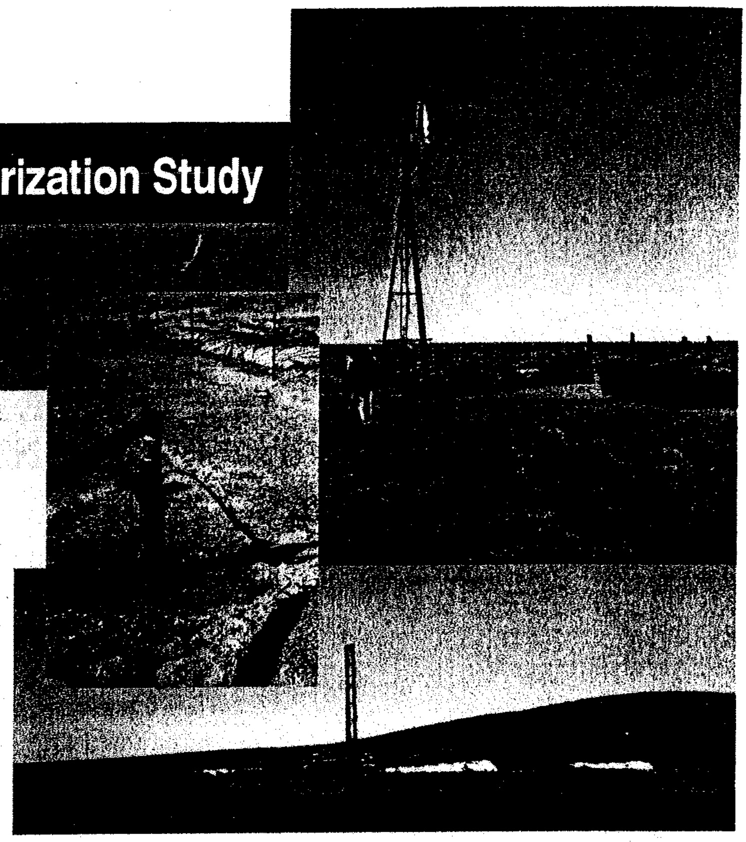
December 18, 2002

Preliminary Ground Water Characterization Study

Pinedale Anticline Production Area (PAPA)
Sublette County, Wyoming



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PRELIMINARY GROUND WATER CHARACTERIZATION STUDY

PINEDALE ANTICLINE PRODUCTION AREA SUBLETTE COUNTY, WYOMING

Prepared for:

U.S. Department of Interior
Bureau of Land Management
Pinedale Field Office

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TABLE OF CONTENTS

FIGURES

ATTACHMENTS

LIST OF ACRONYMS

AMSL	Above Mean Sea Level
BLM	Bureau of Land Management
BTEX	Benzene, toluene, ethylbenzene, and xylene
FO	Field Office
GIS	Geographic Information System
GPM	Gallons per minute
GPS	Global Positioning System
mg/L	Milligrams Per Liter
NSTC	National Science and Technology Center
NWIS	National Well Information System
PAPA	Pinedale Anticline Production Area
PGCS	Preliminary Ground Water Characterization Study
SCCD	Sublette County Conservation District
SOW	Statement of Work
TCF	Trillion cubic feet
TDS	Total Dissolved Solids
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WRCC	Western Regional Climate Center
WRDS	Water Resources Data System
WSEO	Wyoming State Engineers Office

1.0 INTRODUCTION

1.1 Authority, Purpose, and Scope

The Pinedale Anticline Production Area (PAPA) in west-central Wyoming is an important regional source of renewable (ground water) and nonrenewable energy resources. Ground water is drawn from relatively shallow wells (less than a few hundred feet deep) overlying deep natural gas-bearing strata from which deep production wells extract natural gas under very high pressure. The regional ground water aquifer is potentially susceptible to the upward seepage of pressurized natural gas along thrust fault scarp and/or failed production well completion conduits. To facilitate proactive water-resource management and protection, the United States Department of the Interior, Bureau of Land Management (BLM) authorized Dynamac Corporation (Dynamac) to prepare a Preliminary Ground Water Characterization Study (PGCS) and Geographic Information System (GIS) database of the Pinedale Anticline, Sublette County, Wyoming. Authorization directives are stated in BLM Contract Number 1422-N660-C98-3003 and the BLM Statement of Work (SOW) dated September 10, 2002, which was prepared by the BLM Pinedale Field Office and the BLM National Science and Technology Center (NSTC).

The general purpose of this directive is to support BLM's future water-resource management responsibilities associated with regional oil/gas development. This PGCS utilizes existing information such as USGS publications, ground water levels, and major ion chemistry to build a GIS database containing data relative to aquifer characteristics, general water quality, well and spring locations, ground/surface water interaction, and potentiometric surface contour mapping.

The general scope of work consists of several SOW performance requirements. In summary, these requirements stipulate the compilation and presentation of existing water and geologic data corresponding to the study area. The primary sources of existing data include USGS National Well Information System (NWIS) files; BLM well reconnaissance of 2001; University of Wyoming Water Resources Data System (WRDS) files; Wyoming State Engineers Office (WSEO) database; the Sublette County Conservation District (SCCD) well inventory; and various other regional water supply studies, hydrogeologic models, and publications having study area coverage.

Section 2 of this PGCS describes the study area extent, topography, and subsurface conditions of the Pinedale Anticline. **Section 3** focuses on ground water levels, potentiometric surface mapping, and ground water flow mechanics. A discussion concerning the distribution of cations, anions, and total dissolved solids is offered in **Section 4**. **Section 5** identifies gaps and anomalies in the existing data set that may necessitate further investigation or collection of additional new data that can be utilized to effectively characterize/manage ground water resources.

1.2 Data Sources, Use, and Limitations

1.2.1 Data Sources

Most of the data sources obtained and evaluated for this project were identified in the BLM SOW. The data sources include a variety of U.S. Geological Survey (USGS) reports on the geology and hydrogeology of the Upper Green River Basin, some internet-available databases, and water well databases supplied by the BLM Pinedale Field Office (FO) and SCCD. In general, the data sources were intended to be used to develop a complete list of water wells within the study area boundaries, and within one-mile of each producing gas well, and to obtain all existing chemical and water level data available for those wells. These data were to be incorporated into the PAPA Water Well Database (**Attachment A**), PAPA Ground Water Potentiometric Surface Database (**Attachment B**), and PAPA Ground Water Chemistry Database (**Attachment C**) developed by Dynamac to support this PGCS. The data sources that were obtained, evaluated, and used to compile the databases are as follows:

BLM Pinedale FO Water and Gas Well Database

This database, in the form of Microsoft Excel spreadsheets, was supplied on CD ROM from the Pinedale FO. The water well portion of the database includes a total of 388 wells within the study area. The unique identifier for each well is the Well Permit Number. Well locations within this database are presented as the quarter-quarter section on the Township and Range system. The GIS files located each well in the center of its reported quarter-quarter section, meaning each well is plotted in the center of a 40-acre square area - anywhere inside which the well is actually located. The database included well depths, drilling dates, well use, and owner names, but did not include any water level or chemical data.

The BLM database also included information on a total of 329 gas wells drilled within the study area. The gas wells are located by aliquot, which is a footage measurement from the boundaries of the section. The aliquots were converted into latitude and longitude for plotting on the map. The gas wells in the database are lumped under the term "Production/Injection", meaning that it does not distinguish between gas production wells and gas injection wells. Injection wells are not thought to exist in the area, so it is assumed that most or all of these wells are production wells. Further investigation of this issue is future studies is included as a recommendation in Section 5.

Sublette County Conservation District (SCCD) Water Well Database

The SCCD database was supplied on CD ROM from the SCCD. This database includes a total of 318 water wells within the study area. This database includes a wide variety of tables in which the wells are linked by "Well ID". However, one table links the "Well ID" to the Well Permit Number, allowing integration of this database with the other databases. Of the 318 wells, all but 16 directly correlate with the BLM database through their respective Well Permit Numbers. These 16 wells that were not traceable only have a well name, with no "Well ID" or Well Permit Number. Hand plotting and comparisons of locations, depths, owner names, and construction dates allowed probable or definite correlation of some of these 16 wells to other wells in the BLM and WSEO databases. However, most of them were not identifiable. According to Carrie Hatch of SCCD, these 16 wells are not linkable because they were all installed prior to 1969, when well permit number assignments began.

The well locations in the SCCD database are in UTM coordinates obtained by Global Positioning System (GPS) surveys. This allows more exact plotting of well locations than is possible through the other databases. Therefore, all wells that are contained within this database were plotted using the UTM coordinates. After combining databases, this left additional wells in the WSEO and BLM databases which still only had quarter-quarter section locations. Therefore, the final maps contain a mixture of location sources, with most water wells plotted by UTM coordinate, but some plotted by quarter-quarter section, and all gas wells plotted by aliquot (converted to latitude-longitude).

The SCCD database also includes precise elevation data obtained by the GPS survey, and water level information collected between July and October, 2001. These are the data that have been used to plot the potentiometric surface in the study area.

The database includes a template for chemical data, but does not currently include any chemical data. The SCCD did sample three stock wells within the study area in May 2002, and analyzed them for some general chemistry parameters (pH, alkalinity, chloride, nitrogen, sulfate, and Total Dissolved Solids [TDS]). These data were faxed to Dynamac and have been incorporated into the chemical database table in Attachment C.

Wyoming State Engineers Office (WSEO) Water Well Database

The WSEO database was obtained off of the internet from website http://seo.state.wy.us/gwcd. This database includes a total of 420 wells within the study area, making it the most comprehensive of the data sources. All of the BLM and SCCD database wells are contained within this database. The unique identifier for the wells is the Well Permit Number, and the locations are tracked by quarter-quarter section. However, linking of the Well Permit Number to the SCCD database allows plotting of most of these wells by UTM coordinate. The database includes a variety of well construction, date, ownership, and well use data, but does not include recent water levels, top of casing elevations, or water chemistry data. The additional wells in this database (about 40 wells that are not currently included in the BLM database) are newer wells which have not yet been added to BLM's database.

University of Wyoming Water Resources Data System (WRDS)

When obtaining this database, it was found that it linked directly to the WSEO database discussed above. A review of the website addresses and contents showed that no additional data was available through this source.

U.S. Geological Survey (USGS) National Water Information System (NWIS)

The USGS database was obtained off of the internet from website http://waterdata.usgs.gov/nwis/gwsi. In addition, Dynamac contacted the USGS office in Cheyenne, Wyoming which maintains the database to verify that no other data were available, and to determine how well locations were tracked within the database. This database includes a total of 66 wells within the study area, which is a small subset of the total number of wells. Its purpose is not to maintain a comprehensive database of all well locations, but to maintain data on a subset of wells that are designated for periodic water level measurements or sampling.

The wells in this database do not have a unique identifier such as Well ID or Well Permit Number. The wells are located by the quarter-quarter section and latitude/longitude, and the only way to link these data to the other database is to co-plot the locations, and then manually examine well depth, date, and name information to attempt to correlate the USGS well to a well within the other databases. Where only one well exists within a quarter-quarter section, this is a straightforward process, but where multiple wells exist, this becomes more time-consuming. Using this process, Dynamac was able to identify well permit numbers for 26 of the 66 wells. The other 40 wells, which are primarily older wells, may or may not be the same as some with wells in the BLM database. For instance, in some cases, a USGS well and a BLM-database well will have the same name, depth, and drill date, but will be reported to be in different locations. It seems likely that they are the same well, with one of the database locations being incorrect, but it is also possible that they are not the same well.

Of the 66 wells within this database, only 11 have recent water level or chemical data that can be incorporated into the databases. These data have been incorporated into the databases where possible, and are tabulated in Attachment B and Attachment C, respectively. These data have also been plotted on maps presented as **Attachment E** and **Attachment F**, respectively.

U.S. Geological Survey (USGS) Reports

The BLM Rock Springs Field Office and National Science and Technology Center supplied a variety of hard-copy USGS reports to Dynamac for incorporation into this PGCS. In addition, Dynamac obtained several reports from the USGS library in Reston, Virginia. A complete list of these reports in included in the reference list in the back of this report. These sources include reports for other study areas, but which were supplied to provide guidance on format and content for this report. They also include studies which overlap some or all of the study area.

The primary intended application of these reports to this PGCS was to provide background geology, hydrogeology, and water chemistry data to develop the summary information presented in Sections 2, 3, and 4 of this report. However, it was also intended that specific well, spring, and surface water information, such as water level data and water chemistry data, could be obtained from the tables of data contained within these reports, and incorporated into the databases. Document review has revealed minimal historical data in these reports that is applicable to the PAPA study area. In general, these reports cover a wide study area, of which the PAPA study area comprises a small part. In most cases, while these reports include scattered well and spring data from the larger study area, only one or two of the data points fall within the PAPA study area. Where these data were available, they were captured and incorporated into the databases and chemical data tables (Attachment C). However, a very limited amount of supplemental data was determined to be available through these sources.

In addition, where data were included in these reports, they were not available in electronic format, and also were not clearly identifiable or linkable to the Well Permit Numbers or Well ID which are used as unique identifiers within the BLM, SCCD, or WSEO databases. In some cases, Dynamac was able to link these data to wells within the databases by manually tracking well locations, depths, owner names, and/or construction dates. However, this process was very time-consuming, and only accomplished the identification for about half of the wells. Because of this, the databases, especially the chemical database table in Attachment C, contain only partial well identification or location information for these wells.

Data from Gas Companies

The only water quality information obtained through the gas production companies is two1998 Letter Reports by Geoscience & Engineering, Inc.. Both were developed in 1998 for Ultra

Petroleum, with one delivered as a Letter Report to Ultra in July 1998, and the other delivered to BLM as a Latter Report in October 1998. These reports were primarily intended to discuss the advantages and disadvantages of various well sampling and analysis options. However, they included TDS analysis data from seven wells. These data have been included in the chemical database table in Attachment C.

1.2.2 Data Limitations

At this time, the amount of chemical and water level data available within the PAPA study area appears to be very limited. A comprehensive amount of water level data exists through the SCCD database, including water levels on 119 of the 318 wells in the study area, allowing development of a potentiometric map of the study area. However, these data only exist for one period of time (July to October, 2001). Ideally, additional rounds of water level measurement and re-development of a series of potentiometric maps over time would be useful to identify trends in water levels fluctuations caused by seasonal variations, longer-term climatic variations, ground water withdrawal, and/or impact due to natural gas production.

A very limited amount of chemical data currently exists within the study area. The data consists of samples from approximately 20 wells, with severe limitations in the timing of the samples, and in the analytes included in the analyses. No organic analyses are available, which would be useful in assessing whether oil or gas infiltration into the aquifer has occurred. A limited amount of metals data exists. Most of the data consists entirely of general chemistry parameters such as pH and TDS. In order to use Stiff diagrams to develop a more detailed understanding of ground water geochemistry throughout the study area, it is required that each well analysis include a minimum of sodium, potassium, calcium, magnesium, chloride, carbonate, bicarbonate, TDS, and sulfate. Of the data sources obtained and studied for this PGCS, only 5 wells were found that had been analyzed for all of these parameters.

Another major limitation was the difficulty in correlating the USGS data, both from the reports and the NWIS website, to the BLM, SCCD, and WSEO databases. The information in the USGS reports was not available electronically, so had to be manually plotted to identify which data points were within the study area. While the NWIS database was available electronically, these data points (and the data points from the reports) did not contain unique well identifiers such as Well Permit Numbers or the Well ID to allow direct linking of them to the databases. Therefore, a much larger latitude/longitude area needed to be defined which contained hundreds of wells, and then this larger database was manually examined to select and individually download each well that was within the study area. This process was very time-consuming, and although it resulted in bringing the USGS data into the database, it did not completely succeed in linking each well to an already existing well from the BLM, SCCD, or WSEO database.

A final limitation is that the SOW envisioned the ability to identify and plot spring locations, correlate them to nearby wells, and develop an understanding of the interaction between surface water and ground water within the study area. It turned out that the existing reports contained very limited information on the presence and characteristics of springs, and no chemical data. While the regional USGS reports did generally describe the interaction between surface water and ground water (described in **Section 2.4**), it is not possible, with the current level of detail, to provide more information specific to the project area.

2.0 DESCRIPTION OF PAPA STUDY AREA

2.1 Location

The study area is located within the administrative jurisdiction of the BLM Pinedale Field Office, northern Green River Basin, Wyoming. The study area is approximately 309 square miles and is roughly bounded by the town of Pinedale to the north, the Green River to the west, the town of Boulder to the east, and the Jonah Gas Extraction Field to the south. The study area is bisected (east to west) by both Sublette County Road 351 and the New Fork River. The major axis of the study area is oriented northwest to southeast. The study area includes all production, irrigation, stock, and domestic water wells located within one mile of an active gas extraction well within the PAPA. Topography and wells associated with the study area are provided in the base map included as **Attachment D**.

Figure 1 depicts the PAPA study area boundary in relation to surrounding roads, towns, and natural features.

2.2 Climate, Topography, and Surrounding Land Use

The climate of the PAPA is semiarid, with hot, dry summers and occasional intense thunderstorms. Winters are cold, with sparse snow accumulation. Meteorological data from a Pinedale weather station (487260) for the period August 1948 to December 2001 was obtained from the Western Regional Climate Center. Over this period, the annual maximum temperature was 51.6°F and the annual average minimum temperature was 19.8°F. Annual average total precipitation was 10.9 inches, with the month of May having the highest (1.65 inches) monthly average precipitation and the month of February having the lowest (0.50 inches) monthly average precipitation.

The Green River and its tributary, the New Fork River, drain large portions of the study area. These rivers dissect a broad plateau to form a large bench-like mesa named "The Mesa." The surface of the PAPA is generally characterized by The Mesa, dissected upland terrain, river channels, ephemeral washes, and numerous earthen livestock reservoirs. The altitude of the study area ranges from approximately 7,750 feet above mean sea level (amsl) at Stewart Point to 6,840 feet amsl where the New Fork River flows out of the study area. The PAPA is dominated by dryland plant associations and by animals that are adapted to hot, dry conditions. General land uses associated with the PAPA and contiguous lands include oil/gas production and livestock grazing.

2.3 Geologic Setting

The following discussion of the geology of the PAPA study area has been summarized from reports by Law (1984), Law and Spencer (1989), and Welder (1968). The Pinedale Anticline is situated in the northern part of the Green River Basin between the Wyoming thrust belt to the west and the Wind River Mountains to the northeast. During the Laramide orogeny, the northern part of the Green River Basin formed in response to tectonic loading by thrusting events in the Wyoming thrust belt and by uplift of the Wind River Mountains. Because the study area is on the north and east flank of the Green River Basin, the sediments that make up the aquifers thin

FIGURE 1 – PAPA Study Area Boundary

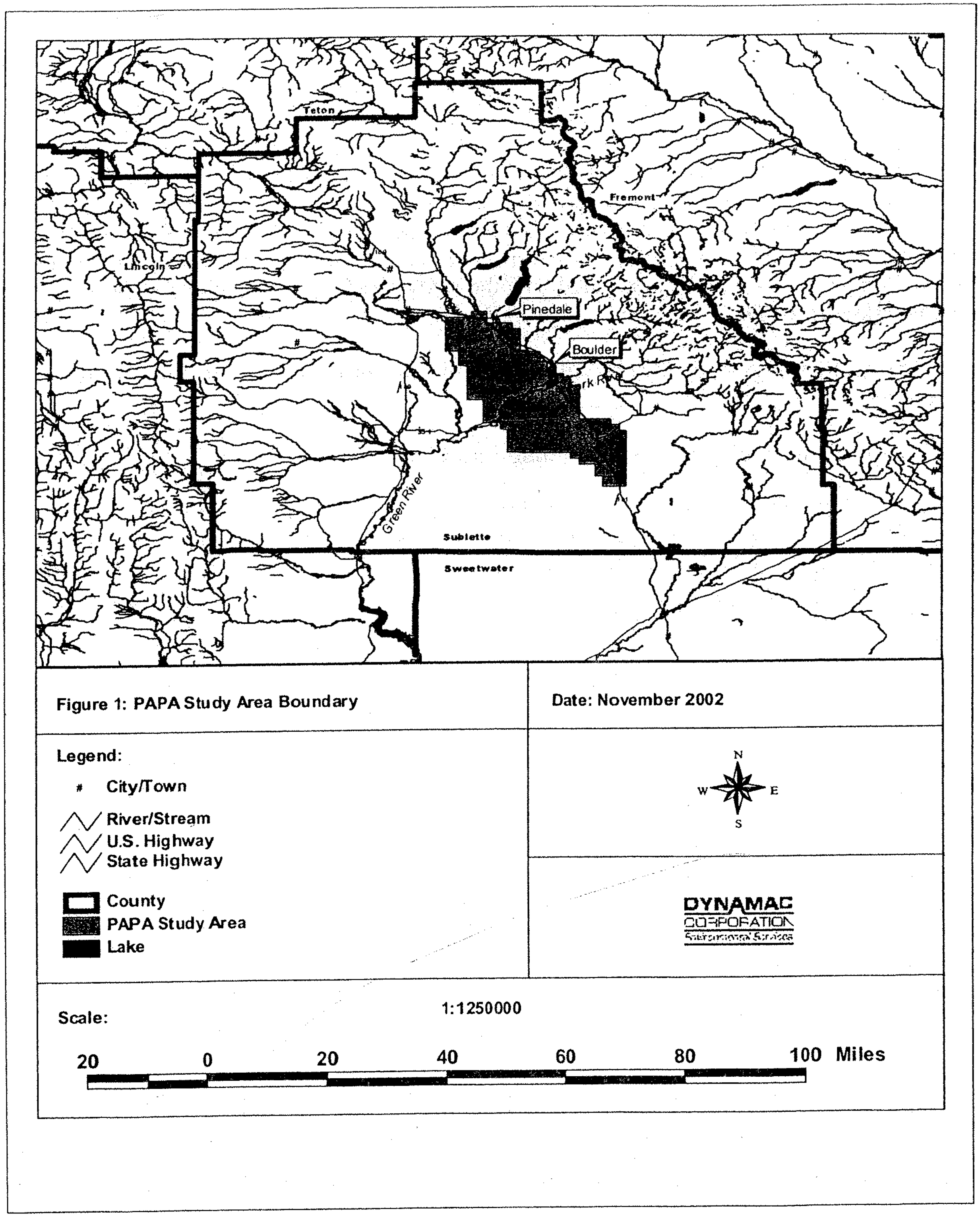


Figure 1: PAPA Study Area Boundary

and pinch-out to the north and east, and thicken and become buried to the south and west. Therefore, the study area comprises the recharge zone for the Tertiary Aquifer which is buried and confined to the south of the study area.

Being about 35 miles long and 6 miles wide, the Pinedale Anticline is the largest known structural feature in the northern Green River Basin. The anticline is a thrust-rooted detachment structure that probably formed in response to southwest-directed compression associated with structural deformation of the Wind River Mountains. The anticline is asymmetric in that its west flank is steeper than its east flank. The west flank of the anticline is bounded by a buried, high-angle, east-dipping reverse or thrust fault. There is about 600 feet of displacement along the fault which flattens out at depth. A generalized cross section of the Pinedale Anticline is shown as **Figure 2**.

Near-surface geologic units (a focus of this study) of the PAPA consist of, in descending order from the surface, unconsolidated alluvial and gravel deposits, the Wasatch Formation, the Fort Union Formation, an unnamed unit, and the Lance Formation. They are dominated by nonmarine sandstone and shale lithofacies.

The unconsolidated alluvial deposits (Pleistocene and recent) reach thicknesses approaching 50 feet in the New Fork River channel. They are comprised of clay, silt, sand, and gravel. Unconsolidated alluvial deposit thicknesses of ephemeral tributaries generally wedge out as their elevation/distance from the river increases. The unconsolidated gravel deposits (Pleistocene and recent) generally coincide with the area inscribing The Mesa. They vary in thickness up to 70 feet and are comprised of gravel (including terrace gravel, sand, and silt).

There is limited detailed stratigraphic and petrographic information on the Wasatch Formation in the study area. The Wasatch Formation (uppermost Paleocene to middle Eocene) is comprised of interbedded fine to coarse-grained, friable, and porous sandstone and mudstone. Though the contact between the Wasatch and underlying Fort Union Formations is, in most publications, gradational and/or undifferentiated, the Wasatch Formation is approximately 4,100 feet thick above the axis of the Pinedale Anticline.

The Fort Union Formation (middle to uppermost Paleocene) consists of interbedded conglomerate, sandstone, siltstone, mudstone, and carbonaceous mudstone. The nature of the contact with the underlying unnamed unit is unknown. The Fort Union Formation was deposited under dominantly fluvial environmental conditions. The Fort Union Formation is approximately 2,300 feet thick above the axis of the Pinedale Anticline.

The unnamed unit (early to middle Paleocene) consists of interbedded conglomerate, sandstone, siltstone, and mudstone. Along the axis of the Pinedale Anticline, it unconformably overlies the Lance Formation and is approximately 1,400 feet thick. The siliciclastic sediments of this unit were derived from the Wind River Mountains and deposited in alluvial-plain and fluvial-deltaic environments.

In the Wagon Wheel well, located in the southern portion of the PAPA study area, the Lance Formation (upper Cretaceous) was found to be composed of tan to brown, fine to medium-grained sandstone, siltstone, shale, and carbonaceous mudstone. Along the axis of the Pinedale Anticline, the Lance Formation is approximately 5,200 feet thick. The Lance Formation is

FIGURE 2 - Generalized Cross Section of the Pinedale Anticline

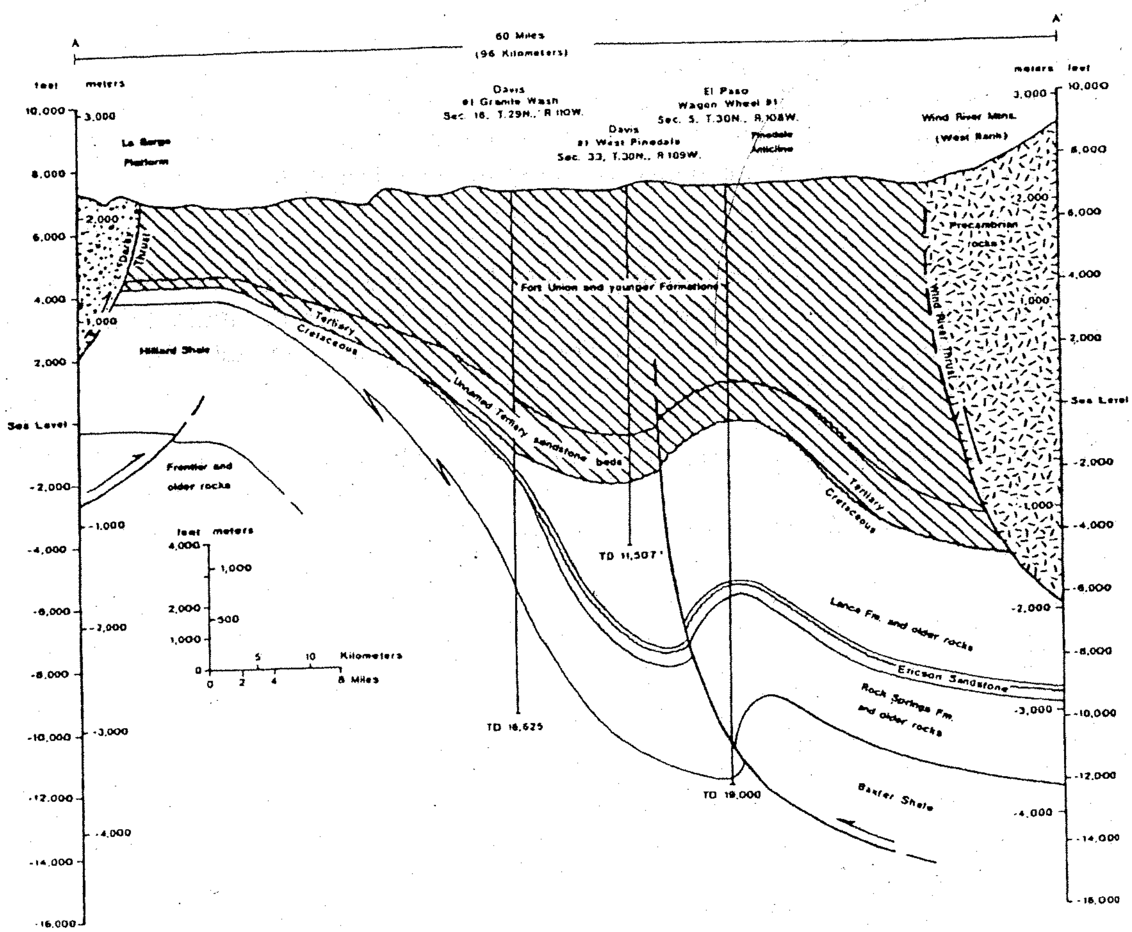


Figure 2.--Cross section A-A' extending from the Wyoming thrust belt, northeast to the Wind River Mountains. High-angle reverse fault on west side of Pinedale anticline from Martin and Shaughnessy (1969) and Shaughnessy and Butcher (1973, 1974).

interpreted to have been deposited in an alluvial plain environment. Its upper contact is unconformable with the overlying Tertiary rocks. Natural gas extraction is concentrated in the Lance Formation (**Section 2.5**).

Underlying the Lance Formation are, in descending order, the Ericson Sandstone (~500 feet thick), the Rock Springs Formation (~6,000 feet thick), and the Hilliard (also referred to as Baxter) Shale, all of which are upper Cretaceous in age.

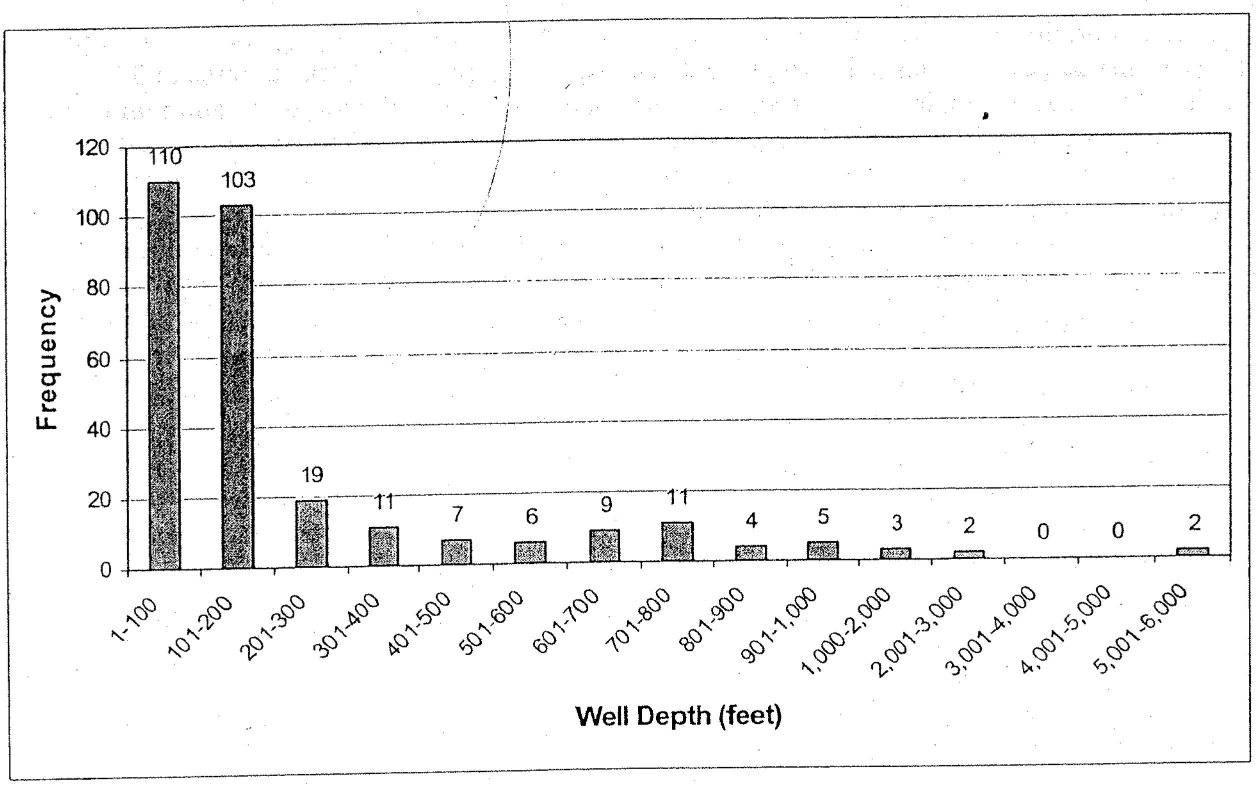
2.4 Hydrogeologic Setting

As published by Welder (1968), Martin (1996), and other USGS reports obtained for this study, ground water conditions in the PAPA are largely controlled by climatic, topographic, geologic, and human influences. Recharge is primarily by seepage from precipitation, streams, and reservoirs. Discharge is mainly by evaporation, seepage to streams, transpiration, and pumpage. Regional and local aquifers corresponding to the PAPA consist of the Wasatch aquifer and the Fort Union aquifer (collectively referred to as the Tertiary Aquifer), the New Fork River alluvial aquifer, and a perched gravel aquifer within the expanse of The Mesa. Water table depths in the area range from a few feet in the alluvial aquifer near the New Fork River to about 200 feet in the Tertiary Aquifer. The distribution of well depths in the study area is provided in **Figure 3.** Most water well depths in the study area are less than 200 feet deep, with a few scattered wells being up to 5,000 feet deep. However, an observation of the distribution of water depths in the SCCD database indicates a very large number of wells with very near-surface water levels (less than 10-20 feet), and fewer wells with deeper water levels. This may indicate a historical propensity to install most of the region's wells in the floodplain of the New Fork River, where access to ground water is relatively easy. It may also indicate a possible artesian condition in which deeper ground water is pressurized and approaches the surface. A more detailed look at well depths and locations versus water level may be required to determine which situation is occurring.

The only information on the total thickness of potable water in the study area is from Dinwiddie (1973), who collected samples from a depth of 2,300 feet in the Wagon Wheel Well #2, and determined that those samples were freshwater, with a TDS concentration of 630 milligrams per liter (mg/L). Samples from over 5,000 feet deep in the same well were salt water, with a TDS concentration of 21,400 mg/L.

The Tertiary Wasatch Formation, being exposed at the surface, makes up most of the surface of the PAPA. The areal extent of the Wasatch aquifer covers the entire area of the PAPA (~309 square miles) and extends aerially beyond the boundaries of the PAPA. The thickness of the Wasatch aquifer is roughly 4,100 feet. Martin (1996) calculated a horizontal hydraulic conductivity range (feet per day) of 0.03 to 2,106, with a median of 8.7. The wide range is due to large variations in lithology of the formation. Water levels in the Wasatch aquifer range from about 7,170 feet amsl at the northern end of the PAPA to 6,860 feet amsl at the southwest boundary of the PAPA. PGCS mapping by Dynamac and previous mapping by Martin (1996), Naftz (1996), and Lowham, et al (1985) indicate a prevalent north to south flow component with minor westerly flow components (Section 3). The Wasatch aquifer is a good water source and has been found to yield, depending on formation lithology and well construction variables, up to 688 gallons per minute (gpm). TDS (50-300 ppm) and salinity concentrations increase with depth.

FIGURE 3: Distribution of well depths in the PAPA Study Area



The Fort Union aquifer underlies the Wasatch aquifer and also extends aerially beyond the boundaries of the PAPA. The thickness of the Fort Union aquifer is roughly 2,300 feet. Martin (1996) calculated a horizontal hydraulic conductivity range (feet per day) of 0.02 to 1,134, with a median of 40.0. However, in the area of the PAPA, the hydraulic conductivity is at the low end of this range given that the Fort Union aquifer is deeply buried. The Fort Union aquifer contains highly mineralized and saline (> 5,000 mg/L) water. Mapping by Martin (1996) indicates a prevalent north to south flow trend.

Alluvial aquifers associated with the New Fork River mainly consist of clay, silt, sand, and gravel, and include some slopewash material. Logged thicknesses of the alluvial aquifer vary up to approximately 50 feet in the PAPA and generally reach a maximum thickness near the midpoint of the drainage channel. The underlying Tertiary aquifer, alluvial aquifer, and New Fork River are hydraulically interconnected, with ground water seepage from the alluvial aquifer to the (gaining) New Fork River and the underlying Tertiary aquifer. Horizontal flow generally follows the course of the New Fork River.

The perched gravel aquifer inscribed by The Mesa yields adequate quantities of water for oil/gas production atop The Mesa. Logged gravel aquifer thicknesses of wells on The Mesa range from approximately 50-70 feet. Mudstones interbedded in the Wasatch Formation likely inhibit substantial downward movement of water from the perched gravel aquifer into the Wasatch Formation and facilitate discharge to the surface in the form of springs situated on slopes of The Mesa. This flow process is evidenced at four mapped springs corresponding to the study area. These include:

1. Mesa Spring, T32N, R110W, Section 26, NW¼, SW¼, Elev. ~ 7,180 feet amsl (USGS, 1964a).
2. Antelope Spring, T30N, R107W, Section 23, SW¼, NW¼, Elev. ~ 7,300 feet amsl (USGS, 1964b).
3. (Unnamed) Spring, T30N, R107W, Section 23, NW¼, NW¼, Elev. ~ 7,310 feet amsl (USGS, 1964b).
4. (Unnamed) Spring, T31N, R109W, Section 27, NW¼, NW¼, Elev. ~ 6,920 feet amsl (USGS, 1964c).

DeLong (1986) refers to "more than 500 spring and miscellaneous surface-water sites for which data were analyzed....". However, location-specific data is not included in the report, and none of those locations having detailed water-quality information correspond to the study area.

2.5 Natural Gas Extraction

The first gas extraction well drilled on the Pinedale Anticline was completed in 1939 to a depth of 10,000 feet by the California Company. Additional wells have since been drilled to depths of 10,000 to 12,000 feet, in the Upper Cretaceous Lance Formation. The deepest well is the El Paso Natural Gas Company Wagon Wheel No. 1 well, which was drilled to 19,000 feet into the Upper Cretaceous Hilliard Shale. The wells have generally targeted thick gas-bearing strata, consisting of low-permeability lenticular sandstones in the Lance Formation, below 8,000 feet. The in-place gas resource contained in low-permeability reservoirs associated with the Pinedale Anticline has been estimated to be 159 trillion cubic feet (TCF), although less than 10% of this is recoverable with present technology.

3.0 WATER LEVEL MEASUREMENTS

3.1 Regional Information from Published Reports and Databases

Regional water contour mapping has been accomplished by Chafin and Kimball (1992), Martin (1996), Naftz (1996), and Lowham, et al (1985). In each case, the Tertiary Wasatch aquifer was mapped on a regional (Green River Basin) basis and localized topographic influences were not considered - namely the perched gravel aquifer within The Mesa in the PAPA area. This resulted in these reports showing a potentiometric high within the Tertiary Aquifer, corresponding to The Mesa, which probably does not actually exist due to the minimal hydraulic connectivity between the perched gravel aquifer atop The Mesa and the underlying Tertiary Wasatch aquifer. In general, these maps covered a wide regional area, with spacing between data points of 5 miles or more. By including a single data point which may represent perched groundwater on The Mesa, and then not having another data point for several miles in any direction, these maps show a large, regional feature in the potentiometric surface which does not actually represent flow conditions within the Tertiary Aquifer.

Although this localized influence of The Mesa covers most of the PAPA area in each of these reports, the wider, regional picture presented in the reports is the same. This is that the major horizontal subsurface flow corresponding to the area of the PAPA was always generally mapped as being from north to south with minor westerly flow components.

3.2 PAPA-specific Data Evaluated for this Study

More focused water contour mapping of the PAPA has been accomplished by Dynamac as an element of this PGCS. A total of 67 wells having the most recent (July to October, 2001) water level data collected by the SCCD (and judged to correlate to the Tertiary Wasatch aquifer) were mapped using a Surfer™ contouring program. These data have been tabulated in Attachment B and are plotted on the map presented as Attachment E. Recent horizontal ground water flow was determined to have a primary north to south flow component with minor westerly flow components. This finding is consistent with the previous studies by Chafin and Kimball (1992), Martin (1996), Naftz (1996), and Lowham, et al (1985).

One observation made during the plotting of the potentiometric surface was that the one data point from a well on The Mesa was anomalous. This is apparently because the water level measured in this well was made from the perched aquifer, which is not in communication with the Tertiary Aquifer. Based on observation during Dynamac's field reconnaissance trip in October, it is clear that a large number of additional water wells have been installed on The Mesa in the year since water levels were measured. In the future, care should be taken to separate The Mesa wells from the other wells, and plot them separately, since they represent separate hydrologic units.

4.0 CHEMICAL QUALITY OF GROUND WATER

4.1 Regional Information from Published Reports and Databases

Information on ground water and surface water geochemistry in the area was obtained through USGS reports including Welder (1968), Chafin and Kimball (1992), Zimmerman and Collier (1985), DeLong (1986), Glover and others (1998), Naftz (1996), and other reports. These reports generally cover the entire northern Green River Basin, and therefore contain only a few limited data points from within the PAPA study area itself. For instance, Welder (1968) presented data for almost 100 wells and springs in the Wyoming portion of the Green River Basin. Of these, only one well was located within the PAPA study area, and that well was screened within shallow alluvial deposits, rather than the Tertiary Aquifer. Similarly, Chafin and Kimball (1992) worked with data from eight wells, of which only two are in the PAPA study area. Naftz (1996) worked with dozens of data points from throughout the Upper Colorado River Basin, but none of the data points were specifically from the PAPA study area. DeLong (1986) studied surface water geochemistry from 11 sampling stations located in the northern Green River Basin. None of these stations was within the PAPA study area, although one was just outside the study area to the north on the Green River, and one was just outside of the study area to the south, on the New Fork River. Glover and others (1998) also studied water chemistry in approximately 50 wells throughout the Upper Colorado River Basin, and again, none of the wells was specifically within the PAPA study area. None of these reports identified or presented data for springs specifically within the study area.

Because of these limitations, most existing information on ground water and surface water geochemistry is regional, and not specific to the PAPA study area. The few data points that exist within the study area have been integrated into the ground water chemical database table, included as Attachment C.

The Tertiary Aquifer in the PAPA study area consists primarily of the Eocene Wasatch Formation, which is exposed at the surface throughout most of the study area. The Fort Union Formation aquifer is buried throughout the study area, and has only been accessed for testing by the two Wagon Well study wells, and not by any known ground water production wells. The only portion of the study area where the Tertiary Aquifer is not exposed at the surface is The Mesa, which covers a substantial portion of the study area, and contains perched ground water within Quaternary gravel deposits.

In general, the PAPA study area is located at the northern and eastern edges of the Green River Basin, within the recharge areas for the Wasatch Formation. Further south of the study area, the Wasatch Formation is not exposed at the surface, and becomes a confined aquifer. Because of its location within the recharge areas for the aquifer, shallow ground water quality within the PAPA study area is generally good. Water quality generally decreases with depth, and to the south of the study area, as the ground water in these areas has had a longer residence time within the aquifer and reacted with soluble components within the formation.

While the existing USGS reports do not include much data from within the PAPA study area, they do provide a regional evaluation of the geochemistry of the Tertiary Aquifer. Welder (1968) provides a regional summary of ground water quality based on TDS concentrations. Welder (1968) defines good water quality as that having TDS concentrations less than 500 mg/L, and poor quality groundwater as that having TDS concentrations from 500 to 3,500 mg/L. In general, water quality in the Tertiary Aquifer is highest in shallow ground water and in the northern part of the basin (the Pinedale area). Water quality generally decreases with depth within the aquifer, and towards the south within the basin. Welder (1968) notes that fluoride content in the Tertiary Aquifer south of Township 29 N may exceed the drinking water standards available at that time. The entire PAPA study area is within or north of Township 29 N.

Chafin and Kimball (1992) report that the near-surface ground water in the Tertiary Aquifer is primarily sodium carbonate-based ground water with an alkaline pH from 9.2 to 9.5. This is corroborated by pH measurements supplied by the SCCD, which ranged from 8.5 to 9.3. Sodium and carbonate are the predominant cation and anion, with higher calcium and sulfate concentrations being identified in only a few locations. This report included data from two wells within the PAPA study area - one from a depth of 141 feet, and one from a depth of 450 feet, allowing a comparison of shallow and deeper ground water quality within the study area. The water quality from these two wells is very similar, with TDS concentrations of 346 and 362 mg/L, and pH values of 9.44 and 9.5. Concentrations for most of the specific chemical components were also similar to each other.

Zimmerman and Collier (1985) includes construction, well log, and chemical data on hundreds of wells within Sublette County. Of this, the report includes location, depth, and lithology information on 56 wells within the PAPA study area, chemical analyses (including anions and cations) on 3 wells within the study area (one of which is simply a repeat of an analysis presented by Welder [1968]), and temperature and specific conductance data on 16 wells within the study area. These data have been incorporated into the ground water chemical database table in Attachment C. However, this report contained no text summaries or observations of the data.

Naftz (1996) also showed that water quality, as indicated by TDS concentrations, within the Wasatch Formation is highest near the northern and eastern edges of the basin (near the Pinedale area), where recharge occurs. As water flows downgradient into the basin south and west of the study area, the TDS concentrations increase due to increased dissolution of minerals, leakage of water from adjacent shales, and/or water flow from adjacent aquifers. In addition, the report used Stiff diagrams to demonstrate that sodium, potassium, chloride, and carbonate-bicarbonate concentrations increase towards the center of the basin relative to calcium and magnesium, indicating cation exchange with the surrounding formation. Although none of the data points were located within the PAPA study area, the general trend shows low TDS, sodium-dominated chemistry in wells near the study area, and much higher TDS, sodium, and chloride concentrations towards the center of the basin to the south.

Glover and others (1998) performed a larger regional study of the Upper Colorado River Basin, providing even less detailed information specific to the Wasatch Formation and the PAPA study area. The report shows, like those discussed above, that the Pinedale area is located on the recharge area for the aquifer, and therefore has ground water quality that is high relative to areas to the south, further into the basin.

Two reports contain information on the "Wagon Wheel" water wells drilled in the southern portion of the PAPA study area in 1969 and 1973. The first report is by Shaughnessy (1969), and was developed by El Paso Natural Gas Company. This well was drilled to a depth of 2,432 feet, and was perforated throughout the length of the well from 130 feet to 2,432 feet. One sample was collected from this well, which represents water from this entire zone. The second report is by Dinwiddie (1973) for Wagon Wheel Well #2. This well was drilled to a depth of 5,200 feet, with perforations and samples at two intervals. Samples were collected from a zone near 5,000 feet deep, and a zone near 2,300 feet deep. In addition, a variety of hydraulic tests were conducted on these zones to determine the hydraulic characteristics of the aquifers at those depths.

These two wells provide information on the quality of deep ground water (at 2,300 feet and 5,000 feet) within the study area. All other wells within the study area are only a few hundred feet deep, at the deepest. The reports conclude that ground water at the 2,300 foot depth is freshwater, with a TDS concentration of 630 mg/L. The ground water at the 5,000 foot depth is saline, with a TDS concentration of 21,400 mg/L. Although it represents only one data point within the study area, this study appears to show that freshwater is available within the Tertiary Aquifer to a depth of at least 2,300 feet.

4.2 PAPA-specific Data Evaluated for this Study

As discussed above, very limited sampling and analysis data exists within the PAPA study area itself. The total amount of data includes:

- 3 sample results from stock well samples provided by the SCCD;
- 2 well sample results provided in Chafin and Kimball (1992);
- 2 unique sample results from Zimmerman and Collier (1985) (a third result is a repeat of information in another report);
- 1 sample result (from the alluvial, not Tertiary Aquifer) from Welder (1968);
- 7 sample results (TDS only) from Geoscience & Engineering (1998);
- 3 sample results from the 2 Wagon Wheel well reports from Shaughnessy (1969) and Dinwiddie (1973); and
- 11 sample results from the USGS NWIS database.

These data are all included within the ground water chemical database table, presented in Attachment C to this PGCS. Stiff diagrams, presenting geochemical plots for the wells for which anion and cation data exist, are presented in the figure in Attachment F.

Because of the very limited dataset, few substantial conclusions can be drawn from the Stiff diagrams plotted. Of the 20 wells which had some chemical analyses, only 5 were analyzed for the parameters necessary to plot Stiff diagrams. All of these 5 wells were sampled in the 1950s, 60s, and 70s, making the data of questionable usefulness. Also, the 5 data points are not well distributed horizontally, so do not provide information on areal variations in water quality. However, the data points are well distributed vertically, with samples from 15, 70, 120, 2,300, and 5,100 feet deep. These Stiff diagrams show the expected trend in water quality with depth. The 15 foot deep sample (collected from adjacent to the New Fork River) shows very low concentrations of the water quality parameters. The samples from 70 and 120 feet are very similar, with slightly higher sodium and sulfate concentrations. The sample from 2,300 feet shows that the deeper water is more dominated by chloride as the anion than sulfate, but the water is still of relatively good quality. The sample from 5,100 feet clearly has concentrations of general chemistry parameters that are several orders of magnitude higher than any of the other wells, and is highly dominated by sodium and chloride.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented here were developed based on a review of the available data, as well as discussions with BLM and SCCD personnel:

1) The vast majority of the well correlations between the different databases was conducted successfully using well permit numbers. In addition, many of the other wells for which permit numbers were not available were manually correlated using location, well name, depth, and installation date information. However, correlation of well data between the various databases is not perfect, and is unlikely to ever be perfect. This is due to two major issues. First, many of the wells in the USGS NWIS database are old, and the USGS's information on them was developed before well permit number assignments began in 1969. Similarly, many of the wells inventoried and included in the SCCD database are old, and while they are still operable and available for measurement and sampling, it is not possible to assign well permit numbers to them for tracking and cross-correlation between databases. The second problem is that errors are known to exist in some of the databases. For instance, it is possible to compare well data between the BLM and USGS databases and determine that a well name, depth, and installation date are the same, but different locations are given. In these cases, it is probable that one or the other databases had an incorrect entry for section number or quarter-quarter section, and the wells are the same. However, this cannot be said with certainty without conducting field visits, and even field visits may fail to verify the well locations if they cannot be found.

2) The wells plotted on the maps in Attachments D and E were plotted using a variety of methods of differing accuracies. The wells inventoried by the SCCD had recent GPS locations which are thought to be very accurate. However, the wells included in the other databases were plotted using latitude/longitude data (USGS NWIS database, which is likely to be from measurements on maps, rather than GPS), using an algorithm to calculate coordinates of the centroid of the quarter-quarter section (for the BLM database wells), or from hand-plotting in the center of the reported quarter-quarter section (for the newest WSEO database wells). These locations are certainly much less accurate than the GPS locations provided for the SCCD wells. One future activity that would be useful would be to expand the SCCD's efforts to collect GPS locations for all of the additional wells so that all would be plotted using the same accurate system.

3) The amount, distribution, and quality of water level measurements in the area by SCCD appears to be good. While each well only has one water level measurement at this point, the well locations, elevations, and casing heights have recently been documented using GPS methods, so should be highly accurate - certainly much more accurate than the quarter-quarter section tracking done in the BLM and WSEO databases. Several improvements can be made if resources exist to expand this program.

   - As time and funding permit, the additional wells not currently included in the SCCD program should have their locations determined with GPS, to allow plotting of all wells using the same system. Two major areas were identified that are not currently covered. First, only one data point currently exists on The Mesa. It is possible that additional water levels have since been measured there, and they will be available in the future. Care should be taken to ensure that data points from hydrologically separate units, especially wells on The Mesa, are plotted separately from the Tertiary Aquifer wells. The second area is the northwest corner of the study area, near the Green River. The potentiometric map presented in Attachment E presents hand-drawn extrapolation of these contours to the north, which would be the normal behavior of the potentiometric surface near this major river. However, there is no data in this area to confirm this extrapolation.

- To monitor long-term trends in water levels and potential impacts due to natural gas operations, a program of regular (at least annual) measurement of water levels, and plotting of potentiometric maps, should be initiated. If possible, quarterly measurements should be made to identify any seasonal changes in the potentiometric surface. Given the wide spacing of the wells (often more than a mile apart), as many wells as possible should be included, since impacts resulting from gas drilling and production may be difficult to identify with such wide spacing.

- To provide additional data on the deeper aquifers, means to measure water levels in wells deeper than 300 feet should be identified.

4) The amount, distribution, and quality of chemical data within the study area is very poor. Data sufficient to plot Stiff diagrams is only available from 5 wells in the study area, and all of these samples were collected over 30 years ago. Additional data may be obtainable through the gas production companies, but BLM and SCCD sources have indicated that data has been requested in the past, and does not exist. The solution to this situation would be to institute a program to collect and analyze samples from selected wells, spring, and surface water locations to develop a recent and comprehensive database. Issues that should be addressed in any sampling program include:

   - Focus should be placed on sampling of wells closer to natural gas wells and production facilities, to determine if there are any potential impacts to ground water quality or quantity. Focus could also be placed on wells near surface water bodies or sensitive ecosystems, to ensure that no impacts are occurring.

   - Given the current lack of available data, collection and evaluation of chemical data from existing wells should be done before considering the installation of additional monitoring wells.

   - The parameters to be analyzed for should be as comprehensive as possible in early rounds of sampling, to establish a baseline dataset. This should include a wide range of general chemistry parameters, metals, and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds. While some analytes that are not detected may be reduced in later rounds, a minimum analytical suite of sodium, potassium, calcium, magnesium, chloride, carbonate, bicarbonate, TDS, and sulfate (the parameters needed to plot Stiff diagrams) should be maintained to track general water quality over time. If changes in water level or general chemistry in a well changes over time, then more detailed investigation in the well's local area may then be implemented, and may include installation of monitoring wells. If enough data are collected to provide a reasonably sized and distributed databases, then Stiff diagrams may be used, in the future, to fingerprint waters from shallow, deep, perched, or surface sources, and develop a more detailed picture of the interaction between them.

5) Comments from BLM on the draft of this report questioned whether it would be useful to obtain existing chemical data from outside the study area, and extrapolate it to compensate for the lack of data inside the study area. Because of the large distances involved (tens of miles), the applicability of ground water chemical data from outside the study area to the PAPA would be highly questionable. Ideally, a comprehensive water quality monitoring program such as that described in (4) above should be established. In the absence of resources available to conduct such a program, it would still be useful to sample a few wells within the PAPA, analyze them for the wide range of parameters defined in (4) above, and use these data as representative of the PAPA study area. Although large distances are still involved, establishment of a limited program, which may include one-time sampling of 4 or 5 wells of various depths, would still *vastly* improve the current level and quality of available data.

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LL MIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
75W	33	109	23	SESE	DOM	WILLIAM W/LUCILLE M BELVEAL	BELVEAL #2	8/30/95	15	20	90	85	75	NO	AD106
45W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-1	10/26/95	0	8.5	13	Unknown	8.5	YES	AMI051
46W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-2	10/26/95	0	6	13	Unknown	6	YES	AMI048
47W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-3	10/26/95	0	6	13	Unknown	6	YES	AMI050
48W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-4	10/26/95	0	6	13	Unknown	6	YES	AMI052
49W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-5	10/26/95	0	6	13	Unknown	6	YES	AMI058
50W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-6	10/26/95	0	6	13	Unknown	6	YES	AMI055
751W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-7	10/26/95	0	6	13	Unknown	6	YES	AMI056
752W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CLMW-8	10/26/95							
759W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CL-SVE 1	10/26/95	0	6	13	Unknown	6	YES	AMI049
760W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CL-SVE 2	10/26/95							
761W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CL-SVE-T	10/26/95	0	6	13	Unknown	6	YES	AMI057
762W	33	109	5	NENE	MON,MIS	WYOMING DEQ-WQD	CL-AS-T	10/26/95	0	6	30	Unknown	6	YES	AMI053
86P	33	109	10	SENE	DOM	JOE R. HICKS	HICKS #1	10/26/68	17.5	30	153	152	103	NO	AD094
823W	30	109	5	SWNE	MIS	USDI, BLM	PINEY CUTOFF NEW FORK RIVER	3/22/96	5	7	55	55	24	NO	AMI039
181W	33	109	6	SENW	DOM	MARY LOU MARINER	MARYS #1	4/29/96	15	19	75	60	58	YES	AD060
716W	33	109	5	SESE	DOM	WILLIAM C/BARBARA STEVENS	STEVENS #1	6/17/96	25	45	105	85	68	NO	AD047
29P	33	109	6	NENE	DOM	GLEN T. DUNNING**KATHERINE MARIE DUNNING	DUNNING #1	8/15/68	17.5	12	90	88	70	YES	AD053
558W	31	110	2	SENW	MIS	USDI, BLM**ALPINE OPERATING CO, LLC	ALPINE MESA WATER WELL #2	8/5/96							
418W	33	109	13	NENW	DOM	JOHN RYAN	W.P. #1	10/25/96	12	45	100	85	75	NO	AD102
464W	33	109	14	NWSW	DOM,STO	WILLIAM M/LAURA J FENN	FENN HOLE 1	4/9/97	15	25	125	95	85	NO	ADS015
517W	33	109	9	SENE	DOM	THOMAS J/JOANNE GASTON	GASTON #1	4/14/97							
518W	33	109	24	NESE	DOM,STO	CHRISTOPHER ROORK	ROORK #1	4/14/97	20	20	168	160	140	NO	ADS024
130W	33	109	9	NENE	DOM	HARVEY R. NORRIS	NORRIS #2	5/29/97	20	12	97	Unknown	Unknown	NO	AD078
520P	31	109	10	SENE	DOM	GEORGE P. WESTMAN	WESTMAN #1	8/14/65	10	10	50	Unknown	Unknown	YES	AD005
537P	33	109	24	SENE	DOM,STO	GRANT BECK**KATHRYNE I. BECK	BECK WELL #1	12/31/59	0.25	75	165	Unknown	Unknown	NO	ADS019
538P	33	109	24	SENE	DOM	GRANT BECK**KATHRYNE I. BECK	BECK WELL #2	12/31/48	0.17	75	165	Unknown	Unknown	NO	AD111
546P	33	109	22	NWNE	DOM,STO	PAUL C. HAGENSTEIN**BETTE ANN HAGENSTEIN	HAGENSTEIN #1	11/30/56	15	25	105	104	97	NO	ADS001
547P	33	109	22	NWNE	DOM,STO	PAUL C. HAGENSTEIN**BETTE A. HAGENSTEIN	HAGENSTEIN #2	11/30/56	15	15	134	126	118	NO	ADS002
5609W	30	108	10	SWSW	MIS	MCMURRY OIL CO	NEW FORK UNIT #13-10W	6/30/97	85	260	755	Unknown	Unknown	YES	AMI005
7024W	31	109	10	SENE	DOM	NERD ENTERPRISES	NERD FARM #1	8/14/97	7	25	145	143	140	YES	AD009
7043W	29	107	23	NESW	MIS	HALLIBURTON ULTRA PETROLEUM	STUD HORSE BUTTE 7-23 W	8/18/97	25	120	635	580	540	YES	AMI006
7304W	32	110	25	NESW	MIS	USDI, BLM ULTRA PETROLEUM	ULTRA LUMAN #1	8/4/97						NO	AMI046
7371W	32	109	8	SWSE	MIS	USDI, BLM QUESTAR EXPL & PROD. CO	MESA 15-8 WW	9/5/97	90	350	813	775	470	YES	AMI007
7438W	33	109	13	NWSW	DOM	HANS F BELL	BELL #2	9/5/97	20	35	90	75	65	NO	AD104
7467W	30	108	19	SWSW	MIS	USDI, BLM** HALLIBURTON ULTRA PETRO	WARBONNETT 13-19 WW	9/18/97	90	250	753	715	705	YES	AMI038
752W	33	110	15	NWSE	DOM	FRANK TYLER	TYLER #1	10/26/71	25	38	220	218	200	NO	AD130
7612W	30	108	23	NESE	MIS	USDI, BLM ULTRA PETROLEUM	WAR BONNET 9-23 WW	9/30/97	100	180	753	700	660	YES	AMI008
7650W	31	108	28	SWSW	MIS	USDI, BLM WESTERN GAS RESOURCES, INC	LIZARD HEAD FEDERAL 13-28 WW	9/15/97	90	60	553	470	455	YES	AMI009
7746W	31	108	8	NESW	MIS	ULTRA PETROLEUM	TIGARD HEAD 11-8 WW	10/7/97	100	85	413	370	350	YES	AMI010
7747W	31	109	8	SWSE	MIS	ULTRA PETROLEUM	MESA LOVATT DRAW 15-8 WW	10/7/97	80	150	490	320	290	YES	AMI043
824W	32	108	27	NESE	STO	CIRCLE NINE RANCH INC.	RANCH #2 WELL	11/3/71	9	50	63	62	51	NO	AS032
08312W	34	109	31	SESE	MIS	ULTRA PETROLEUM	HSR STEELE #16-31	12/22/97							
886P	33	110	3	SESW	DOM	ROY STEELE**HARRY STEELE	STEELE #1	11/14/62	17.5	22	180	Unknown	Unknown	NO	AD126
08960W	30	108	36	NENE	MIS	WY BD OF LAND COMM.** MCMURRY OIL CO	FALCON #1-36W	2/20/98	85	225	733	685	420	YES	AMI011
09008W	33	109	9	SENW	DOM	THE WILL OF MAY K SCHWABACHER	LESLIE WELL #1	3/5/98	15	9	110	Unknown	Unknown	YES	AD087
09403W	31	108	19	SWSW	MIS	USDI, BLM** MCMURRY OIL CO	PINDALE FEDERAL #13-19W	3/26/98	85	440	493	440	425	YES	AMI012
09514W	33	109	26	NWNE	DOM,STO	JAMES L/DELTA A MCCORMICK	MCCORMICK AIRPORT #1	4/6/98	10	15	100	10	80	NO	ADS026
09683W	33	109	26	NWNW	DOM	THOMAS ROSSETTER	ROSSETTER #1	4/20/98	15	3	70	60	50	NO	AD123
09940W	33	110	1	SENE	DOM	HAROLD L. MERRITT	MERRITT #2	5/1/98	15	44	100	62	60	NO	AD125
10359W	33	109	28	NENW	MIS	USDI, BLM** QUESTAR EXPL & PROD. CO	STEWART POINT 3-28 WW	6/12/98	100	150	593	555	540	YES	AMI013
10965W	32	109	22	NENW	MIS	QUESTAR EXPL & PROD. CO	Mesa #3-22D	7/20/98	100	350	772	550	540	YES	AMI014
11249W	33	109	9	NENE	DOM	SAMUEL/DIANNE PEARCE	Pearce #1	7/30/98	15	11	155	Unknown	Unknown	NO	AD069
11295W	29	107	22	SESW	MIS	USDI, BLM** MCMURRY OIL CO	Antelope #14-22W	7/27/98	60	210	710	685	650	NO	AMI015
11464W	33	109	9	NENE	DOM	DAVID NAIL	Nail #1	8/10/98	15	15	145	130	117	NO	AD064
11503W	33	109	14	NWSW	DOM,STO	WILLIAM M/LAURA J FENN	Fenn Hole 2	8/20/98	15	25	115	100	95	NO	ADS016
11580W	33	109	8	SWSE	MIS	USDI, BLM** LANCE OIL/GAS CO, INC.	Sherlock Federal 15-8	8/27/98	45	80	670	635	620	YES	AMI016
11646W	32	109	12	SWSW	MIS	USDI, BLM** ULTRA PETROLEUM	Gemini #13-12	9/8/98						NO	AMI044
1185P	33	109	24	SENW	DOM,STO	MERLE A. THOMAS**GAIL A. THOMAS	THOMAS #1	5/25/64	17.5	17	96	Unknown	Unknown	NO	ADS021
1186P	32	108	31	NWNE	DOM,STO	IVAN G. SHEFFY	SHEFFY WELL #1	3/31/57	17.5	12	155	Unknown	Unknown	NO	ADS006
11928W	29	107	4	SWSE	MIS	USDI, BLM** AMOCO PROD. CO	Antelope 15-4	9/28/98						YES	AMI017
12172W	33	109	24	SESE	DOM	TIMOTHY R CLYNE	Morgan 1	10/12/98	15	40	120	100	85	NO	AD114
13481W	29	107	23	SWSE	MIS	USDI, BLM** AMOCO PROD. CO	ANTELOPE #15-23 WSW	1/7/99	100	100	650	570	555	YES	AMI018

ATTACHMENT A

PAPA Water Well Data

L IIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
3P	34	109	32	SWSE	STO	BILL BLOOM	BLOOM #3	9/30/65	15	10	120	Unknown	Unknown	YES	AS046
4P	33	109	5	NWNE	DOM	BILL BLOOM	BLOOM #4	11/30/67	15	10	130	Unknown	Unknown	YES	AD033
18W	32	108	17	NWSE	STO	LAZY RIVER RANCH LLC	PASTURE WELL	3/11/99	10	11	40	40	30	NO	AS031
63W	33	109	25	NENE	DOM,STO	KEVIN KUNDARD	BRIDLE BIT #1	4/28/99						NO	ADS025
65W	33	109	9	SENW	DOM,STO	MICHAEL/SUSAN KRAMER	KRAMER #1	5/3/99	18	25	120	100	90	YES	ADS011
93W	33	109	34	SWSW	MIS	QUESTAR EXPL & PROD. CO** USDI, BLM	STEWART POINT WW	6/18/99	100	290	930	630	600	YES	AMI019
33W	33	109	24	SESE	DOM	JEANE A SOUMIE	WELL Y NOT	6/14/99	20	11	120	98	85	NO	AD113
55W	33	109	22	SENW	MIS	ANSCHUTZ CORP.** MARGRET MOCROFT FAM LTD	Mocroft 11-22 WW	7/27/99	80	40	292	232	226	NO	AMI020
56W	33	109	25	NWSW	MIS		Mocroft 12-25	7/27/99						NO	AMI070
57W	33	109	27	NESE	MIS		Mocroft 12-26D	7/27/99						NO	AMI021
58W	33	109	27	NENE	MIS		Mocroft 4-27d	7/27/99	100	35	314	290	280	NO	AMI022
59W	33	109	21	NENE	MIS		Mocroft 1-21 WW	7/27/99	80	38	292	270	240	YES	AMI023
89W	34	109	32	NENE	DOM	KENNETH S/LESTA E WINER	SLSZ1	9/9/99	18	60	117	110	107	NO	AD133
88W	33	109	9	SWNW	DOM	CLETUS J/LAURIE S LaMERE	LaMere 99	9/27/99	15	3	110	90	80	YES	AD086
79W	32	109	23	NESE	MIS	ULTRA PETROLEUM** USDI, BLM	Mesa #9-23	10/4/99						NO	AMI024
75W	33	109	16	SWNW	MIS	ANSCHUTZ WY CORP.** WY ST BD OF LAND COMM.	Gannett #5-16	11/29/99						YES	AMI025
71W	29	107	4	SWSE	MIS	YATES PETROLEUM CORP.** USDI, BLM	Antelope #15-4 Water Supply Well	12/13/99						YES	AMI017
11W	33	109	6	NENE	DOM,STO,MIS	LEANNE MCCLAIN RELLSTAB	RELLSTAB #1	2/1/00	18	11	100	90	75	YES	ADSM001
29W	33	109	22	SWSE	DOM	MOCROFT FAMILY PARTNERSHIP	MOCROFT #4	1/31/00	15	30	100	90	80	NO	AD004
99W	33	110	15	SWNE	STO	STEVE & JUDY RARIDAN	RARIDAN #2	4/7/00	25	13	110	95	90	NO	AS043
22W	33	109	26	NWNE	STO	ROBERT UNDEM	UNDEM #2	4/24/00	20	10	50	40	20	NO	AS042
122W	32	110	14	NWSW	MIS	UNITED STS FOREST SERVICE	WHISKEY GROVE HAND PUMP WELL #1	6/19/00	1	27	120	68	30	NO	AMI045
69W	33	109	6	NENE	DOM,STO	SIDNEY A/ SHANE A ROBERTS	SID'S WELL #1	6/22/00						YES	ADS009
523W	32	109	20	NENW	MIS	USDI, BLM** QUESTAR EXPL & PROD. CO.	MESA WATER WELL #03-20	6/29/00	110	495	940	935	730	YES	AMI027
524W	33	109	33	NESW	MIS	USDI, BLM** QUESTAR EXPL & PROD. CO.	STEWART POINT WATER WELL #11-33	6/29/00	110	495	980	795	690	YES	AMI028
525W	32	109	5	SWSW	MIS	USDI, BLM** WEXPRO CO	MESA WATER WELL #13-05	6/29/00	100	490	940	930	780	YES	AMI029
526W	33	109	20	SENW	MIS	USDI, BLM** WEXPRO CO	STEWART POINT WATER WELL #05-20	6/29/00						YES	AMI030
387W	33	109	6	NENE	DOM	ED CARDOZA	CARDOZA #1	8/18/00						YES	AD051
546W	33	109	29	SESE	MIS	USDI, BLM** QUESTAR EXPL & PROD. CO.	STEWART POINT WATER WELL NO. 16-29	8/28/00	96	540	1040	965	925	YES	AMI031
721W	32	108	21	NWNW	DOM	LAZY RIVER RANCH	LAZY RIVER RANCH #1	8/28/00						NO	AD139
727W	33	109	9	NWNE	DOM	THOMAS L. SUEDHOFF	SUEDHOFF #1	8/28/00	20	7	162	158	130	NO	AD081
734W	33	110	10	SWSE	DOM	JEROME T. & BONNIE B. MOORE	MOORE #1	8/30/00						NO	AD128
042W	32	109	21	NESE	MIS	ANSCHUTZ EXPL CORP.	MESA 10-21D WATER WELL	9/11/00	60	500	750	740	730	YES	AMI032
658W	29	107	9	SWNE	MIS	YATES PETROLEUM CORP.** USDI, BLM	HIGHWAY #4	11/1/00						YES	AMI035
850W	30	108	10	SWSW	MIS	MCMURRY ENERGY CO.	NEW FORK UNIT #13-10W	11/17/00						YES	AMI005
008W	29	107	4	NESW	MIS	USDI, BLM** MCMURRY ENERGY CO.	ANTELOPE # 11-4W 2	11/30/00	100	85	700	625	400	YES	AMI034
395W	29	107	23	SWSE	MIS	USDI, BLM** YATES PETROLEUM CORP.	ANTELOPE # 15-23 WATER SUPPLY WELL	12/12/00						YES	AMI018
661W	30	107	31	SWNE	MIS	MCMURRY ENERGY CO.** USDI, BLM	RAINBOW # 7-31W	12/28/00	100	185	765	705	505	YES	AMI037
814W	29	107	3	NENW	MIS	YATES PETROLEUM CORP.** USDI, BLM	HIGHWAY # 11	1/8/01	30	170	700	685	622	YES	AMI033
13W	33	109	26	SWNE	DOM,STO	WARD V. RUMPLER	ECKLUND #1	2/29/72	17.5	25	100	99	80	NO	ADS027
627W	31	109	24	NESW	MIS	MCMURRY ENERGY CO.** USDI, BLM	NEW FORK UNIT #11-24W	2/21/01	100	45	585	555	160	YES	AMI026
241W	32	109	28	NENE	IND	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA 2-28d WATER WELL	3/19/01	100	100	512	510	510	NO	AMI077
064W	31	108	18	SWSW	MON	ANTICLINE DISPOSAL, LLC	MONITORING WELL # 1	4/13/01							
065W	31	108	18	SWSW	MON	ANTICLINE DISPOSAL, LLC	MONITORING WELL # 2	4/13/01							
066W	31	108	18	SWSW	MON	ANTICLINE DISPOSAL, LLC	MONITORING WELL # 3	4/13/01							
067W	31	108	18	SWSW	MON	ANTICLINE DISPOSAL, LLC	MONITORING WELL # 4	4/13/01							
220W	32	109	27	SWNE	MIS	McMURRY ENERGY CO** USDI, BLM	MESA 7-27-32-109	4/12/01	115	195	645	610	425		
221W	32	109	28	NESW	MIS	McMURRY ENERGY CO** USDI, BLM	MESA 11-28-32-109 W	4/19/01	115	550	865	840	690		
278W	31	108	18	SWSW	MIS	ANTICLINE DISPOSAL, LLC	JENSEN 18	4/13/01							
281W	32	109	36	SWSW	MIS	PETROGULF CORP.** WY ST BD OF LAND COMM.	PARADISE DITCH STATE 36-13 WATER WELL	4/16/01							
4656W	30	108	36	NENE	MIS	McMURRY ENERGY CO	FALCON #1-36W	5/3/01	85	225	733	Unknown	Unknown		
5459W	31	108	19	SWSW	MIS	McMURRY ENERGY CO** USDI, BLM	PINEDALE FEDERAL #13-19W	5/18/01	115	300	493	Unknown	Unknown		
5460W	31	109	36	SWNE	IND	PETROGULF CORP.** WY ST BD OF LAND COMM.	STATE 36-1 WATER WELL	5/24/01							
5063W	32	109	7	SWNE	MIS	McMURRY ENERGY CO** USDI, BLM	NORTH MESA 4-7-32-109W	6/25/01	80	500	1040	982	814		
6491W	31	109	11	SWNW	MIS	McMURRY ENERGY CO	JENSEN # 1 WATER WELL	7/9/01							
6908W	33	109	9	NWNE	MIS	SCENIC VIEW SUBDIVISION WELL ASS.	SCENIC VIEW # 1	7/12/01	35	8.5	109	108	100		
7014W	30	108	26	SENW	MIS	ULTRA RESOURCES, INC.** USDI, BLM	WARBONNET 6-26	7/12/01							
7015W	31	109	4	SESE	MIS	ULTRA RESOURCES, INC.** USDI, BLM	PINEDALE 1-4	7/18/01							

L IT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
31W	31	109	2	NENW	MIS	ULTRA RESOURCES, INC.	ULTRA RESOURCES INC.	7/30/01							
21W	33	109	25	NENE	DOM	JOSH / JENNIFER JOHNSON	JOHNSON WELL NO. 1	8/8/01							
74W	32	109	22	NENW	MIS	QUESTAR EXPL & PROD. CO.** USDI, BLM	MESA WATER WELL NO 3-22	8/1/01	100	350	772	550	540		
75W	32	109	8	SWSE	MIS	QUESTAR EXPL & PROD. CO.** USDI, BLM	MESA WATER WELL NO 15-8	8/1/01	90	350	813	775	740		
76W	33	109	28	NENW	MIS	QUESTAR EXPL & PROD. CO.** USDI, BLM	STEWART POINT WATER WELL NO. 3-28	8/1/01	100	150	593	555	540		
2P	33	109	11	NWNW	DOM	THOMAS J & MARY JANE SARACINO	SARACINO #1	12/31/40	17.5	Unknown	55	Unknown	Unknown	NO	AD101
5W	33	109	6	SENE	DOM	LEONA ROBERTS	ROBERTS WELL #1	4/28/72	25	10	90	88	61	YES	AD056
90W	32	109	21	NESE	MIS	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA UNIT # 10-21D # 2	8/6/01							
91W	32	109	28	NENE	MIS	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA 1-28D WELL # 2	8/6/01							
31W	31	109	11	NESW	MIS	McMURRY ENERGY CO	JENSEN # 11-11W	8/27/01							
32W	32	109	29	NENE	MIS	McMURRY ENERGY CO	MESA 4-28-32-109W	8/27/01						NO	AMI090
64W	32	109	27	SENW	MIS	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA 6-27D WATER WELL	8/20/01							
69W	32	109	28	SENE	MIS	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA 8-28 WATER WELL	8/23/01							
81W	29	107	24	NENE	MIS	CAMWEST EXPL LLC	WW TM 14-24	9/5/01							
13W	33	109	20	SESW	MIS	QUESTAR EXPL & PROD. CO.** BLM	STEWART POINT 14-20 WSW	9/7/01							
15W	30	108	16	NENE	MIS	YATES PETRO CORP.** WY ST BD OF LAND COMM.	BLUE RIM STATE # 1 WATER WELL	9/7/01							
920W	32	109	28	SWNE	MIS	ANSCHUTZ EXPL CORP.** USDI, BLM	MESA 7-28 WATER WELL	9/12/01							
239W	32	108	31	SWSW	MIS	NEW FORK ENERGY LLC	SCOTT WELL # 1	9/4/01							
248W	33	109	33	NWNW	MIS	QUESTAR EXPL & PROD. CO.** BLM	STEWART POINT 4-33 WSW	9/6/01							
373W	33	109	9	SENE	DOM	LARRY J. KIRKPATRICK	PAM'S # 1	9/12/01							
40W	33	109	6	NWNW	DOM	JIM & NANCY KENYON	KENYON #1	5/17/72	25	10	96	88	71	YES	AD058
34W	33	109	25	SWNE	MIS	J. M. SULENTA	SUL 1 25	6/21/72							
35W	33	109	25	SWNW	MIS	J.M. SULENTA	SUL 2 25	6/21/72							
48W	33	109	5	NWNE	DOM	C.M. WANNER	WANNER #1	7/21/72							
47W	33	109	23	SESE	DOM	JERRY MCMURRY	MCMURRY #1	7/31/72							
42W	33	109	15	NENW	DOM	DAVID D. MAYTAG	MAYTAG RESIDENCE #1	9/18/72	11	30	106	105	80	NO	AD105
66P	33	109	5	NENW	DOM	C.M. WANNER	WANNER #1	12/31/47	25	Unknown	90	Unknown	Unknown	YES	AD034
22P	32	108	32	SESE	DOM	FAY C. BARGER	HM #3	9/21/10	5	55	168	Unknown	Unknown	NO	AD031
23P	32	108	32	SESE	DOM	FAY C. BARGER	HM #4	9/21/10	5	55	187	Unknown	Unknown	NO	AD030
16P	34	109	32	NESW	DOM	EDWARD F. STEELE RANCH	STEELE #1	4/26/50	5.75	6	104	Unknown	Unknown	YES	AD134
295P	30	107	15	SESE	STO	JAMES N. TIBBALS**JANET D. TIBBALS** US GOV.	RANGE WELL #1	3/30/40	8	24	128	126	119	NO	AS023
911W	33	109	26	NWNW	DOM	DON BAUGHMAN	BAUGHMAN #1	5/7/73							
472W	33	109	25	NWSE	DOM	NICK SKORUP	OSSELTON #1	6/6/73	9	10	100	90	60	NO	AD115
692P	33	109	10	SWSE	DOM	DARRELL & SUE ANN WOODSON	WOODSON #1	2/13/73	25	40	90	98	70	NO	AD095
121P	33	109	24	SWNW	DOM	EUGENE & ELLANORA PFISTERER	PFISTERER #1	3/22/73	25	Unknown	120	Unknown	Unknown	NO	AD112
266W	33	109	6	SESW	MIS	HARRY P. & VIRGINIA K. SCHRIVER	SCHRIVER #1	6/8/73	8	90	160	Unknown	Unknown	NO	AMI069
521W	31	109	27	NENE	STO	USDI BLM	CUT-OFF SPRING 4111	6/26/73	3	Flowing	4	Unknown	Unknown	NO	AS028
433P	32	110	26	SWNW	STO	UNITED STS DEPT. OF INTERIOR	MESA SPRING #344	8/22/73	5	Flowing	1	Unknown	Unknown	NO	AS038
676P	32	108	27	NESE	DOM	INC. CIRCLE NINE RANCH	RANCH #1	1/29/73	25	Unknown	165	Unknown	Unknown	NO	AD028
155W	32	108	27	NESE	DOM	CIRCLE NINE RANCH INC.	RANCH WELL #4	6/26/74	20	75	145	130	125	NO	AD027
160W	31	109	22	NESE	STO	USDI BLM	CHEVRON SPRING 4121	6/28/74	0.5	0	Unknown	Unknown	Unknown	NO	AS012
229W	32	108	6	NENE	DOM	KENNETH SMITH	SMITH #1	10/1/74	12.5	130	160	Unknown	Unknown	NO	AD025
128W	30	108	10	SESW	MON,MIS	EL PASO NATURAL GAS CO.	BLUE RIM #4	2/14/75	0	0	306	Unknown	Unknown	YES	AMI003
129W	30	108	9	NWNW	MON,MIS	EL PASO NATURAL GAS CO.	BLUE RIM #8	2/14/75	0	0	306	Unknown	Unknown	NO	AMI004
867W	33	109	26	SWNE	DOM	FRANK P. & LEONA V. GARNICK**N. GARNICK	GARNICK SPRING #1	5/1/75	5	Unknown	3	Unknown	Unknown	NO	AD121
077W	33	109	10	NENE	DOM	JACK D. RICHARDSON	RICHARDSON #1	4/1/75	25	20	190	Unknown	Unknown	NO	AD093
296W	33	109	6	NESW	DOM	VERNON DELGRADO	DELGADO L-25	10/8/75	15	Unknown	150	144.7	135	YES	AD061
306W	33	109	24	SWNW	DOM,STO	WILLIAM H. REISNER	REISNER #1	10/20/75	25	180	225	Unknown	Unknown	NO	ADS020
767W	31	108	5	NWNW	DOM	DR. CHARLES CHIDSEY	CHIDSEY #1	4/9/76	16	34	141	Unknown	Unknown	NO	AD014
3379W	33	109	10	SESE	DOM	FLOYD E. & VIRGINIA OXNER	OXNER #1	5/13/76	5	7	135	57	2	NO	AD097
3396W	33	109	6	NENE	DOM	GLEN T. DUNNING	DUNNING #2	5/26/76	15	9	12	12	6	YES	AD052
368W	30	108	5	SENW	IND	EL PASO NATURAL GAS CO.	WAGON WHEEL #1	8/20/69	45	98	2500	2428	130	YES	AMI001
380P	33	109	6	NENE	DOM	LOUIS W. ISAACS**ALENE P. ISAACS	ISAACS #1	8/2/62	25	7	81			YES	AD050
6709W	33	110	36	SWNE	DOM	JOE H. BERTAGNOLLI	BERTAGNOLLI #1	7/16/77	25	90	105	105	45	NO	AD131
7928W	33	109	23	SESE	DOM,STO	RAY BRAZELL	BRAZELL #2	5/13/77	20	29	70	70	35	NO	ADS018
8299W	33	109	23	SWSE	STO	JESSE W. MCCLAIN	MCLAIN #1	6/9/77							
8439W	33	109	22	SWSE	DOM	HARLEY C. & MARGARET E. MOCROFT	MOCROFT WINDMILL #1	6/15/77	25	22	92	Unknown	Unknown	NO	AD006
8576W	33	109	13	SESW	STO	WILLIAM R. & DANA FENN	REISNER #2	7/28/77	7	8	79	78	58	NO	AS041
9466W	31	109	32	NESE	DOM	GEORGE E. ROBBINS	ROBBINS #1	7/21/77							
9470W	30	107	5	NESW	STO	LARY LOZIER	LOZIER #1	7/29/77							
9515W	33	109	6	SWSW	MIS	PINEDALE KOA KAMPGROUND	KOA #1	5/16/77	6	106	402	Unknown	Unknown	NO	AMI068

LL MIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
2W	33	109	11	NENE	DOM	KYLE & BEVERLY WALKER	KYLE WALKER #2	10/18/77	25	25	104	103	97.5	NO	AD098
4W	33	109	26	NWNE	DOM	SPENCE CONSTRUCTION CO	SPENCE #1	2/2/78	8	233	259	259	227	NO	AD118
5W	33	109	26	SENE	DOM	RONALD E. SHIELDS	SHIELDS #1	2/15/78	12	19	128	Unknown	Unknown	NO	AD122
3W	31	109	15	NWNW	DOM	JACK & DIXIE SANDERS	POSSIBLES #1	5/8/78	20	12	70	70	16	NO	AD007
9W	33	109	6	NESW	MIS	DEW LUMBER CO.	DEW LUMBER #2	6/15/78	25	48	147	146	130	YES	AMI065
W	32	109	16	SWSW	STO	WY BD OF LAND COMM.**CARL JORGENSEN	JORGENSEN #2	1/30/70							
W	32	109	36	SESE	STO	ST OF WYOMING**CARL JORGENSEN	JORGENSEN #3	1/30/70							
8W	31	109	21	NWNE	DOM	CHARLES C. HALL	THE WATERING HOLE #1	8/7/78	8	5.5	56	Unknown	Unknown	NO	AD017
8W	33	109	11	NENE	DOM	CURTIS E. & JOAN M. YOUNG	EGG FOO YOUNG #1	9/7/78							
9W	33	109	9	NWSE	DOM	GERALD L. ABERCROMBIE	ABERCROMBIE #1	9/12/78							
1W	33	109	9	NWNW	DOM	JOHN MAX SPEALMAN	MAX #1	9/12/78	9.5	66	142	141	132	YES	AD084
1W	31	109	21	NWSW	DOM	WILKINSON & CO.	WILKINSON #1	9/18/78	14	35	80	Unknown	Unknown	NO	AD019
4W	33	109	9	SESE	DOM	CURTIS B. BROWN	BROWN #1	9/19/78	10	7.5	73	Unknown	Unknown	YES	AD091
W	33	109	26	NWNE	DOM	GALE B. & EVELYN M. TUGGLE	TUGGLE #1	1/20/70	8.34	25	102	101	86	NO	AD117
1W	33	109	5	NWSE	DOM	FORREST L. GROSSMAN	GROSSMAN#1	1/23/79	10.5	40	152	151	133	NO	AD045
7W	33	109	6	SWSW	MIS	RANDALL C. & JANET L. MONTGOMERY	MONTGOMERY #1	4/26/79							
3W	33	109	5	NWNW	DOM	LOIS P. KOCH	KOCH #1	6/4/79	25	17	165	164	147	YES	AD036
8W	33	109	11	NENE	DOM	KYLE B. AND BEVERLY C. WALKER	KYLE WALKER #3	6/5/79	20	5.5	94	93	86	NO	AD099
6W	33	109	9	SWNE	DOM	GERALD WILDER	WILDER #1	7/13/79							
4W	33	109	26	NENE	DOM	JOSEPH C. BOZNER	BOZNER #1	7/12/79							
2W	33	109	10	SESE	DOM	EVAN JOHN GRIFFITH	RUBEL NABOB #1	9/12/79	7	18	133	132	124	NO	AD096
6W	33	109	10	NENE	DOM	IVAN V. WALTON	WALTON #1	9/27/79	25	16	75	Unknown	Unknown	NO	AD092
P	34	109	32	NWNE	STO	THE TALLI ROSE MANNING "GRANTEE"	CANTLIN #1 (DEEPENED)	12/31/47	10	Unknown	103	Unknown	Unknown	NO	AS044
9W	32	108	6	NWNE	IRR	ALLEN F. KETTERLING	KETTERLING #2	11/9/79							
7W	33	109	9	NWNE	MIS	PINE TREE INDUSTRIES INC.**JOE HICK	SCENIC VIEW #1	12/20/79	35	8.5	109	108	100	NO	AMI084
0W	33	109	5	NWSE	DOM	HARLE & VIRGINIA DAMON	DAMON #1	2/11/80							
6W	34	109	32	SESE	MIS	IVAN V. WALTON	WALTON WELL #1	2/27/80							
3W	33	109	6	NENE	DOM	GLEN R. DUNNING	ENL DUNNING #2	4/2/80	9	9	12	12	6	YES	AD052
6W	33	109	5	NWNW	DOM	PETE DELMUE	DELMUE #1	5/29/80	25	22	126	125	112	YES	AD037
6P	33	109	6	SENW	DOM	J. CHAUNCEY CLARK	CLARK #1	12/21/22	20	20	120			YES	AD059
7P	33	109	6	SENW	STO	J. CHAUNCEY CLARK	CLARK #2	12/12/68	15	65	176			YES	AS039
3W	33	110	12	NENE	DOM,STO	OWEN L. IRWIN	IRWIN #1	6/25/80	10	95	125	125	95	NO	ADS028
4W	33	109	5	SWNW	DOM,STO	PAUL/JEANNE HICKEY	ELWOOD MEYERS #1	9/2/80	16	80	360	Unknown	Unknown	YES	ADS008
4W	31	109	5	SWSE	STO	HIGGINS RANCH	HIGGINS RANCH #1	12/31/81	20	1	300	280	290	YES	AS027
2W	33	109	24	SENW	DOM,STO	WILLIAM R. & DANA FENN	FENN #1	9/18/80	20	12	84	83	71	NO	ADS022
6W	34	109	32	SWNE	STO	ROBERT T. WILSON	WILSON #2	9/24/80	25	7	59	Unknown	Unknown	YES	AS045
1W	31	109	11	SWNW	MIS	LEONARD HAY	JENSEN I	11/6/80	50	20	146	146	125	YES	AMI083
7W	33	110	1	NENE		NANCY PALUBIAK	PALUBIAK #1	10/22/80	10	63	168	167	143	NO	AD137
3W	33	109	9	NENW		JOE R. HICKS	HICKS #3	12/4/80							
5W	32	109	16	SENW	MIS	MOUNTAIN FUEL SUPPLY CO**WYOMING ST BD OF LAND COMM.	THE MESA UNIT WELL #2	12/24/80							
174W	33	109	5	SENW		ROGER H. & BONNY JO ANDERSON	ANDY	1/12/81	10	80	110	110	70	YES	AD136
040W	33	109	5	NWSE	DOM	JOE HAY	HAY #1	3/13/81	12	45	150	150	130	NO	AD044
161W	33	109	6	NWSE	DOM	JIMMY L. & SHERRY A. BROWN	BROWN #1	6/3/81	12	50	112	112	98	YES	AD063
163W	33	109	5	SWNW	DOM	STARING O. & DORIS L. BRYANT	BRYANT #1	6/3/81							
303W	30	108	25	SWNE	MIS	USDI, BLM** AMERICAN HUNTER EXPL LTD	AMERICAN HUNTER NEW FORK #1 WELL	5/12/81	75	90	630	603	585	YES	AMI085
304W	31	109	35	NWSE	MIS	USDI, BLM** AMERICAN HUNTER EXPL LTD	AMERICAN HUNTER NEW FORK #4 WELL	5/12/81	40	30	320	315	300	NO	AMI086
305W	30	108	2	SWNE	MIS	USDI, BLM** AMERICAN HUNTER EXPL LTD	AMERICAN HUNTER NEW FORK #2 WELL	5/12/81	70	335	650	589	576	NO	AMI087
705W	33	109	5	SWNW	DOM,STO	RICHARD D. & REBECCA S. KEY	KEY #1	7/31/81							
917W	33	109	6	SWSW	MIS	GERALD FLUGEL	FLUGEL #2	8/13/81							
993W	30	107	32	SWSW	MIS	USDI, BLM** AMERICAN HUNTER EXPL LTD	NEW FORK #3 WATER WELL	8/28/81							
067W	33	109	26	NENE	DOM	JOSEPH C. BOZNER	BOZNER #1	8/31/81	20	14	110	109	92	NO	AD116
069W	31	109	21	NWNE	DOM	WILLIAM J. & SHARON J. SCHELL	SCHELL #1	8/31/81							
370W	31	109	21	NWSE	DOM	LARRY L. GERDES	GERDES #2	9/28/81							
478W	33	109	6	NENE	DOM	WILLIAM A. MEYER	MEYER #1	2/24/82							
933W	33	109	31	NENE	STO	USDI BLM	MOUNT AIRY-2 #4694	3/15/82	15	243	490	468	447	YES	AS013
515W	31	109	1	SESE	DOM,STO	CHARLES A. CHIDSEY	CHIDSEY #2	5/5/82	5	Flowing	84	84	80	NO	ADS003
647W	33	109	25	NESE	MIS	RALPH WENZ MUNICIPAL AIRPORT	WENZ #2	8/5/81	10	18	118	117	106	NO	AMI071
066W	33	109	5	SWNW	DOM	LESLIE N. & BARBARA A. BURROUGH	BURROUGH 1 (DEEPENED)	5/26/82	12	2.5	52	30	3	YES	AD041
393W	31	109	21	NWSE	DOM	JACK E. WILLIAMS	CHRISTINA RAE #1	6/30/82	10	5	220	220	218	NO	AD021
602W	31	109	21	SENE	DOM	ORLIE D. & CAROL ROUNKLES	ROUNKLES #1	7/22/82							
704W	31	109	11	SWNW	DOM,STO	BRANDT JENSEN	JENSEN #1	8/9/82						NO	AMI083
788W	33	109	5	NWNW	DOM	JOHN RICHARD MORTENSON	MORTENSON #1	8/18/82	10	22	157	155	143	YES	AD039

LL MIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
0W	31	109	11	SESE	DOM,STO	LEONARD HAY	JENSEN #2	11/16/82	25	40	155	Unknown	Unknown	YES	ADS004
9W	33	109	5	NESE	DOM	JOHN A. SULENTA	SUSIE #1	11/12/82						NO	AD043
56W	29	107	2	NWNW	STO	USDI BLM	WATER HOLE DRAW #4719	3/17/83							
58W	32	109	12	NESE	STO	USDI BLM	TWO BUTTES #4720	3/17/83							
70W	32	110	15	NESE	STO	USDI BLM	WEST NESA #4721	3/17/83							
35W	33	109	10	SESE		MICHAEL J. & RITA N. MCGINNIS	DOM	4/15/83	20	14	164	162	153	NO	AD138
95W	31	109	21	NWSE	DOM	TERRY L. STEGEN	JEREMY #1	4/25/83	12	20	132	132	125	NO	AD020
94W	33	109	6	SENE	DOM	RALPH E. & JAMIE B. WOOD	WOOD #1	6/3/83	25	84	283	281	275	YES	AD057
0P	32	108	33	NENE	DOM	NORMAN RICHIE**JEPTHA RICHIE	NEW FORK #1	12/31/30	7	Unknown	58			NO	AD032
1P	32	108	33	NENE	STO	NORMAN RICHIE**JEPTHA RICHIE	NEW FORK #2	12/31/28	5	10	20			NO	AS033
83W	33	109	6	NENE	DOM	PAUL D. BRADSHAW	BRADSHAW #1	6/27/83							
65W	33	110	3	SESW	DOM	HARRY STEELE	STEELE #2	7/8/83	14	20	202	190	187	NO	AD127
97W	31	109	14	NESE	MIS	USDI, BLM** NORTHWEST PROD. CO.	NWP #1	7/7/83							
98W	31	109	24	SESE	MIS	USDI, BLM** NORTHWEST PROD. CO.	NWP #2	7/7/83							
90W	33	109	11	SENE	DOM,STO	ROBERT C. & SHIRLEY J. LOONEY	R C LOONEY #1	7/25/83	20	6	103	102	93	NO	ADS014
54W	33	110	12	NENE	MIS	JACK E. HEGARDT	HEGARDT #1	9/29/83							
30W	31	109	21	NWNE	DOM	WILLIAM J. & SHARON J. SCHELL	SCHELL #1	3/12/84	13	5	43	43	40	NO	AD016
99W	33	109	5	SENE	MON,MIS		NFIDW #2	5/21/84	0	5	27	30	5	NO	AMI059
00W	34	109	32	NWNE	MON,MIS		NFIDW #3	5/21/84	0	9	16	15	13	NO	AMI073
01W	34	109	32	NESW	MON,MIS		NFIDW #4	5/21/84	0	8	30	30	5	YES	AMI074
02W	33	109	5	NWNW	MON,MIS		NFIDW #5	5/21/84	0	7	15	11	Unknown	YES	AMI061
03W	33	109	6	SENE	MON,MIS		NFIDW #6	5/21/84							
111W	33	109	35	SESE	DOM	RANDY A. DABB	DABB #1	8/3/84	5	28	134	Unknown	Unknown	NO	AD008
231W	32	108	6	NENE	DOM	BILL & LOIS RENZELMAN	RENZELMAN #1	8/8/84	19	27	110	108	101	NO	AD024
398W	32	108	6	NWNE	DOM	JIM MCCORMICK	QUATER MOON #1	9/4/84	25	31	126	121	114	NO	AD026
609W	30	107	30	NWNE	STO	USDI BLM	N W SQUARETOP	9/25/84	15	196	227	226	216	NO	AS014
658W	32	108	6	NENE	DOM	FRANK DISKO	DISKO #1	10/5/84	15	36	102	97	91	NO	AD023
137W	34	109	32	SWSE	MIS	DONALD R. & JANE S. DRIGGS**ROGER & STELLA DAVENPORT	DRIGGS #2	12/7/84	10	10	68	68	50	YES	AMI075
98W	33	109	23	SESE	DOM	RAY BRAZELL	BRAZELL #1	10/23/70	25	16.6	112	110	68	NO	AD108
113W	31	109	20	SESE	DOM	WILKINSON & CO.	WILKINSON #2	5/16/85	20	65	145	143	132	NO	AD015
736W	34	109	32	SESE	MIS	WYOMING ST HIGHWAY DEPARTMENT	PINEDALE SHOP #1	7/23/85	25	10	200	160	77	YES	AMI076
929W	33	110	12	NENE	DOM	TOMMY THOMPSON	THOMPSON 4	8/15/85	26	83	287	Unknown	Unknown	NO	AD129
721W	33	109	9	NWNE	MIS	PINE TREE INDUSTRIES INC.	SCENIC VIEW #1	3/18/85	35	8.5	109	108	100	NO	AMI084
946W	29	107	2	NWNW	STO	USDI BLM	WATER HOLE DRAW	2/19/86	25	145	190	145	135	YES	AS015
948W	32	109	12	SESE	STO	USDI BLM	TWO BUTTES	2/19/86	25	71	131	121	97	NO	AS034
950W	32	110	15	NESE	STO	USDI BLM	WEST MESA	2/19/86	25	145	210	200	180	NO	AS037
678W	33	109	9	NENE	DOM	JAMES J. REYNOLDS	REYNOLDS #2	5/23/86	10	7	116	Unknown	Unknown	NO	AD067
773W	33	109	23	NESW	MIS	SUBLETTE COUNTY	COUNTY SHOP #1	5/21/86	25	42	226	224	195	NO	AMI036
862W	33	109	5	SWNW	DOM	STARLING O. AND DORIS L. BRYANT	BRYANT #1	6/30/86	15	22	87	73	69	YES	AD040
864W	33	109	9	NWNE	DOM	KEN KONICKE	KONICKE #1	7/9/86	20	3	108	106	95	NO	AD080
411W	33	109	5	SENE	MIS	SUBLETTE COUNTY RECREATION BD	RENDEZVOUS MEADOWS #1	9/29/86	15	7	113	106	96	NO	AMI060
52W	33	109	6	SENW	MIS	DEW LUMBER CO.**CHAUNCEY CLARK	DEW LUMBER #1	12/7/70	50	208	210	208	190	YES	AMI064
394W	33	109	9	SESW	DOM,STO	DENNIS L. ALMQUIST	ALMQUIST #1	4/8/87	24	32	100	100	65	YES	ADS012
316W	33	109	24	SWNE	DOM	MARK J. PEARSON	PEARSON #1	8/17/87	10	20	100	84	77	NO	AD110
49P	31	109	32	SWNE	STO	ROBERT E. OLSON**ENA OLSON	OLSON #4	12/31/29	1	8	Unknown			NO	AS030
830W	33	109	22	SWSE	STO	MARGARET MOCROFT	MOCROFT #4	11/9/87	20	4	35	35	4	NO	AS016
253W	31	109	21	NWSW	DOM	TOM G. GRIFFITH	GRIFFITH #1	1/25/88							
369W	31	109	32	NWNE	STO	ROBERT E. AND ENA OLSON	BERTRAM #1	2/24/88	8	30	60	60	41	NO	AS029
760W	31	108	11	NWSW	MON,MIS	WYOMING ST HIGHWAY DEPARTMENT	NEW FORK #1	5/10/88	0	65	400	400	375	NO	AMI042
761W	31	108	3	SWSE	MON,MIS	WYOMING ST HIGHWAY DEPARTMENT	NEW FORK #2	5/10/88	0	73	340	340	201	NO	AMI041
762W	31	108	3	NWNW	MON,MIS	WYOMING ST HIGHWAY DEPARTMENT	NEW FORK #3	5/10/88	0	97	300	300	280	NO	AMI040
005W	33	109	6	NENE	DOM	COURTNEY W. DAVIS	DAVIS #1	9/8/88	20	15	51	51	45	YES	AD054
006W	33	109	23	SWSE	DOM	ROY NIELSEN	SHOSHANAH #1	9/8/88							
110W	33	109	6	SENE	DOM	BRUCE GOOCH	RUSS EKLUND #1	8/12/88							
135W	33	109	5	NWNW	DOM	GLENDA E. VANCE	VANCE #1	2/23/89							
101W	33	109	13	NWSW	DOM	HANS F. BELL	BELL #1	6/21/89	15	30	93	90	70	NO	AD103
163W	33	109	5	SESE	DOM	DAVID J. TROMBLY, SR.	TROMBLY #1	7/10/89	20	36	185	180	160	NO	AD046
929W	33	109	24	SENW	DOM,STO	WILLIAM AND DANA FENN	FENN #2	10/6/89	25	6	52	50	6	NO	ADS023
127W	33	109	9	NWSE	DOM	CAROLYN L. ABERCROMBIE	ABERCROMBIE #1	10/17/89	20	7	68	67	60	YES	AD089
821W	33	109	6	SWSW	DOM	TOM AND LINDA NIXON	NIXON #1	2/8/90							
885W	33	109	11	SENE	DOM	D. CARL INGERSOLL	INGERSOLL #1	2/26/90	10	5	92	90	72	NO	AD100
993W	33	109	9	NWNE	DOM	R. CRAIG AND ELLEN K. SHEPPARD	SHEPPARD #1	3/19/90	10	3	95	Unknown	77	NO	AD082

L IIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
5W	33	109	9	NWNE	DOM	FRANK AND GLORIA SEMPSIS	SEMPSIS #1	3/23/90	10	5.5	90	90	78	NO	AD079
5W	33	109	9	NENE	DOM	WAYNE AND DOROTHY FORNSTROM	FORNSTROM #1	4/4/90	8	7	77	76	65	NO	AD070
0W	32	110	25	NWNW	STO	USDI BLM	BENCH #2	6/4/90							
4W	33	109	24	SWNE	DOM	KATHRYN SPLANE	KATHRYN SPLANE 1	8/10/90	20	65	85	85	75	NO	AD109
2W	34	109	32	SWSE	STO	GARY S. WILSON	BLOOMFIELD #2	9/4/90	25	5	52	Unknown	Unknown	YES	AS047
3W	33	109	9	NENE	DOM	RONALD E/ELEANOR J JOHNSON	JANICKI'S #1	11/28/90	20	14	110	Unknown	Unknown	NO	AD073
1W	33	109	5	NESE	DOM	JOHN A. SULENTA	COLE #5	1/18/91	15	3	120	117	112	NO	AD042
P	30	109	5	NWNE	DOM	BLM	PINEY CUT-OFF NEW FORK #1	10/14/67	3	7	55	53	37	NO	AD012
5W	33	109	9	NENE	DOM,STO	STEVEN AND MARILYN MACKEY	BONNIE'S #3	4/15/91	11	11	90	90	86	NO	ADS010
3W	33	109	9	NENE	DOM	BRUCE C. AND MARY ANN GOOCH	LOG HOME 1	5/16/91	25	5	95	93	80	NO	AD065
3W	31	108	3	NENW	MIS,MON	WY ST DEPT. OF TRANSPORTATION	PINEDALE REST AREA #1	5/20/91							
0W	30	108	20	NENW	STO	BLM	BLUE RIM WELL #4084	3/19/71	10	311	600	600	570	NO	AS001
5W	32	109	13	NESW	STO	BLM	EAST MESA WELL #1	3/19/71	10	24	160	Unknown	Unknown	NO	AS035
0W	30	107	4	NWSE	STO	BLM	LANDER WELL #2	3/19/71	10	85	151	140	120	NO	AS020
57W	32	108	32	NESW	DOM	HIGH MOUNTAIN RANCHES	HIGH MOUNTAIN #1	6/3/91	25	30	92	90	80	NO	AD029
53W	33	109	9	NENE	DOM	DOYLE P. AND LINDA K. HOPPERT	HOPPERT #1	6/27/91							
85W	33	109	6	SENW	MIS	JOHN PENTON	PENTON #1	7/11/91						YES	AMI063
54W	30	108	5	SENW	STO	EL PASO NATURAL GAS CO.**QUARTER CIRCLE FIVE RANCH	ENL WAGON WHEEL #1	7/17/91	0	98	2500	2428	130	YES	AMI001
55W	30	108	5	SENW	STO	USDI, BLM**QUARTER CIRCLE FIVE RANCH**EL PASO NATURAL GAS CO	ENL WAGON WHEEL #2	7/17/91	0	33	5200	Unknown	Unknown	YES	AMI002
57W	33	109	9	NENE	DOM	HARVEY R. NORRIS	NORRIS #1	7/22/91	10	12	97	95	85	NO	AD077
61W	33	109	9	NENE	DOM	BOB LOOS	LOOS #1	11/15/91	15	10	95	95	85	NO	AD076
69W	30	109	5	NWSW	DOM	ROBERT E. AND ENA OLSON	OLSON #6	12/2/91	10	23	60	58	42	NO	AD013
75W	33	109	6	SWSW	MIS	GERALD FLUGEL	FLUGEL #2	11/4/91	25	70	148	147	142	NO	AMI066
74W	33	109	5	NWNW	DOM	GLENDA E. VANCE	VANCE #2	2/5/92	11	18	200	186	182	YES	AD035
929W	33	109	9	NENE	DOM	HANK PHILLIPS	PHILLIPS #1	5/7/92	10	7	100	Unknown	82	NO	AD075
789W	33	109	9	NENE	DOM	HANK PHILLIPS	PHILLIPS #2	7/15/92	20	10	100	94	82	NO	AD074
287W	33	109	6	SWSW	MIS	BRYAN WILLIAMS	WILLIAMS #1	6/22/92	5	95	120	114	112	NO	AMI067
321W	33	109	7	SWNE	STO	USDI BLM	CLARK BLOOM WELL	9/1/92	15	85	192	140	125	NO	AS019
611W	33	109	9	NENE	DOM	HANK PHILLIPS	PHILLIPS #3	10/5/92	10	7	100	86	82	NO	AD071
35W	30	108	5	SENW	IND	EL PASO NATURAL GAS CO.	WAGON WHEEL WATER WELL #2	5/3/71	42	3300	5200	Unknown	Unknown	YES	AMI002
798W	33	109	24	NESE	DOM,STO	LLOYD E. FORCUM	FORCUM #1	2/11/93							
168W	33	109	23	SENW	DOM,STO	PAUL C. AND BETTE A. HAGENSTEIN	HAGENSTEIN #3	3/31/93	10	40	105	97	87	NO	ADS017
359W	33	109	26	NWNE	STO	ROBERT UNDEM	UNDEM #2	4/9/93							
30P	31	109	10	SENW	DOM	ANNA E. TOWNSEND	TOWNSEND #1	5/31/65	12.5	30	105	Unknown	Unknown	YES	AD001
032W	33	109	9	NENE	DOM	HANK PHILLIPS	1-93	9/16/93	10	10	115	115	108	NO	AD072
035W	33	109	5	NENE	MIS	THORNTON & DONNA GROVE	GROVE #1	9/17/93	25	7	80	77	70	YES	AMI054
195W	33	109	26	NWNE	DOM	JOHN SHASSETZ	SHASSETZ #1	10/6/93	12	10	85	78	65	NO	AD119
45P	31	108	9	NESW	STO	BLM	EAST FORK WELL #580	6/30/67	4	60	200	200	190	YES	AS025
48P	31	109	4	SWNW	STO	BLM	MESA HORSE WELL	6/21/65	7.5	140	325	Unknown	Unknown	NO	AS002
49P	29	107	10	SENW	STO	BLM	MUD HOLE WELL #630	9/15/66	Unknown	40	70	Unknown	Unknown	YES	AS003
50P	31	108	13	NESE	STO	BLM	SAND SPRINGS WELL #582	6/30/67	5	110	251	200	60	NO	AS026
52P	31	108	20	SENW	STO	BLM	LANDER WELL #583	6/30/67	5	135	238	237	215	YES	AS004
53P	29	107	10	SENW	STO	BLM	MUD HOLE WELL #629	9/1/66	6	35	70	Unknown	Unknown	YES	AS005
54P	30	107	32	SWNE	STO	BLM	STEELE-HITTLE SQUARE TOP WELL	10/14/66	4	135	233	230	200	YES	AS006
57P	32	109	5	SENW	STO	BLM	MT. AIRY WELL #19	12/23/60	5	165	343	343	300	YES	AS007
59P	32	109	17	NENE	STO	BLM	MESA WELL #106	8/2/41	6	40	150	146	85	YES	AS008
62P	30	107	13	NWSW	STO	BLM	SQUARE TOP WELL #109	7/5/41	3	61	250	253	169	NO	AS022
65P	30	108	23	SWSE	STO	BLM	BUCKHORN #314	6/30/49	3	100	375	Unknown	Unknown	YES	AS009
67P	29	107	5	NWSE	STO	BLM	BUCKHORN WELL #307	4/11/48	6	70	200	198	180	YES	AS010
69P	29	107	10	NESE	STO	BLM	MUD HOLE WELL #69	7/6/63	3	18	102	102	18	YES	AS011
70P	30	107	6	SENE	STO	BLM	SAND SPRINGS WELL #20	12/6/60	4	76	153	153	141	NO	AS021
72P	32	110	12	SWSE	STO	USDI BLM	MIDDLE MESA WELL #509 (DEEPENED)	6/30/66	5	120	425	330	310	NO	AS036
81P	31	108	2	NWSE	STO	BLM	EAST FORK WELL #581	6/30/67	5	45	347	347	290	NO	AS024
84P	33	109	6		DOM	CLARENCE T. DAVIS**FRANCES E. DAVIS	DAVIS #1	5/31/65	15	7.5	100	96	77	YES	AD049
88P	33	109	6		DOM	JULIUS ALBERT MILLER**GLADYS N. MILLER	MILLER #1	6/30/67	17.5	12	95	88	70	YES	AD048
4233W	34	109	32	NENE	DOM	BARBER CREEK ESTS	MAUDE #1	12/20/93	10	20	85	36	25	NO	AD132
4486W	33	109	9	NWNW	DOM	RAMESH DAVE'	DAVE #1	2/4/94	10	4	96	85	70	YES	AD085
6037W	33	109	5	NENE	MIS	CROSSWINDS INVESTMENT GROUP, INC	CROSSWINDS #1	7/7/94	12	4	90	85	63	YES	AMI047
605P	33	109	22	SWSE	DOM	HARLEY C. MOCROFT	MOCROFT #1	7/1/62	20	16	95	90	60	NO	AD002
606P	33	109	22	SWSE	DOM	HARLEY C. MOCROFT	MOCROFT #2	12/31/14	20	16	65	Unknown	Unknown	NO	AD003
607P	33	109	22	SWSE	DOM	MOCROFT FAMILY PARTNERSHIP	MOCROFT #3	12/31/59	20	30	100	90	80	NO	AD004

WELL PERMIT #	T	R	SECT.	QTR. / QTR.	WELL USE	APPLICANT	FACILTY	PRIORITY	YIELD (GPM)	STATIC DEPTH (FT)	WELL DEPTH (FT)	BOTTOM MWBZ	TOP MWBZ	WELL WITHIN 1 MILE OF GPW?	WELL ID
22P	33	109	5	NWNW	DOM,STO	ANTONE J. GOSAR	GOSAR #1	8/25/64	10	8	160	151	82	YES	ADS007
572W	33	109	5	NWNW	DOM	J. MARK & SUSAN G. NOBLE	SUSAN #1	8/15/94	15	14	100	85	75	YES	AD038
319W	33	110	12	NENE	MIS	THOMAS L. JASKOLSKI	TIGER'S #1	8/1/94							
246W	33	109	9	NESE	DOM	GORDON & NANCY RENO	LOT 22, WELL #1	9/26/94	25	8	100	Unknown	Unknown	NO	AD088
051W	33	109	6	SENE	MIS	STEVE & JUDY RARIDAN	RARIDAN #1	12/19/94	10	45	150	100	95	YES	AMI062
148W	33	109	26	SWNE	DOM	ORVIL C. & CLAUDINE C. MERRELL	MERRELL-WELL #1	1/9/95	15	21	100	90	85	NO	AD120
295W	31	109	32	SESW	DOM,STO	JOE SCOTT	SCOTT #1	2/7/95	10	80	120	Unknown	Unknown	NO	ADS005
297W	31	109	21	SWNE	DOM	LEWIS W. EDWARDS	EDWARDS #1	2/10/95	10	2	180	176	168	NO	AD018
395W	33	109	6	SWSW	DOM	STEVEN D. & NORMA J. LICKING	LICKING 1	3/1/95	10	45	120	50	47	NO	AD062
53W	33	109	10	SESE	DOM,STO	EDMUND J. GIEBEL	GIEBEL #1	7/26/71	20	20	80	Unknown	Unknown	NO	ADS013
554W	33	109	9	NESE	STO	GORDON & NANCY RENO	STOCK WELL #1 LOT 21	3/13/95	11	8	40	120	8	NO	AS040
767W	33	109	9	NENE	DOM	ED RICKE**WENDY HOERBER	WENDYS #1	4/12/95	15	7	80	85	75	NO	AD066
847W	33	109	23	SESE	DOM	GARY & BILLIE BINGHAM	BINGHAM #1	4/17/95	3	30	90	90	80	NO	AD107
998W	33	109	9	NWSE	DOM,STO	HAROLD M. & MELITA L. SNOW	SNOW #1	4/17/95	20	8	100	82	68	YES	ADS029
090W	34	109	32	SWSE	DOM	KEN HOKE	HOKE #1	5/1/95	25	8	80	80	8	YES	AD135
123W	33	109	9	SWNE	DOM	KURT A. NELSON	NELSON #1	5/3/95							
291W	31	109	21	NWSE	DOM	WAYNE L. & VIRGINIA P. FELTNER	WATERSDOWN #1	5/24/95	5	2	120	100	98	NO	AD022
350W	33	109	9	SENE	DOM	HANK PHILLIPS	PHILLIPS 1-95	5/26/95	15	7	100	98	90	NO	AD083
486W	33	109	9	SWSE	DOM	RICHARD STEEGE	STEEGE #1	6/22/95	20	20	125	Unknown	Unknown	YES	AD090
689W	33	109	9	NENE	DOM	HANK PHILLIPS	PHILLIPS 2-95	6/30/95	10	7	100	85	65	NO	AD068
888W	33	110	1	NENE	DOM	MARSHL A/JAUNA M MCGINNIS	MCGINNIS #1	7/27/95	12	26	100	82	78	NO	AD124
19429W	T32	R109	S16		MIS	WEXPRO CO** WY ST BD OF	MESA 6-16 WATER SOURCE WELL	9/28/01	--	--	--	--	--		
19427W	T32	R109	S16		MIS	WEXPRO CO** WY ST BD OF	MESA 15-16 WATER SOURCE WELL	9/28/01	--	--	--	--	--		
19428W	T32	R109	S16		MIS	WEXPRO CO	MESA 12-16 WATER SOURCE WELL	9/28/01	100	390	1000	940	540		
10037W	T33	R109	S06		DOM	DOUGLAS STERCK	D.C.# 1	10/17/01	--	--	--	--	--		
10566W	T31	R109	S12		MIS	ULTRA RESOURCES, INC.	RIVERSIDE 15-12 WATER WELL	10/29/01	--	--	--	--	--		
10569W	T30	R108	S04		MIS	ULTRA RESOURCES, INC.	WARBONNET 7-4 WATER WELL	11/2/01	--	--	--	--	--		
10839W	T30	R109	S01		MIS	USDI, BLM**	SOUTH MESA 1-1W	11/15/01	--	--	--	--	--		
10800W	T30	R107	S32		MIS	USDI, BLM**	RAINBOW 13-32W	11/15/01	--	--	--	--	--		
11307W	T32	R109	S16		MIS	WY ST BD OF LAND COMM.	MESA 9-16 WATER SOURCE WELL	11/30/01	--	--	--	--	--		
11310W	T32	R109	S16		MIS	WY ST BD OF LAND COMM.	MESA 16-16 WATER SOURCE WELL	11/30/01	--	--	--	--	--		
11309W	T32	R109	S16		MIS	WY ST BD OF LAND COMM.	MESA 14-16 WATER SOURCE WELL	11/30/01	--	--	--	--	--		
11308W	T32	R109	S16		MIS	WY ST BD OF LAND COMM.	MESA 10-16 WATER SOURCE WELL	11/30/01	--	--	--	--	--		
11374W	T33	R109	S09		DOM	DAVID & LISA DOORN	DOORN #1	12/13/01	--	--	--	--	--		
11737W	T30	R108	S26		MIS	USDI, BLM** U	WARBONNET 9-26	12/21/01	--	--	--	--	--		
11738W	T30	R108	S24		MIS	USDI, BLM** U	WARBONNET 13-24	12/21/01	--	--	--	--	--		
43296W	T32	R109	S28		MIS	ANSCHUTZ CORP.** BLM	ENL. MESA 7-28	3/14/02	25	190	715	702	675		
43295W	T32	R109	S28		MIS	ANSCHUTZ CORP.** BLM	ENL. MESA 1-28D	3/14/02	85	170	645	629	603		
43297W	T32	R109	S21		MIS	ANSCHUTZ CORP.** BLM	ENL. MESA 10-21D #2	3/14/02	93	515	900	900	849		
43763W	T33	R109	S05		DOM	BUDD RANCHES, INC	SWINGER'S GREEN 2ND, LOT 2 WELL	4/10/02	--	--	--	--	--		
44027W	T31	R109	S10		MIS	ULTRA RESOURCES, INC.** USDI, BURE	RIVERSIDE 4-10	4/19/02	--	--	--	--	--		
44088W	T33	R109	S17		MIS	QUESTAR EXPL AND PROD.	STEWART POINT 15-17 WSW	4/22/02	--	--	--	--	--		
44091W	T33	R109	S21		MIS	QUESTAR EXPL AND PROD.	STEWART POINT 11-21 WSW	4/22/02	--	--	--	--	--		
44090W	T32	R109	S21		MIS	QUESTAR EXPL AND PROD.	MESA 7-21 WSW	4/22/02	--	--	--	--	--		
44089W	T33	R109	S17		MIS	QUESTAR EXPL AND PROD.	MESA 3-17 WSW	4/22/02	--	--	--	--	--		
44118W	T31	R109	S32		DOM,STO	NEW FORK PARTNERSHIP	NEW FORK PARTNERSHIP # 1 WELL	4/25/02	--	--	--	--	--		
44144W	T31	R109	S14		MIS	SHELL ROCKY MOUNTAIN PROD., L	RIVERSIDE 2-14W	4/29/02	--	--	--	--	--		
44376W	T32	R109	S28		MIS	ANSCHUTZ EXPL CORP.	ENL MESA 8-28	5/3/02	--	--	--	--	--		
44540W	T32	R109	S34		MIS	ULTRA RESOURCES, INC.	MESA 9-34	5/10/02	--	--	--	--	--		
44541W	T32	R109	S34		MIS	ULTRA RESOURCES, INC.	MESA 7-34	5/10/02	--	--	--	--	--		
44527W	T33	R109	S06		DOM	THOMAS E./SANDRA L. BLACKER	T BONE # 1	5/28/02	--	--	--	--	--		

ATTACHMENT B

PAPA Ground Water Potentiometric Surface Data

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AD106	P100175W	90	7100	7102		7089	12	4740663	595923
AMI051	P100745W	13							
AMI048	P100746W	13							
AMI050	P100747W	13							
AMI052	P100748W	13							
AMI058	P100749W	13							
AMI055	P100750W	13							
AMI056	P100751W	13							
	P100752W								
AMI049	P100759W	13							
	P100760W								
AMI057	P100761W	13							
AMI053	P100762W	30							
AD094	P10086P	153							
AMI039	P101823W	55							
AD060	P102181W	75	7164	7166		7147	19	4746065	588833
AD047	P102716W	105							
AD053	P10329P	90	0	0		0	10	0	0
	P103558W								
AD102	P104418W	100							
ADS015	P105464W	125	7121	7128		7105	17	4742306	594988
	P105517W								
ADS024	P105518W	168							
AD078	P106130W	97							
AD005	P10620P	50	6876	6876		6869	7	4725313	597272
ADS019	P10637P	165							
AD111	P10638P	165							
ADS001	P10646P	105							
ADS002	P10647P	13							
[illegible]	[illegible]	[illegible]	7216	7218		0	0	4714841	605687
AD[illegible]	P107024W	145	6886	6887		6873	14	4725359	597235
AMI006	P107043W	635							
AMI046	P107304W								
AMI007	P107371W	813							
AD104	P107438W	90							
AMI038	P107467W	753							
AD130	P10752W	220							
AMI008	P107612W	753	7348	7348		0	0	4711946	608528
AMI009	P107650W	553	7001	7002		6928	74	4719495	604015
AMI010	P107746W	413	6992	6992		0	0	4724792	602671
AMI043	P107747W	490	7022	7022		6853	169	4724721	593612
AS032	P10824W	63							
	P108312W								
AD126	P10886P	180							
AMI011	P108960W	733							
AD087	P109008W	110	7101	7102		7091	11	4744331	591869
AMI012	P109403W	493							
ADS026	P109514W	100	7062	7064		7058	6	4740034	595757
AD123	P109683W	70	7027	7029		7025	4	4739641	595207
AD125	P109940W	100							
AMI013	P110359W	593	7210	7211		7004	207	4739941	592097
AMI014	P110965W	772							
AD069	P111249W	155							
AMI015	P111295W	710							
AD064	P111464W	145							
ADS016	P111503W	115	7109	7110		7093	17	4742190	594962
AMI016	P111580W	670	7179	7183		7049	134	4743543	590813

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AMI044	P111646W								
ADS021	P11185P	96							
ADS006	P11186P	155							
AMI017	P111928W		7153	7156		6949	207	4706866	614636
AD114	P112172W	120							
AMI018	P113481W	650	7111	7112		6936	176	4702144	617961
AS046	P11403P	120	7147	7149		7141	7	4746733	590673
AD033	P11404P	130							
AS031	P114518W	40							
ADS025	P115563W								
ADS011	P115665W	120	7128	7130		7102	28	4744032	591858
AMI019	P116193W	930							
AD113	P116333W	120							
AMI020	P117255W	292	7084	7083		7048	35	4740740	593702
AMI070	P117256W								
AMI021	P117257W								
AMI022	P117258W	314							
AMI023	P117259W	292	7096	7098		7058	40	4741632	592812
AD133	P118689W	117							
AD086	P119088W	110	7078	7080		7076	5	4744470	592287
AMI024	P119579W								
AMI025	P120975W		7141	7143		7081	62	4742708	591673
AMI017	P121471W		7153	7156		6949	207	4706866	614636
ADSM001	P122411W	100	7148	7150		7141	9	4746562	589768
AD004	P122729W	100	7058	7059		7033	26	4740342	594102
AS043	P124699W	110							
AS042	P125022W	50							
AMI045	P126122W	120							
ADS009	P126569W								
AMI027	P126623W	940							
AMI028	P126624W	980							
AMI029	P126625W	940							
AMI030	P126626W		7345	7347		0	0	4741351	590174
AD051	P128387W								
AMI031	P128546W	1040	7503	7504		0	0	4738782	591251
AD139	P128721W								
AD081	P128727W	162							
AD128	P128734W								
AMI032	P129042W	750	7427	7427		0	0	4731607	595602
AMI035	P130658W		7176	7176		0	0	4706008	614632
AMI005	P130850W		7216	7218		0	0	4714841	605687
AMI034	P131008W	700	7157	7159		6945	214	4707304	614171
AMI018	P131395W		7111	7112		6936	176	4702144	617961
AMI037	P131661W	765	7320	7322		0	0	4709188	611364
AMI033	P131814W	700	7228	7230		0	0	4708011	615774
ADS027	P13213W	100	7053	7053		0	0	4739722	595568
AMI026	P132627W	585	6946	6949		6908	40	4721648	599788
AMI077	P133241W	512	7168	7169		0	0	4730805	595699
	P134064W								
	P134065W								
	P134066W								
	P134067W								
	P134220W	645							
	P134221W	865							
	P134278W								
	P134281W								
	P134656W	733							

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
	P135459W	493							
	P135460W								
	P136063W	1040							
	P136491W								
	P136908W	109							
	P137014W								
	P137015W								
	P137581W								
	P137821W								
	P138174W	772							
	P138175W	813							
	P138176W	593							
AD101	P13822P	55							
AD056	P13825W	90	7152	7153		7144	8	4746478	589698
	P138390W								
	P138391W								
	P138431W								
AMI090	P138432W								
	P138664W								
	P138669W								
	P138681W								
	P138913W								
	P138915W								
	P138920W								
	P139239W								
	P139248W								
	P139373W								
AD058	P13940W	96	7155	7157		7148	8	4746481	589716
	P14434W								
	P14435W								
	P14748W								
	P14947W								
AD105	P15442W	106							
AD034	P15466P	90	0	0		0	4	0	0
AD031	P15922P	168							
AD030	P15923P	187							
AD134	P19016P	104	7156	7156		7147	9	4747251	590337
AS023	P19295P	128							
	P20911W								
AD115	P22472W	100	7052	7055		7046	9	4739409	597509
AD095	P22692P	90							
AD112	P23121P	120							
AMI069	P23266W	160	7098	7099		7066	33	4740955	595342
AS028	P23521W	4							
AS038	P24433P	1							
AD028	P24676P	165							
AD027	P27155W	145							
AS012	P27160W	Unknown							
AD025	P28229W	160							
AMI003	P29128W	306							
AMI004	P29129W	306							
AD121	P29867W	3							
AD093	P30077W	190							
AD061	P31296W	150							
ADS020	P31306W	225							
AD014	P32767W	141	6941	6942		6899	42	4727719	602169
AD097	P33379W	135							

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AD052	P33396W	12	7175	7176		7166	9	4746467	589786
AMI001	P3368W	2500							
AD050	P3380P	81	0	0		0	0	0	0
AD131	P36709W	105							
ADS018	P37928W	70	7087	7089		0	0	4740276	596074
	P38299W								
AD006	P38439W	92	7068	7068		0	0	4740424	594102
AS041	P38576W	79							
	P39466W								
	P39470W								
AMI068	P39515W	402							
AD098	P40472W	104							
AD118	P41674W	259	7073	7073		0	0	4740157	595914
AD122	P41905W	128							
AD007	P43263W	70	6850	6851		0	0	4724353	595874
AMI065	P43819W	147	7193	7193		0	0	4745742	588663
	P4426W								
	P4427W								
AD017	P44818W	56							
	P45128W								
	P45129W								
AD084	P45131W	142	7153	7155		7090	65	4744596	591523
AD019	P45261W	80							
AD091	P45364W	73	7106	7108		7099	8	4743573	592751
AD117	P4577W	102							
AD045	P46371W	152							
	P47687W								
AD036	P48453W	165	7156	7156		0	0	4746465	590137
AD099	P48518W	94							
	P49096W								
	P49134W								
AD096	P50042W	133							
AD092	P50116W	75							
AS044	P5049P	103							
	P50919W								
AMI084	P50927W	109							
	P51100W								
	P51356W								
AD052	P51813W	12	7175	7176		7166	9	4746467	589786
AD037	P52276W	126	7151	7152		7131	21	4746472	590081
AD059	P5276P	120							
AS039	P5277P	176	7160	7161		7150	11	4746236	588743
ADS028	P52783W	125							
ADS008	P53464W	360	7192	7195		7073	120	4745870	589929
AS027	P53594W	300							
ADS022	P53942W	84							
AS045	P53956W	59	7157	7159		7154	5	4747391	590630
AMI083	P54301W	146	6881	6882		6874	9	4725371	597664
AD137	P54407W	168							
	P55033W								
	P55085W								
AD136	P55174W	110	7176	7177		7131	46	4745844	590472
AD044	P56040W	150	7167	7170		7124	46	4745714	590847
AD063	P57161W	112	7173	7174		7117	57	4745439	590796
	P57163W								
AMI085	P57303W	630							
AMI086	P57304W	320							

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AMI087	P57305W	650							
	P57705W								
	P57917W								
	P57993W								
AD116	P58067W	110							
	P58069W								
	P58370W								
	P59478W								
AS013	P59933W	490							
ADS003	P60515W	84	6910	6910		0	0	4727704	602274
AMI071	P60647W	118	7050	7050		0	0	4739086	597761
AD041	P61066W	52	7141	7143		7138	5	4745995	590194
AD021	P61393W	220							
	P61602W								
AMI083	P61704W		6881	6882		6874	9	4725371	597664
AD039	P61788W	157	7156	7157		7137	20	4746370	590186
ADS004	P62550W	155	6863	6865		6848	17	4724387	598979
AD043	P62599W								
	P63466W								
	P63468W								
	P63470W								
AD138	P63635W	164							
AD020	P63795W	132							
AD057	P64294W	283	7193	7194		7095	99	4745841	589647
AD032	P6440P	58							
AS033	P6441P	20							
	P64583W								
AD127	P64765W	202							
	P64797W								
	P64798W								
ADS014	P64890W	103							
	P65654W								
AD016	P66630W	43							
AMI059	P67299W	27							
AMI073	P67300W	16							
AMI074	P67301W	30	7159	7163		7150	8	4747346	590313
AMI061	P67302W	15	7154	7156		7148	9	4746556	589971
	P67303W								
AD008	P68111W	134							
AD024	P68231W	110							
AD026	P68398W	126							
AS014	P68609W	227	7350	7352		7155	197	4711604	611681
AD023	P68658W	102							
AMI075	P69137W	68	0	0		0	6	0	0
AD108	P6998W	112	0	0		0	0	0	0
AD015	P70113W	145							
AMI076	P70736W	200	7160	7161		7151	9	4746653	591300
AD129	P70929W	287							
AMI084	P71721W	109							
AS015	P71946W	190	7252	7254		0	0	4707969	617132
AS034	P71948W	131							
AS037	P71950W	210							
AD067	P72678W	116							
AMI036	P72773W	226							
AD040	P72862W	87	7157	7158		7136	23	4745985	590263
AD080	P72864W	108							
AMI060	P73411W	113							

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AMI064	P7352W	210	7179	7179		7144	35	4745841	588751
ADS012	P74394W	100	7131	7131		0	0	4743511	592000
AD110	P75316W	100							
AS030	P7549P	Unknown							
AS016	P75830W	35	7047	7049		7044	5	4740320	594340
	P76253W								
AS029	P76369W	60							
AMI042	P76760W	400							
AMI041	P76761W	340							
AMI040	P76762W	300							
AD054	P78005W	51	7149	7149		0	0	4746535	589749
	P78006W								
	P78110W								
	P79135W								
AD103	P80101W,	93							
AD046	P80163W	185							
ADS023	P80929W	52							
AD089	P81127W	68	7109	7109		7099	7	4744088	592402
	P81821W								
AD100	P81885W	92							
AD082	P81993W	95							
AD079	P82075W	90							
AD070	P82135W	77							
	P82640W								
AD109	P83214W	85							
AS047	P83512W	52	7157	7158		7153	5	4746807	590756
AD073	P84073W	110							
AD042	P84291W	120							
AD012	P8430P	55							
ADS010	P84915W	90							
AD065	P85113W	95							
	P85123W								
AS001	P8520W	600							
AS035	P8525W	160							
AS020	P8530W	151							
AD029	P85357W	92							
	P85453W								
AMI063	P85685W								
AMI001	P85754W	2500							
AMI002	P85755W	5200							
AD077	P85757W	97							
AD076	P86581W	95							
AD013	P86669W	60							
AMI066	P86975W	148							
AD035	P87074W	200	7161	7162		0	0	4746465	590081
AD075	P87929W	100							
AD074	P88789W	100							
AMI067	P89287W	120							
AS019	P89321W	192							
AD071	P89611W	100							
AMI002	P9035W	5200							
	P90798W								
ADS017	P91168W	105	7099	7100		7080	20	4741080	595361
	P91359W								
AD001	P9230P	105	6915	6915		0	0	4725358	596383
AD072	P93032W	115							
AMI054	P93035W	80	7147	7148		7142	6	4746557	591233

WELL ID	WELL PERMIT #	WELL DEPTH (FT)	GL ELEV (FT)	TC ELEV (FT)	DATE	SWL ELEV (FT)	WL (ft)	NORTHING (m)	EASTING (m)
AD119	P93195W	85	7045	7046		7040	7	4739976	595672
AS025	P9345P	200	6984	6985		0	0	4724770	604360
AS002	P9348P	325							
AS003	P9349P	70	7110	7112		7100	12	4706255	615789
AS026	P9350P	251							
AS004	P9352P	238							
AS005	P9353P	70	7091	7096		0	0	4706239	615846
AS006	P9354P	233	7287	7287		0	0	4709314	613136
AS007	P9357P	343	7393	7394		7217	178	4736460	593234
AS008	P9359P	150	7356	7356		0	0	4734078	594204
AS022	P9362P	250							
AS009	P9365P	375	7344	7344		0	0	4712311	608136
AS010	P9367P	200	7196	7196		0	0	4707355	612923
AS011	P9369P	102	7093	7093		0	0	4705676	616812
AS021	P9370P	153							
AS036	P9372P	425							
AS024	P9381P	347							
AD049	P9384P	100							
AD048	P9388P	95	7184	7189		0	0	4746452	589605
AD132	P94233W	85							
AD085	P94486W	96	7110	7111		7107	4	4744879	591798
AMI047	P96037W	90	7142	7143		7138	5	4746557	591153
AD002	P9605P	95	7069	7069		0	0	4740412	594136
AD003	P9606P	65							
AD004	P9607P	100	7058	7059		7033	26	4740342	594102
ADS007	P9622P	160	7155	7155		0	0	4746538	589851
AD038	P96672W	100	7148	7149		7134	15	4746383	590055
	P96819W								
AD088	P97246W	100							
AMI062	P98051W	150							
AD120	P98148W	100							
ADS005	P98295W	120							
AD018	P98297W	180							
AD062	P98395W	120							
ADS013	P9853W	80							
AS040	P98554W	40							
AD066	P98767W	80							
AD107	P98847W	90							
ADS029	P98998W	100	7093	7095		7088	7	4743919	592541
AD135	P99090W	80	7162	7163		7156	7	4746670	590713
	P99123W								
AD022	P99291W	120							
AD083	P99350W	100							
AD090	P99486W	125	7113	7114		7096	18	4743500	592245
AD068	P99689W	100							
AD124	P99888W	100							

ATTACHMENT C

PAPA Ground Water Chemistry Data

ATTACHMENT F

PAPA Ground Water Chemistry Map

ATTACHMENT E

PAPA Potentiometric Surface Map

(Delivered separately in rolled format)

ATTACHMENT F

PAPA Ground Water Chemistry Map

Draft Preliminary Ground Water Characterization Study, Pinedale Anticline Production Area
Responses to Comments

The following presents the comments that were received from Paul Summers, Dennis Doncaster, and Frank Bain on the draft Pinedale report, and the changes that Dynamac has made in the report to address the comments.

General questions
Comment: We agree with the conclusions and recommendations in section 5.0 and are impressed with the speed at which this document was prepared.

Response: This comment is appreciated.

Comment: Is there any water quality data that could be obtained from the oil companies?

Response: According to discussions with Carrie Hatch and the Pinedale FO staff during our site visit, there did not appear to be any systematic sampling program by the oil companies, or any available reports. A small number of TDS analyses (7 wells) obtained by Geoscience & Engineering, Inc., for Ultra, were supplied by Carrie Hatch. This will be identified as a data gap and discussed in the recommendations. One significant problem with the currently existing chemical data, as discussed in the report, has to do with the constituents analyzed for, and the methods used. Currently, "data" exists for 11 wells. However, many of these had only pH and TDS analyzed – only 5 had analyses for the constituents necessary to plot Stiff diagrams, and none had analyses for organic components. Even if the oil companies have "some" chemical data, it is highly unlikely that includes the full range of constituents necessary to make it really useful on a regional study basis.

Comment: Is there useful data that is in an inconvenient format that was not used? If so, how much extra work/time would it take to incorporate it?

Response: Yes, there is useful data in an inconvenient format that was not incorporated into the full data tables in the draft. This included the USGS NWIS database, which consists of 66 wells located in the study area, and some additional wells in the WSEO database.

For the NWIS database, the problem is that the database does not include well permit numbers, so correlation between these wells and the wells in the BLM and SCCD databases must be done by manual comparisons of locations, depths, and drill dates. This was not accomplished before delivery of the draft, but has been done since then. The final draft database has incorporated approximately 26 NWIS wells in with BLM and SCCD wells, based on these correlations. However, the additional 40 wells were not easily correlated. While these may still be matches to BLM or SCCD wells, it would take a substantial effort to locate these wells in the field to further attempt to correlate them. Given that many of these wells are very old (some going back to the 1940s), it is likely that some wells will never be found, and the database will never be 100% certain.

For the WSEO database, the additional wells do have permit numbers. However, the only location information is by quarter-quarter section, so their locations cannot be plotted electronically in the GIS along with all of the other wells. Instead, the well locations had to be manually plotted within the quarter-quarter section. Paragraphs have been added to the text to provide more information on the limitations of each dataset, and what efforts may be required to address them.

Comment: Do we need to set up a format for adding WQ data or is that already in place?

Response: This format for adding chemical data was already developed by Carrie Hatch, although it was not populated with data. It will be included as a template in the final GIS.

Comment: Would it help to expand the study area to take in some of the studies that bracket the PAPA? This would allow the addition of some of the water quality data that lies just outside the study area boundary to help make interpretations of limited data within the PAPA.

Response: This study, in a broad sense, did include regional water quality observations recorded in the USGS reports. These reports made general observations using regional data from both within and outside of the study area – the problem for us was that the amount of data from within the study area was far more limited than expected. Therefore, even though very few data points exist within the PAPA, the general water quality parameters are known. While future iterations of this study could bring in more specific data points, that may not accomplish the goal of determining what sort of impacts the drilling program is having on groundwater within the PAPA. The regional wells for which data are available are located many miles from the drilling area, so are only rough indicators of water quality within the PAPA. It is recommended that additional effort and resources be placed on acquisition of current chemical data within the PAPA by site-specific sampling and analysis, rather than gathering regional data that may or may not be applicable.

Comment: Given what we do know and given that there is an ongoing program that will collect water quality samples within the PAPA, independent of this program, what would be your recommendations for the best mix and location of future research, specialized monitoring equipment (bladder pumps for specific wells), matching existing data to surrounding studies, or other actions that will help us understand the groundwater situation?

Response: The recommendations section of the report has been revised to provide more information in this area.

Maps

Comment: Would it be possible to separate out the injection wells from the production wells on the map or does the function of a particular well change over time?

Response: The database and base map provided by BLM, which is the source of these data, does not distinguish between production and injection wells. Right now, there is no way of knowing whether any of the wells are injection wells, or if they switch functions. This information will be added to the list of recommendations in the report.

Comment: The potentiometric lines appear to be influenced by the New Fork River with the way they curve back around and point upstream. However, there appears to be no influence further north along the New Fork, or on the west side along the Green River, which is more deeply incised and would be expected to be the discharge point for a shallow ground water flow system.

Response: The draft map was developed using the datapoints available, which were located entirely in the eastern and western portions of the study area, without any manual modification of contours to account for topography or the influence of the rivers. We agree that manual modifications, using professional judgement of the behavior of the system near the Green River, should be used in the western half of the study area. The revised map included with the final draft reflects this modification.

Comment: The ground water contours seem to follow the surface topography, and are influenced by the existence of the New Fork River, at least in the area of T. 31 N., R. 108 W. This seems inconsistent with other areas of the map. It might be useful to use the data gathered in this study to fine tune the potentiometric map drawn by Chafin and Kimball (USGS, 1992).

Response: We studied the map presented in Chafin and Kimball (1992), and a similar potentiometric map presented in Martin (1996). We believe a potential problem exists with these maps. Both maps show a large (15 miles long by 5 miles wide) groundwater high, or mound, coincident with The Mesa. In both cases, it is important to note that the data points upon which the maps are based are *very* widely spaced – on the order of 5 miles or more between data points. In both cases, the closure of the contours which define the feature are based on a single data point located on The Mesa. Our concern is that this one measurement is a result of the perched aquifer which exists on The Mesa, and does not represent the water level within the Tertiary Aquifer. Because the data points are so widely spaced, inclusion of one spurious data point affects the interpretation of the potentiometric surface for a huge area.

We discussed this situation in the second paragraph of Section 3.2 of the draft report. In this paragraph, we simply said that we felt the data point was anomalous, but we did not say what we did about it. This paragraph will be expanded to state that we deleted this data point from our potentiometric map, and that we feel previous authors should have considered deleting it from theirs.

Comment: The data could be from both a shallow aquifer and a deep artesian aquifer and the contouring software is misinterpreting the physical reality. A solution would be to evaluate the data and separate known shallow aquifer data from data that is from the deep aquifer or from wells that a total depth is not known.

Response: See the above response. We believe the situation is not because of mixing the shallow aquifer and a deeper artesian aquifer, but mixing of data from the Tertiary (shallow) Aquifer and the perched (shallower) aquifer on the Mesa. We believe inclusion of the data point would lead the contouring software to misinterpret the reality, so we excluded the data point. We believe our map is more representative of the flow regime in the Tertiary Aquifer on a regional basis. A note will be added to the map to indicate that perched conditions are known to exist on The Mesa, and that this is not represented on the map.

In theory, a separate map of the potentiometric surface of the perched aquifer itself could be developed, if the data were gathered. However, there was only one water level measurement from this area. Because of the importance of The Mesa on a local basis, we will add this as a recommendation.

Comment: There is an apparent discrepancy between the elevations of the potentiometric surface and the ground surface elevations. For example in T32N, R109W one of the contour elevations elevation is listed as 2,250 and the groundwater elevation is 6,950. (this would place the water table 4,700 units above the ground surface. Converting 2250 from meters to feet makes the elevation 7,382, which would make the ground water contours more consistent with the ground surface elevation, and more in line with water level measurements in Welder (1968).

Response: The comment correctly notes that the topographic contours were in meters, and the potentiometric contours were in feet. We agree that the units should be made the same. Because the base map supplied by BLM had topographic contours in meters, and our Statement of Work (SOW) requires development of maps in UTM coordinates (which are based on meters), we have revised the potentiometric contours to meter measurements.

Comment: The township and range markers in the middle of the townships could be made less prominent or eliminated on both maps to make the maps less cluttered. Also, include the designation of North and West in the notations. If possible, put the designations along the sides of the map. There appear to be several overlaid themes that contain township and section lines that are duplicates of but not aligned to similar lines on the background map. These lines appear to be redundant and make the map too busy.
Include on the potentiometric surface map a notation of the period of record used for contouring,

Response: These changes, and others, have been made on the maps to make them more legible and attractive.

Specific Questions

Comment: Page 10 Section 2.4 Paragraph 1
Would water quality data be sufficient to determine if the shallow wells are being supplied by the river or a regional artesian groundwater flow?

Response: A third possibility is that the shallow wells are being supplied not by deeper artesian flow, or recharge from the river, but from shallow water table recharge from local precipitation. The Stiff Diagrams do show that deeper groundwater has a distinct signature (high concentrations of TDS, anions, and cations), and shallow groundwater (including river water) is expected to show low concentrations. In theory, one could sample a shallow well and obtain chemical results that look like deeper water. The problem is, one would not be able to easily state that the result is due to natural artesian flow from a deeper zone, to cross-flow in a poorly completed well, or to surface contamination from a man-made source. The result would simply tell you that something unusual is happening in that well that merits further investigation.

More information discussing these possible results has been incorporated into the text in this section. Given the very sparse amount of chemical data currently available in the study area, it is not possible to look at results from a single well and make determinations like this.

Comment: Page 10 Section 2.4 Paragraph 2
Were the figures for TDS included in the Wagonwheel Well study? If yes, it would be good to include them in the text along with the designations of fresh and salty water.

Response: The text has been revised to include these concentrations.

Comment: Page 12 Section 3.1
Is there a need or the ability to look at the deeper levels of groundwater flow?

Response: More information has been obtained from Carrie Hatch regarding her collection of data from deeper zones. The report had stated that most of the wells were less than 200 feet deep. This is still true, but it appears that there are deeper wells that have not been investigated because SCCD currently does not have the equipment to do so. A histogram has been added to the report which presents the range of well depths within the study area.

Comment: Page 12 Section 3.2
If the Wagonwheel data was used, then this statement about data used in the contouring needs to be changed.

Response: The SCCD database did not include measurement of the water level in the Wagon Wheel well. This text will be revised to more clearly define how our potentiometric map was drawn – we plotted all datapoints in the first draft, and evaluated it to determine if there were any clearly anomalous datapoints, such as the one on The Mesa. Then, we deleted that one datapoint from the dataset used to plot the map, and re-plotted it.

Comment: Page 13 Section 4.1
On the last sentence of this page and the first lines of page 14, the way that low TDS equals high water quality was confusing with the first quick scan. A second reading showed that the statement was correct but the structure of the sentence could be improved.

Response: We agree – the text has been changed to make it clearer.

Comment: Page 14
A rough map (8.5x11) of the various changes in water quality discussed on this page might be helpful

Response: We agree. The problem is, this information was taken from general statements in the regional reports, rather than an investigation of actual chemical analyses, which were not available within the study area, and which were not part of the study outside of the study area. If more chemical analyses were available within the study area, then the plot of Stiff Diagrams would show this trend.

As it is, three more datapoints have been added to the Attachment F plot of Stiff Diagrams. While the horizontal distribution of these data points does not allow for a display of the horizontal variations in water quality (basically, the 5 datapoints are only from 3 locations), the vertical distribution does allow for a display of the vertical variation in water quality. A separate plot has been developed to display this.

Comments from Frank Bain

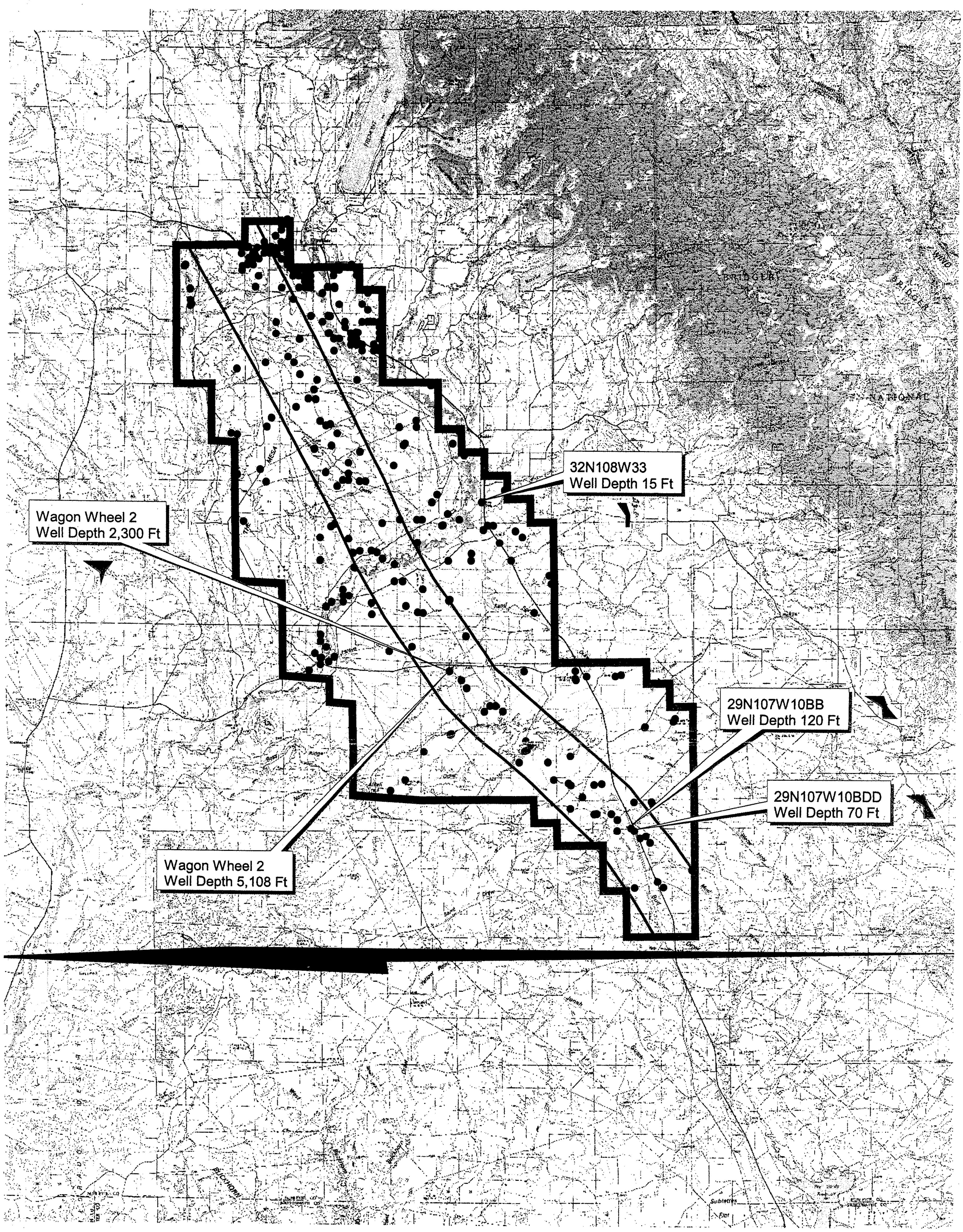
Comment: Page 11, last line
Add a sentence saying that of the estimated 159 TCF of gas in place, less than 10 percent is thought to be recoverable with present technology.

Response: The sentence has been modified.

Comment: Page 8, line 4
Add the word "known" between largest and structural.

Response: The sentence has been modified.

USGS SITE #	WELL PERMIT #	WELL ID or Name	WELL DEPTH (FT)	T-R-S-Q-Q	DATE COLLECTED	SPECIFIC COND.	pH	Nitrate (mg/L)	Sulfide (mg/L)	Alkalinity (mg/L)	Hardness	Carbonate (mg/L)	Bicarbonate (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Silica (mg/L)	Arsenic (mg/L)	Ba (mg/L)	B (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Mo (mg/L)	Sr (mg/L)	Zn (mg/L)	Al (mg/L)	Se (mg/L)	TDS (mg/L)
425150109552001	P54407W		168	33N110W01AA	6/10/86	410	8.1													.3													224
422953109352001			70	29N107W10BDD	6/9/86	1850	7.9													.4													1260
423140109370301	P9354P		233	30N107W32AD	6/9/86	1180	9.0													.9													779
423258109405201	P9365P		375	30N108W23DC	6/9/86	1600	8.6													.8													1170
423320109405601				30N108W23AC	6/9/86	1600	8.6													.8													1170
425137109533301	P55174W		110	33N109W05BD	6/10/86	390	8.3													.2													232
423539109382201				30N107W6DD	6/8/86	475	9.2													1.4													278
424803109482501	P22472			33N109W25DB	6/9/86	365	7.8													.2													215
425019109503501				33N109W10DD	6/10/86	292	9.3													.2													171
423536109382001	P9370P		153	30N107W6DD	6/8/86	475	9.2													1.4													278
423053109342601			200	Waterhole Draw	8/1/85	1000	9.4	.100	.5		9			3.60	.100	220	.60	14.0	360	1.6	4.5	1.0	12.0	90	90	10.0	8.0	2.0	53.0	32	100	1.0	656
	P9372P	AS036			5/23/02	463	9.3	ND		212				ND	ND	108	ND	ND	23			0.028			0.077								278
	MESA7-27	AMI081			5/23/02		8.54	ND		196								12.8	20.4														359
	P138432	AMI090			5/23/02		9.13	ND		217								4.6	41.1														324
			120	29N107W10BB	6/12/65	1,300	7.5				37	0	172	14	0	280	1	13	440	0	9.6			100									838
			70	29N107W10BDD	8/21/76	1,250					10	20	157	3.5	0	260	3.8	15	370	1	2.7			140	80		10						755
	P6441P		15	32N108W33	5/28/58	526	8.8				3	10	150	0.8	0	129		8	120	1	12												359
424146109450401	P93767W		141	31N108W05BB1	8/83		9.44			184				1	0.04	130	0.3	6.6	92	1.8	9.5				8						10		346
423622109510301			450	30N109W05AA1	8/83		9.5		4.7	241				0.8	0.8	150	0.3	55	15	3.4	8.6				5								362
	P3368W	Wagon Wheel 1	2,502	30N108W5SENW	8/15/69		9.2			140	4			4	0	112		156	0														520
	P9035W	Wagon Wheel 2	2,300	30N108W5SENW	5/19/71	1,120	8.2	0			23	0	158	9.3	0	250	1.3	270	4	19	13				0.18				0.09		0.04		640
		Wagon Wheel 2	5,108	30N108W5SENW	5/22/71	28,000	10.1				13,000	20	6	5,000	4.2	2,300	3.6	13,000	100	1.8	9.9				5.6				155		0.04		21,400
		Mt. Airy #19			11/1/98																												250
		Middle Mesa Well #509			11/1/98																												400
		Mesa Horse Well			11/1/98																												560
		Mesa Well #106			11/1/98																												250
		Two Buttes Well			11/1/98																												390
		Mesa 3-22D			11/1/98																												400
		Rest Mesa Well			11/1/98																												580



Preliminary Ground Water Characterization Study
Pinedale Anticline Production Area (PAPA) Sublette County, Wyoming

DYNAMAC CORPORATION
Environmental Services

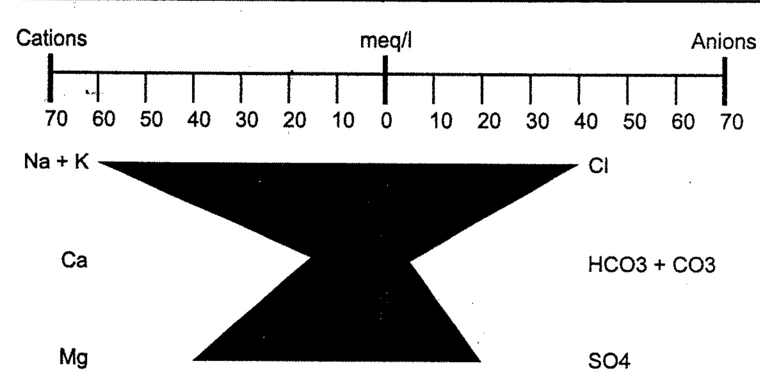
Attachment F: Final PAPA Ground Water Chemistry Map

Date: December 2002

Legend: ● Water Well — PAPA Study Area — Anticline Crest

Scale: 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 Miles

1:275000



Stiff Diagram Shape