

## 1 INTRODUCTION

Test Well #1 (TW#1) for the Gillette Madison Pipeline Project is located in the SW1/4, NE1/4, NE1/4 of Section 36, T.52N., R.67W. of the 6<sup>th</sup> Principal Meridian (W.R.M.), Crook County, Wyoming, at 740,037.46 East, 1,440,638.30 North, U.S. Survey Feet, State Plane (Wyoming East Zone) (Figure 1), NAD83, NAVD88. Land surface elevation at the wellhead is 4569.6 feet above mean sea level datum. Top of casing (TOC) elevation at the time of yield and drawdown testing was 4571.8 feet.

Test Well #1 is part of a groundwater development program implemented by the City of Gillette, Wyoming, as an element of on-going expansion of its sources of water supply in order to meet existing and future demands. Evaluation of potential sources of water in the region around Gillette, including both surface water and groundwater resources, was completed by the City of Gillette in 2007 (Morrison-Maierle, 2007). The 2007 Level II study identified the Madison aquifer in the vicinity of the existing City of Gillette Madison Well Field, north of Key Hole Reservoir and Moorcroft, as the most favorable alternative for future development of additional water supply from the standpoint of long-term resource quantity and reliability.

A test well at site #1 was drilled to verify the Madison aquifer yield and water quality at one of two sites selected for initial evaluation following the 2007 Level II study. The sites are referred to on Bid Documents and plans as test well sites #1 and #2. Test Well #1 was drilled to a total depth of 2801 feet and fully penetrated the Madison aquifer strata with a 6-inch nominal diameter open-hole completion. The static water level was approximately 729 feet to water BTOC. After stimulation by acid frac methods, the well was tested at a constant discharge rate of 1600 gpm, resulting in 711 feet of drawdown after 81 hours of uninterrupted pumping.

### 1.1 Permits and Certificate of Survey

Test Well #1 is located on State Lands. The Wyoming Board of Land Commissioners provided Temporary Use Permit No. 2119 to the City of Gillette for two test wells with drill pads and construction of an access road (Appendix A).

The Wyoming Office of the State Engineer (SEO) provided Permit No. U.W. 195671 to the City of Gillette for construction of a well referred to as "MADISON 11" in the SW1/4, SE1/4 of Section 36, T.52N., R.67W (Appendix A). The quarter-quarter section description is actually for Test Well Site #2, MADISON 12, and the quarter-quarter description on Permit 195672, MADISON 12, is actually the location for MADISON 11. The quarter-quarter descriptions are reversed on the permits. The priority date of Permit No. U.W. 195671 is February 16, 2011. The permit was extended in late 2012.

The Wyoming Department of Environmental Quality (DEQ) issued to the City of Gillette, Permit to Construct, Permit No. 11-065, City of Gillette Madison Well 11, Madison Pipeline Project, issued 7/20/2011. The DEQ also provided the Layne Christensen



Figure 1: Location of Test Well Sites #1 and #2.

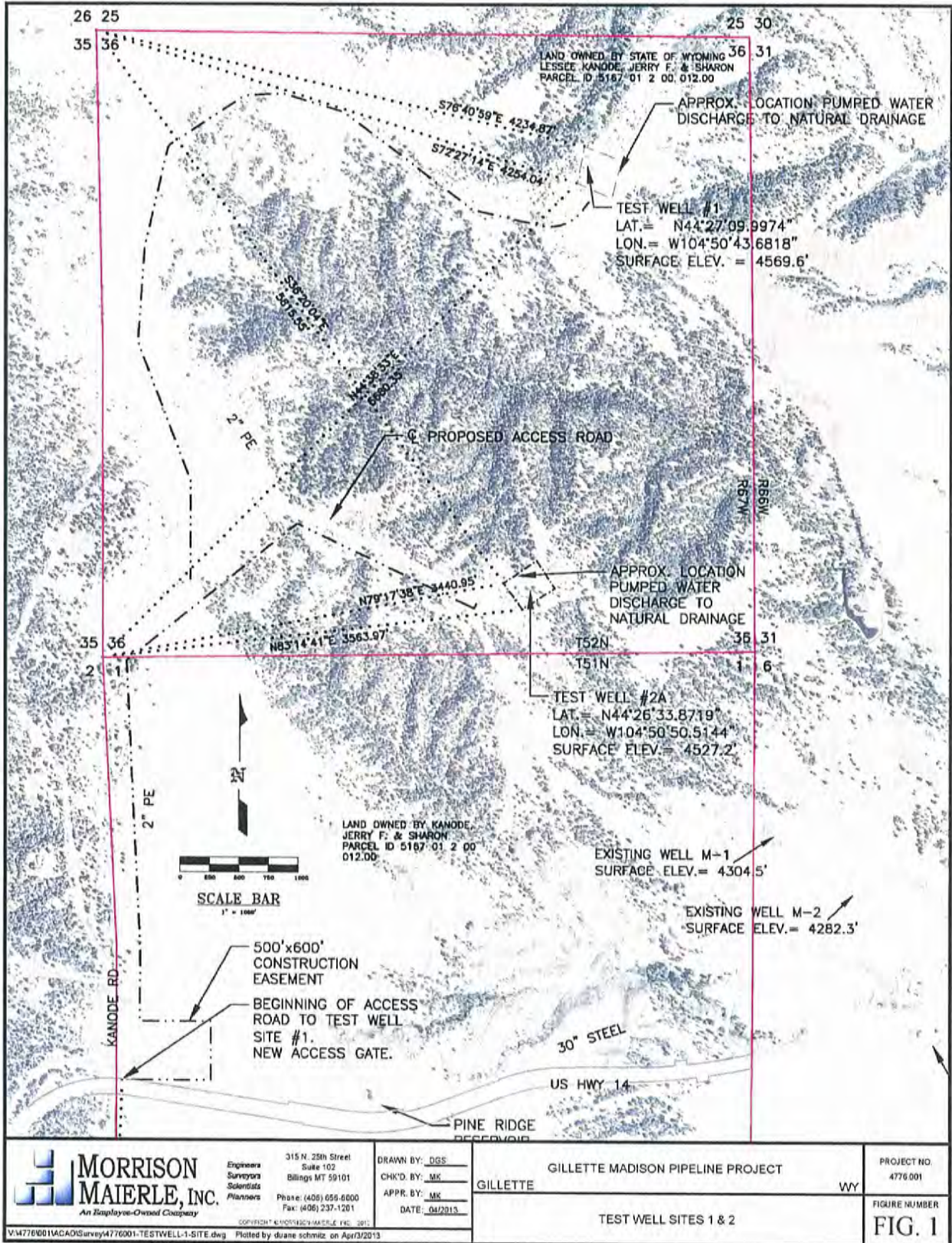




Figure 2: Location of Test Well #1 on drill pad.

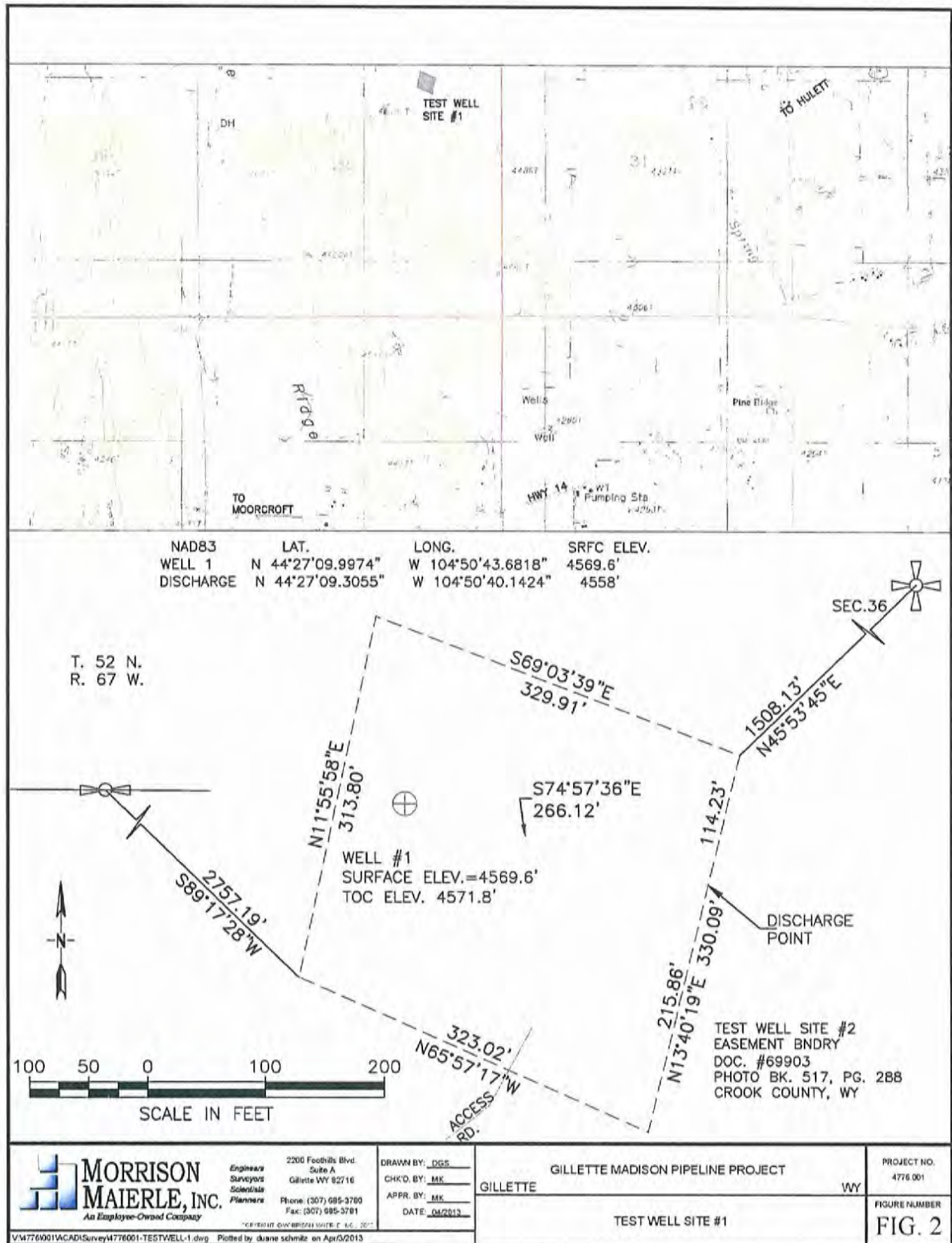
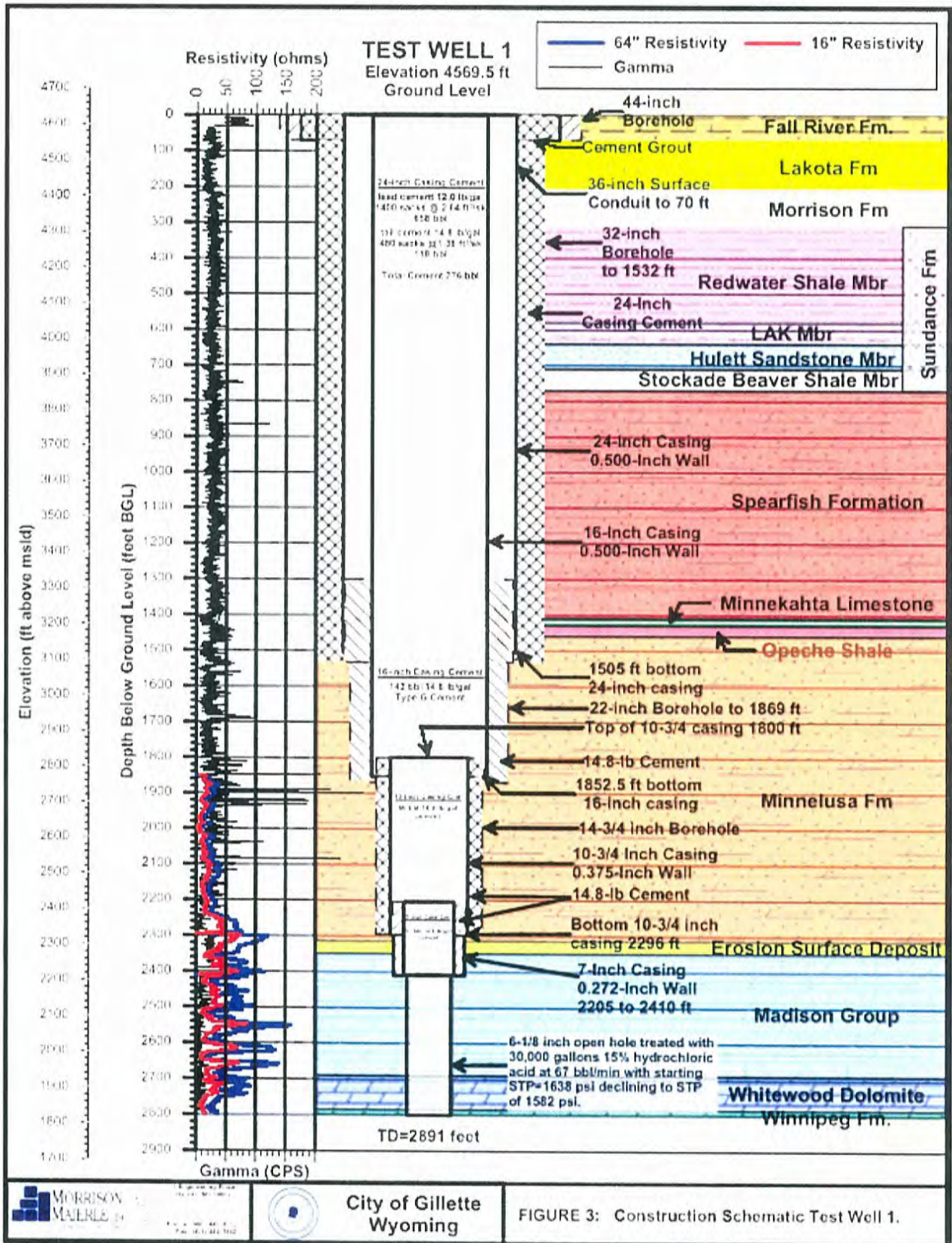


Figure 3: Well completion drawing for Test Well #1.





Company authorization under the Wyoming Pollutant Discharge Elimination System (WYPDES) General Permit for Temporary Discharges, WYG72091 (Appendix A), and renewed that permit on 1/11/2013.

The Certificate of Survey for completed Test Well #1 (Madison Well M-11) is provided in Appendix B.

## **1.2 Consultants, Contractors and Support Services**

Morrison-Maierle, Inc., working as a subconsultant to the design engineering consultant of Burns & McDonnell, provided geologic consulting services for selection of sites for the test wells. Likewise, Morrison-Maierle, Inc. provided civil engineering design services for access roads and drill pads, contract administration of the drilling contract, on-site geologic logging and hydrogeologic support for well completion, geophysical log interpretation and aquifer tests and construction and site surveying services.

The principal well drilling contractor was the Layne Christensen Company of Denver, Colorado with corporate offices in Fontana, California. Subcontractors to the Layne Christensen Company included Northstar Energy and Construction, LLC (formerly MGM) of Gillette for access road and drilling pad construction and Wyoming Caisson Drilling Companies of Gillette and Rat Hole Drilling of Casper for surface conduit installations.

Brannan Trucking Inc. of Gillette installed water line to provide drilling fluid water at the test well sites as well as water hauling services in the winter when water line was frozen. Kissack Water and Oil Service, Inc. of Rozet and Brannan Trucking Inc. of Gillette provided water and mud hauling services; on-site frac tanks and used mud disposal services. Ridgeway Trucking of Casper provided cross-country trucking services.

Local site support included fuel from the Farmers Co-op Association of Gillette; motor oil, filters, and miscellaneous parts from NAPA in Sundance, site sanitation services from Big D Sanitation, Gillette; Ryan Sanitation Co., LLC, Gillette; and fork lift, generator and air compressor rentals from United Rentals in Gillette. Large generators used for primary electrical power to the drilling rig and mud pit pumps, as well as power for yield and drawdown test pumps, were provided by Wagner Cat of Aurora, Colorado.

Machine shop services for resurfacing drill collars, fabricating replacement parts, and rebuilding various rig equipment were provided by L&H Industrial of Gillette. Claude's Welding Service, Inc. of Gillette provided welding of steel well casing and cementing shoes, fabrication of casing hangers, and general rig repair and maintenance welding. Walker Inspection of Gillette provided inspection of drill pipe and drill collar tool joints.

Cement delivery and pumping for surface conduit (caisson) cementing was provided by Campbell County Concrete of Gillette. Drilling fluid products and mud engineering were provided by Baroid Industrial Drilling Products of Arvada, Colorado. Basic Energy

Services of Gillette provided deep well casing cementing services as well as high-pressure, hydraulic fracturing stimulation of Test Well #1 with acid.

Oilfield support services for fishing tools were provided by Weatherford International, Inc. of Riverton, Wyoming. Downhole geophysical logs were provided by Goodwell Incorporated, Gillette; gyroscopic drift and deviation surveys were provided by Gyrodata Incorporated, of Casper with support from Pioneer Wireline Services based in Casper.

Other Gillette businesses that provided support and materials for the project included Blackhawk Crane, Powder River Supply, Contractors Supply, DXP Safety, Airgas, National Oilwell, Firemaster, Conway Freight, Howard Supply (Casper and Gillette for Rigging Certification), Promax Systems, Home Depot, J&T Oilfield Electric, Crumb Electric Supply, Crescent Electric, Wyoming Caterpillar, Carquest Auto Supplies, O'Reilly Auto Supplies and East Side RV Services.

Fencing for the drill sites was installed by the Knode family who graze cattle on the State land where the wells are located and who provided insight to local concerns such as discharge of pumped water, potential for erosion and noise abatement.

Living quarters for the drilling crews and engineering and geologic support staff were obtained from the Best Western Motel, Gillette, the Rangeland Court Motel, Moorcroft, and the Empire Guest House, Pine Haven.

### **1.3 Start and Completion Dates**

Well construction startup began on 10/29/2012 with initiation of surface conduit installation and ended on 5/13 2013 with completion of a final drawdown and yield test. Construction of the well, prior to stimulation with acid fracturing and pumping tests, was completed on 2/26/2013, 120 days after installation of surface casing began.

A caisson drill commenced boring for installation of surface conduit for Test Well #1 (Madison 11) on 10/29/2012. Layne began rigging up on 10/31/2012 and finished cementing surface conduit on 11/1/2012. Rigging up continued through 11/8/2012, including center-punching for pilot hole, and drilling of 14-3/4 inch pilot hole began at 07:30 A.M. on 11/9/2012. The top of the Winnipeg Formation was called at a depth of 2791 feet and drilling was stopped at 2801 feet total depth at 03:00 A.M. on 2/26/2013, thus completing construction of the well.

The well was subjected to a brief step test on 3/10/2013 with rates ranging from 500 to 950 gpm, followed by a 6-hour, 900-gpm constant rate test on 3/11/2013. Based on the latter tests, the well was subjected to high-pressure hydraulic fracturing with 15% hydrochloric acid on 3/25/2013. This was followed by a stepped rate test on 4/13/2013 with rates ranging from 1015 to 1410 gpm before the test pump reached a horsepower limitation. A different pump was used to conduct an 81-hour constant rate test of the well at 1600 gpm, starting on 5/10/2013 with pumping stopped on 5/13/2013, thus ending work on the well other than collecting recovery data and removing the test pump.