

OVERVIEW OF THE PROJECT

The Cal Poly Irrigation Training and Research Center (ITRC) was contracted by the United States Bureau of Indian Affairs (USBIA) to develop a *Modernization Plan* for the Flathead Indian Irrigation Project (FIIP).

Background

The project has numerous operational constraints, some of which are outlined below:

1. **Lack of access to FIIP infrastructure.** This is a major problem. For example:
 - a. In many areas there were no canal access roads.
 - b. Many of the existing canal access roads are in poor condition due to overgrowth, erosion or settlement.
 - c. Blocked roads were prevalent in multiple, more developed areas due to:
 - i. Locked gates
 - ii. Electric fences
 - iii. Completely fenced-off canals with no access to canal structures
2. FIIP staff employment issues:
 - a. Low pay
 - b. Inability to hire
 - c. Difficulties in hiring
 - d. Understaffed – FIIP is operating with perhaps 25% of normal staffing rates
 - e. Lack of training and experience with electronic maintenance/troubleshooting – this will be a future constraint
3. Inability of the local FIIP office to make quick decisions on operating/repair fund allocations
4. Enforcement of rules:
 - a. There seems to be an adequate number of rules, but almost a total lack of enforcement.
 - b. Demoralized workforce due to:
 - i. Cumbersome process to resolve problems; resolutions may require going through the Superintendent, the Portland office, etc. As a result, investigations or enforcement actions are rare.
 - ii. The lack of upper-level support for operators if they try to correct a problem, plus constant complaints from the Tribe(s) and farmers regarding a lack of water and enforcement.
 - c. Lack of documentation to support enforcement activities – little/no effective internal flow measurement or volumetric accounting within the project
5. Regulatory limitations on site-specific diversion flow rates and annual volumes makes some internal recirculation possibilities less valuable.
6. Numerous uncontrolled flows enter many of the FIIP main canals and reservoirs.
7. **Lack of the proper physical infrastructure that is needed for good management.**
8. **Lack of proper real-time information and data management that is needed for good management.**

It should be noted that by all indications the FIIP staff are performing as expected, given the current constraints.

Modernization Plan

Purpose

The purpose of this *Modernization Plan* is to examine constraint items 7 and 8 (previously listed in **bold**), and propose recommendations for improvement within the context of constraint items 1 through 6 and the goals of the USBIA and the Tribes:

- USBIA has an obligation to:
 - Rehabilitate existing and aging infrastructure
 - Operate and manage water deliveries within FIIP with a reasonable level of service reliability, flexibility and equity
 - Begin volumetric accounting of individual water deliveries
- With the recent passing of the CSKT-Montana Compact, the Tribes seek to:
 - Maintain minimum environmental stream flows, which can only be attained through monitoring and enforcement
 - Improve in-stream water quality

Differences

The *Modernization Plan* supplements historical studies, plans, and documentation of the FIIP project. Those reports typically examine broader issues of total water supply, water rights, and inventory of existing structures. In contrast, the *Modernization Plan* focuses on how to improve the internal workings of the project. In other words, modernization deals with how to improve minute-to-minute operations and accountability, and strategies to move water throughout and within the project itself.

Objectives

This *Modernization Plan* outlines prioritized and practical objectives that meet the goals of the USBIA, and where sensible and practical, simultaneously meet the goals of the Tribes. For example:

- Modernizing aging, malfunctioning, or poorly configured infrastructure rather than simply replacing structures
- Simplifying operations to minimize overly complex management and/or decision-making
- Enhancing information management

The anticipated effects of these objectives, as related to USBIA goals, include:

- Enable USBIA to better control and measure flows with less uncertainty
- Improve service, with:
 - Increased water delivery reliability, flexibility and equity
 - Fewer water user complaints
- Streamline processes for decisions to aid employee retention and training through:
 - Focused management and operational efforts
 - Decreased staff time commitments for system monitoring and accounting

These objectives are expected to also meet the Tribal goals as follows:

- Decrease additional diversions that are currently necessary to service water users with the existing, less-than-ideal infrastructure
- Decrease operational spill, thereby improving river water quality

Recommendation Fundamentals

The recommendations provided in this report conform to the following principles:

- Keep it simple. In all cases, simplicity was a key focal point.
- Minimize complex computerized (PLC) control.
- Emphasize engineering solutions that simultaneously resolve control problems and human hassles, as well as enhance social harmony.

Prioritization

The sub-projects were prioritized with the following qualitative metrics:

1. Immediacy
2. Value/Benefit
3. Operational simplification
4. Perceived importance to the Tribe, or USBIA

Modernization Implementation

This report contains a large number of recommended modernization actions. At the present time, the available funding is grossly insufficient to complete the plan. However, the following points are made:

1. A modernization plan provides a completely different view of how to invest in improvements, which are typically done on a site-by-site basis with more of a “rehabilitation” or “replacement” goal than a modernization goal.
2. This modernization plan recommends linkages and synchronization between geographically distant units and structures, for maximum benefit. If one only examines single structures, the possibilities for interaction are missed. For example, one can consider the Hillside Reservoir:
 - a. The Hillside Reservoir is currently underutilized because there is no place to utilize all the stored water.
 - b. A pipeline from the Hillside Reservoir can supply areas of the Moiese area, thereby allowing the Hillside Reservoir to provide flexibility for areas of the Post Unit.
 - c. Pipelined water deliveries from the Hillside Reservoir will reduce seepage losses and make operation and accountability much simpler.
 - d. With the new supply to the Moiese area, less water is needed from the Crow Reservoir via the MA Canal.
 - e. Less water into the MA Canal means that the return flows into the Crow Reservoir should be reduced, or else those traditional return flows will not be recirculated.
 - f. One way to reduce flows into the Crow Reservoir is to pump more from Crow Creek, and into the Post Unit. That will require modification of the existing pumping plant on Crow Creek, and further modifications to where those flows go.
 - g. Another way to reduce flows into Crow Reservoir is to intercept flows from creeks and drains such as Mud Creek, and integrate those flows into a plan for Horte Reservoir.
3. Significant funds might be made available from Congress for modernization and rehabilitation. It is good to have a plan in place, with prior discussions and prioritizations, if such funds should become available.
4. Regardless of whether Congress allocates large sums, every year various structures are modified. This plan provides specific recommendations for improvements to many structures that can be considered on a site-by-site basis.

5. This plan provides designs and alternatives that have not been considered in the past, such as:
 - a. Improved designs for measurement of gravity deliveries from a canal to a field
 - b. Long-crested weir designs to maintain water levels in canals, with significantly less operator effort
 - c. New measurement flume designs
 - d. ITRC Flap Gates to maintain constant water levels in canals
 - e. A pump-back system on the Pablo Feeder Canal to extend the benefits of the Flathead River Pumps

Volumetric Pricing and Billing

Volumetric pricing and billing are discussed in this overview because these have been defined by both USBIA and the tribes as high-priority goals. There are obvious benefits to these practices, such as:

1. Farmers will know how much water they use and when, which in some cases helps them better manage their water.
2. Operators will have reliable information that is needed to enforce rules regarding allowable flow rates and volumes to individual turnouts.
3. Only with good accountability can equity be achieved within the project.
4. The project will have a better idea of the difference between gross diversions, and gross deliveries to turnouts. This is one of several metrics used to target improvements needed in conveyance and distribution.

However, volumetric pricing and billing policies involve much more than just installing flow meters at every turnout – especially in FIIP. In FIIP, there are major pre-requisites that must first be satisfied. Some of these pre-requisites include:

1. A good, accurate flow meter is needed at the delivery point to at least every 40 acres. This report provides recommendations of turnouts configurations for both pipeline and canal deliveries. No turnout flow measurement devices were seen in FIIP. Assuming that 2,800 turnouts will eventually be needed, the cost just for good turnout control and measurement devices will be about \$12 million.
2. Turnouts must be easily and quickly accessible to operators. As mentioned earlier, this is a major problem. Operators should not need to have discussions with farmers when they need to access turnouts. There should be no fences across canal access roads. Many field delivery points are in the middle of fields, with no canal access roads. Pipelines have been proposed for areas with the biggest problems.
3. A water ordering and verification procedure needs to be implemented. A formal structure for water ordering does not currently exist. It is expected that farmers will continue to operate their own turnouts. However, with a more modern and efficient irrigation operation, operators will need to know how much flow is needed at the head of each canal, to match turnout deliveries. Operators will also need to know turnout on/off times and individual flow rates, and will need to record these values for eventual billing and accounting. This will require a major behavior change for both farmers and operators.

PRELIMINARY PRIORITIES

Flathead Indian Irrigation Project Cost Summary and Prioritization

Unit	Location	Water Rights Compact Rehabilitation and Betterment Projects?	Safety hazard now	Emergency actions required now by staff?	Importance for Modernization (1 = V High; 10 = minor)	Est. Cost for sub-projects (2015 \$)	USBIA Priority (1 = Highest; 10 = Lowest)
Camas Canal Unit							
	Hubbart Reservoir Improvements	No	medium	No	8	\$92,000	8
	Improvements near Head of the Camas A Canal						
	Camas A Canal Tunnel Diversion Dam on Little Bitterroot River	Yes	medium	No	2	\$244,000	2
	Camas A Headworks at Mill Creek	No	high	Yes	2	\$329,000	2
	Operation near Upper Dry Fork Reservoir						
	Upper Dry Fork Creek Reservoir Discharge Weir	No	low		8	\$41,000	8
	Camas A Canal Pump to Upper Dry Fork Reservoir	No	low		4	\$709,000	6
	Control near Lower Dry Fork Reservoir						
	Camas B and D Canal Headworks	No	low	No	2	\$354,000	2
	Head of Camas C Canal	No	low	No	5	\$243,000	7
	Restart Camas B Canal near Lower Dry Fork Reservoir	No	low	No	3	\$698,000	3
	Restart Camas D Canal near Lower Dry Fork Reservoir	No	low	No	3	\$257,000	3
	End of the Camas B Canal and Camas B/C Pipeline	No	low	No	3	\$1,112,000	5
	Camas C Canal Regulating Reservoir System	No	low	No	1	\$2,586,000	1
	Improved water level control along the Camas Main Canals						
	Camas B Canal	No	low	No	5	\$1,323,000	9
	Camas C Canal	No	low	No	5	\$866,000	5
	Camas D Canal	No	low	No	5	\$707,000	6
Placid Canal & Tabor Feeder Canal							
	Improvements to the Placid Canal						
	Improved control at Placid Canal diversion	No	medium	Yes	4	\$168,000	6
	Vibratory compaction of the entire Placid Canal	No	high	No	1	\$15,000	1
	Improvements at Upper and Lower Jocko Reservoirs	No	low	No	5	\$10,000	8
	Tabor Feeder Canal Improvements						
	Tabor Feeder Canal at Middle Fork Jocko River	No	medium	No	4	\$187,000	5
	Tabor Feeder Canal at North Fork Jocko River	No	medium	No	4	\$201,000	5
	Tabor Feeder Canal at Falls Creek	Yes	high	Yes	2	\$393,000	2
Jocko Canal Unit							
	S Feeder Canal Improvements, not including reservoir						
	S Feeder Canal Diversion	Yes	low	No	7	\$155,164	1
	Head of D Canal	No	low	No	5	\$153,554	1
	S Feeder Canal at Big Knife Creek	No	medium	Yes	3	\$66,292	1

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	S Feeder Canal at Agency Creek	No	medium	Yes	3	\$129,586	1
S&J Reservoir and Pipelines and E Canal Improvements							
	Regulating Reservoir on the J Canal	No	low	No	3	\$3,578,917	3
	E Canal Limited-Demand Pipelines	No	low	No	6	\$2,434,200	3
	Control improvements on E Canal by Hwy 93	No	low	No	6	\$522,698	3
	E Canal at Finley Creek	No	low	No	6	\$215,136	3
K Canal Diversion from Jocko River							
	K Canal Improvements of the reservoir and new pipelines	Yes	low	No	5	\$293,423	1
K Canal Improvements of the reservoir and new pipelines							
	K Canal Regulating Reservoir	No	low	No	1	\$6,204,690	3
	Restart of the K Canal	No	low	No	1	\$353,194	3
	K Canal Loop Pipeline and pump	No	low	No	3	\$7,696,000	3
	End of K Canal Limited-Demand Pipeline	No	low	No	3	\$1,357,000	3
R Canal connection to K Canal, and Pipeline network							
	D Canal Pipeline network	No	low	No	3	\$4,127,800	5
D Canal Pipeline network							
Improved water level control in Jocko Canals							
	S Canal	No	low	No	5	\$611,000	7
	M Canal	No	low	No	5	\$64,000	7
	N Canal	No	low	No	5	\$201,000	7
	E Canal	No	low	No	5	\$82,000	7
	K10 Lateral and Sub-Laterals	No	low	No	5	\$233,000	7
	K14 Lateral and Sub-Laterals	No	low	No	5	\$230,000	7
	Lower S Canal	No	low	No	5	\$133,000	7
Lower J & Revais Canals							
	Improvements at the Lower J Canal diversion	Yes	low	No	4	\$130,000	6
	Improvements at the Revais Pump	Yes	low	No	1	\$794,000	1
	Improved water level control for the Lower J, Revais, and Revais Pump Canal	No	low	No	8	\$391,000	9
Mission Canal Unit							
	Tabor Reservoir	Yes	low	No	5	\$166,000	2
	Dry Creek Pool	No	low	No	3	\$253,000	2
	Mission Reservoir Discharge	Yes	low	No	2	\$340,000	2
	Mission A Canal at Ashley Creek	No	low	No	6	\$29,000	6
Improvements to Mission B Canal and Pipelines							
	Flow measurement at head of Mission B Canal	Yes	low	No	2	\$163,000	2
	Increase the capacity of the Mission B Canal	No	low	No	5	\$266,000	5
	Improved water level control along Mission B Canal	No	low	No	5	\$270,000	5
	New Emergency Spills	No	low	No	5	\$279,000	5
	New limited-demand pipelines to service Mission B & C Canals	No	low	No	5	\$31,800,000	5
	Mission B Canal Spill to Post F Canal	No	low	No	5	\$337,000	5
	Improvements to the Mission F Canal						

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	Improved water level control along Mission F Canal	No		No	5	\$339,000	8
	Mission F Canal spill measurement	No		No	4	\$13,000	9
Mission H Canal							
	Mission Creek pump and pipeline to National Bison Range	No	high	No	3	\$440,000	5
	Lower Mission H Canal pump and Pipeline	No	high	No	3	\$909,000	5
Crow Creeks, Hillside & Ninepipe Reservoirs							
Pablo Feeder Canal at Post & Crow Creeks							
Post - South	Pablo Feeder Canal at Post Creek	Yes	low	Yes	2	\$627,000	2
Post - North	Pablo Feeder Canal at South Crow Creek	Yes	high	Yes	2	\$627,000	2
Post - North	Pablo Feeder Canal at Middle Crow Creek	No	medium	No	5	\$430,000	6
Post - North	Pablo Feeder Canal at North Crow Creek	Yes	high	Yes	1	\$514,000	1
Control Improvements near Kicking Horse Reservoir							
Post - South	Kicking Horse Feeder Canal diversion on Post Creek	No	low	No	6	\$242,000	4
Post - South	Bifurcation of South Crow Creek and South Crow Creek Feeder	No	medium	Yes	2	\$802,000	1
Post - South	Flow measurement at the end of the Kicking Horse Feeder Canal	No	low	No	6	\$121,000	5
Post - South	Improvements at Kicking Horse Reservoir discharge	No	low	No	7	\$328,000	6
Control Improvements near Ninepipe Reservoir							
Post - South	Improvement near head of Post A Canal	No	low	No	5	\$356,000	6
Post - South	Crow Creek Pump Station	Yes	high	Yes	3	\$665,000	2
Post - South	Post A Canal restart and level pool system	No	low		1	\$307,000	1
Post - South	Improved flow measurement at head of Post C and D Canals	No	low	No	8	\$32,000	5
Post Canal Unit							
Post C Canal and Lateral 25C Sub-System							
	Improved Post B Canal spill intertie to Post C Canal	No	low	No	6	\$204,000	6
	Control improvements at head of Lateral 25C	No	low	No	4	\$119,000	4
	Lateral 25C superhighway improved water level control	No	low	No	4	\$920,000	4
	Pump connection between Post A and Post C Canals	No	low	No	5	\$219,000	3
	Lateral 25C Regulating Reservoir System	No	low	No	3	\$6,739,000	3
Post F Canal Superhighway							
	Change of control at Post F Canal diversion	No	low	No	3	\$655,000	3
	Increase capacity of the Post F Canal	No	low	No	3	\$17,000	3
	Improved 36F Canal diversion	No	medium	No	4	\$232,000	5
	Improved water level control along Post F Canal	No	low	No	5	\$2,303,000	3
	Post F Canal Regulating Reservoir	No	low	No	3	\$7,042,000	3
	Post F Canal Limited-Demand Pipelines	No	low	No	4	\$5,627,200	3
	Improved water level control along Post D Canal	No	low	No	7	\$519,000	8
	Flow measurement to Hillside Reservoir	No	low	No	2	\$297,000	2
Moiese Canal System							
	Improvements to the MA Canal						

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	Diversion Dam in Crow Creek for MA Canal	No	low	No	6	\$127,000	6
	Cleaning and vibratory compaction of the MA Canal	No	high	No	1	\$596,000	3
	Improve water level control along the MA Canal	No	low	No	7	\$97,000	8
	New Hillside Reservoir Pipeline and Level Pool System	No	low	No	1	\$1,210,300	1
	New Moiese Limited-Demand Pipelines						
	Northern Pipeline	No	low	No	3	\$740,200	3
	Looped Pipeline	No	low	No	3	\$5,900,300	3
Pablo Feeder Canal Near Polson							
	Flathead River Pumps	Yes	medium	Yes	2	\$663,924	4
	Pablo Feeder Canal Pumpback System						
	Lining 10 miles of the Pablo Feeder Canal	No	low	No	3	\$10,000,000	9
	Pablo Feeder Pump #1/LCW#7 at Pablo Drop	No	low	No	3	\$4,147,920	9
	Pablo Feeder Pump #2/LCW#6	No	low	No	3	\$2,568,000	9
	Pablo Feeder Pump #3/LCW #5	No	low	No	3	\$2,493,000	9
	Pablo Feeder Pump #4/LCW #4	No	low	No	3	\$2,952,000	9
	Pablo Feeder Pump #5/LCW #3	No	low	No	3	\$2,752,000	9
	Pablo Feeder Pump #6/LCW #2	No	low	No	3	\$2,747,000	9
	Pablo Feeder Pump #7/LCW #1	No	low	No	3	\$2,689,000	9
	Head of the Pablo A Canal	No	low	No	5	\$242,000	3
	Improvements to Mud Creek and Ronan B Canal						
	Mud Creek Diversion	No	low	No	8	\$20,000	8
	Ronan B Canal Diversion on Mud Creek	No	low	No	5	\$77,000	5
	Eliminate flow restriction on Ronan B Canal	No	medium	Yes	2	\$30,000	1
	Polson Pipelines	No	low	No	4	\$11,469,000	8
Valley View Canal System							
	Improvements near the Valley View Tunnel	No	low	No	5	\$458,000	2
	Sub-Lateral 31A-1 restart	No	low	No	4	\$211,000	6
	Lateral 31A Regulating Reservoir	No	low	No	1	\$2,044,000	2
	Improved water level control along Lateral 31A	No	low	No	6	\$356,000	5
	Sub-Lateral 31A-0.6 Limited-Demand Pipeline	No	low	No	5	\$969,000	9
	Improvements along Sub-Lateral 31A-0.7 & 31A-1						
	Vibratory compaction to reduce seepage	No	low	No	3	\$232,000	2
	Improve existing check structures	No	low	No	5	\$339,000	8
Horte Reservoir & Round Butte Road							
	Improvement of Pablo A Canal to Lower Pablo A Canal and head of Lateral 73A including the connection to the reservoir and improved flow control						
	Improved water level control at chute drop on Pablo A Canal	No	low	No	5	\$537,000	1
	New LCW at check structure at inlet of Horte Reservoir	No	low	No	1	\$228,000	1
	Improvements at Lower Pablo A Canal and Lateral 73A headgates	No	low	No	7	\$339,000	1

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	New Horte Reservoir pump and pipeline to Pablo A Canal	No	low	No	1	\$1,404,000	1
	Improvement of Lateral 70 between start and Round Butte Rd						
	New flow measurement at head of the canal	No	low	No	4	\$174,000	5
	Improved water level control	No	low	No	5	\$145,000	5
	Round Butte Road Recovery System all the way to Horte Reservoir, including 73A						
	Round Butte Road Interceptor Pipeline and pumps	No	low	No	1	\$5,902,000	4
	Lateral 70A Restart	No	low	No	1	\$352,000	4
	Horte Reservoir Flowback Pipeline	No	low	No	1	\$2,541,000	4
	Lower Pablo A and Lateral 71A-W Pump	No	low	No	1	\$547,000	4
	West Pablo Interceptor Pipeline and pumps	No	low	No	1	\$5,364,000	4
	Lateral 73A improved water level control	No	low	No	1	\$105,000	4
Misc. Items							
	100 demonstration orifice plate turnouts with excellent access	--	--	--	1	\$250,000	1
	Development of project wide SCADA system (hardware, implementation, etc.)	--	--	--	4	\$7,850,000	5
Total						\$188,823,000	