ELK MOUNTAIN
WATER SUPPLY PROJECT

EXECUTIVE SUMMARY

DECEMBER, 1995

SUBMITTED TO

WYOMING WATER DEVELOPMENT COMMISSION

AND

TOWN OF ELK MOUNTAIN

WESTON
GROUNDWATER • ENGINEERING
Weston Engineering, Inc.

P.O. Box 260
Upton, Wyoming 82730
(307) 468-2427

P.O. Box 6037
Laramie, Wyoming 82070
(307) 745-6118

Project Engineers: Jerry Hunt, P.E., Richard Allen, P.E.
Project Geologists: Todd Jarvis, P.G., Kathleen Murphy, Robert Starkey, Ph.D.

Drilling Contractor: Farnsworth Drilling Company, Inc., Newcastle, Wyoming
Open-Hole Geophysical Logging Contractor: Western Atlas, Mills, Wyoming
Cased-Hole Geophysical Logging Contractor: K&D Perforators, Upton, Wyoming

Water System Engineering: PMPC, Saratoga, Wyoming
Land Easements and Surveying: Coffey and Associates, Laramie, Wyoming
EXECUTIVE SUMMARY

ELK MOUNTAIN WATER SUPPLY PROJECT
LEVEL II

INTRODUCTION

The purpose of the Elk Mountain Water Supply Project was to provide the Town of Elk Mountain with a reliable source of drinking water. The Level I study completed in 1994 determined that access difficulties, aging infrastructure, and the continued threat of pipeline breakage by local landslides threatened the Town's water supply needs. In light of the problems identified in the existing system, the Town of Elk Mountain and the Wyoming Water Development Commission elected to proceed with the construction of an exploration well located close to the Town.

This Level II project was implemented to complete a groundwater exploration and development program. The project included conceptual design and cost estimates for completing the exploration well, if successful, and connecting it to the existing storage facilities, as well as determination of any necessary additional water treatment.

The exploration well was sited adjacent to the existing storage tanks and taps the Cloverly Group aquifer at a depth of approximately 2,800 to 2,900 feet. The well, designated Elk Mountain Well No. 3, flows 48 gallons per minute (gpm) and has a shut-in pressure of 53 pounds per square inch (psig). Aquifer tests indicated a sustainable flow rate of approximately 30 gpm and a sustainable pumping rate of more than 127 gpm with a pump set at 600 feet below the ground surface.

PROJECT AREA

The Town of Elk Mountain is located in Carbon County in southeastern Wyoming (Figure E-1). The Town is a rural, residential community situated along the Medicine Bow River at an elevation of 7,268 feet. It is located three miles south of the Interstate-80 corridor, approximately 55 miles west of Laramie, and 41 miles east of Rawlins. Elk Mountain and the Snowy Range serve as major topographic landmarks to the west and southeast, respectively.

The major employers in the area are the mining industry, the Carbon County School District, the Wyoming Department of Transportation, and agriculture. Local retail businesses also employ several people.

PRESENT AND FUTURE WATER NEEDS

Population

The 1990 census reported 186 residents in the town. Broad swings in the Town's population have occurred over the past 80 years. Recent fluctuations have reflected changes in the number of people employed in coal and uranium mining, with a peak population of over 300 people reported in the 1980 census.

Population projections for the next 25 years were made as part of the Level I study. Ignoring any fluctuations caused by changing commodities prices and assuming a steady growth rate of 2% based on a gradually improving and increasingly diversified economy, the Level I study projected a population of 305 residents for the year 2019.

Water Demand

Water demand predictions were made assuming average daily and peak-day demands of 200 gallons per capita per day (gpcd) and 600 gpcd, respectively. Average daily demand was based on a conservative interpretation of historical water meter records; peak-day demand was assumed to be 300% of average daily demand. To meet these demands and comply with Wyoming Department of Environmental Quality water system design rules and regulations, a source
capacity of 127 gallons per minute (gpm) and a storage capacity of 183,000 gallons will be required to meet the needs of the predicted population of 305 residents in 2019. The peak-day demand scenario represents the worst case relative to water demand. The existing water storage facility capacity, with a total volume of 200,000 gallons, exceeds the maximum storage capacity anticipated to be necessary over the next 25 years.

EXISTING WATER SUPPLY SYSTEM

The Town of Elk Mountain owns and operates the municipal water supply system, which includes two wells, pipelines from both wells to the two water storage tanks, an aeration tower and chlorination system for water treatment, and the water distribution system (see Figure E-2). The municipal water system serves approximately 85 taps, consisting of residences, businesses, and government facilities within the platted area of the town, the Wyoming Department of Transportation facility, and a few residences located outside the platted area.

The two water storage tanks serving the Town of Elk Mountain are located east of the town. Each tank has a capacity of approximately 100,000 gallons. Elk Mountain Well No. 1, an artesian well, is located within 2,000 feet of the storage tanks. Elk Mountain Well No. 2 is located approximately three miles to the south (see Figure E-2). Water is transported to the storage tanks through buried pipelines. The water distribution grid that connects the storage tanks to the taps was replaced in 1992 with financial assistance from the Farm Loan Board. The exploration well drilled during this Level II project is located approximately 100 feet from the storage tanks (see Figure E-2); this well has not yet been completed with pumping equipment or connected to the storage tanks.

The Level I study identified several problems with the existing Elk Mountain water supply system. Well No. 1, an artesian well with a yield of approximately 20 gpm, was originally completed for oil exploration in 1965. The operator transferred ownership of the well to the Town, because the well produced a subeconomic amount of oil. In converting the well to a water well, the Town placed a bridge plug below the water-bearing sandstone of the Cloverly Group in order to isolate the drinking water source from the deeper oil bearing units. Oil and Grease recently detected in the well water may be due to leakage of crude oil from the deeper units through either the bridge plug or perforations in the well casing caused by corrosion. Well No. 1 occasionally stops flowing due to apparent natural gas intrusion into the well; the formation pressures have also reportedly diminished with time. The 4.5-inch diameter casing installed in the well precludes use of a high capacity pump to serve as a backup during times of low flow or supplement the flow from the well. In addition, the surface cement seal in the well is of suspect integrity, leading to concerns regarding wellhead protection. Because of the unreliable artesian flow, the Oil and Grease content of the water, the small casing size, and questionable surface seal, the usefulness of Well No. 1 in supplementing the Town's water supply is limited.

Well No. 2 serves as the primary water supply for the Town and is pumped at a rate of approximately 150 gpm. Well No. 2 is located on private land and is accessed by crossing hay meadows that are impassable during much of the year due to flood irrigation or snow cover. Although the Town has documentation regarding access to Well No. 2, no recorded easements permitting access to either Well No. 2 or the associated pipeline are on file with the Carbon County Clerk's office. Part of the pipeline between Well No. 2 and the storage tanks is located with an active landslide area. A landslide in 1994 ruptured the pipeline, interrupting use of the well for one day. The telemetry system used to control Well No. 2 remotely is unreliable; as a result the pipeline cannot be kept full of water.

The Town installed water meters when the water distribution system was replaced in 1992. The Town has not imposed watering limitations or other water use restrictions, and meter records indicate that local water use is far below the state average. The distribution system improvements caused water bills to be raised to a level above the state average and depleted the Town's water system improvements fund.
NEW WELL SITING

Based on a review of local hydrogeology and aquifer test data obtained during the Level I study, the Dakota and Lakota Sandstones of the Cloverly Group were selected as the target formation of the new water supply well. The well site was selected based on its proximity to the storage tanks and a relatively high degree of certainty of the depth to the target formation, production rate, and water quality. Because the well site was located on private land, an access agreement and permanent easement were obtained prior to beginning work at the site.

GROUNDWATER DEVELOPMENT PROGRAM

Well Design and Construction

The well was designed as a deep, small diameter well with well screens placed across the Dakota and Lakota Sandstones of the Cloverly Group. This design was chosen specifically for the drilling site and the target aquifer. The as-built diagram shows the details of the well construction (see Figure E-3).

Surface casing was installed to a depth of 126 feet and cemented in place. A 9 7/8-inch borehole was advanced from the bottom of the surface casing to a total depth of 2,974 feet. Observation of the cuttings and drilling characteristics indicated the Dakota and Lakota Sandstones of the Cloverly Group were encountered at approximately 2,780 to 2,890 feet. Geophysical logs verified the identification of the target sandstones and assisted in determination of screen placement.

Seven-inch diameter, pipe-based well screen was placed at 2,790 to 2,800 feet and 2,810 to 2,890 feet, the specific intervals identified as the Dakota Sandstone and Lakota Sandstone, respectively. The rest of the well was cased with blank 7-inch casing. A directional vent (DV) cementing collar, included in the string of casing at 2,701 to 2,703 feet, allowed cement to be displaced from the casing into the annular space to form a seal between the borehole walls and the well casing. The gamma ray, cement bond, and casing collar logs run after the well was completed verified that the well screens and cement had been placed properly. After allowing the cement seal to cure, a well development program consisting of three days of jetting and air lift development was initiated. The well began to flow immediately after the drilling mud was displaced from the hole.

Well and Aquifer Testing

A series of flow tests and pumping tests was conducted at Well No. 3 following well development. Well No. 1, located 1,347 feet to the east, was used as an observation well during the 140 gallon per minute (gpm) long-term constant-discharge pumping test.

Based on the flow test data, Well No. 3 has a sustainable flow rate sufficient to meet current average daily water demand, calculated to be less than 30 gpm at the present time. Safe yield calculations indicate that when pumped, the well can safely meet the maximum daily demand of 127 gpm predicted for the year 2019.

Water Quality

During the constant-discharge pumping test water samples were collected from Well No. 3 and submitted to laboratories for a series of chemical and microbiologic analyses. With the exception of Oil and Grease, all analytes were either undetected or occurred at levels below U.S. Environmental Protection Agency and Wyoming DEQ drinking water standards (see Table E-1). Total dissolved solids in the water developed by Well No. 3 are reported to be 158 to 204 milligrams per liter (mg/L).

Because the laboratory neglected to analyze the original sample for turbidity, a water sample was collected from the flowing well on December 4, 1995 and submitted to the laboratory for analysis of turbidity. The laboratory test results indicated a turbidity of 9.0 NTU, which exceeds
FLOWS 48 GPM

AS-BUILT
CONSTRUCTION DETAILS

SESSION IN
PRESSURE = 52 PSI

8-INCH GATE VALVE

126 FEET OF STEEL SURFACE CASING CEMENTED IN PLACE

9 7/8-INCH DIAMETER HOLE

7-INCH DIAMETER CASING

CENTRALIZERS

"LIGHT" CEMENT

TYPE G CEMENT

WEATHERFORD "DV" VALVE

7-INCH DIAMETER PIPE SIZE WIRE WRAP V-SLOT STAINLESS STEEL WELL SCREENS

WELDED STEEL CAP

T.D. = 2974 FEET NOT TO SCALE

CEMENT BASKETS PLACED AT:
2716
2731
2760
2775

SHALE BASKET PLACED AT:
2810

WELL SCREENS PLACED FROM:
2790 - 2800
2810 - 2890

*REFERENCE LEVEL IS TOP OF DRILL RIG KELLY BUSHING (11 FEET ABOVE GROUND LEVEL)

WELL SCREENS PLACED FROM:
2790 - 2800
2810 - 2890

ELK MOUNTAIN
WATER SUPPLY PROJECT
WELL NO. 3 AS-BUILT DIAGRAM
FIGURE E-3
TABLE E-1
WATER SAMPLES COMPARISON WITH EPA DRINKING WATER STANDARDS
ELK MOUNTAIN WELL NO. 3

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>EPA MAXIMUM CONTA MINANT LEVEL (MCL)</th>
<th>MIDWAY SAMPLE 10/24/95</th>
<th>FINAL SAMPLE 10/26/95</th>
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<tr>
<td>Primary EPA Parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asbestos</td>
<td>7 MFL*</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Regulated Organic Chemicals</td>
<td>Various</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Microbiological (detected species listed)</td>
<td>Various</td>
<td>ND</td>
<td>legionella</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.006</td>
<td>NA</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.50</td>
<td>NA</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Barium</td>
<td>1</td>
<td>NA</td>
<td>&lt;0.10</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.004</td>
<td>NA</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.005</td>
<td>NA</td>
<td>&lt;0.0005</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.10</td>
<td>NA</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Cyanide</td>
<td>0.20</td>
<td>NA</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Fluoride</td>
<td>4</td>
<td>NA</td>
<td>0.73</td>
</tr>
<tr>
<td>Lead</td>
<td>0.05</td>
<td>NA</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.002</td>
<td>NA</td>
<td>&lt;0.0005</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.1</td>
<td>NA</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>Nitrite (as N) + Nitrate (as N)</td>
<td>10</td>
<td>NA</td>
<td>&lt;0.10</td>
</tr>
<tr>
<td>Nitrite (as N)</td>
<td>0.10</td>
<td>NA</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.05</td>
<td>NA</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Thallium</td>
<td>0.002</td>
<td>NA</td>
<td>&lt;0.0004</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>5</td>
<td>NA</td>
<td>9.0</td>
</tr>
<tr>
<td>Uranium</td>
<td>0.02**</td>
<td>ND</td>
<td>&lt;0.003</td>
</tr>
<tr>
<td>Radium 226, pCi/l</td>
<td>3</td>
<td>ND</td>
<td>0.4</td>
</tr>
<tr>
<td>Radium 228, pCi/l</td>
<td>5</td>
<td>ND</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Radon 222, pCi/l</td>
<td>300**</td>
<td>ND</td>
<td>NA</td>
</tr>
<tr>
<td>Gross alpha, pCi/l</td>
<td>15</td>
<td>&lt;1.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Gross beta, pCi/l</td>
<td>50</td>
<td>ND</td>
<td>1.1</td>
</tr>
<tr>
<td>Secondary EPA Parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (standard units)</td>
<td>6.5-8.5</td>
<td>9.1</td>
<td>9.04</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>500</td>
<td>158</td>
<td>204</td>
</tr>
<tr>
<td>Conductivity (micromhos/cm @ 25°C)</td>
<td>NS</td>
<td>315</td>
<td>301</td>
</tr>
<tr>
<td>Color (color units)</td>
<td>15.00</td>
<td>NA</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Corrosivity (saturation index)</td>
<td>non-corrosive</td>
<td>NA</td>
<td>-0.34</td>
</tr>
<tr>
<td>Foaming Agents</td>
<td>0.50</td>
<td>NA</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Odor (threshold odor numbers)</td>
<td>3</td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>Acidity</td>
<td>NS</td>
<td>NA</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>NS</td>
<td>NA</td>
<td>142</td>
</tr>
<tr>
<td>Aluminum</td>
<td>0.05 to 0.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>NS</td>
<td>156</td>
<td>156</td>
</tr>
<tr>
<td>Boron</td>
<td>NS</td>
<td>NA</td>
<td>0.1</td>
</tr>
<tr>
<td>Calcium</td>
<td>NS</td>
<td>0.40</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Carbonate</td>
<td>NS</td>
<td>11.1</td>
<td>9.1</td>
</tr>
<tr>
<td>Chloride</td>
<td>250</td>
<td>2.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Copper</td>
<td>1</td>
<td>NA</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Hardness</td>
<td>NS</td>
<td>NA</td>
<td>6.62</td>
</tr>
<tr>
<td>Iron</td>
<td>0.30</td>
<td>NA</td>
<td>0.09</td>
</tr>
<tr>
<td>Magnesium</td>
<td>NS</td>
<td>&lt;0.10</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05</td>
<td>NA</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Potassium</td>
<td>NS</td>
<td>0.30</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Silica</td>
<td>NS</td>
<td>NA</td>
<td>29</td>
</tr>
<tr>
<td>Sodium</td>
<td>250</td>
<td>66.6</td>
<td>68</td>
</tr>
<tr>
<td>Sulfate</td>
<td>250</td>
<td>6.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Zinc</td>
<td>5</td>
<td>NA</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* MFL = Million fibers per liter longer than 10 microns; ** = Proposed
NS = No Standard; NA = Not Analyzed; ND = Not Detected
the EPA Primary Standard of 5 NTU. This result could be an artifact of either gas bubbles in the sample or of sampling conditions -- the sustained wind speed during sampling approached 60 miles per hour, making the collection of a sample uncontaminated by wind-blown particulates difficult. When the permanent pumping equipment is installed in the well, a water sample should be collected and submitted for an additional turbidity analysis.

Although water samples from Well No. 3 were not analyzed for hydrogen sulfide, the distinctive "rotten egg" odor during the well testing signaled its presence. The existing water treatment system includes an aeration tower, which will serve to strip the hydrogen sulfide detected in the Well No. 3 water prior to storage. The Oil and Grease concentration of 4.1 mg/L detected in the water exceeds the DEQ drinking water standard of "substantially free" of Oil and Grease. Although concentrations of Oil and Grease exceeding 10 mg/L have been reported previously in water from Well No. 1, the source of the Oil and Grease detected in the water sample from Well No. 3 remains problematic; potential sources include

- background contribution from the aquifer or other formations open to the well;
- leakage from oil bearing formations in Well No. 1, as discussed above; and
- introduction of lubricating oil by the test pump and/or pump column used during testing.

Methods recommended for identifying the source are

- gas chromatograph analysis of Well No. 3 water to identify individual components of the Oil and Grease and to determine if these components are naturally occurring;
- Oil and Gas analysis of Well No. 2 water to determine if the Oil and Grease is pervasive, which would indicate that it is naturally occurring throughout the aquifer; and/or
- Oil and Grease analysis of water from the distribution system and of water from Well No. 2, in order to determine the concentration of Oil and Grease in the water currently entering the storage tanks and the concentration in the water delivered to customers.

CONCEPTUAL DESIGN AND COST ESTIMATES

During a Town Council meeting held in October of 1995 Town residents were presented with the well completion options outlined in Table E-2. The Town Council passed a motion to proceed with completion of Well No. 3, and decided to pursue the preferred well completion options and additional recommended system improvements under Level III financing offered by the WWDC.

Preferred Well Completion

Completion of the well with a pitless adapter is recommended in order to minimize above-grade development. The recommended pumping equipment is a 20 hp submersible pump and motor capable of lifting at least 100 gpm from depth of 600 feet in the 7-inch diameter well casing and delivering 450 feet of total dynamic head. Figure E-4 depicts the arrangement of the existing water system, connection details, and selected improvements to the water system. A small concrete vault designed to house the pump control valve and meter will be constructed adjacent to the wellhead. The well will be connected to the storage tanks via a short, 6-inch diameter transmission pipeline to the valving station where Well No. 1 is presently connected. The existing altitude valve with allow flow from the well to the storage tanks depending on tank level. An additional control will be required to trip the pump upon receiving a signal of high water level in the tanks.
<table>
<thead>
<tr>
<th>OPTION</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
<th>ESTIMATED COST</th>
<th>MONTHLY RATE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Well Completion: Completion like Well No. 1. Includes Pump Installation</td>
<td>- Minimal Cost to Water Customers - Flowing Well: Lower Electrical Cost</td>
<td>- Confined Space Vault - Unreliable Telemetry Remains for Well No. 2</td>
<td>296K</td>
<td>$42.98 ($7.12)**</td>
<td>Well No. 2 Operational Difficulties Remain. Vault Poses a Safety Hazard to Operator. Well No. 3 = Primary Water Source.</td>
</tr>
<tr>
<td>Preferred Well Completion and Water Supply Improvements</td>
<td>- Improved Safety and Operability - Flowing Well: Lower Electrical Cost</td>
<td>- Greatest Cost to Water Customers</td>
<td>535K</td>
<td>$48.73 ($12.87)</td>
<td>Does not Address Rerouting of Pipeline around Landslide.</td>
</tr>
</tbody>
</table>

*Assumes 20 Year, 33% Loan at 4% Interest and 67% Grant from WWDC. Estimated Baseline Water Rate = $35.86.

**(Increase in Cost/Service/Month of Individual Option)
The preferred well completion also includes modification of the existing below-ground vault located on the south side of the aeration tower. The vault currently is accessible only through a manhole cover, with a ladder to the vault floor. Installing a control building above the vault and replacing the vault ceiling with metal grating similar to that in the building adjacent to Tank No. 1 will relieve confined space conditions and improve ease of operation and access for the water system operator. Minor controls, meter, valves, and appurtenances for Well No. 3 and the telemetry system for Well Nos. 2 and 3 will be housed in the control building and associated vault. Replacement of the telemetry system is also included as part of this option.

Plug and Abandon of Well No. 1. Well No. 1 is considered to be a potential source of aquifer contamination by virtue of the well integrity assessment completed during the Level I study. Plugging and abandonment of this well is included in both the preferred well completion recommended for this reason. The landowner of the Well No. 1 site currently uses water from the well to supply a stock tank; the Level II project report did not examine the Town's legal obligation, if any, regarding the continued supply of water to this tap. The transmission line between Well No. 1 and the storage tanks will be abandoned in place when Well No. 1 is plugged and abandoned. The most cost effective method of continuing to supply the landowner’s tap with water would be to push a service line through the existing 4-inch line transmission line between Well No. 1 and the storage tanks, minimizing the need for trenching. The cost of this task is included in the cost estimates prepared for the preferred well completion.

Analysis of Existing Infrastructure and Recommended Improvements

Three items are suggested for inclusion in the Level III scope of work:

- Replace undersized transmission piping at tank discharges to improve fire flows;
- Sandblast, paint, and install cathodic protection in storage and stripping tanks to extend the life of the tanks; and
- Install chlorination system at Tank No. 2 inlet to increase the effectiveness of disinfection by providing longer contact time between the chlorine and the water.

In accordance with instructions from the WWDC, these options are treated as eligible for WWDC funding with a 67% : 33% grant/loan. The cost of these improvements alone is summarized in Table E-2.

ECONOMIC ANALYSIS AND ABILITY TO PAY

The baseline economic analysis presented in the Level II study assumes the WWDC and the Town of Elk Mountain will be the only funding agencies. Only WWDC-eligible improvements are considered in the baseline economic analysis. Possible alternate funding sources are considered in calculating the cost of the WWDC-ineligible system improvements. The increased cost per tap per month is calculated for each option.

Summary of Current Utility Rates

The current monthly billing rate for Elk Mountain water customers is $25.70 for the first 4,000 gallons and $1.00 per 1,000 gallons for all usage in excess of 4,000 gallons. Monthly charges for garbage collection ($2.50 per household), landfill use ($7.10 per household), and sewage disposal ($18.55 per household) coupled with the monthly water charge result in a typical monthly service bill of $64.01 per household. Annual water system revenues were adequate in fiscal years 92/93 and 93/94; however, system expenditures exceeded revenue in 94/95 due to increased maintenance and repair work needed to correct deficiencies identified in the Level I study. In order to meet system operating costs in 1995 the water system would have to have
charged $35.86 per tap per month; calculated increases in cost per month per tap use $35.86 as the baseline rate.

**Water Rate Studies**

The cost estimates provided for the selected water system alternative, coupled with all expenses incurred through system operation including water treatment and component replacement are used in this Level II study to determine the monthly cost per tap for water system customers. The monthly payments by water customers would cover existing annual operating costs and service the additional debt incurred during Level III of this project; this debt is assumed to be equal to 33% of the project cost. The calculated cost per tap per month with the selected well completion and system improvement options is $48.73, an increase of $12.87 from current water cost and an increase of $23.03 from current water rates.

**FUTURE CONSTRUCTION PERMITS AND EASEMENTS**

It will not be necessary to obtain any additional access agreements or environmental or archeological clearances to complete the Level III construction. The following permits from the State Engineer’s Office (SEO), State Board of Control, and Department of Environmental Quality (DEQ) will be needed for the completion of the proposed water supply system modifications:

- Permit to Appropriate Groundwater (SEO Form UW-5: Municipal Production Well)
- Statement of Completion and Description of Well (SEO Form UW-6)
- Statement of Appropriation and Beneficial Use of Groundwater (SEO Form UW-8)
- Permit to Construct (DEQ-Water Quality Division)

**CONCLUSIONS AND RECOMMENDATIONS**

Completion of Well No. 3 will provide the Town with a water supply capable of delivering current and projected future peak-daily demands. The estimated safe yield meets the peak-daily demand of 127 gpm needed for the predicted 2019 population of 305 individuals.

Well No. 3 exhibits slightly better hydraulic characteristics in comparison with other wells tapping the Cloverly Group in the Elk Mountain area. These improvements in performance include a slight increase in transmissivity over Well No. 1, and may be attributable to a new water well design over a converted oil well. A screened completion provides greater open area than a perforated completion such as Well No. 1.

As expected from the findings of the Level I study, the water produced from Well No. 3 contains hydrogen sulfide gas; this gas can be removed by the existing water treatment system. Low concentrations of Oil and Grease were detected in the produced water. Whether the reported concentration reflects the background concentration for the analytic method or for natural sources remains problematic. Following installation of permanent pumping equipment the well should be resampled for turbidity. With the exception of these naturally occurring constituents, the well water is of good quality with low concentrations of total dissolved solids and in compliance with EPA drinking water standards.

Ease of operation and system reliability are greatly improved by virtue of the productive capacity and close proximity of Well No. 3 to the storage tanks. Because of the greater flexibility that Well No. 3 affords the Town with respect to greater production and ease of access, it is recommended that Well No. 3 be designated as the primary water source. Well No. 2 should be operated as a backup water source in event Well No. 3 is temporarily out of service or both wells are operating to meet high water demand. Although flow from Well No. 3 can meet current average daily demand,
completion of the well with a submersible pump and motor will allow maximum flexibility in meeting the short-term and long-term demands of the water system. The structural integrity of Well No. 1 remains suspect; it is therefore recommended that this well be plugged and abandoned to protect water quality in the aquifer. During the October, 1995 Elk Mountain Town Council meeting, a motion was passed to pursue the recommended completion of Well No. 3 and to undertake the additional recommended system improvements.

Completion of Well No. 3 and the additional system improvements will add to the operating cost of the water system in the form of increased debt; no increase in operation and maintenance cost is anticipated. Proceeding with the selected alternative, which will improve system reliability and operator safety, is expected to increase water rates by $12.87 per tap per month. This rate increase will result in typical monthly water rates of $48.73 per tap per month.

Completion of Well No. 3 and abandonment of Well No. 1 will affect Mr. R. Bowen, the owner of the property on which Well No. 1 is located. Stock water is currently supplied to the landowner's stock tank from a tap connected to Well No. 1. No other permitted wells are expected to be adversely affected by the abandonment of Well No. 1.