# Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana

## APPENDIX B – COST ENGINEERING

## Lower Yellowstone Intake Fish Passage EIS

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# Contents

1.0 Alternative Construction Cost Estimates ..... 1
1.1 General ..... 1
1.2 Purpose ..... 1
1.3 Design Alternatives ..... 1
1.4 Alternative Design Levels ..... 2
1.5 Estimates for Comparison Purposes ..... 3

2.0 Initial Alternatives ..... 4
2.1 Detailed Alternative Descriptions ..... 4
2.1.1 Rock Ramp ..... 4
2.1.2 Bypass Channel ..... 5
2.2 Basis of Estimates ..... 5
2.2.1 Rock Ramp ..... 5
2.2.2 Bypass Channel ..... 6
2.3 Total Project Cost Summary (TPCS) ..... 6
2.4 Project Schedules ..... 7
2.5 Functional Costs ..... 7
2.5.1 01 Account – Lands and Damages ..... 7
2.5.2 02 Account – Relocations ..... 7
2.5.3 06 Account – Fish and Wildlife Facilities ..... 8
2.5.4 30 Account – Planning, Engineering and Design (PED) ..... 8
2.5.5 31 Account – Construction Management (CM) ..... 8
2.6 Project Markups ..... 8
2.6.1 Escalation ..... 8
2.6.2 Contingency ..... 8

3.0 Expanded Alternatives ..... 10
3.1 Detailed Alternative Descriptions ..... 10
3.1.1 Modified Side Channel ..... 10
3.1.2 Multiple Pump ..... 10
3.1.3 Multiple Pumps with Conservation Measures ..... 11
3.2 MCACES Construction Cost Estimates ..... 12
3.3 Basis of Estimate ..... 12
3.3.1 Basis of Design ..... 12
3.3.2 Basis of Quantities ..... 12
3.4 Project Schedules ..... 12
3.5 Acquisition Plan ..... 13
3.6 Project Construction ..... 13
3.6.1 Modified Side Channel ..... 13
3.6.2 Multiple Pump Stations ..... 14
3.6.3 Multiple Pumps with Conservation Measures ..... 15
3.7 Effective Dates for Labor, Equipment and Material Pricing ..... 16
3.8 Estimated Construction Durations ..... 16
3.9 Direct and Contractor Markups ..... 16

3.9.1 Direct Markups ....16
3.9.2 Contractor Markups ....16
3.10 Functional Costs .... 17
3.10.1 01 Account – Lands and Damages....17
3.10.2 02 Account – Relocations ....17
3.10.3 06 Account – Fish and Wildlife Facilities ....17
3.10.4 30 Account – Planning, Engineering and Design (PED)....17
3.10.5 31 Account – Construction Management (CM)....18
3.11 Project Markups .... 18
3.11.1 Escalation....18
3.11.2 Contingency ....18
3.12 Total Project Cost Summary (TPCS) .... 18
3.13 MCACES Construction Cost Estimate Summaries.... 19

4.0 First Cost Summaries.... 20

5.0 Operations, Maintenance and Repairs .... 22
5.1 OM&R Development .... 22

6.0 References.... 23

## LIST OF TABLES

Table 2.1 Rock Ramp Escalation Factors and Cost Updates....6
Table 2.2 Bypass Channel Escalation Factors and Cost Updates....6
Table 3.1 Summary of Assumed Real Estate Costs....17
Table 4.1 Rock Ramp Alternative First Cost Summary ....20
Table 4.2 Bypass Channel Alternative First Cost Summary ....20
Table 4.3 Modified Side Channel Alternative First Cost Summary....20
Table 4.4 Multiple Pump Stations Alternative First Cost Summary ....21
Table 4.5 Multiple Pumps with Conservation Measures Alternative First Cost Summary....21
Table 5.1 Summary of Annual OM&R Costs....22

## ATTACHMENTS

Attachment B.1 Total Project Cost Summary (TPCS) Spreadsheets
Attachment B.2 Tentative Project Schedules
Attachment B.3 Abbreviated Risk Analysis (ARA) Spreadsheets
Attachment B.4 Detailed Quantity Takeoffs
Attachment B.5 Labor Rates
Attachment B.6 Estimated Construction Durations
Attachment B.7 MCACES Construction Cost Estimate Summaries
Attachment B.8 Operations, Maintenance & Repair Cost Estimates

# 1.0 Alternative Construction Cost Estimates

This appendix accounts for the development of five, comparable alternative construction cost estimates. These estimates have all been developed using the Micro-Computer Aided Cost Estimating System (MCACES) software in order to develop detailed unit prices. The estimates have been prepared by various estimators and all estimating assumptions are discussed in detail in subsequent sections of this appendix.

## 1.1 General

This project is located on the Yellowstone River approximately 17 miles northeast of Glendive, Montana. There is currently an Intake Diversion Dam and Diversion Headworks that provides water for the Lower Yellowstone Irrigation Project's (LYIP) main canal. This canal diverts water on the north side of the river and continues for approximately 71.6 miles delivering water primarily for agricultural use.

The existing diversion dam is presumed to be a complete barrier to the endangered pallid sturgeon, due to the increased turbulence and velocities associated with the rock that forms the dam and the boulder field found immediately downstream of the dam. Monitoring of the pallid sturgeon has indicated that they are unable to move upstream beyond the existing intake dam.

Each of the five proposed action alternatives aim to improve fish passage for the endangered pallid sturgeon and other native fish as well as reduce entrainment of fish into the LYIP main canal. Each of the construction alternatives would contribute to recovery of the pallid sturgeon by increasing access to an additional 165 miles of habitat along the Yellowstone River for migration, spawning and development.

## 1.2 Purpose

The purpose of this work is to develop total project cost estimates – consistent with the conceptual level designs - for the five construction alternatives.

## 1.3 Design Alternatives

The project includes five action alternatives and the no action plan. As noted, each of the action alternatives are designed to provide improved fish passage through and/or around the existing Intake Diversion Dam location. The following is a brief description of the alternatives. Subsequent sections of this appendix will discuss in greater detail the construction elements and assumptions for each alternative.

- **No Action** – This alternative does not assume any new construction would be completed. The existing Intake Diversion Dam would remain in place without any modifications.
- **Rock Ramp** – This alternative would replace the existing rock and timber crib structure of the existing intake diversion dam with a concrete weir and a shallow-sloped, un-grouted boulder and cobble rock ramp.
- **Bypass Channel** - This alternative would construct a new bypass channel on Joe's Island, south of the existing Intake Diversion Dam. This alternative would also include replacing the Intake Diversion Dam with a concrete weir.
- **Modified Side Channel** – This alternative would create a fish bypass channel using the existing 'high flow channel' that runs south of the existing Intake Diversion Dam. The existing channel would be modified to allow for more frequent flows to pass through. The existing Intake Diversion Dam would remain in place.
- **Multiple Pump** - This alternative would remove the existing Intake Diversion Dam and construct five pump stations on the Yellowstone River to deliver water to the Lower Yellowstone Irrigation Project main canal. The pump stations would be designed to provide the same amount of water as is currently being diverted by the dam.
- **Multiple Pumps with Conservation Measures** - This alternative would include several new construction components that would allow for the removal of the existing Intake Diversion Dam along with conservation measures to lessen the water required to be diverted. These construction components include implementation of water conservation measures, shallow ground water pumping, gravity diversions and use of wind energy to offset pumping costs. The conservation measures would consist of installing new check structures, flow measuring devices, modifying existing laterals to pipes, center pivot sprinkler installation, lining the main canal, control over checking and groundwater pumping.

## 1.4 Alternative Design Levels

Two of the proposed alternatives have been initially designed and estimated by the Omaha District prior to this current study. These alternatives include the Rock Ramp and Bypass Channel. The Rock Ramp alternative has been designed to a conceptual level while the Bypass Channel has previously been designed and estimated to the 100% design level. Thus the Bypass Channel has much more certainty and has far less chance of future changes, if any.

The remaining three expanded alternatives have been designed only to a conceptual level. These alternatives still have many investigations outstanding that could change many of the

assumptions used in both the designs and estimates. Moving into future design phases with any of these alternatives would allow for development of more integrated hydraulic, geotechnical and other technical studies such that many assumptions here within would be modified as necessary.

## 1.5 Estimates for Comparison Purposes

Given that some of the estimates have been previously completed and/or designed to different levels of detail, each of the five proposed alternative estimates have been newly developed or updated in order for the total project costs to be comparable. These modifications include the updating of price levels based on USACE Civil Works escalation factors, modifying contingencies to reflect associated risks at the estimates' current design levels, and attempting to maintain similar assumptions across all five alternatives. The following sections discuss each of these items in more detail as they relate to each of the five alternatives.

# 2.0 Initial Alternatives

This section discusses the changes made to the cost estimates of the two initial alternatives such that they would be comparable with three newly proposed alternatives. The two previously estimated alternatives, Rock Ramp and Bypass Channel, were developed by USACE, Omaha District (NWO). For this current study, the primary modifications to these two estimates is to escalate the total costs per the Civil Works Construction Cost Index System (CWCCIS) found in EM 1110-2-1304, and to incorporate an updated abbreviated risk analysis contingency mark-up. The following section is a discussion of these two alternatives and the assumptions made to complete the necessary price level updates for inclusion into a Total Project Cost Summary (TPCS).

## 2.1 Detailed Alternative Descriptions

### 2.1.1 Rock Ramp

The Rock Ramp alternative would replace the existing rock and timber crib structure at the Intake Diversion Dam with a concrete weir and a shallow-sloped, un-grouted boulder and cobble rock ramp. The rock ramp would be designed to mimic natural river function and would have reduced velocities and turbulence so that migrating fish could pass over the dam, thereby improving fish passage and contributing to ecosystem restoration.

The replacement concrete weir would approximately 40 feet upstream of the existing weir, and would create sufficient water height to divert 1,374 cfs into the main canal. The cast-in-place reinforced concrete weir would replace the existing timber and rock-filled dam and would provide long-term durability that is lacking in the current structure. The weir crest would vary in elevation, including at least one low-flow channel for fish passage. The historic headworks would be preserved in placed and would serve as a weir abutment on the north bank, while a concrete abutment would be constructed on the south bank. The downstream side of the weir would tie directly into the rock ramp to provide a seamless transition and unimpeded fish passage.

The rock ramp would be constructed downstream of the replacement weir by placing rock and fill material in the river channel to shape the ramp, followed by placement of rock riprap. The new ramp would be constructed over the site of the existing Intake Diversion Dam, preserving most of the historic dam in place. The new ramp would include at least one low flow channel in conjunction with the low flow channel on the weir crest. The rocks in the ramp would be sized to withstand high flows and ice jams and would range from 1 – 4 feet in diameter. The rock would be purchased from commercial quarries in either Wyoming or Minnesota and likely delivered by train to Glendive before being trucked to the project site.

Staging and rock stockpile areas would be located downstream of the headworks and another construction zone would be located on the Joe’s Island side of the dam. Haul roads and a

temporary crossing over the main canal would need to be constructed to prevent damage to the existing county bridge.

### 2.1.2 Bypass Channel

The Bypass Channel alternative would construct a bypass channel on Joe's Island from the inlet of the existing high flow chute to just downstream of the existing dam and rubble field. It would also replace the existing Intake Diversion Dam with a concrete weir. The placement of the bypass channel is thought to allow fish better access to the channel and increase their abilities to migrate upstream of the intake dam.

The bypass channel would be designed to divert approximately 13-15% of total Yellowstone River flows. Significant quantities of excavation would be required to create the channel. The excavated material is assumed to be disposed of all within Joe's Island, and therefore no material would be required to be hauled off-site. Sheet pile cofferdams would be required to complete the channel construction. Two vertical control structures would be constructed within the bypass channel. These structures would consist of riprap and would give the appearance of a seamless channel invert while providing stability during extreme events. The bypass channel would also require stone placement for bank protection and on the channel bed to minimize the risk of erosion. The riprap for the bank protection would be purchased from acceptable quarries and transported to the project site, while the bedding stone is assumed to be screened from the excavation of the bypass channel.

The concrete weir would be constructed approximately 40 feet upstream of the existing dam. The new weir would provide adequate water surface elevations for splitting the river flow into the new bypass channel and also ensuring delivery of irrigation water. The weir would consist of a cantilevered structural wall created by a deep foundation of either driven piles or drilled shafts with a concrete cap. Fill would be placed between the new weir and the existing rock weir, and the new crest would contain at least one low-flow channel for fish passage.

## 2.2 Basis of Estimates

### 2.2.1 Rock Ramp

The MCACES construction cost estimate was completed by the NWO during previous alternatives analysis for this project. The MCACES estimate provided by the NWO for use in this current study was completed in April 2011. For inclusion in the economic analysis, the estimate has been escalated to a current pricing date of April 2016. The Civil Works Construction Cost Index System (CWCCIS) escalation factors were used in the escalation of the construction costs. The CWCCIS factors calculate to an approximate 8.25% increase to each feature account. The original MCACES costs along with the escalation factors and current total costs are provided in Table 2-1.

**Table 2.1 Rock Ramp Escalation Factors and Cost Updates**

| Feature Account | Item Description from MCACES | Original Costs (3Q11) | CWCCIS Factor (3Q11) | CWCCIS Factor (3Q16) | Current Costs |
|---|---|---|---|---|---|
| 06 | Coffer Dam | $3,850,361 | 740.70 | 801.79 | $4,167,924 |
| 06 | Rock Ramp | $42,351,677 | 740.70 | 801.79 | $45,844,675 |
| 06 | Remaining Site Work | $939,069 | 740.70 | 801.79 | $1,016,520 |
| 15 | Concrete Crest Structure | $8,268,256 | 740.70 | 801.79 | $8,950,189 |
| | | | | **Total Construction Cost:** | $59,979,308 |
| | | | | **Total Escalation Percent:** | 8.25% |

### 2.2.2 Bypass Channel

A MCACES construction cost estimate developed in accordance with final design plans has been developed by NWO. However, this estimate was set up in accordance with the bid schedule, and therefore did not include sorting into CWCCIS feature accounts. Therefore it was decided that the 90% estimate, which still contained costs sorted into feature accounts, would be used for the purposes of completing the analysis for this study.

This 90% MCACES construction cost estimate was prepared in February 2015 by NWO. For inclusion in the current economic analysis, the estimate has been escalated to a current pricing date of April 2016. The CWCCIS escalation factors were used in the escalation of the construction costs. The CWCCIS factors calculate to an approximate 1.93% increase on total construction costs. The original MCACES costs along with the escalation factors and current total costs are provided in Table 2-2.

**Table 2.2 Bypass Channel Escalation Factors and Cost Updates**

| Feature Account | Item Description from MCACES | Original Costs (2Q15) | CWCCIS Factor (2Q15) | CWCCIS Factor (3Q16) | Current Costs |
|---|---|---|---|---|---|
| 09 | Bypass Channel | $17,707,099 | 845.53 | 861.75 | $18,046,778 |
| 15 | Intake Weir | $12,065,928 | 788.66 | 801.79 | $12,266,807 |
| 16 | Bank Stabilization Rock | $18,714,085 | 837.55 | 855.31 | $19,110,912 |
| | | | | **Total Construction Cost:** | $49,424,497 |
| | | | | **Total Escalation Percent:** | 1.93% |

## 2.3 Total Project Cost Summary (TPCS)

The escalated costs have been input into the latest version of the TPCS Excel spreadsheet provided by the USACE, Walla Walla District. The TPCS incorporates the projects constructions costs, project markups, and functional costs. The escalated prices shown in the Table 2-1 and Table 2-2 have been input into the TPCS and have been escalated to both the program year (FY17) and the midpoint of construction per the project schedule. The TPCS spreadsheets are provided in Attachment B.1.

## 2.4 Project Schedules

The durations used for the construction components are based on discussions and schedules previously developed. These discussions and scheduling information are from the following documents.

- Intake Diversion Dam Modification, Lower Yellowstone Project, Final EA (2010).
- Intake Diversion Dam Modification Project, Cost Appendix, Summary of Fish Passage Design Features (2012).

From the discussion and information within these two reports, simplified project schedules have been developed for use in this study. The tentative project schedules are provided in Attachment B.2 and are based on the following assumptions:

- The Bypass Channel alternative does not include a design phase, as this alternative has already been fully designed. Thus construction could begin much sooner than the other alternatives.
- Assumes design phase of the Rock Ramp alternative would begin in May of 2016.
- Construction would begin in May of 2016 for the Bypass Channel, and May of 2018 for the Rock Ramp alternative.

## 2.5 Functional Costs

### 2.5.1 01 Account – Lands and Damages

There are currently no costs assumed for this account, as the NWO did not include real estate costs in their original analysis. However, based on estimated real estate costs developed for other alternatives in this current study, it is not likely that real estate costs would be significant. Therefore, no costs for this account have been added.

### 2.5.2 02 Account – Relocations

No relocations items were included in the original NWO estimates for either alternative. Therefore no costs are included in either estimate for this feature account.

### 2.5.3 06 Account – Fish and Wildlife Facilities

In addition to the construction costs, costs for monitoring and adaptive management during construction have been included in the TPCS. These costs are currently estimated at 1.0% of total construction costs.

### 2.5.4 30 Account – Planning, Engineering and Design (PED)

Costs for this account were estimated as percentages of construction costs for the various feature accounts. This account covers planning, engineering and design including; preparation of plans, specifications, and engineering during construction. The current estimate assumes 9.0% of construction costs for this account for the Rock Ramp alternative. This value is the same percentage used by the NWO in previous analysis on this project.

No PED markup is included for the Bypass Channel alternative. This is due to this alternative already having 100% design plans developed. Thus, no further PED expenditures would be required for this alternative to proceed to construction.

### 2.5.5 31 Account – Construction Management (CM)

Costs for this account were estimated as percentages of construction costs of the various feature accounts. This costs is assumed to cover construction management during the construction phase. The current estimate assumes 6.0% of construction costs for this account. This value is the same percentage used by the NWO in previous analysis on this project.

## 2.6 Project Markups

### 2.6.1 Escalation

After the MCACES construction costs for both alternatives have been escalated to current prices (3Q16), the costs have been escalated to the program year (1Q17) as well as to the midpoints of construction to estimate the fully funded project cost. The appropriate escalation cost factors for each date and for each feature account have been calculated within the Total Project Cost Summary.

### 2.6.2 Contingency

An Abbreviated Risk Analysis (ARA) was completed in order to develop the contingency percent used for each alternative. The separate calculated contingencies for construction, PED and CM were used within the TPCS for both alternatives. The ARA documents for these alternatives are found in Attachment B.3.

The overall project contingency for the Rock Ramp is currently 31.0% and the overall project contingency for the Bypass Channel is 8.8%. The Bypass Channel contingency is significantly lower due to the fact that the estimate is based on 90% design plans. Therefore, at this level of design, most risks have been mitigated in the design, and funding streams are already in place.

# 3.0 Expanded Alternatives

This section discusses the three alternatives that have recently been designed and estimated for use in this study. Each of these three alternatives (Modified Side Channel, Multiple Pump Stations, and Multiple Pumps with Conservation Measures) have been designed to a conceptual level and estimated by Tetra Tech. The following sections discuss each alternative and the assumptions used in the development of MCACES construction cost estimates and TPCS documents such that they are comparable to the Initial Alternatives.

## 3.1 Detailed Alternative Descriptions

### 3.1.1 Modified Side Channel

The Modified Side Channel alternative would improve fish passage by creating a fish bypass using the existing "high flow channel." Pallid sturgeon have been documented to pass through the existing high flow channel in previous years. Therefore if the existing channel is constructed to allow for additional and more frequent flows, then it would also provide greater fish passage.

The construction required to allow for additional flow would require the creation of approximately 6,000 feet of new channel. The new channel sections would cutoff several existing bends and create new backwater areas. The entire high flow channel would be lowered significantly and would require bank protection in several areas as well as five grade control structures.

### 3.1.2 Multiple Pump

The Multiple Pump alternative proposes removing the Intake Diversion Dam, using the existing headworks when there is sufficient flow in the Yellowstone River to gravity divert the required flows, and constructing five pumping stations along the banks of the Yellowstone River to deliver water to the Lower Yellowstone Irrigation Project to be operated when gravity flows are insufficient. The pumping plants would be constructed at various locations along the Lower Yellowstone River between Intake Dam and Savage. The intakes would be screened to minimize fish entrainment and would discharge into existing canals to supply the irrigation districts. Because the irrigation canal system was designed for gravity flow of water primarily from a single water source at Intake, this alternative would require some restructuring of the Lower Yellowstone Irrigation Project canal system to accommodate a water supply from multiple points along the canal.

The pumping stations would be designed for a total diversion capacity of 1,374 cfs when the flow in the Yellowstone River is 3,000 cfs at the upper most point of diversion. Each of the five pumping stations would be designed for a capacity of 275 cfs. Water would be drawn from the river through a feeder canal to a fish screen structure, located at the edge of the channel migration zone. The motors and electrical equipment in both the fish screen structure and the

pump station would be located above the 100-year flood elevation. Fish would be screened out and returned to the river through a fish return pipe and irrigation water would pass through the fish screen and flow into the pumping station. Discharge pipes would convey the irrigation water to the main irrigation canal.

### 3.1.3 Multiple Pumps with Conservation Measures

The Multiple Pumps with Conservation Measures alternative includes four primary components including the implementation of water conservation measures, pumping, gravity diversions through the existing headworks and use of wind energy to offset pumping costs. The removal of the dam would allow passage on the Yellowstone River, and other components would provide a continued water source to the Lower Yellowstone Irrigation District.

The conservation measures are proposed to reduce the amount of water needed by the project by reducing inefficiency losses in the delivery system and on the farms. The proposed level of conservation is assumed to be completed by installing/completing the following:

- Installation of check structures to provide water control along the canal as a means of maintaining water levels high enough to allow match between water needs and water diversions
- Installation of flow measuring devices on the main canal and laterals to measure water flows in areas where there is no monitoring currently.
- Converting existing laterals from open ditches to pipes to reduce losses from evaporation, seepage, bank vegetation consumption and spillage.
- Convert farms from flood irrigation to sprinkler irrigation to provide more efficient water use to certain farms.
- Lining of the main canal with 3-inches of shotcrete over a geomembrane layer to lessen losses in the canal from seepage.
- Control of over checking to avoid higher than necessary water levels. Over checking can exacerbate the seepage losses on unlined canals.
- Installing groundwater pumps to provide water for irrigation when needed.

This alternative would also require the installation of Ranney Wells to provide water to the main canal after removal of the existing Intake Diversion Dam. The Ranney Well pumping stations would be installed at seven sites along the Yellowstone River and would the wells would pump water directly into the canal. The energy needed to operate the numerous Ranney Wells is assumed to be off-set by the construction of a wind turbine at a pre-existing wind farm. Once built, the LYIP is assumed to obtain a banking agreement such that the energy costs to operate the wells would be zero.

## 3.2 MCACES Construction Cost Estimates

The three new alternatives were estimated using MCACES 2nd Generation (MII) cost estimating software in accordance with guidance contained in ER 1110-2-1302, Civil Works Cost Engineering.

## 3.3 Basis of Estimate

### 3.3.1 Basis of Design

The available design documents for these three alternatives can all be found in Attachments A-1, A-2 and A-3 of the Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana, Draft Environmental Impact Statement (EIS) (2016). These sections of the EIS contain detailed discussions of the design development and contain all conceptual level design drawings that were used in the estimating process.

### 3.3.2 Basis of Quantities

The cost estimates are based on project quantity take-offs that have been calculated in accordance with the attachments referenced in the EIS. A quantity summary and detailed quantity take-offs that correspond to the three expanded alternative MCACES cost estimates are found in Attachment B.4.

## 3.4 Project Schedules

Simplified tentative project schedules have been developed for each of these three construction alternatives. The durations for each of the alternatives have been used in the cost estimates to determine costs for the contractor to maintain field facilities and provide construction supervision. The simplified tentative project schedules are presented in Attachment B.2. These schedules have been developed with the following assumptions:

- Assumes design phase would begin in May of 2016
- Assumes contractor would try and avoid major construction activities that could interrupt the water supply during the irrigation season, which is assumed to be from the middle of April through September.
- Assumes crews would work 10 hours per day and 6 days per week.

## 3.5 Acquisition Plan

Each cost estimate currently assumes that the projects would be let out in an unrestricted bid process and are expected to have a competitive bidding market. Due to the size of the proposed projects, no small business contracts are assumed. Each estimate has prime and subcontracting assumptions based on an alternative by alternative basis. A brief discussion of the assumptions used in the estimate are below.

- Modified Side Channel – The cost estimate is based on one contract being awarded to a prime contractor to complete the work. The estimate currently assumes that there would be subcontractors required for concrete, landscape and pile driving work. The prime contractor would be responsible for all the preparatory work, and placing all associated site work as well as overseeing the subcontractors' efforts.

- Multiple Pump Stations - The cost estimate is based on two contracts being awarded to a prime contractor. The first contract would be let out for the installation of all five pump stations. The prime contractor for this is currently assumed to be able to handle all the earthwork, but is assumed to require subcontractors for the concrete, pile driving, electrical and pump installation work. The second contract is assumed to be awarded to a prime contractor that would have the capabilities to complete all aspects of the existing dam removal.

- Multiple Pumps with Conservation Measures - The cost estimate is based on six contracts being awarded to a prime contractor to complete. These six contracts, in no particular order) would account for the following: 1) Removal of the existing Intake Diversion Dam, 2) Lining the main canal and converting laterals into pipes, 3) Installing check structures and flow measuring devices, 4) Converting farms to center pivot sprinklers, 5) Erecting a 2 megawatt wind turbine, and 6) Installing the Ranney Wells.

## 3.6 Project Construction

The following is a brief summary of the key construction elements and the estimated construction methodology for each alternative.

### 3.6.1 Modified Side Channel

This alternative would require three staging areas and a gravel construction access road installed along the north and east side of the high flow channel. The staging areas and access roads would require the placement of gravel. A single span access bridge would also need to be placed across the high flow channel to allow for access to both sides of the channel. A cofferdam would then be required to facilitate channel excavation at both the upstream and downstream tie-in locations.

The cofferdams would consist of sheet piles to reduce seepage with an earthen embankment placed over them. The embankment would have bank protection stone placed on the slopes.

Channel excavation would be completed to construct three bend cutoffs and to lower and widen the existing channel. Approximately one third of the material excavated would be used as fill that would be placed in existing bends in order to cut those sections off. The remaining excavated material would be disposed of at the proposed spoil area located on Joe's Island. The disposal location would require some sediment and erosion control measures. Lastly the newly formed high flow channel would have bank protection installed. This bank protection consist of a bedding layer beneath riprap.

### 3.6.2 Multiple Pump Stations

This alternative includes the construction of five pump stations along the Yellowstone River. Each of the stations would require the construction of a staging area and access roads that would be cleared, graded, and have gravel placed. The excavation for the pump station would begin first. After the excavation is complete the placement of the reinforced concrete floors, walls and top slab would be completed. Upon completion of the concrete work all pump station items including pumps, motors, piping, and steel structure would be completed.

A feeder canal would also need to be constructed leading to the pump station. The feeder canal would require the installation of sheet piling for dewatering purposes. The canal area would be cleared prior to be being excavated. A steel trash rack would be installed in the feeder canal as well.

To prevent fish from entering the irrigation pumps, a fish screen structure would also be constructed. The fish screen would require clearing and excavation. Then reinforced concrete foundations, floors, footings and walls would be installed. The fish screen steel supports, screen and deadplates would be installed next. A return pump and pipes would be installed to return fish to the river.

After the pump stations are complete and operational, then the existing Intake Diversion Dam would be removed. The removal of the dam would likely occur in two phases. The initial phase would require steel sheet piles placed just upstream of the dam and downstream of the boulder field. An earthen embankment would be placed, in lieu of sheet piles, over the boulder field to connect the two sheet pile walls. An earthen embankment was assumed because of the uncertain and risk associated with attempting to drive sheet piles through the existing rock dam and boulder field.

After construction of the initial phase cofferdam, a portion of the existing dam and boulder field would be removed. It is assumed that the rock removed would be hauled locally on Joe's Island for stockpiling such that the stone could be reused in the future. After the rock and dam removal is complete, a new sheet pile cofferdam could be driven and the earthen embankment removed. Then the cofferdam would be extended across the remaining portion of the dam and boulder field to allow for the removal of the remaining section of the dam.

### 3.6.3 Multiple Pumps with Conservation Measures

This alternative has numerous components with some taking multiple years to place due to the scope of the project and/or due to possible narrow work windows that may be required to avoid impacting the irrigation season and the extreme cold weather months. Therefore the following is more a general discussion of each of the components and the assumptions for work required to complete that were used in the estimate, and not necessarily a detailed sequencing of all work.

- Convert Laterals from Ditches to Pipe – This work assumes replacing existing earthen ditches, primarily in the most downstream reaches, to reinforced concrete pipe. Based on the existing dimensions of the laterals, it has been assumed that the pipe sizes required would vary from 18 inches to 72 inches. Some laterals would require far greater pipe sizes, and even double or triple barrel piping. Thus it was assumed after 72 inches the lateral would be lined with shotcrete with same procedures as the lining of the main canal.

The new pipes would be placed in the existing laterals on top of a base layer. Once the pipes are laid the pipe, and remaining area of the lateral, would be backfilled.

- Line Main Canal – To reduce seepage losses it is proposed that the entire main canal would be lined with shotcrete placed on top of a geomembrane liner. Prior to placing the shotcrete, the channel would need to be filled to approximately half the current volume due to the significant decrease in flows. The fill material for this is assumed to come from a borrow site within the study region, and therefore would not be purchased. After filling and grading the canal a geomembrane liner would be placed beneath a 3 inch layer of fiber reinforced shotcrete.

- Check Structures – Nine new check structures are anticipated to be constructed within the main canal. These check structures would require earthwork prior to placing the reinforced concrete structures. The check structures would also have hydraulic gates installed for controlling flows. Lastly, riprap erosion protection would be placed.

- Flow Measuring Devices – Numerous flow measuring devices are proposed to be installed at various locations throughout the study region. There are two types of measuring devices proposed, Cipolletti weir and Parshall flumes. These are both concrete structures and can vary in size. Each of the measuring device types would require some earthwork along with reinforced cast-in-place concrete.

- Convert Fields from Flood Irrigation to Sprinklers - Approximately 5,000 acres of flood irrigated farmland is assumed to be converted to sprinkler irrigation. It is assumed that center pivot sprinklers would be installed, and these sprinklers would require pumps for pressurization. The cost estimate also includes costs of installing power lines to the sprinkler systems.

- Renewable Energy Resources – The estimate includes the cost to install a 2 megawatt (MW) wind turbine and a pre-existing windfarm. The construction of the turbine is assumed to offset the cost of the Ranney Well operations.
- Ranney Wells – The Ranney Wells are required to have test drilling and pumping tests. Once finalized, the pumps would be manufactured and the pump station constructed. The Ranney Wells would also require discharge and collector pipelines. Access roads to the pump station would also be built.

## 3.7 Effective Dates for Labor, Equipment and Material Pricing

The labor, equipment, and material pricing were developed using the MCACES 2012 English Unit Cost Library, 2016 Richland County Labor Library (see Attachment B.5 for Davis-Bacon wages used), and the 2014 Equipment Library (Region IV) for the base cost estimates. The index pricing data has been prepared in April 2016 dollars.

The cost estimate has been updated with current quoted fuel prices of $1.66/gal for off-road diesel, $1.94/gal for on-road diesel and $1.95/gal for gasoline in the Glendive, MT area.

## 3.8 Estimated Construction Durations

The estimate contains many user created cost items that were developed outside of the MCACES Unit Cost Library. These developed cost items have had crews and production rates created in order to accurately calculate unit costs. See Attachment B.6 for the estimated production rates and duration estimates for these construction items.

## 3.9 Direct and Contractor Markups

### 3.9.1 Direct Markups

The cost estimate for each alternative includes a direct markup for crews and equipment working overtime. The markup is calculated in MCACES and is based on the assumption that crews would be working 10 hours per day and 6 days per week. The markup percentage used in the estimate is 16.67 percent.

### 3.9.2 Contractor Markups

The prime contractor Job Office Overhead (JOOH) markup for each alternative is based on a calculated percentage within MCACES. The JOOH calculation is based off the estimated duration for all construction components. A running percentage has been used in the estimate for

the prime contractor Home Office Overhead (HOOH) markup. Profit is included for the prime contractor and is calculated using the profit weighted guideline calculation within MCACES. Bonding has also been included for the prime and sub-contractors.

## 3.10 Functional Costs

### 3.10.1 01 Account – Lands and Damages

Real Estate costs have been estimated for these three alternatives. The alternative footprints were overlaid onto parcel data in order to determine the area required to be purchased. Then a value of $10,000 per acre was assumed to be used for purchasing these lands. This value was provided by the Bureau of Reclamation, and was based on reasonable land purchases by the Bureau on other recent projects.

For this project the following acres and costs were included in the TPCS, with an assumed 25% contingency.

**Table 3.1 Summary of Assumed Real Estate Costs**

| Alternative | Acres to be Purchased | Cost per Acre | Total Cost* |
|---|---|---|---|
| Modified Side Channel | 22 acres | $10,000 | $220,000 |
| Multiple Pump Stations | 44.3 acres | $10,000 | $443,300 |
| Multiple Pumps with Conservation | 280 acres | $10,000 | $2,800,000 |
| * Note: Costs do not contain contingency | | | |

### 3.10.2 02 Account – Relocations

Current analysis for each of the three expanded alternatives shows no relocations within the project extent. Therefore, at this time, no relocation costs are included in any of these three alternatives.

### 3.10.3 06 Account – Fish and Wildlife Facilities

In addition to the construction costs, costs for adaptive management during construction have been included in the TPCS. These costs are currently estimated at 1.0% of total construction costs.

### 3.10.4 30 Account – Planning, Engineering and Design (PED)

Costs for this account were estimated as percentages of construction costs for the various feature accounts. This account covers the planning, engineering and design including; preparation of plans, specifications, and engineering during construction. The current estimate assumes 9.0% of

construction costs for this account. This value is the same percentage used by the NWO in previous analysis on this project.

### 3.10.5 31 Account – Construction Management (CM)

Costs for this account were estimated as percentages of construction costs of the various feature accounts. This costs is assumed to cover construction management during the construction phase. The current estimate assumes 6.0% of construction costs for this account. This value is the same percentage used by the NWO in previous analysis on this project.

## 3.11 Project Markups

### 3.11.1 Escalation

Each alternative construction cost has been escalated to the program year (1Q17) as well as to the midpoints of construction to calculate the fully funded project cost. The appropriate escalation cost factors for each date and for each feature account have been calculated within the Total Project Cost Summary spreadsheets.

### 3.11.2 Contingency

An Abbreviated Risk Analysis (ARA) has been completed in order to develop the contingency values for each alternative. The calculated contingencies reflect the uncertainty in designs and other aspects of the alternatives. However, the contingencies are primarily weighted towards the levels of uncertainty in the significant cost drivers of the MCACES estimates. Alternatively stated, the alternatives with less risk of cost increases to these significant cost drivers, in relation to the total cost, are likely to have lower contingencies. The ARA documents are provided in Attachment B.3, and the overall project contingencies for each alternative are as follows:

- Modified Side Channel – 33.7%
- Multiple Pump Stations – 35.4%
- Multiple Pumps with Conservation Measures – 31.6%

## 3.12 Total Project Cost Summary (TPCS)

A TPCS has been prepared for each alternative using the latest TPCS Excel spreadsheet provided by the USACE, Walla Walla District. The TPCS incorporates the projects construction costs, project markups, and functional costs. The TPCS uses these current price level costs and further escalates to the program year and estimated midpoint of construction for each alternative. The TPCS for each alternative is presented in Attachment B.1.

## 3.13 MCACES Construction Cost Estimate Summaries

Summary printouts of the MCACES cost estimates can be found in Attachment B.7. The costs shown in these summaries is for construction work only, and does not include PED, CM, escalation or contingencies.

# 4.0 First Cost Summaries

This section provides summary tables of each of the action alternatives' project costs. These summaries are broken out by work breakdown structure and include the current MCACES costs, functional costs, and estimated contingencies from the risk analysis documents. The costs in the following tables are in third quarter 2016 prices (3Q16), and the tables do not include escalation. The values match the rounded values from the "Estimated Cost" column in the TPCS sheets found in Attachment B.1.

**Table 4.1 Rock Ramp Alternative First Cost Summary**

| Work Breakdown Structure Feature Account | Cost | Contingency | Total Cost |
|---|---|---|---|
| 01 - Real Estate (LERRDs) | - | 25.00% | - |
| 06 - Fish and Wildlife Facilities (Adaptive Mgmt.) | $600,000 | 32.70% | $796,000 |
| 06 - Fish and Wildlife Facilities | $51,029,000 | 32.70% | $67,715,000 |
| 15 - Floodway Control & Diversion Structure | $8,950,000 | 32.70% | $11,877,000 |
| 30 - Planning, Engineering & Design (PED) | $5,453,000 | 18.84% | $6,480,000 |
| 31 - Construction Management (CM) | $3,635,000 | 20.55% | $4,382,000 |
| | | **Total Estimated Cost:** | **$91,250,000** |

**Table 4.2 Bypass Channel Alternative First Cost Summary**

| Work Breakdown Structure Feature Account | Cost | Contingency | Total Cost |
|---|---|---|---|
| 01 - Real Estate (LERRDs) | - | 25.00% | - |
| 06 - Fish and Wildlife Facilities (Adaptive Mgmt.) | $494,000 | 8.82% | $538,000 |
| 09 - Channels and Canals | $18,047,000 | 8.82% | $19,639,000 |
| 15 - Floodway Control & Diversion Structure | $12,267,000 | 8.82% | $13,349,000 |
| 16 - Bank Stabilization | $19,111,000 | 8.82% | $20,797,000 |
| 30 - Planning, Engineering & Design (PED) | - | 8.82% | - |
| | | **Total Estimated Cost:** | **$57,582,000** |

**Table 4.3 Modified Side Channel Alternative First Cost Summary**

| Work Breakdown Structure Feature Account | Cost | Contingency | Total Cost |
|---|---|---|---|
| 01 - Real Estate (LERRDs) | $220,000 | 25.00% | $275,000 |
| 06 - Fish and Wildlife Facilities (Adaptive Mgmt.) | $352,000 | 35.18% | $476,000 |
| 08 - Roads, Railroads and Bridges | $1,042,000 | 35.18% | $1,408,000 |
| 09 - Channels and Canals | $16,703,000 | 35.18% | $22,579,000 |
| 16 - Bank Stabilization | $17,436,000 | 35.18% | $23,570,000 |
| 30 - Planning, Engineering & Design (PED) | $3,201,000 | 23.21% | $3,944,000 |
| 31 - Construction Management (CM) | $2,133,000 | 24.93% | $2,665,000 |
| | | **Total Estimated Cost:** | **$54,916,000** |

**Table 4.4 Multiple Pump Stations Alternative First Cost Summary**

| Work Breakdown Structure Feature Account | Cost | Contingency | Total Cost |
|---|---|---|---|
| 01 - Real Estate (LERRDs) | $443,000 | 25.00% | $554,000 |
| 04 - Dams | $6,600,000 | 36.83% | $9,030,000 |
| 06 - Fish and Wildlife Facilities (Adaptive Mgmt.) | $843,000 | 36.83% | $1,153,000 |
| 19 - Buildings Grounds and Utilities | $77,678,000 | 36.83% | $106,284,000 |
| 30 - Planning, Engineering & Design (PED) | $7,664,000 | 26.52% | $9,697,000 |
| 31 - Construction Management (CM) | $5,108,000 | 26.52% | $6,463,000 |
| | | **Total Estimated Cost:** | **$133,180,000** |

**Table 4.5 Multiple Pumps with Conservation Measures Alternative First Cost Summary**

| Work Breakdown Structure Feature Account | Cost | Contingency | Total Cost |
|---|---|---|---|
| 01 - Real Estate (LERRDs) | $2,800,000 | 25.00% | $3,500,000 |
| 04 - Dams | $7,037,000 | 32.38% | $9,315,000 |
| 06 - Fish and Wildlife Facilities (Adaptive Mgmt.) | $3,131,000 | 32.38% | $4,144,000 |
| 09 - Channels and Canals | $195,853,000 | 32.38% | $259,261,000 |
| 19 - Buildings, Grounds and Utilities | $18,703,000 | 32.38% | $24,758,000 |
| 20 - Permanent Operating Equipment | $91,468,000 | 32.38% | $121,082,000 |
| 30 - Planning, Engineering & Design (PED) | $28,458,000 | 26.52% | $36,006,000 |
| 31 - Construction Management (CM) | $18,972,000 | 26.52% | $24,004,000 |
| | | **Total Estimated Cost:** | **$482,069,000** |

# 5.0 Operations, Maintenance and Repairs

Cost estimates have been developed for the No Action alternative as well as each of the construction alternatives for the anticipated costs for operations, maintenance and repairs (OM&R) over the life cycle of the project (assumed to be 50-years). These estimates are conceptual level estimates for each of the five construction alternatives and have been calculated for comparison purposes only.

## 5.1 OM&R Development

In order to estimate the OM&R costs for each alternative, general assumptions had to be made to determine how much costs would be spent each and every year over the lifespan of the project. This was completed in spreadsheet format where a list of assumptions was developed that noted the OM&R item, the assumed annual cost, and the assumed number of occurrences over a 50 year project life. From there a matrix was developed to display the costs for each year and which OM&R item occurs in any given year. These OM&R calculation spreadsheets are provided in Attachment B.8.

Information and costs were gathered from the Lower Yellowstone Irrigation Project (LYIP), the Bureau of Reclamation, and the USACE for use in the OM&R estimates. The current costs have been reviewed by staff from these entities, and updates to the estimates have been developed by BOR, but are still subject to change as the project progresses. Table 5-1 shows the current net present value of OM&R costs over the 50 year project life as well as the average annual costs for OM&R after discounting.

Discounting of the OM&R costs is completed in order to compare benefits and costs that are in different time scales. Thus, discounting is used to express the future OM&R costs in today's equivalent values. The current Federal discount rate of 3.125% has been used to calculate the discount factors for each and every year over the O&M timeframe. These factors are shown in the annual O&M tables found in Attachment B.8.

**Table 5.1 Summary of Annual OM&R Costs**

| Alternative | Net Present Value of OM&R | Average Annual OM&R[1] |
|---|---|---|
| No Action | $66,419,873 | $2,643,043 |
| Rock Ramp | $71,370,121 | $2,840,028 |
| Bypass Channel | $70,333,034 | $2,798,759 |
| Modified Side Channel | $73,045,804 | $2,906,708 |
| Multiple Pump Stations | $124,394,601 | $4,950,029 |
| Multiple Pumps with Conservation | $114,768,141 | $4,566,963 |

1. Average Annual OM&R is based on 50-year period of analysis and 3.125% Federal discount rate

# 6.0 References

US Army Corps of Engineers (USACE). 1993. “ER 1110-1-1300: Engineering and Design Cost Engineering Policy and General Requirements.” Washington D.C.

US Army Corps of Engineers (USACE). 1999. “ER 1110-2-1150: Engineering and Design for Civil Works Projects.” Washington D.C.

US Army Corps of Engineers (USACE). 2008a. “ER 1110-2-1302: Civil Works Cost Engineering.” Washington D.C.

US Army Corps of Engineers (USACE). 2008b. “ETL 1110-2-573: Construction Cost Estimating Guide for Civil Works.” Washington D.C.

US Army Corps of Engineers (USACE). 2010. “EM 1110-2-1304: Civil Works Construction Cost Index System (CWCCIS).” Washington D.C.

US Army Corps of Engineers (USACE). 2012. “Intake Diversion Dam Modification Project Cost Appendix, Summary of Fish Passage Design Features Concepts and Cost Implications.” Omaha, NE.

U.S. Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (USACE). 2010. Intake Diversion Dam Modification, Lower Yellowstone Project, Montana, Final Environmental Assessment. Report and Appendixes.

U.S. Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (USACE). 2015. Intake Diversion Dam Modification, Lower Yellowstone Project, Montana, Final Supplement to the 2010 Environmental Assessment. Including all attachments.

# Attachment B.1
# Total Project Cost Summary (TPCS) Spreadsheets

# Rock Ramp TPCS

****** TOTAL PROJECT COST SUMMARY ******

**PROJECT:** **Yellowstone River - Rock Ramp Alternative**
PROJECT NO: 0
LOCATION: Yellowstone River, MT and ND

**DISTRICT: Omaha (NWO)**
**POC: CHIEF, COST ENGINEERING, xxx**

**PREPARED: 5/19/2016**

This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Program Year (Budget EC): 2017<br>Effective Price Level Date: 1 OCT 16 | | | | | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | **TOTAL ($K)** | Spent Thru: **10/1/2015** ($K) | **TOTAL FIRST COST** ($K) | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | | *K* | *L* | *M* | *N* | *O* |
| **06** | FISH & WILDLIFE FACILITIES | $51,029 | $16,686 | 32.7% | $67,715 | 1.8% | $51,931 | $16,981 | $68,912 | $0 | $68,912 | 5.4% | $54,750 | $17,903 | $72,653 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $600 | $196 | 32.7% | $796 | 1.8% | $610 | $200 | $810 | $0 | $810 | 5.4% | $644 | $210 | $854 |
| **15** | FLOODWAY CONTROL & DIVERSION STRUCTURE | $8,950 | $2,927 | 32.7% | $11,877 | 1.8% | $9,108 | $2,978 | $12,087 | $0 | $12,087 | 5.4% | $9,603 | $3,140 | $12,743 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $60,579 | $19,809 | | $80,388 | 1.8% | $61,650 | $20,159 | $81,809 | $0 | $81,809 | 5.4% | $64,997 | $21,253 | $86,250 |
| **01** | LANDS AND DAMAGES | $0 | $0 | - | $0 | - | $0 | $0 | $0 | $0 | $0 | - | $0 | $0 | $0 |
| **30** | PLANNING, ENGINEERING & DESIGN | $5,453 | $1,027 | 18.8% | $6,480 | 3.6% | $5,650 | $1,064 | $6,714 | $0 | $6,714 | 3.0% | $5,821 | $1,096 | $6,917 |
| **31** | CONSTRUCTION MANAGEMENT | $3,635 | $747 | 20.6% | $4,382 | 3.6% | $3,766 | $774 | $4,540 | $0 | $4,540 | 11.4% | $4,195 | $862 | $5,058 |
| | **PROJECT COST TOTALS:** | $69,667 | $21,583 | 31.0% | $91,250 | | $71,066 | $21,997 | **$93,063** | $0 | **$93,063** | 5.5% | $75,013 | $23,212 | $98,225 |

**CHIEF, COST ENGINEERING, xxx**

**PROJECT MANAGER, xxx**

**CHIEF, REAL ESTATE, xxx**

**CHIEF, PLANNING,xxx**

**CHIEF, ENGINEERING, xxx**

**CHIEF, OPERATIONS, xxx**

**CHIEF, CONSTRUCTION, xxx**

**CHIEF, CONTRACTING,xxx**

**CHIEF, PM-PB, xxxx**

**CHIEF, DPM, xxx**

| | | |
|---|---|---|
| ESTIMATED FEDERAL COST: | **100%** | **$98,225** |
| ESTIMATED NON-FEDERAL COST: | **0%** | **$0** |
| **ESTIMATED TOTAL PROJECT COST:** | | **$98,225** |

****** TOTAL PROJECT COST SUMMARY ******

CONTRACT 1

****** CONTRACT COST SUMMARY ******

PROJECT: Yellowstone River - Rock Ramp Alternative
LOCATION: Yellowstone River, MT and ND
This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

DISTRICT: Omaha (NWO)
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/19/2016

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate Prepared: | | | 13-Apr-11 | Program Year (Budget EC): | | | 2017 | | | | | |
| | | Effective Price Level: | | | 1-Oct-15 | Effective Price Level Date: | | | 1 OCT 16 | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *P* | *L* | *M* | *N* | *O* |
| | **CONTRACT 1** | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES | $51,029 | $16,686 | 32.7% | $67,715 | 1.8% | $51,931 | $16,981 | $68,912 | 2019Q4 | 5.4% | $54,750 | $17,903 | $72,653 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $600 | $196 | 32.7% | $796 | 1.8% | $610 | $200 | $810 | 2019Q4 | 5.4% | $644 | $210 | $854 |
| **15** | FLOODWAY CONTROL & DIVERSION STRUCTURE | $8,950 | $2,927 | 32.7% | $11,877 | 1.8% | $9,108 | $2,978 | $12,087 | 2019Q4 | 5.4% | $9,603 | $3,140 | $12,743 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $60,579 | $19,809 | 32.7% | **$80,388** | | $61,650 | $20,159 | $81,809 | | | $64,997 | $21,253 | $86,250 |
| **01** | LANDS AND DAMAGES | $0 | $0 | 0.0% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *0.5%* | Project Management | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| *0.5%* | Planning & Environmental Compliance | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| *5.0%* | Engineering & Design | $3,029 | $571 | 18.8% | $3,600 | 3.6% | $3,138 | $591 | $3,729 | 2017Q3 | 2.0% | $3,200 | $603 | $3,803 |
| *0.5%* | Reviews, ATRs, IEPRs, VE | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| *0.5%* | Life Cycle Updates (cost, schedule, risks) | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| *0.5%* | Contracting & Reprographics | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| *0.5%* | Engineering During Construction | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2019Q4 | 11.4% | $350 | $66 | $416 |
| *0.5%* | Planning During Construction | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2019Q4 | 11.4% | $350 | $66 | $416 |
| *0.5%* | Project Operations | $303 | $57 | 18.8% | $360 | 3.6% | $314 | $59 | $373 | 2017Q3 | 2.0% | $320 | $60 | $380 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *5.0%* | Construction Management | $3,029 | $623 | 20.6% | $3,652 | 3.6% | $3,138 | $645 | $3,783 | 2019Q4 | 11.4% | $3,496 | $719 | $4,214 |
| *0.5%* | Project Operation: | $303 | $62 | 20.6% | $365 | 3.6% | $314 | $65 | $378 | 2019Q4 | 11.4% | $350 | $72 | $422 |
| *0.5%* | Project Management | $303 | $62 | 20.6% | $365 | 3.6% | $314 | $65 | $378 | 2019Q4 | 11.4% | $350 | $72 | $422 |
| | **CONTRACT COST TOTALS:** | $69,667 | $21,583 | | $91,250 | | $71,066 | $21,997 | $93,063 | | | $75,013 | $23,212 | $98,225 |

# Bypass Channel TPCS

****** TOTAL PROJECT COST SUMMARY ******

**PROJECT:** **Yellowstone River - Bypass Channel Alternative**
PROJECT NO: 0
LOCATION: Yellowstone River, MT and ND

**DISTRICT: Omaha (NWO)**
**POC: CHIEF, COST ENGINEERING, xxx**

**PREPARED: 5/19/2016**

This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Program Year (Budget EC): 2017<br>Effective Price Level Date: 1 OCT 16 | | | | | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | **TOTAL ($K)** | Spent Thru: **10/1/2015** ($K) | **TOTAL FIRST COST** ($K) | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | | *K* | *L* | *M* | *N* | *O* |
| **06** | FISH & WILDLIFE FACILITIES (Adaptive Mgmt.) | $494 | $44 | 8.8% | $538 | 1.8% | $503 | $44 | $547 | $0 | $547 | 1.4% | $510 | $45 | $555 |
| **09** | CHANNELS & CANALS | $18,047 | $1,592 | 8.8% | $19,639 | 1.8% | $18,366 | $1,620 | $19,985 | $0 | $19,985 | 1.4% | $18,615 | $1,642 | $20,257 |
| **15** | FLOODWAY CONTROL & DIVERSION STRUCTURE | $12,267 | $1,082 | 8.8% | $13,349 | 1.8% | $12,484 | $1,101 | $13,585 | $0 | $13,585 | 1.4% | $12,653 | $1,116 | $13,769 |
| **16** | BANK STABILIZATION | $19,111 | $1,686 | 8.8% | $20,797 | 1.8% | $19,449 | $1,715 | $21,164 | $0 | $21,164 | 1.4% | $19,713 | $1,739 | $21,452 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $49,919 | $4,403 | | $54,322 | 1.8% | $50,801 | $4,481 | $55,282 | $0 | $55,282 | 1.4% | $51,491 | $4,542 | $56,033 |
| **01** | LANDS AND DAMAGES | $0 | $0 - | | $0 | - | $0 | $0 | $0 | $0 | $0 | - | $0 | $0 | $0 |
| **30** | PLANNING, ENGINEERING & DESIGN | $0 | $0 | 0.0% | $0 | - | $0 | $0 | $0 | $0 | $0 | - | $0 | $0 | $0 |
| **31** | CONSTRUCTION MANAGEMENT | $2,996 | $264 | 8.8% | $3,260 | 3.6% | $3,104 | $274 | $3,378 | $0 | $3,378 | 3.0% | $3,197 | $282 | $3,479 |
| | **PROJECT COST TOTALS:** | $52,915 | $4,667 | 8.8% | $57,582 | | $53,905 | $4,755 | **$58,660** | $0 | **$58,660** | 1.5% | $54,688 | $4,824 | $59,512 |

**CHIEF, COST ENGINEERING, xxx**

**PROJECT MANAGER, xxx**

**CHIEF, REAL ESTATE, xxx**

**CHIEF, PLANNING,xxx**

**CHIEF, ENGINEERING, xxx**

**CHIEF, OPERATIONS, xxx**

**CHIEF, CONSTRUCTION, xxx**

**CHIEF, CONTRACTING,xxx**

**CHIEF, PM-PB, xxxx**

**CHIEF, DPM, xxx**

| | | |
|---|---|---|
| ESTIMATED FEDERAL COST: | **100%** | **$59,512** |
| ESTIMATED NON-FEDERAL COST: | **0%** | **$0** |
| **ESTIMATED TOTAL PROJECT COST:** | | **$59,512** |

# **** TOTAL PROJECT COST SUMMARY ****

CONTRACT 1

## **** CONTRACT COST SUMMARY ****

PROJECT: Yellowstone River - Bypass Channel Alternative
LOCATION: Yellowstone River, MT and ND
This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

DISTRICT: Omaha (NWO)
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/19/2016

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate Prepared: | | | 13-Mar-15 | Program Year (Budget EC): | | | 2017 | | | | | |
| | | Effective Price Level: | | | 1-Oct-15 | Effective Price Level Date: | | | 1 OCT 16 | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *P* | *L* | *M* | *N* | *O* |
| | **CONTRACT 1** | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES (Adaptive Mgmt.) | $494 | $44 | 8.8% | $538 | 1.8% | $503 | $44 | $547 | 2017Q4 | 1.4% | $510 | $45 | $555 |
| **09** | CHANNELS & CANALS | $18,047 | $1,592 | 8.8% | $19,639 | 1.8% | $18,366 | $1,620 | $19,985 | 2017Q4 | 1.4% | $18,615 | $1,642 | $20,257 |
| **15** | FLOODWAY CONTROL & DIVERSION STRUCTURE | $12,267 | $1,082 | 8.8% | $13,349 | 1.8% | $12,484 | $1,101 | $13,585 | 2017Q4 | 1.4% | $12,653 | $1,116 | $13,769 |
| **16** | BANK STABILIZATION | $19,111 | $1,686 | 8.8% | $20,797 | 1.8% | $19,449 | $1,715 | $21,164 | 2017Q4 | 1.4% | $19,713 | $1,739 | $21,452 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $49,919 | $4,403 | 8.8% | **$54,322** | | $50,801 | $4,481 | $55,282 | | | $51,491 | $4,542 | $56,033 |
| **01** | LANDS AND DAMAGES | $0 | $0 | 0.0% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *0.0%* | Project Management | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Planning & Environmental Compliance | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Engineering & Design | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Reviews, ATRs, IEPRs, VE | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Life Cycle Updates (cost, schedule, risks) | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Contracting & Reprographics | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Engineering During Construction | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Planning During Construction | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| *0.0%* | Project Operations | $0 | $0 | 8.8% | $0 | 0.0% | $0 | $0 | $0 | 0 | 0.0% | $0 | $0 | $0 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *5.0%* | Construction Management | $2,496 | $220 | 8.8% | $2,716 | 3.6% | $2,586 | $228 | $2,814 | 2017Q4 | 3.0% | $2,663 | $235 | $2,898 |
| *0.5%* | Project Operation: | $250 | $22 | 8.8% | $272 | 3.6% | $259 | $23 | $282 | 2017Q4 | 3.0% | $267 | $24 | $290 |
| *0.5%* | Project Management | $250 | $22 | 8.8% | $272 | 3.6% | $259 | $23 | $282 | 2017Q4 | 3.0% | $267 | $24 | $290 |
| | **CONTRACT COST TOTALS:** | $52,915 | $4,667 | | $57,582 | | $53,905 | $4,755 | $58,660 | | | $54,688 | $4,824 | $59,512 |

# Modified Side Channel TPCS

****** TOTAL PROJECT COST SUMMARY ******

**PROJECT:** **Yellowstone River - Modified Side Channel Alternative**
PROJECT NO: 0
LOCATION: Yellowstone River, MT and ND

**DISTRICT: Omaha (NWO)**
**POC: CHIEF, COST ENGINEERING, xxx**

**PREPARED: 5/19/2016**

This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Program Year (Budget EC): 2017<br>Effective Price Level Date: 1 OCT 16 | | | | | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | **TOTAL ($K)** | Spent Thru: **10/1/2015** ($K) | **TOTAL FIRST COST** ($K) | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | | *K* | *L* | *M* | *N* | *O* |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $352 | $124 | 35.2% | $476 | 1.8% | $358 | $126 | $484 | $0 | $484 | 3.9% | $372 | $131 | $503 |
| **08** | ROADS, RAILROADS & BRIDGES | $1,042 | $367 | 35.2% | $1,408 | 1.8% | $1,060 | $373 | $1,433 | $0 | $1,433 | 3.9% | $1,101 | $387 | $1,489 |
| **09** | CHANNELS & CANALS | $16,703 | $5,876 | 35.2% | $22,579 | 1.8% | $16,998 | $5,980 | $22,978 | $0 | $22,978 | 3.9% | $17,654 | $6,210 | $23,864 |
| **16** | BANK STABILIZATION | $17,436 | $6,134 | 35.2% | $23,570 | 1.8% | $17,744 | $6,242 | $23,986 | $0 | $23,986 | 3.9% | $18,429 | $6,483 | $24,912 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $35,532 | $12,500 | | $48,032 | 1.8% | $36,160 | $12,721 | $48,881 | $0 | $48,881 | 3.9% | $37,556 | $13,212 | $50,767 |
| **01** | LANDS AND DAMAGES | $220 | $55 | 25.0% | $275 | 1.8% | $224 | $56 | $280 | $0 | $280 | 0.9% | $226 | $56 | $282 |
| **30** | PLANNING, ENGINEERING & DESIGN | $3,201 | $743 | 23.2% | $3,944 | 3.6% | $3,316 | $770 | $4,086 | $0 | $4,086 | 2.7% | $3,405 | $790 | $4,195 |
| **31** | CONSTRUCTION MANAGEMENT | $2,133 | $532 | 24.9% | $2,665 | 3.6% | $2,210 | $551 | $2,761 | $0 | $2,761 | 8.2% | $2,390 | $596 | $2,986 |
| | **PROJECT COST TOTALS:** | $41,086 | $13,829 | 33.7% | $54,916 | | $41,910 | $14,097 | **$56,008** | $0 | **$56,008** | 4.0% | $43,577 | $14,654 | $58,231 |

| | | | |
|---|---|---|---|
| ESTIMATED FEDERAL COST: | **100%** | **$58,231** |
| ESTIMATED NON-FEDERAL COST: | **0%** | **$0** |
| **ESTIMATED TOTAL PROJECT COST:** | | **$58,231** |

**CHIEF, COST ENGINEERING, xxx**

**PROJECT MANAGER, xxx**

**CHIEF, REAL ESTATE, xxx**

**CHIEF, PLANNING,xxx**

**CHIEF, ENGINEERING, xxx**

**CHIEF, OPERATIONS, xxx**

**CHIEF, CONSTRUCTION, xxx**

**CHIEF, CONTRACTING,xxx**

**CHIEF, PM-PB, xxxx**

**CHIEF, DPM, xxx**

# **** TOTAL PROJECT COST SUMMARY ****

CONTRACT 1

## **** CONTRACT COST SUMMARY ****

PROJECT: Yellowstone River - Modified Side Channel Alternative
LOCATION: Yellowstone River, MT and ND
This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

DISTRICT: Omaha (NWO)
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/19/2016

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate Prepared: | | | 19-May-16 | Program Year (Budget EC): | | | 2017 | | | | | |
| | | Effective Price Level: | | | 1-Oct-15 | Effective Price Level Date: | | | 1 OCT 16 | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *P* | *L* | *M* | *N* | *O* |
| | **CONTRACT 1** | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $352 | $124 | 35.2% | $476 | 1.8% | $358 | $126 | $484 | 2019Q1 | 3.9% | $372 | $131 | $503 |
| **08** | ROADS, RAILROADS & BRIDGES | $1,042 | $367 | 35.2% | $1,408 | 1.8% | $1,060 | $373 | $1,433 | 2019Q1 | 3.9% | $1,101 | $387 | $1,489 |
| **09** | CHANNELS & CANALS | $16,703 | $5,876 | 35.2% | $22,579 | 1.8% | $16,998 | $5,980 | $22,978 | 2019Q1 | 3.9% | $17,654 | $6,210 | $23,864 |
| **16** | BANK STABILIZATION | $17,436 | $6,134 | 35.2% | $23,570 | 1.8% | $17,744 | $6,242 | $23,986 | 2019Q1 | 3.9% | $18,429 | $6,483 | $24,912 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $35,532 | $12,500 | 35.2% | **$48,032** | | $36,160 | $12,721 | $48,881 | | | $37,556 | $13,212 | $50,767 |
| **01** | LANDS AND DAMAGES | $220 | $55 | 25.0% | $275 | 1.8% | $224 | $56 | $280 | 2017Q3 | 0.9% | $226 | $56 | $282 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *0.5%* | Project Management | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| *0.5%* | Planning & Environmental Compliance | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| *5.0%* | Engineering & Design | $1,777 | $412 | 23.2% | $2,189 | 3.6% | $1,841 | $427 | $2,268 | 2017Q3 | 2.0% | $1,878 | $436 | $2,313 |
| *0.5%* | Reviews, ATRs, IEPRs, VE | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| *0.5%* | Life Cycle Updates (cost, schedule, risks) | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| *0.5%* | Contracting & Reprographics | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| *0.5%* | Engineering During Construction | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2019Q1 | 8.2% | $199 | $46 | $246 |
| *0.5%* | Planning During Construction | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2019Q1 | 8.2% | $199 | $46 | $246 |
| *0.5%* | Project Operations | $178 | $41 | 23.2% | $219 | 3.6% | $184 | $43 | $227 | 2017Q3 | 2.0% | $188 | $44 | $232 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *5.0%* | Construction Management | $1,777 | $443 | 24.9% | $2,220 | 3.6% | $1,841 | $459 | $2,300 | 2019Q1 | 8.2% | $1,991 | $496 | $2,488 |
| *0.5%* | Project Operation: | $178 | $44 | 24.9% | $222 | 3.6% | $184 | $46 | $230 | 2019Q1 | 8.2% | $199 | $50 | $249 |
| *0.5%* | Project Management | $178 | $44 | 24.9% | $222 | 3.6% | $184 | $46 | $230 | 2019Q1 | 8.2% | $199 | $50 | $249 |
| | **CONTRACT COST TOTALS:** | $41,086 | $13,829 | | $54,916 | | $41,910 | $14,097 | $56,008 | | | $43,577 | $14,654 | $58,231 |

# Multiple Pump TPCS

****** TOTAL PROJECT COST SUMMARY ******

**PROJECT:** **Yellowstone River - Multiple Pump Alternative**
PROJECT NO: 0
LOCATION: Yellowstone River, MT and ND

**DISTRICT: Omaha (NWO)**
**POC: CHIEF, COST ENGINEERING, xxx**

**PREPARED: 5/19/2016**

This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Program Year (Budget EC): 2017<br>Effective Price Level Date: 1 OCT 16 | | | | | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | **TOTAL ($K)** | Spent Thru: **10/1/2015** ($K) | **TOTAL FIRST COST** ($K) | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | | *K* | *L* | *M* | *N* | *O* |
| **04** | DAMS | $6,600 | $2,430 | 36.8% | $9,030 | 1.8% | $6,716 | $2,473 | $9,190 | $0 | $9,190 | 12.4% | $7,551 | $2,781 | $10,331 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $843 | $310 | 36.8% | $1,153 | 1.8% | $858 | $316 | $1,174 | $0 | $1,174 | 7.0% | $918 | $338 | $1,256 |
| **19** | BUILDINGS, GROUNDS & UTILITIES | $77,678 | $28,606 | 36.8% | $106,284 | 1.8% | $79,049 | $29,111 | $108,161 | $0 | $108,161 | 6.5% | $84,164 | $30,995 | $115,159 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $85,120 | $31,347 | | $116,467 | 1.8% | $86,623 | $31,901 | $118,524 | $0 | $118,524 | 6.9% | $92,633 | $34,114 | $126,746 |
| **01** | LANDS AND DAMAGES | $443 | $111 | 25.0% | $554 | 1.8% | $451 | $113 | $564 | $0 | $564 | 0.9% | $455 | $114 | $569 |
| **30** | PLANNING, ENGINEERING & DESIGN | $7,664 | $2,033 | 26.5% | $9,697 | 3.6% | $7,940 | $2,106 | $10,047 | $0 | $10,047 | 3.4% | $8,210 | $2,178 | $10,388 |
| **31** | CONSTRUCTION MANAGEMENT | $5,108 | $1,355 | 26.5% | $6,463 | 3.6% | $5,292 | $1,404 | $6,696 | $0 | $6,696 | 14.7% | $6,071 | $1,610 | $7,681 |
| | **PROJECT COST TOTALS:** | $98,335 | $34,846 | 35.4% | $133,181 | | $100,307 | $35,523 | **$135,831** | $0 | **$135,831** | 7.0% | $107,369 | $38,015 | $145,384 |

**CHIEF, COST ENGINEERING, xxx**

**PROJECT MANAGER, xxx**

**CHIEF, REAL ESTATE, xxx**

**CHIEF, PLANNING,xxx**

**CHIEF, ENGINEERING, xxx**

**CHIEF, OPERATIONS, xxx**

**CHIEF, CONSTRUCTION, xxx**

**CHIEF, CONTRACTING,xxx**

**CHIEF, PM-PB, xxxx**

**CHIEF, DPM, xxx**

| | | |
|---|---|---|
| ESTIMATED FEDERAL COST: | **100%** | **$145,384** |
| ESTIMATED NON-FEDERAL COST: | **0%** | **$0** |
| **ESTIMATED TOTAL PROJECT COST:** | | **$145,384** |

****** TOTAL PROJECT COST SUMMARY ******

MULTIPLE PUMP STATIONS

****** CONTRACT COST SUMMARY ******

PROJECT: Yellowstone River - Multiple Pump Alternative
LOCATION: Yellowstone River, MT and ND
This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

DISTRICT: Omaha (NWO)
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/19/2016

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate Prepared: | | | 19-May-16 | Program Year (Budget EC): | | | 2017 | | | | | |
| | | Effective Price Level: | | | 1-Oct-15 | Effective Price Level Date: | | | 1 OCT 16 | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *P* | *L* | *M* | *N* | *O* |
| | **MULTIPLE PUMP STATIONS** | | | | | | | | | | | | | |
| **04** | DAMS | $6,600 | $2,430 | 36.8% | $9,030 | 1.8% | $6,716 | $2,473 | $9,190 | 2023Q1 | 12.4% | $7,551 | $2,781 | $10,331 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $843 | $310 | 36.8% | $1,153 | 1.8% | $858 | $316 | $1,174 | 2020Q3 | 7.0% | $918 | $338 | $1,256 |
| **19** | BUILDINGS, GROUNDS & UTILITIES | $77,678 | $28,606 | 36.8% | $106,284 | 1.8% | $79,049 | $29,111 | $108,161 | 2020Q2 | 6.5% | $84,164 | $30,995 | $115,159 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $85,120 | $31,347 | 36.8% | **$116,467** | | $86,623 | $31,901 | $118,524 | | | $92,633 | $34,114 | $126,746 |
| **01** | LANDS AND DAMAGES | $443 | $111 | 25.0% | $554 | 1.8% | $451 | $113 | $564 | 2017Q3 | 0.9% | $455 | $114 | $569 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *0.5%* | Project Management | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| *0.5%* | Planning & Environmental Compliance | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| *5.0%* | Engineering & Design | $4,256 | $1,129 | 26.5% | $5,385 | 3.6% | $4,410 | $1,170 | $5,579 | 2017Q3 | 2.0% | $4,497 | $1,193 | $5,690 |
| *0.5%* | Reviews, ATRs, IEPRs, VE | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| *0.5%* | Life Cycle Updates (cost, schedule, risks) | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| *0.5%* | Contracting & Reprographics | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| *0.5%* | Engineering During Construction | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2020Q3 | 14.7% | $506 | $134 | $641 |
| *0.5%* | Planning During Construction | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2020Q3 | 14.7% | $506 | $134 | $641 |
| *0.5%* | Project Operations | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2017Q3 | 2.0% | $450 | $119 | $569 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *5.0%* | Construction Management | $4,256 | $1,129 | 26.5% | $5,385 | 3.6% | $4,410 | $1,170 | $5,579 | 2020Q3 | 14.7% | $5,058 | $1,342 | $6,400 |
| *0.5%* | Project Operation: | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2020Q3 | 14.7% | $506 | $134 | $641 |
| *0.5%* | Project Management | $426 | $113 | 26.5% | $539 | 3.6% | $441 | $117 | $558 | 2020Q3 | 14.7% | $506 | $134 | $641 |
| | **CONTRACT COST TOTALS:** | $98,335 | $34,846 | | $133,181 | | $100,307 | $35,523 | $135,831 | | | $107,369 | $38,015 | $145,384 |

# Multiple Pumps with Conservation Measures TPCS

****** TOTAL PROJECT COST SUMMARY ******

**PROJECT:** **Yellowstone River - Multiple Pumps with Conservation Measures**
PROJECT NO: 0
LOCATION: Yellowstone River, MT and ND

**DISTRICT: Omaha (NWO)**
**POC: CHIEF, COST ENGINEERING, xxx**

**PREPARED: 5/19/2016**

This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

Program Year (Budget EC): 2017
Effective Price Level Date: 1 OCT 16

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | **TOTAL ($K)** | Spent Thru: **10/1/2015** ($K) | **TOTAL FIRST COST** ($K) | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | | *K* | *L* | *M* | *N* | *O* |
| **04** | DAMS | $7,037 | $2,278 | 32.4% | $9,315 | 1.8% | $7,161 | $2,318 | $9,479 | $0 | $9,479 | 7.0% | $7,662 | $2,481 | $10,143 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $3,131 | $1,014 | 32.4% | $4,144 | 1.8% | $3,186 | $1,031 | $4,217 | $0 | $4,217 | 7.0% | $3,409 | $1,104 | $4,513 |
| **09** | CHANNELS & CANALS | $195,853 | $63,408 | 32.4% | $259,261 | 1.8% | $199,312 | $64,528 | $263,840 | $0 | $263,840 | 7.0% | $213,271 | $69,048 | $282,319 |
| **19** | BUILDINGS, GROUNDS & UTILITIES | $18,703 | $6,055 | 32.4% | $24,758 | 1.8% | $19,033 | $6,162 | $25,195 | $0 | $25,195 | 7.0% | $20,366 | $6,594 | $26,960 |
| **20** | PERMANENT OPERATING EQUIPMENT | $91,468 | $29,613 | 32.4% | $121,082 | 1.8% | $93,084 | $30,136 | $123,220 | $0 | $123,220 | 0.0% | $93,084 | $30,136 | $123,220 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $316,191 | $102,369 | | $418,559 | 1.8% | $321,775 | $104,177 | $425,952 | $0 | $425,952 | 5.0% | $337,793 | $109,362 | $447,155 |
| **01** | LANDS AND DAMAGES | $2,800 | $700 | 25.0% | $3,500 | 1.8% | $2,849 | $712 | $3,562 | $0 | $3,562 | 5.9% | $3,019 | $755 | $3,773 |
| **30** | PLANNING, ENGINEERING & DESIGN | $28,458 | $7,548 | 26.5% | $36,006 | 3.6% | $29,485 | $7,820 | $37,305 | $0 | $37,305 | 5.2% | $31,015 | $8,226 | $39,241 |
| **31** | CONSTRUCTION MANAGEMENT | $18,972 | $5,032 | 26.5% | $24,004 | 3.6% | $19,656 | $5,214 | $24,870 | $0 | $24,870 | 14.7% | $22,549 | $5,981 | $28,529 |
| | **PROJECT COST TOTALS:** | $366,421 | $115,649 | 31.6% | $482,069 | | $373,765 | $117,923 | **$491,688** | $0 | **$491,688** | 5.5% | $394,375 | $124,324 | $518,699 |

**CHIEF, COST ENGINEERING, xxx**

**PROJECT MANAGER, xxx**

**CHIEF, REAL ESTATE, xxx**

**CHIEF, PLANNING,xxx**

**CHIEF, ENGINEERING, xxx**

**CHIEF, OPERATIONS, xxx**

**CHIEF, CONSTRUCTION, xxx**

**CHIEF, CONTRACTING,xxx**

**CHIEF, PM-PB, xxxx**

**CHIEF, DPM, xxx**

| | | |
|---|---|---|
| ESTIMATED FEDERAL COST: | **100%** | **$518,699** |
| ESTIMATED NON-FEDERAL COST: | **0%** | **$0** |
| **ESTIMATED TOTAL PROJECT COST:** | | **$518,699** |

# **** TOTAL PROJECT COST SUMMARY ****

CONTRACT 1

## **** CONTRACT COST SUMMARY ****

PROJECT: Yellowstone River - Multiple Pumps with Conservation Measures
LOCATION: Yellowstone River, MT and ND
This Estimate reflects the scope and schedule in report; Lower Yellowstone River Intake Diversion Dam Modification Project, Eng. Appx.

DISTRICT: Omaha (NWO)
POC: CHIEF, COST ENGINEERING, xxx

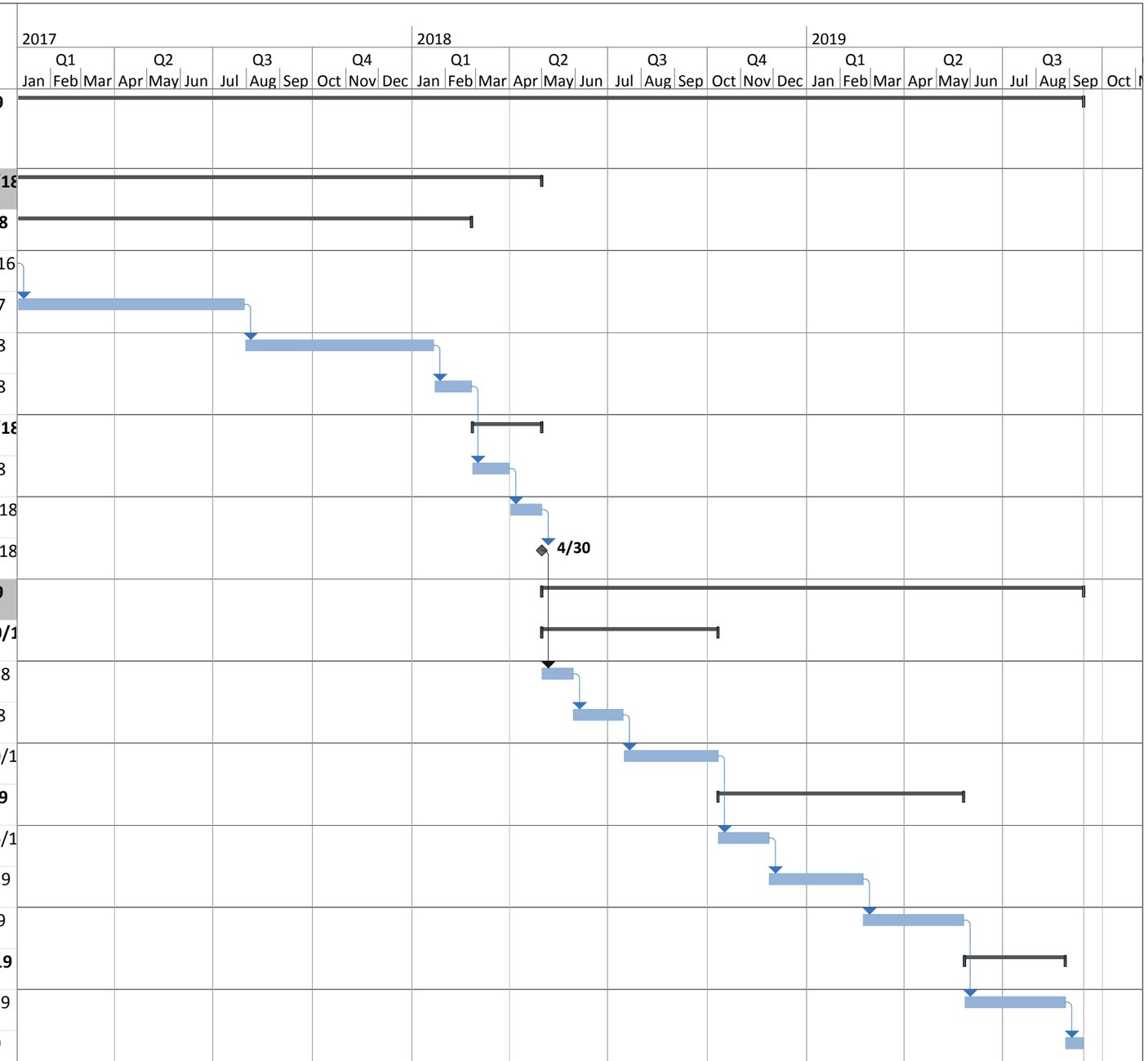
PREPARED: 5/19/2016

| Civil Works Work Breakdown Structure | | ESTIMATED COST | | | | PROJECT FIRST COST (Constant Dollar Basis) | | | | TOTAL PROJECT COST (FULLY FUNDED) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate Prepared: | | | 19-May-16 | Program Year (Budget EC): | | | 2017 | | | | | |
| | | Effective Price Level: | | | 1-Oct-15 | Effective Price Level Date: | | | 1 OCT 16 | | | | | |
| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | INFLATED (%) | COST ($K) | CNTG ($K) | FULL ($K) |
| *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *P* | *L* | *M* | *N* | *O* |
| | **CONTRACT 1** | | | | | | | | | | | | | |
| **04** | DAMS | $7,037 | $2,278 | 32.4% | $9,315 | 1.8% | $7,161 | $2,318 | $9,479 | 2020Q3 | 7.0% | $7,662 | $2,481 | $10,143 |
| **06** | FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Mgmt.) | $3,131 | $1,014 | 32.4% | $4,144 | 1.8% | $3,186 | $1,031 | $4,217 | 2020Q3 | 7.0% | $3,409 | $1,104 | $4,513 |
| **09** | CHANNELS & CANALS | $195,853 | $63,408 | 32.4% | $259,261 | 1.8% | $199,312 | $64,528 | $263,840 | 2020Q3 | 7.0% | $213,271 | $69,048 | $282,319 |
| **19** | BUILDINGS, GROUNDS & UTILITIES | $18,703 | $6,055 | 32.4% | $24,758 | 1.8% | $19,033 | $6,162 | $25,195 | 2020Q3 | 7.0% | $20,366 | $6,594 | $26,960 |
| **20** | PERMANENT OPERATING EQUIPMENT | $91,468 | $29,613 | 32.4% | $121,082 | 1.8% | $93,084 | $30,136 | $123,220 | 2017Q1 | 0.0% | $93,084 | $30,136 | $123,220 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | $316,191 | $102,369 | 32.4% | **$418,559** | | $321,775 | $104,177 | $425,952 | | | $337,793 | $109,362 | $447,155 |
| **01** | LANDS AND DAMAGES | $2,800 | $700 | 25.0% | $3,500 | 1.8% | $2,849 | $712 | $3,562 | 2020Q1 | 5.9% | $3,019 | $755 | $3,773 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *0.5%* | Project Management | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| *0.5%* | Planning & Environmental Compliance | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| *5.0%* | Engineering & Design | $15,810 | $4,193 | 26.5% | $20,003 | 3.6% | $16,380 | $4,345 | $20,725 | 2018Q1 | 4.0% | $17,035 | $4,518 | $21,554 |
| *0.5%* | Reviews, ATRs, IEPRs, VE | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| *0.5%* | Life Cycle Updates (cost, schedule, risks) | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| *0.5%* | Contracting & Reprographics | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| *0.5%* | Engineering During Construction | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2020Q3 | 14.7% | $1,879 | $498 | $2,377 |
| *0.5%* | Planning During Construction | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2020Q3 | 14.7% | $1,879 | $498 | $2,377 |
| *0.5%* | Project Operations | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2018Q1 | 4.0% | $1,704 | $452 | $2,155 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *5.0%* | Construction Management | $15,810 | $4,193 | 26.5% | $20,003 | 3.6% | $16,380 | $4,345 | $20,725 | 2020Q3 | 14.7% | $18,791 | $4,984 | $23,774 |
| *0.5%* | Project Operation: | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2020Q3 | 14.7% | $1,879 | $498 | $2,377 |
| *0.5%* | Project Management | $1,581 | $419 | 26.5% | $2,000 | 3.6% | $1,638 | $434 | $2,072 | 2020Q3 | 14.7% | $1,879 | $498 | $2,377 |
| | **CONTRACT COST TOTALS:** | $366,421 | $115,649 | | $482,069 | | $373,765 | $117,923 | $491,688 | | | $394,375 | $124,324 | $518,699 |

# Attachment B.2
# Tentative Project Schedules

# Rock Ramp Project Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **LOWER YELLOWSTONE IRRIGATION PROJECT - ROCK RAMP ALTERNATIVE** | **1055 days** | **Mon 5/2/16** | **Fri 9/13/19** |
| 2 | **PRE-CONSTRUCTION AWARD** | **625 days** | **Mon 5/2/16** | **Mon 4/30/18** |
| 3 | **Plans & Specifications** | **570 days** | **Mon 5/2/16** | **Sat 2/24/18** |
| 4 | 30% Design | 210 days | Mon 5/2/16 | Sat 12/31/16 |
| 5 | 60% Design | 180 days | Mon 1/2/17 | Sat 7/29/17 |
| 6 | 90% Design | 150 days | Mon 7/31/17 | Sat 1/20/18 |
| 7 | BCOE | 30 days | Mon 1/22/18 | Sat 2/24/18 |
| 8 | **Procurement & Award** | **55 days** | **Mon 2/26/18** | **Mon 4/30/18** |
| 9 | Advertise | 30 days | Mon 2/26/18 | Sat 3/31/18 |
| 10 | Award | 25 days | Mon 4/2/18 | Mon 4/30/18 |
| 11 | NTP | 0 days | Mon 4/30/18 | Mon 4/30/18 |
| 12 | **CONSTRUCTION** | **430 days** | **Tue 5/1/18** | **Fri 9/13/19** |
| 13 | **Phase 1 Construction** | **140 days** | **Tue 5/1/18** | **Wed 10/10/1** |
| 14 | Mobilization and Site Preparation | 25 days | Tue 5/1/18 | Tue 5/29/18 |
| 15 | Place Cofferdam (South Bank to Center of Existing Dam) | 40 days | Wed 5/30/18 | Sat 7/14/18 |
| 16 | Place Concrete Weir (South Half) | 75 days | Mon 7/16/18 | Wed 10/10/1 |
| 17 | **Phase 2 Construction** | **195 days** | **Thu 10/11/1** | **Sat 5/25/19** |
| 18 | Place Cofferdam (Headworks to End of New Weir) | 40 days | Thu 10/11/18 | Mon 11/26/1 |
| 19 | Place Concrete Weir (North Half) | 75 days | Tue 11/27/18 | Thu 2/21/19 |
| 20 | Place Rock Ramp (North Half) | 80 days | Fri 2/22/19 | Sat 5/25/19 |
| 21 | **Phase 3 Construction** | **80 days** | **Mon 5/27/19** | **Tue 8/27/19** |
| 22 | Place Rock Ramp (South Half) | 80 days | Mon 5/27/19 | Tue 8/27/19 |
| 23 | Demobilization | 15 days | Wed 8/28/19 | Fri 9/13/19 |

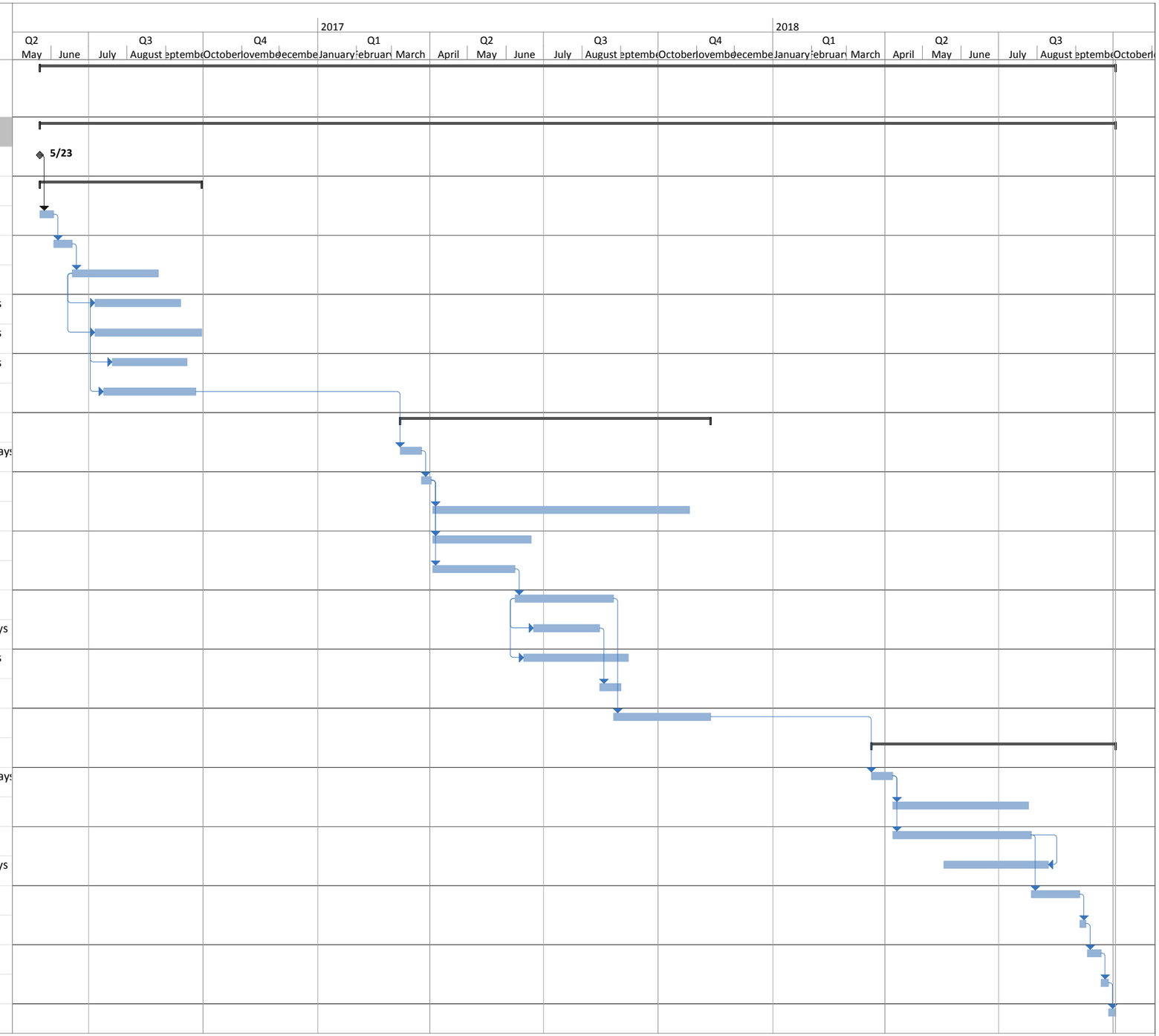



Project: LA River_Project Schedule
Date: Wed 4/20/16

| | | | | |
|---|---|---|---|---|
| Task | Project Summary | Inactive Milestone | Manual Summary | Progress |
| Split | External Tasks | Inactive Summary | Start-only | Manual Progress |
| Milestone | External Milestone | Duration-only | Finish-only | |
| Summary | Inactive Task | Manual Summary Rollup | Deadline | |

# Bypass Channel Project Schedule

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **LOWER YELLOWSTONE IRRIGATION PROJECT - BYPASS CHANNEL ALTERNATIVE** | **740 days** | **Mon 5/23/16** | **Tue 10/2/18** | |
| 2 | **CONSTRUCTION** | **740 days** | **Mon 5/23/16** | **Tue 10/2/18** | |
| 3 | Notice to Proceed | 0 days | Mon 5/23/16 | Mon 5/23/16 | |
| 4 | **Weir Construction** | **112 days** | **Mon 5/23/16** | **Thu 9/29/16** | |
| 5 | Mobilization | 10 days | Mon 5/23/16 | Thu 6/2/16 | 3 |
| 6 | Haul Roads and Access Ramps | 13 days | Fri 6/3/16 | Fri 6/17/16 | 5 |
| 7 | Sheet Pile | 59 days | Sat 6/18/16 | Thu 8/25/16 | 6 |
| 8 | Excavation | 59 days | Wed 7/6/16 | Mon 9/12/16 | 7SS+15 days |
| 9 | Place Fill | 74 days | Wed 7/6/16 | Thu 9/29/16 | 7SS+15 days |
| 10 | Concrete Placement | 52 days | Wed 7/20/16 | Sat 9/17/16 | 8SS+12 days |
| 11 | Remove/Cut Sheetpile | 64 days | Wed 7/13/16 | Sat 9/24/16 | 9SS+6 days |
| 12 | **Bypass Channel - Phase 1** | **214 days** | **Wed 3/8/17** | **Sat 11/11/17** | |
| 13 | Moblization | 15 days | Wed 3/8/17 | Fri 3/24/17 | 11FS+140 days |
| 14 | Erosion Control and Site Access | 7 days | Sat 3/25/17 | Sat 4/1/17 | 13 |
| 15 | Clearing and Grubbing | 177 days | Mon 4/3/17 | Wed 10/25/1 | 14 |
| 16 | Outlet Structure | 68 days | Mon 4/3/17 | Tue 6/20/17 | 14 |
| 17 | Inlet Structure | 57 days | Mon 4/3/17 | Wed 6/7/17 | 14 |
| 18 | Excavate Channel from Outlet to DS Outer Bend Protection | 68 days | Thu 6/8/17 | Fri 8/25/17 | 17 |
| 19 | Excavate Channel Between Inlet and Plug | 45 days | Fri 6/23/17 | Mon 8/14/17 | 18SS+13 days |
| 20 | Screening and Placement of Channel Bottom Armor | 72 days | Thu 6/15/17 | Wed 9/6/17 | 18SS+6 days |
| 21 | Install Channel Plug | 15 days | Tue 8/15/17 | Thu 8/31/17 | 19 |
| 22 | Place DS Channel Bend Protection | 67 days | Sat 8/26/17 | Sat 11/11/17 | 18 |
| 23 | **Bypass Channel - Phase 2** | **168 days** | **Wed 3/21/18** | **Tue 10/2/18** | |
| 24 | Moblization | 15 days | Wed 3/21/18 | Fri 4/6/18 | 22FS+110 days |
| 25 | Excavate Channel From DS Outer Bend Portection US Outer E | 93 days | Sat 4/7/18 | Tue 7/24/18 | 24 |
| 26 | Excavate Channel Between Plug and US Outer Bend Riprap | 95 days | Sat 4/7/18 | Thu 7/26/18 | 24 |
| 27 | Screening and Placement of Channel Bottom Armor | 72 days | Fri 5/18/18 | Thu 8/9/18 | 26FF+12 days |
| 28 | Place US Channel Bend Protection | 33 days | Fri 7/27/18 | Mon 9/3/18 | 26 |
| 29 | Final Grade Spoil Area | 5 days | Tue 9/4/18 | Sat 9/8/18 | 28 |
| 30 | Seed Site | 10 days | Mon 9/10/18 | Thu 9/20/18 | 29 |
| 31 | Remove Access Crossings and Culverts | 5 days | Fri 9/21/18 | Wed 9/26/18 | 30 |
| 32 | Demobilization | 5 days | Thu 9/27/18 | Tue 10/2/18 | 31 |

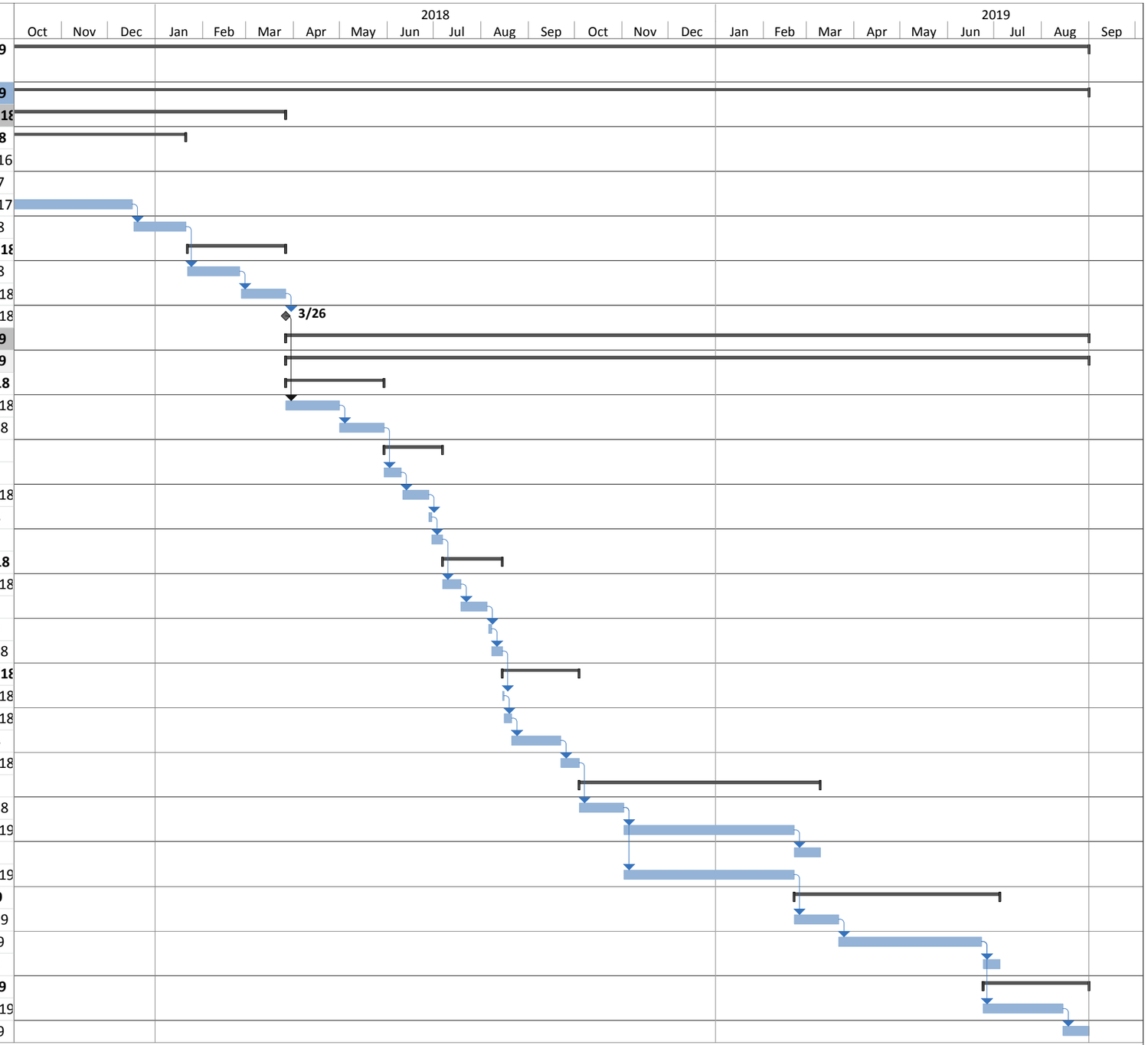



Project: LA River_Project Schedule
Date: Wed 4/20/16

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

# Modified Side Channel Project Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **LOWER YELLOWSTONE IRRIGATION PROJECT - MODIFIED SIDE CHANNEL ALTERNATIVE** | **1044 days** | **Mon 5/2/16** | **Sat 8/31/19** |
| 2 | **CONTRACT 1** | **1044 days** | **Mon 5/2/16** | **Sat 8/31/19** |
| 3 | **PRE-CONSTRUCTION AWARD** | **595 days** | **Mon 5/2/16** | **Mon 3/26/18** |
| 4 | **Plans & Specifications** | **540 days** | **Mon 5/2/16** | **Sat 1/20/18** |
| 5 | 30% Design | 210 days | Mon 5/2/16 | Sat 12/31/16 |
| 6 | 60% Design | 180 days | Mon 1/2/17 | Sat 7/29/17 |
| 7 | 90% Design | 120 days | Mon 7/31/17 | Sat 12/16/17 |
| 8 | BCOE | 30 days | Mon 12/18/1 | Sat 1/20/18 |
| 9 | **Procurement & Award** | **55 days** | **Mon 1/22/18** | **Mon 3/26/18** |
| 10 | Advertise | 30 days | Mon 1/22/18 | Sat 2/24/18 |
| 11 | Award | 25 days | Mon 2/26/18 | Mon 3/26/18 |
| 12 | NTP | 0 days | Mon 3/26/18 | Mon 3/26/18 |
| 13 | **CONSTRUCTION** | **449 days** | **Tue 3/27/18** | **Sat 8/31/19** |
| 14 | **High Flow Channel Construction** | **449 days** | **Tue 3/27/18** | **Sat 8/31/19** |
| 15 | **Mobilization and Preparatory Work** | **55 days** | **Tue 3/27/18** | **Tue 5/29/18** |
| 16 | Mobilization | 30 days | Tue 3/27/18 | Mon 4/30/18 |
| 17 | Site Access and Staging | 25 days | Tue 5/1/18 | Tue 5/29/18 |
| 18 | **Upstream Cofferdam** | **33 days** | **Wed 5/30/18** | **Fri 7/6/18** |
| 19 | Sheet Pile Cutoff | 10 days | Wed 5/30/18 | Sat 6/9/18 |
| 20 | Borrow Fill Place and Compact | 15 days | Mon 6/11/18 | Wed 6/27/18 |
| 21 | Bedding Placement | 2 days | Thu 6/28/18 | Fri 6/29/18 |
| 22 | Riprap Placement | 6 days | Sat 6/30/18 | Fri 7/6/18 |
| 23 | **Downstream Cofferdam** | **33 days** | **Sat 7/7/18** | **Tue 8/14/18** |
| 24 | Sheet Pile Cutoff | 10 days | Sat 7/7/18 | Wed 7/18/18 |
| 25 | Borrow Fill Place and Compact | 15 days | Thu 7/19/18 | Sat 8/4/18 |
| 26 | Bedding Placement | 2 days | Mon 8/6/18 | Tue 8/7/18 |
| 27 | Riprap Placement | 6 days | Wed 8/8/18 | Tue 8/14/18 |
| 28 | **Bridge Installation** | **43 days** | **Wed 8/15/18** | **Wed 10/3/18** |
| 29 | Earthwork | 1 day | Wed 8/15/18 | Wed 8/15/18 |
| 30 | Abutments and Wingwalls | 4 days | Thu 8/16/18 | Mon 8/20/18 |
| 31 | Concrete Cure Time | 28 days | Tue 8/21/18 | Fri 9/21/18 |
| 32 | Prefab Bridge Installation | 10 days | Sat 9/22/18 | Wed 10/3/18 |
| 33 | **Channel Construction** | **135 days** | **Thu 10/4/18** | **Sat 3/9/19** |
| 34 | Clearing and Grubbing | 25 days | Thu 10/4/18 | Thu 11/1/18 |
| 35 | Channel Excavation | 95 days | Fri 11/2/18 | Wed 2/20/19 |
| 36 | Finish Grading | 15 days | Thu 2/21/19 | Sat 3/9/19 |
| 37 | Infill Existing Channel and Spread Material at Waste Site | 95 days | Fri 11/2/18 | Wed 2/20/19 |
| 38 | **Bank Stabilization** | **115 days** | **Thu 2/21/19** | **Thu 7/4/19** |
| 39 | Bedding Placement | 25 days | Thu 2/21/19 | Thu 3/21/19 |
| 40 | Riprap Placement | 80 days | Fri 3/22/19 | Sat 6/22/19 |
| 41 | Boulder Placement | 10 days | Mon 6/24/19 | Thu 7/4/19 |
| 42 | **Demobilization and Site Restoration** | **60 days** | **Mon 6/24/19** | **Sat 8/31/19** |
| 43 | Seeding and Restoration | 45 days | Mon 6/24/19 | Wed 8/14/19 |
| 44 | Demobilization | 15 days | Thu 8/15/19 | Sat 8/31/19 |

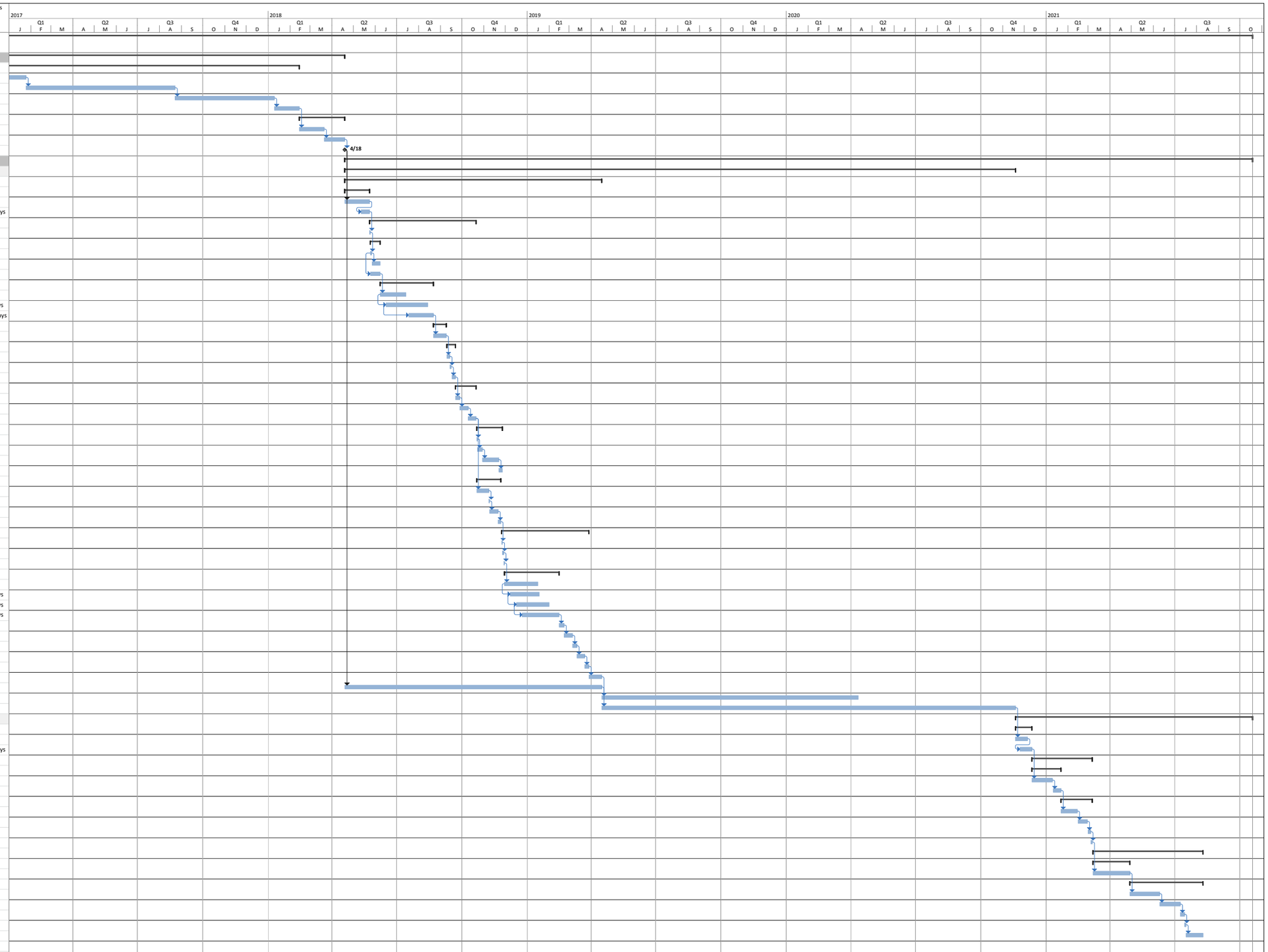



Project: LA River_Project Schedule
Date: Thu 5/19/16

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | | Summary | | External Milestone | | Inactive Summary | | Manual Summary | | Deadline | |
| Split | | Project Summary | | Inactive Task | | Duration-only | | Start-only | | Progress | |
| Milestone | | External Tasks | | Inactive Milestone | | Manual Summary Rollup | | Finish-only | | Manual Progress | |

# Multiple Pump Project Schedule

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **LOWER YELLOWSTONE IRRIGATION PROJECT - MULTIPLE PUMP ALTERNATIVE** | **1691 days** | **Wed 5/25/16** | **Mon 10/18/21** | |
| 2 | **PRE-CONSTRUCTION AWARD** | **595 days** | **Wed 5/25/16** | **Wed 4/18/18** | |
| 3 | **Plans & Specifications** | **540 days** | **Wed 5/25/16** | **Tue 2/13/18** | |
| 4 | 30% Design | 210 days | Wed 5/25/16 | Tue 1/24/17 | |
| 5 | 60% Design | 180 days | Wed 1/25/17 | Tue 8/22/17 | 4 |
| 6 | 90% Design | 120 days | Wed 8/23/17 | Tue 1/9/18 | 5 |
| 7 | BCOE | 30 days | Wed 1/10/18 | Tue 2/13/18 | 6 |
| 8 | **Procurement & Award** | **55 days** | **Wed 2/14/18** | **Wed 4/18/18** | |
| 9 | Advertise | 30 days | Wed 2/14/18 | Tue 3/20/18 | 7 |
| 10 | Award | 25 days | Wed 3/21/18 | Wed 4/18/18 | 9 |
| 11 | NTP | 0 days | Wed 4/18/18 | Wed 4/18/18 | 10 |
| 12 | **CONSTRUCTION** | **1096 days** | **Thu 4/19/18** | **Mon 10/18/2** | |
| 13 | **Multiple Pump Station Construction** | **810 days** | **Thu 4/19/18** | **Wed 11/18/2** | |
| 14 | **Pump Station - Site 1** | **310 days** | **Thu 4/19/18** | **Mon 4/15/19** | |
| 15 | **Mobilization and Preparatory Work** | **30 days** | **Thu 4/19/18** | **Wed 5/23/18** | |
| 16 | Mobilization | 30 days | Thu 4/19/18 | Wed 5/23/18 | 11 |
| 17 | Site Access and Staging | 10 days | Sat 5/12/18 | Wed 5/23/18 | 16FS-10 days |
| 18 | **Pump Station Work** | **129 days** | **Thu 5/24/18** | **Sat 10/20/18** | |
| 19 | Clearing and Grubbing | 1 day | Thu 5/24/18 | Thu 5/24/18 | 17 |
| 20 | **Earthwork** | **12 days** | **Fri 5/25/18** | **Thu 6/7/18** | |
| 21 | Excavation - Dry Material | 2 days | Fri 5/25/18 | Sat 5/26/18 | 19 |
| 22 | Excavation - Wet Material | 10 days | Mon 5/28/18 | Thu 6/7/18 | 21 |
| 23 | Haul and Dispose of Excess Material | 12 days | Fri 5/25/18 | Thu 6/7/18 | 21SS |
| 24 | **Reinforced Concrete** | **64 days** | **Fri 6/8/18** | **Tue 8/21/18** | |
| 25 | Concrete Floor (Include 28-days of Curing) | 31 days | Fri 6/8/18 | Fri 7/13/18 | 23 |
| 26 | Concrete Walls (Include 28-days of Curing) | 50 days | Sat 6/16/18 | Mon 8/13/18 | 25SS+7 days |
| 27 | Concrete Top Slab (Include 28-days of Curing) | 30 days | Wed 7/18/18 | Tue 8/21/18 | 26SS+27 days |
| 28 | **Irrigation Pumps and Motors** | **16 days** | **Wed 8/22/18** | **Sat 9/8/18** | |
| 29 | Install Pumps and Motors | 16 days | Wed 8/22/18 | Sat 9/8/18 | 27 |
| 30 | **Piping** | **11 days** | **Mon 9/10/18** | **Fri 9/21/18** | |
| 31 | 48" Pipe | 4 days | Mon 9/10/18 | Thu 9/13/18 | 29 |
| 32 | 84" Pipe | 2 days | Fri 9/14/18 | Sat 9/15/18 | 31 |
| 33 | Hydraulic Gates | 5 days | Mon 9/17/18 | Fri 9/21/18 | 32 |
| 34 | **Remaining Pump Station Work** | **25 days** | **Sat 9/22/18** | **Sat 10/20/18** | |
| 35 | Concrete Utility Vaults | 5 days | Sat 9/22/18 | Thu 9/27/18 | 33 |
| 36 | Prefabricated Steel Building | 10 days | Fri 9/28/18 | Tue 10/9/18 | 35 |
| 37 | Standby Generators with Buildings | 10 days | Wed 10/10/1 | Sat 10/20/18 | 36 |
| 38 | **Discharge Pipelines** | **31 days** | **Mon 10/22/1** | **Mon 11/26/1** | |
| 39 | Clearing and Grubbing | 1 day | Mon 10/22/1 | Mon 10/22/1 | 37 |
| 40 | Trench Excavation | 6 days | Tue 10/23/1 | Mon 10/29/1 | 39 |
| 41 | 84" Pipe | 20 days | Tue 10/30/1 | Wed 11/21/1 | 40 |
| 42 | Trash Rack | 4 days | Thu 11/22/1 | Mon 11/26/1 | 41 |
| 43 | **Feeder Canal** | **30 days** | **Mon 10/22/1** | **Sat 11/24/18** | |
| 44 | Sheet Pile Cofferdam | 15 days | Mon 10/22/1 | Wed 11/7/18 | 37 |
| 45 | Clearing and Grubbing | 1 day | Thu 11/8/18 | Thu 11/8/18 | 44 |
| 46 | Excavation | 10 days | Fri 11/9/18 | Tue 11/20/18 | 45 |
| 47 | Trash Rack | 4 days | Wed 11/21/1 | Sat 11/24/18 | 46 |
| 48 | **Fish Screen** | **106 days** | **Mon 11/26/1** | **Thu 3/28/19** | |
| 49 | Clearing and Grubbing | 1 day | Mon 11/26/1 | Mon 11/26/1 | 47 |
| 50 | Channel Excavation | 2 days | Tue 11/27/1 | Wed 11/28/1 | 49 |
| 51 | Structural Excavation | 1 day | Thu 11/29/1 | Thu 11/29/1 | 50 |
| 52 | **Reinforced Concrete** | **66 days** | **Fri 11/30/18** | **Thu 2/14/19** | |
| 53 | Concrete Foundations (Include 28-days of Curing) | 40 days | Fri 11/30/18 | Tue 1/15/19 | 51 |
| 54 | Concrete Floor (Include 28-days of Curing) | 35 days | Sat 12/8/18 | Thu 1/17/19 | 53SS+7 days |
| 55 | Concrete Footings (Include 28-days of Curing) | 40 days | Mon 12/17/1 | Thu 1/31/19 | 54SS+7 days |
| 56 | Concrete Walls (Include 28-days of Curing) | 45 days | Tue 12/25/1 | Thu 2/14/19 | 55SS+7 days |
| 57 | Structural Steel Supports | 6 days | Fri 2/15/19 | Thu 2/21/19 | 56 |
| 58 | Fish Screen and Deadplates | 10 days | Fri 2/22/19 | Tue 3/5/19 | 57 |
| 59 | Screen Cleaners | 5 days | Wed 3/6/19 | Mon 3/11/19 | 58 |
| 60 | Fish Return Pump | 10 days | Tue 3/12/19 | Fri 3/22/19 | 59 |
| 61 | Fish Return Pipes | 5 days | Sat 3/23/19 | Thu 3/28/19 | 60 |
| 62 | Demobilization | 15 days | Fri 3/29/19 | Mon 4/15/19 | 61 |
| 63 | Pump Station - Site 2 | 310 days | Thu 4/19/18 | Mon 4/15/19 | 11 |
| 64 | Pump Station - Site 3 | 310 days | Tue 4/16/19 | Fri 4/10/20 | 62 |
| 65 | Pump Station - Sites 4 and 5 | 500 days | Tue 4/16/19 | Wed 11/18/2 | 63 |
| 66 | **Demolition of Existing Intake Diversion Dam** | **286 days** | **Thu 11/19/2** | **Mon 10/18/2** | |
| 67 | **Mobilization and Preparatory Work** | **20 days** | **Thu 11/19/2** | **Fri 12/11/20** | |
| 68 | Mobilization | 15 days | Thu 11/19/2 | Sat 12/5/20 | 65 |
| 69 | Site Access and Staging | 15 days | Wed 11/25/2 | Fri 12/11/20 | 68FS-10 days |
| 70 | **Phase 1 Construction** | **73 days** | **Sat 12/12/20** | **Sat 3/6/21** | |
| 71 | **Phase 1 Cofferdam** | **35 days** | **Sat 12/12/20** | **Thu 1/21/21** | |
| 72 | Sheet Pile Cofferdam | 25 days | Sat 12/12/20 | Sat 1/9/21 | 69 |
| 73 | Earthen Cofferdam | 10 days | Mon 1/11/21 | Thu 1/21/21 | 72 |
| 74 | **Phase 1 Dam Removal** | **38 days** | **Fri 1/22/21** | **Sat 3/6/21** | |
| 75 | Rock Excavation | 20 days | Fri 1/22/21 | Sat 2/13/21 | 73 |
| 76 | Timber Decking Removal | 12 days | Mon 2/15/21 | Sat 2/27/21 | 75 |
| 77 | Timber Cribbing Removal | 4 days | Mon 3/1/21 | Thu 3/4/21 | 76 |
| 78 | Timber Pile Demolition | 2 days | Fri 3/5/21 | Sat 3/6/21 | 77 |
| 79 | **Phase 2 Construction** | **133 days** | **Mon 3/8/21** | **Mon 8/9/21** | |
| 80 | **Phase 2 Cofferdam** | **45 days** | **Mon 3/8/21** | **Wed 4/28/21** | |
| 81 | Sheet Pile Cofferdam | 45 days | Mon 3/8/21 | Wed 4/28/21 | 78 |
| 82 | **Phase 2 Dam Removal** | **88 days** | **Thu 4/29/21** | **Mon 8/9/21** | |
| 83 | Rock Excavation | 36 days | Thu 4/29/21 | Wed 6/9/21 | 81 |
| 84 | Timber Decking Removal | 25 days | Thu 6/10/21 | Thu 7/8/21 | 83 |
| 85 | Timber Cribbing Removal | 5 days | Fri 7/9/21 | Wed 7/14/21 | 84 |
| 86 | Timber Pile Demolition | 2 days | Thu 7/15/21 | Fri 7/16/21 | 85 |
| 87 | Sheet Pile Demolition | 20 days | Sat 7/17/21 | Mon 8/9/21 | 86 |
| 88 | Site Restoration | 10 days | Sat 9/25/21 | Wed 10/6/21 | 87 |
| 89 | Demobilization | 10 days | Thu 10/7/21 | Mon 10/18/21 | 88 |

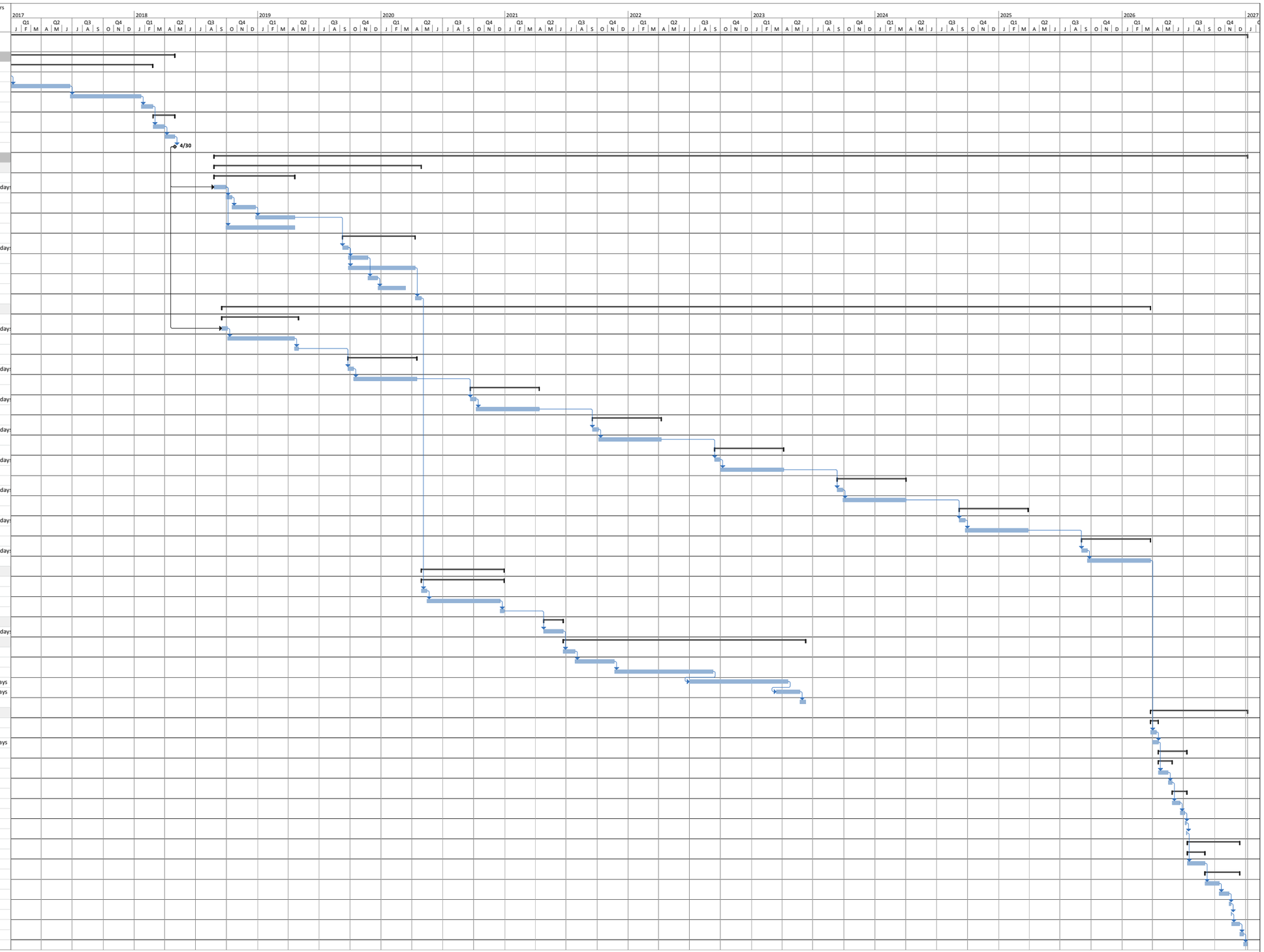



Project: LA River_Project Schedule
Date: Thu 5/19/16

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

# Multiple Pumps with Conservation Measures Project Schedule

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **LOWER YELLOWSTONE IRRIGATION PROJECT - MULTIPLE PUMPS WITH CONSERVATION MEASURES ALTERNATIVE** | **3345 days** | **Mon 5/2/16** | **Wed 1/6/27** | |
| 2 | **PRE-CONSTRUCTION AWARD** | **625 days** | **Mon 5/2/16** | **Mon 4/30/18** | |
| 3 | **Plans & Specifications** | **570 days** | **Mon 5/2/16** | **Sat 2/24/18** | |
| 4 | 30% Design | 210 days | Mon 5/2/16 | Sat 12/31/16 | |
| 5 | 60% Design | 150 days | Mon 1/2/17 | Sat 6/24/17 | 4 |
| 6 | 90% Design | 180 days | Mon 6/26/17 | Sat 1/20/18 | 5 |
| 7 | BCOE | 30 days | Mon 1/22/18 | Sat 2/24/18 | 6 |
| 8 | **Procurement & Award** | **55 days** | **Mon 2/26/18** | **Mon 4/30/18** | |
| 9 | Advertise | 30 days | Mon 2/26/18 | Sat 3/31/18 | 7 |
| 10 | Award | 25 days | Mon 4/2/18 | Mon 4/30/18 | 9 |
| 11 | NTP | 0 days | Mon 4/30/18 | Mon 4/30/18 | 10 |
| 12 | **CONSTRUCTION** | **2620 days** | **Sat 8/25/18** | **Wed 1/6/27** | |
| 13 | **Convert Laterals to Pipe** | **525 days** | **Sat 8/25/18** | **Tue 4/28/20** | |
| 14 | **Construction - Year 1** | **205 days** | **Sat 8/25/18** | **Sat 4/20/19** | |
| 15 | Mobilization and Site preparation | 30 days | Sat 8/25/18 | Fri 9/28/18 | 11SS+100 days |
| 16 | 18" Pipe Laterals | 15 days | Sat 9/29/18 | Tue 10/16/18 | 15 |
| 17 | 24" Pipe Laterals | 60 days | Wed 10/17/1 | Tue 12/25/18 | 16 |
| 18 | 60" Pipe Laterals | 100 days | Wed 12/26/1 | Sat 4/20/19 | 17 |
| 19 | 36" Pipe Laterals | 175 days | Sat 9/29/18 | Sat 4/20/19 | 15 |
| 20 | **Construction - Year 2** | **185 days** | **Mon 9/9/19** | **Fri 4/10/20** | |
| 21 | Mobilization and Site Preparation | 15 days | Mon 9/9/19 | Wed 9/25/19 | 18FS+120 days |
| 22 | 36" Pipe Laterals | 50 days | Thu 9/26/19 | Fri 11/22/19 | 21 |
| 23 | 48" Pipe Laterals | 170 days | Thu 9/26/19 | Fri 4/10/20 | 21 |
| 24 | 72" Pipe Laterals | 25 days | Sat 11/23/19 | Sat 12/21/19 | 22 |
| 25 | Line Remaining Canals with Shotcrete | 70 days | Mon 12/23/1 | Thu 3/12/20 | 24 |
| 26 | Site Restoration and Demobilization | 15 days | Sat 4/11/20 | Tue 4/28/20 | 23 |
| 27 | **Line Main Canal** | **2355 days** | **Mon 9/17/18** | **Wed 3/25/26** | |
| 28 | **Construction - Year 1** | **195 days** | **Mon 9/17/18** | **Wed 5/1/19** | |
| 29 | Mobilization and Site Preparation | 15 days | Mon 9/17/18 | Wed 10/3/18 | 11SS+100 days |
| 30 | Place and Compact Fill in Main Canal | 170 days | Thu 10/4/18 | Fri 4/19/19 | 29 |
| 31 | Site Restoration and Demobilization | 10 days | Sat 4/20/19 | Wed 5/1/19 | 30 |
| 32 | **Construction - Year 2** | **175 days** | **Wed 9/25/19** | **Wed 4/15/20** | |
| 33 | Mobilization and Site Preparation | 15 days | Wed 9/25/19 | Fri 10/11/19 | 31FS+125 days |
| 34 | Place Canal Lining | 160 days | Sat 10/12/19 | Wed 4/15/20 | 33 |
| 35 | **Construction - Year 3** | **175 days** | **Mon 9/21/20** | **Mon 4/12/21** | |
| 36 | Mobilization and Site Preparation | 15 days | Mon 9/21/20 | Wed 10/7/20 | 34FS+135 days |
| 37 | Place Canal Lining | 160 days | Thu 10/8/20 | Mon 4/12/21 | 36 |
| 38 | **Construction - Year 4** | **175 days** | **Fri 9/17/21** | **Fri 4/8/22** | |
| 39 | Mobilization and Site Preparation | 15 days | Fri 9/17/21 | Mon 10/4/21 | 37FS+135 days |
| 40 | Place Canal Lining | 160 days | Tue 10/5/21 | Fri 4/8/22 | 39 |
| 41 | **Construction - Year 5** | **175 days** | **Wed 9/14/22** | **Wed 4/5/23** | |
| 42 | Mobilization and Site Preparation | 15 days | Wed 9/14/22 | Fri 9/30/22 | 40FS+135 days |
| 43 | Place Canal Lining | 160 days | Sat 10/1/22 | Wed 4/5/23 | 42 |
| 44 | **Construction - Year 6** | **175 days** | **Mon 9/11/23** | **Mon 4/1/24** | |
| 45 | Mobilization and Site Preparation | 15 days | Mon 9/11/23 | Wed 9/27/23 | 43FS+135 days |
| 46 | Place Canal Lining | 160 days | Thu 9/28/23 | Mon 4/1/24 | 45 |
| 47 | **Construction - Year 7** | **175 days** | **Fri 9/6/24** | **Fri 3/28/25** | |
| 48 | Mobilization and Site Preparation | 15 days | Fri 9/6/24 | Mon 9/23/24 | 46FS+135 days |
| 49 | Place Canal Lining | 160 days | Tue 9/24/24 | Fri 3/28/25 | 48 |
| 50 | **Construction - Year 8** | **175 days** | **Wed 9/3/25** | **Wed 3/25/26** | |
| 51 | Mobilization and Site Preparation | 15 days | Wed 9/3/25 | Fri 9/19/25 | 49FS+135 days |
| 52 | Place Canal Lining | 160 days | Sat 9/20/25 | Wed 3/25/26 | 51 |
| 53 | **Check Structures and Flow Measuring Devices** | **210 days** | **Wed 4/29/20** | **Tue 12/29/20** | |
| 54 | **Construction** | **210 days** | **Wed 4/29/20** | **Tue 12/29/20** | |
| 55 | Mobilization | 15 days | Wed 4/29/20 | Fri 5/15/20 | 26 |
| 56 | Place and Compact Fill in Main Canal | 185 days | Sat 5/16/20 | Thu 12/17/20 | 55 |
| 57 | Demobilization | 10 days | Fri 12/18/20 | Tue 12/29/20 | 56 |
| 58 | **Construct Wind Turbine** | **50 days** | **Mon 4/26/21** | **Tue 6/22/21** | |
| 59 | Build and Test Wind Turbine | 50 days | Mon 4/26/21 | Tue 6/22/21 | 57FS+100 days |
| 60 | **Construct Ranney Wells** | **615 days** | **Wed 6/23/21** | **Fri 6/9/23** | |
| 61 | Mobilization | 30 days | Wed 6/23/21 | Tue 7/27/21 | 59 |
| 62 | Drill and Pump Tests | 100 days | Wed 7/28/21 | Sat 11/20/21 | 61 |
| 63 | Well Installation | 250 days | Mon 11/22/2 | Thu 9/8/22 | 62 |
| 64 | Pump Station Installation | 250 days | Fri 7/1/22 | Tue 4/18/23 | 63FS-60 days |
| 65 | Discharge Piping | 60 days | Wed 3/15/23 | Tue 5/23/23 | 64FS-30 days |
| 66 | Demoblization | 15 days | Wed 5/24/23 | Fri 6/9/23 | 65 |
| 67 | **Demolition of Existing Intake Diversion Dam** | **246 days** | **Thu 3/26/26** | **Wed 1/6/27** | |
| 68 | **Mobilization and Preparatory Work** | **20 days** | **Thu 3/26/26** | **Fri 4/17/26** | |
| 69 | Mobilization | 15 days | Thu 3/26/26 | Sat 4/11/26 | 52 |
| 70 | Site Access and Staging | 15 days | Wed 4/1/26 | Fri 4/17/26 | 69FS-10 days |
| 71 | **Phase 1 Construction** | **73 days** | **Sat 4/18/26** | **Sat 7/11/26** | |
| 72 | **Phase 1 Cofferdam** | **35 days** | **Sat 4/18/26** | **Thu 5/28/26** | |
| 73 | Sheet Pile Cofferdam | 25 days | Sat 4/18/26 | Sat 5/16/26 | 70 |
| 74 | Earthen Cofferdam | 10 days | Mon 5/18/26 | Thu 5/28/26 | 73 |
| 75 | **Phase 1 Dam Removal** | **38 days** | **Fri 5/29/26** | **Sat 7/11/26** | |
| 76 | Rock Excavation | 20 days | Fri 5/29/26 | Sat 6/20/26 | 74 |
| 77 | Timber Decking Removal | 12 days | Mon 6/22/26 | Sat 7/4/26 | 76 |
| 78 | Timber Cribbing Removal | 4 days | Mon 7/6/26 | Thu 7/9/26 | 77 |
| 79 | Timber Pile Demolition | 2 days | Fri 7/10/26 | Sat 7/11/26 | 78 |
| 80 | **Phase 2 Construction** | **133 days** | **Mon 7/13/26** | **Mon 12/14/2** | |
| 81 | **Phase 2 Cofferdam** | **45 days** | **Mon 7/13/26** | **Wed 9/2/26** | |
| 82 | Sheet Pile Cofferdam | 45 days | Mon 7/13/26 | Wed 9/2/26 | 79 |
| 83 | **Phase 2 Dam Removal** | **88 days** | **Thu 9/3/26** | **Mon 12/14/2** | |
| 84 | Rock Excavation | 36 days | Thu 9/3/26 | Wed 10/14/26 | 82 |
| 85 | Timber Decking Removal | 25 days | Thu 10/15/26 | Thu 11/12/26 | 84 |
| 86 | Timber Cribbing Removal | 5 days | Fri 11/13/26 | Wed 11/18/26 | 85 |
| 87 | Timber Pile Demolition | 2 days | Thu 11/19/26 | Fri 11/20/26 | 86 |
| 88 | Sheet Pile Demolition | 20 days | Sat 11/21/26 | Mon 12/14/26 | 87 |
| 89 | Site Restoration | 10 days | Tue 12/15/26 | Fri 12/25/26 | 88 |
| 90 | Demobilization | 10 days | Sat 12/26/26 | Wed 1/6/27 | 89 |




Project: LA River_Project Schedule
Date: Thu 5/19/16

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

# Attachment B.3
# Abbreviated Risk Analysis (ARA) Spreadsheets

# Rock Ramp ARA

**Abbreviated Risk Analysis**

Project (less than $40M): **Lower Yellowstone River** — **Alternative: Rock Ramp**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Low Risk: Typical Construction, Simple** — **Meeting Date:**

Total Estimated Construction Contract Cost = **$ 59,979,308**

| | CWWBS | Feature of Work | Contract Cost | | % Contingency | $ Contingency | Total |
|---|---|---|---|---|---|---|---|
| | 01 LANDS AND DAMAGES | Real Estate | $ - | | 0.00% | $ - | $ - |
| 1 | 15 FLOODWAY CONTROL AND DIVERSION STRUCTURES | **Concrete Crest Structure** | $ 8,950,189 | | 26.65% | $ 2,385,078 | $ 11,335,267 |
| 2 | 06 FISH AND WILDLIFE FACILITIES | **Coffer Dam** | $ 4,167,924 | | 40.81% | $ 1,701,095 | $ 5,869,019 |
| 3 | 06 FISH AND WILDLIFE FACILITIES | **Rock Ramp** | $ 45,844,675 | | 33.24% | $ 15,239,490 | $ 61,084,165 |
| 4 | 06 FISH AND WILDLIFE FACILITIES | **Mob/Demob, Haul Roads, Staging, etc.** | $ 1,016,520 | | 28.24% | $ 287,106 | $ 1,303,626 |
| 5 | | | $ - | | 0.00% | $ - | $ - |
| 6 | | | $ - | | 0.00% | $ - | $ - |
| 7 | | | | | 0.00% | $ - | $ - |
| 8 | | | $ - | | 0.00% | $ - | $ - |
| 9 | | | $ - | | 0.00% | $ - | $ - |
| 10 | | | $ - | | 0.00% | $ - | $ - |
| 11 | | | $ - | | 0.00% | $ - | $ - |
| 12 | All Other | **Remaining Construction Items** | $ - | *0.0%* | 0.00% | $ - | $ - |
| 13 | 30 PLANNING, ENGINEERING, AND DESIGN | **Planning, Engineering, & Design** | $ 5,453,000 | | 18.84% | $ 1,027,121 | $ 6,480,121 |
| 14 | 31 CONSTRUCTION MANAGEMENT | **Construction Management** | $ 3,635,000 | | 20.55% | $ 747,162 | $ 4,382,162 |
| XX | FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW) | | | | | $ - | |

| **Totals** | | | | | |
|---|---|---|---|---|---|
| Real Estate | $ - | 0.00% | $ - | $ - | |
| Total Construction Estimate | $ 59,979,308 | 32.6992% | $ 19,612,770 | $ 79,592,078 | |
| Total Planning, Engineering & Design | $ 5,453,000 | 18.8359% | $ 1,027,121 | $ 6,480,121 | |
| Total Construction Management | $ 3,635,000 | 20.5547% | $ 747,162 | $ 4,382,162 | |
| Total | **$ 69,067,308** | **30.97%** | **$ 21,387,053** | **$ 90,454,361** | |
| | | **Base** | **50%** | **80%** | |
| | **Range Estimate ($000's)** | $69,067k | $81,899k | $90,454k | |

* 50% based on base is at 5% CL.

| | |
|---|---|
| **Fixed Dollar Risk Add:** (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate. | |

**Lower Yellowstone River Rock Ramp**

Feasibility (Alternatives)

Abbreviated Risk Analysis

**Meeting Date:** 0-Jan-00

**Risk Level**

| | Negligible | Marginal | Moderate | Significant | Critical |
|---|---|---|---|---|---|
| Very Likely | 2 | 3 | 4 | 5 | 5 |
| Likely | 1 | 2 | 3 | 4 | 5 |
| Possible | 0 | 1 | 2 | 3 | 4 |
| Unlikely | 0 | 0 | 1 | 2 | 3 |

# Risk Register

| Risk Element | Feature of Work | Concerns | PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact) | Impact | Likelihood | Risk Level |
|---|---|---|---|---|---|---|
| **Project Scope Growth** | | | | **Maximum Project Growth** | | **40%** |
| PS-1 | Concrete Crest Structure | Estimate is based on conceptual level design plans with many investigations remaining to complete that could change the design; Further analysis may show that the current design assumptions do not accomplish the project's intent, thus leading to more changes in the design. | Because of low design level, the scope/scale of this could change but is not likely to be significantly different than current assumptions. | Marginal | Likely | 2 |
| PS-2 | Coffer Dam | See discussion above. | The current assumptions are likely to change. Further investigations could show need for more dewatering efforts than currently assumed. | Moderate | Likely | 3 |
| PS-3 | Rock Ramp | See discussion above. | Current assumptions show that the design accomplishes the project's intent. However, some investigations still remain, thus there is still a risk that this could change. Any scope growth could lead to cost impacts though. | Moderate | Likely | 3 |
| PS-4 | Mob/Demob, Haul Roads, Staging, etc. | See discussion above. | Because of low design level, the scope/scale of this could change but is not likely to be significantly different than current assumptions. | Marginal | Likely | 2 |
| PS-5 | 0 | | | Negligible | Unlikely | 0 |
| PS-6 | 0 | | | Negligible | Unlikely | 0 |
| PS-7 | 0 | | | Negligible | Unlikely | 0 |
| PS-8 | 0 | | | Negligible | Unlikely | 0 |
| PS-9 | 0 | | | Negligible | Unlikely | 0 |
| PS-10 | 0 | | | Negligible | Unlikely | 0 |
| PS-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| PS-13 | Planning, Engineering, & Design | See discussion above. | Potential need for more investigations to be completed, above and beyond what is already assumed. These investigations could present moderate cost increases. | Negligible | Unlikely | 0 |
| PS-14 | Construction Management | See discussion above. | Construction management could increase moderately given any scope increases as more management would be required to oversee the additional construction. | Negligible | Unlikely | 0 |
| **Acquisition Strategy** | | | | **Maximum Project Growth** | | **30%** |
| AS-1 | Concrete Crest Structure | Due to conceptual level of this project, there is limited contracting plan information; Estimate assumes relatively conservative assumptions regarding number of contracts and sub-contractors; Harsh weather could be a risk, but contractors would likely be experienced in this region; No 8a or small business likely due to scale of the project; | Current estimate assumes one contract to be bid out. Contractor assumes several subs, and schedule includes non-construction period during harsh winter months. So assumptions are relatively conservative, but still have some risk of changing. Impacts would likely be marginal at most if they occured. | Marginal | Likely | 2 |
| AS-2 | Coffer Dam | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-3 | Rock Ramp | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-4 | Mob/Demob, Haul Roads, Staging, etc. | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-5 | 0 | | | Negligible | Unlikely | 0 |
| AS-6 | 0 | | | Negligible | Unlikely | 0 |
| AS-7 | 0 | | | Negligible | Unlikely | 0 |
| AS-8 | 0 | | | Negligible | Unlikely | 0 |
| AS-9 | 0 | | | Negligible | Unlikely | 0 |
| AS-10 | 0 | | | Negligible | Unlikely | 0 |
| AS-11 | 0 | | | Negligible | Unlikely | 0 |
| AS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| AS-13 | Planning, Engineering, & Design | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-14 | Construction Management | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| **Construction Elements** | | | | **Maximum Project Growth** | | **15%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| CE-1 | Concrete Crest Structure | Placing concrete within cofferdam and near flowing water. | Not likely to be significant impact but there could be issues in placing the concrete that change the current productivities. | Marginal | Possible | 1 |
| CE-2 | Coffer Dam | Diversion and control of water | Current dewatering assumptions and sheet pile cofferdams are likely sufficient. There is still a risk that once in place, they are not sufficient. Changes to dewatering efforts could see a large increase in costs. | Significant | Possible | 3 |
| CE-3 | Rock Ramp | Placing rock within cofferdams and near flowing water | Not likely to be significant impact but there could be issues in placing the rock ramp that change the current productivities. | Marginal | Possible | 1 |
| CE-4 | Mob/Demob, Haul Roads, Staging, etc. | No significant risks anticipated | These construction elements are common and are unlikely to have any risks that cause cost increases. | Negligible | Unlikely | 0 |
| CE-5 | 0 | | | Negligible | Unlikely | 0 |
| CE-6 | 0 | | | Negligible | Unlikely | 0 |
| CE-7 | 0 | | | Negligible | Unlikely | 0 |
| CE-8 | 0 | | | Negligible | Unlikely | 0 |
| CE-9 | 0 | | | Negligible | Unlikely | 0 |
| CE-10 | 0 | | | Negligible | Unlikely | 0 |
| CE-11 | 0 | | | Negligible | Unlikely | 0 |
| CE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-14 | Construction Management | Diversion and control of water | If increased effort of diverting flows is required then oversight could increase as well. | Marginal | Possible | 1 |
| **Quantities for Current Scope** | | | | | **Maximum Project Growth** | **20%** |
| Q-1 | Concrete Crest Structure | None anticipated | No significant risks are anticipated for the quantity of the crest structure. | Negligible | Unlikely | 0 |
| Q-2 | Coffer Dam | Cofferdam quantities and dewatering assumptions | The cofferdams have detailed quantity take-offs that have been verified, thus these are likely reasonable. There is risk of the contractor requiring more sheet piling and/or longer periods to dewater. This risk is low but could be significant increase. | Significant | Possible | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q-3 | Rock Ramp | Confidence in rock quantities | Quantities have been calculated with the best info available and have been reviewed. But there is a chance they could change, which could cause a cost increase. | Marginal | Possible | 1 |
| Q-4 | Mob/Demob, Haul Roads, Staging, etc. | Number of mob/demob periods and assumed mob/demob durations | There is a low risk that the number of mob/demob periods increase. Also a risk that the time to mob equipment and crews to site could be greater than those assumed. These risks are low, but could cause moderate increase if they occur. | Moderate | Possible | 2 |
| Q-5 | 0 | | | Negligible | Unlikely | 0 |
| Q-6 | 0 | | | Negligible | Unlikely | 0 |
| Q-7 | 0 | | | Negligible | Unlikely | 0 |
| Q-8 | 0 | | | Negligible | Unlikely | 0 |
| Q-9 | 0 | | | Negligible | Unlikely | 0 |
| Q-10 | 0 | | | Negligible | Unlikely | 0 |
| Q-11 | 0 | | | Negligible | Unlikely | 0 |
| Q-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| Q-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| Q-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Specialty Fabrication or Equipment** | | | | **Maximum Project Growth** | | **50%** |
| FE-1 | Concrete Crest Structure | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-2 | Coffer Dam | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-3 | Rock Ramp | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-4 | Mob/Demob, Haul Roads, Staging, etc. | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-5 | 0 | | | Negligible | Unlikely | 0 |
| FE-6 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FE-7 | 0 | | | Negligible | Unlikely | 0 |
| FE-8 | 0 | | | Negligible | Unlikely | 0 |
| FE-9 | 0 | | | Negligible | Unlikely | 0 |
| FE-10 | 0 | | | Negligible | Unlikely | 0 |
| FE-11 | 0 | | | Negligible | Unlikely | 0 |
| FE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| FE-13 | Planning, Engineering, & Design | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-14 | Construction Management | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| **Cost Estimate Assumptions** | | | | **Maximum Project Growth** | | **25%** |
| CT-1 | Concrete Crest Structure | Productivity assumptions | The assumptions regarding the productivity of placing the concrete crest structure could differ once in the field. Conservative assumptions were used, but there is still a risk of these being different than the contractor. | Marginal | Likely | 2 |
| CT-2 | Coffer Dam | Productivity of placing cofferdams | The cofferdam installation will be completed along the flowing river channel. Therefore there is some risk that current assumptions are wrong. Estimate attempted to make conservative placement assumptions and therefore not likely to see a significant cost increase. | Marginal | Likely | 2 |
| CT-3 | Rock Ramp | Productivity assumptions; Site accessibility at disposal locations | This alternative involves placing large quantities of rock. Estimated production rates may not be correct, but conservative assumptions have been assumed. Therefore not likley to be a large increase but could occur. | Marginal | Likely | 2 |
| CT-4 | Mob/Demob, Haul Roads, Staging, etc. | Site accessibility and transport delays | Due to needing to access the site from Joe's Island, there are no existing roadways capable of handling the construction traffic to and from the site. Therefore, access roads are assumed to be installed. But the access speeds and traffic assumptions may be different during construction than currently assumed. This could lead to cost increases if it happens. | Moderate | Possible | 2 |
| CT-5 | 0 | | | Negligible | Unlikely | 0 |
| CT-6 | 0 | | | Negligible | Unlikely | 0 |
| CT-7 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CT-8 | 0 | | | Negligible | Unlikely | 0 |
| CT-9 | 0 | | | Negligible | Unlikely | 0 |
| CT-10 | 0 | | | Negligible | Unlikely | 0 |
| CT-11 | 0 | | | Negligible | Unlikely | 0 |
| CT-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CT-13 | Planning, Engineering, & Design | Percentages assumed for PED | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| CT-14 | Construction Management | Percentages assumed for CM | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| **External Project Risks** | | | | **Maximum Project Growth** | | **20%** |
| EX-1 | Concrete Crest Structure | Severe winter weathere; unanticipated inflations in fuel, and materials; market conditions and bidding climate; | Winter weather is an issue and construction will be likely completed around those times. But impacts to cost/schedule could still occur. The risk of inflation to fuel and other material items is real and could be a significant impact. The bidding climate at time of award, and for possible numerous contracts, could be unfavorable to the cost. Given all these risks, a significant impact would be assumed if they all occured. | Significant | Possible | 3 |
| EX-2 | Coffer Dam | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-3 | Rock Ramp | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-4 | Mob/Demob, Haul Roads, Staging, etc. | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-5 | 0 | | | Negligible | Unlikely | 0 |
| EX-6 | 0 | | | Negligible | Unlikely | 0 |
| EX-7 | 0 | | | Negligible | Unlikely | 0 |
| EX-8 | 0 | | | Negligible | Unlikely | 0 |
| EX-9 | 0 | | | Negligible | Unlikely | 0 |
| EX-10 | 0 | | | Negligible | Unlikely | 0 |
| EX-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| EX-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| EX-13 | Planning, Engineering, & Design | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-14 | Construction Management | See discussion above. | See discussion above. | Significant | Possible | 3 |

**Lower Yellowstone River Rock Ramp**
Feasibility (Alternatives)
Abbreviated Risk Analysis

## Risk Evaluation

| WBS | Potential Risk Areas | Project Scope Growth | Acquisition Strategy | Construction Elements | Quantities for Current Scope | Specialty Fabrication or Equipment | Cost Estimate Assumptions | External Project Risks | Cost in Thousands |
|---|---|---|---|---|---|---|---|---|---|
| **01 LANDS AND DAMAGES** | **Real Estate** | | | | | | | | $0 |
| **15 FLOODWAY CONTROL AND DIVERSION STRUCTURES** | **Concrete Crest Structure** | 2 | 2 | 1 | 0 | 0 | 2 | 3 | $8,950 |
| 06 FISH AND WILDLIFE FACILITIES | Coffer Dam | 3 | 2 | 3 | 3 | 0 | 2 | 3 | $4,168 |
| 06 FISH AND WILDLIFE FACILITIES | Rock Ramp | 3 | 2 | 1 | 1 | 0 | 2 | 3 | $45,845 |
| 06 FISH AND WILDLIFE FACILITIES | Mob/Demob, Haul Roads, Staging, etc. | 2 | 2 | 0 | 2 | 0 | 2 | 3 | $1,017 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| All Other | Remaining Construction Items | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | 0 | 2 | 0 | 0 | 0 | 1 | 3 | $5,453 |
| 31 CONSTRUCTION MANAGEMENT | Construction Management | 0 | 2 | 1 | 0 | 0 | 1 | 3 | $3,635 |
| | | | | | | | | | **$69,067** |
| **Risk** | | $ 5,010 | $ 2,692 | $ 6,051 | $ 1,120 | $ - | $ 2,347 | $ 4,168 | **$21,387** |
| **Fixed Dollar Risk Allocation** | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$0** |
| | Risk | $ 5,010 | $ 2,692 | $ 6,051 | $ 1,120 | $ - | $ 2,347 | $ 4,168 | **$21,387** |
| | | | | | | | | **Total** | **$90,454** |

# Bypass Channel ARA

**Abbreviated Risk Analysis**

Project (less than $40M): **Lower Yellowstone River** — **Alternative: Bypass Channel**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Low Risk: Typical Construction, Simple** — **Meeting Date:**

Total Estimated Construction Contract Cost = **$ 49,424,497**

| | CWWBS | Feature of Work | Contract Cost | | % Contingency | $ Contingency | Total |
|---|---|---|---|---|---|---|---|
| | 01 LANDS AND DAMAGES | Real Estate | $ - | | 0.00% | $ - | $ - |
| 1 | 09 CHANNELS AND CANALS (Except Navigation Ports and Harbors) | Bypass Channel | $ 18,046,778 | | 8.82% | $ 1,591,828 | $ 19,638,606 |
| 2 | 15 FLOODWAY CONTROL AND DIVERSION STRUCTURES | Intake Weir | $ 12,266,807 | | 8.82% | $ 1,082,002 | $ 13,348,809 |
| 3 | 16 BANK STABILIZATION | Bank Stabilization Rock | $ 19,110,912 | | 8.82% | $ 1,685,690 | $ 20,796,602 |
| 4 | | | $ - | | 0.00% | $ - | $ - |
| 5 | | | $ - | | 0.00% | $ - | $ - |
| 6 | | | $ - | | 0.00% | $ - | $ - |
| 7 | | | | | 0.00% | $ - | $ - |
| 8 | | | $ - | | 0.00% | $ - | $ - |
| 9 | | | $ - | | 0.00% | $ - | $ - |
| 10 | | | $ - | | 0.00% | $ - | $ - |
| 11 | | | $ - | | 0.00% | $ - | $ - |
| 12 | All Other | Remaining Construction Items | $ - | 0.0% | 0.00% | $ - | $ - |
| 13 | 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | $ - | | 0.00% | $ - | $ - |
| 14 | 31 CONSTRUCTION MANAGEMENT | Construction Management | $ 2,996,000 | | 8.82% | $ 264,264 | $ 3,260,264 |
| XX | FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW) | | | | | $ - | |

| Totals | | | | | |
|---|---|---|---|---|---|
| Real Estate | $ - | 0.00% | $ - | $ - | |
| Total Construction Estimate | $ 49,424,497 | 8.8206% | $ 4,359,519 | $ 53,784,016 | |
| Total Planning, Engineering & Design | $ - | 0.0000% | $ - | $ - | |
| Total Construction Management | $ 2,996,000 | 8.8206% | $ 264,264 | $ 3,260,264 | |
| Total | **$ 52,420,497** | **8.82%** | **$ 4,623,784** | **$ 57,044,281** | |
| | | **Base** | **50%** | **80%** | |
| | **Range Estimate ($000's)** | $52,420k | $55,194k | $57,044k | |

* 50% based on base is at 5% CL.

| | |
|---|---|
| **Fixed Dollar Risk Add:** (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate. | |

**Lower Yellowstone River Bypass Channel**

Feasibility (Alternatives)

Abbreviated Risk Analysis

**Meeting Date:** 0-Jan-00

**Risk Level**

| | Negligible | Marginal | Moderate | Significant | Critical |
|---|---|---|---|---|---|
| Very Likely | 2 | 3 | 4 | 5 | 5 |
| Likely | 1 | 2 | 3 | 4 | 5 |
| Possible | 0 | 1 | 2 | 3 | 4 |
| Unlikely | 0 | 0 | 1 | 2 | 3 |

# Risk Register

| Risk Element | Feature of Work | Concerns | PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact) | Impact | Likelihood | Risk Level |
|---|---|---|---|---|---|---|
| **Project Scope Growth** | | | | **Maximum Project Growth** | | **40%** |
| PS-1 | Bypass Channel | None | No risks anticipated as the designs have been fully developed to the 100% level. | Negligible | Unlikely | 0 |
| PS-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| PS-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| PS-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| PS-5 | 0 | | | Negligible | Unlikely | 0 |
| PS-6 | 0 | | | Negligible | Unlikely | 0 |
| PS-7 | 0 | | | Negligible | Unlikely | 0 |
| PS-8 | 0 | | | Negligible | Unlikely | 0 |
| PS-9 | 0 | | | Negligible | Unlikely | 0 |
| PS-10 | 0 | | | Negligible | Unlikely | 0 |
| PS-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| PS-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| PS-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **Acquisition Strategy** | | | | **Maximum Project Growth** | | **30%** |
| AS-1 | Bypass Channel | None | Contract had already been awarded, and assumptions in estimate were likely over estimated. Therefore no likely cost increase due to acquisition strategy issues. | Negligible | Unlikely | 0 |
| AS-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| AS-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| AS-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| AS-5 | 0 | | | Negligible | Unlikely | 0 |
| AS-6 | 0 | | | Negligible | Unlikely | 0 |
| AS-7 | 0 | | | Negligible | Unlikely | 0 |
| AS-8 | 0 | | | Negligible | Unlikely | 0 |
| AS-9 | 0 | | | Negligible | Unlikely | 0 |
| AS-10 | 0 | | | Negligible | Unlikely | 0 |
| AS-11 | 0 | | | Negligible | Unlikely | 0 |
| AS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| AS-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| AS-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **Construction Elements** | | | | **Maximum Project Growth** | | **15%** |
| CE-1 | Bypass Channel | None | Construction elements are of no risk as the project was previously bid on, and current estimate is likely conservative. | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CE-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| CE-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| CE-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| CE-5 | 0 | | | Negligible | Unlikely | 0 |
| CE-6 | 0 | | | Negligible | Unlikely | 0 |
| CE-7 | 0 | | | Negligible | Unlikely | 0 |
| CE-8 | 0 | | | Negligible | Unlikely | 0 |
| CE-9 | 0 | | | Negligible | Unlikely | 0 |
| CE-10 | 0 | | | Negligible | Unlikely | 0 |
| CE-11 | 0 | | | Negligible | Unlikely | 0 |
| CE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CE-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| CE-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **Quantities for Current Scope** | | | | **Maximum Project Growth** | | **20%** |
| Q-1 | Bypass Channel | None | Designs have been built out to the 100% level. Therefore quantities used in the estimate are highly reliable and and are very unlikely to change at this point. | Negligible | Unlikely | 0 |
| Q-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| Q-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| Q-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| Q-5 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q-6 | 0 | | | Negligible | Unlikely | 0 |
| Q-7 | 0 | | | Negligible | Unlikely | 0 |
| Q-8 | 0 | | | Negligible | Unlikely | 0 |
| Q-9 | 0 | | | Negligible | Unlikely | 0 |
| Q-10 | 0 | | | Negligible | Unlikely | 0 |
| Q-11 | 0 | | | Negligible | Unlikely | 0 |
| Q-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| Q-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| Q-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **Specialty Fabrication or Equipment** | | | | **Maximum Project Growth** | | **50%** |
| FE-1 | Bypass Channel | None | No specialty fabrication or equipment required for this alternative. | Negligible | Unlikely | 0 |
| FE-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| FE-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| FE-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| FE-5 | 0 | | | Negligible | Unlikely | 0 |
| FE-6 | 0 | | | Negligible | Unlikely | 0 |
| FE-7 | 0 | | | Negligible | Unlikely | 0 |
| FE-8 | 0 | | | Negligible | Unlikely | 0 |
| FE-9 | 0 | | | Negligible | Unlikely | 0 |
| FE-10 | 0 | | | Negligible | Unlikely | 0 |
| FE-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| FE-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| FE-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **Cost Estimate Assumptions** | | | | **Maximum Project Growth** | | **25%** |
| CT-1 | Bypass Channel | None | Conservative assumptions were made across the board in the cost estimate. This was proven when contractor bids were received. Thus no risk of cost increases from the assumptions made within the MCACES. | Negligible | Unlikely | 0 |
| CT-2 | Intake Weir | None | See discussion above. | Negligible | Unlikely | 0 |
| CT-3 | Bank Stabilization Rock | None | See discussion above. | Negligible | Unlikely | 0 |
| CT-4 | 0 | None | See discussion above. | Negligible | Unlikely | 0 |
| CT-5 | 0 | | | Negligible | Unlikely | 0 |
| CT-6 | 0 | | | Negligible | Unlikely | 0 |
| CT-7 | 0 | | | Negligible | Unlikely | 0 |
| CT-8 | 0 | | | Negligible | Unlikely | 0 |
| CT-9 | 0 | | | Negligible | Unlikely | 0 |
| CT-10 | 0 | | | Negligible | Unlikely | 0 |
| CT-11 | 0 | | | Negligible | Unlikely | 0 |
| CT-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CT-13 | Planning, Engineering, & Design | None | See discussion above. | Negligible | Unlikely | 0 |
| CT-14 | Construction Management | None | See discussion above. | Negligible | Unlikely | 0 |
| **External Project Risks** | | | | **Maximum Project Growth** | | **20%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| EX-1 | Bypass Channel | Weather, market volatility, unexpected increases in materials/gas | There are some small possibility of these risks occuring. But if this alternative moves forward, it would likely begin construciton quickly and therefore there shouldn't be any major changes to material prices. Contractor is likely very capable of working in the weather conditions at the site. Also, if project needs to be re-bid, likely would not expect price increase. | Marginal | Possible | 1 |
| EX-2 | Intake Weir | None | See discussion above. | Marginal | Possible | 1 |
| EX-3 | Bank Stabilization Rock | None | See discussion above. | Marginal | Possible | 1 |
| EX-4 | 0 | None | See discussion above. | Marginal | Possible | 1 |
| EX-5 | 0 | | | Negligible | Unlikely | 0 |
| EX-6 | 0 | | | Negligible | Unlikely | 0 |
| EX-7 | 0 | | | Negligible | Unlikely | 0 |
| EX-8 | 0 | | | Negligible | Unlikely | 0 |
| EX-9 | 0 | | | Negligible | Unlikely | 0 |
| EX-10 | 0 | | | Negligible | Unlikely | 0 |
| EX-11 | 0 | | | Negligible | Unlikely | 0 |
| EX-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| EX-13 | Planning, Engineering, & Design | None | See discussion above. | Marginal | Possible | 1 |
| EX-14 | Construction Management | None | See discussion above. | Marginal | Possible | 1 |

**Lower Yellowstone River Bypass Channel**
Feasibility (Alternatives)
Abbreviated Risk Analysis

## Risk Evaluation

| WBS | Potential Risk Areas | Project Scope Growth | Acquisition Strategy | Construction Elements | Quantities for Current Scope | Specialty Fabrication or Equipment | Cost Estimate Assumptions | External Project Risks | Cost in Thousands |
|---|---|---|---|---|---|---|---|---|---|
| **01 LANDS AND DAMAGES** | **Real Estate** | | | | | | | | $0 |
| **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Bypass Channel** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $18,047 |
| 15 FLOODWAY CONTROL AND DIVERSION STRUCTURES | Intake Weir | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $12,267 |
| 16 BANK STABILIZATION | Bank Stabilization Rock | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $19,111 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| All Other | Remaining Construction Items | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $0 |
| 31 CONSTRUCTION MANAGEMENT | Construction Management | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $2,996 |
| | | | | | | | | | **$52,420** |
| **Risk** | | $ - | $ - | $ 3,669 | $ - | $ - | $ - | $ 954 | **$4,624** |
| **Fixed Dollar Risk Allocation** | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$0** |
| | Risk | $ - | $ - | $ 3,669 | $ - | $ - | $ - | $ 954 | **$4,624** |
| | | | | | | | | **Total** | **$57,044** |

# Modified Side Channel ARA

**Abbreviated Risk Analysis**

Project (less than $40M): **Lower Yellowstone River**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Low Risk: Typical Construction, Simple**

**Alternative:** **Modified Side Channel**

**Meeting Date:**

Total Estimated Construction Contract Cost = **$ 35,180,547**

| | CWWBS | Feature of Work | Contract Cost | | % Contingency | $ Contingency | Total |
|---|---|---|---|---|---|---|---|
| | 01 LANDS AND DAMAGES | Real Estate | **$ 220,000** | | **25.00%** | $ 55,000 | $ 275,000 |
| 1 | | **Mob, Demob & Site Preparation** | **$ 2,254,556** | | 29.96% | $ 675,528 | $ 2,930,085 |
| 2 | | **Diversion and Control of Water** | **$ 2,178,186** | | 36.97% | $ 805,283 | $ 2,983,470 |
| 3 | **08 ROADS, RAILROADS, AND BRIDGES** | **Bridge Installation** | **$ 975,827** | | 35.74% | $ 348,726 | $ 1,324,553 |
| 4 | **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Channel Construction** | **$ 12,490,132** | | 36.29% | $ 4,532,849 | $ 17,022,981 |
| 5 | **16 BANK STABILIZATION** | **Channel Armoring** | **$ 17,281,844** | | 34.80% | $ 6,013,658 | $ 23,295,503 |
| 6 | | | **$ -** | | 0.00% | $ - | $ - |
| 7 | | | **$ -** | | 0.00% | $ - | $ - |
| 8 | | | **$ -** | | 0.00% | $ - | $ - |
| 9 | | | **$ -** | | 0.00% | $ - | $ - |
| 10 | | | **$ -** | | 0.00% | $ - | $ - |
| 11 | | | **$ -** | | 0.00% | $ - | $ - |
| 12 | All Other | **Remaining Construction Items** | **$ -** | *0.0%* | 0.00% | $ - | $ - |
| 13 | 30 PLANNING, ENGINEERING, AND DESIGN | **Planning, Engineering, & Design** | **$ 3,201,000** | | 23.21% | $ 742,931 | $ 3,943,931 |
| 14 | 31 CONSTRUCTION MANAGEMENT | **Construction Management** | **$ 2,133,000** | | 24.93% | $ 531,717 | $ 2,664,717 |
| XX | FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW) | | | | | **$ -** | |

| **Totals** | | | | | |
|---|---|---|---|---|---|
| Real Estate | $ 220,000 | 25.00% | $ 55,000 | $ 275,000.00 | |
| Total Construction Estimate | $ 35,180,547 | 35.2% | $ 12,376,044 | $ 47,556,591 | |
| Total Planning, Engineering & Design | $ 3,201,000 | 23.2% | $ 742,931 | $ 3,943,931 | |
| Total Construction Management | $ 2,133,000 | 24.9% | $ 531,717 | $ 2,664,717 | |
| Total | **$ 40,734,547** | **33.6%** | **$ 13,705,692** | **$ 54,440,239** | |
| | | **Base** | **50%** | **80%** | |
| | **Range Estimate ($000's)** | $40,735k | $48,958k | $54,440k | |

* 50% based on base is at 5% CL.

| | |
|---|---|
| **Fixed Dollar Risk Add:** (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate. | |

**Lower Yellowstone River Modified Side Channel**

Feasibility (Alternatives)
Abbreviated Risk Analysis
**Meeting Date:** 0-Jan-00

**Risk Level**

| | Negligible | Marginal | Moderate | Significant | Critical |
|---|---|---|---|---|---|
| Very Likely | 2 | 3 | 4 | 5 | 5 |
| Likely | 1 | 2 | 3 | 4 | 5 |
| Possible | 0 | 1 | 2 | 3 | 4 |
| Unlikely | 0 | 0 | 1 | 2 | 3 |

# Risk Register

| Risk Element | Feature of Work | Concerns | PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact) | Impact | Likelihood | Risk Level |
|---|---|---|---|---|---|---|
| **Project Scope Growth** | | | | **Maximum Project Growth** | | **40%** |
| PS-1 | Mob, Demob & Site Preparation | Estimate is based on conceptual level design plans with many investigations remaining to complete that could change the design; Further analysis may show that the current design assumptions do not accomplish the project's intent, thus leading to more changes in the design. | Because of low design level, the scope/scale of this could change but is not likely to be significantly different than current assumptions. | Marginal | Likely | 2 |
| PS-2 | Diversion and Control of Water | See discussion above. | The current assumptions are likely to change. Further investigations could show need for more dewatering efforts than currently assumed. | Moderate | Likely | 3 |
| PS-3 | Bridge Installation | See discussion above; ice considerations | Only one bridge is required for crews to travel over the channel. May be slight risk that larger bridge/abutments may be required. Further investigations need to be completed in order to account for ice flows. Current bridge may require changes in future designs | Moderate | Likely | 3 |
| PS-4 | Channel Construction | See discussion above. | Current assumptions show that the design accomplishes the project's intent. However, some investigations still remain, thus there is still a risk that this could change. Any scope growth could lead to significant cost impacts though. | Significant | Possible | 3 |
| PS-5 | Channel Armoring | See discussion above. | Current assumptions show that the design accomplishes the project's intent. However, some investigations still remain, thus there is still a risk that this could change. Any scope growth could lead to significant impacts though. | Significant | Possible | 3 |
| PS-6 | 0 | | | Negligible | Unlikely | 0 |
| PS-7 | 0 | | | Negligible | Unlikely | 0 |
| PS-8 | 0 | | | Negligible | Unlikely | 0 |
| PS-9 | 0 | | | Negligible | Unlikely | 0 |
| PS-10 | 0 | | | Negligible | Unlikely | 0 |
| PS-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| PS-13 | Planning, Engineering, & Design | See discussion above. | Potential need for more investigations to be completed, above and beyond what is already assumed. These investigations could present moderate cost increases. | Moderate | Possible | 2 |
| PS-14 | Construction Management | See discussion above. | Construction management could increase moderately given any scope increases as more management would be required to oversee the additional construction. | Moderate | Possible | 2 |
| **Acquisition Strategy** | | | | | **Maximum Project Growth** | **30%** |
| AS-1 | Mob, Demob & Site Preparation | Due to conceptual level of this project, there is limited contracting plan information; Estimate assumes relatively conservative assumptions regarding number of contracts and sub-contractors; Harsh weather could be a risk, but contractors would likely be experienced in this region; No 8a or small business likely due to scale of the project; | Current estimate assumes one contract to be bid out. Contractor assumes several subs, and schedule includes non-construction period during harsh winter months. So assumptions are relatively conservative, but still have some risk of changing. Impacts would likely be marginal at most if they occured. | Marginal | Likely | 2 |
| AS-2 | Diversion and Control of Water | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-3 | Bridge Installation | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-4 | Channel Construction | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-5 | Channel Armoring | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-6 | 0 | | | Negligible | Unlikely | 0 |
| AS-7 | 0 | | | Negligible | Unlikely | 0 |
| AS-8 | 0 | | | Negligible | Unlikely | 0 |
| AS-9 | 0 | | | Negligible | Unlikely | 0 |
| AS-10 | 0 | | | Negligible | Unlikely | 0 |
| AS-11 | 0 | | | Negligible | Unlikely | 0 |
| AS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| AS-13 | Planning, Engineering, & Design | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| AS-14 | Construction Management | See concerns listed above. | See discussion listed above. | Marginal | Likely | 2 |
| **Construction Elements** | | | | | **Maximum Project Growth** | **15%** |
| CE-1 | Mob, Demob & Site Preparation | Number of mob/demob periods | Current estimate assumes several mob/demob periods that occur before/after the winter closure period. Risk of requiring more mob/demob efforts than currently assumed is there, but not likely to occur. | Moderate | Unlikely | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CE-2 | Diversion and Control of Water | Diversion and control of water | Current assumption for earthen cofferdam with sheetpile cut-offs are likely to be enough. But estimate also made assumptions for well points to be installed. Changes to these dewatering efforts are likely by the contractor, but due to conservative assumptions used, costs is not likely to increase significantly. | Marginal | Likely | 2 |
| CE-3 | Bridge Installation | No significant risks anticipated | The bridge work should be standard work for the contractor, and therefore very unlikely to see significant cost increases. | Negligible | Unlikely | 0 |
| CE-4 | Channel Construction | No significant risks anticipated | The construction elements involved for the channel construction are common. Therefore no risks likely to occur or increase costs. | Negligible | Unlikely | 0 |
| CE-5 | Channel Armoring | No significant risks anticipated | The construction elements involved for the channel construction are common. Therefore no risks likely to occur or increase costs. | Negligible | Unlikely | 0 |
| CE-6 | 0 | | | Negligible | Unlikely | 0 |
| CE-7 | 0 | | | Negligible | Unlikely | 0 |
| CE-8 | 0 | | | Negligible | Unlikely | 0 |
| CE-9 | 0 | | | Negligible | Unlikely | 0 |
| CE-10 | 0 | | | Negligible | Unlikely | 0 |
| CE-11 | 0 | | | Negligible | Unlikely | 0 |
| CE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-14 | Construction Management | Diversion and control of water | If increased effort of diverting flows is required then oversight could increase as well. | Marginal | Possible | 1 |
| **Quantities for Current Scope** | | | | **Maximum Project Growth** | | **20%** |
| Q-1 | Mob, Demob & Site Preparation | Number of mob/demob periods and assumed mob/demob durations | There is a low risk that the number of mob/demob periods increase. Also a risk that the time to mob equipment and crews to site could be greater than those assumed. These risks are low, but could cause moderate increase if they occur. | Moderate | Possible | 2 |
| Q-2 | Diversion and Control of Water | Cofferdam quantities; Well point and other pumping assumptions | The cofferdams have detailed quantity take-offs that have been verified, thus these are not-likely to change. The dewater wells and pumps are based on general assumptions currently, and there is a risk of the contractor requiring more wells and/or longer periods to dewater. This risk is low but could be significant increase. | Significant | Possible | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q-3 | Bridge Installation | Accounting for ice flow | Bridge quantities for abutments and earthwork are likely to change once further analysis determines the exact height needed to avoid or limit damage from ice. These are not significant cost drivers for the bridge but could have a moderate impact. | Moderate | Likely | 3 |
| Q-4 | Channel Construction | Confidence level in earthwork quantities | Based on the current design, the quantities were calculated using CAD and therefore are expected to be accurate. The quantities have been backchecked and therefore are not likely to change unless further analysis shows the design must change. Thus the risk of occuring is low, but increases in quantities could have moderate cost impacts. | Moderate | Possible | 2 |
| Q-5 | Channel Armoring | Confidence level in armoring quantities | The quantities were calculated using the typical bank sections. Further design would likely develop more sections for use in the calculation. However, further sections are likely not going to increase the quantities therefore likelihood and impact of increases would be low. | Marginal | Possible | 1 |
| Q-6 | 0 | | | Negligible | Unlikely | 0 |
| Q-7 | 0 | | | Negligible | Unlikely | 0 |
| Q-8 | 0 | | | Negligible | Unlikely | 0 |
| Q-9 | 0 | | | Negligible | Unlikely | 0 |
| Q-10 | 0 | | | Negligible | Unlikely | 0 |
| Q-11 | 0 | | | Negligible | Unlikely | 0 |
| Q-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| Q-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| Q-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Specialty Fabrication or Equipment** | | | | **Maximum Project Growth** | | **50%** |
| FE-1 | Mob, Demob & Site Preparation | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-2 | Diversion and Control of Water | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-3 | Bridge Installation | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-4 | Channel Construction | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-5 | Channel Armoring | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FE-6 | 0 | | | Negligible | Unlikely | 0 |
| FE-7 | 0 | | | Negligible | Unlikely | 0 |
| FE-8 | 0 | | | Negligible | Unlikely | 0 |
| FE-9 | 0 | | | Negligible | Unlikely | 0 |
| FE-10 | 0 | | | Negligible | Unlikely | 0 |
| FE-11 | 0 | | | Negligible | Unlikely | 0 |
| FE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| FE-13 | Planning, Engineering, & Design | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| FE-14 | Construction Management | None anticipated | No specialty fabrication or equipment required. | Negligible | Unlikely | 0 |
| **Cost Estimate Assumptions** | | | | **Maximum Project Growth** | | **25%** |
| CT-1 | Mob, Demob & Site Preparation | Site accessibility and transport delays | Due to needing to access the site from Joe's Island, there are no existing roadways capable of handling the construction traffic to and from the site. Therefore, access roads are assumed to be installed. But the access speeds and traffic assumptions may be different during construction than currently assumed. This could lead to cost increases if it happens. | Moderate | Possible | 2 |
| CT-2 | Diversion and Control of Water | Productivity of placing cofferdams | The cofferdam installation will be completed along the flowing river channel. Therefore there is some risk that current assumptions are wrong. Estimate attempted to make conservative placement assumptions and therefore not likely to see a significant cost increase. | Marginal | Possible | 1 |
| CT-3 | Bridge Installation | Unit price for bridge | Due to conceptual level of the design, a bridge quote has not been obtained as no details are available. However, the MII unit price used is relatively conservative based on past bridge estimates. Thus it is possible that the costs would change, but not anticipated to increase significantly as cost is adequate for a basic road bridge. | Moderate | Possible | 2 |
| CT-4 | Channel Construction | Productivity assumptions; Site accessibility at disposal locations | This alternative is excavating large quantity and disposing of nearby using large haulers. However, the current production rates may not be correct. Also accessing some of the disposal locations may show to be more difficult than assumed. These are not likely to be the case, but could increase earthwork costs significantly. | Significant | Possible | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CT-5 | Channel Armoring | Unit prices for bedding, riprap, and boulders | In order for this estimate to be comparable to previously developed alternatives, the same unit price for the stone material and delivery were assumed. However, given the distances the stone would need to be transported over, there is a likelihood that costs could increase greatly given supply and transport assumptions. This may not be likely to occur but could be significant impact to the rock prices. | Significant | Possible | 3 |
| CT-6 | 0 | | | Negligible | Unlikely | 0 |
| CT-7 | 0 | | | Negligible | Unlikely | 0 |
| CT-8 | 0 | | | Negligible | Unlikely | 0 |
| CT-9 | 0 | | | Negligible | Unlikely | 0 |
| CT-10 | 0 | | | Negligible | Unlikely | 0 |
| CT-11 | 0 | | | Negligible | Unlikely | 0 |
| CT-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CT-13 | Planning, Engineering, & Design | Percentages assumed for PED | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| CT-14 | Construction Management | Percentages assumed for CM | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| **External Project Risks** | | | | **Maximum Project Growth** | | **20%** |
| EX-1 | Mob, Demob & Site Preparation | Severe winter weathere; unanticipated inflations in fuel, and materials; market conditions and bidding climate; | Winter weather is an issue and construction will be likely completed around those times. But impacts to cost/schedule could still occur. The risk of inflation to fuel and other material items is real and could be a significant impact. The bidding climate at time of award, and for possible numerous contracts, could be unfavorable to the cost. Given all these risks, a significant impact would be assumed if they all occured. | Significant | Possible | 3 |
| EX-2 | Diversion and Control of Water | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-3 | Bridge Installation | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-4 | Channel Construction | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-5 | Channel Armoring | See discussion above. | See discussion above. | Significant | Possible | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| EX-6 | 0 | | | Negligible | Unlikely | 0 |
| EX-7 | 0 | | | Negligible | Unlikely | 0 |
| EX-8 | 0 | | | Negligible | Unlikely | 0 |
| EX-9 | 0 | | | Negligible | Unlikely | 0 |
| EX-10 | 0 | | | Negligible | Unlikely | 0 |
| EX-11 | 0 | | | Negligible | Unlikely | 0 |
| EX-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| EX-13 | Planning, Engineering, & Design | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-14 | Construction Management | See discussion above. | See discussion above. | Significant | Possible | 3 |

**Lower Yellowstone River Modified Side Channel**
Feasibility (Alternatives)
Abbreviated Risk Analysis

## Risk Evaluation

| WBS | Potential Risk Areas | Project Scope Growth | Acquisition Strategy | Construction Elements | Quantities for Current Scope | Specialty Fabrication or Equipment | Cost Estimate Assumptions | External Project Risks | Cost in Thousands |
|---|---|---|---|---|---|---|---|---|---|
| **01 LANDS AND DAMAGES** | **Real Estate** | | | | | | | | $220,000 |
| **0** | **Mob, Demob & Site Preparation** | 2 | 2 | 1 | 2 | 0 | 2 | 3 | $2,255 |
| 0 | Diversion and Control of Water | 3 | 2 | 2 | 3 | 0 | 1 | 3 | $2,178 |
| 08 ROADS, RAILROADS, AND BRIDGES | Bridge Installation | 3 | 2 | 0 | 3 | 0 | 2 | 3 | $976 |
| 09 CHANNELS AND CANALS (Except Navigation Ports and Harbors) | Channel Construction | 3 | 2 | 0 | 2 | 0 | 3 | 3 | $12,490 |
| 16 BANK STABILIZATION | Channel Armoring | 3 | 2 | 0 | 1 | 0 | 3 | 3 | $17,282 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| All Other | Remaining Construction Items | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | 2 | 2 | 0 | 0 | 0 | 1 | 3 | $3,201 |
| 31 CONSTRUCTION MANAGEMENT | Construction Management | 2 | 2 | 1 | 0 | 0 | 1 | 3 | $2,133 |
| | | | | | | | | | **$40,515** |
| **Risk** | | $ 3,343 | $ 1,579 | $ 2,976 | $ 994 | $ - | $ 2,314 | $ 2,445 | **$13,651** |
| **Fixed Dollar Risk Allocation** | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$0** |
| | Risk | $ 3,343 | $ 1,579 | $ 2,976 | $ 994 | $ - | $ 2,314 | $ 2,445 | **$13,651** |
| | | | | | | | | **Total** | **$54,165** |

# Multiple Pump ARA

**Abbreviated Risk Analysis**

Project (less than $40M): **Lower Yellowstone River**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Low Risk: Typical Construction, Simple**

**Alternative:** **Multiple Pump Alternative**

**Meeting Date:**

Total Estimated Construction Contract Cost = **$ 84,277,276**

| | CWWBS | Feature of Work | Contract Cost | | % Contingency | $ Contingency | Total |
|---|---|---|---|---|---|---|---|
| | 01 LANDS AND DAMAGES | Real Estate | $ 443,000 | | 25.00% | $ 110,750 | $ 553,750 |
| 1 | 04 DAMS | Dam Removal | $ 6,599,764 | | 45.02% | $ 2,971,122 | $ 9,570,886 |
| 2 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Mob, Demob & Site Prep | $ 1,821,234 | | 29.48% | $ 536,863 | $ 2,358,097 |
| 3 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Diversion and Control of Water | $ 2,489,513 | | 39.25% | $ 977,025 | $ 3,466,538 |
| 4 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Pump Stations | $ 23,599,255 | | 38.10% | $ 8,992,108 | $ 32,591,363 |
| 5 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Discharge Pipelines | $ 25,527,106 | | 32.46% | $ 8,286,712 | $ 33,813,818 |
| 6 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Feeder Canal | $ 2,449,067 | | 27.68% | $ 677,917 | $ 3,126,984 |
| 7 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Fish Screen | $ 18,301,220 | | 38.02% | $ 6,957,999 | $ 25,259,219.15 |
| 8 | 19 BUILDINGS, GROUNDS, AND UTILITIES | Power System Uprating | $ 3,490,118 | | 46.90% | $ 1,636,975 | $ 5,127,092.65 |
| 9 | | | $ - | | 0.00% | $ - | $ - |
| 10 | | | $ - | | 0.00% | $ - | $ - |
| 11 | | | $ - | | 0.00% | $ - | $ - |
| 12 | All Other | Remaining Construction Items | $ - | 0.0% | 0.00% | $ - | $ - |
| 13 | 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | $ 7,664,000 | | 26.52% | $ 2,032,783 | $ 9,696,783 |
| 14 | 31 CONSTRUCTION MANAGEMENT | Construction Management | $ 5,108,000 | | 26.52% | $ 1,354,835 | $ 6,462,835 |
| XX | FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW) | | | | | $ - | |

| Totals | | | | | |
|---|---|---|---|---|---|
| Real Estate | $ 443,000 | 25.0% | $ 110,750 | $ 553,750.00 | |
| Total Construction Estimate | $ 84,277,276 | 36.8% | $ 31,036,720 | $ 115,313,996 | |
| Total Planning, Engineering & Design | $ 7,664,000 | 26.5% | $ 2,032,783 | $ 9,696,783 | |
| Total Construction Management | $ 5,108,000 | 26.5% | $ 1,354,835 | $ 6,462,835 | |
| Total | **$ 97,492,276** | **35.4%** | **$ 34,535,089** | **$ 132,027,365** | |
| | | **Base** | **50%** | **80%** | |
| | **Range Estimate ($000's)** | $97,492k | $118,213k | $132,027k | |

* 50% based on base is at 5% CL.

| | |
|---|---|
| **Fixed Dollar Risk Add:** (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate. | |

**Lower Yellowstone River Multiple Pump Alternative**

Feasibility (Alternatives)

Abbreviated Risk Analysis

**Meeting Date:** 0-Jan-00

**Risk Level**

| | Negligible | Marginal | Moderate | Significant | Critical |
|---|---|---|---|---|---|
| Very Likely | 2 | 3 | 4 | 5 | 5 |
| Likely | 1 | 2 | 3 | 4 | 5 |
| Possible | 0 | 1 | 2 | 3 | 4 |
| Unlikely | 0 | 0 | 1 | 2 | 3 |

# Risk Register

| Risk Element | Feature of Work | Concerns | PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact) | Impact | Likelihood | Risk Level |
|---|---|---|---|---|---|---|
| **Project Scope Growth** | | | | **Maximum Project Growth** | | **40%** |
| PS-1 | Dam Removal | Estimate is based on conceptual level design plans with many investigations remaining to complete that could change the design; Further analysis may show that the current design assumptions do not accomplish the project's intent, thus leading to more changes in the design. | The dam removal requires signficantly more analysis to determine the extent of the rock/boulder debris field downstream of the existing dam. There is a chance that current assumptions are off, which although not likely, it would be significant to the costs. | Significant | Possible | 3 |
| PS-2 | Mob, Demob & Site Prep | See concerns above. | Because of low design level, the scope/scale of this could change but is not likely to be significantly different than current assumptions. | Marginal | Likely | 2 |
| PS-3 | Diversion and Control of Water | See concerns above. | The current assumptions are likely to change. Further investigations could show need for more dewatering efforts than currently assumed. | Moderate | Likely | 3 |
| PS-4 | Pump Stations | See concerns above; Ice protection | If further investigations show that more pumps are required, then a major cost increase could occur. However, further analysis could also show that less pumps are required. Thus, the likelihood of a change is very low and the impact could swing either way, and thus is only moderate. Further analysis into ice flows could require changes to the scope of the pump stations. Could be significant impact. | Significant | Unlikely | 2 |
| PS-5 | Discharge Pipelines | See concerns above. | Discharge pipelines, based on current pump station design, are not likely to increase in scope. The current design calls for large pipe, with already expensive costs, thus any change should not be significant impact. | Marginal | Possible | 1 |
| PS-6 | Feeder Canal | See concerns above. | No significant risks to scope growing as all items that could be required are included. Some minor issues may arise upon further analysis but these are unlikely and should not increase costs significantly. | Marginal | Possible | 1 |
| PS-7 | Fish Screen | See concerns above; Ice protection | No significant risk to scope growth as design assumptions are robust for the fish screen. Furhter analysis could change the design but not likely to occur and cost imapcts likely would only be moderate. Further analysis into possible ice flows could significantly impact the design of the fish screens. | Significant | Unlikely | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PS-8 | Power System Uprating | See concerns above. | Current scale of the power system changes are based on preliminary analysis and discussions with the local power company. Much analysis is likely still needed to ensure there is sufficient utility structures capable of providing power to the pumps. The current assumptions are likely to change and could have significant cost impacts. | Significant | Likely | 4 |
| PS-9 | 0 | | | Negligible | Unlikely | 0 |
| PS-10 | 0 | | | Negligible | Unlikely | 0 |
| PS-11 | 0 | | | Negligible | Unlikely | 0 |
| PS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| PS-13 | Planning, Engineering, & Design | See concerns above. | Potential need for more investigations to be completed, above and beyond what is already assumed. These investigations could present moderate cost increases. | Moderate | Possible | 2 |
| PS-14 | Construction Management | See concerns above. | Construction management could increase moderately given any scope increases as more management would be required to oversee the additional construction. | Moderate | Possible | 2 |
| **Acquisition Strategy** | | | | **Maximum Project Growth** | | **30%** |
| AS-1 | Dam Removal | Due to conceptual level of this project, there is limited contracting plan information; Estimate assumes relatively conservative assumptions regarding number of contracts and sub-contractors; Harsh weather could be a risk, but contractors would likely be experienced in this region; No 8a or small business likely due to scale of the project; | Contracting plan changes could significantly impact each of these costs. If the work needs to be broken into multiple contracts then costs would increase. Individual components may be constructed at different times, based on water demands and winter weather conditions, which also could impact costs. Without lack of a detailed contracting plan, there could be changes both increasing and decreasing costs, thus it is likely to change but only marginal impact to costs. | Marginal | Likely | 2 |
| AS-2 | Mob, Demob & Site Prep | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-3 | Diversion and Control of Water | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-4 | Pump Stations | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-5 | Discharge Pipelines | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-6 | Feeder Canal | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-7 | Fish Screen | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-8 | Power System Uprating | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-9 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AS-10 | 0 | | | Negligible | Unlikely | 0 |
| AS-11 | 0 | | | Negligible | Unlikely | 0 |
| AS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| AS-13 | Planning, Engineering, & Design | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| AS-14 | Construction Management | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| **Construction Elements** | | | | **Maximum Project Growth** | | **15%** |
| CE-1 | Dam Removal | Working in wet conditions within the channel, even when dewatered; potential for construction mods/claims; high risk due to river water being diverted nearby and likely working in wet conditions; | The dewatering effort is a significant cost driver. The existing rock downstream of the dam could be a significant hinderance to effectively dewatering the area. Current assumptions are conservative, but there could be significant risks to these assumptions changing. | Significant | Likely | 4 |
| CE-2 | Mob, Demob & Site Prep | Number of mob/demob periods | There are numerous mob/demob periods across mutliple areas in the study region. These assumptions are assumed to be conservative but are still likely to change. | Marginal | Likely | 2 |
| CE-3 | Diversion and Control of Water | The assumptions required for dewatering are based on limited information; Future analysis could greatly change the dewatering efforts. | Conservative assumptions have currently been made for dewatering during pump station construction. However, some items may require more dewatering efforts that are currently not assumed. This could impact costs signficantly but is not likely to occur. | Significant | Unlikely | 2 |
| CE-4 | Pump Stations | Special subcontractors likely needed to install and test pumps and other equipment; Deep excavation for pump stations could increase risks; | The contractors tasked with the installation of the pumps should not be hard to find and would likely be able to complete with little risk; The excavation should not be that difficult but contractor may make different assumptions on how to exactly excavate the area. If shoring or some other methodology is required, costs could increase signficantly. | Significant | Possible | 3 |
| CE-5 | Discharge Pipelines | See discussions in CE-4 | Not likely to be a significant impact. | Marginal | Possible | 1 |
| CE-6 | Feeder Canal | See discussions in CE-4 | Not likely to be a significant impact. | Marginal | Possible | 1 |
| CE-7 | Fish Screen | See discussions in CE-4 | Not likely to be a significant impact. | Marginal | Possible | 1 |
| CE-8 | Power System Uprating | See discussions in CE-4 | Not likely to be a significant impact. | Marginal | Possible | 1 |
| CE-9 | 0 | | | Negligible | Unlikely | 0 |
| CE-10 | 0 | | | Negligible | Unlikely | 0 |
| CE-11 | 0 | | | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Quantities for Current Scope** | | | | **Maximum Project Growth** | | **20%** |
| Q-1 | Dam Removal | Quantities are based on conceptual level designs and therefore are anticipated to change as project progresses; Many investigations remain to assist in developing accurate quantities. | Due to the low level of design for this alternative quantities are likely to change as the project progresses. The quantity development did take very conservative assumptions and therefore increases to the quantities is not likely to be significant. Thus it is possible that they will change, but due to conservative assumptions, should only be a marginal impact at most to certain elements. | Marginal | Likely | 2 |
| Q-2 | Mob, Demob & Site Prep | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-3 | Diversion and Control of Water | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-4 | Pump Stations | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-5 | Discharge Pipelines | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-6 | Feeder Canal | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-7 | Fish Screen | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-8 | Power System Uprating | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-9 | 0 | | | Negligible | Unlikely | 0 |
| Q-10 | 0 | | | Negligible | Unlikely | 0 |
| Q-11 | 0 | | | Negligible | Unlikely | 0 |
| Q-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| Q-13 | Planning, Engineering, & Design | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| Q-14 | Construction Management | See concerns above. | See discussion above. | Marginal | Likely | 2 |
| **Specialty Fabrication or Equipment** | | | | **Maximum Project Growth** | | **50%** |
| FE-1 | Dam Removal | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FE-2 | Mob, Demob & Site Prep | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-3 | Diversion and Control of Water | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-4 | Pump Stations | Main irrigation pumps and associated equipment | Discussions have already been held with contractors capable of providing these items. So it can be assumed that there is a reasonable ability to obtain. However, there is still a risk at time of construction the materials needed are not available or have increased in costs. Thus the impact could be moderate. | Moderate | Possible | 2 |
| FE-5 | Discharge Pipelines | Delivery of large pipes. | The pipes are not huge by any means but delivering 8-ft diameter pipes to this location may be troublesome. It is not likely but could be significant cost increase. | Moderate | Possible | 2 |
| FE-6 | Feeder Canal | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-7 | Fish Screen | Fish return pumps and associated equipment | Discussions have already been held with contractors capable of providing these items. So it can be assumed that there is a reasonable ability to obtain. However, there is still a risk at time of construction the materials needed are not available or have increased in costs. Thus the impact could be moderate. | Moderate | Possible | 2 |
| FE-8 | Power System Uprating | Electrical towers and equipment to upgrade power system | Cost were provide by the local power company, and are not anticipated to be significantly off. However, at time of construction, and upon further analysis, there may be more specialty items needed. This is not likely but could be a marginal impact. | Marginal | Possible | 1 |
| FE-9 | 0 | | | Negligible | Unlikely | 0 |
| FE-10 | 0 | | | Negligible | Unlikely | 0 |
| FE-11 | 0 | | | Negligible | Unlikely | 0 |
| FE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| FE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Cost Estimate Assumptions** | | | | **Maximum Project Growth** | | **25%** |
| CT-1 | Dam Removal | Rock disposal assumptions; cofferdam assumptions | Current estimate assumes disposing of rock removed from the dam nearby, likely on Joe's island. There is risk rock may need to be be trucked to another location, which would increase the haul costs significantly; Placement of cofferdam may be more difficult than assumed and may not be as efficient at diverting flows. Contractor may assume different methods to control flows and seepage. | Significant | Possible | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CT-2 | Mob, Demob & Site Prep | Mob/demob and site prep have been developed based on general assumptions. | The assumptions have been conservatively estimated and therefore are not likely to increase much. | Marginal | Possible | 1 |
| CT-3 | Diversion and Control of Water | Sheet pile cofferdams and well points sufficient for construction | The estimate assumes sheetpiles with well points also. There is also an assumption of pumping during the pump station work. These assumptions are conservative, but until further analysis is completed there is still a significant impact risk. | Significant | Possible | 3 |
| CT-4 | Pump Stations | Use of cost quotes on major equipment items; Productivity assumptions; | Significant percentage of cost for this item are in the pump and motor quotes. These were provided by a vendor and then received sub markups in MII. Thus they are likely conservative, but still could increase at time of construction; All productivity assumptions have been estimated with best engineering judgment at this time. These could change though which would obviously impact costs. | Moderate | Possible | 2 |
| CT-5 | Discharge Pipelines | | | Moderate | Possible | 2 |
| CT-6 | Feeder Canal | | | Moderate | Possible | 2 |
| CT-7 | Fish Screen | Use of previous project costs for fish screens and deadplates | A previous project estimate was used to estimate the unit costs for the fish screen and dead plates. The value was escalated to current prices, but still may not be accurate at time of construction. This could be significant impact with low likelihood. | Significant | Possible | 3 |
| CT-8 | Power System Uprating | | | Moderate | Possible | 2 |
| CT-9 | 0 | | | Negligible | Unlikely | 0 |
| CT-10 | 0 | | | Negligible | Unlikely | 0 |
| CT-11 | 0 | | | Negligible | Unlikely | 0 |
| CT-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CT-13 | Planning, Engineering, & Design | Percentages assumed for PED | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| CT-14 | Construction Management | Percentages assumed for CM | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| **External Project Risks** | | | | | **Maximum Project Growth** | **20%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| EX-1 | Dam Removal | Severe winter weathere; unanticipated inflations in fuel, and materials; market conditions and bidding climate; | Winter weather is an issue and construction will be likely completed around those times. But impacts to cost/schedule could still occur. The risk of inflation to fuel and other material items is real and could be a significant impact. The bidding climate at time of award, and for possible numerous contracts, could be unfavorable to the cost. Given all these risks, a significant impact would be assumed if they all occured. | Significant | Possible | 3 |
| EX-2 | Mob, Demob & Site Prep | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-3 | Diversion and Control of Water | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-4 | Pump Stations | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-5 | Discharge Pipelines | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-6 | Feeder Canal | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-7 | Fish Screen | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-8 | Power System Uprating | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-9 | 0 | | | Negligible | Unlikely | 0 |
| EX-10 | 0 | | | Negligible | Unlikely | 0 |
| EX-11 | 0 | | | Negligible | Unlikely | 0 |
| EX-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| EX-13 | Planning, Engineering, & Design | See concerns above. | See discussion above. | Significant | Possible | 3 |
| EX-14 | Construction Management | See concerns above. | See discussion above. | Significant | Possible | 3 |

**Lower Yellowstone River Multiple Pump Alternative**
Feasibility (Alternatives)
Abbreviated Risk Analysis

## Risk Evaluation

| WBS | Potential Risk Areas | Project Scope Growth | Acquisition Strategy | Construction Elements | Quantities for Current Scope | Specialty Fabrication or Equipment | Cost Estimate Assumptions | External Project Risks | Cost in Thousands |
|---|---|---|---|---|---|---|---|---|---|
| **01 LANDS AND DAMAGES** | **Real Estate** | | | | | | | | $443,000 |
| **04 DAMS** | **Dam Removal** | 3 | 2 | 4 | 2 | 0 | 3 | 3 | $6,600 |
| 19 BUILDINGS, GROUNDS, AND UTILITIES | Mob, Demob & Site Prep | 2 | 2 | 2 | 2 | 0 | 1 | 3 | $1,821 |
| 19 BUILDINGS, GROUNDS, AND UTILITIES | Diversion and Control of Water | 3 | 2 | 2 | 2 | 0 | 3 | 3 | $2,490 |
| 19 BUILDINGS, GROUNDS, AND UTILITIES | Pump Stations | 2 | 2 | 3 | 2 | 2 | 2 | 3 | $23,599 |
| 19 BUILDINGS, GROUNDS, AND UTILITIES | Discharge Pipelines | 1 | 2 | 1 | 2 | 2 | 2 | 3 | $25,527 |
| 19 BUILDINGS, GROUNDS, AND UTILITIES | Feeder Canal | 1 | 2 | 1 | 2 | 0 | 2 | 3 | $2,449 |
| **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Fish Screen** | 2 | 2 | 1 | 2 | 2 | 3 | 3 | $18,301 |
| **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Power System Uprating** | 4 | 2 | 1 | 2 | 1 | 2 | 3 | $3,490 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| All Other | Remaining Construction Items | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | 2 | 2 | 0 | 2 | 0 | 1 | 3 | $7,664 |
| 31 CONSTRUCTION MANAGEMENT | Construction Management | 2 | 2 | 0 | 2 | 0 | 1 | 3 | $5,108 |
| | | | | | | | | | **$97,049** |
| **Risk** | | $ 4,555 | $ 3,783 | $ 9,550 | $ 3,217 | $ 3,301 | $ 4,163 | $ 5,856 | **$34,424** |
| **Fixed Dollar Risk Allocation** | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$0** |
| | Risk | $ 4,555 | $ 3,783 | $ 9,550 | $ 3,217 | $ 3,301 | $ 4,163 | $ 5,856 | **$34,424** |
| | | | | | | | | **Total** | **$131,474** |

# Multiple Pumps with Conservation Measures ARA

**Abbreviated Risk Analysis**

Project (less than $40M): **Lower Yellowstone River**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Low Risk: Typical Construction, Simple**

**Alternative:** **Multiple Pumps w/ Conservation Mea**

**Meeting Date:**

Total Estimated Construction Contract Cost = **$ 313,059,999**

| | CWWBS | Feature of Work | Contract Cost | | % Contingency | $ Contingency | Total |
|---|---|---|---|---|---|---|---|
| | 01 LANDS AND DAMAGES | Real Estate | **$ 2,800,000** | | **25.00%** | $ 700,000 | $ 3,500,000 |
| 1 | | **Mob, Demob & Site Prep** | **$ 2,658,292** | | 27.57% | $ 733,006 | $ 3,391,298 |
| 2 | | **Diversion and Control of Water** | **$ 4,158,633** | | 39.25% | $ 1,632,081 | $ 5,790,715 |
| 3 | **04 DAMS** | **Existing Dam Removal** | **$ 2,533,964** | | 45.02% | $ 1,140,755 | $ 3,674,719 |
| 4 | **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Convert Laterals to Pipe** | **$ 61,636,775** | | 34.25% | $ 21,110,979 | $ 82,747,754 |
| 5 | **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Line Open Canals** | **$ 128,664,185** | | 31.04% | $ 39,936,622 | $ 168,600,807 |
| 6 | **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Check Structures** | **$ 2,547,694** | | 34.74% | $ 884,953 | $ 3,432,647 |
| 7 | **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Flow Measuring Devices** | **$ 887,117** | | 27.68% | $ 245,560 | $ 1,132,676.44 |
| 8 | **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Convert Fields to Sprinklers** | **$ 14,920,816** | | 29.24% | $ 4,362,342 | $ 19,283,157.44 |
| 9 | **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Wind Turbines** | **$ 3,584,337** | | 30.74% | $ 1,101,955 | $ 4,686,292.79 |
| 10 | **20 PERMANENT OPERATING EQUIPMENT** | **Ranney Wells** | **$ 91,468,186** | | 33.02% | $ 30,206,753 | $ 121,674,938.77 |
| 11 | | | **$ -** | | 0.00% | $ - | $ - |
| 12 | All Other | **Remaining Construction Items** | **$ -** | *0.0%* | 0.00% | $ - | $ - |
| 13 | 30 PLANNING, ENGINEERING, AND DESIGN | **Planning, Engineering, & Design** | **$ 28,458,000** | | 26.52% | $ 7,548,141 | $ 36,006,141 |
| 14 | 31 CONSTRUCTION MANAGEMENT | **Construction Management** | **$ 18,972,000** | | 26.52% | $ 5,032,094 | $ 24,004,094 |
| XX | FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW) | | | | | **$ -** | |

| **Totals** | | | | | |
|---|---|---|---|---|---|
| Real Estate | $ 2,800,000 | 25.0% | $ 700,000 | $ 3,500,000.00 | |
| Total Construction Estimate | $ 313,059,999 | 32.4% | $ 101,355,006 | $ 414,415,005 | |
| Total Planning, Engineering & Design | $ 28,458,000 | 26.5% | $ 7,548,141 | $ 36,006,141 | |
| Total Construction Management | $ 18,972,000 | 26.5% | $ 5,032,094 | $ 24,004,094 | |
| Total | **$ 363,289,999** | **31.6%** | **$ 114,635,241** | **$ 477,925,240** | |
| | | **Base** | **50%** | **80%** | |
| | **Range Estimate ($000's)** | $363,290k | $432,071k | $477,925k | |

* 50% based on base is at 5% CL.

| | |
|---|---|
| **Fixed Dollar Risk Add:** (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate. | |

**Lower Yellowstone River Multiple Pumps w/ Conservation M**

Feasibility (Alternatives)

Abbreviated Risk Analysis

**Meeting Date:** 0-Jan-00

**Risk Level**

| | Negligible | Marginal | Moderate | Significant | Critical |
|---|---|---|---|---|---|
| Very Likely | 2 | 3 | 4 | 5 | 5 |
| Likely | 1 | 2 | 3 | 4 | 5 |
| Possible | 0 | 1 | 2 | 3 | 4 |
| Unlikely | 0 | 0 | 1 | 2 | 3 |

# Risk Register

| Risk Element | Feature of Work | Concerns | PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact) | Impact | Likelihood | Risk Level |
|---|---|---|---|---|---|---|
| **Project Scope Growth** | | | | **Maximum Project Growth** | | **40%** |
| PS-1 | Mob, Demob & Site Prep | Estimate is based on conceptual level design plans with many investigations remaining to complete that could change the design; Further analysis may show that the current design assumptions do not accomplish the project's intent, thus leading to more changes in the design. | Because of low design level, the scope/scale of this could change but is not likely to be significantly different than current assumptions. | Marginal | Likely | 2 |
| PS-2 | Diversion and Control of Water | See discussion above. | The current assumptions are likely to change. Further investigations could show need for more dewatering efforts than currently assumed. | Moderate | Likely | 3 |
| PS-3 | Existing Dam Removal | See discussion above. | The dam removal requires signficantly more analysis to determine the extent of the rock/boulder debris field downstream of the existing dam. There is a chance that current assumptions are off, which although not likely, it would be significant to the costs. | Significant | Possible | 3 |
| PS-4 | Convert Laterals to Pipe | See discussion above. | Large quantity of laterals are anticipated to be converted to pipes. But current conditions, primarily the slopes, may show that this is not feasible. This would then change the design by possibly requiring pumps, lining of canals, etc. | Significant | Possible | 3 |
| PS-5 | Line Open Canals | See discussion above. | Current assumptions are based on a benefit-cost analysis of various canal lining methods. The method chosen is a more robust lining method, but may be shown to be over designed. Thus the impact for this risk is low, as costs/quantities could actually decrease. Also, the estimate currently assumes lining the entire canal, which may not be needed upon further research. | Negligible | Likely | 1 |
| PS-6 | Check Structures | See discussion above. | Check structures are based off typical drawings from previous reports, and are basic check structures. Future phases may require more significant structures, and/or higher quantities to accomplish this feature's intent. | Moderate | Likely | 3 |
| PS-7 | Flow Measuring Devices | See discussion above. | Flow measuring devices are based off typical drawings from previous reports, and are basic check structures. Future phases may require more significant structures, and/or higher quantities to accomplish this feature's intent. Expected only to have a marginal impact though. | Marginal | Possible | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PS-8 | Convert Fields to Sprinklers | See discussion above. | Much more analysis needs to be completed to determine exactly which farms will be converted. Current assumption is a rough 50% of farms that are fed by the laterals to be converted to pipes. This is likley to change, but possibly could decrease too. Therefore the impact is to be considered low. | Marginal | Possible | 1 |
| PS-9 | Wind Turbines | See discussion above. | Current assumptions are based on estimated energy required for the Ranney wells. Further analysis needs to be completed to finalize this value. Thus there is a risk of this changing, but estimate has already taken conservative steps. Therefore, costs not likely to increase significantly. | Marginal | Possible | 1 |
| PS-10 | Ranney Wells | See discussion above; Ice protection | Ranney well installation design is based on current assumption of water requirements needed to be pumped into the canal. Further design refinements could change the water needs, and therefore change this design. This is not likely, but could be a moderate impact to costs. Further analysis into ice flows may require changes to the Ranney Well design. Unlikely to occur but could be significant impact to costs. | Significant | Unlikely | 2 |
| PS-11 | 0 | | | Negligible | Unlikely | 0 |
| PS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| PS-13 | Planning, Engineering, & Design | See discussion above. | Potential need for more investigations to be completed, above and beyond what is already assumed. These investigations could present moderate cost increases. | Moderate | Possible | 2 |
| PS-14 | Construction Management | See discussion above. | Construction management could increase moderately given any scope increases as more management would be required to oversee the additional construction. | Moderate | Possible | 2 |
| **Acquisition Strategy** | | | | | **Maximum Project Growth** | **30%** |
| AS-1 | Mob, Demob & Site Prep | Due to conceptual level of this project, there is limited contracting plan information; Estimate assumes relatively conservative assumptions regarding number of contracts and sub-contractors; Harsh weather could be a risk, but contractors would likely be experienced in this region; No 8a or small business likely due to scale of the project; | Contracting plan changes could significantly impact each of these costs. If the work needs to be broken into multiple contracts then costs would increase. Individual components may be constructed at different times, based on water demands and winter weather conditions, which also could impact costs. Without lack of a detailed contracting plan, there could be changes both increasing and decreasing costs, thus it is likely to change but only marginal impact to costs. | Marginal | Likely | 2 |
| AS-2 | Diversion and Control of Water | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-3 | Existing Dam Removal | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-4 | Convert Laterals to Pipe | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-5 | Line Open Canals | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-6 | Check Structures | See discussion above. | See discussion above. | Marginal | Likely | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AS-7 | Flow Measuring Devices | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-8 | Convert Fields to Sprinklers | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-9 | Wind Turbines | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-10 | Ranney Wells | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-11 | 0 | | | Negligible | Unlikely | 0 |
| AS-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| AS-13 | Planning, Engineering, & Design | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| AS-14 | Construction Management | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| **Construction Elements** | | | | **Maximum Project Growth** | | **15%** |
| CE-1 | Mob, Demob & Site Prep | Number of mob/demob periods | There are numerous mob/demob periods across mutliple areas in the study region. These assumptions are assumed to be conservative but are still likely to change. | Marginal | Likely | 2 |
| CE-2 | Diversion and Control of Water | The assumptions required for dewatering are based on limited information; Future analysis could greatly change dewatering efforts; | Conservative assumptions have currently been made for dewatering of certain measures. However, some items may require dewatering that are currently not assumed to need it. This could impact costs signficantly but is not likely to occur. | Significant | Unlikely | 2 |
| CE-3 | Existing Dam Removal | Working in wet conditions within the channel, even when dewatered; potential for construction mods/claims; high risk due to river water being diverted nearby; | The dewatering effort is a significant cost driver. The existing rock downstream of the dam could be a significant hinderance to effectively dewatering the area. Current assumptions are conservative, but there could be significant risks to these assumptions changing. | Significant | Likely | 4 |
| CE-4 | Convert Laterals to Pipe | Scheduling conversion of laterals around irrigation needs. | No significant risks for this item, but the work would need to be coordinated efficiently with the irrigation district to ensure that water is available for farm use. May cause increases to costs and schedule but is not likely to be significant. | Marginal | Likely | 2 |
| CE-5 | Line Open Canals | Diversion and control of water could be significant risk; Coordinating the construction with irrigation season. | Current assumption is that the intake to the canal would be closed when the canal is lined. Therefore, no significant dewatering costs are assumed. Further analysis may show the need for more dewatering efforts. Coordinating the work with irrigation season may also add some risk. | Significant | Possible | 3 |
| CE-6 | Check Structures | Scheduling conversion of laterals around irrigation needs. | No significant risks for this item, but the work would need to be coordinated efficiently with the irrigation district to ensure that water is available for farm use. May cause increases to costs and schedule but is not likely to be significant. | Marginal | Possible | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CE-7 | Flow Measuring Devices | Scheduling conversion of laterals around irrigation needs. | No significant risks for this item, but the work would need to be coordinated efficiently with the irrigation district to ensure that water is available for farm use. May cause increases to costs and schedule but is not likely to be significant. | Marginal | Possible | 1 |
| CE-8 | Convert Fields to Sprinklers | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-9 | Wind Turbines | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-10 | Ranney Wells | Diversion and control of water; specialty contractor | Contractor would likely be able to adequately control water for well installations, and contractor should be more than capable to install. Still a slight risk that construction required is more complex than currently assumed. | Marginal | Possible | 1 |
| CE-11 | 0 | | | Negligible | Unlikely | 0 |
| CE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| CE-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Quantities for Current Scope** | | | | | **Maximum Project Growth** | **20%** |
| Q-1 | Mob, Demob & Site Prep | Quantities are based on conceptual level designs and therefore are anticipated to change as project progresses; Many investigations remain to assist in developing accurate quantities. | Due to the low level of design for this alternative quantities are likely to change as the project progresses. The quantity development did take very conservative assumptions and therefore increases to the quantities is not likely to be significant. Thus it is possible that they will change, but due to conservative assumptions, should only be a marginal impact at most to certain elements. | Marginal | Likely | 2 |
| Q-2 | Diversion and Control of Water | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-3 | Existing Dam Removal | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-4 | Convert Laterals to Pipe | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-5 | Line Open Canals | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-6 | Check Structures | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-7 | Flow Measuring Devices | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-8 | Convert Fields to Sprinklers | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-9 | Wind Turbines | See discussion above. | See discussion above. | Marginal | Likely | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q-10 | Ranney Wells | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-11 | 0 | | | Negligible | Unlikely | 0 |
| Q-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| Q-13 | Planning, Engineering, & Design | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| Q-14 | Construction Management | See discussion above. | See discussion above. | Marginal | Likely | 2 |
| **Specialty Fabrication or Equipment** | | | | **Maximum Project Growth** | | **50%** |
| FE-1 | Mob, Demob & Site Prep | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-2 | Diversion and Control of Water | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-3 | Existing Dam Removal | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-4 | Convert Laterals to Pipe | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-5 | Line Open Canals | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-6 | Check Structures | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-7 | Flow Measuring Devices | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-8 | Convert Fields to Sprinklers | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| FE-9 | Wind Turbines | None anticipated | Wind turbines are a specialty item, but the assumption is that the turbines needed would be constructed at a pre-existing wind farm. The contractor would also be an experienced turbine builder, thus very low risk for the equipment not functioning as designed. | Moderate | Possible | 2 |
| FE-10 | Ranney Wells | None anticipated | Estimate assumes a contractor with experience installing these wells would be used. The design is at a point for these that the proposed wells would be sufficient in providing the needed amount of water upon construction. However, more analysis remains to ensure that these assumptions are correct. | Moderate | Possible | 2 |
| FE-11 | 0 | | | Negligible | Unlikely | 0 |
| FE-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| FE-13 | Planning, Engineering, & Design | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FE-14 | Construction Management | None anticipated | No significant risks anticipated | Negligible | Unlikely | 0 |
| **Cost Estimate Assumptions** | | | | **Maximum Project Growth** | | **25%** |
| CT-1 | Mob, Demob & Site Prep | Mob/demob and site prep have been developed based on general assumptions. | | Negligible | Unlikely | 0 |
| CT-2 | Diversion and Control of Water | Cofferdam productivity at existing dam; | Placement of both a sheetpile cofferdam and earthen portion may be more difficult than assumed. Also, different crews and placement methods may be used. These risk could increase costs for dewatering significantly. | Significant | Possible | 3 |
| CT-3 | Existing Dam Removal | Rock disposal assumptions | Current estimate assumes disposing of rock removed from the dam nearby, likely on Joe's island. There is risk rock may need to be be trucked to another location, which would increase the haul costs significantly. | Significant | Possible | 3 |
| CT-4 | Convert Laterals to Pipe | Crew and productivity assumptions | This work is pretty straight forward, and the current assumptions in the estimate are not likely to see significant changes. Therefore there is a possible risk of the assumptions on crews and productivity changing, but would only be a marginal impact. | Marginal | Possible | 1 |
| CT-5 | Line Open Canals | Crew and productivity assumptions | The assumptions in the estimate have been based on previous canal lining analysis completed by the BOR. The unit cost for the lining has been compared with previous costs from BOR and are in-line, if not slightly conservative. Therefore risk of increase is small and would likely be moderate at most. | Moderate | Possible | 2 |
| CT-6 | Check Structures | Crew and productivity assumptions | Typical construction efforts required, and not likely to change significantly. | Marginal | Likely | 2 |
| CT-7 | Flow Measuring Devices | Crew and productivity assumptions | Typical construction efforts required, and not likely to change significantly. | Marginal | Likely | 2 |
| CT-8 | Convert Fields to Sprinklers | Cost estimate assumptions; power costs | Use of industry standard installation costs has been compared with recent costs to install sprinkler systems within this region. After the MII markups are applied, unit costs are pretty conservative, therefore there is a small risk of the costs increasing for this item. Costs for updating power grid to power the pumps required for spinkler pressurizaiont is not included. This is a likley cost and could be significant given the amount of spinklers to be placed. | Significant | Possible | 3 |
| CT-9 | Wind Turbines | | | Moderate | Possible | 2 |
| CT-10 | Ranney Wells | | | Marginal | Possible | 1 |
| CT-11 | 0 | | | Negligible | Unlikely | 0 |
| CT-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| CT-13 | Planning, Engineering, & Design | Percentages assumed for PED | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CT-14 | Construction Management | Percentages assumed for CM | A typical percentage for this item has been assumed. Percentage may change, but not likely to increase significantly from current. | Marginal | Possible | 1 |
| **External Project Risks** | | | | **Maximum Project Growth** | | **20%** |
| EX-1 | Mob, Demob & Site Prep | Severe winter weathere; unanticipated inflations in fuel, and materials; market conditions and bidding climate; | Winter weather is an issue and construction will be likely completed around those times. But impacts to cost/schedule could still occur. The risk of inflation to fuel and other material items is real and could be a significant impact. The bidding climate at time of award, and for possible numerous contracts, could be unfavorable to the cost. Given all these risks, a significant impact would be assumed if they all occured. | Significant | Possible | 3 |
| EX-2 | Diversion and Control of Water | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-3 | Existing Dam Removal | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-4 | Convert Laterals to Pipe | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-5 | Line Open Canals | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-6 | Check Structures | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-7 | Flow Measuring Devices | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-8 | Convert Fields to Sprinklers | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-9 | Wind Turbines | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-10 | Ranney Wells | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-11 | 0 | | | Negligible | Unlikely | 0 |
| EX-12 | Remaining Construction Items | | | Negligible | Unlikely | 0 |
| EX-13 | Planning, Engineering, & Design | See discussion above. | See discussion above. | Significant | Possible | 3 |
| EX-14 | Construction Management | See discussion above. | See discussion above. | Significant | Possible | 3 |

**Lower Yellowstone River Multiple Pumps w/ Conservation Measures**
Feasibility (Alternatives)
Abbreviated Risk Analysis

## Risk Evaluation

| WBS | Potential Risk Areas | Project Scope Growth | Acquisition Strategy | Construction Elements | Quantities for Current Scope | Specialty Fabrication or Equipment | Cost Estimate Assumptions | External Project Risks | Cost in Thousands |
|---|---|---|---|---|---|---|---|---|---|
| **01 LANDS AND DAMAGES** | **Real Estate** | | | | | | | | $2,800,000 |
| **0** | **Mob, Demob & Site Prep** | 2 | 2 | 2 | 2 | 0 | 0 | 3 | $2,658 |
| 0 | Diversion and Control of Water | 3 | 2 | 2 | 2 | 0 | 3 | 3 | $4,159 |
| 04 DAMS | Existing Dam Removal | 3 | 2 | 4 | 2 | 0 | 3 | 3 | $2,534 |
| 09 CHANNELS AND CANALS (Except Navigation Ports and Harbors) | Convert Laterals to Pipe | 3 | 2 | 2 | 2 | 0 | 1 | 3 | $61,637 |
| 09 CHANNELS AND CANALS (Except Navigation Ports and Harbors) | Line Open Canals | 1 | 2 | 3 | 2 | 0 | 2 | 3 | $128,664 |
| 09 CHANNELS AND CANALS (Except Navigation Ports and Harbors) | Check Structures | 3 | 2 | 1 | 2 | 0 | 2 | 3 | $2,548 |
| **09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)** | **Flow Measuring Devices** | 1 | 2 | 1 | 2 | 0 | 2 | 3 | $887 |
| **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Convert Fields to Sprinklers** | 1 | 2 | 0 | 2 | 0 | 3 | 3 | $14,921 |
| **19 BUILDINGS, GROUNDS, AND UTILITIES** | **Wind Turbines** | 1 | 2 | 0 | 2 | 2 | 2 | 3 | $3,584 |
| **20 PERMANENT OPERATING EQUIPMENT** | **Ranney Wells** | 2 | 2 | 1 | 2 | 2 | 1 | 3 | $91,468 |
| **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| All Other | Remaining Construction Items | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| 30 PLANNING, ENGINEERING, AND DESIGN | Planning, Engineering, & Design | 2 | 2 | 0 | 2 | 0 | 1 | 3 | $28,458 |
| 31 CONSTRUCTION MANAGEMENT | Construction Management | 2 | 2 | 0 | 2 | 0 | 1 | 3 | $18,972 |
| | | | | | | | | | **$360,490** |
| **Risk** | | $ 15,770 | $ 14,052 | $ 35,642 | $ 11,948 | $ 4,545 | $ 10,226 | $ 21,753 | **$113,935** |
| **Fixed Dollar Risk Allocation** | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$0** |
| | Risk | $ 15,770 | $ 14,052 | $ 35,642 | $ 11,948 | $ 4,545 | $ 10,226 | $ 21,753 | **$113,935** |
| | | | | | | | | **Total** | **$474,425** |

# Attachment B.4
# Detailed Quantity Takeoffs

# Modified Side Channel Quantities

| Item Description | quantity | unit | Comment |
|---|---|---|---|
| Mob/Demob | 1 | ls | |
| | | | |
| Coffer dam-upstream | | | |
| Earth embankment | 21,400 | cy | See separate tab |
| sheet pile | 4,800 | sf | See separate tab |
| riprap, d100=27 inch | 2,800 | cy | See separate tab |
| bedding 4"minus | 600 | cy | See separate tab |
| | | | |
| Coffer dam-downstream | | | |
| Earth embankment | 21,400 | cy | See separate tab, assume same as upstream c |
| sheet pile | 4,800 | sf | See separate tab, assume same as upstream c |
| riprap, d100=27 inch | 2,800 | cy | See separate tab, assume same as upstream c |
| bedding 4"minus | 600 | cy | See separate tab, assume same as upstream c |
| | | | |
| | | | |
| Dewatering (subgrade for riprap placement and bridge footings) | 1 | ls | |
| Clearing and grubbing, including some tree removal | 226 | ac | See separate tab |
| | | | |
| Excavation | 1,143,900 | cy | From CAD |
| Embankment (compact) overbanks, side channels and floodplain | 362,265 | cy | From CAD, assume all fill is included in this lin |
| Haul and dispose (grade); less than 5 miles RT | 781,635 | cy | From CAD |
| Finish grading (shaping) channel | 100 | ac | See separate tab |
| | | | |
| Channel armoring (1 to 6 inch d50) | 50,100 | cy | See separate tab |
| | | | |
| Bank protection at confluence | | | |
| Riprap d100 = 27 inch | 30,300 | cy | See separate tab |
| Riprap bedding | 6,500 | cy | See separate tab |
| | | | |
| Bank protection on bend cutoff (sta 147+00 - 157+00) | | | |
| Riprap d100 = 16 inch | 8,200 | cy | See separate tab |
| Riprap bedding | 4,100 | cy | See separate tab |
| | | | |
| Bank protection on bend cutoff (sta 92+50 - 101+00) | | | |
| Riprap d100 = 16 inch | 5,500 | cy | See separate tab |
| Riprap bedding | 2,800 | cy | See separate tab |
| | | | |
| Grade-control structures (5 structures) | | | |
| Cobble/Boulder material | 2,000 | cy | See separate tab |
| Riprap d100 = 16 inch | 11,000 | cy | See separate tab |
| Riprap bedding | 5,500 | cy | See separate tab |
| | | | |
| Construction access road (30' wide with shoulders) | 17,000 | lf | Measured length, assumed width with should |
| Staging Areas | 34 | ac | See separate tab |
| | | | |
| Bridge Crossing | | | |
| Bridge 150 ft clear span truss style bridge | 1 | ls | |
| Concrete for Abutments/Wingwalls | 74 | cy | See separate tab |
| Micropiles to 10 foot depth | 40 | ls | Assumed number and depth |
| | | | |
| Haul road construction and rehabilitation (24' wide, gravel road base) | 4000 | ft | Measured length |
| | | | |
| Seed, mulch and netting | 128 | ac | See separate tab |
| | | | |
| Erosion control-silt fence | 10000 | lf | |
| Dewatering ponds | 3 | ac-ft | 3-1 ac-ft ponds |

## Quantities for: Upstream Riprap Protection

Comments/Assumptions: Based on RS 20762

| Item Description | Length (ft) | Bank Ht (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *27" D100 Riprap* | | | | | | | | |
| **U/S Confluence, YS River** | **1000** | **20** | **2.5** | **53.85** | **3.5** | **6981** | **7000** | **CY** |
| **U/S Confluence, HFC LB** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 10.5 | 4 | 43.09 | | | | |
| Top and Toes | | | | 13.50 | | | | |
| **Total** | **860** | | | **113.17** | **3.5** | **12616** | **12600** | **CY** |
| **U/S Confluence, HFC RB** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 4.25 | 4 | 17.52 | | | | |
| Top and Toes | | | | 13.50 | | | | |
| **Total** | **940** | | | **87.60** | **3.5** | **10675** | **10700** | **CY** |
| | | | | | **Grand Total** | **30271** | **30300** | **CY** |
| *9" Bedding* | | | | | | | | |
| **Bedding Volume** | | | | | **0.75** | **6487** | **6500** | **CY** |

## Quantities for: Side Channel Cutoff Riprap (Sta 147+00 - 157+00)

Comments/Assumptions: Based on RS 16254

| Item Description | Length (ft) | Bank Ht (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *16" D100 Riprap on Left Bank, Sta 152+50 - 157+00* | | | | | | | | |
| **Left Bank 16" D100 Riprap** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 0.4 | 4 | 1.65 | | | | |
| Top and Toes | | | | 11.50 | | | | |
| **Total** | **650** | | | **69.73** | **1.5** | **2518** | **2600** | **CY** |
| *16" D100 Riprap on Right Bank, Sta 147+00 - 154+00* | | | | | | | | |
| **Right Bank 16" D100 Riprap** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 10.4 | 4 | 42.78 | | | | |
| Top and Toes | | | | 11.50 | | | | |
| **Total** | **900** | | | **110.86** | **1.5** | **5543** | **5600** | **CY** |
| *9" Bedding* | | | | | | | | |
| **Bedding Volume** | **1550** | | | **Varies** | **0.75** | **4030** | **4100** | **CY** |

## Quantities for: Right Bank Side Channel Cutoff Riprap (Sta 93+50 - 101+00)

Comments/Assumptions: Based on RS 10264

| Item Description | Length (ft) | Bank Ht (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *16" D100 Riprap on Right Bank* | | | | | | | | |
| **Right Bank 16" D100 Riprap** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 8.5 | 4 | 35.05 | | | | |
| Top and Toes | | | | 11.50 | | | | |
| **Total** | **950** | | | **103.13** | **1.5** | **5443** | **5500** | **CY** |
| *9" Bedding* | | | | | | | | |
| **Bedding Volume** | **950** | | | **103.13** | **0.75** | **2721** | **2800** | **CY** |

## Quantities for: Grade Control Structure

Comments/Assumptions: Based on RS 20273. Crest length is 50', bank protection extends for 240' (from USACE Desi

| Item Description | Length (ft) | Bank Ht (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *16" D100 Riprap* | | | | | | | | |
| **Channel Bed** | **43** | | | **40.00** | **0** | **0** | **0** | **CY** |
| **Left Bank** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 4.0 | 4 | 16.49 | | | | |
| Top | | | | 5.00 | | | | |
| **Total** | **240** | | | **78.07** | **1.5** | **1041** | **1000** | **CY** |
| **Right Bank** | | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | | |
| Slope 3 | | 4 | 4 | 16.49 | | | | |
| Top | | | | 11.50 | | | | |
| **Total** | **240** | | | **84.57** | **1.5** | **1128** | **1100** | **CY** |
| | | | | | **Grand Total** | **2169** | **2200** | **CY** |
| *Cobble/Boulder Material (Bed, 64mm - 512mm)* | | | | | | | | |
| **Bed** | **50.0** | | | **38.50** | **6** | **428** | **400** | **CY** |
| *9" Bedding* | | | | | | | | |
| Bedding Volume, Banks | 480 | | | 162.65 | 0.75 | 1084 | 1100 | CY |
| Bedding Volume, Bed | 50.0 | | | 38.50 | 0 | 0 | 0 | CY |
| | | | | | **Grand Total** | **1084** | **1100** | **CY** |

Grand Totals for 5 Structures

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *16" D100 Riprap* | | | | | | | | |
| | | | | | **Grand Total** | | **11000** | **CY** |
| *Cobble/Boulder Material (Bed, 64mm - 512mm)* | | | | | | | | |
| | | | | | **Grand Total** | | **2000** | **CY** |
| *9" Bedding* | | | | | | | | |
| | | | | | **Grand Total** | | **5500** | **CY** |

## Quantities for: Upstream Coffer Dam

Comments/Assumptions: Assume 15' tall, 640 ft long (best estimate is 600 ft long), 4" minus bedding, 400' of sheet pile

| Item Description | Length (ft) | Bank Ht/ Height (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness/ Topwidth (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *27" D100 Riprap* | | | | | | | | |
| **Face Riprap** | **640** | **15** | **2** | **33.54** | **3.5** | **2783** | **2800** | **CY** |
| *4" minus Bedding* | | | | | | | | |
| **Bedding for Face Riprap** | **640** | | | **33.54** | **0.75** | **596** | **600** | **CY** |
| *Earth Fill for Embankment* | | | | | | | | |
| **Compacted Earth Fill** | **640.0** | **15** | **2** | **33.54** | **20** | **21333** | **21400** | **CY** |
| *PZ 22 Sheet Pile* | | | | | | | | |
| **PZ 22 Sheet Pile** | **400.0** | **12** | | | | **4800** | **4800** | **SF** |

## Quantities for: Channel Armor

Comments/Assumptions:

| Item Description | Length (ft) | Armored Bank Height (ft) | Side Slope (XH:1V) | Slope Length (ft) | Thickness/ Topwidth (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *9" Armor Layer* | | | | | | | | |
| Left Bank | 20400 | 3 | 8 | 24.19 | 0.75 | 13706 | 13,700 | CY |
| Right Bank | 20400 | 3 | 8 | 24.19 | 0.75 | 13706 | 13,700 | CY |
| Bed | 20400 | | | 40.00 | 0.75 | 22667 | 22,700 | CY |
| | | | | | | **Grand Total** | **50,100** | **CY** |

## Quantities for: Finished Grading (HFC Area)

Comments/Assumptions: Assume upper bank height is 6 feet (estimated average from RAS model)

| Item Description | Length (ft) | Bank Ht (ft) | Side Slope (XH:1V) | Slope Length (ft) | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|
| *16" D100 Riprap* | | | | | | | |
| **Channel Bed** | **20440** | | | **40.00** | **18.8** | **19** | **ac** |
| **Left Bank** | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | |
| Slope 3 | | 6.0 | 4 | 24.74 | | | |
| Top | | | | 5.00 | | | |
| **Total** | **20440** | | | **86.32** | **40.5** | **41** | **ac** |
| **Right Bank** | | | | | | | |
| Slope 1 | | 4 | 8 | 32.25 | | | |
| Slope 2 | | 4 | 6 | 24.33 | | | |
| Slope 3 | | 6 | 4 | 24.74 | | | |
| Top | | | | 5.00 | | | |
| **Total** | **20440** | | | **86.32** | **40.5** | **41** | **ac** |
| | | | | **Grand Total** | **100** | **100** | **ac** |

## Quantities for: Misc. Areas and Volumes

Comments/Assumptions:

| Item Description | Length (ft) | Width (ft) | Area (ac) | Rounded Quantity | Unit | Comment |
|---|---|---|---|---|---|---|
| *Staging Areas* | | | | | | |
| Single Staging Area | 540 | 540 | 6.7 | | | Assume 540' x 540' |
| | | Number: | 5.0 | | | |
| | | **Total** | **33.5** | **34** | **ac** | |
| *Construction Access Road* | | | | | | |
| Construction Access Road | 17000 | 30 | 11.7 | 12 | ac | Assume 30' Wide |
| *Disturbed channel and overbanks (Channel Margins)* | | | | | | |
| Channel Margins | 20400 | 100 | 46.8 | 47 | | Assume 50' disturbance on both banks |
| Abandoned Channel Area 1 | 2200 | 350 | 17.7 | | | |
| Abandoned Channel Area 2 | 3450 | 275 | 21.8 | | | |
| Abandoned Channel Area 3 | 1470 | 220 | 7.4 | 47 | | |
| New channel reach Area 1 | 1500 | 150 | 5.2 | | | |
| New channel reach Area 2 | 2000 | 150 | 6.9 | | | |
| New channel reach Area 3 | 1400 | 150 | 4.8 | 17 | | |
| | | **Total** | **110.6** | **111** | **ac** | |
| *Clearing and Grubbing* | | | | | | |
| Disturbed channel and overbanks | | | | 64 | ac | channel margins and new channel |
| Staging areas | | | | 34 | ac | See staging area calculations |
| Disposal site | 3550 | 1420 | 115.7 | 116 | ac | on bluff |
| Construction Access Road | | | | 12 | ac | see construction access rd calculations |
| | | **Total** | | **226** | **ac** | |
| *Seed, mulch and net* | | | | | | |
| Channel Margins | | | | 47 | ac | |
| Staging areas | | | | 34 | ac | |
| Abandoned Channel Areas | | | | 47 | ac | |
| | | | | | | |
| | | **Total** | | **128** | **ac** | |
| | | | | | **ac** | |

| Item Description | Length (ft) | Height (ft) | Side Slope (XH:1V) | Width (ft) | Number | Quantity | Rounded Quantity | Unit |
|---|---|---|---|---|---|---|---|---|
| *Abutment and Wingwall Concrete* | | | | | | | | |
| Abutments | 24 | 12 | | 1.00 | 2 | 21 | 21 | CY |
| U/S Wingwalls | 12 | 12 | | 0.75 | 2 | 8 | 8 | CY |
| D/S Wingwalls | 12 | 12 | | 0.75 | 2 | 8 | 8 | CY |
| | | | | | | **Grand Total** | **37** | **CY** |

| | |
|---|---|
| Ice Factor | 100% |
| Abutment Quantity: | 42 |
| Wingwalls Quantity: | 32 |
| Total: | 74 |

# Multiple Pump Quantities

**Multiple Pump Station Alternative QTO Line Items - 2016-03-23**

| Item Description | UOM | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Quantity |
|---|---|---|---|---|---|---|---|
| Mob/Demob | LS | 1 | 1 | 1 | 1 | 1 | 5 |
| | | | | | | | |
| **Intake/Feeder Canals:** | | | | | | | |
| Dewatering for channel excavation near river (at 5 sites) | LS | 1 | 1 | 1 | 1 | 1 | 5 |
| Clearing and grubbing (where on land) | SY | 3,400 | 11,200 | 12,300 | 5,700 | 10,000 | 42,600 |
| Dredging / In-water excavation (assumed 5% of total excavation) | CY | 600 | 2,100 | 2,300 | 1,100 | 1,900 | 8,000 |
| Excavation (on land) | CY | 12,000 | 40,000 | 44,000 | 20,000 | 35,000 | 151,000 |
| Trashrack (60' wide x 6' tall) | EA | 1 | 1 | 1 | 1 | 1 | 5 |
| | | | | | | | |
| **Fish Screens:** | | | | | | | |
| Dewatering for excavation (at 5 sites) | LS | 1 | 1 | 1 | 1 | 1 | 5 |
| Clearing and grubbing | SY | 1,720 | 1,720 | 1,720 | 1,720 | 1,720 | 8,600 |
| Excavation for fish screen facility | CY | 5,831 | 5,831 | 5,831 | 5,831 | 5,831 | 29,155 |
| Reinforced concrete | CY | 1,498 | 1,498 | 1,498 | 1,498 | 1,498 | 7,491 |
| Reinforcement | Tons | 140 | 140 | 140 | 140 | 140 | 699 |
| Fish screens and deadplates | SF | 4,176 | 4,176 | 4,176 | 4,176 | 4,176 | 20,880 |
| Steel support structures for fish screens (estimated per 2004 study, for 5 site | Tons | 50 | 50 | 50 | 50 | 50 | 250 |
| Screen cleaners **(NOTE: price is in 2004 dollars, for 5 sites)** | LS | $ 88,000 | $ 88,000 | $ 88,000 | $ 88,000 | $ 88,000 | $ 440,000 |
| 6" Crushed surfacing (access road surfacing around buildings) | CY | 107 | 107 | 107 | 107 | 107 | 533 |
| Fish return pumps (total cost for 10 pumps with HPUs, per vendor) | LS | $ 306,000 | $ 306,000 | $ 306,000 | $ 306,000 | $ 306,000 | $ 1,530,000 |
| 18" HDPE Fish return pipe | LF | 50 | 50 | 50 | 50 | 50 | 250 |
| 14" HDPE Fish return pipe | LF | 1,000 | 2,400 | 2,600 | 1,400 | 2,200 | 9,600 |
| | | | | | | | |
| **Pump Stations:** | | | | | | | |
| Dewatering for excavation (at 5 sites) | LS | 1 | 1 | 1 | 1 | 1 | 5 |
| Clearing and grubbing | SY | 2,600 | 2,600 | 2,600 | 2,600 | 2,600 | 13,000 |
| Excavation for wetwell (5 sites, assumes 1:1 temp. cut slopes) | CY | 26,300 | 26,300 | 26,300 | 26,300 | 26,300 | 131,500 |
| Reinforced concrete | CY | 616 | 616 | 616 | 616 | 616 | 3,080 |
| Reinforcement | Tons | 100 | 100 | 100 | 100 | 100 | 500 |
| Pumps, motors, and controls (per estimates from pump vendors, 5 sites) | LS | $ 1,673,938 | $ 1,726,799 | $ 1,726,799 | $ 1,762,040 | $ 1,762,040 | $ 8,651,616 |
| 48" steel pipe (individual pump discharge lines) | LF | 190 | 190 | 190 | 190 | 190 | 950 |
| 84" steel pipeline (assume 9' depth to IE) | LF | 20 | 20 | 20 | 20 | 20 | 100 |
| 48" check valves | EACH | 4 | 4 | 4 | 4 | 4 | 20 |
| 48" gate valves | EACH | 4 | 4 | 4 | 4 | 4 | 20 |
| Concrete utility vaults (11' wide x 14' long x 12' deep) | EACH | 4 | 4 | 4 | 4 | 4 | 20 |
| 48" x 84" wyes | EACH | 3 | 3 | 3 | 3 | 3 | 15 |
| 48" bends (45 degrees) | EACH | 3 | 3 | 3 | 3 | 3 | 15 |
| 48" x 84" reducers | EACH | 2 | 2 | 2 | 2 | 2 | 10 |
| Prefabricated steel building for pump station, heated and insulated, 40' x 25' | EACH | 1 | 1 | 1 | 1 | 1 | 5 |
| Standby generators: | - | | | | | | |
| Site 1: 500 kW, 3 phase, 480V standby generator - (price per vendor) | LS | $ 120,000 | | | | | $ 120,000 |
| Site 2: 1250 kW (price per vendor) | LS | | $ 450,000 | | | | $ 450,000 |
| Site 3: 1750 kW (price per vendor) | LS | | | $ 625,000 | | | $ 625,000 |
| Site 4: 1750 kW (price per vendor) | LS | | | | $ 625,000 | | $ 625,000 |
| Site 5: 2000 kW (price per vendor) | LS | | | | | $ 675,000 | $ 675,000 |
| 6" Crushed surfacing (access road surfacing around buildings) | CY | 40 | 40 | 40 | 40 | 40 | 200 |
| | | | | | | | |
| **Discharge Pipelines:** | | | | | | | |
| Clearing and grubbing | SY | 800 | 3,000 | 16,800 | 12,300 | 5,400 | 38,300 |
| Excavate trenches (assumes temporary side slopes at 1:1) | CY | 1,422 | 6,000 | 33,600 | 24,600 | 10,800 | 76,422 |
| 72" steel pipeline (assume 8' depth to IE) | LF | 300 | | | | | 300 |
| 84" steel pipeline (assume 9' depth to IE) | LF | | 1,000 | 5,600 | 4,100 | 1,800 | 12,500 |
| | | | | | | | |
| **Concrete Outlet Structures:** | | | | | | | |
| Excavation | CY | 446 | 365 | 281 | | 473 | 1,564 |
| Reinforced concrete (BOR type 1 concrete transitions) | CY | 130 | 109 | 87 | | 120 | 447 |
| Reinforcement | Tons | 11.6 | 9.7 | 7.8 | | 10.7 | 39.8 |
| Riprap (9" nominal, 18" thick) | CY | 800 | 361 | 361 | | 361 | 1,883 |
| Bedding Stone (6" thick) | CY | 267 | 120 | 120 | | 120 | 628 |
| | | | | | | | |
| **Access Roads:** | | | | | | | |
| Clearing and grubbing | SY | 3,733 | 11,200 | 4,356 | 9,022 | 1,556 | 29,867 |
| Excavation (assumed 2' average cut, 50% of road length) | CY | 1,067 | 3,200 | 1,244 | 2,578 | 444 | 8,533 |
| Fill (assumed 2' average cut, 50% of road length) | CY | 1,067 | 3,200 | 1,244 | 2,578 | 444 | 8,533 |
| 6" Crushed surfacing (access road surfacing) | CY | 444 | 1,333 | 519 | 1,074 | 185 | 3,556 |
| | | | | | | | |
| **Power System Uprating:** | | | | | | | |
| (all cost estimates per MDU) | | | | | | | |
| Site 1 | LS | 1 | | | | | 1 |
| Site 2 | LS | | 1 | | | | 1 |
| Site 3 | LS | | | 1 | | | 1 |
| Sites 4 and 5 total: | LS | | | | | 1 | 1 |
| | | | | | | | |
| | | | | | | | |

**Feeder Canal QTO**

| | | | |
|---|---|---|---|
| Calc By: | Matt Moore | Date: | 2/22/2016 |
| Revised: | JPP | Date: | 3/4/2016 |
| Checked By: | FMB | Date: | 3/4/2016 |

| Feeder Canal to Pump Site Number | Average existing elevation (Feet NAVD88) | Average depth to Canal Invert (Feet) | Feeder Canal Length (Feet) | Bottom Width (Feet) | Top Width (Feet) | Section Area (SF) | Estimated Cut Volume (CY) | Estimated Wet Excavation (CY) | Estimated Dry Excavation (CY) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2000 | 17 | 300 | 32 | 101 | 1143 | 12,701 | 600 | 12,000 |
| 2 | 1972 | 17 | 1000 | 32 | 100 | 1124 | 41,630 | 2100 | 40,000 |
| 3 | 1964 | 17 | 1100 | 32 | 100 | 1130 | 46,056 | 2300 | 44,000 |
| 4 | 1950 | 17 | 500 | 32 | 101 | 1147 | 21,232 | 1100 | 20,000 |
| 5 | 1947 | 17 | 900 | 32 | 100 | 1113 | 37,084 | 1900 | 35,000 |
| **Total Intake Channel Excavation:** | | | | | | | **158,703** | **8,000** | **151,000** |
| | | | | | | | | [5% of total Vol.] | [95% of total Vol.] |

**Feeder Canal Wet Excavation** **8,000**

**Feeder Canal Dry Excavation** **151,000**

**Feeder Canal Clearing Area** **43,000**

(See original QTO workbook for calculations of the existing elevation and average depth. Only the summary sheet is shown, here)

# Fish Screen Quantity Takeoff

| | | | |
|---|---|---|---|
| By: | JPP | Date: | 2/23/2016 |
| Checked By: | FMB | Date: | 3/4/2016 |

**Clearing**

| | | |
|---|---|---|
| L | 180 | Feet |
| W | 86 | Feet |
| Area | 1720 | SY |
| Num. of Sites | 5 | |
| **Total Area** | **8600** | **SY** |

**Access Roads**

*(Onsite, around the fish screens only)*

| | | |
|---|---|---|
| L | 180 | Feet |
| W | 16 | Feet |
| Number | 2 | |
| Thickness | 0.5 | Feet |
| Area | 5760 | SF |
| Volume | 107 | CY |
| Num. of Sites | 5 | |
| **Total Volume** | **533** | **CY** |

**Excavation**

*Assume that the existing ground at the PS location is at the 100 year flood elevation.*

Excavate to the bottoms of the walls:

| | | |
|---|---|---|
| Width | 42 | Feet |
| Depth | 23 | Feet |
| Length | 126 | Feet |
| Section Area | 966 | SF |
| Volume | 4508 | CY |

Trapezoidal Section:

| | | |
|---|---|---|
| Base W | 74 | Feet |
| Depth | 3.5 | Feet |
| Top W | 88 | Feet |
| Length | 126 | Feet |
| Section Area | 284 | SF |
| Volume | 1323 | CY |

| | | |
|---|---|---|
| Total Vol. per site | 5831 | CY |
| Num. of Sites | 5 | |
| **Total Excav.** | **29155** | **CY** |

**Fish Return Pipe**

*Fish return pipe from the bypass sump to the fish pump*

| | | |
|---|---|---|
| Length each | 25 | Feet |
| Number | 10 | |
| Total | 250 | Feet |

*Assume fish return pipe length = intake canal length + 200'*

14" dia. HDPE pipe, length varies at each site

| | Length, each | | Length, total | |
|---|---|---|---|---|
| Site 1 | 500 | Feet | 1000 | Feet |
| Site 2 | 1200 | Feet | 2400 | Feet |
| Site 3 | 1300 | Feet | 2600 | Feet |
| Site 4 | 700 | Feet | 1400 | Feet |
| Site 5 | 1100 | Feet | 2200 | Feet |
| Total | | | 9600 | LF |

**Fish Screens and Deadplates**

*Cost information per Shawn Foster email dated 2016-02-16.*

| | | |
|---|---|---|
| Length | 116 | Feet |
| Height | 18 | Feet |
| Number | 2 | |
| Total Area | 4176 | SF |
| Unit Cost | $ 300.00 | per SF |
| Cost per Site | $ 1,252,800.00 | |
| Num. of Sites | 5 | |
| Total Cost | $ 6,264,000.00 | |

**Fish Screens Support Structure**

*Base on weight estimate listed in 2004 study by BOR. Scale linearly based on length and height.*

| | Reference proj. | Design value | Factor |
|---|---|---|---|
| Length | 244 | 126 | 52% |
| Height | 20 | 25 | 125% |
| Weight | 150000 | 96824 | 65% |

| | | |
|---|---|---|
| Estimated weight per site: | 48.41 | Tons |
| Number of sites: | 5 | |
| **Estimated weight total:** | **242** | **Tons** |

**Fish Screen Cleaner**

*Fish screen cleaners will be approximately the same price and type as cleaners in the 2004 cost estimate by BOR. Smaller screen size won't significantly affect price of screen cleaners. Note that price is still in 2004 dollars.*

| | |
|---|---|
| Cost in 2004 (per pair): | $ 88,000 |
| Number of sites: | 5 |
| **Total screen cleaner cost in 2004 dollars:** | **$ 440,000** |

**Walls and Concrete QTO**

| | Length | Height/Width | Thickness | Area | Volume | Reinf. Ratio | Reinforcing |
|---|---|---|---|---|---|---|---|
| R Wall-footing | 214.0 | 8.0 | 2.5 | 1712 | 4280 | 6.59 | 28192 |
| R Wall-stem | 214.0 | 22.0 | 1.5 | 4708 | 7062 | 6.59 | 46517 |
| L Wall-footing | 214.0 | 8.0 | 2.5 | 1712 | 4280 | 6.59 | 28192 |
| L Wall-stem | 214.0 | 22.0 | 1.5 | 4708 | 7062 | 6.59 | 46517 |
| Floor | 136.0 | 38.0 | 1.0 | 5168 | 5168 | 9.11 | 47080 |
| R Screen Fdn | 126.0 | 20.0 | 2.5 | 2520 | 6300 | 6.59 | 41498 |
| L Screen Fdn | 126.0 | 20.0 | 2.5 | 2520 | 6300 | 6.59 | 41498 |

| | | |
|---|---|---|
| Reinforced Concrete Volume, per site | 1498 | CY, per site |
| Reinforcement Weight, per site | 140 | Tons, per site |
| **Total Reinforced Concrete Volume** | **7491** | **CY** |
| **Total Reinforcement Weight** | **699** | **Tons** |

**Fish Return Pumps**

*Cost estimates as provided by Magic Valley Heli-Arc & Mfg, Inc. on March 17, 2016.*

| | |
|---|---|
| BP-420 Pump | $ 93,000 |
| HPU | $ 35,000 |
| Ancillary Equipment | $ 25,000 |
| Total Cost per Pump | $ 153,000 |
| Num. of Pumps per Site | 2 |
| Number of Sites | 5 |
| Total Cost | $ 1,530,000 |

## Pump Station Quantity Takeoff

| | | | |
|---|---|---|---|
| By: | JPP | Date: | 2/23/2016 |
| Checked By: | FMB | Date: | 3/4/2016 |
| | | Revision Date: | 5/12/2016 |

*All calculations are for a single, typical pump station, except where noted.*

**Access Roads**

*(Onsite, around the fish screens only)*

| | | |
|---|---|---|
| L | 110 | Feet |
| W | 16 | Feet |
| Number | 1 | |
| Thickness | 0.5 | Feet |
| Area | 1760 | SF |
| Volume | 33 | CY |
| Num. of Sites | 5 | |
| **Total Volume** | **163** | **CY** |

**Excavation**

*Assume that the existing ground at the PS location is at the 100 year flood elevation.*
*Assume temporary side slopes are cut at 1:1 from the foundation to the EG.*

| | | |
|---|---|---|
| Bottom L | 34 | Feet |
| Bottom W | 44 | Feet |
| Depth | 57 | Feet |
| Side Slopes | 1 | :1 |
| Bottom Area | 1496 | SF |
| Top Area | 23384 | SF |
| Volume | 26262 | CY |
| Num. of Sites | 5 | |
| **Total Volume** | **131311** | **CY** |

**Clearing**

*Use calculation for excavation, above.*

| | | |
|---|---|---|
| Area | 2598 | SY |
| Num. of Sites | 5 | |
| **Total Clearing** | **12991** | **SY** |

**Pumps** Revised on

*Base cost estimate on quote for Site 5 from Russell Pumps, dated 2016-02-19, including adder for 480V power.*
*Per Russell Pumps, cost for pumps and motors at sites 1-4 would be 2-5% less than at site 5.*

Cost for pumps at Site 5: $ 440,510

| | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 |
|---|---|---|---|---|---|
| Num. of Pumps | 4 | 4 | 4 | 4 | 4 |
| Cost Adj. | 95% | 98% | 98% | 100% | 100% |
| Cost Each | $ 418,485 | $ 431,700 | $ 431,700 | $ 440,510 | $ 440,510 |
| Total Cost | $ 1,673,938 | $ 1,726,799 | $ 1,726,799 | $ 1,762,040 | $ 1,762,040 |

**Total Pump and Motor Cost: $ 8,651,616**

**Pump Station Walls** Added on 2

| | Length | Height/Width | Thickness | Area | Volume | Reinf. Ratio (l | Reinforcing |
|---|---|---|---|---|---|---|---|
| D/S Wall-lower | 26.0 | 25.0 | 2.3 | 650 | 1517 | 11.77 | 17851 |
| D/S Wall-upper | 26.0 | 32.0 | 1.5 | 832 | 1248 | 12.57 | 15687 |
| U/S Wall-lower | 26.0 | 25.0 | 2.3 | 650 | 1517 | 11.77 | 17851 |
| U/S Wall-upper | 26.0 | 7.0 | 1.5 | 182 | 273 | 12.57 | 3432 |
| R Wall-lower | 30.0 | 25.0 | 3.0 | 750 | 2250 | 12.12 | 27270 |
| R Wall-upper | 30.0 | 32.0 | 1.5 | 960 | 1440 | 17.39 | 25042 |
| L Wall-lower | 30.0 | 25.0 | 3.0 | 750 | 2250 | 12.12 | 27270 |
| L Wall-upper | 30.0 | 32.0 | 1.5 | 960 | 1440 | 17.39 | 25042 |
| R Wing | 21.0 | 25.0 | 1.5 | 525 | 788 | 6.59 | 5187 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| L Wing | 21.0 | 25.0 | 1.5 | 525 | 788 | 6.59 | 5187 |
| Sump Floor | 26.0 | 30.0 | 3.0 | 780 | 2340 | 9.11 | 21317 |
| Top Slab | 26.0 | 30.0 | 1.0 | 780 | 780 | 7.00 | 5460 |

| | | |
|---|---|---|
| Reinforced Concrete Volume, per site | 616 | CY, per site |
| Reinforcement Weight, per site | 98 | Tons, per site |
| **Total Reinforced Concrete Volume** | **3080** | **CY** |
| **Total Reinforcement Weight** | **491** | **Tons** |

**Discharge Pipelines**

*Assumes all pipelines are buried with 2' of cover and the temporary sideslopes are at 1:1.*

| | Length | Dia | Depth | Base Width | Top Width | Sectional Are | Excavated Volume |
|---|---|---|---|---|---|---|---|
| Site 1 | 300 | 6 | 8 | 8 | 24 | 128 | 38400 |
| Site 2 | 1000 | 7 | 9 | 9 | 27 | 162 | 162000 |
| Site 3 | 5600 | 7 | 9 | 9 | 27 | 162 | 907200 |
| Site 4 | 4100 | 7 | 9 | 9 | 27 | 162 | 664200 |
| Site 5 | 1800 | 7 | 9 | 9 | 27 | 162 | 291600 |

| | | |
|---|---|---|
| | 2063400 | CF |
| **Total Excavated Volume:** | **76422** | **CY** |
| **Total Cleared Area:** | **38300** | **SY** |

**Ice Protection Berms** (Added: 2016-05-12) (Added: 20

*All dimensions are approximate, for a typical ice protection berm, top elevation 2' above the 100 year flood*

**Left Side:**

| | | |
|---|---|---|
| Length | 280 | Feet |
| Width | 62 | Feet |
| Average Height | 4 | Feet |
| Top Area | 17360 | SF |
| Bottom Area | 20300 | SF |
| Left Side Vol.: | 75320 | CF |
| | 2790 | CY |

**Right Side:**

| | | |
|---|---|---|
| Length | 230 | Feet |
| Width | 30 | Feet |
| Average Height | 4 | Feet |
| Top Area | 6900 | SF |
| Bottom Area | 9600 | SF |
| Right Side Vol.: | 33000 | CF |
| | 1222 | CY |

| | | |
|---|---|---|
| Total berm volume per site: | 4012 | CY |
| Number of sites: | 5 | |
| **Total ice berm volume:** | **20059** | **CY** |

## Pipe Outlet Structure Quantity Takeoff

By: JPP Date: 2/24/2016
Checked By: FMB Date: 3/4/2016

**Discharge Pipeline Outlets**

*Estimate for Type 1 concrete outlet transitions, per USBR's "Design of Small Canals"*
*Wall thickness of 1.5' estimated by scaling up textbook values.*
*Floor area measured in AutoCAD. Wall heights based on 10' design depth in irrigation canal + 4' at headwall.*

| | Length | Height/Width | Thickness | Area | Volume | Reinf. Ratio | Reinforcing |
|---|---|---|---|---|---|---|---|
| **Site 1:** | | | | | | | |
| L Wall | 23.5 | 10.0 | 1.5 | 235 | 353 | 6.6 | 2322 |
| Head Wall | 7.0 | 14.0 | 1.5 | 98 | 147 | 6.6 | 968 |
| R Wall | 101.0 | 10.0 | 1.5 | 1010 | 1515 | 6.6 | 9979 |
| Floor | | | 1.0 | 1205 | 1205 | 6.6 | 7937 |
| 2 Wings (total) | 20.0 | 10.0 | 1.5 | 200 | 300 | 6.6 | 1976 |
| **Site 2:** | | | | | | | |
| L Wall | 23.5 | 10.0 | 1.5 | 235 | 353 | 6.6 | 2322 |
| Head Wall | 7.0 | 14.0 | 1.5 | 98 | 147 | 6.6 | 968 |
| R Wall | 77.0 | 10.0 | 1.5 | 770 | 1155 | 6.6 | 7608 |
| Floor | | | 1.0 | 985 | 985 | 6.6 | 6488 |
| 2 Wings (total) | 20.0 | 10.0 | 1.5 | 200 | 300 | 6.6 | 1976 |
| **Site 3:** | | | | | | | |
| L Wall | 23.5 | 10.0 | 1.5 | 235 | 353 | 6.6 | 2322 |
| Head Wall | 7.0 | 14.0 | 1.5 | 98 | 147 | 6.6 | 968 |
| R Wall | 53.5 | 10.0 | 1.5 | 535 | 803 | 6.6 | 5286 |
| Floor | | | 1.0 | 758 | 758 | 6.6 | 4993 |
| 2 Wings (total) | 20.0 | 10.0 | 1.5 | 200 | 300 | 6.6 | 1976 |
| **Site 4/5:** | | | | | | | |
| L Wall | 23.5 | 10.0 | 1.5 | 235 | 353 | 6.6 | 2322 |
| Head Wall | 19.0 | 14.0 | 1.5 | 266 | 399 | 6.6 | 2628 |
| R Wall | 60.6 | 10.0 | 1.5 | 606 | 909 | 6.6 | 5988 |
| Floor | | | 1.0 | 1276 | 1276 | 6.6 | 8405 |
| 2 Wings (total) | 20.0 | 10.0 | 1.5 | 200 | 300 | 6.6 | 1976 |

**Total Reinforced Concrete Volume** **447 CY**
**Total Reinforcement Weight** **40 Tons**

**Excavation:**

*Rough estimate based on average cut depth at each site.*

| | Area | Depth | Volume |
|---|---|---|---|
| Site 1 | 1205 | 10 | 12050 |
| Site 2 | 985 | 10 | 9850 |
| Site 3 | 758 | 10 | 7580 |
| Site 4/5 | 1276 | 10 | 12760 |

**Total excavation volume all sites:** **1564 CY**

**Riprap**

*QTO is as shown on drawings C-001 to C-005.*

| | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | |
|---|---|---|---|---|---|---|
| Length | 180 | 100 | 100 | 100 | 100 | feet |
| Width | 80 | 65 | 65 | 65 | 65 | feet |
| Thickness | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | feet |
| Area | 14400 | 6500 | 6500 | 6500 | 6500 | SF |
| Volume | 800.00 | 361.11 | 361.11 | 361.11 | 361.11 | CY, per site |

**Total riprap volume, all sites:** **2244 CY**

## Access Road Quantity Takeoff

By: JPP Date: 2/17/2016
Checked By: FMB Date: 3/4/2016

*All calculations assume that 50% of each road is cut by an average of 2' and 50% is filled by an average of 2'.*

**Access Roads**

*(Onsite, around the fish screens only)*

| | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Total | |
|---|---|---|---|---|---|---|---|
| Road Width | 20 | 20 | 20 | 20 | 20 | | |
| Length | 1200 | 3600 | 1400 | 2900 | 500 | | |
| Side Slopes | 2 | 2 | 2 | 2 | 2 | | |
| Cut/Fill Depth | 2 | 2 | 2 | 2 | 2 | | |
| Clear Area | 33600 | 100800 | 39200 | 81200 | 14000 | 268800 | SF |
| Cut Volume | 28800 | 86400 | 33600 | 69600 | 12000 | 230400 | CF |
| Fill Volume | 28800 | 86400 | 33600 | 69600 | 12000 | 230400 | CF |
| Surfacing Area | 24000 | 72000 | 28000 | 58000 | 10000 | 192000 | SF |
| Surf. Thickness | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | FT |
| Surf. Volume | 12000 | 36000 | 14000 | 29000 | 5000 | 96000 | CF |

| | | |
|---|---|---|
| **Total Clearing Area** | **29867** | **SY** |
| **Total Cut Volume** | **8533** | **CY** |
| **Total Fill Volume** | **8533** | **CY** |
| **Total Surfacing Volume** | **3556** | **CY** |

# Multiple Pumps with Conservation Measures Quantities

**Canal Lining Area Calculation** **Last updated:** **2/22/2016**

(Assumptions:

1. Based the U.S BOR's 2002 canal lining demonstration project report, geomembrane with concrete cover was selected for canal lining method.
2. Canal lining area represents finish surface of canal geometry between top of both canal slopes and does not include any overlaps of fabrics or anchors that are buried.
3. Eleven (11) typical canal cross sections used for the area calculations were based on the U.S BOR's 1992(?) document, and no additional sections were included.

| | Cross Sections - U.S.BOR's 1992 document | | | | | | | | Surface Area at Each Section [SF/ft] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | RM [mi] | RM [ft] | Bottom [ft] | SS [H:V] | Ht [ft] | V [fps] | S [ft/ft] | Q [cfs] | Sideslope (x2) [SF/ft] | Bottom [SF/ft] | Full X-Section [SF/ft] | Distance [ft] | Surface Area [SF] |
| U/S End of Canal | 0 | 0 | | | | | | | | | | | |
| at Headgate (1) | 0.05 | 264 | 28.5 | 1.5:1 | 40 | 2.2 | 0.0001 | 847 | 144.0 | 28.5 | 172.5 | 660 | 113850 |
| at Headgate (2) | 0.2 | 1056 | 23.5 | 1.5:1 | 26 | 2.15 | 0.0001 | 828 | 93.6 | 23.5 | 117.1 | 28908 | 3385127 |
| below Lateral HH | 11 | 58080 | 20.5 | 1.5:1 | 12 | 2.1 | 0.0001 | 745 | 43.2 | 20.5 | 63.7 | 50424 | 3212009 |
| below Pumping Plant | 19.3 | 101904 | 21.5 | 1.5:1 | 11 | 2 | 0.0001 | 630 | 39.6 | 21.5 | 61.1 | 36168 | 2209865 |
| at Sears Bridge | 24.7 | 130416 | 20.5 | 1.5:1 | 18 | 1.99 | 0.0001 | 609 | 64.8 | 20.5 | 85.3 | 44088 | 3760706 |
| below Fox Creek Siphon | 36 | 190080 | 23 | 1.5:1 | 10 | 1.89 | 0.0001 | 529 | 36.0 | 23.0 | 59.0 | 46992 | 2772528 |
| below Lone Tree Creek Siphon | 42.5 | 224400 | 23.5 | 1.5:1 | 9 | 1.76 | 0.0001 | 419 | 32.4 | 23.5 | 55.9 | 29040 | 1623336 |
| below Lateral G | 47 | 248160 | 15.5 | 1.5:1 | 8 | 2.08 | 0.0002 | 318 | 28.8 | 15.5 | 44.3 | 22440 | 994092 |
| below Lateral J | 51 | 269280 | 16.5 | 1.5:1 | 7 | 2.37 | 0.0003 | 284 | 25.2 | 16.5 | 41.7 | 26400 | 1100880 |
| below Lateral M | 57 | 300960 | 14.5 | 1.5:1 | 6 | 2 | 0.0001 | 164 | 21.6 | 14.5 | 36.1 | 25080 | 905388 |
| below Lateral P | 60.5 | 319440 | 9 | 1.5:1 | 5 | 1.87 | 0.0001 | 75.7 | 18.0 | 9.0 | 27.0 | 60984 | 1646568 |
| D/S End of Canal | 70.3 | 371184 | | | | | | | | | | | |

**Total:** **21,724,349** **[SF]**

**Total:** **371,184** **[LF]**

**Total:** **70.3** **[MI]**

| | Shotcrete Volume | | | Fill Canal Volume | | |
|---|---|---|---|---|---|---|
| Location | Surface Area [sf] | Shotcrete [in] | V [cy] | Length [lf] | XS Area [sf] | V x 50% [cy] |
| U/S End of Canal | | | | | | |
| at Headgate (1) | 113,850 | 3.0 | 1,054 | 660 | 2970 | 36,300 |
| at Headgate (2) | 3,385,127 | 3.0 | 31,344 | 28,908 | 1320 | 706,372 |
| below Lateral HH | 3,212,009 | 3.0 | 29,741 | 50,424 | 339 | 316,551 |
| below Pumping Plant | 2,209,865 | 3.0 | 20,462 | 36,168 | 300 | 200,766 |
| at Sears Bridge | 3,760,706 | 3.0 | 34,821 | 44,088 | 671 | 547,426 |
| below Fox Creek Siphon | 2,772,528 | 3.0 | 25,672 | 46,992 | 265 | 230,609 |
| below Lone Tree Creek Siphon | 1,623,336 | 3.0 | 15,031 | 29,040 | 227 | 122,210 |
| below Lateral G | 994,092 | 3.0 | 9,205 | 22,440 | 158 | 65,658 |
| below Lateral J | 1,100,880 | 3.0 | 10,193 | 26,400 | 131 | 64,167 |
| below Lateral M | 905,388 | 3.0 | 8,383 | 25,080 | 98 | 45,283 |
| below Lateral P | 1,646,568 | 3.0 | 15,246 | 60,984 | 60 | 67,760 |
| D/S End of Canal | | | | | | |

**Total:** **2,403,102** **[CY]**

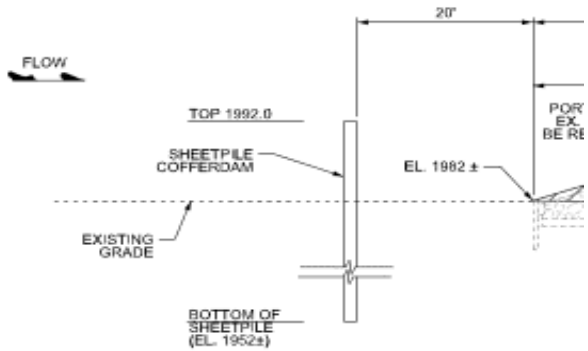
Note: Assumes 50% of existing canal to be filled

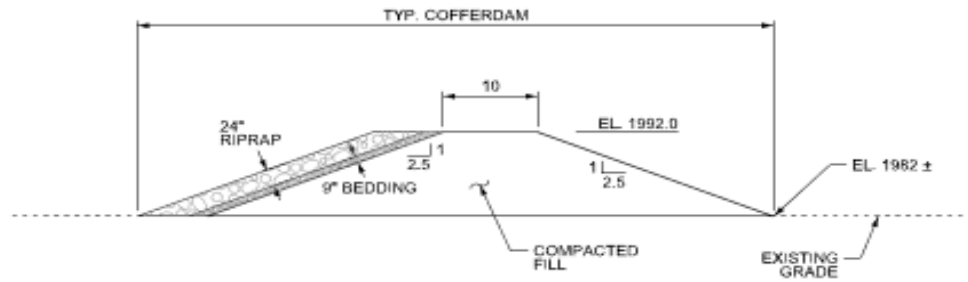
**Cofferdam Calculation** **Last updated:** **3/4/2016**

(Assumptions:

1. Dam removal will take place in 2 phases.
2. A typical cofferdam will be a sheetpile with the exception of the segment along the flow direction (west to east) in Phase 1.
3. A sheetpile will be total of 40 feet in height (10' exposed + 30' embedded).

| | | Sheetpile | Earthen Dam (X-Section) | | | Sheetpile | Earthen Dam (Volume) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Length [ft] | Height [ft] | Comp Fill [SF/ft] | 9" Bedding [SF/ft] | 24" Riprap [SF/ft] | Area [SF] | Comp Fill | 9" Bedding | 24" Riprap | |
| | | | | | | | | | | |
| Phase 1 - Removal of North half | | | | | | | | | | |
| Sheetpile (U/S Face & D/S Face) | 895 | 40 | | | | ***35,800*** | | | | |
| Earthen (along the flow direction) | 410 | | 380.0 | 21.20 | 56.54 | | 155800 | 8694 | 23183 | [CF] |
| | | | | | | | ***5,770*** | ***322*** | ***859*** | [CY] |
| | | | | | | | | | | |
| Phase 2 - Removal of South half | | | | | | | | | | |
| Sheetpile | 1420 | 40 | | | | ***56,800*** | | | | |
| | | | | | | | | | | |




TYPICAL EARTHEN COFFERDAM

N.T.S

**Existing Intake Dam Removal Calculation** **Last updated:** **3/4/2016**

(Assumptions:

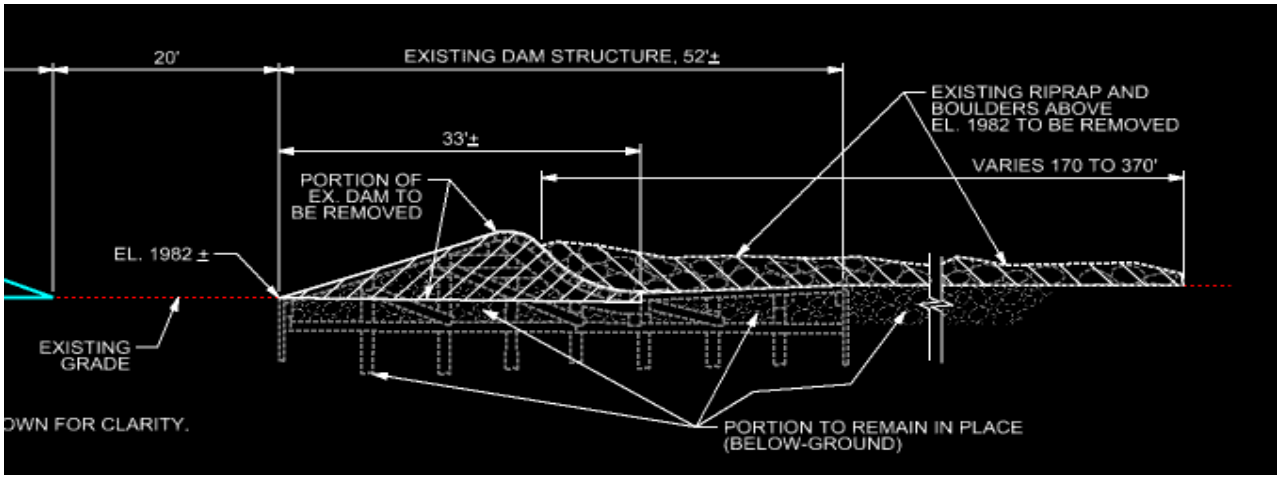
1. A typical intake dam geometry (shown here) is based on the USACE's 1910 as-built plans.
2. Only the portion of the dam that is above adjacent ground elevation (1981.5) was assumed to be removed.
3. The dam crest was assumed to be 1988'.
4. The portion of the dam that is below ground, including timber piles, will be left in place.
5. Quantity of riprap and boulders downstream of the existing dam was based on bathymetric survey.

| | | X-Section | | | Volume | | |
|---|---|---|---|---|---|---|---|
| Location | Length [ft] | Removal [SF/ft] | [SF/ft] | [SF/ft] | Removal [CF] | [CY] | |
| | | | | | | | |
| Existing Dam | 700 | 112.0 | | | 78400 | | |
| | | | | | | | |

**Total:** **2904** [CY]

| | | | Volume | | |
|---|---|---|---|---|---|
| Location | Surface Area [SF] | Avg Thickness [ft] | Removal [CF] | [SF/ft] | [SF/ft] |
| | | | | | |
| Riprap and Boulders D/S of Ex. Dam | 190190 | 6 | 1141140.0 | | |
| | | | | | |

**Total:** **42264** [CY]



**Convert Laterals to Pipe - Lengths**

| 1.5 | 2 | 3 | 4 | 5 | 6 | No Piping |
|---|---|---|---|---|---|---|
| | Pipe Length (feet) | | | | | |
| - | 1,653 | 14,994 | 16,181 | 11,800 | - | - |
| - | 1,760 | 27742 | 26425 | 23911 | - | 14089 |
| - | 2973 | 14688 | 5766 | - | 4134 | - |
| - | 511 | 32620 | - | 300 | - | 5900 |
| 3026 | 8027 | 35775 | 5200 | 4096 | - | 9904 |
| - | 10548 | 2150 | - | - | 2700 | - |
| - | 17075 | 25522 | 23635 | - | - | 8400 |
| - | - | 14377 | 5600 | 11000 | - | - |
| 652 | - | 5275 | 5600 | - | - | - |
| - | - | - | 6684 | - | - | - |
| - | - | 3232 | - | - | - | - |
| - | - | | 8622 | - | - | - |
| | | | | | | |
| 3678 | 42547 | 176375 | 103713 | 51107 | 6834 | 38293 |

# Attachment B.5
# Labor Rates

General Decision Number: MT160077 01/08/2016 MT77

Superseded General Decision Number: MT20150077

State: Montana

Construction Type: Heavy

Counties: Big Horn, Carter, Daniels, Dawson, Fallon, Garfield, McCone, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure and Wibaux Counties in Montana.

HEAVY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.15 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

| Modification Number | Publication Date |
|---|---|
| 0 | 01/08/2016 |

ELEC0233-021 06/01/2015

PHILLIPS COUNTY

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN..... | $ 29.98 | 11.60 |

---

ELEC0532-013 06/01/2015

BIG HORN, CARTER, DANIELS, DAWSON, FALLON, GARFIELD, MCCONE, POWDER RIVER, PRAIRIE, RICHLAND, ROOSEVELT, ROSEBUD, SHERIDAN, TREASURE, AND WILBAUX COUNTIES

| | Rates | Fringes |
|---|---|---|
| ELECTRICIAN..... | $ 31.39 | 12.84 |

---

ENGI0400-010 05/01/2013

| | Rates | Fringes |
|---|---|---|
| POWER EQUIPMENT OPERATOR: | | |
| (Zone 1) | | |
| (1) A-frame truck Crane, | | |

```
          oiler  (except crane)..$ 23.47           10.40
     (2)  Crane
     Oiler,Bulldozer, Roller
     (Dirt and Grade
     Compaction), Backhoe........$ 23.94           10.40
     (3) Mechanic................$ 24.34           10.40
     (4) Cranes, 25 tons - 44
     tons........................$ 27.00           11.40
     (5) Cranes, 45 tons to and
     incl. 74 tons...............$ 28.00           11.40
     (6) Cranes, 75 tons to and
     incl. 149 tons; Cranes,
     Whirley (All)...............$ 29.00           11.40
     (7) Cranes, 150 tons to
     including 250 tons (add
     $1.00

       for every 100 tons over
     250 tons); Crane, Stiff-
     Leg or

       Derrick; Helicopter
     Hoist; Crane, Tower (all)...$ 30.00           11.40

ZONE DEFINITIONS FOR POWER EQUPMENT OPERATORS:
  The zone hourly rates applicable to each project shall be
  determined by measuring the road miles over the shortest
  practical maintained route from the nearest County Court
  House of the following listed towns to the center of the
  job:

  BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL,
  MISSOULA

Zone 1:   0 to 30 miles - Base Pay
Zone 2:  30 to 60 miles - Base Pay + $3.50
Zone 3:  Over 60 miles - Base Pay + $5.50

-----------------------------------------------------------------
* IRON0732-018 06/01/2015

                                  Rates          Fringes

IRONWORKER:  Reinforcing and
Structural.....................$ 27.00          19.78+a

  a: PAID HOLIDAYS: New Years Day, Memorial Day, July 4th,
  Labor Day, Veteran's DAy, Thanksgiving Day, Day following
  Thanksgiving, and Christmas Day.

-----------------------------------------------------------------
  SUMT2011-052 02/08/2011

                                  Rates          Fringes

CARPENTER (Form Work Only).......$ 24.30             7.80

CARPENTER, Excludes Form Work....$ 21.13             7.00

LABORER:  Common or General......$ 17.99             5.90
```

```
LABORER:  Pipelayer.............$ 21.10            5.46

LABORER: Landscape and
Irrigation......................$ 15.14            1.30

OPERATOR:  Bobcat/Skid
Steer/Skid Loader...............$ 23.53            8.05

OPERATOR:  Excavator............$ 23.62            8.05

OPERATOR:  Grader/Blade.........$ 25.44            8.45

OPERATOR:  Loader (Front End)....$ 24.58            8.05

OPERATOR:  Scraper..............$ 23.00            6.76

TRUCK DRIVER:  Dump Truck........$ 19.99            5.09
----------------------------------------------------------------

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

================================================================


Unlisted classifications needed for work not included within
the scope of the classifications listed may be added after
award only as provided in the labor standards contract clauses
(29CFR 5.5 (a) (1) (ii)).


----------------------------------------------------------------


The body of each wage determination lists the classification
and wage rates that have been found to be prevailing for the
cited type(s) of construction in the area covered by the wage
determination. The classifications are listed in alphabetical
order of "identifiers" that indicate whether the particular
rate is a union rate (current union negotiated rate for local),
a survey rate (weighted average rate) or a union average rate
(weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed
in dotted lines beginning with characters other than "SU" or
"UAVG" denotes that the union classification and rate were
prevailing for that classification in the survey. Example:
PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of
the union which prevailed in the survey for this
classification, which in this example would be Plumbers. 0198
indicates the local union number or district council number
where applicable, i.e., Plumbers Local 0198. The next number,
005 in the example, is an internal number used in processing
the wage determination. 07/01/2014 is the effective date of the
most current negotiated rate, which in this example is July 1,
2014.

Union prevailing wage rates are updated to reflect all rate
changes in the collective bargaining agreement (CBA) governing
```

this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

---

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION

# Attachment B.6
# Estimated Construction Durations

# Modified Side Channel Construction Durations

TITLE: Yellowstone River - Modified Side Channel
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.: T35234
DATE: 5/10/2016



**08 - Roads, Railroads and Bridges**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Mobilization | 0.10 | 100% | 10 | DAY | 10 | 1 | 100.0 | 10.00 |
| | | | | | | | | |
| *Prefabricated Bridge Installation* | | | | | | | | |
| Structural Excavation | 25.00 | 100% | 10 | CY | 50 | 1 | 2.0 | 0.20 |
| Concrete Abutments and Wingwalls | | | | | | | | |
| *Concrete, Forms* | *60.63* | *100%* | *10* | *SFC* | *300* | *1* | *4.9* | *0.49* |
| *Reinforcing Steel* | *0.07* | *100%* | *10* | *TON* | *2.8* | *2* | *21.3* | *2.13* |
| *Concrete, Placement* | *18.75* | *100%* | *10* | *CY* | *41* | *1* | *2.2* | *0.22* |
| Bridge Installation | 18.13 | 100% | 10 | SF | 3,600 | 2 | 99.3 | 9.93 |
| | | | | | | | | |
| *Haul Road Construction and Rehab* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 2 | 1 | 17.6 | 1.76 |
| Fine Grading | 250.00 | 100% | 10 | SY | 10,667 | 2 | 21.3 | 2.13 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 10,667 | 1 | 15.8 | 1.58 |
| | | | | | | | | |
| Demobilization | 0.10 | 100% | 10 | DAY | 5 | 1 | 50.0 | 5.00 |

**16 - Bank Stabilization**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Mobilization | 0.10 | 100% | 10 | DAY | 20 | 1 | 200.0 | 20.00 |
| | | | | | | | | |
| Channel Armoring | | | | | | | | |
| Bedding Stone Placement | 30.00 | 100% | 10 | CY | 24,840 | 4 | 207.0 | 20.70 |
| Riprap Placement | 25.00 | 100% | 10 | CY | 115,610 | 6 | 770.7 | 77.07 |
| Boulder Placement | 17.50 | 100% | 10 | CY | 2,200 | 2 | 62.9 | 6.29 |
| | | | | | | | | |
| Demobilization | 0.10 | 100% | 10 | DAY | 5 | 1 | 50.0 | 10.00 |

TITLE: Yellowstone River - Modified Side Channel
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.: T35234
DATE: 5/10/2016



**09 - Channels**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| Mobilization | 0.10 | 100% | 10 | DAY | 20 | 1 | 200.0 | 20.00 |
| Site Preparation | | | | | | | | |
| *Staging Areas* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 33.5 | 3 | 89.3 | 8.93 |
| Fine Grading | 250.00 | 100% | 10 | SY | 162,140 | 4 | 162.1 | 16.21 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 81,070 | 2 | 60.1 | 6.01 |
| Temporary Fencing | 25.00 | 100% | 10 | LF | 10,800 | 4 | 108.0 | 10.80 |
| *Access/Haul Roads* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 11.7 | 2 | 46.8 | 4.68 |
| Fine Grading | 250.00 | 100% | 10 | SY | 56,667 | 2 | 113.3 | 11.33 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 56,667 | 2 | 42.0 | 4.20 |
| *Erosion Control* | | | | | | | | |
| Silt Fence | 43.75 | 100% | 10 | LF | 10,000 | 2 | 114.3 | 11.43 |
| Jute Mesh | 300.00 | 100% | 10 | SY | 10,000 | 2 | 16.7 | 1.67 |
| Upstream Cofferdam | | | | | | | | |
| Sheetpile Cutoff | 60.63 | 100% | 10 | SF | 4,800 | 1 | 79.2 | 7.92 |
| *Earthen Cofferdam* | | | | | | | | |
| Borrow Fill Excavate and Load | 130.00 | 100% | 10 | CY | 24,610 | 2 | 94.7 | 9.47 |
| Cycel Haul to/from Borrow Site | 60.61 | 100% | 10 | CY | 24,610 | 4 | 101.5 | 10.15 |
| Place and Compact Embankment | 240.00 | 100% | 10 | CY | 24,610 | 2 | 51.3 | 5.13 |
| Bedding Placement | 30.00 | 100% | 10 | CY | 690 | 2 | 11.5 | 1.15 |
| Riprap Placement | 25.00 | 100% | 10 | CY | 3,080 | 2 | 61.6 | 6.16 |
| Downstream Cofferdam | | | | | | | | |
| Sheetpile Cutoff | 60.63 | 100% | 10 | SF | 4,800 | 1 | 79.2 | 7.92 |
| *Earthen Cofferdam* | | | | | | | | |
| Borrow Fill Excavate and Load | 130.00 | 100% | 10 | CY | 24,610 | 2 | 94.7 | 9.47 |
| Cycel Haul to/from Borrow Site | 60.61 | 100% | 10 | CY | 24,610 | 4 | 101.5 | 10.15 |
| Place and Compact Embankment | 240.00 | 100% | 10 | CY | 24,610 | 2 | 51.3 | 5.13 |
| Bedding Placement | 30.00 | 100% | 10 | CY | 690 | 2 | 11.5 | 1.15 |
| Riprap Placement | 25.00 | 100% | 10 | CY | 3,080 | 2 | 61.6 | 6.16 |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 226 | 8 | 226.0 | 22.60 |
| Channel Excavation | 210.00 | 100% | 10 | CY | 1,143,900 | 6 | 907.9 | 90.79 |
| Cycle Haul to/from Overbank Sites | 72.70 | 100% | 10 | CY | 416,605 | 6 | 955.1 | 95.51 |
| Place and Compact Channel Fill | 224.00 | 100% | 10 | CY | 416,605 | 6 | 310.0 | 31.00 |
| Cycle Haul to/from Borrow Site | 60.61 | 100% | 10 | CY | 898,880 | 10 | 1483.1 | 148.31 |
| Spread Material at Disposal Site | 140.00 | 100% | 10 | CY | 898,880 | 8 | 802.6 | 80.26 |
| Finish Grading, Channel | 900.00 | 100% | 10 | SY | 484,000 | 4 | 134.4 | 13.44 |
| *Seeding* | | | | | | | | |
| Mechanical Seeding | 0.19 | 100% | 10 | ACRE | 128 | 4 | 170.7 | 17.07 |
| Mulching | 75.00 | 100% | 10 | MSF | 5,576 | 2 | 37.2 | 3.72 |
| Netting | 312.50 | 100% | 10 | SY | 619,520 | 4 | 495.6 | 49.56 |
| Demobilization | 0.10 | 100% | 10 | DAY | 5 | 1 | 50.0 | 10.00 |

# Multiple Pump Construction Durations

TITLE: Yellowstone River - Multiple Pump Alternative
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.: T35234
DATE: 5/10/2016



**Typical Pump Station Durations**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Mobilization | 0.10 | 100% | 30 | DAY | 30 | 1 | 300.0 | 10.00 |
| | | | | | | | | |
| *Staging Areas* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.5 | 1 | 3.7 | 0.37 |
| Fine Grading | 250.00 | 100% | 10 | SY | 2,500 | 1 | 10.0 | 1.00 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 2,500 | 1 | 3.7 | 0.37 |
| Temporary Fencing | 25.00 | 100% | 10 | LF | 600 | 2 | 12.0 | 1.20 |
| *Access/Haul Roads* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.8 | 1 | 6.4 | 0.64 |
| Fine Grading | 250.00 | 100% | 10 | SY | 3,733 | 1 | 14.9 | 1.49 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 2,667 | 1 | 4.0 | 0.40 |
| *Erosion Control* | | | | | | | | |
| Silt Fence | 43.75 | 100% | 10 | LF | 2,500 | 2 | 28.6 | 2.86 |
| Jute Mesh | 300.00 | 100% | 10 | SY | 5,000 | 2 | 8.3 | 0.83 |
| Feeder Canal Dewater | | | | | | | | |
| Sheet Piling | 60.63 | 100% | 10 | SF | 8,000 | 1 | 132.0 | 13.20 |
| Wellpoints | 2.00 | 100% | 10 | LF | 400 | 2 | 100.0 | 10.00 |
| | | | | | | | | |
| Pump Staitons | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.54 | 1 | 4.3 | 0.43 |
| *Earthwork* | | | | | | | | |
| Channel Excavation | 180.00 | 100% | 10 | CY | 13,150 | 4 | 18.3 | 1.83 |
| Wet Excavation | 35.00 | 100% | 10 | CY | 13,150 | 4 | 93.9 | 9.39 |
| Cycle Haul to/from Borrow Site | 53.10 | 100% | 10 | CY | 12,098 | 2 | 113.9 | 11.39 |
| Spread Material at Disposal Site | 140.00 | 100% | 10 | CY | 12,098 | 2 | 43.2 | 4.32 |
| Fill and Compact from Stockpile | 96.00 | 100% | 10 | CY | 18,147 | 2 | 94.5 | 9.45 |
| Reinforced Concrete | | | | | | | | |
| *Concrete Floor* | | | | | | | | |
| Concrete Forms | 34.38 | 100% | 10 | SFC | 159 | 2 | 2.3 | 0.23 |
| Reinforcing Steel | 0.07 | 100% | 10 | TON | 10.7 | 6 | 24.8 | 2.48 |
| Concrete Placement | 23.13 | 100% | 10 | CY | 96 | 1 | 4.1 | 0.41 |
| *Concrete Walls* | | | | | | | | |
| Concrete Forms | 50.00 | 100% | 10 | SFC | 903 | 2 | 9.0 | 0.90 |
| Reinforcing Steel | 0.09 | 100% | 10 | TON | 85 | 6 | 150.7 | 15.07 |
| Concrete Placement | 15.00 | 100% | 10 | CY | 550 | 1 | 36.7 | 3.67 |
| *Concrete Top Slab* | | | | | | | | |
| Concrete Forms | 34.38 | 100% | 10 | SFC | 53 | 2 | 0.8 | 0.08 |
| Reinforcing Steel | 0.07 | 100% | 10 | TON | 3 | 6 | 6.3 | 0.63 |
| Concrete Placement | 23.13 | 100% | 10 | CY | 32 | 1 | 1.4 | 0.14 |
| Irrigation Pumps and Motors | 0.03 | 100% | 10 | EA | 4 | 1 | 160.0 | 16.00 |
| *Piping* | | | | | | | | |
| 48" Steel Pipe | 2.71 | 100% | 10 | LF | 190 | 2 | 35.1 | 3.51 |
| 84" Steel Pipe | 1.25 | 100% | 10 | LF | 20 | 1 | 16.0 | 1.60 |
| Hydraulic Gate | 0.06 | 100% | 10 | EA | 4 | 2 | 32.0 | 3.20 |
| Pipe Wyes and Tees | 1.50 | 100% | 10 | EA | 3 | 1 | 2.0 | 0.20 |
| Pipe Bends/Elbows | 1.50 | 100% | 10 | EA | 3 | 1 | 2.0 | 0.20 |
| Pipe Reducers | 1.00 | 100% | 10 | EA | 2 | 1 | 2.0 | 0.20 |
| Concrete Utility Vaults | 0.10 | 100% | 10 | EA | 4 | 1 | 40.0 | 4.00 |
| Prefab Steel Building | 0.01 | 100% | 10 | EA | 1 | 1 | 100.0 | 10.00 |
| Standby Generators | 0.01 | 100% | 10 | EA | 1 | 1 | 80.0 | 8.00 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 40 | 1 | 0.4 | 0.04 |

TITLE: Yellowstone River - Multiple Pump Alternative
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.: T35234
DATE: 5/10/2016



**Typical Pump Station (Cont.)**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| *Discharge Pipelines* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.6 | 1 | 5.0 | 0.50 |
| Trench Excavation | 50.00 | 100% | 10 | CY | 6,000 | 2 | 60.0 | 6.00 |
| 84" Steel Pipe | 1.25 | 100% | 10 | LF | 1,000 | 4 | 200.0 | 20.00 |
| Concrete Outlet Structures | | | | | | | | |
| Structural Excavation | 25.00 | 100% | 10 | CY | 365 | 1 | 14.6 | 1.46 |
| Structural Concrete | 5.00 | 100% | 10 | CY | 109 | 1 | 21.8 | 2.18 |
| Bedding Stone | 30.00 | 100% | 10 | CY | 138 | 1 | 4.6 | 0.46 |
| Riprap Placement | 28.00 | 100% | 10 | CY | 415 | 1 | 14.8 | 1.48 |
| *Feeder Canal* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.3 | 1 | 2.1 | 0.21 |
| In Water Excavation | 33.00 | 100% | 10 | CY | 2,100 | 3 | 21.2 | 2.12 |
| Channel Excavation | 180.00 | 100% | 10 | CY | 40,000 | 3 | 74.1 | 7.41 |
| Trash Rack | 0.03 | 100% | 10 | EA | 1 | 1 | 40.0 | 4.00 |
| Fish Screen | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.4 | 1 | 2.8 | 0.28 |
| Channel Excavation | 180.00 | 100% | 10 | CY | 5,539 | 2 | 15.4 | 1.54 |
| Structural Excavation | 33.00 | 100% | 10 | CY | 292 | 1 | 8.8 | 0.88 |
| Reinforced Concrete | | | | | | | | |
| *Concrete Foundations* | | | | | | | | |
| Concrete Forms | 43.75 | 100% | 10 | SFC | 730 | 2 | 8.3 | 0.83 |
| Reinforcing Steel | 0.07 | 100% | 10 | TON | 41.5 | 6 | 96.2 | 9.62 |
| Concrete Placement | 50.00 | 100% | 10 | CY | 514 | 1 | 10.3 | 1.03 |
| *Concrete Floor* | | | | | | | | |
| Concrete Forms | 34.38 | 100% | 10 | SFC | 348 | 2 | 5.1 | 0.51 |
| Reinforcing Steel | 0.07 | 100% | 10 | TON | 23.5 | 6 | 54.5 | 5.45 |
| Concrete Placement | 23.13 | 100% | 10 | CY | 210 | 1 | 9.1 | 0.91 |
| *Concrete Footings* | | | | | | | | |
| Concrete Forms | 60.63 | 100% | 10 | SFC | 2,220 | 2 | 18.3 | 1.83 |
| Reinforcing Steel | 0.07 | 100% | 10 | TON | 28 | 6 | 71.6 | 7.16 |
| Concrete Placement | 18.75 | 100% | 10 | CY | 349 | 1 | 18.6 | 1.86 |
| *Concrete Walls* | | | | | | | | |
| Concrete Forms | 50.00 | 100% | 10 | SFC | 944 | 2 | 9.4 | 0.94 |
| Reinforcing Steel | 0.09 | 100% | 10 | TON | 47 | 6 | 82.6 | 8.26 |
| Concrete Placement | 15.00 | 100% | 10 | CY | 575 | 1 | 38.3 | 3.83 |
| Fish Screens and Deadplates | 0.02 | 100% | 10 | EA | 1 | 1 | 60.0 | 6.00 |
| Structural Steel Supports | 0.83 | 100% | 10 | TON | 50 | 1 | 60.0 | 6.00 |
| Screen Cleaners | 0.02 | 100% | 10 | EA | 1 | 1 | 50.0 | 5.00 |
| Fish Return Pump | 0.02 | 100% | 10 | EA | 1 | 1 | 50.0 | 5.00 |
| 14" HDPE Pipe | 27.50 | 100% | 10 | LF | 2,400 | 2 | 43.6 | 4.36 |
| 18" HDPE Pipe | 17.50 | 100% | 10 | LF | 50 | 1 | 2.9 | 0.29 |
| Demobilization | 0.10 | 100% | 10 | DAY | 15 | 1 | 150.0 | 15.00 |

# Multiple Pumps with Conservation Measures Construction Durations

TITLE: Yellowstone River - Multiple Pumps with Conservation Measures
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.:
DATE: 3/20/2016



**Existing Intake Dam Removal**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| Mobilization | 0.10 | 100% | 10 | DAY | 15 | 1 | 150.0 | 15.00 |
| Site Preparation | | | | | | | | |
| *Staging Areas* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 2.0 | 2 | 8.0 | 0.80 |
| Fine Grading | 250.00 | 100% | 10 | SY | 9,680 | 2 | 19.4 | 1.94 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 4,840 | 2 | 3.6 | 0.36 |
| Temporary Fencing | 25.00 | 100% | 10 | LF | 2,000 | 2 | 40.0 | 4.00 |
| *Access/Haul Roads* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 0.7 | 2 | 2.8 | 0.28 |
| Fine Grading | 250.00 | 100% | 10 | SY | 3,388 | 2 | 6.8 | 0.68 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 3,388 | 2 | 2.5 | 0.25 |
| *Erosion Control* | | | | | | | | |
| Silt Fence | 43.75 | 100% | 10 | LF | 3,000 | 2 | 34.3 | 3.43 |
| Jute Mesh | 300.00 | 100% | 10 | SY | 5,000 | 2 | 8.3 | 0.83 |
| Cofferdam - Phase 1 | | | | | | | | |
| Sheet Pile Cofferdam | 69.13 | 100% | 10 | SF | 35,800 | 2 | 259.0 | 25.90 |
| *Earthen Cofferdam* | | | | | | | | |
| Excavate at Borrow Site | 130.00 | 100% | 10 | CY | 6,636 | 2 | 25.5 | 2.55 |
| Cycle Haul from Borrow Site | 53.10 | 100% | 10 | CY | 6,636 | 4 | 31.2 | 3.12 |
| Place and Compact Embankment | 240.00 | 100% | 10 | CY | 6,636 | 1 | 27.7 | 2.77 |
| *Bedding Stone* | | | | | | | | |
| Place Bedding | 30.00 | 100% | 10 | CY | 556 | 2 | 9.3 | 0.93 |
| *Riprap Placement* | | | | | | | | |
| Place Riprap | 25.00 | 100% | 10 | CY | 1,416 | 2 | 28.3 | 2.83 |
| Cofferdam - Phase 2 | | | | | | | | |
| Sheet Pile Cofferdam | 69.13 | 100% | 10 | SF | 56,800 | 2 | 410.8 | 41.08 |
| *Dam Removal* | | | | | | | | |
| Rock Removal | 10.50 | 100% | 10 | CY | 45,168 | 8 | 537.7 | 53.77 |
| Rock Load and Haul | 157.00 | 100% | 10 | CY | 45,168 | 1 | 287.7 | 28.77 |
| Timber Decking Removal | 27.50 | 100% | 10 | SF | 38,500 | 4 | 350.0 | 35.00 |
| Timber Cribbing Removal | 100.00 | 100% | 10 | LF | 6,864 | 1 | 68.6 | 6.86 |
| Timber Pile Demolition | 75.00 | 100% | 10 | VLF | 2,024 | 1 | 27.0 | 2.70 |
| Misc. Material Load and Haul | 78.00 | 100% | 10 | CY | 1,200 | 1 | 15.4 | 1.54 |
| Demobilization | 0.10 | 100% | 10 | DAY | 7 | 1 | 70.0 | 7.00 |

TITLE: Yellowstone River - Multiple Pumps with Conservation Measures
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.:
DATE: 3/20/2016



**Convert Laterals to Pipe**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| Mobilization | 0.10 | 100% | 10 | DAY | 15 | 1 | 150.0 | 15.00 |
| Convert Laterals to Pipe | | | | | | | | |
| *Staging Areas* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 33.5 | 3 | 89.3 | 8.93 |
| Fine Grading | 250.00 | 100% | 10 | SY | 162,140 | 4 | 162.1 | 16.21 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 81,070 | 2 | 60.1 | 6.01 |
| Temporary Fencing | 25.00 | 100% | 10 | LF | 10,800 | 4 | 108.0 | 10.80 |
| *18" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 1,226 | 1 | 4.9 | 0.49 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 235 | 1 | 2.3 | 0.23 |
| 18" RCP | 16.50 | 100% | 10 | LF | 3,678 | 2 | 111.5 | 11.15 |
| Backfill | 132.50 | 100% | 10 | CY | 1,410 | 1 | 10.6 | 1.06 |
| *24" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 18,910 | 2 | 37.8 | 3.78 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 2,718 | 2 | 13.0 | 1.30 |
| 24" RCP | 12.50 | 100% | 10 | LF | 42,547 | 8 | 425.5 | 42.55 |
| Backfill | 132.50 | 100% | 10 | CY | 13,591 | 2 | 51.3 | 5.13 |
| *36" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 97,987 | 3 | 130.6 | 13.06 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 15,025 | 3 | 48.0 | 4.80 |
| 36" RCP | 9.00 | 100% | 10 | LF | 176,376 | 12 | 1633.1 | 163.31 |
| Backfill | 132.50 | 100% | 10 | CY | 105,172 | 3 | 264.6 | 26.46 |
| *48" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 87,770 | 3 | 117.0 | 11.70 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 12,016 | 3 | 38.4 | 3.84 |
| 48" RCP | 8.00 | 100% | 10 | LF | 112,847 | 12 | 1175.5 | 117.55 |
| Backfill | 132.50 | 100% | 10 | CY | 101,137 | 3 | 254.4 | 25.44 |
| *60" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 51,107 | 3 | 68.1 | 6.81 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 7,619 | 3 | 24.3 | 2.43 |
| 60" RCP | 6.00 | 100% | 10 | LF | 51,107 | 12 | 709.8 | 70.98 |
| Backfill | 132.50 | 100% | 10 | CY | 65,303 | 3 | 164.3 | 16.43 |
| *72" Pipe Laterals* | | | | | | | | |
| Fine Grading | 250.00 | 100% | 10 | SY | 7,593 | 2 | 15.2 | 1.52 |
| Aggregate Base Course | 104.38 | 100% | 10 | CY | 1,164 | 2 | 5.6 | 0.56 |
| 60" RCP | 6.00 | 100% | 10 | LF | 6,834 | 8 | 142.4 | 14.24 |
| Backfill | 132.50 | 100% | 10 | CY | 8,732 | 2 | 33.0 | 3.30 |
| *Line Remaining Laterals* | | | | | | | | |
| Earthwork | 181.25 | 100% | 10 | SY | 63,822 | 2 | 176.1 | 17.61 |
| Geomembrane | 8.13 | 100% | 10 | MSF | 603 | 1 | 74.2 | 7.42 |
| Shotcrete Placement | 337.50 | 100% | 10 | SF | 574,398 | 4 | 425.5 | 42.55 |

TITLE: Yellowstone River - Multiple Pumps with Conservation Measures
SUBJECT: Estimated Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.:
DATE: 3/20/2016



**Line Open Canals**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| Mobilization | 0.10 | 100% | 10 | DAY | 30 | 1 | 300.0 | 30.00 |
| *Staging Areas* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 14.0 | 1 | 112.0 | 11.20 |
| Fine Grading | 250.00 | 100% | 10 | SY | 67,760 | 2 | 135.5 | 13.55 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 33,880 | 1 | 50.2 | 5.02 |
| Temporary Fencing | 25.00 | 100% | 10 | LF | 17,500 | 4 | 175.0 | 17.50 |
| *Access Roads* | | | | | | | | |
| Clearing and Grubbing | 0.13 | 100% | 10 | ACRE | 9.6 | 1 | 76.8 | 7.68 |
| Fine Grading | 250.00 | 100% | 10 | SY | 46,667 | 2 | 93.3 | 9.33 |
| Aggregate Base Course | 675.00 | 100% | 10 | SY | 23,334 | 1 | 34.6 | 3.46 |
| *Fill Canal* | | | | | | | | |
| Borrow Fill Excavate and Load | 130.00 | 100% | 10 | CY | 2,763,567 | 12 | 1771.5 | 177.15 |
| Cycle Haul From Borrow Site | 157.00 | 100% | 10 | CY | 2,763,567 | 12 | 1466.9 | 146.69 |
| Place and Compact Fill | 224.00 | 100% | 10 | CY | 2,763,567 | 12 | 1028.1 | 102.81 |
| *Line Main Canal* | | | | | | | | |
| Shape Embankments | 181.25 | 100% | 10 | SY | 2,413,817 | 6 | 2219.6 | 221.96 |
| Geomembrane | 8.13 | 100% | 10 | MSF | 22,811 | 6 | 467.9 | 46.79 |
| Shotcrete Placement | 337.50 | 100% | 10 | SF | 21,724,353 | 6 | 10728.1 | 1072.81 |

**Durations per Typical Check Structure**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| *Earthwork* | | | | | | | | |
| Structural Excavation | 14.50 | 100% | 10 | CY | 25 | 1 | 1.7 | 0.17 |
| Structural Backfill | 56.88 | 100% | 10 | CY | 29 | 1 | 0.5 | 0.05 |
| *Reinforced Concrete* | | | | | | | | |
| Concrete Forms | 49.38 | 100% | 10 | SFC | 900 | 1 | 18.2 | 1.82 |
| Reinforcing Steel | 0.09 | 100% | 10 | TON | 3.4 | 1 | 36.2 | 3.62 |
| Concrete Placing | 15.00 | 100% | 10 | CY | 50 | 1 | 3.3 | 0.33 |
| *Remaining Check Structure Items* | | | | | | | | |
| Hydraulic Gates and Controllers | 0.01 | 100% | 10 | EA | 1 | 1 | 80.0 | 8.00 |
| Riprap Placement | 28.00 | 100% | 10 | CY | 50 | 1 | 1.8 | 0.18 |

**Flow Measuring Devices per 1-ea**

| Item | Prod. Rate | Prod. Index | Work Hrs/Day | UOM | Quantity | Crews (EA) | Duration (Hrs.) | Duration (Days) |
|---|---|---|---|---|---|---|---|---|
| Lateral Turnouts at Main Canal | | | | | | | | |
| *Cipolletti Weir* | | | | | | | | |
| Excavation | 9.00 | 100% | 10 | CY | 9 | 1 | 1.0 | 0.10 |
| Reinforced Concrete Placement | 4.00 | 100% | 10 | CY | 4.5 | 1 | 1.1 | 0.11 |
| Backfill | 9.00 | 100% | 10 | CY | 9 | 1 | 1.0 | 0.10 |
| *Parshall Flume* | | | | | | | | |
| Excavation | 9.00 | 100% | 10 | CY | 28 | 1 | 3.1 | 0.31 |
| Reinforced Concrete Placement | 8.28 | 100% | 10 | CY | 27.9 | 1 | 3.4 | 0.34 |
| Backfill | 9.00 | 100% | 10 | CY | 28 | 1 | 3.1 | 0.31 |
| Sublateral Turnouts | | | | | | | | |
| *Cipolletti Weir* | | | | | | | | |
| Excavation | 8.00 | 100% | 10 | CY | 8 | 1 | 1.0 | 0.10 |
| Reinforced Concrete Placement | 4.00 | 100% | 10 | CY | 8.0 | 1 | 2.0 | 0.20 |
| Backfill | 8.00 | 100% | 10 | CY | 8 | 1 | 1.0 | 0.10 |
| *Parshall Flume* | | | | | | | | |
| Excavation | 10.60 | 100% | 10 | CY | 40 | 1 | 3.7 | 0.37 |
| Reinforced Concrete Placement | 8.28 | 100% | 10 | CY | 19.8 | 1 | 2.4 | 0.24 |
| Backfill | 19.80 | 100% | 10 | CY | 40 | 1 | 2.0 | 0.20 |

# Attachment B.7
# MCACES Construction Cost Estimate Summaries

# Rock Ramp MCACES Summary

| | |
|---|---|
| Estimated by | CENWO-ED-C |
| Designed by | Omaha District COE |
| Prepared by | Gary Norenberg |
| Preparation Date | 4/13/2011 |
| Effective Date of Pricing | 4/13/2011 |
| Estimated Construction Time | Days |

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| Description | Quantity | UOM | ContractCost | ProjectCost | CostOverride |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **55,409,363** | **55,409,363** | |
| **Rock Ramp Options** | **1.00** | **LS** | **55,409,363** | **55,409,363** | |
| **Coffer Dam Alternatives** | **1.00** | **LS** | **3,850,361** | **3,850,361** | |
| **3 Partial Coffer Dam Alternative** | **1.00** | **LS** | **3,850,361** | **3,850,361** | |
| **Crest Structure Alternatives** | **1.00** | **LS** | **8,268,256** | **8,268,256** | |
| **1 Concrete Crest Structure** | **1.00** | **LS** | **8,268,256** | **8,268,256** | |
| **Rock Ramp Alternatives** | **1.00** | **LS** | **42,351,677** | **42,351,677** | |
| **1 Original Design Rock Ramp** | **1.00** | **LS** | **42,351,677** | **42,351,677** | |
| **Project Costs** | **1.00** | **LS** | **939,069** | **939,069** | |
| **All Remaining Work** | **1.00** | **LS** | **939,069** | **939,069** | |

# Bypass Channel MCACES Summary

Added Markups:

Contingencies from CSRA, 80% confidence - 28%

Escalation from TPCS

-Construction - 1.6%

-E&D, S&A - 2.9%

| | |
|---|---|
| Estimated by | CENWO-ED-C |
| Designed by | Omaha & Portland Districts, COEÐ'A |
| Prepared by | Gary Norenberg |
| Preparation Date | 3/13/2015 |
| Effective Date of Pricing | 2/17/2015 |
| Estimated Construction Time | 720 Days |

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| Description | Quantity | UOM | ContractCost | ProjectCost | CostOverride |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **48,487,112** | **48,487,112** | |
| **Selected Plan - 15% Diversion Channel** | **1.00** | **LS** | **48,487,112** | **48,487,112** | |
| **1 Construction Costs** | **1.00** | **LS** | **48,487,112** | **48,487,112** | |
| **CWWBS 09 01 Bypass Channel** | **1.00** | **LS** | **17,707,099** | **17,707,099** | |
| **CWWBS 15 Intake Weir** | **1.00** | **LS** | **12,065,928** | **12,065,928** | |
| **CWWBS 16 Bank Stabilization Rock** | **1.00** | **LS** | **18,714,085** | **18,714,085** | |

# Modified Side Channel MCACES Summary

| | |
|---|---|
| Estimated by | Tetra Tech, Inc. |
| Designed by | Tetra Tech, Inc. |
| Prepared by | Tetra Tech, Inc |
| Preparation Date | 5/19/2016 |
| Effective Date of Pricing | 5/19/2016 |
| Estimated Construction Time | 435 Days |

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| Description | Quantity | UOM | ContractCost | ProjectCost | CostOverride |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **35,180,547** | **35,180,547** | |
| **Yellowstone River - Modified Side Channel Alternative** | **1.00** | **LS** | **35,180,547** | **35,180,547** | |
| **08 Roads, Railroads and Bridges** | **1.00** | **LS** | **1,041,844** | **1,041,844** | |
| **08 01 Bridge** | **1.00** | **LS** | **1,041,844** | **1,041,844** | |
| **09 Channels and Canals** | **1.00** | **LS** | **16,702,882** | **16,702,882** | |
| **09 01 Channels** | **1.00** | **LS** | **16,702,882** | **16,702,882** | |
| **16 Bank Stabilization** | **1.00** | **LS** | **17,435,821** | **17,435,821** | |
| **16 01 Channel Armoring** | **1.00** | **LS** | **17,435,821** | **17,435,821** | |

# Multiple Pump MCACES Summary

| | |
|---|---|
| Estimated by | Tetra Tech, Inc. |
| Designed by | Tetra Tech, Inc. |
| Prepared by | Tetra Tech, Inc |
| Preparation Date | 5/19/2016 |
| Effective Date of Pricing | 5/19/2016 |
| Estimated Construction Time | 800 Days |

This report is not copyrighted, but the information contained herein is For Official Use Only.

| Description | Quantity | UOM | ContractCost | ProjectCost | CostOverride |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **84,277,276** | **84,277,276** | |
| **Yellowstone River - Multiple Pump Alternative** | **1.00** | **LS** | **84,277,276** | **84,277,276** | |
| **04 Dams** | **1.00** | **LS** | **6,599,764** | **6,599,764** | |
| **04 01 Existing Timber Dam Removal** | **1.00** | **LS** | **6,599,764** | **6,599,764** | |
| | | | *15,535,502.33* | *15,535,502.33* | |
| **19 Buildings, Grounds & Utilities** | **5.00** | **EA** | **77,677,512** | **77,677,512** | |
| | | | *10,483,659.19* | *10,483,659.19* | |
| **19 01 Pump Station - Site 1** | **1.00** | **EA** | **10,483,659** | **10,483,659** | |
| | | | *12,650,555.78* | *12,650,555.78* | |
| **19 02 Pump Station - Site 2** | **1.00** | **EA** | **12,650,556** | **12,650,556** | |
| | | | *22,012,550.11* | *22,012,550.11* | |
| **19 03 Pump Station - Site 3** | **1.00** | **EA** | **22,012,550** | **22,012,550** | |
| | | | *17,835,852.83* | *17,835,852.83* | |
| **19 04 Pump Station - Site 4** | **1.00** | **EA** | **17,835,853** | **17,835,853** | |
| | | | *14,694,893.73* | *14,694,893.73* | |
| **19 05 Pump Station - Site 5** | **1.00** | **EA** | **14,694,894** | **14,694,894** | |

# Multiple Pumps with Conservation Measures MCACES Summary

| | |
|---|---|
| Estimated by | Tetra Tech, Inc. |
| Designed by | Tetra Tech, Inc. |
| Prepared by | Tetra Tech, Inc |
| Preparation Date | 5/19/2016 |
| Effective Date of Pricing | 5/19/2016 |
| Estimated Construction Time | 2,750 Days |

This report is not copyrighted, but the information contained herein is For Official Use Only.

| Description | Quantity | UOM | ContractCost | ProjectCost | CostOverride |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **313,059,999** | **313,059,999** | |
| **Yellowstone River - Multiple Pumps with Conservation Measures Alternative** | **1.00** | **LS** | **313,059,999** | **313,059,999** | |
| **04 Dams** | **1.00** | **LS** | **7,036,521** | **7,036,521** | |
| **04 01 Existing Timber Dam Removal** | **1.00** | **LS** | **7,036,521** | **7,036,521** | |
| **09 Channels and Canals** | **1.00** | **LS** | **195,852,565** | **195,852,565** | |
| **09 02 Convert Laterals From Ditches to Pipe** | **1.00** | **LS** | **62,146,232** | **62,146,232** | |
| **09 03 Line Open Canals** | **1.00** | **LS** | **130,070,099** | **130,070,099** | |
| **09 04 Check Structures** | **1.00** | **LS** | **2,648,406** | **2,648,406** | |
| **09 05 Flow Measuring Devices** | **1.00** | **LS** | **987,828** | **987,828** | |
| **19 Buildings, Grounds and Utilities** | **1.00** | **LS** | **18,702,727** | **18,702,727** | |
| **19 01 Convert Fields From Flood Irrigation to Sprinklers** | **1.00** | **LS** | **15,118,390** | **15,118,390** | |
| **19 02 Renewable Energy Resources** | **1.00** | **LS** | **3,584,337** | **3,584,337** | |
| **20 Permanent Operating Equipment** | **1.00** | **LS** | **91,468,186** | **91,468,186** | |
| **20 01 Ranney Wells** | **1.00** | **LS** | **91,468,186** | **91,468,186** | |

# Attachment B.8
# Operations, Maintenance & Repair Cost Estimates

# No Action OM&R Costs

## NO ACTION ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| **Main Canal, Laterals, Drains** | | | |
| 1 | Main Canal, Laterals, Drains | $ 1,875,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| **Headworks** | | | |
| 2 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 3 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 4 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 5 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 6 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 7 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 8 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| **Diversion Dam** | | | |
| 9 | Diversion Dam Maintenance | $ 77,000.00 | Average cost over the last 3 years (2013, 2014, 2015) and 2012 Rocking Event. James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) It is considered resonable and prudent that the LYP would not replace the existing diversion dam. They would just continue to rock. The blue book is a guide developed for financial purposes; it is helpful information that we are taking into consideration along with LYP's real world experience with these features and equipment to identify estimates based on best available information. |
| **Rocking Structure** | | | |
| 10 | Trolley Rehab | $ 150,000.00 | Replacement at 7 years and not again during the 50 years. The south rocking tower was replaced in the 1990s for approximately $35,000. This number represents replacement of both towers. Also considered is the inflation of costs since the 90's. |
| 11 | Cable Replacement | $ 127,000.00 | Assumes 1 replacement every 50 years. Shawn Higley Email to David Trimpe April 25, 2016 (SWR Enquiry). |
| **Pumps** | | | |
| 12 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| **Admin. Costs** | | | |
| 13 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| **ESA Monitoring Costs** | | | |
| 14 | Passage and Entrainment Monitoring | $ 400,000.00 | Per David Trimpe BOR. Current Monitoring Costs. It is resonable to assume that Reclamation would be required to monitor for at least the first 8 Years. |

| | |
|---|---|
| Discount Rate (2016): | 3.125% |
| Net Present Value of O&M: | $ 66,419,873 |
| Average Annual O&M: | $ 2,643,043 |
| Cost Per Acre (56,799): | $ 46.53 |

## NO ACTION ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | End of Construction | | | | | | | | $ - | 1.0000 | $ - |
| 1 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.9697 | $ 2,652,121 |
| 2 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.9403 | $ 2,571,754 |
| 3 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.9118 | $ 2,493,822 |
| 4 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.8842 | $ 2,418,252 |
| 5 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 3,215,000 | 0.8574 | $ 2,756,520 |
| 6 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.8314 | $ 2,273,912 |
| 7 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | $ 150,000 | $ 127,000 | $ 235,000 | $ 61,000 | $ 400,000 | $ 3,012,000 | 0.8062 | $ 2,428,327 |
| 8 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | $ 400,000 | $ 2,735,000 | 0.7818 | $ 2,138,187 |
| 9 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.7581 | $ 1,770,155 |
| 10 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,935,000 | 0.7351 | $ 2,157,588 |
| 11 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.7128 | $ 1,664,498 |
| 12 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.6912 | $ 1,614,059 |
| 13 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.6703 | $ 1,565,148 |
| 14 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.6500 | $ 1,517,719 |
| 15 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,815,000 | 0.6303 | $ 1,774,267 |
| 16 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.6112 | $ 1,427,130 |
| 17 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.5927 | $ 1,383,884 |
| 18 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.5747 | $ 1,341,948 |
| 19 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.5573 | $ 1,301,283 |
| 20 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,935,000 | 0.5404 | $ 1,586,094 |
| 21 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.5240 | $ 1,223,612 |
| 22 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.5082 | $ 1,186,533 |
| 23 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4928 | $ 1,150,577 |
| 24 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4778 | $ 1,115,711 |
| 25 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 6,055,000 | 0.4633 | $ 2,805,531 |
| 26 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4493 | $ 1,049,117 |
| 27 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4357 | $ 1,017,325 |
| 28 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4225 | $ 986,497 |
| 29 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.4097 | $ 956,604 |
| 30 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,935,000 | 0.3973 | $ 1,165,975 |
| 31 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3852 | $ 899,506 |
| 32 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3736 | $ 872,248 |
| 33 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3622 | $ 845,817 |
| 34 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3513 | $ 820,186 |
| 35 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,815,000 | 0.3406 | $ 958,826 |
| 36 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3303 | $ 771,231 |
| 37 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3203 | $ 747,860 |
| 38 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3106 | $ 725,198 |
| 39 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.3012 | $ 703,222 |
| 40 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,935,000 | 0.2920 | $ 857,136 |
| 41 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2832 | $ 661,248 |
| 42 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2746 | $ 641,210 |
| 43 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2663 | $ 621,780 |
| 44 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2582 | $ 602,938 |
| 45 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,815,000 | 0.2504 | $ 704,856 |
| 46 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2428 | $ 566,950 |
| 47 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2354 | $ 549,770 |
| 48 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2283 | $ 533,110 |
| 49 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 2,335,000 | 0.2214 | $ 516,955 |
| 50 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 235,000 | $ 61,000 | | $ 6,175,000 | 0.2147 | $ 1,325,681 |
| Total Cost: | $ 47,118,893 | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 1,935,016 | $ 120,933 | $ 102,390 | $ 5,905,568 | $ 1,532,935 | $ 2,793,130 | | Net Present Value: | $ 66,419,873 |
| Annual Cost: | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 55,041 | $ 32,377 | $ 45,092 | $ 45,092 | $ 10,408 | $ 77,000 | $ 4,812 | $ 4,074 | $ 235,000 | $ 61,000 | $ 111,147 | | Average Annual: | $2,643,043 |

# Rock Ramp OM&R Costs

## ROCK RAMP ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| | | | **Main Canal, Laterals, Drains** |
| 1 | Main Canal, Laterals, Drains | $ 1,875,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Headworks** |
| 2 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 3 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 4 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 5 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 6 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 7 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 8 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| | | | **Diversion Dam** |
| 9 | Diversion Dam Maintenance | $ 10,000.00 | Estimate from 2015 EA |
| | | | **Rock Ramp** |
| 10 | Minor Rock Repairs | $ 128,000.00 | Estimate from 2015 EA |
| 11 | Place Rock (Major Repair) | $ 250,000.00 | Every 10 years, assumes 5% riprap placed (TT Estimate) |
| 12 | Coffer Dam (Major Repair) | $ 1,000,000.00 | Every 10 years, coffer off section of river (TT Estimate) |
| 13 | Barge Cost (Major Repair) | $ 100,000.00 | Every 10 Years (TT Estimate) |
| | | | **Pumps** |
| 14 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Admin. Costs** |
| 15 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **ESA Monitoring Costs** |
| 16 | Passage and Entrainment Monitoring | $ 500,000.00 | Per David Trimpe BOR. Anticipated costs for entrainment and passage monitoring. Approximately $200,000 each. Hydrologic criteria monitoring would be another $100,000. It is resonable to assume that Reclamation would be required to monitor for at least the first 8 Years. |

| | |
|---|---|
| Discount Rate (2016) | 3.125% |
| Net Present Value of O&M | $ 71,370,121 |
| Average Annual O&M | $ 2,840,028 |
| Cost Per Acre (56,799 acres) | $ 50.00 |

## ROCK RAMP ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | End of Construction | | | | | | | | | $ - | 1.000 | $ - |
| 1 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.970 | $ 2,808,242 |
| 2 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.940 | $ 2,723,144 |
| 3 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.912 | $ 2,640,625 |
| 4 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.884 | $ 2,560,606 |
| 5 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 3,376,000 | 0.857 | $ 2,894,560 |
| 6 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.831 | $ 2,407,769 |
| 7 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.806 | $ 2,334,806 |
| 8 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,896,000 | 0.782 | $ 2,264,054 |
| 9 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.758 | $ 1,816,399 |
| 10 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 128,000 | $ 250,000 | $ 1,000,000 | $ 100,000 | $ 235,000 | $ 61,000 | | $ 4,346,000 | 0.735 | $ 3,194,847 |
| 11 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.713 | $ 1,707,982 |
| 12 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.691 | $ 1,656,225 |
| 13 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.670 | $ 1,606,036 |
| 14 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.650 | $ 1,557,368 |
| 15 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,876,000 | 0.630 | $ 1,812,715 |
| 16 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.611 | $ 1,464,413 |
| 17 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.593 | $ 1,420,036 |
| 18 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.575 | $ 1,377,005 |
| 19 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.557 | $ 1,335,278 |
| 20 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 128,000 | $ 250,000 | $ 1,000,000 | $ 100,000 | $ 235,000 | $ 61,000 | | $ 4,346,000 | 0.540 | $ 2,348,608 |
| 21 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.524 | $ 1,255,578 |
| 22 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.508 | $ 1,217,530 |
| 23 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.493 | $ 1,180,635 |
| 24 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.478 | $ 1,144,858 |
| 25 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 6,116,000 | 0.463 | $ 2,833,795 |
| 26 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.449 | $ 1,076,524 |
| 27 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.436 | $ 1,043,902 |
| 28 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.422 | $ 1,012,269 |
| 29 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.410 | $ 981,594 |
| 30 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 128,000 | $ 250,000 | $ 1,000,000 | $ 100,000 | $ 235,000 | $ 61,000 | | $ 4,346,000 | 0.397 | $ 1,726,517 |
| 31 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.385 | $ 923,005 |
| 32 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.374 | $ 895,035 |
| 33 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.362 | $ 867,913 |
| 34 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.351 | $ 841,612 |
| 35 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,876,000 | 0.341 | $ 979,603 |
| 36 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.330 | $ 791,378 |
| 37 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.320 | $ 767,397 |
| 38 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.311 | $ 744,143 |
| 39 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.301 | $ 721,593 |
| 40 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 128,000 | $ 250,000 | $ 1,000,000 | $ 100,000 | $ 235,000 | $ 61,000 | | $ 4,346,000 | 0.292 | $ 1,269,203 |
| 41 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.283 | $ 678,523 |
| 42 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.275 | $ 657,961 |
| 43 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.266 | $ 638,023 |
| 44 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.258 | $ 618,689 |
| 45 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,876,000 | 0.250 | $ 720,130 |
| 46 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.243 | $ 581,761 |
| 47 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.235 | $ 564,132 |
| 48 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.228 | $ 547,037 |
| 49 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | $ 128,000 | | | | $ 235,000 | $ 61,000 | | $ 2,396,000 | 0.221 | $ 530,460 |
| 50 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 128,000 | $ 250,000 | $ 1,000,000 | $ 100,000 | $ 235,000 | $ 61,000 | | $ 7,586,000 | 0.215 | $ 1,628,601 |
| Total Cost: | $ 47,118,893 | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 251,301 | $ 3,216,650 | $ 544,880 | $ 2,179,521 | $ 217,952 | $ 5,905,568 | $ 1,532,935 | $ 3,491,412 | | Net Present Value: | $ 71,370,121 |
| Annual Cost: | $1,875,000 | $10,000 | $77,000 | $55,041 | $32,377 | $45,092 | $45,092 | $10,408 | $10,000 | $128,000 | $21,682 | $86,730 | $8,673 | $235,000 | $61,000 | $138,934 | | Average Annual: | $2,840,028 |

# Bypass Channel OM&R Costs

## BYPASS CHANNEL ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| | | | **Main Canal, Laterals, Drains** |
| 1 | Main Canal, Laterals, Drains | $ 1,875,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Headworks** |
| 2 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 3 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 4 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 5 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 6 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 7 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 8 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| | | | **Diversion Dam** |
| 9 | Diversion Dam Maintenance | $ 10,000.00 | Estimate from 2015 EA |
| 10 | Rock Replacement (Major Repair) | $ 100,000.00 | Every 5 Years - This cost is assuming a routine amont of scour behind new diversion structure. Already spending 77,000 for rock costs under no action. |
| 11 | Barge Cost (Major Repair) | $ 100,000.00 | Every 5 Years - This cost is assuming a routine amont of scour behind new diversion structure |
| | | | **Bypass Channel** |
| 12 | Bypass Channel (Minor Repairs) | $ 57,000.00 | Cost Estimate from 2015 EA. This includes minor repairs and riprap replacement in bypass channel |
| 13 | Coffer Dam (Major Repairs) | $ 500,000.00 | Every 10 years (TT Estimate) |
| 14 | Riprap Repairs (Major Repairs) | $ 400,000.00 | Assumes 2.5% Replacement every 10 Years |
| 15 | Channel Repairs | $ 150,000.00 | Assumes 1% of excavation every 5 years |
| 16 | Bypass Channel Inspection | $ 3,000.00 | $1,500 per inspection - twice a year. Lower cost than modified side channel because they bypass channel is much shorter. |
| | | | **Pumps** |
| 17 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Admin. Costs** |
| 18 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **ESA Monitoring Costs** |
| 19 | Passage and Entrainment Monitoring | $ 500,000.00 | Per David Trimpe BOR. Anticipated costs for entrainment and passage monitoring. Approximately $200,000 each. Hydrologic criteria monitoring would be another $100,000. It is resonable to assume that Reclamation would be required to monitor for at least the first 8 Years. |

| | |
|---|---|
| Discount Rate (2016) | 3.125% |
| Net Present Value of O&M | $ 70,333,034 |
| Average Annual O&M | $ 2,798,759 |
| Cost Per Acre (56,799 acres) | $ 49.27 |

## BYPASS CHANNEL ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | End of Construction | | | | | | | | | | | $ - | 1.0000 | $ - |
| 1 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.9697 | $ 2,742,303 |
| 2 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.9403 | $ 2,659,203 |
| 3 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.9118 | $ 2,578,621 |
| 4 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.8842 | $ 2,500,481 |
| 5 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | | | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 3,658,000.00 | 0.8574 | $ 3,136,345 |
| 6 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.8314 | $ 2,351,233 |
| 7 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.8062 | $ 2,279,983 |
| 8 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,828,000.00 | 0.7818 | $ 2,210,893 |
| 9 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.7581 | $ 1,764,848 |
| 10 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | $ 500,000 | $ 400,000 | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 4,178,000.00 | 0.7351 | $ 3,071,347 |
| 11 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.7128 | $ 1,659,508 |
| 12 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.6912 | $ 1,609,220 |
| 13 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.6703 | $ 1,560,456 |
| 14 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.6500 | $ 1,513,169 |
| 15 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | | | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 3,158,000.00 | 0.6303 | $ 1,990,457 |
| 16 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.6112 | $ 1,422,852 |
| 17 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.5927 | $ 1,379,735 |
| 18 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.5747 | $ 1,337,925 |
| 19 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.5573 | $ 1,297,382 |
| 20 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | $ 500,000 | $ 400,000 | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 4,178,000.00 | 0.5404 | $ 2,257,819 |
| 21 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.5240 | $ 1,219,944 |
| 22 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.5082 | $ 1,182,976 |
| 23 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4928 | $ 1,147,128 |
| 24 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4778 | $ 1,112,366 |
| 25 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | | | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 6,398,000.00 | 0.4633 | $ 2,964,457 |
| 26 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4493 | $ 1,045,972 |
| 27 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4357 | $ 1,014,276 |
| 28 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4225 | $ 983,540 |
| 29 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.4097 | $ 953,736 |
| 30 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | $ 500,000 | $ 400,000 | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 4,178,000.00 | 0.3973 | $ 1,659,776 |
| 31 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3852 | $ 896,809 |
| 32 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3736 | $ 869,633 |
| 33 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3622 | $ 843,281 |
| 34 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3513 | $ 817,727 |
| 35 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | | | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 3,158,000.00 | 0.3406 | $ 1,075,656 |
| 36 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3303 | $ 768,919 |
| 37 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3203 | $ 745,618 |
| 38 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3106 | $ 723,024 |
| 39 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.3012 | $ 701,114 |
| 40 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | $ 500,000 | $ 400,000 | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 4,178,000.00 | 0.2920 | $ 1,220,141 |
| 41 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2832 | $ 659,266 |
| 42 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2746 | $ 639,288 |
| 43 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2663 | $ 619,916 |
| 44 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2582 | $ 601,130 |
| 45 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | | | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 3,158,000.00 | 0.2504 | $ 790,740 |
| 46 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2428 | $ 565,250 |
| 47 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2354 | $ 548,121 |
| 48 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2283 | $ 531,512 |
| 49 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 10,000 | | | $ 57,000 | | | | $ 3,000 | $ 235,000 | $ 61,000 | | $ 2,328,000.00 | 0.2214 | $ 515,405 |
| 50 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 10,000 | $ 100,000 | $ 100,000 | $ 57,000 | $ 500,000 | $ 400,000 | $ 150,000 | $ 3,000 | $ 235,000 | $ 61,000 | | $ 7,418,000.00 | 0.2147 | $ 1,592,534 |
| Total Cost: | $ 47,118,893 | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 251,301 | $ 472,155 | $ 472,155 | $ 1,432,414 | $ 1,089,760 | $ 871,808 | $ 708,233 | $ 75,390 | $ 5,905,568 | $ 1,532,935 | $ 3,491,412 | | Net Present Value: | $ 70,333,034 |
| Annual Cost: | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 55,041 | $ 32,377 | $ 45,092 | $ 45,092 | $ 10,408 | $ 10,000 | $ 18,788 | $ 18,788 | $ 57,000 | $ 43,365 | $ 34,692 | $ 28,183 | $ 3,000 | $ 235,000 | $ 61,000 | $ 138,934 | | Average Annual: | $ 2,798,759 |

# Modified Side Channel OM&R Costs

## MODIFIED SIDE CHANNEL ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| | | | **Main Canal, Laterals, Drains** |
| 1 | Main Canal, Laterals, Drains | $ 1,875,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Headworks** |
| 2 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 3 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 4 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 5 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 6 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 7 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 8 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| | | | **Diversion Dam** |
| 9 | Diversion Dam Maintenance | $ 77,000.00 | Average cost over the last 3 years (2013, 2014, 2015) and 2012 Rocking Event. James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) It is considered resonable and prudent that the LYP would not replace the existing diversion dam. They would just continue to rock. The blue book is a guide developed for financial purposes; it is helpful information that we are taking into consideration along with LYP's real world experience with these features and equipment to identify estimates based on best available information. |
| | | | **Rocking Structure** |
| 10 | Trolley Rehab | $ 150,000.00 | Replacement at 7 years and not again in 50. The south rocking tower was replaced in the 1990s for approximately $35,000. This number represents replacement of both towers and cable. Also considered is the inflation of costs since the 90's. |
| 11 | Cable Replacement | $ 127,000.00 | Assumes 1 replacement every 50 years. Shawn Higley Email to David Trimpe April 25, 2016 (SWR Enquiry) |
| | | | **Modified Channel** |
| 12 | Minor Channel Repairs | $ 100,000.00 | This includes minor repairs and riprap replacement in the modified Channel. Slightly higher than the bypass channel because of additional length. Accounts for modifications needed for Boxelder Creek and runoff from county road 303. |
| 13 | Coffer Dam (Major Repair) | $ 500,000.00 | Every 10 years (TT Estimate) |
| 14 | Riprap (Major Repair) | $ 450,000.00 | Assumes 2.5% Replacement every 10 Years (TT estimate) |
| 15 | Channel Excavation (Major Repair) | $ 125,000.00 | Assumes 1% of excavation every 5 years (TT estimate). |
| 16 | Channel Inspection | $ 5,000.00 | $2,500 per inspection - twice a year. Higher cost than the bypass channel because this channel is much longer (TT estimate). |
| | | | **Bridge Maintenance** |
| 17 | Bridge Maintenance | $ 25,000.00 | Assumes 2.5% per year (TT estimate) |
| | | | **Pumps** |
| 18 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Admin. Costs** |
| 19 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **ESA Monitoring Costs** |
| 20 | Passage and Entrainment Monitoring | $ 500,000.00 | Per David Trimpe BOR. Anticipated costs for entrainment and passage monitoring. Approximately $200,000 each. Hydrologic criteria monitoring would be another $100,000. It is resonable to assume that Reclamation would be required to monitor for at least the first 8 Years. |

| | |
|---|---|
| Discount Rate (2016) | 3.125% |
| Net Present Value of O&M | $ 73,045,804 |
| Average Annual O&M | $ 2,906,708 |
| Cost Per Acre (56,799 acres) | $ 51.18 |

## MODIFIED SIDE CHANNEL ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | End of Construction | | | | | | | | | | | $ - | 1.0000 | $ - |
| 1 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.9697 | $ 2,875,152 |
| 2 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.9403 | $ 2,788,026 |
| 3 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.9118 | $ 2,703,540 |
| 4 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.8842 | $ 2,621,615 |
| 5 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 100,000 | | | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 3,570,000 | 0.8574 | $ 3,060,895 |
| 6 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.8314 | $ 2,465,136 |
| 7 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | $ 150,000 | $ 127,000 | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 3,242,000 | 0.8062 | $ 2,613,757 |
| 8 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | $ 500,000 | $ 2,965,000 | 0.7818 | $ 2,317,998 |
| 9 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.7581 | $ 1,868,707 |
| 10 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 100,000 | $ 500,000 | $ 450,000 | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 4,140,000 | 0.7351 | $ 3,043,412 |
| 11 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.7128 | $ 1,757,168 |
| 12 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.6912 | $ 1,703,921 |
| 13 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.6703 | $ 1,652,287 |
| 14 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.6500 | $ 1,602,217 |
| 15 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 100,000 | | | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 3,070,000 | 0.6303 | $ 1,934,991 |
| 16 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.6112 | $ 1,506,585 |
| 17 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.5927 | $ 1,460,931 |
| 18 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.5747 | $ 1,416,660 |
| 19 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.5573 | $ 1,373,731 |
| 20 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 100,000 | $ 500,000 | $ 450,000 | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 4,140,000 | 0.5404 | $ 2,237,284 |
| 21 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.5240 | $ 1,291,736 |
| 22 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.5082 | $ 1,252,592 |
| 23 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4928 | $ 1,214,635 |
| 24 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4778 | $ 1,177,828 |
| 25 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 100,000 | | | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 6,310,000 | 0.4633 | $ 2,923,683 |
| 26 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4493 | $ 1,107,526 |
| 27 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4357 | $ 1,073,965 |
| 28 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4225 | $ 1,041,420 |
| 29 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.4097 | $ 1,009,862 |
| 30 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 100,000 | $ 500,000 | $ 450,000 | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 4,140,000 | 0.3973 | $ 1,644,680 |
| 31 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3852 | $ 949,586 |
| 32 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3736 | $ 920,810 |
| 33 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3622 | $ 892,907 |
| 34 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3513 | $ 865,849 |
| 35 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 100,000 | | | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 3,070,000 | 0.3406 | $ 1,045,682 |
| 36 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3303 | $ 814,169 |
| 37 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3203 | $ 789,497 |
| 38 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3106 | $ 765,573 |
| 39 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.3012 | $ 742,373 |
| 40 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 100,000 | $ 500,000 | $ 450,000 | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 4,140,000 | 0.2920 | $ 1,209,043 |
| 41 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2832 | $ 698,063 |
| 42 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2746 | $ 676,909 |
| 43 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2663 | $ 656,397 |
| 44 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2582 | $ 636,506 |
| 45 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 77,000 | | | $ 100,000 | | | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 3,070,000 | 0.2504 | $ 768,706 |
| 46 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2428 | $ 598,515 |
| 47 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2354 | $ 580,378 |
| 48 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2283 | $ 562,791 |
| 49 | $ 1,875,000 | $ 10,000 | $ 77,000 | | | | | | $ 77,000 | | | $ 100,000 | | | | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 2,465,000 | 0.2214 | $ 545,736 |
| 50 | $ 1,875,000 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 77,000 | | | $ 100,000 | $ 500,000 | $ 450,000 | $ 125,000 | $ 5,000 | $ 25,000 | $ 235,000 | $ 61,000 | | $ 7,380,000 | 0.2147 | $ 1,584,376 |
| Total Cost: | $ 47,118,893 | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 1,935,016 | $ 120,933 | $ 102,390 | $ 2,513,008 | $ 1,089,760 | $ 980,784 | $ 590,194 | $ 125,650 | $ 628,252 | $ 5,905,568 | $ 1,532,935 | $ 3,491,412 | | Net Present Value: | $ 73,045,804 |
| Annual Cost: | $1,875,000 | $10,000 | $77,000 | $55,041 | $32,377 | $45,092 | $45,092 | $10,408 | $77,000 | $4,812 | $4,074 | $100,000 | $43,365 | $39,028 | $23,486 | $5,000 | $25,000 | $235,000 | $61,000 | $138,934 | | Average Annual: | $ 2,906,708 |

## MULTIPLE PUMP STATIONS ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| | | | **Main Canal, Laterals, Drains** |
| 1 | Main Canal, Laterals, Drains | $ 1,875,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| 2 | Sediment Removal | $ - | We do not anticipate a significant increase in sediment accumulation in the main canal and laterals as a result of this alternative. Water would be supplied from the Pump Stations only during the low-river-flow periods and should have comparatively low sediment loads. During high-river-flow periods when sediment loads are higher, water would be supplied only from the upstream end, which would not represent a change from the existing condition and is not expected to increase sedimentation. |
| | | | **Headworks** |
| 3 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 4 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 5 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 6 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 7 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 8 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 9 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| | | | **Pumps** |
| 10 | Lateral Pumps | $ 50,000.00 | Small Lateral Pumps (TT estimate) Lateral AA through FF |
| 11 | Large Pumps Rehab | $ 2,000,000.00 | Rehab of 1 pump at each pumping facility is $100,000, four pumps per stations, five pumping stations. Rehab of individual pump every 4 years. Based on BRID #1 (assumes turbine pumps not submersible) |
| 12 | Large Pump Motors Rehab | $ 100,000.00 | Estimate $5k per year, per motor (average) |
| 13 | Large Pumps Replacement | $ 4,400,000.00 | Once at 35 years - Based on Reclamation and WAPA Blue Book - Life expectancy of structures and experience with life expectancy of LYP existing pumps. Estimate pump cost at $220,000 each. |
| 14 | Large Pump Motor Replacement | $ 4,400,000.00 | Once at 50 years - Based on Reclamation and WAPA Blue Book - Life expectancy of structures and experience with life expectancy of LYP existing motors. Estimate motor cost at $220,000 each. |
| 15 | Pump House Maintenance | $ 10,000.00 | Per Year - Tetra Tech Estimate |
| 16 | Pump and Motor Removal and Install | $ 200,000.00 | Assumes 5 pumps would be pulled and replaced each year at 10,000 per pump. Pull and replace each pump every 4 years. (Assumes no gantry at each pump station) |
| 17 | Control Panel and Electronics | $ 5,000.00 | Assume $1000/yr per site, average across all years. |
| 18 | Man Power to Maintain and Operate Pump sites | $ 240,000.00 | 4 workers at $60,000 per worker. Oversite and Operation during irrigation season - Maintenance activites on pumps during the off season |
| 19 | Vehicle | $ 64,152.00 | Mileage - 54 cents by 180 miles by 165 Days by 4 vehicles. (Government Rate by Mileage by length of irrigation season by 4 people) (4th Person is night shift) |
| 20 | Power Costs | $ 163,317.00 | Using Pick-Sloan rates, includes upfront capacity charge of $6,546,687.50 in year 1 plus $163,317 per year over duration of project. |
| 21 | Service discharge pipes and valves | $ 400,000.00 | Estimate a 25 year life on gate and check valves, with a replacement cost of $10,000 each. Total: 40 valves @ $10,000 = $400,000 at 25 years and at 50 years. |
| 22 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Inlet Channel and Fish Screens** |
| 23 | Fish Screens | $ 20,000.00 | Need to include service life for screen cleaning device (TT Help) How are ice concerns addressed? If its still removing screens we need to account for this cost. Also if screens are removed every year need to account for spring calibration (adjusting baffles ie flow velocity)<br>Maintain fish screen cleaners every 5 years (1 site every year) at $20,000, based on costs for existing screen system. Screen cleaner replacement included in next line item. |
| 24 | Fish Screen and Cleaner Replacement | $ 6,904,000.00 | Expected life 25 years for screens and cleaners - Assuming the same as headworks screen life. |
| 25 | Dewatering and Sediment Removal from Fish Screens | $ 150,000.00 | Annual Cost - sediment removal, stop log removal and replacement, crane costs. |
| 26 | Sediment Removal from Feeder Canal | $ 300,000.00 | Annual Cost - 2,800 cy ever year per pumping station. $60,000 per pumping station |
| 27 | Trash Rack Cleaning - Manual | $ 48,600.00 | Assume manually cleaned every 2 weeks while in operation, 2 people for 8 hours at each site. Estimate $48,600 per year for 2 half-time staff for 6 months per year, using same rate as for ditch riders. |
| 28 | Bank Stabilization | $ 66,000.00 | Every 5 Years - a total of 6,000-ft to be placed over 50-yrs (Previous estimate of 5000-ft was increased by 20% to include the ice protection berms) |
| | | | **Admin. Costs** |
| 29 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **ESA Monitoring Costs** |
| 30 | Passage and Entrainment Monitoring | $ 1,000,000.00 | Per David Trimpe BOR. Anticipated costs for entrainment monitoring and pump bypass channel monitoring at 5 sites. Also monitoring would be required at existing headworks. 8 Years consistent with all alternatives. |

| | |
|---|---|
| Discount Rate (2016) | 3.125% |
| Net Present Value of O&M | $ 124,394,601 |
| Average Annual O&M | $ 4,950,029 |
| Cost Per Acre (56,799 acres) | $ 87.15 |

# Multiple Pump OM&R Costs

## MULTIPLE PUMP STATIONS ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | | | | End of Construction | | | | | | | | | | | | | | | | $ - | 1.0000 | $ - |
| 1 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 6,710,005 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 10,955,757 | 0.9697 | $ 10,623,764 |
| 2 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 4,409,069 | 0.9403 | $ 4,145,901 |
| 3 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 4,409,069 | 0.9118 | $ 4,020,268 |
| 4 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 6,609,069 | 0.8842 | $ 5,843,653 |
| 5 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | $ 1,000,000 | $ 4,955,069 | 0.8574 | $ 4,248,444 |
| 6 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 4,409,069 | 0.8314 | $ 3,665,752 |
| 7 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 4,409,069 | 0.8062 | $ 3,554,669 |
| 8 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | $ 1,000,000 | $ 6,609,069 | 0.7818 | $ 5,166,883 |
| 9 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.7581 | $ 2,584,402 |
| 10 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 4,075,069 | 0.7351 | $ 2,995,680 |
| 11 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.7128 | $ 2,430,145 |
| 12 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.6912 | $ 3,877,245 |
| 13 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.6703 | $ 2,285,095 |
| 14 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.6500 | $ 2,215,850 |
| 15 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 3,955,069 | 0.6303 | $ 2,492,841 |
| 16 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.6112 | $ 3,428,210 |
| 17 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.5927 | $ 2,020,452 |
| 18 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.5747 | $ 1,959,226 |
| 19 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.5573 | $ 1,899,855 |
| 20 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 6,275,069 | 0.5404 | $ 3,391,090 |
| 21 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.5240 | $ 1,786,457 |
| 22 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.5082 | $ 1,732,322 |
| 23 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.4928 | $ 1,679,827 |
| 24 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.4778 | $ 2,680,129 |
| 25 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | $ 400,000 | $ 235,000 | $ 20,000 | $ 6,904,000 | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 14,499,069 | 0.4633 | $ 6,718,017 |
| 26 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.4493 | $ 1,531,697 |
| 27 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.4357 | $ 1,485,282 |
| 28 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.4225 | $ 2,369,735 |
| 29 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.4097 | $ 1,396,629 |
| 30 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 4,075,069 | 0.3973 | $ 1,618,885 |
| 31 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3852 | $ 1,313,267 |
| 32 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.3736 | $ 2,095,289 |
| 33 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3622 | $ 1,234,881 |
| 34 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3513 | $ 1,197,460 |
| 35 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 100,000 | $ 4,400,000 | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 8,355,069 | 0.3406 | $ 2,845,846 |
| 36 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.3303 | $ 1,852,628 |
| 37 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3203 | $ 1,091,866 |
| 38 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3106 | $ 1,058,779 |
| 39 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.3012 | $ 1,026,695 |
| 40 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 6,275,069 | 0.2920 | $ 1,832,568 |
| 41 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2832 | $ 965,414 |
| 42 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2746 | $ 936,159 |
| 43 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2663 | $ 907,790 |
| 44 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.2582 | $ 1,448,360 |
| 45 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 3,955,069 | 0.2504 | $ 990,321 |
| 46 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2428 | $ 827,739 |
| 47 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2354 | $ 802,656 |
| 48 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | $ 2,000,000 | $ 100,000 | | | $ 10,000 | $ 200,000 | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 5,609,069 | 0.2283 | $ 1,280,621 |
| 49 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 100,000 | | | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | | $ 235,000 | $ 20,000 | | $ 150,000 | $ 300,000 | $ 48,600 | | $ 61,000 | | $ 3,409,069 | 0.2214 | $ 754,747 |
| 50 | $ 1,875,000 | $ - | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | | $ 100,000 | | $ 4,400,000 | $ 10,000 | | $ 5,000 | $ 240,000 | $ 64,152 | $ 163,317 | $ 400,000 | $ 235,000 | $ 20,000 | $ 6,904,000 | $ 150,000 | $ 300,000 | $ 48,600 | $ 66,000 | $ 61,000 | | $ 19,019,069 | 0.2147 | $ 4,083,111 |
| Total Cost: | $ 47,118,893 | $ - | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 1,256,504 | $ 11,783,070 | $ 2,513,008 | $ 1,498,698 | $ 944,614 | $ 251,301 | $ 1,178,307 | $ 125,650 | $ 6,031,218 | $ 1,612,145 | $ 10,452,472 | $ 271,211 | $ 5,905,568 | $ 502,602 | $ 4,681,094 | $ 3,769,511 | $ 7,539,023 | $ 1,221,322 | $ 311,622 | $ 1,532,935 | $ 6,982,824 | Net Present Value: | $ 124,394,601 | |
| Annual Cost: | $1,875,000 | $0 | $10,000 | $77,000 | $55,041 | $32,377 | $45,092 | $45,092 | $10,408 | $50,000 | $468,883 | $100,000 | $59,638 | $37,589 | $10,000 | $46,888 | $5,000 | $240,000 | $64,152 | $415,935 | $10,792 | $235,000 | $20,000 | $186,275 | $150,000 | $300,000 | $48,600 | $12,400 | $61,000 | $277,867 | Average Annual: | $ 4,950,029 | |

# Multiple Pumps with Conservation Measures OM&R Costs

## MULTIPLE PUMPS WITH CONSERVATION MEASURES ALTERNATIVE - ANNUAL O&M ASSUMPTIONS

| No. | O&M Item Description | Cost Value | Assumptions/Notes |
|---|---|---|---|
| | | | **Main Canal, Laterals, Drains** |
| 1 | Main Canal, Laterals, Drains | $ 980,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| 2 | Sediment Removal | $ - | We do not anticipate a significant increase in sediment accumulation in the main canal and laterals as a result of this alternative. Water supplied from the Ranney Wells is groundwater and should be relatively sediment-free. Water supplied by gravity feed is from the upstream end, the same as it is currently and should not result in an increase. |
| | | | **Conservation Measures** |
| 3 | Additional Ditch Riders | $ 583,200.00 | 12 Ditch Riders at $48,600 per year (6 months working)--assumes a SCADA system implemented. Without SCADA # of ditch rides may double |
| 4 | Vehicles | $ 129,600.00 | 20000 miles per season by .54, per employee |
| 5 | Piped Laterals | $ 750,000.00 | Replace Approximately 5000 lf every 15 years |
| 6 | Lined Lateral | $ 100,000.00 | Replace Approximately 1000 lf every 10 years |
| 7 | Lined Open Canals | $ 825,000.00 | Replace Approximately 2500 lf every 10 years |
| 8 | Remove Sediment and inspect check structures | $ 45,000.00 | Assumes $5,000 per check structure every year. 9 Check structures in total |
| 9 | Flow Measuring devices inspection and sediment removal | $ 30,000.00 | $250 per device per year. 120 devices |
| 10 | Operate and Maintain Center Pivots | $ 300,000.00 | $60 per acre on 5,000 acres. NDSU Cost (This needs to be pulled out. Cannot be spread across the entire district. O&M costs would be bore by the individual users. Note: This cost isn't included in the cost calculations on this sheet, to the right.) |
| 11 | Wind Turbine Maintenance | $ 50,000.00 | Windustry.com - Would Start after 5 years |
| 12 | O&M of SCADA System and Flow Measuring Devices | $ 105,000.00 | Estimate $15k per site annually for maintenance and replacement |
| 13 | Technicians for SCADA System | $ 120,000.00 | 2 Technicians - 60,000 per year (Work all year round) |
| 14 | Transportation | $ 32,400.00 | 30,000 miles per employee by 2 emplyees by .54 cents |
| | | | **Headworks** |
| 15 | Sediment Removal | $ 10,000.00 | Cost estimate fron 2015 EA |
| 16 | Daily Operations | $ 77,000.00 | Cost estimate from 2015 Operation Expenses. James Brower Email to David Trimpe on April 13, 2016. (Problem with Draft EIS O&M Numbers). Costs include: Daily gate adjustments, power costs, backup generator costs and debris/tree removal from screens. |
| 17 | Fish Screen Manifolds | $ 2,040,000.00 | $170,000 per unit - 12 fish screens - Expected Service life is 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 18 | Fish Screen Cylinder Units | $ 1,200,000.00 | $50,000 per unit - 2 units per screen - 12 screens - Expected Service Life 25 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 19 | Fish Screen External Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 20 | Fish Screen Internal Brushes | $ 240,000.00 | $10,000 per unit - 2 units per screen - 12 screens - Expected Service Life 5 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| 21 | Fish Screen Seal System | $ 120,000.00 | $10,000 per unit - 1 Unit per screen - 12 Screens - Expected Service Life 10 years. Information Obtained from ISI. Jim Forseth Email to David Trimpe April 21, 2016 (Schedule of Values) |
| | | | **Pumps** |
| 22 | Lateral Pumps | $ 50,000.00 | Small Lateral Pumps (TT estimate) Laterals AA - FF |
| 23 | Ranney Well Pumps Rehab | $ 2,100,000.00 | Pump rehab every 10 years @ $50,000 per pump, or $2,100,000 for 42 pumps |
| 24 | Ranney Well Pump Motors Rehab | $ 126,000.00 | Estimate average $3,000 per pump per year |
| 25 | Ranney Well Pump Replacement | $ 6,300,000.00 | Replace pumps every 35 years @ $150,000 per pump |
| 26 | Ranney Well Pump Motor Replacement | $ 6,300,000.00 | Replace motors every 50 years @ $150,000 per pump |
| 27 | Pump and Motor Removal and Install | $ 42,000.00 | Rough estimate per Layne Construction: Remove pumps and motors and inspect every 5-10 years @ $5-10k each. Assume average annual cost of $1,000 per well or $42,000 per year total. |
| 28 | Inspection and Maintenance of Ranney Well Screens | $ 672,000.00 | Rough estimate per Layne Construction: Inspect each well every 7 years at $7500, maintain wells every 15 years at $100-250k. Layne recommends assuming $16,000 per well annually. 42 Ranney Wells @ $16,000 per year per well = $672000 / year |
| 29 | Control Panel and Electronics | $ 7,000.00 | Assume $1000 per site per year, average across all years. |
| 30 | Man Power to Maintain and Operate Pump sites | $ 240,000.00 | 4 workers at $60,000 per worker. Oversite and Operation during irrigation season - Maintenance activites on pumps during the off season |
| 31 | Vehicle | $ 64,152.00 | Mileage - 54 cents by 180 miles by 165 Days by 4 vehicles. (Government Rate by Mileage by length of irrigation season by 4 people) (4th Person is night shift) |
| 32 | Power Costs | $ 67,914.00 | Using Pick-Sloan rates, includes upfront capacity charge of $5,508,644.73.50 in year 1 plus $67,914 per year over first 5 years until wind generation is complete |
| 33 | Service discharge pipes and valves | $ 252,000.00 | Estimate a 25 year life on gate and check valves, with a replacement cost of $3,000 each. Total: 84 valves @ $3,000 = $252,000 at 25 years and at 50 years. |
| 34 | Existing Pumps | $ 235,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **Admin Costs** |
| 35 | Administrative/Indirect Costs | $ 61,000.00 | Average cost over the last 3 years (2013, 2014, 2015). James Brower Email to David Trimpe on March 17, 2016 (Attached District OM Numbers High Priority Questions/Information (Conservation Measures)) |
| | | | **ESA Monitoring Costs** |
| 36 | Passage and Entrainment Monitoring | $ 200,000.00 | Per David Trimpe BOR. Anticipated costs for entrainment monitoring at the headworks. |

| | |
|---|---|
| Discount Rate (2016) | 3.125% |
| Net Present Value of O&M | $ 114,768,141 |
| Average Annual O&M | $ 4,566,963 |
| Cost Per Acre (56,799 acres) | $ 80.41 |

## MULTIPLE PUMPS WITH CONSERVATION MEASURES ALTERNATIVE - ESTIMATED O&M COSTS BY YEAR

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | O&M Annual Total | Discount Factor | Discounted O&M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | | | | | | | End of Construction | | | | | | | | | | | | | | | | | | | $ - | 1.0000 | $ - |
| 1 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | $ 5,576,559 | | $ 235,000 | $ 61,000 | $ 200,000 | $ 9,385,911 | 0.9697 | $ 9,101,489 |
| 2 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | $ 67,914 | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,877,266 | 0.9403 | $ 3,645,841 |
| 3 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | $ 67,914 | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,877,266 | 0.9118 | $ 3,535,361 |
| 4 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | $ 67,914 | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,877,266 | 0.8842 | $ 3,428,228 |
| 5 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | $ 67,914 | | $ 235,000 | $ 61,000 | $ 200,000 | $ 4,407,266 | 0.8574 | $ 3,778,761 |
| 6 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,859,352 | 0.8314 | $ 3,208,711 |
| 7 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,859,352 | 0.8062 | $ 3,111,477 |
| 8 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | $ 200,000 | $ 3,859,352 | 0.7818 | $ 3,017,190 |
| 9 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.7581 | $ 2,774,141 |
| 10 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | $ 100,000 | $ 825,000 | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,100,000 | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 7,284,352 | 0.7351 | $ 5,354,899 |
| 11 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.7128 | $ 2,608,559 |
| 12 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.6912 | $ 2,529,511 |
| 13 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.6703 | $ 2,452,860 |
| 14 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.6500 | $ 2,378,531 |
| 15 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | $ 750,000 | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 4,889,352 | 0.6303 | $ 3,081,711 |
| 16 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.6112 | $ 2,236,561 |
| 17 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.5927 | $ 2,168,787 |
| 18 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.5747 | $ 2,103,066 |
| 19 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.5573 | $ 2,039,337 |
| 20 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | $ 100,000 | $ 825,000 | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,100,000 | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 7,284,352 | 0.5404 | $ 3,936,513 |
| 21 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.5240 | $ 1,917,613 |
| 22 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.5082 | $ 1,859,504 |
| 23 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4928 | $ 1,803,155 |
| 24 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4778 | $ 1,748,514 |
| 25 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | $ 252,000 | $ 235,000 | $ 61,000 | | $ 7,631,352 | 0.4633 | $ 3,535,920 |
| 26 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4493 | $ 1,644,149 |
| 27 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4357 | $ 1,594,326 |
| 28 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4225 | $ 1,546,013 |
| 29 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.4097 | $ 1,499,165 |
| 30 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | $ 750,000 | $ 100,000 | $ 825,000 | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,100,000 | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 8,034,352 | 0.3973 | $ 3,191,773 |
| 31 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3852 | $ 1,409,683 |
| 32 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3736 | $ 1,366,965 |
| 33 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3622 | $ 1,325,542 |
| 34 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3513 | $ 1,285,374 |
| 35 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 126,000 | $ 6,300,000 | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 10,439,352 | 0.3406 | $ 3,555,780 |
| 36 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3303 | $ 1,208,653 |
| 37 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3203 | $ 1,172,027 |
| 38 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3106 | $ 1,136,511 |
| 39 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.3012 | $ 1,102,071 |
| 40 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | $ 100,000 | $ 825,000 | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,100,000 | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 7,284,352 | 0.2920 | $ 2,127,318 |
| 41 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2832 | $ 1,036,291 |
| 42 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2746 | $ 1,004,888 |
| 43 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2663 | $ 974,437 |
| 44 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2582 | $ 944,909 |
| 45 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | $ 750,000 | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | $ 240,000 | $ 240,000 | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 4,889,352 | 0.2504 | $ 1,224,258 |
| 46 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2428 | $ 888,509 |
| 47 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2354 | $ 861,585 |
| 48 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2283 | $ 835,476 |
| 49 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | | | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | | | | | | $ 50,000 | | $ 126,000 | | | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | | $ 235,000 | $ 61,000 | | $ 3,659,352 | 0.2214 | $ 810,159 |
| 50 | $ 980,000 | $ - | $ 583,200 | $ 129,600 | | $ 100,000 | $ 825,000 | $ 45,000 | $ 30,000 | $ - | $ 50,000 | $ 105,000 | $ 120,000 | $ 32,400 | $ 10,000 | $ 77,000 | $ 2,040,000 | $ 1,200,000 | $ 240,000 | $ 240,000 | $ 120,000 | $ 50,000 | $ 2,100,000 | $ 126,000 | | $ 6,300,000 | $ 42,000 | $ 672,000 | $ 7,000 | $ 240,000 | $ 64,152 | | $ 252,000 | $ 235,000 | $ 61,000 | | $ 17,076,352 | 0.2147 | $ 3,666,038 |
| Total Cost: | $ 24,627,475 | $ - | $ 14,655,861 | $ 3,256,858 | $ 958,462 | $ 217,952 | $ 1,798,105 | $ 1,130,853 | $ 753,902 | $ - | $ 1,071,203 | $ 2,638,658 | $ 3,015,609 | $ 814,214 | $ 251,301 | $ 1,935,016 | $ 1,383,174 | $ 813,632 | $ 1,133,172 | $ 1,133,172 | $ 261,542 | $ 1,256,504 | $ 4,576,994 | $ 3,166,390 | $ 2,145,863 | $ 1,352,516 | $ 1,055,463 | $ 16,887,411 | $ 175,911 | $ 6,031,218 | $ 1,612,145 | $ 5,651,635 | $ 170,863 | $ 5,905,568 | $ 1,532,935 | $ 1,396,565 | Net Present Value: | $ 114,768,141 |
| Annual Cost: | $980,000 | $0 | $583,200 | $129,600 | $38,140 | $8,673 | $71,552 | $45,000 | $30,000 | $0 | $42,626 | $105,000 | $120,000 | $32,400 | $10,000 | $77,000 | $55,041 | $32,377 | $45,092 | $45,092 | $10,408 | $50,000 | $182,132 | $126,000 | $85,390 | $53,821 | $42,000 | $672,000 | $7,000 | $240,000 | $64,152 | $224,895 | $6,799 | $235,000 | $61,000 | $55,573 | Average Annual: | $ 4,566,963 |