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Executive Summary

Cheyenne Water Supply
Level II Project

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Prepared for:
The Wyoming Water Development Commission
and the Cheyenne Board of Public Utilities

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EXECUTIVE SUMMARY

Introduction
This report presents the results of a feasibility level investigation for the City of Cheyenne, Wyoming. The Cheyenne Board of Public Utilities (BOPU) is the project sponsor, and project funding was provided by the Wyoming Water Development Commission (WWDC). The report was prepared by States West Water Resources Corporation (SWWRC) as prime consultant, with subconsultants CH2M-HILL, RUSTNOT, Wester-Wetstein and Associates, and Intermountain Professional Services, Inc. Work for this project was as outlined in WWDC Request for Proposal No. 95-12, and further described in the project contract dated June 2, 1995, between SWWRC and the WWDC.

The immediate predecessor to the current study, the Level I Cheyenne Water Supply Master Plan, was published in July 1994. The Master Plan was sponsored by the Cheyenne BOPU and funded by the WWDC. The work was performed by the team of Black and Veatch, Wester-Wetstein and Associates, and Western Water Consultants. The study investigated water supply needs, surface water supply and storage, groundwater supplies, water supply alternatives, surface water treatment plants, distribution system evaluations, and monitoring and control systems.

This Level II study has identified recommended alternatives to be implemented to address the study objectives. In brief, these objectives were:

1. **Quantify Demand Management Opportunities and Costs** by reviewing areas where demand management could be implemented, and the associated costs. Specifically, this focuses on irrigation and, to a lesser extent, industrial uses which do not require, but are currently using, treated water. Several methods for supplanting treated water with raw water, groundwater, or wastewater effluent were reviewed to determine which method best suited a particular application. To determine if demand management was viable, costs for implementation were to be compared to the cost of continued use of treated water for those applications.

2. **Identify Infrastructure Improvements at the Round Top Water Treatment Plant (WTP)** needed to allow storage and piping at this location to function properly when the filtration plant is taken off line in the near future. Improvements reviewed included control valving, disinfection systems for groundwater, and facilities to provide radon removal from groundwater which will continue to be routed through the plant.
3. **Evaluate the Need to Relocate Part of the 30-Inch Sherard WTP Supply Pipeline**, which the Level I study had identified as possibly too close to the hydraulic grade line. Under this objective, the hydraulics of the entire 30-inch line were reviewed to assess the ability of this line to deliver water to Sherard relative to the proposed expansion of the plant.

4. **Evaluate the Need for a 12 MGD Pump Station from Round Top to Sherard**, as recommended in the Level I study. The purpose of the pump is to increase raw water delivery to Sherard. Following from the results of the demand management analysis, the need for and sizing of a pump at Round Top were reevaluated. Other alternatives for increasing deliveries to Sherard, including new pipelines or construction of the pump station at another location, such as the WYE, were reviewed and compared to find the best alternative.

5. **Provide Preliminary Design and Layout of a New 42/36-Inch Main** across Cheyenne, following review of the Level I CYBERNET model of the city distribution system and determination of need for the upgrade.

6. **Review the Current SCADA System** and make recommendations for upgrades or replacements as needed, and,

7. **Perform a Pipeline Corrosion Investigation** to identify the condition and expected remaining useful life of, and possible remediation alternatives (if necessary) for, the main transmission pipelines.

Once recommended alternatives are identified, a final task was to estimate the effects of the cost of the improvements on the BOPU's rate structure.

A summary of the recommended course of action for the various objectives follows.

**Demand Management**
Up to 5.13 mgd of water treatment capacity could be freed up by serving existing parks, golf courses, cemeteries, and the Frontier Refinery with raw and/or ground water. Additionally, 1.44 mgd of demand could be averted by using similar methods on the three larger proposed community parks. According to economic analyses, most of the demand management alternatives are feasible if grants are available for 50 percent of the project costs. If such grant funding cannot be found, 100 percent of the costs must be provided for by loans, making only 9 of the 15 service areas listed in Chapter 2 favorably economical. Detailed cost estimates are given in Appendix 2.4 and are summarized in
Table 2.3 in the main report. Figure I shows the City of Cheyenne and the areas evaluated for demand management.

Assuming a 100 percent loan, the most cost effective method of supplanting treated water for irrigation of the Northwest Park Complex is using the existing 16-inch cast iron line from Round Top, delivering raw water by gravity to area lakes, and constructing pump stations to provide irrigation water at the rates and pressures desired.

The East-Central Park Complex appears to be best served with a pump station situated at a deepened Carey Reservoir, with raw water provided either through an extension of the 16-inch line at Lion's Park or via conveyance down Dry Creek. Although the application of Aquifer Storage and Recovery (ASR) technology to this park complex ranks third from a cost standpoint, this area appears to be the best location for a pilot ASR program.

The cemeteries would be best served by extending a low pressure line from the existing 16-inch line (planned for delivering water to Sloans Lake in Lion's Park) to a pump station at the cemeteries, which would be necessary to provide irrigation pressure. Holliday Park appears best served by extending a low pressure pipe from the cemeteries to Lake Minnehaha and installing a pump station for irrigation. This alternative assumes raw water is available at the cemeteries.

The preferred alternative for the Miller School Athletic field is connecting it to pumping equipment at the cemeteries, and therefore assumes water is available at the cemeteries. If the cemeteries are not served, this field must continue to use treated water. The combination of the Veterans Hospital and Okie Blanchard Stadium were evaluated as an add-on to the East-Central Park Complex. It appears economical to add these service areas to the pump station serving the East-Central Park Complex.

The McCormick Jr. High/Central High irrigated areas appear best served by pumping from Dry Creek. For this service area, it is assumed the Riser Well will supplement pumping from Dry Creek. The only viable alternative for serving the Frontier Refinery is pumping from Crow Creek. This alternative is especially attractive when combined with similar service to the Proposed South Cheyenne Community Park, and possibly Martin Luther King Park.

A cost estimate was prepared for providing raw water to Frontier Refinery by pumping from Crow Creek, incremental to the cost of pumping raw water from Crow Creek for Martin Luther King and the proposed South Cheyenne Community Parks. Raw water could be provided to the Frontier Refinery at a cost significantly less than the cost of providing treated water. This industrial use, if served by other than treated water, would reduce peak day treated water demand by 0.68 mgd.
Round Top Reservoir Piping and Well Line Evaluation

Round Top Control Valving
The original scope of work for this task stated that control valving was necessary on pipelines leaving the Round Top Reservoir to prevent overflow of the reservoir from treated water flowing from the King II Reservoir via the 36-inch intertie. Discussion with BOPU staff regarding this issue revealed that potential filling and overflow of the Round Top Reservoir from the King II Reservoir is currently satisfactorily controlled by adjustment of the control valve on the 36-inch intertie. Therefore, additional control valving to mitigate this condition is not necessary. However, control valving on the 16-inch, 24-inch, and 30-inch lines exiting the Round Top Reservoir would be beneficial to remotely control filling and emptying of the reservoir with groundwater from the Bell and Federal well fields.

New 5 MG Round Top Treated Water Reservoir
In the Level I study, a 5 MG Round Top Reservoir was proposed to store groundwater from the Bell and Federal well fields. The most probable location for the new reservoir is on the site of the existing water treatment plant.

The proposed method for piping and valving configuration to support potable water storage and distribution from the new 5 MG reservoir, and nonpotable water storage and distribution from the current Round Top Reservoir, is intended to reuse, to the maximum extent possible, the current piping and valving and reservoir operational strategy. The concept includes: repiping the current lines that empty Basin Nos. 1 and 3, so that they empty the new 5 MG reservoir; repiping the current lines that handle overflows from the east side of the treatment plant, so that they empty Basin Nos. 1 and 3; isolating the 24-inch and 30-inch potable lines from the current Round Top Reservoir; and isolating the current 16-inch line for nonpotable service.

Well Line Disinfection
Once the Round Top filtration plant is taken out of service, incoming groundwater will need to pass through a new disinfection facility. Based on the comparative evaluation given in Chapter 3, sodium hypochlorite disinfection is the preferred disinfection method. Conceptually, a sodium hypochlorite storage and feed building (approximately 25 ft. by 16 ft.) could be located between the two incoming well field pipelines just west of the existing Round Top reservoir. The location likely could be where the existing well house is located. Two buried plastic chemical feed lines would then deliver sodium hypochlorite to chemical diffusion injectors tapped into the Bell and Federal well field pipelines upstream of entry into the existing Round Top Reservoir.

Radon Removal
Radon levels range from 150 to 1,100 picocuries per liter (pCi/L) in the Federal and Bell well field groundwater. The proposed Environmental Protection Agency (EPA) maximum contaminant level (MCL) for radon is 300 pCi/L. Up to 73-percent radon removal is
required to contend with the proposed MCL. Based on the comparative evaluation presented in Chapter 3, in-line aeration is the preferred radon removal method for the Bell and Federal well fields. Conceptually, an in-line injection/degassing system could be placed on each of the well field lines just upstream of both the existing Round Top Reservoir and the disinfection application points.

**Relocation of 30-Inch Sherard WTP Supply Line**

### Relocation of Pipe near Sherard WTP

The Level I study noted a potential problem with the hydraulic grade line (HGL) dropping below the 30-inch line from Crystal to Sherard at approximately 800 feet upstream from the treatment plant, possibly resulting in air binding or cavitation and reducing pipe capacity, and recommended relocating about 1,500 feet of pipe. Figure II shows the system of transmission pipelines that serve the water treatment plants west of Cheyenne, including the 30-inch line discussed here.

The top of the 30-inch pipe in the air relief/vacuum valve vault is 15.2 feet below the contact basin overflow level, or about 1.2 feet below the bottom of the contact basin. Considering that the pipe elevation at the point of concern is physically below the bottom of the contact basins, and that under high flows (when the hydraulic grade would be lowest) the water level in the basins would be at or near their operating HWL, there is no opportunity for the HGL to fall below the top of the pipe at the point of concern. Thus, relocation of the pipe in this reach is not warranted.

### Hydraulics of 30-inch Line, Crystal Reservoir to Sherard WTP

The maximum capacity of this line was reported in the Level I study to be 26 mgd. However, no qualification of this number was provided, and there are no recent tests documenting flow characteristics from which the BOPU can reliably plan. Data from tests conducted under this study allowed an estimate to be made of the maximum capacity of the line (without the existing PolyJet valve). Flow tests of this pipe were conducted on December 19, 1995, January 4, 1996, and February 20, 1996. Using the "C" factors calculated from the flow test data, and assuming the PolyJet valve to be removed, the maximum capacity for this pipe by gravity is in the range of 24-26.5 mgd. The upper end of this range assumes the BOPU connects the 20-inch cast iron Hecla line to the 30-inch Sherard supply line at the WYE.

### 12 MGD Pump Station and Pipeline, Round Top WTP to Sherard WTP

The choice of facilities for increasing deliveries to Sherard depends on the BOPU's view of a 40-year planning window, particularly as it relates to whether or not future demands will unfold as the projections say they should. For the 40-year planning period, Alternative 2 (as described in Chapter 5) involving a new 30-inch pipe from the WYE to Sherard (in addition to increasing production from the wellfields to 14 mgd) is the better choice. However, it is not the lowest annual cost project in the short term, where the debt
service on pipeline construction is greater than debt repayment plus power costs for either Alternative 1 or 3, both of which use pump stations early on. If a shorter period (about 13 years) were to be used for the planning window, to see if demands increase as projected, Alternative 1 (constructing 6 mgd incremental pumping capacity at the WYE) is the better choice. However, when surface water treatment capacity at Round Top is ultimately removed, only Alternative 2 includes new piping from the WYE to Sherard (without which there is no redundancy in delivery capability to Sherard, and therefore no backup surface water source in the event of a line break).

Implementing either of the two alternative ASR applications (storage and recovery wells along the southeast periphery of Cheyenne, and using the Happy Jack well field for recharged water storage) could delay the effects of population projections on treated water demand by up to four years. Implementing both could delay those same effects up to eight years, if ASR wells along the southeast periphery of the city can be constructed to operate as assumed. Unquantified secondary benefits of these projects include reduced stress on the city distribution system, and possible delayed construction of the cross-town main described in the next section.

**42/36-Inch Main Across Cheyenne**
The Level I study recommended phased construction of a new transmission main from King No. 1 Reservoir to Cheyenne. Three routes, including Alternative 1 from the Level I report, were evaluated. Cost summaries for the three alternatives are provided in Table 6.1 in the main report. For these estimates, it was assumed steel pipe would be used for the 42-inch transmission line to town, and the in-town 36-inch line would be ductile iron. Discussions with the BOPU have indicated Alternative 3, a route which generally stays on the south side of Cheyenne, to be their preferred choice. In current dollars, Alternative 3 capital costs total $11.2 million.

Review of and minor modifications to the BOPU’s CYBERNET distribution system model (under a separate contract) indicate that while this new main will be needed at some point in the future, that need is not imminent. The question of need depends not only on how quickly demands actually increase, but also on the location of those demands. Growth on the northern periphery of the city will not be helped significantly by this pipeline. Therefore, in this study, the priority of this capital project has been lowered. The BOPU should monitor pressures in critical areas in the central and eastern parts of the city so that as needs in these areas become more critical, funding for this project can be sought and construction planning can commence.

**SCADA Upgrades**
The existing BOPU SCADA system must be replaced. In its current state, it does not allow for affordable expansion of the overall system. The four alternatives presented in Chapter 7 were evaluated for their initial capital costs and operation and maintenance costs. The existing RTUs can be included in this new system to provide some salvage of the old hardware. New communication facilities can be established using radio links, but existing telephone lines are still recommended to comprise parts of the system not suitable
for radio coverage. Control software and hardware are identified which provide open architecture, user-friendly programming, alarm functions, and easy to read informational displays.

**Pipeline Corrosion Investigation**

In general, the condition of the various pipelines investigated is a function of the material of which the pipe is made, and the length of service seen. Concrete cylinder pipes (e.g. the 30-inch Hynds line) are in good shape except where buried steel appurtenances show evidence of corrosion. These pipes are also exhibiting accumulation of aluminum, iron and manganese deposits on their inner surfaces. Cathodic protection and pigging are recommended for several sections of these pipes.

Cast iron pipes appear to be in relatively good shape considering their long service. Many have been functioning for up to 80 years (e.g., the north and south 20-inch lake lines). External corrosion is minimal, but internal pitting is occurring at a rate of 1 to 5 mils per year. Some samples exhibited corrosion of up to half the wall thickness. Rehabilitation in the form of lining (slip lining or mortar lining) should be considered as the pipes continue to age and show more frequent failures. For now, the pipes appear to be serviceable.

Steel lines, such as the Federal wellfield line, are generally in good shape, although internal and external coatings are beginning to age. Cathodic protection should be considered for steel lines in 5 to 10 years.

Ductile iron lines, such as the Crystal-to Sherard 30-inch line, are generally the youngest pipes in service and show the least wear over time. Minimal rehabilitation is anticipated for these lines. One exception is the Round Top No. 2 line, which was installed without polyethylene encasement. This line should be observed over time to detect problems that may necessitate attention.

**Summary of Project Costs**

Table I presents a summary of capital, first-year annual and present worth costs for the various project components evaluated herein. For more detail on how these costs were developed, the reader is referred to the appropriate chapter in the main report as given in the table.

Table 9.2 in the main report also shows the approximate effects of construction of these capital projects on customer rates. Assuming 4 billion gallons of water delivered per year, and whether grant money is available or all funding must come from loans, the total effect of these projects is to increase rates from $0.52 to $0.90 per thousand gallons. This estimate does not differentiate between the various types of customers served by the BOPU or their location.
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1 1 is highest priority, 2 is moderate priority, 3 is lower priority
2 only Alternative 2 is included in total.

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