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EXEcutive summary of the final report

Goshen Irrigation District
Horse Creek Reregulating Reservoir, Level II Project

Submitted to the

Wyoming Water Development Commission

December 21, 1983
EXECUTIVE SUMMARY

GOSHEN IRRIGATION DISTRICT
HORSE CREEK RE-REGULATING RESERVOIR
LEVEL II PROJECT
FINAL REPORT

PREPARED FOR:

Wyoming Water Development Commission
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Cheyenne, WY 82002

and

Goshen Irrigation District
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PREPARED BY:

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736 Whalers Way, Suite F-200
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December 21, 1993
EXECUTIVE SUMMARY

Authorization and Purpose

In the fall of 1992, the Wyoming Water Development Commission (WWDC) received an application to fund a feasibility study for construction of a re-regulating reservoir on Horse Creek. The application was submitted by the Goshen Irrigation District (GID) and subsequently approved by the WWDC for funding.

On May 18th, 1993 Lidstone & Anderson, Inc. (LA) entered into a contract with the WWDC to provide professional services related to the Goshen Irrigation District Re-regulating Reservoir Level II Project. As stated in the contract, the purpose of the Level II project is to investigate the feasibility of storing excess flows (operational waste) and storm flows in a re-regulating reservoir located on Horse Creek. The re-regulating reservoir would allow the GID to better utilize the operational waste and stormwater flows to satisfy their irrigation requirements throughout the irrigation season. Prior to submittal of the application for funding of the Level II project, the GID estimated that approximately 3,000 to 5,000 acre-feet of water could be conserved annually with construction of the re-regulating reservoir.

History of the Existing System

The Goshen Irrigation District (GID) is located in Goshen County, Wyoming. The primary source of water is obtained from the North Platte River via the Gering-Fort Laramie Canal. The water earmarked for the GID consists of a combination of direct flow rights in the North Platte River and storage rights within the reservoirs on the North Platte River. Approximately 52,484 acres of land in Wyoming and an additional 54,850 acres of land in Nebraska are served by the water conveyed in the canal. The Gering-Fort Laramie Canal begins at the Whalen Dam approximately 6 miles northwest of Fort Laramie, continues in a southeasterly direction, and finally exits Wyoming 7 miles south of Lyman, Nebraska.

Construction of a re-regulating reservoir would permit the storage of operational waste and stormwater flows for release later during the irrigation season. Operationally, the water stored in the reservoir may be released to meet the downstream commitments thereby conserving water taken from storage in the reservoirs on the North Platte River. Conceptually, the re-regulating reservoir is not intended to be a permanent impoundment; rather storage of the water will be temporary and may not exceed 10 to 14 days in duration. By conserving water in this manner, the irrigation season may be extended by the amount of water temporarily stored on an
annual basis in the re-regulating reservoir. Figure 1 presents a vicinity map indicating the location of the Gering-Fort Laramie Canal and Horse Creek.

Overview of the Level II Investigation

This Level II project initially focused on the evaluation of alternative sites for the re-regulating reservoir. During the scoping process, six alternatives for storage of the operational waste and stormwater flows were identified. Several of these alternatives were eliminated in the early phases of the project following conversations with board members of the GID. The GID, with the approval of the WWDC, recommended the following alternative sites for initial evaluation: (a) Horse Creek Siphon Site, (b) Coxbill Off-channel Site, (c) Cox Off-channel Site, and (d) storage within the main canal. A map illustrating the location of the alternative sites is presented on Figure 2.

A preliminary evaluation of the four alternatives storage locations was conducted. Criteria were established to evaluate the advantages and disadvantages of each site and a decision matrix developed to assist in the selection of the preferred reservoir location. Following a coordination meeting to discuss the alternative evaluation, the GID and WWDC selected a reservoir site for more detailed evaluation.

A geotechnical/geological investigation of the preferred site(s) was conducted and conceptual design information and cost estimates prepared. Operational considerations for the re-regulating reservoir were identified along with the permits necessary for construction of the reservoir. Finally, an economic analysis was completed to assist the State of Wyoming in the development of a fair and equitable financing plan for the project improvements.

Review of Alternative Sites

The focus of the Phase I investigation was the review of all potential storage alternatives. During the screening process, criteria were established to evaluate the advantages and disadvantages of each alternative. The criteria which were utilized to evaluate the alternatives included the following:

- storage potential;
- construction requirements (potential length and height of dam embankment, canal improvements, etc.);
- foundation/geologic constraints;
Figure 1. Vicinity Map.
Figure 2. Location Map of Alternative Storage Sites.
• water sources available for storage;
• material availability;
• considerations with respect to the operation of the canal and reservoir by the GID;
• water rights considerations;
• environmental issues;
• institutional constraints; and
• right-of-way/access/property acquisition considerations.

To assist in the selection of the recommended alternative, a decision matrix was developed. Each alternative was evaluated based on the above criteria. Through the evaluation process, the Coxbill Off-channel Site received the highest rating. It should be noted, however, that the environmental issues significantly reduced the feasibility of the Horse Creek Siphon Site. Assuming these issues could be resolved, the Horse Creek Siphon Site becomes a feasible alternative.

The results of the alternative evaluation were presented to the GID and the WWDC during a coordination meeting on September 3rd, 1993. A recommendation to proceed with the preparation of conceptual designs and detailed cost estimates for both the Coxbill Off-channel Site and Horse Creek Siphon Site was provided and approved by the GID and the WWDC.

Water Available for Storage/Operational Considerations

A detailed analysis of the diversion and spill records (daily water reports) of the GID was conducted to determine the water available for storage. This analysis provided the frequency and timing of the operational waste along with the average volume of water wasted on a biweekly, monthly, and annual basis. In addition, the average operational waste volume per month during the irrigation season was also identified.

Information from the daily water reports for the years from 1952 to 1992 were evaluated. The following table (Table 1) presents the results of the analysis.
Table 1. Results of Operational Waste Analysis (1952 to 1992).

<table>
<thead>
<tr>
<th>Duration</th>
<th>Available Water (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual</td>
<td>6,839</td>
</tr>
<tr>
<td>Average Monthly</td>
<td>1,368</td>
</tr>
<tr>
<td>Average Biweekly</td>
<td>684</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monthly Averages</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>1,371</td>
</tr>
<tr>
<td>June</td>
<td>2,114</td>
</tr>
<tr>
<td>July</td>
<td>1,030</td>
</tr>
<tr>
<td>August</td>
<td>566</td>
</tr>
<tr>
<td>September</td>
<td>1,758</td>
</tr>
</tbody>
</table>

The results indicate an average annual operational waste volume of approximately 6,840 acre-feet. Assuming water is stored and released every two weeks during the irrigation season, the capacity of the reservoir would need to be approximately 680 acre-feet.

To more fully utilize the re-regulating reservoir to meet the needs of the GID, a set of operational rules were developed. These rules, formulated in conjunction with Mr. Bill Vandivoort of the GID, reflect: (a) the timing of the releases through the reservoir to meet the peak demand; and (b) storage of the majority of the operational waste on annual basis.

The simulation of the reservoirs incorporated the operational rules with the reservoir storage volumes and the results of the operational waste analysis. The volume available for storage of operational waste at the Horse Creek Siphon Site was determined to be 390 acre-feet assuming minimum criteria for freeboard. For the Coxbill Off-channel Site, volumes of 550 acre-feet and 850 acre-feet were determined for a dam embankment placed on the Coxbill property or Michael property, respectively. The following conclusions were obtained from the storage simulations:

1. For each simulation, the re-regulating reservoir captures 100% of the operational waste on an annual basis or approximately 6,840 acre-feet.

2. The additional capacity in the main canal in July and August, created by the re-regulating reservoir, provides the GID with the following increase in water delivered to its users:
3. The extension to the irrigation season, assuming a GID diversion of 500 cfs at Whalen Dam, is determined by subtracting the additional water utilized during July and August from the annual capture of operational waste. The number of days of additional water is summarized below.

Horse Creek Siphon Site ................ 5.5 days (5,398 acre-feet)
Coxbill Off-channel Site
  located on Coxbill property ............ 5.3 days (5,248 acre-feet)
  located on Michael property .......... 5 days (4,876 acre-feet)

It is obvious that significant storage volumes can be captured by the re-regulating reservoir during the average year. Unfortunately, the benefits to the GID are limited during the time of peak irrigation demand. To fully benefit by the operational waste generated during the operation of the canal system would require a much larger reservoir (in excess of 7,000 acre-feet) that would release 70 cfs from the reservoir from July 15th to the end of August. GID could conceivably deliver an additional 70 cfs to its users during this time period; consequently, a reservoir of this magnitude could not only conserve water annually, but provide GID with an increased capability to provide water to its users during the peak irrigation demand.

Conceptual Design and Cost Estimates

The conceptual design included the determination of the geometry of the dam embankment along with the configuration of the outlet works and all appurtenant structures. The conceptual design information was completed in sufficient detail to promote the estimation of unit costs and the development of total costs for the final design and construction of the project. For the re-regulating reservoir, cost estimates were prepared for the Horse Creek Siphon Site, Coxbill Off-channel Site located on the Coxbill property and the Coxbill Off-channel Site located on the Michael property. The total project costs and repayment plan for the three alternative sites are presented in Table 2.
Table 2. Total Project Costs and Repayment Plan.

<table>
<thead>
<tr>
<th>Item</th>
<th>Horse Creek Siphon</th>
<th>Coxbill Off-Channel Site (Coxbill Property)</th>
<th>Coxbill Off-Channel Site (Michael Property)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Project Cost</td>
<td>$ 1,037,245</td>
<td>$ 1,464,195</td>
<td>$ 1,570,810</td>
</tr>
<tr>
<td>50% Loan</td>
<td>$ 518,625</td>
<td>$ 732,100</td>
<td>$ 785,405</td>
</tr>
<tr>
<td>Repayment Factor (25 years @ 4%)</td>
<td>0.06401</td>
<td>0.06401</td>
<td>0.06401</td>
</tr>
<tr>
<td>Annual Payment</td>
<td>$ 33,200</td>
<td>$ 46,860</td>
<td>$ 50,275</td>
</tr>
</tbody>
</table>

As indicated in Table 2, the annual cost to divert and benefit from an additional 6,840 acre-feet is estimated to be $33,200, $46,860, or $50,275 respectively for reservoirs with storage volumes of 390, 550 and 850 acre-feet. Consequently, the cost per acre-foot of water becomes $4.85 for construction of the Horse Creek Siphon Site, $6.85 for construction of the Coxbill Off-channel Site located on the Coxbill property, and $7.35 for construction of the Coxbill Off-channel Site located on the Michael property.

Economic Analysis

Net benefits attributable to the project were estimated to be $7.98 per acre-foot of water assuming an additional water supply of 6,840 acre-feet. The benefit-cost ratios for construction of the re-regulating reservoir ranged from 1.64 (Horse Creek Siphon Site) to 1.16 (Coxbill Off-channel Site on the Michael property). The proposed annual project costs of $33,200 (Horse Creek Siphon Site), $46,860 (Coxbill Off-channel Site on Coxbill property) or $50,275 (Coxbill Off-channel Site on Michael property) represent a $0.63, $0.89, or $0.96 increase, respectively in the existing assessment for a total of either $19.39, $19.65 or $19.72 per acre per year.

Conclusions and Recommendations

The following conclusions and recommendations generated during the completion of this Level II study are provided below.
1. Approximately 6,840 acre-feet of operational waste is available for storage during the average irrigation season. Average monthly operational waste volumes range from 566 acre-feet in August to 2,114 acre-feet in June.

2. Two sites were selected for preparation of conceptual designs and detailed cost estimates. These sites include the Horse Creek Siphon Site and the Coxbill Off-channel Site. The storage capacity available at these sites is provided below.

<table>
<thead>
<tr>
<th>Site</th>
<th>Storage Capacity (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse Creek Siphon Site</td>
<td>390</td>
</tr>
<tr>
<td>Coxbill Off-channel Site</td>
<td></td>
</tr>
<tr>
<td>Coxbill Property</td>
<td>550</td>
</tr>
<tr>
<td>Michael Property</td>
<td>850</td>
</tr>
</tbody>
</table>

3. Through frequent filling and drawdown cycles, both the Horse Creek Siphon Site and the Coxbill Off-channel Site can store the annual operational waste volume of 6,840 acre-feet. The relatively small storage volumes limit the release of water necessary to fully satisfy the peak irrigation demands in July and August. At best, approximately 1,954 acre-feet of additional water are provided during this time period. To fully utilize the operational waste during the months of July and August would require a reservoir in excess of 7,000 acre-feet.

4. Benefits to the GID include conservation of storage during an allocation year with the potential of extending the irrigation season by the amount of water conserved. On an average year, the irrigation season could be extended by a maximum of 5.5 days. In addition, utilization of operational waste to satisfy downstream users on Horse Creek will create additional conveyance capacity in the Fort Laramie Canal for the GID. This additional capacity can provide more water to the GID users during the peak irrigation season and will increase the average annual water usage by the GID. Based on the procedures for allocating storage to the GID during an allocation year, increasing the long-term average annual water usage will result in an increase in allocated storage.

5. The annual cost to store the additional 6,840 acre-feet is estimated to be $33,200 for construction of a re-regulating reservoir on the Horse Creek Siphon Site; $46,860 for construction of the re-regulating reservoir on the Coxbill Off-channel Site located on the Coxbill property; and $50,275 for construction of the re-regulating reservoir on the Coxbill Off-channel Site located on the Michael
Property. This results in a cost per acre-foot ranging from $4.85 to $7.35. Costs associated with construction of the re-regulating reservoir are estimated to increase the annual assessment from $18.76 per acre to either $19.39, $19.65 or $19.72 per acre.

6. Typical of a new reservoir project, permitting requirements and institutional constraints must be addressed before funding can be appropriated and construction initiated. Construction of a reservoir on or adjacent to Horse Creek will require the approval of several agencies including the Corps of Engineers, U.S. Bureau of Reclamation, U.S. Fish & Wildlife Service, and the State Historic Preservation Office. In addition, the State of Nebraska is likely to oppose the construction of a reservoir that will store water presently conveyed across the state line. Environmental interest groups supporting the enhancement of wildlife habitat on the Platte River in Nebraska are also likely to oppose construction of the reservoir. A more detailed investigation of these issues is recommended prior to proceeding with Level III design and construction. This can be accomplished by scheduling a Section 404 permit pre-application meeting with the Corps of Engineers. This meeting will involve limited manpower and generate minimum costs; it will also: (a) identify potential problems that may prohibit the construction of the reservoir, or (b) provide incentive to pursue either the re-regulating reservoir or a reservoir on Horse Creek that can provide storage in excess of 7,000 acre-feet.

7. Although a significant volume of water is conserved annually by the construction of the re-regulating reservoirs identified during this project, limited benefits are accrued during the time period when the irrigation requirements are the highest. Long-term benefits can be achieved by increasing the storage allocation to GID. Short-term benefits include an extension of the irrigation season during an allocation year. Given this information, the costs to construct the reservoirs and the potential permitting requirements, we do not recommend proceeding into Level III design and construction at this time.