GLENROCK RAW WATER IRRIGATION PROJECT

LEVEL II STUDY

PHASE 1

OCTOBER 1998

PREPARED FOR

WYOMING WATER DEVELOPMENT COMMISSION

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

GLENROCK RAW WATER IRRIGATION STUDY

1.0 INTRODUCTION

The Town of Glenrock is located in Converse County in the middle of the eastern half of Wyoming. In response to increasing demands on its water system and the need for additional culinary water, the City of Glenrock has requested the assistance of the Wyoming Water Development Commission to complete this Level II Study. Sunrise Engineering, Inc. was selected by the Wyoming Water Development Commission to perform the engineering reconnaissance, analysis, and evaluation necessary to provide Glenrock with a comprehensive water system plan.

The study area includes the present corporate limits of the Town of Glenrock and surrounding lands which may eventually become part of the Town. The present Town limits encompass approximately 1.5 square miles. The service area of the water system includes all residential and commercial customers within the Town limits.

In the past, the Town’s population has been driven by natural resource industries such as oil production. As a result, the population of Glenrock has cycled through boom and bust periods in the local economy. The Town of Glenrock experienced a significant increase in population during the early 1980s oil boom. The Town’s population declined and leveled off during the late 1980s but has shown modest growth in the 1990s. According to the 1990 U.S. Census, the population of the Town of Glenrock was 2,153. Estimates by the Wyoming Department of Administration and Information (WDAI) estimate the 1995 population at 2,261. This represents a 1.0% growth rate per year from 1990 to 1995. The number of service connections currently on record is 924, of which 87 are commercial and 837 are residential.

The purpose of this study is to provide a comprehensive plan for improvements to the Town’s water system until the year 2025. The study will evaluate both culinary and secondary irrigation alternatives. This includes an inventory of the existing water system, identification of alternatives, and preparation of preliminary designs and cost estimates for the preferred alternatives. The evaluation includes all elements of the water system, including source, treatment, storage, transmission, and distribution facilities.
2.0 EXISTING SUPPLY & WATER SYSTEM

The Glenrock Water System has experienced numerous upgrades in the last fifteen years, which have resulted in significant improvements to the performance of the water system, both in quantity and quality. Prior to 1986, the sources for the water supply included the Park Well, Gallery & Deer Creek Wells, and Fox Hills Well #1 and #2. Due to the poor quality of water and reduction of capacity produced by these wells, other sources were developed. In 1986 the Little Deer Creek #1 and #2 Wells were developed.

The Little Deer Creek Wells were developed approximately 8-miles southwest of Glenrock. These well site locations were selected due to the changes in the geological formations, and the quality of water found beneath these formations. Currently these wells are supplying the entire Town of Glenrock with their water. The water produced by these wells flows by gravity to the Town after being pumped out of the ground.

Present demands on the Little Deer Creek Wells are nearing design capacity, to the point that the wells are required to operate 18 to 20 hours per day during the peak season. Consequently, if one of these wells were to fail, the capacity of the other well could not meet the Town’s needs during peak use. In order to establish future alternatives for the water system, evaluation of various new sources of water and methods to relieve peak demands caused by irrigation needs are analyzed. The other elements of the system must also be evaluated to ensure that they are capable of meeting the future needs of the community. The various elements of the existing water system are discussed below in terms of capacity, condition, and configuration.

The following chart shows the current water usage for the Town of Glenrock based on a population of 2800 and 924 connections.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total (gal / day)</th>
<th>Water Use (gpcd)</th>
<th>Water Use (gal / conn. / day)</th>
<th>Flow (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. Day</td>
<td>579,000</td>
<td>207</td>
<td>627</td>
<td>395</td>
</tr>
<tr>
<td>Av. Winter Day</td>
<td>314,000</td>
<td>112</td>
<td>340</td>
<td>218</td>
</tr>
<tr>
<td>Av. Summer Day</td>
<td>1,050,000</td>
<td>375</td>
<td>1135</td>
<td>729</td>
</tr>
<tr>
<td>Max. Day</td>
<td>1,780,000</td>
<td>636</td>
<td>1925</td>
<td>1236</td>
</tr>
<tr>
<td>Peak Hour (2 * Max. Day)</td>
<td>3,560,000</td>
<td>1272</td>
<td>3850</td>
<td>2472</td>
</tr>
</tbody>
</table>
The actual developed maximum production rate of the wells is 1750 gallons per minute. By national design standards for water source capacity, it is unrealistic to assume that water sources can be expected to produce above 80% of maximum capacity on a continuous basis. The need for maintenance, aquifer recharge, and other factors makes an expectation of continuous operation (100% capacity) unrealistic. Eighty percent of the present maximum production of the wells is approximately 1400 gallons per minute.

Several existing wells and infiltration galleries are located within the Town Boundaries. Their success at producing the volume and quality of water needed by the Town has been inadequate. The infiltration galleries draw water from the Deer Creek alluvium. They traditionally have had trouble plugging off, and also with water quality. They could be a resource for a non-potable pressure irrigation system. The Park Well and Fox Ridge Wells are deeper sources. However, they both test high for salinity, SAR, RSC and boron. None of these wells are suitable for culinary or irrigation purposes.

The transmission pipeline from the Little Deer Creek Wells was constructed in 1986 in conjunction with the development of the wells. The pipelines from the wells is a 14" ductile iron pipe with a polyethylene wrap and is approximately 7.6 miles long. The transmission pipe parallels Deer Creek Road as it enters the Town. Near the Town boundary, a pressure reducing valve reduces the pressure from 120 pounds per square inch (psi) to approximately 60 psi. The transmission line has a capacity of 2000 gallons per minute gravity flow. The capacity of the line could be increased with a booster pump. Approximately every 2000 feet, valves are located to allow the operator to isolate sections for maintenance and repair. Blow-off valves are located at low points in every isolation section, allowing the sections to be drained. Combination air release-vacuum relief valves are located at all high points and each side of the isolation valves. The pipeline is designed for working pressures up to 350 pounds per square inch. The elevation of the transmission line near Little Deer Creek Well #1 is 5412 feet. The elevation of the pipeline at the pressure reducing valve, near the golf course, is 5120 feet. The pipeline is equipped with corrosion protection measures, and has a minimum projected life of 50 years.

While much of the distribution system in the Town performs reasonably well, certain areas of the system have proven to be problematic, with one to two pipeline breaks occurring in each month during certain periods of time. The breaks are caused primarily by pipe corrosion, due to the high electrolytic activity of the soils. Usually, this occurs in the sections of town where steel pipelines were used. Since pipe failures occur fairly regularly, the Town's staff has identified areas where additional isolation valves are needed. These valves are needed to allow repairs to be made without shutting off water to large sections of Town. The following table identifies the streets or subdivisions where major corrosion problems have occurred in the distribution system.
Throughout the older part of town the water distribution system is primarily made up of 6 or 8 inch ductile iron pipe (DIP) with 4 inch DIP in a few places. Ten and 12 inch DIP is also used on major arteries. Glenrock requires the use of PVC pipe with all new developments and distribution line replacements.

As mentioned above, some areas of Glenrock are serviced with 4 inch pipes. These areas are causing bottle-necks and restrict fire fighting capabilities. Additional fire hydrants are also needed in some areas of Town. Without dedicated transmission lines to the storage tanks, the response of the water levels in the tanks is often sluggish. It is often necessary during the summer season to increase the system pressure at the PRV facility to ensure that the tanks fill properly. This indicates zones of flow restriction in the distribution system. It is recommended that a hydraulic analysis be completed on the water distribution network. This analysis will identify the exact locations of the restrictions, the location of existing valves and fire hydrants, and where pipe up-sizing will eliminate restrictive flows. This analysis will be extremely beneficial to the Town of Glenrock.

The Town’s distribution system was mapped as part of this study. Those drawings can be located and reviewed in the Report.

The Town of Glenrock currently has 1.75 million gallons of storage. The storage facilities include a 1.0 million gallon tank at the east side of Town on top of Sunup Ridge and a 0.75 million gallon tank on the west side of Town in Indian Hills near the golf course. The facilities described above are of steel construction.

The Sunup Ridge Tank is in good condition and is in need of no improvements other than regular maintenance. Divers video taped the inside of the Indian Hills Tank in 1995. They identified that the coated metal panels are in moderately good shape in terms of coating integrity. However, the welds between the panels, and where the tank walls meet the floor, are pitting and rusting heavily. If allowed to continue, this rusting and pitting could result in failure of the welds and subsequent leakage. Another area of concern is located near the full water level, where the roof begins to dome along a painter’s shelf or ring. The painter’s shelf is approximately 6 to 8 inches wide with a 4 inch vertical lip that extends around the entire circumference of the tank. Major pitting, rusting, and corrosion are occurring along this shelf, causing flakes of paint and rust to fall. It is recommended that the Indian Hills Tank be sand-blasted and repainted.
3.0 FUTURE WATER SYSTEM NEEDS

This section will analyze all aspects of Glenrock’s future water users, water system needs, and propose improvement alternatives to insure that Glenrock is capable of meeting their water needs for the next 27 years, until the year 2025. Along with the proposed improvement alternatives, conceptual designs for each preferred alternative will be presented. Each preferred alternative will be carefully analyzed to identify the long term water benefits, hydraulics, costs, and any political or social ramifications.

The lands within the present corporate limits of the Town of Glenrock allow for a significant increase in population density. The geographics at the City boundary could also allow for expansion of the future service area of the water system. Past patterns of growth would indicate that growth could likely occur along established transportation routes. This produces a reasonable sequence of development for the water system, since main trunklines are typically placed along significant transportation routes. Growth within the present boundaries will typically follow the presently established trends for type and density of use. Present improvements to the water system lend themselves to expansion in those areas.

Projecting accurately the population growth of a community such as Glenrock which has experienced a series of major economic fluctuations can be a challenging task. Through a series of investigations and projections, it was determined that a 2.5% growth rate for the design period would be a realistic growth projection. The projected population of Glenrock in 2025, at a 2.5% growth rate would be 5454 people. This would result in a water use of 1.13 million gallons per day (MGD) with peak use of 3.47 MGD. This would represent a water use of nearly twice the present water use in 1997. This maximum water use equates to a continuous flow rate of 2400 gallons per minute.

As the production of the Little Deer Creek Wells approaches maximum design capacity, three options exist for meeting future water needs in the Town of Glenrock. The first option considers the development of new sources of drinking water. The most important focus of any future water source must be the availability of good quality water and the requirements to prepare the water for potable use. The second option evaluates methods to reduce the volume of water being consumed through the drinking water system. The third option involves development of a non-potable water source to be used to irrigate the largest green areas in the community, thus reducing the potable water demand during summer peak uses. Any of the options presented deals with the patterns of water usage in the community.

Another key issue given consideration is that Glenrock needs a back-up source of culinary water. If one of the Little Deer Creek wells were to fail during current peak demands, the other well would not be able to produce adequate water to meet the Town’s needs.
As discussed in the sections above, the only existing nonfunctioning wells that possibly could be used for culinary or irrigation purposes would be the Gallery and the four shallow Deer Creek Wells. At their last use these wells produced water of a quality suitable for drinking, but the water production was decreasing. Since these wells are constructed near Deer Creek and are located in the geological formation known as the Deer Creek alluvium, new regulations will require that these wells be tested for the influence of surface water. If surface water is found to influence these wells, water produced by them will be required to be treated as surface water, if intended for culinary use. This type of treatment would likely prove to be very costly.

Drilling new culinary water wells appears to be the most logical means of obtaining additional culinary water. Due to the geology of the area, the nearest and most reliable water aquifer is found below the Casper formation. Any future well should be targeted to have a capacity of 1000 gallons per minute, as described previously, and should be sited where no impacts to surface water will occur. The reason for targeting a well of this size is two fold. One reason is to meet future needs and the second is to provide back-up to the Little Deer Creek Well #1 which produces 1100 gallons per minute.

A hydrogeologic investigation was completed around Glenrock, by Weston Engineering, in exploration of future well sites. The investigation identifies four potential groundwater sites, Exhibit 3.2.1.A identifies these areas on a map. Weston's Report states:

Criteria used to select the exploratory well sites include (1) anticipated yield, (2) potability, (3) depth to the target, (4) potential for interference with senior surface water rights, (5) proximity to the service area, and (6) land ownership.

A review of pertinent geologic and hydrogeologic literature, past water supply studies, local records, and previous experience in the area indicate that a well completed in the sandstone and limestone of the Casper and Madison Formations and the Flathead sandstone is most likely to meet the needs of the Town of Glenrock.

The following Table summarizes various aspects of the test well sites presented above. Given the relative ease of access to the site, the relatively shallow drilling depth, and the site's proximity to existing infrastructure Site No. 4, the Section 9 site, is the preferred site alternative. Significant drilling and pipeline costs may be realized by drilling at this site if a test well proves successful. The Tenneco Well was not considered after no further data were found regarding static water levels and production rates.
Map adapted from WWC, 1982; JMM, 1990; and Stacy, 1994

APPROXIMATE SCALE

6 MILES

WESTON GROUNDWATER ENGINEERING

GLENROCK WATER SUPPLY PROJECT
LOCATION MAP
EXHIBIT 3.2.1.A
The following table compares the characteristics of each site with relation to distance for existing facilities, target formation, anticipated depth, and land ownership.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Site Name</th>
<th>Approximate Distance</th>
<th>Target Formation</th>
<th>Anticipated Depth</th>
<th>Land Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Hat Six</td>
<td>13.0 miles to Casper, Well #1 Surge Tank</td>
<td>Casper, Madison, and Flathead</td>
<td>2,000 Feet</td>
<td>Private</td>
</tr>
<tr>
<td>#2</td>
<td>Pole Creek</td>
<td>13.5 miles to Well #1 Surge Tank</td>
<td>Casper, Madison, and Flathead</td>
<td>4,000 Feet</td>
<td>Private</td>
</tr>
<tr>
<td>#3</td>
<td>Smith Creek</td>
<td>13.5 miles to Well #1 Surge Tank</td>
<td>Casper, Madison, and Flathead</td>
<td>4,000 Feet</td>
<td>State</td>
</tr>
<tr>
<td>#4</td>
<td>Section 9</td>
<td>3.5 miles to Well #1 Surge Tank</td>
<td>Casper, Madison, and Flathead</td>
<td>1,000 Feet</td>
<td>State</td>
</tr>
</tbody>
</table>

*Note: Summary of Weston Engineering’s Table 1 in Appendix III*

Based on Weston Engineering’s comparison of all possible sites, the fourth or Section 9 site is the preferred well site due to the proximity to the existing Little Deer Creek wells, the anticipated shallow drilling depth, and the site being on State land. Significant drilling and pipeline costs may be realized by drilling at this site if a test well proves successful. The Tenneco Well was not considered further, due to the depth to static water level and poor water quality.

Hydraulically, if a well is drilled on the Section 9 site, the water should be pumped into the surge tank near Little Deer Creek Well #1. When all three wells are required to be running it will be necessary to increase the pressure in the transmission line to overcome the hydraulic losses of flows in excess of the 2000 gpm capacity of the line. This would be accomplished through the construction of a booster pump facility. This facility would only be used during the summer months when demands are high. Exhibit 3.2.1.B illustrates the conceptual location of the proposed well source and new transmission line. The Report provides a detailed cost estimate to complete this well along with the necessary pipeline, pumps and appurtenances. The complete estimate is $1,110,000.

Through the addition of a new well, the anticipated total capacity of Glenrock’s sources would equal approximately 2700 gallons per minute. Comparing the future source capacity of 2700 gallons per minute with the projected peak day demands for the year 2025, a well producing 1000 gallons per minute provides
Proposed Well & Transmission Pipeline

Exhibit 3.2.1.B
adequate source capacity beyond the entire planning period. A new well source that produces 1000 gallons per minute will provide Glenrock with adequate water for future needs and provides a redundancy in water sources, allowing back-up capabilities.

Concerning the other elements of the Town’s water system, analysis in the reports concludes the following: There are weaknesses in the distribution system, but they are not significant. The supplyline is adequate to meet needs well into the design period. Glenrock has adequate storage capacity to meet future growth. However, hydraulically the tanks are not able to be used to their fullest capacity. A computer model of the distribution system is being proposed for the subsequent study phase.

The Town does have some concern about securing the needed water rights for their system. The Report presented their options and recommendations for solidifying those rights.

4.0 RAW WATER IRRIGATION

As described in the sections above, the greatest demand on the culinary water system occurs in the summertime, and can be attributed largely to summer irrigation demands. Therefore, providing raw water for irrigation appears to be a logical method of reducing the demand on the culinary system. Currently, culinary water is used to irrigate the cemetery, middle and elementary schools, Glenrock Town Park, and supplement the golf course. If raw water was used to irrigate these larger green areas of Town approximately 415 gallons per minute of water would be saved for future growth. The following table shows the irrigation areas associated with each proposed irrigation site.

<table>
<thead>
<tr>
<th>Proposed Green Areas Characteristics</th>
<th>Location</th>
<th>Area</th>
<th>Flow Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glenrock Town Park</td>
<td>20 Acres</td>
<td>65 GPM</td>
<td></td>
</tr>
<tr>
<td>Walk-way</td>
<td>5 Acres</td>
<td>50 GPM</td>
<td></td>
</tr>
<tr>
<td>Cemetery</td>
<td>14 Acres</td>
<td>75 GPM</td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>3 Acres</td>
<td>110 GPM</td>
<td></td>
</tr>
<tr>
<td>Elementary School</td>
<td>1.5 Acres</td>
<td>65 GPM</td>
<td></td>
</tr>
<tr>
<td>Golf Course</td>
<td>31 Acres (N/A)</td>
<td>50 GPM</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43.5 Acres</strong></td>
<td><strong>415 GPM</strong></td>
<td></td>
</tr>
</tbody>
</table>

After analyzing all possible avenues for supplying raw water to the above mentioned green areas of Glenrock, it appears that two new diversion points would need to be constructed. Both sources would be infiltration galleries along
Deer Creek. The first infiltration gallery would be constructed in Glenrock Town Park and could supply water to the park and walkway.

The second infiltration gallery would be located directly east of the intersection of Grant St. and Young Blvd., near the west bank of Deer Creek. Water from this gallery would be pumped through a pipeline that parallels Young Blvd. The transmission line would branch off from the Young Blvd. line to feed the cemetery, schools, and golf course. The golf course branch is planned to connect into the existing Indian Hills pipeline that currently feeds the golf course.

The Engineers Estimate to construct the pressure irrigation system is $850,000. Although the irrigation concept is a sound one, this alternative could not stand alone in meeting Glenrock’s future needs. The relatively small amount of irrigation demands of 415 gpm would only give Glenrock a temporary relief of their water shortage situation. The projected need of 2400 gpm, along with the immediate need for a backup culinary source indicates that a new potable production well is the first priority. Once on line, the irrigation demands could be met without the $850,000 capital expenditure.

5.0 COST ANALYSIS OF RECOMMENDATIONS

The improvements recommended to address the needs of Glenrock’s water system include the development of another well, the rehabilitation of the existing Indian Hills storage tank, and the replacement of water distribution lines in the Oregon Estates Subdivision and the Scott Addition. A summary of the costs of the recommended improvements are shown in the table below.

<table>
<thead>
<tr>
<th>Estimated Project Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WWDC Eligible</strong></td>
</tr>
<tr>
<td>1. New Well &amp; Appurtenances</td>
</tr>
<tr>
<td>2. Storage Tank Refurbish</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td><strong>Non-WWDC Eligible</strong></td>
</tr>
<tr>
<td>3. Distribution System Replacement</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>
WWDC Eligible Projects - Preferred Alternatives

The total cost of the new well and transmission line and storage tank rehabilitation is $1,185,000. These are WWDC-eligible projects. The grant amount (60% of project cost) would be $711,000. The loan amount (40% of project cost) would be $474,000.

SLIB Eligible Projects - Preferred Alternatives

The total cost of the distribution piping replacement projects in Oregon Estates and Scott Addition is $1,955,000. These are SLIB eligible projects, but do not qualify for WWDC funding. The grant amount (50% of project costs) would be $977,500. The loan amount (50% of project costs) would also be $977,500.

End User Fees in Monthly Payments

Since both WWDC and SLIB will allow a community to seek other loan sources for the non-grant amount of a project, it is logical that the Town of Glenrock would pursue the lower interest rate loan through Rural Utility Services (RUS) or private banks. However, Glenrock may also choose to fund the non-grant amount through their own savings. The end user rate increases below are shown below for reference, and assume a loan through RUS.

The WWDC eligible projects shown above result in an end user rate increase of $2.78/month, based on a loan amount of $474,000, a loan term of 30 years, and an interest rate of 5%.

The SLIB eligible projects shown above result in an end user rate increase of $5.73/month, based on a loan amount of $977,500, a loan term of 30 years, and an interest rate of 5%.

The Town of Glenrock will decide which, if any, of these projects will be pursued. At the time this decision is made, specific terms and interest rates will be negotiated with the funding entity.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The water source needs of the Town of Glenrock are presently served by the Little Deer Creek Wells #1 and #2. The water use demands of the water system are approaching the capacity of the two wells. The peak demand occurs in the summer when irrigation demands are high. For this reason, it has been assumed
that by implementing raw water irrigation improvements, the Town of Glenrock might be able to alleviate the need for immediate development of additional culinary water source.

The evaluation of the development of additional culinary water source versus the implementation of irrigation alternatives has shown that the development of additional culinary water source is the best alternative for the Town. However, a new source must be located in reasonably close proximity to the existing well sources. Weston Engineering’s hydrogeologists have recommended a location to drill this well. With its relatively lower cost, and good potential for producing the volume of water desired, this location is considered the most favorable target for a new well source.

This site is recommended for additional study through a continuance of this WWDC Level II Study. The additional investigation would involve drilling a test well and subsequent production well. The total cost of drilling the new well is estimated at $265,569. In addition to the cost of drilling the new well, the continuance of the study would also involve the hydraulic analysis of the distribution system, the preliminary design of the transmission line and other features associated with the new well, economic analysis of the new well and improvements, meetings and hearings, and final report and executive summaries. The estimated cost for these study tasks is $29,431. The total proposed budget for the continuance of the Level II Study is $295,000.