*** EXECUTIVE SUMMARY ***

CONSTRUCTION AND TESTING OF CRWD-1 WELL AND CONCEPTUAL DESIGN AND COST ESTIMATION FOR
COOK ROAD WATER SUPPLY PROJECT LEVEL II

Prepared For:
WYOMING WATER DEVELOPMENT COMMISSION
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In Conjunction With:
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EXECUTIVE SUMMARY

COOK ROAD WATER SUPPLY PROJECT

INTRODUCTION

The Cook Road Water District (CRWD) is located approximately six miles west of the City of Gillette. The District was formed in September 1990 to encompass roughly 220 acres. Presently, residents within the District haul water to cisterns or rely on shallow wells of poor quality. In 1991, the Wyoming Water Development Commission (WWDC) authorized a Level I study to determine the feasibility of developing a supply source and installing a transmission and distribution system for the Cook Road Water District. This study was completed in 1992 by HKM Associates as part of the Gillette Area Master Plan Study. Due to the location of the District and distance from the City of Gillette or other potential supply systems, it was concluded the District should pursue a supply source and system independent of any regionalization efforts.

Following completion of a Level I feasibility study in 1992, the 1993 Wyoming Legislature authorized the Wyoming Water Development Commission (WWDC) to conduct a Level II study for the Cook Road Water District. The study was to include construction of an exploratory well and development of conceptual designs for storage, treatment, transmission, and distribution systems to service the water needs of the District.

Soda Butte Services, Inc., in conjunction with Wester-Wetstein & Associates, Inc., was selected by the WWDC to provide geological and engineering services for the Level II, Cook Road Water Supply Project. Work began in May 1993 with the development of well designs and preparation of specifications for bidding of well construction.

During the course of the project, CRWD pursued participation in the project from surrounding residents and nearby subdivisions. As a result of their efforts, an additional 12 landowners from adjacent properties and from the Redrocks Estates subdivision annexed into the District. This increased the number of initial water users to 28 with the potential for expansion of service within these areas to a total of 78 users.

This summary report was prepared to provide a brief overview of the construction and aquifer testing of the exploratory well, conceptual design of the system, and cost estimates for the construction and operation of the supply system.
PHASE I - WELL SITING AND CONSTRUCTION

Well Construction

The Cook Road Water Supply Project began with the preparation of well designs and construction specifications. Public bidding was then conducted for drilling, construction, development, and testing of an exploratory well to be completed to 2,200 feet in the Fort Union Formation. The well was designed to incorporate proven construction and development techniques from other Fort Union Wells in this region. In addition, forthcoming guidelines being prepared by the State Engineer’s office for Fort Union wells in this area were considered.

Construction of the well consisted of installing a 1,200-foot pump chamber to allow for the large drawdown expected. An 8½-inch diameter casing was selected for the pump chamber to accommodate installation of larger diameter pumps and meet the proposed State Engineer’s guidelines. The lower portion of the well was designed with a 4½-inch diameter liner of well casing and stainless steel screen. Table 1 shows a summary of the pertinent well information and construction materials used by the contractor in completion of the CRWD-1 well. Figure 1 shows a schematic of the formation lithology, geophysical logs, and "as-built" construction details of the well.

Well Development

Development of the CRWD-1 well included hydraulic jetting, surging, bailing, and air-lifting procedures. These procedures serve to break down the drilling fluids, bring them into the well through the screens, and out of the casing. The development also brings in the fine-grained materials contained in the water bearing zones so that water can flow readily from the aquifer through the screens. Throughout the nine days of development operations, waters discharged from the well contained visibly noticeable amounts of drilling polymer. The presence of excessive drilling polymer was felt to be a primary contributing factor to the extensive development required on the CRWD-1 well.

Aquifer Testing and Analysis

A step-drawdown test was performed to determine well performance characteristics, while aquifer characteristics were determined using constant-rate pumping and recovery tests. Well performance testing determined that the well efficiency was high, nearly 100% efficient. Aquifer testing determined that the water producing sand layers of the Fort Union Formation make up a confined aquifer system (the static water level is well above the initial screened interval) with near-term effective well transmissivity of approximately 900 gallons per day per foot of drawdown (gpd/ft). Long-term, effective transmissivity (based upon the recovery data) increases to approximately 1,600 gpd/ft.
TABLE 1
WELL SUMMARY

COOK ROAD WATER DISTRICT CRWD-1 WELL

Owner: Wyoming Water Development Commission

State Engineer Permit Number: UW 91880

Location: NE 1/4, SW 1/4, Section 28, T50N, R73W

Surface Elevation: 4941.6 feet (MSL)

Total Depth Drilled: 2,232 feet

Formations: 0 - 950 feet Wasatch Formation; 950 - 2,232 feet Fort Union Formation

Hole Diameter:

- 0 - 120 feet = 14 3/4-inch
- 120 - 1,195 feet = 11 3/4-inch
- 1,195 - 2,232 feet = 7 7/8-inch

Casing/Screen:

- 0 - 107.6 feet = 12 3/4-inch O.D., 0.25 inch wall thickness, steel pipe;
- 0 - 1,181 feet = 8 5/8-inch O.D., API K-55, 28 lb/ft threaded steel casing;
- 1,135 - 2,205 feet = 4 1/2-inch O.D., API J-55, 10 lb/ft threaded steel liner with 4 inch pipe size V-slot, continuous wire-wound, triple-extra-strong 15 slot stainless steel screen.

Drilling and Completion Dates: 8/17/93 - 10/5/93

Testing Dates: 10/7/93 - 10/14/93

Engineering and Geology: Soda Butte Services, Inc., Upton, Wyoming

Well Design: Larry Wester, Tim Barritt
Well Construction Inspection: Steve Hampton, John Wetstein, Larry Wester, Tim Barritt
Testing Supervision: John Wetstein, Steve Hampton

Drilling Contractor: Williams Drilling, Inc., Gillette, Wyoming
Drilling Rig: Midway 2500 with Gardner Denver 5 1/2 x 8 FXX-172 mud pump
Cementing Contractor: Sun Cementing of Wyoming, Gillette, Wyoming
Geophysical Logging Contractor: Goodwell, Inc., Upton, Wyoming
FORMATION / LITHOLOGY / WELL LOG

CONSTRUCTION DETAILS

SURFACE CASING, 12 3/4-INCH O.D., ASTM A65, GRADE B, WELDED STEEL CASING SET TO A DEPTH OF 102 FEET

14 3/4-INCH DIAMETER BOREHOLE

11-INCH DIAMETER BOREHOLE

6 5/8-INCH O.D., API K-45, 28 LBF/FT THREADED STEEL CASING SET TO A DEPTH OF 1100 FEET

NEAT CEMENT GROUT: TYPE G - 1180 TO 440 FEET; LIGHT CEMENT - 440 TO 154 FEET; AND 8 BACK MIX TREATED IN FROM SURFACE TO 154 FEET.

BAKER-HUGHES UNDERHANGER/PACER ASSEMBLY SET AT A DEPTH OF 1135 FEET

7 7/8-INCH DIAMETER BOREHOLE

SHALE BASKET SET BELOW SCREENED SECTION IN AN EFFORT TO DECREASE METHANE GAS MIGRATION FROM COAL SEAM BELOW

SHALE BASKET AND CENTRALIZER PLACED ABOVE EACH SCREEN SECTION

CENTRALIZER PLACED BELOW EACH SCREEN SECTION

4 1/2-INCH O.D., API J-95, 10 LBF/FT, THREADED STEEL LINER

6-INCH PIPE SIZE, Y-SLOT, CONTINUOUS WIRE-WOUND, TRIPLE EXTRA STRONG, 15 SLOT STAINLESS STEEL SCREEN MANUFACTURED BY JOHNSON WELL SCREENS; SCREENS PLACED AT:

- 1503 FEET TO 1524 FEET,
- 1544 FEET TO 1563 FEET,
- 1743 FEET TO 1767 FEET,
- 1874 FEET TO 1894 FEET,
- 2004 FEET TO 2024 FEET,
- 2087 FEET TO 2092 FEET,
- 2165 FEET TO 2195 FEET, AND
- 2175 FEET TO 2195 FEET

THREADED STEEL CAP AT A DEPTH OF 2205 FEET

WELL TO - 2225 FEET

EXPLANATION

COAL

MUDSTONE AND SMALL SAND LENSES

SANDS/SANDSTONE

SHALE/CLAYSTONE

Soda Butte Services, Inc.
Wester Metzstein & Associates, Inc.
CONTRACTORS IN ENGINEERING AND HYDROLOGY

FIGURE 1

COOK ROAD CRWD-1
AS-BUILT DIAGRAM
To evaluate the potential long-term production capability of the CRWD-1 well, a safe yield analysis was completed. Safe yield is a groundwater resource evaluation concept originally employed to designate the withdrawal rate from an aquifer without depleting the supply over a 20-year period. These evaluations involved estimating the hydraulic response of the aquifer using methods developed by Theis, 1935. The results of the safe yield analysis indicated the CRWD-1 well was capable of sustaining continuous production at rates in excess of 85 gallons per minute (gpm). This rate is approximately equal to the design peak-day demand for the capacity of the well assuming 54 users.

Well Interference

The vertical distance separating the screened sand intervals in the CRWD-1 well from the producing zones of other water wells in the area should effectively seal the lower sands and preclude any upward leakance of groundwater. This separation approaches 300 feet between the CRWD-1 and the next deepest well in the area - the Cross Subdivision well (completed in the very upper Fort Union/lower Wasatch sands). The interval between the producing sands in CRWD-1 and the Cross Subdivision well consists predominantly of shales and clay. These shales and clays should effectively seal the producing sands and preclude any future impacts on existing wells by groundwater development from the Cook Road well.

Water Quality

Quality analyses of the water developed from the CRWD-1 well is within EPA primary and secondary drinking water standards with the following exceptions: radium exceeds the current standards very slightly, but is well within the proposed standards; total dissolved solids is slightly over the standard; iron exceeds the standard by nearly 300 percent; color and turbidity both exceed standards (the midterm sample also exceeded the MCL for sodium). These other parameters are associated with the taste and aesthetic qualities of the water and will pose no health problems, except sodium which may cause some health problems in association with heart diseases.

Several treatment methods can be used to remove radium from the groundwater. However, prior to initiating any design costs for radium removal, the District should first obtain another water sample and have it analyzed for radium and radon. If the levels of contaminants in this sample exceed the current EPA standards, then a representative of the EPA should be contacted to ascertain when and if the proposed radionuclides standards will be promulgated. It can then be determined if the District will need to design the treatment facility for removal of radium prior to the implementation of the proposed new regulations.

During the pump tests, a consistent supply of gas (most likely methane gas produced from the coal seams present in the Fort Union Formation) was produced. Initially, the quantity of gas was sufficient to gas-lock the pump impellers during start-up and testing of the pump. Dissipation of this gas will need to be addressed in the final design of the Cook Road water system.
PHASE II - CONCEPTUAL DESIGN AND COST ESTIMATES

Conceptual Design

The water system for Cook Road Water District will consist of four basic components. These are: the water source (the well); water treatment (chlorination facility); storage (tanks); and the transmission pipelines. The sizing of the latter three is dependent on the water demand. At the time of the Level I study, 16 of the 24 lots within the District were to be served by the system. With the addition of the Redrocks Estates area, there will initially be 28 taps and it is possible that the water system may ultimately service 90 or more taps. Due to the growing interest in the project and the real potential for increasing the number of taps in the near future, the conceptual design and cost estimates are based on providing service to 54 taps in both the Cook Road and Redrocks areas. This assumption corresponds with the projected capacity of the CRWD-1 well in meeting the maximum daily demand of 550 gpd per capita.

Based on the water quality analyses for the CRWD-1 well, required treatment for the system would include aeration of gases and chlorination. Production water from the well will be pumped to a well house, metered, and transferred to an initial gas treatment tank. Upon entering the gas treatment tank, the water will pass through a cascading aerator to drive the gases from the well water. Water will then be transferred to the first of two 120,000 gallon tanks which will be used to meet DEQ requirements for storage of finished water. Chlorine treatment will take place after the water is aerated.

Transmission within the original Cook Road Water District will require installation of approximately 11,770 feet of 6-inch diameter polyvinyl chloride (PVC) pipe. With the addition of users located in the Redrocks Estates subdivision to the east of Cook Road, roughly 13,400 feet of 8-inch PVC transmission line will be required to convey water to this area. Within the Redrocks subdivision, transmission will require approximately 16,000 feet of 6-inch PVC pipeline. Figure 2 shows the location of the transmission lines for conveying water to and within the Cook Road and Redrocks area.

Cost Estimates

Cost estimates for construction and installation of the storage, treatment, transmission, and distribution systems were developed based on current projections from contractors and actual expenditures for similar systems recently completed around the State. Engineering cost and construction contingencies were developed in accordance with standard percentages currently used in WWDC budget projections. Table 2 and 3 present the details for construction estimates for the storage, treatment, and transmission system and the distribution system, respectively.
FINAL LEVEL III COST ESTIMATES

Preparation of Final Designs and Specifications $68,666.00
Permitting and Mitigation $7,250.00
Legal Fees $2,500.00
Acquisition of Access and Rights-of-Way $7,500.00

Cost of Project Components $858,325.25
(See Table 2 for Details)

Engineering Costs (CCS #1 x 10%) $85,832.53
Subtotal #2 $944,157.78
Contingency (CCS #2 x 15%) $141,623.67

Construction Cost Total $1,085,781.45

Project Cost Total $1,171,697.25

TABLE 2
CONSTRUCTION COST ESTIMATE
FOR
CRWD-1 WELL APPURTENANCES, STORAGE,
TREATMENT AND TRANSMISSION

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilization/Demobilization</td>
<td>Lump Sum</td>
<td>L.S.</td>
<td>$18,500.00</td>
</tr>
<tr>
<td>Furnish &amp; Install 8-inch PVC Pipeline</td>
<td>13,400</td>
<td>L.F.</td>
<td>$14.00</td>
</tr>
<tr>
<td>Furnish &amp; Install 6-inch PVC Pipeline</td>
<td>27,769</td>
<td>L.F.</td>
<td>$12.00</td>
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<tr>
<td>Gate Valves: 8-inch</td>
<td>5</td>
<td>Each</td>
<td>$750.00</td>
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<tr>
<td>Gate Valves: 6-inch</td>
<td>7</td>
<td>Each</td>
<td>$550.00</td>
</tr>
<tr>
<td>Hydrants</td>
<td>8</td>
<td>Each</td>
<td>$2,500.00</td>
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<tr>
<td>Blow Off Hydrants</td>
<td>3</td>
<td>Each</td>
<td>$1,450.00</td>
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<tr>
<td>Air Vacuum Relief Valves</td>
<td>3</td>
<td>Each</td>
<td>$4,500.00</td>
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<tr>
<td>Tanks</td>
<td>275,000</td>
<td>Per Gallon</td>
<td>$0.68</td>
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<tr>
<td>Controls, Treatment &amp; Building</td>
<td>Lump Sum</td>
<td></td>
<td>$38,800.00</td>
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<tr>
<td>Pump, Motor, &amp; Controls</td>
<td>Lump Sum</td>
<td></td>
<td>$29,000.00</td>
</tr>
<tr>
<td>Bedding Materials</td>
<td>20,585</td>
<td></td>
<td>$0.85</td>
</tr>
<tr>
<td>Record Drawings</td>
<td>Lump Sum</td>
<td></td>
<td>$1,250.00</td>
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</table>

Subtotal Construction Cost Estimate $858,325.25
TABLE 3
CONSTRUCTION COST ESTIMATE
FOR
DISTRIBUTION SYSTEM

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services with Meters</td>
<td>54</td>
<td>Each</td>
<td>$1,100.00</td>
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<tr>
<td>Design and Engineering Costs @ 20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contingency @ 15%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Distribution Cost Estimate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Operation and Maintenance Costs

Cost estimates for long-term operation by a qualified system operator, sampling and analyses, and contributions to a sinking fund for replacement of capital components were developed as part of the monthly user cost evaluations. A breakdown of the cost components which were used to derive the monthly operation and maintenance costs are contained in Table 4.

TABLE 4
OPERATION AND MAINTENANCE
COST ESTIMATES
COOK ROAD WATER DISTRICT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Cost/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Expense:</td>
<td></td>
</tr>
<tr>
<td>Legal *</td>
<td>$ 300.00</td>
</tr>
<tr>
<td>Billing *</td>
<td>$1,200.00</td>
</tr>
<tr>
<td>System Operator *</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>Electrical Power *</td>
<td>$5,500.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>Sinking Fund - Equipment Rebuild/Replacement</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Total Operation &amp; Maintenance Cost</td>
<td>$11,000.00</td>
</tr>
</tbody>
</table>

* Based on the assumption of 28 users. Some items would be increased with increased numbers of users.

Monthly Costs and Financing

Cook Road Water District will rely on grants, loans, and user fees to generate the necessary income for construction, operation, and maintenance of the water system. At the present time, the CRWD has no substantial cash reserves. The WWDC has made a preliminary recommendation for funding of the CRWD supply well, storage, treatment and transmission systems in the amount of $1,100,000. Funding will be in the form of a grant
for 67% and a loan for the remaining 33%. In addition, the District will be provided a grant for 67% of the cost for construction of the exploratory well and loan for the remaining 33% or roughly $34,000.

Other financing options for funding the cost of constructing the distribution system include the Wyoming Farm Loan Board (FLB), Farmers Home Administration (FmHA), and the Campbell County Grant Assistance Program. The CRWD is presently applying for grant assistance through the Campbell County District Support Grant Program. The final amount of assistance to be received through this program was not available at the time of this report. As such, evaluations of varying scenarios were completed to project the monthly user costs.

**Monthly User Fees**

Based on the amount of interest shown by other land owners in Redrocks Estates and other areas in the vicinity of Cook Road, the number of potential water users CRWD is likely to service should increase dramatically in the near future. This factor served as the basis for requesting a deferment of loan payments to the WWDC. Consideration of this factor was also included in evaluating the monthly user costs. Two scenarios were evaluated using the base number of 28 users and projecting the expansion of service to 54 users.

Tables 5 and 6 below detail the projected monthly cost for debt retirement, operation, and maintenance of the system for the varying numbers of users.

| TABLE 5 |
|---|---|---|
| **ESTIMATE OF MONTHLY USER COST** |
| **WWDC FUNDING ONLY** |

<table>
<thead>
<tr>
<th>ITEM</th>
<th>28 Users</th>
<th>54 Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt Retirement - WWDC - 33% ($1,100,000 @ 4%, 35 Years)</td>
<td>$57.88</td>
<td>$30.01</td>
</tr>
<tr>
<td>Well Construction - WWDC - 33%</td>
<td>$5.40</td>
<td>$2.80</td>
</tr>
<tr>
<td>Distribution System and Additional Transmission: Loan @ 7%, 30 Years</td>
<td>$36.43</td>
<td>$18.89</td>
</tr>
<tr>
<td>O&amp;M Cost</td>
<td>$32.74</td>
<td>$26.49</td>
</tr>
<tr>
<td><strong>Total Monthly Cost</strong></td>
<td><strong>$132.45</strong></td>
<td><strong>$78.19</strong></td>
</tr>
</tbody>
</table>
TABLE 6
ESTIMATE OF MONTHLY USER COST
INCLUDES $100,000 GRANT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>28 Users</th>
<th>54 Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt Retirement - WWDC - 33% ($1,100,000 @ 4%, 35 Years)</td>
<td>$57.88</td>
<td>$30.01</td>
</tr>
<tr>
<td>Well Construction - WWDC - 33%</td>
<td>$5.40</td>
<td>$2.80</td>
</tr>
<tr>
<td>Distribution System and Additional Transmission: Loan @ 7%, 30 Years</td>
<td>$12.44</td>
<td>$6.45</td>
</tr>
<tr>
<td>O&amp;M Cost</td>
<td>$32.74</td>
<td>$26.49</td>
</tr>
<tr>
<td>Total Monthly Cost</td>
<td>$108.46</td>
<td>$65.75</td>
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Depending on the degree of grant assistance received, the initial monthly cost for users in the CRWD has the potential for being among the highest in the State. However, with the real potential for increased numbers of users, the monthly user cost will likely decline to a level which would be considered mid-range in comparison with similar systems throughout the State.

Conclusions and Recommendations

Completion and testing of the CRWD-1 well has provided the WWDC and the CRWD with a proven water supply suitable for meeting the District's water needs. The inclusion of users within Redrocks Estates into the Cook Road Water District should provide the basis for development of a long-term, viable service district to meet the water needs of these two rural areas. Despite the high monthly cost for service initially projected, the real potential for increasing the numbers of users in both the Cook Road and Redrocks Estates areas will ultimately decrease the monthly costs to a more palatable level.