EXECUTIVE SUMMARY
OF THE FINAL REPORT

COKEVILLE TRI-DIVERSION STRUCTURES
LEVEL II PROJECT

LOOKING D/S ALONG
THE TRI-DIVERSION STRUCTURE
TRASH RACK

LOOKING D/S OF ALONG
THE TRI-DIVERSION STRUCTURE

SUBMITTED TO THE
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EXECUTIVE SUMMARY

COKEVILLE TRI-DIVERSION STRUCTURES
LEVEL II PROJECT

PREPARED FOR:

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November 1, 1995
EXECUTIVE SUMMARY

Authorization and Purpose

In the fall of 1994, the Wyoming Water Development Commission (WWDC) received an application to fund a feasibility study for the rehabilitation of the Cokeville Tri-Diversion Structures. The application was submitted by the Cokeville Watershed Improvement District (CWID) and subsequently approved by the WWDC for funding.

On June 2, 1995 Lidstone and Anderson, Inc. (LA) entered into a contract with the WWDC to provide professional services related to the Cokeville Tri-Diversion Structure, Level II Project. As stated in the contract, the purpose of the Level II project is to investigate the feasibility of modifying or rehabilitating the existing structures. Improvements to the structures would allow the CWID to: (a) more effectively divert flood flows within the Smiths Fork; (b) minimize the existing debris and trash accumulation problems; and (c) reduce the costs associated with the annual operation and maintenance of the structures. The feasibility study was completed in two phases; Phase I involved the identification and evaluation of alternative improvements while Phase II pertained to the preparation of conceptual designs and cost estimates associated with the rehabilitation measures or improvements selected for implementation. This document summarizes the results generated during the Phase I and Phase II efforts.

History of the Project

As indicated on Figure 1, the Cokeville Tri-Diversion Structures are located in Lincoln County on the Smiths Fork approximately one mile northeast of the Town of Cokeville. The structures originally constructed at that location consist of: (a) a concrete diversion dam across the main channel of the Smiths Fork; (b) a headwall and headgate structure across the South Fork (Middle Channel); and (c) a headwall and headgate structure across Spring Creek. These facilities were designed by the Soil Conservation Service (SCS) and constructed in 1963 to primarily serve as a flood control structure for the Town and 12 farmers irrigating from the South Fork and Spring Creek. In 1964, a trash rack was designed by the SCS and constructed to mitigate the debris and sediment accumulation in the vicinity of the headgates. These facilities presently continue to divert flood waters during spring runoff and thunderstorm events as well as irrigation water during the irrigation season.
Figure 1. Location and Vicinity Map.
In 1984, the Corps of Engineers (COE) conducted a flooding investigation of the Smiths Fork near Cokeville. During the COE investigation, it was noted that the Smiths Fork overflows and causes damage an average of once every three years. The COE also noted that flooding near the community was aggravated by debris accumulation and sediment deposition where the channel gradient flattens and deposition causes flood flows to overtop the streambanks.

In response to the continued operation and maintenance efforts to reduce the debris accumulation at the diversion structures, the District placed additional trash screens on the existing trash rack structure in approximately 1986. These trash screens consist of a square framed metal plate with perforations to allow the conveyance of water through the metal plate.

In recent years, the debris problem was addressed by the placement of a concrete-block, cable-stayed jetty immediately upstream of the diversion facilities. The jetty is only partially effective to divert or deflect debris from the trash rack structure and may exacerbate the sediment deposition problems in the immediate vicinity of the headgates.

Presently, the District continues to endure debris and sediment accumulation on an annual basis in the vicinity of the existing trash rack and diversion structures. Annual operation and maintenance costs associated with removal of the debris and sediment are excessive with daily maintenance of the facilities often required during the spring runoff period.

**Inventory and Assessment of Existing Structures**

Given that the existing structures were constructed over 30 years ago, each structure appears to be in good overall condition. The concrete shows very little deterioration due to freeze-thaw action, abrasion, ice loading or mineral/chemical attack. All concrete surfaces which were inspected exhibit a dense, durable and smooth texture with no evidence of cracking or spalling. All exposed steel portions including gates, gate frames, stems, pilings, catwalk supports and trash rack bars are in equally good physical condition.

The diversion into the South Fork consists of two arch corrugated metal pipes. The crown of each pipe has collapsed approximately 6 inches, probably due to heavy equipment traffic during maintenance operations. In addition, the headwall for the South Fork diversion structure has settled approximately 2 inches on the north end. This settlement has resulted in a clockwise rotation of the headwall away from the vertical construction joint along the south end. No noticeable deterioration of the diversion structure in the Smith Fork or the Spring Creek headgate was noted.

In general, the catwalk along the trash rack should be improved. The improvements include replacement of the boards along the catwalk, widening the catwalk to 36 inches and replacement of the handrails to the standards promulgated by the OSHA and the USBR.
Historically, the Tri-Diversion Structures have been operated to promote the diversion of water for both irrigation and flood control. Maintenance efforts have largely been associated with the removal of debris and sediment accumulation during the periods of high flows or spring runoff. Daily monitoring and removal of debris accumulated on the trash rack structure is frequently necessary. In addition, dredging operations have been conducted as often as every other year to remove the sediment accumulated in the Smiths Fork, in the forebay between the trash rack structure and the headgates, and in the South Fork and Spring Creek. Presently, sediment has accumulated in the southern arch CMP associated with the South Fork headwall and diversion structure. Approximately 1 foot of sediment has accumulated in the CMP; removal of this sediment will be necessary to ensure the maximum available capacity of the diversion pipe.

With the exception of the noted deficiencies, the structures are in good physical condition. Providing the historical maintenance practices of the CWID are continued, it is estimated that at least 20 years of serviceable life remains.

Summary of Alternative Evaluation

Based on the results of the field investigation and the subsequent technical analysis, the following alternatives were identified:

A. Install improved flow diversion structures/jetties that will be more effective in deflecting the debris downstream.

B. Replace the existing trash rack with a floating boom structure to deflect the debris downstream.

C. Relocate the existing diversion structures upstream to a straight reach of the Smiths Fork and install flow diversion structures/jetties.

D. Modify the existing structure to incorporate improvements to the height, alignment, and spacing of the trash bars along with improvements that will flush sediment downstream or localize sediment deposition.

Several criteria were utilized to evaluated the alternatives listed above. These criteria included: (a) ability to divert water for flood control purposes; (b) ability to alleviation of debris accumulation problems; (c) ability to mitigate the sediment accumulation problems; (d) capital construction costs; and (e) long-term operation and maintenance costs. To assist in the selection of the recommended alternative, a decision matrix was developed. Alternative D received the
highest rating during the evaluation process. The following specific improvements were associated with Alternative D.

- Placement of trash bars from the bottom of the channel in an alignment angle that will promote the utilization of the hydraulic forces to float the debris to the top of the flow and ultimately downstream.

- In conjunction with placement of the trash bars, installation of a metal plate on top of the trash bars that will serve to skim and sweep the debris downstream. As debris is floated to the skimmer plate, the flood waters will be diverted through the trash bars and below the skimmer plate.

- Placement of a concrete sill and sedimentation basin adjacent to the trash rack structure. The concrete sill will promote the flushing of sediment downstream of the trash rack. Additional sediment that is conveyed through the trash bars will be captured by the sedimentation basin to facilitate removal.

In conjunction with these specific improvements, several design considerations were identified for more detailed investigations during the Phase II conceptual design of the proposed improvements. These design considerations are itemized below.

- The optimal height, spacing and angle of inclination of the trash bars were identified to promote the removal of debris and the diversion of the flood waters.

- The elevation and height of the sheet metal plate were investigated to promote the sweeping of debris downstream and also ensure that the orifice opening is sufficient to divert the necessary flood waters.

- Transitions into and out of the trash rack structure were designed to minimize the creation of eddy zones that would otherwise trap debris and accumulate sediment.

- The upstream southern bank of the Smiths Fork was realigned to coincide with the improvements to the trash rack and improve the transition into the structure.

- Removal of the existing concrete jetty was necessary to allow the concentration of the meander thalweg along the outside of the bend. This will promote the removal of debris from the trash rack.

- The optimal height of the concrete sill was determined. This height should promote the flushing of sediment downstream.

- An operation plan was developed to regulate the headgates for both the South Fork and Spring Creek during high flows. The plan incorporates a means to identify the flow rate in the Smiths Fork and then regulate the headgates to
remove a portion of the flood flows. Staff gages in both Spring Creek and the South Fork are necessary to identify the appropriate settings for the headgates.

**Conceptual Design and Cost Estimates**

Based on the alternative recommendation, conceptual design details and cost estimates were generated for the rehabilitation of the Cokeville Tri-Diversion structures. The capital construction cost includes the following major project components.

- Modifications to the existing trashrack structure including: (a) removal of the existing trash bars and screens; (b) removal and replacement of existing walkway and handrails; (c) construction of a sediment sill; and (d) installation of inclined trash bars and skimmer plate.
- Removal and disposal of the existing concrete jetty.
- Realignment of the southern bank of the Smiths Fork upstream of the Cokeville Tri-Diversion structures.
- Modifications to the forebay between the existing trash rack and the head gates to the South Fork and Spring Creek.
- Placement of fill material over the culverts associated with the South Fork headgate and diversion structure.
- Bank stabilization along the south bank of the Smiths Fork downstream of the diversion structure.

The total project cost and final repayment plan are presented in Table 1. All WWDC funding for the project is assumed to be in the form of a 50% grant and 50% loan. The terms of the loan assume an interest rate of 4% for a period of 30 years. Furthermore, construction is assumed to be completed in one construction season.

Conversations with the CWID indicated a desire to construct the project over the course of two construction seasons. Construction during the first season would involve the realignment of the Smith Fork upstream of the structures and removal of the jetty. The remaining items would be installed during the second season of construction. Table 1 reflects the total project cost and final repayment plan if construction is completed over the course of two construction seasons.
Table 1. Total Project Cost and Repayment Plan.

<table>
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<th>Scenario 1. One Construction Season</th>
<th>Item</th>
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<tr>
<td></td>
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<td></td>
<td>Annual Payment</td>
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<td>Annual Payment</td>
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Finally, the CWID also indicated their desire to conduct a physical model of the proposed improvements. It is believed that the physical model would be utilized to refine the recommended improvements to more efficiently divert flood flows and remove the sediment and debris accumulated in the vicinity of the structure. Consequently, the physical model would provide an increased level of confidence that the recommended improvements will successfully mitigate the existing problems. The total project cost and final repayment plan assuming completion of a physical model is also presented in Table 1.
Economic Analysis

For the users associated with the Cokeville Watershed Improvement District, an annual assessment is levied to each property owner. On March 14, 1994 the District changed their method of tax assessment as follows:

- $5.00 for each landowner who owns less than or equal to 1 acre of land within the Town of Cokeville;
- $10.00 for each landowner who owns greater than 1 acre of land within the Town of Cokeville; and
- $0.25 per acre for agricultural land located outside the Town of Cokeville and within the boundaries of the District.

For the 1995 assessment year, the District collected $1,085.05 from residential landowners and $1,066.07 from agricultural users for a total annual assessment of $2,151.12. Depending on the construction scenario (one construction season versus two construction seasons) and the addition of a physical model, the annual payment to retire the debt ranges from $3,623 to $4,614. Adding the annual payment for each scenario to the existing tax assessment results in a required annual assessment ranging from $5,594 to $6,765. This represents an increase of 268% to 315% in the current annual assessment. Depending on the construction scenario and the completion of physical modeling, the District would need to increase the tax assessment to:

- a minimum of $13.40 (one construction season, no physical model) up to a maximum of $15.75 (two construction seasons, physical model) for each landowner who owns less than or equal to 1 acre of land within the Town of Cokeville;
- a minimum of $26.80 (one construction season, no physical model) up to a maximum of $31.50 (two construction seasons, physical model) for each landowner who owns greater than 1 acre of land within the Town of Cokeville; and
- a minimum of $0.67 (one construction season, no physical model) up to a maximum of $0.79 (two construction seasons, physical model) per acre for agricultural land located outside the Town of Cokeville and within the boundaries of the District.
Conclusions and Recommendations

Based on the information presented in the previous chapters, the following conclusions and recommendations are provided.

1. Modifications recommended to mitigate the existing debris and sediment accumulation problems include the items listed below.
   - Removal of the existing trash rack members (horizontal bars and perforated screens) and replacement with a structure consisting of inclined trash bars and a steel skimmer plate. A sediment sill is incorporated into the proposed improvements to limit the transport of sediment through the trash rack structure.
   - Excavation of the forebay between the trash rack structure and the headgates to the South Fork and Spring Creek.
   - Realignment of approximately 200 feet of the upstream left (southern) channel bank.
   - Removal of the existing concrete jetty.
   - Placement of additional fill material over the crossing of the South Fork immediately west of the headgate. This fill will prevent the collapse of the existing culverts.
   - Regrading and placement of rock revetment along 40 feet of the left (south) channel bank immediately downstream of the existing diversion structure. The revetment is intended to mitigate erosion of the bank at this location.

2. Assuming construction is completed in one construction season, the cost associated with construction of the recommended improvements is estimated to be $88,250. The total project cost including the costs associated with engineering, permitting, access and right-of-ways and a 15% contingency is estimated to be $125,286. Assuming a 50% grant and 50% loan (30 years @ 4%) from the WWDC, the annual payment necessary to retire the debt is estimated to be $3,623. If physical modeling is added to this scenario, the total project cost becomes $152,890 with an annual payment of $4,420.

3. Assuming construction is completed in two construction seasons, the cost associated with construction of the recommended improvements is estimated to be $92,750. The total project cost including the costs associated with engineering, permitting, access and right-of-ways and a 15% contingency is estimated to be $132,005. Assuming a 50% grant and 50% loan (30 years @
4% of the WWDC, the annual payment necessary to retire the debt is estimated to be $3,817. If physical modeling is added to this scenario, the total project cost becomes $159,595 with an annual payment of $4,614.

4. To meet the debt retirement, the District would need to increase the tax assessment from:

- $5 to a minimum of $13.40 (one construction season, no physical model) or as much as $15.75 (two construction seasons, physical model) for each landowner owning less than or equal to 1 acre of land within Cokeville;

- $10 to a minimum of $26.80 (one construction season, no physical model) or as much as $31.50 (two construction seasons, physical model) for each landowner owning greater than 1 acre of land within Cokeville; and

- $0.25 to a minimum of $0.67 (one construction season, no physical model) or as much as $0.79 (two construction seasons, physical model) per acre for agricultural land located outside the Town of Cokeville and within the boundaries of the District.

5. An operation plan should be implemented to maximize: (a) the diversion of flood waters into the South Fork and Spring Creek, and (b) the diversion of water to meet irrigation requirements during low flows.

Given the information presented above, we recommend proceeding into Level III design and construction at this time. It is important to understand, however, that the recommended improvements will not alleviate the requirements for debris removal. The trash rack structure will continue to accumulate debris and will require periodic maintenance. However, the addition of the proposed improvements to the trash rack structure will significantly reduce the maintenance requirements and will promote the diversion of flood water. Given the complex nature of the channel hydraulics coupled with the debris and sediment accumulation problems, a physical model should be considered either prior to, or in conjunction with, the Level III design effort. The physical model will provide an increased level of confidence that the recommended improvements will successfully mitigate the existing problems. In addition, the model can be utilized to refine the recommended improvements to more efficiently remove the sediment and debris accumulated in the vicinity of the structures.