

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Checkerboard Bar, Motel, and Trailer Court Public Water Supply (PWS # MT0001522)

Date of Report: December 2012

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Facility Location:

Checkerboard Bar, Motel, and Trailer Court
Intersection of Highway 12 and Forest Road S.

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INTRODUCTION

This source water delineation and assessment report (SWDAR) was prepared for the Checkerboard Bar, Motel, and Trailer Court's water system, a Public Water Supply (PWS), located within the small settlement called Checkerboard, in Meagher County, Montana. Jeffrey Frank Herrick, a hydrogeologist with the Source Water Protection Program at the Montana Department of Environmental Quality (DEQ), completed this SWDAR. The report is based information derived from a previous Source Water Delineation and Assessment Report (SWDAR) and other publicly available data sources.

Purpose

The primary purpose of this delineation and assessment report (SWDAR) is to provide information that helps the Checkerboard Bar, Motel, and Trailer Court protect its drinking water source. Delineation is the process of identifying areas that contribute water to aquifers or surface water bodies used as drinking water supplies. The delineated areas are called source water protection areas. Assessment involves identifying and inventorying potential sources of contamination within the source water protection areas, and then determining the potential for contamination of drinking water by these sources. This report is intended to meet the technical requirements for the completion of a SWDAR for the Checkerboard Bar, Motel, and Trailer Court PWS (public water supply), as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (Public Law 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination.

Limitations

This report was prepared to assess threats to the Checkerboard Bar, Motel, and Trailer Court public water supply (PWS), and is based on published documents and information obtained from reports and persons familiar with the area. The terms '*drinking water supply*' or '*drinking water source*' refer specifically to the source of the Checkerboard Bar, Motel, and Trailer Court PWS, and not to any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the vicinity of the Checkerboard Bar, Motel, and Trailer Court public water supply are identified. Potential sources of contamination are considered only in areas that contribute water to the source water used by this PWS. It is requested that the owners and operators of this facility provide corrected information on the important site features (such as septic tanks and drainfields) to DEQ, so this report can be updated.

BACKGROUND

PWS Location

The Checkerboard Bar, Motel, and Trailer Court business is located at the northeast corner of the small residential community of Checkerboard. It is located on the south side of Highway 12 about 20 miles east of White Sulphur Springs and 14 miles west of Martinsdale. It is located near the summit and on the east slope between the Little Belt Mountains to the north and the Castle Mountains to the south, and is within the watershed of the Musselshell River. The North Fork of the Musselshell River flows to the east within 500 yards north of Checkerboard. Figures 1a and 1b depict the community of Checkerboard and the Checkerboard Bar, Motel, and Trailer Court facility. Along Highway 12 (near the Checkerboard), the elevation is about 5,246 feet above sea level.

Geologic Setting

This section provides an overview of the geology and hydrology of the area surrounding Checkerboard and is based primarily on geologic mapping of the area by the USGS (2007), other MBMG mapping and digital

data sets, and well logs available from the Montana Bureau of Mines and Geology (MBMG) Ground Water Information Center (GWIC). A geologic map for the area was developed for this SWDAR and is attached as Figure 2.

The Musselshell River drains this portion of the southern Little Belt Mountains and the northern portion of the Castle Mountains. Both mountain ranges are comprised of igneous rocks that have intruded into and up-warped previously tabular sections of sedimentary rock that covered the region. Refer to Figure 2 for a geologic map of the area. The existing bedrock in the area consisted of near horizontal tabular sedimentary rock cored hills and terraces, with the bedrock ranging in age from pre-Cambrian Belt Supergroup meta-sedimentary rock formations to Cambrian or possibly Ordovician sedimentary formations. These meta-sedimentary and sedimentary rocks are predominantly comprised of sandstone, shale, and limestone. The igneous intrusive rocks arrived and pushed upward and through the existing sedimentary bedrock during early Tertiary times. These intrusive rocks are seen an assortment of igneous crystalline rock lithologies such as dacite or monzonite, but with unique chemical and crystalline makeup. In the area of Checkerboard the sedimentary units all dip (slope) to the southwest and away from the intrusive igneous pluton(s) in the core of the Little Belt Mountains (to the northeast of Checkerboard). Further to the south (not shown on Figure 2) these same sedimentary strata will dip to the east away from the core of the Castle Mountains. It is noted that on this figure there is a large area of Tertiary-age basalt identified as O_{Gb} and some Tertiary age porphyry located northeast of Checkerboard (E_{Orp}). Basalt and porphyry are extrusive volcanic rocks that are estimated to be Middle Tertiary age and were deposited long after the Early Tertiary intrusive crystalline rock penetrated the area. All of the above rock types (both sedimentary and igneous) form the bedrock beneath this portion of the Musselshell River watershed and beneath the small community of Checkerboard. The area seems to have been covered by a thick layer of Middle Tertiary sedimentary deposits of sand, gravel, and possibly other materials. The remnants of these deposits are seen on the map northeast of Checkerboard as Tertiary sediments, undifferentiated ($MiOgs$). During a later period of the Tertiary there were extensive gravel deposits spread thinly across the surface of the older and somewhat planed-off bedrock surface. Some scattered remnants of these gravel deposits are still present along some of the old depressions and fault lines. They are seen on the map as Quaternary-Tertiary pediment ($QTp_{1, 2,}$ or 3) and are seen to the southwest of Checkerboard. Younger terrace and alluvial deposits are found along the bottom of drainages such as the Musselshell River and Checkerboard Creek. These deposits are noted on the map as semi-recent terrace gravel (Qt). These materials were deposited during the last glaciation and are often thin layers of gravel and sand spread across the older bedrock surfaces. The bedrock surfaces over which they lay appear to be mostly Belt Supergroup meta-sedimentary rock, especially beneath the community of Checkerboard and beneath the Checkerboard Bar, Motel, and Trailer Court. A narrow band of younger alluvium lines the active stream channels and is noted on the geologic map as recent alluvium (Qa). The map only shows this younger alluvium lining the active channel of the Musselshell River.

Hydrogeology

Groundwater has never been characterized in the Checkerboard Creek drainage. The following discussion is based on local well drilling records, observations, experience, and general geologic/hydrogeologic principals. Groundwater in the area beneath Checkerboard and the Checkerboard Bar, Motel, and Trailer Court is present in what appears to be an unconfined aquifer. That unconfined aquifer is comprised of thin deposits of stream alluvium within the active stream channel and the fractured bedrock that forms the benches on which Checkerboard is located. Several well logs for properties in the area are attached at the end of this document. The precise location of these wells is unknown due to the inaccurate locational information provided by the drillers at the time they were recorded. My assumption is that the wells I have attached are found within or close to the community. The logs indicate that shale or sandstone were the first bedrock encountered during drilling and the depth of bedrock was anywhere from a few inches to 30 feet below ground surface (bgs). The unconsolidated overburden was described as topsoil, sandy clay, gravel, and sandy clay and boulders. All of these wells were drilled much deeper into the bedrock in an attempt to reach fractures in the rock that were sufficiently open, contained water, and were interconnected

sufficiently to allow water to flow to the well when it is pumped. The depth to water bgs (below ground surface) ranged from 4-18 feet in several relatively shallow wells drilled to depths of 42, and 43, and 55 feet. Most other wells were drilled to between 55-197 feet deep, with static water levels measured between 20-79 feet bgs. The wells appear to have been completed in (terminated into) and drew most of their water from limestone, sandstone, and shale. These are all rock types seen within the meta-sedimentary Belt Supergroup. This aquifer is considered a shallow unconfined aquifer that is within fractured bedrock. Fractured rock is an extremely variable aquifer where yields are dependent upon the degree of fracturing, the orientation of the fractures, their interconnectivity with other fractures, and whether the fractures are sufficiently open to contain and transmit water to a well. As such, well yields are generally low, but quite variable, and seem to mostly be from 10-25 gallons/minute.

Groundwater within the shallow unconfined aquifer (mostly within the fractured bedrock) flows from the highlands to points of discharge, which are the small or large stream valleys eroded into the bedrock. Within the Checkerboard Creek watershed groundwater flows relatively parallel to surface water, which is down the flanks of the highlands and toward the stream valleys. Within the stream valley groundwater may discharge to the surface as a spring, discharge into the creek, or within the bedrock or alluvium turn and flow parallel the stream channel in a downstream direction. So, beneath the community of Checkerboard, groundwater is estimated to be flowing to the northeast toward the Checkerboard Creek confluence with the North Fork Musselshell River. This should also be the situation for groundwater beneath the Checkerboard Bar, Motel, and Trailer Court public water supply (PWS). There is an additional source of water located in the vicinity of the PWS well (Well 1 2000 / WL003) that can potentially impact the well. An irrigation ditch draws water from Checkerboard Creek just upstream from the confluence with Brooks Creek. This irrigation ditch then flows northeast along the north face of the hill toward the highway, before turning to the east. It is very common for irrigation ditches to leak and discharge water to the subsurface along much of their length. This ditch has the potential to allow water from the creek to recharge groundwater just uphill from the well.

General Description of the Source Water

Groundwater beneath the Checkerboard Bar, Motel, and Trailer Court PWS is present within the shallow fractured bedrock beneath the site. Most area wells are between 55-197 feet deep, with static water levels measured between 20-79 feet bgs. Area wells draw water from limestone, sandstone, and shale bedrock which are the meta-sedimentary rock of the Belt Supergroup. This aquifer is considered a shallow unconfined aquifer. Fractured rock is an extremely variable aquifer, but local yields are generally between 10-25 gallons/minute. Groundwater beneath the PWS is estimated to be flowing to the northeast toward the Checkerboard Creek confluence with the North Fork Musselshell River.

The Public Water Supply

The Checkerboard Bar, Motel, and Trailer Court public water supply has 7 commercial service connections and 1 residential connection that provide water each day for up to 50 transients and 4 residents. The water system is served by 1 well and a pressure control assembly. Information detailing the construction of Well 1 2000 (WL003) is seen below with a well log attached at the end of this document. The well for this PWS is located approximately as depicted on Figures 1a and 1b. DEQ classifies this water system as a Transient Non-Community PWS due to the nature of the population served. Tables 1 and 2 provide a tabular summary of this PWS and what is known about the PWS well.

Table 1. Checkerboard Bar, Motel, and Trailer Court PWS

DEQ PWS ID # MT0001522		Transient Non-Community PWS	
Total Population: 50 transients (customers) 4 non-transients/residents		Service Connections: 7 commercial 1 residential	
DEQ Facilities List		Location	
Facility Name	DEQ ID	Latitude	Longitude
Well #1 2000	WL003	46.57114	-110.54511
Well 1 Sample Pt.	EP502 RW003	Well and sample points are Active	
Spring 1 (inactive)	SP002 (inactive)	46.5701	-110.5489
Pressure Tank 1	PC001		
Distribution System	DS001	Service to the bar, trailer court, buildings, and grounds	
Distr. Sample Pt.	SP001	Sample point for the distribution lines	

Table 2. PWS Well Log Information

Well 1 2000 (WL003)	
Site Name on Log	Richard George
GWIC ID	186211
Owner Name	Richard George
Location	See Table 1, above
Completion Date	01 December 2000
Driller	Vidic Drilling, Inc. Lic. # WWC-526
Casings	-2-38 feet bgs, 6 inch steel 10-140 feet bgs, 4 inch PVC 140-160 feet bgs, 4 inch factory slotted PVC screen
Well Seal	0-38 bentonite pellets
Total Depth	160 feet bgs
Static Water Level	50 feet bgs
Pumped at 12 gpm w/ drawdown to 140 feet bgs	

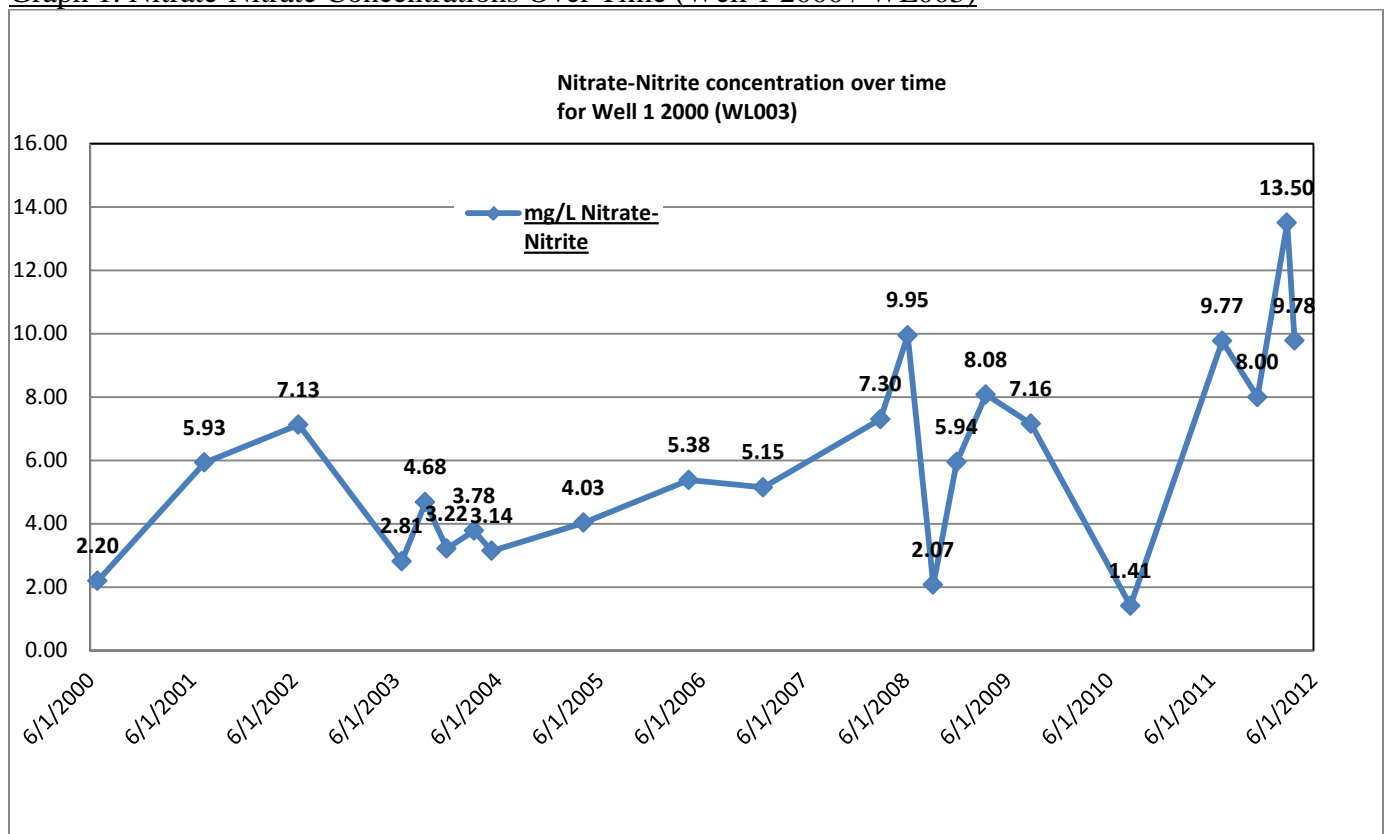
Note: The above information is drawn from the MBMG GWIC well log and DEQ files. This and several other well logs for Checkerboard are also found at the end of this document. Also note that there is a well log for the Checkerboard Bar and Trailer (GWIC # 22273, installed on 24 November 1987) included at the end of this document. This well matches what is known of the previous well used by this PWS. Water quality data collected by the MBMG GWIC is also included for the PWS well, the old PWS well, and another well believed to be located in the area.

Water Quality

Every PWS is required to perform regular sampling of their water supply to detect contamination. The analytical parameters for transient non-community PWSs include: coliform bacteria (including fecal coliform and *E. coli* bacteria) and nitrate-nitrite. The Checkerboard Bar, Motel, and Trailer Court PWS’s list of facilities, monitoring schedule, monitoring data (analytical history), and a summary of the regulatory history for the PWS are available from DEQ’s PWS database, which is can be accessed at the following site: (<http://www.deq.mt.gov/wqinfo/pws/reports.mcp>). Coliform bacteria (including fecal coliform

bacteria) have not been detected at confirmed levels in the source water for the past 7 years. Since Well 1 2000 (WL003) has been on-line, the nitrite + nitrate concentrations have ranged from 2.07-13.5 mg/L. The EPA's maximum contaminant level (MCL) allowable in public water supplies is 10 mg/L. The concentrations of nitrate-nitrite in the water samples have fluctuated wildly over time and no clear pattern seen. That is besides the fact that the most recent samples are the highest yet and seem to be remaining high. It is completely unclear if the well is receiving significant contamination from septic or other human-related sources or if the nitrate originates in the groundwater already present in the aquifer. It should be noted that ambient groundwater quality was analyzed in 3 wells in and around Checkerboard by the MBMG GWIC. These wells are the current PWS's Well 1 2000 (WL003), the Checkerboard Bar's old PWS well, and a well identified as belonging to Dave Sorensen. The well logs and the water quality data for these wells are attached. I was unable to find water quality for any other wells in the area, other than one for the USDA Forest Service campground in Spring Gulch. Due to the distance from Checkerboard, the water quality data from this well is not comparable with that in the PWS well. The 2 nearer wells (the old PWS well and the Sorensen well) both have data nitrate-nitrite data from the MBMG GWIC well sampling. Sorensen's well had 1.14 mg/L nitrate. The current PWS Well 1 2000 had 6.87 mg/L nitrate, and the old PWS well had 7.38 mg/L nitrate. I didn't go back into the DEQ Public Water Supply database to pull out the sampling history of the old PWS well. Both the old and new PWS wells have a very similar water chemistry, with elevated sulfate, nitrate, calcium, magnesium, total dissolved solids, and hardness. Most of these constituents are approximately 50% higher in the PWS Well 1 2000 and the old PWS well than seen in the Sorensen well. It is unclear if this suggests that the nitrate is coming from a geologic source (a bedrock deposit) or some human contaminant source that is reaching both the wells. It is noteworthy that the current PWS Well 2000 and the Sorensen well are drawing water from similar depths, whereas the old PWS well draws from a significantly shallower depth in the bedrock and seems to be located within the stream valley of Checkerboard Creek. Why the similarities between the wells and groundwater exist or why they are different are important questions with no clear answers. See below for a graph of nitrate concentrations over time in routine water samples taken from Well 1 2000 (WL003).

Graph 1. Nitrate-Nitrite Concentrations Over Time (Well 1 2000 / WL003)



Wastewater Disposal

This PWS probably utilizes several large capacity septic tanks and drainfields. These scattered systems would be associated with the trailer court, the trailers and cabin area, and the bar. The last sanitary survey (2012) suggested that the cabins may not have been serviced with water or septic disposal, but didn't go on to indicate where any of the septic facilities are located onsite. The surface vegetation above any drainfield on this site is likely to be grass. This information was derived from the DEQ's Sanitary Survey report (2012), and the 2011 aerial photograph of the site.

DELINEATION

Conceptual Model and Aquifer Sensitivity

Groundwater beneath the Checkerboard Bar, Motel, and Trailer Court PWS is present within the shallow fractured bedrock beneath the site. Most area wells are between 55-197 feet deep, with static water levels measured between 20-79 feet bgs. Area wells draw water from limestone, sandstone, and shale bedrock which are the meta-sedimentary rock of the Belt Supergroup. This aquifer is considered a shallow unconfined aquifer. Fractured rock is an extremely variable aquifer, but local yields are generally between 10-25 gallons/minute. Groundwater beneath the PWS is estimated to be flowing to the northeast toward the Checkerboard Creek confluence with the North Fork Musselshell River.

Based on the above information and assumptions, the aquifer beneath this site has a High Source Water Sensitivity to contamination at or near the surface. DEQ has defined sensitivity as the degree of ease with which contaminants may migrate to the source water aquifer. This determination is according to the DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (DEQ 1999).

Delineation Results

Control Zone

A 100-foot radius Control Zone is delineated around the Checkerboard Bar, Motel, and Trailer Court's PWS well. Refer to Figures 1a and 1b for a depiction of the Control Zone and surrounding area. Note that the PWS well is probably isolated from the septic systems associated with the bar, trailer court, and the cabins, but is located down-gradient from the mobile home to the southwest. The well is located north of the irrigation ditch that runs along the flank of the hill to the south. The ditch encroaches within the Control Zone, which is a concern due to the common problem of leakage from ditches, especially those that run across coarse sediments or bedrock. All potential contaminant sources should be excluded from the Control Zone.

Inventory Region

The Inventory Region for the Checkerboard Bar, Motel, and Trailer Court PWS consists of a modified 1-mile radius circle around the PWS well. This 1-mile delineated region was modified to eliminate areas that would be lateral or down-gradient from the well (based on groundwater flowing to the northeast). As such, the region ended up being a somewhat fan-shaped area that extends up the Checkerboard Creek and Brooks Creek drainages (see Figure 4 – Inventory Region). Potential contaminant sources of nitrate and pathogens were inventoried within this region.

Limiting Factors

Delineation of the source water protection areas for the Checkerboard Bar, Motel, and Trailer Court PWS well is based on a simplified approach using an arbitrary modified fixed radius. Due to the variable influence of fractures on groundwater flow, the actual movement of groundwater within the bedrock formations is not completely understood (especially within a small area) and the changes in the flow

regime under seasonal conditions is a complication that adds to the difficulty. This delineation was completed using conservative assumptions to help ensure that the source water protection areas reflect the actual areas where contamination to the PWS may occur.

INVENTORY

Inventory Method

Significant potential contaminant sources (PCSs) in the source water protection areas (the Control Zone and Inventory Region) were inventoried to assess the susceptibility of the Checkerboard Bar, Motel, and Trailer Court's PWS well to contamination, and to provide a foundation for protection planning. The inventory for this PWS's protection regions focuses on facilities or features that generate, use, store, or transport potential contaminants. It is important to remember that the sites and areas identified in this section are only potential sources of contamination to the drinking water. Contamination of drinking water sources is less likely when potential contaminants are properly used, managed, and/or disposed. The inventory for the Checkerboard Bar, Motel, and Trailer Court focuses on all activities in the Control Zone for the well and certain types of facilities and land uses in the Inventory Region. Information on facilities and land uses that are potential sources of regulated contaminants comes from a number of databases and other publicly available information sources.

Inventory Results

Control Zone

The high-resolution aerial photo-base used for the Figures was collected in the summer of 2011, so it is the most recent aerial photo of the property available at the time of this report. There probably are several onsite large capacity septic disposal systems (septic tanks; sewer lines; and drainfields) servicing the bar, cabins, and trailer court, but it doesn't appear that these are within the Control Zone. Although a request was made to the Meagher County sanitarian, no septic permits for the area were provided. The Control Zone for the PWS well encloses a grassed area that is bounded by the bar to the west, a residence to the southwest, the trailer court and motel cabins are on the north and northeast. An irrigation ditch runs through the southern portion of the Control Zone. The water system should take steps to reduce or eliminate the use or storage of chemicals within the Control Zone.

Inventory Region

The inventory results for the Checkerboard Bar, Motel, and Trailer Court PWS's Inventory Region are summarized in the following section, on Tables 3, and are depicted on Figure 3. The inventory of significant potential contaminant sources (PCSs) includes at least a couple of large capacity septic systems serving the Checkerboard Bar, Motel, and Trailer Court. A large capacity septic system is one that serves more than 20 persons/day. Within the Inventory Region there is an underground fuel storage tank (UST) site and leaking underground fuel storage tank (LUST) site associated with the bar. Contaminants associated with UST & LUST sites are not regulated for transient non-community PWSs (such as the Checkerboard Bar). As such, the LUST or UST sites are not assigned a hazard. There is an area of medium density private onsite septic systems serving residences in the community of Checkerboard. Along Checkerboard Creek are several fields that are dedicated to hay production. They don't appear to be irrigated. The determination of Hazard is discussed in the following section. It is basically the likelihood of contamination (from a PCS) within the Inventory Region. The actual potential susceptibility of the PWS well to these PCSs (potential contaminant sources) is assessed in the next section. Susceptibility reflects the fact that there are several types of barriers that may stand between a PCS and the PWS well.

SUSCEPTIBILITY ASSESSMENT

Hazard and Susceptibility

The threat of contamination is referred to as hazard. For wells drawing water from a shallow unconfined bedrock aquifer, the degree of hazard is determined by several factors. These are the proximity of a potential contaminant source (PCS) to a well intake; potential contaminant migration pathways (properly sealed/grouted wells, channels of contaminant flow, or drainage patterns); the volume and toxicity of a potential contaminant; or by the density of potential non-point contaminant sources (such as agricultural acres or septic system density).

Susceptibility is an expression of the probability for a public water supply to be contaminated by inventoried PCSs at concentrations that would pose a concern. Susceptibility is assessed to prioritize potential pollutant sources and focus attention on management strategies that may reduce the likelihood of contamination events. Several management strategies that could be used by the PWS managers and operators are recommended in this chapter. Susceptibility is determined by considering the hazard rating for each PCS relative to any barriers that may stand between the PCS and the PWS well. Barriers to contamination are anything that decreases the likelihood that contaminants will reach a spring or well. Barriers can be any of the following items: a) engineered structures, b) management actions, or c) natural conditions.

- Examples of engineered barriers include spill catchment structures and leak detection for underground storage tanks. They can be the use of lined lagoons and secondary containment for livestock waste lagoons.
- Emergency planning and best management practices (BMPs) are considered management barriers. Programs to monitor and evaluate contaminant migration are also considered management barriers.
- Thick clay-rich soils, a deep water table, or a thick saturated zone above the well intake are examples of natural barriers.

A summary of the susceptibility assessment for the Checkerboard Bar, Motel, and Trailer Court production well is provided in Table 3 (below). The greatest threats to the Checkerboard Bar, Motel, and Trailer Court PWS well (i.e., the PCS for which the well is most susceptible) appears to be:

- The facility's own onsite large capacity septic disposal systems. These tanks and drainfields can fail and discharge effluent into the shallow bedrock without a system backing up.
- The irrigation canal. These canals are known to leak and may transport contaminants to the area of the PWS well.
- Domestic septic systems in the community of Checkerboard that are near and directly up-gradient from the well. These would be the homes located on either side of Forest Road South directly southwest of the wellhead.

Management Recommendations

Note that even small releases of some effluent or chemicals in close proximity to a public water supply well might have significant negative impact on water quality (can cause serious contamination), and therefore are a significant threat to the public water supply. This is especially true when the soil or overburden is thin and the fractured bedrock is near the surface (as is the case beneath this PWS). System managers can take steps to reduce the likelihood of releases into the source water. The susceptibility table (Table 3) details management recommendations for protecting the Checkerboard Bar, Motel, and Trailer Court's drinking water supply. Implementing these management recommendations together with other similar actions should act as additional barriers between a contaminant source and the PWS well. Collectively they should reduce the susceptibility of the well intake to specific contaminant sources.

Table 3. Susceptibility Assessment

(For significant potential contaminant sources in the Inventory Region)

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Large capacity onsite septic systems servicing the bar, trailer court, and other buildings onsite.	Pathogens and nitrate	Leaks or effluent discharge that may be poorly treated that might reach the water table / unconfined aquifer. These are treated as point sources in the Inventory Region.	High Hazard Due to proximity of the large septic systems to the PWS well.	<ul style="list-style-type: none"> • The static water level and the top of the aquifer are greater than 100 feet above the well's intake. • Well construction for Well 1 2000 listed up to 38 feet of bentonite seal around the outside of the well casing. • Most of these septic systems are believed to be lateral to the groundwater flow direction (they are not up-gradient from the well). 	Moderate Susceptibility	<ul style="list-style-type: none"> • Attempt to manage the volumes and types of chemicals that are dumped to the onsite septic systems. This can be done by posting notices at all sinks and drains. Some of these chemicals are extremely difficult for bacteria to eliminate or will actually kill off the bacteria in a septic system that are needed to treat septic effluent. • Ensure that the septic tanks are pumped on a regular basis to maintain proper treatment. These systems can build up solids and reach a point where they fail to treat the effluent, and may do so without the septic lines backing up. • Montana DEQ Source Water Protection can and does provide free training classes on the management of small well and septic systems. • When a system fails, consider upgrading to a system with higher level of nutrient reduction.

Table 3. Susceptibility Assessment

(For significant potential contaminant sources in the Inventory Region)

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
<p>Irrigation canal. Leakage of water from the canal can introduce nitrogen and/or pathogens into the water table near the well.</p>	<p>Pathogens and nitrate</p>	<p>Water discharge from the irrigation ditch that reaches the local water table near the PWS well. The ditch may collect and transport contaminants that were present in Checkerboard Creek and bring them to the wellhead.</p>	<p>High Hazard Due to proximity of the irrigation ditch to the well in an up-gradient location.</p>	<ul style="list-style-type: none"> • The static water level and the top of the aquifer are greater than 100 feet above the well's intake. • Well construction for Well 1 2000 listed up to 38 feet of bentonite seal around the outside of the well casing. 	<p>Moderate Susceptibility</p>	<ul style="list-style-type: none"> • Ask the ditch managers about the potential leakage of water from the ditch. If it appears to be leaking, encourage the ditch managers to line the ditch with clay (especially in the vicinity and upgradient/upstream of your well)

Table 3. Susceptibility Assessment

(For significant potential contaminant sources in the Inventory Region)

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
<p>Smaller onsite septic systems servicing the residences in-town. Located on the east side of Checkerboard Creek. These are treated collectively as a point source of contamination.</p>	Pathogens and nitrate	Leaks or effluent discharge that may be poorly treated that might reach the water table / unconfined aquifer. These are treated collectively as a point source in the Inventory Region.	<p>High Hazard Due to proximity of the large septic systems to the PWS well. Note that these septic systems are directly up-gradient from the well.</p>	<ul style="list-style-type: none"> • The static water level and the top of the aquifer are greater than 100 feet above the well’s intake. • Well construction listed up to 38 feet of bentonite seal around the outside of the well casing. 	<p>Moderate Susceptibility</p>	<ul style="list-style-type: none"> • Encourage landowners to manage the volumes and types of chemicals that are dumped to their onsite septic systems. This can be done by supplying them with educational materials. Some of these chemicals are extremely difficult for bacteria to eliminate or will actually kill off the bacteria in a septic system needed to treat septic effluent. • Promote septic tank pumping on a regular basis to maintain proper treatment. These systems can build up solids and reach a point where they fail to treat the effluent, and may do so without the septic lines backing up. • Montana DEQ Source Water Protection can and does provide free training classes on the management of small well and septic systems. • When a system fails, encourage the landowner to upgrade to a system with higher level of nutrient reduction.

Table 3. Susceptibility Assessment

(For significant potential contaminant sources in the Inventory Region)

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
<p>Smaller onsite septic systems servicing the residences in-town. Located on the west side of Checkerboard Creek. These are collectively treated as a non-point source of contamination.</p>	Pathogens and nitrate	Leaks or effluent discharge that may be poorly treated that might reach the water table / unconfined aquifer. These are treated collectively as a non-point source in the Inventory Region.	<p>Moderate Hazard Due to proximity of these septic systems to the PWS well.</p>	<ul style="list-style-type: none"> • The static water level and the top of the aquifer are greater than 100 feet above the well’s intake. • Well construction for Well 1 2000 listed up to 38 feet of bentonite seal around the outside of the well casing. • Most of these septic systems are believed to be lateral to the groundwater flow direction (they are not up-gradient from the well). • Checkerboard Creek probably acts as a barrier between these septic systems and the PWS well. 	<p>Low Susceptibility</p>	<ul style="list-style-type: none"> • Encourage landowners to manage the volumes and types of chemicals that are dumped to their onsite septic systems. This can be done by supplying them with educational materials. Some of these chemicals are extremely difficult for bacteria to eliminate or will actually kill off the bacteria in a septic system needed to treat septic effluent. • Promote septic tank pumping on a regular basis to maintain proper treatment. These systems can build up solids and reach a point where they fail to treat the effluent, and may do so without the septic lines backing up. • Montana DEQ Source Water Protection can and does provide free training classes on the management of small well and septic systems. • When a system fails or needs repair, encourage the landowner to upgrade to a system with higher level of nutrient reduction.

Table 3. Susceptibility Assessment

(For significant potential contaminant sources in the Inventory Region)

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Agricultural land used for hay production, along Checkerboard Creek.	Nitrate	If this land is fertilized or cropped in such a way that nitrate is released into the subsurface and reaches the shallow unconfined fractured bedrock aquifer. This could be due to over fertilization or fertilizer spills, followed by wet weather that can drive the fertilizer into the subsurface.	Low (due to small acreage/low percent of the Inventory Region because it appears to be non-irrigated.	<ul style="list-style-type: none"> • Longitudinal riparian area along Checkerboard Creek. • Subsurface flow of Brooks Creek into Checkerboard Creek. 	Very Low Susceptibility	<ul style="list-style-type: none"> • Encourage best management practices by the landowner and the hay producer.

Note : The above susceptibility determination is for wells that withdraw water from a shallow fractured bedrock unconfined/water table aquifer. The aquifer is within the shallow bedrock. Groundwater flow direction is to the northeast.

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- Various Authors, 2007-2012. Correspondence in DEQ’s PWS files regarding Checkerboard Bar, Motel, and Trailer Court Water Supply.

GLOSSARY

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Aquifer. A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing non-point source pollution.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Confined Aquifer. A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit. A geologic formation present above a confined aquifer that inhibits the flow of water and maintains the pressure of the groundwater in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

Delineation. The process of determining and mapping source water protection areas.

Glacial. Of or relating to the presence and activities of ice or glaciers. Also, pertaining to distinctive features and materials produced by or derived from glaciers.

Hazard. A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

Hydraulic Conductivity. A constant number or coefficient of proportionality that describes the rate water can move through an aquifer material.

Inventory Region. A source water management area for groundwater systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified three year groundwater travel time.

Large Capacity Septic System. Defined by Underground Injection Control regulations as an on-site septic system serving 20 or more persons.

Maximum Contaminant Level (MCL). Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act to establish concentrations of contaminants in drinking water that are protective of human health.

Montana Bureau of Mines and Geology – Groundwater Information Center (MBMG/GWIC). The database of information on all well drilled in Montana, including stratigraphic data and well construction data, when available.

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or groundwater at increased levels that may exceed MCLs.

Pathogens. A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

Point Source. A stationary location or a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

Pollutant. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource (e.g. groundwater used for drinking water).

Public Water System (PWS). A system that provides water for human consumption through at least 15 service connections or regularly serves 25 individuals.

Pumping Water Level. Water level elevation in a well when the pump is operating.

Recharge Region. An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers. As a source water management region, the term generally describes the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

Source Water. Any surface water, spring, or groundwater source that provides water to a public water supply.

Source Water Delineation and Assessment Report (SWDAR). A report for a public water supply that delineates source water protection areas, provides an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under “worst-case” conditions.

Source Water Protection Areas. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For groundwater sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Spill Response Region. A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

Static Water Level (SWL). Water level elevation in a well when the pump is not operating.

Susceptibility (of a PWS). The relative potential for a PWS to draw water contaminated at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. herbicides and pesticides).

Total Dissolved Solids (TDS). The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Toxicity. The quality or degree of being poisonous or harmful to plants, animals, or humans.

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

Turbidity. The cloudy appearance of water caused by the presence of suspended matter.

Unconfined Aquifer. An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Underground Storage Tanks (UST). A tank located at least partially underground and designed to hold gasoline or other petroleum products or chemicals, and the associated plumbing system.

Watershed. The region drained by, or contributing water to, a stream, lake, or other water body of water.

APPENDIX A – FIGURES

Figure 1a – Site Map

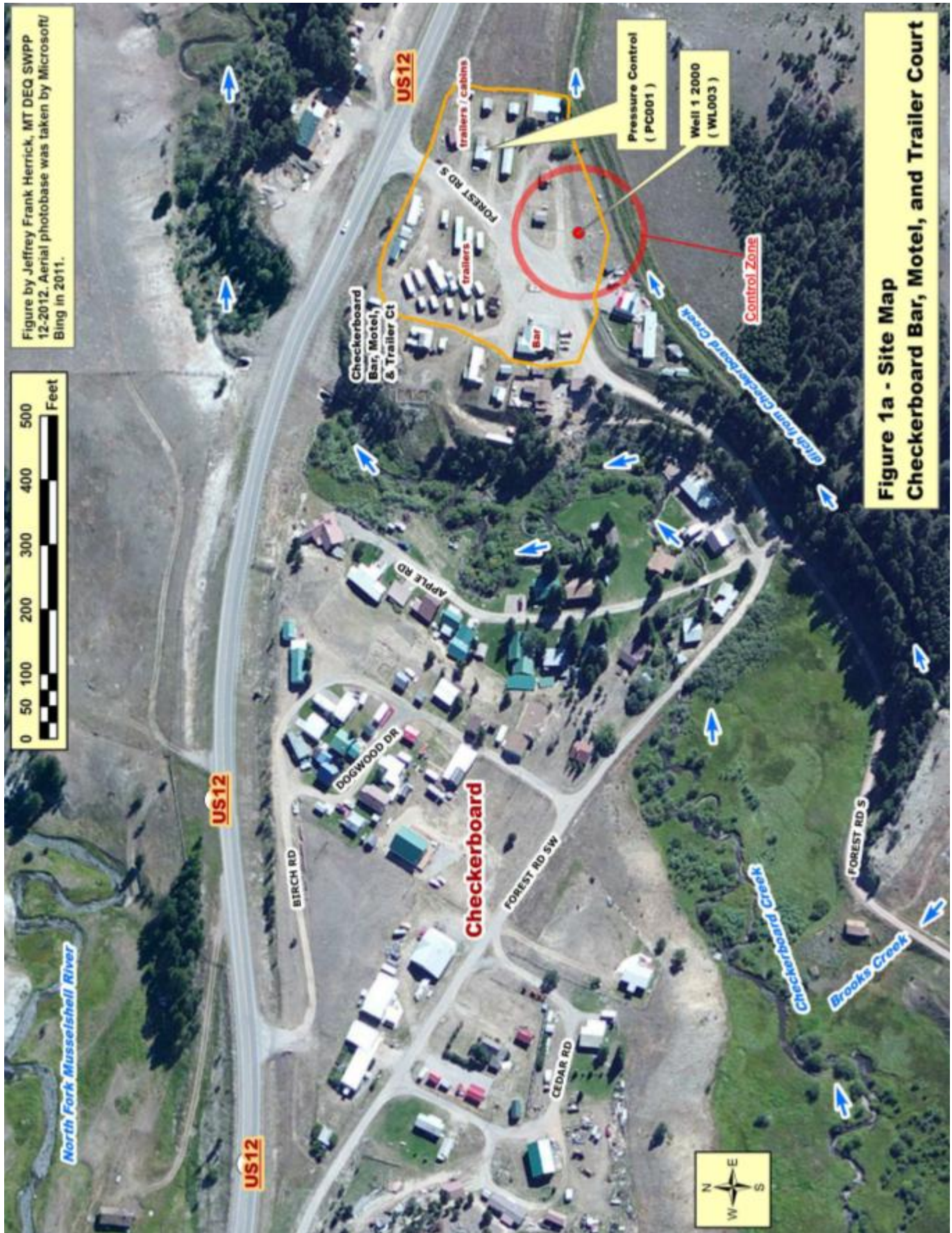


Figure 1b – Facilities Map

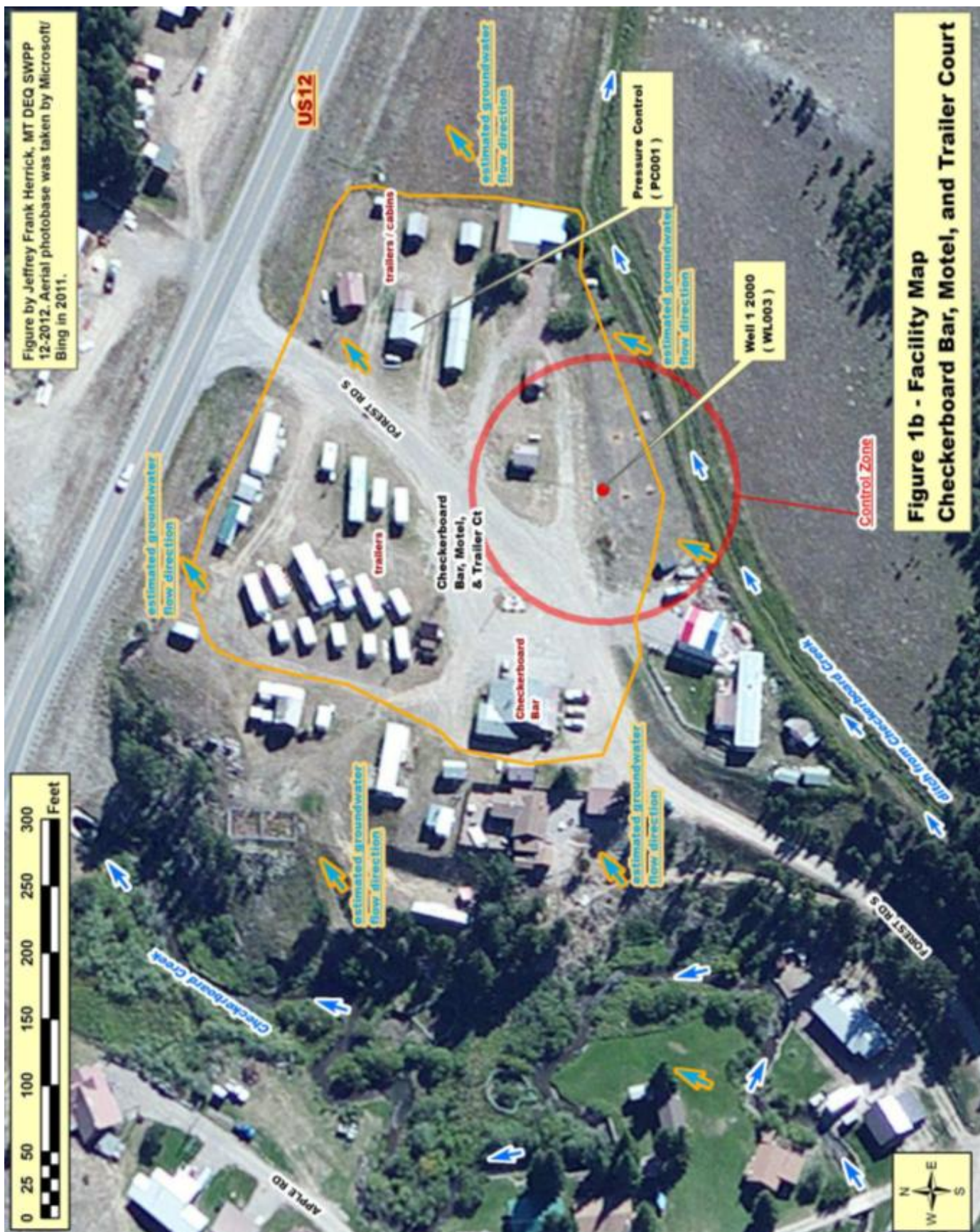


Figure 1b - Facility Map
Checkerboard Bar, Motel, and Trailer Court

Figure 2 – Geologic Map

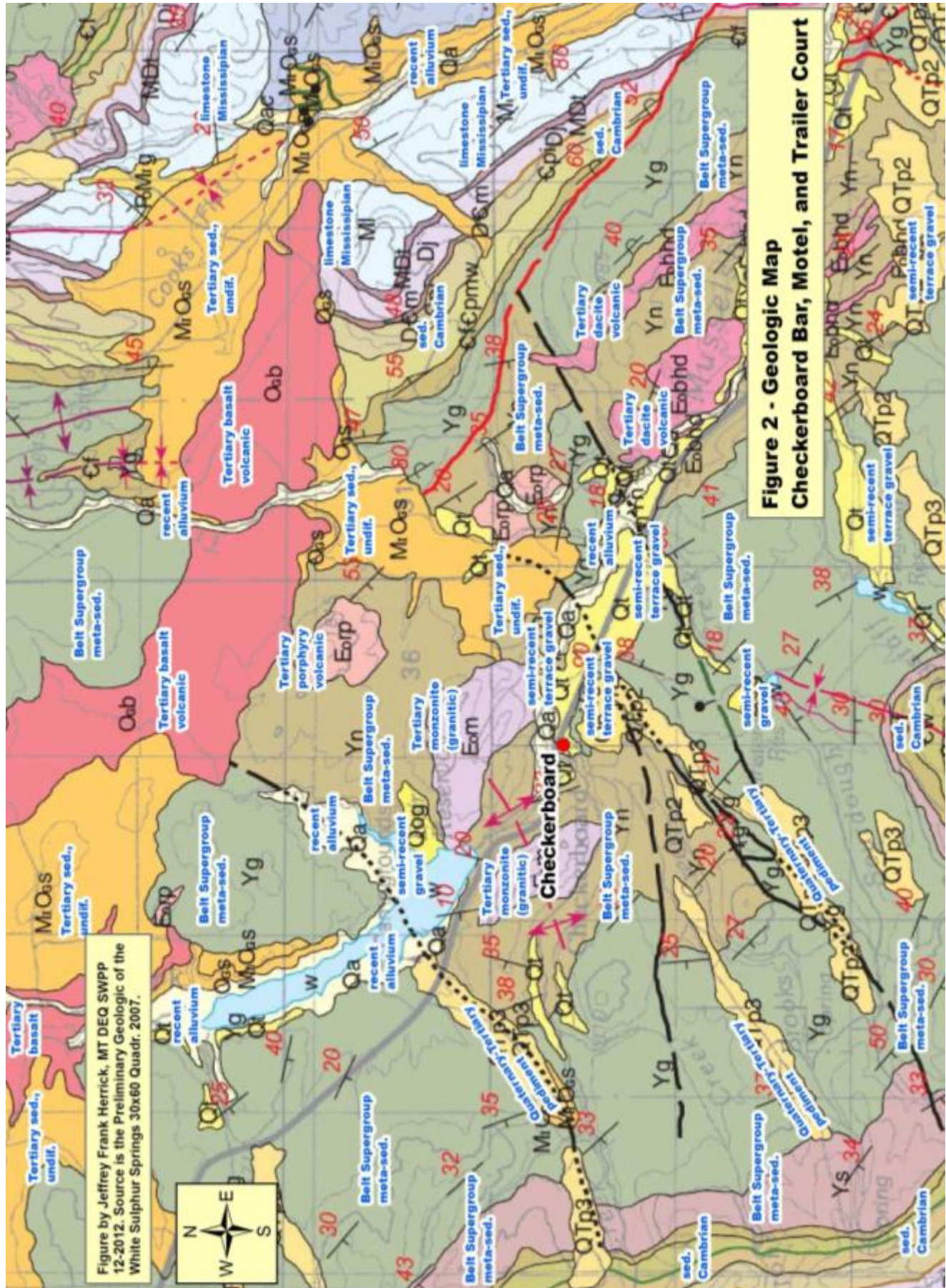
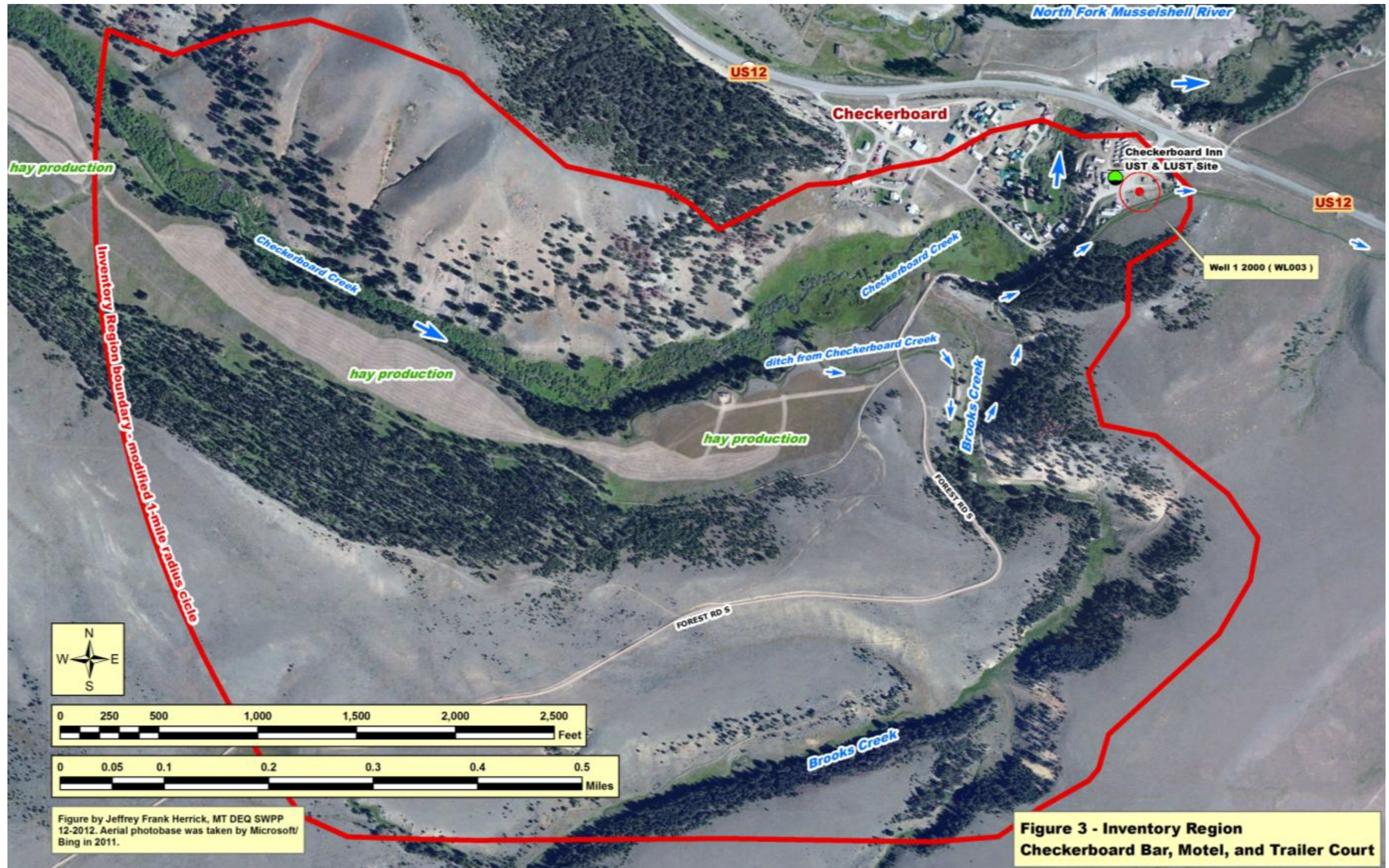


Figure 3 – Inventory Region



APPENDIX B – WELL LOGS

Note: Well logs are available through the Montana Bureau of Mines and Geology's Ground-Water Information Center (MBMG GWIC). What follows are several well logs for wells inside or adjacent to the Inventory Region of the Checkerboard Bar, Motel, and Trailer Court PWS. Well locations are extremely questionable.

The following well log is the most recent and currently active PWS well for the Checkerboard Bar, Motel, and Trailer Court.

MONTANA WELL LOG REPORT

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.

Site Name: GEORDGE, RICHARD
GWIC Id: 186211
DNRC Water Right: C115036-00

Section 7: Well Test Data

Total Depth: 160
 Static Water Level: 50
 Water Temperature:

Section 1: Well Owner

Owner Name
 GEORDGE RICHARD
Mailing Address
 HC 83 BOX 667
City **State** **Zip Code**
 MARTINSDALE MT 59053

Pump Test *

Depth pump set for test _ feet.
 12 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
 Time of recovery 0.25 hours.
 Recovery water level 50 feet.
 Pumping water level 140 feet.

Section 2: Location

Township	Range	Section	Quarter Sections
09N	09E	1	SW¼ SW¼ NW¼
County		Geocode	
MEAGHER			
Latitude	Longitude	Geomethod	Datum
46.5711115181	110.544683686	TRS-SEC	NAD83
Ground Surface Altitude		Method	Datum
5260			8/7/2001
Addition	Block	Lot	

* 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 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 8: Remarks

Section 4: Type of Work

Drilling Method: ROTARY

Section 9: Well Log

Geologic Source

400PIGN - PIEGAN GROUP

From	To	Description
0	1	TOPSOIL
1	10	SHALE AND CLAY STRINGERS
10	15	BROKEN SHALE LAYERS
15	20	SOFT CLAY
20	32	SHALE AND CLAY STRINGERS
32	43	HARD BLACK SHALE
43	55	LIMESTONE
55	60	FRACTURED BROWN SANDSTONE
60	76	LIMESTONE
76	85	BROWN CLAY AND BENTONITE
85	88	RED SHALE AND CLAY
88	95	GREEN SANDSTONE
95	135	GRAY LIMESTONE
135	145	GRAY LIMESTONE W/ FRACTURES
145	160	GRAY LIMESTONE

Section 5: Well Completion Date

Date well completed: Friday, December 01, 2000

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.

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	20	12
20	38	10
38	160	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	38	6	0.250			STEEL
10	140	4		200.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
140	160	4		0.0025X3	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	38	BENTONITE PELLETS	

Name:DENNIS VIDIC
Company:VIDIC DRILLING INC
License No:WWC-526
Date 12/1/2000
Completed:

Ground-Water Information Center Water Quality Report

Site Name: GEORDGE, RICHARD

Report Date: 12/4/2012

Location Information

Sample Id/Site Id: 2002Q0093 / 186211	Sample Date: 8/7/2001 12:10:00 PM
Location (TRS): 09N 09E 01 BCC	Agency/Sampler: MBMG / MLH
Latitude/Longitude: 46° 34' 16" N 110° 32' 40" W	Field Number:
Datum: NAD83	Lab Date: 11/20/2001
Altitude: 5260	Lab/Analyst: MBMG / JMC
County/State: MEAGHER / MT	Sample Method/Handling: /
Site Type: WELL	Procedure Type: DISSOLVED
Geology: 400PIGN	Total Depth (ft): 160
USGS 7.5' Quad: CHECKERBOARD	SWL-MP (ft): 48.5
PWS Id:	Depth Water Enters (ft): 140
Project: MRWS-SWP	

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	201.000	10.030	Bicarbonate (HCO3)	276.500	4.532
Magnesium (Mg)	129.000	10.615	Carbonate (CO3)	0.000	0.000
Sodium (Na)	37.100	1.614	Chloride (Cl)	22.900	0.646
Potassium (K)	4.940	0.126	Sulfate (SO4)	886.000	18.455
Iron (Fe)	0.060	0.002	Nitrate (as N)	6.87 P	0.490
Manganese (Mn)	<.001	0.000	Fluoride (F)	0.800	0.042
Silica (SiO2)	14.600		Orthophosphate (as P)	<.5	0.000
Total Cations		22.446	Total Anions		24.166

Trace Element Results (µg/L)

Aluminum (Al): <150	Cesium (Cs): NR	Molybdenum (Mo): <50	Strontium (Sr): 2,010.000
Antimony (Sb): <10	Chromium (Cr): <10	Nickel (Ni): <10	Thallium (Tl): <25
Arsenic (As): <5	Cobalt (Co): <10	Niobium (Nb): NR	Thorium (Th): NR
Barium (Ba): 11.300	Copper (Cu): 23.900	Neodymium (Nd): NR	Tin (Sn): NR
Beryllium (Be): <2	Gallium (Ga): NR	Palladium (Pd): NR	Titanium (Ti): <1
Boron (B): 92.700	Lanthanum (La): NR	Praseodymium (Pr): NR	Tungsten (W): NR
Bromide (Br): <500	Lead (Pb): <10	Rubidium (Rb): NR	Uranium (U): 36.900
Cadmium (Cd): <10	Lithium (Li): 135.000	Silver (Ag): <5	Vanadium (V): <25
Cerium (Ce): NR	Mercury (Hg): NR	Selenium (Se): 18.700	Zinc (Zn): 109.000
			Zirconium (Zr): <2

Field Chemistry and Other Analytical Results

**Total Dissolved Solids (mg/L): 1433.59	Field Hardness as CaCO3 (mg/L): NR	Ammonia (mg/L): NR
**Sum of Diss. Constituents (mg/L): 1574.13	Hardness as CaCO3: 1032.86	T.P. Hydrocarbons (µg/L): NR
Field Conductivity (µmhos): 1305	Field Alkalinity as CaCO3 (mg/L): NR	PCP (µg/L): NR
Lab Conductivity (µmhos): 1854	Alkalinity as CaCO3 (mg/L): 227.19	Phosphate, TD (mg/L as P): <.05
Field pH: 6.9	Ryznar Stability Index: 5.971	Field Nitrate (mg/L): NR
Lab pH: 7.71	Sodium Adsorption Ratio: 0.501	Field Dissolved O2 (mg/L): NR
Water Temp (°C): 14.5	Langlier Saturation Index: 0.870	Field Chloride (mg/L): NR
Air Temp (°C): 30	Nitrite (mg/L as N): NR	Field Redox (mV): NR
Nitrate + Nitrite (mg/L as N): NR	Hydroxide (mg/L as OH): NR	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: NR	Acidity to 8.3: NR
As(III) (ug/L): NR	As(V) (ug/L): NR	

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

Qualifiers: A = Hydride atomic absorption; E = Estimated due to interference; H = Exceeded holding time; J = Estimated quantity above detection limit but below reporting limit; K = Na+K combined; N = Spiked sample recovery not within control limits; 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 (HCO3, CO3, SO4, Cl, SiO2, NO3, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

MONTANA WELL LOG REPORT

Form No. 603 R2-99

Well ID# _____

This log reports the activities of a licensed Montana well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered. **This form is to be completed by the driller and filed with DNRC within 60 days of completion of the work. Acquiring Water Rights is the well owner's responsibility and is not accomplished by the filing of this report.**

Well log information is stored in the Groundwater Information Center at the Montana Bureau of Mines and Geology (Butte) and water right information is stored in the Water Rights Bureau records (Helena).

For fields that are not applicable, enter NA. Optional fields have a grayed background. Record additional information in the REMARKS section.

1. WELL OWNER:
 Name Richard George
 Mailing address HC 83 Box 667
Martinsdale, Montana 59053

2. WELL LOCATION: List ¼ from smallest to largest
 _____ ¼ SW ¼ SW ¼ NW ¼, Section 1
 Township 9 N Range 9 E County Meagher
 Lot _____, Tract/Blk _____ Subdivision Name _____
 Well Address _____
 GPS Yes No
 Latitude _____ Longitude _____
 Error as reported by GPS locator (± feet) _____
 Horizontal datum NAD27 WGS84

3. PROPOSED USE: Domestic Stock Irrigation
 Public water supply Monitoring Well Other: _____

4. TYPE OF WORK:
 New well Deepen existing well Abandon existing well
 Method: Cable Rotary Other: _____

5. WELL CONSTRUCTION DETAILS:
Borehole:
 Dia. 12 in. from 0 ft. to 20 ft.
 Dia. 10 3/4 in. from 20 ft. to 38 ft.
 Dia. 6 in. from 38 ft. to 160 ft.

Casing:
 Steel: Wall thickness 1.250 Threaded Welded
 Dia. 6 7/8 in. from 12 ft. to 38 ft.
 Dia. _____ in. from _____ ft. to _____ ft.

Plastic: Pressure Rating 200 lbs. Threaded Welded
 Dia. 4.5 in. from 10 ft. to 140 ft.

Perforations/Slotted Pipe:
 Type of perforator used Factory slotted
 Size of perforations/slots 0.025 in. by 3 in.
slots no. of perforations/slots from 140 ft. to 160 ft.
 _____ no. of perforations/slots from _____ ft. to _____ ft.

Screens: Yes No
 Material _____
 Dia. _____ Slot size _____ from _____ ft. to _____ ft.
 Dia. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel Packed: Yes No
 Size of gravel _____
 Gravel placed from _____ ft. to _____ ft.

Packer: Yes No
 Type _____ Depth(s) _____

Grout: Material used Bentonite Scheller
 Depth from 0 ft. to 38 ft. OR Continuous feed

6. WELL TEST DATA:
 A well test is required for all wells. (See details on well log report cover.)
 Static water level 50 ft. below top of casing or
 Closed-in artesian pressure _____ psi.
 How was test flow measured:
 bucket/stopwatch, weir, flume, flowmeter, etc _____
 Yellowstone Controlled Groundwater Area - Water Temperature _____ °F
 AQUIFER TEST DATA FORM ATTACHED

Test - 1 hour minimum
 Drawdown is the amount water level is lowered below static level.
 All depth measurements shall be from the top of the well casing.
 Time of recovery is hours/minutes since pumping stopped.

Air test*
8 gpm with drill stem set at 160 ft. for 1 hours
 Time of recovery 15 hrs/min. Recovery water level 50 ft.

OR Bailer test*
 _____ gpm with _____ ft. of drawdown after _____ hours
 Time of recovery _____ hrs/min. Recovery water level _____ ft.

OR Pump test*
 Depth pump set for test 150 ft.
12 gpm pump rate with 90 ft. of drawdown after 2 hrs pumping
 Time of recovery 15 hrs(min) Recovery water level 50 ft.

OR Flowing Artesian*
 _____ gpm for _____ hours
 Flow controlled by _____

*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.

7. WELL LOG: EA

Depth, Feet		Material:
From	To	color/rock and type/descriptor (example: blue/shale/hard, or brown/gravel/water, or brown/sand/heaving)
0	1	Topsoil
1	10	Shale & Clay stringers
10	15	Broken shale layers
15	20	Soft clay
20	32	Shale + Clay stringers
32	43	Hard Black shale
43	55	Limestone
55	60	Fractured Brown Sandstone
60	76	Limestone
76	85	Brown Clay & Bentonite
85	88	Red shale + clay
88	95	Green Sandstone
95	135	Gray limestone
135	145	Gray limestone w/ Fractures
145	160	Gray limestone

ADDITIONAL SHEETS ATTACHED

8. DATE WELL COMPLETED: 12-1-00

9. REMARKS: _____

10. DRILLER/CONTRACTOR'S 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, firm, or corporation (print) Vibic Drilling INC.
 Address P.O. Box 183, Roundup Mt.
 Signature Dennis J. Vukobratovic
 Date 12-24-00 License no. 526

The following well appears to be located (based on the listed coordinates) directly west of the active Checkerboard Bar PWS well, gwic 186211. It actual location is likely to be elsewhere in the area, but nearby.

MONTANA WELL LOG REPORT

Site Name: SORENSEN, DAVE
GWIC Id: 120963
DNRC Water Right: C075138-00

Section 7: Well Test Data

Total Depth: 197
 Static Water Level: 35
 Water Temperature:

Section 1: Well Owner

Owner Name
 SORENSEN DAVE
Mailing Address
 PO BOX 6931
City State Zip Code
 HARLOWTON MT 59036

Air Test *

1 gpm with drill stem set at feet for 1.25 hours.
 Time of recovery hours.
 Recovery water level feet.
 Pumping water level 185 feet.

Section 2: Location

Township	Range	Section	Quarter Sections			
09N	09E	1	NW¼	SW¼	SW¼	NW¼
County			Geocode			
MEAGHER						
Latitude	Longitude	Geomethod	Datum			
46.571322291667	110.544495058333	SUR-GPS	NAD83			
Ground Surface Altitude	Method	Datum	Date			
5259.262	SUR-GPS	NAVD88	4/4/2012			
Measuring Point Altitude	Method	Datum	Date Applies			
5260.262	SUR-GPS	NAVD88	11/9/1993	10:55:00 AM		
Addition	Block	Lot				

* 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
 400PIGN - PIEGAN GROUP

From	To	Description
0	2	TOP SOIL
2	50	HARD BROWN SANDSTONE
50	59	BLACK SHALE W/CLAY
59	67	HARD BLACK SHALE W/CHERT AND QUARTZ STONE
67	78	DARK GRAY SAND
78	98	DARK GRAY BACK SHALE W/BENT (DAMP)
98	121	HARD BLACK SILTY SHALE W/CHERT AND QUARTZ
121	128	HARD GRAY BROWN LIME W/CHERT
128	138	HARD DARK GRAY SAND W/GYM STREAKS
138	162	HARD DARK GRAY SAND
162	169	GREEN SAND
169	180	HARD GRAY LIME W/CHERT AND QUARTZ (VERY FRACTURED)
180	185	LIME (PIPER)
185	192	HARD GRAY SAND (AQUIFER)
192	197	HARD SILTY SANDY SHALE

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: UNKNOWN

Section 5: Well Completion Date

Date well completed: Thursday, June 07, 1990

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	18.6	10
18.6	197	6.5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.5	18.57		0.25		WELDED	STEEL
7	195	4				PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
0	0	4			.2IN FACTORY CUT

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18.6	JOLCLAY & BENTONITE	

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:
Company: HUNT DRILLING
License No: WWC-207
Date: 6/7/1990
Completed:

Location Information

Sample Id/Site Id: 2002Q0095 / 120963	Sample Date: 8/7/2001 12:35:00 PM
Location (TRS): 09N 09E 01 BCCB	Agency/Sampler: MBMG / MLH
Latitude/Longitude: 46° 34' 16" N 110° 32' 40" W	Field Number: 120963
Datum: NAD83	Lab Date: 11/20/2001
Altitude: 5259.262	Lab/Analyst: MBMG / JMC
County/State: MEAGHER / MT	Sample Method/Handling: PUMPED / 4220
Site Type: WELL	Procedure Type: DISSOLVED
Geology: 400PIGN	Total Depth (ft): 197
USGS 7.5' Quad: CHECKERBOARD 7 1/2'	SWL-MP (ft): 38
PWS Id:	Depth Water Enters (ft): 0
Project: GWAAMON, RADON	

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	151.000	7.535	Bicarbonate (HCO3)	274.300	4.496
Magnesium (Mg)	85.700	7.052	Carbonate (CO3)	0.000	0.000
Sodium (Na)	15.000	0.653	Chloride (Cl)	7.110	0.201
Potassium (K)	4.060	0.104	Sulfate (SO4)	563.000	11.727
Iron (Fe)	0.068	0.002	Nitrate (as N)	1.14 P	0.081
Manganese (Mn)	0.002	0.000	Fluoride (F)	0.086	0.005
Silica (SiO2)	16.100		Orthophosphate (as P)	<.5	0.000
Total Cations		15.386	Total Anions		16.510

Trace Element Results (µg/L)

Aluminum (Al): <150	Cesium (Cs): NR	Molybdenum (Mo): <50	Strontium (Sr): 1,490.000
Antimony (Sb): <10	Chromium (Cr): <10	Nickel (Ni): <10	Thallium (Tl): <25
Arsenic (As): <5	Cobalt (Co): <10	Niobium (Nb): NR	Thorium (Th): NR
Barium (Ba): 28.300	Copper (Cu): 32.400	Neodymium (Nd): NR	Tin (Sn): NR
Beryllium (Be): <2	Gallium (Ga): NR	Palladium (Pd): NR	Titanium (Ti): <1
Boron (B): 36.300	Lanthanum (La): NR	Praseodymium (Pr): NR	Tungsten (W): NR
Bromide (Br): <500	Lead (Pb): <10	Rubidium (Rb): NR	Uranium (U): <2.5
Cadmium (Cd): <10	Lithium (Li): 97.900	Silver (Ag): <5	Vanadium (V): <25
Cerium (Ce): NR	Mercury (Hg): NR	Selenium (Se): 9.030	Zinc (Zn): 55.800
			Zirconium (Zr): <2

Field Chemistry and Other Analytical Results

**Total Dissolved Solids (mg/L): 976.76	Field Hardness as CaCO3 (mg/L): NR	Ammonia (mg/L): NR
**Sum of Diss. Constituents (mg/L): 1115.79	Hardness as CaCO3: 729.79	T.P. Hydrocarbons (µg/L): NR
Field Conductivity (µmhos): 1048	Field Alkalinity as CaCO3 (mg/L): NR	PCP (µg/L): NR
Lab Conductivity (µmhos): 1404	Alkalinity as CaCO3 (mg/L): 224.73	Phosphate, TD (mg/L as P): <.05
Field pH: 7.42	Ryznar Stability Index: 5.879	Field Nitrate (mg/L): NR
Lab pH: 8.06	Sodium Adsorption Ratio: 0.2416	Field Dissolved O2 (mg/L): NR
Water Temp (°C): 16.3	Langlier Saturation Index: 1.091	Field Chloride (mg/L): NR
Air Temp (°C): 32	Nitrite (mg/L as N): NR	Field Redox (mV): NR
Nitrate + Nitrite (mg/L as N): NR	Hydroxide (mg/L as OH): NR	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: NR	Acidity to 8.3: NR
As(III) (ug/L): NR	As(V) (ug/L): NR	

Notes

Sample Condition: CLEAR COLORLESS
 Field Remarks:
 Lab Remarks:

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

Qualifiers: **A** = Hydride atomic absorption; **E** = Estimated due to interference; **H** = Exceeded holding time; **J** = Estimated quantity above detection limit but below reporting limit; **K** = Na+K combined; **N** = Spiked sample recovery not within control limits; **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 (HCO3, CO3, SO4, Cl, SiO2, NO3, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

This appears to be the old PWS well, now inactivated. I believe it is located near the confluence with Brooks Creek.

MONTANA WELL LOG REPORT

Site Name: CHECKERBOARD BAR MOTEL AND TRAILER COURT

Section 7: Well Test Data

GWIC Id: 22273
DNRC Water Right: C066906-00

Total Depth: 69
Static Water Level: 48
Water Temperature:

Section 1: Well Owner

Owner Name
GEORDGE, RICHARD AND JUDITH
Mailing Address
HC83 BOX 646
City State Zip Code
MARTINDALE MT 59053

Air Test *

20 gpm with drill stem set at feet for 2 hours.
Time of recovery hours.
Recovery water level feet.
Pumping water level 60 feet.

Section 2: Location

Township	Range	Section	Quarter Sections	
09N	09E	2	SE¼ SW¼	SE¼ NE¼
County			Geocode	
MEAGHER				
Latitude	Longitude	Geomethod	Datum	
46.5701	110.5489	MAP	NAD27	
Ground Surface Altitude		Method	Datum	Date
5275				8/26/2002
Measuring Point Altitude		Method	Datum	Date Applies
5275		UNKNOWN	NGVD29	2/27/2002
Addition		Block	Lot	

* 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**

400BELT - BELT SUPERGROUP

From	To	Description
0	2	TOPSOIL
2	50	HARD BROWNSTONE WITH BLACK SHALE STREAKS
50	56	BROWN SANDSTONE WITH CLAY
56	59	HARD QUARTZ ROCK
59	62	HARD BLACK GRAY SHALE
62	64	BROWN STONE AND CLAY
64	68	HARD BLACK QUARTZ SHALE
68	69	DARK BROWN SANDSTONE WITH CLAY

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: FORWARD ROTARY

Section 5: Well Completion Date

Date well completed: Tuesday, November 24, 1987

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	19	10
19	69	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint Type
-1.5	19	7			17 LB STEEL
15	65	4			3.25 LB SCH. 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
50	65	4			SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	45	CLAY AND BENTONITE	

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: MERLE E. HUNT
Company: HUNT DRILLING
License No: WWC-207
Date: 11/24/1987
Completed:

**Ground-Water Information Center Water Quality
Report**

Site Name: CHECKERBOARD BAR MOTEL AND TRAILER COURT

Report Date: 12/6/2012

Location Information

Sample Id/Site Id: 2003Q0341 / 22273	Sample Date: 8/26/2002 11:40:00 AM
Location (TRS): 09N 09E 02 ADCD	Agency/Sampler: MBMG / LGO
Latitude/Longitude: 46° 34' 12" N 110° 32' 56" W	Field Number: 09N09E0
Datum: NAD27	Lab Date: 11/25/2002
Altitude: 5275	Lab/Analyst: MBMG / KTH
County/State: MEAGHER / MT	Sample Method/Handling: PUMPED / 4000
Site Type: WELL	Procedure Type: DISSOLVED
Geology: 400BELT	Total Depth (ft): 69
USGS 7.5' Quad: CHECKERBOARD	SWL-MP (ft): NR
PWS Id: 01522002	Depth Water Enters (ft): 50
Project: PWSINV	

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	225.000	11.228	Bicarbonate (HCO3)	314.800	5.160
Magnesium (Mg)	135.000	11.109	Carbonate (CO3)	0.000	0.000
Sodium (Na)	48.200	2.097	Chloride (Cl)	21.000	0.592
Potassium (K)	4.880	0.125	Sulfate (SO4)	913.000	19.018
Iron (Fe)	0.014	0.001	Nitrate (as N)	7.38 P	0.527
Manganese (Mn)	<0.001	0.000	Fluoride (F)	2.000	0.105
Silica (SiO2)	13.400		Orthophosphate (as P)	<1.0	0.000
Total Cations		24.621	Total Anions		25.402

Trace Element Results (µg/L)

Aluminum (Al): <30	Cesium (Cs): NR	Molybdenum (Mo): <10	Strontium (Sr): 2,180.000
Antimony (Sb): <10	Chromium (Cr): <10.0	Nickel (Ni): <2.0	Thallium (Tl): <20
Arsenic (As): NR	Cobalt (Co): <2.0	Niobium (Nb): NR	Thorium (Th): NR
Barium (Ba): 13.600	Copper (Cu): <5.0	Neodymium (Nd): NR	Tin (Sn): NR
Beryllium (Be): <2.0	Gallium (Ga): NR	Palladium (Pd): NR	Titanium (Ti): <1.0
Boron (B): 122.000	Lanthanum (La): NR	Praseodymium (Pr): NR	Tungsten (W): NR
Bromide (Br): <1000	Lead (Pb): NR	Rubidium (Rb): NR	Uranium (U): NR
Cadmium (Cd): <1.0	Lithium (Li): 165.000	Silver (Ag): NR	Vanadium (V): <10
Cerium (Ce): NR	Mercury (Hg): NR	Selenium (Se): <15	Zinc (Zn): 31.300
			Zirconium (Zr): <2

Field Chemistry and Other Analytical Results

**Total Dissolved Solids (mg/L): 1517.2	Field Hardness as CaCO3 (mg/L): NR	Ammonia (mg/L): NR
**Sum of Diss. Constituents (mg/L): 1677.03	Hardness as CaCO3: 1117.49	T.P. Hydrocarbons (µg/L): NR
Field Conductivity (µmhos): 1717	Field Alkalinity as CaCO3 (mg/L): NR	PCP (µg/L): NR
Lab Conductivity (µmhos): 1956	Alkalinity as CaCO3 (mg/L): 258.35	Phosphate, TD (mg/L as P): <0.05
Field pH: 6.7	Ryznar Stability Index: 5.761	Field Nitrate (mg/L): NR
Lab pH: 7.71	Sodium Adsorption Ratio: 0.6248	Field Dissolved O2 (mg/L): NR
Water Temp (°C): 8.7	Langlier Saturation Index: 0.974	Field Chloride (mg/L): NR
Air Temp (°C): NR	Nitrite (mg/L as N): <1.0	Field Redox (mV): NR
Nitrate + Nitrite (mg/L as N): NR	Hydroxide (mg/L as OH): NR	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: NR	Acidity to 8.3: NR
As(III) (ug/L): NR	As(V) (ug/L): NR	

Notes

Sample Condition: CLEAR ODORLESS
 Field Remarks:
 Lab Remarks:

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

Qualifiers: A = Hydride atomic absorption; E = Estimated due to interference; H = Exceeded holding time; J = Estimated quantity above detection limit but below reporting limit; K = Na+K combined; N = Spiked sample recovery not within control limits; 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 (HCO3, CO3, SO4, Cl, SiO2, NO3, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

MONTANA WELL LOG REPORT

Site Name: EVIG ROSS
GWIC Id: 194119
DNRC Water Right: C30001306

Section 7: Well Test Data

Total Depth: 72
 Static Water Level: 40
 Water Temperature:

Section 1: Well Owner

Owner Name
 EVIG ROSS
Mailing Address
 305 WANDA LANE
City **State** **Zip Code**
 BILLINGS MT 59101

Air Test *

15 gpm with drill stem set at 70 feet for 1 hours.
 Time of recovery 0.08 hours.
 Recovery water level 40 feet.
 Pumping water level feet.

Section 2: Location

Township	Range	Section	Quarter Sections	
09N	09E	2	SE¼ SE¼ NE¼	
County		Geocode		
MEAGHER				
Latitude	Longitude	Geomethod	Datum	
46.571119	110.54721	TRS-SEC	NAD83	
Ground Surface Altitude		Method	Datum	Date

** 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.*

Addition	Block	Lot
RUX LAND	13	

Section 8: Remarks

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	1	TOPSOIL
1	12	BROKEN SHALE ROCK
12	25	HARD SHALE AND SANDSTONE
25	30	CLAY
30	40	BLACK HARD SHALE
40	45	BROWN LIMESTONE
45	50	BLACK SHALE AND QUARTZ
50	60	BLACK AND GRAY SHALE
60	65	BROWN LIMESTONE
65	72	GRAY SHALE AND CLAY

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Friday, February 01, 2002

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	18	10
18	72	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	18	6	0.250			STEEL
10	52	4		200.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
52	72	4		0.0025X3	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18	BENTONITE	
45	45	SHALE PACKER	

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.

<p>Name: Company:VIDIC DRILLING INC License No:WWC-526 Date:2/1/2002 Completed:</p>
--

This well was among those found in the area. The coordinates place it in Checkerboard, but it is unknown exactly where.

MONTANA WELL LOG REPORT

Site Name: GEORGE RICHARD
 GWIC Id: 186213

Section 7: Well Test Data

Total Depth: 110
 Static Water Level: 65
 Water Temperature:

Section 1: Well Owner

Owner Name
 GEORGE RICHARD

Mailing Address

HC 83 BOX 667

City	State	Zip Code
MARTINSDALE	MT	59053

Air Test *

18 gpm with drill stem set at 128 feet for 1 hours.
 Time of recovery 0.17 hours.
 Recovery water level 65 feet.
 Pumping water level feet.

Section 2: Location

Township	Range	Section	Quarter Sections
09N	09E	2	SE¼ NE¼

County	Geocode
MEAGHER	

Latitude	Longitude	Geomethod	Datum
46.572071	110.548524	TRS-SEC	NAD83

Ground Surface Altitude	Method	Datum	Date

* 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.

Addition	Block	Lot

Section 8: Remarks

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Friday, December 01, 2000

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	18	10
18	130	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	18	6	0.250			STEEL
10	110	4		200.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
110	130	4		0.0025X3	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18	BENTONITE PELLETS	

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	1	TOPSOIL
1	8	BROWN SANDSTONE AND GRAVEL
8	20	BROWN SANDSTONE
20	45	HARD BLACK SHALE
45	50	SOFT BLACK SHALE
50	55	LIMESTONE
55	70	BLACK SOFT SHALE
70	78	LIMESTONE
78	100	BLACK SOFT SHALE
100	105	HARD BLACK SHALE
105	108	BLACK SHALE SEMI HARD
108	120	GRAY SANDSTONE WATER
120	130	LIMESTONE-HARD

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:DENNIS VIDIC
Company:VIDIC DRILLING INC
License No:WWC-526
Date 12/1/2000
Completed:

MONTANA WELL LOG REPORT

Site Name: GLEASON VERN & F
GWIC Id: 22278
DNRC Water Right: C066908-00

Section 7: Well Test Data

Total Depth: 55
 Static Water Level: 10
 Water Temperature:

Section 1: Well Owner

Owner Name
 GLEASON, VERN & FRANCIS
Mailing Address
 2952 GEORGIN DRIVE
City State Zip Code
 BILLINGS MT 59102

Bailer Test *

20 gpm with feet of drawdown after 2.5 hours.
 Time of recovery hours.
 Recovery water level feet.
 Pumping water level 45 feet.

Section 2: Location

Township	Range	Section	Quarter Sections
09N	09E	2	SE¼ SE¼ NE¼
County		Geocode	
MEAGHER			
Latitude	Longitude	Geomethod	Datum
46.571119	110.54721	TRS-SEC	NAD83
Ground Surface Altitude	Method	Datum	Date

* 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.

Addition	Block	Lot

Section 8: Remarks

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: FORWARD ROTARY

Section 5: Well Completion Date

Date well completed: Saturday, November 28, 1987

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	21	7.875
10	55	6.5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.5	21	7				STEEL
10	55	4.5				PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
25	50	4.5			SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	21	BENTONITE DROVE PIPE THRU GRAVEL	

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	8	TOPSOIL
8	21	GRAVEL
21	28	BLACK SAND
28	29	DARK SANDY SHALE AND CHERT STREAKS
29	30	BROWNISH CLAY W/ SANDY SHALE
30	37	HARD BLACK SAND
37	38	BROWN SANDSTONE W/ CLAY
38	43	HARD BLACK SAND W/ CHERT
43	45	DOLOMITE AND CHERT
45	52	HARD BLACK SAND
52	55	HARD DARK SANDY SHALE

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:MERLE E. HUNT
Company:HUNT DRILLING
License No:WWC-207
Date 11/28/1987
Completed:

The following well log is for the Forest Service well located at the Spring Gulch Campground, which is not near Checkerboard and unlikely to have water quality data that is comparable.

MONTANA WELL LOG REPORT

Site Name: USDA FOREST SERVICE
GWIC Id: 159257
DNRC Water Right: C100579-00

Section 7: Well Test Data

Total Depth: 102
 Static Water Level: 26
 Water Temperature:

Section 1: Well Owner

Owner Name

LEWIS & CLARK NAT FOR-USFS

Mailing Address

PO BOX 869

City	State	Zip Code
GREAT FALLS	MT	59403

Pump Test *

Depth pump set for test _ feet.
 _ gpm pump rate with _ feet of drawdown after 1.5 hours of pumping.
 Time of recovery 1 hours.
 Recovery water level 26 feet.
 Pumping water level 80 feet.

Section 2: Location

Township	Range	Section	Quarter Sections
10N	10E	33	NE¼ NE¼ SW¼ NE¼
County		Geocode	
MEAGHER			
Latitude	Longitude	Geomethod	Datum
46.587844124	110.46896851825	TRS-SEC	NAD83
Ground Surface Altitude	Method	Datum	Date
5240	UNKNOWN		8/6/2001

* 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.

Addition	Block	Lot
SPRING CREEK CAMPGROUND		

Section 8: Remarks

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Tuesday, October 22, 1996

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	18	10
18	102	6.5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	18	6	.250			STEEL
3	102	4.5				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
10	30	4		0.025	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18	BENTONITE	

Section 9: Well Log

Geologic Source

377UDFD - LOWER CAMBRIAN UNDIFFERENTIATED

From	To	Description
0	21	ALLUVIAL GRAVEL SANDS
21	24	SANDSTONE
24	27	LIMESTONE
27	36	FRACTURED SANDSTONE INTERMITTENT CLAY BEDS
36	39	SANDSTONE
39	45	SANDSTONE
45	47	SANDSTONE CLAY LAYERS
47	50	BROWN CLAY
50	69	SANDSTONE
69	78	GRAY SHALE SILTSTONE LAYERS
78	93	BROWN SANDSTONE
93	102	GRAY SILTSTONE

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.

<p>Name:DAVID WARD Company:FOUR STAR DRILLING License No:WWC-520 Date:10/22/1996 Completed:</p>
--

Location Information

Sample Id/Site Id: 2002Q0091 / 159257	Sample Date: 8/6/2001 3:45:00 PM
Location (TRS): 10N 10E 33 ACAA	Agency/Sampler: MBMG / MLH
Latitude/Longitude: 46° 35' 16" N 110° 28' 8" W	Field Number: 159257
Datum: NAD83	Lab Date: 11/20/2001
Altitude: 5240	Lab/Analyst: MBMG / JMC
County/State: MEAGHER / MT	Sample Method/Handling: PUMPED / 4220
Site Type: WELL	Procedure Type: DISSOLVED
Geology: 377UDFD	Total Depth (ft): 102
USGS 7.5' Quad: MOUNT HOWE	SWL-MP (ft): NR
PWS Id:	Depth Water Enters (ft): 10
Project: MRWS-SWP	

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	53.300	2.660	Bicarbonate (HCO3)	270.400	4.432
Magnesium (Mg)	16.500	1.358	Carbonate (CO3)	0.000	0.000
Sodium (Na)	4.210	0.183	Chloride (Cl)	0.918	0.026
Potassium (K)	1.540	0.039	Sulfate (SO4)	7.160	0.149
Iron (Fe)	0.020	0.001	Nitrate (as N)	<.5 P	0.000
Manganese (Mn)	0.015	0.001	Fluoride (F)	0.096	0.005
Silica (SiO2)	13.700		Orthophosphate (as P)	<.05	0.000
Total Cations		4.284	Total Anions		4.612

Trace Element Results (µg/L)

Aluminum (Al):	<30	Cesium (Cs):	NR	Molybdenum (Mo):	<10	Strontium (Sr):	310.000
Antimony (Sb):	<2	Chromium (Cr):	<2	Nickel (Ni):	2.140	Thallium (Tl):	<5
Arsenic (As):	<1	Cobalt (Co):	<2	Niobium (Nb):	NR	Thorium (Th):	NR
Barium (Ba):	183.000	Copper (Cu):	4.520	Neodymium (Nd):	NR	Tin (Sn):	NR
Beryllium (Be):	<2	Gallium (Ga):	NR	Palladium (Pd):	NR	Titanium (Ti):	<1
Boron (B):	<30	Lanthanum (La):	NR	Praseodymium (Pr):	NR	Tungsten (W):	NR
Bromide (Br):	<50	Lead (Pb):	<2	Rubidium (Rb):	NR	Uranium (U):	0.909
Cadmium (Cd):	<2	Lithium (Li):	11.000	Silver (Ag):	<1	Vanadium (V):	<5
Cerium (Ce):	NR	Mercury (Hg):	NR	Selenium (Se):	<1	Zinc (Zn):	1,160.000
						Zirconium (Zr):	<2

Field Chemistry and Other Analytical Results

**Total Dissolved Solids (mg/L): 231.97	Field Hardness as CaCO3 (mg/L): NR	Ammonia (mg/L): NR
**Sum of Diss. Constituents (mg/L): 368.97	Hardness as CaCO3: 201	T.P. Hydrocarbons (µg/L): NR
Field Conductivity (µmhos): 592	Field Alkalinity as CaCO3 (mg/L): NR	PCP (µg/L): NR
Lab Conductivity (µmhos): 424	Alkalinity as CaCO3 (mg/L): 221.45	Phosphate, TD (mg/L as P): <.05
Field pH: 7.1	Ryznar Stability Index: 6.916	Field Nitrate (mg/L): NR
Lab pH: 7.94	Sodium Adsorption Ratio: 0.1228	Field Dissolved O2 (mg/L): NR
Water Temp (°C): 22.8	Langlier Saturation Index: 0.512	Field Chloride (mg/L): NR
Air Temp (°C): 35	Nitrite (mg/L as N): NR	Field Redox (mV): NR
Nitrate + Nitrite (mg/L as N) NR	Hydroxide (mg/L as OH): NR	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 NR	Acidity to 8.3 NR
As(III) (ug/L) NR	As(V) (ug/L) NR	

Notes

Sample Condition:
 Field Remarks:
 Lab Remarks:

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