

Scope of Work: CITT Workplan for Water Measurement at Instream Flow, River Diversion Allowance, Natural Flow and Irrigation Return Flow Locations

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List of Abbreviations

CSKT	Confederated Salish and Kootenai Tribes
CITT	Compact Implementation Technical Team
FIIP	Flathead Indian Irrigation Project
IIF	Interim Instream Flow
ISF	Instream Flow
MBMG	Montana Bureau of Mines and Geology
MEF	Minimum Enforceable Instream Flow
TIF	Target Instream Flow
RDA	River Diversion Allowance
USGS	United States Geological Survey

Water measurement at instream flow, river diversion allowance, natural flow, and irrigation return flow locations is proposed. Measurement at these locations is planned-for in Section 3.d. of Appendix 3.5 to the Compact. Five monitoring activities are identified: a) installation of one new ISF station and seventeen new RDA stations; b) upgrades at six ISF and four RDA stations; c) development of a monitoring protocol at eleven ISF and eight RDA stations; d) upgrades or new installations at a small set of natural flow and irrigation return flow stations; and e) placement of artificial control sections in four canal locations. Compact-related measurement requirements at ISF and RDA locations will be fulfilled when proposed work is combined with existing CSKT stream and canal gages.

1.0 Overview

The Confederated Salish and Kootenai Tribes (CSKT) – Montana Water Rights Compact both authorizes and defines the responsibilities for a Compact Implementation Technical Team (CITT). This team allows for technical representation from the signatories to the Compact, the Flathead Indian Irrigation Project (FIIP), and an irrigator representative. The State of Montana, concurrent with their legislative approval of the Compact in April 2015, appropriated funds for the CITT to initiate work under three themes – water measurement, stock-water delivery and mitigation, and on-farm efficiency. The CITT has identified preparation of a water measurement plan as a team task.

Water measurement is a well-recognized building block for effective water management¹, and is called for in several areas of the Compact. Water measurement and data dissemination support stock-water and on-farm efficiency themes, since these efforts are focused to efficiently utilize available water supply, which must be measured to match supply to demand.

This proposal builds on the CSKT Water Management Program gaging network and program capabilities. The Tribes’ measurement program has been active since 1982. Most of the Compact-related instream flow (ISF) stations are part of the current Tribal measurement network, and a large number of Compact-related River Diversion Allowance (RDA) stations are part of the current Tribal network or were historically part of the network.

The body of the proposal provides background and detail, including the schedule and budget. Supplement One describes the existing Tribal water measurement program, and Supplement Two

¹ U.S. Bureau of Reclamation, 2001. Water Measurement Manual, A guide to effective water measurement practices for better water management.

describes the proposed additions to the water measurement program. The proposal assumes some familiarity with terminology found in the Compact. For readers needing clarification, the definitions section of the Compact found at <http://dnrc.mt.gov/divisions/reserved-water-rights-compact-commission/confederated-salish-and-kootenai-tribes> defines specific terms.

2.0 Water Measurement as it relates to the Compact

Water measurement, data management and dissemination, and planning for and allocation of water between instream and irrigation uses of water are explicitly called for in the Compact and Appendices 3.1 through 3.7. This occurs in part because:

- MEF, TIF and RDA levels are set to vary based on defined wet through dry water-year types;
- MEF and TIF levels are set to be incrementally met as operational improvements occur on the FIIP;
- Seasonal water supply planning and potential within-season adjustments to water allocations are keyed to water measurement information;
- Shared shortage conditions are identified based on water measurement information;
- Compliance for IIF's has relied on measurement since the late 1980's, and will continue to for a period of time; and
- The FIIP water use right is satisfied and tracked through measurement at RDA locations.

Specifically, Articles IV. C., D., and E. of the Compact recognize the role of water measurement and Article IV. F. confirms this, explicitly identifying comprehensive water measurement as essential to the Compact. Appendices 3.1 through 3.7 call for water measurement, with Appendix 3.4 identifying water measurement in the operational improvements schedule, and Appendix 3.7 identifying indicator natural flow stream gages for determination of wet through dry years. In Appendix 3.5, the guidance document for CITT activities, water measurement is identified as a task in several locations, and Section 3.d.i. identifies that the Tribes shall manage data at instream flow, RDA, and irrigation return flow locations.

Water measurement has been, and will continue to be, critical on streams and canals associated with the FIIP due to the variability in seasonal runoff volumes, the complexity of the stream and canal network, and the very high level of utilization of available water supply for irrigation uses.

3.0 The Current CSKT Water Management Program

The CSKT Water Management Program has been operating since 1982 with a staff of hydro-technicians and hydrologists. Emphasis has been placed on surface water measurement, however the Program also maintains a groundwater monitoring network, the Program completes monitoring for the Tribes' Safety of Dams Program, and the Program completes water quality monitoring and special projects work. Since approximately 1990, the Program has participated in the NRCS snow survey program, and is currently one of the largest cooperators in the State, monitoring snowpack from Marias Pass south to the Rattlesnake Range.

Also since 1982, the Water Management Program has maintained cooperator status with the Montana US. Geological Survey office. Several activities have occurred through the cooperator arrangement, including larger water resource studies, extensive training and quality assurance for Program staff, and maintenance of a set of natural flow stream gages on the Reservation. Starting in 1992, as the Program transitioned to greater use of continuously recording equipment, the USGS completed site evaluations and installation recommendations for measurement stations, many of which are still operational. For a period of six years, the Program employed a retired USGS hydro-technician full-time to work with Tribal staff on field and data management techniques.

The Program currently has four full-time hydro-technicians, a data management hydrologist, and a supervisory hydrologist. Field and office procedures rigorously adhere to standard operating procedures prepared by the Program and procedures found in various USGS publications (ex: USGS WSP 2175, 1982; USGS TM 3-A8, 2010; USGS TM 3-A22, 2013). Gaging station data and rating curves are compiled by field staff, reviewed and quality assured by the chief of field operations, and finally quality assured by a hydrologist. Data are currently maintained in an SQL database developed for the Program; this database houses all records dating back to 1982, including records for 159 active or discontinued stream stations, 76 active or discontinued canal stations, and 21 active or discontinued irrigation return flow stations. Hard copy data management files are also maintained and hold annual station analyses, level notes, rating curves and other station details.

In the last three years, the Program has completed the following upgrades.

- Field staff have discontinued use of mechanical stream gaging meters and use acoustic doppler velocimeters (ADV's) for wading discharge measurements.

- Field staff use an acoustic doppler current profiler (ADCV) for peak flow and large canal measurements.
- Electronics at forty five stations have been upgraded to support telemetry and real-time data acquisition using the GOES satellite network for data transmission. These data are reported to a dedicated website.
- The program is currently transitioning from their SQL database to the Aquatic Informatics Aquarius Time Series database and Aquarius Web data portal. This data management software has been selected by the USGS and Water Resource Survey of Canada as their primary data management platform, and will provide a robust data management solution for the Water Management Program. The database transition is ongoing with completion expected in mid to late 2016.
- The Program is scanning hard copy records prior to 2015 for electronic data storage and retrieval.

Currently, the Program maintains 66 active stations – 38 stream stations, 25 canal stations, and three irrigation return flow stations. Twenty of the stream stations are identified as instream flow compliance locations in the Compact and twenty of the canal stations are identified as RDA stations in the Compact. Three return flow stations are monitored to assist FIIP comply with the biological opinion for project operations.

The cost savings that will accrue to CITT-related water measurement responsibilities from the existing Tribal investment in water measurement are significant and include:

- Numerous active stream and canal stations with greater than a 20-year period of quality-assured and fully documented record. This dataset provides insight into streamflow variability, streamflow trends, and ISF and FIIP operations under various water supply scenarios;
- Forty instream flow and RDA compliance locations, most of which are equipped for telemetry;
- Investment in a database and web-based reporting system;
- A fully operational and equipped program with expertise developed over 34 years; and
- A program that is able to incorporate new responsibilities and train new staff.

Supplement One includes: a) maps and tables showing the existing stream, canal, and return flow monitoring network; and b) a position description for the Water Management Program hydro-technician job.

4.0 Proposed Additions to the Water Measurement Program

Proposed additions to the measurement program to support CITT activities focus on instream flow and RDA stations, but also include natural flow locations which are part of the definition of wet through dry water-year types, and additional irrigation return flows. Focus for instream flow and RDA locations is to bring these stations forward to support telemetry and real-time data acquisition.

There are a number of instream flow and RDA stations where a monitoring protocol is recommended, instead of the investment in a continuously recording station and the associated long-term operations cost. These situations occur where the specified flow levels are low or the canal headworks water management does not require system-level coordination. The primary monitoring protocol will be to identify a measurement section, install a staff gage, and complete check measurements and maintain a rating, as needed. Experience will indicate which stations require more diligence for measurement and rating work. The Flathead River pumping plant is a unique situation because the pump canal is a level canal supporting two-way flow. Pump volume records will be maintained by tracking electrical usage and on-off times for the pumps. This will require preparation of a standard operating procedure for information reporting.

Irrigation return flow stations are identified for measurement in the Compact. While there are well over 30 active return flow locations on the FIIP, the CITT recommends maintaining current return flow stations and adding three return flow locations which have been shown to carry higher flow volumes.

Natural streamflow information is needed for water supply forecasting and to define wet through dry water-year conditions. The proposal identifies upgrades to two existing CSKT stations which are applied for water-year definitions. USGS natural flow stations are maintained through the CSKT-USGS cooperative agreement. The Tribes and the CITT recognizes that this program is challenging to fund, and may need to look to alternative funding sources in future years.

Some premises for proposed additions to the measurement program follow:

- All continuous monitoring stations should support telemetry;
- All telemetered data should be available to the public via website access;
- Artificial controls (weirs or flumes, other) should be placed in canals to reduce long-term operational costs;
- A monitoring protocol should be applied where continuous monitoring may not be warranted; and

- Programmatic costs for the CSKT Water Management Program should be incorporated into the measurement budget.

Access to data will occur through the Aquarius Web portal, which will be identified on the CITT website. The CITT is also exploring options to provide access to data through the Montana Bureau of Mines and Geology surface water web data portal. The CITT supports this concept, and is working with the MBMG to evaluate options. Costs that may be associated with MBMG data hosting are not reflected in this proposal.

Supplement Two contains equipment details and several tables that break-out measurement stations by proposed activities; these tables form the basis for the budget. Table 1.0 below sequentially summarizes measurement plans for MEF and TIF locations, as they are found in Appendix 3.1 to the Compact. Table 2.0 sequentially summarizes measurement plans for RDA locations, as they are found in Appendix 3.2 to the Compact. Table 3.0 summarizes natural flow and irrigation return flow locations proposed for measurement activity. Table 4.0 identifies the initial priority list for installation of artificial controls in canal sections. Table S2.d (Supplement 2) contains the full list of canals identified for artificial controls.

Table 1.0: Measurement activities at MEF and TIF locations

Orange – existing CSKT telemetry station and equipment, count = 14;

Green – existing CSKT station with proposed upgrade to monitoring equipment, count = 6;

Yellow – new installation, count = 1;

Grey – monitoring protocol, count = 11

Station name	Station type	Measurement plan	Notes
Middle Fork Jocko River	IIF/MEF/TIF	Existing equipment	
North Fork Jocko River	IIF/ MEF/TIF	Existing equipment	
Falls Creek below Tabor Feeder	MEF/TIF	Monitoring protocol	Install staff gage or rate orifice gate planned for 2016 construction
S-14 Creek below Tabor Feeder	MEF/TIF	Monitoring protocol	Install staff gage after gate reconstructed in Tabor Feeder Canal
Jocko River below Upper S Canal	IIF/ MEF/TIF	Monitoring protocol	Maintain staff gage and rating, use downstream river gage at K Canal for primary water management
Cold Creek below Upper S Canal	MEF	Monitoring protocol	Install staff gage after gate reconstructed in Upper S Canal
Gold Creek below Upper S Canal	MEF	Monitoring protocol	Install staff gage after gate reconstructed in Upper S Canal
Big Knife Creek below Upper S Canal	IIF/MEF/TIF	Upgrade to telemetry	
Jocko River at K Canal	IIF/MEF/TIF	Existing equipment	
Agency Creek below Upper J Canal	IIF/MEF/TIF	Upgrade to telemetry	
East Fork Finley Creek below N	IIF/MEF/TIF	Upgrade to telemetry	
Schley Creek below Doney Ditch	MEF/TIF	Monitoring protocol	Install staff gage
Finley Creek near mouth	IIF/MEF/TIF	Existing equipment	
Jocko River below lower S Canal	IIF/MEF/TIF	Upgrade to telemetry	

Jocko River below lower J Canal	IIF/MEF/TIF	Existing equipment	
Revais Creek below Revais R	MEF/TIF	New installation	
Mission Creek below Pablo Feeder Canal	IIF/MEF/TIF	Existing equipment	
Post Creek above Pablo Feeder Canal	MEF/TIF	Existing equipment	
Middle Crow Creek below Pablo Feeder Canal	IIF/MEF/TIF	Upgrade to telemetry	
North Crow Creek below Pablo Feeder Canal	IIF/MEF/TIF	Existing equipment	
Mission Creek below 6C Canal	IIF/MEF/TIF	Existing equipment	Station moved to St. Ignatius due to poor measuring conditions around HW 93
Post Creek below F Canal	IIF/MEF/TIF	Existing equipment	
Marsh Creek below KH Feeder	IIF/MEF/TIF	Monitoring protocol	Use existing staff gage and measurement location
South Crow Creek below South Crow Feeder	IIF/MEF/TIF	Existing equipment	
Crow Creek below Crow Pump	IIF/MEF/TIF	Existing equipment	
Mud Creek below Ronan B Canal	IIF/MEF/TIF	Upgrade to telemetry	
Crow Creek below Moiese A Canal	IIF/MEF/TIF	Existing equipment	
Hellroaring Creek below Twin Feeder Canal	MEF	Monitoring protocol	Install staff gage
Little Bitterroot River above Mill Creek	MEF	Monitoring protocol	Install staff gage
Mill Creek below Camas A Canal	MEF	Monitoring protocol	Install staff gage
Little Bitterroot River below Mill Creek	IIF/MEF/TIF	Existing equipment	
Hot Springs Creek below Camas C Canal	IIF / MEF	Monitoring protocol	Install staff gage
Little Bitterroot River below Hot Springs Creek			No action

Table 2.0: Measurement activities at RDA locations

Orange – existing CSKT station and equipment, count = 16;

Green – existing CSKT station with proposed upgrade to monitoring equipment, count = 4;

Yellow – new installation, count = 17;

Grey – monitoring protocol, count = 8

Station name	Station type	Measurement plan	Notes
Tabor Feeder Canal below MF Jocko River	RDA	Upgrade to telemetry	
Tabor Feeder Canal below NF Jocko River	RDA	Existing equipment	
Tabor Feeder Canal below Twin Lakes	RDA	Existing equipment	
Placid Canal above Black Lake	Incremental inflow	Existing equipment	
Upper Jocko S Canal at headworks at Jocko River	RDA	Existing equipment	
Upper Jocko S Canal at Big Knife Creek	RDA	New installation	
Jocko K Canal at headworks	RDA	Existing equipment	
Upper Jocko S Canal at Agency Creek	RDA	New installation	
Upper Jocko J Canal at Agency Creek	RDA	New installation	

Jocko E Canal at Agency Creek	RDA	New installation	
Jocko E Canal below Finley Creek	RDA	New installation	
Jocko N Canal at East Fork Finley Creek	RDA	New installation	
Doney Ditch at Schley Creek	RDA	Monitoring protocol	Install staff gage
Lower Jocko S Canal at Jocko River	RDA	New installation	
Lower Jocko J Canal at Jocko River	RDA	New installation	
Revais R Canal at Revais Creek	RDA	New installation	
Mission DA Canal at DC pool	RDA	Upgrade to telemetry	
Mission A Canal below Mission Creek	RDA	Existing equipment	
Pablo Feeder Canal below Post Creek	RDA	Existing equipment	
Pablo Feeder Canal below South Crow Creek	RDA	New installation	
Pablo Feeder Canal below Middle Crow Creek	RDA	Monitoring protocol	Install staff gage
Pablo Feeder Canal below North Crow Creek	RDA	Existing equipment	
Pablo Feeder Canal at Pablo Drop	RDA	Existing equipment	
DC-2 Lateral at Dry Creek lining	RDA	Monitoring protocol	Install staff gage
Cold Creek Ditch at Cold Creek	RDA	Monitoring protocol	Install staff gage
Mission F Canal at headworks	RDA	Upgrade to telemetry	
Mission B Canal at Mission Creek	RDA	New installation	
Mission C Canal at Mission Creek	RDA	Existing equipment	
Mission 6C Canal at Mission Creek	RDA	New installation	
Kicking Horse Feeder at Post Creek	RDA	Existing equipment	
Post F Canal at Post Creek	RDA	Existing equipment	
Mission H Canal at Mission Creek	RDA	New installation	
South Crow Feeder at South Crow creek	RDA	Upgrade to telemetry	
Crow Pump Canal at Crow Creek	RDA	Monitoring protocol	Install staff gage
Ronan B Canal at Mud Creek	RDA	New installation	
Moiese A Canal at Crow Creek	RDA	Existing equipment	
Hillside Ditch	RDA	Existing equipment	
Twin Feeder Canal at Hellroaring Creek	RDA	Monitoring protocol	Install staff gage
Twin Feeder Canal at Centipede Creek	RDA	New installation	
Lower Twin Feeder Canal at Bisson Creek	RDA	Monitoring protocol	Install staff gage
Pablo A Canal below Pablo Reservoir	RDA	Existing equipment	
Flathead River Pumping Plant	RDA	Monitoring protocol	Derive flow from power usage
Camas A Canal at Mill Creek	RDA	Existing equipment	
McGinnis Diversion	RDA	New installation	
Alder Diversion	RDA	New installation	

Table 3.0: Measurement activities at Natural Flow and Irrigation Return Flow locations

Orange – existing CSKT/USGS station and equipment, count = 7;

Green – existing CSKT station with proposed upgrade to monitoring equipment, count = 2;

Yellow – new installation, count = 3

Station name	Station type	Measurement plan	Notes
South Fork Jocko River	Natural flow	Existing USGS coop	Part of definition for wet/dry/normal years
Agency Creek above Upper S Canal	Natural flow	Upgrade to telemetry	Part of definition for wet/dry/normal years
South Crow Creek	Natural flow	Existing USGS coop	Part of definition for wet/dry/normal years
North Crow Creek	Natural flow	Upgrade to telemetry	Part of definition for wet/dry/normal years
Hellroaring Creek	Natural flow	Existing CSKT station	Part of definition for wet/dry/normal years
Mill Creek	Natural flow	Existing USGS coop	Part of definition for wet/dry/normal years
Dublin Gulch	Return flow	Existing equipment	BIOP compliance
Coleman Coulee	Return flow	Existing equipment	BIOP compliance
Moiese MA Canal	Return flow	Existing equipment	BIOP compliance
West Miller Coulee	Return flow	New installation	Large return flow to Mud Creek from Pablo area
Hopkins Draw	Return flow	New installation	Large return flow to Flathead River from Round Butte
Westphal Coulee	Return flow	New installation	Large return flow to Flathead River from Valley View

Table 4.0: Initial priorities for artificial controls in canals. Further prioritization will be based on experience installing initial structures

Station	Priority ranking	Planned-for control structure
Hillside Ditch	1	Flume
Mission B Canal	2	Flume
Lower Jocko J Canal	3	Flume
Lower Jocko S Canal	4	Flume

5.0 Budget

The budget estimate for the proposed work is broken into one of four categories: CSKT staff costs; equipment costs; database costs; and artificial control structure costs.

- CSKT staff costs are based on five year and ten year terms. Planning for water measurement activities cannot effectively proceed on a one year term and CSKT staff costs are not provided on this basis. Staff costs include:
 - One full-time hydro-technician progressing from hydro-technician level 1 to level 2 after two years. This position is essential considering the increased number of measurement stations. Support costs, including vehicle and one-time purchase of field equipment are included.

- Part-time FTE's (0.20 FTE) for the data management hydrologist and chief of field operations. These positions are intimately involved in all aspect of Water Management Program work, and are essential for effective implementation of proposed work.
- Equipment costs include costs for installation of new stations, upgrades to existing stations, and staff gage installations. Installation field service costs (equipment and operator, labor) are included. An 8% contingency is included for electronics only; the contingency is based on Program experience that certain of the electronics equipment requires maintenance, repair or replacement during and after the warranty period.
- Database costs are directly attributable to costs to increase the number of stations reporting to Aquarius Web.
- Artificial control structure costs are based on installation of four structures. Costs for four structures are included in the five-year and ten-year projections. Additional structure costs can be prorated out to the full sixteen canal stations recommended for control structures.

Budget Compilation

CSKT Staff Costs

Hydro-technician	5 year cost	\$ 324,436.00
Data Hydrologist	5 year cost	\$ 70,278.00
Chief of Field Operations	5 year cost	\$ 77,736.00
	5 year labor subtotal	\$ 472,450.00
Hydro-technician	10 year cost	\$ 674,594.00
Data Hydrologist	10 year cost	\$ 140,556.00
Chief of Field Operations	10 year cost	\$ 155,472.00
	10 year labor subtotal	\$ 970,622.44

Equipment Costs

New installations	electronics – 21 stations	\$ 121,391.00
New installations	well, house, staff – 21 stations	\$ 30,240.00
Upgrade stations	electronics – 12 stations	\$ 69,366.00
Staff gage stations	materials – 18 stations	\$ 3,600.00
Installation – field services	backhoe, operator, labor	\$ 18,000.00
Electronics contingency (8%)		\$ 15,261.00
	One-time installation subtotal	\$ 257,858.00

Database Costs (does not include potential MBMG costs)

Aquarius Web increase in stations reported to web	\$ 14,000.00
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Artificial Controls in canals – 4 locations

Four structure designs and installations	\$ 60,000.00
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Total Cost based on five year labor costs **\$ 804,308.00**

Total Cost based on ten year labor costs **\$ 1,302,308.00**

6.0 Schedule

The schedule for project implementation is contingent based on approval of the proposal and disbursement of funds to implement the proposal. Consequently, the schedule is defined in terms of time following funds disbursement.

Hillside Ditch and Mission B Canal are identified for installation of a ratable, artificial control in fall, 2016. Lower Jocko J Canal and Lower Jocko S Canal are identified for installation of a ratable, artificial control in spring, 2017. These dates could change, pending project start-up.

Table 5.0: Schedule

Activity		Time following funds disbursement
1	Hire field hydrographer	3 months
2	Purchase and receipt of gage station electronics	4 months
3	Purchase, fabrication, and receipt of gage station wet wells and gage houses	6 months
4	Upgrade gaging equipment at existing stations	6 months
5	Install wet wells, gage houses and gage station electronics at new stations	8 months
6	Install staff gages at monitoring protocol stations	12 months
7	Database activities, including new GOES assignments	4 months
8	Install control structures	2 – fall 2016, 2 – spring 2017

Supplement One: Existing Tribal Water Measurement Program

This supplement contains: a) maps and tables with currently active CSKT Water Management Program gaging stations; and b) a position description for the Program hydro-technician position. This is included to illustrate the job responsibilities for the staff position identified in the project budget. This position description has been used for recent hires.

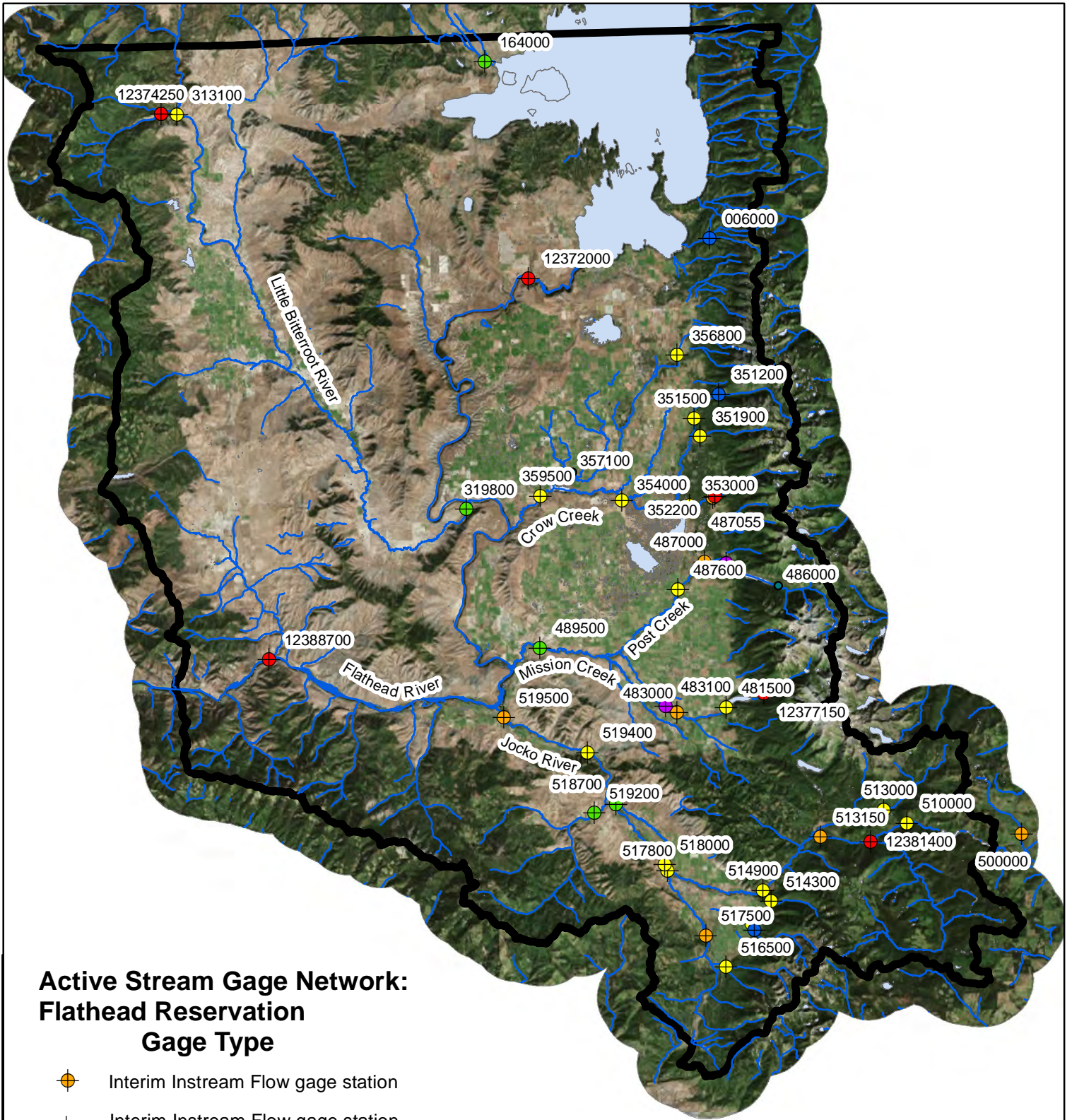
Table S.1a: Active CSKT/USGS stream gages [IIF = interim instream flow location; MEF and TIF = Compact instream flow location; stream = active station that is not a proposed instream flow compliance station]

Station Identifier	Station Name	Station Type	Period of Record
500000	Placid Creek below Placid Canal	IIF	1989 - P
510000	Middle Fork Jocko River below Tabor Feeder	IIF / MEF / TIF	1989 - P
513000	North Fork Jocko River below Tabor Feeder	IIF / MEF / TIF	1986 - P
513150	Jocko River below Upper S Canal	IIF/MEF / TIF	2009 - P
514300	Big Knife Creek below Upper S Canal	IIF / MEF / TIF	1985 - P
514900	Jocko River below K Canal	IIF / MEF / TIF	1986 - P
516500	East Finley Creek below Upper N Canal	IIF / MEF / TIF	1982 - P
516700	Agency Creek above Upper S Canal	Stream	1999 - P
516900	Agency Creek below Upper J Canal	IIF / MEF / TIF	1992 - P
517500	Finley Creek below E Canal	IIF	1989 - P
517800	Finley Creek near mouth	IIF / MEF / TIF	1985 - P
518000	Jocko River below lower S Canal	IIF / MEF / TIF	1989 - P
518700	Jocko Spring Creek near mouth	Stream	1993 - P
519200	Valley Creek near mouth	Stream	1993 - P
519400	Jocko River below lower J Canal	IIF / MEF / TIF	1989 - P
519500	Jocko River near mouth	IIF	2009 - P
313100	Little Bitterroot River below Camas A Canal	IIF / MEF / TIF	1982 - P
319800	Little Bitterroot River near mouth	Stream	1987 - P
164000	Dayton Creek near mouth	Stream	1992 - P
006000	Hellroaring Creek above reservoir	Stream	1982 - P
356800	Mud Creek below Ronan B Canal	IIF / MEF / TIF	1989 - P
351200	North Crow Creek at campground	Stream	1982 - P
351500	North Crow Creek below Pablo Feeder Canal	IIF / MEF / TIF	1987 - P
351900	Middle Crow Creek below Pablo Feeder Canal	IIF / MEF / TIF	1987 - P
352200	South Crow Creek below Pablo Feeder Canal	IIF	1987 - P
353000	South Crow Creek below South Crow Feeder Canal	IIF / MEF / TIF	1989 - P
354000	Crow Creek below Crow Pump	IIF / MEF / TIF	1989 - P
357100	Mud Creek above Crow Reservoir	Stream	2014 - P
359500	Crow Creek below Moiese A Canal	IIF / MEF / TIF	1982 - P
486000	Post Creek above McDonald Reservoir	Stream	1990 - P
486700	Post Creek above Pablo Feeder Canal	MEF / TIF	1992 - P
487055	Marsh Creek above Kicking Horse Feeder Canal	IIF / MEF	2001 - P
487000	Post Creek below Kicking Horse Feeder Canal	IIF	1989 - P
487600	Post Creek below F Canal	IIF / MEF / TIF	1982 - P
481500	Mission Creek below Mission A Canal	IIF / MEF / TIF	1987 - P
483000	Mission Creek below C Canal	IIF	1991 - P
483100	Mission Creek at St Ignatius	IIF / MEF / TIF	2014 - P
489500	Mission Creek at National Bison Range	Stream	1982 - P







12381400	South Fork Jocko River near mouth	Stream	1982 – P
12377150	Mission Creek above Reservoir	Stream	1982 – P
12375900	South Crow Creek near Ronan	Stream	1982 – P
12374250	Mill Creek above Bassoo Creek	Stream	1982 – P
12372000	Flathead River near Polson	Stream	1908 – P
12388700	Flathead River near Perma	Stream	1982 - P

Table S.1b: Active CSKT canal gages [RDA = river diversion allowance monitoring location, Canal headworks = canal monitoring location not assigned to RDA's; Canal operations = canal monitoring location on canal, not associated with a headworks]

Station Identifier	Station Name	Station Type	Period of Record
510100	Placid Canal above Black Lake	RDA	1992 – P
510510	Tabor Feeder Canal below Middle Fork Jocko	RDA	1992 – P
510520	Tabor Feeder Canal below North Fork Jocko	RDA	1992 – P
510570	Tabor Feeder Canal below Twin Lakes	RDA	1994 – P
513100	Upper S Canal near headworks	RDA	1992 – P
514000	Jocko K Canal near headworks	RDA	1992 – P
514090	Jocko K Canal below Lamoose Creek	Canal operations	2015 – P
311100	Camas A Canal near headworks	RDA	1982 – P
317610	Camas B Canal near headworks	Canal headworks	2015 – P
317710	Camas C Canal near headworks	Canal headworks	2015 – P
482900	Mission F Canal at headworks	RDA	1994 – P
482810	Mission DA Canal near headworks	RDA	1992 – P
481410	Mission A Canal below Mission Reservoir	RDA	1992 - P
482910	Mission C Canal near headworks	RDA	1992 – P
487510	Post F Canal near headworks	RDA	1992 – P
486920	Kicking Horse Feeder Canal above KH Reservoir	RDA	1994 – P
352900	South Crow Feeder near headworks	RDA	1992 – P
486800	Pablo Feeder Canal below Post Creek	RDA	1994 - P
486830	Pablo Feeder Canal below North Crow Creek	RDA	1992 – P
486880	Pablo Feeder Canal above Pablo Drop	RDA	1994 – P
486891	Pablo A Canal below Pablo Reservoir	RDA	1994 – P
486897	Pablo A Canal at Round Butte Weir	Canal operations	1994 – P
358500	Moiese A Canal at headworks	RDA	1992 – P
487590	Post F Canal above Hillside Reservoir	Canal operations	1994 – P
489000	Hillside Ditch near headworks	RDA	2015 – P
489200	Dublin Gulch in Bison Range	Wasteway	2015 – P
489700	Coleman Coulee near mouth	Wasteway	1990 - P
358590	Moiese MA Canal above mouth	Wasteway	1994 - P

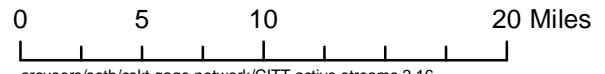


**Active Stream Gage Network:
Flathead Reservation
Gage Type**

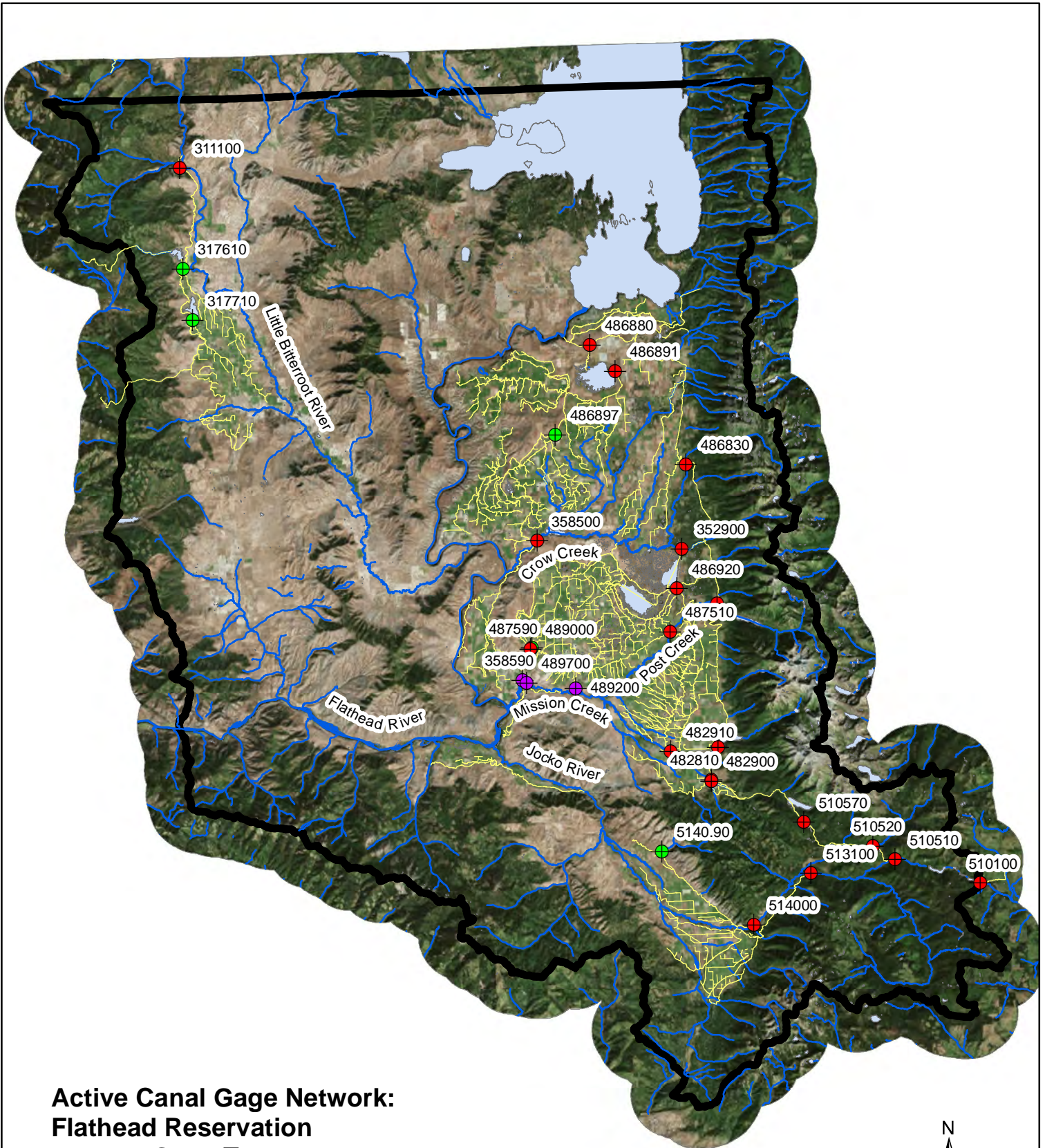
-  Interim Instream Flow gage station
-  Interim Instream Flow gage station, also Minimum Enforceable and Target Instream Flow gage station
-  Minimum Enforceable and Target Instream Flow gage station
-  Stream gage with altered flow pattern
-  Natural flow stream gage
-  Natural flow U.S. Geological Survey stream gage

517800 - CSKT station identifier

12381400 - USGS station identifier



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**Active Canal Gage Network:
Flathead Reservation
Gage Type**

- Canal Headworks, also RDA gage station
- Canal Headworks
- Irrigation Wasteway



311100 - CSKT station identifier



Supplement Two: Proposed Water Measurement Program

Proposed new installations and upgrades to existing installations will be maintained, measured, and rated by a hydro-technician using current Water Measurement Program practice. This includes monthly discharge measurements to maintain station rating tables, continuous updates of the data and entry into the database, and quality assurance and documentation before a record is considered final.

The Program, after a procurement evaluation, selected Sutron Satlink data loggers and shaft encoders for stage data collection, storage, and transmission. Equipment is placed in a metal shelter placed over a stilling well. Stilling wells have proven to be sensitive to stage changes and durable, especially in a canal setting.

Proposed installations and upgrades are budgeted and planned-for based on a similar setup using Sutron equipment.



Jocko River below Lower J Canal (station 519400)

The following tables contain station-by-station detail for proposed upgrades.

Table S.2a) Proposed New Installations ISF and RDA stations. Budgeted items include new wells, equipment shelters, staff gages, electronics, and associated web-hosting costs.

Table S.2b) Proposed Upgrades ISF and RDA stations. Budgeted items include electronics and associated web-hosting costs.

Table S.2c) MEF and RDA locations proposed for a compliance monitoring protocol. Budgeted items include staff gage.

Table S.2d) RDA locations proposed for placement of an artificial control structure. Budgeted items include 4 RDA control installations.

Table S.2e) Natural flow and return flow stations proposed for new installation or upgrade. Budget items as above.

Table S.2a: New installation - Instream flow and RDA stations proposed for stilling well, equipment house, and telemetric equipment installation. Count = 18

Station Identifier	Station Name	Station Type	Period of Record
	Revais Creek below the Revais R Canal	MEF / TIF	
513200	Upper Jocko S Canal below Big Knife Creek	RDA	1992 - 2005
516750	Upper Jocko S Canal below Agency Creek	RDA	1993 - 2005
516710	Upper Jocko J Canal below headworks below Agency Creek	RDA	1992 - 2005
	Jocko E Canal below Agency Creek	RDA	
516910	Jocko E Canal below Finley Creek	RDA	1992 - 2005
516200	Jocko N Canal below headworks below East Finley Creek	RDA	1992 - 1993
517950	Lower Jocko S Canal below headworks below Jocko River	RDA	1992 - 1994
519350	Lower Jocko J Canal below headworks below Jocko River	RDA	1992 - 1998
541000	Revais R Canal below headworks below Revais Creek	RDA	1993 – 1995
486810	Pablo Feeder Canal below South Crow Creek	RDA	1994 - 2005
482710	Mission B Canal below headworks below Mission Creek	RDA	1992 - 2005
483150	Mission 6C Canal below headworks below Mission Creek	RDA	1992 - 2005
482950	Mission H Canal below headworks below Mission Creek	RDA	1992 - 2005
356710	Ronan B Canal below headworks below Mud Creek	RDA	1992 - 2006
006600	Twin Feeder Canal below Centipede Creek	RDA	1987 – 1988
317100	McGinnis Diversion below headworks	RDA	1982 - 1987
	Alder Diversion near headworks	RDA	

Table S.2b: Upgrade equipment – Active instream flow and RDA stations proposed for equipment upgrade to support telemetry. Count = 10

Station Identifier	Station Name	Station Type	Period of Record
514300	Big Knife Creek below Upper S Canal	IIF /MEF / TIF	1992 – P
516900	Agency Creek below Upper J Canal	IIF / MEF/ TIF	1992 – P
516500	East Fork Finley Creek below N Canal	IIF / MEF / TIF	1992 - P
518000	Jocko River below lower S Canal	IIF / MEF / TIF	1992 - P
510510	Tabor Feeder Canal at headworks at MF Jocko	RDA	1992 – P
482810	Mission DA Canal below DC pool	RDA	1992 - P
351900	Middle Crow Creek below Pablo Feeder Canal	IIF / MEF/ TIF	1987 - P
356800	Mud Creek below Ronan B Canal	IIF / MEF / TIF	1992 - P
482900	Mission F Canal at headworks	RDA	1994 - P
352900	South Crow Feeder Canal at headworks	RDA	1992 - P

Table S.2c: MEF and RDA locations that are proposed for a compliance monitoring protocol – staff gage or pumping plant records. Count = 19

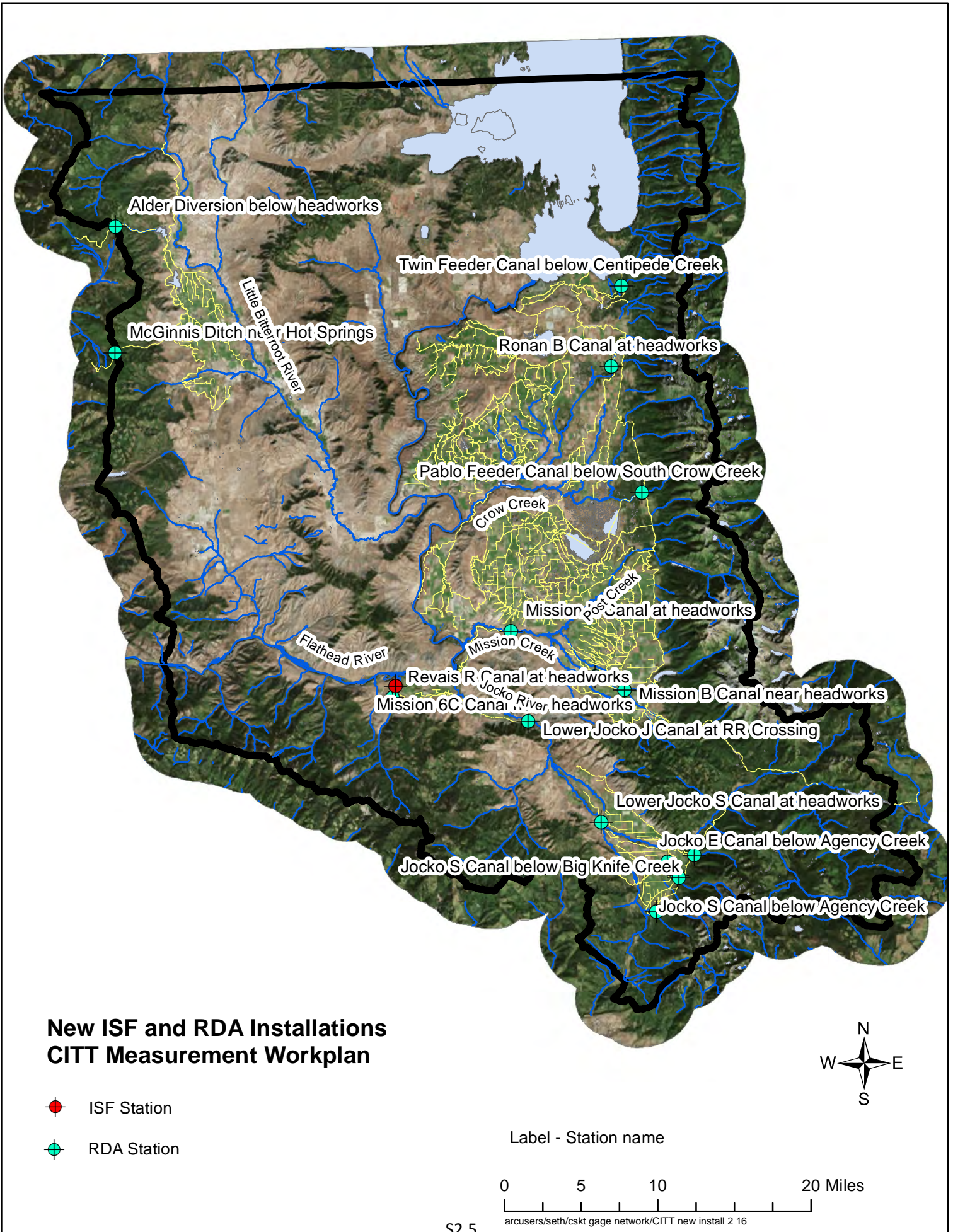
Station Identifier	Station Name	Station Type	Period of Record
482400	DC-2 Lateral at Dry Creek Lining	RDA	1987 - 1988
	Falls Creek below Tabor Feeder Canal	MEF/ TIF	1912 - 1916
	S-14 Creek below Tabor Feeder Canal	MEF/ TIF	
513150	Jocko River below Upper S Canal	IIF / MEF / TIF	2009 - p
	Gold Creek below Upper S Canal	MEF	
	Cold Creek below Upper S Canal	MEF	
	Schley Creek below Doney Ditch	MEF / TIF	
	Doney Ditch below Schley Creek	RDA	
	Cold Creek Ditch at headworks	RDA	
487055	Marsh Creek below Marsh Creek Feeder Canal	MEF /TIF	2001 - P
354010	Crow Pump Canal below Crow Pump	RDA	1994 - 1998
486820	Pablo Feeder Canal below Middle Crow Creek	RDA	1987 - 1988
	Hellroaring Creek below Twin Feeder Canal	MEF	
006500	Twin Feeder Canal at headworks	RDA	1982 - 1987
	Twin Feeder Canal at Bisson Creek	RDA	
	Flathead Pumping Plant	RDA	
	Little Bitterroot River below Camas A Canal, above Mill Creek	MEF	
	Mill Creek below Camas A Canal	MEF	
317000	Hot Springs Creek below Camas C Canal	MEF	1989 - 1997
	Little Bitterroot River below Hot Springs Creek	No action	

Table S.2d: RDA locations that are proposed for an artificial control structure. Count = 16

Station Identifier	Station Name	Station Type	Period of Record
513200	Upper Jocko S Canal at Big Knife Creek	RDA	1992 - 2005
516750	Upper Jocko S Canal at Agency Creek	RDA	1993 - 2005
516710	Upper Jocko J Canal at headworks at Agency Cr.	RDA	1992 - 2005
	Jocko E Canal at Agency Creek	RDA	
516910	Jocko E Canal at Finley Creek	RDA	1992 - 2005
516200	Jocko N Canal at headworks at East Finley Creek	RDA	1992 - 1993
517950	Lower Jocko S Canal at headworks at Jocko River	RDA	1992 - 1994
519350	Lower Jocko J Canal at headworks at Jocko River	RDA	1992 - 1998
541000	Revais R Canal at headworks at Revais Creek	RDA	1993 – 1995
482710	Mission B Canal at headworks at Mission Creek	RDA	1992 - 2005
483150	Mission 6C Canal at headworks at Mission Creek	RDA	1992 - 2005
482950	Mission H Canal at headworks at Mission Creek	RDA	1992 - 2005
356710	Ronan B Canal at headworks at Mud Creek	RDA	1992 - 2006
006600	Twin Feeder Canal at Centipede Creek	RDA	1987 – 1988
317100	McGinnis Diversion below headworks	RDA	1982 - 1987
	Alder Diversion near headworks	RDA	

**Table S.2e: Natural flow and irrigation return flow stations proposed for new installation or upgrade.
Count for upgrade = 2; Count for new installation = 3**

Station Identifier	Station Name	Measurement plan	Station Type	Period of Record
516700	Agency Creek above Upper S Canal	Upgrade telemetry	Natural	1999 - P
351200	North Crow Creek	Upgrade telemetry	Natural	1982 - P
	West Miller Coulee	New installation	Return flow	
	Hopkins Draw	New installation	Return flow	
	Westphal Coulee	New installation	Return flow	



Alder Diversion below headworks

Twin Feeder Canal below Centipede Creek

McGinnis Ditch near Hot Springs

Ronan B Canal at headworks

Little Bitterroot River

Pablo Feeder Canal below South Crow Creek

Crow Creek

Mission Post Canal at headworks

Flathead River

Mission Creek

Revais R Canal at headworks
Mission 6C Canal at Jocko River headworks

Mission B Canal near headworks

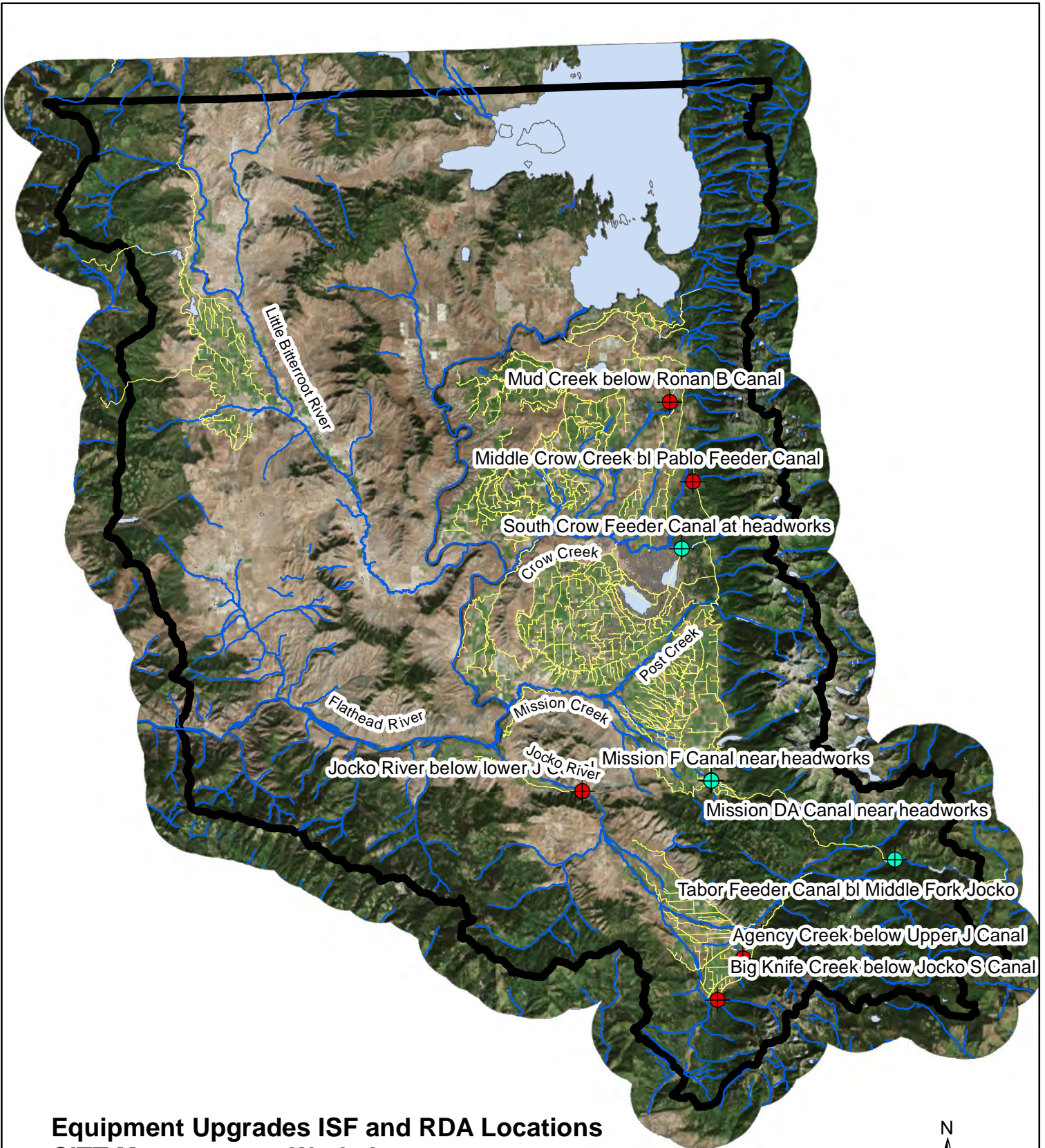
Lower Jocko J Canal at RR Crossing

Lower Jocko S Canal at headworks

Jocko E Canal below Agency Creek

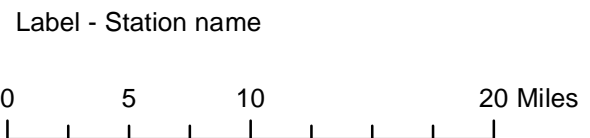
Jocko S Canal below Big Knife Creek

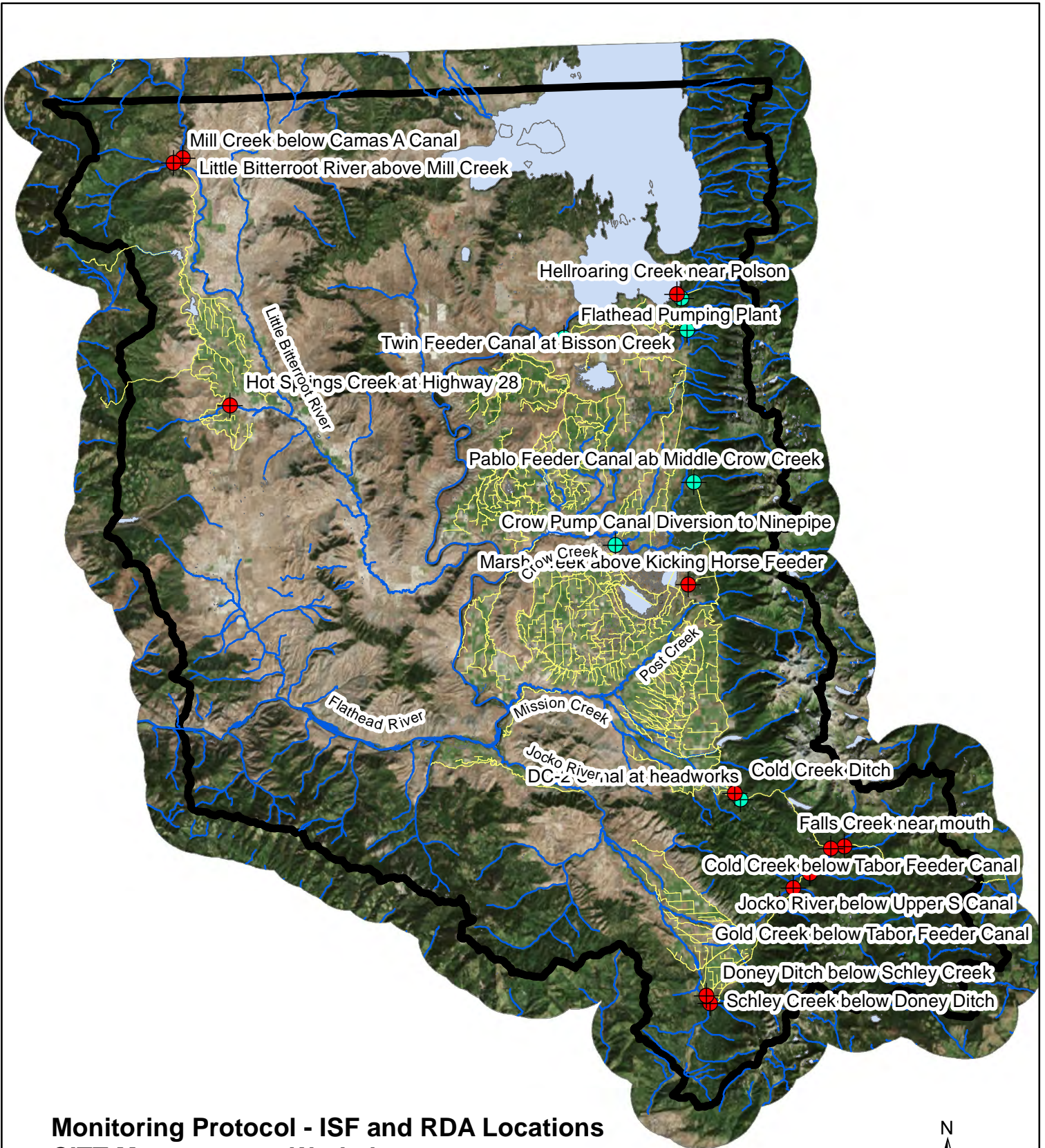
Jocko S Canal below Agency Creek



**Equipment Upgrades ISF and RDA Locations
CITT Measurement Workplan**

- ISF Station
- RDA Station





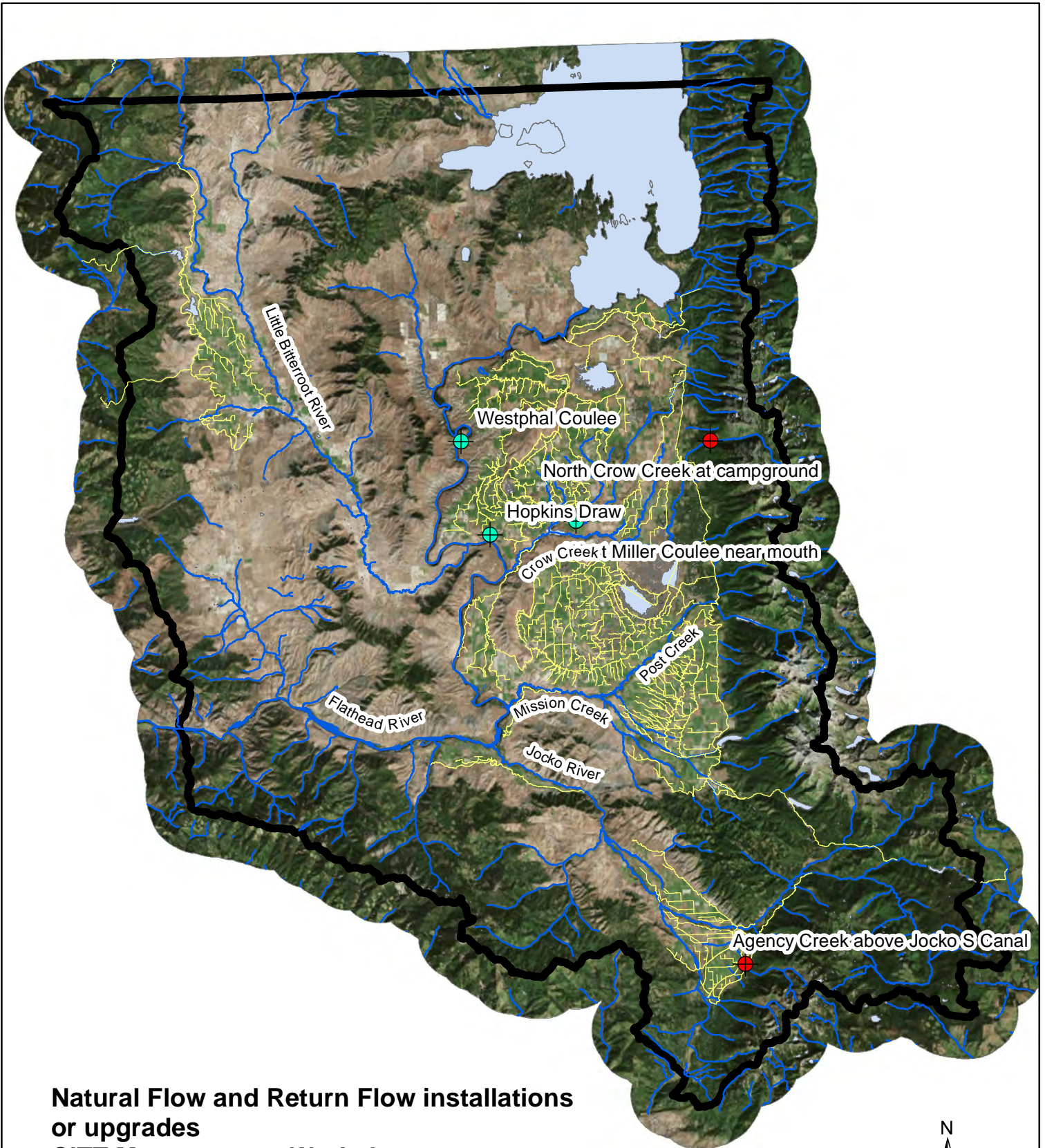
**Monitoring Protocol - ISF and RDA Locations
CITT Measurement Workplan**

- ISF Station
- RDA Station

Label - Station name, several stations not assigned station id



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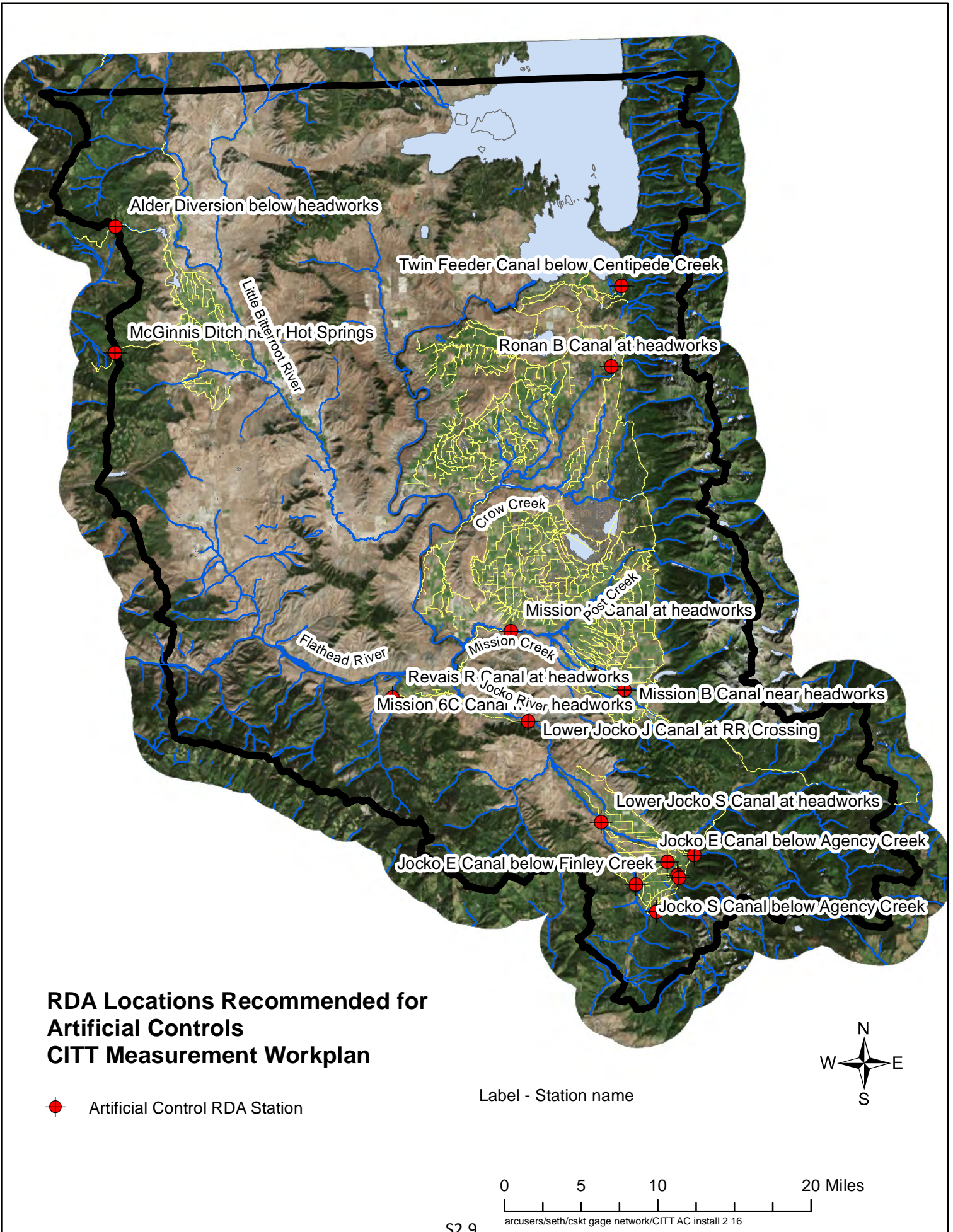


**Natural Flow and Return Flow installations
or upgrades
CITT Measurement Workplan**

- Natural Flow Station
- ⊕ Irrigation Return Flow Station

Label - Station name





RDA Locations Recommended for Artificial Controls CITT Measurement Workplan

● Artificial Control RDA Station

Label - Station name



0 5 10 20 Miles

arcusers/seth/cskt gage network/CITT AC install 2 16