West Side Canal
Rehabilitation of the Jons Drop Structure and the Four Mile Flume Level II Study

Prepared for:

Wyoming Water Development Commission
Cheyenne, Wyoming

Prepared by:

States West Water Resources Corporation
Cheyenne, Wyoming

Fleming, Inc.
Colorado
Table of Contents

I. Introduction
II. Jons Drop Structure Rehabilitation
III. Four Mile Flume Structure Rehabilitation
IV. Permits
V. Economic Analysis
I. Introduction

A. Purpose of the Study

This report presents the findings of a Level II study to investigate the potential rehabilitation or replacement of the Jons Drop Structure and the Four Mile Flume on the West Side Canal. The study was conducted under the direction and funding of the Wyoming Water Development Commission (WWDC) by States West Water Resources Corporation, in association with Gannett-Fleming, Inc.

The purpose of the study was to determine the most feasible and economical solutions to the problems at the Jons Drop, and the Four Mile Flume. The Jons Drop was rehabilitated as a part of the previous West Side Canal rehabilitation project. However the channel below the drop has eroded severely since that time. The purpose of the study of the Jons Drop was to determine the most feasible and economical method of eliminating the erosion problem. The Four Mile Flume has developed leaks, overtops, and is in generally poor structural condition. The purpose of this study was to develop the most feasible and economical method of conveying the water across the drainage. The study also determined the permitting effort to construct the project. Economic analysis of the project financing to determine cost to the sponsors were completed. Hydropower potential at the Jons Drop was also considered. This report summarizes the findings of the study.
II. Jons Drop

A. Existing Conditions

Jons Drop was rehabilitated as part of the West Side Ditch project. A new splitter structure was constructed and a new HDPE pipe was installed. The first drop pipe installed was thin wall corrugated HDPE pipe. The thin wall could not withstand the debris and failed. A thick wall HDPE pipe was installed which could withstand the debris. However, the channel below the drop has actively eroded and steps to prevent the erosion have failed to solve the problem, as shown on the photos on pages II-4 thru II-7. A CMP extension and dissipation pool with additional riprap have been installed. The channel below has continued to erode and increased the drop. The erosion can be seen down stream for a length of 1200 feet as seen on figure II-1.

We surveyed the channel to determine if erosion is likely to continue in the future. The slopes of the channel are 2%-3% which is too steep to be stable. Consequently, the erosion will continue for some time. We estimate that the channel could erode an additional 20 feet over time.

The capacity of the proposed drop was determined by the maximum capacity of the canal upstream of the splitter structure. The maximum capacity of the canal before overtopping was estimated to be approximately 100 cfs. The capacity of the splitter structure to pass the flow to a pipe outlet was determined to be approximately 110 cfs. The alternatives were designed for 100 cfs. Normal maximum flows for irrigation purposes are approximately 54 cfs.

B. Alternative Solutions

The NRCS has prepared preliminary designs on a pipe alternative that would bypass the eroded section of the channel. This alternative was reviewed and cost estimates developed. Channel stabilization alternatives and a concrete chute alternative were also developed to compare with the pipe alternative. A detailed discussion of the different alternatives follows.

1. Alternative 1 – New Pipe – This alternative would involve constructing a new drop pipe from the splitter structure to the channel downstream of the eroded sections as shown in figure II-2. The proposed route would align the pipe east of the erosion cut for a distance of approximately 150 feet on a relatively flat area. The pipe would then bend and be routed down a steep slope for a distance of approximately 750 feet to the channel. The channel appears to be stable below this location. The upper portion of the drop pipe would require a 36 inch pipe to carry the 100 cfs flow at a slope of approximately 2.5% as shown on figure II-3. The steeper section of the pipe with average slopes of 8.5 % would require a 30 inch pipe to carry the flow. The velocity in the 36 inch pipe section would be approximately
14 feet per second, while the velocity in the 30 inch pipe would be a maximum of 27 feet per second. The higher velocity in the steep sections coupled with the possibility of accumulating debris lead to the need for the thick wall HDPE pipe. SDR 26 HDPE pipe would be recommended for this application, because it has a 1.38 inch wall for the 36 inch pipe and 1.15 inch thickness for the 30 inch pipe. This pipe would be the best product for the application, but it is relatively expensive. Energy would be dissipated in a riprap pool at the bottom of the slope before it enters the channel as shown on figure II-3. Riprap from the existing pool could be utilized. Cost estimates for this alternative were developed. Total project cost including construction, engineering and contingencies were considered. No costs for rehabilitation of the eroded channel were included. The total project cost is estimated to be $92,000. If rehabilitation of the existing channel is included, the cost estimate would increase by $20,000. The detailed cost estimate is shown on page II-8. This alternative would allow for the installation of a hydropower generation unit in the future. The hydropower potential will be discussed later in the section.

2. Alternative 2 - Channel Stabilization - This alternative would involve stabilization of the channel below the existing drop pipe as shown on figure II-4. A series of sheet pile drop structures could be used to stabilize the channel. The channel would be reshaped to eliminate the potential for more erosion. A total of ten drop structures would be required to flatten and stabilize the slope. Cost estimates indicate that the total project costs for this alternative would be approximately $240,000. The detailed cost estimate is shown on page II-9.

3. Alternative 3 – Outlet Pipe Extension and Channel Stabilization - This alternative would involve extending the existing 36 inch HDPE pipe and stabilization of the stream below the pipe outlet as shown on figure II-5. The 36 inch pipe would be extended approximately 100 feet past the existing riprap, dropping approximately 30 vertical feet. A riprap dissipation pool using existing riprap would be constructed below the pipe outlet. A total of three sheet pile drop structures would be needed to stabilize the remainder of the channel. The channel would be reshaped to eliminate potential erosion. The total estimated project cost for this alternative is $120,000. The detailed cost estimate is shown on page II-10.

4. Alternative 4 – Concrete Chute – This alternative would involve a concrete lined chute on essentially the same slope as the pipe alternative, as shown in figure II-6. The downstream wall of the splitter structure would be removed and a transition constructed to a trapezoidal concrete channel. The upper portion of the chute would be constructed on a 2.5% slope and the lower portion on a slope of up to 10.6%. A chute with a 2 foot wide bottom and a depth of 5 feet with 2:1 side slopes would be required to carry the flow. The chute would be approximately 900 feet long. A headwall would be constructed at the end of the chute which
would discharge into a riprap lined plunge pool. Cost estimates indicate that the total project cost for this alternative would be approximately $152,000. The detailed cost estimate is shown on page II-11.

C. Summary and Recommendations

The pipe alternative as recommended by the NRCS is the most economical and would be reliable. The estimated total cost is $92,000. This alternative did not include costs for rehabilitation of the eroded channel. The rehabilitation of the channel would increase the estimated costs by approximately $20,000. This alternative also allows for the installation of hydropower.

D. Hydropower Potential

The Jons drop has a normal maximum flow of 50 cfs with a total drop of 80 feet. The drop available for hydropower production would be approximately 65 feet. At maximum flow approximately 225 kW of hydropower could be produced. The expected cost for a hydropower unit of this size is $1600/kW, producing an estimated cost of installing a 225 kW generator at $360,000. The annual cost for a loan for 20 years at 6% would be $31,860.

The average expected hydropower production per year has to be estimated based on estimated flows and the duration of those flows. The drop does not run 50 cfs for the entire irrigation season. For purposes of estimating hydropower potential it was assumed that a full 50 cfs could be available for 2 months, with gradually decreasing flows after July 1. The total expected hydropower potential would be approximately 450,000 kW hr in an average year.

The return per kW hr that would be required to pay the loan costs would be 7.08 cents/kW hr. When operation and maintenance cost are included, the required price would be approximately 8.6 cents/kW hr. This price is far beyond what power companies are willing to pay for power. As examples, PacifiCorp has on file with the Wyoming public service commission avoided costs for the purchase of power. The prices for non firm summer power generation is 1.57 cents/kW hr in 2003. Colorado has on file prices for “green” power of 2.5 cents/kW hr. All fall short of break even costs.

If water were available for considerably longer periods continually, the financial picture becomes more favorable. If 50 cfs could be available on a reliable basis for 6 months, the cost per kW hr would drop to approximately 4.7 cents/kW hr. Firm energy prices are typically higher and the project could be feasible in the future. Small scale hydropower is very difficult to operate profitably unless flows are available year round.
Existing Pipe Outlet

Down Stream End of Riprap Protection
Typical Erosion of Channel

Typical Erosion of Channel
Typical Erosion of Channel

Pipeline Route, View From the Top of the Hill
Pipeline Route, View From the Bottom of the Hill

Pipeline Outlet Area
IF THIS BAR DOES NOT MEASURE 1', DRAINAGE IS NOT TO SCALE.
REMOVE END OF EXISTING STRUCTURE

HORIZONTAL AND VERTICAL BEND

CONCRETE CHUTE

EXISTING GROUND

CONCRETE CHUTE

PLUNGE POOL

TRANSITION FROM 4'X6' RECTANGULAR CHUTE TO 2'X5' TRAPEZOIDAL CHUTE

JONS DROP CHUTE PROFILE

REINFORCED CONCRETE CHUTE

CONCRETE HEADWALL

CONCRETE HEADWALL

GRouted RIPRAP

PLUNGE POOL

CONCRETE CHUTE

JONS DROP CHUTE ALTERNATIVE II -7

WEST WYOMING WATER DEVELOPMENT COMMISSION

JONS DROP CHUTE ALTERNATIVE II-7
## ALTERNATIVE 1
### COST ESTIMATE - JONS DROP - PIPE ALTERNATIVE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>CONNECTION 36&quot; PIPE</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>36&quot; HDPE PIPE</td>
<td>L.F.</td>
<td>150</td>
<td>70</td>
<td>$10,500.00</td>
</tr>
<tr>
<td>REDUCER</td>
<td>Ea.</td>
<td>2</td>
<td>1500</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>30&quot; HDPE PIPE</td>
<td>L.F.</td>
<td>750</td>
<td>55</td>
<td>$41,250.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>200</td>
<td>20</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>GROUTED RIPRAP</td>
<td>C.Y.</td>
<td>20</td>
<td>100</td>
<td>$2,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$64,750.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $64,750.00
ENGINEERING COST = CCS#1 X 10%: $6,475.00
SUBTOTAL #2: $71,225.00
CONTINGENCY = SUBTOTAL #2 X 15%: $10,683.75

CONSTRUCTION COST TOTAL: $81,908.75
PREPARATION OF FINAL DESIGNS: $8,000.00
PERMITTING AND MITIGATION: -
LEGAL FEES: -
ACQUISITION OF ACCESS & RIGHT OF WAY: $2,000.00

PROJECT COST TOTAL: $91,908.75
USE: $92,000.00
## ALTERNATIVE 2

COST ESTIMATE - JONS DROP - STABILIZATION ALTERNATIVE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>SHEET PILE</td>
<td>S.F.</td>
<td>4500</td>
<td>20</td>
<td>$90,000.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>750</td>
<td>50</td>
<td>$37,500.00</td>
</tr>
<tr>
<td>EXCAVATION AND FILL</td>
<td>C.Y.</td>
<td>20000</td>
<td>1.50</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>REVEG</td>
<td>Ac.</td>
<td>6</td>
<td>1000</td>
<td>$6,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$173,500.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: **$173,500.00**

ENGINEERING COST = CCS#1 X 10%: **$17,350.00**

SUBTOTAL #2: **$190,850.00**

CONTINGENCY = SUBTOTAL #2 X 15%: **$28,627.50**

CONSTRUCTION COST TOTAL: **$219,477.50**

PREPARATION OF FINAL DESIGNS: **$18,000.00**

PERMITTING AND MITIGATION: -

LEGAL FEES: -

ACQUISITION OF ACCESS & RIGHT OF WAY: -

PROJECT COST TOTAL: **$237,477.50**

USE: **$240,000.00**
### ALTERNATIVE 3
### COST ESTIMATE - JONS DROP - PIPE AND STABILIZATION ALTERNATIVE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>36&quot; HDPE PIPE</td>
<td>L.F.</td>
<td>100</td>
<td>70</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>500</td>
<td>20</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>SHEET PILE</td>
<td>S.F.</td>
<td>1350</td>
<td>20</td>
<td>$27,000.00</td>
</tr>
<tr>
<td>EXCAVATION AND FILL</td>
<td>C.Y.</td>
<td>20000</td>
<td>1.50</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>REVEG</td>
<td>Ac.</td>
<td>6</td>
<td>1000</td>
<td>$6,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$85,000.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $85,000.00  
ENGINEERING COST = CCS#1 X 10%: $8,500.00  
SUBTOTAL #2: $93,500.00  
CONTINGENCY = SUBTOTAL #2 X 15%: $14,025.00  

CONSTRUCTION COST TOTAL: $107,525.00  
PREPARATION OF FINAL DESIGNS: $10,500.00  
PERMITTING AND MITIGATION: -  
LEGAL FEES: -  
ACQUISITION OF ACCESS & RIGHT OF WAY: -  

PROJECT COST TOTAL: $118,025.00  
USE: $120,000.00
## ALTERNATIVE 4
### COST ESTIMATE - JONS DROP - CHUTE ALTERNATIVE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 5,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 1,000.00</td>
</tr>
<tr>
<td>TRANSITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 2,000.00</td>
</tr>
<tr>
<td>CHUTE</td>
<td>L.F.</td>
<td>900</td>
<td>100</td>
<td>$ 90,000.00</td>
</tr>
<tr>
<td>HEADWALL</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 4,000.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>200</td>
<td>20</td>
<td>$ 4,000.00</td>
</tr>
<tr>
<td>GROUTED RIPRAP</td>
<td>C.Y.</td>
<td>20</td>
<td>100</td>
<td>$ 2,000.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>$ 108,000.00</td>
</tr>
</tbody>
</table>

Construction Cost Subtotal #1: $ 108,000.00

Engineering Cost = CCS#1 X 10%: $ 10,800.00

Subtotal #2: $ 118,800.00

Contingency = Subtotal #2 X 15%: $ 17,820.00

Construction Cost Total: $ 136,620.00

Preparation of Final Designs: $ 13,500.00

Permitting and Mitigation: -

Legal Fees: -

Acquisition of Access & Right of Way: $ 2,000.00

Project Cost Total: $ 152,120.00

Use: $ 152,000.00
III. FOUR MILE CROSSING

A. Existing Conditions

The existing structure at the Four-Mile crossing was investigated for potential rehabilitation or replacement. The structure utilizes a steel half pipe supported on a steel support structure to convey water across the drainage. Normal maximum flows at the flume are approximately 30 cfs based on water rights. However, the canal can carry extra water so the design basis was the maximum carrying capacity of the canal. The maximum capacity of the canal was estimated to be 50 cfs which was used for the preliminary design. The existing structure is shown on the photos on the pages III-5 thru III-7, and figure III-1. The structure has the following problems.

1. Steel half pipe leaks – At the time of inspection, there was a trickle of water passing through the structure which indicated that the half pipe leaks at several locations. The steel half pipe is very thin walled and it has rusted through at several points.

2. Overtopping of structure – It has been reported that the half pipe overtops at high flows. We surveyed and checked the slopes of the crossing, the road culvert downstream, and the twin culvert further down stream. The slope on the half pipe indicates that the crossing should pass 36 cfs before overtopping. This would indicate that the problem would be downstream. The 48” CMP road culvert has the capacity to pass more than 50 cfs before backing up. The twin 48” CMP located further downstream also have plenty of capacity, but are used as a check dam for an irrigation turn out. A permanent plate has been installed in front of the culverts. There is evidence that debris collects on the crossing. It has been reported that the probable cause of the overtopping has been sedimentation of the canal below the twin culverts. The canal is very flat and the sediment from the Jons Drop erosion has accumulated in this area. It was reported that the overtopping problem was less severe before the erosion at the drop became severe.

3. Structural Adequacy – The steel half pipe is supported by a steel pipe support system that appears marginally adequate structurally and is exposed to debris build up during flood flows. A structural engineer could probably prove that the structure failed long ago. The support pipes do not show rust deterioration either above or below ground.

B. Alternatives

Four permanent alternatives and one temporary alternative to address the rehabilitation or replacement of the crossing were investigated. These included replacing the half pipe and structural rehabilitation, installation of an inverted
siphon pipe, and construction of two types of overhead crossings. The five alternatives are discussed in the following sections.

1. Alternative 1 - Rehabilitation of existing structure – The potential for rehabilitating the existing structure was investigated. Replacing the half pipe and structurally upgrading the support system was considered. After meeting with our structural engineering consultant, it was his conclusion that the existing structure could not be rehabilitated economically and reliably. The support pipes do not meet minimum standards, and it is surprising they have stood up for so long. Upgrading the structure to meet minimum standards would be expensive and would still result in a cobbled up structure. If rehabilitation is done to the structure the supports are still vulnerable to flood debris.

2. Alternative 2 - Inverted siphon pipe – It is proposed to utilize corrugated high density polyethylene pipe (HDPE) with water tight connections capable of the pressures involved. This alternative would replace the overhead crossing with a 48” HDPE pipe as shown on figure III-2. The total length would be approximately 130 feet. Concrete structures would be constructed at the inlet and outlet ends of the pipe. A trash rack would be installed on the upstream inlet structure. Erosion protection (riprap) would be placed over the pipe in the creek bottom to prevent erosion during large floods. A drain and flushing pipe would be installed at the bottom of the siphon.

3. Alternative 3 - New Half Pipe Overhead crossing – This alternative would involve an entirely new structure to carry the water in a half pipe across the drainage. A six foot steel half pipe would be supported by concrete piers, spaced at 40 ft. as shown on figure III-3 and III-4. The piers would be founded below frost depth and below the creek bottom. The steel half pipe would be supported by H-beams with intermittent supports at 5 ft spacing.

4. Alternative 4 – New Full Pipe Overhead Crossing – This alternative would involve constructing a full overhead pipe crossing the drainage. The steel pipe would be supported by concrete piers, spaced at 40 feet as shown in figure III-5. The piers would be founded below frost depths and below the creek bottom. The full pipe would be designed to span the distance with no other supports. A 60” inch steel pipe with 5/8 inch wall would be self supporting. No personnel crossing could be included with the design.

5. Alternative 5 - Temporary Repair – To temporarily address the leakage from the half pipe, flexible HDPE liners could be used. These liners have been developed to line ponds. They have been advanced to the point that the liners are not damaged by the sun or weather exposure, and are relatively resistant to puncture. If punctures from debris do occur the liners can be patched. The liners can be ordered in various widths and lengths. The life of the liner would be dependant
on damage caused by debris. The upstream headwall is deteriorated and leaking, and a new headwall should be installed with provision for a trash rack. The trash rack would protect the liner from sharp debris.

C. Cost Estimates

Estimates of the total project costs were developed for each of the alternatives. The estimates were done utilizing the standard WWDC format. This format includes construction costs, contingencies, engineering, permitting, and legal costs. The total estimated project costs for the alternatives are:

Alternative 2 - $50,000
Alternative 3 - $75,000
Alternative 4 - $85,000
Alternative 5 - $11,000

The detailed cost estimates are included on pages III-8 thru III-11.

D. Summary

The four permanent alternatives have the following advantages and disadvantages.

1. Alternative 1 – Rehabilitation of Existing structure
   a. Structure cannot be rehabilitated to meet structural standards.
   b. Structure will still be vulnerable to large flood failure.
   c. Alternative should be eliminated from consideration.

2. Alternative 2 - Inverted Siphon pipe
   a. Addresses flood concerns.
   b. System entrance could collect debris.
   c. Inverted siphon could accumulate sediment
   d. No access to inlet trash rack across the drainage.
   e. Most economical.

3. Alternative 3 - New Half Pipe Overhead Crossing
   a. Better flood safety than the existing crossing.
   b. Better at passing debris in the canal.
   c. More expensive.

4. Alternative 4 – New Full Pipe Overhead Crossing
   a. Better flood safety than the existing crossing.
   b. Better at passing debris in the canal.
   c. More expensive.
   d. No personnel access across drainage.
E. Recommendation

The recommended permanent alternative is the inverted siphon pipe, due to economics and the protection it provides from floods. The sediment should be removed from the canal below the crossing. With the elimination of the sediment from the Jons Drop the water back up problem should be greatly reduced.
Four Mile Flume Looking Upstream

Four Mile Flume Looking Downstream
Leaking Half Pipe and Support System
Upstream Support System

Sheet Pile Erosion Protection
HALF-PIPE OVERHEAD CROSSING PROFILE

SCALE

10 0 10 20

CONCRETE APRON
CROSS SUPPORTS
6' STEEL HALF PIPE
H-BEAM W16X26
SUPPORT RODS AND BEAMS AT 5'
CONCRETE APRON
TOP OF BANK
CANAL INVERT
CONCRETE APRON
TOP OF BANK
CONCRETE PIER AND HEADWALL
EXISTING GROUND
CONCRETE PIER AND HEADWALL

CONCRETE APRON
TOP OF BANK

HALF-PIPE OVERHEAD CROSSING PROFILE

SCALE

10 0 10 20

CONCRETE APRON
CROSS SUPPORTS
6' STEEL HALF PIPE
H-BEAM W16X26
SUPPORT RODS AND BEAMS AT 5'
CONCRETE APRON
TOP OF BANK
CANAL INVERT
CONCRETE APRON
TOP OF BANK
CONCRETE PIER AND HEADWALL
EXISTING GROUND
CONCRETE PIER AND HEADWALL
FULL OVERHEAD PIPE CROSSING

5' DIAMETER STEEL HALF PIPE

INTERMEDIATE PIERS
END PIERS

HEIGHT VARIES

CONCRETE HEADWALL

HEADWALL AND APRON

5' STEEL PIPE - 5/8' WALL THICKNESS
### ALTERNATIVE 2

COST ESTIMATE - FOUR MILE CROSSING - INVERTED SIPHON PIPE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 5,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 2,000.00</td>
</tr>
<tr>
<td>42&quot; PIPE</td>
<td>L.F.</td>
<td>130</td>
<td>100</td>
<td>$ 13,000.00</td>
</tr>
<tr>
<td>HEAD WALLS</td>
<td>C.Y.</td>
<td>15</td>
<td>400</td>
<td>$ 6,000.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>50</td>
<td>50</td>
<td>$ 2,500.00</td>
</tr>
<tr>
<td>42&quot; FITTINGS</td>
<td>Ea</td>
<td>2</td>
<td>1500</td>
<td>$ 3,000.00</td>
</tr>
<tr>
<td>DRAIN</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 2,000.00</td>
</tr>
<tr>
<td>TRASHRACK</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$ 500.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$ 34,000.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $ 34,000.00

ENGINEERING COST = CCS#1 X 10%: $ 3,400.00

SUBTOTAL #2: $ 37,400.00

CONTINGENCY = SUBTOTAL #2 X 15%: $ 5,610.00

CONSTRUCTION COST TOTAL: $ 43,010.00

PREPARATION OF FINAL DESIGNS: $ 4,000.00

PERMITTING AND MITIGATION: $ 2,000.00

LEGAL FEES: -

ACQUISITION OF ACCESS & RIGHT OF WAY: -

PROJECT COST TOTAL: $ 49,010.00

USE: $ 50,000.00
**ALTERNATIVE 3**

**COST ESTIMATE - FOUR MILE CROSSING - NEW HALF PIPE OVERHEAD CROSSING**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>CONCRETE</td>
<td>C.Y.</td>
<td>40</td>
<td>400</td>
<td>$16,000.00</td>
</tr>
<tr>
<td>HALF PIPE</td>
<td>L.F.</td>
<td>120</td>
<td>125</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>H-BEAM</td>
<td>L.F.</td>
<td>240</td>
<td>40</td>
<td>$9,600.00</td>
</tr>
<tr>
<td>SUPPORTS</td>
<td>Ea.</td>
<td>26</td>
<td>150</td>
<td>$3,900.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$50,500.00</strong></td>
</tr>
</tbody>
</table>

**CONSTRUCTION COST SUBTOTAL #1:** $50,500.00

**ENGINEERING COST = CCS#1 X 10%:** $5,050.00

**SUBTOTAL #2:** $55,550.00

**CONTINGENCY = SUBTOTAL #2 X 15%:** $8,332.50

**CONSTRUCTION COST TOTAL:** $63,882.50

**PREPARATION OF FINAL DESIGNS:** $6,388.25

**PERMITTING AND MITIGATION:** $2,000.00

**LEGAL FEES:** -

**ACQUISITION OF ACCESS & RIGHT OF WAY:** -

**PROJECT COST TOTAL:** $72,270.75

**USE:** $75,000.00
## ALTERNATIVE 4

**COST ESTIMATE - FOUR MILE CROSSING - NEW FULL PIPE OVERHEAD CROSSING**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>CONCRETE</td>
<td>C.Y.</td>
<td>40</td>
<td>400</td>
<td>$16,000.00</td>
</tr>
<tr>
<td>60&quot; STEEL PIPE- 1/2&quot;</td>
<td>L.F.</td>
<td>120</td>
<td>300</td>
<td>$36,000.00</td>
</tr>
</tbody>
</table>

**TOTAL** $59,000.00

**CONSTRUCTION COST SUBTOTAL #1:** $59,000.00

**ENGINEERING COST = CCS#1 X 10%:** $5,900.00

**SUBTOTAL #2:** $64,900.00

**CONTINGENCY = SUBTOTAL #2 X 15%:** $9,735.00

**CONSTRUCTION COST TOTAL:** $74,635.00

**PREPARATION OF FINAL DESIGNS:** $7,463.50

**PERMITTING AND MITIGATION:** $2,000.00

**LEGAL FEES:** -

**ACQUISITION OF ACCESS & RIGHT OF WAY:** -

**PROJECT COST TOTAL:** $84,098.50

**USE:** $85,000.00
### ALTERNATIVE 5
COST ESTIMATE - FOUR MILE CROSSING - TEMPORARY REPAIR

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$500.00</td>
</tr>
<tr>
<td>HDPE LINER</td>
<td>S.F.</td>
<td>1500</td>
<td>2</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>HEAD WALLS</td>
<td>C.Y.</td>
<td>7</td>
<td>400</td>
<td>$2,800.00</td>
</tr>
<tr>
<td>TRASHRACK</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$500.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$7,800.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $7,800.00
ENGINEERING COST = CCS#1 X 10%: $780.00
SUBTOTAL #2: $8,580.00
CONTINGENCY = SUBTOTAL #2 X 15%: $1,287.00

CONSTRUCTION COST TOTAL: $9,867.00
PREPARATION OF FINAL DESIGNS: $1,000.00
PERMITTING AND MITIGATION:
LEGAL FEES: -
ACQUISITION OF ACCESS & RIGHT OF WAY: -

PROJECT COST TOTAL: $10,867.00
USE: $11,000.00
IV. Permits

A. Jons Drop and Four Mile Flume.

U.S. Corps of Engineers Permits

Upon completion of the conceptual designs, the primary major components of the project consist of the following:

- Replacement of the existing Jons Drop with a 30” and 36” pipeline.
- Replacement of the existing Four Mile Flume with an inverted siphon.

Based upon preliminary investigations, it appears that little or no wetlands will be impacted by the proposed project and, as a result, should be eligible for a Nationwide Permit from the Corps of Engineers. The Nationwide Permit consists of a letter from the Cheyenne office authorizing the activity based upon submittals from the Applicant.

Prior to initiating construction, the Applicant will be required to submit to the Corps the following information:

- A description of the activities along with preliminary plans, maps, and photos of the area to be disturbed.
- A wetland delineation, if any wetlands are found to be temporarily impacted by the proposed activity (pipeline).
- A description of the proposed mitigation for reseeding of any wetland plant species temporarily impacted by pipeline construction.
- A schedule for the proposed construction activity.

It is recommended that the Applicant and/or their representative have and initial project meeting with Cheyenne office of the Corps of engineers prior to initiating final designs to confirm the project’s eligibility for a Nationwide Permit.

Since project improvements are to be installed along the existing canal, no other permits should be required for project construction.
V. Economic Analysis

This project qualifies as a rehabilitation project with the WWDC. Rehabilitation projects are presently funded with 50% grant and 50% loan at 6% interest. With these funding conditions and assuming a 20 year loan, the annual payments for the two projects are as follows.

**Jons Drop**

- Total Project Estimated cost – $92,000
- 50% Loan Amount – $46,000
- Annual Payment @ 6% for 20 years – $4,071.00

**Four Mile Flume**

- Total Project Estimated cost – $50,000
- 50% Loan Amount – $25,000
- Annual Payment @ 6% for 20 years – $2,212.5

The total estimated project cost for both projects is $142,000. These costs were estimated assuming separate projects. If both projects are bid as a package, some cost savings would be expected. Mobilization of people and equipment should be reduced.

- The irrigated acres benefited by the Jons Drop improvements total 1,345.8 acres. The cost per acre per year would be $3.02.
- The irrigated acres benefited by the Four Mile improvements total 1,045.5 acres. The cost per acre per year would be $2.12.
- The total irrigated acreage under the West Side Canal is approximately 5,600 acres. If the total combined project cost were to be spread through out the canal, the annual cost per acre would be approximately $1.12.