Instream Flow and Irrigation Diversion Aspects of the FIIP Water Use Agreement: State of Montana Evaluation and Recommendations

The State of Montana, the Confederated Salish and Kootenai Tribes (CSKT or Tribes), and the United States have agreed to a limited reopening of negotiations to address the relationship between Flathead Indian Irrigation Project (FIIP) water rights and CSKT instream flow (ISF) rights, which were the subject of the previously negotiated Water Use Agreement (WUA). The WUA was never approved by a vote of the irrigators. The State has proposed[1] a negotiated solution that would be predicated on a simpler approach but would retain or expand upon many elements of the WUA. This document presents a brief overview of the WUA and the model outputs—specifically addressing Farm Turnout Allowances (FTA), River Diversion Allowances (RDA), Minimum Enforceable Flows (MEF), and Target Instream Flows (TIF)—and concludes with the State's evaluation and the technical basis for the State's recommendations outlined below. These recommendations are based on the State's understanding that the original principle underlying WUA negotiations was to retain project deliveries necessary to satisfy current crop consumption levels while increasing project efficiency to allow for increased instream flows over time.

Summary Conclusions and Recommendations:

- The State concludes that the Farm Turnout Allowance (FTA) values set forth in the WUA are appropriate when used as an average for an aggregate of farms within a large service area, but that these FTA values do not accurately account for the typical farm-to-farm variations in crop consumption and application efficiencies that result from variations in farming practices and water supplies across the project. As a result, the State proposes to move forward with the concept of RDAs that address water supply at the headworks of the FIIP, but to eliminate from the settlement acreage-specific FTA restrictions and instead allow the FIIP Project Operator and the FIIP irrigators to resolve issues pertaining to internal project deliveries and routing.

- The Tribes' model used to support RDA, MEF, and TIF quantifications provides credible monthly flow and volume estimates, but as with any model, there is uncertainty associated with the predictions. The State recommends the Tribes' model outputs be used initially to describe how the Tribes' fisheries instream flow water rights and FIIP irrigation water rights will be enforced. To address the model uncertainty, the State proposes that the settlement include mandatory water measurement provisions to verify model estimates and that the parties work together to create a process by which to address potential discrepancies between modeled projections and measured water availability.

- The State is concerned that the WUA prioritization scheme for water deliveries would be technically difficult to implement as the WUA provides limited details for specifying how and when enforceable ISFs convert from MEF to TIF values or how annual RDA values should be

[1] See letter and proposal dated June 26, 2014 and available at: http://www.dnrc.mt.gov/rwrcc/Compacts/CSKT/state_proposal_cover_letter.pdf

delivered throughout a given year. The State would like to explore options that maintain the original principles of the WUA, offer more clarity regarding the distribution of water throughout a given year, and are simpler to implement and enforce.

- The concept of adaptive management contained the WUA is pivotal to the above-described measurement and adjustment period. The State proposes that adaptive management provisions be included in the Compact and linked to the measurement and evaluation processes referenced above.

- The Compact allows non-project irrigators holding water rights arising under state law within the FIIP influence area to enter into an agreement whereby the irrigator may divert the lesser of the FTA *or* their historically used amount, free from the possibility of call by either the Project or the Tribes. As the State is proposing to eliminate the concept of an FTA from the settlement, the State recommends replacing the FTA reference in these protections with a reference to "an amount of water per acre that is delivered by FIIP to project water users in the immediate service area."

Water Use Agreement and HYDROSS modeling:

The WUA was negotiated by the Tribes, the United States, and the Flathead Joint Board of Control (FJBC), an organization of the three irrigation districts that are served water by the FIIP. The agreement was never finalized by a vote of the FIIP irrigators. The FIIP is a federal irrigation project currently owned and operated by the Bureau of Indian Affairs (BIA) that serves up to 130,000 acres and includes 10 major reservoirs and more than a thousand miles of canals that cross and re-cross many streams. The WUA was designed as an appendix to the proposed 2013 Compact agreement, and was incorporated by reference into the Compact. The Compact sets the legal parameters and quantities of the FIIP ISFs and FIIP irrigation water rights, while the WUA clarified how those water rights would be enforced and managed relative to one another, balancing the needs of irrigators with those of fisheries.

The proposed Compact includes 33 FIIP ISF water rights, matching the 33 ISF enforcement locations specified in the WUA. The former WUA set forth 44 RDAs within 16 administrative areas, as compared to the 495 points of diversion specified by the three FIIP irrigation water rights enumerated in the Compact appendices. These 44 locations are the principal points at which FIIP diversions would be managed to achieve the balancing of water uses described above. The FIIP ISF water right monthly values set forth in the Compact appendices were to be enforced pursuant to flow rate schedules set forth in the WUA. The RDA quantifications set forth in the former WUA include annual values of irrigation volumes for specific service areas.

The RDA, MEF, and TIF values presented in the WUA were developed by the CSKT and DOWL-HKM using the Hydrologic River Operation Study System (HYDROSS) model platform originally developed by the US Bureau of Reclamation. The HYDROSS model is a mass-balance water accounting system that uses measured or calculated flows to numerically track inflow, outflow, and water consumption within an irrigation project or river system. At each individual calculation point, known as a model node, specific estimations of water supply, seepage, conveyance loss, return flow, and operational constraints, among other elements, are entered as inputs. Estimations of canal diversion requirements and corresponding streamflows are predicted as outputs and take the form of spreadsheet tables and graphs.

The basic premise of HYDROSS and the WUA that existing crop water consumption at the farm level would be kept whole, taking into account reasonable conveyance and application inefficiencies, is predicated on the notion that increased instream flows would be achieved by State and Federal investment in improved irrigation management and infrastructure. These improvements would reduce water losses due to inefficiency and retain those previously diverted inefficiencies in the stream, protected as instream flows to sustain fisheries. Initial water savings from management improvements are illustrated by two sets of HYDROSS outputs: baseline conditions[2] and operational improvements[3]. These two sets of model computations represent "before" and "after" depictions of baseline conditions and possible water savings that might be achieved through improved FIIP management within a given area of the project.

The baseline conditions generally describe stream and canal flows on the FIIP under current operations,[4] before implementation of the operational improvements described below. An active irrigation land base map of the FIIP from 2009 was combined with 1983-2002 climate and flow data to provide the majority of data inputs for this baseline modeling. Separate HYDROSS models were developed for three separate management regions within the FIIP: the Jocko, the Mission, and the Little Bitterroot.

The Operational Improvement modeling inputs estimated water conveyance and application efficiency improvements that could result from improved water management upgrades including: improved diversion scheduling, water measurement and accounting, the addition of stilling wells for irrigation pumps that reduce the amount of bypass flow required to keep the pump intake fully submerged, the elimination of stock water deliveries,[5] and the repair of leaking and ineffective irrigation structures and the increased reliance on irrigation water pumped from the Flathead Pumping Station. The Operational Improvement modeling limits irrigation diversions to the essentials estimated to be necessary for crop-based demands inclusive of reasonable canal, lateral, and on-farm inefficiencies as they currently exist. On-farm efficiencies were allocated based on irrigation method, with 40-50% application efficiencies assigned to flood irrigation and 60-80% application efficiencies assigned to sprinkler irrigation. Imposed operational improvements reduce excessive inefficiencies and yield lower diversion requirements and therefore more water is left in the stream as compared to current practice. Operational improvements include a 3% limit to tailwater, which is the water not used by farm turnouts that flows out the end of a supply ditch.

[2] CSKT modeling reports, "2009 Historic Irrigable Acres Baseline Modeling"
[3] CSKT modeling reports, "Operational Improvements, Alternative 2"
[4] FIIP has undergone some recent stock water and tailwater management changes in the last two irrigation seasons that may not be reflected in this statement.
[5] Stock water deliveries were never federally authorized. The State has proposed to invest 4 million dollars in alternative stockwater funding to address this issue.

To achieve this level of operational efficiency, accurate water measurement will be required at key locations, large diversion structures may need to be replaced or modified to allow fine-tuning of deliveries, telemetric controls may need to be installed to allow remote monitoring and control, and an improved accounting system would be needed to track water use and ensure that it is properly distributed to both the farm and the stream. Given that the FIIP has far more sources of inflow and outflow than do most irrigation projects of similar size, this would take a significant investment of money and time. The existing crop consumption conditions accounted for in HYDROSS and the associated RDAs and ISFs should not be confused with full-service irrigation for all acres served by the FIIP; the project has not historically realized full-service irrigation for all acres served and the proposed settlement does not envision protections for irrigation deliveries in excess of historic crop consumption.

Operational improvement modeling was not provided for the Little Bitterroot area because the negotiated WUA maintains the current water budget there. The Little Bitterroot is a heavily appropriated area with a hydrology dominated by irrigation uses. Operational improvements are unlikely to yield improved streamflows while simultaneously protecting existing irrigation water consumption. Accordingly, the Tribes conceded to MEF ISFs based solely on baseline conditions for the Little Bitterroot and are not seeking larger MEF or TIF ISFs based on operational improvements.

Infrastructure betterment is not the focus of this evaluation and is mentioned primarily to distinguish it from operational improvements. Betterment includes the lining of earthen ditches, conversion of open ditches to pipelines, stabilization of canal sections that are prone to failure/seep, etc. Betterment would be primarily funded through federal payments. The amount of water actually saved would ultimately be determined by site-specific measurements and calculations rather than through HYDROSS modeling. Any water saved would constitute a future addition to the ISF values not accounted for by the modeled operational improvements.

CSKT Tables 3.5 summarize projected percent changes of diverted volumes, crop consumption, and streamflows resulting from implementation of the operational improvements (Appendices A. i-ii). For the Jocko, HYDROSS predicts that operational improvements can reduce average annual diversion by 30%, while simultaneously increasing crop consumptive use by 2% and yielding a 3% increase to average annual streamflows. For the Mission, model predictions depict a more modest 23% reduction in average annual diversions, thereby resulting in a decrease in crop consumption of 2% and a 14% increase to average annual streamflows.

The Tribes also provided graphs depicting improved streamflow conditions at individual node locations as a result of the imposition of the operational improvements modeled by HYDROSS (Appendix B. i-v). These graphs illustrate the modeled streamflow improvements to individual instream flow locations. The Tribes have expressed that they consider these improved streamflow values to represent a significant compromise designed to allow for existing irrigation and yielding significantly lower flow rates than would ISFs based solely on optimum fisheries needs.

To demonstrate how operational improvements would impact irrigation diversions, the Tribes provided graphs depicting the reduced diversion volumes overlain with changes in crop water consumption attributable to these reductions (Appendix C. i-vi). These graphs illustrate model projections that depict historic crop water consumption levels *and* improved instream fisheries flows that might be achieved through decreased river diversions. Results vary by location, but generally depict a reduction to diversions coupled with minimal changes to water available for crop consumption (see Appendix D. i-ii & E. i-ii).

The principles that informed HYDROSS inputs and the WUA negotiations appear to meet the State's objectives pertaining to this limited reopening of negotiations—namely to keep existing on-farm water use—as indicated by crop water consumption—whole, while directing water savings gained through operational improvements and infrastructure betterment to support CSKT instream fisheries flows. Maintaining existing crop consumptive uses while simultaneously mandating improved FIIP operations for purposes of reducing FIIP diversion impacts to streams is a preferred outcome. The pressing issues to be resolved concern the mechanics of putting these principles into practice in a manner that is practicable and provides some measure of certainty for both irrigation deliveries and instream flows into the future.

State History of evaluating HYDROSS Outputs:

The State contracted with the University of Idaho to conduct a remote sensing based study using the Mapping Evapotranspiration at high Resolution using Internalized Calculations (METRIC) method for the Reservation.[6] Using the METRIC results, the State worked to assess crop water consumption for lands served by the FIIP. The results demonstrated a wide range of water use within the FIIP, with some fields demonstrating a near maximum potential evaporation (PET) rate for alfalfa, but most fields transpiring considerably less than the PET, with the average crop consumption closer to half the PET for alfalfa. These estimates of crop water consumption derived using METRIC are consistent with results from HYDROSS, and demonstrate that the WUA FTA values appear reasonable when applied as an average value to an aggregate of farms over a large service area. As expected, however, crop water consumption was not consistent for all irrigated lands when comparing individual parcels. Some irrigated parcels used more than the FTA values and some used less. This leads the State to conclude that applying the FTA values as an average value over a large service area is appropriate, but that applying the FTA values to individual parcels may not always achieve the goal of protecting existing crop consumption at the farm level. The State recognizes that the Measured Water Use Allowance (MWUA) was the solution negotiated by the WUA parties to address this issue. The State's proposed approach would not assert authority over internal FIIP water distributions. The State proposes to remove the individual FTA values set forth in the WUA and instead to focus on RDAs, where composite volumes would reflect existing crop consumption including reasonable conveyance and application inefficiencies; allocations to individual irrigators would be managed by the Project operator according to the RDA value.

[6] http://www.dnrc.mt.gov/rwrcc/Compacts/CSKT/2012/Sept04MetricPresentation.pdf

The State-negotiated components of the Compact that directly utilized the HYDROSS outputs tie to on-Reservation ISFs termed “Natural,” “Other,” and “FIIP” ISFs. Because of specific implementation and enforcement provisions associated with these ISF water rights, detailed analysis of the specific HYDROSS quantification outputs were not of paramount importance because of negotiated protections for existing users explained below. The various ISF categories are named according to their geographic location. Natural ISFs are in the headwaters, while Other and FIIP ISFs are bifurcated based on whether or not they occur within or outside of the FIIP Influence Area, which is the hydrologic zone in which the FIIP irrigation withdrawals constitute the dominant water use that affects streams and water supply.[7]

Natural ISFs were designed to protect headwaters on the reservation. Natural ISFs are situated almost entirely upstream of all existing diversions. For the limited instances in which there are water users situated upstream of these Natural ISFs and located in a manner that would make them susceptible to call, the Natural ISF water right abstracts specifically exempt those existing water rights from call. Accordingly, the quantifications of these water rights will not impact existing water users and there was no need for the State to scrutinize specific monthly enforcement values as generated by HYDROSS.

Other ISFs were designed to protect CSKT ISFs in lower or downstream areas of the FIR that are outside of the FIIP influence area. These areas contain a multitude of existing non-project water rights arising under state law. For these areas, enforceable ISF monthly values generated by HYDROSS would directly affect existing users and the values would be of substantive concern. Negotiating parties addressed these concerns in the Unitary Management Ordinance (UMO), which offers a process that takes precedence over the Compact quantifications of Other ISFs and specifically provides that the Other ISFs must be quantified for enforcement purposes in a way that allows existing rights to be exercised, effectively making the Other ISFs subordinate to existing water rights.

FIIP ISFs affect existing water users within the FIIP influence area, and can be enforced against both FIIP diversions and State-based irrigation purposed water rights. There are State-based water users within this area, and accordingly, the State negotiated protection options on their behalf. Article III.G.3 of the Compact would have allowed non-project irrigators who are potentially subject to call by both the FIIP irrigation water rights and the Tribes’ ISF water rights to enter into an agreement whereby the irrigator may divert the lesser of the FTA *or* their historically used amount, free from the possibility of call by either the Project or the Tribes. These agreements were predicated on the FTA. In the absence of an FTA, the State suggests that the FTA reference be replaced with language providing for an amount of water equal to that delivered by the FIIP to irrigators in the immediate service area. Consistent with existing Compact language, an irrigator choosing not to enter into an agreement could continue to exercise their water right as filed and ultimately decreed by the Montana Water Court, but that water right would be subject to call by the senior rights of the FIIP and the CSKT ISFs. The agreements would be entirely voluntary on the part of the irrigator, and would be available to any non-project irrigator holding a water right arising under State law within the FIIP influence area.

[7] The map designating the boundaries of the FIIP Influence Area is found at Appendix 2 of the Compact: http://www.dnrc.mt.gov/rwrcc/Compacts/CSKT/2013/Appendix2FIIP_InfluenceAreaMap.pdf

Absent a settlement agreement, both state-based water rights and the FIIP water rights (regardless of who owns the latter) will be subject to call by the Tribes' senior instream flow water rights, which will likely carry a "time immemorial" priority date. This is the situation the WUA was intended to address and remains the crux of future proposed negotiations between the State and the Tribes.

The State's Evaluation of HYDROSS Baseline Condition Outputs:

The State performed gage evaluations at a number of sites that have corresponding modeling nodes, where gage data existed and uncertainties with regard to other flow contributions appeared to be minimal. Similar analyses could have been completed at a number of other sites, but those presented are sufficient for illustrative purposes. These sites include locations at the headworks of canals, where gage data was available for both the diversion and a site downstream of the diversion. The locations analyzed by the State include five sites from the Mission Drainage and three sites from the Jocko Drainage: **Mission Drainage** - Lower Crow Creek below Moiese A Canal, Mission Creek below Mission A Canal, Mud Creek below Ronan B Canal, Post Creek above Pablo Feeder Canal and Post Creek Below Kicking Horse Feeder Canal; **Jocko Drainage** - Jocko River North Fork at Tabor Feeder Canal, Jocko River below K Canal, and Jocko River Middle Fork at Tabor Feeder Canal.

The State compared HYDROSS baseline model outputs with stream and canal flow measurements to verify whether or not HYDROSS accurately predicted baseline conditions (Appendices F and G to this document). At nodes where existing gage data supports model node estimates, the HYDROSS model accurately predicts baseline flow conditions, with the exception of the Lower Crow below Moiese A Canal where the node is located lower in the system and the effects of upstream diversions and reservoir operations reduce baseline model prediction accuracy. Many model nodes could not be evaluated in a similar manner as the available streamflow and canal diversion gage data was not available. Baseline estimations at those locations rely more heavily on extrapolation of adjacent or incomplete data and are likely to be less accurate.

WUA Comparison with Existing Use:

The State examined streamflow and diversion records, applied the conditions set forth in the WUA, and generated monthly and annual values in a manner intended to simulate how the WUA ISFs would affect existing FIIP irrigation diversions should the ISFs be enforced. The State applied the WUA conditions rigidly, without taking into account operational improvements or adaptive management. The State's analysis indicated that it could be very difficult to administer the priority system set forth in the WUA Article VIII. 22. That section specifies that the FIIP Project Operator shall deliver available water in a given year in the following order or priority: (a) MEF and Minimum Reservoir Pool Elevations; (b) FTA and RDA; (c) TIF; (d) Maximum FTA; and (e) Measured Water Use Allowance (MWUA). When the State attempted to constrain FIIP diversions pursuant the terms of the WUA, it was extremely difficult to determine the point at which the FTA was met such that the enforceable ISF would convert from MEF to TIF values.

The State assumes that the parties to the WUA planned to use FIIP diversion measuring devices at both headworks and individual farm turnouts for purposes of supplying tallies of diversion volumes so that on any given day of the irrigation season, FTAs and RDAs could be apportioned. At some triggering event not specified in the WUA, the ISFs would presumably convert from MEF to TIF values when the information feedback demonstrated that the FTA and/or RDA thresholds had been met. Taking into account that there are well over a thousand individual farm turnouts—very few of which are equipped with measuring devices—the State concluded that the resources required to collect and manage this type of data in a way that would allow for real-time information feedback to inform ISF and diversion management are unlikely to be available within the deferral periods contemplated by the WUA. Because of this lack of real-time information, it would be very difficult to determine when FTAs had been met such that MEFs would switch to TIFs under the priority scheme contemplated by the WUA. Moreover, if the data is summarized in longer time intervals, (such as the monthly time-steps contemplated by the WUA) the resultant ISF conversions from MEF to TIF could result in pulsated streamflows as FIIP diversions cease and ISF enforceable values increase abruptly at the end of a time-step in which water managers determine that FIIP diversions have already supplied the allowable apportionment of the annual FTA or RDA. The State recognizes that adaptive management could be used to address some of these MEF to TIF conversion issues, but initiating an agreement that includes such a fundamentally difficult to achieve water distribution priority arrangement seems problematic. The State believes that an approach based on RDAs that utilizes a smaller time-step increment would serve the dual purpose of allowing the Project Operator greater freedom to distribute water according to internal operational rules and needs while also ensuring that CSKT ISFs follow an enforcement pattern that more closely mimics natural hydrology.

In order to better understand how the enforcement of the MEFs could affect FIIP water supply, the State used FIIP diversions and streamflow data to mathematically impose the MEFs, restricting diversions so that the MEFs would be met every month. The State also applied the period of use restriction from April 15-September 15[8] and maximum flow rate restrictions for individual canals specified by Appendix A3 of the WUA. Comparison results are summarized in tables (Appendix H. i-xi). As a final evaluation step, for purposes of quantifying the differences between MEF and TIF values, the State imposed the TIFs, again restricting diversions so that the TIFs would be met every month.

These evaluations assume no operational improvements, no changes to the management of upstream reservoirs, and no changes to downstream demands (timing and quantity), and retrospectively impose MEFs and TIFs on diversions as quantified by historic flow records. In reality, changes in both upstream and downstream operations would occur as the MEFs and TIFs are phased in. The State also applied a rigid enforcement schedule in its review, estimating that the Tribes' FIIP ISFs would be enforced at maximum MEF or TIF levels, a scenario not likely to occur in practice. The result is that the State's analysis likely magnifies the impacts on irrigation supplies, and as such, these evaluations represent the maximum possible impact of MEF and TIF implementation on irrigation supplies.

[8] This provision was designed to eliminate stockwater deliveries, which were never federally authorized. The State has proposed to invest 4 million dollars in alternative stock water funding to address this problem.

The State's analysis did not attempt to apply the priority scheme set forth in the WUA because of the perceived difficulties described above. The tables produced by the State's analysis (Appendix H. i-xi) serve only as a comparison of MEF and TIF values to illustrate that they are substantially different, thereby demonstrating the need for a clear trigger mechanism that will offer a consistently predictable point at which the Tribes' enforceable ISFs convert from MEF to TIF levels. It should also be emphasized that the State took into account neither the adaptive management language nor the quantification reevaluation provisions contained in the WUA for purposes of its analysis. From the State's perspective, both adaptive management and measurement-based re-evaluation of model outputs are key to an equitable balancing and practical enforcement of the CSKT ISFs and FIIP irrigation water rights.

Conclusions:

The HYDROSS model appears to be a reasonable model capable of providing credible monthly flow and volume estimates at key locations. Like any model, it carries some uncertainty as to the likelihood that model outputs will be obtainable. The most notable uncertainty is tied to estimations of the amount of irrigation water that is proposed to be saved and left in the stream as instream flow through operational improvements and how the success of these water savings will impact FIIP irrigation water supplies. If these values are substantially in error, rigid enforcement of the WUA could result in deficient water supplies for both irrigation and instream flow purposes. The State understands that the adaptive management and reevaluation provisions of the WUA were designed to address this uncertainty and believes that the current renegotiation presents an opportunity provide additional detail and clarity through clearly articulated processes for measurement, re-evaluation, and adaptive management to help ensure that modeled values can be implemented in a way that benefit both ISF and irrigation rights.

While the State has concluded that the priority scheme articulated by the WUA would be difficult to implement, the State's METRIC data suggests that the values used in the HYDROSS model provide a good approach to supplying service-area scale FIIP water supplies. This approach would be consistent with the State's belief that the details of internal project operations should be left to a comprehensive FIIP operations plan that is not part of the Compact agreement. The State hopes that the parties will be willing to discuss alternative ideas for prioritizing service and ISF implementation in the project influence area that is consistent in principal with the WUA, but offers greater structure, certainty, and simplicity of implementation.

The state believes that a settlement package that includes water rights, deliveries, and adaptive management based on the Tribes' technical work can be implemented in a way that protects both existing irrigation crop consumption and CSKT instream flows. Such a settlement will need to be bolstered by a commitment to high-quality measurement and on-the-ground management and an ability to adapt the enforceable levels of those water rights in response to real-time conditions. The State is confident that with continuing commitment by all parties to the original principles that motivated the WUA negotiations, this result is achievable.

Summary of Appendices to the State of Montana's Technical Evaluation of the FIIP Water Use Agreement

Appendix A. i-iv: CSKT Model Output Tables: These tables were presented in HYDROSS Alternative 2 reports. They compare baseline conditions (2009 HIA) with conditions after operational improvements are made (Alt 2). Instream flow, diversion volumes, and crop water consumption percent change values are presented.

Appendix B. i-v: CSKT Model Output Graphs; Individual Node Streamflow Changes: These graphs were presented in HYDROSS Alternative 2 reports. They illustrate how the HYDROSS modeling predicted changes in monthly streamflow resulting from operational improvements. Baseline streamflows (green line; 2009 HIA) are plotted against streamflows resulting from operational improvements (red line; Alt 2). These graphs also include Interim Instream Flow requirements (IFR). These minimum instream flows were established through litigation in the late 1980s and would be replaced by the CSKT ISFs as proposed in the Compact.

Appendix C. i-vi: CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption: These graphs were presented in HYDROSS Alternative 2 reports. They illustrate how the HYDROSS modeling predicted changes to monthly diversions of water into selected canals resulting from operational improvements; they also illustrate predicted changes to monthly crop water consumption for the associated areas served by these select diversions. Baseline diversion volumes (green line; 2009 HIA) are plotted against the changed diversion volumes resulting from operation improvements (red line; Alt 2). Baseline crop consumption volumes (green bar; 2009 HIA) are plotted against crop consumption volumes resulting from operational improvements (red bar; Alt 2).

Appendix D. i-ii & Appendix E. i-ii: CSKT Model Output Graphs; Composite – Jocko & Mission: These graphs were presented in HYDROSS Alternative 2 reports. They illustrate how the HYDROSS modeling predicted changes to monthly diversions of water resulting from operational improvements; the graphs are for the entire Jocko and Mission Service Areas and are presented as composites of all individual diversions serving those areas. Modeling predictions of changes in monthly crop water consumption for these areas are included. Baseline diversion volumes (green line; 2009 HIA) are plotted against the changed diversion volumes resulting from operational improvements (red line; Alt 2). Baseline crop consumption volumes (green bar; 2009 HIA) are plotted against crop consumption volumes resulting from operational improvements (red bar; Alt 2).

Appendix F & G: State Comparison of 2009 HIA (baseline model output) with gage data – Jocko & Mission: The State compared the HYDROSS 2009 HIA baseline model outputs for select Jocko and Mission model nodes with stream and canal flow measurements to verify whether or not the HYDROSS model accurately predicted baseline conditions.

Appendix H. i-xi: State Comparison of Historic Diversions and WUA Enforcement: The State compared WUA MEF and TIF values for select Jocko and Mission model nodes with stream and canal flow measurements. MEFs and TIFs were used to restrict diversions so that the MEFs would be met every month. This analysis did not take into account the mitigating effects of modeled operational improvements and adaptive management; this was done to demonstrate the effects of the MEFs and TIFs on historic diversions. TIF restrictions are not consistent with the WUA, and should only be used to illustrate the difference between MEF and TIF monthly enforceable values.

Appendix A (i): CSKT Model Output Tables

3.5 Observations

The following observations can be made when comparing the **"Operational Improvements"** results to **"2009 Irrigated Lands Mapping"**:

	2009 Irrigated Lands Mapping	*Operational Improvements*	*Percent Change*
Average Annual Diversions	298,376	209,647	30% reduction
Tabor Feeder Canal	153,129	129,138	16%
Jocko S Canal	38,452	17,750	54%
Jocko K & R Canals	67,012	50,071	25%
Jocko N Canal	1,281	980	24%
Jocko E Canal	6,946	1,464	79%
Lower S Canal	3,310	315	90%
Lower J, Revais R & Revais Pump Canals	9,643	4,315	55%
Average Annual Crop Irrigation Consumption	8,997	9,192	2% increase
Jocko S Canal	1,770	1,391	-21%
Jocko K & R Canals	3,456	4,349	26%
Jocko N Canal	106	119	12%
Jocko E Canal	631	468	26%
Lower S Canal	116	129	11%
Lower J, Revais R & Revais Pump Canals	1,069	949	11%
Average Annual Streamflow *	183,980	190,010	3% increase
Middle Fork Jocko River at Tabor Feeder Canal (510000)	18,750	20,289	8%
Jocko River at Jocko S Canal (999504)	58,864	63,039	7%
North Fork Jocko River at Tabor Feeder Canal (513000)	14,062	16,923	20%
Falls Creek at Tabor Feeder Canal (999501)	1,337	1,913	43%
S-14 Creek at Tabor Feeder Canal (999502)	166	208	25%
Kellys Creek at Mouth (999525)	5,670	4,956	-12%
Jocko River at Jocko K Canal (999507)	73,662	90,971	24%
Big Knife Creek at Jocko S Canal (514300)	5,603	5,649	1%
Agency Creek at Jocko S & J Canals (516700)	4,735	7,039	49%
Agency Creek at Mouth (999508)	3,141	8,233	162%
East Fork Finley Creek at Jocko N Canal (516100)	6,357	6,658	5%
Schley Creek at Mouth (999530)	992	992	0%
Antoine Creek at Mouth (999522)	1,450	1,462	1%
Finley Creek at Jocko E Canal (517500)	11,929	11,698	-2%
Finley Creek at Mouth (517800)	21,570	23,952	11%
Jocko River at Lower S Canal (517900)	117,689	139,320	18%
Jocko Spring Creek near Mouth (518700)	16,143	12,464	23%
Hewolf Creek at Mouth (999529)	2,201	2,207	0.3%
North Fork Valley Creek at Mouth (999518)	4,689	4,855	4%
Valley Creek at Mouth (519200)	17,179	17,746	3%
Jocko River below Highway (519500)	172,358	177,396	3%

Appendix A (ii): CSKT Model Output Tables

	2009 Irrigated Lands Mapping	*Operational Improvements*	*Percent Change*
Revais Creek at Revais R Canal (999511)	11,210	12,187	9%
Gunderson Creek at Private Diversion (999523)	412	427	4%

* The overall Average Annual Streamflow compares the total flow for the Jocko River below Highway (#519500), Revais Creek at Revais R Canal (#999511), and Gunderson Creek at Private Diversion (#999523).

Appendix A (iii): CSKT Model Output Tables

3.5 Observations

The following observations can be made when comparing the **"Operational Improvements – Alternative 2"** results to **"2009 Irrigated Lands Mapping"**:

	2009 Irrigated Lands Mapping	*Operational Improvements*	*Percent Change*
Average Annual Diversions	1,152,937	885,032	23% reduction
Pablo Feeder Canal	811,768	576,713	29%
DC-2 Lateral	243	262	-8%
Cold Cr Ditch	96	88	8%
Mission F Canal	8,520	5,755	32%
Mission B Canal	3,249	3,350	-3%
Mission C & 6C Canals	8,300	8,323	-0.3%
Kicking Horse Feeder Canal	32,252	33,478	-4%
Post A Canal	7,116	4,948	30%
Post G Canal	2,287	2,156	6%
Ninepipe Feeder Canal	19,006	17,981	5%
Post B & C Canals	20,638	20,713	-0.4%
Post D & E Canals	6,388	6,298	1%
Post F Canal	7,316	6,558	10%
Dublin Ditch	763	892	-17%
Hillside Ditch	3,237	4,423	-37%
Mission H Canal	1,868	528	72%
South Crow Feeder Canal	11,209	8,410	25%
Crow Pump Canal	1,074	1,101	-2%
Ronan A Canal	2,119	1,946	8%
Ronan B Canal	3,440	4,283	-24%
Moiese A Canal	17,752	14,945	16%
Pablo A Canal	146,138	144,316	1%
Polson Z-1 Canal	1,345	264	80%
Polson B & C Canals	1,547	1,532	1%
Polson D Canal	1,044	1,099	-5%
Twin Feeder Canal	2,108	2,506	-19%
Lower Twin Feeder Canal	448	37	92%
Reuse	4,019	3,566	11%
Private (Secretarial & Junior)	26,063	7,002	73%
Ground Water	1,585	1,560	2%
Average Annual Crop Irrigation Consumption	79,548	77,895	2% reduction
Pablo Feeder Canal	9,103	9,281	-2%
DC-2 Lateral	177	191	-8%
Cold Cr Ditch	66	61	8%
Mission F Canal	1,474	1,166	21%
Mission B Canal	1,826	1,873	-2%
Mission C & 6C Canals	3,849	3,904	-1%

Appendix A (iv): CSKT Model Output Tables

Run Date: 11/25/2011 | **Mission HYDROSS Model — Operational Improvements – Alternative 2**

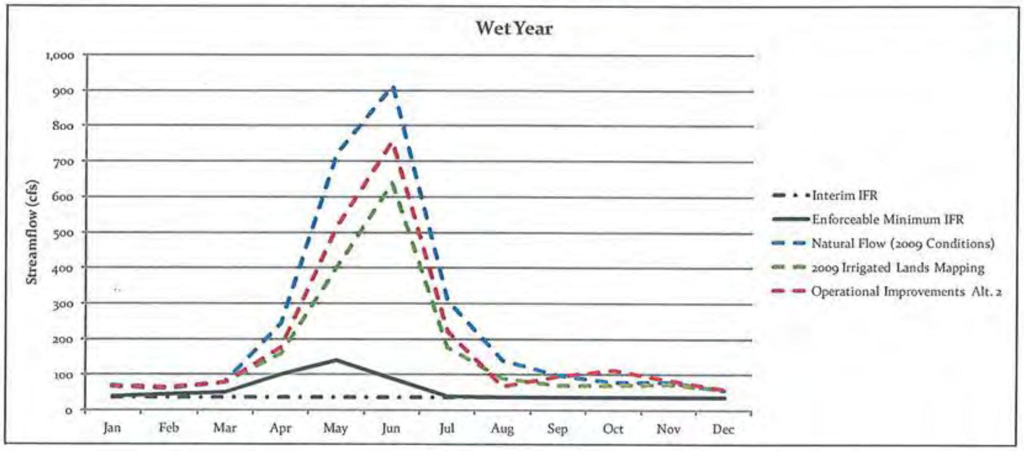
	2009 Irrigated Lands Mapping	*Operational Improvements*	*Percent Change*
Kicking Horse Feeder Canal	302	215	29%
Post A Canal	2,485	1,957	21%
Post G Canal	1,047	981	6%
Ninepipe Feeder Canal	0	0	NA
Post B & C Canals	6,435	5,988	7%
Post D & E Canals	2,886	2,811	3%
Post F Canal	2,991	2,849	5%
Dublin Ditch	0	0	NA
Hillside Ditch	623	494	21%
Mission H Canal	194	188	3%
South Crow Feeder Canal	0	0	NA
Crow Pump Canal	0	0	NA
Ronan A Canal	1,143	1,201	-5%
Ronan B Canal	2,237	2,759	-23%
Moiese A Canal	4,858	4,925	-2%
Pablo A Canal	27,489	27,727	-1%
Polson Z-1 Canal	156	158	-1%
Polson B & C Canals	427	506	-18%
Polson D Canal	623	718	-15%
Twin Feeder Canal	218	197	10%
Lower Twin Feeder Canal	0	0	NA
Reuse	2,834	2,518	11%
Private (Secretarial & Junior)	4,948	4,089	17%
Ground Water	1,156	1,138	2%
Average Annual Streamflow *	143,823	163,531	14% increase
Sabine Creek @ Mouth (999424)	9,147	7,870	-14%
Mission Creek @ Mission A Canal (481500)	30,064	53,046	76%
Mission Creek below Dry Creek (999408)	32,329	45,629	39%
Mission Creek @ Mission C & 6C Canal (483300)	23,742	40,289	70%
Mission Creek above Sabine Creek (999423)	28,053	46,046	64%
Post Creek @ Pablo Feeder Canal (486700)	36,588	54,668	49%
Post Creek @ Kicking Horse Feeder Canal (999430)	27,122	39,174	44%
Post Creek @ Post F Canal (487600)	25,420	38,059	50%
Post Creek @ Mouth (999422)	72,730	66,816	-8%
Mission Creek below Post Creek (999429)	104,434	114,696	10%
Mission Creek @ Mission H Canal (999412)	108,116	120,574	12%
Crow Creek @ Crow Pump Canal (354000)	29,472	33,808	15%
Mud Creek @ Ronan B Canal (356800)	2,635	6,140	133%
Crow Creek @ Moiese A Canal (999414)	35,707	42,956	20%

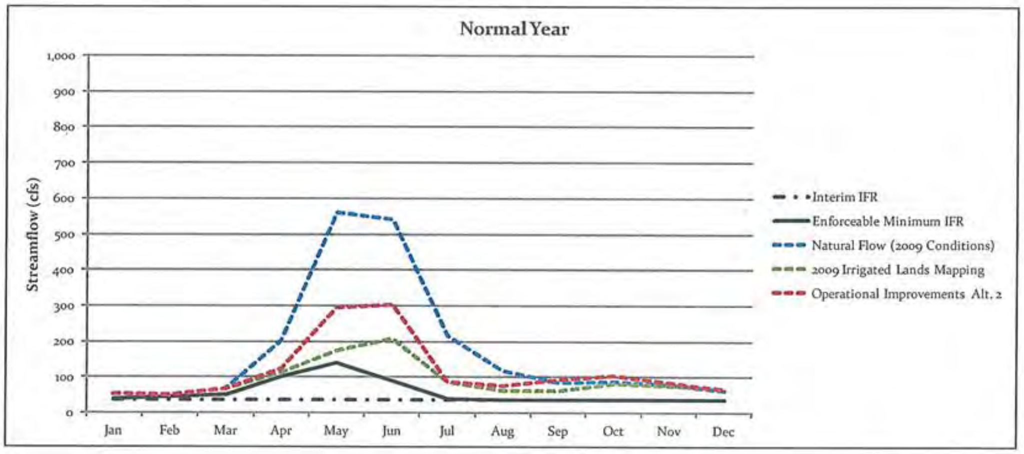
* The overall Average Annual Streamflow compares the total flow for Mission Creek @ Mission H Canal (999412) and Crow Creek @ Moiese A Canal (999414).

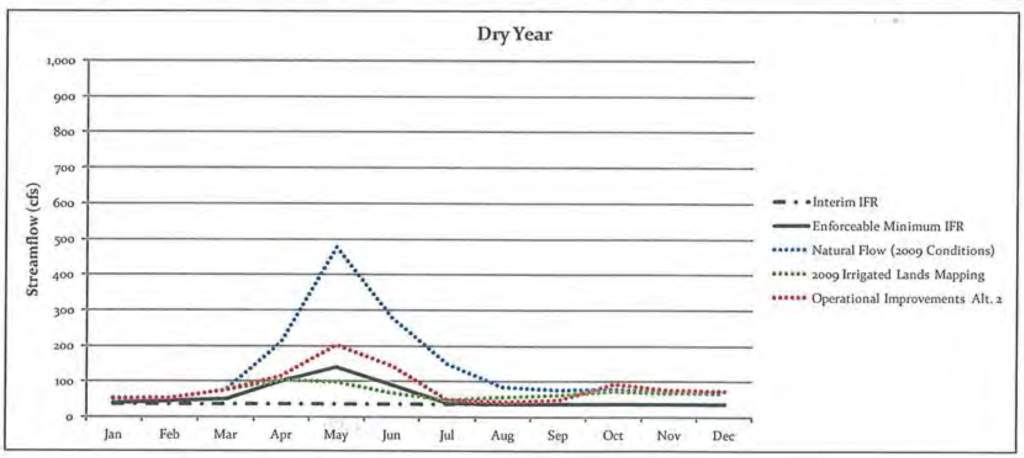
Rec'd by LEPO from RWRCC 8/5/14

Appendix B (i): CSKT Model Output Graphs; Individual Node Streamflow Changes

999507: Jocko River below Jocko K Canal



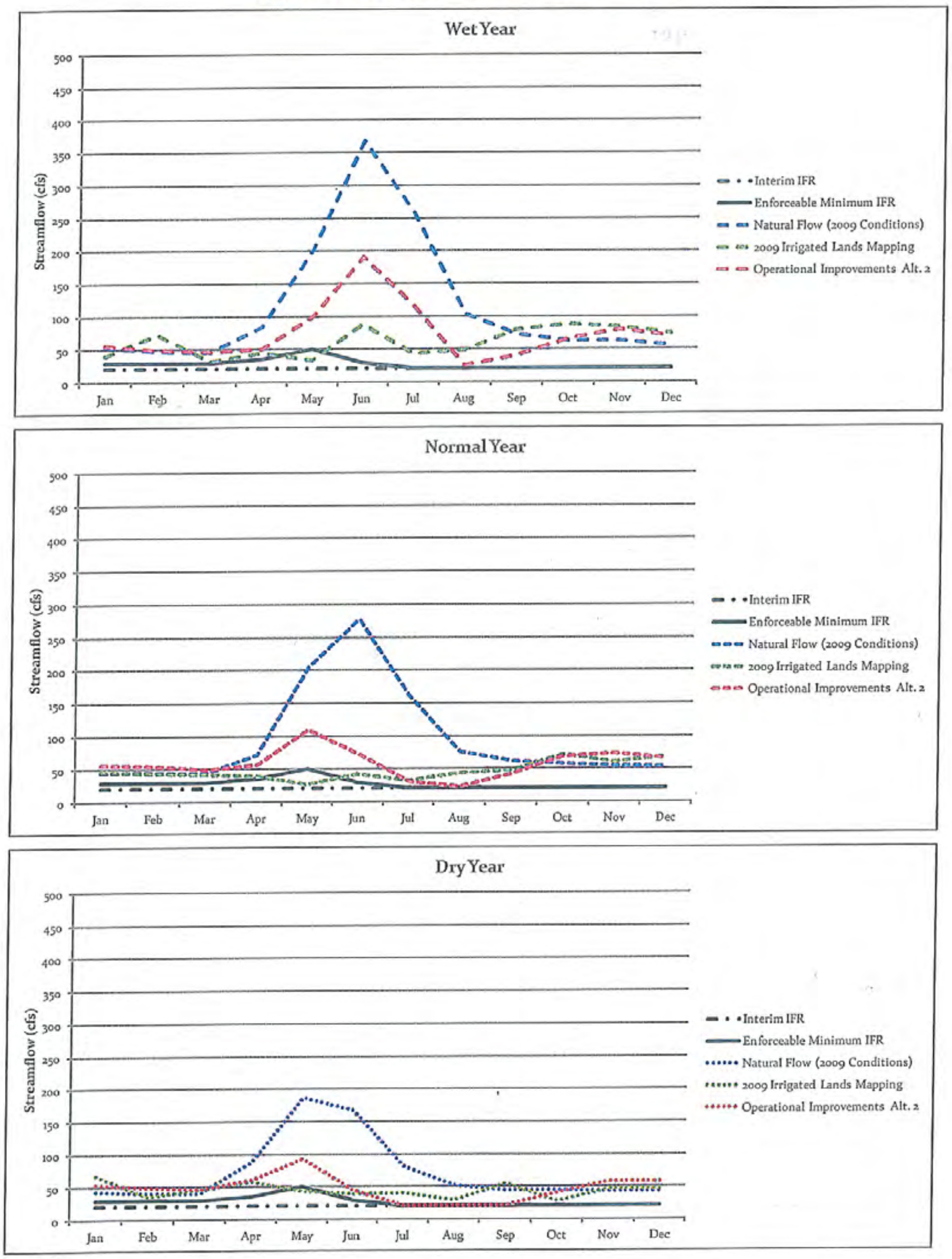




Rec'd by LEPO from RWRCC 8/5/14

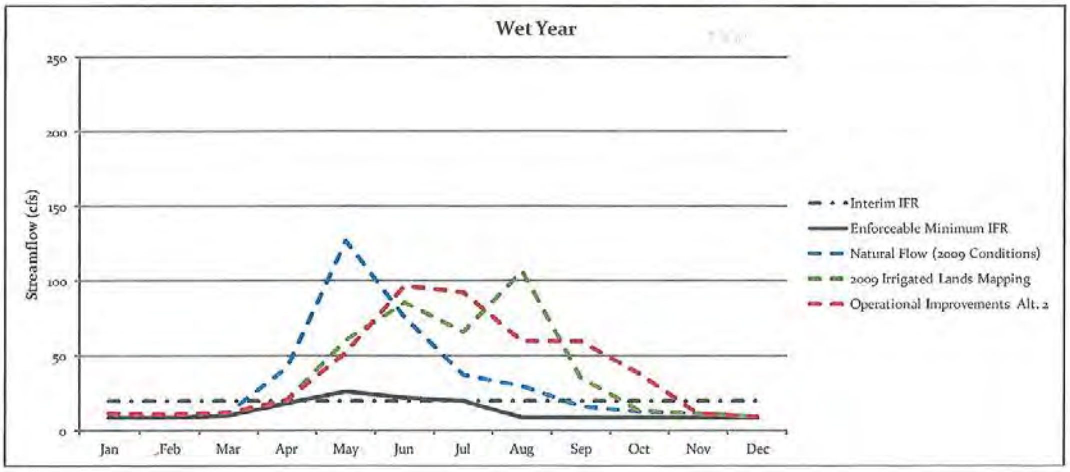
Appendix B (ii): CSKT Model Output Graphs; Individual Node Streamflow Changes

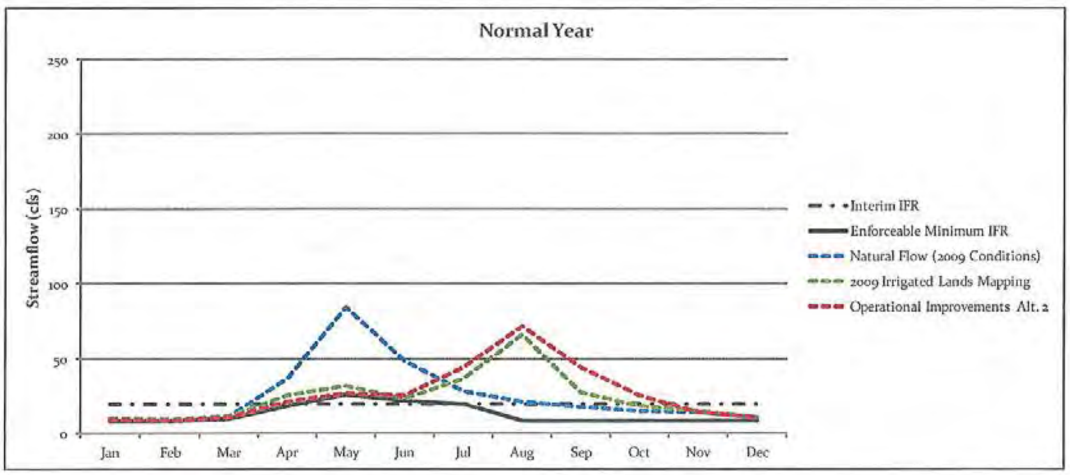
999414: Crow Creek below Moiese A Canal

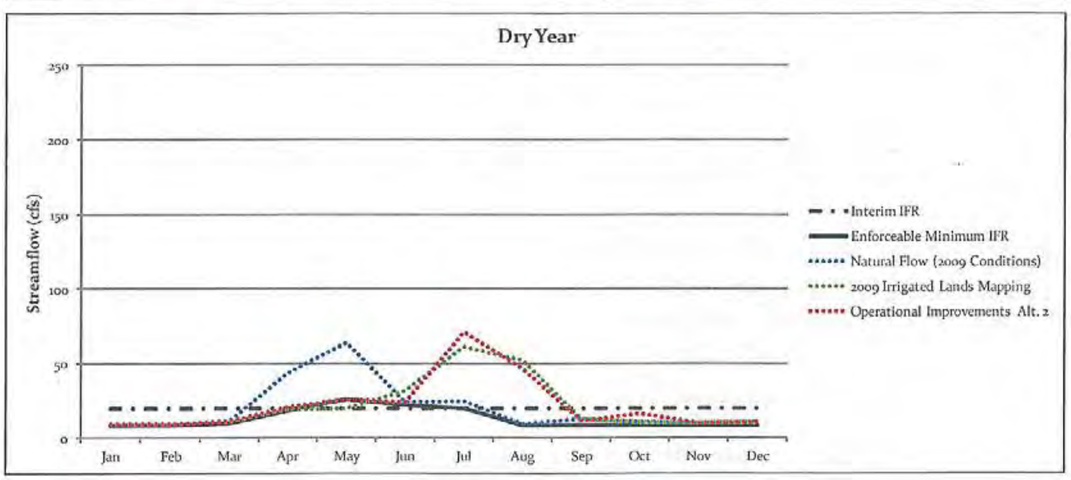


Appendix B (iii): CSKT Model Output Graphs; Individual Node Streamflow Changes

510000: Middle Fork Jocko River below Tabor Feeder Canal



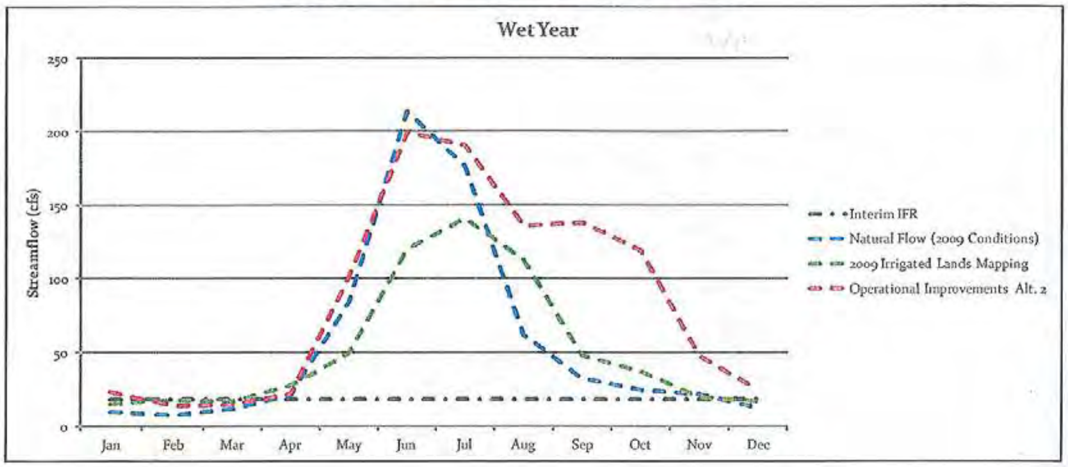


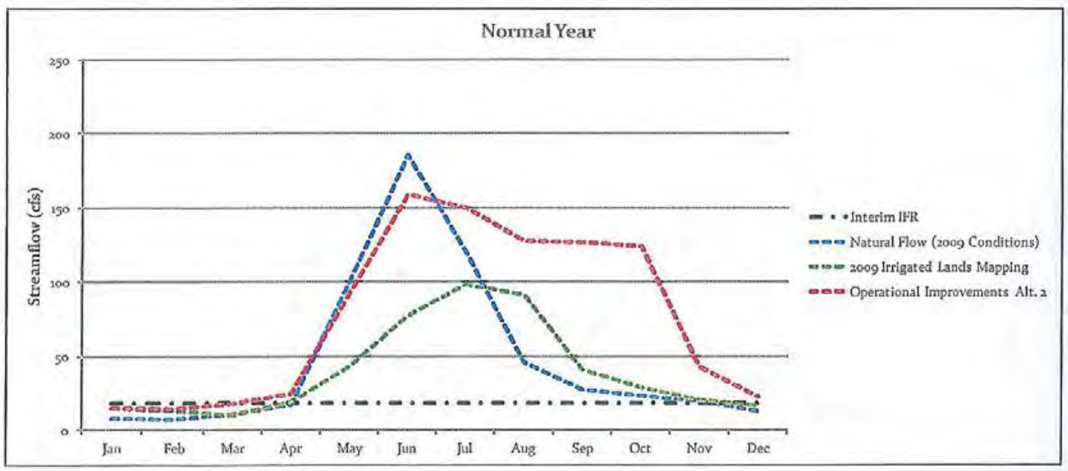


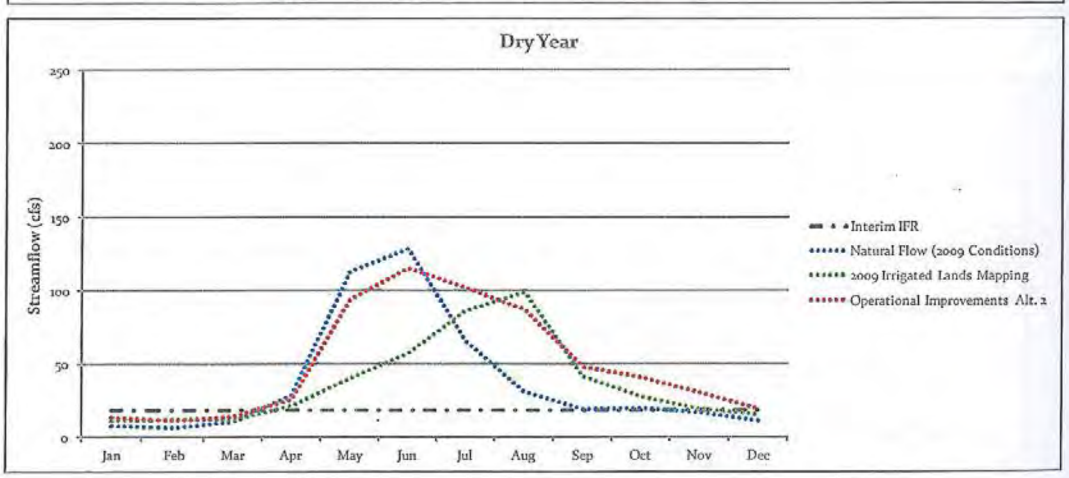
Rec'd by LEPO from RWRCC 8/5/14

Appendix B (iv): CSKT Model Output Graphs; Individual Node Streamflow Changes

481500: Mission Creek below Mission A Canal



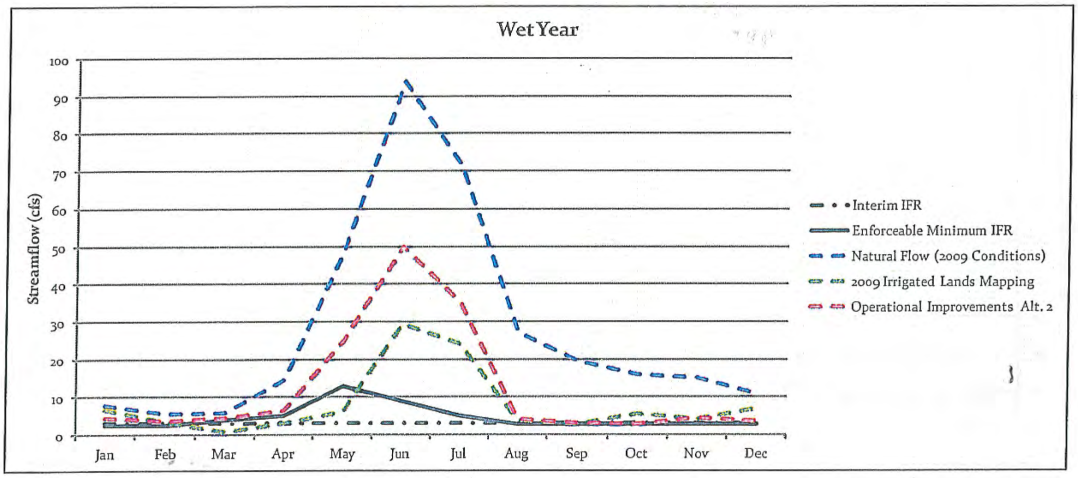


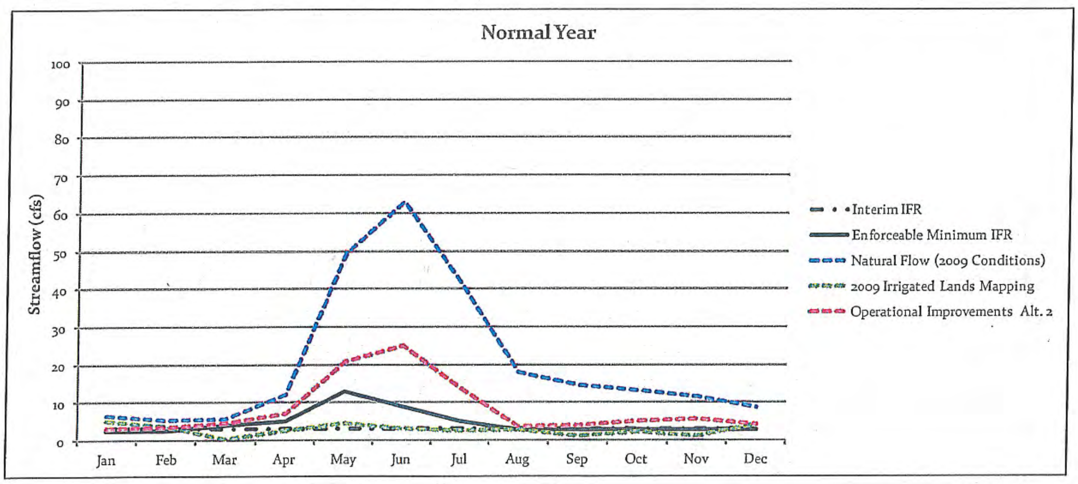


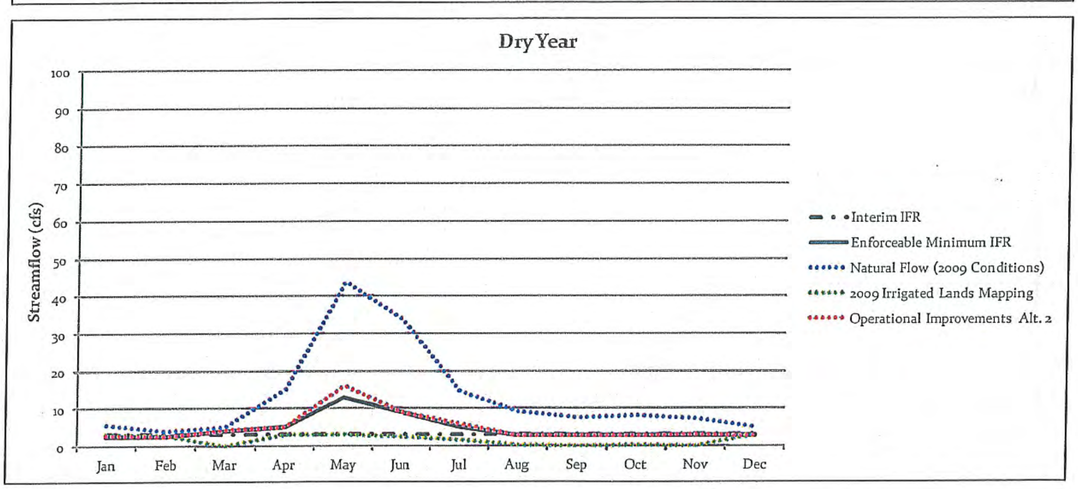
Rec'd by LEPO from RWRCC 8/5/14

Appendix B (v): CSKT Model Output Graphs; Individual Node Streamflow Changes

356800: Mud Creek below Ronan B Canal







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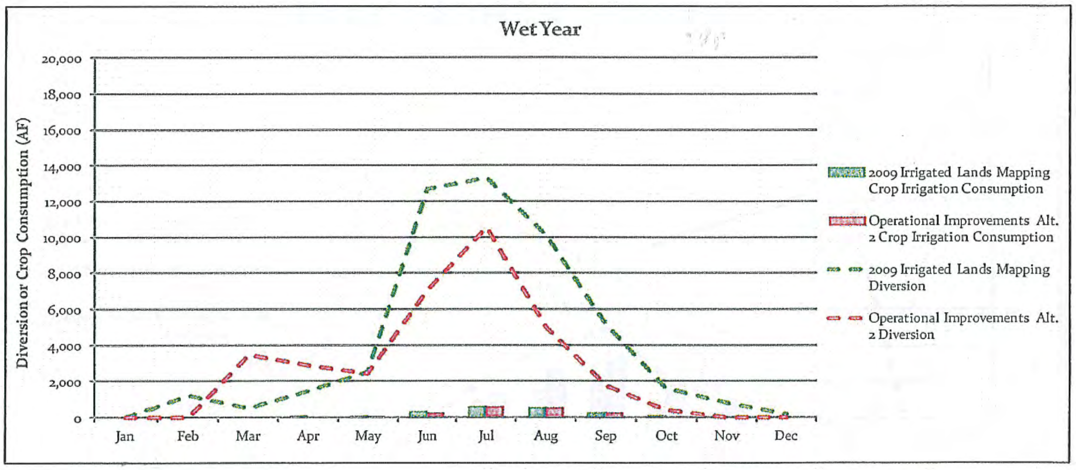
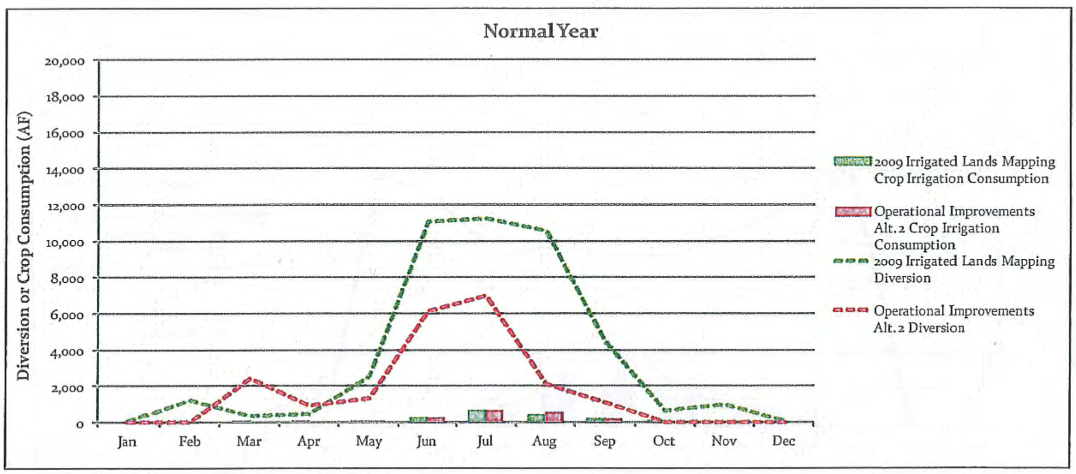
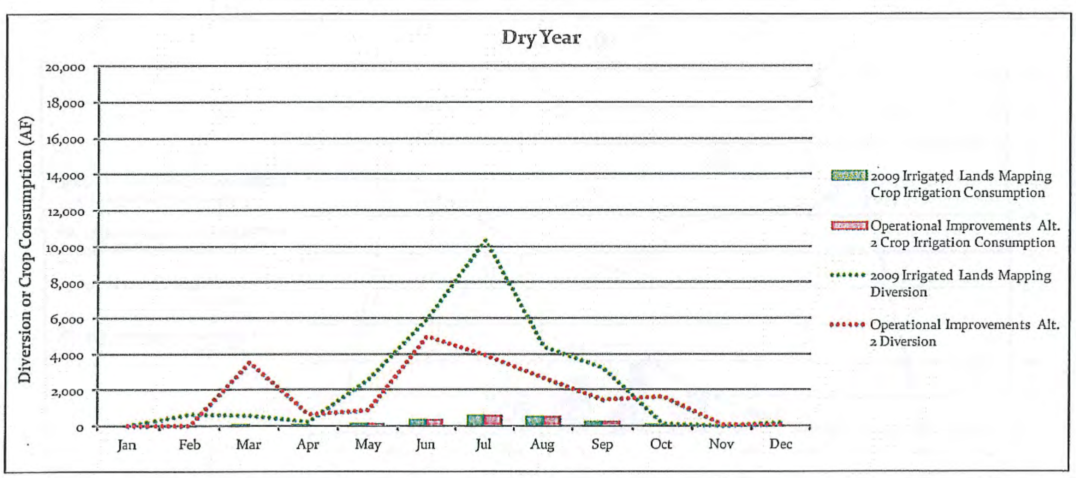
Appendix C (i): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

481500: Mission A Canal at Mission Creek







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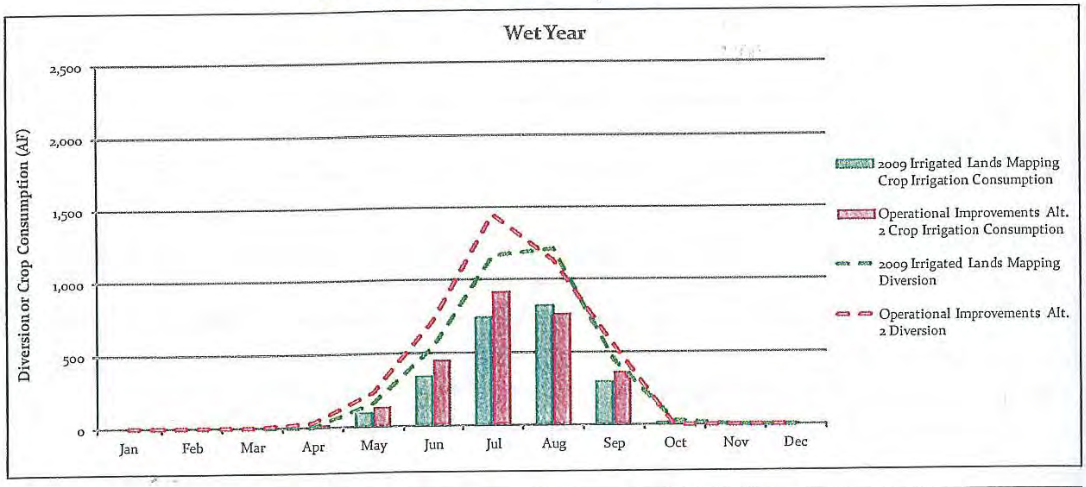
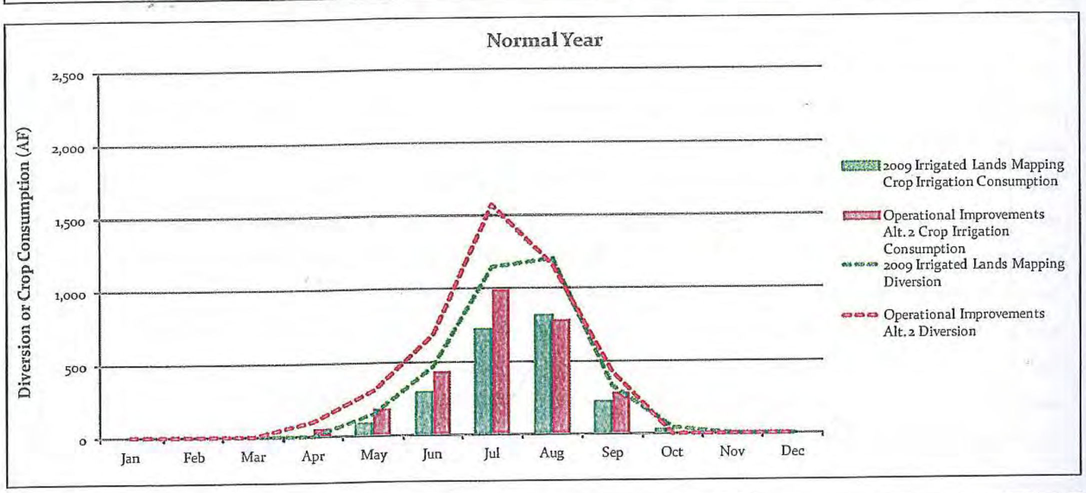
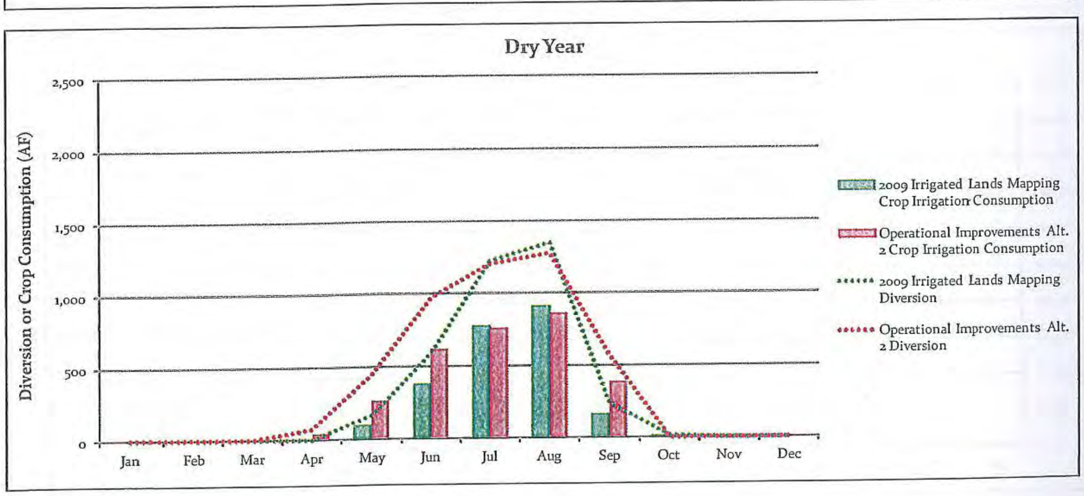
Appendix C (ii): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

356800: Ronan B Canal at Mud Creek

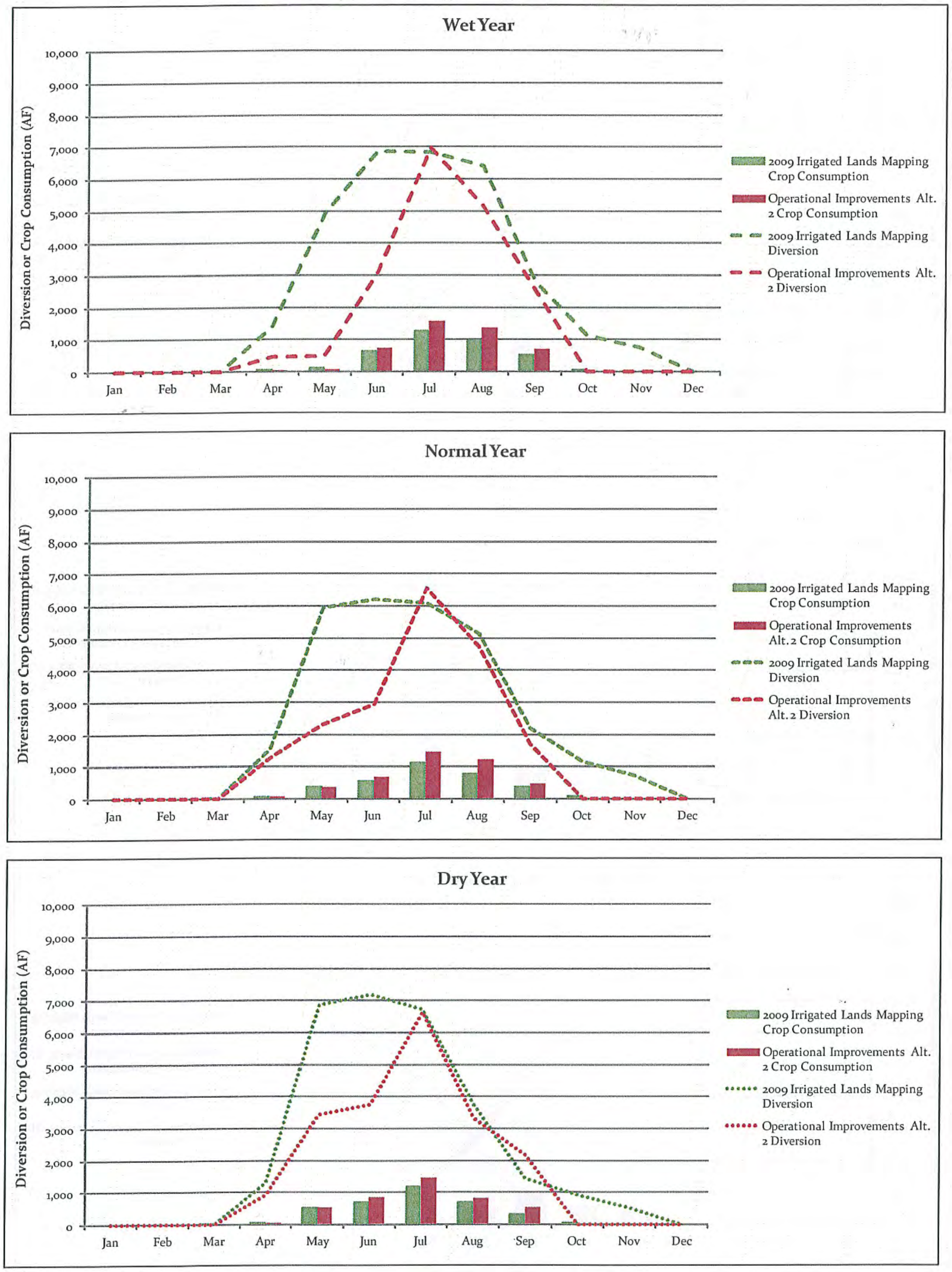






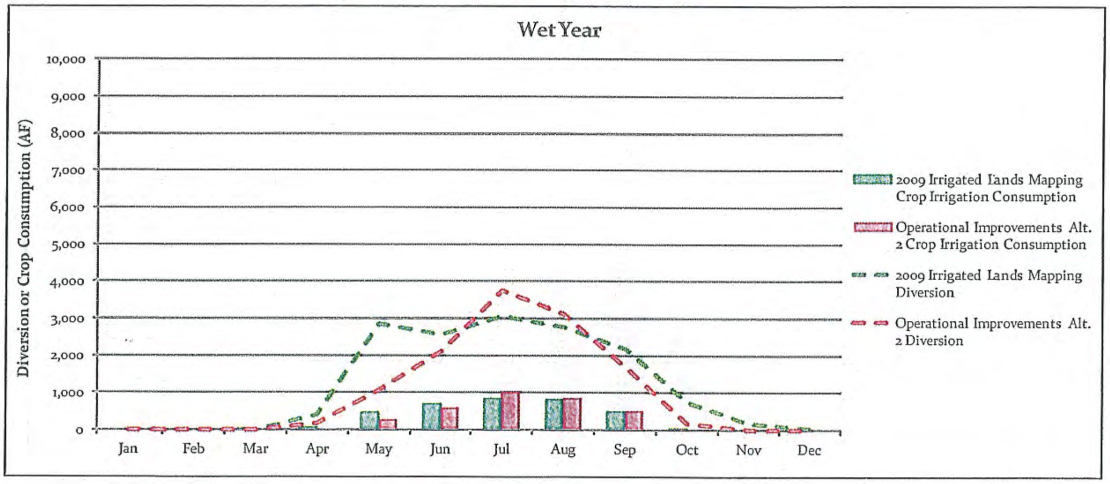
Appendix C (iii): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

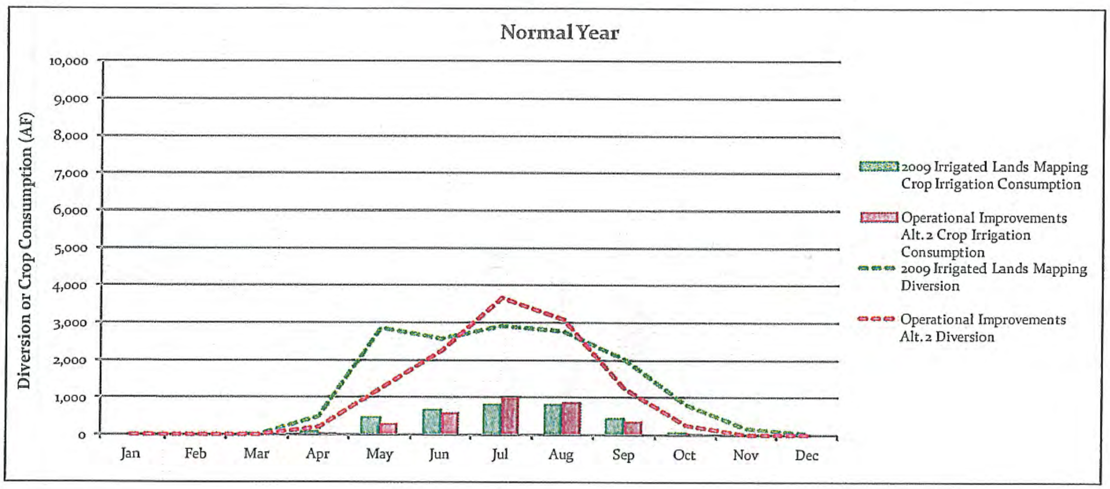
999507: Jocko K Canal at Jocko River

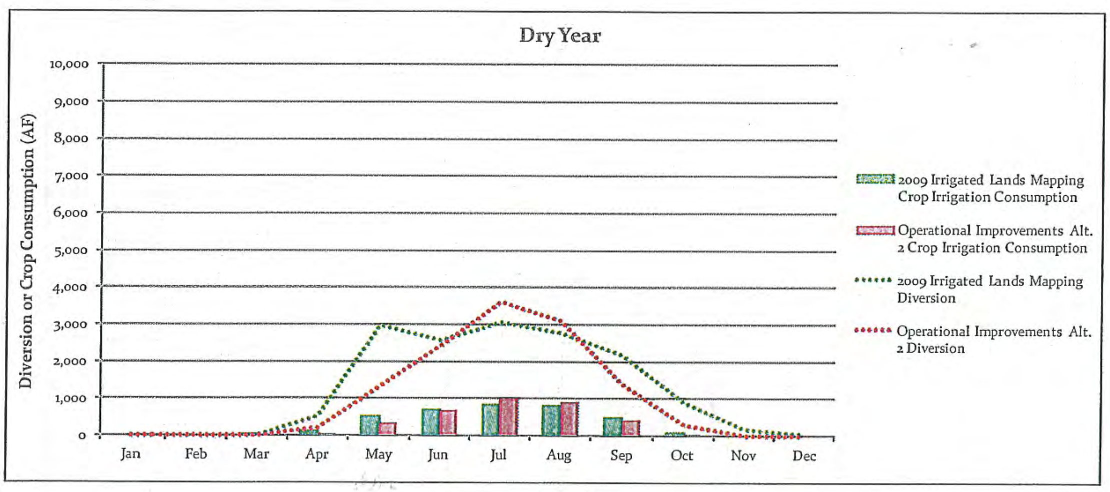


Appendix C (iv): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

999414: Moiese A Canal at Crow Creek







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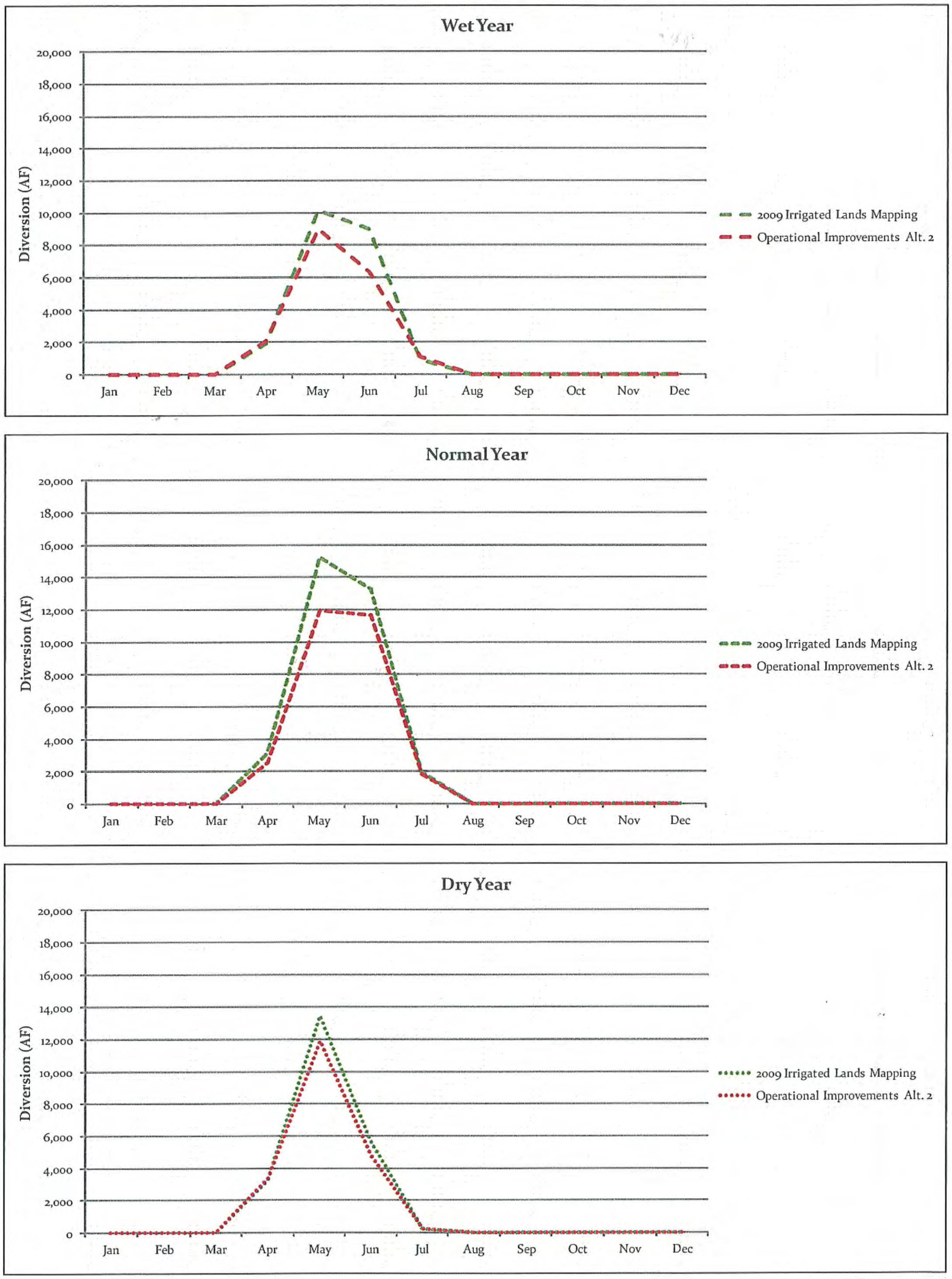
Appendix C (v): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

513000: Tabor Feeder Canal at North Fork Jocko River



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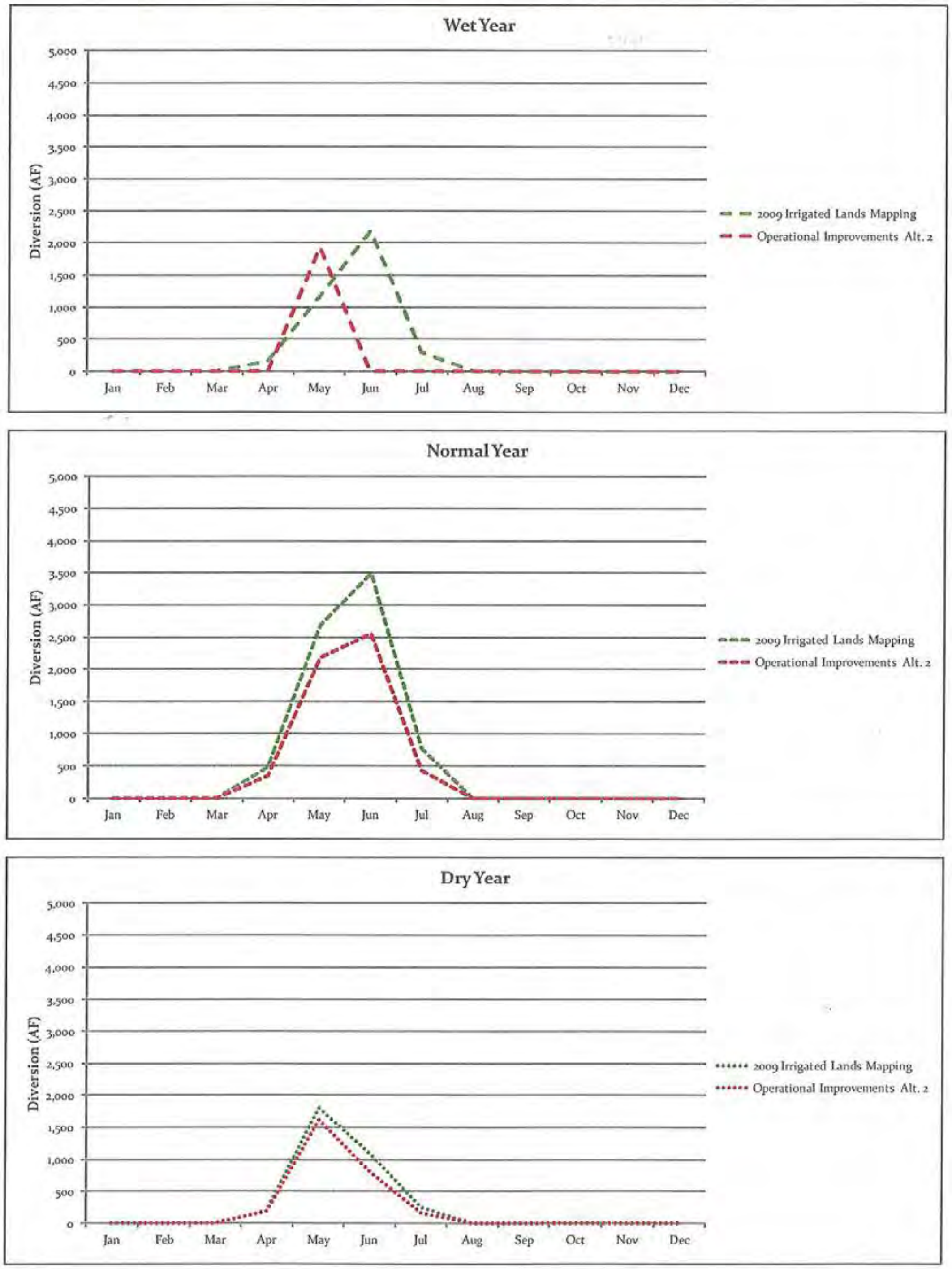
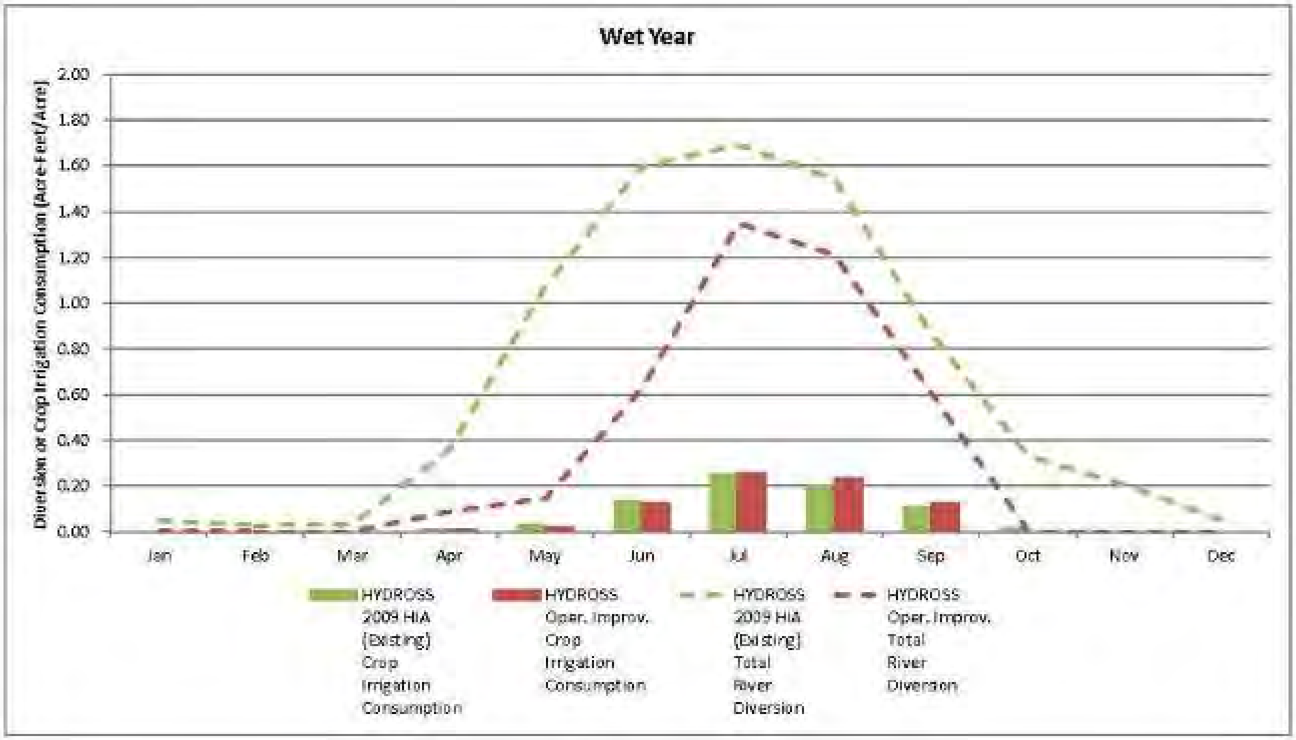
Appendix C (vi): CSKT Model Output Graphs; Individual Node Diversions and Crop Consumption

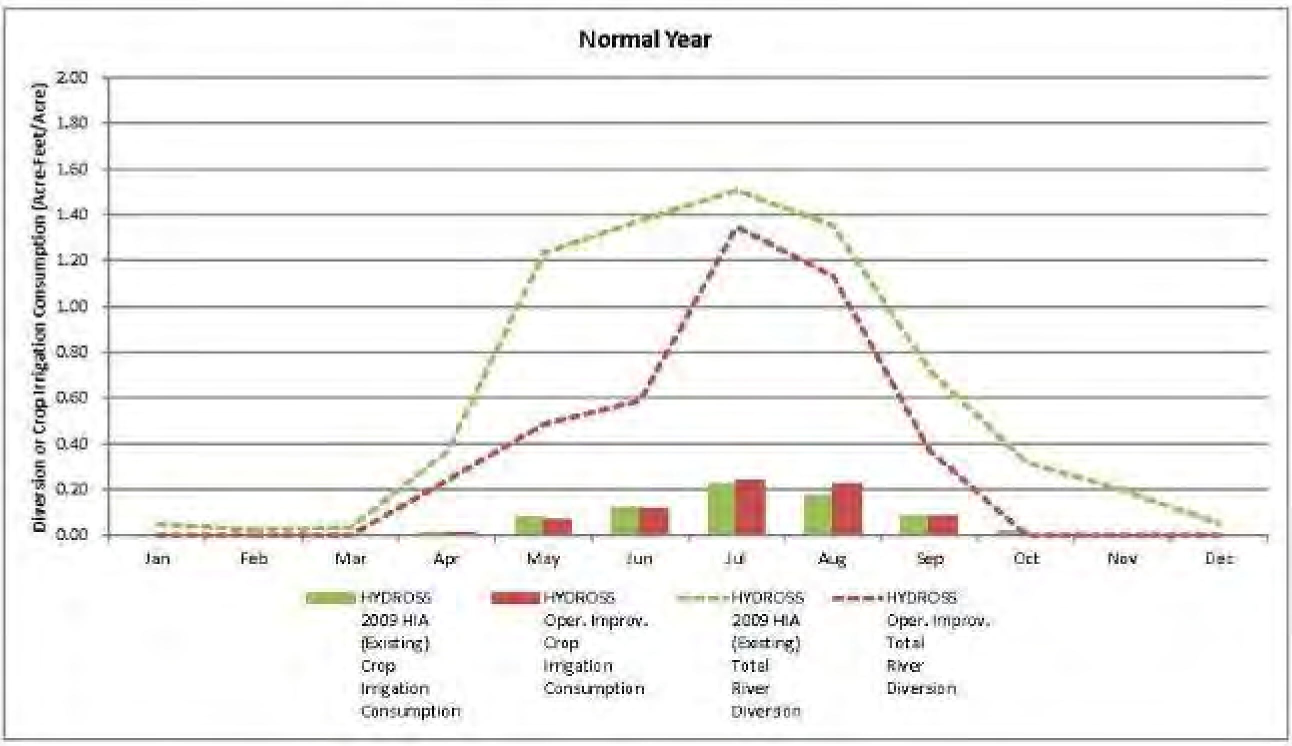
510000: Tabor Feeder Canal at Middle Fork Jocko River



Rec'd by LEPO from RWRCC 8/5/14

Appendix D (i): CSKT Model Output Graphs; Composite - Jocko





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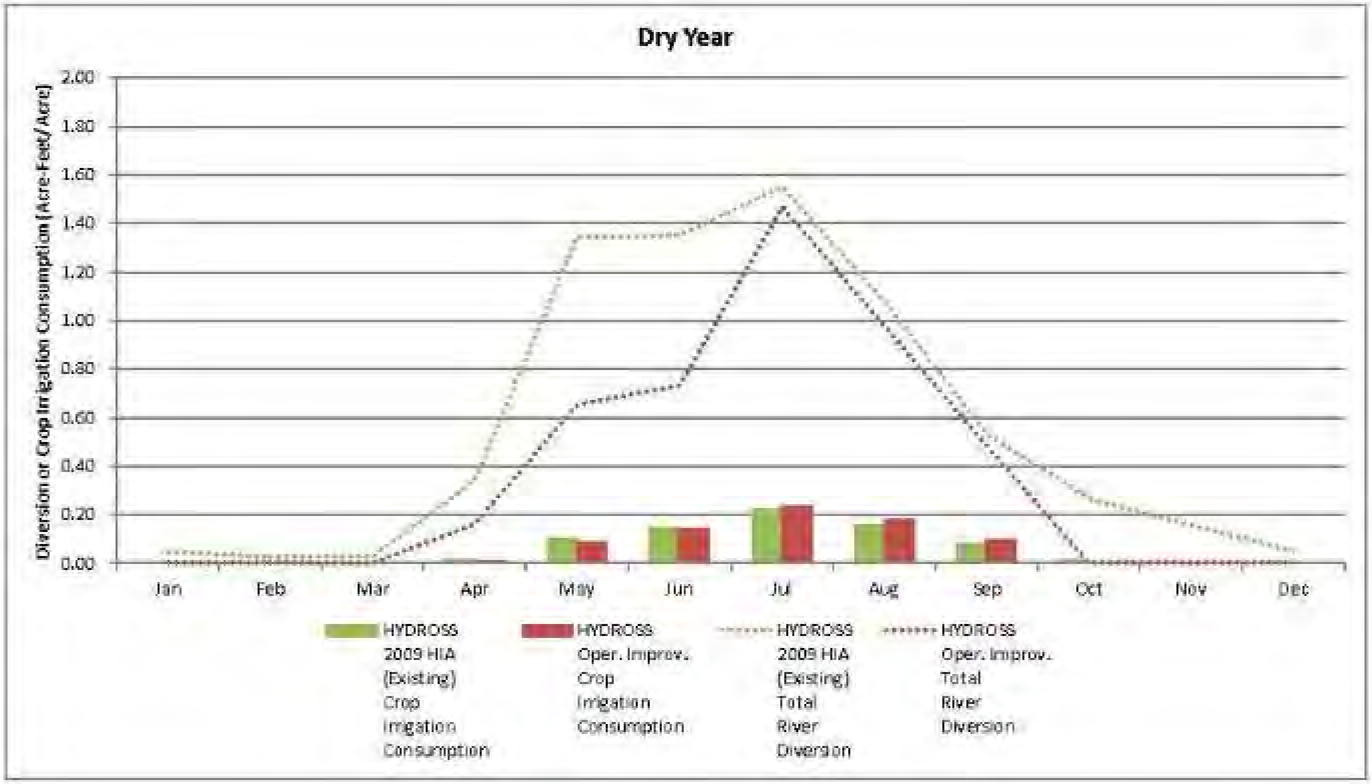
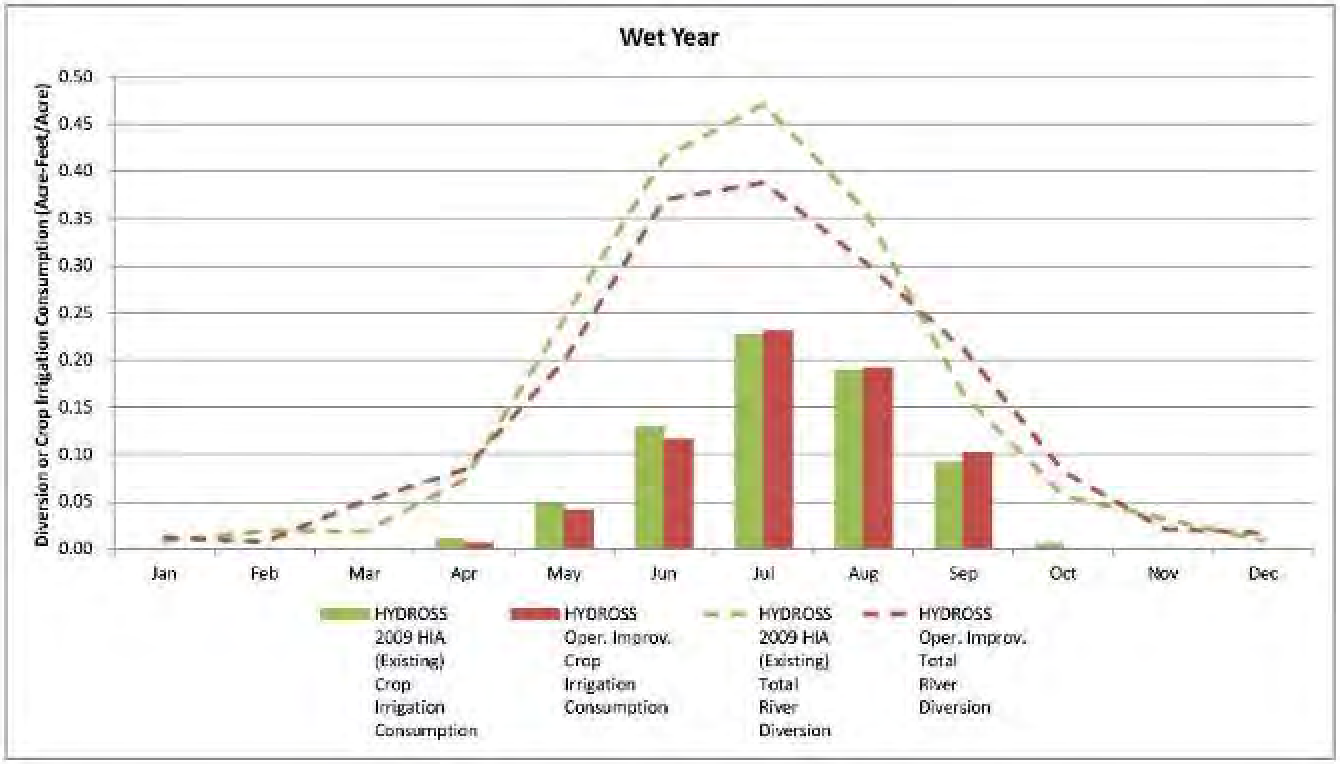
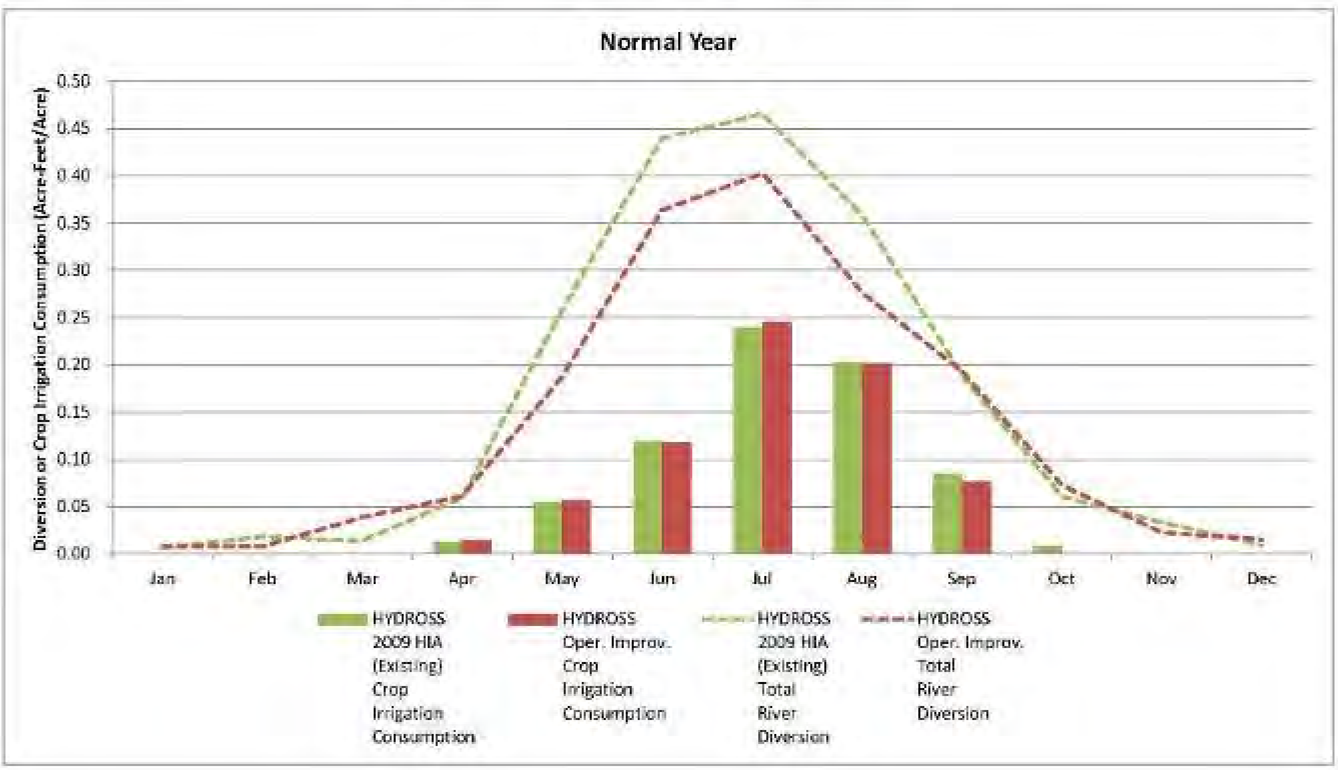
Appendix D (ii): CSKT Model Output Graphs; Composite - Jocko



Appendix E (i): CSKT Model Output Graphs; Composite - Mission





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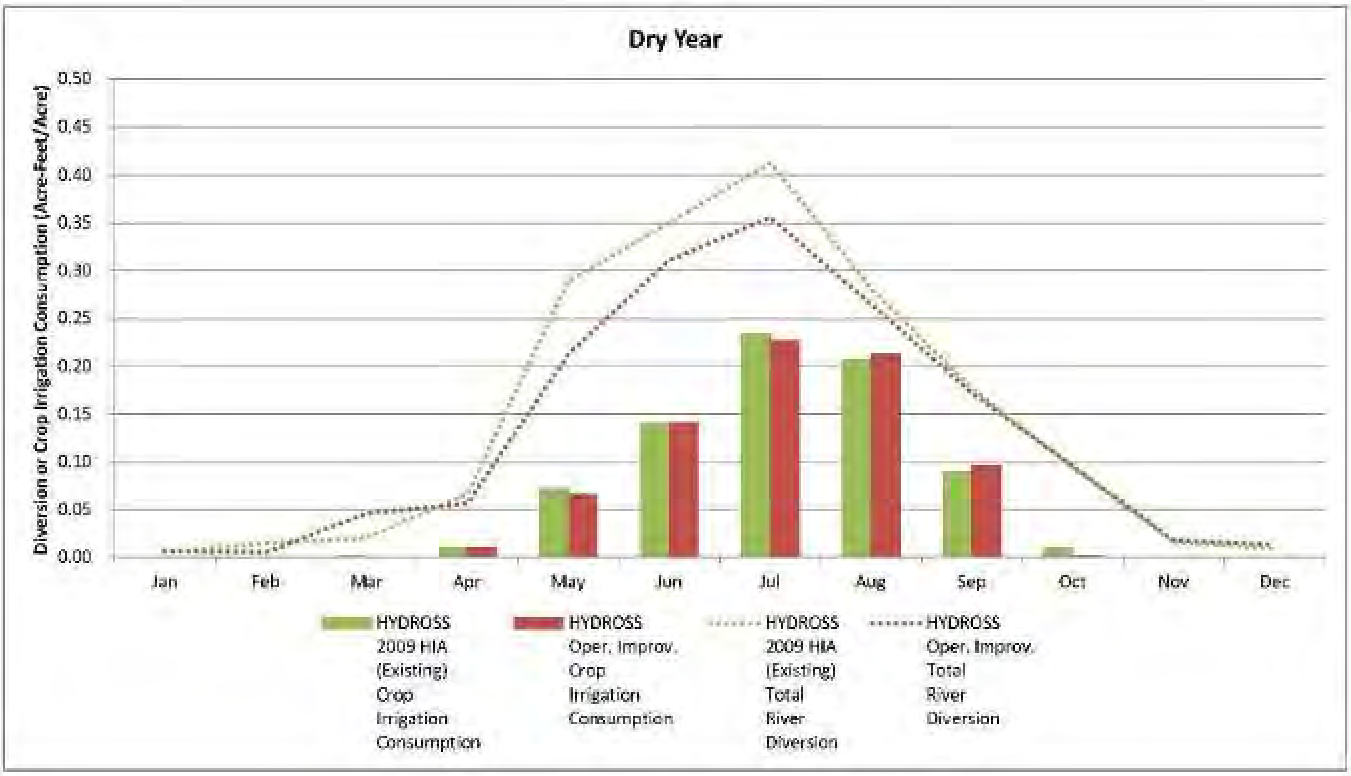
Appendix E (ii): CSKT Model Output Graphs; Composite - Mission



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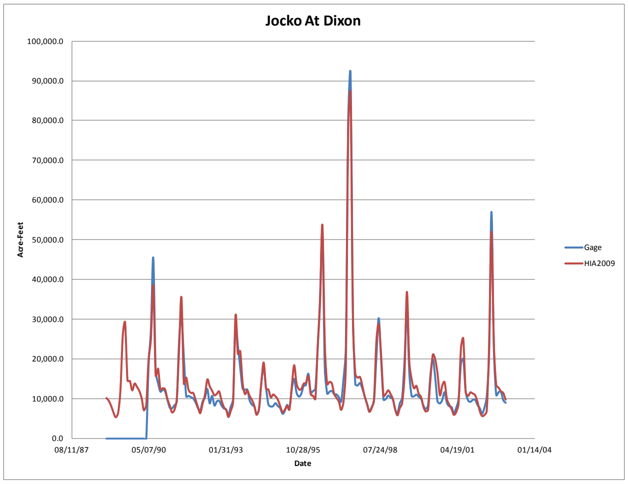
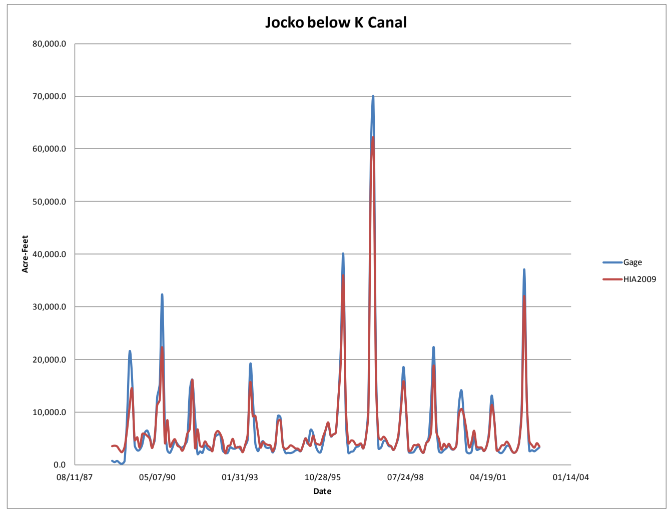
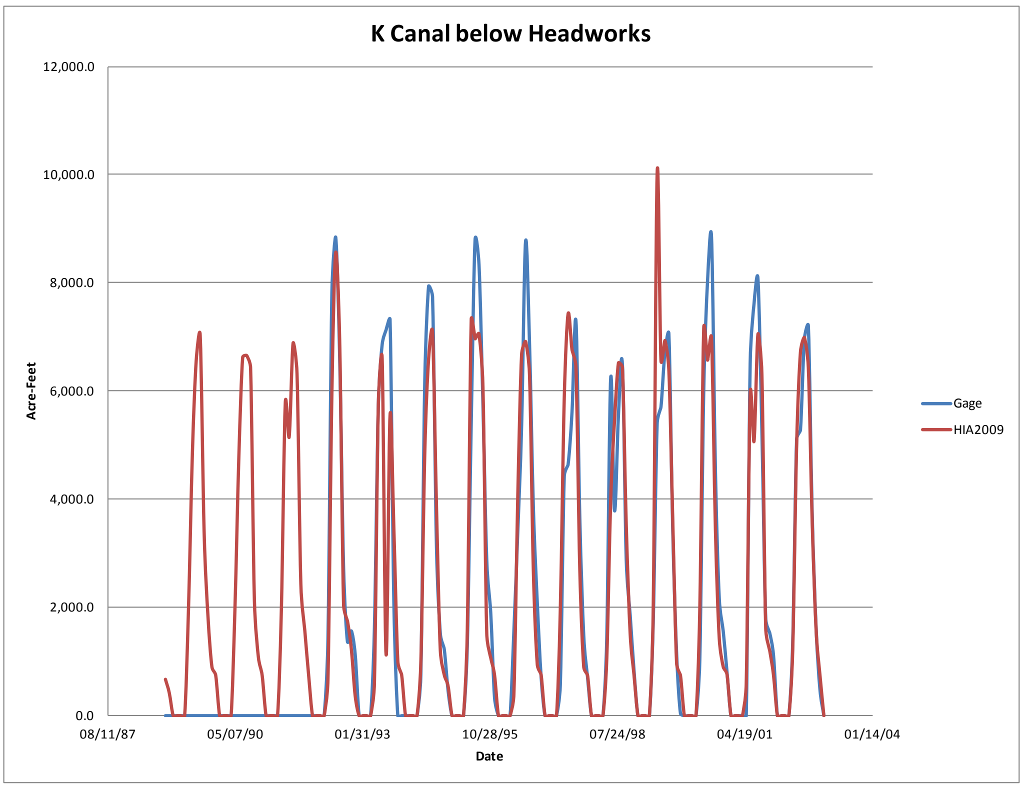
Appendix F: State Comparison of 2009 HIA (baseline model output) with gage data - Jocko

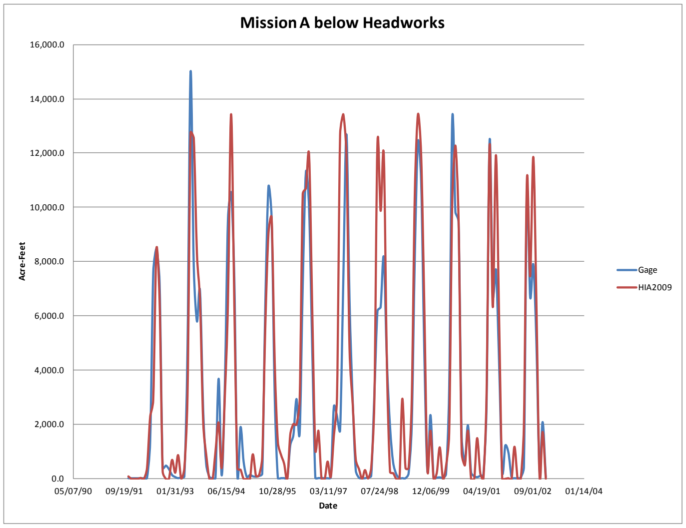


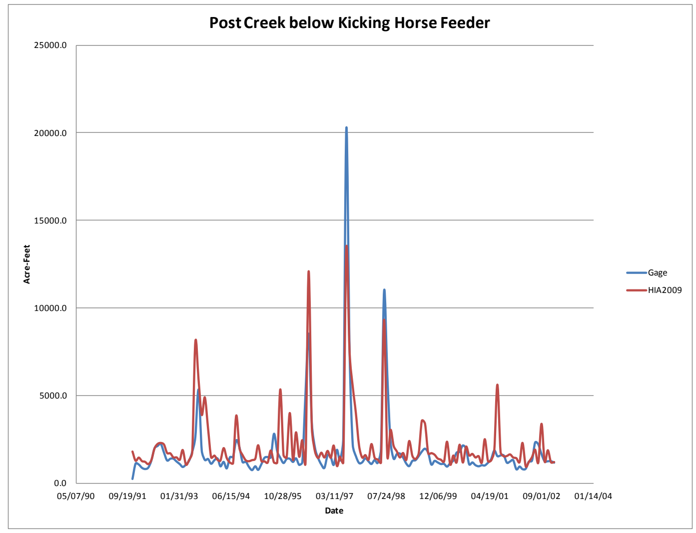


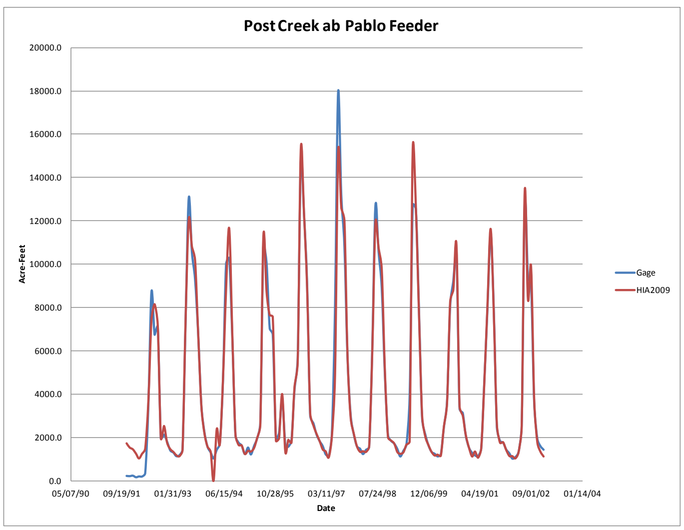


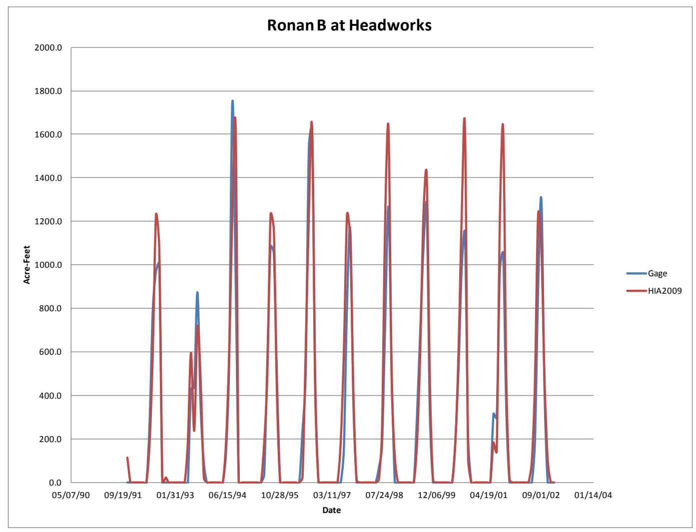
Rec'd by LEPO from RWRCC 8/5/14

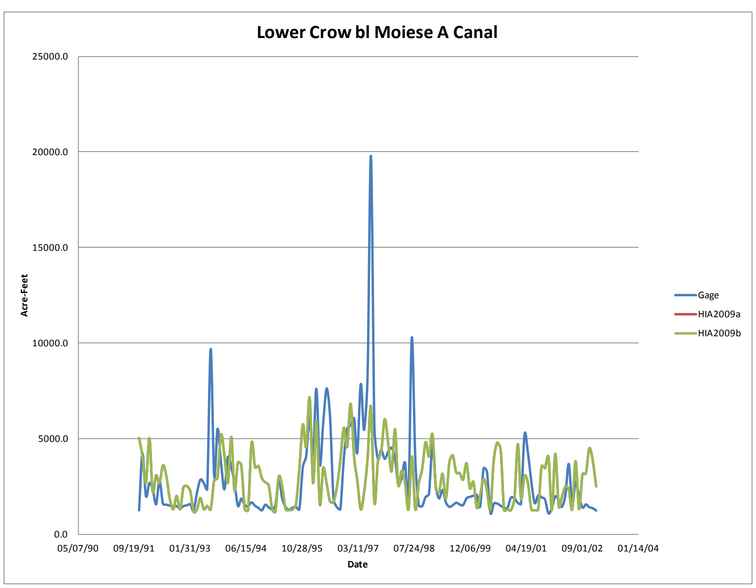
Appendix G: State Comparison of 2009 HIA (baseline model output) with gage data - Mission











Appendix H (i): State Comparison of Historic Diversions and WUA Enforcement

Tabor Feeder Canal at Jocko River North Fork
Total Irrigation Period Diversion Reduction as compared to Historic
Due to MEF, Max Flow Rate, and RDA Date Restrictions

Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	112	4%	906	7%	4	0%	0	0%	0	0%	0	0%	1021	6%
1993	Normal	423	55%	683	5%	0	0%	0	0%	0	0%	0	0%	1106	5%
1994	Dry	128	3%	1105	9%	350	8%	0	0%	0	0%	0	0%	1583	8%
1995	Dry	305	94%	1155	13%	442	6%	7	1%	0	0%	0	0%	1909	11%
1996	Wet	399	30%	492	5%	12	0%	0	0%	0	0%	0	0%	903	5%
1997	Wet	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1998	Normal	16	1%	808	5%	115	2%	0	0%	0	0%	0	0%	939	4%
1999	Normal	0	0%	542	8%	255	2%	0	0%	0	0%	0	0%	797	3%
2000	Normal	702	14%	1002	9%	157	2%	2	36%	0	0%	0	0%	1863	7%
2001	Normal	82	5%	856	6%	244	3%	12	5%	0	0%	0	0%	1193	5%
2002	Wet	88	28%	636	7%	0	0%	0	0%	0	0%	0	0%	724	4%
2003	Normal	67	3%	815	10%	277	3%	0	0%	0	0%	0	0%	1159	6%
2004	Dry	2018	48%	1175	12%	154	2%	36	10%	0	0%	0	0%	3384	16%
2005	Wet	246	17%	782	7%	0	0%	0	0%	0	0%	0	0%	1029	7%
2006	Wet	0	0%	359	4%	0	0%	2	1%	0	0%	0	0%	361	2%
2007	Dry	289	28%	703	7%	481	9%	5	8%	0	0%	0	0%	1478	9%
2008	Wet	0	0%	1	0%	10	0%	9	1%	0	0%	0	0%	20	0%
2009	Normal	50	3%	531	5%	108	1%	0	0%	0	0%	0	0%	689	3%
Average	Dry	570	35%	1009	10%	286	5%	10	4%	0	0%	0	0%	1875	10%
Average	Normal	191	12%	748	7%	165	2%	2	6%	0	0%	0	0%	1107	5%
Average	Wet	122	12%	378	4%	4	0%	2	0%	0	0%	0	0%	506	3%
Average	Total	274	18%	697	7%	145	2%	4	3%	0	0%	0	0%	1120	6%

Rec'd by LEPO from RWRCC 8/5/14

Appendix H (ii): State Comparison of Historic Diversions and WUA Enforcement

Tabor Feeder Canal at Jocko River North Fork Total Irrigation Period Diversion Reduction as compared to Historic Due to TIF, Max Flow Rate, and RDA Date Restrictions																
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	112	4%	906	7%	4	0%	0	0%	0	0%	0	0%	1021	6%
1993	Normal	455	59%	2010	13%	204	5%	0	0%	0	0%	0	0%	2670	13%
1994	Dry	128	3%	1105	9%	350	8%	0	0%	0	0%	0	0%	1583	8%
1995	Dry	305	94%	1155	13%	442	6%	7	1%	0	0%	0	0%	1909	11%
1996	Wet	407	30%	2702	29%	2450	30%	3	0%	0	0%	0	0%	5562	28%
1997	Wet	0	0%	0	0%	23	0%	432	51%	0	0%	0	0%	455	4%
1998	Normal	22	1%	2572	17%	430	9%	0	0%	0	0%	0	0%	3024	14%
1999	Normal	1	0%	1745	25%	717	5%	0	0%	0	0%	0	0%	2463	9%
2000	Normal	734	15%	2760	24%	741	8%	2	41%	0	0%	0	0%	4237	16%
2001	Normal	92	6%	2399	18%	996	13%	39	16%	0	0%	0	0%	3527	16%
2002	Wet	215	68%	2811	32%	4124	42%	284	24%	0	0%	0	0%	7434	37%
2003	Normal	92	4%	2067	27%	1017	11%	10	7%	0	0%	0	0%	3186	16%
2004	Dry	2018	48%	1175	12%	154	2%	36	10%	0	0%	0	0%	3384	16%
2005	Wet	350	24%	4664	43%	1104	75%	51	71%	0	0%	0	0%	6169	45%
2006	Wet	3	25%	2757	29%	2515	45%	331	97%	0	100%	0	0%	5606	36%
2007	Dry	289	28%	703	7%	481	9%	5	8%	0	0%	0	0%	1478	9%
2008	Wet	0	0%	2269	27%	7078	55%	553	34%	0	0%	0	0%	9900	43%
2009	Normal	67	4%	1437	14%	657	5%	0	0%	0	0%	0	0%	2162	9%
Average	Dry	570	35%	1009	10%	286	5%	10	4%	0	0%	0	0%	1875	10%
Average	Normal	209	13%	2141	20%	680	8%	7	9%	0	0%	0	0%	3038	13%
Average	Wet	162	25%	2534	26%	2882	41%	276	46%	0	17%	0	0%	5854	32%
Average	Total	294	23%	1958	19%	1305	18%	97	20%	0	6%	0	0%	3654	19%

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Appendix H (iii): State Comparison of Historic Diversions and WUA Enforcement

Tabor Feeder Canal at Jocko River Middle Fork Total Irrigation Period Diversion Reduction as compared to Historic Due to MEF, Max Flow Rate, and RDA Date Restrictions															
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	0	0%	261	28%	0	0%	0	0%	0	0%	0	0%	261	24%
1993	Normal	0	0%	48	2%	11	0%	0	0%	0	0%	0	0%	58	1%
1994	Dry	0	0%	41	4%	0	0%	0	0%	0	0%	0	0%	41	1%
1995	Dry	12	5%	348	28%	89	7%	0	0%	0	0%	0	0%	449	16%
1996	Wet	243	38%	286	9%	4	0%	0	0%	0	0%	0	0%	533	6%
1997	Wet	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1998	Normal	25	11%	244	15%	33	3%	0	0%	0	0%	0	0%	301	10%
1999	Normal	0	0%	98	5%	0	0%	0	0%	0	0%	0	0%	98	1%
2000	Normal	31	5%	148	4%	0	0%	0	0%	0	0%	0	0%	179	2%
2001	Normal	8	5%	320	16%	39	1%	0	0%	0	0%	0	0%	367	7%
2002	Wet	0	0%	115	8%	0	0%	0	0%	0	0%	0	0%	115	2%
2003	Normal	0	0%	145	7%	0	0%	0	0%	0	0%	0	0%	145	3%
2004	Dry	0	0%	314	13%	20	1%	0	0%	0	0%	0	0%	334	5%
2005	Wet	0	0%	152	6%	0	0%	0	0%	0	0%	0	0%	152	4%
2006	Wet	0	0%	42	2%	0	0%	0	0%	0	0%	0	0%	42	1%
2007	Dry	0	0%	5	0%	0	0%	0	0%	0	0%	0	0%	5	0%
2008	Wet	0	0%	4	7%	0	0%	0	0%	0	0%	0	0%	4	1%
2009	Normal	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Average	Dry	2	1%	194	15%	22	2%	0	0%	0	0%	0	0%	218	9%
Average	Normal	9	3%	143	7%	12	1%	0	0%	0	0%	0	0%	164	3%
Average	Wet	40	6%	100	5%	1	0%	0	0%	0	0%	0	0%	141	2%
Average	Total	18	4%	143	9%	11	1%	0	0%	0	0%	0	0%	171	5%

Rec'd by LEPO from RWRCC 8/5/14

Appendix H (iv): State Comparison of Historic Diversions and WUA Enforcement

Tabor Feeder Canal at Jocko River Middle Fork Total Irrigation Period Diversion Reduction as compared to Historic Due to TIF, Max Flow Rate, and RDA Date Restrictions																
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	16	9%	55	6%	0	0%	0	0%	0	0%	0	0%	71	6%
1993	Normal	0	0%	1195	47%	1466	52%	807	41%	0	0%	0	0%	3468	47%
1994	Dry	116	20%	28	2%	215	18%	0	0%	0	0%	0	0%	359	12%
1995	Dry	0	0%	160	13%	126	10%	0	0%	0	0%	0	0%	286	10%
1996	Wet	243	39%	2169	67%	1535	43%	374	38%	0	0%	0	0%	4322	51%
1997	Wet	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1998	Normal	34	15%	400	25%	299	27%	0	0%	0	0%	0	0%	733	24%
1999	Normal	0	0%	871	47%	2585	53%	724	40%	0	0%	0	0%	4180	49%
2000	Normal	104	15%	2272	60%	2280	61%	0	0%	0	0%	0	0%	4656	56%
2001	Normal	5	3%	904	45%	1752	58%	0	0%	0	0%	0	0%	2661	51%
2002	Wet	0	0%	432	31%	1943	43%	81	40%	0	0%	0	0%	2456	40%
2003	Normal	0	0%	683	33%	1826	55%	0	0%	0	0%	0	0%	2509	44%
2004	Dry	2	1%	1202	48%	1566	56%	219	30%	0	0%	0	0%	2988	48%
2005	Wet	8	3%	966	40%	58	6%	0	0%	0	0%	0	0%	1032	27%
2006	Wet	0	0%	5	0%	371	13%	58	6%	0	0%	0	0%	435	7%
2007	Dry	0	0%	800	32%	692	32%	0	0%	0	0%	0	0%	1492	30%
2008	Wet	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
2009	Normal	0	0%	0	0%	1281	60%	431	53%	0	0%	0	0%	1712	58%
Average	Dry	27	6%	449	20%	520	23%	44	6%	0	0%	0	0%	1039	21%
Average	Normal	20	5%	904	37%	1641	52%	280	19%	0	0%	0	0%	2846	47%
Average	Wet	42	7%	595	23%	651	18%	86	14%	0	0%	0	0%	1374	21%
Average	Total	29	6%	675	28%	1000	33%	150	14%	0	0%	0	0%	1853	31%

Appendix H (v): State Comparison of Historic Diversions and WUA Enforcement

K Canal on Jocko River Total Irrigation Period Diversion Reduction as compared to Historic Due to MEF, Max Flow Rate, and RDA Date Restrictions															
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	784	56%	3453	44%	2618	30%	357	5%	352	13%	705	51%	8269	29%
1993	Normal	1297	81%	676	12%	31	0%	0	0%	168	2%	175	8%	2347	8%
1994	Dry	0	0%	709	11%	1628	21%	352	5%	352	11%	831	55%	3872	14%
1995	Dry	1248	97%	2016	37%	609	7%	0	0%	192	3%	1166	41%	5231	16%
1996	Wet	0	0%	0	0%	0	0%	103	1%	359	5%	1574	41%	2035	7%
1997	Wet	0	0%	0	0%	0	0%	0	0%	31	0%	1172	32%	1203	5%
1998	Normal	645	45%	231	4%	0	0%	12	0%	313	5%	1302	45%	2503	9%
1999	Normal	362	21%	2260	42%	0	0%	62	1%	190	3%	1279	37%	4154	14%
2000	Normal	0	0%	0	0%	41	1%	302	3%	446	10%	1036	48%	1825	6%
2001	Normal	0	0%	60	1%	18	0%	48	1%	274	5%	996	55%	1396	5%
2002	Wet	1061	80%	2832	56%	0	0%	8	0%	64	1%	1305	35%	5269	18%
2003	Normal	0	0%	0	0%	369	5%	195	3%	290	8%	970	57%	1823	8%
2004	Dry	651	45%	1562	27%	0	0%	168	2%	193	4%	887	39%	3460	13%
2005	Wet	82	6%	0	0%	0	0%	12	0%	155	2%	835	39%	1084	5%
2006	Wet	16	1%	0	0%	0	0%	30	0%	232	4%	943	52%	1220	4%
2007	Dry	117	6%	0	0%	548	8%	220	3%	259	9%	846	60%	1989	7%
2008	Wet	753	93%	532	10%	0	0%	0	0%	102	1%	1327	38%	2714	9%
2009	Normal	14	9%	42	1%	0	0%	0	0%	79	1%	972	30%	1106	3%
Average	Dry	560	41%	1548	24%	1080	13%	220	3%	269	8%	887	49%	4564	16%
Average	Normal	331	22%	467	8%	66	1%	88	1%	251	5%	961	40%	2165	8%
Average	Wet	319	30%	561	11%	0	0%	25	0%	157	2%	1192	39%	2254	8%
Average	Total	391	30%	799	14%	326	4%	104	1%	225	5%	1018	42%	2861	10%

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Appendix H (vi): State Comparison of Historic Diversions and WUA Enforcement

K Canal on Jocko River
Total Irrigation Period Diversion Reduction as compared to Historic
Due to TIF Max Flow Rate, and RDA Date Restrictions

Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	784	56%	3453	44%	2618	30%	357	5%	352	13%	705	51%	8269	29%
1993	Normal	1585	99%	1850	32%	4289	63%	1271	18%	2178	30%	1666	80%	12839	42%
1994	Dry	0	0%	709	11%	1628	21%	352	5%	352	11%	831	55%	3872	14%
1995	Dry	1248	97%	2016	37%	609	7%	0	0%	192	3%	1166	41%	5231	16%
1996	Wet	0	0%	2433	71%	3008	56%	6301	72%	1957	29%	3175	82%	16875	57%
1997	Wet	0	0%	872	20%	757	16%	2233	40%	1153	16%	2693	74%	7708	29%
1998	Normal	735	51%	5233	84%	1676	44%	774	14%	2318	36%	2769	96%	13505	51%
1999	Normal	617	36%	3559	66%	608	11%	1218	18%	2154	31%	2806	81%	10963	36%
2000	Normal	0	0%	3446	57%	7288	91%	2862	32%	2557	57%	2145	99%	18298	60%
2001	Normal	0	0%	3433	53%	7430	98%	2199	27%	2383	45%	1796	100%	17240	59%
2002	Wet	1333	100%	4660	91%	3783	72%	4304	62%	1573	22%	2889	77%	18542	63%
2003	Normal	33	3%	2320	65%	4203	62%	2745	39%	2300	63%	1693	100%	13293	56%
2004	Dry	651	45%	1562	27%	0	0%	168	2%	193	4%	887	39%	3460	13%
2005	Wet	461	36%	3353	94%	1980	64%	4415	72%	1727	26%	2094	98%	14030	62%
2006	Wet	31	3%	2785	49%	4616	88%	7589	93%	1830	31%	1817	100%	18669	67%
2007	Dry	117	6%	0	0%	548	8%	220	3%	259	9%	846	60%	1989	7%
2008	Wet	811	100%	3969	78%	5143	93%	4982	62%	1515	21%	2818	81%	19239	64%
2009	Normal	14	9%	2800	43%	1801	23%	809	9%	1861	30%	2519	78%	9804	30%
Average	Dry	560	41%	1548	24%	1080	13%	220	3%	269	8%	887	49%	4564	16%
Average	Normal	426	28%	3234	57%	3899	56%	1697	23%	2250	42%	2199	90%	13706	48%
Average	Wet	439	40%	3012	67%	3215	65%	4971	67%	1626	24%	2581	85%	15844	57%
Average	Total	468	36%	2692	51%	2888	47%	2378	32%	1492	26%	1962	77%	11879	42%

Appendix H (vii): State Comparison of Historic Diversions and WUA Enforcement

Mission A Canal at Mission Creek
Total Irrigation Period Diversion Reduction as compared to Historic
Due to MEF, Max Flow Rate, and RDA Date Restrictions

Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	0	0%	943	69%	1675	22%	1754	21%	524	7%	379	100%	6081	24%
1993	Normal	40	61%	1755	36%	2173	14%	1473	19%	642	11%	2206	32%	11308	28%
1994	Dry	36	35%	2180	63%	3203	34%	0	0%	246	3%	139	100%	8309	27%
1995	Normal	84	100%	163	97%	3807	60%	288	3%	840	9%	618	20%	5810	19%
1996	Normal	112	4%	764	46%	25	0%	235	2%	164	2%	692	14%	2015	5%
1997	Wet	1796	68%	938	41%	0	0%	154	2%	0	0%	3287	50%	9350	28%
1998	Normal	68	75%	1288	41%	1389	23%	295	5%	72	1%	1341	31%	6941	25%
1999	Normal	14	8%	1144	59%	1877	23%	235	2%	42	0%	113	2%	6016	16%
2000	Normal	34	22%	1344	41%	3283	25%	151	2%	78	1%	455	30%	7869	21%
2001	Normal	123	91%	772	29%	3145	25%	258	4%	0	0%	277	6%	6037	18%
2002	Normal	27	100%	415	100%	3309	31%	6	0%	0	0%	1032	20%	7117	23%
2003	Normal	28	22%	812	67%	1635	16%	0	0%	404	6%	131	100%	5936	20%
2004	Normal	32	24%	1526	100%	3159	23%	0	0%	606	6%	1762	48%	10652	27%
2005	Normal	5	0%	3112	52%	204	5%	145	1%	7	0%	252	16%	3935	11%
2006	Normal	15	85%	1156	22%	2155	22%	1102	15%	148	1%	183	6%	8478	24%
2007	Dry	0	0%	2161	96%	2732	24%	0	0%	636	10%	846	95%	7910	26%
Average	Dry	12	12%	1761	76%	2537	27%	585	7%	469	7%	455	98%	7433	26%
Average	Normal	49	49%	1188	57%	2180	22%	349	4%	250	3%	755	27%	6843	20%
Average	Wet	1796	68%	938	41%	0	0%	154	2%	0	0%	3287	50%	9350	28%
Average	Total	151	43%	1280	60%	2111	22%	381	5%	276	4%	857	42%	7110	21%

Appendix H (viii): State Comparison of Historic Diversions and WUA Enforcement

Mission A Canal at Mission Creek Total Irrigation Period Diversion Reduction as compared to Historic Due to TIF, Max Flow Rate, and RDA Date Restrictions															
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	0	0%	943	69%	1675	22%	1754	21%	524	7%	379	100%	6081	24%
1993	Normal	40	61%	1755	36%	4655	31%	4325	55%	2985	52%	3689	53%	20468	51%
1994	Dry	36	35%	2180	63%	3203	34%	0	0%	246	3%	139	100%	8309	27%
1995	Normal	84	100%	163	97%	5628	88%	2099	20%	3010	31%	2210	73%	13205	44%
1996	Normal	112	4%	764	46%	885	12%	2046	18%	2569	26%	2624	54%	9023	24%
1997	Wet	1803	68%	1019	45%	562	32%	2616	36%	1968	16%	4942	75%	16086	48%
1998	Normal	68	75%	1288	41%	2555	41%	1792	28%	1289	16%	2463	57%	11943	42%
1999	Normal	14	8%	1144	59%	3836	47%	1991	16%	1807	16%	1245	26%	12628	33%
2000	Normal	34	22%	1344	41%	5960	45%	2389	24%	1793	19%	1122	74%	15166	40%
2001	Normal	123	91%	772	29%	5822	47%	2999	44%	880	11%	877	20%	12935	38%
2002	Normal	27	100%	415	100%	5183	49%	2174	32%	1267	16%	1828	36%	13221	43%
2003	Normal	28	22%	812	67%	4206	41%	1263	12%	828	12%	131	100%	10194	34%
2004	Normal	32	24%	1526	100%	5465	39%	1754	19%	2561	25%	3683	100%	18588	48%
2005	Normal	5	0%	3112	52%	468	12%	2001	18%	1811	15%	549	35%	8157	23%
2006	Normal	15	85%	1156	22%	4121	41%	3834	52%	2449	24%	970	33%	16264	46%
2007	Dry	0	0%	2161	96%	2732	24%	0	0%	636	10%	846	95%	7910	26%
Average	Dry	12	12%	1761	76%	2537	27%	585	7%	469	7%	455	98%	7433	26%
Average	Normal	49	49%	1188	57%	4065	41%	2389	28%	1937	22%	1783	55%	13483	39%
Average	Wet	1803	68%	1019	45%	562	32%	2616	36%	1968	16%	4942	75%	16086	48%
Average	Total	151	44%	1285	60%	3560	38%	2065	25%	1664	19%	1731	64%	12511	37%

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Appendix H (ix): State Comparison of Historic Diversions and WUA Enforcement

Moiese A at Crow Creek Total Irrigation Period Diversion Reduction as compared to Historic Due to MEF, Max Flow Rate, and RDA Date Restrictions																
Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	113	15%	1488	38%	256	9%	0	0%	7	0%	380	20%	2427	17%
1993	Normal	88	25%	1021	26%	95	3%	0	0%	0	0%	589	36%	2217	16%
1994	Dry	118	14%	1535	54%	328	12%	0	0%	1	0%	1306	45%	3808	22%
1995	Normal	198	17%	1667	55%	512	21%	2	0%	0	0%	678	34%	3495	24%
1996	Normal	0	0%	203	22%	0	0%	8	0%	7	0%	1108	39%	2315	15%
1997	Wet	29	21%	45	2%	15	1%	1	0%	0	0%	748	44%	1719	15%
1998	Normal	26	11%	1408	45%	0	0%	0	0%	9	0%	811	35%	3024	23%
1999	Normal	265	16%	1637	58%	280	12%	0	0%	4	0%	1256	55%	4651	31%
2000	Normal	180	44%	1969	54%	408	13%	0	0%	5	0%	500	52%	3130	20%
2001	Normal	4	35%	1065	35%	225	14%	0	0%	0	0%	1731	53%	4311	30%
2002	Normal	0	0%	1228	67%	158	6%	165	4%	39	1%	1102	45%	3744	27%
2003	Normal	0	0%	98	50%	426	13%	138	3%	33	1%	402	18%	1097	7%
2004	Normal	189	39%	1542	68%	402	17%	299	7%	232	7%	873	45%	4527	32%
2005	Normal	142	37%	1323	67%	18	1%	0	0%	0	0%	1208	42%	3457	25%
2006	Normal	11	11%	1252	36%	10	0%	0	0%	24	1%	852	35%	3434	22%
2007	Dry	343	39%	1630	46%	426	13%	66	2%	21	1%	324	16%	3321	19%
Average	Dry	191	23%	1551	46%	337	11%	22	1%	10	0%	670	27%	3185	20%
Average	Normal	92	20%	1201	49%	211	8%	51	1%	29	1%	926	41%	3283	23%
Average	Wet	29	21%	45	2%	15	1%	1	0%	0	0%	748	44%	1719	15%
Average	Total	107	20%	1194	45%	222	8%	42	1%	24	1%	867	38%	3167	22%

Appendix H (x): State Comparison of Historic Diversions and WUA Enforcement

Moiese A at Crow Creek
Total Irrigation Period Diversion Reduction as compared to Historic
Due to TIF, Max Flow Rate, and RDA Date Restrictions

Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	113	15%	1488	38%	256	9%	0	0%	7	0%	380	20%	2427	17%
1993	Normal	236	68%	2975	75%	2096	68%	48	4%	5	0%	589	36%	6374	47%
1994	Dry	118	14%	1535	54%	328	12%	0	0%	1	0%	1306	45%	3808	22%
1995	Normal	584	51%	3036	100%	2243	94%	781	24%	6	0%	791	40%	7881	54%
1996	Normal	0	0%	205	22%	352	9%	462	11%	36	1%	1186	42%	3231	21%
1997	Wet	38	28%	609	24%	771	39%	1219	42%	0	0%	748	44%	4265	37%
1998	Normal	85	35%	3025	98%	175	21%	423	13%	23	1%	882	38%	5384	41%
1999	Normal	726	45%	2801	100%	2235	95%	519	16%	13	1%	1287	57%	8789	59%
2000	Normal	322	79%	3639	100%	2610	84%	561	14%	13	0%	562	59%	7776	49%
2001	Normal	12	100%	2980	99%	1450	88%	363	10%	2	0%	1800	56%	7892	55%
2002	Normal	0	0%	1843	100%	1681	68%	703	18%	60	2%	1154	48%	6494	46%
2003	Normal	0	0%	195	100%	2849	89%	824	17%	48	1%	417	19%	4334	30%
2004	Normal	361	74%	2280	100%	2252	94%	1147	28%	285	9%	981	50%	8296	58%
2005	Normal	168	44%	1783	91%	181	10%	124	4%	0	0%	1232	43%	4255	30%
2006	Normal	70	68%	3288	96%	455	21%	383	10%	50	1%	932	39%	6461	41%
2007	Dry	343	39%	1630	46%	426	13%	66	2%	21	1%	324	16%	3321	19%
Average	Dry	191	23%	1551	46%	337	11%	22	1%	10	0%	670	27%	3185	20%
Average	Normal	214	47%	2337	90%	1548	62%	528	14%	45	1%	985	44%	6431	44%
Average	Wet	38	28%	609	24%	771	39%	1219	42%	0	0%	748	44%	4265	37%
Average	Total	199	41%	2082	78%	1272	51%	477	13%	36	1%	911	41%	5687	39%

Appendix H (xi): State Comparison of Historic Diversions and WUA Enforcement

Ronan B Canal below Mud Creek
Total Irrigation Period Diversion Reduction as compared to Historic
Due to MEF, Max Flow Rate, and RDA Date Restrictions

Year	Year Category	April		May		Jun		Jul		Aug		Sep		Annual Irrigation	
		(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)	(AF)	(%)
1992	Dry	0	0%	281	100%	407	52%	195	20%	51	5%	0	0%	935	31%
1993	Normal	0	0%	0	0%	279	65%	141	32%	0	0%	178	51%	688	33%
1994	Dry	0	0%	138	100%	281	51%	6	0%	30	3%	0	0%	455	13%
1995	Normal	0	0%	24	63%	286	51%	32	3%	10	1%	113	24%	465	14%
1996	Normal	0	0%	213	90%	71	14%	17	1%	0	0%	88	19%	390	9%
1997	Wet	0	0%	0	0%	110	74%	79	10%	2	0%	155	44%	356	14%
1998	Normal	0	0%	68	100%	91	55%	95	13%	9	1%	13	2%	276	10%
1999	Normal	0	0%	246	78%	241	35%	132	12%	1	0%	46	14%	666	18%
2000	Normal	0	0%	190	100%	344	66%	56	6%	0	0%	6	3%	596	20%
2001	Normal	0	0%	290	92%	170	57%	65	7%	43	4%	21	6%	589	20%
2002	Normal	0	0%	0	0%	145	80%	66	7%	0	0%	20	5%	232	8%
2003	Normal	0	0%	39	100%	348	51%	42	3%	6	1%	0	0%	434	14%
2004	Normal	2	37%	233	100%	214	53%	35	3%	0	0%	177	38%	683	20%
2005	Normal	0	0%	0	0%	247	61%	59	5%	3	0%	9	2%	318	9%
Average	Dry	0	0%	210	100%	344	51%	100	10%	40	4%	0	0%	695	22%
Average	Normal	0	3%	118	66%	222	54%	67	8%	6	1%	61	15%	485	16%
Average	Wet	0	0%	0	0%	110	74%	79	10%	2	0%	155	44%	356	14%
Average	Total	0	3%	123	66%	231	55%	73	9%	11	1%	59	15%	506	17%