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8.5 FISH AND AQUATIC RESOURCES ENVIRONMENTAL EFFECTS

This section describes the potential impacts to riverine and reservoir fish and aquatic resources under the Proposed Action for the Middle Fork American River Project (MFP or Project). Potential impacts to riparian resources are identified in Section 8.8 – Riparian Resources Environmental Effects. Potential impacts to geomorphology resources are provided in Section 8.7 – Geomorphology Environmental Effects. Section 4.0 – Proposed Action (including Tables 4-4, 4-5, and 4-6) provides a description of routine operation and maintenance activities to be implemented under the Proposed Action compared to the No-Action Alternative. Appendix A – Modified or New Facilities Construction Activities and Concept Designs includes a description of facility modification and construction activities to be implemented under the Proposed Action. The No-Action Alternative is summarized in Section 3.0.

Potential impacts to fish and aquatic resources have been identified based on changes in Project operations, changes in routine Project maintenance activities, implementation of non-routine recreation facility activities, and modification of existing or construction of new Project facilities. Specifically, potential impacts to fish and aquatic resources include loss or degradation of habitat, reduction in productivity (algae, benthos), reduction in habitat and/or species diversity, modification of a species distribution, reduced growth/condition/abundance of a species, modifications to timing of breeding seasons, and loss of individuals.

Potential impacts evaluated in this analysis are based on the activities to be implemented under the Proposed Action. Impacts on fish and aquatic resources are evaluated as follows:

- Potential impacts on riverine physical habitat from changes in Project operations affecting:
 - Hydrology
 - Channel geomorphology and sediment transport and supply
 - Riparian vegetation
 - Water temperature and dissolved oxygen
 - Wetted perimeter
- Potential impacts on the riverine aquatic community from changes in Project operations affecting:
 - Productivity (algae and benthos)
 - Habitat and species diversity
 - Seasonal hydrograph shape and year-to-year flow variability
 - Peaking reach flow fluctuations

- Potential impacts on riverine fish from changes in Project operations affecting:
 - Fish distribution
 - Growth/condition/abundance
 - Bypass reach habitat
 - Peaking reach habitat
- Potential impacts on foothill yellow-legged frogs (FYLF) from changes in operations affecting:
 - Distribution, abundance, and breeding timing
- Potential impacts on reservoir fish from changes in operations, sediment management, and fish stocking affecting:
 - Physical habitat and fish populations
- Potential impacts on fish entrainment from modification of small diversion dams and other Project facilities.
- Potential impacts on fish and aquatic resources from vegetation and noxious weed management affecting:
 - Water quality and aquatic habitats
- Potential impacts on fish and aquatic resources associated with modified or new Project facilities or Project recreation facilities and sediment management activities affecting:
 - Water quality and aquatic habitats
 - Loss of individuals

The hydrology baselines and hydrology operations model runs used to quantify impacts of the Proposed Action compared to the No-Action Alternative are discussed in Section 8.1 – Analytical Approach Environmental Effects.

A description of the potential impacts to fish and aquatic resources resulting from implementation of the Proposed Action, considering avoidance and protection (AP) and enhancement measures, by resource topic, is provided below. At the end of this section (Section 8.5), an impact conclusion is provided for fish and aquatic species, including special-status aquatic species (Section 8.5.10). In addition, unavoidable adverse effects are summarized at the end of this section.

8.5.1 Riverine Physical Habitat

The Proposed Action will modify minimum instream flows, environmental pulse flows, spill flows, operations of the Oxbow Powerhouse, recreation flows, and sediment management. The riverine physical habitat that the Proposed Action could potentially impact includes: (1) hydrology; (2) channel geomorphology and sediment transport and

supply; (3) riparian vegetation; (4) water temperature and dissolved oxygen; and (5) wetted perimeter. Each element is discussed below.

8.5.1.1 Hydrology

The MFP (Section 7.3 – Water Use Affected Environment, Map 7.3–2) includes hydrological bypass reaches and a peaking reach. The bypass reaches are sections of streams/ivers below diversions or reservoirs where Project operations result in the diversion of a portion of the water from that reach. The peaking reach is the river below Oxbow Powerhouse. In this reach, flows fluctuate substantially to meet power demand or to support whitewater recreation.

- Bypass Reaches
 - Duncan Creek, North Fork Long Canyon Creek, South Fork Long Canyon Creek, Long Canyon Creek, Middle Fork American River below French Meadows Reservoir, Middle Fork American River below Middle Fork Interbay, and Rubicon River
- Peaking Reach
 - Middle Fork and North Fork American rivers below Oxbow Powerhouse

In the bypass and peaking reaches, the Proposed Action specifies modifications to hydrology including:

- Higher minimum instream flows in all bypass and peaking reaches;
- Environmental pulse flows in the all bypass reaches and down ramping of spill flows in the bypass reaches below French Meadows and Hell Hole reservoirs; and
- Specific operations requirements at Oxbow Powerhouse to reduce flow fluctuation in the peaking reach.

Minimum Instream Flows

The Proposed Action includes higher minimum instream flow requirements based on five water year types compared to the No-Action Alternative minimum instream flow requirements, which are based on one or two water year types (depending on location). The Proposed Action water year type designation allows better differentiation of water year types. In particular, it provides the ability to differentially enhance flows in the wettest water year types (wet and above normal); whereas, this is not possible with the more limited No-Action Alternative water year type designation (Instream Flow and Reservoir Minimum Pool Measure [IFRM] PCWA 2011a; Supporting Document [SD] A).

The Proposed Action minimum instream flow requirements are either greater than or equal to the No-Action Alternative minimum instream flow requirements in all bypass and peaking reaches. The Proposed Action greatly increases the spring minimum

instream flow requirements in all reaches in all water year types. Summer instream flow requirements are also increased in all bypass and peaking reaches in wet and above normal water year types. Summer flow requirements in the drier year types (critical, dry, and above normal) are increased above or maintained at the No-Action Alternative minimum instream flow requirements, depending on location. Winter minimum flow requirements are either increased or maintained compared to the No-Action Alternative (Figures 8.5-1a–g).

In the peaking reach, the Proposed Action includes annual maintenance outage minimum instream flow requirements (30-day period, beginning between the last Sunday in September and October 30). These flow requirements are the same as or greater than the No-Action Alternative minimum instream flow requirements. The maintenance outage minimum instream flow requirements in extreme critical, critical, and dry water year types will be the same as in the No-Action Alternative (75 cubic feet per second [cfs]), but in the other water year types (below normal, above normal, and wet) they will be 35 to 75 cfs higher than the No-Action Alternative.

Figures 8.5-2a–g show the minimum flow for each day of the year in the Proposed Action (resulting from implementation of the proposed flow measures) compared to the measured historical hydrology used to represent the No-Action Alternative. For each water year type, the analysis shows the minimum daily flow that occurred based on all the hydrology for years with the same water year type (i.e., a composite of all the data in each water year type for 1975–2007 hydrology period of record). In the peaking reach, the analysis for the Proposed Action is based on the hourly model data (minimum for each day) and in the No-Action Alternative the analysis is based on the 15-minute historical flow data (minimum for each day) for the 1988–2007 period of record. There are some instances in the small streams (Duncan Creek, North Fork Long Canyon, and South Fork Long Canyon) where the minimum daily flow is below the minimum flow line on the figures. The minimum flow requirement in these streams is the “minimum flow or inflow, whichever is less” and in some year types the inflow is less than the specified minimum flow. Also, on the figures, the Proposed Action minimum flow is often a few cfs higher than the minimum flow requirement; this represents a purposeful over-release of water in the hydrology operations model to mimic how the Project would be operated to avoid minimum flow violations.

Environmental Pulse Flows (including Reservoir Spills)

Scheduled environmental pulse flows are included in the Proposed Action in May of wet and above normal water year types in all bypass reaches. The wet and above normal year types encompass approximately 50% of the water years in the 33-year period of record (1975–2007) (Table 7.3-2a). The No-Action Alternative does not specify environmental pulse flows; although, high spring flows have occurred historically as a result of reservoir spills or inflows exceeding the capacity of diversions. The Proposed Action increases the number of years that environmental pulse flows would occur in May by 71–300% (11–16 years during the period of record) compared to the No-Action Alternative (4–7 years during the period of record) depending on the reach

(Table 8.5-1). This analysis includes the reservoir spill flows or stream flows that exceed diversion capacity in May.

In the peaking reach, no environmental pulse flows are specified in the Proposed Action because natural high-flow events from unimpaired river inflows (North Fork of the Middle Fork American River, North Fork American River) and accretion flows from smaller watersheds in the reach provide high-flow events. Therefore, the frequency of high-flow events in the Proposed Action is maintained compared to the No-Action Alternative (Channel Geomorphology and Sediment section, below).

The Proposed Action specifies streamflow release facility modifications (Section 4.0) and additional flow gaging stations (Flow and Reservoir Monitoring Plan [FRMP] [PCWA 2011b; SD A]) necessary to release and monitor the environmental pulse flows into six bypass reaches. Environmental pulse flows and the down ramp of the pulse flows would not be possible under the No-Action Alternative. In particular, modification of release facilities at Hell Hole Dam and modification of the small stream diversion structures (Duncan, North Fork Long Canyon, and South Fork Long Canyon) in the Proposed Action (Section 4.0) will allow pulse flow releases and flow gaging at these locations that could not occur with the No-Action Alternative.

The Proposed Action also requires that reservoir spills be down ramped at Hell Hole Dam and French Meadows Dam when spill occurs in May–July (see down ramp schedule in PCWA 2011a; SD A). In addition, at Hell Hole Dam some spills will be extended for four days and then down ramped. In the No-Action Alternative, no down ramping of May–July spills will occur at Hell Hole or French Meadows Dam. There are nine years (in the 33-year period of record) that spills are down ramped under the Proposed Action that, otherwise, would not be down ramped in the No-Action Alternative.

In the Proposed Action, the shape of the down ramp for both environmental pulse flows and reservoir spills provides a slowly declining hydrograph that provides riparian and other environmental/recreational benefits compared to the faster decline of spill flows for the No-Action Alternative. The Proposed Action down ramp was set at an average rate of approximately 1.6 inches of stage per day. For the spill-event down ramp, the same rate was used for Hell Hole Dam; but a faster down ramp (approximately twice as fast) was used below French Meadows Dam due, in part, to the different environmental resource conditions (e.g., FYLF are not present in the river reach between French Meadows Dam and Middle Fork Interbay; riparian vegetation is sparsely distributed due to the coarse substrate and bedrock-dominated channel).

Accretion flows along the length of the bypass reaches further shape the declining limb (recession) of the pulse flows. The recession of the wet and above normal water year Proposed Action and unimpaired hydrographs were compared. For comparison, the hydrographs between years were shifted to align the timing of the receding limbs (Figures 8.5-3a–b, 8.5-4a–b, and 8.5-5a–b). In addition, an average hydrograph by water year type was added to each of the figures. The average hydrographs were

converted to stage using the average stage-discharge relationships at the instream flow study sites (PCWA 2011a; SD A) (Figures 8.5-6a–b, 8.5-7a–b, and 8.5-8a–b).

Accretion flows had a large effect on the recession hydrographs in the 29.7-mile-long reach of the Rubicon River. For example, in the lower 20 miles of the Rubicon River that contains FYLF (RM0.6–RM 20.9), the Proposed Action flow recessions were similar to or slower than the unimpaired hydrograph recessions (Figure 8.5-6a–b and 8.5-7a–b). On average the Rubicon River Proposed Action recessions at Ellicott Bridge (R20.9) were approximately 1.0 inches stage/day (wet years) and 0.9 inches stage/day (above normal) compared to the unimpaired recessions of approximately 1.1 inches stage/day (wet and above normal years). Below Long Canyon on the Rubicon River (R3.5), the Proposed Action hydrograph recessions were approximately 0.8 inches stage/day (wet and above normal years) compared to the unimpaired recessions of approximately 1.0 inches stage/day (wet years) and 0.9 inches stage/day (above normal years).

For the Middle Fork American River below Middle Fork Interbay at MF26.2, the effect of accretion is shown in Figure 8.5-8a–b. The distance from Middle Fork Interbay to Ralston Afterbay is approximately 9.5 miles (RM26.0 to RM35.5). FYLF are present primarily in the lower 3 miles of the reach (RM26.0 to approximately RM29.0). The hydrograph recession rate at the bottom of the reach was approximately 0.9 inches stage/day (wet years) and 1.2 inches stage/day (above normal years) compared to the unimpaired recession of approximately 0.8 inches stage/day (wet years) and 1.4 inches stage/day (above normal years).

Peaking Reach-Specific Hydrology

In the peaking reach, the Proposed Action includes specific operational requirements at Oxbow Powerhouse to reduce: (1) flow fluctuations: and (2) powerhouse ramping rates.

FLOW FLUCTUATIONS

The Proposed Action includes a 900 cfs upper limit on Oxbow Powerhouse releases during the summer of extreme critical, critical, and dry water year types along with increased minimum instream flow requirements (in all water year types) that were designed to decrease potential flow fluctuations in the peaking reach by about 100 cfs or more compared to the existing license requirements in the No-Action Alternative. The Proposed Action minimum flow requirements, Oxbow Powerhouse maximum release requirement, and physical maximum release from Oxbow Powerhouse are shown in Figure 8.5-1g.

An analysis of flow fluctuations using the Proposed Action operations hourly model compared to the 15-minute historical flows in the peaking reach between 1988–2007 (when 15-minute flow data are available) is provided below. Two measures of flow fluctuation are used for the analysis (Moog 1993; Bain 2009):

Absolute fluctuation = daily maximum – daily minimum

Peaking discharge ratio = daily maximum / daily minimum

The daily flow fluctuations (absolute fluctuation and peaking discharge ratio) were summarized (averaged) for three seasons summer/fall (June–October), winter (November–February), and spring (March–May) and for each water year type (all, wet, above normal, below normal, dry, critical) (Figures 8.5-9a–b). In addition, flow fluctuation exceedance plots for each seasons and water year type were created to show all of the daily data (Figure 8.5-10a–c and 8.5-11a–c). Maximum, minimum, median and any exceedance value (e.g., 90% exceedance) of flow fluctuations can be identified in these plots. Time series plots (Figures 8.5-12a–e) of the Proposed Action and No-Action Alternative hydrographs show the flow fluctuations graphically. Five large run-off events with flows 20,000 cfs or greater were not included in the analysis; the events were not controllable by the MFP, and they biased the flow fluctuation results.

The results of the analyses show that the daily-flow fluctuations under the Proposed Action were reduced in the summer and spring and were similar during the winter, compared to the No-Action Alternative (Figures 8.5-9a–b). During the winter, the results varied by water year type. Proposed Action fluctuations were greater in the drier water year types, and the fluctuations were less in the wetter water year types compared to the No-Action Alternative. Overall, for all water year types there was a 157-cfs reduction in absolute fluctuation, but a 0.05 increase in the peaking discharge ratio during the winter. During the summer the flow fluctuations in the Proposed Action were reduced in all water year types compared to the No-Action Alternative. The average reduction (across all water year types) was 88 cfs, absolute fluctuation, and 1.5, peaking discharge ratio (4.1 versus 5.6). The spring Proposed Action reductions in flow fluctuation were larger than those that occurred during the summer.

The daily-flow fluctuation exceedance plots (Figures 8.5-10a–c and 8.5-11a–c) and time series plots (Figures 8.5-12a–e) show similar results as those described above. For example, the time series plots visually show that the Proposed Action increased minimum flows and Oxbow Powerhouse maximum flow release (900 cfs during the summer of dry, critical, and extreme critical water year types) during the summer decrease daily flow fluctuations compared to the No-Action Alternative.

RAMPING RATES

The Proposed Action establishes Oxbow Powerhouse maximum ramping rate requirements that result in an approximate ramping rate of approximately 1.0 feet per hour at numerous representative transects within the instream flow study sites in the peaking reach. This is 50% slower than the No-Action Alternative up ramping rate and 41% slower than the No-Action Alternative down ramping rate requirement. The No-Action Alternative ramping rate requirement is 3.0 feet per hour at the Middle Fork American River near Foresthill United States Geological Survey (USGS) gage (No. 114333000) (Foresthill Gage). Table 8.5-2 shows hourly increments of 1.0 feet per hour flow change at the peaking reach instream flow study sites compared to the corresponding hourly stage change at the Foresthill Gage that is used for compliance in the No-Action Alternative. The 1.0 feet per hour ramping rate in the Proposed Action corresponds to an average 1.5 feet per hour up ramp and -1.77 feet per hour down

ramp at the Foresthill Gage (the No-Action Alternative ramp rate requirement is 3.0 feet per hour).

The Proposed Action ramping rate requirement is based on stepped flow change increments that approximate a 1.0 feet per hour ramping rate (Figure 8.5-13) at the instream flow study sites. The actual increments of flow change at the Oxbow Powerhouse are compared to a continuous flow change relationship that would create a 1.0 feet per hour stage change at the instream flow sites in Figure 8.5-13. The stepped increments of ramping rate in the Proposed Action correspond closely to the continuous 1.0 feet per hour ramping rate relationship.

The effects of the Proposed Action hourly ramping rate requirement on peaking reach hydrology is compared to historical impaired hydrology under the No-Action Alternative ramping rate requirement in Figure 8.5-14 for three seasons summer/fall (June–October), winter (November–February), and spring (March–May) (1988–2007 period of record). The Proposed Action, when compared to the No-Action Alternative, reduces the percent of time that maximum daily ramping rates are greater than 400 cfs change per hour to 27% versus 40% in the summer/fall, 23% versus 40% in the winter, and 5% versus 27% in the spring. Note that some of the highest ramping rates in the figures are the result of storm events that are not controlled by the MFP.

8.5.1.2 Channel Geomorphology and Sediment Transport and Supply

The Proposed Action results in changes to hydrology and sediment management compared to the No-Action Alternative that could modify: (1) fine sediment in pools and gravels; (2) gravel supply; and (3) channel geometry.

Fine Sediment in Pools and Gravels

In the Middle Fork American and Rubicon rivers, the Proposed Action maintains/schedules a similar frequency of high flow events (5-year recurrence and gravel initiation of motion flows) that has occurred historically in the No-Action Alternative¹ (Tables 8.7-3a and 8.7-4a). Therefore, fine sediment in pools and spawning gravels will be maintained at the level of existing conditions (No-Action Alternative). Under existing conditions, the fine sediment volume in pools was very low (less than 8%, and often much less) (Table 8.7-2); and the percentage of fine sediments in spawning gravels was low and conducive to high spawning success (Section 7.7 – Geomorphology Resources Affected Environment) in all river reaches (Table 7.7-8).

In the small streams (Duncan, North Fork Long Canyon, South Fork Long Canyon, and mainstem Long Canyon creeks), the number days and years that the 5-year recurrence flows and the gravel initiation of motion flows occur under the Proposed Action are

¹ The No-Action Alternative does not include specified channel-maintenance flow; and while they have occurred in past operations, there is no guarantee that they would continue in the future under the No-Action Alternative.

reduced when compared to the existing conditions (No-Action Alternative) (Tables 8.7-3b and 8.7-4b). For example, the number of days of initiation motion in the Proposed Action is 50–80% of days in the No-Action Alternative. However, the number of days/years these flow events occur in the Proposed Action is sufficient to maintain low fine sediment content in pools and spawning gravels equivalent to the No-Action Alternative. In part, this is due to the low fine sediment supply present in the system (also see discussion below). The Geomorphology/Riparian Monitoring Plan (GRMP) (PCWA 2011c; SD A) in the Proposed Action will be used to document fine sediment conditions in the small streams. A report summarizing the data collected each monitoring period will be prepared by Placer County Water Agency (PCWA) and distributed to the United States Department of Agriculture-Forest Service (USDA-FS), State Water Resources Control Board (State Water Board), and California Department of Fish and Game (CDFG) for review and comment. Based on the results of the monitoring and/or comments received during the review process, PCWA and the agencies may call a meeting to discuss the results.

Gravel Supply

The Proposed Action specifies modifications to the small diversions and sediment augmentation activities at the medium reservoirs (Middle Fork Interbay and Ralston Afterbay) that will enhance sediment supply, and particularly gravels, in five bypass reaches compared to the No-Action Alternative. Gravel supply would increase downstream of the following facilities: Duncan Creek Diversion, North Fork Long Canyon Creek Diversion, South Fork Long Canyon Diversion, Middle Fork Interbay, and Ralston Afterbay. Table 7.7-11 shows the average annual amount of spawning gravel-sized sediment (75 to 2,645 cubic yards/year depending on location) that will pass downstream of these facilities in the Proposed Action rather than being captured and removed from the reaches as under the No-Action Alternative (Table 7.7-11).

Channel Geometry

The Proposed Action would maintain the channel geometry similar to the No-Action Alternative. The bypass and peaking reaches exhibit limited adjustability and they do not have any berm development under existing conditions (No-Action Alternative) (Section 7.7). The number of days and years that the 5-year recurrence flows occur for the Proposed Action and No-Action Alternative are similar for all bypass reaches except the small streams (Table 8.7-3b). The GRMP (PCWA 2011c; SD A) in the Proposed Action will be used to document channel geometry in the small streams. A report summarizing the data collected each monitoring period will be prepared by PCWA and distributed to the USDA-FS, State Water Board, and CDFG for review and comment. Based on the results of the monitoring and/or comments received during the review process, PCWA and the agencies may call a meeting to discuss the results.

8.5.1.3 Riparian Vegetation

In the Proposed Action, the riparian corridor along the bypass and peaking reach streams will be maintained or enhanced (similar vegetation composition and position

along the stream channel, better recruitment in most reaches) compared to the No-Action Alternative (see riparian impacts in Section 8.8 – Riparian Resources Environmental Effects).

8.5.1.4 Water Temperature and Dissolved Oxygen

The Proposed Action includes modifications to hydrology² (pulse flows, increased minimum instream flows) in the bypass reaches that have the potential to decrease water temperature. The Proposed Action, however, is not anticipated to affect hydrology in a manner that will modify dissolved oxygen concentrations in the bypass reaches. In the peaking reach, the Proposed Action is not anticipated to affect hydrology in a way that will affect either water temperature (i.e., daily magnitude of flow is similar) or dissolved oxygen concentrations (see discussion below).

Decreased water temperature in the bypass reaches could potentially impact the location of the transition zones of coldwater and warmer water species (cold water trout and warmer water FYLF and hardhead). Transition zones are found in the middle/lower portion of the Rubicon River and the lower portion of the Middle Fork American River below Middle Fork Interbay. Secondly, potential decreases in water temperature could delay the timing of life history processes (e.g., breeding timing) or prolong development stages (e.g., egg incubation).

Late Spring

In late spring, higher minimum instream flows in the Proposed Action have little effect on stream temperature due to cool air temperatures and accretion flows in the lower portion of the Rubicon River and Middle Fork American River below Middle Fork Interbay (AQ 4 – Water Temperature Modeling Technical Study Report [TSR] [AQ 4 – TSR], Section 6.4 [PCWA 2011d; SD B]). The Proposed Action pulse flows in May; however, because they are high magnitude and occur when the rivers are beginning to warm, they potentially can depress the water temperature or delay spring water temperature warming in these bypass reaches.

Analyses show that the Proposed Action pulse flows in wet and above normal water years decrease the river temperatures up to 4°C and delay spring water temperature warming compared to the No-Action Alternative. Water temperature sensitivity modeling of pulse flows in the lower portion of the Rubicon River (R3.7) and lower portion of the Middle Fork American River below Middle Fork Interbay (MF26) (PCWA 2011d; SD B; Figures H-27 and H-16, respectively) show that pulse flows of similar or greater magnitude to those in the Proposed Action result in water temperatures that are below the reported FYLF breeding threshold of approximately

² The effect of increased minimum flows from the South Fork Rubicon River, as a result of recent relicensing of the Upper American River Project, FERC Project No. 2101, was incorporated into both the hydrology and the boundary-condition water temperature inputs to the models in all of the water temperature analyses.

12°C (54°F). When the pulse flow begins to recede, water temperatures quickly increase above the pre-pulse water temperature.

Summer/Early Fall

The largest potential water temperature effects of higher minimum instream flows under the Proposed Action occur in the Rubicon River and Middle Fork American River below Middle Fork Interbay during the summer/early fall. Sensitivity modeling of wet years (e.g., 2006) and higher Proposed Action minimum flows indicate minor effects of the higher minimum flows on water temperature. Higher existing minimum flows and accretions in wet years minimize the effects of flow changes on water temperature. During drier water year types (critical, dry, and below normal water year types); however, when minimum flows are lower, increasing minimum flows could potentially reduce water temperature several degrees Celsius (PCWA 2011d; SD B; Section 6.4).

Under the Proposed Action, however, June–September water temperatures are very similar to the No-Action Alternative water temperatures in the Rubicon River and Middle Fork American River below Middle Fork Interbay in critical, dry, and below normal water year types. The reason for this is that there is little difference between the minimum flows of the Proposed Action and the No-Action Alternative in June–September in these water years (Figures 8.5-1a–g). The potential exception is in the Rubicon River in critical water year types when the Proposed Action summer minimum flow is 15 cfs versus 10 cfs in the No-Action Alternative (see below). In this case, water temperature in the summer decreases less than 1°C along the length of the river.

Under the Proposed Action, the locations of species-specific water temperature transition in the Middle Fork American River below Middle Fork Interbay are similar to the No-Action Alternative. The river miles where the July through August 17°C (FYLF lower optimum³ water temperature) transition and the 20°C (trout upper water temperature) transition occurs are shown in Tables 8.5-3a and 8.5-3b. The greatest difference/change in the location of the 17°C transition is 0.1 mile, and there is no change in the location of the 20°C transition.

For the Rubicon River, the location of the 17°C transition under the Proposed Action is similar to the No-Action Alternative in dry and below normal water year types but is approximately 1 mile downstream in critical year types due to the increased minimum flow of 5 cfs in the critical water year type under the Proposed Action (10 cfs existing versus 15 cfs Proposed Action). Under the Proposed Action, the 20°C water temperature transition is 1.9 to 2.58 miles downstream compared to the No-Action Alternative, depending on water year type (Tables 8.5-3b).

³ Water temperature identified by FYLF experts, Dr. Amy Lind, USDA-FS and Dr. Sarah Yarnell, Cardno ENTRIX as an approximate lower-optimum summer (July through August) water-temperature range for FYLF, which also corresponds approximately to the upstream distribution of FYLF in the Rubicon River and the Middle Fork American River.

Basin Plan

The bypass and peaking reach water temperatures in the Proposed Action are maintained compared to the water temperatures in the No-Action Alternative. The temperatures are consistent with the Basin Plan beneficial uses for cold freshwater habitat (COLD), warm freshwater habitat (WARM), and habitat for reproduction and early development of fish (CVRWQCB 2007). There is natural warming of the water along the length of the river reaches. This is consistent with the Basin Plan objectives (CVRWQCB 2007).

In the No-Action Alternative, dissolved oxygen concentrations in the bypass and peaking reaches were greater than 7.0 mg/L (Section 7.5.5.1), consistent with the Basin Plan objective of 7.0 mg/L (CVRWQCB 2007). Dissolved oxygen concentrations will not be affected by the Proposed Action; therefore, they will be maintained compared to the No-Action Alternative.

The Water Quality Monitoring Plan (WQMP) (PCWA 2011e; SD A) will periodically characterize water quality in the bypass and peaking reaches and reservoirs associated with the MFP over the term of the new license.

8.5.1.5 Wetted Perimeter

The Proposed Action specifies higher minimum instream flows and provides pulse flows that increase wetted perimeter. The effects of the minimum instream flows on wetted perimeter are quantified below for three seasons in the bypass reaches (spring, summer/fall, and winter) and for four seasons in the peaking reach (spring, summer, October outage, and winter). In the bypass reaches, the percent change in the 50% exceedance value (median) of wetted perimeter is compared to the No-Action Alternative and the Existing License Condition for each water year type. The median value of wetted perimeter was derived from a daily time series analysis using the wetted perimeter versus discharge relationships in the AQ 1 – Instream Flow TSR (AQ 1 – TSR) (PCWA 2011f; SD B). In the peaking reach, the percent change in wetted bed area at the 2D modeling sites was used instead of wetted perimeter (wetted bed area is a readily available metric from the 2D models).

The analysis shows that the Proposed Action maintains or enhances wetted perimeter/bed area in all river reaches (Tables 8.5-4a–d; Appendix C2a), as discussed below, by season.

- **Spring:** Wetted perimeter increases approximately 10% or more at the top of the bypass reaches due to the increased minimum instream flows in the Proposed Action compared to the No-Action Alternative. Spring wetted-perimeter enhancement is less in the lower end of the bypass reaches, because natural accretion augments the minimum flows such that the incremental effect of the increased minimum flow is reduced (i.e., “dilutes” the effect of the increases in minimum flow). In the peaking reach the average increase in wetted perimeter is 12%.

- **Summer:** Wetted perimeter increases approximately 5% in the Rubicon River and the Middle Fork American River reaches. In the small streams there is no change, because the small streams are typically at natural flow in the summer. In the peaking reach the average increase is 8%.
- **Winter:** Wetted perimeter increases approximately 10% in the Rubicon River and approximately 3% in the Middle Fork American River below French Meadows Reservoir bypass reach and in the peaking reach. In the Middle Fork American River below Middle Fork Interbay the wetted perimeter remains about the same. In the small streams, there are a couple of instances, water year types, where the wetted perimeter decreases slightly due to a couple of water years when historically the diversions were not operated for various reasons; but they would be in the Proposed Action. The average wetted perimeter in the small streams, however, ranges from 98 to 100% of the No Action Alternative.
- **Annual Maintenance Outage:** Wetted bed area increases in the peaking reach approximately 5% during wet, above normal, and below normal water year types due to the increased minimum flows in the Proposed Action compared to the No-Action Alternative. In dry and critical water year types, the wetted perimeter in the two alternatives are the same (i.e., both alternatives have the same minimum flows).

8.5.2 Riverine Aquatic Community

As described above, the Proposed Action modifies instream flows and physical habitat, which has the potential to affect: (1) productivity (algae and benthos); (2) habitat and species diversity; (3) the seasonal hydrograph shape and year-to-year flow variability; and (4) peaking reach flow fluctuations.

8.5.2.1 Productivity (Algae and Benthos)

The Proposed Action predominately increases or maintains wetted perimeter in the bypass and peaking reaches compared to the No-Action Alternative (Section 8.5.1.5). This increase in wetted perimeter in the Proposed Action will result in enhanced productivity (algae and benthos) compared to the No-Action Alternative. Productivity related to flow fluctuations in the peaking reach is discussed in the Peaking Reach Flow Fluctuations Section (Section 8.5.2.4).

The Benthic Macroinvertebrate Monitoring Plan (BMIMP) (PCWA 2011g; SD A) will monitor and report benthic macroinvertebrates (BMI) abundance and community metrics in selected bypass and peaking reaches associated with the MFP during the term of the new license.

8.5.2.2 Habitat and Species Diversity

The Proposed Action maintains or increases minimum instream flows in all river reaches (Section 8.5.1.1). The increases in minimum instream flow, where they occur,

result in an overall increase in total stream habitat (feet²/1000 feet) and a greater diversity of habitat types compared to the No-Action Alternative (Appendix B2; Tables 1A–12B and Figures 1–36) and (PCWA 2011f; SD B; Appendix M). Within the range of instream flows encompassed by the Proposed Action and No-Action Alternative, the amount of deeper and faster water-habitat types increase with increased flow. At the same time, the increases in minimum instream flows result in relatively small changes in the amount of shallow and slower water habitat in each of the stream reaches. The increase in deeper and faster water, while maintaining shallow and slow water habitats, increases the diversity of habitat types and is an enhancement to the overall aquatic community under the Proposed Action (e.g., Section 7.5 – Fish and Aquatic Resources Affected Environment, Table 7.5-3).

8.5.2.3 Seasonal Hydrograph Shape and Year-to-Year Flow Variability

The Proposed Action increases the dynamic nature of the flows in the bypass reaches associated with the MFP. The Proposed Action specifies higher minimum instream flows in the wetter water year types and increases instream flows during the spring of all year types compared to the No-Action Alternative. The Proposed Action will create flow regimes in each of the bypass reaches that are more naturally shaped both seasonally and between water year types, which are typically viewed as a benefit to the aquatic community (Poff et al. 1997). The Proposed Action minimum instream and pulse flow regimes are, therefore, an enhancement to the aquatic community.

8.5.2.4 Peaking Reach Flow Fluctuations

Flow fluctuations related to hydroelectric generation peaking have the potential to reduce overall productivity of rivers (Morgan et al. 1991; Cushman 1985; Gislason 1985; Moog 1993; Bain 2009) and to affect the diversity of aquatic species and/or abundance of juvenile life stages (e.g., shallow, slow water species, and life stages) (Bain et al. 1988; Kinsolving and Bain 1993; Scheidegger and Bain 1995; Bain 2009). Many aquatic species have specific habitat requirements and limited mobility (e.g., Edington 1968) and daily-flow fluctuations modify the location and amount of habitat (depths and velocities and/or location of the channel margin), thereby decreasing overall habitat quality and availability. Habitat for relatively immobile species, such as aquatic macroinvertebrates, was modeled and quantified using an effective habitat analysis (quantifies the habitat that maintains suitability continuously over a specified time period such as a day or season) (PCWA 2011f; SD B).

The Proposed Action reduces flow fluctuations in the peaking reach during the summer and spring and increases minimum flows in all seasons (Section 8.5.1.1). Increases in effective food-production habitat in the peaking reach were estimated using the effective food-production plots in Appendix B2 (Figures 43 and 50). If for example, the Proposed Action peaking ranged from 1025 cfs (maximum Oxbow Powerhouse release) to 200 cfs (Proposed Action average summer minimum instream flow) instead of 1025 to 75 cfs (75 cfs is the No-Action Alternative summer minimum flow requirement), the increase in effective food-production habitat would range from approximately 70–170% at the instream flows study sites in the peaking reach compared to the No-Action Alternative.

Similar reductions in average peaking ratio to $5.1 = 1025 \text{ cfs}/200 \text{ cfs}$ from $13.7 = 1025 \text{ cfs}/75 \text{ cfs}$ using the data in Moog (1993) would result in a 160% increase in fish biomass. The actual amount of fish biomass increase under the Proposed Action is unknown, but fish biomass is expected to be enhanced compared to the No-Action Alternative.

The Proposed Action decrease in flow fluctuations, increased minimum flows (Section 8.5.1.1), and increased wetted perimeter will also decrease the amount of varial zone area in the peaking reach (the area along the stream margin that is subject to wetting and drying resulting from hydropower peaking). Decreasing the varial zone should increase the abundance of species/life stages that use shallow slow-water habitat (e.g., benthic macroinvertebrates); and, thus, the amount of productivity would be expected to increase (Gislason 1985; Blinn et al. 1995; Cushman 1985). The reduction in flow fluctuations and increase in minimum flows under the Proposed Action will enhance productivity and shallow-slow water habitat compared No-Action Alternative (e.g., Bain 2009).

8.5.3 Riverine Fish

The Proposed Action results in changes to instream flows and water temperature, which have the potential to impact riverine fish. Potential impacts from the Proposed Action on riverine fish include changes in the following: (1) distribution; (2) growth/condition/abundance; (3) bypass reach habitat; and (4) peaking reach habitat. The discussion of riverine habitat is separated into effects in the bypass and peaking reaches because of their different flow regimes (non-peaking and peaking operations).

8.5.3.1 Fish Distribution

The Proposed Action will maintain the existing (No-Action Alternative) spatial distribution of fish species in the bypass and peaking reaches. The existing distribution of trout (rainbow trout and brown trout) and minnows (e.g., hardhead and Sacramento pikeminnow) is primarily determined by water temperature and physical barriers (e.g., waterfalls) in the MFP area (AQ 2 – Fish Population TSR [AQ 2 – TSR]; [PCWA 2011h; SD B]; Section 7.5). Trout are present throughout the bypass and peaking reaches. The upstream distribution of hardhead and Sacramento pikeminnow on the Middle Fork American River and the Rubicon River is controlled by natural barriers in the rivers upstream of Ralston Afterbay. The Proposed Action will not change barriers and will have very limited effect on water temperature (Section 8.5.1.4). A slight decrease in summer temperature in the lower Rubicon River (Table 8.5-3b) is not anticipated to affect hardhead or Sacramento pikeminnow distribution, because the magnitude of the change is small and limited to critical water years.

8.5.3.2 Growth/Condition/Abundance

Growth and condition of fish in the bypass and peaking reaches is primarily determined by water temperature and food availability (productivity). Abundance is primarily

controlled by productivity and availability of habitat. The Proposed Action maintains or enhances productivity (Section 8.5.2.1) and water temperature (Section 8.5.1.4) and enhances spawning and/or rearing habitat availability in all river reaches (see below); therefore the growth, condition, and abundance of fish will be enhanced in all river reaches compared to the No-Action Alternative.

8.5.3.3 Bypass Reach Habitat

The discussion of fish habitat in the bypass reaches is organized into: (1) rainbow trout spawning; (2) summer/fall rearing (rainbow trout and hardhead); and (3) winter fish habitat.

Rainbow Trout Spawning

The analysis of spawning habitat in the bypass reaches for the Proposed Action includes: (1) spawning flow releases analysis; (2) spawning habitat time series analysis; and (3) a discussion of scour related to spawning habitat.

SPAWNING FLOW RELEASES

Spring minimum flow releases by water year type were analyzed for the bypass reaches associated with the MFP (Table 8.5-5). Percent of maximum rainbow spawning habitat with and without flow accretion was quantified in each stream reach associated with the minimum flow release. The “without accretion” analysis was based on the percent of maximum spawning habitat at the first instream flow study site below the release location and included only the minimum flow release (no accretion). The “with accretion” analysis used a conservative measure of accretion (e.g., groundwater and surface inflow) along the length of each of the reaches (95% exceedance value by water year type) and summed the total amount of spawning habitat along the reach using habitat relationships for each of the instream flow study sites/sub-reaches (PCWA 2011f; SD B).

Based on either the “without accretion” or the “with accretion” spawning analysis, the Proposed Action enhances rainbow trout spawning habitat in all of the bypass river reaches compared to the No-Action Alternative. The “without accretion” average increase in percent of maximum spawning habitat across all bypass reaches and water year types is 38% (range 6–65%) under the Proposed Action compared to the No-Action Alternative (Table 8.5-5). The “with accretion” analysis shows the spawning habitat is maximized (100%) under the Proposed Action in the wet and above normal year types except in North and South Fork Long Canyon where it is 80% of the maximum available habitat. The average increase in total habitat for the “with accretion” analysis under the Proposed Action is 26% (range 6–61%) (Table 8.5-5). The “without accretion” and “with accretion” difference indicates that the spawning habitat benefits resulting from the Proposed Action are greatest at the tops of the bypass reaches (where no accretion exists) and are relatively smaller as natural flow accretion increases downstream.

SPAWNING HABITAT TIME SERIES

A rainbow trout spawning habitat time series analysis (1975–2007) was completed for the Proposed Action, No-Action Alternative (historical hydrology), and for the Existing License Condition operations model run (Appendix C2b). The Proposed Action and No-Action Alternatives are used below. The time series analysis calculates the habitat available on each day for the period of record during the March–May spawning period. Separate analyses were completed for the top and bottom of each subreach to account for accretion flows.

A summary of the Proposed Action median habitat values (50% exceedance) compared to the No-Action Alternative for each water year type shows that the Proposed Action results in overall large increases in spawning habitat compared to the No-Action Alternative (Tables 8.5-6a–c). Again, as in the Spawning Flow Releases section above, the spawning habitat increases occur primarily at the top of the reaches. Less increase occurs at the lower end of each reach due to higher flows from natural accretion.

In some lower reaches under the Proposed Action, the spawning habitat actually decreases for the primary rainbow trout spawning habitat suitability criteria (HSC) (PCWA 2011f; SD B), because flows exceed the optimal spawning flow as a result of accretion. The primary spawning HSC indicate that water deeper than 3 feet is not suitable for spawning. A second rainbow trout spawning analysis that makes deep water habitat suitable for spawning (“depth sensitivity HSC”) (PCWA 2011f; SD B) indicates that spawning habitat is maintained or enhanced at the bottoms of the subreaches with the increased accretion flow.

During wet water year types under the Proposed Action, the longer duration pulse flows reduce spawning habitat (using the primary spawning HSC) due to the increased flow magnitude. An example is below Middle Fork Interbay (Table 8.5-6b) where the primary spawning analysis (Proposed Action) shows decreased spawning habitat in wet years. However, using the depth sensitivity spawning HSC, there is an increase in wet year spawning habitat rather than a decrease.

SCOUR

The Proposed Action pulse flows (Section 8.5.1.2) could potentially scour any rainbow trout redds that were created prior to the pulse flow release. The magnitude and duration of pulse flows, however, are well within the range of unimpaired conditions. They are of equal or lower magnitude than would have occurred in the unimpaired condition, and have a relatively natural timing and shape. The pulse flows were designed to initiate motion of gravels (clean fines from gravels), but not excessively remove gravel substrates from the system (e.g., Wilcock et al. 1996). Therefore, the pulse flow releases are not anticipated to result in large-scale redd scour. In the event that the pulse flow releases result in some localized redd scour, it would be typical of natural stream conditions (Seegrist and Gard 1972; Lisle 1989).

Summer/Fall Rearing

A rainbow trout and hardhead rearing habitat time series analysis (1975–2007) was completed for the Proposed Action, No-Action Alternative (historical hydrology), and for the Existing License Condition operations model run (Appendix C2b).

The Proposed Action median habitat values (50% exceedance) compared to the No-Action Alternative show that the Proposed Action results in an overall enhancement of rearing habitat compared to the No-Action Alternative (Tables 8.5-6a–c). In the small streams (Table 8.5-6a), there is no change in the summer/fall rearing habitat for rainbow trout adult or juveniles because the MFP has little to no affect on flows during the summer/fall. There is little change in the hardhead rearing habitat (adult/juvenile) in the lower Rubicon River; because, with accretion, the amount of flow and habitat was relatively high in the existing conditions (No-Action Alternative) and the increased flow from the Proposed Action results in minimal change to the amount of habitat.

Winter

The Proposed Action maintains or enhances flows during the winter time period and maintains or enhances wetted perimeter compared to the No-Action Alternative (Section 8.5.1.5). The primary determinant for setting winter minimum instream flows in the Proposed Action was to maintain winter flows similar to the fall flows and thereby maintain wetted channel habitat (e.g., wetted perimeter) and productivity of the river channels. The Proposed Action enhances winter habitat compared to the No-Action Alternative.

8.5.3.4 Peaking Reach Habitat

In the peaking reach, fluctuating flows and the rate that the flows change are the primary factors affecting habitat suitability for fish. The reductions in flow fluctuations and ramping rates under the Proposed Action affect: (1) effective spawning habitat; (2) fish abundance and production; and (3) fish stranding in the peaking reach.

Effective Spawning Habitat

The Proposed Action increases minimum instream flow requirements compared to the No-Action Alternative resulting in higher instream flows that reduce potential flow fluctuations in the peaking reach during the spawning season (e.g., March–May) (Section 8.5.1.1). For example, the Proposed Action increases the minimum flow requirements 50 to 375 cfs, depending on water year type, compared to the No-Action Alternative. The Proposed Action average spawning minimum instream flow requirement (across water year types) is 290 or 215 cfs greater than the 75 cfs minimum instream flow in the No-Action Alternative. Figures 8.5-2a–g shows the hydrology in the peaking reach (minimum flows) resulting from the Proposed Action for each water year type compared to the historical impaired hydrology (minimum flows).

Using for example, the Proposed Action dry year minimum instream flow (210 cfs) (135 cfs higher than the No-Action Alternative), and assuming the Proposed Action

peaking ranges from 1025 cfs to 210 cfs instead of 1025 to approximately 100 cfs (historical flow in the No-Action Alternative, see Figure 8.5-2g), the increase in effective spawning habitat due to the Proposed Action would range from 51–160% at the instream flows study sites in the peaking reach (Appendix B2, Figures 37 and 44). The actual reduction in flow fluctuations depends on the spring base flow, water year type, and actual powerhouse operations and is difficult to assess quantitatively using “well behaved” operational model runs compared to historical flow data. However, operational model runs of the Proposed Action show potential reductions in flow fluctuations compared to the No-Action Alternative (Figures 8.5-12a–e) (Section 8.5.1.1). Also the Proposed Action higher minimum instream flows will reduce the potential flow fluctuations compared to the No-Action Alternative (Section 8.5.1.1); therefore, spawning habitat will be maintained or enhanced under the Proposed Action compared to the No-Action Alternative.

Fish Abundance and Productivity

The Proposed Action results in reductions in flow fluctuations and increased minimum flows that will increase food production (Section 8.5.2.1). Literature studies concluded that increased food production and reduced flow fluctuations or the reduction in the ratio between high and low flows (peaking discharge ratio) lead to increased fish production (e.g., Moog 1993). An approximate estimate of the increase in fish production in the peaking reach based on Moog (1993) is as high as 160% (Section 8.5.2.4). Reductions in flow fluctuations below Glen Canyon Dam resulted in relatively large increases in fish abundance (McKinney et al. 2001) and increased growth of young-of-year fish (Korman and Campana 2009). Therefore, fish abundance and production will be maintained or enhanced under the Proposed Action compared to the No-Action Alternative.

Fish Stranding

Stranding study results (PCWA 2011f; SD B) showed that some temporary trapping/isolation of fish occurred in the upper part of the peaking reach, depending on base flow. In the stranding study (PCWA 2011f; SD B), following the decline (down ramping) of daily high flow (900 cfs) to a low base flow of approximately 100 cfs, fish were observed in permanently wetted locations that were disconnected from the main channel and would not be connected until flows were increased the following day (assuming no predation of the fish occurred). One sculpin was observed stranded and dead. The down ramping rate requirement (river stage reduction per hour) under the Proposed Action (Section 8.5.1.1) is slower than the No-Action Alternative ramping rate requirement. There is a resulting decrease in the frequency of time that high ramping rates (e.g., >400 cfs/hr) would occur (Section 8.5.1.1). The decrease in ramping rates will provide fish additional time during down ramp events to move from portions of the channel that will become disconnected from the main channel or that will become dewatered. Slower down ramping rates have been shown to reduce stranding of fish (e.g., Irvine et al. 2009); however, it is possible in situations where fish are ‘trapped’ in large channel depressions or side channels that reduced ramping rates can have limited effect on ‘trapping’ of fish (Addley Pers. Obsv.). The Proposed Action reduced ramping

rate will in general be an enhancement to fish in the peaking reach by reducing the amount of temporary stranding and/or mortality compared to the No-Action Alternative.

The Proposed Action increases minimum flow requirements in the peaking reach compared to the No-Action Alternative minimum flow of 75 cfs. During above normal and wet water years, the minimum flow requirements in the Proposed Action are 150 cfs or greater than those in the No-Action Alternative all year long (including the maintenance outage). During dry and below normal water year types, the spring and summer minimum flow requirements are 150 cfs or greater than the No-Action Alternative. The Proposed Action will decrease the number of days that low flows (e.g., 75–150 cfs) will occur (Figures 8.5-2a–g). The Proposed Action also includes a maximum release from Oxbow Powerhouse of 900 cfs (Memorial Day weekend to October 15) in dry, critical, and extreme critical water year types. The reduction in magnitude of the peaking events under the Proposed Action will, when combined with the increased minimum flows, slower ramping rates; and reduced flow fluctuations (Section 8.5.1.1) also reduce temporary stranding and/or mortality compared to the No-Action Alternative.

8.5.4 Foothill Yellow-Legged Frogs

The Proposed Action changes to minimum instream flows, pulse flows, water temperature, spill flows, and operations of Oxbow Powerhouse (Section 8.5.1.1) could potentially affect FYLF distribution, abundance, and breeding timing in the bypass and peaking reaches.

8.5.4.1 Bypass Reaches

In the Middle Fork American River and Rubicon River above Ralston Afterbay, the existing upstream distribution and abundance of FYLF appears to be largely a function of water temperature (AQ 12 – Special-Status Amphibian and Aquatic Reptile TSR 2007 [AQ 12 – TSR] [Maps 12-3b and 12-4] [PCWA 2011i; SD B]). Within the range of minimum flows present in the Proposed Action and No-Action Alternative, the total amount of FYLF breeding or tadpole habitat created by the minimum flows is, in general, not viewed as a limiting factor to FYLF populations. This is because there is a large amount of habitat along the channel margins compared to the size of the FYLF populations.

Measures in the bypass reaches associated with the Proposed Action that could affect the distribution and abundance of FYLF include minimum flows, pulse flows, and spill flow ramping .

The Proposed Action was specifically designed to maintain the current No-Action Alternative upstream distribution/abundance of FYLF in the bypass reaches. During critical, dry, and below normal water year types when water temperature modeling showed that changes to minimum flows could affect water temperature (PCWA 2011d; SD B), the Proposed Action summer minimum flows were set to approximately maintain the existing location of the 17°C water temperature transition zone (No-Action

Alternative) in the Middle Fork American River below Middle Fork Interbay and Rubicon River. Minimal change to the summer water temperature in these streams is expected to occur (Section 8.5.1.4). Surveys and water temperature monitoring will be used in the Proposed Action to monitor FYLF (Foothill Yellow-Legged Frog Monitoring Plan [FYLFMP] [PCWA 2011j; SD A]) and (Water Temperature Monitoring Plan [WTMP] [PCWA 2011k; SD A]).

Pulse flows (wet and above normal water year types) in the Proposed Action are timed to start in early May prior to FYLF breeding initiation, which begins approximately mid-May through early June depending on the water year). The pulse flows also include a down ramp recession designed to the extent practicable to mimic a snowmelt run-off hydrograph. Water temperature modeling indicates that the pulse flows would cool water temperatures and delay warming (Section 8.5.1.4), which could potentially delay the onset of FYLF breeding (Section 7.5). Any potential delay as a result of the Proposed Action pulse flows is not anticipated to result in adverse impacts to FYLF breeding, because the pulse flow recedes prior to the end of the breeding season and would result in breeding timing more synchronized with natural hydrology timing (late May and June). The shape and timing of the pulse flows would also provide breeding cues to FYLF similar to natural cues to which FYLF are adapted.

Spill flows from the reservoirs (Hell Hole and French Meadows/Middle Fork Interbay) will still occur in the Proposed Action similar to the No-Action Alternative (e.g., May–July), except that the Proposed Action includes provisions for down ramping of the spills in May through July. Spill flows could disrupt breeding, destroy egg masses, and flush tadpoles downstream. During the recession of spill flows tadpoles could be stranded. The Proposed Action will down ramp spill flows, which will reduce potential stranding of tadpoles. There is also a slight reduction in the number of spill events below Hell Hole Reservoir that would affect FYLF under the Proposed Action (Table 8.5-7) compared to the No-Action Alternative. These changes to minimum flow and pulse flows (and the subsequent effects on water temperature), and changes to spill ramping under the Proposed Action are considered an enhancement to FYLF distribution/abundance compared to the No-Action Alternative.

8.5.4.2 Peaking Reach

FYLF are present and breeding occurs in the tributaries to the peaking reach of the Middle Fork American River (below Oxbow Powerhouse). However, FYLF have rarely been observed along the peaking reach and no breeding has been documented. Cold water temperatures and fluctuating flows likely are the primary factors limiting the FYLF in the peaking reach.

The Proposed Action will have negligible effects to existing FYLF populations along the peaking reach and its tributaries compared to the No-Action Alternative. Under the Proposed Action, water temperatures would remain essentially the same (too cold) (Section 8.5.1.4) and the reductions in flow fluctuations (magnitude and rate) are not anticipated to be large enough to allow FYLF breeding to occur in the peaking reach. Additionally, the Proposed Action does not affect tributaries to the peaking reach and,

thus, is not expected to affect FYLF breeding or rearing that currently occurs in the tributaries to the peaking reach.

The Sediment Management Plan (SMP) (PCWA 2011I; SD A) could result in the removal of vegetation and placement of sediment on Indian Bar and Junction Bar in the peaking reach potentially impacting FYLF. However, AP measures in the SMP specify that sediment management activities will not occur on these bars during the breeding season (May 15 to June 15) and that prior to any sediment management activity the bars will be surveyed for FYLF and any FYLF within 100 m of any sediment management activity will be translocated downstream.

8.5.5 Reservoirs and Diversion Pools

The Proposed Action includes minimum instream flow and minimum pool measures, the Hell Hole Reservoir Seasonal Storage Increase Improvement, sediment management, and fish stocking that have the potential to affect reservoir physical habitat (reservoir elevations, dissolved oxygen) and fish. The impacts of the Proposed Action on physical habitat and fish populations are discussed below based on the following reservoir size categories: (1) large reservoirs; (2) medium reservoirs; and (3) small diversion pools.

8.5.5.1 Large Reservoirs

Physical Habitat

Under the Proposed Action, the reservoir minimum pools, Hell Hole Seasonal Storage Increase Improvement, and bypass reach minimum flows and pulse flows could potentially affect physical habitat (reservoir volumes, water temperature, and dissolved oxygen) in French Meadows Reservoir and Hell Hole Reservoir. However, the nature in which the reservoirs are operated on an annual basis will not change under the Proposed Action. The reservoirs will still be used to capture winter and spring run-off to meet consumptive water supply and electrical energy demand. The following summarizes the potential impacts associated with the Proposed Action.

Minimum pool requirements for the Proposed Action and the No-Action Alternative are shown in Appendix C2c. In essence, the Proposed Action changes to the minimum pools were designed to do the following:

- Require higher water surface elevations in the wetter water year types;
- Require higher winter minimum pools in the dry and critical dry water year types;
- Reduce the winter minimum pool requirement in the wet and above normal water year types in French Meadows Reservoir (enhance capacity to accommodate spring runoff); and
- Modify the summer/winter minimum pool requirement transition time period to immediately following Labor Day instead of the end of September.

The Proposed Action also includes increasing Hell Hole Reservoir maximum normal water surface elevations by 6 feet by installing gates on the currently un-gated spillway.

Based on operation model runs for the period of record, the Proposed Action results in relatively little change in the actual operational reservoir elevations/volumes compared to Existing License Conditions and No-Action Alternative. Consequently, the Proposed Action will not affect reservoir fish habitat in French Meadows or Hell Hole reservoirs. Operations model runs showing reservoir elevations for the Proposed Action (existing demand and future demand), Existing License Conditions, and historical water surface elevations (No-Action Alternative) are shown in Appendix C2c. For example, at Hell Hole Reservoir, the Proposed Action future demand reservoir elevations would be above the current maximum reservoir elevation in 15 of 33 years for a median number of days of 24 days per year (Figures C-1 to C-6). The percent increase in reservoir depth during these days is 1.5%. At Hell Hole Reservoir during the period of record, the Proposed Action future demand average depth is 318 feet (volume 133,700 acre-feet [ac-ft]) and the Existing License Condition average depth is 321 feet (volume 135,256 ac-ft). The average percent change in depth is -1% to 1% and the percent change in volume is -1% to 2% (Table 8.5-8). At French Meadows Reservoir during the period of record (Figures C-7 to C-12), the Proposed Action future demand average depth is 171 feet (volume 76,239 ac-ft) and the Existing License Condition average depth is 178 feet (volume 82,621 ac-ft). The average percent change in is -4% to -3% and the percent change in volume is -8% to -7% (Table 8.5-8).

Existing conditions water temperature in the reservoirs (42°F in the hypolimnion to typically less than 70°F at the surface) provide good habitat for salmonid fish species (Figures 7.5-10a–b) and (PCWA 2011d; SD B). During the 2005–2008 sampling period, dissolved oxygen concentrations were typically greater than 5–6 mg/L (protective of coldwater species [Bjornn and Reiser 1991]) throughout the water column; and there was generally always large amounts of the water column, either in the epilimnion or hypolimnion, with dissolved oxygen 7.0 mg/L or greater (Basin Plan objective [CVRWQCB 2007]) (Section 7.5.10). Because the Proposed Action does not substantively affect reservoir elevations or the location of water withdrawals from the reservoirs compared to the No-Action Alternative, the Proposed Action will maintain water temperature compared to the No-Action Alternative and maintain dissolved oxygen concentrations consistent with the Basin Plan objective (CVRWQCB 2007). The Proposed Action will, therefore, maintain reservoir fish habitat compared to the No-Action Alternative.

Fish Population

Under existing conditions, French Meadows Reservoir supports rainbow and brown trout fishery and Hell Hole Reservoir supports a kokanee salmon, brown trout, and lake trout fishery (also contains rainbow trout, Sacramento sucker, and tui chub). Both reservoirs have abundant crayfish populations. Because little change is expected in the reservoir habitat (reservoir volume, water temperature, dissolved oxygen) and the reservoirs will continue to be stocked (Recreation Plan [PCWA 2011m; SD A]), the

Proposed Action is expected to maintain the fish populations (have no impact) in the reservoirs compared to the No-Action Alternative.

8.5.5.2 Medium Reservoirs

Physical Habitat

Under the Proposed Action, physical habitat in Middle Fork Interbay and Ralston Afterbay will not change compared to the No-Action Alternative. Reservoir water surface elevations will continue to be operated similar to the way they were under the No-Action Alternative, and water quality and water temperature will remain the same. Measured dissolved oxygen concentration under existing conditions (No-Action Alternative) were always greater than 7 mg/L (Section 7.5.10) (Basin Plan objective [CVRWQCB 2007]). Dissolved oxygen under the Proposed Action will be maintained compared to the No-Action Alternative and will be consistent with the Basin Plan. The reservoirs will continue to be drained to the bottom of the spill gates annually for gate inspection and maintenance.

Sediment management activities (i.e., periodic lowering of the reservoirs and removal of the sediment) will continue as under existing conditions (No-Action Alternative). The SMP (PCWA 2011; SD A) AP measures specify that during sediment removal at Ralston Afterbay, water surface elevation will be maintained at an elevation no lower than the bottom of the spill gates (1149 feet) to provide a refuge pool for fish. This is the same elevation that Ralston Afterbay is maintained at during the Project annual maintenance outage. Oxbow Powerhouse will be shut down when the reservoir elevation reaches below approximately 1167 feet elevation. The minimum flow requirement applicable to the peaking reach will flow through Ralston Afterbay and the refuge pool (e.g., over the spill gates) to maintain water quality conditions in the refuge pool. A hardhead tagging study is also specified in the SMP during the first sediment removal event at Ralston Afterbay. The tagging study will provide information regarding hardhead movements during sediment management.

The fish habitat (including habitat for hardhead) in the two reservoirs under the Proposed Action will be maintained compared to the No-Action Alternative.

Fish Population

Middle Fork Interbay supports a rainbow and brown trout fishery. Ralston Afterbay supports a rainbow and brown trout fishery and contains hardhead, Sacramento pikeminnow, and Sacramento sucker. Because no change is expected in the reservoir habitat (water temperature, reservoir volumes), the Proposed Action will have no effect on the fish populations compared to the No-Action Alternative.

8.5.5.3 Small Diversion Pools

Physical Habitat

The North Fork and South Fork Long Canyon creek diversion pools under existing conditions are essentially dewatered during the summer, with the creeks winding through a short section of pool bed under low flow conditions. The diversion pools are very small (<1.0 acres) when full. The Duncan Creek Diversion impounds water year-round, although the elevation of the pool can decrease 5 feet under low flow summer/fall conditions. When full, it is also relatively small (2.2 acres; 20 ac-ft).

Under the Proposed Action, the small stream (Duncan Creek, North Fork Long Canyon Creek, and South Fork Long Canyon Creek) diversion dams will be modified into self-cleaning, stream-bottom intakes. A concrete retaining wall and sloped wedge-wire screen will be constructed on the upstream side of the existing ogee dam/spillway of each diversion. The top (crest) of the sloped wedge-wire screen will be 1.3–3.1 feet higher than the existing dam (the bottom of the slope screen will be at the elevation of the existing dam) (Figures DC 4, NF 4, and SF 4 in Section 4.0).

Under the Proposed Action, the existing diversion pools will aggrade with sediment to near the top of the wedge-wire screen. The new diversion pools will become much shallower and more riverine. The area footprint of the new diversion pools will remain approximately similar to the existing diversion pools. The water surface of the new diversion pools will be 1.3–3.1 feet higher than the existing diversion pools (1.5, 3.0, and 3.1 feet at North Fork Long Canyon, South Fork Long Canyon, and Duncan creeks, respectively). Once the diversion pools are aggraded, sediment moving downstream will pass over the diversion screen and downstream. The reductions in pool habitat that occur at the small diversion pools under the Proposed Action are expected to have negligible effects because: (1) very little pool habitat currently exists under summer/fall low flow conditions; (2) abundant pool habitat exists throughout Duncan, North Fork Long Canyon, and South Fork Long Canyon creeks; and (3) the pool habitat that was lost would be replaced with riverine habitat.

Water temperature and dissolved oxygen in the Proposed Action in the diversion pools will be the same as the temperature and dissolved oxygen concentrations in the inflowing streams. Dissolved oxygen under existing conditions (No-Action Alternative) were 7.0 mg/L and greater. This is consistent with the Basin Plan objective of 7.0 mg/L (CVRWQCB 2007). The Proposed Action will maintain temperature and dissolved oxygen concentrations compared to the No-Action Alternative.

Fish Population

Rainbow trout are present in the Long Canyon Creek diversion pools and rainbow and brown trout are present in the Duncan Creek Diversion Pool. Fish sampling results for each of the diversion pools indicated very low numbers of fish (<15 observed) (PCWA 2011h; SD B). The physical habitat changes described above that will occur to the small diversion pools under the Proposed Action are not anticipated to affect fish

populations in Duncan, North Fork Long Canyon, and South Fork Long Canyon creeks compared to the No-Action Alternative due to the relatively minor changes to physical habitat relative to the total amount of habitat available to fish in these streams.

8.5.6 Fish Entrainment

Modifications to the small stream diversion facilities under the Proposed Action could potentially affect entrainment of fish and fish populations in these streams, and on-going operations at existing facilities that potentially result in fish entrainment could potentially affect fish populations. The locations where fish entrainment could result in fish translocation or mortality through MFP powerhouses include: (1) large reservoir tunnel intakes (French Meadows Reservoir and Hell Hole Reservoir); (2) medium reservoir tunnel intakes (Middle Fork Interbay and Ralston Afterbay); and (3) small stream diversions (Duncan Creek, North Fork Long Canyon Creek, and South Fork Long Canyon Creek).

8.5.6.1 Large Reservoirs

The Proposed Action will maintain the existing low entrainment vulnerability at the large reservoir intakes (No-Action Alternative). The minor changes in reservoir elevation that result from implementation of the Proposed Action (increased minimum flows, pulse flows, etc.) are not expected to be sufficient enough to result in altered fish behavior; and there are no facility modifications that would result in changes to the physical characteristics with which water is withdrawn from the deep water tunnel intakes. Sonar estimates of fish elevations above the deep water tunnel intakes in French Meadows Reservoir (French Meadow – Hell Hole Tunnel) and Hell Hole Reservoir (Hell Hole – Middle Fork Tunnel), 145 and 308 feet, respectively, indicate that few fish are present at the depth of the intakes (AQ 7 – Entrainment Contingency Study TSR [AQ 7 – Contingency TSR] [PCWA 2011n; SD B] and Section 7.5). In French Meadows Reservoir, 98% of the fish observed were at an elevation higher than the elevation of the tunnel intake. In Hell Hole Reservoir, 100% of the fish observed were at an elevation higher than the elevation of the intake. The maximum approach velocities at the tunnel intake grates are ≤ 1.1 feet per second. Only larger fish were present in the deep water portions of the reservoirs near the intakes (smaller fish were near the surface) and the larger fish could easily escape the vicinity of the intake. The outlet works at both of the large reservoirs are located deeper than the tunnel intakes. Entrainment vulnerability is currently low and will remain low under the Proposed Action.

8.5.6.2 Medium Reservoirs

The Proposed Action will not alter facilities or operations at Middle Fork Interbay and Ralston Afterbay and, thus, potential fish entrainment at the tunnel intakes in these medium reservoirs will be the same as in the No-Action Alternative. The amount of entrainment currently occurring is expected to be low. The direct sampling study conducted for the MFP relicensing (PCWA 2011m; SD B) was not successful due to milling of fish at the low velocity portion of the intakes and the inability of the split-beam

sonar setup to accurately track and differentiate milling fish from entrained fish and differentiate entrained debris (e.g., sticks and leaves) from fish.

PCWA has committed to further study fish entrainment at Ralston Powerhouse and Oxbow Powerhouse intakes in consultation with USDA-FS, State Water Board, and CDFG (Fish Population Monitoring Plan [FPMP] [PCWA 2011n; SD A]). Regardless of the results of future entrainment studies, the Proposed Action will result in no change to fish entrainment compared to the No-Action Alternative.

8.5.6.3 Small Diversions

In the Proposed Action the small diversions are being modified with self-cleaning 1 mm wedge-wire (inclined plane) screens to bypass sediment and other debris. This will modify the fish entrainment characteristics of the diversions (i.e., reduce potential fish entrainment).

Fish entrainment was studied at the Duncan Creek Diversion intake under its current configuration via a tagging study of approximately 1,000 fish (fall 2008–summer 2009). The study was designed to be used as a surrogate for the North Fork Long Canyon Creek and South Fork Long Canyon Creek diversion intakes as well. The timing of fry emergence in the spring was also sampled at all of the small diversions (spring 2007 and spring 2009) to illustrate the potential overlap between diversion operations and fry emergence.

Under existing conditions, a total of 0.9% (43 of an estimated 4836 fish extrapolated from the tagging study results and fish population data) of the trout population within the first 2 miles upstream of the Duncan Creek Diversion was estimated to be entrained annually (PCWA 2011m; SD B). A similar small percentage (<1%) would be expected to be entrained at the North and South Fork Long Canyon Creek diversions. The timing of emergence in each of the streams occurred after the diversions had been closed for the year (in both years studied); therefore, no entrainment of emerging fish occurred.

Under the Proposed Action, the modification of the small diversions with wedge-wire (inclined plane) screens will reduce existing entrainment. The wedge-wire diversion screens (1-mm-diameter screen openings) meet (and exceed) federal and state fish screen design criteria. As a result, any fish entrainment that is currently occurring will be eliminated. Thus, the Proposed Action will be an enhancement to fish populations compared to the No-Action Alternative.

8.5.7 Vegetation and Noxious Weed Management

The use of herbicides, surfactants, and fungicides as part of routine vegetation and noxious weed management in the vicinity of bypass and peaking reaches and large and medium reservoirs could potentially degrade water quality and aquatic habitats associated with the MFP. Refer to Section 4.5 (Vegetation and Integrated Pest Management Plan [VIPMP] [PCWA 2011p; SD A]) for a description of vegetation and noxious weed management under the Proposed Action. A summary of vegetation and

noxious weed management activities, including changes from the No-Action Alternative are provided in Tables 4.5-4 through 4.5-6.

The VIPMP includes AP measures to protect aquatic habitats by preventing the entry of potentially toxic chemicals into the Middle Fork American River Watershed. These measures include:

- Restrictions on the use of herbicides, surfactants, and fungicides within protective buffers around bypass and peaking reaches and Special Aquatic Features⁴;
- Use of herbicide formulations that are considered by the Environmental Protection Agency to be safe for aquatic areas;
- Specific measures requiring supervision of herbicide application by a licensed pest control advisor and restrictive application and disposal methods; and
- Implementation of a Water Quality Monitoring Program to evaluate the effectiveness of protective measures included in the VIPMP (PCWA 2011p; SD A).

Implementation of these measures in the Proposed Action will protect water quality and aquatic resources.

8.5.8 Existing Facility Modification, Construction of New Facilities, and Sediment Management Activities

Under the Proposed Action, sediment management activities (small diversions and medium reservoirs), modification of existing MFP facilities (e.g., dam outlet structures), and construction of new facilities (small diversion structures, gages/weirs, Hell Hole Seasonal Storage Increase) could potentially impact water quality and result in temporary loss of habitat for aquatic species during construction. Refer to the SMP (PCWA 2011I; SD A) for a description of sediment management activities and to Section 4.1 and Section 4.0 (Appendix A) for a description of facility modifications and construction projects.

Heavy equipment and ground disturbing activities during periodic sediment management activities and modifications/construction of MFP facilities required to implement the Proposed Action could potentially temporarily degrade water quality from increased turbidity, erosion, and sedimentation, and potential contamination from accidental hazardous material spills. Under the Proposed Action, the SMP (PCWA 2011I; SD A) and Section 4.0 (Appendix A) describe USDA-FS Water Quality Best Management Practices (BMPs) that will be implemented to protect water quality during

⁴ Special Aquatic Features are Intermittent and ephemeral streams, meadows, seeps, springs, and seasonal wetlands.

sediment management activities. Requirements of the BMPs include (but are not limited to): (1) development of an erosion control plan and a spill prevention, containment, and countermeasure plan; (2) timing construction activities to occur in the dry season; (3) implementation of slope stabilization measures; and (4) minimization of in-channel excavation.

Below Middle Fork Interbay, where sediment (gravel) is being placed in the channel, the SMP (PCWA 2011I; SD A) includes methods to ensure minimum instream flows and protect water quality during placement. These methods include installation of a streamflow bypass pipe from upstream of Middle Fork Interbay to a point downstream of the augmentation area and placement of a silt screen to capture fine sediment. The bypass pipe will not be removed until water quality in the adjacent stream channel meets background levels.

In the Proposed Action, sediment management and facility modification/construction activities will result in temporary loss of habitat during dewatering of small diversion pools (Duncan Creek, North Fork Long Canyon Creek, South Fork Long Canyon Creek), reservoirs (Middle Fork Interbay, Ralston Afterbay), and/or very short stream segments (immediately downstream of Middle Fork Interbay) to implement sediment management or construction activities. Measures incorporated into the SMP (PCWA 2011I; SD A) and Section 4.0 (Appendix A) will avoid loss of fish species during dewatering construction activities. These measures will include capturing all fish prior to dewatering of diversion pools or reservoirs (or prior to placement of gravel at the Middle Fork Interbay Sediment Augmentation Areas) and relocating them downstream of the construction area. Appropriate data (e.g., records of fish rescued) will be obtained during the fish rescue and provided to appropriate resource agencies following completion of the sediment management or modification/construction activities.

The SMP (PCWA 2011I; SD A) AP measures specify that during sediment removal at Ralston Afterbay, water surface elevation will be maintained at an elevation no lower than the bottom of the spill gates (1149 feet) to provide a refuge pool for fish. This is the same elevation that Ralston Afterbay is maintained at during the Project annual maintenance outage. Oxbow Powerhouse will be shut down when the reservoir elevation reaches below approximately 1167 feet elevation. The minimum flow requirement applicable to the peaking reach will flow through Ralston Afterbay and the refuge pool (e.g., over the spill gates) to maintain water quality conditions in the refuge pool. A hardhead tagging study is also specified in the SMP during the first sediment removal event at Ralston Afterbay. The tagging study will provide information regarding hardhead movements during sediment management. AP measures are also included in the SMP for FYLF at the gravel placement location downstream of Ralston Afterbay. FYLF will be surveyed prior to any sediment placement activities and if any are present in the placement area they will be translocated downstream.

Although the Proposed Action sediment management and facility modification/construction activities will result in a small temporary loss of habitat for fish species, these activities will do the following:

- Provide increased sediment supply (e.g., spawning gravels) in several bypass stream reaches (Duncan Creek, North Fork Long Canyon Creek, South Fork Long Canyon Creek, and Middle Fork American River below Middle Fork Interbay) and in the peaking reach;
- Eliminate the need for periodic sediment removal activities at the small stream diversions (Duncan Creek, North Fork Long Canyon Creek, South Fork Long Canyon Creek)
- Provide the ability to implement new minimum instream flows, new environmental pulse flows, and the down ramp of spill flows.

With implementation of the BMPs to protect water quality and minimize potential fish mortality, the Proposed Action sediment management, facility modification, and facility construction activities will be an overall enhancement to the fish and aquatic species and their habitat compared to the No-Action Alternative.

8.5.9 Special-Status Species

There are four special-status aquatic species in the MFP:

- Hardhead (*Mylopharodon conocephalus*) – FSS, CSC
- Foothill yellow-legged (FYLF) (*Rana boylei*) – FSS, CSC
- California red-legged frog (CRLF) (*Rana aurora draytonii*) – FT, CSC
- Western pond turtle (WPT) (*Actinemys marmorata*) – FSS, CSC⁵

Implementation of the Proposed Action (Section 8.5.3.2) could potentially impact the habitat or the distribution/abundance of special-status aquatic species. The impacts of the Proposed Action on FYLF and hardhead were addressed in the FYLF, riverine fish, and reservoir sections above; a brief synopsis is presented below. Potential CRLF and WPT impacts are also addressed in the following section.

8.5.9.1 Hardhead

Hardhead and other fish species and their habitat are discussed above in detail in Section 8.5.3 Riverine Fish and Section 8.5.5 Reservoirs. The Proposed Action will maintain approximately the same water temperatures and hardhead physical habitat in the lower portions of the Rubicon River and Middle Fork American River below Middle Fork Interbay, in the peaking reach, and in Ralston Afterbay as exists currently under

⁵ Where: FT = Federal Threatened Species, FSS = USDA Forest Service Sensitive Species, CSC = California Department of Fish and Game Species of Special Concern.

the No-Action Alternative. Under the Proposed Action, the distribution and abundance of hardhead in the MFP will be maintained as compared to the No-Action Alternative.

The FPMP (PCWA 2011n; SD A) and the SMP (PCWA 2011i; SD A) include tagging studies designed to understand the movements of hardhead in Ralston Afterbay. These studies will benefit the understanding of hardhead behavior and applicable hardhead management approaches.

8.5.9.2 Foothill Yellow-legged Frog

FYLF are discussed in detail above in Section 8.5.4 – Foothill Yellow-legged Frog. The Proposed Action will maintain approximately the same water temperatures and FYLF physical habitat in the Rubicon River, Middle Fork American River below Middle Fork Interbay, and peaking reach as exists currently under the No-Action Alternative. Under the Proposed Action, the distribution and abundance of FYLF will be maintained (and monitored) as compared to the No-Action Alternative.

The FYLFMP (PCWA 2011j; SD A) will characterize and report FYLF distribution and abundance in the bypass and peaking reaches associated with the MFP over the term of the license.

8.5.9.3 California Red-legged Frog

There is only one known CRLF record within 1 mile of the MFP study area. This record is a single adult CRLF that was observed on the western end of Ralston Ridge in the right-of-way below a Pacific Gas & Electric (PG&E) transmission line. No individuals have been observed at this location since 2001. This site was burned in the Ralston Ridge wildfire of 2006.

A site assessment and field studies were completed as part of the MFP relicensing to determine the presence of CRLF populations and potential habitat in the MFP (PCWA 2011i; SD B) and AQ 12 – Special-Status Amphibian and Aquatic Reptile Supplemental Report: California Red-legged Frog Protocol-Level Survey Report (AQ 12 – Supplemental TSR) (PCWA 2011q; SD B). Based on the site assessments, field surveys, and consultation with United States Fish and Wildlife Service (USFWS), it was determined that rivers and reservoirs in the MFP do not represent CRLF aquatic breeding habitat. As defined by USFWS (2002), these large rivers and reservoirs (e.g., the Middle Fork American River, Rubicon River, Hell Hole Reservoir and Ralston Afterbay) represent barriers that would restrict the northward and/or southward movement of CRLF throughout the study area.

Potential aquatic breeding habitat was identified by USFWS at only three of the off-channel ponds at Horseshoe Bar (ponds C, E, and F) (PCWA 2011i; SD B). As requested by USFWS, protocol-level surveys were completed at these sites. No CRLF were observed (PCWA 2011q; SD B). Potential CRLF upland habitats in the MFP would include riparian areas, grasslands that contain seeps and springs (USFWS 2002), or deeply shaded forest streams immediately adjacent to aquatic breeding areas

(PCWA 2011q; SD B). However, any upland habitat that does not contain significant barriers to dispersal may potentially be used by CRLF (USFWS 2002).

Under the Proposed Action, no routine MFP operations or maintenance activities will impact areas identified by USFWS as potential aquatic breeding habitat or adjacent upland areas. Additionally, CRLF are not known to exist in the MFP. Therefore, implementation of the Proposed Action will not affect CRLF breeding habitat or individuals.

8.5.9.4 Western Pond Turtle

WPT were observed downstream of Ralston Afterbay in the peaking reach and in the Horseshoe Bar ponds. WPT also were observed in a pond in Wallace Canyon (a tributary to Long Canyon Creek); however, Wallace Canyon is not affected by the MFP. Although, habitat exists for WPT in the bypass reaches and in the MFP reservoirs (Section 7.5), WPT were not observed during field studies in any other portions of the MFP.

The Proposed Action minimum instream flows and pulse flows in the bypass reaches create more natural shaped hydrographs within water years (e.g., higher spring flows) and between water year types (higher flows in wetter water year types) as compared to the No-Action Alternative. In the peaking reach, the Proposed Action reduces flow fluctuations and modifies minimum instream flows to create more natural shaped hydrographs compared to the No-Action Alternative. In addition, the Proposed Action will increase wetted perimeter (Section 8.5.1.5) and enhance productivity (algae and benthos), increase habitat diversity (Section 8.5.2.2), and maintain the river channels and create a more natural sediment supply (Section 8.5.1.2). These changes will maintain or enhance WPT and WPT habitat in the bypass and peaking reaches compared to the No-Action Alternative. Additionally, implementation of the Proposed Action will not affect the Horseshoe Bar ponds.

In the MFP reservoirs, the Proposed Action will maintain the reservoir physical habitat (water surface elevations, water quality, water temperature) (Section 8.5.5) similar to current conditions (No-Action Alternative). Therefore, the Proposed Action will maintain WPT potential habitat in reservoirs compared to the No-Action Alternative.

The Western Pond Turtle Monitoring Plan (WPTMP) (PCWA 2011r; SD A) will periodically characterize and report WPT distribution and abundance in the bypass and peaking reaches and Project reservoirs associated with the MFP during the term of the new license.

8.5.10 Conclusions—Fish and Aquatic Resources

Overall, the Proposed Action enhances fish and aquatic resources compared to the No-Action Alternative. For each of the individual fish and aquatic resources analyzed, the Proposed Action either maintains or enhances the resource. In some cases where the resources are maintained (e.g., sediment initiation of motion flows), the Proposed Action ensures that the resources will be maintained by scheduling flow releases that may

have historically occurred under the No-Action Alternative, but are not guaranteed to occur in the future for the No-Action Alternative (i.e., not a requirement in the existing Federal Energy Regulatory Commission [FERC] License). General resource categories and the effects of the Proposed Action on the resources compared to the No-Action Alternative are listed below:

- River physical aquatic habitat (channel geomorphology, riparian vegetation, and water temperature) will all be maintained/scheduled;
- General river aquatic community resources (e.g., productivity) will be enhanced;
- Fish resources in the bypass and peaking reaches will be enhanced;
- FYLF resources will be maintained or enhanced;
- Reservoir physical habitat and fish resources will be maintained; and
- Special-status species will be protected and maintained.

Figures 8.5-15a–g present a graphical summary, by river reach, of the specific fish and aquatic resources that are maintained or enhanced under the Proposed Action:

8.5.11 Unavoidable Adverse Effects

There are no unavoidable adverse effects to fish and aquatic resources under the Proposed Action.

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TABLES

Table 8.5-1. Number of Days, Years and Average Number of Days May Pulse Flows Occur by Water Year Type under the Proposed Action and No-Action Alternative.

Site / Release Location	Pulse Flow Threshold (cfs)	WYT	Proposed Action				No Action			
			Total Number of Days	Average Number of Days ¹	Average Number of Days in Event Years ²	Number of Years ³	Total Number of Days	Average Number of Days ¹	Average Number of Days in Event Years ²	Number of Years ³
Small Streams										
Duncan Creek	149	Wet	54	5	8	7 / 10	29	3	6	5 / 10
		Abv Normal	24	4	5	5 / 6	12	2	6	2 / 6
		Blw Normal	0	0	0	0 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	78	---	---	12/33	41	---	---	7/33
North Fork Long Canyon	29	Wet	57	6	11	6 / 10	89	9	18	5 / 10
		Abv Normal	25	4	4	6 / 6	0	0	0	0 / 6
		Blw Normal	0	0	0	0 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	82	---	---	12/33	89	---	---	5/33
South Fork Long Canyon	40	Wet	74	7	9	8 / 10	107	11	21	5 / 10
		Abv Normal	30	5	5	6 / 6	0	0	0	0 / 6
		Blw Normal	0	0	0	0 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	104	---	---	12/33	107	---	---	5/33
Middle Fork American River										
Middle Fork American River below French Meadows	343	Wet	90	9	9	10 / 10	47	5	9	5 / 10
		Abv Normal	24	4	4	6 / 6	22	4	11	2 / 6
		Blw Normal	3	1	2	2 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	117	---	---	18/33	69	---	---	7/33
Middle Fork American River below Middle Fork Interbay	450	Wet	146	15	14	10 / 10	81	8	14	6 / 10
		Abv Normal	28	5	5	6 / 6	7	1	7	1 / 6
		Blw Normal	1	0	1	1 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	175	---	---	17/33	88	---	---	7/33
Rubicon River below Hell Hole Dam										
Rubicon River below Hell Hole Dam	200	Wet	65	31	22	10 / 10	59	6	20	3 / 10
		Abv Normal	6	19	6	6 / 6	6	2	6	1 / 6
		Blw Normal	0	0	0	0 / 6	0	0	0	0 / 6
		Dry	0	0	0	0 / 5	0	0	0	0 / 5
		Critical	0	0	0	0 / 6	0	0	0	0 / 6
		Total	71	---	---	16/33	65	---	---	7/33

¹Total number of pulse flow days / number of years in water year type.

²Number of pulse flow events / number of years that pulse flows occurred in water year type.

³Number of years pulse flows occurred / number of years in water year type.

Table 8.5-2. Proposed Action 1-foot-per-hour Stage Change at Instream Flow Study Sites and Corresponding Stage Change at Middle Fork American River Gage (No-Action Alternative FERC License ≤ 3 feet per hour).

Middle Fork Gage Starting Flow (cfs)	Up Ramp			Down Ramp		
	Flow Change Increment (cfs/hr)	Ending Flow (cfs)	Middle Fork Gage Stage Change (ft/hr)	Flow Change Increment (cfs/hr)	Ending Flow (cfs)	Middle Fork Gage Stage Change (ft/hr)
75	272	347	1.94	-158	<75	-2.05
100	297	397	1.87	-161	<75	-2.06
150	346	496	1.77	-175	<75	-2.06
200	393	593	1.71	-193	<75	-2.02
250	431	681	1.66	-217	<75	-1.99
300	455	755	1.58	-245	<75	-1.98
350	487	837	1.54	-274	76	-1.94
400	532	932	1.54	-299	101	-1.86
450	568	1018	1.53	-322	128	-1.80
500	591	1091	1.49	-348	152	-1.77
550	614	1164	1.47	-373	177	-1.74
600	637	1237	1.44	-396	204	-1.71
650	652	1302	1.41	-421	229	-1.70
700	667	1367	1.39	-437	263	-1.64
750	681	1431	1.37	-453	297	-1.59
800	696	1496	1.35	-470	330	-1.55
850	705	1555	1.32	-493	357	-1.54
900	714	1614	1.30	-517	383	-1.54
950	723	1673	1.27	-540	410	-1.54
1000	732	1732	1.25	-560	440	-1.53
1050	741	1791	1.23	-578	472	-1.51
1100	748	1848	1.22	-594	506	-1.49
1150	756	1906	1.20	-610	540	-1.47
1200	764	1964	1.19	-626	574	-1.46
1250	773	2023	1.18	-640	610	-1.44
1300	787	2087	1.17	-651	649	-1.41
1350	800	2150	1.16	-663	687	-1.40
1400	814	2214	1.15	-674	726	-1.38
1450	827	2277	1.14	-685	765	-1.36
1500	841	2341	1.13	-696	804	-1.35
1550	846	2396	1.12	-704	846	-1.32
1600	851	2451	1.10	-712	888	-1.30
1650	856	2506	1.09	-720	930	-1.28
1700	860	2560	1.07	-727	973	-1.26
1750	864	2614	1.05	-735	1015	-1.25
1800	867	2667	1.04	-742	1058	-1.23
1850	871	2721	1.02	-749	1101	-1.22
1900	875	2775	1.01	-755	1145	-1.21
1950	879	2829	0.99	-762	1188	-1.19
2000	882	2882	0.98	-768	1232	-1.18
Average Between 75-1000 cfs			1.50			-1.77

Table 8.5-3a. Middle Fork American River below Middle Fork Interbay Water Temperature Profiles (July–August) and the Corresponding River Mile at which the Water Temperature Reaches 17°C and 20°C.

Modeled Temperature Profile	17°C		20°C	
	River Mile	% Difference (mi)	River Mile	% Difference (mi)
Critical				
No-Action Alternative (12 cfs)	22.84	-	20.73	-
Proposed Action (12 cfs)	22.84	0% (0.0)	20.73	0% (0.0)
Dry				
No-Action Alternative (23 cfs or Natural Inflow) (Typically about 18 cfs)	22.07	-	NA ¹	-
Proposed Action (18 cfs)	22.07	0% (0.0)	18.92	-
Below Normal				
No-Action Alternative (23 cfs)	21.16	-	NA ¹	-
Proposed Action (24 cfs)	21.06	0.5% (0.1)	NA ¹	-

¹Not applicable because the temperature doesn't reach 20°C.

Table 8.5-3b. Rubicon River Water Temperature Profiles (July–August) and the Corresponding River Mile at which the Water Temperature Reaches 17°C and 20°C.

Modeled Temperature Profile	17°C		20°C	
	River Mile	% Difference (mi)	River Mile	% Difference (mi)
Critical				
No-Action Alternative (10 cfs)	22.68	-	19.42	-
Proposed Action (15 cfs)	21.66	4.5% (1.02)	17.52	9.8% (1.9)
Dry				
No-Action Alternative (20 cfs)	21.33	-	16.25	-
Proposed Action (20 cfs)	21.28	0.2% (0.05)	14.89	8.4% (1.36)
Below Normal				
No-Action Alternative (20 cfs)	21.33	-	16.25	-
Proposed Action (20 cfs)	21.33	0% (0.0)	13.67	15.9% (2.58)

Table 8.5-4a. Small Streams Wetted Perimeter Time Series Summary Comparing the 50% Exceedance Wetted Perimeter of the Proposed Action to the Existing License Condition and No-Action Wetted Perimeter.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Water Year Type	Proposed Action 50% Habitat Exceedance					
			Summer/Fall Wetted Perimeter		Winter Wetted Perimeter		Spring Wetted Perimeter	
			% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action
Duncan Creek								
Duncan Creek below Diversion	D6.3 Top	All Years	100%	101%	97%	98%	113%	109%
		Wet	100%	101%	100%	95%	120%	112%
		Ab Norm	100%	100%	90%	90%	120%	110%
		Bl Norm	100%	101%	100%	100%	114%	110%
		Dry	100%	100%	100%	100%	108%	106%
	Critical	100%	100%	100%	101%	107%	109%	
	D6.3 Bottom	All Years	100%	100%	100%	99%	104%	103%
		Wet	100%	100%	100%	99%	105%	103%
		Ab Norm	100%	100%	100%	99%	104%	101%
		Bl Norm	100%	100%	100%	99%	103%	102%
Dry		100%	100%	100%	101%	103%	102%	
Critical	100%	101%	100%	100%	103%	104%		
North Fork Long Canyon Creek								
North Fork Long Canyon Creek below Diversion	NFLC1.9	All Years	100%	100%	100%	102%	119%	118%
		Wet	100%	100%	100%	93%	127%	117%
		Ab Norm	100%	100%	100%	98%	127%	126%
		Bl Norm	100%	100%	100%	102%	125%	125%
		Dry	100%	100%	100%	100%	116%	116%
Critical	100%	100%	100%	100%	103%	110%		
South Fork Long Canyon Creek								
South Fork Long Canyon Creek below Diversion	SFLC2.3	All Years	100%	100%	99%	101%	111%	111%
		Wet	100%	100%	100%	99%	113%	113%
		Ab Norm	100%	100%	95%	93%	113%	113%
		Bl Norm	100%	100%	100%	102%	111%	113%
		Dry	100%	100%	100%	100%	106%	107%
Critical	100%	100%	100%	100%	102%	104%		
Long Canyon Creek								
Long Canyon Creek below North and South Fork Long Canyon Creek	LC9.0 Top	All Years	100%	100%	100%	99%	110%	109%
		Wet	100%	100%	100%	96%	106%	101%
		Ab Norm	100%	100%	100%	96%	106%	105%
		Bl Norm	100%	100%	100%	100%	110%	110%
		Dry	100%	100%	100%	100%	110%	110%
	Critical	100%	100%	100%	100%	108%	108%	
	LC9.0 Bottom	All Years	100%	100%	100%	99%	102%	102%
		Wet	100%	100%	100%	99%	102%	101%
		Ab Norm	100%	100%	100%	98%	102%	102%
		Bl Norm	100%	100%	100%	100%	102%	102%
Dry		100%	100%	100%	99%	103%	103%	
Critical	100%	100%	100%	100%	103%	104%		
Values greater than 5%.								
Values less than 5%.								

Table 8.5-4b. Middle Fork American River Wetted Perimeter Time Series Summary Comparing the 50% Exceedance Wetted Perimeter of the Proposed Action to the Existing License Condition and No-Action Wetted Perimeter.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Water Year Type	Proposed Action 50% Habitat Exceedance						
			Summer/Fall Wetted Perimeter		Winter Wetted Perimeter		Spring Wetted Perimeter		
			% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	
Middle Fork American River Upstream of Middle Fork Interbay									
Middle Fork American River below French Meadows Reservoir	MF44.7 Top	All Years	104%	105%	104%	104%	106%	106%	
		Wet	106%	107%	106%	104%	113%	109%	
		Ab Norm	104%	104%	104%	104%	113%	109%	
		BI Norm	102%	104%	102%	103%	106%	106%	
		Dry	101%	102%	104%	104%	106%	106%	
		Critical	108%	107%	101%	102%	104%	104%	
	MF44.7 Bottom	All Years	105%	106%	103%	103%	106%	106%	
		Wet	105%	106%	103%	102%	107%	105%	
		Ab Norm	105%	106%	102%	102%	106%	105%	
		BI Norm	103%	104%	102%	102%	102%	104%	
		Dry	102%	103%	105%	105%	102%	102%	
		Critical	106%	106%	103%	104%	104%	104%	
	Middle Fork American River Immediately above Middle Fork Interbay	MF36.2 Top	All Years	103%	102%	101%	99%	103%	100%
			Wet	103%	101%	100%	98%	103%	100%
Ab Norm			102%	102%	101%	98%	103%	100%	
BI Norm			102%	101%	101%	98%	101%	100%	
Dry			102%	101%	102%	101%	102%	100%	
Critical			103%	102%	101%	100%	104%	102%	
MF36.2 Bottom		All Years	102%	102%	101%	98%	102%	100%	
		Wet	102%	102%	100%	98%	103%	100%	
		Ab Norm	102%	102%	101%	98%	103%	100%	
		BI Norm	102%	101%	101%	98%	101%	100%	
		Dry	102%	101%	102%	101%	101%	99%	
		Critical	103%	102%	101%	100%	104%	102%	
Middle Fork American River from Middle Fork Interbay to Ralston Afterbay									
Middle Fork American River between Middle Fork Interbay and Ralston Afterbay		MF26.2 Top	All Years	103%	102%	102%	101%	110%	109%
	Wet		107%	106%	102%	99%	143%	104%	
	Ab Norm		102%	102%	102%	102%	118%	117%	
	BI Norm		102%	101%	101%	101%	110%	109%	
	Dry		100%	99%	102%	102%	102%	102%	
	Critical		100%	99%	101%	100%	102%	101%	
	MF26.2 Bottom	All Years	103%	102%	101%	99%	103%	102%	
		Wet	103%	102%	102%	100%	106%	105%	
		Ab Norm	103%	102%	100%	98%	103%	104%	
		BI Norm	102%	101%	101%	101%	101%	102%	
		Dry	101%	99%	100%	100%	103%	101%	
		Critical	102%	100%	102%	100%	102%	101%	
	Values greater than 5%.								
	Values less than 5%.								

Table 8.5-4c. Rubicon River Wetted Perimeter Time Series Summary Comparing the 50% Exceedance Wetted Perimeter of the Proposed Action to the Existing License Condition and No-Action Wetted Perimeter.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Water Year Type	Proposed Action 50% Habitat Exceedance						
			Summer/Fall Wetted Perimeter		Winter Wetted Perimeter		Spring Wetted Perimeter		
			% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	
Rubicon River									
Rubicon River below Hell Hole Reservoir	R25.7 Top	All Years	104%	104%	114%	111%	123%	116%	
		Wet	106%	106%	114%	107%	130%	117%	
		Ab Norm	106%	106%	114%	112%	128%	120%	
		Bl Norm	100%	100%	110%	109%	123%	118%	
		Dry	100%	100%	114%	112%	120%	114%	
	Critical	105%	103%	110%	108%	120%	117%		
	R25.7 Bottom	All Years	103%	103%	104%	104%	114%	113%	
		Wet	106%	105%	105%	102%	125%	124%	
		Ab Norm	105%	106%	104%	103%	119%	117%	
		Bl Norm	100%	100%	105%	106%	111%	110%	
		Dry	100%	100%	109%	108%	110%	108%	
	Critical	105%	102%	110%	109%	117%	114%		
	Rubicon River Near Ellicott Bridge	R20.9 Top	All Years	102%	102%	103%	102%	106%	106%
			Wet	103%	102%	102%	101%	104%	105%
Ab Norm			103%	103%	102%	101%	108%	108%	
Bl Norm			100%	100%	102%	101%	104%	103%	
Dry			100%	100%	104%	103%	103%	103%	
Critical		104%	100%	104%	104%	107%	106%		
R20.9 Bottom		All Years	101%	101%	101%	101%	104%	104%	
		Wet	102%	101%	101%	100%	102%	102%	
		Ab Norm	101%	101%	101%	101%	103%	103%	
		Bl Norm	101%	100%	101%	101%	101%	101%	
		Dry	100%	100%	101%	101%	103%	102%	
Critical		103%	99%	102%	102%	103%	103%		
Rubicon River Near Ralston Afterbay		R3.5 Top	All Years	102%	102%	101%	101%	103%	103%
			Wet	102%	101%	100%	100%	101%	101%
	Ab Norm		102%	102%	100%	100%	102%	102%	
	Bl Norm		101%	100%	101%	100%	101%	101%	
	Dry		100%	100%	102%	101%	102%	102%	
	Critical	102%	99%	103%	102%	104%	104%		
	R3.5 Bottom	All Years	102%	102%	101%	101%	103%	103%	
		Wet	102%	101%	100%	100%	101%	101%	
		Ab Norm	102%	102%	100%	100%	103%	102%	
		Bl Norm	101%	100%	101%	100%	101%	101%	
		Dry	100%	100%	102%	101%	102%	102%	
	Critical	102%	99%	103%	102%	104%	104%		
	Values greater than 5%.								
	Values less than 5%.								

Table 8.5-4d. Middle Fork American River Peaking Reach Percent Change in Wetted Bed Area Based on the Existing License Condition Minimum Flows versus Proposed Action Minimum Flows.

Instream Flow Study Reaches / Sites	Water Year Type	Proposed Action			
		Summer Wetted Perimeter	Outage Wetted Perimeter	Winter Wetted Perimeter	Spring Wetted Perimeter
		% of No Action and ELC	% of No Action and ELC	% of No Action and ELC	% of No Action and ELC
Middle Fork American River					
Middle Fork American River below Ralston Afterbay	All Years	108%	103%	104%	112%
	Wet	113%	106%	108%	118%
	Ab Norm	111%	106%	106%	116%
	Bl Norm	108%	104%	104%	113%
	Dry	106%	100%	102%	109%
	Critical	103%	100%	100%	104%
Values greater than 5.					
Values less than 5%.					

Table 8.5-5. Rainbow Trout Spawning Weighted Usable Area under Proposed Action and No-Action Alternative Spring Minimum Flows.

Site / Release Location	WYT	Spawning Minimum Flow (cfs)		Resulting Weighted Usable Area (% Max)			
		Proposed Action	No Action	Rainbow Trout Spawning Without Accretion ¹		Rainbow Trout Spawning With Accretion ²	
				Proposed Action	No Action	Proposed Action	No Action
Small Streams							
Duncan Creek	Wet	24	8	97	53	100	77
	Abv Normal	24		97		100	80
	Blw Normal	17		87		95	76
	Dry	14	80	89	72		
	Critical	13	4	76	32	82	43
North Fork Long Canyon Creek	Wet	11.5	2	80	19	80	19
	Abv Normal	11.5		80		80	19
	Blw Normal	10		74		74	19
	Dry	10	74	74	19		
	Critical	6	2	52	19	52	19
South Fork Long Canyon Creek	Wet	14	5	81	43	81	43
	Abv Normal	14		81		81	43
	Blw Normal	12		75		75	43
	Dry	12	75	75	43		
	Critical	6	2.5	49	25	49	25
Long Canyon Creek	Wet	NA	NA	NA	NA	91	68
	Abv Normal					92	70
	Blw Normal					87	64
	Dry					87	63
	Critical					74	42
Middle Fork American River below French Meadows							
River Mile 47.1 - 36.0	Wet	20	8	96	63	100	89
	Abv Normal	20		96		100	93
	Blw Normal	13		81		95	88
	Dry	13	81	93	84		
	Critical	11	4	76	42	83	61
Middle Fork American River below Middle Fork Interbay							
River Mile 35.5 - 26.0	Wet	65	23	98	69	100	88
	Abv Normal	65		98		100	88
	Blw Normal	40		88		95	84
	Dry	27	75	76	70		
	Critical	18	12	60	45	62	48
Rubicon River below Hell Hole Dam							
River Mile 28.8 - 14.0	Wet	60	10	99	34	100	76
	Abv Normal	55		97		100	81
	Blw Normal	42		88		96	69
	Dry	35	80	92	65		
	Critical	31	6	75	23	82	44

¹Resulting percent of maximum weighted usable area calculated without accretion at the Instream Flow Study Site nearest to the release point.

²Resulting percent of maximum weighted usable area calculated using 95% exceedance accretion and all Instream Flow Study Sites within the reach (total reach spawning habitat).

Table 8.5-6a. Small Streams Habitat Summary Table Comparing the 50% Habitat Exceedance of the Proposed Action Habitat to the Existing License Conditions and No-Action Alternative Habitat Values.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Biological Reach Management Species	Water Year Type	Proposed Action 50% Exceedance							
				Rainbow Trout Spawning		Rainbow Trout Spawning Depth Sensitivity		Rainbow Trout Adult		Rainbow Trout Juvenile	
				% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action
Duncan Creek											
Duncan Creek below Diversion	D6.3 Top	Rainbow Trout	All Years	136%	118%	156%	125%	100%	100%	100%	100%
			Wet	142%	117%	187%	142%	100%	103%	100%	102%
			Ab Norm	144%	110%	187%	129%	100%	100%	100%	100%
			BI Norm	144%	119%	161%	128%	100%	100%	100%	100%
			Dry	130%	114%	139%	119%	100%	100%	100%	100%
			Critical	126%	130%	132%	136%	100%	102%	100%	101%
	D6.3 Bottom	Rainbow Trout	All Years	95%	99%	102%	101%	100%	101%	100%	100%
			Wet	93%	96%	105%	103%	100%	101%	100%	101%
			Ab Norm	92%	96%	104%	102%	100%	100%	100%	100%
			BI Norm	96%	98%	102%	101%	100%	100%	100%	100%
			Dry	98%	100%	102%	102%	100%	100%	100%	100%
			Critical	102%	103%	106%	107%	100%	100%	100%	100%
North Fork Long Canyon Creek											
North Fork Long Canyon Creek below Diversion	NFLC1.9	Rainbow Trout	All Years	232%	212%	236%	216%	100%	100%	100%	100%
			Wet	287%	128%	297%	130%	100%	100%	100%	100%
			Ab Norm	287%	248%	297%	256%	100%	100%	100%	100%
			BI Norm	271%	264%	278%	271%	100%	100%	100%	100%
			Dry	202%	190%	205%	193%	100%	100%	100%	100%
			Critical	120%	133%	120%	133%	100%	100%	100%	100%
South Fork Long Canyon Creek											
South Fork Long Canyon Creek below Diversion	SFLC2.3	Rainbow Trout	All Years	159%	159%	161%	161%	100%	100%	100%	100%
			Wet	169%	152%	172%	149%	100%	100%	100%	100%
			Ab Norm	169%	164%	172%	167%	100%	100%	100%	100%
			BI Norm	159%	167%	161%	170%	100%	100%	100%	100%
			Dry	135%	135%	136%	136%	100%	100%	100%	100%
			Critical	111%	127%	111%	128%	100%	100%	100%	100%
Long Canyon Creek											
Long Canyon Creek below North and South Fork Long Canyon Creek	LC9.0 Top	Rainbow Trout	All Years	106%	108%	109%	110%	100%	100%	100%	100%
			Wet	103%	109%	105%	108%	100%	100%	100%	100%
			Ab Norm	103%	102%	106%	104%	100%	100%	100%	100%
			BI Norm	108%	107%	112%	110%	100%	100%	100%	100%
			Dry	107%	107%	110%	109%	100%	100%	100%	100%
			Critical	111%	115%	112%	116%	100%	100%	100%	100%
	LC9.0 Bottom	Rainbow Trout	All Years	94%	96%	100%	100%	100%	100%	100%	100%
			Wet	96%	102%	96%	102%	100%	100%	100%	100%
			Ab Norm	96%	97%	96%	97%	100%	100%	100%	100%
			BI Norm	92%	93%	101%	101%	100%	100%	100%	100%
			Dry	100%	101%	102%	102%	100%	100%	100%	100%
			Critical	104%	104%	106%	106%	100%	100%	100%	100%

Values greater than 5%

Values less than 5%

Values greater than 5% in reaches where rainbow trout are not the primary target species

Values less than 5% in reaches where rainbow trout are not the primary target species

Table 8.5-6b. Middle Fork American River Habitat Summary Table Comparing the 50% Habitat Exceedance of the Proposed Action Habitat to the Existing License Conditions and No-Action Habitat Values.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Biological Reach Management Species	Water Year Type	Proposed Action 50% Exceedance											
				Rainbow Trout Spawning		Rainbow Trout Spawning Depth Sensitivity		Rainbow Trout Adult		Rainbow Trout Juvenile		Hardhead Juvenile		Hardhead Adult	
				% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action
Middle Fork American River Upstream of Middle Fork Interbay															
Middle Fork American River below French Meadows Reservoir	MF44.7 Top	Rainbow Trout	All Years	118%	118%	125%	118%	123%	129%	105%	108%	NA	NA		
			Wet	128%	123%	151%	130%	132%	139%	107%	109%				
			Ab Norm	125%	112%	151%	125%	132%	133%	107%	107%				
			Bl Norm	118%	113%	125%	118%	114%	121%	104%	106%				
			Dry	118%	118%	125%	125%	107%	112%	102%	104%				
	Critical	111%	115%	115%	120%	164%	161%	123%	122%						
	MF44.7 Bottom	Rainbow Trout	All Years	95%	97%	101%	102%	119%	124%	104%	105%	NA	NA		
			Wet	79%	83%	101%	101%	117%	121%	104%	104%				
			Ab Norm	83%	90%	101%	100%	116%	121%	103%	104%				
			Bl Norm	97%	97%	101%	101%	114%	119%	103%	104%				
Dry			100%	100%	102%	102%	111%	115%	102%	103%					
Critical	101%	102%	106%	107%	137%	150%	113%	117%							
Middle Fork American River Immediately above Middle Fork Interbay	MF36.2 Top	Rainbow Trout	All Years	94%	104%	101%	101%	113%	109%	105%	104%	NA	NA		
			Wet	73%	102%	100%	103%	112%	105%	104%	103%				
			Ab Norm	77%	113%	99%	102%	110%	105%	103%	103%				
			Bl Norm	97%	107%	101%	101%	111%	107%	103%	102%				
			Dry	98%	102%	103%	99%	113%	109%	104%	103%				
	Critical	102%	103%	107%	101%	118%	116%	106%	105%						
	MF36.2 Bottom	Rainbow Trout	All Years	90%	102%	100%	101%	112%	108%	104%	103%	NA	NA		
			Wet	71%	100%	98%	102%	111%	104%	102%	101%				
			Ab Norm	74%	113%	98%	101%	108%	105%	102%	102%				
			Bl Norm	96%	109%	101%	101%	108%	105%	103%	102%				
Dry			97%	102%	102%	100%	113%	109%	104%	103%					
Critical	101%	103%	105%	101%	117%	113%	105%	104%							
Middle Fork American River from Middle Fork Interbay to Ralston Afterbay															
Middle Fork American River between Middle Fork Interbay and Ralston Afterbay	MF26.2 Top	Rainbow Trout	All Years	108%	106%	134%	130%	113%	108%	104%	102%	101%	101%	106%	104%
			Wet	79%	79%	162%	104%	133%	129%	108%	107%	103%	103%	115%	113%
			Ab Norm	133%	129%	162%	158%	108%	108%	102%	102%	101%	101%	104%	104%
			Bl Norm	128%	125%	134%	130%	109%	103%	103%	101%	101%	100%	104%	102%
			Dry	108%	106%	110%	107%	98%	91%	99%	97%	100%	98%	99%	96%
	Critical	105%	103%	106%	103%	100%	93%	100%	98%	100%	99%	100%	97%		
	MF26.2 Bottom	Hardhead	All Years	100%	98%	102%	100%	111%	108%	102%	101%	101%	100%	106%	104%
			Wet	69%	78%	99%	103%	113%	108%	102%	101%	101%	101%	107%	104%
			Ab Norm	95%	93%	101%	101%	108%	108%	101%	101%	102%	101%	104%	104%
			Bl Norm	101%	101%	101%	102%	106%	103%	101%	101%	101%	100%	103%	101%
Dry			102%	102%	103%	100%	102%	92%	101%	98%	100%	100%	101%	96%	
Critical	102%	101%	103%	101%	108%	104%	103%	101%	101%	101%	101%	103%	102%		

Values greater than 5%

Values less than 5%

Values greater than 5% in reaches where rainbow trout are not the primary target species

Values less than 5% in reaches where rainbow trout are not the primary target species

Table 8.5-6c. Rubicon River Habitat Summary Table Comparing the 50% Habitat Exceedance of the Proposed Action Habitat to the Existing License Conditions and No-Action Habitat Values.

Instream Flow Study Reaches / Sites	Top / Bottom Reach by Site	Biological Reach Management Species	Water Year Type	Proposed Action 50% Exceedance											
				Rainbow Trout Spawning		Rainbow Trout Spawning Depth Sensitivity		Rainbow Trout Adult		Rainbow Trout Juvenile		Hardhead Juvenile		Hardhead Adult	
				% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action	% of ELC	% of No Action
Rubicon River															
Rubicon River below Hell Hole Reservoir	R25.7 Top	Rainbow Trout	All Years	212%	177%	259%	204%	115%	115%	105%	105%	NA	NA		
			Wet	251%	163%	307%	181%	128%	124%	108%	107%				
			Ab Norm	251%	222%	307%	254%	128%	128%	108%	108%				
			Bl Norm	230%	216%	259%	242%	100%	100%	100%	100%				
			Dry	212%	161%	233%	174%	100%	100%	100%	100%				
	Critical	212%	187%	233%	205%	157%	100%	122%	100%						
	R25.7 Bottom	Rainbow Trout	All Years	128%	121%	150%	141%	116%	114%	105%	104%	NA	NA		
			Wet	107%	98%	123%	116%	124%	122%	106%	106%				
			Ab Norm	112%	109%	143%	138%	124%	122%	106%	106%				
			Bl Norm	133%	127%	149%	141%	100%	98%	100%	99%				
Dry			143%	131%	156%	141%	100%	98%	100%	100%					
Critical	156%	145%	169%	157%	151%	101%	119%	100%							
Rubicon River Near Ellicott Bridge	R20.9 Top	Rainbow Trout	All Years	103%	102%	113%	112%	108%	106%	101%	101%	99%	100%	103%	102%
			Wet	90%	90%	105%	105%	109%	107%	102%	101%	99%	99%	103%	103%
			Ab Norm	88%	88%	108%	108%	109%	108%	102%	102%	99%	99%	103%	103%
			Bl Norm	103%	102%	111%	110%	101%	99%	100%	100%	100%	100%	100%	100%
			Dry	106%	104%	120%	115%	100%	99%	100%	100%	100%	100%	100%	99%
	Critical	115%	115%	129%	128%	104%	102%	101%	101%	101%	100%	100%	102%	101%	
	R20.9 Bottom	Hardhead	All Years	88%	88%	102%	102%	105%	104%	101%	101%	100%	100%	102%	101%
			Wet	81%	75%	102%	103%	104%	103%	101%	101%	100%	100%	102%	101%
			Ab Norm	81%	82%	101%	101%	105%	104%	101%	101%	100%	100%	101%	101%
			Bl Norm	94%	95%	102%	102%	101%	98%	100%	100%	100%	100%	100%	99%
Dry			99%	99%	104%	104%	100%	99%	100%	100%	100%	100%	100%	99%	
Critical	102%	102%	113%	112%	102%	100%	101%	100%	100%	100%	100%	101%	100%		
Rubicon River Near Ralston Afterbay	R3.5 Top	Hardhead	All Years	76%	76%	101%	101%	105%	104%	100%	100%	100%	100%	103%	102%
			Wet	85%	89%	97%	98%	104%	103%	101%	101%	99%	100%	102%	102%
			Ab Norm	73%	76%	96%	96%	104%	104%	101%	101%	99%	99%	102%	102%
			Bl Norm	82%	82%	101%	101%	101%	96%	100%	99%	100%	100%	100%	98%
			Dry	90%	91%	102%	102%	100%	99%	100%	100%	100%	100%	100%	100%
	Critical	93%	94%	105%	105%	102%	97%	101%	99%	100%	100%	101%	99%		
	R3.5 Bottom	Hardhead	All Years	77%	76%	101%	101%	105%	103%	100%	100%	100%	100%	103%	102%
			Wet	85%	88%	97%	98%	104%	103%	101%	101%	99%	100%	102%	102%
			Ab Norm	75%	77%	96%	96%	104%	104%	101%	101%	99%	99%	102%	102%
			Bl Norm	82%	82%	101%	101%	101%	96%	100%	99%	100%	100%	100%	98%
Dry			89%	90%	102%	101%	100%	99%	100%	100%	100%	100%	100%	100%	
Critical	93%	94%	105%	105%	102%	97%	101%	99%	100%	100%	101%	99%			

Values greater than 5%

Values less than 5%

Values greater than 5% in reaches where rainbow trout are not the primary target species

Values less than 5% in reaches where rainbow trout are not the primary target species

Table 8.5-7. Qualitative Assessment of Spill Events With Potential to Impact Foothill-Yellow Legged Frog Tadpoles and Egg masses.

Rubicon River					
Water Year Type	Year	Proposed Action		No-Action Alternative	
		High Risk	Low Risk	High Risk	Low Risk
Wet	1983	X	-	X	-
Wet	1984	-	-	-	-
Wet	1986	-	-	X	-
Dry	1990	-	-	-	-
Wet	1995	X	-	X	-
Wet	1996	-	-	-	-
Wet	1998	X	-	X	-
Below Normal	2003	-	-	X	-
Above Normal	2005	X	-	X	-
Wet	2006	-	X	-	X
Total		4	1	6	1
Middle Fork American River below Middle Fork Interbay					
Water Year Type	Year	Proposed Action		No-Action Alternative	
		High Risk	Low Risk	High Risk	Low Risk
Wet	1982	-	X	X	-
Wet	1983	X	-	X	-
Wet	1986	-	-	X	-
Dry	1990	-	-	-	-
Above Normal	1993	X	-	-	-
Wet	1995	X	-	X	-
Wet	1996	-	-	-	X
Wet	1998	X	-	X	-
Below Normal	2003	X	-	-	-
Above Normal	2005	X	-	X	-
Wet	2006	X	-	X	-
Total		7	1	7	1

Table 8.5-8. Average Percent Change by Month in Reservoir Volume and Depth for the Proposed Action Versus the No-Action Alternative and Existing License Conditions (1975–2007).

French Meadows Reservoir													
Proposed Action Compared to:	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Average
Percent Change in Reservoir Volume													
No-Action Alternative	-1%	-6%	-17%	-18%	-15%	-8%	-4%	-3%	-2%	-3%	-5%	-6%	-7%
Existing License Conditions	-9%	-11%	-13%	-12%	-10%	-8%	-7%	-8%	-5%	-4%	-5%	-7%	-8%
Percent Change in Reservoir Depth													
No-Action Alternative	0%	-2%	-7%	-8%	-6%	-3%	-1%	-1%	-1%	-1%	-2%	-2%	-3%
Existing License Conditions	-4%	-5%	-6%	-5%	-5%	-4%	-3%	-4%	-2%	-2%	-3%	-3%	-4%
Hell Hole Reservoir													
Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Average
Percent Change in Reservoir Volume													
No-Action Alternative	0%	2%	-1%	1%	3%	7%	7%	6%	4%	1%	-1%	-3%	2%
Existing License Conditions	-2%	-4%	-2%	-1%	-1%	-1%	0%	0%	0%	0%	-1%	-3%	-1%
Percent Change in Reservoir Depth													
No-Action Alternative	0%	1%	-1%	1%	2%	4%	4%	3%	2%	1%	-1%	-1%	1%
Existing License Conditions	-2%	-3%	-2%	-1%	-1%	0%	0%	0%	0%	0%	-1%	-2%	-1%

FIGURES

Figure 8.5-1a. Duncan Creek Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

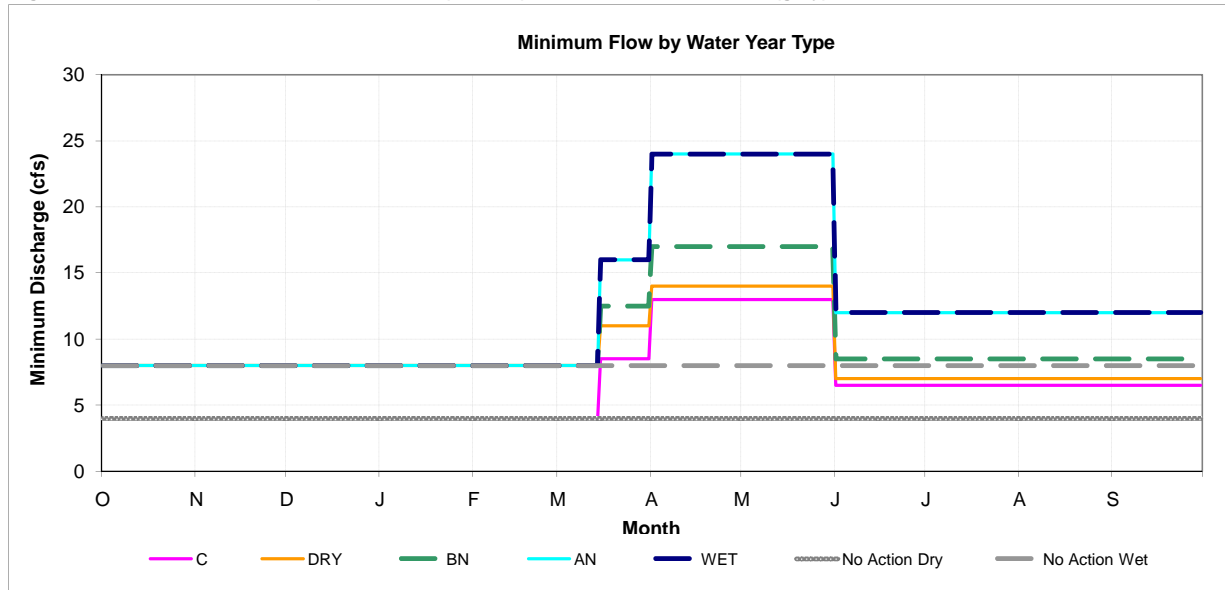


Figure 8.5-1b. North Fork Long Canyon Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

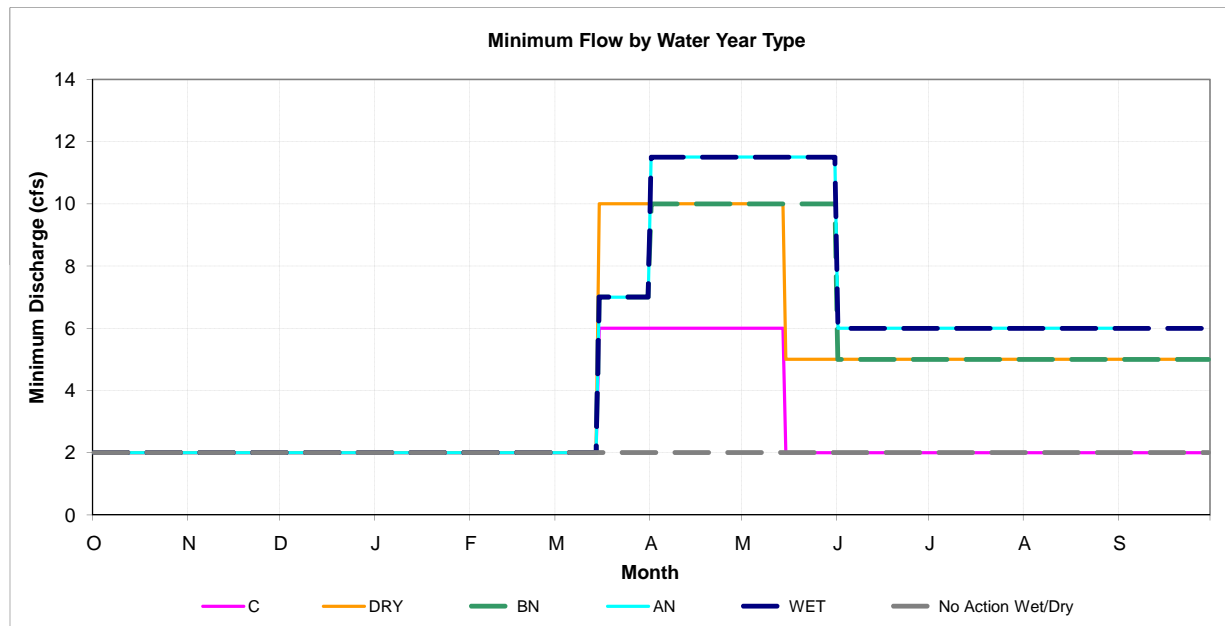


Figure 8.5-1c. South Fork Long Canyon Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

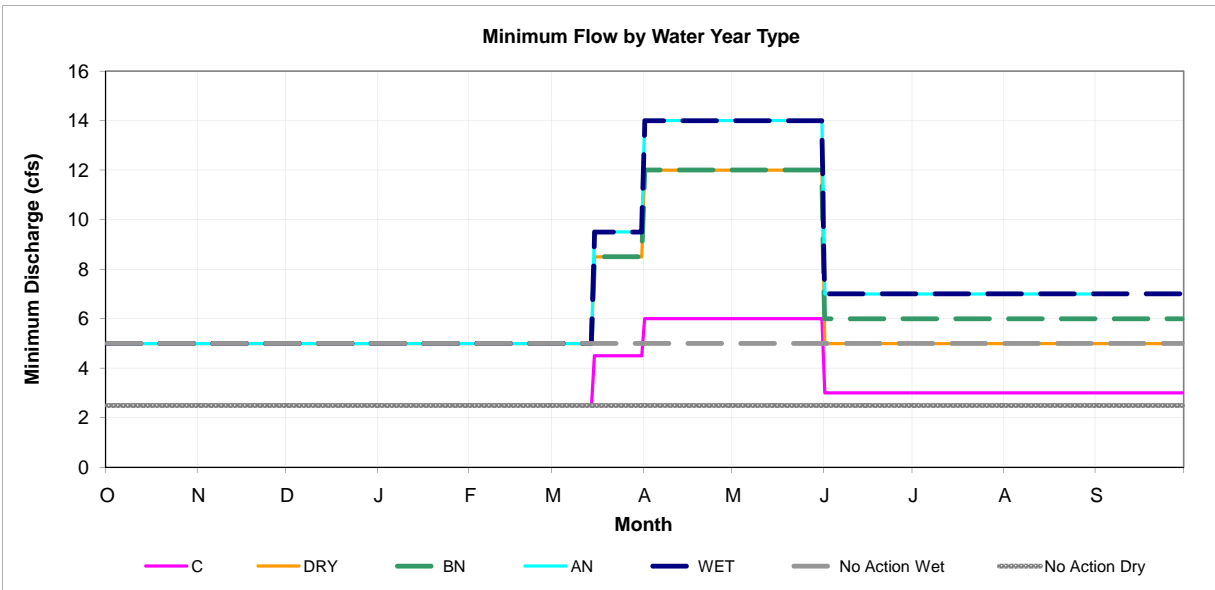


Figure 8.5-1d. Middle Fork American River Below French Meadows Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

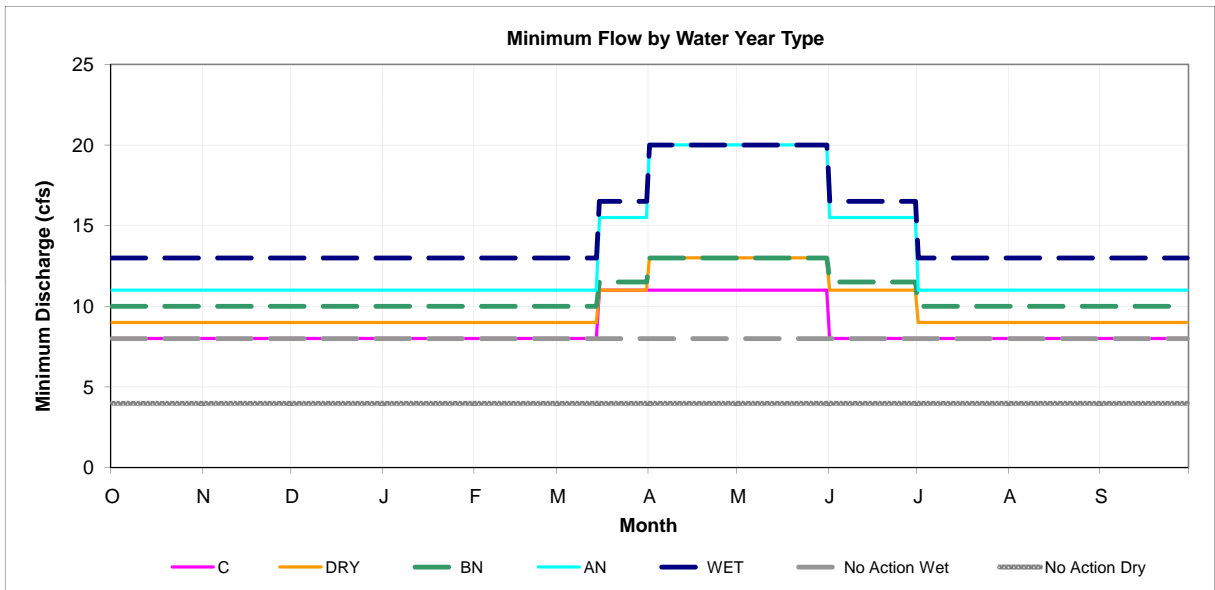


Figure 8.5-1e. Middle Fork American River Below Middle Fork Interbay Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

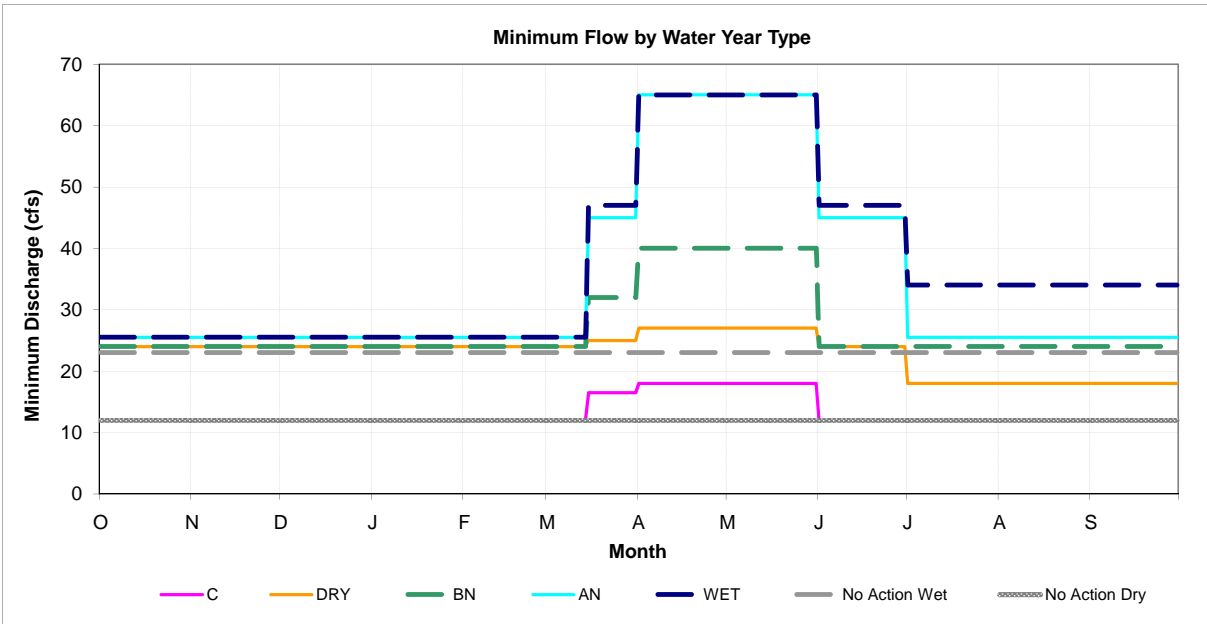


Figure 8.5-1f. Rubicon River Below Hell Hole Reservoir Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.

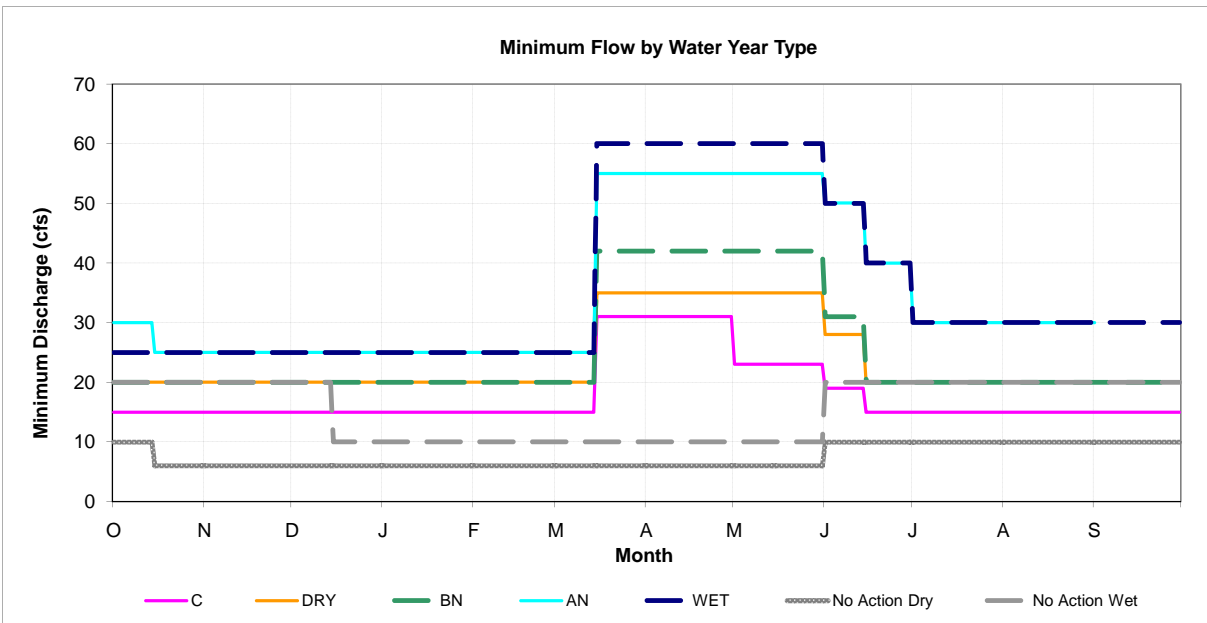
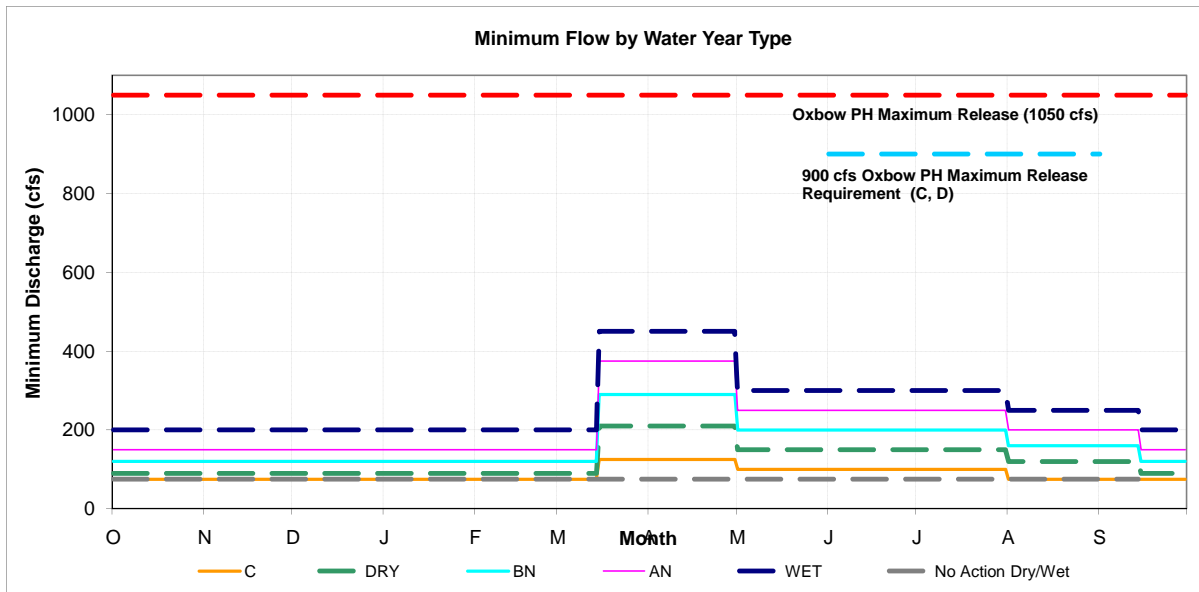


Figure 8.5-1g. Middle Fork American River Below Ralston Afterbay Proposed Action (colored) and No-Action Alternative (gray) Minimum Instream Flows.



Note: Minimum Instream Flow Schedule for Middle Fork American Below Ralston Afterbay During Annual Maintenance Outages (1 month, starting between September 15 - October 15).

Water Year Type	Minimum Flow (cfs)
Extreme Critical	75
Critical	75
Dry	75
Below Normal	110
Above Normal	150
Wet	150

Figure 8.5-2a. Minimum Daily Flow under the Proposed Action and No-Action Alternative in the Rubicon River Downstream of Hell Hole Dam (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

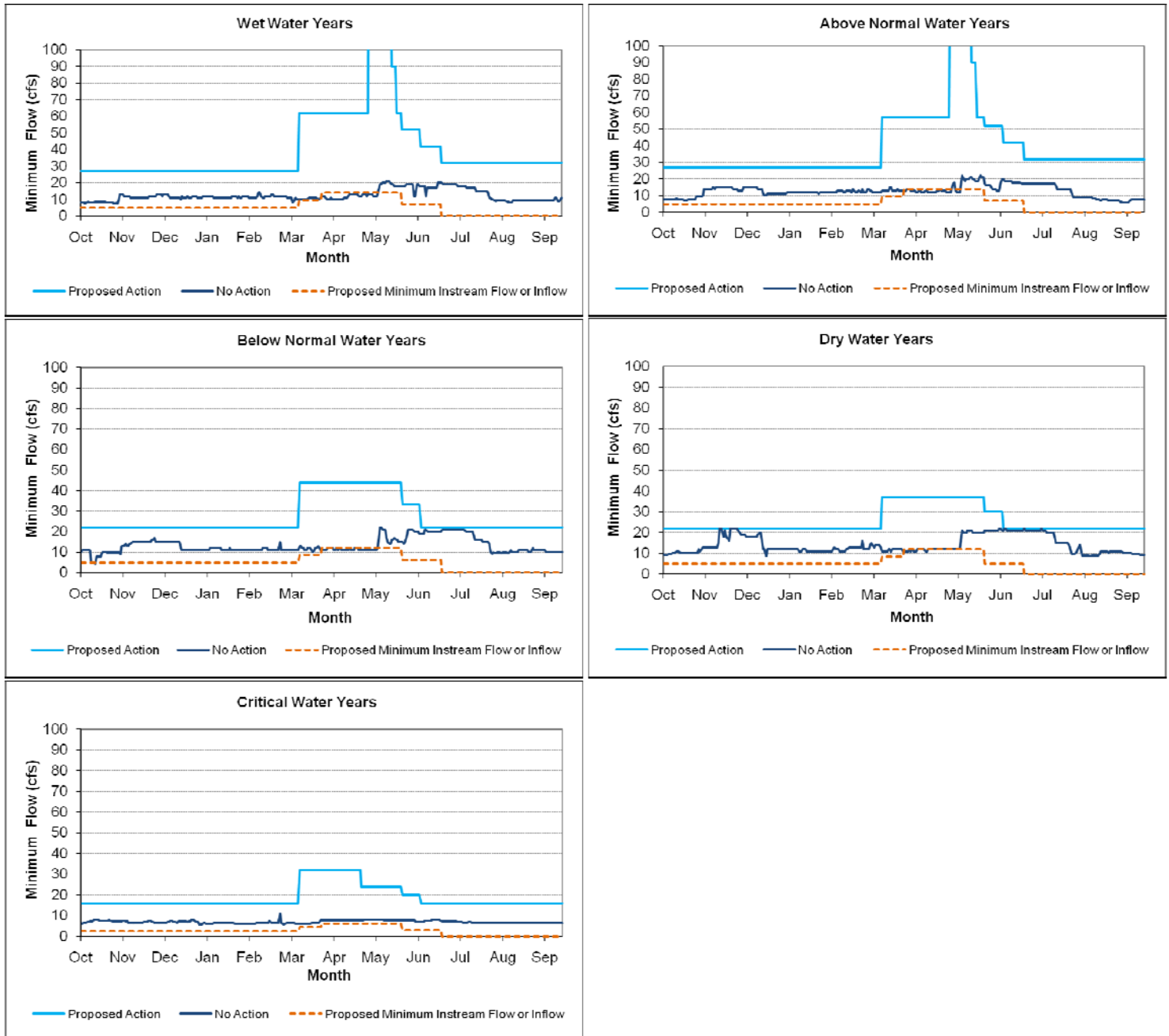


Figure 8.5-2b. Minimum Daily Flow under the Proposed Action and No-Action Alternative in the Middle Fork American River downstream of French Meadows Dam (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

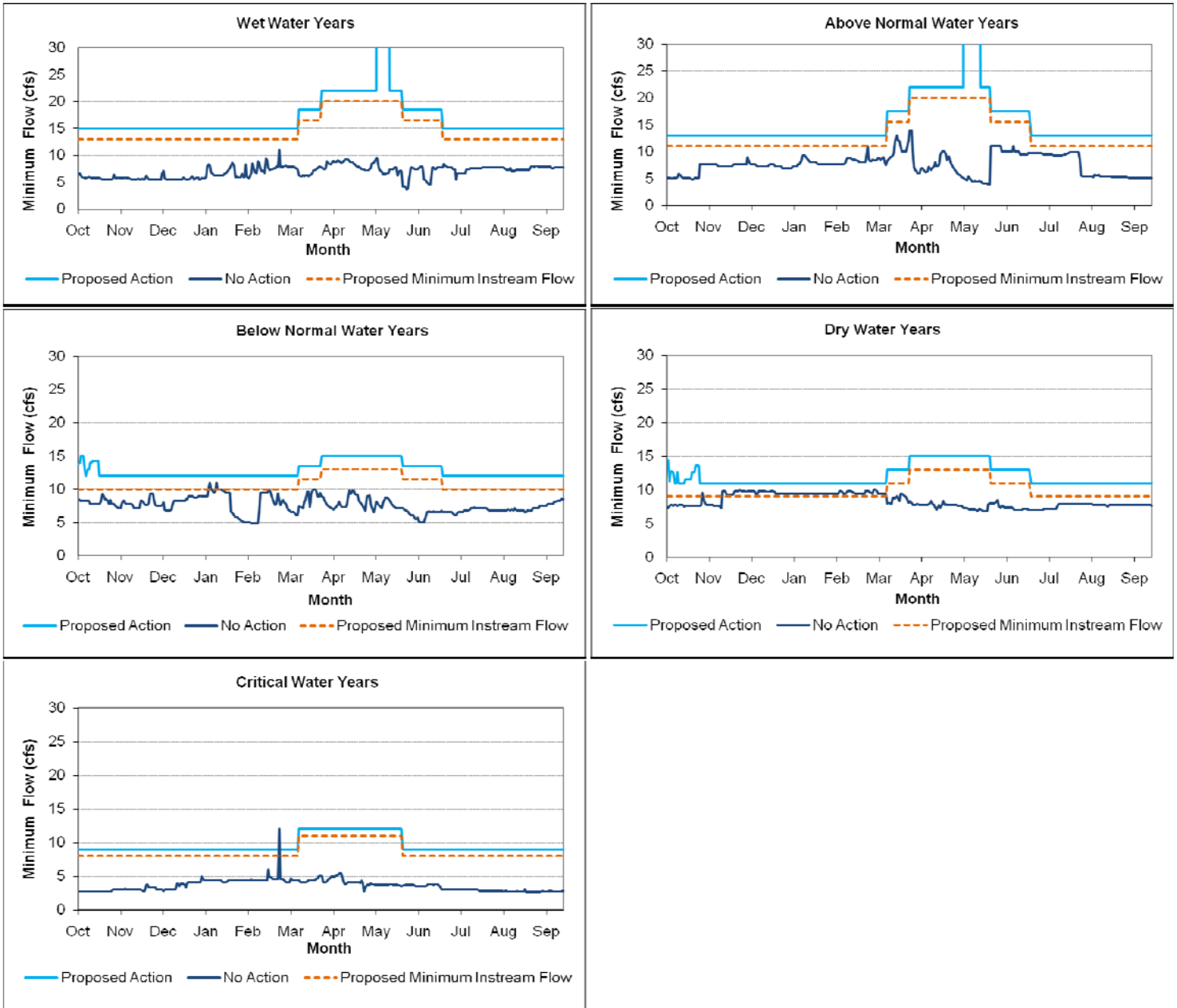


Figure 8.5-2c. Minimum Daily Flow under the Proposed Action and No-Action Alternative in the Middle Fork American River downstream of Middle Fork Interbay Dam (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

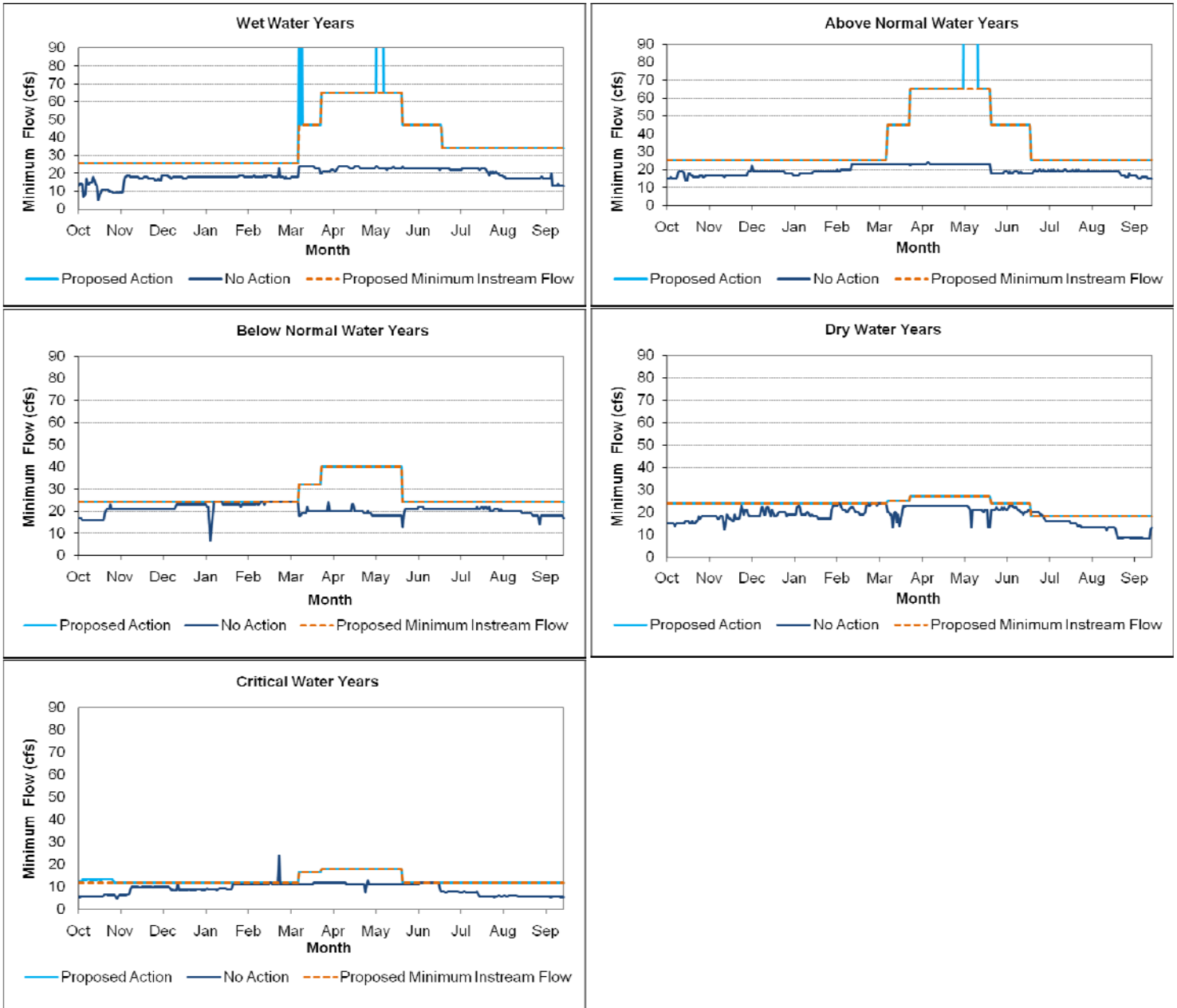


Figure 8.5-2d. Minimum Daily Flow under the Proposed Action and No-Action Alternative in Duncan Creek downstream of the Diversion (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

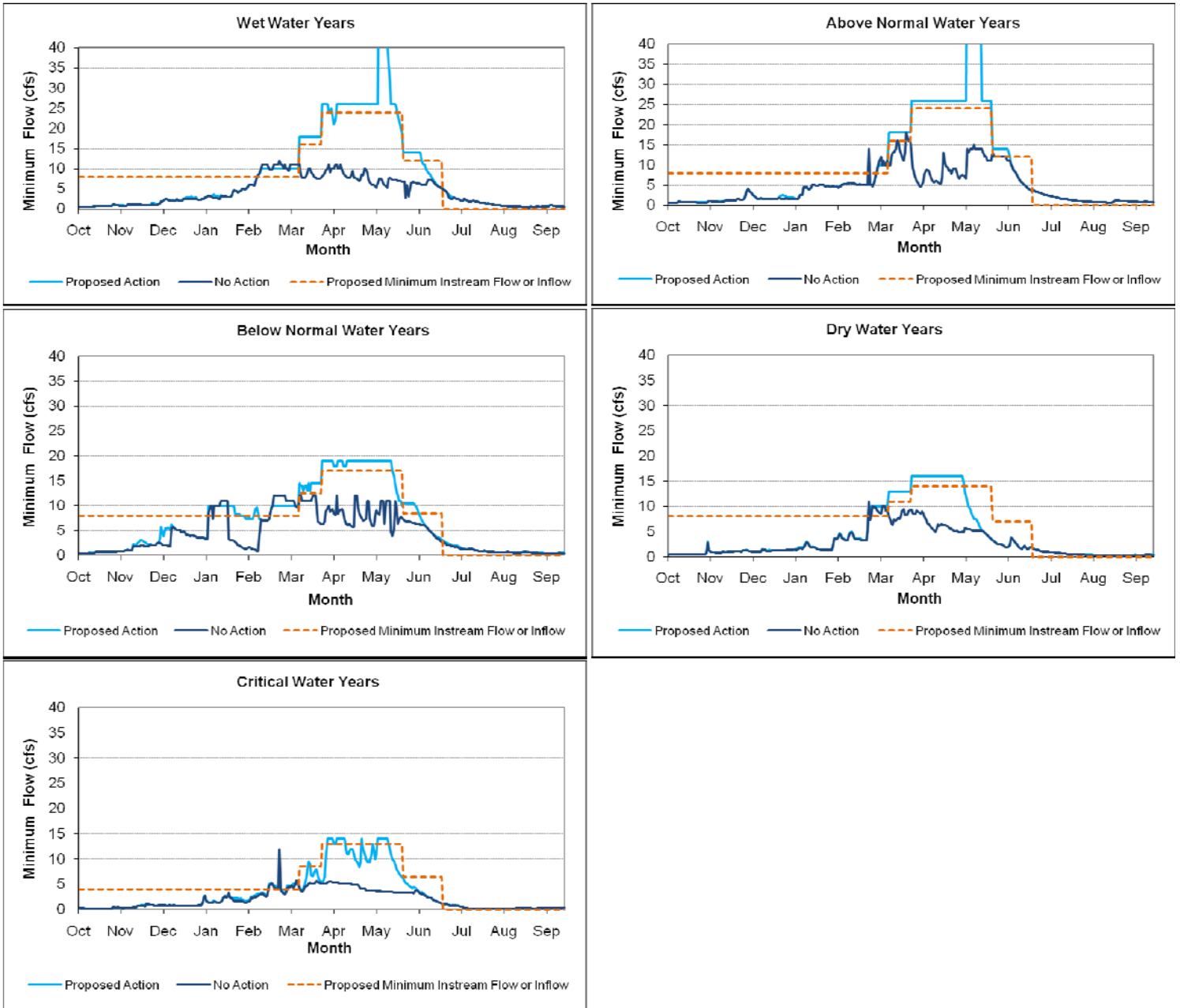


Figure 8.5-2e. Minimum Daily Flow under the Proposed Action and No-Action Alternative in North Fork Long Canyon Creek downstream of the Diversion (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

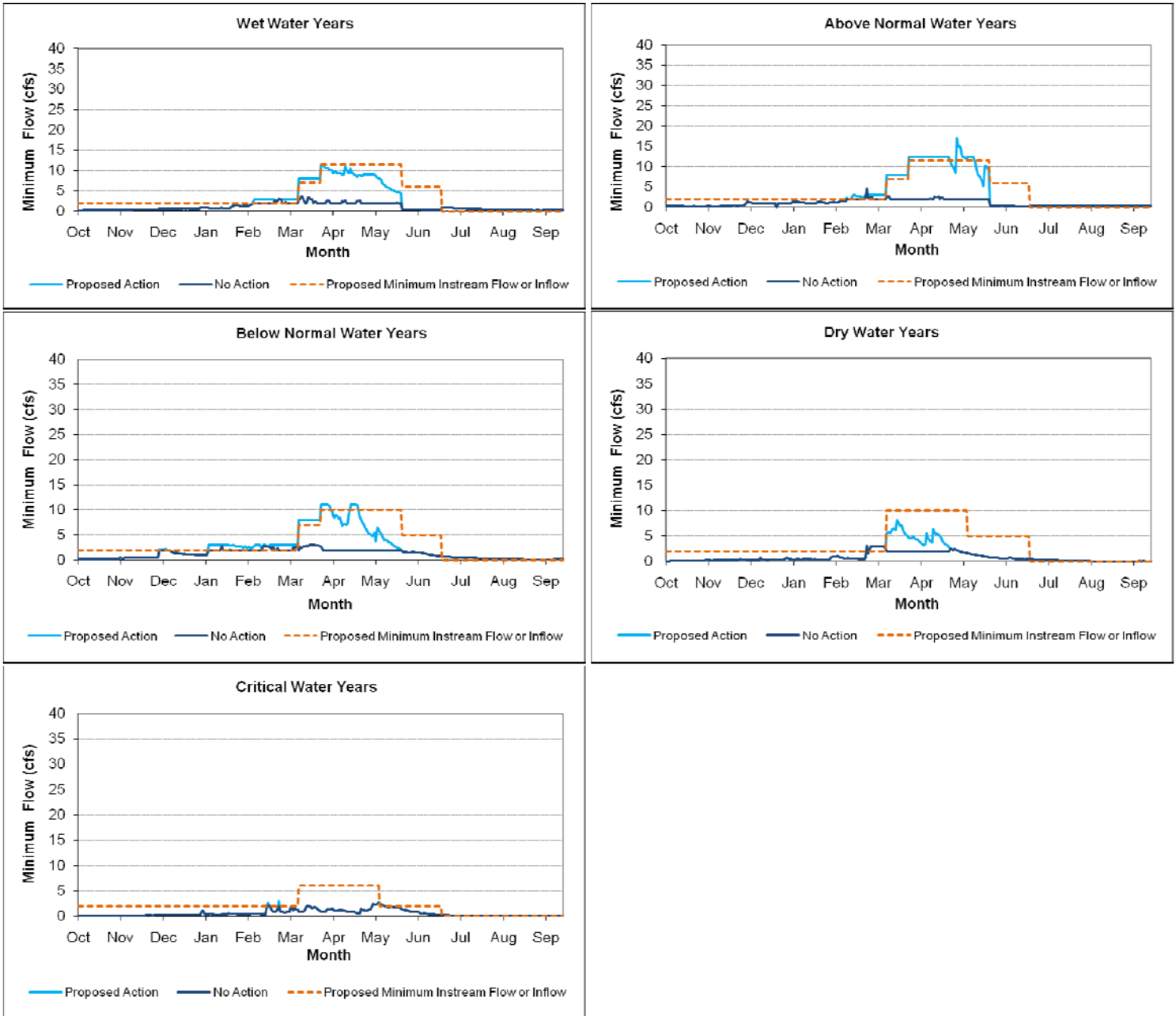


Figure 8.5-2f. Minimum Daily Flow under the Proposed Action and No-Action Alternative in South Fork Long Canyon Creek downstream of the Diversion (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

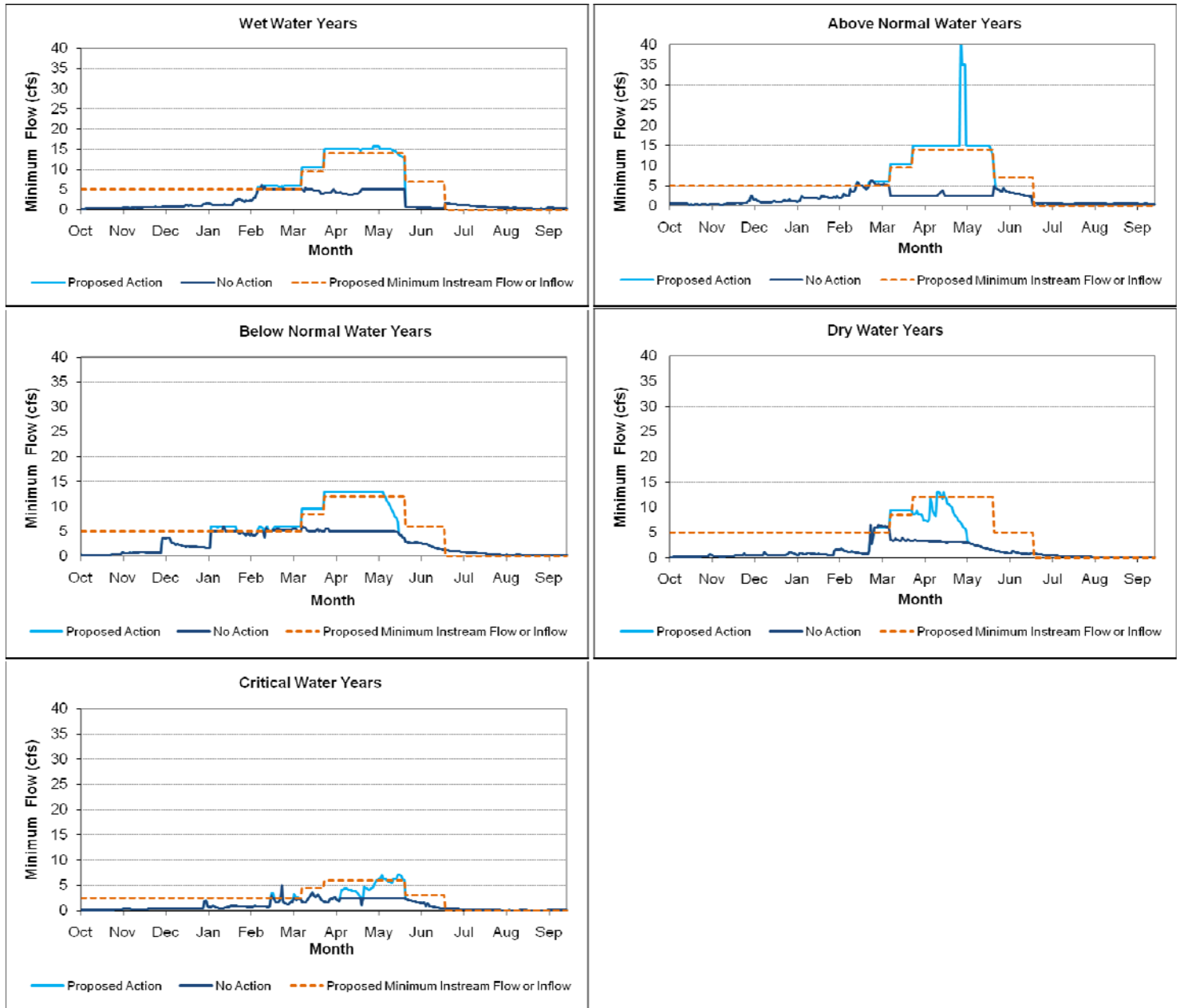


Figure 8.5-2g. Minimum Flow under the Proposed Action (Hourly Data) and No-Action Alternative (15-Minute Data) in the Middle Fork American River Peaking Reach (Based on the 1975-2007 Hydrology Data Combined by Water Year Type).

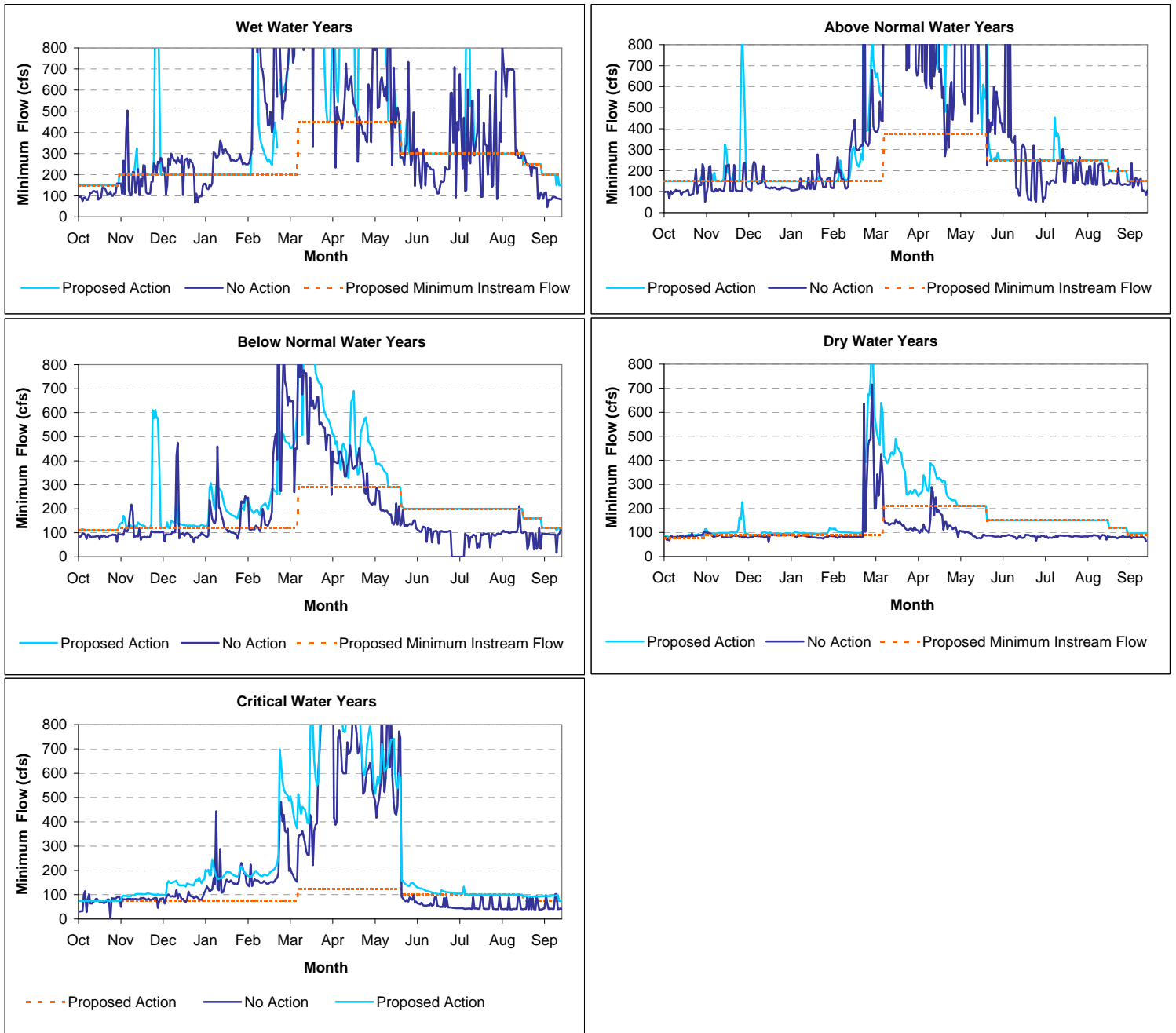


Figure 8.5-3a. Rubicon River Near Ellicott Bridge (R20.9) Flow Recession in Wet Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

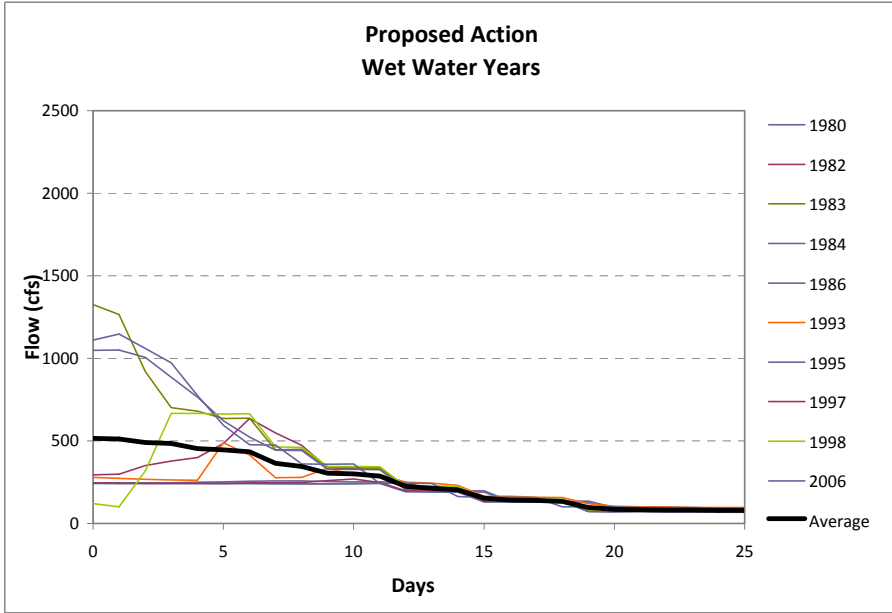


Figure 8.5-3b. Rubicon River Near Ellicott Bridge (R20.9) Flow Recession in Above Normal Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

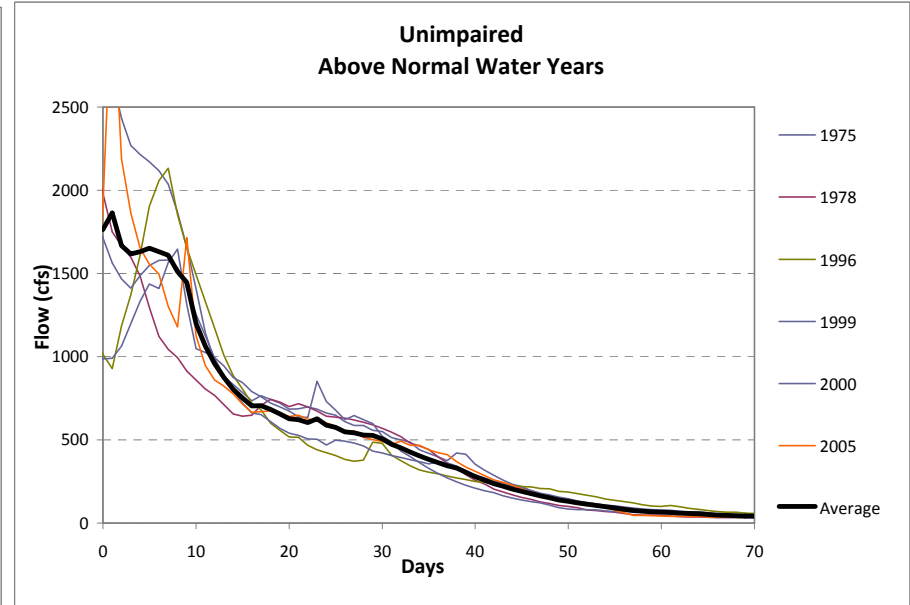
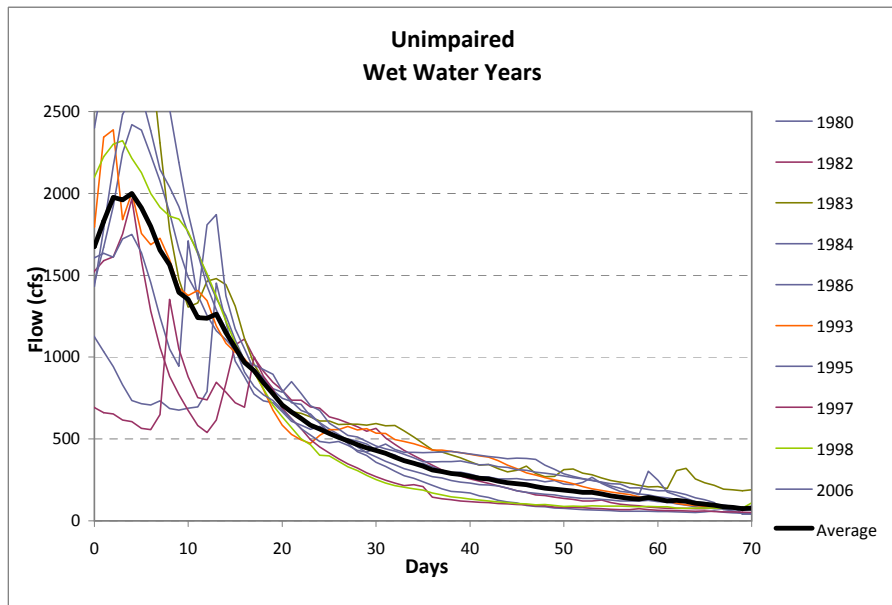
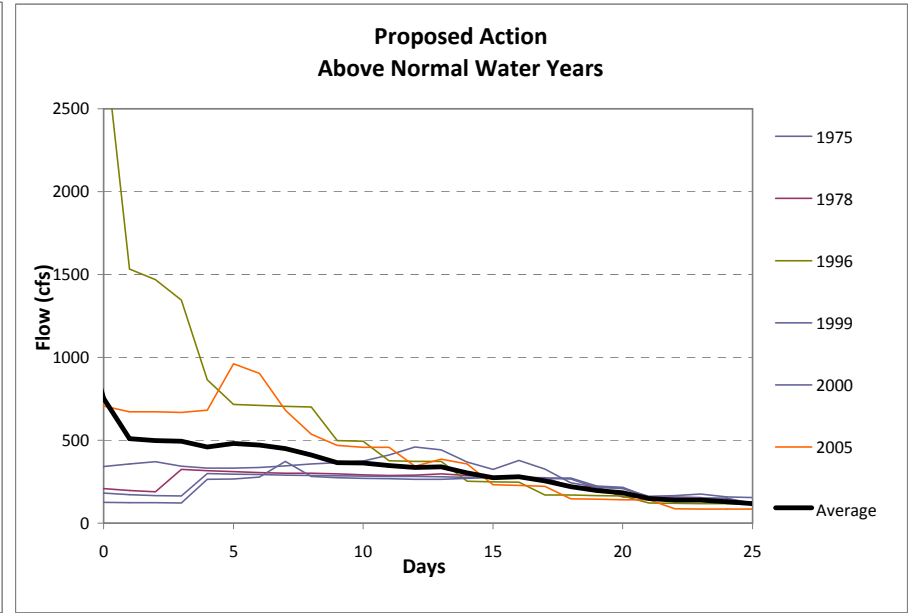


Figure 8.5-4a. Rubicon River Below Long Canyon (R3.5) Flow Recession in Wet Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

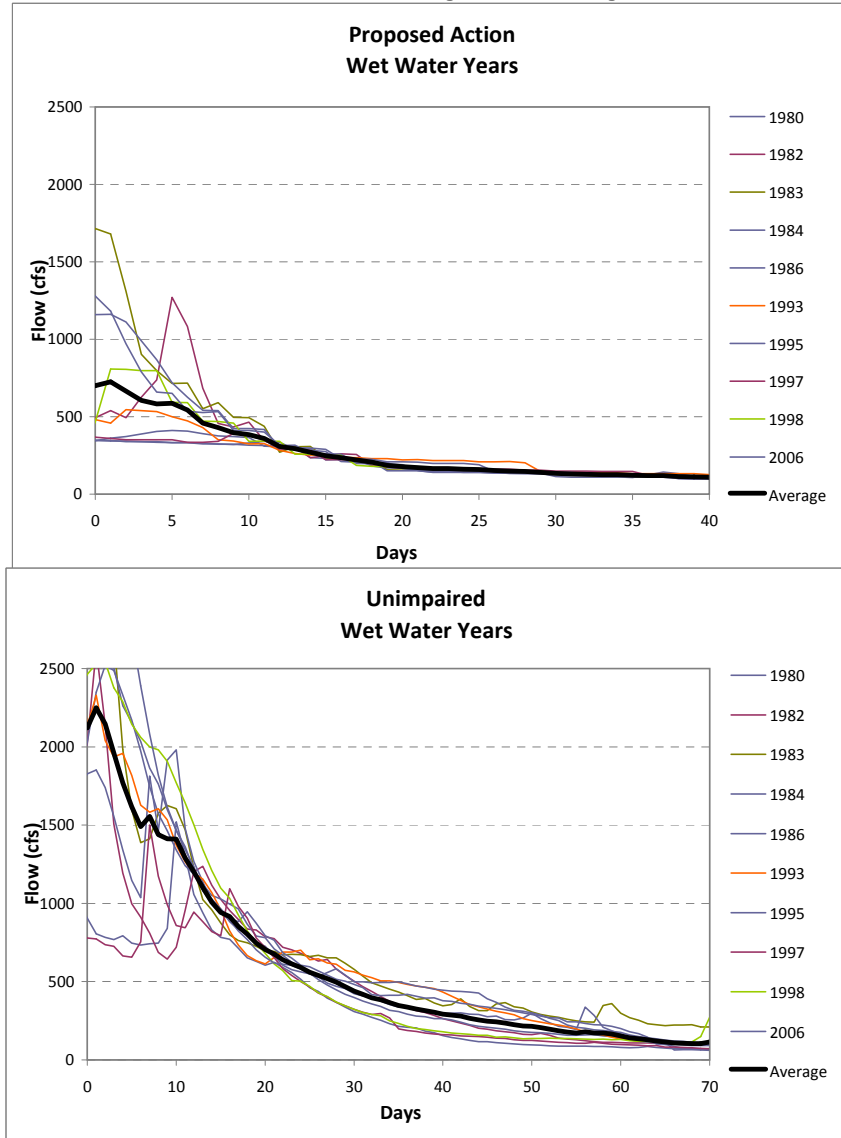


Figure 8.5-4b. Rubicon River Below Long Canyon (R3.5) Flow Recession in Above Normal Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

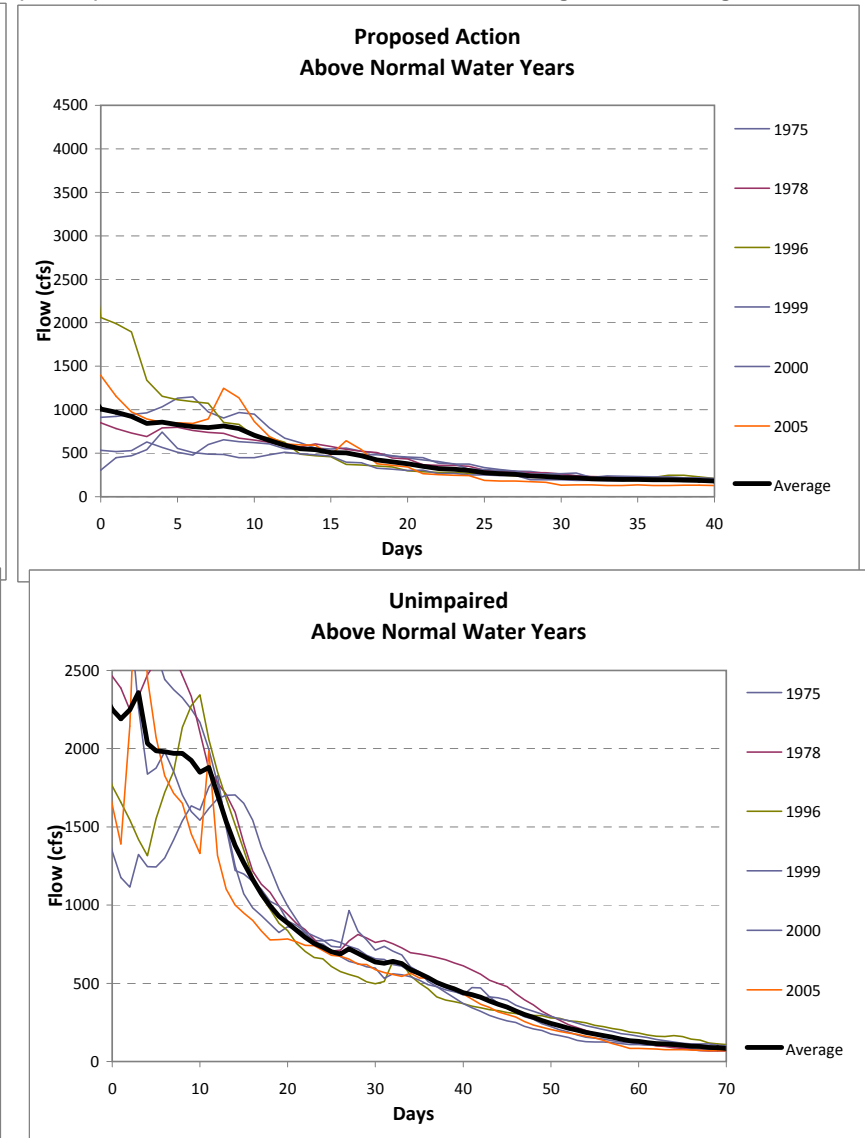


Figure 8.5-5a. Middle Fork American River Above Ralston Afterbay (MF26.2) Flow Recession in Wet Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

Figure 8.5-5b. Middle Fork American River Above Ralston Afterbay (MF26.2) Flow Recession in Above Normal Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

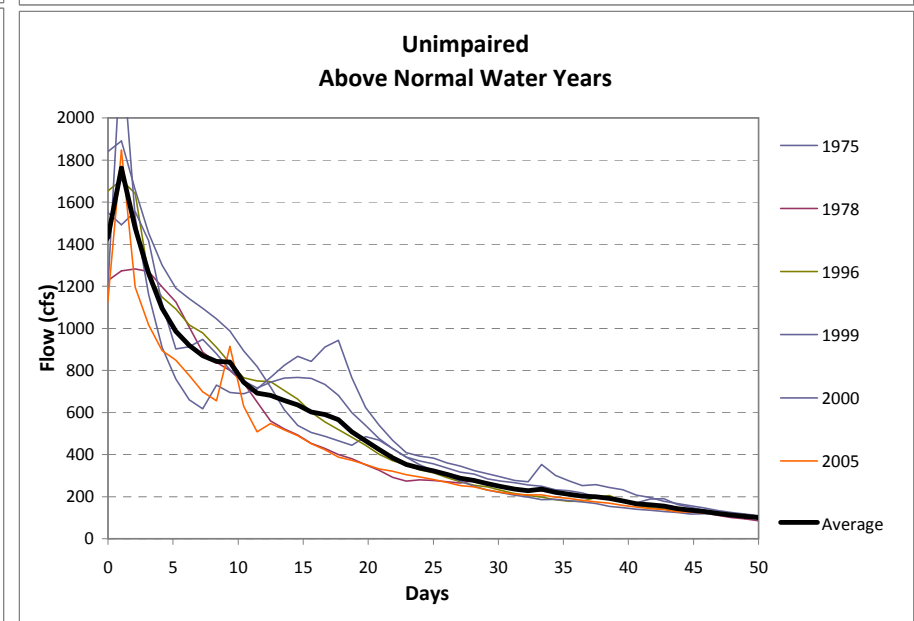
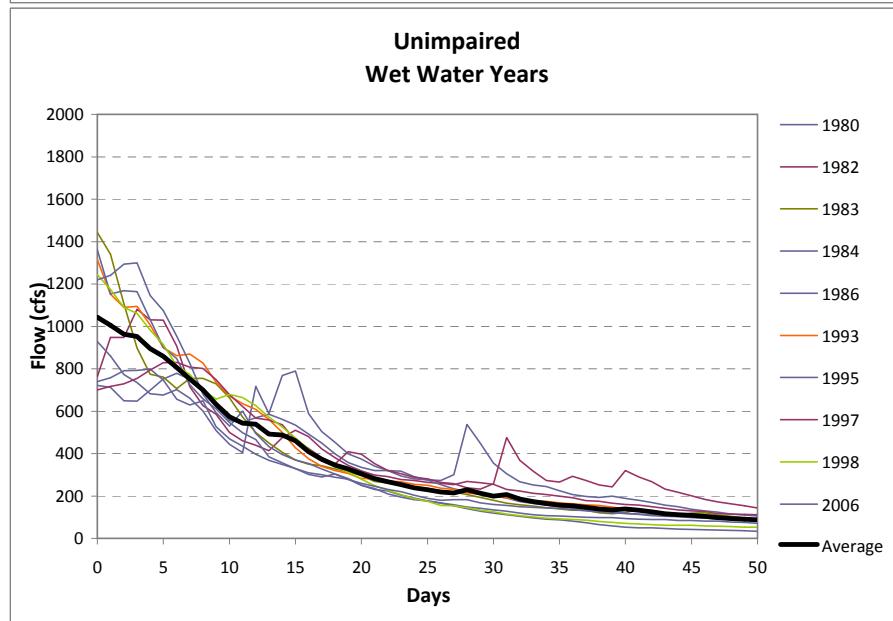
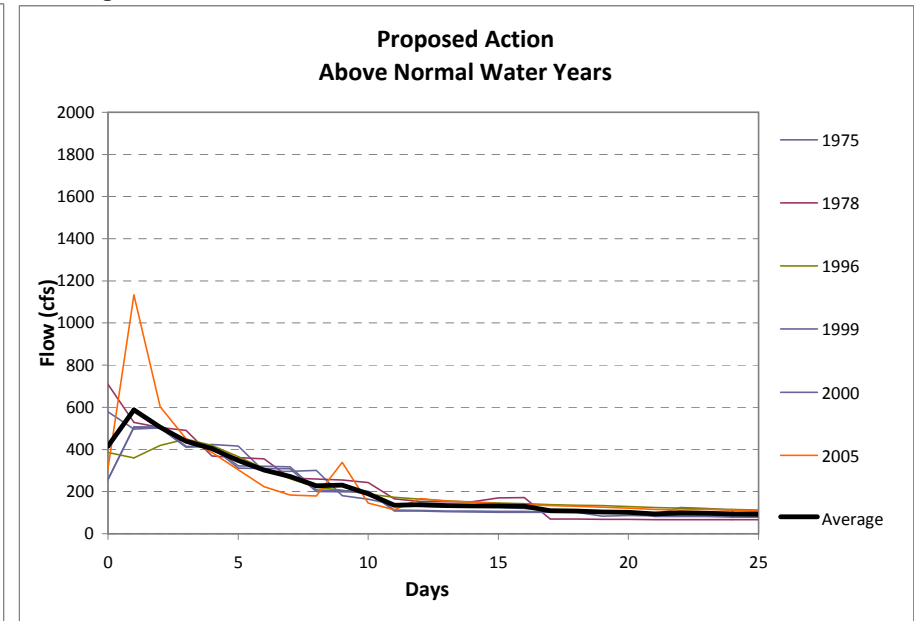
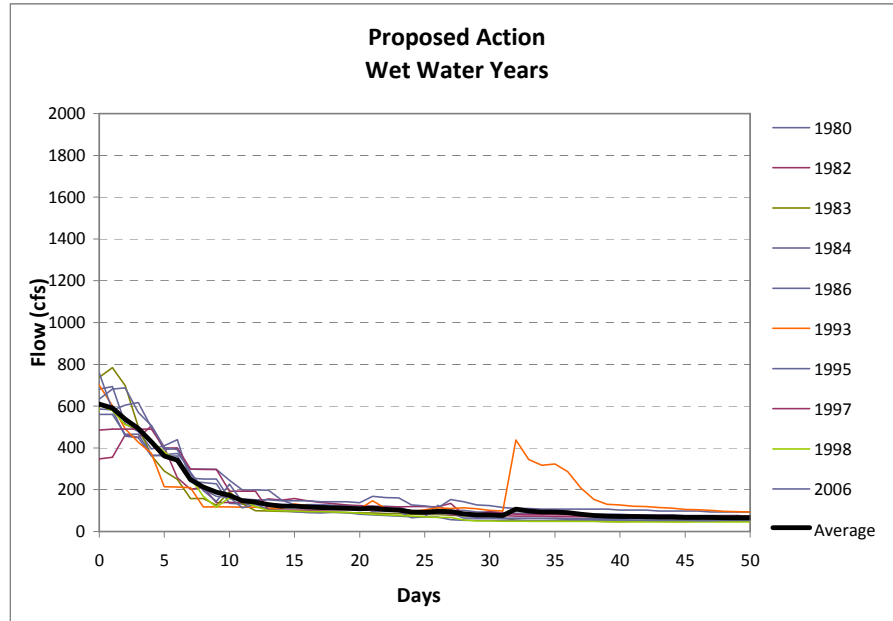


Figure 8.5-6a. Rubicon River Near Ellicott Bridge (R20.9) Average Flow Recession (top) and Relative Stage Change (bottom) in Wet Water Years for the Proposed Action and Unimpaired Conditions.

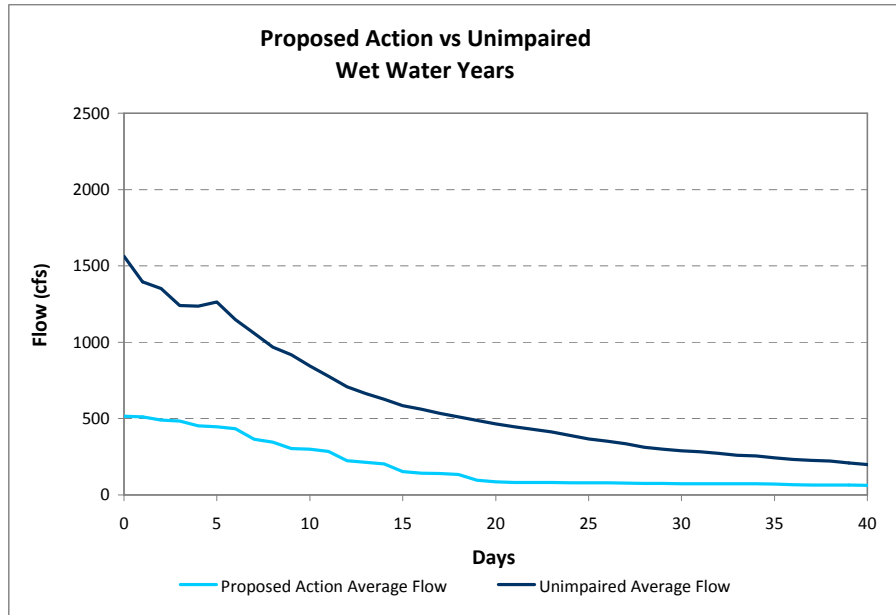


Figure 8.5-6b. Rubicon River Near Ellicott Bridge (R20.9) Average Flow Recession (top) and Relative Stage Change (bottom) in Above Normal Water Years for the Proposed Action and Unimpaired Conditions.

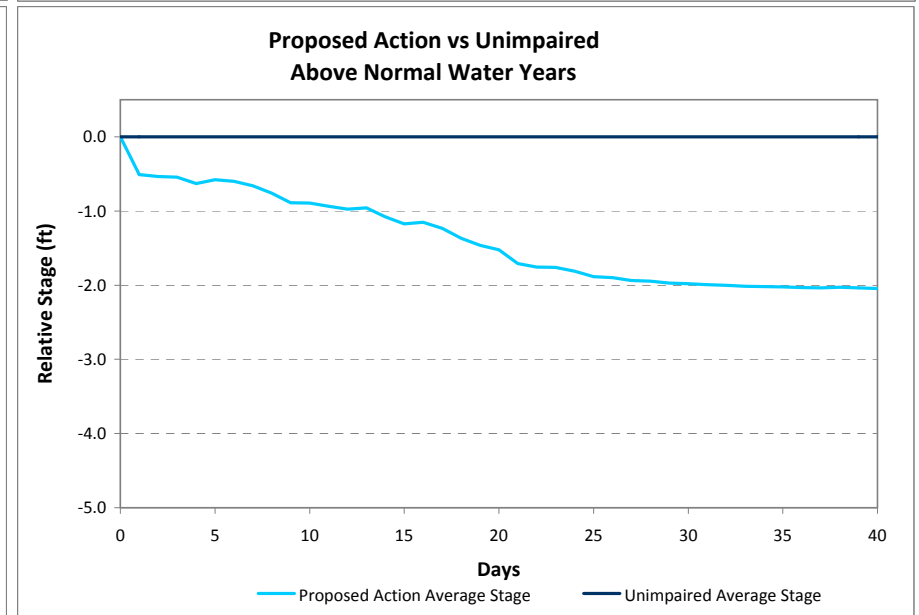
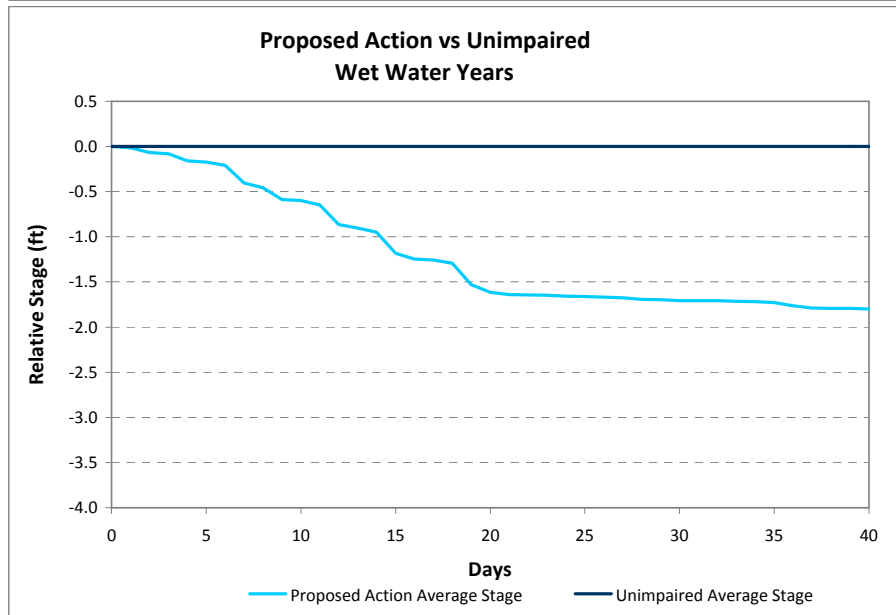
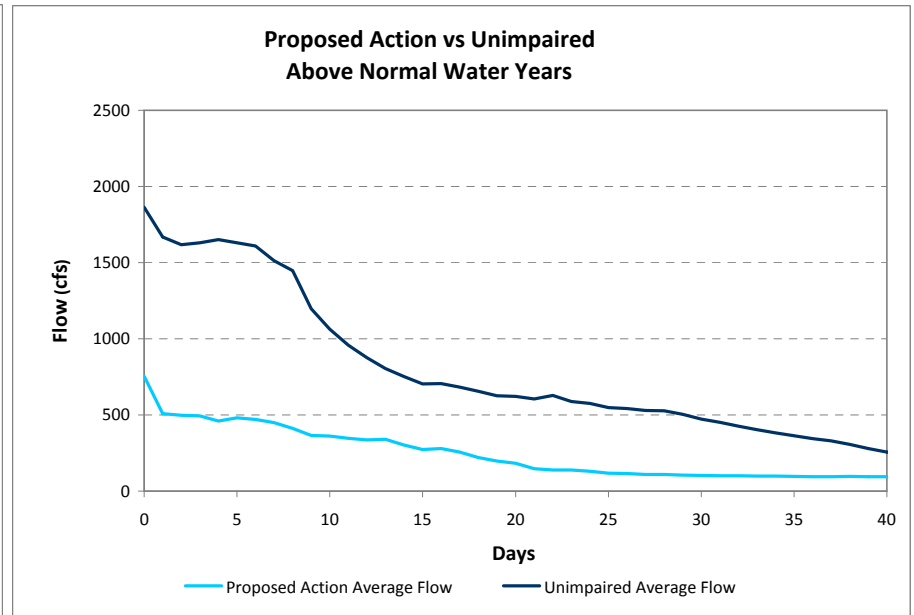


Figure 8.5-7a. Rubicon River Below Long Canyon (R3.5) Average Flow Recession (top) and Relative Stage Change (bottom) in Wet Water Years for the Proposed Action and Unimpaired Conditions.

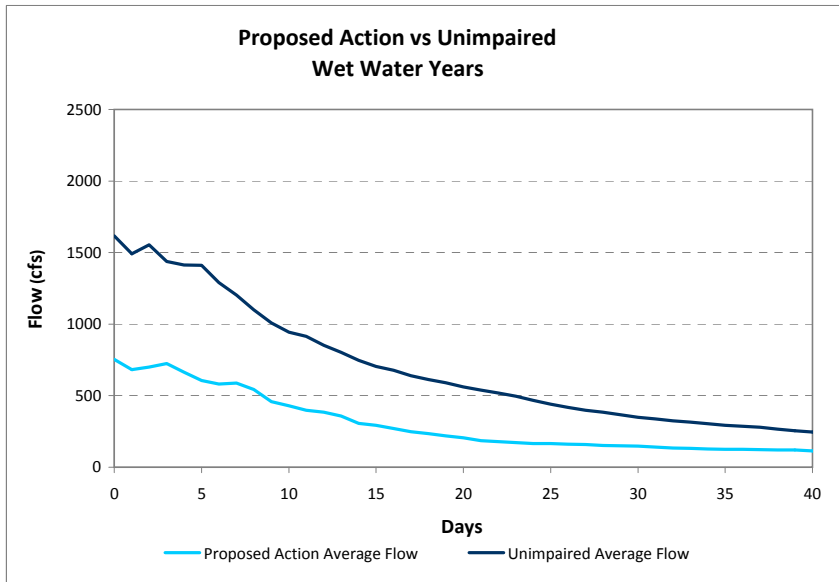


Figure 8.5-7b. Rubicon River Below Long Canyon (R3.5) Average Flow Recession (top) and Relative Stage Change (bottom) in Above Normal Water Years for the Proposed Action and Unimpaired Conditions.

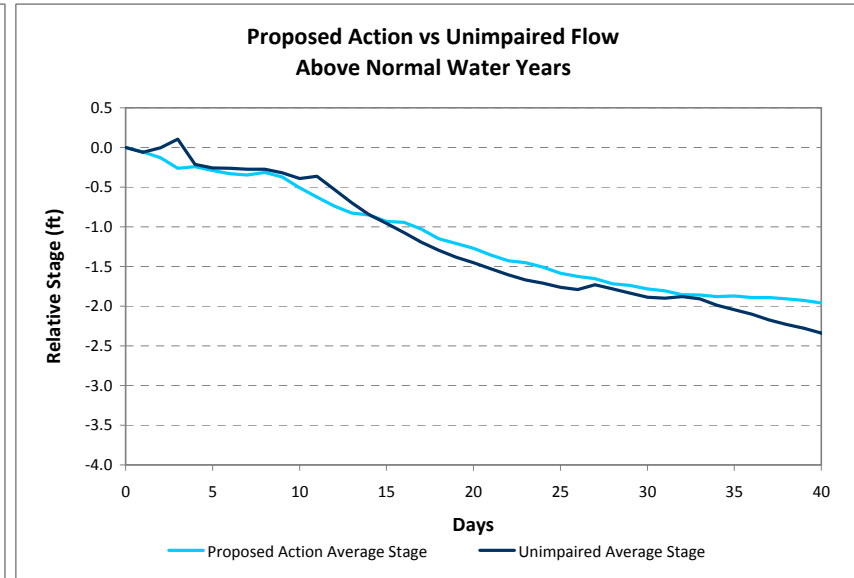
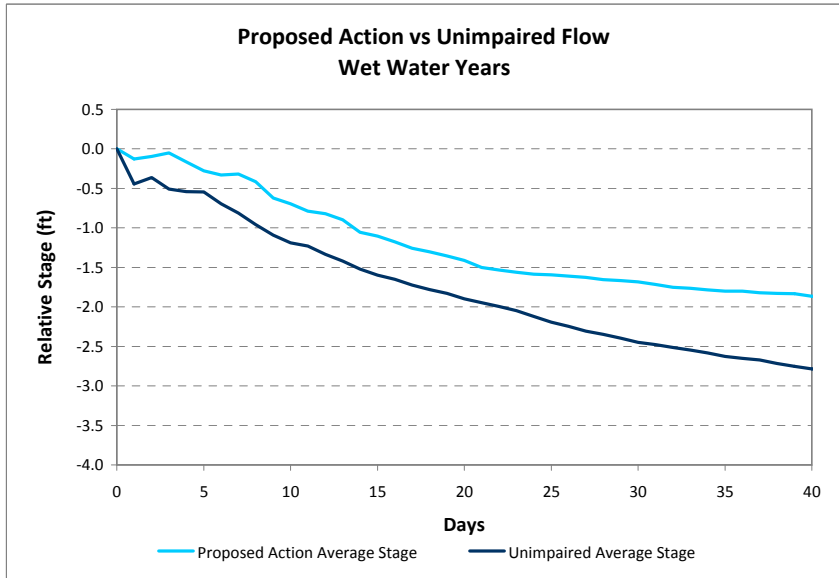
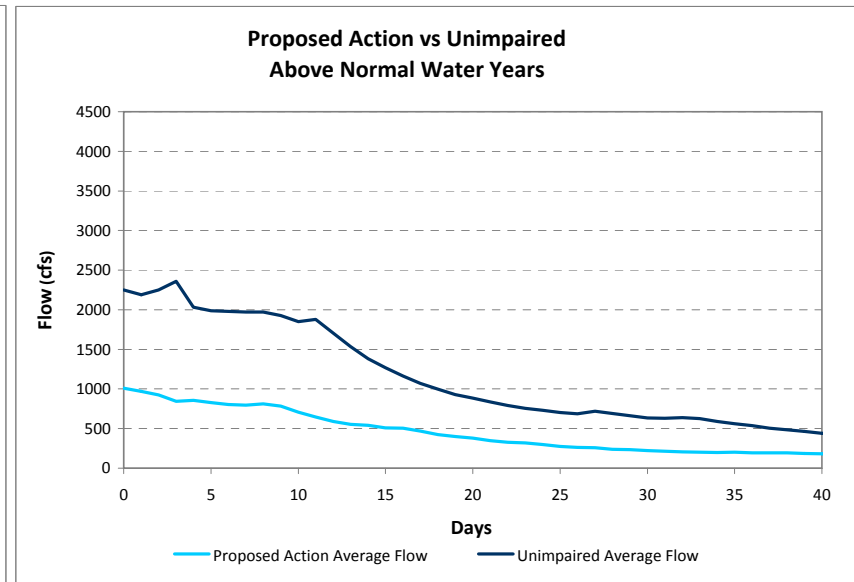


Figure 8.5-8a. Middle Fork American River Above Ralston Afterbay (MF26.2) Flow Recession in Wet Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

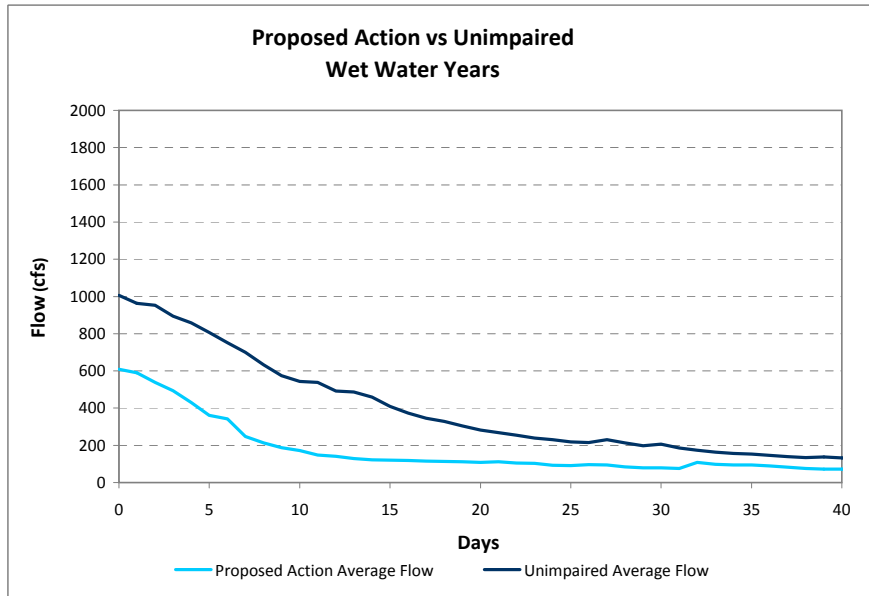


Figure 8.5-8b. Middle Fork American River Above Ralston Afterbay (MF26.2) Flow Recession in Above Normal Water Years for the Proposed Action (top) and Unimpaired Conditions (bottom). Flows were Time-Shifted to Match the Timing of the Receding Limb.

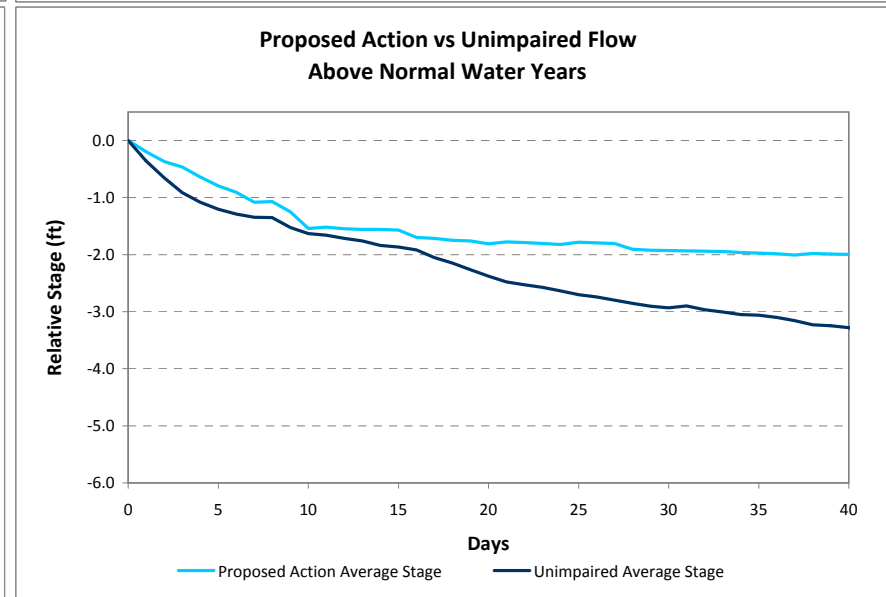
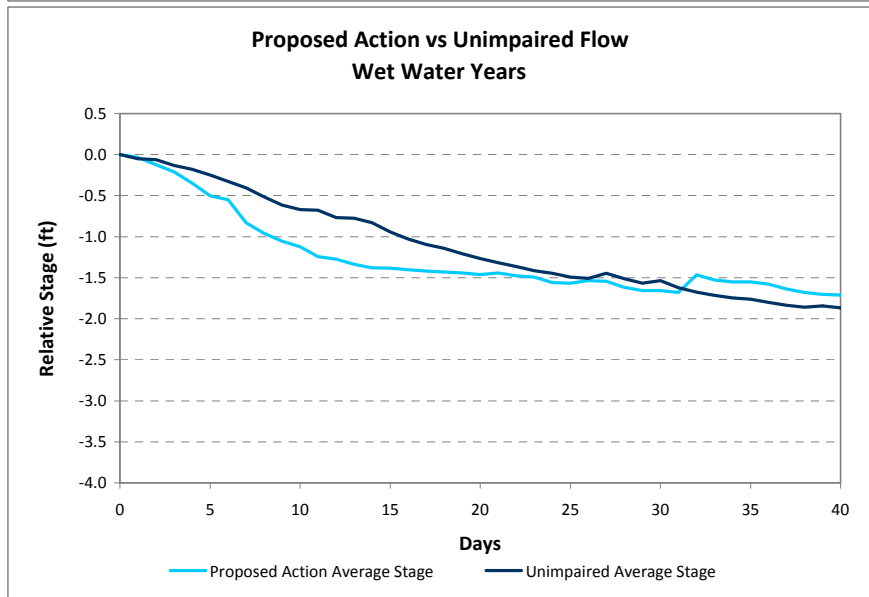
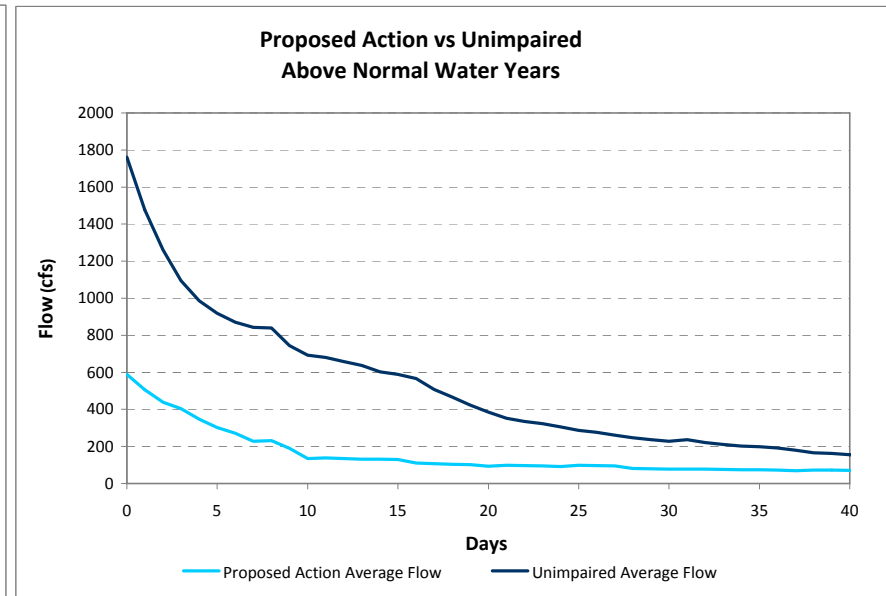


Figure 8.5-9a. Average Flow Fluctuations in the Peaking Reach for the Proposed Action and No-Action Alternatives in Summer/Fall (Jun-Oct), Winter (Nov-Feb), and Spring (Mar-May).

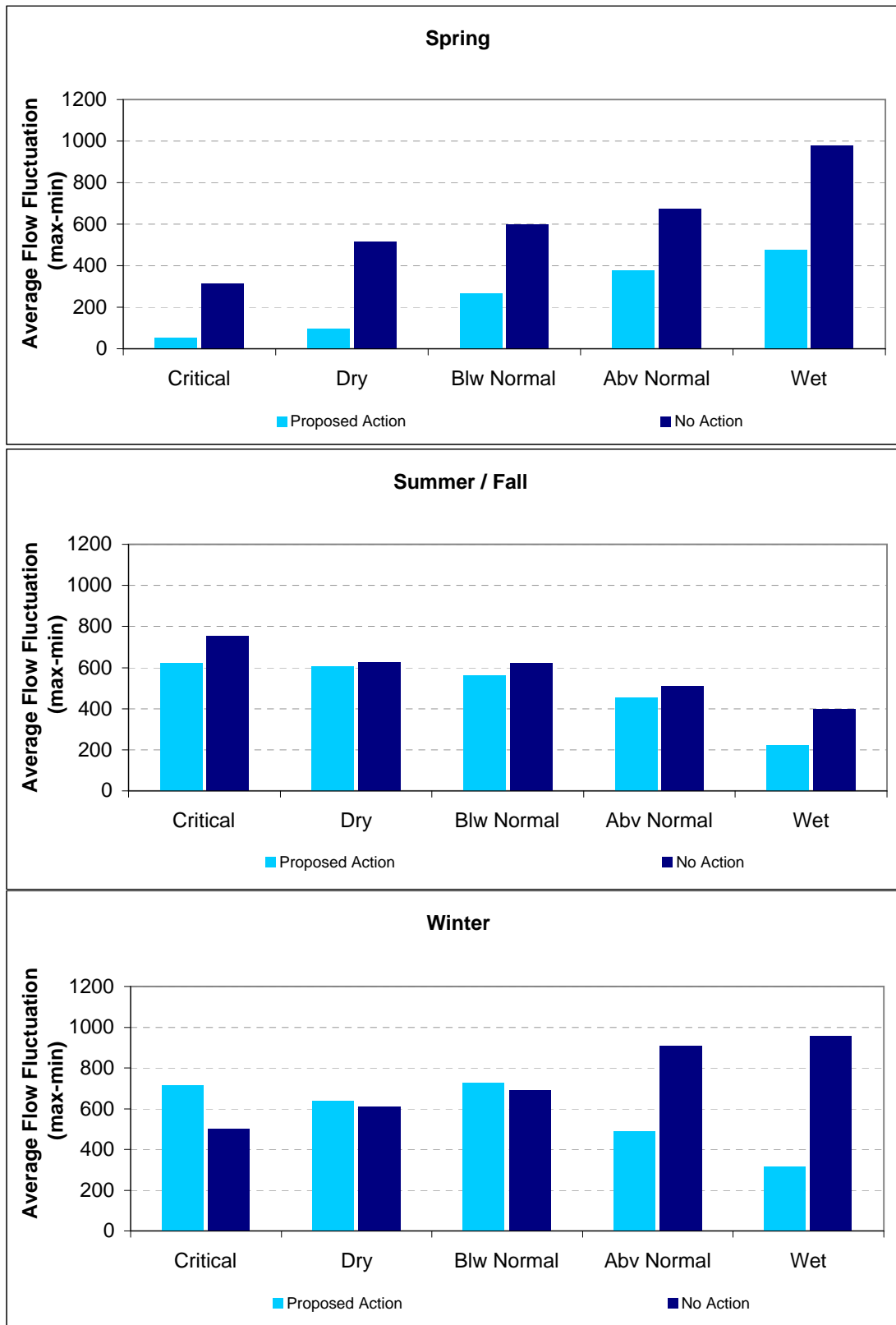


Figure 8.5-9b. Average Ratio of Flow Fluctuations in the Peaking Reach for the Proposed Action and No-Action Alternatives in Spring (Mar-May), Summer/Fall (Jun-Oct), and Winter (Nov-Feb).

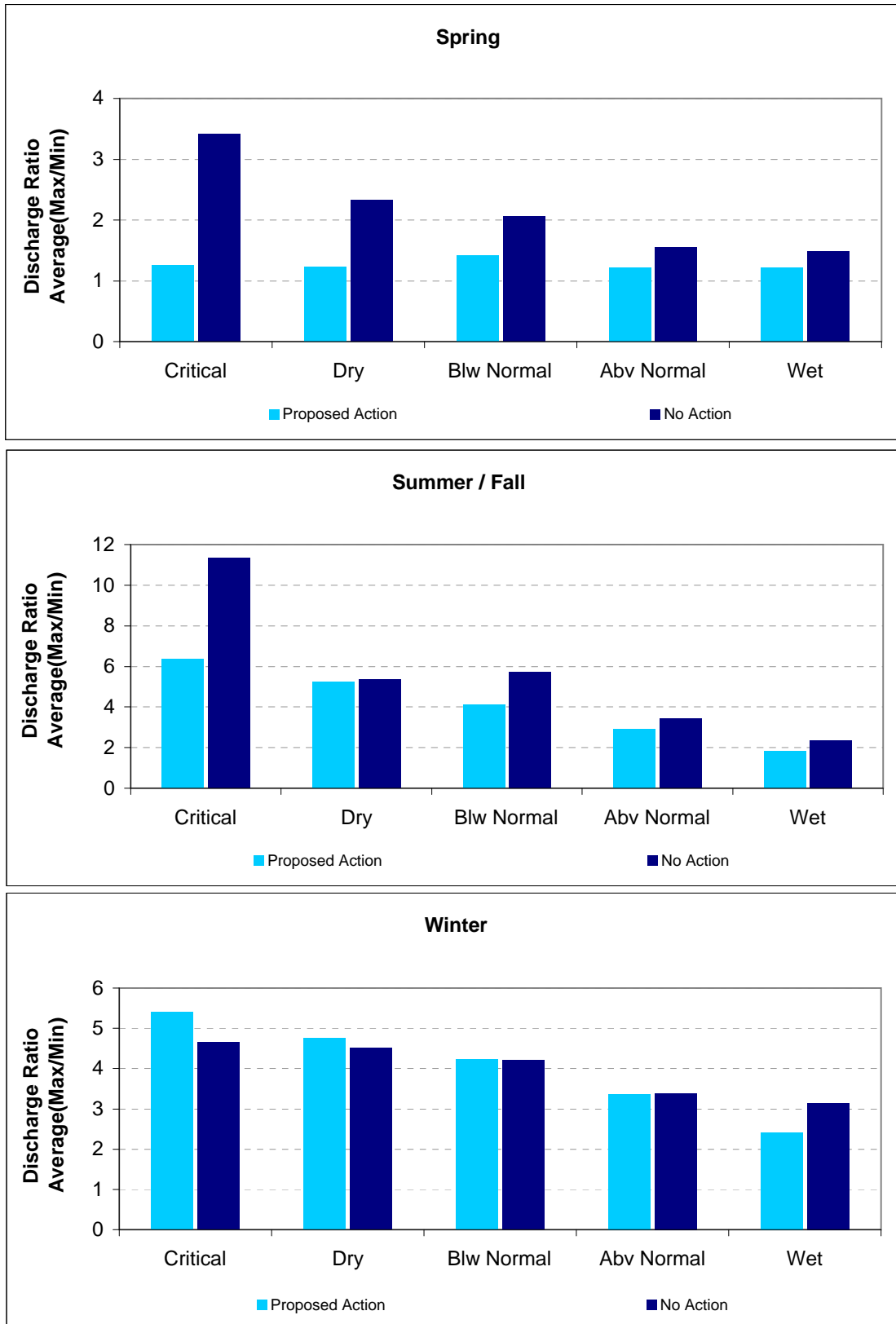
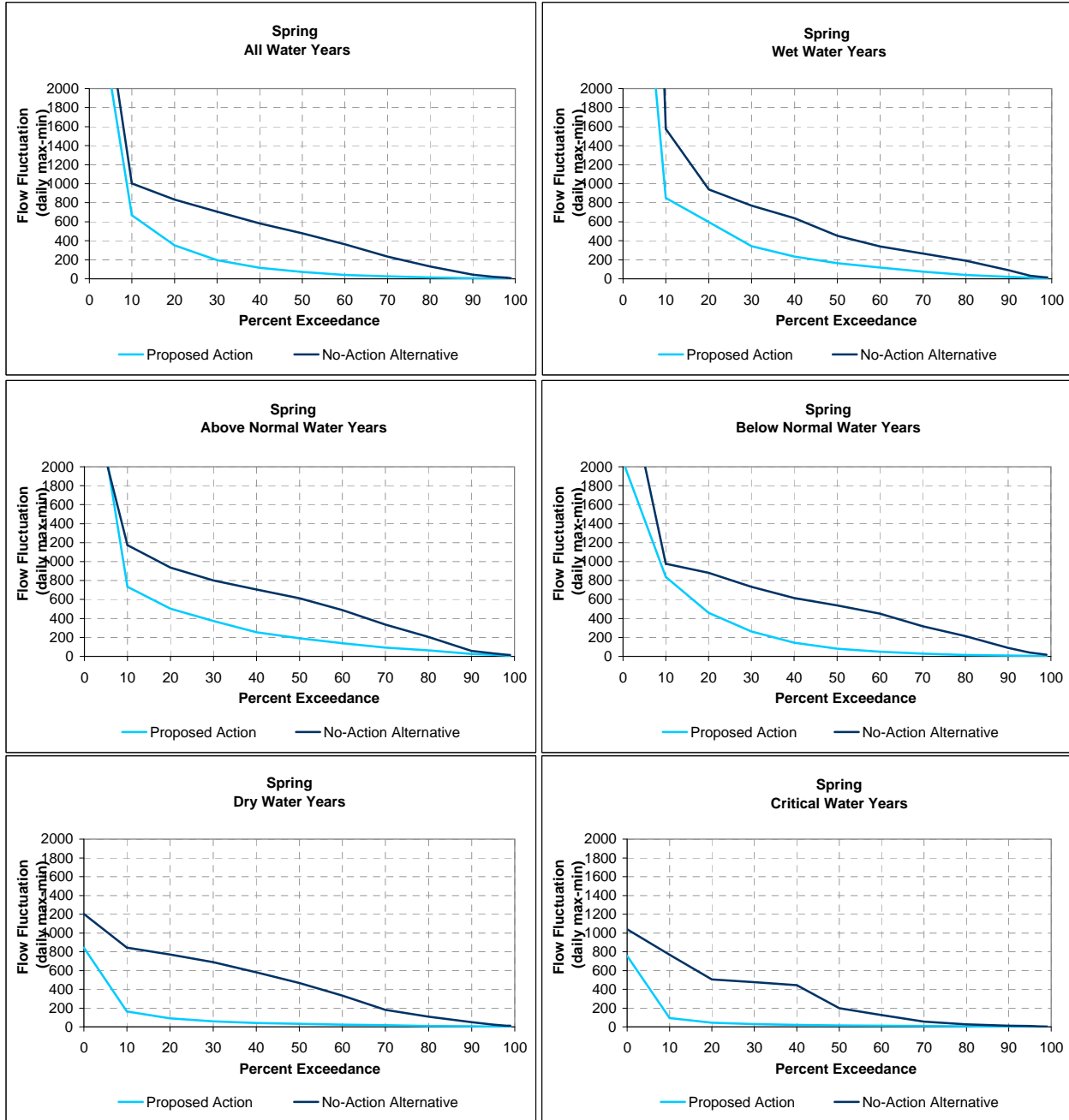
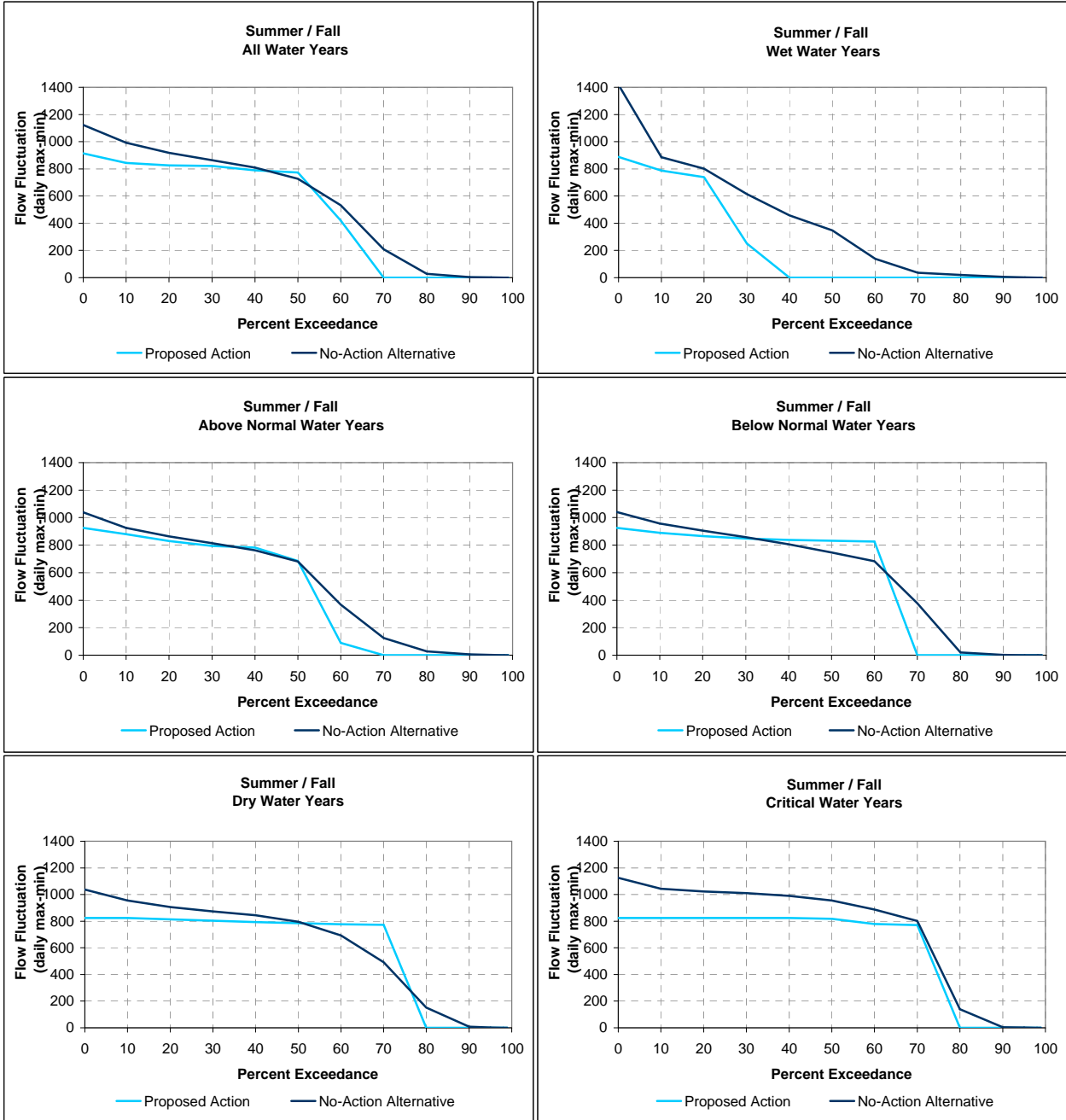


Figure 8.5-10a. Daily Flow Fluctuation (daily maximum - daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Spring¹.



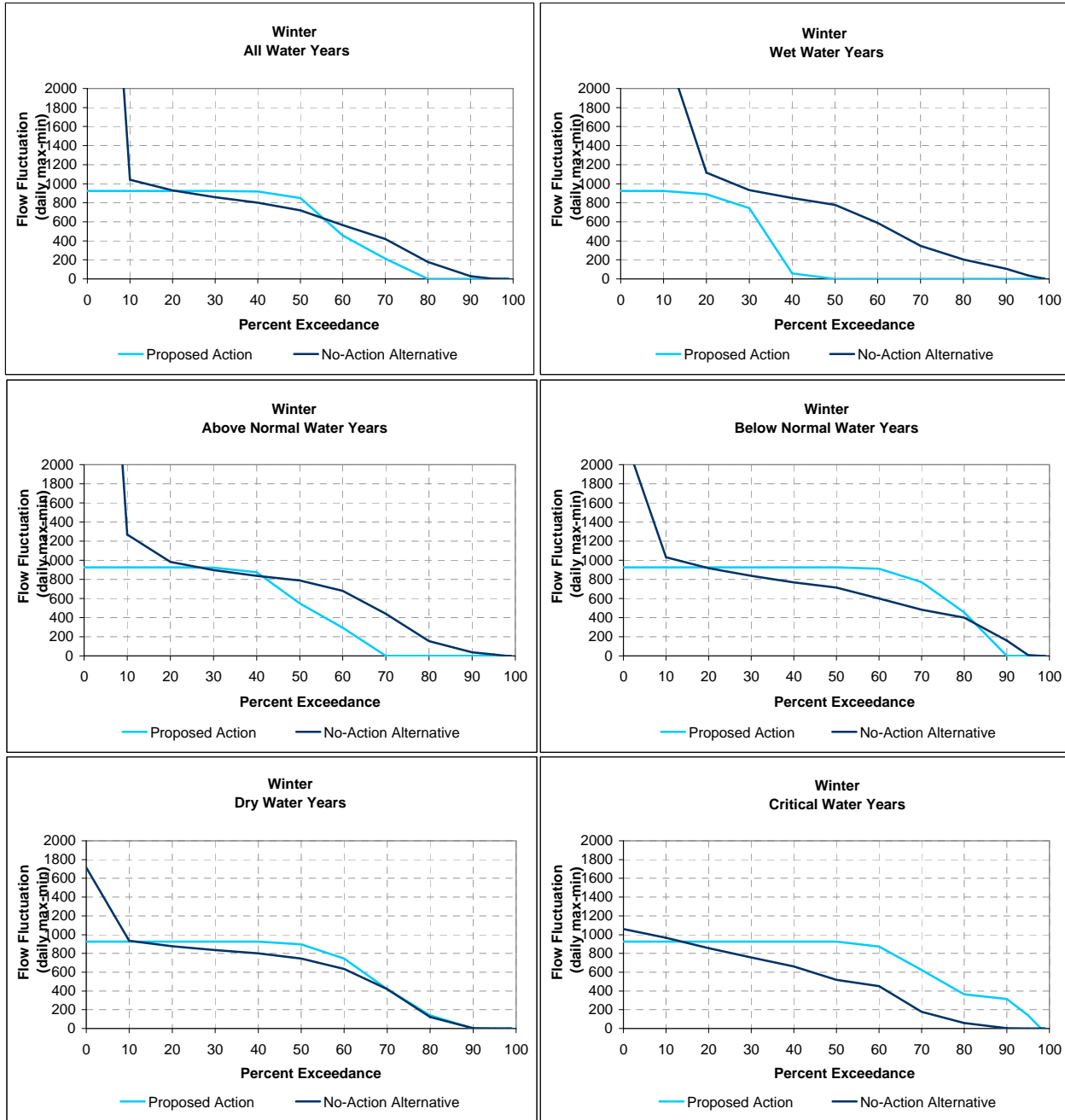
¹Spring = March - May

Figure 8.5-10b. Daily Flow Fluctuation (daily maximum - daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Summer / Fall¹.



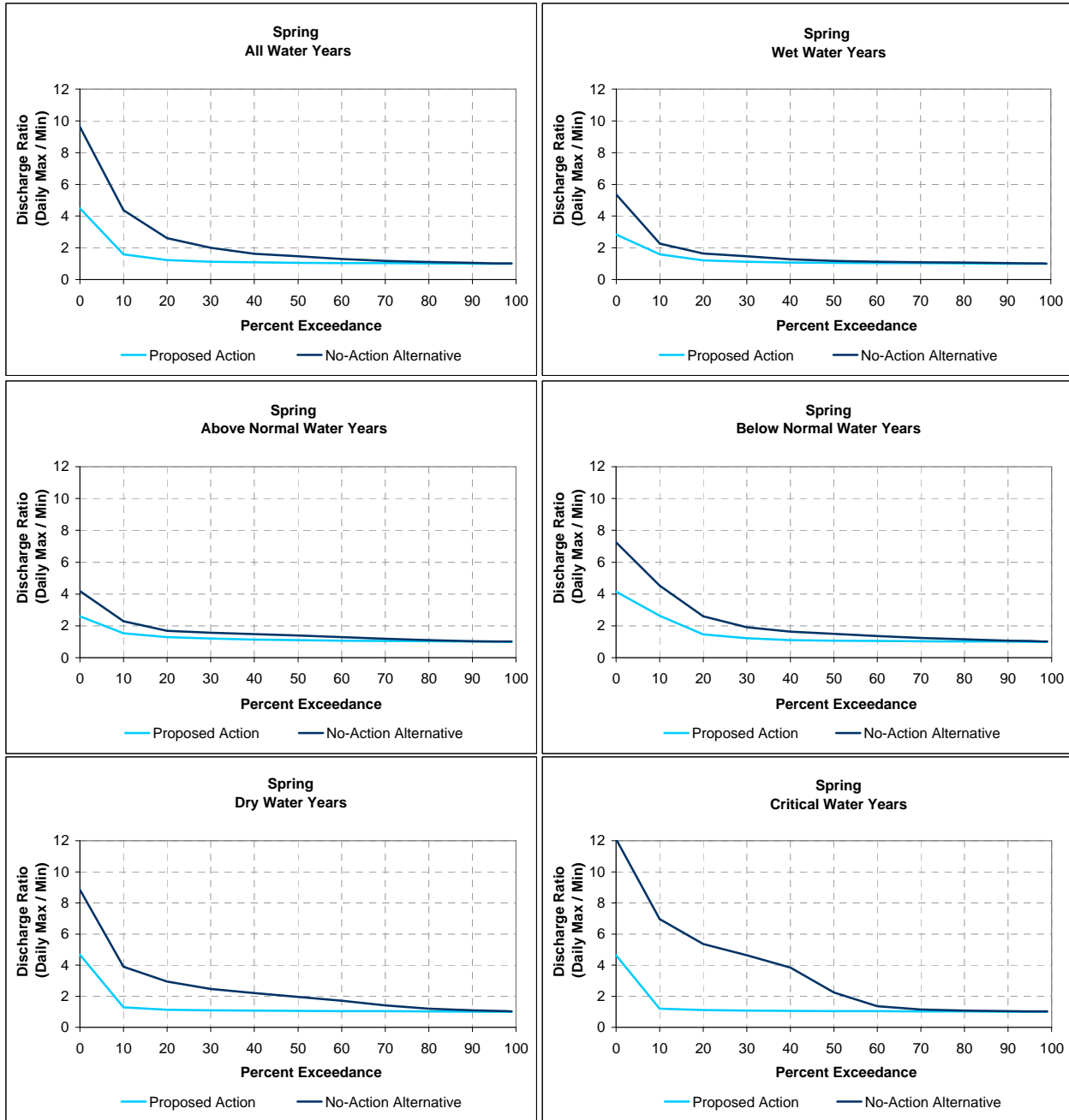
¹Summer / Fall = June - October

Figure 8.5-10c. Daily Flow Fluctuation (daily maximum - daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Winter¹.



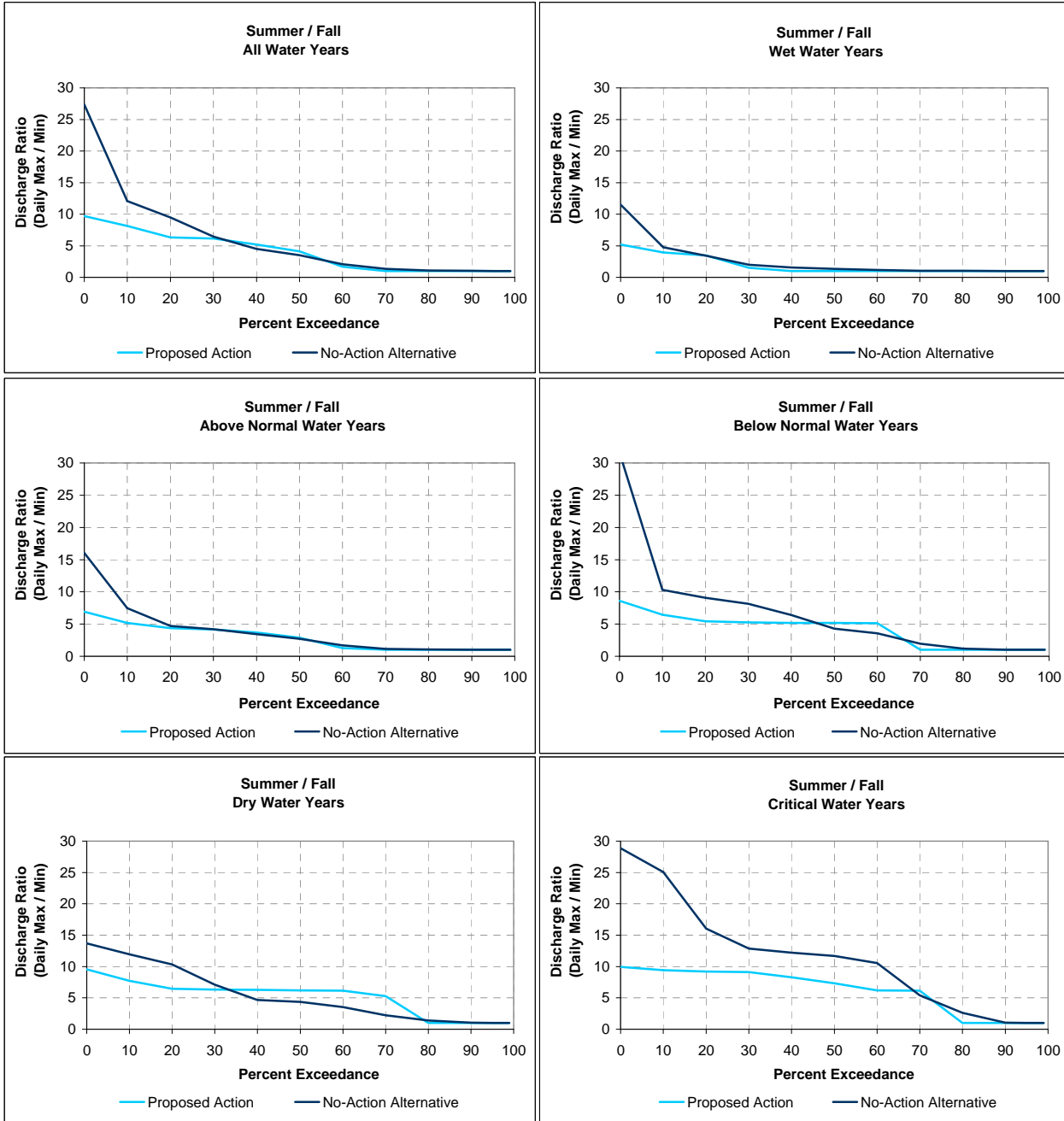
¹Winter = November - February

Figure 8.5-11a. Daily Discharge Ratio (daily maximum / daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Spring¹.



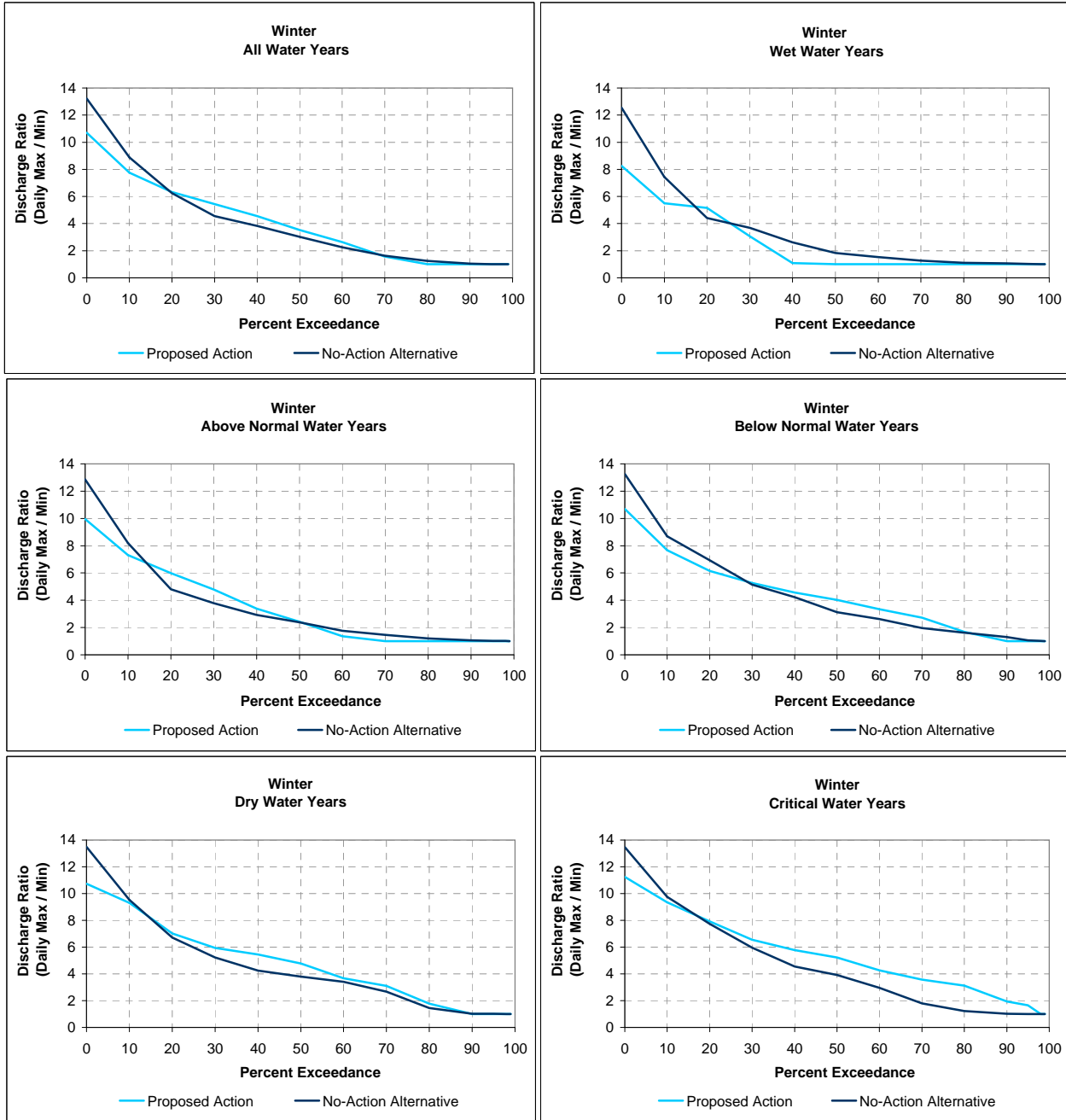
¹Spring = March - May

Figure 8.5-11b. Daily Discharge Ratio (daily maximum / daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Summer / Fall¹.



¹Summer / Fall = June - October

Figure 8.5-11c. Daily Discharge Ratio (daily maximum / daily minimum) Exceedances in the Middle Fork American River Peaking Reach by Water Year Type during the Winter¹.



¹Winter = November - February

Figure 8.5-12a. Hydrographs for the Middle Fork American Peaking Reach in Wet Water Years under the Proposed Action and No-Action Alternative.

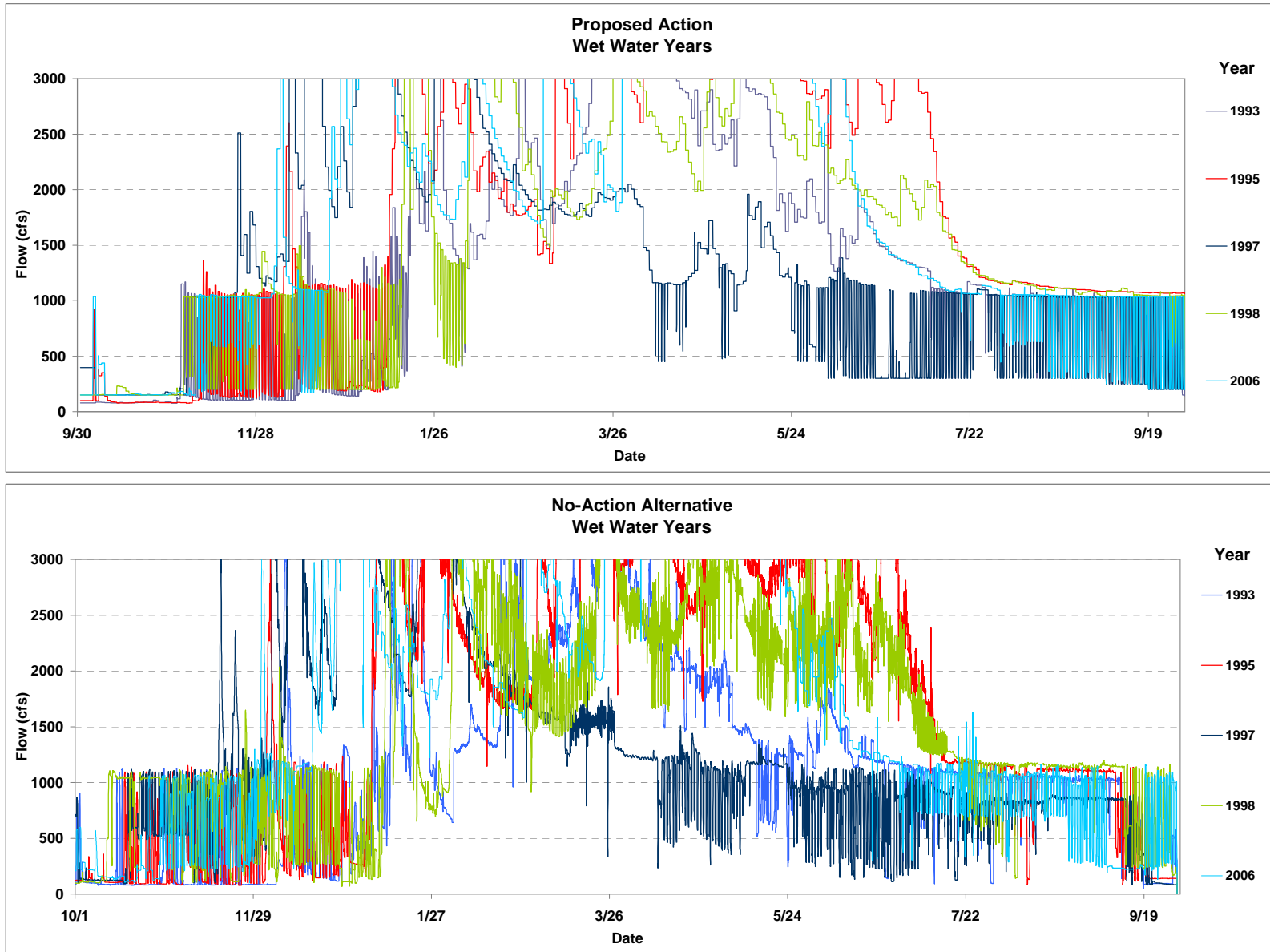


Figure 8.5-12b. Hydrographs for the Middle Fork American Peaking Reach in Above Normal Water Years under the Proposed Action and No-Action Alternative.



Figure 8.5-12c. Hydrographs for the Middle Fork American Peaking Reach in Below Normal Water Years under the Proposed Action and No-Action Alternative.

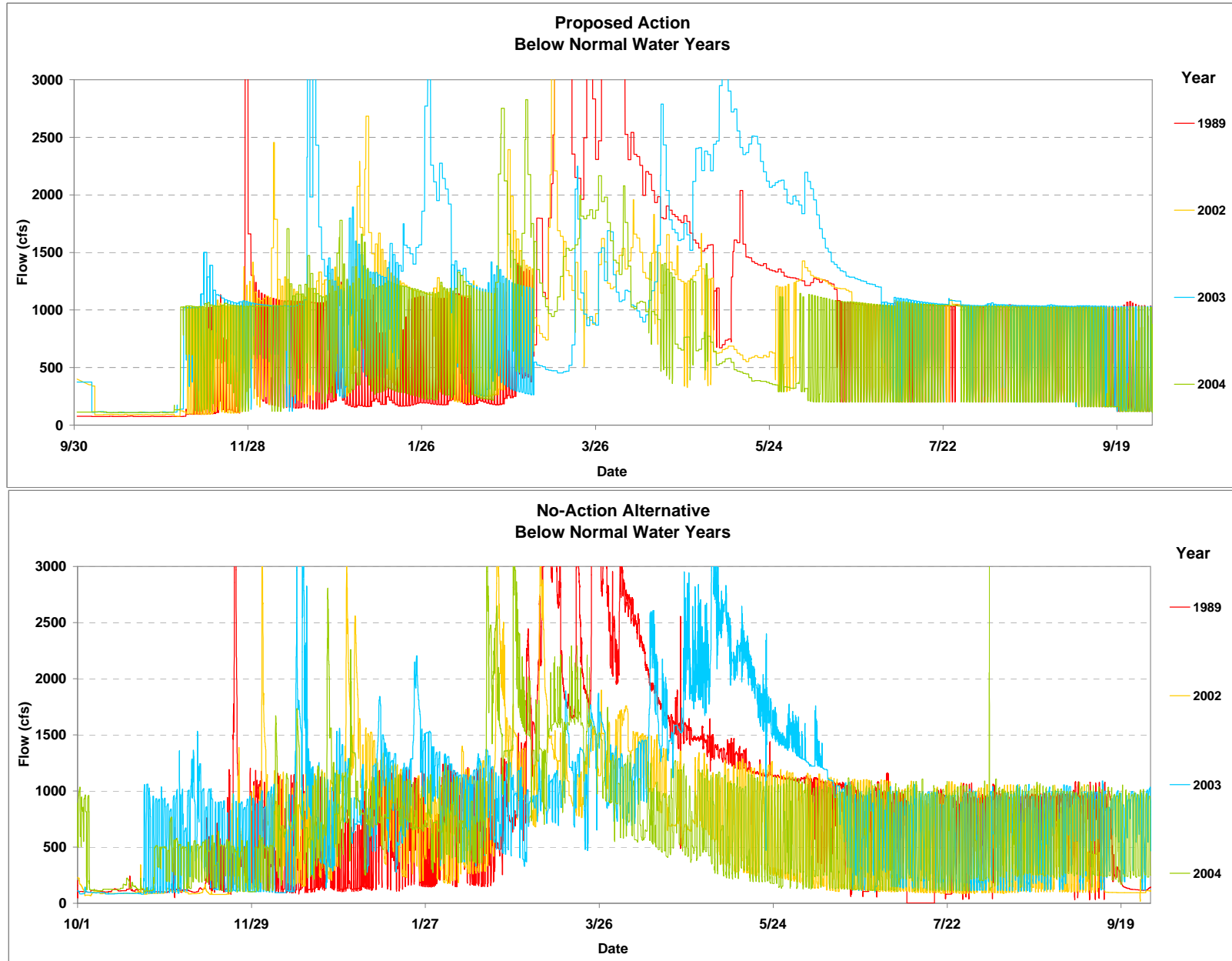


Figure 8.5-12d. Hydrographs for the Middle Fork American Peaking Reach in Dry Water Years under the Proposed Action and No-Action Alternative.

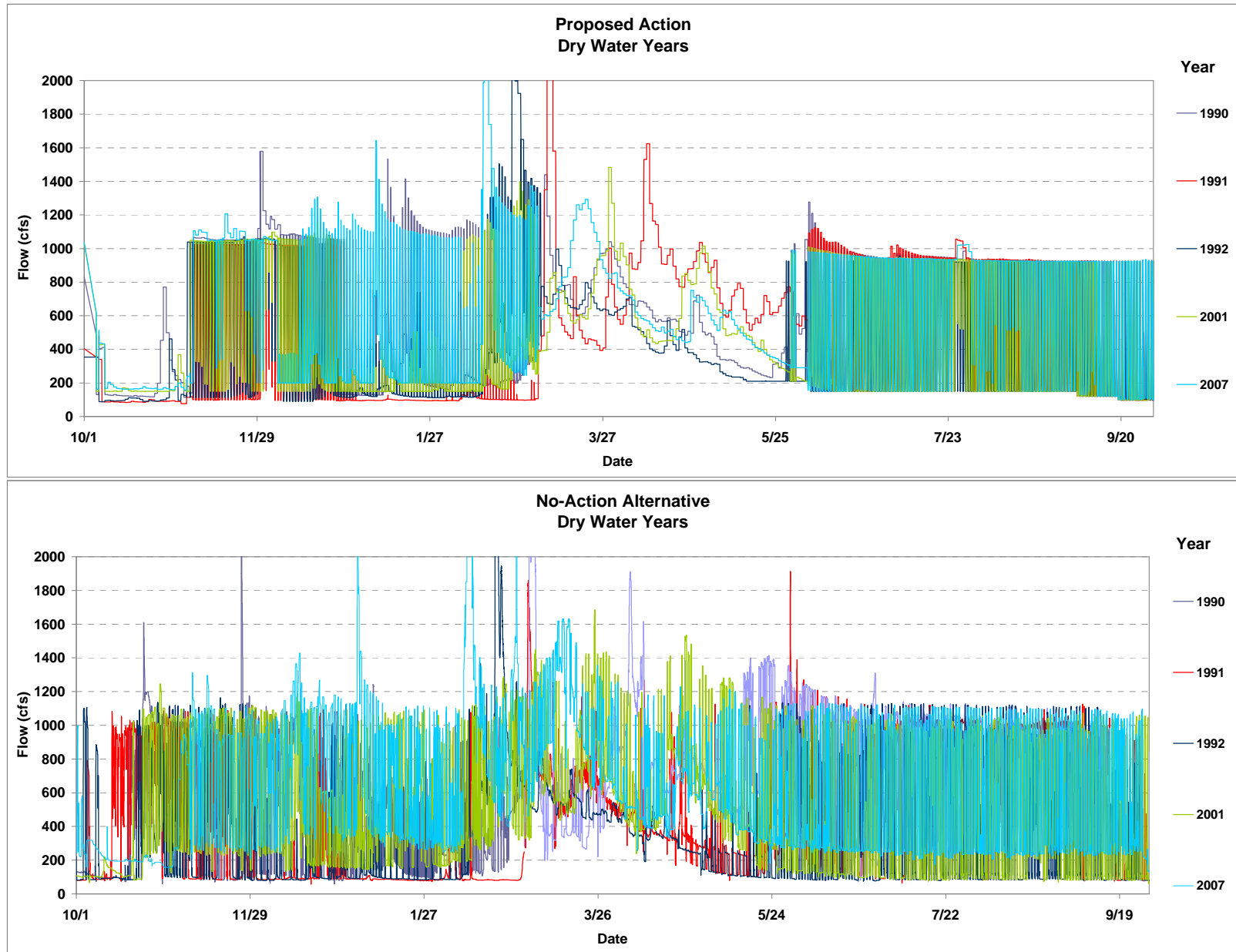


Figure 8.5-12e. Hydrographs for the Middle Fork American Peaking Reach in Critical Water Years under the Proposed Action and No-Action Alternative.



Figure 8.5-13. Proposed Action Oxbow Powerhouse Up Ramp and Down Ramp Categories Compared to 1-foot-per-hour Stage Change at Instream Flow Study Sites.

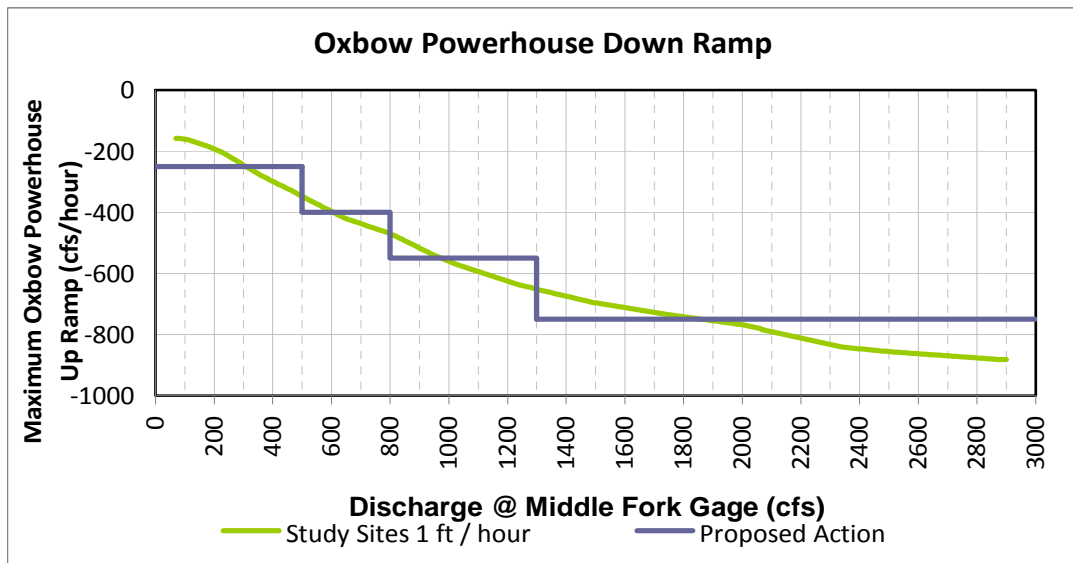
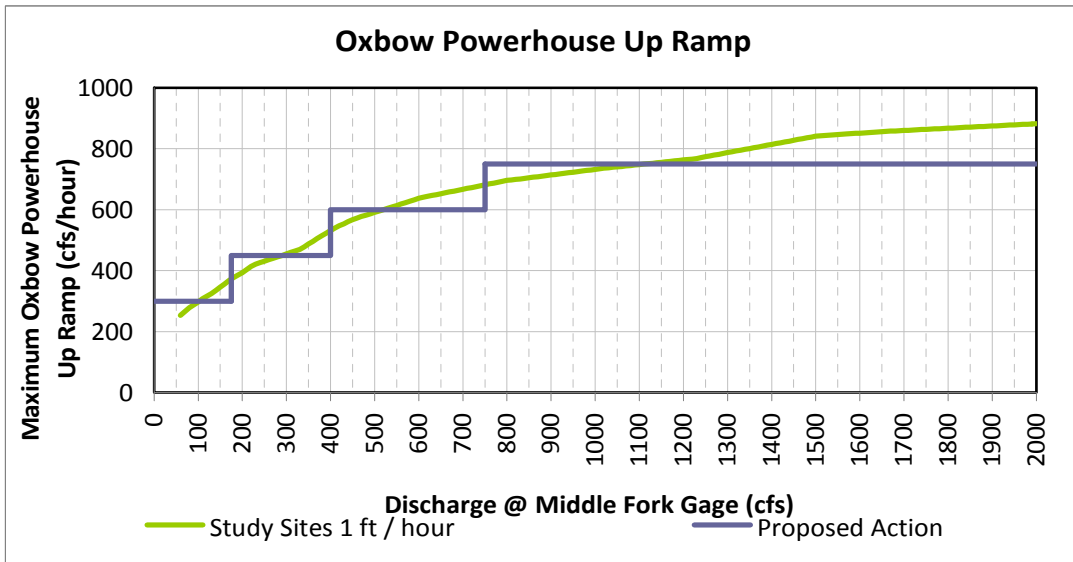


Figure 8.5-14. Maximum Daily One Hour Ramping Rates for the Proposed Aciton and No-Action Alternative during the Spring (Mar-May), Summer/Fall (Jun-Oct), and Winter (Nov-Feb).

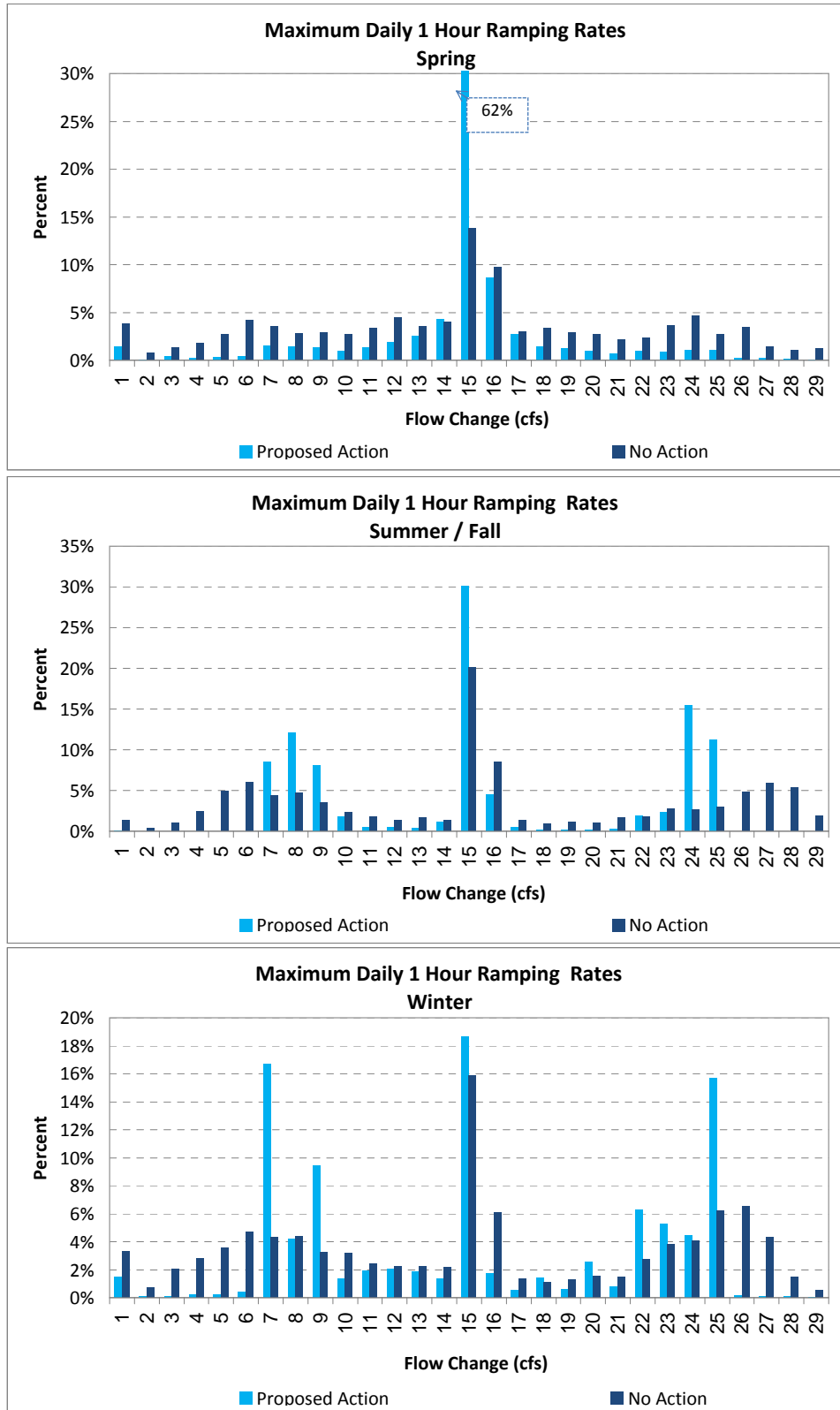


Figure 8.5-15a. Duncan Creek Resulting Effects.

Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow														
Initiation of Motion			Maintain			Maintain/Schedule								Maintain
Scouring/Resetting Flow						Maintain								Maintain
Riparian														
Recruitment (seed setting)						Enhance/Schedule								
Rainbow Trout														
Distribution														Maintain
Spawn						Enhance								
Incubation						Enhance								
Adult						Maintain			Enhance					Maintain
Juvenile														Maintain
Other Fish Species (brown trout)														Maintain
Productivity (algae and benthos)														Maintain
Recreation														
Angling														Enhance
Hydrograph (shape)						Enhance								
Water Temperature										Enhance		Maintain		

Figure 8.5-15b. South and North Fork Long Canyon Creek Resulting Effects.

Key Considerations	Winter			Spring			Summer/Fall					Winter		
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow														
Initiation of Motion	Maintain			Maintain/Schedule									Maintain	
Scouring/Resetting Flow	Maintain												Maintain	
Riparian														
Recruitment (seed setting)						Enhance/Schedule								
Rainbow Trout														
Distribution	Maintain						Maintain							
Spawn				Enhance										
Incubation				Enhance										
Adult	Maintain			Maintain			Enhance		Maintain					
Juvenile	Maintain						Maintain							
Productivity (algae and benthos)	Maintain						Maintain							
Recreation														
Angling	Enhance						Enhance							
Hydrograph (shape)				Enhance										
Water Temperature									Enhance		Maintain			

Figure 8.5-15c. Long Canyon Creek Resulting Effects.

Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow														
Initiation of Motion			Maintain			Maintain/Schedule								Maintain
Scouring/Resetting Flow			Maintain			Maintain								Maintain
Riparian														
Recruitment (seed setting)						Enhance/Schedule								
Rainbow Trout														
Distribution							Maintain							
Spawn					Enhance									
Incubation					Maintain									
Adult							Maintain							
Juvenile							Maintain							
Productivity (algae and benthos)							Maintain							
Recreation														
Angling							Maintain							
Hydrograph (shape)														
Water Temperature						Enhance			Enhance	Maintain				

Figure 8.5-15d. Middle Fork American River below French Meadows Reservoir Resulting Effects.
Middle Fork American River

Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow														
Initiation of Motion	Maintain			Maintain/Schedule									Maintain	
Scouring/Resetting Flow	Maintain												Maintain	
Riparian														
Recruitment (seed setting)						Schedule	Maintain							
Rainbow Trout														
Distribution					Maintain									
Spawn					Enhance									
Incubation					Enhance									
Adult					Maintain				Enhance				Maintain	
Juvenile					Maintain									
Other Fish Species					Maintain									
Productivity (algae and benthos)	Maintain			Enhance									Maintain	
Recreation														
Angling					Enhance									
Hydrograph (shape)					Enhance									
Water Temperature										Maintain				
French Meadows Reservoir														
Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Physical Habitat					Maintain									
Fish Species					Maintain									

Figure 8.5-15e. Middle Fork American River below Middle Fork Interbay Resulting Effects.

Key Considerations	Key Driver	Winter			Spring				Summer/Fall					Winter	
		Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow															
Initiation of Motion					Maintain		Maintain/Schedule								Maintain
Scouring/Resetting Flow					Maintain										Maintain
Riparian															
Recruitment (seed setting)							Enhance/Schedule								
Rainbow Trout															
Distribution	Upper Reach							Maintain							
Spawn					Enhance										
Incubation							Enhance								
Adult					Maintain				Enhance						Maintain
Juvenile								Maintain							
Hardhead															
Distribution	Lower Reach (0.6 mile)							Maintain							
Adult								Maintain							
Juvenile									Maintain						
Other Fish Species								Maintain							
Productivity (algae and benthos)								Maintain							
FYLF															
Distribution	Lower Reach (3 miles)							Maintain							
Breeding															
Tadpoles										Maintain					
Recreation															
Middle Fork Interbay Reservoir								Maintain							
Angling								Enhance							
Hydrograph (shape)								Enhance							
Water Temperature										Maintain					

Middle Fork Interbay

Key Considerations	Key Driver	Winter			Spring				Summer/Fall					Winter	
		Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Physical Habitat								Maintain							
Fish Species								Maintain							

Figure 8.5-15f. Rubicon River below Hell Hole Reservoir Resulting Effects.

		Rubicon River													
Key Considerations	Key Driver	Winter			Spring				Summer/Fall					Winter	
		Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow															
Initiation of Motion		Maintain			Maintain/Schedule										Maintain
Scouring/Resetting Flow		Maintain													Maintain
Riparian															
Recruitment (seed setting)							Enhance/Schedule	Maintain							
Rainbow Trout															
Distribution	Upper Reach					Maintain									
Spawn						Enhance									
Incubation						Enhance									
Adult						Maintain				Enhance				Maintain	
Juvenile						Maintain									
Hardhead															
Distribution	Lower Reach					Maintain									
Adult						Maintain									
Juvenile						Maintain									
Other Fish Species						Maintain									
Productivity (algae and benthos)	Upper Reach					Enhance									
FYLF															
Distribution	Lower Reach					Maintain									
Breeding						Maintain									
Tadpoles										Maintain					
Recreation															
Angling						Enhance									
Hydrograph (shape)						Enhance									
Water Temperature											Maintain				

		Hell Hole Reservoir													
Key Considerations	Key Driver	Winter			Spring				Summer/Fall					Winter	
		Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Physical Habitat						Maintain									
Fish Species						Maintain									

Figure 8.5-15g. Middle Fork American River below Ralston Afterbay (Peaking Reach) Resulting Effects.

Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Channel/Riparian Maintenance Flow														
Initiation of Motion				Maintain										Maintain
Scouring/Resetting Flow				Maintain										Maintain
Riparian														
Recruitment (seed setting)						Maintain								
Rainbow Trout														
Distribution							Maintain							
Spawn				Enhance										
Incubation				Enhance										
Adult							Maintain							
Juvenile							Maintain							
Fry							Enhance							
Hardhead/Pikeminnow														
Distribution							Maintain							
Adult							Maintain							
Juvenile							Maintain							
Other Fish Species							Maintain							
Productivity (algae and benthos)							Enhance							
FYLF														
Distribution							Maintain							
Breeding						Maintain								
Tadpoles							Maintain							
Recreation														
Angling							Enhance							
Ramping Rate							Enhance							
Hydrograph														
Fluctuations (reduced)							Enhance							
Seasonal Shape							Maintain							
Water Temperature									Maintain					

Ralston Afterbay

Key Considerations	Winter			Spring				Summer/Fall					Winter	
	Jan	Feb	Mar	Mar	Apr	May	Jun	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Physical Habitat								Maintain						
Fish Species								Maintain						