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Appendix A - Photographs of the Site
PROFESSIONAL CERTIFICATION

I, Douglas L. Beahm, President of BRS Inc., a Wyoming Corporation, hereby certify that the professional services required for the AftonWater Supply Project, Level II, were developed by me or under my direction and that I am a Professional Engineer licensed in Wyoming as required by the provisions of W.S. 33-29-105 through W.S. 33-29-113. IN WITNESS WHEREOF, I have hereunder set my hand and affixed my seal.

By: Douglas L. Beahm, P.E. #5499
President, BRS Inc.

I further certify that I am a Professional Geologist licensed as required by the provisions of W.S. 33-41-101 through W.S. 33-41-121, and that all geological work performed in relation to this Project was performed by me or under my direction. IN WITNESS WHEREOF, I have hereunder set my hand and affixed my seal.

By: Douglas L. Beahm, P.G. #1341
President, BRS Inc.
1.0 INTRODUCTION

The Afton Water Supply Project is a Level II feasibility study, funded by the Wyoming Water Development Commission (WWDC). Afton is located south of Jackson and north of Kemmerer in the Star Valley of western Wyoming. Previous studies include the Periodic Spring Remediation Project, by Weston Engineering, June 8, 1998 and the Afton Municipal Water Supply Level II Study, November 1990, by Forsgren Associates. The Afton Municipal Water System serves the Town of Afton and North Afton. The study area includes the Periodic Spring, Afton's primary water supply source, and the pipeline from the spring through the first storage tank (see Figure 1.2).

The preferred option for increasing and protecting the town's water supply, as discussed in Section 6.0, is to replace the existing pipeline with one providing greater capacity and stability. In its present condition, the existing pipeline is in imminent danger of being damaged from rockfall, landslides, and avalanches which would interrupt the primary water supply to Afton. The necessity of replacing in such a manner that it is protected is exemplified by the following photograph, Figure 1.1, taken on November 2, 1999 following the completion of site investigation and the draft report. A portion of the area identified in the report as having a high potential for rock fall failed. This failure probably occurred during the last week of October as a result of freeze/thaw conditions. Fortunately, the base of the rock failure slid before toppling over the pipe. This prevented a direct impact which may have severed the pipe. Additional failures are imminent underscoring the need for the project.

FIGURE 1.1
LEGEND
ROADS
CREEK OR DITCH

GRAPHIC SCALE

1 inch = 2000 ft.

LOCAL LOCATION MAP
PERIODIC SPRING
AFTON WATER SUPPLY PROJECT
LINCOLN COUNTY, WYOMING
1.1 Project Overview

The Periodic Spring is located in Lincoln County, Wyoming, near the Town of Afton, (Refer to the local location map, Figure 1.2). The study area is in the Bridger National Forest, approximately 4 miles east of Afton in the Swift Creek Canyon. The WWDC and the Town of Afton have completed a backup water supply well and other improvements on the Afton system.

The goal of this project is to increase or enhance water collection and conveyance at the Periodic Spring in a manner which will provide reasonable protection of the facilities over the long term. If the project is determined to be feasible by Afton and the potential funding agencies, it may proceed to Level III funding for final design and construction.

1.2 Acknowledgments

BRS, Inc. would like to acknowledge the efforts, assistance, and data provided for this project by the City of Afton, Mayor Jerry Hansen, the Afton City Council and Utilities Commission, Lael Eddins (Superintendent of Public Works), Larry Lancaster (Department of Public Works), Benton Smith, USFS, and our WWDC Project Officer Kevin Boyce.

2.0 EXISTING CONDITIONS

2.1 Project Setting

The study is located in the Bridger National Forest in a tributary canyon to the Swift Creek Canyon. The canyon is narrow and deep, approximately 1000' long, 100' wide, and 300' deep, with elevations ranging from 7165' at the spring outlet to 7000' at the 97,000 gallon storage tank (refer to Figure 1.2). The terrain is mountainous, with substantial amounts of snowfall in the winter. Avalanches, rockslides, and rockfall are quite common in the area, preventing work in the area during the winter and spring. Flows from the spring are quite high in the spring and early summer, leaving only late summer and fall for construction activities. The site is a popular tourist destination due to the spring's unique and scenic qualities. Aesthetic criteria will play an important role in all designs. The majority of the construction activities will be located in previously disturbed areas.

2.2 Current Water Sources and Water Quality

The Periodic Spring is the town's primary water supply. It is the largest of only three known cold water geysers in the world. The term "geyser" was used to describe the periodic nature of it's flow, although it is more accurately portrayed as a siphon. The unique nature of the siphon creates "on" and "off" flow cycles which vary in duration and quantity of flows depending upon seasonal fluctuations and the level of precipitation in a given year. The water quality from the Periodic Spring is excellent and meets or exceeds all applicable EPA safe drinking water standards. Water supply backup is provided by a single well completed previously as a WWDC water supply project in 1995 (yield 1150 gpm). Water from the backup well is also reported to be of excellent quality.
2.3 Periodic Spring - Flow Characteristics

The Periodic Spring is sufficient to supply the Town's water supply needs for the majority of the year. However, in some years during the winter and/or early spring, the Spring’s “on cycles” will be of a relatively short duration and the off cycles will approach 30 minutes. This results in a relatively short time window for water to be collected for the Town's water supply system. The Periodic Spring’s discharge for an annual period is presented in the following table. It is important to note that the data utilized to generate the discharge rates and discharge volumes from the Periodic Spring were quite limited. In addition, the cycle observations of the Spring will vary for any given year. The flow estimates listed in Table 1 are based upon the limited data available and may have a substantial margin of error. During the winter of 1999/2000 Afton intends to collect data on the spring flow/cycle.

**TABLE 1**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Typical Periodic Spring Cycle Sequence</th>
<th>Estimated Peak Discharge from Periodic Spring during “on cycle”</th>
<th>Periodic Spring Discharge Volume</th>
<th>Volume collected by Spring Intake Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>June - Aug.</td>
<td>Continuous Flow</td>
<td>45,000gpm</td>
<td>65 MGPD</td>
<td>14.2 MGPD</td>
</tr>
<tr>
<td>Sept. - Nov.</td>
<td>15 min on, 15 min off&lt;sup&gt;1&lt;/sup&gt;</td>
<td>17,950gpm</td>
<td>12.9 MGPD</td>
<td>7.2 MGPD</td>
</tr>
<tr>
<td></td>
<td>14 min on, 17 min off&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec. - May (lowest flow)</td>
<td>3.5 min on, 28 min off&lt;sup&gt;3&lt;/sup&gt;</td>
<td>11,200gpm</td>
<td>1.8 MGPD</td>
<td>1.8 MGPD</td>
</tr>
<tr>
<td></td>
<td>4.5 min on, 26 min off&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> L&A. Sept. 1999  
<sup>2</sup> Averages from Lael Eddins Data: 1979-1991  
<sup>3</sup> Forsgren Associates, 1990

3.0 POTENTIAL WATER SUPPLY ALTERNATIVES

Ground water sources include the Periodic Spring itself, additional springs in the area, and additional ground water wells. Currently, the Periodic Spring does not meet Afton’s demand during the low output periods in the winter. Based upon available data, the cause for this may either be related to factors in the collection and conveyance system, or supply may be limited by the actual quantity of flow coming from the spring. Historically, the Town of Afton relied on a surface water intake system located in Spring Creek. The system was abandoned due to surface water treatment regulations. A review of USGS streamflow gauging records from 1943 to 1980 indicates the lowest observed flows on Swift Creek occurred in the winter of 1966-1967, as follows.

**TABLE 2 - Swift Creek 1966/1967**

<table>
<thead>
<tr>
<th>Month</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.f.s.</td>
<td>39.16</td>
<td>33.43</td>
<td>29.97</td>
<td>29.13</td>
<td>29.04</td>
<td>29.06</td>
<td>29.40</td>
<td>87.00</td>
<td>308.4</td>
<td>253.9</td>
<td>90.26</td>
<td>60.73</td>
</tr>
</tbody>
</table>
The flow during the months of December 1966 through April 1967 was fairly constant at about 29 c.f.s. This portion of the flow is assumed to be directly related to a base flow condition generated from ground water sources. At 29 c.f.s., approximately 13,000 gallons per minute, or over 18 million gallons per day, flow through Swift Creek from ground water sources. At Afton's current peak usage of approximately 3 million gallons per day, this base flow quantity would be more than sufficient to meet the town's demand. Development of a portion of this base flow, as an alternative supply, could be classified as either ground or surface water depending on the method and location of the collection system.

4.0 SERVICE AREA/WATER DEMAND

The service area of the Afton Municipal Water System includes the Town of Afton proper and North Afton. The Town of Afton serves a reported population of 1,640 persons residing in Afton and North Afton. The service area includes 769 taps (as of November, 1999 - data provided by the town of Afton) within Afton and North Afton. No meter data is available, however, reported water usage follows in Table 3.

<table>
<thead>
<tr>
<th>TABLE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEMAND</strong></td>
</tr>
<tr>
<td>Data Source</td>
</tr>
<tr>
<td>WWDC 1998 Survey</td>
</tr>
<tr>
<td>EPA Sanitary Survey 1/7/97</td>
</tr>
<tr>
<td>Current Est. Afton</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SUPPLY</strong>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supply Source</td>
</tr>
<tr>
<td>Spring &amp; Well</td>
</tr>
<tr>
<td>Spring Only</td>
</tr>
</tbody>
</table>

*Supply estimates are based upon limited data at low flow conditions.

With respect to future growth, from 1990 to 1998, population has increased from 1,324 people to 1,640 people based upon data from the town of Afton, an overall growth of 24% in an eight year period. With continued growth, demand will exceed the capacity of the Periodic Spring on a more regular basis at some point in the future, necessitating the implementation of water supply alternatives or a reduction in per capita water use.
5.0 GEOTECHNICAL ANALYSIS

Afton is located in Wyoming’s westernmost large valley, the Star Valley. The Star Valley roughly parallels the north-trending folds and faults of the overthrust belt and is bounded on the east by the Salt River Range and on the west by the Caribou Range. The eastern side of the Star Valley is bounded by faults with recent movement displacing the valley alluvial fill (Blackstone, 1988). The Periodic Spring is located in the Salt River Range. This area has been intensely folded and faulted, creating steeply dipping beds and rough, fractured terrain. The Periodic Spring itself is located along an unnamed fault, which has provided the necessary environment for the formation of this unique geological feature. The geologic formations at the spring site include the Madison Formation to the west of the fault line as expressed by the spring canyon, and the Amsden Formation to the east. The beds are nearly vertical, and the fault zone is easily observed in the head of the canyon.

The Missippian Madison Formation is a dolomitic limestone. At the site the formation is very competent and does not present a hazard in terms of rockfall or sliding at the site. The Pennsylvanian Amsden Formation is a combination of interbedded sandstone, limestone, and shales. Along the east side of the canyon fractures, loose rubble, and unstable rock slabs create many hazards, and there is ample evidence of previous failures in the area. During the course of the study, portions an unstable slab failed, covering a portion of the pipe but not causing appreciable damage (See Figure 1.1 and site photographs, Appendix A).

As a result of these physical conditions, work in this area will be considerably more costly than most typical pipeline projects. A substantial amount of rock work will be required to create a stable bed for the pipeline, and to establish a safe work environment for the workers on the project. In unstable areas such as the upper reaches of the canyon, the pipe must be encased in a carrier pipe attached to the rock with rock bolts and stabilized with reinforced concrete. The initial work required to prepare the pipe bed more closely resembles a hardrock mining project than a typical pipeline construction project.

6.0 PRELIMINARY DESIGN

Alternatives were evaluated for improving the capacity of the spring intake structure and upper pipeline. Alternatives included replacement of the 14 inch pipeline with a 16 inch pipeline or an 18 inch pipeline. As shown on Table 4, a 16 inch pipeline could convey approximately 25% more flow than the existing 14 inch pipeline and the 18 inch pipeline could convey approximately 55% more flow than the 14 inch pipeline. An 18 inch pipe was selected as the preferred alternative and used for the purposes of cost estimating. During the high flow periods, increased conveyance capacity would be desirable for additional fire flow. The incremental cost of the 18 inch pipeline as compared to the 16 inch line was approximately $12,000.00 or about 3% of the total project cost. During Level III design, the final pipe size determination will be made based on low flow data to be collected by the town of Afton during the winter of 1999/2000. It is possible that evaluation of low flow data may indicate that a larger pipe size would be detrimental to collection based upon siphon flow conditions.
TABLE 4

Afton Periodic Spring Intake Improvements

<table>
<thead>
<tr>
<th>Intake - Pipeline</th>
<th>Capacity *</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 inch dia. Pipeline</td>
<td>~10,000 gpm</td>
</tr>
<tr>
<td>16 inch dia. Pipeline</td>
<td>~13,000 gpm</td>
</tr>
<tr>
<td>18 inch dia. Pipeline</td>
<td>~17,000 gpm</td>
</tr>
</tbody>
</table>

* Assumes a spill elevation at 7163.5

Other alternatives considered included the replacement and/or argumentation of the 97,000 gallon storage tank with a vented 20,000 gallon surge tank. This alternative was eliminated due to cost and aesthetical concerns. Ultimately, Afton may wish to pursue additional supply alternatives as discussed in Section 3. However, the development of additional supply sources is outside the scope of the current project.

7.0 EASEMENTS, ENVIRONMENTAL ISSUES, AND PERMITS

Anticipated construction activities for the Afton Water Supply Project are situated solely on Bridger National Forest Lands. It is our understanding after meeting with representatives of the United States Forest Service that construction at the site would fall under the Town of Afton’s current Special Use Permit, which allows for maintenance of the water supply system at the site. All of the required permits and easements would be obtained during the Level III stage of the project. The following is a list of the permits, easements, approvals, etc. which may apply to this project prior to construction and would have to be addressed:

1. United States Forest Service
2. State Historical Preservation Office
3. Wyoming Fish and Game and US Fish and Wildlife
4. U.S. Army Corps of Engineers 404 Permits
5. Wyoming Department of Environmental Quality (WDEQ) Permits

8.0 ESTIMATED COSTS AND FINANCING

8.1 Construction Costs

Construction costs for the installation of a new, more stable transmission pipeline are expected to be higher than typical pipe installation projects due the unique nature of the site. Much of the work will require manual labor versus modern equipment methods. The total construction cost is expected to be about $305,000. As shown on Table 5, the final cost estimate including permitting, legal fees, engineering, and contingencies, estimates total project costs to be $450,000. All of the system components are related to the water supply system, eligible for WWDC funding.
TABLE 5 - FINAL COST ESTIMATE

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation of Final Designs and Specifications</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>Permitting and Mitigation</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>Legal Fees</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>Acquisition of Access and Rights of Way</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

Cost of Project Components:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation Materials</td>
<td>$18,000.00</td>
</tr>
<tr>
<td>Equipment</td>
<td>$66,000.00</td>
</tr>
<tr>
<td>Labor</td>
<td>$94,000.00</td>
</tr>
<tr>
<td>Pipe Materials and Installation</td>
<td>$70,000.00</td>
</tr>
<tr>
<td>Subsidiary Items</td>
<td>$57,000.00</td>
</tr>
</tbody>
</table>

Construction Cost Subtotal #1: $305,000.00

Engineering Costs = CCS #1 x 10%: $30,500.00

Construction Cost Subtotal #2: $335,500.00

Contingency = CCS #2 x 15%: $50,325.00

Construction Cost Total: $385,825.00

Project Cost Total: $445,825.00

For Financing Calculations, Assume: $450,000.00

Note: None of the components of the proposed project are eligible for State Land and Investment Board funding as all components are supply related. The project has been discussed with RUS and would not be eligible for RUS funding. The project met all of RUS’s criteria except the Afton water users are not metered.

-8-
8.2 Financing Alternatives

Since this project is a rehabilitation project, WWDC funding would most likely be limited to a 50% grant, 50% loan. Currently, the loan would be at a 7.25% rate over a maximum 30 year period. Table 6 provides funding estimates based on WWDC funding.

### TABLE 6

<table>
<thead>
<tr>
<th>TOTAL PROJECT</th>
<th>GRANT %</th>
<th>Grant $</th>
<th>Loan Terms</th>
<th>Loan $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Cost $450,000.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PREFERRED ALTERNATIVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWDC Financing Only</td>
<td>50%</td>
<td>$225,000.00</td>
<td>7.25%, 30yrs</td>
<td>$225,000.00</td>
</tr>
<tr>
<td>Monthly Debt Retirement</td>
<td></td>
<td></td>
<td></td>
<td>$1,526.00</td>
</tr>
<tr>
<td>Per tap/month (769 taps)</td>
<td></td>
<td></td>
<td></td>
<td>$1.98</td>
</tr>
<tr>
<td>TOTAL PAYMENTS</td>
<td></td>
<td></td>
<td></td>
<td>$452,160.00</td>
</tr>
</tbody>
</table>

9.0 RECOMMENDED RATE SCHEDULE

Assuming WWDC funding only, the increased cost for debt retirement per tap is estimated at $1.98 per month for the existing taps. A rate increase could raise residential and commercial taps differently since the commercial taps would be expected to use more water. The reported per tap rate for Afton is $15.00 per month without a usage charge. If the projected additional debt retirement cost were passed through equally, this would represent a 13% increase in rates. All other costs including operating and maintenance costs would be expected to remain the same.

The final rate determination will be made by Afton. In addition to the direct costs for debt retirement for the proposed system improvements, consideration should be given to other additional costs such as operating and maintenance costs for chlorination (now required by GWTR) and sinking funds for future repairs and/or alternative supply development.

10.0 ADDITIONAL REQUIREMENTS

The District must request funding from WWDC for the Afton project to proceed to Level III. This request must be made on or before November 1, 1999. WWDC will review the project, the Level II report, and determine whether to present the project to the legislature for funding in 2000. At present no other funding sources are being sought due to the nature of the project and the current lack of RUS eligibility.
11.0 CONCLUSIONS AND RECOMMENDATIONS

1. It is recommended that the transmission line from the Periodic Spring to the 97,000 gallon tank be replaced to prevent damage to the existing system and provide a more stable water supply system for the Town of Afton. Based upon additional data, designs should attempt to increase collection capacity to provide for additional supply in the future. During construction, the intake structure should be renovated to ensure maximum efficiency. The 97,000 gallon tank should be repaired, and the abandoned surface water intake system should be removed to decrease susceptibility to contamination of the system. The Periodic Spring is a valuable asset to the Town of Afton, and should be protected and preserved as a viable source for years to come.

2. The Level II report, conceptual design and cost estimation for Level III funding have been completed based on available data for winter month spring yields. It is recommended that during the 1999/2000 winter season remote recording or telemetry equipment be installed to provide a basis for final design during Level III. Afton has installed telemetry in their main storage tanks and any data collected at the spring and/or upper tank would be integrated with this data. Pending results from telemetry measurements at low flow conditions during the winter 1999/2000, examination of other supply sources may be appropriate. These may include additional supply wells and/or collection of additional flow in the Swift Creek Canyon. (Note: Afton has indicated that they will install remote telemetry this fall.)

3. It is recommended that the site preparatory rock work be completed on a time and materials basis with the potential of a sole source contract. Delivery and installation of pipe could be bid separately on a unit basis.
Appendix A:
Photographs of the Site
The Periodic Spring which serves as the water supply for Afton is a unique geological feature and a local tourist attraction.
Recent rock failure covering exposed pipeline.

This failure occurred in the last week of October 1999.
Additional failures are imminent.
Spring Creek Canyon

Exposed pipe along access.