UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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JAN 2 9 2015

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Mr. Mark Cowin
Director
California Department of Water Resources
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Sacramento, California 95814

Re: Interim Contingency Plan for February and March Pursuant to Reasonable and Prudent Alternative Action I.2.3.C of NOAA's National Marine Fisheries Service's 2009 Coordinated Long-term Operation of the Central Valley Project and State Water Project Biological Opinion

Dear Mr. Murillo and Mr. Cowin:

This letter is in response to your January 27, 2015, letter and enclosures: (1) Temporary Urgent Change Petition (TUC Petition) dated January 23, 2015; (2) Project Description for February – March 2015 Drought Response Actions To Support Endangered Species Act Consultations (Project Description); and (3) Salmonid and Green Sturgeon Supporting Information for Endangered Species Act Compliances for Temporary Urgency Change Petition Regarding Delta Water Quality (Biological Review). The TUC Petition outlines the U.S. Bureau of Reclamation's (Reclamation) and California Department of Water Resources' (DWR) requested approval from the State Water Resources Control Board (State Board) for temporary modification to the Water Rights Decision 1641 (D-1641) permit terms related to the Delta outflow, export limits, Delta Cross Channel (DCC) gate operations and Vernalis flow standards described in D-1641, Table 3, for the months of February and March 2015. The Project Description provides additional details regarding the specific TUC Petition requests for February and March 2015, and in addition, includes: (1) a description of a framework for future requests for Old and Middle River flow management flexibility; and (2) identification of potential operations that may be implemented in 2015 and beyond to address the ongoing drought conditions or to help recover from the conditions created from the previous three years of drought, in the event the hydrology becomes wetter.

Reclamation requests NOAA's National Marine Fisheries Service's (NMFS) concurrence that the TUC Petition, serving as the drought contingency plan is consistent with the provisions of NMFS' June 4, 2009, biological and conference opinion on the long-term operation of the Central Valley Project (CVP) and State Water Project (SWP, CVP/SWP Opinion), reasonable

and prudent alternative (RPA) Action I.2.3.C. NMFS received subsequent clarification from Reclamation that the Project Description, including the TUC Petition and the supporting Biological Review, serves as the interim contingency plan for February and March 2015.

We are aware that California continues to face critically dry conditions in the current water year in what could be its fourth straight year of below-average rainfall and very low snowmelt runoff. Water year 2014 was the fourth driest year in recorded history for California (after 1924, 1931, and 1977 based on the Sacramento Valley water year index), resulting in the low initial storage at the beginning of water year 2015. Although November and December 2014 storms brought much needed precipitation, the State's overall water storage levels remain far below that which would be necessary to supply human needs, repel saltwater intrusion to the Delta, and provide for cold water necessary for listed fish. In light of the continuing dry conditions, NMFS reaffirms its commitment to provide assistance in managing natural resources in California during the drought.

Considering the potential for extremely dry hydrological conditions to occur in California, NMFS built flexible drought provisions into the CVP/SWP Opinion and its reasonable and prudent alternative (RPA). The RPA Action I.2.3.C (pages 26-27 of the 2009 RPA with 2011 amendments) provides drought exception procedures and requires that Reclamation develop and submit to NMFS a contingency plan. The rationale for this action explicitly recognizes that in drought conditions, there is potential for conflict between the need to maintain storage at Shasta Reservoir and other legal and ecological requirements in the Delta, including outflow and salinity standards. This RPA provision is triggered if the February forecast, based on 90 percent hydrology, shows that the Clear Creek temperature compliance point or 1.9 million acre-feet (MAF) end of September storage at Shasta Reservoir is not achievable.

Although the February forecast will not be available for several weeks, the January 90 percent exceedance hydrology forecast, included with the January 15 Drought Contingency Plan (http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/docs/2015_drought_contingency_plan.pdf) indicates that the end of September 2015 storage in Shasta Reservoir will be approximately 1.875 MAF. The weather and lack of precipitation throughout January indicates that the February forecast will show reduced storage levels compared to those described in the January forecast. We agree with your determination that given the current and forecasted hydrology, Reclamation will not likely meet the Shasta Reservoir storage requirement and maintain Delta outflow and water quality standards requirements pursuant to D-1641, and that Action I.2.3.C is triggered.

The Project Description meets all of the required aspects of the contingency plan required in Action I.2.3.C, as follows:

- By March 1, 2015, Reclamation will update the interim contingency plan as per RPA Action I.2.3.C.
- Reclamation commits to target a navigation control point at Wilkins Slough not to exceed 4,000 cfs during the month of February.

- On January 23, 2015, Reclamation and DWR filed a TUC Petition to the State Board that considers additional technological and operational measures that may increase the ability to manage the cold water pool by modifying D-1641 requirements.
- The TUC Petition also serves to notify the State Board that meeting the biological needs of winter-run and the needs of resident species in the Delta, delivery of water to nondiscretionary Sacramento Settlement Contractors, and Delta outflow requirements per D-1641, may be in conflict in the coming season, and requests the Board's assistance in determining appropriate contingency measures and exercising their authorities to put these measures in place.

Based on Reclamation's January 27, 2015, transmittal letter, the TUC Petition, the Project Description, and the Biological Review, the following summarizes Reclamation's proposals for NMFS concurrence under RPA Action I.2.3.C:

- Outflow: The February and March outflow requirements would be modified to require the Net Delta Outflow Index (NDOI) be no less than 4,000 cubic feet per second (cfs) on a monthly average.
- Exports: Combined exports would be limited to a health and safety level (*i.e.*, 1,500 cfs) if the DCC gates are open or if outflow is between 4,000 cfs and 5,500 cfs. An intermediate combined export level of no greater than 3,500 cfs would apply if outflow is greater than 5,500 cfs but less than 7,100 cfs, and if the DCC gates are closed.
- DCC gate operations: The DCC gates may be opened during February and March as necessary to preserve limited storage in upstream reservoirs and reduce intrusion of high salinity water into the Delta, as determined through the Real-Time Drought Operations Management (RTDOT) process and the DCC gate triggers matrix[1] (enclosure).
- Vernalis: The Vernalis flow objective would be reduced to a minimum of 500 cfs on a monthly average.
- OMR: OMR measures in the Biop may be adjusted for limited periods to capture inflow associated with sporadic storms. The proposal contains a framework for developing specific requests for OMR flow management flexibility based on real-time forecasting of hydrology and fish conditions. If conditions warrant, these requests will be developed and analyzed as soon as the forecasts indicate that such flexibility may be utilized.
- Programmatic Considerations: The Project Description also identifies programmatic considerations that highlight specific actions and factors that may be considered throughout 2015, and identifies actions that may be included in future consultations, if necessary. The list was not intended to be a fully inclusive list, nor does inclusion in the list mean the agencies will implement these actions. Reclamation and DWR are not proposing these actions at this time, however these actions are considered in looking at the future status of the species in the accompanying Biological Review, in assessing the effects on species of the specific actions proposed in February and March 2015.

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[1] The Matrix of Triggers for Delta Cross Channel Gate Operations was provided as Appendix G to the April 8, 2014, Drought Operations Plan, and to be applied April 1 through November 15, 2014. However, in consideration of the DCC gate operations for water year 2015, Reclamation, DWR, NMFS, USFWS, and CDFW have agreed that the matrix would still be applicable and an important component of DCC gate operations when the default operation is for the DCC gates to be closed.

On or about February 15, Reclamation will consult with NMFS on its February forecast according to the process provided in RPA Action I.2.3. Consistent with past practice and the RPA, we expect that Reclamation will make its February 15 forecast of deliverable water based on at least as conservative as the 90 percent probability of exceedance. Reclamation's associated Sacramento River temperature modeling runs will provide a projection of temperature management operations for the summer months. As required by Action I.2.3, NMFS will review the draft February forecast to determine whether the predicted delivery schedule is likely to leave sufficient water for temperature management to meet ESA requirements. In addition, throughout much of the summer of 2014, actual water temperatures, as monitored through the California Data Exchange Center, were upwards of 4°F higher than Sacramento River temperature modeling results. As part of the February forecast, NMFS expects an update on Reclamation's effort to recalibrate its Sacramento River temperature model, as provided in monitoring action IV.B.i.2.b (page 23) in the *Central Valley Project and State Water Project Drought Contingency Biological Monitoring Plan for Water Year 2015 and Beyond* (WY2015 Monitoring Plan, http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf). As the Biological Review and NMFS' juvenile production estimate (JPE) letter[2] describe, the egg and fry life history stages of winter-run in broodyear 2014 experienced approximately 95% temperature-related mortality last year – far greater than what was predicted by last year's forecast. Therefore, it will be critically important to enhance the accuracy of temperature effects associated with this year's February forecast and associated allocation decisions.

In the TUC Petition, Reclamation and DWR have also proposed that anticipated future requests submitted to the State Board will be developed through the existing multi-party coordination process, the RTDOT. This team of managers from Reclamation, DWR, State Board, California Department of Fish and Wildlife, NMFS, and the U.S. Fish and Wildlife Service is tasked with coordinating the management of water supplies and the protection of natural resources during the course of the declared drought emergency. NMFS agrees with the recommendation that the RTDOT continue to meet at least weekly. Among other topics, the RTDOT should address the following:

- Implement the Old and Middle River (OMR) flow management consultation framework, and specifically, the streamlined OMR consultation framework, if OMR flexibilities are warranted, as follows:
    1. Identify upcoming storm events;
    2. Evaluate forecasted run-off and anticipated available in-Delta flows;
    3. Develop and model a specific OMR and outflow proposal, including specific proposed OMR flow and expected duration of action;
    4. Finalize proposed project description; and
    5. Prepare listed species and critical habitat biological review including:
        - Existing Delta conditions and supporting hydrodynamic modeling;
        - Species distribution and risk of entrainment in the South and Central Delta

[2] January 16, 2015, letter from NMFS to Reclamation providing the juvenile production estimate for winter-run Chinook salmon in broodyear 2014 (2015,http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/20150116_nmfs_winter-run_juvenile_production_estimate_nr.pdf).

- o Particle Tracking Model (PTM) results, including enhanced PTM if available for salmonids;
- o Discussion of any existing RPA action that may be in place and any associated effects analysis that provides biological support for a deviation from that action.

If Reclamation and DWR determine through the described streamlined process that OMR flexibility is warranted, then Reclamation and DWR will describe the requested flexibility in a written request to NMFS that provides the information described above. USFWS and NMFS will provide an evaluation of the anticipated effects of the action on listed species and critical habitats. DWR and CDFW will undertake a similar process for CESA. In addition, in anticipation of an OMR flexibility, Reclamation shall initiate the monitoring to support and evaluate OMR flow Management (starting on page 18 in the Central Valley Project and State Water Project Drought Contingency Biological Monitoring Plan For Water Year 2015 and Beyond, http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf).

- Implement the DCC gate operations matrix and evaluate whether adjustments are warranted to provide a reasonable balance between fisheries protection and providing operational flexibility for the operation of the DCC gates to ameliorate water quality issues in the central and southern Delta.
- Further delineate the programmatic considerations on pages 5-8 in the Project Description, for example, flexibility with San Joaquin inflow-to-export ratio RPA Action IV.2.1, preferential pumping, and temporary emergency drought barriers.

The Biological Review submitted with Reclamation's letter provides status updates on the abundance and distribution in water year 2015 of ESA-listed salmonids and sturgeon covered by the NMFS BiOp, and summarizes the generalized effects of project operations, including the proposed drought flexibilities, on those species. In anticipation of potential high water temperatures in 2014, NMFS developed the winter-run drought contingency plan for 2014 that was included as part of the April 8, 2014, Drought Operations Plan (see Attachment D in http://www.water.ca.gov/waterconditions/docs/2014-Operations-Plan.pdf). As mentioned above, winter-run eggs and juveniles in broodyear 2014 experienced approximately 95% temperature-related mortality of the egg and fry life history stages last year. NMFS included this high mortality rate in its JPE, and estimated that approximately 124,521 wild juvenile winter-run from broodyear 2014 are expected to enter the Delta. Based on discussions at the Delta Operations for Salmonids and Sturgeon Technical Work Group, >95% of young-of-year winter-run are currently rearing in the Delta, and <5% have exited the Delta (past Chipps Island).

In addition, Livingston Stone National Fish Hatchery increased its winter-run broodstock collection in 2014 by three-fold, and is currently rearing approximately three times (current estimate is 610,000) the typical hatchery production of juvenile winter-run, awaiting release into the upper Sacramento River in February. The hatchery winter-run are an important component of broodyear 2014, and therefore, are important to track as they migrate down the Sacramento River, and enter and exit the Delta. All of the hatchery winter-run have been coded-wire tagged and adipose fin clipped, so they could be tracked at various monitoring locations within the Sacramento River and Delta. In addition, a portion of the release groups will be implanted with acoustic tags as part of an ongoing survival study through the NMFS-Southwest Fisheries

Science Center. This year, several real-time monitoring stations will be established at various locations in the Sacramento River and Delta so the location of those fish can be detected in real time and better inform operational considerations.

Inherent in the interim contingency plan is the objective to meet multiple needs with limited water resources. Most of the adverse effects to species identified in the Biological Review (*e.g.*, the potential for reduced survival of outmigrating salmonids from the Sacramento Basin due to modifications to outflow criteria in D-1641) are the consequences of actions intended to result in conditions (*e.g.*, greater Shasta Reservoir storage and a greater cold water pool) that will pre-empt more severe adverse effects to species (*e.g.*, potentially running out of cold water in Shasta Reservoir to meet the needs of winter-run and spring-run egg incubation throughout the temperature management season). Some adverse effects to species identified in the Biological Review (*e.g.*, the potential for increased entrainment of salmonids in the South Delta region due to modifications to export limits that allow above-minimum exports when outflow is at least 5,500 cfs, but less than the requirement in footnote 10 of Table 3 of D-1641) are the consequences of actions intended to result in conditions (*e.g.*, greater south-of-delta storage) that will pre-empt adverse effects to non-fish-and-wildlife beneficial uses of CVP and SWP project water (*e.g.*, municipal and agricultural purposes).

The Biological Review describes the direction of effect expected and assigns a qualitative level of certainty to each effect conclusion. Quantifying the specific effects of any particular interim contingency plan element, or of the full suite of proposed actions, is difficult as a result of combined uncertainties relating to:

- specific timing and duration of any particular component of the modified action (for example, it is not known when or if the DCC might open, though the opening is provided for under certain conditions);
- specific migration timing of listed species and presence in the "footprint" of any particular component of the modified action (for example, a storm in mid-February could trigger migration of hatchery winter-run Chinook salmon and wild spring-run young-of-year Chinook salmon into the Delta, which will result in exposure of a greater fraction of those listed salmonid populations to Delta conditions);
- uncertainty in the quantitative relationship between any underlying factor (*e.g.*, outflow) and the response variable of interest (*e.g.*, survival).

The following are NMFS' summaries and expectations based on Reclamation's proposed interim contingency plan for February and March:

- NMFS supports the January 27, 2015, Project Description, including the January 23, 2015, TUC Petition, as the interim contingency plan pursuant to RPA Action I.2.3.C.
- When outflow is greater than 5,500 cfs but less than 7,100 cfs, the combined export limit of 3,500 cfs would only apply to natural or abandoned flow. Combined exports will be limited to 1,500 cfs if reservoir releases are necessary to meet D-1641 or other water quality requirements.
- DCC gate opening will only be considered if combined exports are (or will be) at 1,500 cfs.
- NMFS anticipates that the enclosed DCC gate matrix of triggers could be further refined to include more real-time data such as location information gained through the

acoustically-tagged winter-run hatchery releases. Information related to the operation of DCC gate will be continuously analyzed for changes in risk to species and relative to water quality.

- This response does not provide concurrence on any forecasted operations after March. NMFS expects the February forecast process to provide additional detail on spring and summer operations and allocations necessary to maintain minimum cold water pool, as provided in Action I.2.3. Throughout much of the summer of 2014, real water temperatures as monitored through CDEC were upwards of 4°F higher than Sacramento River temperature modeling results.
- NMFS will review Reclamation's updated contingency plan, which will be submitted by March 1, 2015, as provided in RPA Action I.2.3.C.
- NMFS expects that all actions within the anadromous fish section of the WY2015 Monitoring Plan will (continue to) be implemented. Due to the very low viability of this year's winter-run Chinook cohort and the general status of this species as affected by multiple years of drought, we expect Reclamation and DWR to work closely with us to track and assess the real-time distribution of both wild and hatchery juvenile winter-run Chinook salmon and continually assess whether additional measures may be implemented to minimize adverse effects of operations to this critically imperiled species.
- By March 15, Reclamation and DWR should work through a coordinated interagency effort to describe expected upstream operations, based on 50%, 90% and 99% exceedance forecasts. The planned operations throughout the summer and into the fall should help minimize the amount or extent of winter-run redd dewatering, and also maintain temperature compliance through September and into the first two weeks of October as cold water allows.
- In order to develop a Shasta temperature management plan, Reclamation and DWR should include a flow schedule for the Sacramento River with specific monthly range of Keswick releases from March through October, an end of May storage target, and an analysis of how depletions were analyzed and how water will be provided to settlement and other contractors is consistent with the interim contingency plan.

In conclusion, NMFS concurs that Reclamation's Project Description is consistent with Action 1.2.3.C and meets the specified criteria for an interim contingency plan. We are making this finding based on both the Biological Review attached to Reclamation's letter, which describes the additional adverse effects of the drought and drought operations, and our conclusion that the potential effects of the types of operations proposed in the interim contingency plan were considered in the underlying analysis of the CVP/SWP Opinion, which considered that droughts would occur and concluded that implementation of the RPA, including Action I.2.3.C, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, the Southern Distinct Population Segment of North American green sturgeon, and the Southern Resident killer whales, and will not result in the destruction or adverse modification of their designated critical habitats. Furthermore, the best available scientific and commercial data indicate that implementation of the interim contingency plan will not exceed levels of take anticipated for implementation of the RPA specified in the CVP/SWP Opinion.

We look forward to continued close coordination with you and your staff throughout this extremely challenging water year.

If you have any questions regarding this letter, please contact me at will.stelle@noaa.gov, (206) 526-6150, or contact Maria Rea at (916) 930-3600, maria.rea@noaa.gov.

Sincerely,

Maria Rea

William W. Stelle, Jr.
Regional Administrator

Enclosure: DCC gates matrix of triggers

cc: Copy to file

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Matrix of Triggers for Delta Cross Channel Gate Operations
April 1 through November 15, 2014

The triggers outlined in this matrix provide direction and a method which strives to balance water quality objectives while protecting fisheries resources. This document addresses April 1 through November 15, 2014 Delta Cross Channel (DCC) gate operations while operating under the Drought Operations Plan. There is a reasonable potential that water quality will be affected by a continuation of the drought into early water year (WY) 2015, therefore the Drought Operations Plan proposes modifications to water quality criteria to achieve the aforementioned balance. The triggers are arranged in an upstream to downstream manner, but all triggers are independent of one another and do not need to occur sequentially.

Two to three separate catch indices, specific to species or age-classes, will be calculated at each monitoring location, as specified below. Exceedance of any catch index, at any location, will require implementation of the action specified for trigger exceedance at that monitoring location depending on the date. If multiple trigger thresholds are exceeded, the action most protective for fish shall be implemented.

Trigger calculated based on:	**Knights Landing Catch Index (KLCI)[f]**	**Sacramento Trawl Catch Index (STCI) [f]**	**Sacramento Beach Seine Index (SBCI)[f]**
Winter-run trigger: "Older juveniles" and winter-run-sized hatchery Chinook[a]	Yes	Yes	Yes
Spring-run trigger: Young-of-year spring-run-sized Chinook, both natural-origin and hatchery[b]	Yes	Yes	Yes
Steelhead trigger: Natural origin steelhead[c]	No	Yes	Yes

Water Year 2014 -April 1-May 20

Tisdale Catch Index (TCI) Rotary Screw Trap (RST) Alert

Catch @ RST	Water Quality Concern Levels Exceeded[e]	Action to be Taken at DCC Gates[d]
Any catch of fish	independent of WQ	No Action

Wilkins Slough flow increase Alert

Flow Increase	Water Quality Concern Levels Exceeded[e]	Action to be Taken at DCC Gates[d]
Flow increase over base flow by 45% within a 5-day time period, calculated using daily flow averages.	independent of WQ	No Action

Knights Landing Catch Index (KLCI) RST[f]

Catch @ RST	Water Quality Concern Levels Exceeded[e]	Action to be Taken at DCC Gates[d] Closures to occur within 24 hours of trigger being met and NMFS providing notification or data are disseminated by fisheries agencies.
N/A	N	Closed
< 3 fish per trap day	Y	Open
≥ 3 fish per trap day	Y	Closed until 3 consecutive days of catch < 3 fish per trap day; then open gates

Sacramento Beach Seine Catch Index (SBCI)[f]

Catch per day: standardized beach seines	Water Quality Concern Levels Exceeded[e]	Action to be Taken at DCC Gates[d] Closures to occur within 24 hours of trigger being met and NMFS providing notification or data are disseminated by fisheries agencies.
<1 per day	N	Closed
<1 per day	Y	Open
≥ 1 per day	N	Closed
≥ 1per day	Y	Diurnal Operations[g] until catch <1 fish per day for three consecutive days; then open gates.

Sacramento Trawl Catch Index (STCI) [f]

Catch per day : standardized trawl	Water Quality Concern Levels Exceeded[e]	Action to be Taken at DCC Gates[d] Closures to occur within 24 hours of trigger being met and NMFS providing notification or data are disseminated by fisheries agencies.
<1 per day	Y	Open
<3 per day	N	Closed
1 ≤ X ≤3 per day	Y	Diurnal Operations[g] Diurnal Operations until catch <1 fish per day for three consecutive days; then open gates.
3< X < 5 per day	Y	Closed until 3 consecutive days of daily catch <3 fish per day; then operate diurnally until catch <1 fish per day, then open gates (see above)
≥ 3 per day	N	Closed
≥ 5 per day	N	Closed
≥ 5 per day	Y	Closed until catch per day is < 5 fish

Water Year 2014 - May 21 – June 15

Date	Action Trigger	Action Response
May 16-Jun 15	D-1641 gate operations criteria	DCC gates may be closed for up to 14 days during the period, per 2006 WQCP, if RTDOT determines it is necessary.

WY 2015 - October 1 – November 15

Date	Action Trigger	Action Responses
October 1 – November 15	Water quality concern levels[e] are met and either the KLCI or either of the SCIs are greater than 3 fish per day but less than or equal to 5 fish per day	Within 24 hours of trigger exceedance, DCC gates are closed. Gates will remain closed for 3 days.
	Water quality concern levels[e] are met and either the KLCI or either of the SCIs are greater than 5 fish per day.	Within 24 hours of trigger exceedance, DCC gates are closed and kept closed until catch indices are less than 3 fish per day at both the Knights Landing and Sacramento monitoring sites.
	The KLCI or either of the SCIs triggers are met but water quality concern levels are not met[e]	DOSS review monitoring data and makes recommendation to NMFS and WOMT per procedures in Action IV.5.

Footnotes:

a) Catch of older juvenile Chinook salmon and hatchery-produced Winter-run-sized Chinook will be the basis for one trigger criterion. The use of older juveniles is consistent with the triggers used in the Long Term Operations of the State Water Project and Central Valley Project biological opinion (NMFS June 4, 2009), reasonable and prudent alternative Action IV.2.3 Old and Middle River flow management. Older juvenile Chinook salmon are unclipped Chinook that are larger than the minimum Winter-run size criteria of the size at date river model for Chinook salmon. Older juveniles will include Winter-run Chinook salmon and older fish such as yearling Spring-run Chinook salmon and yearling Late Fall/Fall-run Chinook salmon as part of the catch considered for triggers. In addition, the work group decided to include hatchery Winter-run Chinook salmon as part of this trigger criterion. Hatchery-produced Winter-run-sized Chinook salmon will be distinguished by their missing adipose fin and their classification as winter-run based on the size-at-date table. While the CWTs will be verified as soon as possible, clipped fish will be included in the trigger calculation based on size-based, not CWT-confirmed, run assignment. At this time, no releases of hatchery-produced Chinook salmon should overlap with the sizes of the Living Stone National Fish Hatchery (LSNFH) Winter-run production release. Current hatchery produced Late Fall-run Chinook salmon from the Coleman National Fish Hatchery (CNFH) are considerably larger than the Winter-run production fish, thus there should be no mistaking one group of fish for the other. The average fork length at the time of release was 95mm; ad-clipped fish falling within the Winter-run size criteria of the size at date river model for Chinook salmon will be assumed to be hatchery Winter-run.

b) Natural origin (adipose fin present) Spring-run Chinook young-of-year (*not* yearlings) and hatchery origin (adipose fin absent) spring-run Chinook young-of-year identified using the size at date river model will be the basis for another trigger criterion until such time as the first release of hatchery Fall-run occurs (not expected until April 2014), after which time differentiation of natural origin Spring-run from unclipped hatchery Fall-run and hatchery origin spring-run from clipped hatchery-origin Fall-run becomes unreliable due to size overlap of the two runs.

In regards to young of the year Spring-run Chinook salmon, it is difficult to adequately distinguish between wild Spring-run and wild Fall-run Chinook salmon due to the overlap of the sizes of the fish emigrating downstream and the emergence timing of the fish from the spawning areas upstream of the monitoring efforts. Young of the year wild Spring-run are only slightly larger than the wild Fall-run Chinook salmon that are emerging from the gravel just a few weeks behind the wild Spring-run fish in streams and watersheds where they co-occur. For wild fish, this difference in the date of emergence from the gravel should allow for run discrimination based on size at date, assuming that ambient rearing conditions are similar for both groups of fish. However, run discrimination solely by length is further complicated by the large releases (tens of millions) of hatchery produced Fall-run Chinook salmon in river, typically in early April, that overlap with young-of-the-year Spring-run emigration. Seventy-five percent of the Fall-run hatchery release is not adipose fin clipped, and their larger sizes due to hatchery production techniques would overlap and swamp any wild produced Spring-run Chinook salmon production in the river, making the ability to distinguish runs by size at date unreliable. The DCC group believes that triggers using wild Spring-run Chinook salmon within the appropriate length at date size criteria can be implemented if the captures of these fish occur prior to the release of any hatchery produced fall run Chinook salmon. Furthermore, if hatchery production Fall-run Chinook salmon are trucked downstream to the Delta or bays, below the monitoring stations used in the Sacramento region beach seines and trawl, then the integrity of the size at date discrimination should still remain valid. It is not expected that hatchery produced Fall-run Chinook would subsequently ascend the Sacramento River from their downstream release locations and be present in the reaches where the monitoring efforts used in the DCC triggers are being conducted.

Hatchery origin Spring-run will also be included in the trigger criteria prior to any hatchery Fall-run release. For the past few years Feather River Fish Hatchery has released a portion of Spring-run production (all fish are clipped) into the Feather River and upstream of the confluence with the Sacramento River. Similar to hatchery origin Winter-run, these fish are distinguishable by their missing adipose fin and fork lengths and at the time of release are not expected to overlap with other production releases that have occurred to date. An in-river release may not be possible this year if conditions in the river deteriorate due to drought but providing protection for these fish if conditions allow is crucial.

c) Natural origin (adipose fin present) steelhead will also be used as the basis for a trigger criterion but only for the Sacramento Catch Indices (trawl and beach seines). Initially, the group did not come to a consensus regarding the use of steelhead as a potential trigger in the RST catches, beach seines or river trawls. Steelhead are considerably rarer than Chinook in the RST, trawl, or beach seine catches. Although any steelhead (with or without adipose fin) captured in the Tisdale or Knights Landing RSTs are assumed to be part of the California Central Valley steelhead DPS (because natural origin fish and hatchery fish from both hatcheries upstream of those sampling locations, Coleman National Fish Hatchery (CNFH) and the Feather River Fish Hatchery (FRFH), are considered to be part of the protected DPS), clipped steelhead captured below the confluence of the American River cannot be considered wholly fish from the protected DPS due to the potential input of fish from the Nimbus Fish Hatchery (NFH; *not* considered to be part of the protected DPS). All wild fish (intact adipose fin) are considered to be part of the

protected DPS, and because all hatchery-produced steelhead are clipped, a trigger based on natural origin, unclipped, steelhead will include only fish that are part of the protected DPS. Given the unpredictability of steelhead downstream emigration, the group decided that only the Sacramento beach seine and trawl monitoring sites near the DCC gate location, and *not* the KLCI, should be used as indicators of steelhead being present in the vicinity of the gates and thus be vulnerable to entrainment into the DCC junction when gates are open. Capture of any wild steelhead in these beach seines or in the Sacramento River trawl will serve as a trigger for gate closures, using the same index thresholds as used for Chinook salmon.

d) The actions pertaining to the different sampling metrics are designed to protect both downstream migrating juvenile Chinook salmon and also those that may be rearing or holding in the Sacramento River near the DCC. With unidirectional river flow, catch data from Tisdale and Knights Landing provides an early warning of emigrating salmonids entering the Delta. Data from both the Sacramento River beach seine and trawl monitoring programs serves to further refine locational information on emigrating salmonids as well as provide information on salmonids rearing in the proximity of the DCC gates. The Tisdale and Knights Landing data provides information from discrete locations within the Sacramento River at the location of the RSTs. In comparison, the Sacramento River Trawl and the Sacramento River Beach Seines provides information from a broader suite of locations within the Sacramento River including mid-channel and river margin habitats that may harbor different life history strategies for juvenile salmonids (rearing versus emigration). In a 2012 NMFS Southwest Fisheries Science Center study using acoustically-tagged Winter-run Chinook hatchery smolts; the approximate travel time from the Knights Landing area to Georgiana Slough, which is downstream of the DCC, was approximately 2.5 days (unpublished data). Data from the aforementioned study and previous acoustic-tagged salmonid studies indicate that movement through the Delta is rapid. As such, the three-day closure period was deemed a reasonable balance between fisheries protection and providing operational flexibility for the operation of the DCC gates to ameliorate water quality issues in the central and southern Delta.

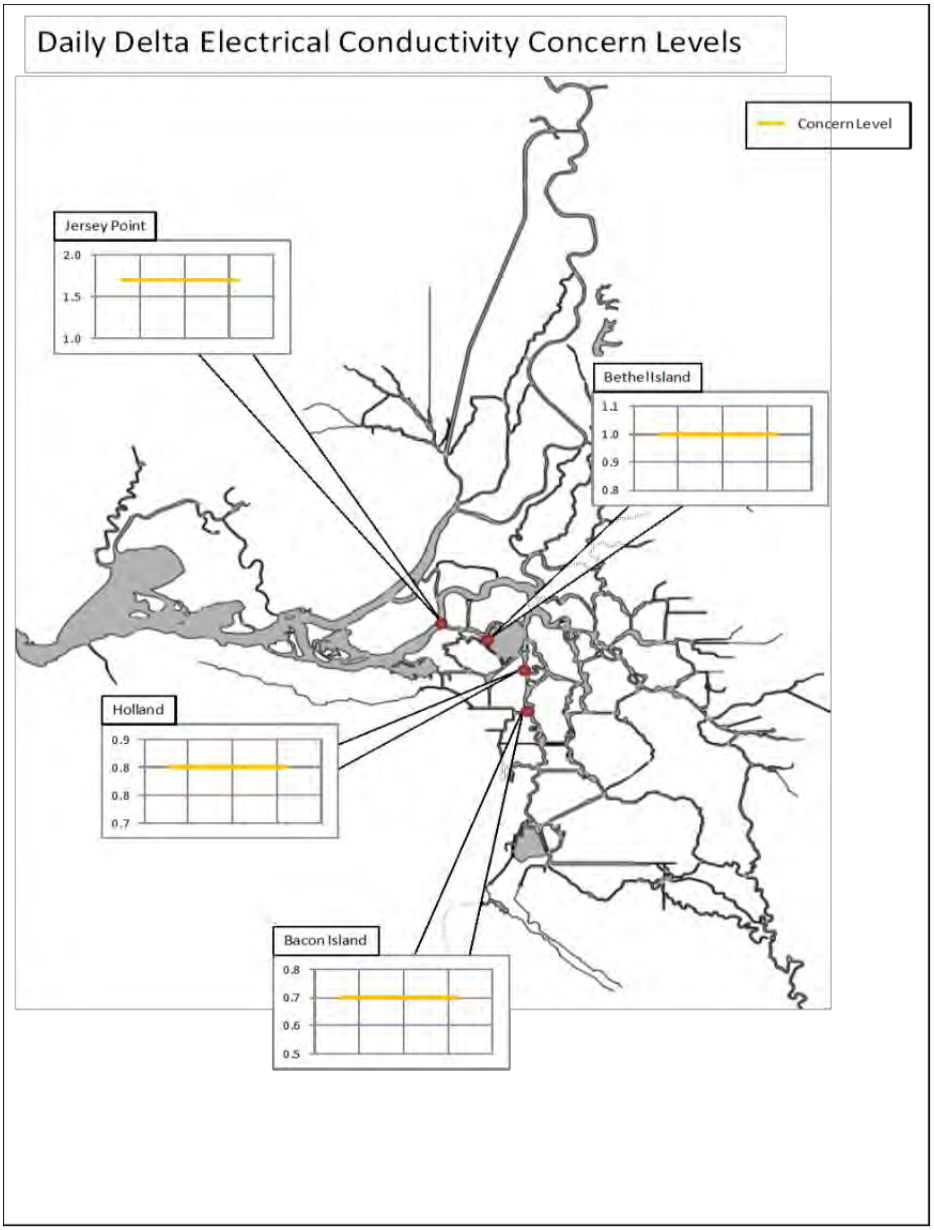
During periods when the DCC gates are closed, consideration should be given to returning the increased Sacramento Trawl and beach seine efforts to baseline levels. Historic baseline efforts are defined as follows. The Sherwood Harbor trawl will continue with sampling occurring 3 days per week through March 31st using a Kodiak trawl, then switching to a mid-water trawl on April 1st. The frequency of trawls will decrease in May and June to twice per a week, resuming to three days per week in July. Kodiak trawls will resume in October. The Lower Sacramento and North Delta beach seine sites will be sampled once per week year round. The special Sacramento region beach seine sites, which includes portions of the Lower Sacramento and North Delta seine routes will be sampled weekly after February 1st, and will continue to include the three additional sites (Sand Cove, Sherwood Harbor, and Miller Park) for the duration of the emergency drought response. Tisdale and Knights Landing RSTs will continue to sample daily with an elevated level of effort until listed species are no longer observed in the monitoring effort. The Projects must notify the Real Time Drought Operations Management Team that water quality concerns levels may be reached within 5-7 days so that monitoring efforts can be increased to daily sampling no less than 72 hours prior to DCC gate opening, depending on fisheries catch indices. Having a complete set of data that maintains the frequency of sampling effort will provide substantial benefits in any retrospective analysis of this data for future

operations of the DCC. If sampling effort is allowed to vary across time, then the analysis of fish presence and movement becomes much more difficult as "zero" could mean fish were either not present, or were missed on the off days that sampling did not occur. It should additionally be noted that determining where in the Sacramento River or Delta a majority of Winter-run and Spring-run out-migrating population is will be more difficult if sampling is discontinued.

e) The values for Jersey Point, Bethel Island, and Holland were adapted from the Chinook Salmon Decision Tree. Water Quality Concern Levels are exceeded when the electrical conductivity levels listed below are reached at one or more stations. The Chinook Salmon Decision Tree can be found at:
(https://www.usbr.gov/mp/cvo/OCAP/sep08_docs/Appendix_B.pdf).

Table1

Station	Water Quality Concern Level
Jersey Point	1.8 mmhos/cm
Bethel Island	1.0 mmhos/cm
Holland	0.8 mmhos/cm
Bacon Island	0.7 mmhos/cm



f) The Knights Landing rotary screw trap (RST) data are standardized to the number of older juvenile Chinook salmon (defined as fish larger than the minimum size length for winter-run Chinook salmon at date, *i.e.*, >95mm and hatchery winter-run Chinook) captured in one trap day (24 hours). The number of older juvenile fish captured in each RST is enumerated, and then the cumulative number of fish is divided by the number of hours the two RSTs were operated between sampling days divided by 24. For example, if the two traps are fished for 2 days there is a maximum of 96 hours that the 2 traps could have been fished: (2 days x 24 hours per day x 2 traps = 96 hours total time fished). If 100 fish were caught between both traps, then the catch per trap day is: 100 ÷ (96 hours/ 24 hours per day) = 25 fish per trap day. In a similar fashion the catch from the Sacramento trawl (STCI) and Sacramento area beach seines (SBCI) are standardized to one catch day with 10 tows per sampling day for the trawl data and eight hauls per day for the beach seine data. Data used to calculate the indices will represent the most current

day of sampling, data from the Sacramento trawl and the Sacramento area beach seine Catch Indices sites will be reported on the day sampling occurs. Data collected from the Knights Landing RST, representing a 24 hour period, will include the previous daytime trap check (pm) and the current morning trap check (am).

g) Should diurnal operations[1] occur, operations of the gates will follow table 2 (DCC Gate Diurnal Operations):

Table 2: DCC Gate Diurnal Operations

Tidal Phase	Operational window. DCC gates will be closed during crepuscular periods and at night.
	Day is considered to be from sunrise to sunset (approximately 7am-7pm PST). Crepuscular periods are considered to be 1 hour after sunrise and 1 hour before sunset. Gate open window of operations for up to 6 hours within the daylight period.
Ebb Tide[2]	Period of operations for opening the DCC gates will occur during the ebb tidal phase during daylight periods. Periods of gate openings shall avoid the period of slack water surrounding the low tide and high tide changes (± 1 hour; bottom and top of the tides).
Slack[3]	Avoid the period of slack water surrounding the low tide and high tide changes (± 1 hour; bottom and top of the tides).
Flood Tide[4]	If Water Quality concern levels are being exceeded with DCC operations limited to the ebb tidal phase, the Real Time Drought Operations Team can request DCC operations to occur on the flood tide phase.

1 It has not been determined whether or not the necessary water quality benefits can be achieved through diurnal operations of the DCC gates. Additionally the design and wear of the gates may preclude successive openings and closings that may occur through diurnal operations.

2 This phase of the tide has been shown to create hydraulic conditions at junctions that enhance fish entrainment. Best to use period of the ebb tide with the strongest downstream flow. Avoid overlapping this phase of the tide with crepuscular period. Fish migratory movement is elevated during the crepuscular period.

3 Avoid the period of slack water surrounding the low tide and high tide changes (± 1 hour; bottom and top of the tides, as fish may be holding in the vicinity of the DCC and the increased movement by fish (milling behavior) will create conditions for greater exposure to entrainment.

4 This is a less optimal period of DCC gate operations for fish protection since flow convergence will occur with the water moving upstream on the flood tide meeting water still moving downstream at the beginning of the flood tide. This will send more water into an open DCC channel and extend the zone of entrainment across a significant proportion of the Sacramento River channel. If gates are opened 1 to 2 hours after flows change at the bottom of tide, there are likely fewer impacts due to opening during this period. Avoid crepuscular periods.

Biological Justification for Diurnal Delta Cross Channel Gate Operations.

Chapman *et al*. (2013) described a series of experiments conducted on the Sacramento River in which hatchery produced late-fall Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) were released in the upper Sacramento River and tracked as they migrated downstream through the San Francisco Bay estuary and into the Pacific Ocean through the Golden Gate. From 2007 to 2010, during the months of December and January, a total of 1,110 Late-fall Chinook salmon and 1,100 steelhead trout were released into the upper Sacramento River. In 2007 the release was made in Battle Creek. From 2008 to 2010, releases were made at three different sites: 1) Jellys Ferry; 2) Butte City; and 3) Hamilton City within the upper and middle sections of the Sacramento River. Fish were released just after twilight at each site. Fish were tracked through 420 monitors placed at 186 different locations within the Sacramento and San Joaquin river systems and Delta, the San Francisco estuary, and coastal waters outside the Golden Gate. Receivers were deployed to provide coverage across river channels as single, dual, and multiple arrays to ensure complete coverage of the channel width.

This study found that within the upper river section, late-fall Chinook salmon traveled almost exclusively at night with 90.6 percent of detections recorded at night between sunset and sunrise. As the Chinook salmon smolts moved downstream, the proportion of movement during diurnal periods progressively increased, although movements at night still remained significantly greater than diurnal movements. Within the upper river reaches there were no significant differences in the timing of fish movement during the night, in particular movements were not concentrated within crepuscular periods, but were distributed relatively evenly throughout the nocturnal period. Movement ceased relatively quickly after sunrise and began shortly after sunset (. In contrast, as fish moved downstream into the middle and lower reaches, salmon movement did not stop abruptly at sunrise, but instead detections gradually decreased as light increased.

Tagged hatchery steelhead migrated more uniformly throughout the day in all regions of the river, estuary, and ocean compared to yearling late-fall Chinook salmon smolts. Like the Chinook salmon smolts, the proportion of detected movement at night decreased as fish migrated downstream. In the upper river 63.0 percent of detections occurred at night compared 90.6 percent for salmon smolts in the same reaches. Once these steelhead reached the estuary, the detections of night time movements decreased to 40.9 percent compared to 57.0 percent for late-fall Chinook salmon. In the upper river, there was a significant preference for nighttime movement. In the lower river, where Knights Landing is located, there is no significant difference between night time and day time movement, however in the middle river, Delta, and estuary there were significant preferences for daytime migration.

Chapman *et al.* (2013) found that more than 50 percent of Chinook salmon travelled at night in all of the study reaches, while steelhead were more variable. Chinook salmon also moved more during the day when river flows were increasing, regardless of flow direction (important in the tidal Delta and estuarine environment). In the estuary, incoming flood tides between zero and a flow of approximately -3500 cfs increased daytime detections. Similarly, downstream flows of approximately 12,300 cfs elicited daytime movements of Chinook salmon. Steelhead responded in a more muted manner. Incoming tides did not appear to stimulate more daytime movements in the estuary. In the riverine reaches of the study area, steelhead daytime movement was more likely when flows were 25,000 cfs or greater. Thus, both Chinook salmon and steelhead

responded to increases in flow with increased daytime movements. However, Chinook salmon appear to be more sensitive to these higher flows, and also responded to the perceived higher flows of an incoming flood tide in the estuary.

The movement of both Chinook salmon smolts and steelhead were affected by increasing turbidity. In general, increasing turbidity reduced the percentage of nighttime movement, and stimulated daytime movement in fish. However, increasing turbidity is often associated with increasing flow and these two variables typically co-occur.

Plumb reported that in a U.S. Geological Survey (USGS) study the majority of acoustically tagged fish moving downstream past the location of the DCC did so at night. During the winter of 2008-2009 (November through March) 2,983 acoustically tagged Late-Fall Chinook salmon were released upriver from the DCC gate location. The release point was far enough upstream that fish were distributed in the river channel and were believed to be exhibiting normal migratory behavior and movements. Results indicated that 39 percent of the released fish (1,162 fish) were eventually detected in the vicinity of the DCC gates with approximately 5 percent of these detections believed to be fish within predators (154 fish). Of the arriving fish detected (1,008 fish), approximately 83 percent (840 fish) arrived at night, with the remainder (17 percent) arriving during the day (168 fish). Of the fish arriving at the DCC location (day and night), approximately 13 percent (143 fish) arrived when the gate was open. Of the 143 fish arriving at the gates when they were open, 20 percent (20 fish out of 100 fish) were entrained at night and 21 percent were entrained during the day (9 fish out of 43 fish). USGS performed an analysis of the data and calculated the joint probability of arriving at night and being subsequently entrained using different environmental covariates and determined that there was approximately a 19 percent chance of being entrained into the DCC at night. Conversely, the probability of being entrained during the day was approximately 6 percent. During the period of the study (November 2008 through March 2009), 73 percent of negative flood flows occurred during the day, and entrainment was more likely during these periods. Plumb *et al.* (2013 unpublished study) summarized that operation of the DCC gates during the day may allow for water diversion in to the interior Delta while minimizing the risk of entrainment of migrating Chinook salmon into the DCC.

Preliminary results from the 2012 Georgiana Slough non-physical barrier study (DWR 2013 draft) also help to illustrate the behavior of fish moving through this section of the river under different diel and flow conditions. Similar to the Plumb *et al*. 2013 and Chapman *et al.* (2013) studies, the majority of fish detected moving past the junctions of the DCC and Georgiana Slough channels with the main stem Sacramento occurred at night. In addition, data from tagged Late-Fall Chinook salmon passing through the Georgiana Slough junction indicate that greater numbers of fish passed through this study area at night than during the day. Furthermore, the passage of fish was also shown to be strongly influenced by tidal phase. During the night, more fish successfully passed the junction of the Georgiana Slough channel during a strong ebb phase than during the changing of the tide or a flood tide. During the changing of the tide from an outflowing tide to a flood tide, the flow of water increases into Georgiana Slough. It is during this transition that a converging flow situation sets up at the junction and 100 percent of the Sacramento River flow enters Georgiana Slough from both the upstream and downstream directions with little to no flow bypassing the junction. Under this specific scenario, all fish

present across the width of the Sacramento River channel are vulnerable to entrainment into the junction. This is particularly true during nocturnal periods when fish are more likely to be moving rather than holding and thus become vulnerable to entrainment as they encounter the junction reach. During the day, more fish are holding, and move less in the region of the junction, thus reducing their vulnerability to entrainment, although not being becoming completely immune to entrainment.).

Summary:
Chapman *et al*. (2013) illustrates how Chinook salmon smolts emigrate primarily at night in the upper reaches of the Sacramento River but progressively increase movements during daytime periods as fish emigrate downstream towards the Delta and San Francisco Bay. Daytime movement is also increased by increasing river flows and stronger flood tidal flows, as well as increased turbidity. Steelhead smolts are more balanced in their use of daytime and night time periods for movements in all river reaches in comparison to Chinook salmon. They are less sensitive to changes in flow and turbidity in comparison to Chinook salmon, but still respond in the same manner: more flow and/or turbidity reduce the proportion of nocturnal movement and increases daytime movement.

The USGS analysis of Chinook salmon at the DCC junction indicates that Chinook salmon predominately arrive at night and are more susceptible to entrainment at night than during the day based on the joint probabilities of arriving at the DCC junction at night and subsequently being entrained into the DCC junction.

The analyses conducted in support of the 2012 Georgiana Slough non-physical barrier (DWR 2013 draft) finds that fish move more at night past the Georgiana Slough junction than during the day based on the number of detections at the non-physical barrier acoustic receiver array and that the behavior of the fish in the junction is strongly dependent on tidal phase and position in the channel cross section at the time of encountering the junction. Fish are more likely to successfully move downstream on a strong ebb tide past the Georgiana Slough junction and avoid entrainment into the Georgiana Slough channel than when downstream flow is weaker and the tides are changing from ebb to flood. The period of time when fish are most vulnerable to entrainment into the Georgiana Slough channel is during the period when flows are reversing and essentially all of the flow in the Sacramento River channel is directed into the channel of Georgiana Slough (converging flows). As negative flows increase and the flood tide strengthens, the vulnerability of entrainment lessens and fish were found to "mill' in the vicinity of the junction or move back upstream, avoiding the region surrounding the junction.

If the DCC gates are to be operated (*i.e*., opened), then the option which minimizes the entrainment vulnerability to listed salmonids emigrating in the Sacramento River in the vicinity of the DCC gates would involve opening the gates on a diurnal cycle, and closing the gates during the night, thus avoiding the greater nocturnal presence of fish in the vicinity of the gates during fish movements. In addition, further reductions in entrainment vulnerability could be gained by operating the gates with recognition of the tidal phases in which the fish are more vulnerable to entrainment (*i.e*., periods of tidal transition from ebb to flood and when upstream and downstream flows result in converging flow phases entering the DCC channel).

References:

California Department of Water Resources. 2013 draft. 2012 Georgiana Slough Non-Physical Barrier Performance Evaluation Project Report: External Technical Review Draft. Prepared by AECOM for the California Department of Water Resources with multiple contributors. November. 296 pages.

Chapman, E.D., A.R. Hearn, C.J. Michel, A.J. Ammann, S.T. Lindley, M.J. Thomas, P.T. Sandstrom, G.B. Singer, M.L. Peterson, R.B. MacFarlane, and A.P. Klimley. 2013. Diel movements of out-migrating Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) smolts in the Sacramento/San Joaquin watershed. Environmental Biology of Fish 96:273-286.

Plumb, J, 2014. Personal communication. Power point presentation to NMFS staff. "Diel Activity Patterns of Juvenile Chinook Salmon with Implications for Operation of the Delta Cross Channel." Authored by: John Plumb, Noah Adams, Russell Perry, Theresa Liedtke, Jason Romine, and others, USGS, Western Fisheries Research Center, Cook, WA. 14 slides. Preliminary Draft findings. January 29.