

Action I.2.4 May 15¹ Through October 31 Keswick Release Schedule (Summer Action)

Objective: To manage the cold water storage within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable spawning, egg incubation, and fry emergence habitat temperatures for winter-run and spring-run in the Sacramento River while retaining sufficient storage to manage for next year's cohorts. To the extent feasible, manage for suitable temperatures for naturally spawning fall-run.

Action: Reclamation shall develop and implement an annual Temperature Management Plan by May 15 to manage the cold water supply within Shasta Reservoir and make cold water releases from Shasta Reservoir and Spring Creek to provide suitable temperatures for listed species, and, when feasible, fall-run.

Reclamation shall manage operations in the Sacramento River as follows:

- 1) Not exceed the temperature-dependent mortality objectives identified in Action I.2.1.
- 1) Not in excess of 56.0°F DAT at a compliance location between Balls Ferry and Bend Bridge from the start of winter-run spawning, based on CDFW aerial redd or carcass surveys, through 100 percent winter-run emergence for protection of winter-run, and not in excess of 56.0°F DAT at the same compliance location between Balls Ferry and Bend Bridge through October 31 for protection of mainstem spring run, whenever possible.
 - a) Reclamation shall implement a pilot study for up to 3 years to meet the temperature target of 55.0°F 7DADM at CCR. A surrogate temperature target of 53.0°F DAT may be used in lieu of 55.0°F 7DADM. This pilot would focus management on temperature management at the downstream-most winter-run redd, based on water year type, as follows:
 - i. Critically dry: < 56.0°F DAT². In this case, temperature management shall be to CCR or the downstream-most winter-run redd, whichever location is further downstream
 - ii. Dry: < 54.0°F DAT
 - iii. Below Normal: < 53.0°F DAT
 - iv. Above Normal: < 53.0°F DAT
 - v. Wet: < 53.0°F DAT
 - vi. Exception procedure: If a winter-run redd is detected considerably farther downstream than other winter-run redds, the SWIM Team shall convene pursuant to Action I.2.4(4), below, and determine if temperature management must be to that downstream most redd.

¹ This action will be initiated at the onset winter-run spawning, determined by CDFW aerial redd surveys and carcass surveys, and therefore, may be earlier or later than May 15.

² This temperature was not achievable in 2014/2015. This temperature management target in critically dry years will require interactive decision making processes to determine the optimal management strategies during extreme conditions.

- b) If Reclamation determines at anytime that it is not feasible to meet the target in the pilot study without causing significant system-wide impacts, the environment, and/or impacts to other ESA-listed species, then Reclamation shall document this finding to NMFS, and request that the pilot study be suspended for the remainder of the water year. In this event, Reclamation shall:
 - i. Submit an alternative plan for NMFS's concurrence that fully complies with all RPA requirements; and
 - ii. Submit additional modeling and analysis, with recommendations on how to further adjust the pilot study for the following year.
 - c) During the course of the first year of the pilot study, Reclamation shall develop an analysis according to a workplan developed in conjunction with NMFS. The analysis will evaluate the impacts of the revised temperature management values, locations, and metrics.
 - i. Should the analysis result in a finding that the revised temperature management compliance values, locations, and metrics would result in system-wide impacts to the environment, and/or impacts to other ESA listed species, Reclamation and NMFS will revise the pilot study, as appropriate, in light of these impacts, and also assess whether further adjustments to this RPA action are warranted. In addition, information from this pilot period will inform the larger reconsultation on CVP/SWP operations.
 - 2) Reclamation shall operate to a final Temperature Management Plan starting May 15 and ending October 31.
 - 3) Reclamation and NMFS shall convene a Shasta Water Interagency Management (SWIM) Team, comprised of representatives from Reclamation, NMFS, USFWS, CDFW, and the SWRCB, to track the implementation of the final Temperature Management Plan (including significant changes in real-time operations). The SWIM Team will utilize information from its member agencies, as well as technical information from the SRTTG and other relevant stakeholders, to inform decisions and changes in operations.
 - a) The SWIM Team will consider:
 - i. data on winter-run redd construction and egg/alevin incubation timing, location, and distribution;
 - ii. Shasta isothermalbaths;
 - iii. temperature-dependent mortality modeling results;
 - iv. actual vs. modeled Shasta cold water pool volume <49°F to ensure that actual cold water pool volume is:
 - 1. not less than 95% of modeled for wet and above normal water year types, and
 - 2. not less than 99% of modeled for critical, dry, and below normal water year types;
 - v. projected temperature control device gate operations and configurations;
 - vi. date of full side gate access, and adjust operations to ensure that full side gate access is no earlier than October 9; and
 - vii. downstream diversions, flows, and Delta requirements.
 - b) The SWIM Team will determine:
 - i. the frequency of its meetings; and

- ii. if existing interagency teams, for example, WOMT, would satisfy the requirements and expectations, above.
- 4) As part of the adaptive management process, and in coordination with NMFS, by March 2010, Reclamation shall fund an independent modeler to review these procedures and the recommendations of the Calfed Science Panel report on temperature management and recommend specific refinements to these procedures to achieve optimal temperature management, with due consideration of the Calfed Science panel's recommendations (Deas *et al.*, 2009) regarding temperature management. Upon written concurrence of NMFS, refinements to the implementation procedures for this action suite, based on the independent contractor's report, may be adopted and implemented.
 - a) Reclamation, in coordination with NMFS and the Sacramento River Settlement Contractors, shall develop and implement a work plan for Shasta and Trinity divisions seasonal operational water temperature modeling. The resulting water temperature modeling shall support better initial forecasting and decision making, to include uncertainty estimates, joint probabilities of risk, and estimates of Shasta Reservoir stratification. Any temperature model developed through this effort shall utilize a platform so that it can be independently run.

Implementation Procedures: Reclamation shall take the following steps to develop an annual Temperature Management plan:

- 1) By April 25, Reclamation shall develop and submit to NMFS a draft Temperature Management Plan, to include:
 - a) both 50 percent and 90 percent forecasts, including EOS storages, consistent with its draft plan of summer operations.
 - b) outputs that demonstrate that the objectives in Action I.2.1 have a high probability of being met.
- 2) NMFS will provide comments within five business days to Reclamation, recommending that Reclamation either: (a) operate to one of the options; or (b) develop an alternative operations plan necessary to meet reasonably attainable preferred TCP and EOS storage.
- 3) Within five business days of receiving NMFS' recommendations, and based on NMFS's comments, Reclamation will develop an operations plan with specific monthly average Keswick releases to attain both TCP from May 15 through the EOS and EOS storage, and submit the plan to NMFS for concurrence.
- 4) By May 15, Reclamation and NMFS shall jointly submit a final Temperature Management Plan to meet the SWRCB 90-5 requirements using the SRTTG. From May 15 through October 31, the SWIM Team shall track implementation of this plan, and shall refine it based on real-time information, including run timing, location of redds, air and surface water temperature modeling, and projected versus actual extent of the cold water pool.
- 5) The temperature management plan shall also include the projected volume of cold water to be tracked, and triggers and corresponding actions if the volume is less than projected³.

Rationale: Depending on hydrology and air temperature, from May through October, it is necessary to use the cold water pool in Shasta Reservoir to provide cold water releases to

³ This approach was piloted successfully in summer 2015.

maintain suitable water temperatures for listed anadromous fish below Shasta. Without access to the cold water pool, suitable temperatures for spawning, egg incubation, and fry emergence are not attainable. Preparation of an annual Temperature Management Plan allows Reclamation, in consultation with NMFS, to achieve optimal cold water management in a given year and conserving EOS storage. The storage level at the EOS is important to manage the risk of unsuitably warm water temperatures for winter-run in the following summer. Maintaining suitable temperatures in September and October is also important to minimize adverse effects of project operations to main stem Sacramento River spring-run. Fall-run, a non-listed species that is important as a prey base for Southern Resident killer whales, also benefits from suitable temperatures in the Fall.

Development of 2 to 4 options for temperature management, prior to finalizing a plan allows for meaningful discussion of appropriate risk management strategies in a given year, based on timely hydrologic and biological considerations. Important factors differ from year to year, and need to be considered in operations planning. They include timing and location of spawning and redds based on aerial surveys; the extent of the cold water pool, given air temperatures; and operation of the Temperature Control Device to provide optimal use of the cold water pool. Preparation of a draft plan also allows for iterative planning and feedback. Operations can be tailored each year to achieve the optimal approach to temperature management to maintain viable populations of anadromous fish, based on the best available information.

The CalFed Science Program peer review report on temperature management emphasized the importance of refining temperature management practices in the long term and included recommendations for doing so. The requirement to hire an independent contractor to recommend specific refinements to the procedures in this RPA responds to these recommendations.

Rationale for 2017 Amendment:

- Best available science (*e.g.*, Martin *et al.* 2016⁴) and monitoring (*e.g.*, rotary screw trapping at Red Bluff Diversion Dam) since issuance of the 2009 CVP/SWP operations Opinion have indicated that 56°F DAT is not as protective as historically required for minimizing adverse temperature related effects on incubating eggs and alevin. Martin *et al.* (2016) predicted that the slower flowing water in the river would not supply the oxygen needed for egg viability in elevated temperature conditions, and that field studies found that the slower flow in the river equated to about a 3°C difference in the temperature tolerance of eggs.
- EPA (2003) recommends 55°F 7DADM for incubating Chinook salmon eggs and alevin. Anderson *et al.* (2010, 2011) and EPA (2003) recommend temperature management to the downstream most redds.
- A DAT (maintaining 56.0°F further downstream or 53°F at the downstream-most redd) is provided as a surrogate to 55.0°F 7DADM to provide operational flexibility and allow for a pilot study to be conducted.

⁴ Martin, B. T., A. Pike, S. N. John, N. Hamda, J. Roberts, S. T. Lindley, and E. M. Danner. 2016. Phenomenological vs. biophysical models of thermal stress in aquatic eggs. *Ecology Letters* (2016).

- The SWIM Team was created in 2016 to monitor the implementation of the Sacramento River temperature management plan. The SWIM Team member agencies found the regular meetings helpful in both accountability to the temperature management plan, and also would provide the member agencies enough time in case operational adjustments are necessary.