This is a digital document from the collections of the Wyoming Water Resources Data System (WRDS) Library.

For additional information about this document and the document conversion process, please contact WRDS at wrds@uwyo.edu and include the phrase “Digital Documents” in your subject heading.

To view other documents please visit the WRDS Library online at: http://library.wrds.uwyo.edu

Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)
EXECUTIVE SUMMARY

OF THE

LECLAIR IRRIGATION REHABILITATION PROJECT

LEVEL II
EXECUTIVE SUMMARY

OF THE

LECLAIR IRRIGATION REHABILITATION PROJECT

LEVEL II

Prepared for
Wyoming Water Development Commission
Cheyenne, Wyoming
and
LeClair Irrigation District
Riverton, Wyoming

By
Crank Companies, Incorporated
Consulting Engineering and Land Surveying Division
722 Cedar Avenue
Kemmerer, Wyoming 83101

November 28, 1988
INTRODUCTION

The LeClair Irrigation District is located in Water Division No. 3 of the State of Wyoming, and just to the west and north of the City of Riverton, Wyoming. The District is comprised of approximately 31 miles of canals and provides water to approximately 850 operators, irrigating just over 13,000 acres.

In 1984 the district requested the United States Department of Agriculture (USDA), Soil Conservation Service (SCS) study their irrigation water delivery system. An item to be studied included an evaluation of structural rehabilitation required for the various structures along the canal. In September 1987 the SCS released its report, the LeClair Irrigation District RB-09 Study, and identified six structures estimated to have a remaining useful life from zero to two years. The failure of any one of these structures could shut down the entire portion of the irrigation system below the point of failure.

The LeClair Irrigation District then submitted an application for assistance in evaluating design alternatives to replace the six structures to the Wyoming Water Development Commission. The Wyoming Legislature early in 1988 authorized the Water Development Commission to conduct this Level II Feasibility Study of the LeClair Irrigation Rehabilitation Project. The Water Development Commission then issued its Request for Proposals No. 88-13, and subsequently entered into an agreement with Crank Companies, Incorporated (CCI) to perform this study.

PROJECT PURPOSE

The purpose of this study is to determine the feasibility of options available to the District to prevent a shut down of the system should a failure in any of the following structures occur:

A. Cooper No. 1 Chute, station 839+68
B. Jake Haun Chute (Cooper No. 2), station 897+60
C. Sievelcribs Chute (Cooper No. 3), station 908+16
D. Flume, Station 913+44
E. Stagg Chute (Stagg Drop), station 982+08
F. Hog Farm Chute, station 1452+00

This study has been conducted in two phases. Phase I being the evaluation of at least two preliminary design alternatives and cost estimates for the rehabilitation of each of the six structures. Phase II being the development of the preferred alternative, determined in Phase I, into conceptual designs, cost estimates, ability to pay and finance, and any additional right of way acquisition that may be required.
PHASE I

CONDITION OF EXISTING STRUCTURES

The condition of the existing structures were evaluated based on a site visit and photographs made in March 1988 when the structures were dry and site visits made at the time of the scoping meetings. Our personnel reviewed each of the six structures and subsequently did agree with the SCS findings that each of the structures was in need of replacement.

During our right-of-way acquisition surveys of October, 1988, all of the structures were again observed in the dry state. No additional damages were readily visible in the top four structures, but additional deterioration was noted at the Stagg Drop Chute and Hog Farm Chute. The sink holes on the outside of the stilling basin walls at the head of the Stagg Drop Chute have increased in size, as well as additional erosion being noted along the north side of the chute above the bridge. The chute at Hog Farm has spalled considerably since last spring. It is recommended by Crank Companies, Incorporated that these two structures be reconstructed as soon as possible.

PRELIMINARY ALTERNATIVES REVIEW

Several meetings were held during Phase I in which various design alternatives were discussed for each of the six structures in question. These meetings began the elimination process of potential designs down to two to four alternatives for each structure. The finalized preliminary design alternatives considered in Phase I are as listed below.

1. Cooper No. 1 and Cooper No. 2 Chutes
   a) Replace both with a single pipeline and channel realignment.
   b) Replace both with similar structures.
   c) Replace both with a single concrete chute and channel realignment.

2. Cooper No. 3 Chute and Flume at 913+44
   a) Replace both with a single pipeline and canal realignment.
   b) Replace both with similar structures.
   c) Replace the flume with a raised channel over culverts at the drainage crossing.
   d) Replace both with a single concrete chute and canal realignment.

3. Stagg Chute
   a) Replace with a similar structure.
   b) Replace with a pipe drop.
4. Hog Farm Chute

a) Replace with a similar structure.
b) Replace with a pipeline and channel realignment.
c) Replace with a concrete chute and canal realignment.

At the scoping meetings in early July it was reported that the upper five canal structures should be designed to handle a flow of 200 cfs. It was also reported at this time that the flow in the canal can vary greatly during the day and is dependent on the amount of water taken out of the canal above by the City of Riverton. All of the upper five structures pipelines were thus designed for an average flow of 200 cfs, but can handle a maximum flow of 300 cfs without causing excessive backwater depths above the pipe inlets.

Design flows at the Hog Farm Chute are considerably lower than the five other structures in this study. Based on measurements made in March 1988 of the existing chute, and a measured water mark (stain on side of chute) an average flow of 175 cfs was calculated at this chute. Then as a factor of safety all design calculations for the Hog Farm Chute were based on a maximum flow of 225 cfs. All pipeline designs were based on culvert design procedures, as the pipes are relatively short, on steep grades, must handle large volumes without excessive backwater depths at the inlets, and pipeline submergence below the tailwater depths of the outlets would cause stilling basin drainage problems when the system is shut down for the winter.

All preliminary designs of replacement with similar structures involved installing an inlet structure and chute of the same size as the original ones but replacing the outlet structures with a modified design sized to better handle the design flows.

A more detailed description of each of the preliminary designs can be found in the Alternatives Review section of the Phase I report.

PRELIMINARY ALTERNATIVES COST COMPARISONS

Preliminary cost estimates of each of the preliminary design alternatives were preformed and are presented in Table 1 of the following page. All cost estimates reflect 1989 construction costs, plus an additional 15% for contingencies, and an additional 10% for engineering of the structures. All cost estimates were based on the same unit prices for similar items, and due to discounting on larger projects and mobilization factors, the smaller the cost estimate presented the larger the possible percent error in cost. It is thus recommended that in bidding any of the smaller alternatives, they should be included with at least one other larger alternative to reduce the overall cost of the structures.

Also presented in Table 1 are cost estimates the SCS prepared and presented in its report Wyoming Cooperative Irrigation Water Conservation Study for the LeClair Irrigation District, dated September 1987. The SCS report presented its construction cost estimates for replacement alternatives based on 1986 prices. Crank Companies,
### Table 1
LeClair Irrigation District - Wyoming Water Development Commission
LeClair Irrigation Rehabilitation Project Level II
Phase I
ALTERNATIVE COST COMPARISONS

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>1986-SCS REPLACEMENT CONSTRUCTION COST</th>
<th>SCS - COST PROJECTED TO 1989 PLUS 10% ENGINEERING</th>
<th>CCI-1989 ESTIMATED REPLACEMENT COST OF SIMILAR STRUCTURE (a)</th>
<th>CCI - ALTERNATIVE REPLACEMENT COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOPER #1</td>
<td>Replace w/pipe drop $64,500</td>
<td>$78,300</td>
<td>$55,400</td>
<td>Pipeline to replace both Cooper #1 and Cooper #2</td>
</tr>
<tr>
<td>COOPER #2</td>
<td>Replace w/pipe drop $39,000</td>
<td>$47,350</td>
<td>$46,500</td>
<td>$150,800*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Concrete Chute to replace both Cooper #1 and Cooper #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$120,000</td>
</tr>
<tr>
<td>COOPER #3</td>
<td>Replace w/pipe drop $58,000</td>
<td>$70,400</td>
<td>$76,200</td>
<td>Pipeline to replace both Cooper #3 and Flume (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$128,500</td>
</tr>
<tr>
<td>FLUME 913+44</td>
<td>Replace w/siphon $43,000</td>
<td>$52,200</td>
<td>$25,850</td>
<td>Channel over Culverts (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Concrete Lined $27,025</td>
</tr>
<tr>
<td>STAGG DROP</td>
<td>Replace w/pipe drop $54,000</td>
<td>$65,500</td>
<td>$85,950</td>
<td>Replace w/pine drop $ 89,700</td>
</tr>
<tr>
<td>HOG 1AW1 CHUTE</td>
<td>Replace w/conc. chute $30,000</td>
<td>$36,400</td>
<td>$26,300</td>
<td>Pipeline and Channel Realignment $ 91,150</td>
</tr>
</tbody>
</table>

SCS costs taken from "Wyoming Cooperative Irrigation Water Conservation Study" for LeClair Irrigation District, Sept. 1987
* Revised after meeting 8/18/88 to match alignment of Alternative #2
** Added as Addendum No. 1 to Phase 1 Report 9/20/88
Incorporated then projected these costs to 1989 using 3% inflation for 1987 and 1988 and 4% inflation to 1989. Then an additional 10% engineering fee was added to the construction cost.

D. SOILS REPORT CONCLUSIONS

Our subconsultant, Chen and Associates, preformed soils testing at the five drill hole sites selected by our personnel. The basic conclusions of the soils report are as follows:

1. Structures to be placed on the bedrock encountered can be designed for an allowable soil bearing pressure up to 10,000 psf. Structures located on the dense gravel found at the base of the Cooper No. 3 Chute can be designed for a maximum soil bearing pressure of 5,000 psf.

2. All overburden materials above bedrock are suitable for backfill and bedrock materials may be suitable provided they do not excavate in large chucks.

3. All of the soils and bedrock can be excavated with conventional equipment, such as large backhoes. Some layers in bedrock may require the use of percussion hammers or light blasting.

4. Type II cement is recommended for use of all concrete structures.

5. All backfill should be compacted to at least 95% standard proctor density.

6. Concrete placement for structure support should not be placed on loose material over bedrock, but should rest directly on bedrock or a grout cap.

The report did not identify any soil conditions that would cause cost increases above that of general construction work. A copy of the complete report can be found in Appendix E of the final report.

PHASE I PREFERRED ALTERNATIVES

At the completion of Phase I a report presentation meeting was held on September 15, 1988. The following alternatives were selected as the preferred alternatives for each of the structures studied:

Cooper #1 and Cooper #2 Chutes - replace both structures with a single concrete chute and channel realignment.

Cooper #3 Chute and Flume @ 913+44 - replace both with a single concrete chute and channel realignment.

Stagg Drop - replace with a pipe drop without a pipe size reduction.

Hog Farm Chute - replace with a similar structure.

With the selection of the preferred alternatives Phase I was
completed.

PHASE II

STUDY PROCEDURE

Phase II of this project consists of taking data and information compiled during Phase I and refining it so that conceptual designs and cost estimates could be prepared for each of the preferred alternatives selected in Phase I. Economic analysis was then preformed based on the conceptual design cost estimates so that the most economical financing plan could be identified to the LeClair Irrigation District. Additional items included in Phase II were archeological site identification maps so that archeological clearance can be obtained for the project, maps and descriptions so that easements can be obtained on lands in which reconstruction is to take place, and ownership mapping in areas of the proposed reconstruction.

CONCEPTUAL DESIGNS

Conceptual designs of each of the four preferred alternatives were prepared based on refined information from Phase I and more detailed design calculations for the specific alternatives. Design calculations were intended to properly size the systems to handle the design flows, but not to design the structural integrity of the various components of the systems. Actual wall thicknesses, reinforcing steel, footing design, slope anchors, etc., would be designed during Level III, construction design, of the project. Conceptual designs of each of the four preferred alternatives were presented in Appendix A of the final report.

CONCEPTUAL COST ESTIMATES

Cost estimates were prepared from take offs of the conceptual designs. These cost estimates are based on 1990 construction costs, with a 10% fee added for construction engineering, and an additional 15% of construction cost added for construction contingencies. In addition the cost to provide construction inspection for each recommended alternatives was prepared. Construction inspection costs are estimated on the basis that each alternative structure would be let for construction by competent contractors. The estimated cost of each alternative is presented below.

I. COOPER NO. 1 AND COOPER NO. 2 - (Replace both structures with relocated canal and concrete chute)

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Construction Cost</td>
<td>$97,070.00</td>
</tr>
<tr>
<td>Contingency 15%</td>
<td>14,561.00</td>
</tr>
<tr>
<td>Engineering Design 10%</td>
<td>9,707.00</td>
</tr>
<tr>
<td>Construction Inspection 8%</td>
<td>7,765.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$129,103.00</strong></td>
</tr>
</tbody>
</table>
II. COOPER NO. 3 AND FLUME @ 913+44 - (Replace both structures with concrete chute and on canal realignment)

<table>
<thead>
<tr>
<th>Estimated Construction Cost</th>
<th>$111,458.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingency 15%</td>
<td>16,719.00</td>
</tr>
<tr>
<td>Engineering Design 10%</td>
<td>11,146.00</td>
</tr>
<tr>
<td>Construction Inspection 8%</td>
<td>8,916.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$148,239.00</strong></td>
</tr>
</tbody>
</table>

III. STAGG DROP CHUTE - (Replace with pipe drop)

<table>
<thead>
<tr>
<th>Estimated Construction Cost</th>
<th>$91,009.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingency 15%</td>
<td>13,651.00</td>
</tr>
<tr>
<td>Engineering Design 10%</td>
<td>9,101.00</td>
</tr>
<tr>
<td>Construction Inspection 8%</td>
<td>7,280.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$121,041.00</strong></td>
</tr>
</tbody>
</table>

IV. HOG FARM - (Replace with similar structure)

<table>
<thead>
<tr>
<th>Estimated Construction Cost</th>
<th>$22,347.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingency 15%</td>
<td>3,352.00</td>
</tr>
<tr>
<td>Engineering Design 10%</td>
<td>2,235.00</td>
</tr>
<tr>
<td>Construction Inspection 8%</td>
<td>1,788.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$29,722.00</strong></td>
</tr>
</tbody>
</table>

**SUMMARIZING THE ABOVE ESTIMATES COSTS**

| TOTAL ESTIMATED CONSTRUCTION COST | $321,884.00 |
| TOTAL ESTIMATED CONTINGENCY       | 48,283.00   |
| TOTAL ESTIMATED ENGINEERING       | 32,189.00   |
| TOTAL ESTIMATED CONSTRUCTION INSPECTION | 25,749.00 |
| TOTAL ESTIMATED PROJECT COST      | **$428,105.00** |

**ECONOMIC ANALYSIS**

Some of the options available to the District to finance the improvements selected by the District include loans from the private sector and the state and of course the grant-loan program available through the Wyoming Water Development Commission.

For the purposes of this study we have assumed that a commercial loan for a twenty year period could be obtained at an interest rate of 12.5 percent for 25 years, a state loan (Wyoming Land Commission) should be obtained at an interest rate of 6.0 percent for 25 years, and the Wyoming Water Development loan-grant would be obtainable for a 50 percent grant and a loan for 50% at a rate of 4% for a period of 25 years. In kind services provided by the District are eligible for consideration in reducing the loan requirements.

Since the annual cost analysis is to be developed for the same period for all financing arrangements it is obvious that the WWDC program with 50% grant and 50% loan will have the lowest annual cost. For comparison however, the analysis based on a capital recovery method for annual costs provides the following:
1. Commercial loan - 25 years at 12\%  
   Total Cost $428,105.00  
   Annual Cost $56,484.18  

2. State loan - 25 years at 6\%  
   Total Cost $428,105.00  
   Annual Cost $33,490.65  

3. WWDC - loan, grant  
   Total Cost $428,105.00  
   Grant 50\% $214,052.50  
   Loan 50\% $214,052.50  
   Annual Cost $13,701.50  

Based on the 12,000 assessable acres the annual assessment to retire the debt for the three types of loans would be:

1. Commercial loans $4.7070 per acre per year  
2. State loan $2.7909 per acre per year  
3. WWDC grant-loan $1.1418 per acre per year  

BENEFIT-COST ANALYSIS  

The development of a benefit-cost analysis for the purpose of this study was based on a worst case scenario in which a comparison was made between costs associated with the failure of the upper most canal structure, the Cooper No. 1 Chute, to that of replacing it and the Cooper No. 2 Chute with the preferred alternative previously evaluated.  

Cost of temporary replacement structure $22,915.00  
Salvage value -$4,008.00  
Cost of permanent structure (preferred alternate) $129,100.00  
Crop yield reduction value $154,700.00  
Total cost of failure $302,707.00  
Cost of preferred alternative $129,100.00  

The total cost to the irrigators who make up the LeClair Irrigation District for a failure of the Cooper No. 1 Chute theoretically may approach $302,700 as compared to the estimated cost of $129,100 for replacing the structure before a failure occurs. The cost of waiting for a failure to occur may be 2.34 times greater than that of replacement before a failure occurs.  

PERMITTING AND LAND ACQUISITION/EASEMENTS  

All ownership maps, legal descriptions, right of way easements and archeologist site identification maps necessary for the construction of the preferred alternatives were submitted in the appendices of the final report.
CONCLUSIONS

1. All six structures reviewed are in need of replacement in the near future. The Stagg Drop Chute and the Hog Farm Chute are both undergoing rapid deterioration at this time and should be replaced as soon as possible.

2. Existing subsurface soil investigations identified no areas of exceptional rock and soil conditions that would cause cost increases above that of normal heavy construction costs. No subsurface soils testing was performed in the area of the stilling basin of the Cooper No. 2 Chute. A test hole should be completed in this area before the final design of the stilling basin in this area is performed. All other structures should have adequate soils testing in their vicinity, except perhaps additional tests should be performed at approximately station 4+50 of the chute and canal realignment to replace the Cooper No. 3 Chute and Flume at 913+44.

The complete soils report can be found as Appendix E of the final report.

3. The total cost of reconstructing all of the proposed structures has been estimated at $428,105.00. This cost does not include any costs for obtaining rights of way, or the cost of having appraisals done on any of the lands affected.

4. The LeClair Irrigation District should pursue a grant-loan from the Wyoming Water Development Commission in order to finance the proposed reconstruction project. This method of financing is two to four times less costly than the other types of financing.

5. A Benefit-Cost analysis has been performed based on a worst case scenario in which it was demonstrated that it would be 2.3 times cheaper to replace a structure before a failure occurs. The actual cost of a failure may vary considerably but it can be concluded that waiting for a failure to occur only increases the cost of replacing a structure. The cost associated with the loss of revenue the producers may face because of crop stress can easily exceed that of the replacement structure. The structures are all nearing the end of their useful life to the district and will need replaced in the near future. The District will ultimately have to make the decision on the time and scope of the improvements needed to maintain the system.