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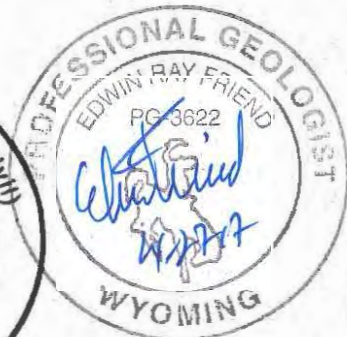
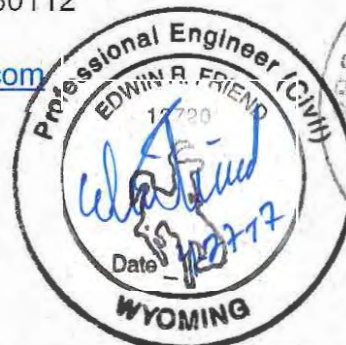
GEOTECHNICAL AND
WATER RESOURCES ENGINEERING

EXECUTIVE SUMMARY
FOR
FEASIBILITY STUDY REPORT
NEW FORK LAKE DAM ENLARGEMENT, LEVEL II, PHASE I
STUDY
SUBLETTE COUNTY, WYOMING

Submitted to
Wyoming Water Development Commission
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Project 15118



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EXECUTIVE SUMMARY

PURPOSE

The Wyoming Water Development Commission (WWDC) retained RJH Consultants, Inc. (RJH) to perform a Level II, Phase I feasibility study for the New Fork Lake Irrigation District (District). The purpose of this report is to identify potential irrigation shortages, identify potentially available water in the West Fork New Fork River upstream of Pine Creek, and develop and evaluate potential storage alternatives to mitigate any identified irrigation shortages (Project).

HYDROLOGIC EVALUATION

Wenck Associates developed several scenarios of a surface water model to identify shortages, water availability, and possible irrigation efficiency improvements in the New Fork River watershed.

Physically and legally available flow at New Fork Lake was evaluated over the 1981 to 2014 period. Based on the analysis, it appears that the currently irrigated acreage average annual shortage and available flow that could be stored at the New Fork Dam are 6,700 and 11,200 acre-feet (ac-ft) respectively. Based on the results of a firm yield analysis, a 9,400 ac-ft enlargement to the existing New Fork Lake could provide an 8- out of 10-year firm yield of approximately 3,000 ac-ft at the reservoir.

The enlargement would reduce the average annual shortages at the diversion structures (headgates) of the currently irrigated acreage in the District by 2,400 ac-ft. The average annual shortage reduction at the crop would be 1,060 ac-ft, which is less than at the headgates due to irrigation system inefficiencies.

PURPOSE AND NEED

The purpose for the proposed Project is to provide supplemental irrigation water to enhance production of farm commodities (hay and beef) within the existing New Fork Irrigation District using 9,400 ac-ft of available surface water placed in storage.

The Project is needed to raise revenues to repair components of the irrigation system (the existing dam) and to increase annual net revenues by alleviating the approximately 6,700 ac-ft per year of annual shortages for currently irrigated areas.

ALTERNATIVE SCREENING

Twelve storage concepts located at eight different sites were developed and evaluated to assess their ability to meet the irrigation demands, and to identify three alternatives to be further developed. The alternatives included modifications to existing dams at New Fork Lake and Willow Lake, and new dams at six locations in the New Fork drainage that could provide irrigation water to the District. The new dams included on-channel dams that could be filled from direct stream flows and off-channel dams that would require a new water conveyance canal and or pipeline to fill the reservoir.

A scoring matrix was developed to assist in evaluating and ranking the alternatives. The scoring matrix consisted of 15 categories that included technical categories, permitting categories, and environmental categories.

Alternatives that modified existing facilities ranked higher than alternatives requiring new construction because they have generally fewer environmental impacts and lower costs. The following storage alternatives ranked highest:

- Alternative 1: New Fork Lake – Lower Inlet
- Alternative 2: New Fork Lake – Raise Dam
- Alternative 3: New Fork Lake – Raise Dam and Lower Inlet

These alternatives use different approaches to modify the existing New Fork Dam. The New Fork Dam alternatives ranked highest because of a combination of lower cost, fewer environmental impacts, ability to fill without needing a filling conveyance channel, and ability to provide irrigation water to the entire irrigation district.

ENVIRONMENTAL

Western Ecosystems Technology (WEST) performed an environmental permitting analysis for the three preferred alternatives. The analysis evaluated the following:

- Fisheries
- Wetlands
- Greater Sage-Grouse
- Big Game
- Threatened, Endangered, and Other Sensitive Species

The permitting analysis identified potential impacts and mitigation. No fatal flaws were identified for the preferred alternatives as a result of the permitting analysis.

GEOTECHNICAL INVESTIGATION

RJH evaluated the surficial and bedrock geologic conditions, potential borrow materials, and seismic loading at the New Fork Lake Dam and existing lake.

Published maps and reports were reviewed to identify the geologic setting, surficial and bedrock materials, and seismicity. A site visit was performed on June 21 and 22, 2016 to confirm and refine published mapping.

The site geology consists of Wasatch Formation Bedrock overlain by glacial deposits from multiple glacial events and occasional landslides.

The results from the geotechnical investigations are that adequate materials likely exist and the foundation materials appear suitable to construct the preferred alternatives.

STRUCTURE EVALUATION

RJH performed a preliminary evaluation of the condition of the existing New Fork Lake Dam structure to identify if the structure is acceptable in its current condition, suitable for rehabilitation, or if complete removal and replacement is required.

The existing dam consists of a concrete spillway on the right (north) side of the dam, an outlet works near center of the dam (left of the concrete spillway), and an embankment portion on the left (south) side of the dam.

Based on the results of the site observation, the portions of the dam that were visible were in satisfactory condition, but a number of items were identified that will require attention including:

- Vegetation
- Seepage
- Vortex in the reservoir
- Concrete deterioration
- Inadequate spillway capacity

ALTERNATIVES CONCEPTUAL DESIGN

The conceptual design for each of the alternatives is described below.

COMMON COMPONENTS

The access road, bridge, and outlet works are common to all three preferred alternatives. We recommend that the bridge be removed from the spillway in Alternatives 1 and 3, and that no spillway bridge be used in Alternative 2 to improve dam security and safety for the public. Access to the Northern portion of the New Fork Lake will be provided by a new access road and bridge located downstream of the existing dam.

The conceptual design for all three alternatives uses the same outlet configuration. The outlet consists of a two chamber inlet tower at the upstream toe of the dam with an access bridge extending from the crest of the dam to the inlet tower. The inlet tower includes a trashrack and bulkhead located on the upstream side (lake side) of the tower. A guard gate is provided on the upstream end of an internal splitter wall. To provide a large range of discharge flows, a 7-foot gate and a 3-foot gate are provided at the upstream end of the outlet conduit.

ALTERNATIVE 1 – LOWER INLET

New Fork Lake is a glacial lake that is up to approximately 150 feet deep in the portion of the lake that is downstream of the narrows. Approximately 20,000 ac-ft of currently available active storage is within the upper 17 feet of the lake, the total storage in the lake far exceeds 20,000 ac-ft.

The characteristics of the lake provide unique opportunity to increase available active storage by lowering the inlet of the dam. Specifically, Alternative 1 provides an additional 9,400 ac-ft of active storage in New Fork Lake by lowering the inlet by 7.1 feet.

Alternative 1 consists of removing the embankment section of the dam, excavating the foundation deeper, constructing a new outlet works in the foundation excavation then constructing a new homogeneous embankment section with drains and filters above the outlet conduit. The alternative would be implemented using the existing outlet conduit and a coffer dam to manage river flows during construction of the outlet and embankment.

ALTERNATIVE 2 – RAISE DAM

Alternative 2 provides an additional 9,400 ac-ft of active storage in New Fork Lake by raising the spillway crest 7.1 feet.

Alternative 2 consists of constructing a new embankment dam downstream of the existing dam. The new embankment section would consist of a homogeneous embankment with filters and drains similar to the concept design for Alternative 1. The alternative would be implemented by using the existing dam as a cofferdam during construction of the new dam then removing the entire existing dam when the new dam is completed.

ALTERNATIVE 3 – RAISE DAM AND LOWER INLET

Alternative 3 is similar to Alternative 1, except it would use a combination of lowering the inlet by 5.1 feet and raising the spillway crest by 2.0 feet to provide an additional 9,400 ac-ft of active storage.

PROJECT COSTS

RJH developed an opinion of probable construction costs (OPCC) for the three preferred alternatives. The OPCC is based on the conceptual-level design concepts presented in this report and estimated quantities of the major construction items. A summary of the OPCC for the three preferred alternatives is provided in Table ES.1.

**TABLE ES.1
SUMMARY OF OPCC FOR PREFERRED ALTERNATIVES**

Alternative	Description	OPCC (\$)
1	New Fork Dam – Lower Inlet	12,700,000
2	New Fork Dam – Raise Dam	25,400,000
3	New Fork Dam – Lower Inlet and Raise Dam	14,100,000

ECONOMIC ANALYSIS

Harvey Economics (HE) completed an economic analysis for the preferred alternatives. The analysis consists of two parts: (1) a benefit-cost analysis and (2) an evaluation of the ability of the District to pay for a portion of the Project costs.

BENEFIT COST ANALYSIS

The benefit-cost analysis for each of the three alternatives incorporates capital and operating costs, and the evaluation of potential benefits, over a period of 50 years.

Additional irrigation water would allow operators to increase hay production, which would also allow them to increase the number of cattle raised on their farms. The agricultural benefits of this Project were calculated in terms of the additional revenue associated with increased cattle production.

The annual agricultural benefits are summarized in Table ES.2.

**TABLE ES.2
 ANNUAL AGRICULTURAL BENEFITS**

Additional Irrigation Water	1,060 ac-ft per year
Regional Grass Production per ac-ft	1.58 tons per ac-ft
Total Additional Hay Produced	1,670 tons
Hay Consumption per Cow/Calf Pair (in District)	3.2 tons per year
Additional Cattle Supported	530
Gross Revenue per Cow/Calf Pair	\$566
Annual Gross Revenue for District Landowners	\$298,200
Agricultural Multiplier	1.57
Total Annual Agricultural Benefits	\$468,300
Net Revenue per Cow/Calf Pair	\$33
Annual Net Revenue for District Landowners	\$17,400

For each alternative, construction activities would require hiring a number of specialized workers and general labor to perform various tasks and materials, and other supplies would need to be purchased to support the development of certain infrastructure. The hiring of labor and the purchase of material items are considered to be benefits to residents and businesses within Wyoming. The construction benefits are summarized in Table ES.3.

**TABLE ES.3
 DIRECT AND TOTAL CONSTRUCTION BENEFITS**

	Alternative 1 (Lower Inlet)	Alternative 2 (Raise Dam)	Alternative 3 (Lower and Raise)
Direct Construction Benefits	\$12,700,000	\$25,400,000	\$14,100,000
Construction Multiplier	1.49	1.49	1.49
Total Construction Benefits	\$18,976,402	\$37,952,804	\$21,068,289

The three preferred alternatives would also provide a number of benefits that are not quantifiable. A listing of these benefits is provided below:

- Recreation
- Fisheries
- Public Safety
- Fire Suppression

COMPARISON OF COSTS AND BENEFITS

A summary of comparison of the present value of the total costs and total benefits of each alternative with and without construction benefits is provided in Tables ES.4 and ES.5.

**TABLE ES.4
 COMPARISON OF PRESENT VALUE COSTS AND BENEFITS WITH
 CONSTRUCTION BENEFITS**

Alternative	Total Costs (\$)	Direct Benefits (\$)	Total Benefits (\$)	Net Total Benefits (\$)	Benefit-Cost Ratio
Alternative 1 (Lower Inlet)	12,852,460	22,653,905	34,625,996	21,773,536	2.7:1
Alternative 2 (Raise Dam)	25,364,775	35,166,221	53,321,958	27,957,183	2.1:1
Alternative 3 (Lower and Raise)	14,231,770	24,033,216	36,686,968	22,455,198	2.6:1

Notes:

1. All costs and benefits were discounted back to 2016 using a discount rate of 1.5 percent.
2. Total costs are direct construction costs and O&M costs.
3. Direct benefits are the additional annual gross revenues to District irrigators and direct construction benefits.
4. Total benefits include the direct, indirect and induced benefits of increased agricultural production and construction activity.
5. The benefit-cost ratio incorporates total costs and total benefits.

Source: Harvey Economics (Harvey, 2016).

**TABLE ES.5
 COMPARISON OF PRESENT VALUE COSTS AND BENEFITS WITHOUT
 CONSTRUCTION BENEFITS**

	Total Costs (\$)	Direct Benefits (\$)	Total Benefits (\$)	Net Total Benefits (\$)	Benefit- Cost Ratio
Alternative 1 (Lower Inlet)	\$12,852,460	\$10,141,590	\$15,930,033	\$3,077,573	1.24 : 1
Alternative 2 (Raise Dam)	\$25,364,775	\$10,141,590	\$15,930,033	-\$9,434,742	0.63 : 1
Alternative 3 (Lower and Raise)	\$14,231,770	\$10,141,590	\$15,930,033	\$1,698,263	1.12 : 1

Notes:

1. All costs and benefits were discounted back to 2016 using a discount rate of 1.5 percent.
2. Total costs are direct construction costs and O&M costs.
3. Direct benefits are the additional annual gross revenues to District irrigators.
4. Total benefits are the direct, indirect, and induced benefits of increased agricultural production.

PROJECT PAYMENT AND EVALUATION OF DISTRICT ABILITY TO PAY

Payment for the chosen alternative would come from multiple sources, including both the WWDC and the District. The District would likely apply for a WWDC grant through the Water Development Program (Program) to cover the majority of project costs. The remainder of the capital costs could be covered through a WWDC loan to the District to be paid off over a period of 50 years at an interest rate of 4 percent. Three grant funding allocations were evaluated: 67, 75, and 90 percent.

The District’s total estimated annual costs for any of the three preferred storage alternatives far exceed the District’s current annual revenues from assessments and fees. However, the District does currently generate enough revenue on an annual basis to fully cover the estimated O&M costs for any of the alternatives. The current assessment of \$1.50 per acre would need to be increased many times over to cover the total anticipated annual loan costs. Table ES.6 shows the necessary increase in the assessment rate to cover the District’s estimated loan repayment costs for the preferred alternatives with each of the funding allocations.

**TABLE ES.6
 CHANGES IN ASSESSMENT RATES**

Alternative	Total Annual District Costs (\$)	Assessed Acres	Current Assessment (\$)	Assessment to Cover Costs (\$)	Percent Increase (%)
Alternative 1 (Lower Inlet)					
67% WWDC Grant	205,092	14,613	1.50	14.04	836
75% WWDC Grant	157,797	14,613	1.50	10.80	620
90% WWDC Grant	69,119	14,613	1.50	4.73	215
Alternative 2 (Raise Dam)					
67% WWDC Grant	400,184	14,613	1.50	27.39	1,726
75% WWDC Grant	305,594	14,613	1.50	20.91	1,294
90% WWDC Grant	128,238	14,613	1.50	8.78	485
Alternative 3 (Lower and Raise)					
67% WWDC Grant	226,598	14,613	1.50	15.51	934
75% WWDC Grant	174,089	14,613	1.50	11.91	694
90% WWDC Grant	75,636	14,613	1.50	5.18	245

Notes:

1. The annual \$20 per landowner fee is assumed to cover the District's administrative costs. That revenue has not been included in the calculations of changes in the assessment rate.
2. Assessments are applied on a per acre basis.

Source: WWDC and Harvey Economics, 2016.

CONCLUSIONS

Based on the work completed in this Level II, Phase I Study, RJH offers the following conclusions:

- Annual average shortage of currently irrigated acreage in the New Fork Lake Irrigation District shortage is 6,700 ac-ft or 8 percent.
- Current condition annual average available flows at New Fork Lake are 11,200 ac-ft.
- The Project appears to be technically feasible and likely permissible.

RECOMMENDATIONS

Advance Alternative 1, New Fork Dam - Lower Inlet, from Level II, Phase I to Level II, Phase II, in order to gain a better understanding of project risks, requirements, costs, and benefits.

