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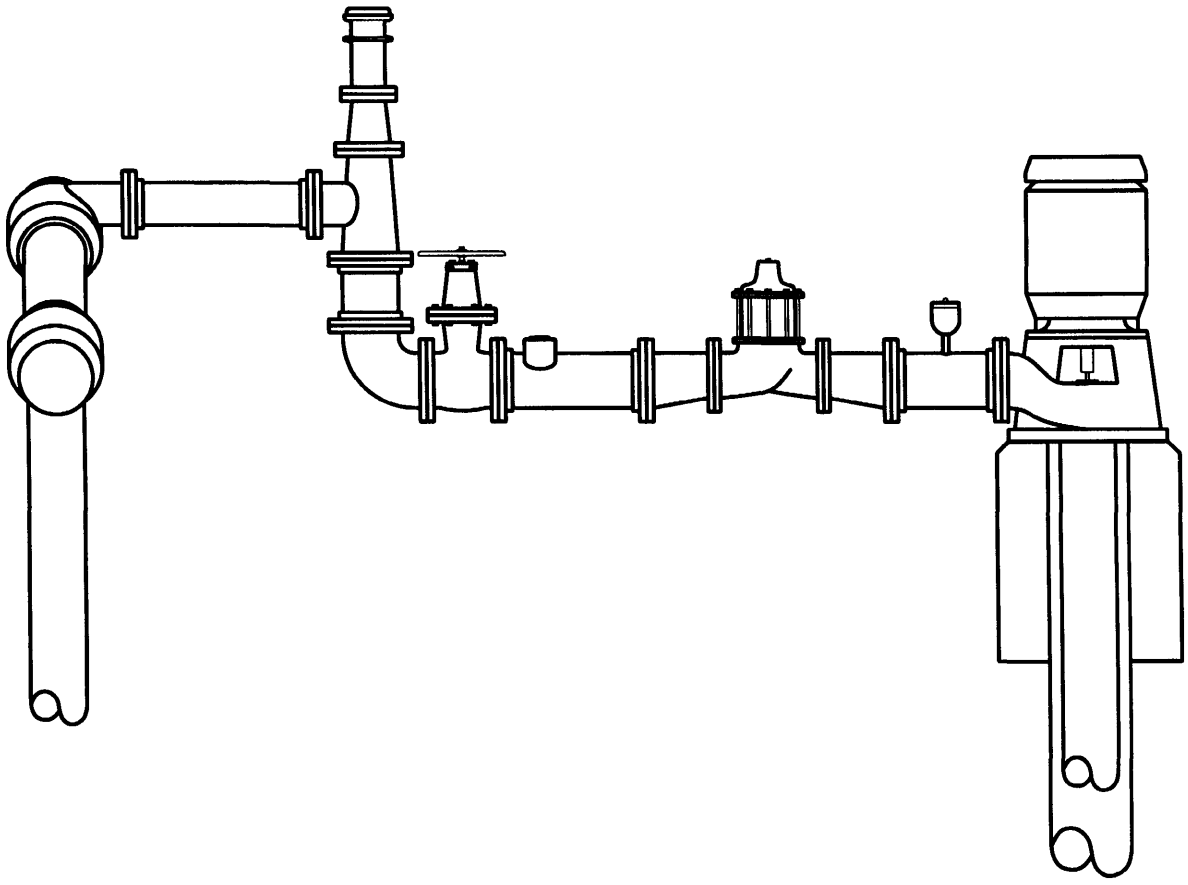
WYOMING WATER DEVELOPMENT COMMISSION
LEVEL II – LUSK WATER SUPPLY PROJECT
LUSK, WYOMING

NOVEMBER 1995

EXECUTIVE SUMMARY



MK CENTENNIAL

CENTENNIAL ENGINEERING, INC.

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EXECUTIVE SUMMARY

Conceptual Design

Introduction and Purpose

In October, 1994 a Level I Plan Study of the Lusk Water System was completed and presented to the Wyoming Water Development Commission (WWDC). MK Centennial Engineers entered into an agreement to provide professional services related to the Level II, Phase I - Well Construction and Aquifer testing and Phase II - Conceptual Design, Archeological Investigations and Cost Estimate for the Lusk Water Supply Project. The purpose of this project is to construct an additional water supply well and prepare conceptual designs and cost estimates for improvements to the existing system.

Project Overview

Currently, the water supply for the town is primarily provided by Well No. 8, located east of town 2 miles and adjacent to the airport. Well No. 8 has a yield of 819 GPM. The town has experienced critical situations where limited supply caused dangerous conditions in the town. In the summer of 1995 the well screen in Well No. 8 had an opening develop that resulted in sand entering the casing and the closure of the well. The town of Lusk had to start-up a well, which is seldom used, causing a very critical situation in the town if a fire had occurred.

The Level I Master Plan study recommended the construction of an additional Arickaree well, a new 400,000 gallon storage tank, approximately 5,500 feet of new transmission line, and the repair of an existing storage tank. Total construction costs, include converting the Level II test well to production status and distribution system improvements, are estimated to be $1,600,000. The total amount eligible for WWDC assistance at Level III is approximately $750,000. In addition, the report did an extensive economic and population forecast to the year 2030. Different scenarios were developed for population projections involving low, moderate, high and boom growths. This report only utilizes the scenarios for low and moderate growth projections to the year 2010, to prevent over designing the system.

Level II - Discussion

The Level II investigations utilized Level I data provided from the Master Plan Study. Electronic files from the Level I study were incorporated into this report. A new node location file was created as a result of not being available from the Level I information.

(1) Existing Water System

The town of Lusk has a present population of 1,504 according to the Level I Report with an

average daily demand of 275 GPCD. There is an average of 2.2 people per house with a peak daily demand of 1.0 GPM/house. These values were used for peak node demands, which is based on the number of houses that contribute to the demand at each node.

The investigation of the existing system and available fire flow model reflects severe deficiencies at key locations throughout the town. The specific locations of concern are:

Location	Available Fire Flow At Fire Hydrant
High School	250 GPM
Elementary School	600
3rd & Main Businesses	1920
Hospital	560
8th & Main	1340

Guide for determination of required fire flow suggests: 2500 GPM for 2 hours.

The deficiencies above will determine where water main improvements should take place to improve the fire flows to an acceptable rate.

The existing water supply with Well No. 8 presents a dangerous situation with minimal backup capabilities available if the supply is interrupted. New improvements with Well No. 9 will improve the supply situation to double the existing supply to approximately 1600 GPM.

Water storage is also a concern for the town with the present 665,000 gallon of surface storage. The tanks consist of a 440,000 gallon welded steel tank and a 225,000 gallon bolted steel tank located side by side on a hill overlooking the downtown area of Lusk.

(2) Proposed Water System Improvements

Several improvements to the distribution system were proposed in the Level I report and modified in this report to accommodate the needs of the system. The system was improved in certain areas to accomplish better fire flows at the designated locations mentioned above. The contours for existing and proposed fire hydrant flow rates were determined for the town. Modifications to the proposed improvements from the Level I report are as follows:

1) 10" waterline was extended around the Elementary School from the east side and tied into the existing 10" waterline on the west side (Maple Street). The existing 6" waterline is not operational at this time due to unknown problems.

2) The proposed 10" waterline to the proposed 400,000 gallon storage tank was realigned north following Onyx Avenue alignment to Fifth Street. Construction of the proposed alignment had severe grades and conflicted with the existing radio tower. This

realignment eliminates the 10" from Onyx Avenue and Seventh Street to Diamond Avenue and Seventh Street. Also, it replaces the proposed 8" waterline in Fifth Street with a 10" waterline. The net change is 200 feet less of 10" waterline.

3) Eliminate the 8" waterline from Onyx Avenue and Radium Street to the Pump House north of the river. The expense of $100k for an alternate river crossing and to provide better circulation in the system appeared to be high for the benefit realized. MK Centennial suggests providing a solenoid operated valve actuated from a timer during the summer months for circulation and provide an alternate power source at the pump for emergency use.

4) Decrease the storage tank to 375,000 gallons for a low growth rate projection for the year 2010, versus 400,000 gallons proposed in the Level I Report. In addition to the new tank the existing two tanks should be repaired and cleaned.

STORAGE SUMMARY

With 2 Pumps Operating 12 hrs/day

		Population Projection	
Req. Storage	Current	Low Year 2010	Low Year 2030
Equalization	278,160	581,520	652,560
Fire	300,000	300,000	300,000
Emergency	136,480	165,165	171,880
Required Total Storage	714,650	1,046,685	1,124,440
Available Storage	665,000	665,000	665,000
Additional Storage	49,650	381,685	459,440

STORAGE SUMMARY

With 2 Pumps Operating 18 hrs/day

		Population Projection	
Req. Storage	Current	Low Year 2010	Low Year 2030
Equalization	278,160	* 82,720	*82,720
Fire	300,000	300,000	300,000
Emergency	136,480	165,165	171,880
Required Total Storage	714,640	547,885	554,600
Available Storage	665,000	665,000	665,000
Additional Storage	49,650	- 0 -	-0-

* Calculations are less than minimum 20% x Av. Daily Flow

Results From Improvements

The proposed improvements will provide the Town of Lusk a water system capable of handling a population growth to 1820 people (low growth rate projection to 2010). Also, the system has improved fire storage and backup pumping capacity if required. The improved fire flows are at fire hydrants for the following locations:

Location	Available Fire Flow At Fire Hydrant
High School	1930 GPM
Elementary School	1980
3rd & Main Businesses	2200
Hospital	1150
8th & Main Business	2090

NEW WATER SUPPLY

Well No. 9

Well Site Description

The Town of Lusk currently receives its primary water supply from two municipal water supply wells (wells No. 3 and No. 8). The two wells have a combined yield of approximately 1,170 gallons per minute (gpm) to the Town's storage facilities. The desired yield of the new well is approximately 800 gpm.

The new well site is located on lands owned by the Town of Lusk and is approximately one-half mile east of the Lusk No. 8 Well. The well site is located in the northeast quarter of the northwest quarter of Section 14, Township 32 North, Range 63 West, Niobrara County, Wyoming. A description of the geology in proximity of the well site was presented in a 1994 Level I Report prepared for the WWDC.

The new well site is located approximately 2.5 miles east of the Town of Lusk. The new well targets the Tertiary Arikaree Formation for aquifer development. The Arikaree Formation is composed of predominantly sandstone with a coarse basal conglomerate. The Arikaree Formation also contains interbedded siltstone, thin lenses of hard concretionary sandstone, and soft volcanic ash. This formation is the primary source of municipal water for the towns of Lusk and Manville. Numerous local wells are also completed in the Arikaree Formation for domestic and agricultural use.

Permits

On July 12, 1995, a Form U.W.5 for the Lusk No. 9 Test Well was filed with the Wyoming State Engineer's Office (WSEO). The WSEO issued Permit No. U.W.99727 for the well on July 20, 1995.

The Wyoming Department of Environmental Quality/Water Quality Division (WDEQ/WQD) and the Wyoming Water Development Office (WWDO) signed a "Memorandum of Agreement" (MOA) on April 6, 1995. Permit No. 95-123 was issued by the WDEQ/WQD on April 8, 1995, and expires on April 8, 2000. The Permit authorizes the WWDO to construct, install, or modify public water supply wells statewide according to the procedures and conditions of the permit Number 95-123.

In accordance with the MOA, the WDEQ/WQD was notified by letter, dated August 8, 1995, of the intent to construct the Lusk No. 9 Well and identified seven deviations from the WWDO Standard Well Specifications and Designs of the MOA. On September 11, 1995, Mr. Gary Steele, the Southeast District Engineer of the WDEQ/WQD, was notified by telephone of the anticipated date that the well construction would commence, and an estimated completion date for the project in

accordance the Permit No. 95-123.

Well Construction

The construction of the test well, designated "Lusk No. 9," commenced on September 12, 1995. The location of the well is shown on Figure 1 and a chronological history of well construction activities is included in Appendix A. Well construction services were provided by D.C. Drilling Co. of Lusk, Wyoming.

Pilot Borehole Construction

A 6-inch diameter pilot boring was advanced from the ground surface to a total depth drilled of 540 feet below ground surface on September 12, 1995. The drilling rig was a Midway 1500 Series using the direct circulation, mud rotary drilling method.

During pilot boring construction, water-bearing sandstone units were penetrated below 450 feet. A decision was reached to construct the well to 520 feet in depth. The proposed well design was modified to install 12-inch diameter well screen and casing to approximately 300 feet in depth and 8-inch diameter screen and casing from 300 to 520 feet below ground surface.

Well Logging

Samples of drill cuttings were collected at 10-foot intervals to log the lithology of the penetrated formations from the ground surface to the total depth drilled of 540 feet. The cuttings samples were collected at the discharge point from the wellhead and rinsed with fresh water. The samples were placed in appropriately labeled (well name, sample number, depth interval, and date), porous, sand-type sample bags. The samples will be submitted to the WWDC at the end of the project.

The lithologic log of the pilot borehole is included in Appendix B. Drill cuttings samples were examined for the following lithologic characteristics:

- Rock type(s);
- Color;
- Cementation and/or hardness;
- Structure(s);
- Composition; and
- Texture (including grain/crystal size, grain/crystal shape, and sorting).

The 6-inch diameter test boring was logged with geophysical logging tools from 8 feet to 538 feet below ground surface by Goodwell, Inc. of Upton, Wyoming on September 13, 1995. The geophysical logs included a dual normal electric log with spontaneous potential and a compensated density log with caliper and gamma ray.

Surface Casing Installation

The 6-inch diameter pilot boring was reamed open to a 27-inch diameter boring from the ground surface to 39.5 feet in depth on September 18, 1995. The pilot hole was reamed using a 27-inch diameter reamer assembly with an attached 6-inch diameter pilot bit.

On September 22, 1995, the 20-inch outside diameter steel surface casing was installed to a depth of 39.50 feet below ground surface. The 20-inch casing was cemented in place with 75 sacks of portland cement, mixed 5 gallons of water per 94-pound sack of cement. The cement was mixed and transported to the well site by Concrete Construction, Inc. of Torrington, Wyoming using a cement mixing truck. The portland cement was emplaced in the annulus between the 20-inch casing and the 27-inch diameter borehole using a 1.25-inch PVC tremie pipe set at 38 feet below ground surface. The stick-up height of the 20-inch surface casing is 0.92 feet above the ground surface.

Full Diameter Borehole Construction

From September 25 through 28, 1995, the 6-inch diameter pilot boring was reamed open to 19 inches in diameter from 39.5 to 538 feet below ground surface. The reaming process involved the use of the reverse circulation, air rotary drilling method. A Midway 1500 Series drilling rig modified for reverse circulation operation was mobilized to the well site and used to construct the 19-inch diameter boring.

Following the construction of the 19-inch diameter borehole to 538 feet in depth, the static water level was determined to be at approximately 30 feet below ground surface.

Aquifer Development

The purpose of aquifer development is to remove unconsolidated and loosely consolidated sediment from the water-bearing portions of the formation. From September 29 through October 2, 1995, a Layne Aurora line shaft turbine pump was installed at a depth of 205 feet in the open borehole. On October 2 and 3, 1995, the pump was operated at discharge rates ranging from approximately 1,400 to 900 gpm to conduct aquifer development using the overpumping technique. The average discharge rate during overpumping was 1,000 gpm and abundant silt and very fine grained sand were discharged to the surface.

Overpumping was conducted for a total of 13 hours and the sediment content of the discharged water was greatly reduced. The line shaft turbine pump was removed from the borehole on October 3, 1995. Following aquifer development and pump removal, the sediment accumulation in the 19-inch

diameter borehole was determined to be from 528 to 290 feet below ground surface.

On October 6 and 7, 1995, the 19-inch diameter borehole was cleared of sediment from 290 to 470 feet below ground surface using the reverse circulation, air rotary drilling method. On October 9, 1995, the borehole was unstable below 470 feet in depth and use of the reverse circulation, air rotary drilling method to clear the 19-inch diameter borehole was abandoned.

A decision was made on October 10, 1995, to attempt to clear the lower 58 feet, from 470 to 528 feet in depth, of the 19-inch diameter borehole using an air-lifting operation with 5.5-inch diameter steel pipe installed in the borehole.

Well Construction

Final location of the well screens will be determined based on the success of the attempt to clear the sediment out of the 19-inch borehole to total depth.

Well Development

Following installation of the well screen and casing, initial well development will be conducted using air-lifting method. Final well development will be conducted using the overpumping method.

Operation and Maintenance Costs

In addition to the capital construction costs outlined above, long-term operation of a water system will require certain operation and maintenance costs shown below.

Summary

Item	Cost/year
Salaries/benefits	$49,333
Supplies	5,000
Vehicle Expense	1,000
Fuel	1,600
Maintenance/repairs	8,000
Utilities	8,000
Water Samples	4,000
Equipment Expense	2,500
Metering System Expense	1,000
Tank Inspection/Repair	2,000
Debt Service - Principal	34,000

Debt Service - Interest 3,800

TOTAL O & M Cost $120,233/yr

Project Financing

Estimated Construction Cost

1. New Production Well No. 9 ..... $375,199

2. Storage Modifications
Rehabilitating Existing Tanks ..... $ 80,000
New Tank/Site $240,475
Other Modifications $20,000
Contingency/Engineer $90,225
Sub-Total $430,701

3. Transmission Lines $928,602

4. Distribution $364,354

TOTAL Estimated Construction Cost $2,098,856

Project Eligible for 50/50 Funding

Tank Rehabilitation = $80,000 + 21,200 = $101,200
25 years @ 4%
P = (50,600) n = 25 years
Payment = (50,600) (0.0640)
Payment = $3,238/year

Project Construction Eligible for 67/33 Funding

1) Production Well No. 9
Construction Cost = $375,199
Loan Amount = 33% x 375,199
= $123,816
Payment = 123,816 (0.0640)
= $7,924/year

2) Storage
Construction = $329,500

Loan Amount = 33% x 329,500
= 108,735
Payment = 108,735 x 0.0640
= $6,959/year

3) Transmission
Construction = $928,602
Loan Amount = 33% x 928,602
= $306,438
Payment = 306,438 x 0.0640
= $19,612/year

CONSTRUCTION FUNDED BY OTHERS (50/50 FUNDING)

Distribution System = $364,354
Loan Amount = $364,354 x 50%
= $182,177
25 years @ 10%
Payment = $182,177 x 0.1102
=$20,076/year
$1,673/month

TOTAL PAYMENT PER YEAR TO WWDC

TOTAL = $3,238 + 7,924 + 6,959 + 19,612
= $37,733/year

INCREASE PER TAP FOR NEW CONSTRUCTION

Total Number of Taps = 815
Total Increase = $37,733 + $1,673
Per Tap Increase = $\frac{\$39,406}{815}$
= $48.35/year
$4.02/month