DRAFT Recommendations for Sacramento River Bypass Flows

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Sacramento River flows support a variety of ecological functions. These functions include, but are not limited to, the transport of nutrients (organic material, phytoplankton, zooplankton, macroinvertebrates) from the upper regions of the watershed, including seasonally inundated floodplains, transport and dispersal of fish eggs and larvae (e.g., larval delta and longfin smelt from spawning areas within the river and adjacent areas (e.g., Cache Slough complex) downstream into the estuarine rearing habitat, and as a migration corridor and rearing habitat for juvenile fish such as salmon and steelhead, as well as a migration pathway for adult migration or upstream spawning habitat. In addition, river flows support geomorphic processes, affect tidal hydrodynamics, and other physical riverine processes. These factors combine to affect the seasonal and interannual variability in habitat conditions and functions of the river for covered fish species and their food supplies. The importance of these seasonal flow conditions varies in response to the seasonal timing and life history characteristics of each of the covered species. The primary period of the year when riverine habitat is most important to spawning, juvenile rearing, larval transport, and juvenile migration extends from the late winter (e.g., December-February) through spring (May-June) depending on the specific species and lifestage of interest as well as variability among years in response to factors such as variation in water temperatures and hydrology. Consideration of these biologic processes, habitat requirements, and the response of different species and life stages of covered fish were used, in combination with results of hydrologic model simulations to develop recommended bypass flows for operation of one or more water diversions located on the Sacramento River in the reach from Walnut Grove to Freeport. Consideration was also given in developing the recommendations for Sacramento River bypass flows on the interactions and affects of habitat modifications in the northern region of the Delta (e.g., expansion of the Cache Slough tidal marsh) on tidal dynamics and water velocities occurring in the mainstem Sacramento River as well as areas such as Sutter and Steamboat sloughs.

Factors considered in developing the recommended Sacramento River bypass flow included:

- Seasonal timing when various life stages of covered fish inhabit the Sacramento River in the vicinity of the proposed water diversion locations;

- Changes in the biological processes and relationship within river flow that occur seasonally (e.g., differences in the biological processes of phytoplankton and zooplankton production between winter-spring and summer-fall);

- Relationship between river bypass flow rate and constraints on water diversions and water supplies;

- The relationship between downstream transport rate of planktonic particles (simulating larval delta and longfin smelt transport between the upstream spawning areas, such as Cache Slough, and the downstream estuarine habitat where first deeding and juvenile rearing occur) and river flow rate;

- Relationship between river flow and downstream transport of nutrients and organic material during the summer and fall;

- Relationship between fall river flows and attraction and migration flows in the mainstem river for adult upstream migration by fall-run and late fall-run Chinook salmon, steelhead, delta and longfin smelt, splittail, and other upstream migrating adults;

- Relationships between river flow rate and juvenile transit time through the lower river (a factor thought to affect vulnerability to predation mortality), juvenile survival rates, and river flow;

- Relationships between river flow and habitat conditions for predatory fish (e.g., largemouth bass, pikeminnow, striped bass, smallmouth bass) in the river and sloughs;

- Relationship between river flow rate and tidal dynamics (e.g., changes in water velocity and direction in response to flood and ebb tide conditions) and the river flows at various potential diversion locations that maintain a net unidirectional downstream flow over all tidal conditions;

- Relationship between mainstem river flows and seasonal flows into a floodplain habitat such as the Yolo Bypass and the resultant effects on hydrodynamic conditions in the river at the points of diversion;

- Relationship between existing and expanded tidal marsh habitat (e.g., 10,000-20,000 additional acres of tidally inundated shallow water habitat) within the Cache Slough complex and tidal hydrodynamics within the river at various potential points of diversion;

- Relationship between river flow, channel geometry, and resulting sweeping velocities across a positive barrier fish screen at each potential diversion location. Sweeping velocity is intended to help remove accumulated debris from the fish screen surface to maintain approach velocities and to help transport fish downstream and reduce their exposure to entrainment and impingement at the diversion.

Results of hydrodynamic simulation modeling allow predictions of the relationship between Sacramento River flow rates at Freeport and the various metrics and biological and water supply objectives outlined above. The Sacramento River bypass flow is intended to serve as an operational parameter for regulating water diversion operations in a way that minimize and reduce the effects of diversions on hydrodynamics (e.g., reduce Sacramento River flow downstream of the point of diversion) needed to support functions within the river. The bypass flow for the Sacramento River acts as an operational criteria in which water diversions would only occur when flows were maintained above the minimum bypass flow rate. The minimum bypass flow rate acts as a restriction on water diversions during those years and seasons when flow in the Sacramento River is low. In addition to establishing the minimum bypass flow rate as an operating criterion, at least two additional operating considerations exist in response to low river flow conditions. The first operational condition is preferential operation on one or more diversions located further upstream (e.g., near Freeport) to reduce the effects of low river flow on tidal reversal in the vicinity of the diversion (maintain positive downstream flows across the intake structures and reduce the likelihood that larval and juvenile fish will move upstream into the area of potential entrainment/impingement at the diversion). Results of hydrodynamic modeling show that a higher level of river flow needs to me maintained to avoid tidal flow reversal further downstream (e.g., near Walnut Grove) when compared to the flow needed to maintain downstream river flows further upstream. The second operational response to low river flow conditions would be to implement preferential diversion operations in response to tidal conditions (e.g., divert water during ebb tide stage to maintain sweeping velocity and avoid tidal flow reversal) and then reduce or curtail diversion during the flood tide stage. Based on these and other considerations the following recommendations (depicted graphically in Figure 1) are offered for Sacramento River bypass flows as part of the initial phase, recognizing that further modeling and analyses will be required to assess the interactions among various habitat enhancements and other operating parameters that have not yet been identified, of developing the BDCP conservation plan:

- December 1 through June 30 maintain a Sacramento River bypass flow of not less than 11,000 cfs when the Yolo Bypass is not inundated and a bypass flow of not less than 9,000 cfs when flows entering the Yolo Bypass at Fremont Weir are 2000 cfs (daily average) or greater;

- July 1 through August 30 maintain a Sacramento River bypass flow of not less than 5,000 cfs;

- September 1 through November 30 maintain a Sacramento River bypass flow of not less than 7,000 cfs for fall salmon attraction and migration;

- Preferentially operated the water diversions located in the upstream reach (Hood to Freeport) when river bypass flows are less than 15,000 cfs. The northern diversions may be designed and constructed to have a larger diversion capacity than diversions located further downstream to allow greater water supply deliveries under preferential diversion operations when river flows are low. Preferential diversion operations are intended to maintain a positive net downstream flow within the river at the point of diversion under all tidal stages;

- Maintain a minimum downstream sweeping velocity of 0.8 ft/sec across operating diversions during the period from December 1 through June 30 and a minimum sweeping velocity of 0.4 ft/sec from July 1 through November 30. Sweeping velocity and bypass criteria may be met by preferentially operating the diversion during ebb tide. A flood tide (closed) and ebb tide (open) operation would likely be the preferred operation for river flows less than 20,000 cfs;

- Maintain the Delta Cross Channel gates closed from December 1 through June 30, except on weekends between May 15 and June 30 to reduce impacts to recreational boating in the area, to increase flows in the lower reaches of the Sacramento River and reduce fish and flows moving into the central Delta;

- Conduct additional hydrologic simulation and particle tracking modeling to examine the interactions among operating parameters and habitat enhancement proposals as part of re-evaluating and refining Sacramento River bypass criteria as part of an integrated BDCP process for developing final conservation actions.

- Additional criteria for percentage of Sacramento River flows above the minimum criteria that may be required to bypass the diversion need to be further analyzed and integrated into a Delta-wide conservation action (an example of such an approach is shown in Figure 2).

Figure 1. DRAFT Consultant's proposal for minimum Hood bypass flow rule

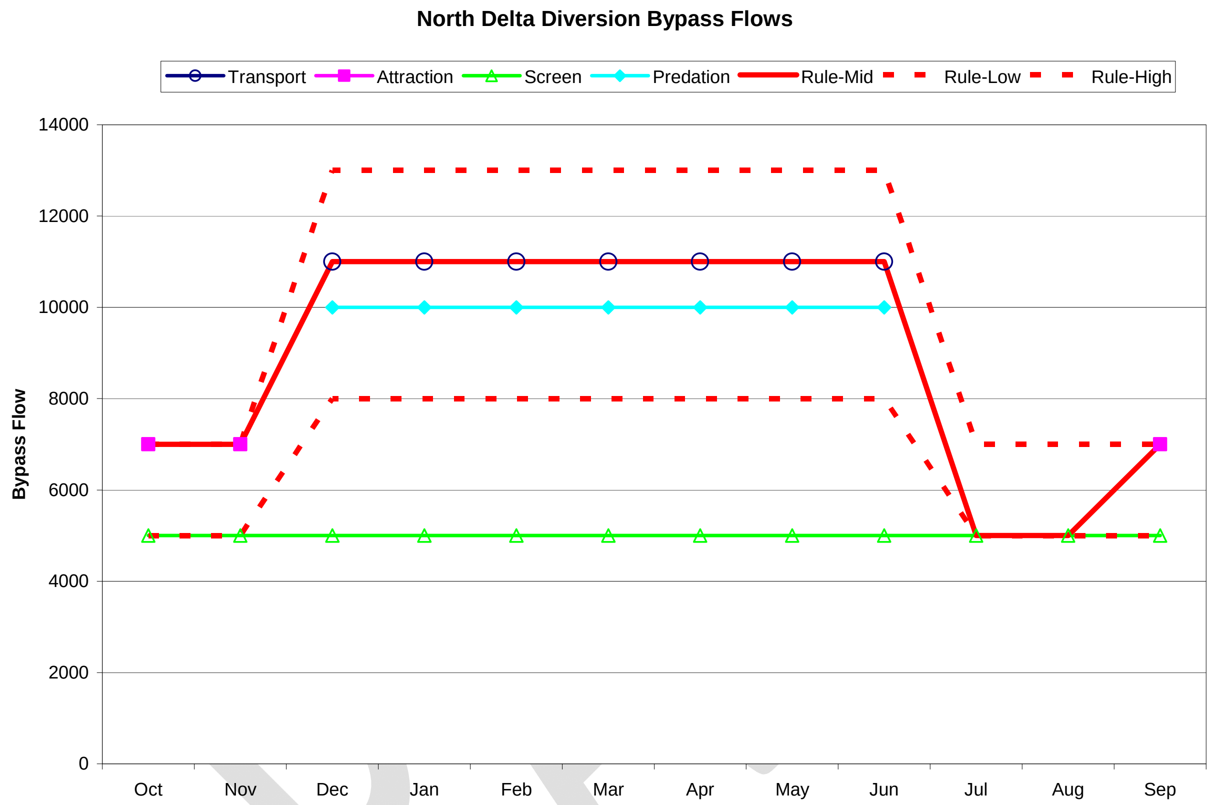

Figure 2. DRAFT Example of integrated Hood minimums and hydrologic environmental cues.