

**Montana Bureau of Mines and Geology**  
**Final Technical Report for NGWMN Award G21AC10418-02**

**Miscellaneous Contribution 26**

**March 2025**

**John LaFave and James Madison**



Montana Bureau of Mines and Geology NGWMN Final Technical Report

Award Number: G21AC10418-02

Agency Name: Montana Bureau of Mines and Geology

Title: NGWMN Network: Improvements to Current Network, Increased Spatial Resolution, and Continuous Data Collection

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Term Covered: 08/01/2021–07/31/2024

Date of Final Report: March 21, 2025

## Background

The Montana Bureau of Mines and Geology (MBMG) maintains a statewide groundwater monitoring network to collect water-level and water-quality data from about 800 wells. Many of these wells are completed in principal aquifers, including the heavily developed intermontane basin aquifers in the west (S100NRMTIB), and the less intensively developed but widely used alluvial (N100ALLUVL), Lower Tertiary (N300LTRTRY), Upper Cretaceous (N300UPCTCS), Lower Cretaceous (N300LCRTCS), and Paleozoic aquifers (N500PLOZOC) in the east (Whitehead, 1996). The MBMG became a National Groundwater Monitoring Network (NGWMN) data provider in 2015 and, at the start of this project, provided water-level data for 224 sites and water-quality data for 58 sites.

In 2021, the MBMG submitted a proposal in response to Program Announcement/Funding Opportunity G21AS00008 to: (1) fill data gaps at 5 NGWMN wells (Objective 3); (2) drill a new nested well pair on the Blackfeet Reservation to fill an NGWMN spatial gap, and drill 2 replacement wells (Objective 5); and (3) replace 20 aging pressure transducers, and equip 5 existing NGWMN sites with transducers (Objective 6).

### Description of Work Done to Fill Data Gaps: Confederated Salish Kootenai Tribes Monitoring Wells—Objective 3

The work done under Objective 3 included inspecting and sounding five wells to confirm the total depth, obtaining GPS locations, and, where possible, performing downhole camera surveys to assess the well-casing and well-screen conditions. The wells are located on the Flathead Reservation and are part of the Confederated Salish Kootenai Tribes (CSKT) Water Resources Program that oversees water management on the Flathead Reservation. The CSKT is a long-time, active cooperator in the MBMG statewide groundwater monitoring network, and six CSKT wells are part of the NGWMN (fig. 1).

All the wells were inspected and located. However, obstructions (pump drop pipes) and/or small diameter ports or inaccessible caps prevented successful sounding and downhole camera surveys on most of the wells. A table summarizing the work is presented below. All GPS location data were uploaded into the NGWMN Registry and the MBMG GWIC database.

**Table 1. Objective 3 sites on the Flathead Reservation.**

<u>NGWMN-ID</u>	<u>Principal Aquifer</u>	<u>Aquifer Type</u>	<u>Well Depth</u>	<u>Inspect</u>	<u>GPS Location</u>	<u>Downhole Camera</u>
MBMG-6276	S100NRMTIB	UNCONFINED	80	X	X	X
MBMG-6283	S100NRMTIB	CONFINED	377	X	X	*
MBMG-76048	S100NRMTIB	CONFINED	295	X	X	*
MBMG-133880	S100NRMTIB	UNCONFINED	75	X	*	*
MBMG-703168	S100NRMTIB	CONFINED	307	X	X	*

*Note.* The sites are shown in figure 1; photographs and site details are presented below (figs. 2–6).

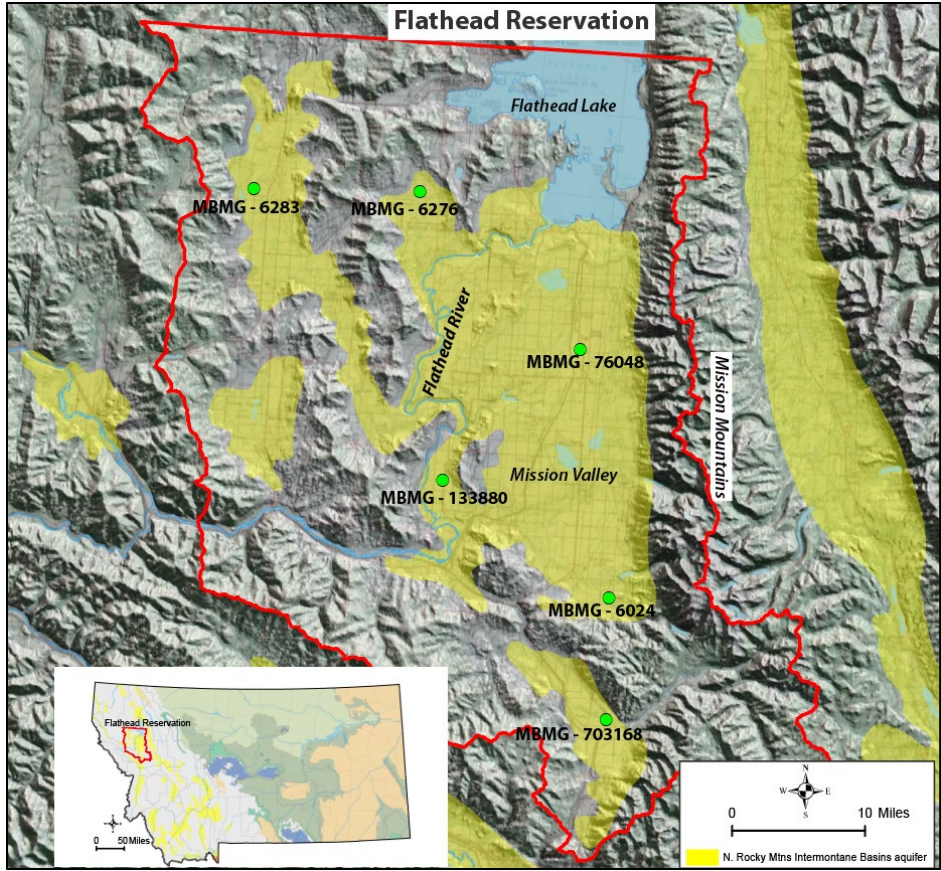


Figure 1. Location of the NGWMN wells on the Flathead Reservation; five sites were inspected under Objective 3.



Figure 2. MBMG-6276. This was the only well that could accommodate a downhole camera; the well was GPS surveyed and sounded.



Figure 3. MBMG-6283. The drop pipe could not be completely removed, preventing a downhole camera survey and sounding; the well was surveyed.



Figure 4. MBMG-76048. The well cap is welded on, preventing a downhole camera survey and sounding; the well was surveyed.



Figure 5. MBMG-133880. The well is located in the foundation of an old building. Pump and drop pipe are still in the well and could not be removed. Lack of cell coverage prevented successful GPS survey. Location updated with navigational GPS.



Figure 6. MBMG-76048. The well is only accessible through a small measuring port; well has a GPS location.

## **Description of Work Done Well Drilling: Gap Filling and Replacements—Objective 5**

The Objective 5 well drilling aimed to: (1) establish a nested well pair to fill a data gap in the alluvial (N100ALLUVL) and Upper Cretaceous (N300UPCTCS) aquifer systems in north-central Montana, and (2) replace two wells that monitor water levels in the Northern Rocky Mountains Intermontane Basins aquifer system (S100NRMTIB).

A nested well pair was targeted for the Blackfeet Reservation in north-central Montana to monitor the glacial–alluvial aquifer and the underlying upper Cretaceous Two Medicine Formation. In addition to filling an NGWMN spatial data gap, these wells will: (1) support the Blackfeet Nation in establishing a groundwater monitoring network to track changes in groundwater storage and recharge, and to monitor the effects of long-term climate variability on the Blackfeet Reservation, and (2) serve as a replacement USGS Climate Response Network (CRN) well for this climate region.

The two wells identified for replacement were vandalized and filled with debris, preventing water-level measurements. The first well (MBMG-6024, fig. 1) is 175 feet deep and located on the Flathead Reservation near the base of the Mission Mountains in the Mission Valley; it serves as a background-trend well and has been monitored since 1985. Its location provides a measure of mountain-front recharge from the Mission Mountains to the heavily used basin-fill aquifer in the Mission Valley. The other is a 75-foot-deep well in southwest Montana, near the city of Butte (MBMG-4719), that serves as a background-trend well and has been monitored since 1988. It tracks long-term changes in storage and recharge and is used to assess the effects of long-term and seasonal climate variability in the Summit Valley basin-fill aquifer, a headwaters basin for the Clark Fork River.

### Blackfeet Well Pair

MBMG staff met with representatives of the Blackfeet Nation Water Department (BNWD) and the USGS Wyoming–Montana Water Science Center to identify a suitable location on tribal land with permanent access. A site was agreed upon that is located about 21 miles NE of Browning, MT, 12 miles NW of Cutbank, MT, and 750 feet north of Cutbank Creek (fig. 7); the site is also close to the USGS stream gage (USGS 06098800) on Cut Bank Creek (fig. 8).



Figure 7. Location of well pair drilled on the Blackfoot Reservation to fill a spatial data gap.

Only one contractor, O’Keefe Well Drilling, responded to the “Invitation to Bid,” and the estimate was considerably higher than the proposed estimate; the per-foot drilling cost was bid at \$150/ft, more than double the proposal estimate of \$70/ft. These wells were a priority, so negotiations ensued, and the contractor eventually agreed to a \$100/ft cost. In October 2021, O’Keefe Well Drilling was awarded the contract.

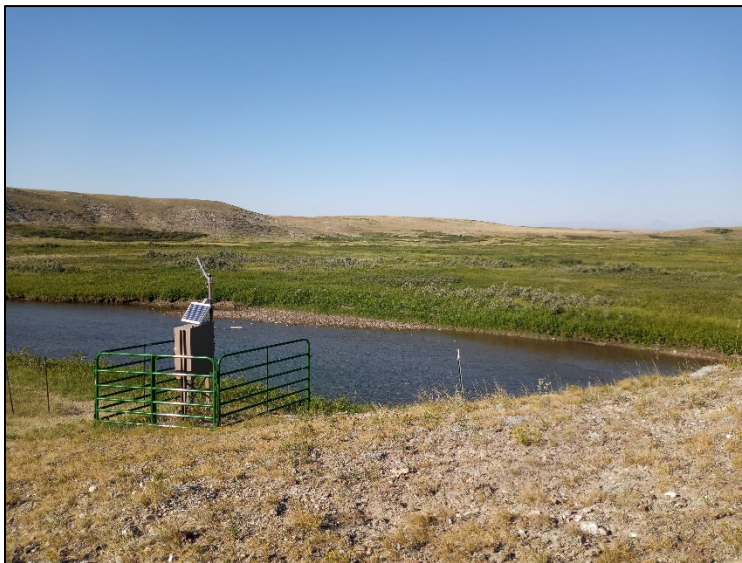


Figure 8. The well site is close to USGS gage 06098800 on Cut Bank Creek, MT.

Following the site and contractor selection, a Water Resource Permit, Aquatic Lands Protection Permit, TERO Business License were obtained, and a Cultural Survey completed. The permitting process took longer than expected and was not completed until early August 2022, and drilling started on August 16, 2022 (fig. 9).





Figure 9. Wells were drilled using a dual rotary rig.

The deeper of the nested wells was drilled first to a depth of 201 feet below land surface (bls). At 35 feet bls, the hole produced about 30 gallons per minute (gpm) with a specific conductance (SC) of 1,217  $\mu\text{S}/\text{cm}$ . Casing was advanced to seal off the productive zone. The hole was drilled dry with air to remove cuttings so as to be able to observe wet zones (fig. 10). From about 181 to 201 feet, the cuttings were moist; however, the hole produced less than 1 gpm of water with an SC of 4,900  $\mu\text{S}/\text{cm}$ . The well was screened from 181 to 201 ft with 4-inch PVC 0.020-inch slotted screen, and a 10-20 silica sand pack was placed to about 6 feet above the top of the screen or 175 ft below land surface. Bentonite chips were poured on top of the sand pack; the top of the bentonite chips was about 167 feet below land surface. The sand pack and bentonite chips were added slowly and the temporary 8-inch steel casing was slowly pulled back. A Bentonite slurry was tremied into the hole and pumped to the surface to ensure a proper seal. The temporary steel casing was completely removed, and an 8-inch-diameter protective steel casing and locking cap were installed. Unfortunately, this hole produced very little water. It was initially pumped almost dry and recovered about 0.04 feet in 2 hours; this well was not sampled. Because this well is not well connected to a principal aquifer, it will not be included as an active NGWMN well. The well log is included in appendix A.



Figure 10. Cuttings from the deep well.

The second shallow well was drilled about 5 feet west of the first, to a depth of about 41 feet; it targeted the productive zone identified in the deep well. Between 35 and 41 feet bls, the hole produced 27 gpm with an SC of 1,195  $\mu\text{S}/\text{cm}$ . The well was screened from 30.4 to 40.4 feet with 0.020 factory slotted screen and completed with a sand pack, bentonite chips, bentonite slurry, and protective casing similar to the first well. The well log is included in appendix A.

This well was sampled for major ions, trace-element constituents, and stable-water isotopes on August 24, 2023, with assistance of the USGS Wyoming–Montana Water Science Center, Helena Office. The sample was analyzed by the MBMG Analytical Laboratory; the results are included in appendix B. The water was slightly mineralized—the total dissolved solids (TDS) was 776 mg/L with a sulfate concentration of 329 mg/L, above the secondary standard of 250 mg/L; no other constituents exceeded a primary or secondary standard.

The initial static water level was 10.22 feet bls. The well was pumped 1.3 gpm for 2 hours for sampling, and the pumping water level was 10.34 feet bls, yielding a specific capacity of 10.8 gpm/ft.

The well was incorporated into the USGS CRN network (USGS 484047112353301, fig. 11). All site information (table 2) and well construction details have been included in the Montana Bureau of Mines and Geology Ground Water Information Center database and added to the National Groundwater Monitoring Network well registry.



Figure 11. Completed well pair.

**Table 2. Details for MBMG-322961.**

<b>Agency</b>	MBMG/USGS
<b>Site Name</b>	MBMG-322961
<b>National Aquifer Code</b>	N300UPCTS
<b>Aquifer Type</b>	UNCONFINED
<b>Water Quality Subnetwork</b>	No
<b>WQ Baseline Achieved</b>	No
<b>Water Level Subnetwork</b>	Yes
<b>WL Baseline Achieved</b>	No
<b>WL Well Characteristics</b>	Background
<b>WL Well Type</b>	Trend
<b>WL Well Purpose</b>	Dedicated Monitoring

**Replacement wells MBMG-6024 and MBMG 4719**

Because of the increased drilling costs, a scope change was requested and approved (09/22/2022-G21AC10418-01) to clean out and rehabilitate the wells targeted for replacement (MBMG-6024 and MBMG-4719). The remaining Objective 5 and MBMG funds were used to pay licensed water-well contractors to remove debris and secure both wells. That work is described below.

## MBMG-6024—Well Rehabilitation

This well is located on the Flathead Reservation near the base of the Mission Mountains in the Mission Valley (fig. 2). It was drilled in 1984 and has been monitored since 1985; it is 175 feet deep and serves as a background-trend well. Because of its location, it provides a measure of mountain-front recharge from the Mission Mountains to the heavily used basin-fill aquifer in the Mission Valley. The well cap had been removed and the well was filled in with rocks and debris in 2019 (fig. 12).

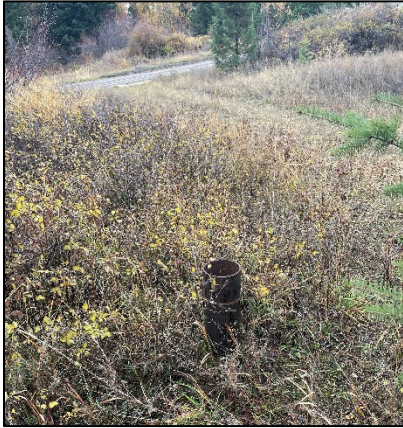


Figure 12. MBMG-6024, the cap was removed and debris was added to the well.

A downhole camera survey showed gravel in the well at about 16 feet below land surface, but it wasn't clear if the gravel filled the well or just bridged off a portion of the well. A contractor was hired and was able to use a high-capacity air compressor to blow the gravel out (fig. 13). The well wasn't filled with gravel, but was bridged off with cobbles, and a portion of a 2 x 4 was pulled out of the bottom.



Figure 13. Sand, gravel and cobbles were blown from the well.

The well was originally constructed with 5 feet of screen, but rather than being exposed to formation it was sitting inside the steel casing. The driller hooked on to it and easily removed it. A subsequent downhole camera survey revealed a clean well bore with an open-bottom completion directly connected to the aquifer (fig. 14).



Figure 14. Downhole image of the bottom of the casing at 147 ft.

To secure the well, a new 8-inch protective surface casing was placed around the well casing to a depth of 6 feet. This was cemented at the surface and a new locking well cap was installed (fig. 15).



Figure 15. MBMG-6024 well rehabilitation.

A temporary pump was placed in the well to test the well's connection to the aquifer and obtain a sample. Field parameters, discharge (bucket and stopwatch), and pumping water level were monitored during the well purge and are documented in figure 16. The results indicate a good connection to the aquifer, with 1.37 feet of drawdown at a discharge rate of 33 gpm. The sample results are included in appendix B.

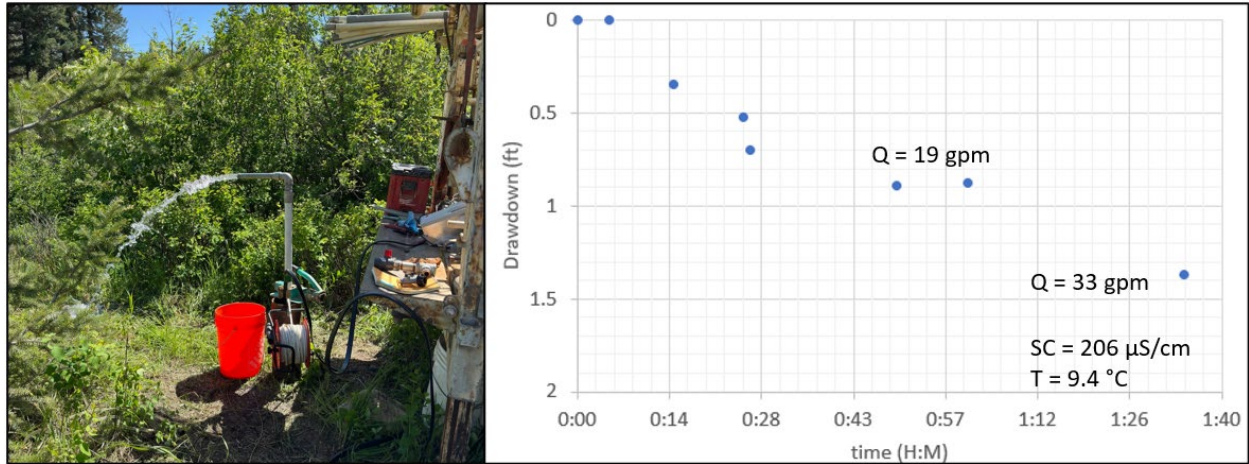


Figure 16. MBMG-6024. Test pumping results.

MBMG-4719—Well Rehabilitation

Well MBMG-4719 is located in southwest Montana, near the city of Butte. It is 75 feet deep and has been monitored since 1988. The well tracks long-term changes in storage and recharge, and is used to assess the effects of long-term and seasonal climate variability. In addition to serving as a background-trend well for the MBMG and NGWMN networks, data from this well are also used to assess background conditions as part of EPA Superfund activities related to legacy mine reclamation in the Butte area. This well was vandalized and filled in with rocks and debris in 2018.

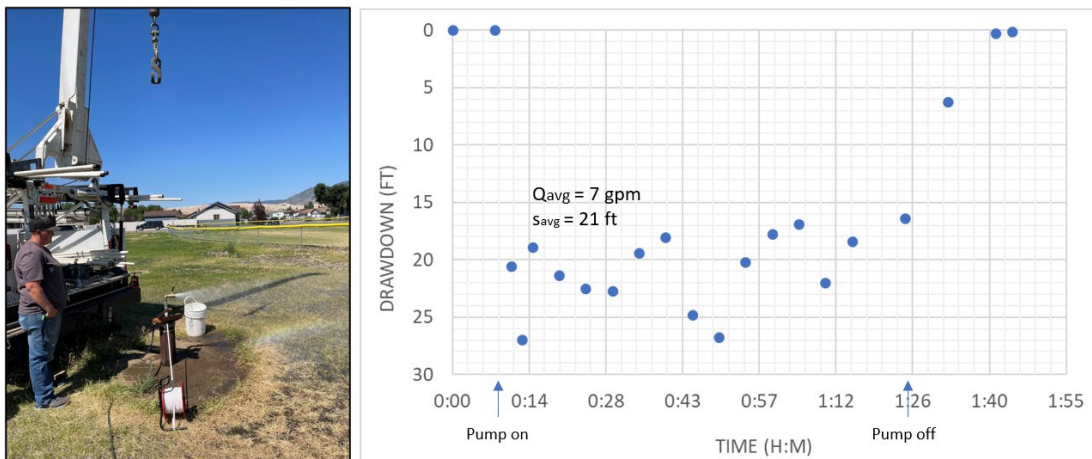


Figure 17. MBMG-4719. Test pumping results.

A downhole camera survey revealed an obstruction at 14 feet. A licensed water well contractor was engaged to “fish” the material out of the well and, if possible, test pump the well. Several burlap bags and grass clippings were removed from the well. After removing the material, the well was “blown” with air to clean it further and develop it. The well was then pumped with a submersible pump; discharge and pumping water levels were monitored during the purge (fig. 17). The well was pumped until the discharge cleared (fig. 18); a sample was collected and the results are included in appendix B.



Figure 18. MBMG-4719. The well was pumped until the discharge cleared.

### **Description of Work Done to Support Continuous Water-Level Data Collection—Objective 6**

Under Objective 6, the MBMG proposed replacing 20 pressure transducers (“loggers”) and 11 barologgers over 10 years old and equipping five existing NGWMN sites that were measured quarterly with loggers to obtain continuous water-level data. The transducers being replaced were all “Solinst Gold” models; the proposed replacement models are “Solinst LevelLoggers.”

A list of the proposed replacement and new logger sites is presented in table 3, and the locations are shown in figure 19. Solinst LevelLoggers were successfully deployed in all the sites except MBMG-133880. This well has a pump and drop pipe that could not be removed (see fig. 5 above), so we were unable to deploy a transducer. In its place, a barologger was added to MBMG-258852 (table 3).

**Table 3. Replacement logger details; locations are shown in Figure 19.**

<b>Replacement Sites</b>					
<b>NGWMN-ID</b>	<b>Aquifer</b>	<b>Old Model</b>	<b>New Model</b>	<b>SN's</b>	<b>Year</b>
MBMG-6283	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1052250 : 1064934	2024
MBMG-9950	N300LTRTRY	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	2190173 : 2190746	2024
MBMG-78891	N100ALLUVL	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	2190187 : 2190747	2024
MBMG-85046	N300UPCTCS	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	2190190 : 2190748	2024
MBMG-96132	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	2190225 : 2190751	2024
MBMG-126044	N300UPCTCS	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	2156559 : 2111715	2024
MBMG-136964	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1028335	2024
MBMG-148187	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1028500 : 1044773	2024
MBMG-148191	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1025401	2024
MBMG-151190	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	2190863	2024
MBMG-151204	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1052253	2024
MBMG-163226	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1049282	2024
MBMG-191532	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1041633 : 1044781	2024
MBMG-216851	N500PLOZOC	Solinst Gold	SOLINST LEVELLOGGER	2190185	2024
MBMG-219909	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1061035	2024
MBMG-256854	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1052258 : 1051564	2024
MBMG-256859	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER	1051790	2024
MBMG-257677	N100ALLUVL	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1032982 : 1032733	2024
MBMG-258852	S100NRMTIB	Solinst Gold	SOLINST LEVELLOGGER + Baro **	2003968 : 2010436	2024
MBMG-892116	S100NRMTIB	Solinst Gold + Baro	SOLINST LEVELLOGGER + Baro	1044203 : 1038498	2024
<b>New Sites</b>					
MBMG-6024	S100NRMTIB	NA	SOLINST LEVELLOGGER	2190690	2024
MBMG-4719	S100NRMTIB	NA	SOLINST LEVELLOGGER	2077559	2024
MBMG-76048	S100NRMTIB	NA	SOLINST LEVELLOGGER	159078	2024
MBMG-6276	S100NRMTIB	NA	SOLINST LEVELLOGGER	2156560	2024
MBMG-133880	S100NRMTIB	NA	**		



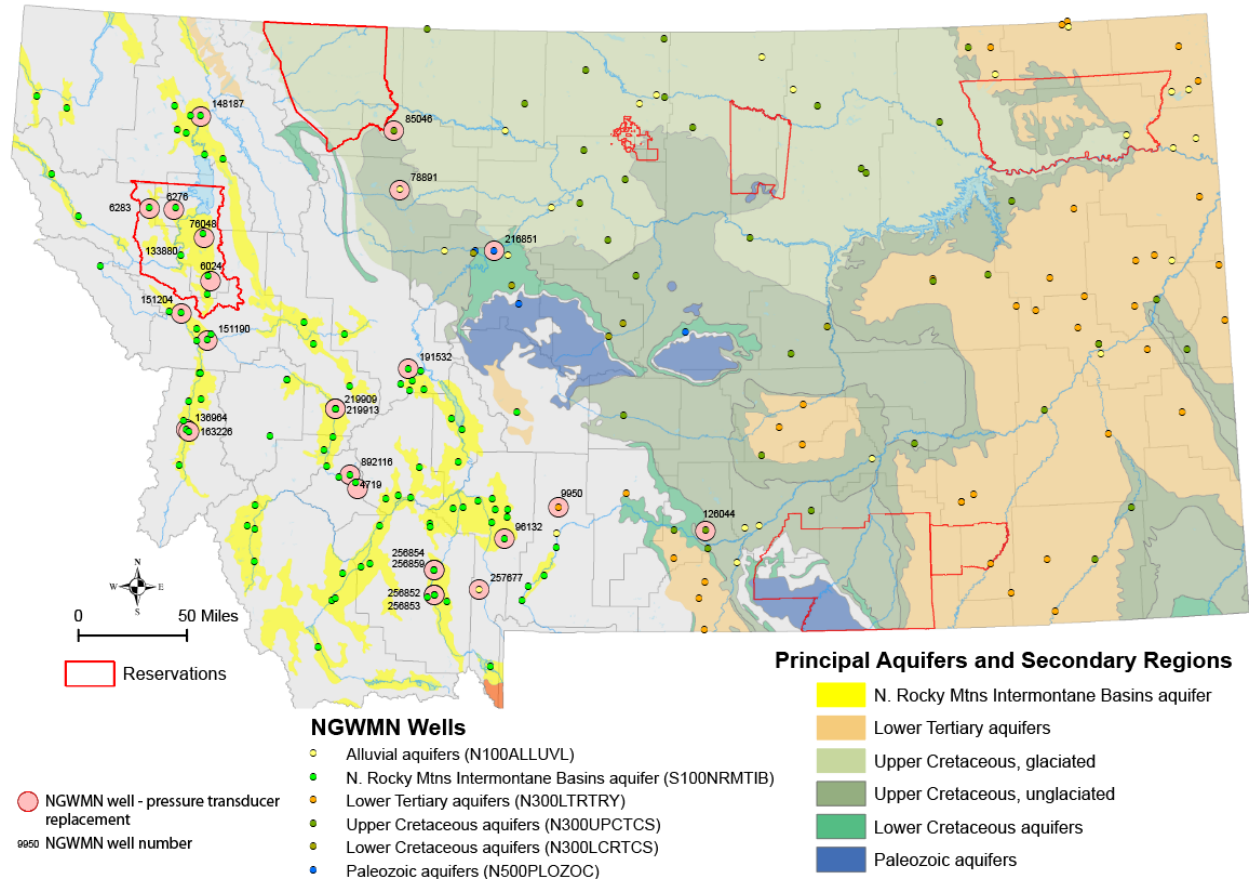


Figure 19. Locations of replacement loggers.

**References**

Whitehead, R.L., 1996, Ground Water Atlas of the United States Segment 8—Montana, North Dakota, South Dakota, Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas 370-I, 24 p.

## Appendix A—Well Logs

MBMG-322961

MBMG-322962

# MONTANA WELL LOG REPORT

## Other Options

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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**Site Name: MBMG PERRY RANCH 01**

**GWIC Id: 322961**

### Section 1: Well Owner(s)

1) MBMG PERRY RANCH 01 (MAIL)  
1300 WEST PARK STREET  
BUTTE MT 59701 [08/18/2022]

### Section 2: Location

Township	Range	Section	Quarter Sections
34N	08W	25	NW¼ SW¼ NW¼ NE¼

County: GLACIER Geocode:

GLACIER

Latitude	Longitude	Geomethod	Datum
48.679693	-112.592402	DIGITALMAP	NAD83
Ground Surface Altitude	Ground Surface Method	Datum	Date
3836	DIGITALMAP	NAVD88	
Measuring Point Altitude	MP Method	Datum	Date Applies
3838	DIGITALMAP	NAVD88	8/19/2022

Addition: Block Lot

### Section 3: Proposed Use of Water

MONITORING (1)

### Section 4: Type of Work

Drilling Method: ROTARY  
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, August 18, 2022

### Section 6: Well Construction Details

#### Borehole dimensions

From	To	Diameter
0	41	8

#### Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	3	8	0.322		WELDED	A53B STEEL
0	31	4			THREADED	PVC-SCHED 80

#### Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
31	41	8		.020	FACTORY SLOTTED

#### Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	24	BENTONITE GROUT	
24	41	10/20 SAND	

### Section 7: Well Test Data

Total Depth: 41  
Static Water Level: 12.4  
Water Temperature:

#### Air Test \*

27 gpm with drill stem set at    feet for    hours.  
Time of recovery    hours.  
Recovery water level 12.4 feet.  
Pumping water level    feet.

\* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.

### Section 8: Remarks

### Section 9: Well Log

#### Geologic Source

211TMD - TWO MEDICINE FORMATION (OF MONTANA GROUP)

From	To	Description
0	2	SOIL WITH SHALE CHIPS
2	5	BROWN SOIL/CLAY WITH SILT
5	12	BROWN DAMP CLAY
12	20	GRAY DRY SHALE
20	25	GRAY DRY SHALE UNTIL 24', WET AT 24'
25	30	GRAY SHALE, MAKING WATER AT 26'
30	34	GRAY SHALE
34	35	RAPID ADVANCEMENT OF DRILL; SOFT/SMOOTH
35	38	GRAY SHALE; HOLE MAKING 8.7 GPM
38	41	GRAY SHALE; HOLE MAKING 27 GPM

#### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** SCOTT MCGAUGH  
**Company:** OKEEFE DRILLING CO  
**License No:** MWC-701  
**Date Completed:** 8/18/2022

MBMG PERRY RANCH WELL 01

AQUIFER 211TMD



DEPTHS BELOW GROUND SURFACE IN FEET

COMPLETION

MP 3838 FT

GS 3836 FT

CASING SIZE/MATERIAL  
4" PVC

BOREHOLE DIAMETER 8"

BACKFILL MATERIAL GROUT SLURRY/CHIPS

SEAL TOP/MATERIAL  
15 FT  
3/8 Bentonite chips

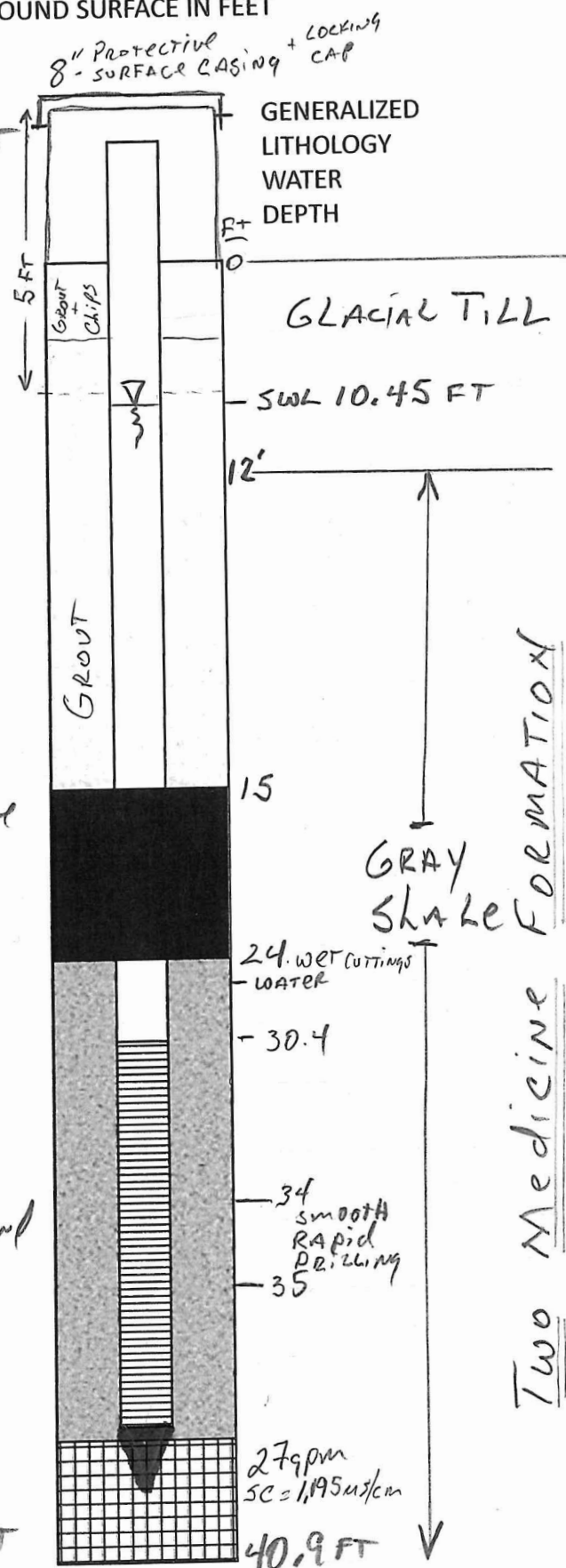
SEAL BOTTOM 24 FT

SCREEN TOP/TYPE  
30.4 FT  
0.020 IN  
PVC

PACK MATERIAL  
10-20 SILICA SAND

SCREEN BOTTOM 40.4

DRILLED DEPTH 40.9 FT



PROJECT GWAAMON

GWIC \_\_\_\_\_

WELL NAME Perry Ranch 01

LOCATION  
T 34 N, R 8 E  
S 25 TRACT ABCB 01  
LATITUDE  
48.679693

LONGITUDE  
-112.592402

DATUM/METHOD  
NAD83 / DIGMAP

DATE WELL STARTED  
08/18/2022

DATE WELL COMPLETED  
08/23/2022

RECORDED BY  
JAMES MADISON

DRILLER/LICENSE  
SCOTT McGAUGH / 718

COMPANY  
O'KEEFE

NOTES  
DRILLED DRY

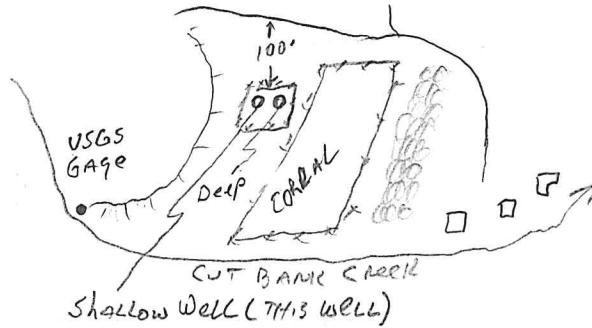
8" Temp SURF

CASING SET TO 15 FT  
DRILLED OPEN HOLE TO T.D.

Two Medicine FORMATION

PROJECT: GWAMON WELL NAME: PERRY RANCH 01  
 LANDOWNER: BLACK FEET TRIBAL  
 CONTACT INFO \_\_\_\_\_

site diagram  
 See INVENTORY  
 Sheet FOR GWICID=



ACCESS INSTRUCTIONS \_\_\_\_\_

SWL\_MP 12.45 YIELD 27gpm Bucket: Stopwatch  
 SWL\_GS 10.45 DURATION \_\_\_\_\_  
 PWL\_MP - DEVELOPMENT TIME \_\_\_\_\_

**DRILLING LOG**

FROM (ft)	TO (ft)	CUTTINGS DESCRIPTION/WATER CONDITIONS/DEVELOPMENT/ ACTIVITY NOTES	CONNECTION	
			DEPTH	TIME WATER YIELD
0	2	SOIL WITH SHALE CHIPS		
2	5	BROWN SOIL / CLAY WITH SILT		
5	12	BROWN DAMP CLAY		
12	20	GRAY DRY SHALE		
20	25	GRAY DRY SHALE UNTIL 24 FT; WET AT 24 FT		
25	30	GRAY SHALE; MAKING WATER AT 26 FT		
-	-	Est. AT 5gpm. SC ≈ 1100 us/cm		
30	34	GRAY SHALE		
34	35	Rapid advancement of Drill; SOFT/SMOOTH		
35	38	GRAY SHALE; hole MAKING 18.7gpm		
38	40.9	GRAY SHALE; hole MAKING 27gpm; SC ≈ 195 us/cm		
	<u>TD</u>			

## MONTANA WELL LOG REPORT

## Other Options

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**Site Name: MBMG PERRY RANCH 02**  
**GWIC Id: 322962**

### Section 1: Well Owner(s)

1) MBMG PERRY RANCH 02 (MAIL)  
 1300 WEST PARK STREET  
 BUTTE MT 59701 [08/18/2022]

### Section 2: Location

<b>Township</b>	<b>Range</b>	<b>Section</b>	<b>Quarter Sections</b>
34N	08W	25	NW¼ SW¼ NW¼ NE¼
<b>County</b>			<b>Geocode</b>

GLACIER

<b>Latitude</b>	<b>Longitude</b>	<b>Geomethod</b>	<b>Datum</b>
48.679693	-112.592402	DIGITALMAP	NAD83
<b>Ground Surface Altitude</b>	<b>Ground Surface Method</b>	<b>Datum</b>	<b>Date</b>
3836	DIGITALMAP	NAVD88	
<b>Measuring Point Altitude</b>	<b>MP Method</b>	<b>Datum</b>	<b>Date Applies</b>
3838	DIGITALMAP	NAVD88	8/19/2022 7:00:00 AM
<b>Addition</b>	<b>Block</b>	<b>Lot</b>	

### Section 3: Proposed Use of Water

MONITORING (1)

### Section 4: Type of Work

Drilling Method: ROTARY  
 Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, August 18, 2022

### Section 6: Well Construction Details

#### Borehole dimensions

From	To	Diameter
0	221.5	8

#### Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	3	8	0.322		WELDED	A53B STEEL
-2	181	4			THREADED	PVC-SCHED 80

#### Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
181	201	4		.020	FACTORY SLOTTED

#### Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	175	BENTONITE GROUT	
175	220	10/20 SAND	

### Section 7: Well Test Data

Total Depth: 221.5  
 Static Water Level: 63  
 Water Temperature:

#### Air Test \*

   gpm with drill stem set at    feet for    hours.  
 Time of recovery    hours.  
 Recovery water level 63 feet.  
 Pumping water level    feet.

*\* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

SHALLOW WATER FROM 35-36 WAS TEMPORALLY CASSED OFF AND SUBSEQUENTLY GROUTED OFF. BOREHOLE MADE ABOUT 1 GPM IN THE 180-220 FT RANGE. INITIALLY WATER LEVEL IN THIS WELL RECOVERED AS THE WELL WAS BEING CONSTRUCTED/ COMPLETED; THE RECOVERING WATER LEVEL COMPRESSED AIR IN THE CASING AND BLEW THE CAP OFF OF THE WELL SEVERAL TIMES. WHEN PUMPED, WELL PRODUCED VERY SMALL AMOUNT OF WATER (<<1 GPM) AND RECOVERED ONLY 0.04 FT IN 2 HRS.

### Section 9: Well Log

#### Geologic Source

211TMDC - TWO MEDICINE FORMATION (OF MONTANA GROUP)

From	To	Description
0	10	BROWN DRY DRIFT/SILT AND CLAY
10	12	DAMP/CLAY/SILT
12	15	GRAY DRY SHALE
15	18	WET/GRAY/SHALE
18	25	GRAY DRY SHALE
25	28	MOIST DRY SHALE
28	35	GRAY DRY SHALE
35	36	GRAY SHALE 35 GPM
36	42.5	SILTY SHALE
42.5	45	MOIST TO DRY SHALE
45	70	DRY GRAY SHALE
70	75	DRY GRAY SHALE WITH SMALL AMOUNT OF SILT
75	138	DRY GRAY SHALE WITH MINOR SILT
138	140	FRACTURE ZONE PER DRILLER
140	145	GRAY SHALE WITH MINOR SILT

#### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Site Name: MBMG PERRY RANCH 02**

**GWIC Id: 322962**

**Additional Lithology Records**

<b>From</b>	<b>To</b>	<b>Description</b>
145	150	MOIST SILT, FINE SANDS, CLAY
150	175	MOIST SHALE
175	180	DRY GRAY SHALE
180	200	MOIST GRAY SHALE
200	210	WET GRAY SHALE; MAKING ABOUT 1 GPM
210	221.5	GRAY SHALE; MINIMAL RETURNS, DRY CUTTINGS

MBMG Perry Ranch Well 02

AQUIFER 211 TMDC  
 DEPTHS BELOW GROUND SURFACE IN FEET



**COMPLETION**

MP 3838 FT

GS 3836 FT

CASING SIZE/MATERIAL  
4" PVC

BOREHOLE DIAMETER 8"

BACKFILL MATERIAL GROUT SCURRY/CHIPS

SEAL TOP/MATERIAL  
16 FT 3/8 BENTONITE CHIPS

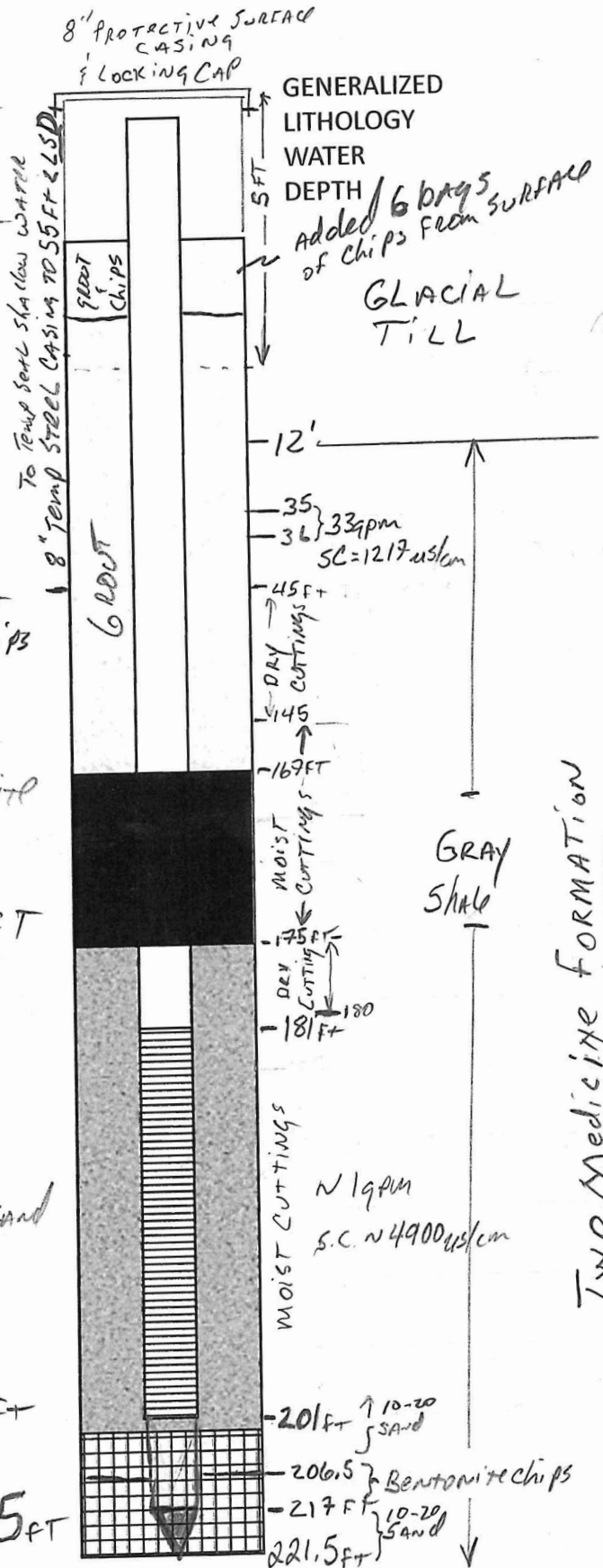
SEAL BOTTOM 175 FT

SCREEN TOP/SIZE/TYPE  
181 FT 0.020m PVC

PACK MATERIAL 10-20 SILICA SAND

SCREEN BOTTOM 201 FT

DRILLED DEPTH 221.5 FT



PROJECT GWAAADON

GWIC \_\_\_\_\_

WELL NAME MBMG Perry Ranch 02

LOCATION T34 N/S, R 9 E/W  
S 25 TRACT ABCB 02  
 LATITUDE

48.679693  
 LONGITUDE

-112.592402  
 DATUM/METHOD

NAD 83 / DIGI MAP  
 DATE WELL STARTED

8/16/2022  
 DATE WELL COMPLETED

8/23/2022  
 RECORDED BY

JAMES MADISON  
 DRILLER/LICENSE

SCOTT MCGAUGH / 718  
 COMPANY

O'KEEFE  
 NOTES

DRILLED DAY  
8" TEMP SURF  
CASING TO 55 FT,  
DRILLED OPEN HOLE  
TO TD.

\*WELL CAP BLOWN OFF AS WATER LEVEL IN THE WELL RECOVERED WHILE ADDING THE SLURRY.

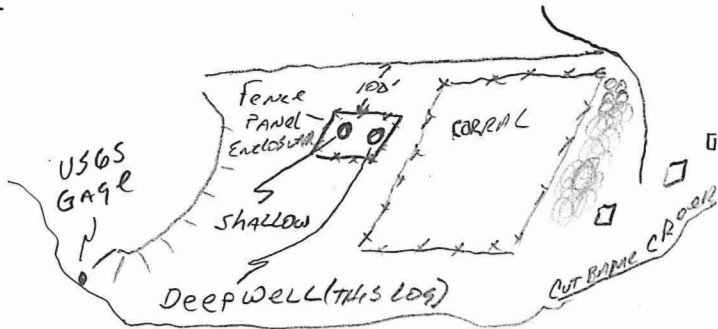


PROJECT: GWAMOX WELL NAME: MBMG Perry Ranch 02  
 LANDOWNER: BLACKFEET TRIBAL  
 CONTACT INFO \_\_\_\_\_

site diagram  
 See INVENTORY  
 Sheet P06 GVIC LD=

ACCESS INSTRUCTIONS \_\_\_\_\_

SWL\_MP — YIELD —  
 SWL\_GS — DURATION —  
 PWL\_MP — DEVELOPMENT TIME —



Initially Produced ~1 gpm from Borehole,  
 Completed well Produced Very Little. **DRILLING LOG**  
 8-19-2012 - Pumped well recovered 0.04 ft in 2 hrs.

FROM (FT)	TO (FT)	CUTTINGS DESCRIPTION/WATER CONDITIONS/DEVELOPMENT/ ACTIVITY NOTES	CONNECTION	DEPTH	TIME	WATER YIELD
0	10	BROWN DRY DRIFT / SILT / CLAY				
10	12	DAMP / CLAY / SILT				
12	15	GRAY DRY SHALE				
15	18	WET / GRAY / SHALE				
18	25	GRAY DRY SHALE				
25	28	MOIST GRAY SHALE				
28	35	GRAY DRY SHALE				
35	36	GRAY SHALE 33 gpm SC = 1217 us/cm				
36	42.5	SILTY SHALE				
42.5	45	MOIST TO DRY SHALE				
45	55	DRY GRAY SHALE. Temp Casing to 55 FT				
55	70	DRY GRAY SHALE. USING DOWNHOLE HAMMER				
70	75	DRY GRAY SHALE WITH SMALL AMOUNT OF SILT				
75	138	DRY GRAY SHALE WITH MINOR SILT				
138	140	FRACTURE ZONE FOR DRILLER				
140	145	GRAY SHALE WITH MINOR SILT				
145	150	MOIST SILT / FINE SAND / CLAY				
150	175	MOIST SHALE				
175	180	DRY GRAY SHALE				
180	200	MOIST GRAY SHALE				
200	210	WET GRAY SHALE; Hole making ~1 gpm; SC ~ 4800 us/cm				
210	221.5	GRAY SHALE; minimal returns; DRY CUTTINGS				

Sounded TO

## Appendix B–Water Quality Results

MBMG-322961

MBMG-6024

MBMG-4719

**Location Information**

Sample Id/Site Id:	253896 / 322961	Sample Date:	8/24/2022 1:00:00 PM
Location (TRS):	34N 08W 25 ABCB	Agency/Sampler:	MBMG / MADISON, JAMES
Latitude/Longitude:	48° 40' 46" N 112° 35' 32" W	Field Number:	PERRY RANCH 1
Datum:	NAD83	Lab Date:	9/23/2022 9:19:22 AM
Altitude:	3836	Lab/Analyst:	MBMG / TIMMER, JACKIE
County/State:	GLACIER / MT	Sample Method/Handling:	PUMPED / ru:1 ra:0 fu:2 fa:2
Site Type:	WELL	Procedure Type:	DISSOLVED
Geology:	211TMDC	Total Depth (ft):	41
USGS 7.5' Quad:		SWL-MP (ft):	12.22
PWS Id:		Depth Water Enters (ft):	31
Project:	GWAAMON, NGWMN-MONTANA		

**Major Ion Results**

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	3.370	0.168	Bicarbonate (HCO <sub>3</sub> )	218.040	3.574
Magnesium (Mg)	0.990	0.081	Carbonate (CO <sub>3</sub> )	21.260	0.761
Sodium (Na)	276.550	12.030	Chloride (Cl)	28.040	0.791
Potassium (K)	0.600	0.015	Sulfate (SO <sub>4</sub> )	329.000	6.853
Iron (Fe)	<0.038 U	0.000	Nitrate (as N)	<0.010 U	0.000
Manganese (Mn)	<0.005 U	0.000	Fluoride (F)	0.300	0.016
Silica (SiO <sub>2</sub> )	8.320		Orthophosphate (as P)	0.030 J	0.000
<b>Total Cations</b>		12.312	<b>Total Anions</b>		11.995

**Trace Element Results (µg/L)**

Aluminum (Al):	<5.000 U	Cesium (Cs):	<0.250 U	Molybdenum (Mo):	3.520	Strontium (Sr):	113.280
Antimony (Sb):	<0.250 U	Chromium (Cr):	<0.250 U	Nickel (Ni):	<0.250 U	Thallium (Tl):	<0.250 U
Arsenic (As):	0.680 J	Cobalt (Co):	<0.250 U	Niobium (Nb):	<0.250 U	Thorium (Th):	<0.250 U
Barium (Ba):	28.050	Copper (Cu):	<1.250 U	Neodymium (Nd):	<0.250 U	Tin (Sn):	<0.250 U
Beryllium (Be):	<0.250 U	Gallium (Ga):	0.810 J	Palladium (Pd):	<0.250 U	Titanium (Ti):	<0.250 U
Boron (B):	159.490	Lanthanum (La):	<0.250 U	Praseodymium (Pr):	<0.250 U	Tungsten (W):	<0.250 U
Bromide (Br):	284.000	Lead (Pb):	<0.150 U	Rubidium (Rb):	<0.250 U	Uranium (U):	<0.250 U
Cadmium (Cd):	<0.250 U	Lithium (Li):	57.410	Silver (Ag):	<0.250 U	Vanadium (V):	19.850
Cerium (Ce):	<0.250 U	Mercury (Hg):	NR	Selenium (Se):	<0.250 U	Zinc (Zn):	<1.250 U
						Zirconium (Zr):	<0.250 U

**Field Chemistry and Other Analytical Results**

**Total Dissolved Solids (mg/L):	775.75	Field Hardness as CaCO <sub>3</sub> (mg/L):	NR	Ammonia (mg/L):	NR
**Sum of Diss. Constituents (mg/L):	886.36	Hardness as CaCO <sub>3</sub> :	12.49	T.P. Hydrocarbons (µg/L):	NR
Field Conductivity (µmhos):	1157	Field Alkalinity as CaCO <sub>3</sub> (mg/L):	202.2	PCP (µg/L):	NR
Lab Conductivity (µmhos):	1215.1	Alkalinity as CaCO <sub>3</sub> (mg/L):	213.82	Phosphorus, TD (mg/L):	<0.030 U
Field pH:	8.84	Ryznar Stability Index:	8.425	Field Nitrate (mg/L):	NR
Lab pH:	8.86	Sodium Adsorption Ratio:	34.1064	Field Dissolved O <sub>2</sub> (mg/L):	0.180
Water Temp (°C):	9.6	Langlier Saturation Index:	0.218	Field Chloride (mg/L):	NR
Air Temp (°C):	NR	Nitrite (mg/L as N):	<0.010 U	Field Redox (mV):	NR
Nitrate + Nitrite (mg/L as N)	<0.200 U	Hydroxide (mg/L as OH):	0.000	Lab, Dissolved Organic Carbon (mg/L):	NR
Total Kjeldahl Nitrogen (mg/L as N)	NR	Lab, Dissolved Inorganic Carbon (mg/L):	NR	Lab, Total Organic Carbon (mg/L):	NR
Total Nitrogen (mg/L as N)	NR	Acidity to 4.5 (mg/L CaCO <sub>3</sub> )	NR	Acidity to 8.3 (mg/L CaCO <sub>3</sub> )	NR
As(III) (ug/L)	NR	As(V) (ug/L)	NR	Total Susp Solids (mg/L)	NR

Sample TURBIDITY 2.03 NTU; PUMP SET AT 25 FT  
 Condition:

Field Remarks: RAINED ON 08/23//2022 2120 TO 2200; MUDDY

Lab Remarks:

**Notes**

**Explanation:** mg/L = milligrams per Liter; µg/L = micrograms per Liter; ft = feet; NR = No Reading in GWIC

**Qualifiers:** J = Estimated quantity above detection limit but below reporting limit; P = Preserved sample; S = Method of standard additions; U = Undetected quantity below detection limit; \* = Duplicate analysis not within control limits; \*\* = Sum of Dissolved Constituents is the

sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO<sub>3</sub>, CO<sub>3</sub>, SO<sub>4</sub>, Cl, SiO<sub>2</sub>, NO<sub>3</sub>, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

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**Location Information**

Sample Id/Site Id:	255660 / 6024	Sample Date:	5/23/2023 3:50:00 PM
Location (TRS):	18N 19W 28 CCDB	Agency/Sampler:	MBMG / MADISON, JAMES
Latitude/Longitude:	47° 17' 3" N 114° 1' 48" W	Field Number:	6024
Datum:	NAD83	Lab Date:	6/27/2023 1:28:59 PM
Altitude:	3360	Lab/Analyst:	MBMG / TIMMER, JACKIE
County/State:	LAKE / MT	Sample Method/Handling:	PUMPED / ru:2 ra:0 fu:2 fa:2
Site Type:	WELL	Procedure Type:	DISSOLVED
Geology:	112OTSH	Total Depth (ft):	147
USGS 7.5' Quad:	SAINT IGNATIUS 7 1/2'	SWL-MP (ft):	117.8
PWS Id:		Depth Water Enters (ft):	142
Project:	GWCP02, GWAAMON, NGWMN-MONTANA		

**Major Ion Results**

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	23.420	1.169	Bicarbonate (HCO <sub>3</sub> )	125.550	2.058
Magnesium (Mg)	9.910	0.815	Carbonate (CO <sub>3</sub> )	3.010	0.108
Sodium (Na)	1.440	0.063	Chloride (Cl)	0.560	0.016
Potassium (K)	0.410	0.010	Sulfate (SO <sub>4</sub> )	3.820	0.080
Iron (Fe)	<0.015 U	0.000	Nitrate (as N)	0.150	0.011
Manganese (Mn)	<0.002 U	0.000	Fluoride (F)	0.060	0.003
Silica (SiO <sub>2</sub> )	6.220		Orthophosphate (as P)	<0.020 U	0.000
<b>Total Cations</b>		2.058	<b>Total Anions</b>		2.275

**Trace Element Results (µg/L)**

Aluminum (Al):	2.680 J	Cesium (Cs):	<0.100 U	Molybdenum (Mo):	0.240 J	Strontium (Sr):	30.980
Antimony (Sb):	<0.100 U	Chromium (Cr):	<0.100 U	Nickel (Ni):	0.380 J	Thallium (Tl):	<0.100 U
Arsenic (As):	0.560	Cobalt (Co):	<0.100 U	Niobium (Nb):	<0.100 U	Thorium (Th):	<0.100 U
Barium (Ba):	121.610	Copper (Cu):	<0.500 U	Neodymium (Nd):	<0.100 U	Tin (Sn):	0.150 J
Beryllium (Be):	<0.100 U	Gallium (Ga):	2.930	Palladium (Pd):	<0.100 U	Titanium (Ti):	<0.100 U
Boron (B):	3.530	Lanthanum (La):	<0.100 U	Praseodymium (Pr):	<0.100 U	Tungsten (W):	<0.100 U
Bromide (Br):	<10.000 U	Lead (Pb):	<0.060 U	Rubidium (Rb):	0.430 J	Uranium (U):	0.490 J
Cadmium (Cd):	<0.100 U	Lithium (Li):	<2.000 U	Silver (Ag):	<0.100 U	Vanadium (V):	<0.100 U
Cerium (Ce):	<0.100 U	Mercury (Hg):	NR	Selenium (Se):	<0.100 U	Zinc (Zn):	1.090 J
						Zirconium (Zr):	<0.100 U

**Field Chemistry and Other Analytical Results**

**Total Dissolved Solids (mg/L):	110.4	Field Hardness as CaCO <sub>3</sub> (mg/L):	NR	Ammonia (mg/L):	NR
**Sum of Diss. Constituents (mg/L):	174.33	Hardness as CaCO <sub>3</sub> :	99.27	T.P. Hydrocarbons (µg/L):	NR
Field Conductivity (µmhos):	206	Field Alkalinity as CaCO <sub>3</sub> (mg/L):	NR	PCP (µg/L):	NR
Lab Conductivity (µmhos):	211.6	Alkalinity as CaCO <sub>3</sub> (mg/L):	108.35	Phosphorus, TD (mg/L):	<0.030 U
Field pH:	8.36	Ryznar Stability Index:	7.921	Field Nitrate (mg/L):	NR
Lab pH:	8.27	Sodium Adsorption Ratio:	0.0437	Field Dissolved O <sub>2</sub> (mg/L):	9.540
Water Temp (°C):	9.2	Langlier Saturation Index:	0.174	Field Chloride (mg/L):	NR
Air Temp (°C):	NR	Nitrite (mg/L as N):	<0.010 U	Field Redox (mV):	3.5
Nitrate + Nitrite (mg/L as N)	<0.200 U	Hydroxide (mg/L as OH):	0.000	Lab, Dissolved Organic Carbon (mg/L):	NR
Total Kjeldahl Nitrogen (mg/L as N)	NR	Lab, Dissolved Inorganic Carbon (mg/L):	NR	Lab, Total Organic Carbon (mg/L):	NR
Total Nitrogen (mg/L as N)	NR	Acidity to 4.5 (mg/L CaCO <sub>3</sub> )	NR	Acidity to 8.3 (mg/L CaCO <sub>3</sub> )	NR
As(III) (ug/L)	NR	As(V) (ug/L)	NR	Total Susp Solids (mg/L)	NR

Sample Condition: CLEAR, FILTER HAD A SOME IRON STAINING

**Notes**

Field Remarks: SAMPLE AFTER WELL REHAB TO REMOVE PLUG  
 Lab Remarks: SAMPLE WAS NOT COLD WHEN RECEIVED IN LAB.

Explanation: **mg/L** = milligrams per Liter; **µg/L** = micrograms per Liter; **ft** = feet; **NR** = No Reading in GWIC

Qualifiers: **J** = Estimated quantity above detection limit but below reporting limit; **P** = Preserved sample; **S** = Method of standard additions; **U** = Undetected quantity below detection limit; \* = Duplicate analysis not within control limits; \*\* = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO<sub>3</sub>, CO<sub>3</sub>, SO<sub>4</sub>, Cl, SiO<sub>2</sub>, NO<sub>3</sub>, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

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Report Date: 3/20/2025

[Compare to Water Quality Standards](#)

## Location Information

Sample Id/Site Id:	204267 / 4719	Sample Date:	7/16/2013 10:51:00 AM
Location (TRS):	03N 07W 30 DCBA	Agency/Sampler:	MBMG / RICHTER, MIKE
Latitude/Longitude:	45° 58' 41" N 112° 30' 56" W	Field Number:	4719
Datum:	NAD83	Lab Date:	8/27/2013 7:08:07 AM
Altitude:	5477.59	Lab/Analyst:	MBMG / MCGRATH, STEVE
County/State:	SILVER BOW / MT	Sample Method/Handling:	GRAB / ru:1 ra:0 fu:2 fa:2
Site Type:	WELL	Procedure Type:	DISSOLVED
Geology:	120SNGR	Total Depth (ft):	75
USGS 7.5' Quad:	BUTTE SOUTH	SWL-MP (ft):	13.73
PWS Id:		Depth Water Enters (ft):	65
Project:	MINEFLO, GWAAMON, GWCP05, DC_ARCO2009, NGWMN- MONTANA, BPSOU		

## Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	32.540	1.624	Bicarbonate (HCO <sub>3</sub> )	115.060	1.886
Magnesium (Mg)	8.620	0.709	Carbonate (CO <sub>3</sub> )	0.000	0.000
Sodium (Na)	9.320	0.405	Chloride (Cl)	5.630	0.159
Potassium (K)	3.530	0.090	Sulfate (SO <sub>4</sub> )	38.220	0.796
Iron (Fe)	0.409	0.015	Nitrate (as N)	0.890	0.064
Manganese (Mn)	0.023 J	0.000	Fluoride (F)	0.140	0.007
Silica (SiO <sub>2</sub> )	24.930		Orthophosphate (as P)	<0.020 U	0.000
<b>Total Cations</b>		<b>2.849</b>	<b>Total Anions</b>		<b>2.912</b>

## Trace Element Results (µg/L)

Aluminum (Al):	2.210	Cesium (Cs):	<0.100 U	Molybdenum (Mo):	4.000	Strontium (Sr):	200.250
Antimony (Sb):	<0.100 U	Chromium (Cr):	<0.100 U	Nickel (Ni):	0.370 J	Thallium (Tl):	<0.100 U
Arsenic (As):	0.230 J	Cobalt (Co):	<0.100 U	Niobium (Nb):	<0.100 U	Thorium (Th):	<0.100 U
Barium (Ba):	45.700	Copper (Cu):	<0.040 U	Neodymium (Nd):	<0.100 U	Tin (Sn):	<0.100 U
Beryllium (Be):	<0.100 U	Gallium (Ga):	<0.100 U	Palladium (Pd):	<0.100 U	Titanium (Ti):	0.350 J
Boron (B):	7.580	Lanthanum (La):	<0.100 U	Praseodymium (Pr):	<0.100 U	Tungsten (W):	<0.100 U
Bromide (Br):	<10.000 U	Lead (Pb):	<0.060 U	Rubidium (Rb):	<0.100 U	Uranium (U):	1.950
Cadmium (Cd):	<0.100 U	Lithium (Li):	<1.500 U	Silver (Ag):	<0.100 U	Vanadium (V):	1.130
Cerium (Ce):	<0.100 U	Mercury (Hg):	NR	Selenium (Se):	<0.100 U	Zinc (Zn):	0.860 J
						Zirconium (Zr):	<0.100 U

## Field Chemistry and Other Analytical Results

**Total Dissolved Solids (mg/L):	180.81	Field Hardness as CaCO <sub>3</sub> (mg/L):	NR	Ammonia (mg/L):	NR
**Sum of Diss. Constituents (mg/L):	239.16	Hardness as CaCO <sub>3</sub> :	116.73	T.P. Hydrocarbons (µg/L):	NR
Field Conductivity (µmhos):	273	Field Alkalinity as CaCO <sub>3</sub> (mg/L):	190	PCP (µg/L):	NR
Lab Conductivity (µmhos):	288	Alkalinity as CaCO <sub>3</sub> (mg/L):	94.32	Phosphorus, TD (mg/L):	0.050 J
Field pH:	7.11	Ryznar Stability Index:	9.136	Field Nitrate (mg/L):	0.000
Lab pH:	6.79	Sodium Adsorption Ratio:	0.3625	Field Dissolved O <sub>2</sub> (mg/L):	0.530
Water Temp (°C):	10.4	Langlier Saturation Index:	-1.173	Field Chloride (mg/L):	NR
Air Temp (°C):	NR	Nitrite (mg/L as N):	<0.010 U	Field Redox (mV):	132
Nitrate + Nitrite (mg/L as N)	0.820	Hydroxide (mg/L as OH):	0.000	Lab, Dissolved Organic Carbon (mg/L):	NR
Total Kjeldahl Nitrogen (mg/L as N)	NR	Lab, Dissolved Inorganic Carbon (mg/L):	NR	Lab, Total Organic Carbon (mg/L):	NR
Total Nitrogen (mg/L as N)	1.000	Acidity to 4.5 (mg/L CaCO <sub>3</sub> )	NR	Acidity to 8.3 (mg/L CaCO <sub>3</sub> )	NR
As(III) (ug/L)	NR	As(V) (ug/L)	NR	Total Susp Solids (mg/L)	NR

Sample CLEAR

Condition:

Field Remarks: SURVEYED WITH LEICA GPS. CALL AHEAD TO GET GATE UNLOCKED

Lab Remarks:

Notes

Explanation: **mg/L** = milligrams per Liter; **µg/L** = micrograms per Liter; **ft** = feet; **NR** = No Reading in GWIC

Qualifiers: **J** = Estimated quantity above detection limit but below reporting limit; **P** = Preserved sample; **S** = Method of standard additions; **U** = Undetected quantity below detection limit; \* = Duplicate analysis not within control limits; \*\* = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO<sub>3</sub>, CO<sub>3</sub>, SO<sub>4</sub>, Cl, SiO<sub>2</sub>, NO<sub>3</sub>, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

Disclaimer

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