Gooseberry Level III Project

Executive Summary

Prepared for

WYOMING WATER DEVELOPMENT COMMISSION

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A MORRISON-KNUDSEN COMPANY
GOOSEBERRY LEVEL III PROJECT
EXECUTIVE SUMMARY

Prepared for:
Wyoming Water Development Commission

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Objective
The Gooseberry Level III study was conducted to evaluate the Upper Gooseberry Dam site, both from a physical and economic standpoint. The general location of the site is shown on Figure 1. Geotechnical investigation of the site was to be performed and preliminary designs developed. From these designs, cost estimates were to be prepared and an economic analysis made of the feasibility. Monitoring of the quantity and quality of the streamflow was also to be undertaken.

Results
Drilling at the dam site revealed the thickness of the overburden to be about 40 feet. Auger holes and test pits indicated the material in the reservoir area is mainly of clay and silt overlying gravel. The thicknesses are quite variable and interbedded because of the meandering of Gooseberry Creek. The top of the bedrock at the dam axis was found to be highly fractured and moderately permeable.

Water quality monitoring identified several water standards for agriculture which were being exceeded. These include sulfate, chloride, total dissolved solids, and sodium adsorption ratio. In general, the quality deteriorated in a downstream direction. The relationship between quality and streamflow generally followed an inverse pattern.

The dam type selected for design at the Upper Gooseberry site was a zoned earthfill dam. It would have a central impervious core with upstream and downstream zones of more pervious material. A cutoff trench will be excavated into bedrock to form a positive control of the seepage. The plan view and maximum section characteristics of the dam are shown on Figures 2 and 3. The design flood has a significant impact on the spillway size and cost of the dam. Several flood volumes were analyzed, ranging from the 100-year frequency
SECTION B-B / MAXIMUM EMBANKMENT SECTION

Figure 3
to a 0.5 Probable Maximum Flood (PMF) magnitude. The combination of spillway and reservoir storage volume required to pass these flood volumes safely through the structure was determined. Two feet of freeboard were provided above the maximum level of the routed flood.

The outlet works will be combined with a service spillway and consist of an inlet box, concrete conduit, wet well gate structure including an overflow weir, slide-gates, and a stilling basin. The spillway will operate automatically to discharge flood volumes up to the 100-year frequency flood.

The yield of the reservoir was estimated as the difference in water supply with and without a reservoir. Although the average releases from the reservoir would be 902 acre-feet, reuse and regulation would result in a yield to the project lands of 1570 acre-feet annually.

Cost estimates were developed using data from similar projects updated to January, 1986 levels. The construction costs were increased to cover land acquisition and construction management. The total capital cost for a dam design adequate to pass the 0.5 PMF is shown in Table 1. The estimated construction costs for dams designed to handle other levels of design floods, including a 0.25 PMF, are shown in Table 2.

**Alternative Site**

Since the overburden at the upper site was much thicker than originally estimated and the reservoir yield quite low, it was decided to analyze an alternate site. The site selected was the Lower Gooseberry about 20 miles downstream from the upper site. The approximate location is also shown on Figure 1.

Geotechnical investigation consisted of drilling three holes into bedrock along the dam axis. The overburden was much shallower at this site than the upper site but the dam axis was about twice as long. The same type of dam and control features were used in the design estimate at the lower site as had been used at the upper site.
The design flood was much greater at this site because of the larger drainage area. The emergency spillway was located just upstream from the left abutment. The rock conditions in this abutment are unknown but were assumed to be such that about 50 percent of the spillway excavation would need to be blasted.

Reservoir operation and sedimentation studies were made to estimate the yield at this site and to determine the storage capacity required. The reservoir yield was estimated to average 2,550 acre feet annually. Cost estimates were then developed for several dam sizes ranging from a design flood requirement of 200-year frequency to 0.5 PMF.

**Economic Analysis**

Benefits were based on a farm budget analysis using the average cropping pattern and comparing it to the water supply available.

The average water supply for project lands using the upper site was 62 percent for the period studied. This would result in a net return of $19.47 per acre. The existing baseline conditions for project lands was estimated to be a loss of $11.29 per acre. Elimination of this loss and the net return of $19.47 per acre results in an ability to pay of $30.76 per acre. Using a financing interest rate of 4% over a 50 year period, the estimated cost of sponsoring the project (25% of construction plus O&M) would be $29.66 per acre.

Similar analyses for the lower site show the net return to be $29.19 per acre resulting in an ability-to-pay of $40.48 per acre. However, the costs of the lower site will require an annual charge of $51.13 per acre to sponsor the project.

**Conclusions**

Comparison of several parameters at the two sites shows the upper site to be superior in all categories except reservoir yield, and the only one potentially feasible under the criteria used. The following table shows the
embankment volumes, design floods, reservoir yields, and cost data for the two sites for a design flood of 0.5 PMF.

Reduction of the design flood to 0.25 PMF would result in a reduction of costs of approximately $800,000 at the upper site. The cost of sponsoring the project using this level of design flood would be about $24.51 per acre.

**TABLE 1**
GOOSEBERRY LEVEL III PROJECT
COMPARISON OF DAMSITES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Upper</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dam Height (ft.)</td>
<td>105</td>
<td>96</td>
</tr>
<tr>
<td>Crest Length (ft.)</td>
<td>1050</td>
<td>1800</td>
</tr>
<tr>
<td>Embankment Volume (cu. yd.)</td>
<td>864,000</td>
<td>1,255,000</td>
</tr>
<tr>
<td>Reservoir Area (Ac)</td>
<td>240</td>
<td>700</td>
</tr>
<tr>
<td>Total Storage (ac-ft)</td>
<td>9100</td>
<td>21,700</td>
</tr>
<tr>
<td>Annual Res. Release (ac-ft)</td>
<td>902</td>
<td>1,642</td>
</tr>
<tr>
<td>Annual Res. Yield (ac-ft)</td>
<td>1,570</td>
<td>2,550</td>
</tr>
<tr>
<td>1/2 PMF Peak (cfs)</td>
<td>31,250</td>
<td>90,510</td>
</tr>
<tr>
<td>Spillway Width (ft)</td>
<td>120</td>
<td>340</td>
</tr>
<tr>
<td>Benefitted Acres</td>
<td>2,484</td>
<td>2,484</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$4,970,000</td>
<td>$9,023,000</td>
</tr>
<tr>
<td>Total Capital Cost</td>
<td>$5,308,000</td>
<td>$9,883,000</td>
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</tbody>
</table>
### TABLE 2
GOOSEBERRY LEVEL III PROJECT
COMPARISON OF FLOOD PEAKS AND COSTS - UPPER SITE

<table>
<thead>
<tr>
<th>Flood Magnitude</th>
<th>Peak (cfs)</th>
<th>Construction Cost ($)</th>
<th>Ann. Assessment/ac*($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Year</td>
<td>3,412</td>
<td>3,450,000</td>
<td>20.99</td>
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<tr>
<td>10,000 Year</td>
<td>8,660</td>
<td>3,770,000</td>
<td>22.49</td>
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<tr>
<td>1/4 PMF</td>
<td>15,625</td>
<td>4,200,000</td>
<td>24.51</td>
</tr>
<tr>
<td>1/2 PMF</td>
<td>31,250</td>
<td>4,970,000</td>
<td>29.66</td>
</tr>
</tbody>
</table>

*Based on 25% of construction cost at 4% interest for 50-year period and annual O & M charge of $4.83 per acre.*