Prepared for:
The Wyoming Water Development Commission
Herschler Building
Cheyenne, Wyo. 82002

Mr. Mike Purcell, Director
Mr. Evan Green, Project Manager

Prepared by:
Bearlodge Ltd., Inc.
P.O. Box 130
Sundance, Wyoming

December 5, 1991
Executive Summary:

HULETT WATER SUPPLY PROJECT, LEVEL II

The Hulett Water Supply Project, Level II is divided into three phases each covering a discrete area of investigation. Those phases are;

I: Preliminary analysis:

II: Water well design, construction, and testing:

and, III: Preliminary design and cost estimates.

PHASE I:

The initial effort for Phase I, Preliminary analysis was meeting with the Project Sponsor, the Town of Hulett, and defining the exact scope of project. During this meeting, it was determined that the Town of Hulett wished to find and develop a new water supply source for the Town's Public Water System. The existing source consists of three wells each producing water from the Minnelusa formation. The water produced from that formation is of relatively poor quality and when stressed, the wells produce sand that enters the water distribution system. In addition to identifying and developing a new source of supply, the Town wished to improve their water storage capabilities for improved fire protection.

The Geological Consultant for the Project, Dr. J. Paul Gries conducted an investigation of the groundwater potential in the Hulett area and determined that there are two potential sources for groundwater in the quantity necessary to serve the Town of Hulett. Those sources are the Minnelusa formation already used by the Town, and the Madison formation. After review and consultation with the Town and the Wyoming Water Development Commission (WWDC) project representative, it was decided to design, construct, and test a Madison formation water well.

Dr. Gries indicated that the exact location in the area of Hulett was not of importance in locating the well. For ease of access the well was located on a tract owned by the town where one of the existing Minnelusa wells is located.

In addition to siting the proposed well potential surface water impacts from the proposed Madison well were considered and reviewed. It was determined that no significant impact would be generated from producing the proposed well.

A complete report of findings for Phase I is included in the Appendix of the final report as Appendix "A".
PHASE II:

The initial phase II activity was preparation of the design of the proposed well along with the necessary contract documents necessary to take competitive bids for the well construction. The design and document preparation was completed as a Joint Effort between Bearlodge Ltd., and Mr. Tim Barritt of Weston Engineer. Upon completion of that preparation, bids were taken for the construction of the proposed well. Ruby Drilling of Gillette was the successful bidder.

Ruby Drilling rigged up and commenced drilling on Oct 16, 1990. Drilling continued until the Project Geologist, Dr. Gries, indicated that the Madison formation had been encountered at a level of 1389 feet below ground surface. At that time open hole electronic logging operations were executed with the log indicating that the Madison formation had been reached.

The casing string was set and cemented into the top of the Madison formation. The drilling then continued into the Madison to a depth of 1617 feet below ground surface. An airlift test was conducted at that level to determine to viability of the well. There being no significant water production, the drilling continued.

Upon reaching the 1892 feet below ground surface level, Dr. Gries indicated that the Madison formation had been penetrated. At that point additional electronic logs were run on the open portion of the hole and an airlift test was performed. It is estimated that approximately 100 gallons per minute (gpm) was air-lifted at that point. The driller rigged down and the pump test was initiated.

The initial pump test was a stepped rate test with tests run at 50, 100, and 135 gpm. The draw down level for each test was 288 feet, 484 feet and 650 feet respectively. Because these levels of production were not adequate to serve the Town of Hulett, the decision was made to perform and acid stimulation.

A contract for acid stimulation was negotiated with Haliburton Services of Gillette. The stimulation consisted of pumping 4000 gallons of 28% Hydrochloric acid in to the well at a rate of 20 barrels per minute. This stimulation was performed and the well was cleaned and prepared for additional pump tests.

A stepped rate test was then performed with the following results:

<table>
<thead>
<tr>
<th>Pumping rate (gpm)</th>
<th>Draw down (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>32</td>
</tr>
<tr>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>150</td>
<td>99</td>
</tr>
<tr>
<td>200</td>
<td>138</td>
</tr>
<tr>
<td>250</td>
<td>182</td>
</tr>
<tr>
<td>300</td>
<td>221</td>
</tr>
</tbody>
</table>
As indicated, the acid stimulation resulted in a tremendous improvement in well yield and draw down.

The constant discharge test was then performed at the rate of 400 gallons per minute for 30 hours. The draw down stabilized at 348 feet after the 30 hours of production.

Water quality analysis of the Madison water indicated that the water meets or exceeds all requirements for Public Water supply quality.

A complete report of the well construction, acid stimulation, testing and quality analysis is included in the appendix of the final report as Appendix "B".

PHASE III:
The preliminary design and estimating tasks associated with phase III include the requirement for projecting population growth and estimating water usage for the Town of Hulett, selecting a suitable site for the proposed water storage tank, and calculating estimates for the construction costs of the designed improvements. In the course of this investigation four alterations in the basic parameters for this phase occurred, each impacting the proposed design. Those were:

1) The 1990 census results were reported midway through the project rendering obsolete the population projections prepared as per contract requirements;
2) The Town of Hulett started to gather and record water production rates for the Town's water system;
3) The Town was unable to negotiate the use of the preferred site for the Water Storage tank and an alternate site was selected and analyzed; and
4) The Devil's Tower Forest Products saw mill requested that they be allowed to participate in the project in order that storage and transmission line sizing be increased to provide for fire fighting capabilities at the saw mill.

The preliminary design for water supply and storage requirements for Hulett include calculating a projected population for the area and estimating water usage rates for the end of a design period (in this case the design period was established at 20 years). By contract, in the absence of current population data the Wyoming Department of Administration and Fiscal Control (DAFC) projections were to be used, and absent water usage data from the Town of Hulett, estimating values from the Wyoming Department of Environmental Quality (DEQ) was to be used. When the project started neither type of information was available from the Town so the State information was used.

The actual design of the system depends upon three projected quantities, average daily water usage, maximum
daily water usage, and fire flow requirements. The water source should be designed to provide for the maximum daily water usage averaged over the 24 hour period and the storage requirements include the necessary fire flow requirements for the Town plus a quantity equal to the average daily water consumption.

Using the above described parameters, the initial design for the system included a well production rate to satisfy the maximum daily demand of 109 gallons per minute. The recommended fire flow requirements for communities such as Hulett is 1500 gallons per minute for a duration of two hours for a fire flow storage requirement of 180,000. With an estimated average daily demand of 57,625 gallons, the required storage would be approximately 238,000 gallons.

The initial proposed design for the system included a well with a production capability of 150 gallons per minute and a new storage tank with a capacity of 250,000 gallons.

In January of 1991, the town of Hulett started to collect water production data from its wells. Two months of data was taken and used to correlate water production with power usage. This correlation was then applied to the power use data for the years 1989 and 1990. This correlation produced a current use rate of 124,000 gallons per day and an average daily use during the maximum month of 284,000 gallons per day. This new information indicates that the well should be designed to produce 250 gallons per minute and that the storage for the town should be approximately 304,000 gallons. The proposed 250,000 gallon storage tank, in conjunction with the existing 40,000 gallons of storage would still be marginally adequate.

The population information available from DAFC indicated a 1980 population of 291 and an estimated 1990 population of 317. The actual 1990 census, when completed showed a Hulett population of 429 people for a 10 year growth of approximately 50%. The original population projection taken from DAFC information projected a year 2010 service population for the Hulett area of 461. This projection is obviously erroneous. For purposes of preliminary design, a growth rate in water consumption of 1% per year was assumed. Because the well has adequate capacity to be upgraded in the future and the storage requirements have been altered to reflect fire flow demands for the Devil's Tower Forest Products Saw Mill, it is recommended that the production rate designed into the well development be 300 gallons per minute and the storage requirement be based on the increased storage necessary to provide protection to the saw mill.

The Devil's Tower Forest Products Saw Mill approached the Hulett Town Council and requested that the council investigate the potential for allowing the Saw Mill to participate in the water improvement project. The purpose for the participation is the desire to obtain fire protection capabilities in a quantity that would reduce the fire insurance rating for the saw mill. The required volume of
storage is 500,000 and the flow rate necessary is 2500 gallons per minute. These parameters would require an increase in the size of the storage tank from 250,000 to 500,000 and an increase in the size of the water transmission line from the storage tank to the saw mill from 8" diameter to 10" diameter. The council reacted favorably to this request and this new design was incorporated into this preliminary study.

The selection of the site for the proposed water storage tank was directed first by the elevation necessary to be compatible with the existing system pressure. The other criteria were accessibility both by the transmission line and surface access, and the ability to serve areas which are currently not served by the Town's water system. The most appropriate site appeared to be one lying south of Wyoming Highway 24 adjacent to the Devil's Tower Forest Products saw mill. This site is located at the top of a hill on property owned by Wayne Ballou. Preliminary discussions with Mr. Ballou indicated that the use of the site for a storage facility could be negotiated therefore, surveying was done to provide data for legal descriptions for both the tank site and pipeline access. Additionally, a geotechnical investigation was done to determine suitability of the site. The geotechnical analysis indicated that constructing a tank at that location was feasible. Upon completion of these tasks, Mr. Ballou was not able to reach an agreement with the Town of Hulett and the site was abandon.

The second site selected lies west of the tank site on land owned by the Bush Land Development Corporation. The principles of that Corporation indicated that the site was available, therefore the necessary survey and geotechnical investigation work was done. That investigation revealed that this site is also adequate for the storage tank.

COST ESTIMATES

Cost estimates for the major elements included in the proposed improvements were made based on the following criteria:
1) Fire protection to the saw mill is included;
2) Engineering costs are assumed to be 15% of project cost;
3) Contingencies are estimated to be 10% of project cost.

The estimated project cost for all elements including engineering and contingencies is approximately $306,000.

The complete phase III report is included in the appendix of the final report as Appendix "C".