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# EXECUTIVE SUMMARY

# SHELL VALLEY DOMESTIC WATER SUPPLY PROJECT

# LEVEL III

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PREPARED FOR
WYOMING WATER DEVELOPMENT COMMISSION
HERSCHLER BUILDING
CHEYENNE, WYOMING

Prepared by
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## I. AUTHORITY

The Wyoming Legislature has authorized the Wyoming Water Development Commission to conduct a one-year Level III design of a conveyance system to connect two existing well to the Town of Greybull's existing water supply pipeline. Crank Companies, Incorporated was authorized to conduct this study through a contract with the Wyoming Water Development Commission dated June 20, 1986. The basic task of Crank Companies, Incorporated, therefore, was to complete the design, and to prepare plans and specifications for a construction project to connect the two new wells to the Greybull transmission line.

## II. INTRODUCTION

In the course of the Level II feasibility analysis of the Shell Valley/Lake Adelaide project, two deep wells were completed on Trapper Creek about one mile east of the community of Shell. A decision by the Shell Valley Watershed Improvement District to pursue enlargement of Lake Adelaide left the two wells available for domestic and municipal use.

The inlet and collection system for the existing Greybull supply transmission line is located adjacent to Shell Creek and is approximately two miles north and two and one quarter miles east of these new wells. The transmission line conveys water from the infiltration gallery westerly along the Shell Valley, passing through a portion of the community of Shell and then on to the town of Greybull. The transmission line is approximately seventeen miles in length, of which about three miles of the line is 12 inch diameter asbestos cement pipe and the rest is 14 inch diameter asbestos cement pipe. The fourteen inch pipe was installed in 1974. The twelve inch asbestos pipe was installed in short segments over a time frame from the early 1940's to 1974. The original pipeline was a twelve inch steel pipeline installed in the early 1940's. The steel pipeline experienced corrosion problems resulting in the pipe developing leaks in a number of areas. These areas were replaced with the 12 inch asbestos cement pipe. The result, therefore, is that the pipeline changes back and forth from 12 inch to 14 inch pipe along the pipeline.

The Greybull transmission line is a source of domestic water supply not only for the residents of the town of Greybull, but for a number of residents within Shell Valley between the intake works and the town.

The town of Greybull has 55 applications for new connections to its water system that are pending. Many of these requests are from residents of Shell Valley. Greybull has not taken action on these requests due to a concern of the possibility of an insufficient water supply to satisfy the requests.

## III. SUMMARY OF ANAYLSIS

The elevation of the water surface of Shell Creek at the intake of the Greybull pipeline is approximately 4325. The well head elevation at the new wells is approximately 4413 at well number one and 4359 at well number two. Well shut in pressure for well number one is 143 psi and for well number two the shut in pressure is 161 psi. The resulting shut in energy head elevation at the wells would be approximately 4740 for well number one and 4730 for well number two. This is an energy head differential of 180 psi between well number one and the Shell Creek intake and 175 psi between well number two and the Shell Creek intake. If the wells were to be connected directly to the Greybull transmission line this large increase in pressure could damage the transmission line as well as many of the individual service lines connected to the transmission line.

Therefore, an important part of the design of the system had to deal with what impact on the Greybull pipeline and the operation thereof this increase in pressure would create. In order to identify potential problems an analysis of the Greybull pipeline was undertaken. The first step was to obtain a complete set of "As Built" drawings of the 1974 transmission line. From these drawings, on site inspections and meetings with the Greybull town personnel, we were able to identify the locations of the 12 inch asbestos cement pipe and the location of the 14 inch asbestos cement pipe. The pressure classes of the 14 inch pipe and its location in the transmission line were identified. No record could be found for the pressure class of the 12 inch diameter pipe.

The next step was to determine the capacity of the Greybull transmission line. In order to accomplish this a method had to be developed to determine the friction factor for the transmission line. In cooperation with the personnel of the town of Greybull a method to determine line pressures at various locations was developed, in addition through the use of flow meters, the actual quantity of water flowing through the pipe was determined at several locations. From the data gathered and through an analysis completed in the office the Hazen-Williams coefficient of roughness for the Greybull transmission line was determined to be 140. (This matches published data for this type of pipe).

Having determined the coefficient of roughness, we then were able to use the pipeline profile and pipeline class information to predict the effect of increasing or decreasing pressures, increasing or decreasing the quantity of water flowing through the line or combinations of each. Capacity of the transmission line is controlled by the pipeline profile and topography as well as pipe roughness and diameter. At a point approximately three quarters of a mile east of the town of Greybull, there is a high point in the pipeline. As the flow through the pipeline increases the energy gradient along the pipeline becomes more steep. As long as the energy gradient is above the top of the pipe the pipeline remains pressurized. At the location along the pipeline when the flow is increased to the point that the resultant energy gradient intersects the top of the pipe, the pipeline from that point on would have to operate under a negative head, thereby creating a vacuum on the pipe. If provisions have not been made to allow air to enter the pipe at this location, the vacuum created could cause the pipe to collapse. In the case of the Greybull pipeline, a vacuum relief valve has been installed which prevents the collapsing the pipe. The energy gradient is also prevented from going below this point and in effect prevents additional steeping of the slope. The gradient up to this point therefore, is as steep as the gradient can get with no upstream breaks or major water withdraws. From this slope the maximum flow through the pipeline is determined. For the Greybull pipeline as now installed, this relates to a maximum capacity of about 1900 GPM or a rate of about 2.74 million gallons per day.

Our analysis of the Greybull pipeline indicates that if the pipeline operation was set to produce this flow rate of 1900 gallons per minute through the pipeline, at a number of locations along the pipeline the pressure in the pipeline would be reduced to where some of the users on the line would not be able to obtain water.

The present operation of the Greybull transmission line has been developed over the years and has been dictated, more or less, by the demands of those users connecting to the pipeline. If the pipeline is operated such to supply the maximum benefit and maximum quantity of water to the Greybull residents, water users in the community of Shell and along the transmission line would suffer severely. The present method of operating the pipeline has been developed to minimize the negative impact to the Greybull residents, the users in the community of Shell and the users in Shell Valley. The operation plan describes the methods being employed in more detail.

## IV. PROJECT CONFIGURATION

One important consideration in the design and layout of this project has been to design the system such that some fire protection could be provided for the community of Shell. One method to provide some fire protection would, of course, be to run the pipeline from the wells through Shell and simply install a couple of hydrants on the line. Since the wells are artesian and when shut off build up relatively high pressure that rapidly bleeds off when the wells are opened, this large fluctuation in flow and available pressure would not provide an acceptable system. Therefore, as an alternative, a configuration was developed and evaluated that consists of a separate line being installed from each well a short distance to a common location. At this common location, the flow from each well could be metered and the flow totalized. The flow from each well would be then combined and chlorinated.

At this location it would then be practical to run this combined flow into the storage tank. The installation of the storage tank would provide two important benefits. One, it would allow the use of a relatively simple method to control the flow from the wells and two, it would provide water for fire protection to the Shell community at a relatively constant flow rate and pressure.

By using a storage tank, the fluctuation in pressure downstream of the tank will be minimal. This relatively constant pressure simplifies the pressure control valve arrangement at the connection to the Greybull pipeline.

Overall system configuration is as follows: an eight inch line from well number one will be installed along the east and north side of Trapper Creek road to a point in the SW¼SE¼ of Section 26, T53N, R91W. The line would then run northwesterly a short distance across the SW¼SE¼ of said Section 26 and into a well control and chlorinator building. A ten inch line will be installed from well number two parallel with and 25 feet north of the south line of Section 26, T53N, R91W until the line enters the Trapper Creek Road right of way. The line will then roughly parallel the eight inch line from well number one from here to the well control and chlorinator building.

Inside the well control and chlorinator building an altitude valve and a flow meter will be installed on each well line. Downstream of the meters the two lines will be connected for discharge into the storage tank. However, prior to being piped to the storage tank, the combined flow will be chlorinated. The chlorination rate will be controlled by pacing equipment interconnected with the flow meters.

The altitude valves are used to maintain a certain range of water depth in the storage tank. The normal operational sequence is as follows: with the tank in a full condition each altitude valve will be closed, therefore, no water will be flowing from either well. As water is being used downstream of the tank the water level in the tank will drop. At a preset level the altitude valve or valves will open allowing water to flow from the well or wells into the storage tank to help meet the flow demands. Each altitude valve operates independently of the other. Therefore the depth of the water in the tank resulting in the opening or closing of each altitude valve can be the same or at different points.

As the demand for water downstream of the storage tank is satisfied the tank will begin filling again. At a desired preset high water level point in the tank, the altitude valve(s) will shut and stop the flow from the respective well.

From the storage tank the pipeline will be placed along the north side of Trapper Creek Road and run west to Smith Street in the community of Shell. At this point the water line will turn and run north in Smith Street to Fourth Street. At Fourth Street the water line will run east to the east side of U.S. Highway 14 then staying on the east side of U.S. Highway 14 the line will run north to connect with the existing Greybull pipeline.

Along Smith Street three fire hydrants have been installed for fire protection. In Fourth Street at station 49+44 a Pressure Reducing Vault will be installed. At this location the new pipeline will be constructed just to the north of the existing supply line for the users on the east side of Shell. By connecting the tank line to this existing Shell line at this point we will be able to increase the water pressure to the users in this part of Shell. It is expected that these Shell users could experience a pressure increase of at least 30 psi. The

Greybull pipeline has a normal operating pressure at this point of about 35 psi during the summer operations.

Just downstream of the Shell line connection in this same Pressure Reducing Vault a pressure reducing valve will be installed on the main line. The valve will be adjusted to maintain a selected downstream pressure to match that in the Greybull pipeline. As demand for water from the Greybull transmission line increases this valve will sense the requirement for more water and open more to allow more water to flow from the wells into the Greybull pipeline.

The Town of Greybull maintains pressure ranges in various reaches of the pipeline by adjusting the position of some of the line valves on the pipeline. At one location, referred to locally as the Herren valve, the valve is maintained in an almost a closed position. In this position the water passes through the valve at very high velocities and will eventually damage the valve. We have designed a pressure reducing-pressure sustaining system to be installed near this existing line valve. The pressure reducing-pressure sustaining valve is designed to maintain a certain upstream pressure and to reduce the pressure below to the valve to a desired operating level. This unit is to be installed on the existing Greybull pipeline at station 609+71 which is approximately six miles east of the town of Greybull.

## V. FINANCIAL

As an intergal part of the design process we have developed a detained construction cost estimate for the project. The complete breakdown is given in Appendix A of this summary. The total estimated project cost is as follows:

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| TOTAL ESTIMATED CONSTRUCTION COST | $ 492,789.25 |
| CONSTRUCTION CONTINGENCIES BUDGET - 15% | $ 73,900.00 |
| CONSTRUCTION INSPECTION BUDGET - 10% | $ 49,300.00 |
| TOTAL ESTIMATED PROJECT COST | $ 615,989.25 |

APPENDIX A
DETAILED CONSTRUCTION COST ESTIMATE
WYOMING WATER DEVELOPMENT COMMISSION
SHELL VALLEY DOMESTIC WATER SUPPLY PROJECT
LEVEL III

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|---|---|---|---|
| 1. | 8 Inch Water Main | 1300 L.F. @ $16.60/L.F. | $ 21,580.00 |
| 2. | 10 Inch Water Main | 1075 L.F. @ $20.31/L.F. | 21,833.25 |
| 3. | 12 Inch Water Main | 4350 L.F. @ $21.94/L.F. | 95,439.00 |
| 4. | 6 Inch Water Main | 100 L.F. @ $16.31/L.F. | 1,631.00 |
| 5. | 12 Inch Insulating Coupling | 2 each @ $200.00/each | 400.00 |
| 6. | 12 Inch Valve & Box | 8 each @ $1100.00/each | 8,800.00 |
| 7. | 6 Inch Valve & Box | 3 each @ $450.00/each | 1,350.00 |
| 8. | 12 Inch 90° Bend | 4 each @ $352.00/each | 1,408.00 |
| 9. | 12" X 12" X 12" Tee | 3 each @ $540.00/each | 1,620.00 |
| 10. | 12" X 12" X 6" Tee | 3 each @ $477.00/each | 1,431.00 |
| 11. | 12 Inch 22½° Bend | 3 each @ $310.00/each | 930.00 |
| 12. | 12 Inch 11¼° Bend | 2 each @ $310.00/each | 620.00 |
| 13. | 10 Inch 90° Bend | 1 each @ $274.00/each | 274.00 |
| 14. | 10 Inch 45° Bend | 2 each @ $241.00/each | 482.00 |
| 15. | 10 Inch 22½° Bend | 1 each @ $241.00/each | 241.00 |
| 16. | 10 Inch 11¼° Bend | 3 each @ $241.00/each | 723.00 |
| 17. | 8 Inch 90° Bend | 1 each @ $214.00/each | 214.00 |
| 18. | 8 Inch 45° Bend | 1 each @ $194.00/each | 194.00 |
| 19. | 8 Inch 22½° Bend | 3 each @ $194.00/each | 582.00 |
| 20. | 8 Inch 11¼° Bend | 3 each @ $194.00/each | 582.00 |
| 21. | Fire Hydrant | 3 each @ $1800.00/each | 5,400.00 |
| 22. | Excavation & Backfill in Unstable Soil | 10 c.y. @ $100.00/c.y. | 1,000.00 |
| 23. | Excavation & Backfill in Rock | 10 c.y. @ $100.00/c.y. | 1,000.00 |
| 24. | Thrust Block | 35 each @ $100.00/each | 3,500.00 |
| 25. | Connection to existing 4" Line | Lump Sum | 500.00 |
| 26. | Connection to existing 14" Line | Lump Sum | 3,390.00 |
| 27. | Air Relief & Vacuum Vault | 2 each @ $1450.00/each | 2,900.00 |
| 28. | Pressure Reducing Valve Station | Lump Sum | 19,380.00 |
| 29. | Pressure Sustaining Station | Lump Sum | 14,215.00 |
| 30. | Well House No. 1 | Lump Sum | 18,650.00 |
| 31. | Well House No. 2 | Lump Sum | 19,300.00 |
| 32. | Well Control and Chlorinator Building | Lump Sum | 86,870.00 |
| 33. | Water Storage Tank | Lump Sum | 137,350.00 |
| 34. | Disinfection Well No. 1 and Well No. 2 | Lump Sum | 19,000.00 |

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|---|---|
| TOTAL ESTIMATED CONSTRUCTION COST | $492,789.25 |
| BUDGET CONTINGENCIES 15% | 73,900.00 |
| BUDGET CONSTRUCTION INSPECTION 10% | 49,300.00 |
| TOTAL ESTIMATED PROJECT COST | $615,989.25 |