Approved by CITT 2021-04-14

RESERVOIR MONITORING PROJECT

INSTALLATION PLAN – PHASES II & III

Flathead Indian Reservation, MT

TABLE OF CONTENTS

Introduction

This plan provides a proposal to the Compact Implementation Technical Team (CITT) to install reservoir level monitoring equipment and provide real-time stage and storage data for the 14 primary reservoirs that are used for the impoundment of water associated with the Flathead Indian Irrigation Project (FIIP). This project is proposed for inclusion as part of the CITT's comprehensive water measurement program as set forth in Appendix 3.5 3.a.i to the CSKT-MT Compact.

Project Overview and Objectives

The Flathead Indian Irrigation Project, located primarily within the boundaries of the Flathead Indian Reservation, supplies water to approximately 127,000 acres of agricultural land. The project consists of over 1,000 miles of canal and lateral systems, and 14 primary dams and reservoirs. These reservoirs impound water for irrigation deliveries, provide recreational opportunities, provide a place for cultural activities to be performed and support wildlife and fisheries habitats. The project is operated by the Bureau of Indian Affairs, and FIIP staff control reservoir releases both during and outside of the irrigation season.

The Water Resources Program historically collected end-of-month reservoir data and maintained these records in their streamflow database; this work was discontinued several years ago as staff time availability decreased. The current proposal represents an effort to re-establish the reservoir monitoring network and to update the monitoring protocol to publish data in real-time.

The CSKT Safety of Dams (SOD) Program oversees various safety aspects of all dams and irrigation reservoirs both within and outside of the exterior boundaries of the Flathead Reservation. SOD staff are responsible for conducting and coordinating annual, periodic, and comprehensive dam safety reviews, as well as overseeing emergency warning system functions, and project management for dam rehabilitation, physical modification, and general construction activities.

CSKT SOD maintains an emergency warning system reservoir water level monitoring network consisting of pressure transducers, staff gages, upstream slope markers and float switches. These systems were designed and installed as part of the SOD Early Warning System. This system will alert various offices, including the BIA 24/7 National Monitoring Center, in the event of sudden changes in downstream canal flows, reservoir elevations, or a dam failure. The BIA Safety of Dams & CSKT Safety of Dams Program completed a system-wide update of this monitoring system in autumn 2020. This system provides EWS data to the 24/7 National Monitoring Center, but is not used by FIIP staff to inform reservoir operations.

Currently, FIIP staff primarily rely on manual measurement to determine reservoir stage and storage volume and subsequent rates of reservoir fill and release. This is a time-consuming and inefficient means of collecting data that would benefit from remote monitoring capabilities, particularly in remote locations - some facilities are inaccessible

in the winter and even in favorable conditions require round-trip drive times in excess of two hours.

Access to accurate and real-time reservoir levels would allow FIIP staff to more efficiently manage the reservoir inflows, reservoir water storage levels, and discharge from reservoirs. In addition, being able to track rapidly changing reservoir water surface elevations may provide valuable emergency management information to support decisions during critical situations.

Currently, the CSKT Water Resources Program operates an expansive network of 80 real-time gages on stream and canals, both inside and outside of the boundaries of the Flathead Indian Reservation. Discharge data are transmitted via satellite telemetry to the Program's database. These 15-minute resolution discharge data are published online hourly through the CSKT Hydrology Data WebPortal (https://www.csktwaterdata.org).

To provide FIIP staff with real-time reservoir stage and storage data, the CSKT Water Resources Program proposes to expand this network by installing water level sensor, data logger, and telemetry equipment at each of the 14 irrigation reservoirs. Reservoir level data will be published hourly through the CSKT Hydrology Data WebPortal. The WebPortal is configurable to include access permissions and security roles, so select data could be published either publically, or privately to select user groups who have been granted access.

The project objective will be to capture reservoir levels at typical ranges of operation, i.e. from minimum pools to spillway elevations. Due to reservoir drawdown limitations at the time of installation, the operational objective during Phase I is to install at minimum fisheries pools on each reservoir. Future visits are planned to extend the orifice line to the invert at the inlet of the outlet conduit. These activities will take place in future years during less frequent and more extensive reservoir drawdown operations such as those during major BIA or Safety of Dams activities. These future activities will allow for monitoring reservoir levels outside of those associated with typical reservoir operations.

Water Resources Staff will validate sensor data on a monthly basis. During each visit, staff members will review all instruments and hardware to ensure that equipment is functioning correctly. During field visits Hydrographers will manually measure reservoir level to check the recorded reservoir storage data against field measurements. Following each measurement, the Hydrographer will enter field measurements in the Water Resource Program's hydrologic database. If observed water levels do not match recorded water levels, the Hydrographer will correct the deviation through equipment or records maintenance. Recorded water levels will be downloaded quarterly and uploaded to the hydrologic database. The operations and data outputs of the Hydrographers, including annual records, will be reviewed for completeness annually in a two-step review process which includes both the Water Resources Program Chief of Field Operations and then a Hydrologist.

In addition to providing FIIP with accurate real-time stage and volume data for reservoir operations, this upgrade will allow integrated water resource planning and allow for better streamflow management; for example, accurate reservoir pool data will enable more effective scheduling for spring runoff hydrographs to benefit ESA-listed fish species. Real-time reservoir level data will help ensure compliance with interim and compact reservoir pool elevations and will allow monitoring of compact implementation procedures that allow deviation from reservoir minimum levels. These data may also help assist with the reduction of canal wasteway flows.

Reservoirs were evaluated for installation priority based upon a) potential and realized dynamic nature of reservoir elevation change during seasonal operation; b) site logistics and feasibility; and c) location priority as determined by FIIP Project Manager, Watermaster, and senior FIIP staff.

Following prioritization, the Water Resources Program proposed a phased installation of monitoring equipment in the 2020 Reservoir Water Level Monitoring Installation Plan. Phase I, which was completed in 2020, consisted of the installation of monitoring equipment at three locations: McDonald Reservoir, Kicking Horse Reservoir, and Ninepipes Reservoir. Phases II and III of installation are proposed for 2021 and 2022, and will consist of six and five locations per phase, respectively.

Proposed installation sequence is outlined below.

Project Location

Installation activities will occur at FIIP Reservoirs both within and outside of the boundaries of the Flathead Indian Reservation. Specifically, installation will occur at the following locations:

Phase I (2020 - Complete):

- Ninepipe Reservoir
- Kicking Horse Reservoir
- McDonald Reservoir

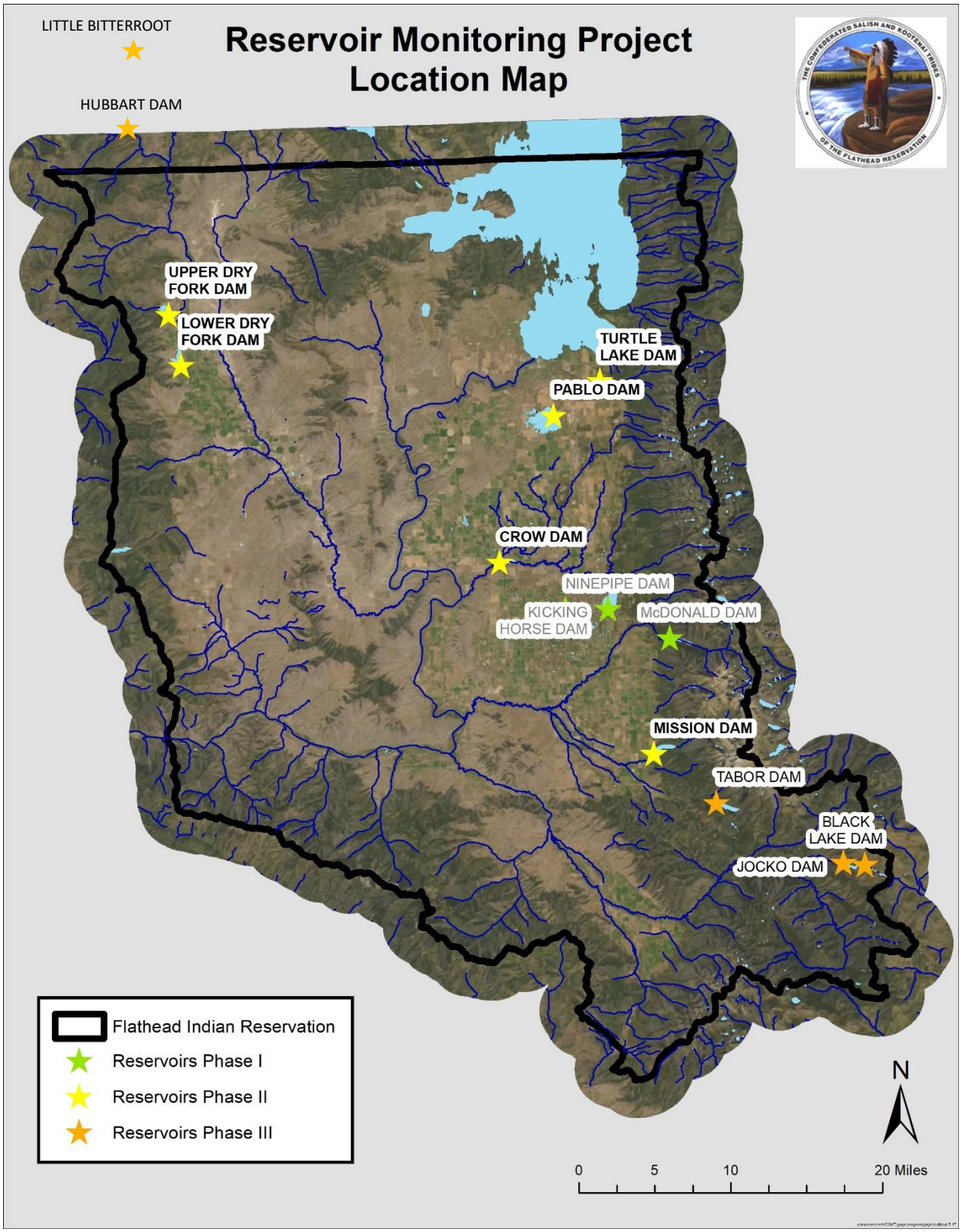
Phase II (2021):

- Upper Dry Fork Reservoir
- Lower Dry Fork Reservoir
- Twin Lake Reservoir/Turtle Lake Reservoir
- Pablo Reservoir
- Crow Reservoir
- Mission Reservoir

Phase III (2022):

- Little Bitterroot Reservoir
- Hubbart Reservoir

- Tabor Reservoir/St. Mary’s
- Black Lake
- Jocko Lake


Reservoir Monitoring Project
Location Map
LITTLE BITTERROOT
HUBBART DAM
UPPER DRY FORK DAM
LOWER DRY FORK DAM
TURTLE LAKE DAM
PABLO DAM
CROW DAM
NINEPIPE DAM
KICKING HORSE DAM
McDONALD DAM
MISSION DAM
TABOR DAM
BLACK LAKE DAM
JOCKO DAM
Flathead Indian Reservation
Reservoirs Phase I
Reservoirs Phase II
Reservoirs Phase III
N
0
5
10
20 Miles

Scope of Work

This project is a collaborative effort between the CITT, the CSKT Division of Engineering and Water Resources, and the Flathead Indian Irrigation Project. Specific planned installation activities by program are outlined below.

CSKT Water Resources Program will:

1. Provide project oversight, develop plan, scope of work, project schedule, and facilitate coordination and scheduling of activities between programs.
2. Serve as the point of contact for specific questions regarding the project.
3. Serve as the liaison to the Compact Implementation Technical Team.
4. Execute necessary environmental review and permitting.
5. As necessary, bid work to qualified Contractors utilizing standard CSKT procurement procedures and provide contract management.
6. Provide staff members to assist with installation, including providing labor and manual trenching activates.
7. Install, program, and maintain sensor, datalogger, and telemetry equipment.
8. Publish reservoir elevation and storage data to selected user groups via the CSKT Hydrology Data WebPortal (https://www.csktwaterdata.org), including CSKT Water Resources Staff, Safety of Dams Staff, and Flathead Indian Irrigation Project Staff.
9. QA/QC reservoir level data through monthly verification and annual review.
10. Configure and maintain CSKT Hydrology Data WebPortal software.
11. Establish and survey benchmarks to a vertical elevation accuracy of 1/100 ft.
12. Survey benchmarks annually and reestablish benchmarks as necessary.
13. Provide a project completion report at the conclusion of each phase of installation.

CSKT Safety of Dams Program will:

1. As program resources allow, provide staff assistance, particularly in the areas of knowledge of existing infrastructure, EWS expertise, and planning assistance.

CSKT Roads Program will:

- As program resources allow, provide staff assistance, particularly in the areas of skilled labor and equipment operation to install monitoring hardware such as rigid pipe and trenching activities where machinery and skilled operators are required.

BIA Flathead Indian Irrigation Project will:

1. Provide access to gatehouses, reservoirs, and other facilities.

2. Offer feedback and input on project planning and activities through scheduled meetings and personal correspondence.

3. In coordination with Water Resources Program staff, conduct reservoir drawdowns to facilitate installation of monitoring equipment on reservoir bed. Reservoir drawdowns will adhere to all effective reservoir level restrictions.

4. Provide skilled laborers to install monitoring hardware such as rigid pipe, trenching activities, and welding where machinery and skilled operators are required.

Project Schedule

Phase I: Ninepipe, Kicking Horse, McDonald Reservoirs

Installation activities complete

Phase II: Upper Dry Fork, Lower Dry Fork, Twin/Turtle, Pablo, Crow, Mission Reservoirs

February 2021: Field reconnaissance

September 18 – October 21, 2021: Install Phase II Reservoirs

Phase III: Little Bitterroot, Hubbart, Tabor Reservoir/St. Mary's, Black, Jocko

August 2021: Field reconnaissance

May 2022: Bid out installation services where necessary

September 29 – October 20, 2022: Install Phase III Reservoirs

Phase II Installation Activities – Upper Dry Fork, Lower Dry Fork, Twin/Turtle, Pablo, Crow, Mission Reservoirs

Phase II Installation Activities

Installation for Phase II will occur in autumn 2021 and consist of the installation of a stand-alone datalogger & telemetry setup on the bank of the reservoir at a selected location. Orifice line will be encased in 1" PVC pipe extending from datalogger into the reservoir as far as current reservoir levels will allow. A second orifice line will be placed in the pipe to allow for future extension of the orifice line into the reservoir.

CSKT will work with FIIP to coordinate reservoir drawdowns to allow for installation activities as reservoir operations allow. All reservoir drawdowns will adhere to current reservoir level restrictions.

Phase II Cost Estimates

Appendix A includes projected costs for Phase II of the project. The total Phase II Cost Estimate is $89,224.

Phase III Installation Activities – Little Bitterroot, Hubbart, Tabor/St. Mary's, Black, Jocko Lake Reservoirs

Phase III Installation Activities

Installation for Phase III will occur in autumn 2022 and will consist of the installation of a stand-alone datalogger & telemetry setup on the bank of the reservoir at a selected location. Orifice line will be encased in 1" PVC pipe extending from datalogger into the reservoir as far as current reservoir levels will allow. A second orifice line will be placed in the pipe to allow for future extension of the orifice line into the reservoir.

CSKT will work with FIIP to coordinate reservoir drawdowns to allow for installation activities as reservoir operations allow. All reservoir drawdowns will adhere to current reservoir level restrictions.

Phase III Cost Estimates

Phase III includes several reservoirs with a larger range of stage values must be measured (Jocko Lake, Black Lake, Tabor), requiring 0-50 PSI bubbler setups and longer orifice line installations.

Appendix A includes projected costs for Phase III of the project. The total Phase III Cost Estimate is $96,160.

Reservoir Monitoring Project: Phase II Cost Estimates

	Upper Dry Fork	Lower Dry Fork	Twin/Turtle	Crow	Mission	Pablo		Totals
Electronics	Bubbler (25 psi)	Bubbler (25 psi)	Bubbler (25 psi)	Bubbler (25 psi)	Bubbler (50 psi)	Bubbler (25 psi)		
Bubbler	$3,490	$3,490	$3,490	$3,490	$3,995	$3,490		$21,445
Satlink 3 Logger/Transmitter	$2,795	$2,795	$2,795	$2,795	$2,795	$2,795		$16,770
Geostationary Antennae	$499	$499	$499	$499	$499	$499		$2,994
Enclosure	$958	$958	$958	$958	$958	$958		$5,748
Orifice termination tube	$196	$196	$196	$196	$392	$196		$1,372
Tubing	$410	$410	$410	$410	$820	$410		$2,870
Factory integration	$250	$250	$250	$250	$250	$250		$1,500
Lighting protector RF kit	$141	$141	$141	$141	$141	$141		$846
Solar panel charger	$93	$93	$93	$93	$93	$93		$558
Contingency (10%)	$883	$883	$883	$883	$994	$883		$5,410
TOTAL	**$9,715**	**$9,715**	**$9,715**	**$9,715**	**$10,937**	**$9,715**		**$59,513**
Hardware								
Tower	$300	$300	$300	$300	$300	$300		$1,800
Schedule 80 conduit	$200	$200	$200	$200	$400	$200		$1,400
Solar panel	$100	$100	$100	$100	$100	$100		$600
Battery	$260	$260	$260	$260	$260	$260		$1,560
Fittings & misc. hardware	$250	$250	$250	$250	$300	$250		$1,550
Contingency (10%)	$111	$111	$111	$111	$136	$111		$691
TOTAL	**$1,221**	**$1,221**	**$1,221**	**$1,221**	**$1,496**	**$1,221**		**$7,601**
Contracted Earthwork								
Mobilization	$ 250	$ 250	$ 250	$ 250	$ 250	$ 250		$ 1,500
Trenching & Labor	$ 2,550	$ 2,550	$ 1,500	$ 4,000	$ 4,000	$ 4,000		$ 18,600
Contingency (10%)	$ 280	$ 280	$ 175	$ 425	$ 425	$ 425		$ 2,010
TOTAL	**$ 3,080**	**$ 3,080**	**$ 1,925**	**$ 4,675**	**$ 4,675**	**$ 4,675**		**$ 2,061**

Notes:

Electronics costs are in 2020 USD.

Total Cost Estimate Phase II	**$69,175**

Reservoir Monitoring Project: Phase III Cost Estimates

	Little Bitterroot	Hubbart	Tabor/St. Mary	Black Lake	Jocko Lake		Totals
Electronics	Bubbler (25 psi)	Bubbler (50 psi)	Bubbler (50 psi)	Bubbler (50 psi)	Bubbler (50 psi)		
Bubbler	$3,490	$3,995	$3,995	$3,995	$3,995		$19,470
Satlink 3 Logger/Transmitter	$2,795	$2,795	$2,795	$2,795	$2,795		$13,975
Geostationary Antennae	$499	$499	$499	$499	$499		$2,495
Enclosure	$958	$958	$958	$958	$958		$4,790
Orifice termination tube	$196	$392	$392	$392	$392		$1,764
Tubing	$410	$820	$820	$820	$820		$3,690
Factory integration	$250	$250	$250	$250	$250		$1,250
Lighting protector RF kit	$141	$141	$141	$141	$141		$705
Solar panel charger	$93	$93	$93	$93	$93		$465
Inflation (10%)	$883	$994	$994	$994	$994		$4,860
Contingency (10%)	$883	$994	$994	$994	$994		$4,860
TOTAL	**$10,598**	**$11,932**	**$11,932**	**$11,932**	**$11,932**		**$58,325**
Hardware							
Tower	$300	$300	$300	$300	$300		$1,500
Schedule 80 conduit	$200	$400	$400	$400	$400		$1,800
Solar panel	$100	$100	$100	$100	$100		$500
Battery	$260	$260	$260	$260	$260		$1,300
Fittings & misc. hardware	$250	$300	$300	$300	$300		$1,450
Inflation (10%)	$111	$136	$136	$136	$136		$655
Contingency (10%)	$111	$136	$136	$136	$136		$655
TOTAL	**$1,332**	**$1,632**	**$1,632**	**$1,632**	**$1,632**		**$7,860**
Contracted Earthwork							
Mobilization	$ 250	$ 250	$ 250	$ 250	$ 250		$ 1,250
Trenching & Labor	$ 4,000	$ 4,000	$ 6,000	$ 6,000	$ 6,000		$ 26,000
Contingency (10%)	$ 425	$ 425	$ 625	$ 625	$ 625		$ 2,725
TOTAL	**$ 4,675**	**$ 4,675**	**$ 6,875**	**$ 6,875**	**$ 6,875**		**$ 29,975**

Notes:
Cost estimates in 2020 USD. Inflation included.

Total Cost Estimate Phase III	**$96,160**

Total Cost Task Order 10	**$165,335**