



— BUREAU OF —
RECLAMATION

Boise River Basin Feasibility Study

3-foot Dam Raise Engineering Summary

Boise Project, Idaho

Interior Region 9: Columbia Pacific Northwest



Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
1D	one-dimensional
2D	two-dimensional
APS	Allowance for Procurement Strategies
AASHTO	American Association of State Highway and Transportation Officials
BrR	Bridge Rating
CFR	Code of Federal Regulations
cfs	cubic feet per second
Contractor	Sundance-EA Partners II Joint Venture
D	diameter
DEM	Digital Elevation Model
FHWA	Federal Highway Administration
GIS	geographic information system
GPS	global positioning system
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HW	headwater
IDEQ	Idaho Department of Environmental Quality
IDWR	Idaho Department of Water Resources
IPC	Idaho Power Company
ITD	Idaho Transportation Department
Jacobs	Jacobs Engineering Group Inc.
ksi	kilopound(s) per square inch

kW	kilowatt(s)
LiDAR	Light Detection and Ranging
Master Agreement	U.S. Forest Service Master Interagency Agreement No. 86-SIE-004
MBE	<i>The Manual for Bridge Evaluation, 3rd Edition</i> (2018)
MSE	mechanically stabilized earth
NLCD	National Land Cover Database
No.	Number
NPDES	National Pollutant Discharge Elimination System
NRL	Notional Rating Load
NTP	notice to proceed
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROFA	Runway Object Free Area
RPZ	Runway Protection Zone
RSA	Runway Safety Area
Rim Analysis	Boise River Storage Feasibility Study – Land, Structure, and Real Estate Survey/Analysis
TM	technical memorandum
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Table of Contents

1. Introduction.....	1
2. 3-foot Dam Raise Conceptual Design.....	1
2.1 Assumptions.....	1
2.2 Cost Estimating.....	1
2.3 Summary of Cost Estimate & Construction Schedule.....	2
3. 3-foot Reservoir Raise Conceptual Design	2
3.1 Assumptions.....	2
3.2 Summary of Cost Estimate and Construction Schedule	3

List of Tables

Table 1. Preliminary field cost and schedule	3
--	---

Attachments

Attachment 1. Anderson Ranch Dam Raise Quantities

Attachment 2. Anderson Ranch Dam Raise Reservoir Rim Quantities

Page intentionally left blank.

1. Introduction

This document summarizes efforts and assumptions to develop conceptual designs for a 3-foot raise of Anderson Ranch Dam, resulting projects necessary around the perimeter of Anderson Ranch Reservoir, and the associated preliminary level cost estimates and schedule.

2. 3-foot Dam Raise Conceptual Design

Reclamation's Technical Service Center (TSC) developed a preliminary level cost estimate and government construction schedule for a conceptual 3-foot dam raise for Anderson Ranch Dam. This estimate was intended to provide a preliminary level design alternative to be analyzed in the Environmental Impact Statement (EIS) alongside the feasibility level design for a 6-foot dam raise of Anderson Ranch Dam completed by the TSC in 2019 [1].

2.1 Assumptions

The design team evaluated which parts of the existing design for the 6-foot dam raise project would be substantially affected from a cost and/or schedule perspective if a 3-foot dam raise were to occur. The team determined that the crest raise earthwork would have both measurable cost and construction schedule impacts. The design team modified the crest detail earthfill such that the final crest elevation is 3-feet below the elevations presented in the feasibility level design. The design team assumed the same slopes and embankment zones widths as presented in the feasibility level design in order to best compare the 6-foot raise alternative to this preliminary-level 3-foot raise alternative.

The cost impact of the spillway crest modification portion of the dam raise work was judged to be negligible for this level of design. The total change in concrete placement would be less than 5 percent of the total volume of concrete placement with a 3-foot raise compared to a 6-foot raise. However, there is judged to be a notable impact to the schedule by reducing one 3-foot concrete lift placement from the total project.

2.2 Cost Estimating

In order to develop new cost estimates, the design team prepared revised quantity estimate work sheets for the crest raise earthwork for the two raise alternatives presented in the feasibility level design (Alt 1 – Downstream Raise & Alt 2 Mechanically Stabilized Earth). The design team estimated earthwork and foundation preparation pay items that are impacted by a 3-foot raise. The cost estimating team developed unit prices for the revised quantities. The cost estimate was prepared to a Preliminary Level Estimate as outlined in FAC 09-01 4-C (1)(a).

2.3 Summary of Cost Estimate & Construction Schedule

The preliminary cost estimate and construction schedule for Alternative 1, 3-foot Downstream Raise is \$31 Million and 921 days (approximately 30 months). The preliminary cost estimate and construction schedule for Alternative 2, 3-foot MSE Raise is \$37 Million and 908 days (approximately 30 months).

3. 3-foot Reservoir Raise Conceptual Design

Reclamation's Snake River Area Office developed designs for the projects around the perimeter of Anderson Ranch Reservoir associated with the conceptual 3-foot dam raise at Anderson Ranch Dam. The designs, cost estimates, and schedule were extracted from those associated with a 6-foot dam raise as prepared by Jacobs Engineering Group, Inc. and Quadrant Consulting, Inc. This document is intended to be part of the preliminary level alternative to be included in the Environmental Impact Statement (EIS) alongside the feasibility level design for projects around the perimeter of Anderson Ranch Reservoir associated with a 6-foot dam raise at Anderson Ranch Dam.

3.1 Assumptions

This effort utilized the assumptions included in Jacobs Engineering Group, Inc. and Quadrant Consulting, Inc.'s November 2019 Technical Memorandum *Engineering Design and Cost Estimates – Anderson Ranch Reservoir Rim* unless stated otherwise. In general, new design elements are 3-feet below the elevations presented in the feasibility-level designs.

Utilizing the proposed rim projects designs associated with the 6-foot dam raise, overlain with one-foot contour inundation lines, Reclamation identified which components of the 28 projects would be substantially affected from a cost and/or schedule perspective if a 3-foot dam raise were to occur. Quantity estimates and schedule durations were scaled and revised accordingly.

In order to develop a new field cost estimate, Reclamation prepared revised estimate work sheets for all affected rim projects greater than \$50K (25 of the 28 projects). Items in the attached estimate worksheets that are highlighted in yellow reflect differences from the estimate worksheets prepared for the rim projects associated with a 6-foot Anderson Ranch Dam raise. The cost estimate was prepared to a Preliminary Level Estimate as outlined in FAC 09-01 4-C (1)(a).

It is worth noting that of the 28 rim projects associated with a 6-foot dam raise, only six of them (21%) have subtotals greater than \$300,000, but account for approximately 58% of the costs. By reducing the dam raise height by 50% (from 6-feet to 3-feet), costs for these six projects are reduced by 43%; however, the total subtotal cost for all 28 projects associated with a 3-foot raise reflects only a 31% savings, as the average reduction of costs associated with any given project is only 19%.

Over 72% of the decreased costs associated with the 3-foot dam raise are from the following three projects: Lester Creek Road, Pine Airstrip, Pine Airport Campground. Key factors contributing to the reduction of costs are as follows:

Lester Creek Road Roadway improvements required to accommodate a 6-foot dam raise are not needed for a 3-foot dam raise. This reduces the subtotal for this project by over \$450K.

Pine Airstrip Relocation of the runway required to accommodate a 6-foot dam raise is not needed for a 3-foot dam raise. The normal maximum water surface elevation of 4199 associated with a 3-foot dam raise would breach existing unpaved roads, but wouldn't encroach on the runway. Maintaining a consistent 3-foot minimum freeboard design factor, the southeast corner of the runway would be inundated; however, in a maximum surcharge event (less than 2 feet), only a small portion of corner of the runway would be inundated. Reclamation could pursue a waiver to minimally encroach on the existing runway in surcharge events, extend the existing runway to offset the encroachment, or construct a retaining wall to prevent the encroachment, but has not yet conferred with Idaho Transportation Department. Reclamation has conservatively included a low profile retaining wall with top of wall elevation 4202 near the southern end of the runway. This wall would cross existing unpaved roadways, but would not prevent vehicle access from a nearby alternate unpaved roadways. This reduces the subtotal for this project by over \$650K.

Pine Airport Campground A 3-foot dam raise reduces the amount of fill required at this site. It also reduces the number of new picnic shelters, tables, fire rings, and dock sections. This reduces the subtotal for this project by over \$100K.

The cost estimate for the non-contract costs were judged to be very similar to those associated with a 6-foot dam raise. As such, non-contract costs were not modified for this effort.

3.2 Summary of Cost Estimate and Construction Schedule

The preliminary field cost estimate is \$7 Million. The preliminary construction schedule is 693 days (approximately 23 months).

Table 1. Preliminary field cost and schedule

	6-foot dam raise	3-foot dam raise	Difference	% Decrease
Field Costs	\$10M	\$7M	\$3M	30%
Schedule	716 days	693 days	23 days	3%

Page intentionally left blank.

Attachment 1: Anderson Ranch Dam Raise Quantities

Page intentionally left blank.

Anderson Ranch Dam Raise Quantities

4/22/2020

Affected Item	Unit	Quantities	
		6' Raise	3' Raise
Downstream Embankment Raise Method			
Water for dust abatement - 9000 gal truck per day over 12 months	LS	230000	210000
Stripping at borrow, contractor use area, and stockpile areas - assumes 6" - 8" depth	AC	77	77
Clearing and grubbing at borrow, contractor use area, and stockpile areas - assumes trees and brush from 2" to 12"	AC	38	38
Asphalt removal and disposal	CY	340	340
Jersey barrier removal and disposal	LF	2800	2800
Upstream and downstream riprap removal and stockpile - max size 36", stockpile within 0.5 miles	CY	3300	5100
Downstream cobble and rockfill removal and stockpile - max size 36", stockpile within 0.5 miles	CY	8600	2000
Security berm removal and stockpile - sand, gravel, cobbles; stockpile within 0/5 miles	CY	6200	6200
Excavation and stockpile - clay with sand and gravel; stockpile within 0.5 miles	CY	8200	4700
Excavation and waste - sand with gravel, waste at Dixie Pit 2.5 miles away	CY	10500	4200
Excavation and waste - gravel and cobbles, waste at Dixie Pit 2.5 miles away	CY	5400	5400
Abutment cutoff trench excavation (soil overburden/fill; approx. 5' deep)	CY	980	930
Abutment cutoff trench (rock excavation)	CY	120	105
Clean exposed rock surface (air, air and water, or water)	SF	8500	8100
Furnish and place slush grout	CF	67	67
Furnish and place dental concrete - assume one concrete truck for each abutment	CY	16	16
Placement from stockpiled zone 1 - compacted with sheepsfoot	CY	8200	4700
Placement from Dixie Pit borrow - compacted with sheepsfoot	CY	17000	8800
Placement - commercial source, vibratory compaction	CY	18500	5700
Placement from downstream borrow	CY	9500	7900
Soil cement placement from Dixie Pit borrow	CY	16500	8500
Riprap placement from stockpiled riprap within 0.5 miles	CY	1400	1400
Riprap waste, wasted in Dixie Pit Borrow Pit 2.5 miles away	CY	1900	1900
6" base course - commercial source 35 miles away	CY	1250	1250
4" asphalt	CY	810	810
Drainage inlets installation	EA	6	6
Site restoration (top soil, seeding, erosion matting)	AC	77	77
Asphalt restoration - assume milling and overlay on 950 feet of haul road	SF	29000	29000

Affected Item	Unit	Quantities	
		6' Raise	3' Raise
MSE Wall Method			
Water for dust abatement - 9000 gal truck per day over 12 months	LS	230000	210000
Stripping at borrow, contractor use area, and stockpile areas - assumes 6" - 8" depth	AC	77	77
Clearing and grubbing at borrow, contractor use area, and stockpile areas - assumes trees and brush from 2" to 12"	AC	38	38
Asphalt removal and disposal	CY	340	340
Jersey barrier removal and disposal	LF	2800	2800
Riprap removal and stockpile - max size 36", stockpile within 0.5 miles	CY	1450	1450
Security berm removal and stockpile - sand, gravel, cobbles; stockpile within 0/5 miles	CY	6200	6200
excavation and waste - gravel and cobbles, waste at Dixie Pit 2.5 miles away	CY	4300	4300
Abutment cutoff trench excavation (soil overburden/fill; approx. 5' deep)	CY	980	980
Abutment cutoff trench (rock excavation)	CY	120	120
Clean exposed rock surface (air, air and water, or water)	SF	8500	8500
Furnish and place slush grout	CY	67	67
Furnish and place dental concrete - assume one concrete truck for each abutment	CY	16	16
Right abutment stabilization	LS	310000	310000
placement from Dixie Pit borrow - compacted with sheepsfoot	CY	31000	26000
placement - commercial source, vibratory compaction	CY	3600	2600
Uniaxial geogrid reinforcing	SF	390000	325000
Facing elements	SF	36000	29000
Bearing pad	LF	3000	3000
Upstream riprap placement from stockpiled riprap within 0.5 miles	CY	1450	1450
Upstream riprap placement from downstream borrow within 3 miles	CY	480	480
6" base course - commercial source 35 miles away	CY	1250	1250
4" asphalt	CY	810	810
placement from Dixie Pit borrow - compacted with sheepsfoot	CY	7100	4900
placement - commercial source, vibratory compaction	CY	590	420
placement from downstream borrow	CY	2100	1450
Riprap placement from downstream borrow within 3 miles	CY	2000	2000
Site restoration (top soil, seeding, erosion matting)	AC	77	77
Asphalt restoration - assume milling and overlay on 950 feet of haul road	SF	29000	29000

Attachment 2: Anderson Ranch Dam Raise Reservoir Rim Quantities

Page intentionally left blank.

Anderson Ranch Dam Raise Reservoir Rim Quantities

4/22/2020

Project #	Affected Item	Unit	Quantities	
			6' Raise	3' Raise
Subtotal Project 01 - Anderson Dam Road	Slope Clearing & Grading for Rip Rap Placement	SY	953	715
	Slope Stabilization - Rip Rap	CY	953	715
Subtotal Project 02 - Anderson Dam Road	Slope Clearing & Grading for Rip Rap Placement	SY	816	612
	Slope Stabilization - Rip Rap	CY	816	612
Subtotal Project 03 - Lester Creek Road	Import Borrow - 4 Wheeler Path	CY	200	0
	Import Borrow - Lester Creek Road	CY	1250	0
	Slope Clearing & Grading for Rip Rap Placement	SY	4666	700
	Slope Stabilization - Rip Rap	CY	4666	700
	Gravel Surfacing - 4Wheeler Path	TON	114	0
	Base Course - Lester Creek Road	TON	182	0
	AC Pavement - Lester Creek Road	TON	178	0
	Surplus Material Removal	CY	54	9
Subtotal Project 04 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	1604	1203
	Slope Stabilization - Rip Rap	CY	1604	1203
Subtotal Project 05 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	850	765
	Slope Stabilization - Rip Rap	CY	850	765
Subtotal Project 06 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	941	706
	Slope Stabilization - Rip Rap	CY	941	706
Subtotal Project 07 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	845	676
	Slope Stabilization - Rip Rap	CY	845	676
Subtotal Project 08 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	630	536
	Slope Stabilization - Rip Rap	CY	630	536
Subtotal Project 09 - Pine-Featherville Road	Slope Clearing & Grading for Rip Rap Placement	SY	374	318
	Slope Stabilization - Rip Rap	CY	374	318
Subtotal Project 10 - Pine-Featherville Road	Structural Backfill	CY	35	28
	MSE Wall w/ Wall Cap	SF	1400	1100
Subtotal Project 11 - Pine-Featherville Road	Structural Backfill	CY	70	55
	MSE Wall w/ Wall Cap	SF	2800	2200
Subtotal Project 12 - Pine-Featherville Road	Structural Backfill	CY	35	28
	Surplus Material Removal	CY	35	28
	MSE Wall w/ Wall Cap	SF	1200	943

Project #	Affected Item	Unit	Quantities	
			6' Raise	3' Raise
Subtotal Project 13 - Anderson Dam Road	Slope Clearing & Grading for Rip Rap Placement	SY	232	174
	Slope Stabilization - Rip Rap	CY	232	174
Subtotal Project 14 - Anderson Dam Road	Import Borrow	CY	700	510
	Slope Clearing & Grading for Rip Rap Placement	SY	115	87
	Slope Stabilization - Rip Rap	CY	115	87
	MSE Walls	SF	1500	1091
Subtotal Project 15 - Anderson Dam Road	Slope Clearing & Grading for Rip Rap Placement	SY	215	162
	Slope Stabilization - Rip Rap	CY	215	162
Subtotal Project 16 - Pine Airstrip	Site Clearing	AC	1	0
	Site Cut - Airstrip	CY	54075	0
	Site Fill - Airstrip	CY	54075	0
	Site Grading - Airstrip	AC	16	0
	New Turf/Grass Runway	AC	16	0
	Surplus Material Removal	CY	110	0
	Trenchwork for Piping and Materials	CY	190	0
	24" CMP Drainage Culvert	LF	232	250
	Wall Footing Excavation	CY	0	350
	Structural Backfill	CY	0	500
	Surplus Material Removal	CY	0	175
	Slope Clearing & Grading for Retaining Walls	SY	0	83
	Grading Along Top of Retaining Walls	LF	0	500
	MSE Walls	SF	0	3500
Subtotal Project 17 - Pine Bridge	Demolition Work - Roadway Connections	EA	2	NA
	Demolition Work - Sawcut Deck	LF	432	NA
	Demo Work - Center Portion of Bridge Deck	CY	20	NA
	Demo - Slabs\End Diaphragms\Pile Caps\Wingwalls	CY	247	NA
	Removal and Storage - Bridge Deck Superstructures	EA	2	NA
	Reinstallation - Bridge Deck Superstructures	EA	2	NA
	Reinstallation - Bridge Approach Railing	LS	3700	NA
	Reinstallation - Existing Utilities	LS	7400	NA
	Bridge Deck Closure Pour	CY	20	NA
	Concrete Pile Caps	CY	34	NA

Project #	Affected Item	Unit	Quantities	
			6' Raise	3' Raise
	Concrete End Diaphragms	CY	69	NA
	Concrete Wingwalls	CY	134	NA
	Concrete Approach Slabs w/ Sleeper Slabs	CY	75	NA
	Site Grading	SY	167	NA
	Structure Excavation	CY	330	NA
	Structure Backfill	CY	330	NA
	Slope Stabilization - Rip Rap	CY	30	NA
	H-Pile Supports	VLF	520	NA
Subtotal Project 18 - Lime Creek Bridge	Site Cut	CY	300	255
	Site Fill - Import Granular	CY	361	306
	Surplus Material Removal	CY	300	255
	Slope Stabilization - Rip Rap	CY	1200	1020
Subtotal Project 19 - Deer Creek Fish Passage	No changes between 3' and 6'	NA	NA	NA
Subtotal Project 20 - Fall Creek Fish Passage	No changes between 3' and 6'	NA	NA	NA
Subtotal Project 21 - Curlew Creek Campground	Earthwork - Fill	CY	4900	3430
Subtotal Project 22 - Castle Creek Campground	No changes between 3' and 6'	NA	NA	NA
Subtotal Project 23 - Little Wilson Creek Campground	No changes between 3' and 6'	NA	NA	NA
Subtotal Project 24 - Evans Creek Campground	Earthwork - Fill	CY	5200	4000
Subtotal Project 25 - Fall Creek Boat Ramp	Clearing and Grubbing	AC	1	0.9958678
	Earthwork - Fill	CY	1100	846
	Rock Riprap - Procurement and Placement	CY	150	115
	Boat Ramp - Cast in Place Concrete	CY	170	156
	16' x 8' Dock Section - Furnish and Install	EA	4	3
Subtotal Project 26 - Pine Campground	Earthwork - Fill	CY	3600	2520
	16' x 8' Dock Section - Furnish and Install	EA	4	3
	Picnic Table - Furnish and Install	EA	9	3
	Fire Ring - Furnish and Install	EA	9	3
	Picnic Shelter - Furnish and Install	EA	9	3
Subtotal Project 27 - Elk Creek Boat Ramp	Earthwork - Fill	CY	600	420
	Boat Ramp - Cast in Place Concrete	CY	28	21
	16' x 8' Dock Section - Furnish and Install	EA	3	0

Project #	Affected Item	Unit	Quantities	
			6' Raise	3' Raise
Subtotal Idaho Power Company Utility Relocations	Pole & Line Relocation	LF	1000	875