EXECUTIVE SUMMARY

LITTLE GOOSE DOMESTIC WATER SUPPLY PROJECT

Prepared For Wyoming Water Development Commission

January 1987
December 15, 1986

State of Wyoming
Water Development Commission
Herschler Building
Cheyenne, Wyoming 82002

Gentlemen:

We are pleased to submit the Executive Summary of the Little Goose Domestic Water Supply Project. The intent of this program was to utilize a groundwater source for a centralized water distribution system in the Little Goose Valley. This report summarizes the groundwater investigation and water distribution system analysis. A detailed discussion of the study is contained in Volume I - Report of Findings and Volume II - Supplemental Groundwater Information.

Our primary tasks included: deepening the exploration well drilled in 1985 approximately 350 feet to increase the water development potential; determination of long-term yields for one and two wells; assessment of interest for a centralized system and existing water quality problems; and economic analysis of alternative water supply systems.

We would like to thank the Wyoming Water Development Commission for the opportunity to undertake this complex water supply project. We would also like to extend our appreciation to residents in the Little Goose Valley that participated during the study.

If HNTB can be of assistance to answer any questions, or serve the Commission and our State any further, please contact us at your convenience. We look forward to working with you, your staff, and the City of Sheridan in the future.

Respectfully submitted,

HOWARD NEEDLES TAMMEN & BERGENDOFF

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LITTLE GOOSE DOMESTIC WATER SUPPLY PROJECT - LEVEL II

EXECUTIVE SUMMARY

Prepared for:
Wyoming Water Development Commission

January 1987

Howard Needles Tammen & Bergendoff (HNTB) -- Project No. 11100

Subconsultants
Anderson And Kelly
ACKNOWLEDGEMENTS

The HNTB team wishes to express their appreciation to the following individuals for their cooperation in supplying information and assistance essential to the successful and timely completion of this project:

WYOMING WATER DEVELOPMENT COMMISSION

Evan Green, Water Division II Project Manager
Jon Wade, Hydrogeologist

SHERIDAN COUNTY

Joe Hollingsworth, County Engineer

LITTLE GOOSE COMMITTEE

Milo Namtvedt
LITTLE GOOSE DOMESTIC WATER SUPPLY PROJECT

TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PURPOSE</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND AND AUTHORIZATION</td>
<td>1</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>2</td>
</tr>
<tr>
<td>GOALS</td>
<td>2</td>
</tr>
<tr>
<td>STUDY APPROACH</td>
<td>3</td>
</tr>
<tr>
<td>SUMMARY OF FINDINGS</td>
<td></td>
</tr>
<tr>
<td>Study Area</td>
<td>3</td>
</tr>
<tr>
<td>Existing Conditions</td>
<td>4</td>
</tr>
<tr>
<td>Water Demands</td>
<td>5</td>
</tr>
<tr>
<td>Groundwater Supplies</td>
<td>6</td>
</tr>
<tr>
<td>Distribution System Alternatives</td>
<td>6</td>
</tr>
<tr>
<td>Alternative Analysis</td>
<td>8</td>
</tr>
<tr>
<td>RECOMMENDATIONS</td>
<td>10</td>
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**LIST OF TABLES**

<table>
<thead>
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<td>1</td>
<td>Little Goose Valley Water Distribution System</td>
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<tr>
<td></td>
<td>Alternatives</td>
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<td>2</td>
<td>Little Goose Valley Water System Cost Summary</td>
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**LIST OF EXHIBITS**

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<td>1</td>
<td>Location Map</td>
<td>12</td>
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<tr>
<td>2</td>
<td>Service Areas</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>Alternative 1A</td>
<td>14</td>
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<tr>
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LITTLE GOOSE DOMESTIC WATER SUPPLY PROJECT
EXECUTIVE SUMMARY

PURPOSE

The Little Goose Domestic Water Supply Project was undertaken by the Wyoming Water Development Commission (WWDC) to develop a centralized water supply and distribution system for Little Goose Valley. The purpose of this phase of the project is to define the water development potential of the Little Goose Creek well and evaluate the feasibility of satisfying the domestic water needs in Little Goose Valley through a rural water system.

BACKGROUND AND AUTHORIZATION

State funded exploration for groundwater in this area began in 1982 and led to the drilling of a test well in 1985. Reports covering this program include, chronologically: Potential for Groundwater Development, City of Sheridan, Wyoming, 1982 by Western Water Consultants; and Tongue River Level I Reconnaissance Study - 1984 by Banner Associates. The Tongue River Study indicated the potential for surface water development in the Little Goose drainage would be limited to storing winter flows only. There would be no water available for development during the spring due to the existing appropriations on Little Goose Creek.

In June, 1985 the Wyoming Water Development Commission (WWDC) entered into an agreement with Howard Needles Tammen & Bergendoff (HNTB) to perform the Level II investigation for the Sheridan Area Water Supply project. During the 1985 Level II Program, an exploration well along Little Goose Creek was drilled to determine the potential for developing groundwater supplies. The findings of the Phase 1 study were presented in Sheridan Area Water Supply Investigation - Level II report (HNTB, November 1985).
In June 1986 the WWDC entered into an agreement with HNTB to deepen the Little Goose well and perform a Level II feasibility analysis for a rural water system along the Little Goose Valley.

The Little Goose well site is along Little Goose Creek, as shown in Exhibit 1, at the intersection of the east flank of the Bighorns and Moncrief Ridge, approximately 15 miles south of Sheridan, Wyoming. Interest in developing additional domestic water supplies in the Little Goose Creek area has been expressed by the Southeast Water and Sewer District, the Woodland Hills Improvement District, and the Bighorn School.

OBJECTIVES

The objectives of this study are as follows:

- Deepen the Little Goose well by approximately 400 additional feet to reach Precambrian granite.
- Perform tests on the Little Goose well to determine the water bearing characteristics of the aquifer and water quality.
- Estimate the long term yield of the Little Goose well and the total yield from a well field completed in the same vicinity.
- Determine service areas which could be provided with water from the Little Goose well field.
- Evaluate alternative preliminary designs of water systems to serve Little Goose Valley for yields from one or two wells.

GOALS

The goals of this project are to maximize the service area utilizing a groundwater supply and provide a water distribution system to residents in Little Goose Valley at a minimal cost.
STUDY APPROACH

The study approach to accomplish the objectives and goals of this project was divided as follows:

- Study Area
- Existing Conditions
- Water Demands
- Groundwater Supplies
- Distribution System Alternatives
- Alternative Analysis

Each of these items was examined in detail. The culmination of these activities resulted in the conceptual design for the rural water system with a groundwater supply. A summary of the findings are presented in this document – Executive Summary. A detailed discussion is provided in Volume I - Report of Findings and Volume II - Supplemental Groundwater Information.

SUMMARY OF FINDINGS

The procedure followed and the results of this study are summarized below for each portion of the project.

STUDY AREA

The study area was divided into 19 individual service areas to determine water demands, evaluate needs, and identify the interest in developing a central water system. The service areas were used in developing alternative water systems. These service areas are shown in Exhibit 2.
1) The study area includes the Little Goose Valley and extends from the Little Goose well to the Sheridan City limits, a distance of approximately 13 miles.

2) The study area contains approximately 1,000 existing homes and 52 recorded subdivisions.

EXISTING CONDITIONS

The existing water sources and water quality conditions were documented through a survey letter to Little Goose residents and review of previous studies. Existing water distribution systems within respective service areas were identified.

1) The existing water source for the majority of homes in Little Goose Valley is individual shallow wells, typically with a depth of 40 to 300 feet. The yields range from 5 to 300 gpm.

2) Water quality problems are widespread, especially with regard to high total dissolved solids, hardness, sodium, iron, sulfates, and taste and odor problems. Several wells have been reported to be bacteriologically contaminated.

3) In certain areas the density of homes with individual wells has diminished groundwater supplies to the point where wells have had to be redrilled to a greater depth to obtain sufficient water.

4) Due to water quality and quantity problems, the use of individual shallow wells as a water source in Little Goose Valley has been dismissed.

5) Several of the subdivisions in Little Goose Valley contain small centralized water systems. In general, these small water systems rely on relatively shallow wells and have not been successful in providing water of adequate quality or quantity.
6) A survey letter was sent to residents in Little Goose Valley. As a whole, resident responses received indicating "interested" or "very interested" in joining a water district exceeded responses which were "uninterested" by a factor of three to one.

WATER DEMANDS

Water demands were developed by service area to assist in developing alternatives and to allow modifications when the Water District is established.

1) There are no metered records of water demands in Little Goose Valley.

2) Little Goose water demands were estimated based on existing meter records from water taps on the City of Sheridan raw water transmission mains along Big Goose Valley. The land development patterns in Big Goose Valley are similar to those in Little Goose Valley.

3) The estimated peak day water demand is 0.8 gallons per minute (gpm) per user. It is assumed the peak hour water demand is twice the peak day demand, or 1.6 gpm per user.

4) The largest water users identified in Little Goose Valley included Big Horn School, Woodland Park Elementary School, and Sheridan Commercial Park Development. The Big Horn School has an estimated peak day demand of 10,000 gpd, Woodland Park Elementary School 6,000 gpd, and Sheridan Commercial Park Development 2,000 gpd.

5) It was assumed 75 percent of the existing homes would initially join a Water District. The initial peak day demand in each service area was estimated by multiplying the number of existing homes in each service area by 75 percent at 0.8 gpm per user.

6) A residual growth factor of 25 percent was allowed for future growth.
GROUNDWATER SUPPLIES

The Little Goose well was deepened approximately 350 feet to increase the water development potential that would hopefully provide a long-term water supply to Little Goose Valley residents.

1) The Little Goose well is cased and cemented 560 feet into the Madison Limestone formation and completed with a slotted steel casing open to the lower Bighorn Dolomite, the Gallatin Limestone, the Gros Ventre Formation, and the Flathead Sandstone to a total depth of 2,849 feet.

2) The yield of the well was not increased significantly by stabilization of the Gros Ventre Formation and penetration of the Flathead Sandstone.

3) Analysis of aquifer flow and recovery test data demonstrate a transmissivity of 400 gpd/ft, storage coefficient of 0.0001 and a shut-in pressure of 244 psi. These results are consistent with the results of the 1985 Program.

4) The long-term continuous yield of the well is estimated to be 85 gpm, predominantly from the Gallatin Limestone. The development potential is probably limited to 135 gpm from a multiple well field.

5) The water for this aquifer is of good quality, meeting all primary and secondary Environmental Protection Agency (EPA) drinking water standards.

DISTRIBUTION SYSTEM ALTERNATIVES

Six water distribution system alternatives were developed for one well and two well scenarios utilizing the long-term groundwater yields of 85 gpm from one well and 130 gpm from two wells. The six alternatives are graphically shown on Exhibits 3, 4, 5, 6, 7 and 8, and the components summarized on Table 1.
# TABLE 1

## LITTLE GOOSE VALLEY

WATER DISTRIBUTION SYSTEM ALTERNATIVES

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Service Areas</th>
<th>Equivalent Service Connections(^1) (gpm)</th>
<th>Average Day Demand (gpm)</th>
<th>Peak Day Demand (gpm)</th>
<th>Required Well Service Capacity (gpm)</th>
<th>Future Conditions</th>
<th>Regional Storage Capacity (gallons)</th>
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<td>Future Conditions</td>
<td>Regional Storage Capacity (gallons)</td>
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<td>56</td>
<td>169</td>
<td>85</td>
<td>282</td>
<td>75</td>
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</table>

\(^1\)Assumes demand at Big Horn School equivalent to 9 residential service connections and 10,000 gallon storage tank at Big Horn School is integrated into system.

\(^2\)One well will be provided to meet initial demand; A second well will be added as future demand requires.
General

1) Typically a water supply system is designed to provide a capacity equivalent to the peak day demand. Under this assumption, it would only be possible to serve 110 homes with one well or 160 homes with two wells.

2) To maximize the water available and extent of areas served, it was assumed an ordinance would be imposed on the users to restrict the use of the central water system for domestic needs only. Irrigation of lawns would be prohibited.

Design Criteria

3) Storage facilities were sized with an equivalent volume of two future average day demands plus one peak day demand. This volume is approximately twice the normal design assumptions.

4) With the irrigation restriction and additional storage capacity, the peaking factors and design requirements on the distribution system will be reduced. It is assumed that the required well capacity is 1.5 times the average day demand.

5) The transmission main and distribution mains are sized to convey the peak hour demand of 1.6 gpm per connection, and to maintain pressures between 30 and 140 psi at all service connections.

6) Chlorination facilities were provided immediately upstream of the storage facilities.

ALTERNATIVE ANALYSIS

The six water distribution system alternatives were evaluated and project costs developed. Costs per user were developed assuming state financing from the Wyoming Water Development Commission (WWDC) and Farm Loan Board (FLB).
General

1) No unusual differences were identified between the alternatives for administrative activities, construction problems and maintenance requirements. The alternatives were evaluated primarily based on cost estimates.

Cost Estimates

2. The cost estimates were broken down to transmission main and distribution system components. The transmission main portion was assumed to be WWOC grant eligible and the distribution main portion FLB grant eligible. The difference for the eligibility assumption was that the WWDC does not participate in funding water system improvements following the point-of-treatment. Although a clean definition was not available regarding what portion of a water distribution system is eligible for WWDC funding following disinfection of a groundwater source, for this project the segment of transmission line from the well site to the Town of Big Horn was assumed WWDC grant eligible along with the chlorination and storage facilities.

3. The WWDC financing was assumed to be 75 percent grant/25 percent loan with the loan portion financed at four (4) percent over 25 years. The FLB financing was assumed to be 50 percent grant/50 percent loan with the loan portion financed at 8-1/2 percent over 25 years.

4. Operation and maintenance costs were developed for each alternative to cover: water billings; water meter reading; routine maintenance of the distribution system and chlorination facilities; electrical power; water samples; rental of office; and emergency fund for water line breaks, valve replacement, meter repairs, and tank and well maintenance. The annual O&M cost is estimated at $50,000 per year. The two booster stations for Alternatives 2C and 2D are estimated to require an additional $2,000 each per year for O&M.
5. The total annual costs per customer with state financing are shown on Table 2 and range from $68 per month for Alternative 2B to $76 per month for Alternative 2C. The costs per user for all six alternatives are approximately within 10 percent.

RECOMMENDATIONS

The survey letter indicated a high level of interest in Little Goose Valley to provide a centralized water distribution system. Water quality problems and quantity restrictions were established throughout the valley.

1. It is believed the cost per user to provide a centralized water system to a rural water district utilizing a groundwater supply is cost prohibitive. Also, the supply would only be designed to satisfy the base domestic water needs.

2. The Little Goose Valley could also be supplied water from the Big Goose drainage or the City of Sheridan. Supplies from the Big Goose drainage could be provided to Little Goose Valley from Sheridan's raw supply system if the proposed 30-inch pipeline recommended in the 1985 Sheridan Water Supply Investigation - Level II report was implemented. A water treatment plant would be needed prior to distribution. A Level II cost analysis should be performed to determine the feasibility of providing water to Little Goose Valley from either Sheridan's raw water supply system or potable water supply system.
<table>
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<th>ALTERNATIVE</th>
<th>PROJECT COST ($)</th>
<th>GRANT ELIGIBLE PORTION ($)</th>
<th>FINANCED PORTION ($)</th>
<th>PAYBACK PERIOD (YRS)</th>
<th>PERCENT FINANCING (%)</th>
<th>INITIAL ANNUAL FINANCING ($/YR)</th>
<th>ANNUAL COST ($)</th>
<th>INITIAL TOTAL COST ($)</th>
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<td>2,900</td>
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<tr>
<td><strong>Alternative 2C (Service Area 1, 2, 3, 4, 5)</strong></td>
<td>1,536,000</td>
<td>1,152,000</td>
<td>384,000</td>
<td>25</td>
<td>4.0</td>
<td>24,600</td>
<td>77,100</td>
<td>158,600</td>
<td>236</td>
<td>68</td>
</tr>
<tr>
<td>Transmission Main</td>
<td>1,536,000</td>
<td>1,152,000</td>
<td>384,000</td>
<td>25</td>
<td>4.0</td>
<td>24,600</td>
<td>77,100</td>
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<td>8.5</td>
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<tr>
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<td>-</td>
<td>30,000</td>
<td>25</td>
<td>8.5</td>
<td>2,900</td>
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<td>1,343,500</td>
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<td>4.0</td>
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<td>109,400</td>
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<td>109,400</td>
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<tr>
<td>Right-of-Way</td>
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<td>-</td>
<td>30,000</td>
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<td>8.5</td>
<td>2,900</td>
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<tr>
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</table>
UTTLE GOOSE
WE L L
EL 6-HO
CAPAC I TY (gal.) - 605,000 O.F. 4835

SCALE IN Fhl

AREA

NUMBER

®

®

®

®

®

SERVICE

AREA

PRESSURES

PRESSU R ES (psi)

Zone 1

Zone 2

Zone 3

Zone 4

14' 50
137
45
102
33
128
60
78
55
90
33
112

WOODLAND HLS
IMPROVEMENT
SEFNICE DISTRICT

EXHIBIT 6
ALTERNATIVE 2B
LITTLE GOOSE

WELL

14390

O.F. EL 4935

 SCALE IN FEET

AREA

NUMBER

SERVICE

PRESSURES

PRESSURES (psi)

Zone 1

Zone 2

Zone 3

Zone 4

min. max.

min. max.

min. max.

min. max.

50

>45

50

45

12

5

.13.

48

121

WOODLAND HILLS

IMPROVEMENT

SERVICE DISTRICT

EXHIBIT 8

ALTERNATIVE 2D