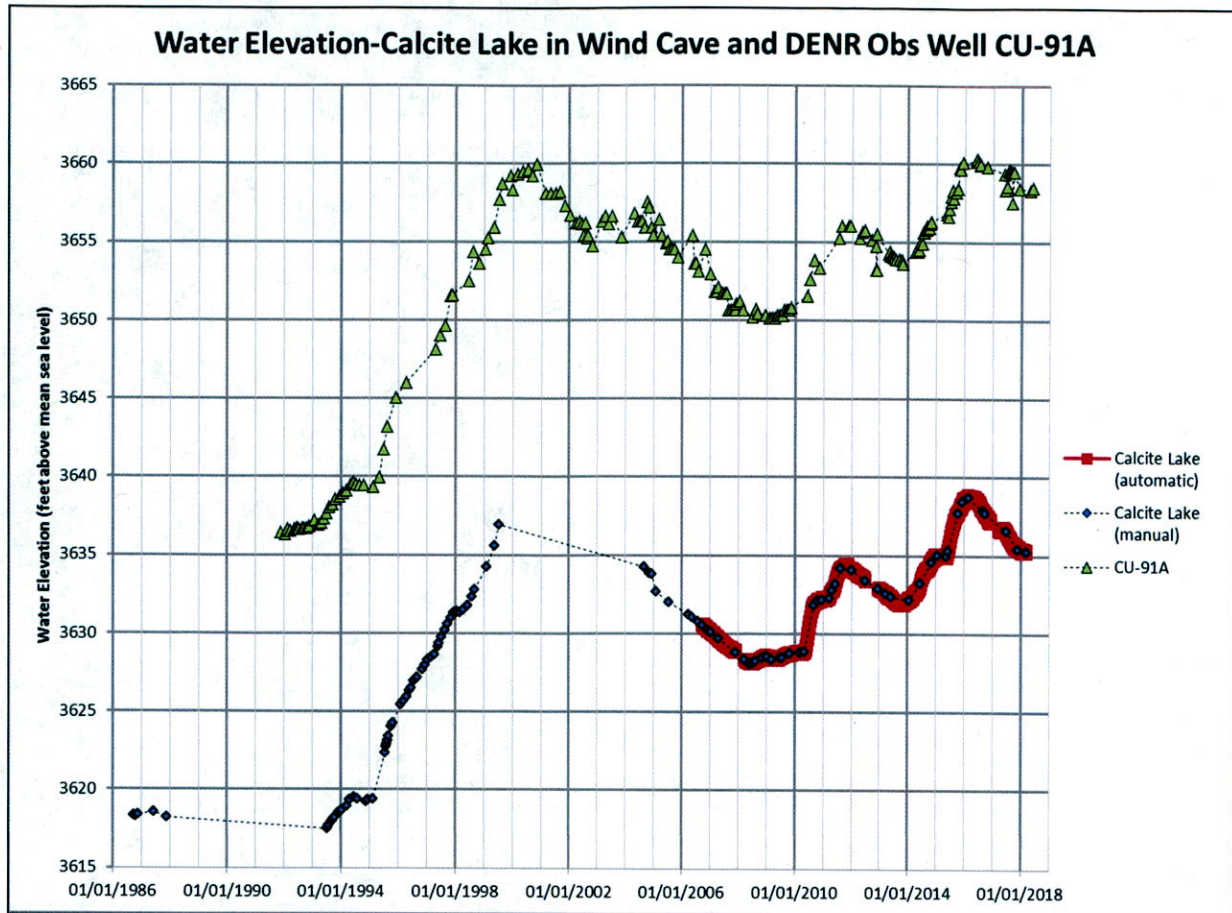


Figure 8- Water level data for Calcite Lake in Wind Cave both manual and automatic (NPS Continuous Water Data, 2018) and DENR observation well CU-91A (Water Rights, 2018a)

TERM LIMITATION:

In consideration of applications to withdraw water from the Madison aquifer in Butte, Fall River, Custer, Lawrence, Meade or Pennington Counties, SDCL 46-2A-20 requires:

“...no water permit for construction of works to withdraw water from the Madison formation in Butte, Fall River, Custer, Lawrence, Meade and Pennington counties may be issued for a term of more than twenty years, unless the water management board determines, based upon the evidence presented at a hearing that:

- (1) Sufficient information is available to determine whether any significant adverse hydrologic effects on the supply of water in the Madison formation would result if the proposed withdrawal were approved; and
- (2) The information, whether provided by the applicant or by other means, shows that there is a reasonable probability that issuance of the proposed permit would not have a significant adverse effect on nearby Madison formation wells and springs.”

Although the criteria for approval of a water permit reviewed (i.e.: there is a reasonable probability unappropriated water is available and this proposed diversion can be developed without unlawful impairment of existing rights) in this report as established in SDCL 46-2A-9

are met, evidence is not available to justify issuing this permit without a term limitation of 20 years.

CONCLUSIONS:

1. Application No. 2633B-2 proposes to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well to the one well authorized under Water Permit No. 2633A-2.
2. Water Permit No. 2633A-2 authorizes the appropriation of 484 ac-ft/yr. from one well completed into the Madison aquifer for rural water system use at a maximum diversion rate of 0.67 cfs.
3. The Madison aquifer is a viable aquifer and is found under confined conditions in the area of the proposed well site.
4. The applicant had a constant-rate aquifer pumping test conducted and analyzed by Leggette, Brashears & Graham, an engineering firm, to determine suitability for pumping at the well sites proposed by Application No. 2633B-3.
5. The methodology for completing the aquifer pumping test as well as for analyzing the data are sound and within published standard operating procedures for conducting a constant-rate aquifer pumping test.
6. The aquifer pumping test determined site specific aquifer transmissivity as well as measuring no drawdown at monitoring wells that can be attributed to pumping during the aquifer pumping test.
7. Based on the observation well data and a hydrologic budget, there is a reasonable probability unappropriated water is available for this proposed appropriation.
8. There is a reasonable probability the diversion proposed by this application can be made without adversely impacting existing appropriative or domestic users with adequate wells.
9. There have been public interest concerns in the past regarding artesian springs, and the lakes and pools in Wind Cave National Park with the development of Madison aquifer water rights/permits in the southern Black Hills area. Development of this proposed appropriation is not expected to impact the springs or cave pools.
10. This application should include the 20 year term limitation as required by SDCL 46-2A-20.


Adam Mathiowetz, PE
SD DENR-Water Rights Program

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**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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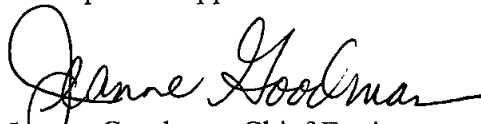
**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 2633B-2, Southern Black Hills Water System**

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. 2633B-2, Southern Black Hills Water System, c/o Don Peterson, Manager, 26858 Hwy 385, Hot Springs SD 57747.

The Chief Engineer is recommending APPROVAL of Application No. 2633B-2 pursuant to SDCL 46-5-30.4 with a 20 year term pursuant to SDCL 46-1-14 and 46-2A-20 because 1) the proposed diversion can be developed without unlawful impairment of existing rights, 2) the proposed use is a beneficial use and, 3) it is in the public interest with the following qualifications:

1. In accordance with SDCL 46-1-14 and 46-2A-20, Permit No. 2633B-2 is issued for a twenty year term. Pursuant to SDCL 46-2A-21, the twenty year term may be deleted at any time during the twenty year period or following its expiration. If the twenty year term is not deleted at the end of the term, the permit may either be cancelled or amended with a new term limitation of up to twenty years. Permit No. 2633B-2 may also be cancelled for nonconstruction, forfeiture, abandonment or three permit violations pursuant to SDCL 46-1-12, 46-5-37.1 and ARSD 74:02:01:37.
2. The wells 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 withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
3. Southern Black Hills Water System shall report to the Chief Engineer annually the amount of water withdrawn from the Madison aquifer.
4. Water Permit Nos. 2633-2, 2633A-2, and 2633B-2, combined appropriate up to 484 acre feet of water annually.
5. Southern Black Hills Water System under this permit shall control withdrawals from the well so there is not a significant effect on the water flow from Beaver Creek Springs or a significant adverse effect on the water quality and character in Beaver Creek Springs.

See report on application for additional information.


Jeanne Goodman, Chief Engineer
June 14, 2018

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA

COUNTY OF FALL RIVER

RECEIVED

JUL 02 2018

WATER RIGHTS
PROGRAM

I, Sara Pesch, office manager of the Hot Springs Star, being first duly sworn, on my oath, depose and say that the Hot Springs Star is a weekly legal newspaper for the publication of legal and other official notices, printed and published at Hot Springs, in Fall River County, South Dakota, in the English language and having a bonafide circulation of at least three hundred copies weekly and which said Hot Springs Star has been published within said county of Fall River County for more than fifty-two successive weeks prior to the publication of the attached notice, and printed in an office maintained in Hot Springs, the place of publication, and that I have personal knowledge of the fact of the publication of said notice as hereafter specified.

That a legal notice of which the annexed is a printed copy, cut from the said Hot Springs Star and to which reference is hereby made as part of this affidavit was regularly published in said weekly newspaper once each week for 1 successive weeks, the first of said weekly publications having been so made in said newspaper on the 20th day of June, 20 18; and the last of said weekly publications having been so made in said newspaper on the 20th day of June, 20 18; that the said notice was published in the regular and entire issue of every number of said newspapers during the time of publication; and that said published in the newspaper, and not in the supplement.

Sara Pesch

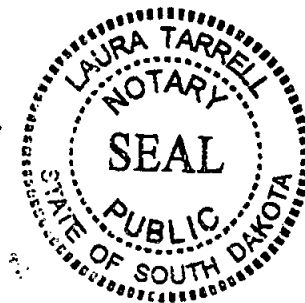
Subscribed in my presence and sworn to before me this

21 day of June, A.D., 20 18.

Laura Tarrell Notary Public

Printer's Fee \$ 167.21

Paid by _____



My Commission Expires
December 3, 2019

Legals

NOTICE OF APPLICATION NO. 2633A-2 to Amend Water Permit No. 2633A-2

Notice is given that Southern Black Hills Water System, c/o Don Peterson, Manager, 26858 Hwy 383, Hot Springs SD 57747 has filed an application to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually at a maximum pump rate of 0.67 cubic feet of water per second from one well to be completed into the Madison Aquifer located in the SE 1/4 SE 1/4 Section 35-T5S-R6E. This application requests the point of diversion be transferred to two Madison Aquifer wells (883 and 923 feet deep) located in the N 1/2 SE 1/4 Section 24-T6S-R5E which is approximately 6 miles southwest of the original well location. The second well will be a monitoring well but also, if needed, serve as an emergency backup well. This site is located approximately five miles north of Hot Springs. The rural water system serves users in Custer, Fall River and Pennington counties.

SDCL 46-2A-4(10) provides that "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 Chief Engineers recommendation and no hearing may be held before the board, unless the Chief Engineer makes a finding that an application, even if uncontested, presents important issues of public policy or public interest that should be heard by the board." In this case, the Chief Engineer finds that this application presents important issues of public interest that should be heard by the Water Management Board.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends Approval of Application No. 2633B-2 pursuant to SDCL 46-5-30.4 with a 30 year term pursuant to SDCL 46-1-14 and 46-2A-20 because 1) the proposed diversion can be developed without unlawful impairment of existing rights; 2) the proposed use is a beneficial use; and 3) 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 Granlund for this information, or other information, at the Water Rights Program address provided below.

The Water Management Board will consider this application at 1:30 pm (central time) on July 12, 2018 in the Matthew Training Center, Joe Foss Bldg, 523 E. Capitol Ave., Pierre SD. The Chief Engineers recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application based on the facts presented at the public hearing.

Any interested person who intends to participate in the hearing shall file a petition to oppose or support the application and the petition shall be filed with BOTH the applicant and Chief Engineer. The applicant must also file a petition if opposed to the Chief Engineers recommendation. The Chief Engineers address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501 (605) 773-3352" and the applicants mailing address is given above. A petition filed by either an interested person or the applicant must be filed by July 2, 2018.

The petition may be informal, but shall be in writing and shall include a statement describing the petitioners interest in the application, the petitioners reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioners legal counsel, if legal counsel is obtained. The hearing is an adversary proceeding and any party has the right to be present at

Legals

The July 2, 2018 hearing date will be automatically delayed for at least 20 days upon written request to the Chief Engineer from the applicant or any person who has filed a petition to oppose or support the application. The request for an automatic delay must be filed by July 2, 2018. If an automatic delay is requested, the hearing will be rescheduled for a future Board meeting and personal notice will be provided to all petitioners regarding the time, date and location.

Notice is given to individuals with disabilities that this hearing is being held in a physically accessible place. Please notify the Department of Environment and Natural Resources at least 48 hours before the hearing if you have a disability for which special arrangements must be made at the hearing. The telephone number for making arrangements is (605) 773-3352.

Under SDCL 1-26-17(7) notices must state that "if the amount in controversy exceeds \$2,500.00 or if a property right may be terminated, any party to the contested case may require the agency to use the Office of Hearing Examiners by giving notice of the request to the agency no later than ten days after service of a notice of hearing issued pursuant to SDCL 1-26-17." This is a Notice of Hearing, service is being provided by publication, and the applicable date to give notice to the Chief Engineer is July 2, 2018. However, since this particular matter is a water permit application and not a monetary controversy in excess of \$2,500.00 or termination of a property right the Chief Engineer disputes the applicability of this provision and maintains that the hearing must be conducted by the Board.

As applicable, the following provides the legal authority and jurisdiction under which the hearing will be held and the particular statutes and rules pertaining to this application: SDCL 1-26-16 thru 1-26-28; SDCL 46-1-1 thru 46-1-9, 46-1-13 thru 46-1-16; 46-2-3.1, 46-2-9, 46-2-11, 46-2-17; 46-2A-1 thru 46-2A-12, 46-2A-14, 46-2A-15, 46-2A-20, 46-2A-21, 46-2A-23; 46-5-1.1, 46-5-2 thru 46-5-26, 46-5-30.2 thru 46-5-30.4, 46-5-31, 46-5-32 thru 46-5-34.1, 46-5-38 thru 46-5-39, 46-5-46, 46-5-47, 46-5-49; 46-6-1 thru 46-6-3.1, 46-6-6.1, 46-6-10, 46-6-13, 46-6-14, 46-6-21, 46-6-26; and Board Rules ARSD 24:02:01:01 thru 24:02:01:25.02; 24:02:01:33.01. Steven M. Pimmet, Secretary, Department of Environment and Natural Resources. Published once at an approximate cost of \$67.21

Affidavit of Publication

State of South Dakota)

)ss.

County of Custer)

Charles W. Najacht of said county, being duly sworn, on oath says that he is publisher of the Custer County Chronicle, a weekly newspaper printed and published in Custer City, said County of Custer and has full and personal knowledge of all the facts herein stated; that said newspaper is a legal newspaper and has a bona-fide circulation of at least two hundred copies weekly, and has been published within said County for fifty-two successive weeks next prior to the publication of the notice herein, mentioned, and was and is printed wholly or in part in an office maintained at said place of publication: that the

Water Rights Program
Notice of Application No. 2633B-2
Southern Black Hills Water System
a printed copy of which, taken from the paper in which the same was published, is attached to this sheet, and is made a part of this Affidavit, was published in said newspaper at least once each week for one successive week(s), on which said newspaper was regularly published, to wit:

June 20, 2018; _____;

_____; _____;

_____; _____;

_____; _____;

_____; _____;

the full amount of the fees for the publication of the annexed notice is \$ 59.26.

Charles W. Najacht

Subscribed and sworn to me before this 20th

of June, 20 18;

Norma Najacht

NOTARY PUBLIC

MY COMMISSION EXPIRES: May 5, 2024

NORMA NAJACHT

NOTARY PUBLIC
SOUTH DAKOTA

RECEIVED

JUN 25 2018

WATER RIGHTS
PROGRAM

Continued from previous page -

NOTICE OF APPLICATION

NO. 2633B-2 TO AMEND
WATER PERMIT NO. 2633A-2

Notice is given that Southern Black Hills Water System, c/o Don Peterson, Manager, 26858 Hwy 385, Hot Springs SD 57747 has filed an application to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually at a maximum pump rate of 0.67 cubic feet of water per second from one well to be completed into the Madison Aquifer located in the SE 1/4 SE 1/4 Section 35-T5S-R6E. This application requests the point of diversion be transferred to two Madison Aquifer wells (883 and 923 feet deep) located in the N 1/2 SE 1/4 Section 24-T6S-R5E which is approximately 6 miles southwest of the original well location. The second well will be a monitoring well but also, if needed, serve as an emergency backup well. This site is located approximately five miles north of Hot Springs. The rural water system serves users in Custer, Fall River and Pennington counties.

SDCL 46-2A-4(10) provides that "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 Chief Engineer's recommendation and no hearing may be held before the board, unless the Chief Engineer makes a finding that an application, even if uncontested, presents important issues of public policy or public interest that should be heard by the board." In this case, the Chief Engineer finds that this application presents important issues of public interest that should be heard by the Water Management Board.

Pursuant to SDCL 46-2A-2, the

Chief Engineer recommends Approval of Application No. 2633B-2 pursuant to SDCL 46-5-30.4 with a 20 year term pursuant to SDCL 46-1-14 and 46-2A-20 because 1) the proposed diversion can be developed without unlawful impairment of existing rights, 2) the proposed use is a beneficial use, and 3) 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.

The Water Management Board will consider this application at 1:30 pm (central time) on July 12, 2018 in the Matthew Training Center, Joe Foss Bldg, 523 E. Capitol Ave. Pierre SD. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application based on the facts presented at the public hearing.

Any interested person who intends to participate in the hearing shall file a petition to oppose or support the application and the petition shall be filed with BOTH the applicant and Chief Engineer. The applicant must also file a petition if opposed to 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 July 2, 2018.

The petition may be informal, but shall be in writing and shall 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. The hearing is an adversary proceeding and any

party has the right to be present at the hearing and to be represented by a lawyer. These and other due process rights will be forfeited if they are not exercised at the hearing and decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law.

The July 2, 2018 hearing date will be automatically delayed for at least 20 days upon written request to the Chief Engineer from the applicant or any person who has filed a petition to oppose or support the application. The request for an automatic delay must be filed by July 2, 2018. If an automatic delay is requested, the hearing will be rescheduled for a future Board meeting and personal notice will be provided to all petitioners regarding the time, date and location.

Notice is given to individuals with disabilities that this hearing is being held in a physically accessible place. Please notify the Department of Environment and Natural Resources at least 48 hours before the hearing if you have a disability for which special arrangements must be made at the hearing. The telephone number for making arrangements is (605) 773-3352.

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Steven M. Pirner, Secretary,
Department of Environment and
Natural Resources.

Published once at an approximate cost of \$59.26.

6/20

Affidavit of Publication

RECEIVED

JUN 22 2018

WATER RIGHTS
PROGRAM

June 20 L21087112

NOTICE OF APPLICATION NO. 2633B-2 to Amend Water Permit No. 2633A-2

Notice is given that Southern Black Hills Water System, c/o Don Peterson, Manager, 26858 Hwy 385, Hot Springs, SD 57747 has filed an application to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually at a maximum pump rate of 0.67 cubic feet of water per second from one well to be completed into the Madison Aquifer located in the SE 1/4 SE 1/4 Section 35-T5S-R6E. This application requests the point of diversion be transferred to two Madison Aquifer wells (883 and 923 feet deep) located in the N 1/2 SE 1/4 Section 24-T6S-R5E which is approximately 6 miles southwest of the original well location. The second well will be a monitoring well but also, if needed, serve as an emergency backup well. This site is located approximately five miles north of Hot Springs. The rural water system serves users in Custer, Fall River and Pennington counties.

SDCL 46-2A-4(10) provides that "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 Chief Engineer's recommendation and no hearing may be held before the board, unless the Chief Engineer makes a finding that an application, even if uncontested, presents important issues of public policy or public interest that should be heard by the board." In this case, the Chief Engineer finds that this application presents important issues of public interest that should be heard by the Water Management Board.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends Approval of Application No. 2633B-2 pursuant to SDCL 46-5-30.4 with a 20 year term pursuant to SDCL 46-1-14 and 46-2A-20 because 1) the proposed diversion can be developed without unlawful impairment of existing rights, 2) the proposed use is a beneficial use, and 3) 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 Granlund for this information, or other information, at the Water Rights Program address provided below.

The Water Management Board will consider this application at 1:30 pm (central time) on July 12, 2018 in the Matthew Training Center, Joe Foss Bldg, 523 E. Capitol Ave, Pierre SD. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application based on the facts presented at the public hearing.

Any interested person who intends to participate in the hearing shall file a petition to oppose or support the application and the petition shall be filed with BOTH the applicant and Chief Engineer. The applicant must also file a petition if opposed to 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 July 2, 2018.

The petition may be informal, but shall be in writing and shall include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the appli-

STATE OF SOUTH DAKOTA

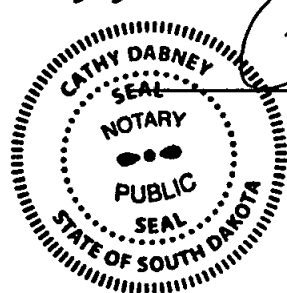
County of Pennington

SS:

Sheri Sponder being first duly sworn, upon his/her oath says: That he/she is now and was at all time hereinafter mentioned, an employee of the RAPID CITY JOURNAL, a corporation of Rapid City, South Dakota, the owner and publisher of the RAPID CITY JOURNAL, a legal and daily newspaper printed and published in Rapid City, in said County of Pennington, and has full and personal knowledge of all the facts herein stated as follows: that said newspaper is and at all of the times herein mentioned has been a legal and daily newspaper with a bonafide paid circulation of at least Two Hundred copies daily, and has been printed and published in the English language, at and within an office maintained by the owner and publisher thereof, at Rapid City, in said Pennington County, and has been admitted to the United States mail under the second class mailing privilege for at least one year prior to the publication herein mentioned; that the advertisement, a printed copy of which, taken from said Rapid City Journal, the paper in which the same was published, is attached to this sheet and made a part of this affidavit, was published in said paper once each day for one successive day, the first publication there of being on the 20th day of June 2018 that the fees charged for the publication there of are 139 dollars and 94 cents.

Sheri Sponder

Subscribed and sworn to before me this 20th day of June, 2018.



Cathy Dabney
Notary public

4-16-2024

My commission expires

cation, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained. The hearing is an adversary proceeding and any party has the right to be present at the hearing and to be represented by a lawyer. These and other due process rights will be forfeited if they are not exercised at the hearing and decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law.

The July 2, 2018 hearing date will be automatically delayed for at least 20 days upon written request to the Chief Engineer from the applicant or any person who has filed a petition to oppose or support the application. The request for an automatic delay must be filed by July 2, 2018. If an automatic delay is requested, the hearing will be rescheduled for a future Board meeting and personal notice will be provided to all petitioners regarding the time, date and location.

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Rules ARSD 74:02:01:01 thru 74:02:01:25.02; 74:02:01:35.01.

Steven M. Pirner, Secretary
Department of Environment and
Natural Resources.

(Published once at the total approximate
cost of \$139.94)

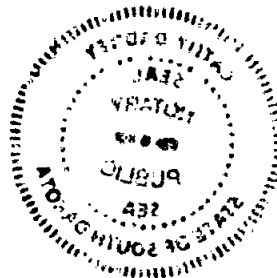
IN THE _____ COURT
COUNTY OF PENNINGTON

**Publisher's and Attorney's
Affidavit**

Filed in the office of _____ on
the _____ day of _____

20 _____

Attorney for _____



NOTICE OF APPLICATION NO. 2633B-2 to Amend Water Permit No. 2633A-2

Notice is given that Southern Black Hills Water System, c/o Don Peterson, Manager, 26858 Hwy 385, Hot Springs SD 57747 has filed an application to amend Water Permit No. 2633A-2 by transferring the point of diversion and adding an additional well. Water Permit No. 2633A-2 appropriates 484 acre-feet of water annually at a maximum pump rate of 0.67 cubic feet of water per second from one well to be completed into the Madison Aquifer located in the SE 1/4 SE 1/4 Section 35-T5S-R6E. This application requests the point of diversion be transferred to two Madison Aquifer wells (883 and 923 feet deep) located in the N 1/2 SE 1/4 Section 24-T6S-R5E which is approximately 6 miles southwest of the original well location. The second well will be a monitoring well but also, if needed, serve as an emergency backup well. This site is located approximately five miles north of Hot Springs. The rural water system serves users in Custer, Fall River and Pennington counties.

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Pursuant to SDCL 46-2A-2, the Chief Engineer recommends Approval of Application No. 2633B-2 pursuant to SDCL 46-5-30.4 with a 20 year term pursuant to SDCL 46-1-14 and 46-2A-20 because 1) the proposed diversion can be developed without unlawful impairment of existing rights, 2) the proposed use is a beneficial use, and 3) 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.

The Water Management Board will consider this application at 1:30 pm (central time) on July 12, 2018 in the Matthew Training Center, Joe Foss Bldg, 523 E. Capitol Ave. Pierre SD. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application based on the facts presented at the public hearing.

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Steven M. Pirner, Secretary, Department of Environment and Natural Resources. Published once at an approximate cost of_____.

Schlaak, Karen

From: Schlaak, Karen
Sent: Thursday, June 14, 2018 2:23 PM
To: sara.pesch@rapidcityjournal.com
Subject: 2633B-2, Southern Black Hills Water System
Attachments: 2366B-2public.wmb1.docx; FORM8.FRM.doc

Attached is a notice to be published on June 20, 2018 in the Hot Springs Star.

Southern Black Hills Water System, c/o Don Peterson, Mgr, 26858 Hwy 385, Hot Springs SD 57747 (605 745-4669) 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 to the Water Rights Program, 523 E Capitol, Pierre SD 57501.

Let me know if you have questions. Please acknowledge receipt of this email.

Karen Schlaak

SD DENR, Water Rights Program
(605) 773-3352



Schlaak, Karen

From: Schlaak, Karen
Sent: Thursday, June 14, 2018 2:24 PM
To: custerchronicle@gwtc.net
Subject: 2633B-2, Southern Black Hills Water System
Attachments: 2366B-2public.wmb1.docx; FORM8.FRM.doc

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Karen Schlaak
SD DENR, Water Rights Program
(605) 773-3352



Schlaak, Karen

From: Schlaak, Karen
Sent: Thursday, June 14, 2018 2:24 PM
To: RCY Legals (legals@rapidcityjournal.com)
Subject: 2633B-2, Southern Black Hills Water System
Attachments: 2366B-2public.wmb1.docx; FORM8.FRM.doc

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Karen Schlaak
SD DENR, Water Rights Program
(605) 773-3352





DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

denr.sd.gov

**NOTE: TO BE SURE OF PUBLICATION ON
THE CORRECT DATES, CONTACT
THE NEWSPAPERS RIGHT AWAY.**

June 14, 2018

Southern Black Hills Water System
c/o Don Peterson, Manager
26858 Hwy 385
Hot Springs SD 57747

Dear Mr. Peterson:

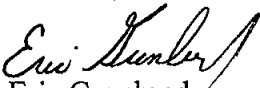
Water Permit Application No. 2633B-2 for rural water system use has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice has been sent to the following papers:

Hot Springs Star	605 745-4170
Custer County Chronicle	605 673-2217
Rapid City Journal	605 394-8300

You will need to contact the newspapers 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 newspapers to authorize publication of your Notice and to arrange for payment. Early contact with the papers 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.

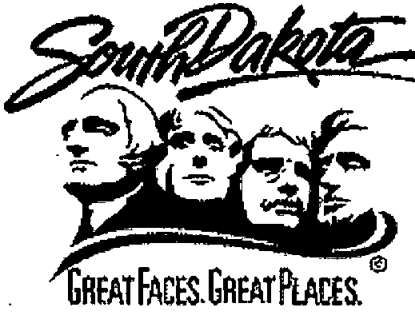
Sincerely,


Eric Gronlund
Natural Resources Engineer
(605) 773-3352

enclosures

c: Matthew E Naasz, Attorney

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.



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3182
<http://denr.sd.gov>

SEP 04 2018

Southern Black Hills Water System
c/o Don Peterson, Manager
26858 Hwy 385
Hot Springs SD 57747

Dear Mr. Peterson:

Enclosed is Water Permit No. 2633B-2 authorizing the transfer of the point of diversion, an additional well, 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, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures