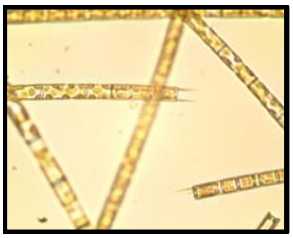

North Delta Flow Action Study

2019 Operation Plan

Prepared by:

California Department of Water Resources

May 2019

North Delta Flow Action Study

Operation Plan

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Abbreviations and Acronyms

ADP	adaptive management planning
AF	acre feet
Ag #4	Agricultural Crossing #4
BO	Biological Opinion
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CSC	Cache Slough Complex
CVWRCB	Central Valley Water Resources Control Board
DWR	Department of Water Resources
DFM	Division of Flood Management
FLaSH	Fall Low Salinity Habitat
GCID	Glenn Colusa Irrigation District
ha	hectare
IEP	Interagency Ecology Program
KLOG	Knights Landing Outfall Gates
LIS	Yolo Bypass at Lisbon gauge site
NMFS	National Marine Fisheries Service
RD 108	Reclamation District 108
RD 2035	Reclamation District 2035
SFSU	San Francisco State University
UCD	University of California Davis
USBR	United States Bureau of Reclamation
USFWS	US Fish and Wildlife Service
USGS	United States Geological Study
YBFMP	Yolo Bypass Fish Monitoring Program
YBWA	Yolo Bypass Wildlife Area

Chapter 1. Introduction

1.1 Background

1.1.1 Delta Smelt Resiliency Strategy

California Department of Water Resources (DWR) is evaluating the feasibility of implementing Action #2 in the *Delta Smelt Resiliency Strategy* (Resources Agency, 2016) which calls for augmented flow in the Yolo Bypass in summer and fall as described below:

> ***Linkage to Conceptual Models***
>
> This management action described above would benefit juvenile and sub-adult life Delta Smelt (*Hypomesus transpacificus*) stages. The primary Habitat Attribute that would be affected is Food Availability and Quality.
>
> ***Summary of Action***
>
> DWR will re-operate the Knights Landing Outfall Gates (KLOG) and work with local Reclamation Districts and local landowners to increase flows from the Colusa Basin into the Yolo Bypass during late-summer and fall months. The goal of the management action is to enhance both the quantity and quality of food for Delta Smelt in both the North Delta and lower Estuary. Food web enhancement flows will also be considered for additional months in ways that will not conflict with agricultural and waterfowl management actions based on the availability of water to augment flows in the Yolo Bypass. DWR will also explore options for increasing outflow from the Yolo Bypass during the spring.

1.1.2 Permits

This operation plan will comply with all water quality objectives set for the Bay-Delta Estuary as implemented with the State Water Resources Control Board D-1641. In addition, this operation will abide by listed species and critical habitat criteria set forth by the 2009 National Marine Fisheries Service (NMFS) Biological Opinion (BO) and 2008 U.S. Fish and Wildlife Service (USFWS) BO for the Long-Term Operations of the Central Valley and State Water Project.

The reoperation and altering of summer and fall outflows in the North Delta will file a California Environmental Quality Act (CEQA) exemption pursuant to Section 15306 of the California Code of Regulation. This is a categorical exemption for "information collection", consisting of the following activities:

> Class 6 consists of basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.

The preceding exemption applies to the North Delta Flow Action Study. The project consists of a multi-year scientific study to monitor the response of plankton in Yolo Bypass/North Delta to summer and fall

flows. The purpose of the project is to gather data to increase the understanding of the biological and physical parameters necessary to promote transport of these food resources to downstream areas. These activities will not result in a "serious or major disturbance to an environmental resource" as they consist of replicating and observing naturally occurring flow conditions.

1.2 Study Summary

1.2.1 Action Plan

DWR proposes to undertake a study which involves altering the operation of the Knights Landing Outfall Gates and Wallace Weir (near Knights Landing, CA) to increase fall agricultural return flows in the Yolo Bypass Toe Drain. Study operations will begin in mid- to late-August 2019, depending on suitable water allocations and water quality conditions within the Colusa Basin Drain, Knights Landing Ridge Cut (Ridge Cut), and Yolo Bypass as determined by DWR and Reclamation District monitoring efforts. Overall, the effort represents a modest change to normal operations of the facilities in the region. The action is designed to maximize the environmental benefits of water. Water is not "consumed" by the action, but it is directed down a different and more productive path to the Delta. DWR will monitor the study operation to determine if it is effective at enhancing Delta Smelt habitat in select locations throughout the Yolo Bypass, Cache Slough Complex, and lower Estuary. The results of the study will help inform the efficacy of using Colusa Basin Drain, Ridge Cut, and Yolo Bypass fall agricultural return water on improving downstream Delta Smelt habitat, and will support the development and permitting of a more permanent operations plan, as needed.

1.2.2 Action Background

The San Francisco Estuary as compared to other estuaries throughout the world has a poor pelagic biomass and primary productivity (Cloern and Jassby 2008). The decline in phytoplankton biomass and primary productivity has been a long-term trend since the mid-1970s (Jassby 2008). The Yolo Bypass has been identified as a significant source of phytoplankton biomass to the Delta during the winter and spring times during floodplain inundation (Lehman et al. 2008; Sommer et al. 2004), but little is known about its contribution to the food web during the dryer summer and fall months. In 2011, Fall Low Salinity Habitat (FLaSH) studies observed a phytoplankton bloom in the lower Sacramento River shortly after a seasonal agricultural flow pulse passed through the Yolo Bypass. Moreover, isotopic studies indicate that the bloom came largely from contributions from the Cache Slough corridor, of which Yolo Bypass is a part (C. Kendall, USGS, 2012 Interagency Ecological Program [IEP] Workshop oral presentation).

Much like 2011, scientists observed a larger-than-normal agricultural flow pulse again through the Yolo Bypass in 2012 that was followed by a downstream Delta plankton bloom (Figure 1). These were the first fall blooms in over 20-years. Additional sampling efforts in 2013 and 2014 provided sufficient evidence of significant fall phytoplankton blooms and subsequent increased zooplankton abundance occurring in the Yolo Bypass and Cache Slough Complex, while conversely there was no increase in phytoplankton abundance within the main-stem Sacramento River (Frantzich 2014). In 2013 and 2014, a collaborative study that included DWR (Jared Frantzich), Central Valley Water Resources Control Board (CVWRCB) (Chris Foe), University of California at Davis (UCD) (Randy Dahlgren), and U.S. Bureau of Reclamation (USBR) (Erwin Van Nienwenhuyse) investigated nutrient concentrations, water quality, flow, and phytoplankton dynamics within the Yolo Bypass and south through the Cache Slough Complex (Frantzich et al. 2018).

These monitoring studies have continued in subsequent years (2015-2018) by DWR, and preliminary results suggest that such blooms are likely determined by several interacting factors including flow, phytoplankton dynamics, nutrient inputs, and grazing (from zooplankton and clam community). This long-term monitoring effort has identified that the volume of water and the max daily net flow that is conveyed through the Yolo Bypass Toe Drain and Cache Slough Complex in summer and fall is critical in facilitating downstream Delta phytoplankton blooms. In 2011 and 2012, those years with largest downstream Delta phytoplankton blooms, we observed max daily net flows in excess of 400 cfs and more than 20,000 AF pass through the Yolo Bypass over four to six weeks (Table 1).

Since these observed bloom events in 2011 and 2012, we have realized the potential of the Yolo Bypass as a source of valuable phytoplankton to the Cache Slough Complex and as far south as Rio Vista. This has direct, positive implications for the zooplankton and pelagic fish communities, which have also been on the decline (Sommer et al. 2007). Initial study results from 2012-2018 have shown that the phytoplankton species composition during the fall flow pulse is dominated by the higher nutritional quality diatoms (Figure 3), which are a primary food for copepods (Brown 2009; Lehman 1992; Orsi 1995). Copepods are a very important diet item for many Delta larval and juvenile fishes, including the endangered Delta Smelt (Cloern et al. 1983; Obreski et al. 1992; Orsi 1995).

Figure 1. Continuous daily average of chlorophyll (µg L^{-1}) at Sacramento River at Hood (SRH; solid line) and Sacramento River at Rio Vista Bridge (RVB; solid-bold line) correlated with water flow (cfs) at Lisbon (LIS; dashed line).

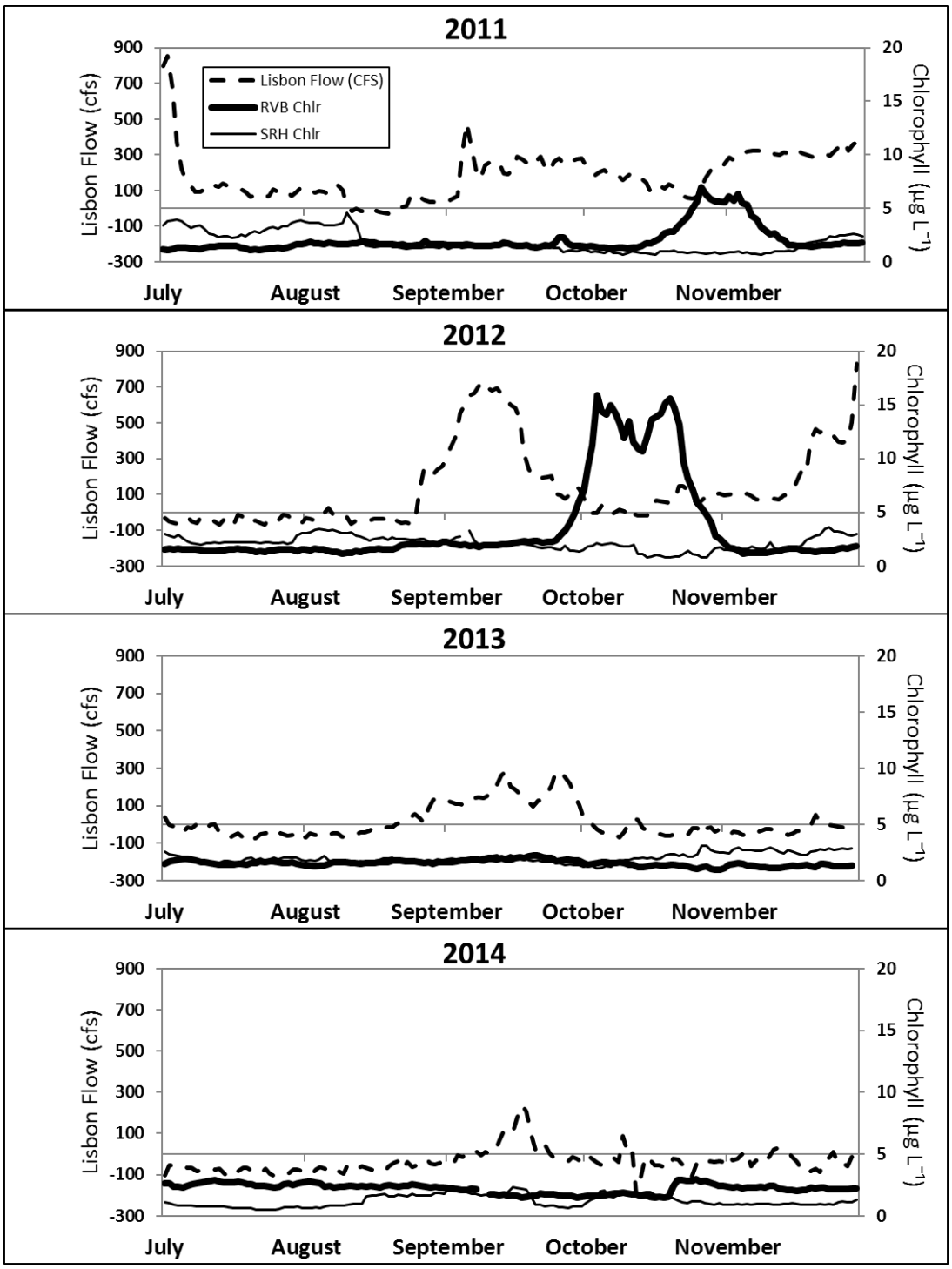


Table 1. Annual positive net flow-pulse estimates and duration measured during the summer and fall flow actions at Lisbon (LIS).

Year	WY Type	Max Daily Ave Net Flow (cfs)	Total Average Net Volume (AF)	Total Average Net Volume (m^3)	Net Flow Total Days	Date Range (start/end of flow pulse)	Rio Vista Plankton Response
2011	W	412	22,356	27,575,432	63	Aug 23 - Oct 24	Yes
2012	BN	723	27,224	33,579,959	38	Aug 26 - Oct 2	Yes
2013	D	283	11,437	14,107,235	42	Aug 22 - Oct 2	No
2014	C	239	2,503	3,087,097	15	Sep 9 - Sep 23	No
2015	C	383	17,909	22,090,187	42	Aug 21 - Oct 1	No
2016	BN	546	12,752	15,729,074	19	Jul 14 - Aug 1	Yes
2017	W	125	1,022	1,260,724	12	Aug 29 - Sep 18	No
2018	BN	548	19,821	24,448,691	30	Aug 28 - Sep 26	No

1.2.3 North Delta Flow Actions

1.2.3.1 2016 Summer North Delta Flow Action

In summer 2016, with support from the Natural Resources Agency and the addition of a North Delta Flow Action as a Delta Smelt Resiliency Strategy, DWR executed the first managed flow action through the Yolo Bypass. Due to planned construction in Ridge Cut Slough at Wallace Weir in the fall, this managed flow pulse was constrained to the summer month of July. This provided a unique opportunity to work with local landowners, irrigation and reclamation districts to generate a flow pulse by supplementing outflows with additional upstream pumping of water from the Sacramento River (Figure 4). The action resulted in a substantial flow pulse (12,700 AF) for over two weeks (Jul 14 – Aug 1). Although flow was well below our target of 24,000 AF, the action was followed by a significant increase in phytoplankton biomass in the Cache Slough Complex and further downstream in the lower Sacramento River at Rio Vista (Figures 2, 3). This downstream bloom was dominated by high quality phytoplankton (i.e. diatoms and cryptophytes) and not harmful species. Preliminary results found positive correlation between zooplankton growth and reproductive rates in response to increased phytoplankton biomass (Frantzich 2017). This successful action provided a template for future multi-agency action strategy and further support for continuing this action as a Delta Smelt Resiliency Strategy.

1.2.3.2 2018 Fall North Delta Flow Action

In fall 2018, DWR, with support from the Natural Resources Agency, collaborated with local landowners, irrigation, and reclamation districts to execute a second managed flow action through the Yolo Bypass (Figure 5). This fall flow action was the first attempt to try and replicate an entirely agricultural return flow pulse (primarily Colusa Basin Drain rice return water) similar to what was

observed in 2012. This flow action resulted in a flow pulse of 19,821 AF for roughly four weeks (Aug 28 – Sep 26). This flow action was close to the study's target volume of 20,000 AF, but it did not reach the daily maximum flow of 700 cfs that was observed in 2012.

Contrary to predictions, an increase in phytoplankton biomass further downstream in the lower Cache Slough Complex and Sacramento River at Rio Vista was not observed (Figure 3). Preliminary results found that the phytoplankton composition was completely void of the prevalent species *Aulacoseira sp.* seen in past blooms (i.e. 2012 and 2016). The flow pulse did, however, export higher densities of zooplankton into downstream habitats of lower Cache Slough and lower Sacramento River at Rio Vista.

Figure 2. Flow (cfs; blue dashed line) at the Toe Drain below Lisbon (LIS) and total chlorophyll fluorescence (µgL^{-1}; green solid line) from Sacramento River at Rio Vista during the 2016 Flow Action.

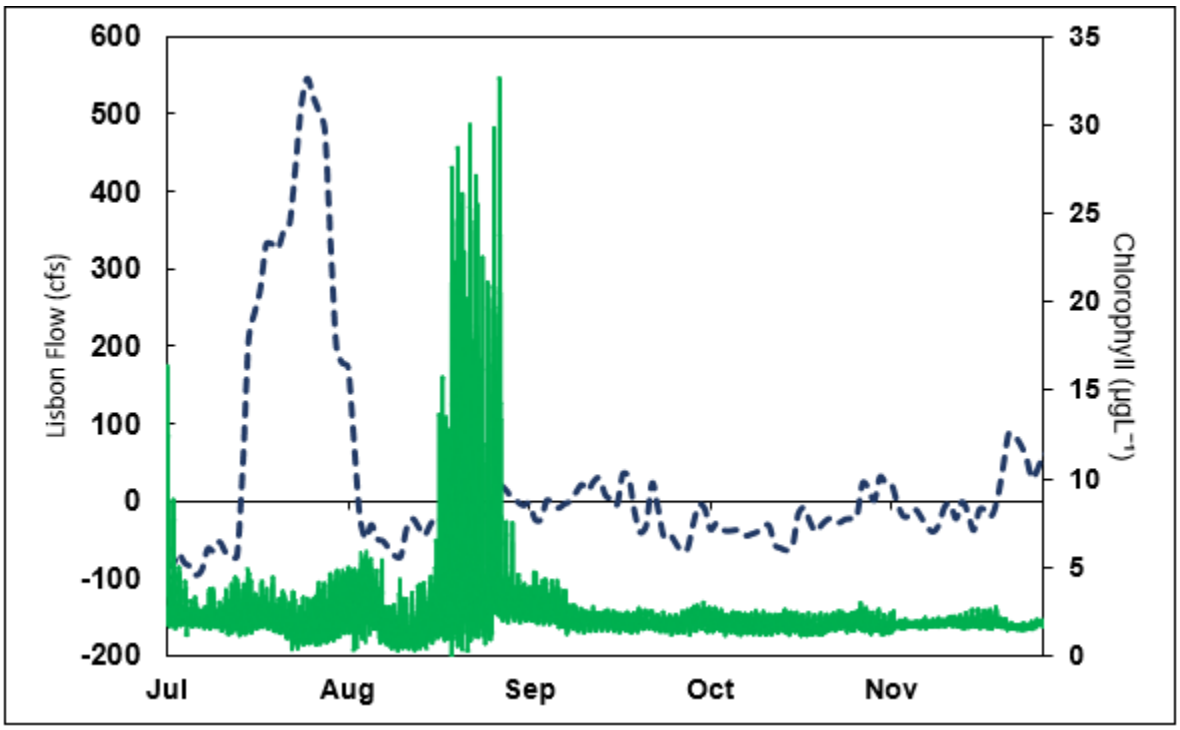


Figure 3. Flow (cfs; blue dashed line) at the Toe Drain below Lisbon (LIS) and total chlorophyll fluorescence (µgL^{-1}; green solid line) from Sacramento River at Rio Vista during the 2018 Flow Action.

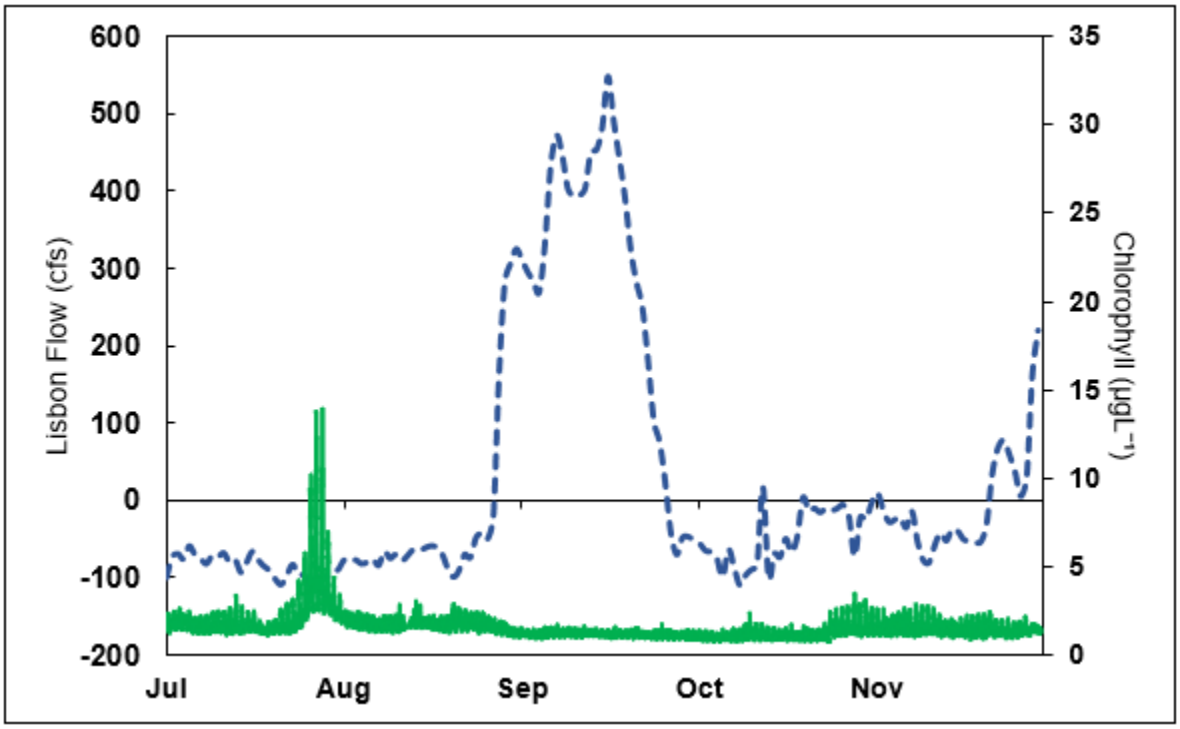


Figure 4. Map of 2016 Summer North Delta Flow Action operation elements.

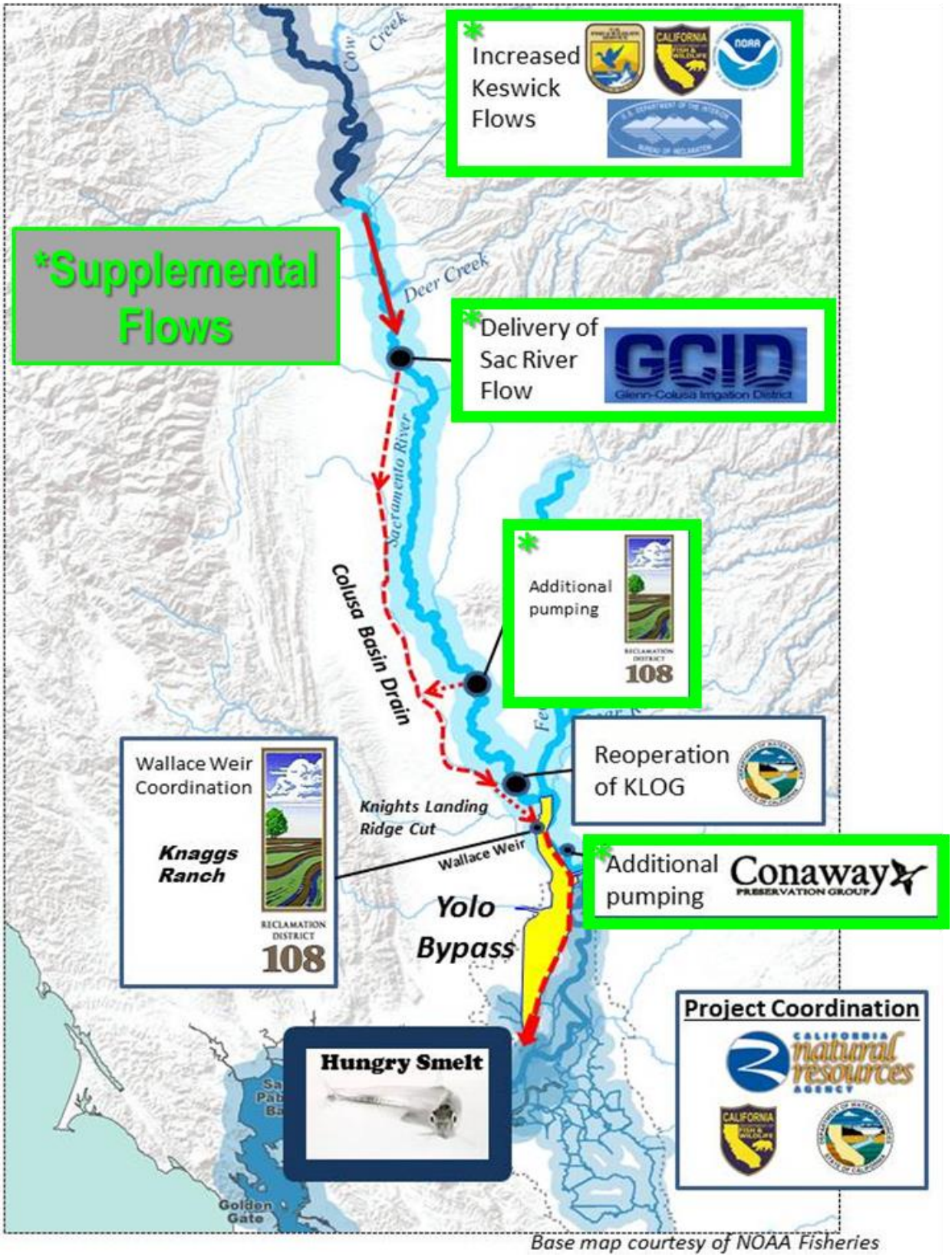
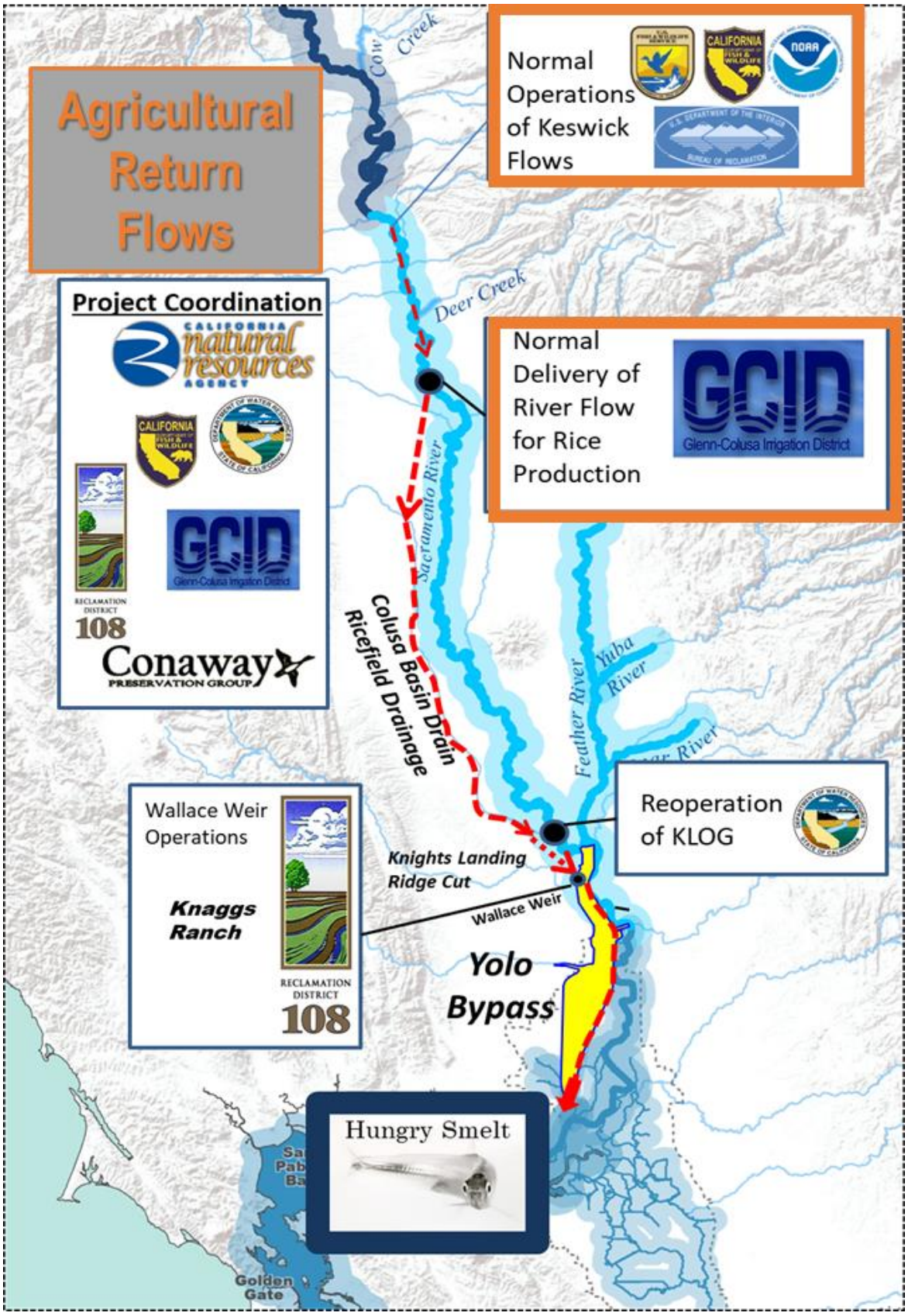


Figure 5. Map of 2018 Fall North Delta Flow Action operation elements.

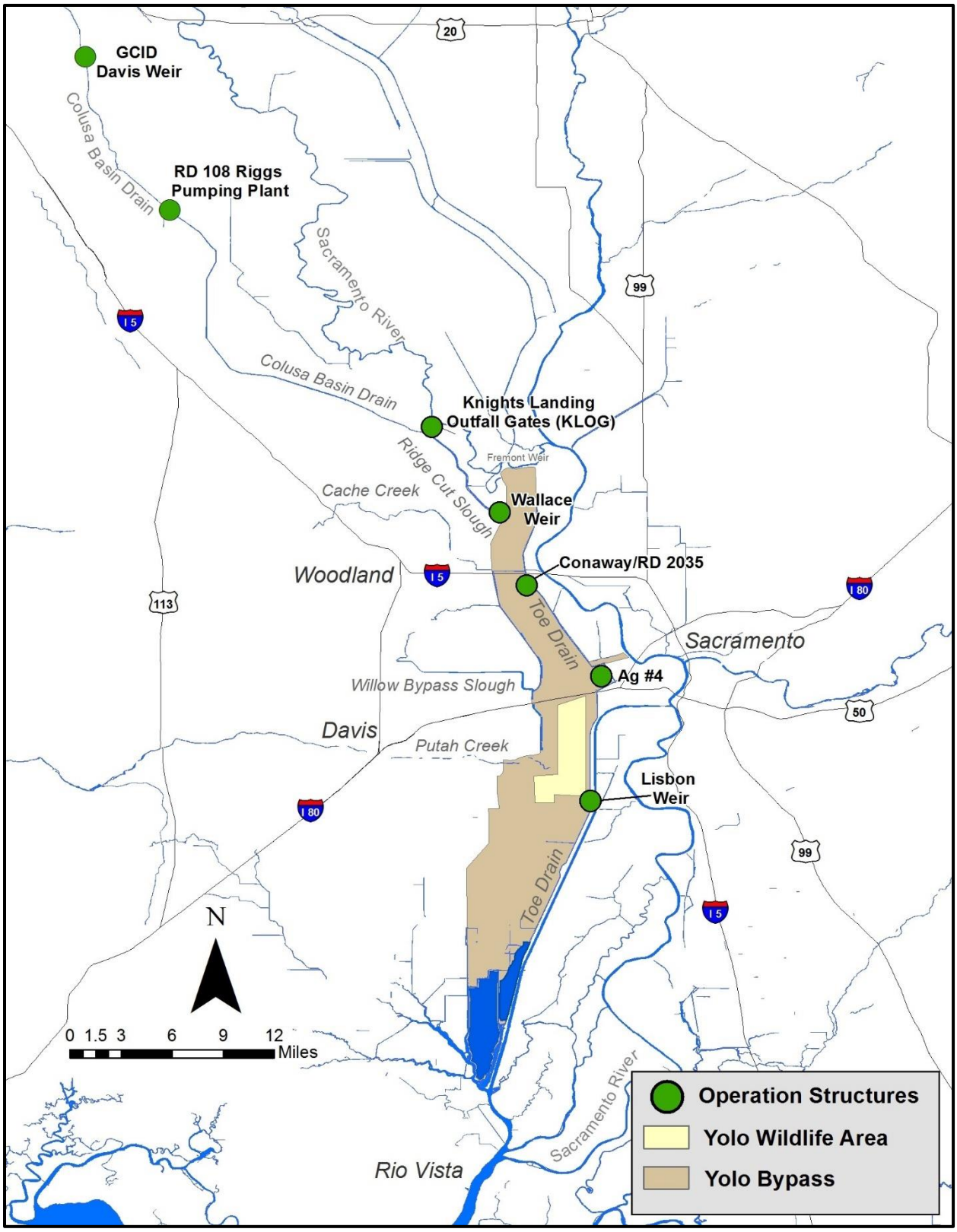


Chapter 2. Current Yolo Bypass Operations (Dry Season)

2.1 Operation Structures

The 24,000 ha Yolo Bypass engineered floodplain is the primary flood control system for the Sacramento Valley, as it conveys up to 80% of the Sacramento River basin flow through the Fremont and Sacramento Weirs during high water periods of winter and spring (Sommer et al. 2001). Although the Yolo Bypass is primarily a flood control system, it is also heavily utilized during non-inundation periods for agriculture (primarily May-Sept.) and as a seasonal and permanent wetland habitat for migratory waterfowl. In the dry season of summer and fall the waters within the Yolo Bypass are confined to the Toe Drain, a perennial man-made channel that flows along the east-side of the leveed floodplain. During this low flow period the channel receives minimal flow inputs from several west-side tributaries (Cache Creek, Willow Bypass Slough, and Putah Creek), but much of the source water is from agricultural return flows from the Colusa Basin Drain into Ridge Cut Slough (Figure 4). Flows during this dry season are often net negative in the Toe Drain, with water use exceeding outflows, causing water to move northward into the Yolo Bypass and Cache Slough Complex. This net flow becomes positive in the Toe Drain each year in late-summer and early-fall (late-August to mid-September) during periods of increased agricultural return water discharge from local and upstream rice-field harvest. In the fall the Yolo Bypass Wildlife Area will begin pumping water from the Toe Drain to fill and maintain seasonal flooded wetland habitat for migratory waterfowl.

Figure 6. Map of the Yolo Bypass tributary inputs and primary operation structures.



2.1.1 Colusa Basin Drain/Davis Weir


Davis Weir

The Colusa Basin Drain is a man-made channel that interconnects a network of historical streams within the Colusa basin and operates as the primary irrigation canal for Northern Sacramento Valley counties and several counties within the Sacramento Metro region. The Colusa Basin Drain does not have a natural outlet to the Sacramento River, but maintains periodic connection based on operations at the Knights Landing Outfall Gates (KLOG) and through Knights Landing Ridge Cut Slough that joins the Yolo Bypass near the northern most extent of the Toe Drain. Glenn Colusa Irrigation District (GCID), the largest irrigation district in the Sacramento Valley, is the primary water rights holder and conveyor of water throughout the Colusa Basin Drain and the complex network of interconnected canals and laterals. GCID operates a main pumping station that diverts from the Sacramento River near Hamilton City and maintains the Davis Weir as a downstream water control structure. Reclamation District No. 108 (RD 108) is another water rights holder in southern Colusa County and northern Yolo County that pumps water into the Colusa Basin Drain from the Sacramento River through a series of river diversion pumping plants south of the city of Williams to the city of Woodland. RD 108 also operates several reuse pumping plants with the primary plant along the Colusa Basin Drain being the Ridge Ranch pumping plant.


Riggs Ranch South Pumping Plant

2.1.2 Knights Landing Outfall Gates


KLOG

The Knights Landing Outfall Gates (KLOG) is a gate operated water control structure at the base of the Colusa Basin Drain. It acts as a barrier to protect the lower Colusa Basin against backwater flooding from the Sacramento River and to control water elevations in the Colusa Basin Drain for irrigation and drainage during low flow periods. KLOG is currently operated by California Department of Water Resources (DWR) Division of Flood Management Office (DFM).

2.1.3 Wallace Weir

Wallace Weir was historically a mostly earthen berm with a series of manually operated slide gates to hold back water in Knights Landing Ridge Cut Slough and Colusa Basin Drain for irrigation by local farmers and Reclamation District 108 (RD 108) within the lower Colusa Basin and northern Yolo Bypass. This weir structure is the primary flow control structure between Colusa Basin Drain flows and the Yolo Bypass Toe Drain during low flow periods of summer and fall. In 2016, DWR contracted with RD 108 to develop a new permanent and improved Obermeyer Weir structure as part of a larger habitat restoration and fish passage improvement project included in the 2009 NMFS BO. This project provides more year-round automated operational control and includes a fish rescue facility. This structure is currently operated jointly by local landowners, RD108 and DWR.


Wallace Weir

2.1.4 Reclamation District No. 2035/Conaway Ranch

Reclamation District 2035, Conaway Ranch, and Woodland Davis Clean Water Agency operate and jointly own an intake on the Sacramento River just north of Interstate 5 (I5). This intake delivers water in separate pipelines to the cities of Woodland and Davis as well as for irrigation within the northern Yolo Bypass for Conaway Ranch farming operations. Conaway Ranch also operates a reuse pumping plant located just above I5 in the northern Toe Drain.


Conaway Ranch Pump Station

2.1.5 Agricultural Road Crossing #4/Swanston Ranch

The Swanston Ranch within the central Yolo Bypass maintains a primarily earthen road crossing (Ag #4) with a manually operated central culvert and upstream slide gate. This road crossing acts as both a transportation corridor and a weir to retain water in the upper Toe Drain for irrigation by local farmers in the central Yolo Bypass. This weir structure resides at the upper most extent of the tidal excursion from the lower Delta.


Ag#4

2.1.6 Lisbon Weir/Yolo Bypass Wildlife Area:

Lisbon Weir is the downstream-most weir structure within the Yolo Bypass Toe Drain, and operates primarily as a tidal retention dam. A series of one-way flap gates on the west side of the weir structure allow tidal flows to convey water upstream during the flood tide and close on the ebb tide. The water is retained upstream of the weir, allowing upstream water users to pump water throughout the tidal cycle. Primary water users include private landowners as well as the California Department of Fish and Wildlife managed Yolo Bypass Wildlife Area (YBWA). The YBWA is a 16,000-acre region of the Yolo Bypass that is managed and operated as seasonal and perennial wetland wildlife habitat, riparian woodland, and for agriculture. DWR operates a continuous and real-time telemetered stage, flow, and water quality station below the weir that is a critical element to the monitoring and assessment of the flow action (CDEC site: LIS http://cdec.water.ca.gov/dynamicapp/QueryF?s=lis).

Lisbon Weir

2.2 Operators

During the dry season, the Yolo Bypass has several water users and managers starting upstream in the Northern Sacramento Valley south to the Yolo Bypass Wildlife Area. This requires collaborative water management strategy by reclamation districts, irrigation districts, state agencies, and local landowners. To undertake a new water management strategy, as required by the North Delta Flow Action, it requires close communication with primary lead contacts for each of the operational structures mentioned in section 2.1 (Table 2).

Table 2. Yolo Bypass primary water operators and contact information.

Operation Structure	Primary Lead Contacts	Title/Role/Property	Phone	Email
Colusa Basin Drain/Davis Weir	Thad Bettner	GM, Glen Colusa Irrigation District	530.588.3450	tbettner@gcid.net
	Jerred Shipley	Assistant Water Operations Superintendent	530.518.7187	jshipley@gcid.net
	Lewis Bair	RD 108, General Manager	530.979.1536	lbair@rd108.org
KLOG	Eric Koch	Chief, Division of Flood Management, DWR	916.574.1403	eric.koch@water.ca.gov
	Brian Murphy	Flood Maintenance Office, DWR	916.574.0341	brain.murphy@water.ca.gov
Wallace Weir	Lewis Bair	RD 108, General Manager	530.979.1536	lbair@rd108.org
	John Brennan	Knagg's Ranch, Manager	530.870.6625	john@landmba
	Colin Purdy	Fish Collection Facility, CDFW Region 2 Supervisor	916.358.2943	Colin.Purdy@wildlife.ca.gov
RD 2035/Conaway Ranch	Mike Hall	Conaway Ranch	530.308.0681	mike@conawayranch.com
	Darren Cordova	MBK Engineers, for Conaway Ranch	916.456.4400 ext. 127	cordova@mbkengineers.com
Ag. Crossing #4/Swanston Ranch	Mike Lear	Swanston Ranch	530.682.8752	
Lisbon Weir/Yolo Bypass Wildlife Area	Joe Hobbs	Yolo Bypass Wildlife Area, CDFW Manager/Supervisor	530.757.2431	Joe.Hobbs@wildlife.ca.gov

Chapter 3. Operation Plan

3.1 Operations

The planning and re-operation of the Yolo Bypass to carry-out the North Delta Flow Action in summer or fall for any given year requires state/federal agency support and local water right interest, but most importantly it requires adequate water supply. This flow action may not be pursued during the most extreme water years for both dry and wet conditions. Each year there will be required hydrologic forecasting to properly assess whether there will be sufficient water allocations for the Northern Sacramento Valley and Yolo counties to ensure that there will be adequate agricultural return water available to generate a fall flow pulse. In extremely wet years, there may also be impacts to planted acreage of rice, which is the predominate source of agricultural return water in the late-summer and fall. Alternatively, if a summer action is desired, there will need to be an assessment of main-stem Sacramento River outflows and water levels to determine if additional upstream pumping by irrigation and reclamation districts is feasible, as water is heavily impacted by irrigation use this time of year.

3.1.1 2019 Collaborative Pre-Planning Meetings

For 2019, DWR proposes to facilitate a fall flow action in the Yolo Bypass from late-August through late-September. The first planning meeting for this effort will commence in May. This meeting will determine coordination feasibility of the DWR proposed flow action timing with state and federal agencies, local landowners, irrigation districts, and reclamation districts (**Appendix A**). This meeting will be followed by two additional coordination meetings in June and July to maintain group collaboration, planning efforts, and to continue providing updates on the water supply and allocation outlook. In early-August, the group will have an implementation meeting to establish the specific start date, duration, and flow targets (see timeline in Figure 7).

3.1.2 2019 Project Actions

1. Treatment of Aquatic Vegetation

Due to the increase in aquatic vegetation above Wallace Weir in Ridge Cut Slough, both flow action efforts and landowners were negatively impacted in 2018. In effort to reduce complications of vegetation (mainly primrose species), the DWR project team (Josh Martinez) will work with the DWR's Division of Flood Management (DWR) and Reclamation District 108 to discuss mechanisms for treatment applications approved for the canal. Vegetation treatments should reduce the amount of impedance in the slough, though the effects of treatment applications may not be observed until 2020.

2. Local Landowner Outreach

As a first priority, local landowners not directly involved in the planning efforts will be contacted in July and August. Thad Bettner (GCID) and Lewis Bair (RD 108) will inform local landowners along the Colusa Basin Drain of the planned flow action, timing, and expected changes to water operations (i.e. Davis Weir, Riggs Pumping Plant, KLOG, Wallace Weir, etc.). John Brennan (Knagg's Ranch)

will be the primary contact for Yolo Bypass landowners below Wallace Weir, and will keep them informed on all planned water operations. DWR will contact the Yolo Bypass Wildlife Area manager Joe Hobbs and keep YBWA staff updated on timing and planned operation changes.

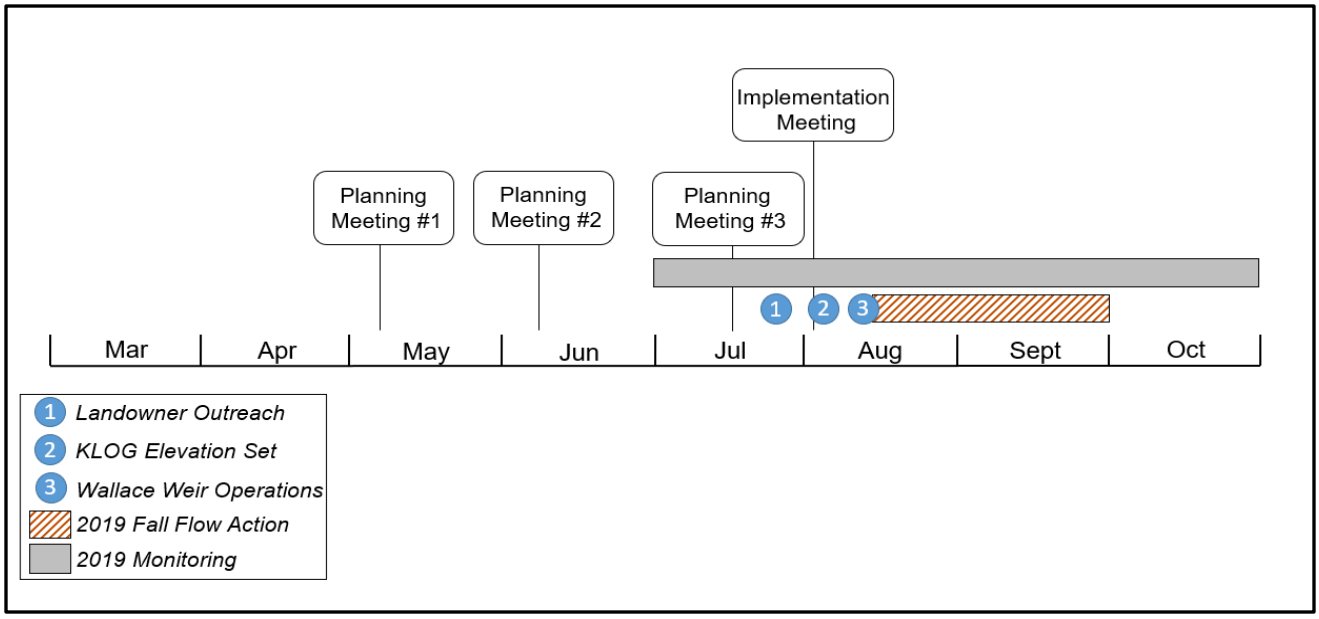
3. KLOG Elevation Set

The elevation at KLOG will be set to 27' by Erik Koch and Brian Murphy with DWR's Division of Flood Management one-two weeks prior (mid-August) to the target flow action. This effort will be in collaboration with the timing of increased agricultural return flows in the Colusa Basin Drain reported by GCID's Thad Bettner and Jerred Shipley based on the upstream flow gauges at Davis Weir and Lewis Bair (RD 108). This action will also be in collaboration with planned water operations at Wallace Weir by Lewis Bair (RD 108) and John Brennan (Knagg's Ranch).

4. Wallace Weir Operations

John Brennan (Knagg's Ranch) and Lewis Bair (RD 108) will work closely with DWR KLOG operations to change operations at Wallace Weir to create a backwater of agricultural return water above the weir for one-two weeks prior (mid-August) to the targeted fall flow action. In mid-August, Chad Navarro with RD 108 will notify downstream water users, including and Mike Lear with Swanston Ranch, the operator of Agricultural Road Crossing #4 (Ag #4). Modifications to AG#4 culverts will need to be made to prepare and allow for the increased outflow through the Toe Drain. In late-August and early-September, John Brennan (Knagg's Ranch) and Lewis Bair (RD 108) will open Wallace Weir in an effort to reach targeted outflows. Wallace Weir will be kept open for the duration of peak fall Colusa Basin Drain agricultural return period (late-August to end of September).

Figure 7. Timeline for operations planning meetings, flow action, and monitoring for 2019.



3.1.3 2019 Target Flows

In 2019, the target flow action will be from late-August through September at a minimum target volume of 27,000 acre-ft (AF) over a 4-week period. The plan is to retain water in Ridge Cut Slough above

Wallace Weir to try and maximize daily net outflows to as high as 700 cfs. Water operations will be adjusted to try and maintain a minimum daily mean net flow of >300 cfs over the 4-week period. These flow targets are based on historical flow data collected at the gauging station LIS from the past nine-years. These targets are based primarily on 2011, 2012, and 2016, the three years in which we observed evidence of downstream plankton response to in the lower Delta at Rio Vista.

DWR will also coordinate in advance (June-July) with GCID, RD 108, and RD 2035 on a contingency plan to supplement outflows by pumping Sacramento River water through the Colusa Basin Drain and Yolo Bypass Toe Drain if target flows cannot be met. This could be a result of reduced water allocations or rice-acreage planted, or operation impediments that would drastically affect the flow action. DWR will work with GCID, RD 108 and RD 2035 to draft and file a resource agreement that identifies the flow action plan timing, proposed water allocations, cost, and terms of liability. If a supplemental flow is required to perform the flow action, there may need to be additional coordination between DWR, USBR, USFW, and NMFS to adjust Keswick Dam outflows from Shasta Reservoir into the Sacramento River.

3.2 Monitoring and Assessment

DWR's Work Plan for Monitoring and Assessment (**Attachment B**) and Fact Sheet (**Attachment C**) describe the basis and design for monitoring and evaluation of the study. Monitoring will begin in July to capture baseline conditions before the start of the proposed flow action. Monitoring will also continue from August to October to capture the full temporal range of the proposed Project's effects. DWR will collect continuous water quality data at three temporary and two long-term monitoring station from Ridge Cut Slough at Highway 113 south to the base of the Yolo Bypass Toe Drain. In addition, water quality data will be collected downstream at continuous stations operated in the Cache Slough Complex by USGS and in the lower estuary by DWR. Water samples will be collected weekly at twelve sites from Ridge Cut Slough south to the lower Sacramento River at Decker Island to measure changes in nutrients, chlorophyll-*a*, and phytoplankton biomass.

Additional water samples will be collected for determining nutrient subsidies and changing primary productivity rates, and pesticide concentrations with collaborators San Francisco State University (SFSU) and USGS. Zooplankton sampling will occur biweekly for identification and enumeration. DWR will conduct monitoring and assessment as baseline data regardless of whether a flow action occurs.

In addition to monitoring and assessments of food web productivity, in 2019 two cages of hatchery Delta Smelt will be deployed and monitored at DWR's Yolo Bypass Fish Monitoring Program's rotary screw trap site for periods before (August) and after (October) the flow action. No smelt cages will be deployed during the flow action to limit damage to the cages and loss of smelt. The addition of Delta Smelt cages (that have already shown success at Rio Vista and the Sacramento River Deep Water Ship Channel) will be the first step towards assessing the effects of the flow action and productivity in supplying more suitable habitat for fishes. Weekly monitoring and assessments of behavior and mortality will occur in conjunction with collection of water sampling for nutrients and productivity.

Chapter 4. Summary of Anticipated Effects

4.1 Water Quality

The project operations will have some anticipated changes to local and downstream water quality during summer and perhaps early-fall. Due to the use of agricultural return water, it is anticipated that the managed flow action will increase salinity and water temperature marginally within the downstream reaches of the Yolo Bypass Toe Drain and upper Cache Slough Complex. It is also anticipated that downstream nutrient concentrations (i.e. nitrogen and phosphorus) and phytoplankton biomass will increase due to initial transport from the Colusa Basin Drain and upper Yolo Bypass. There may also be some increased transport downstream of both water soluble and suspended sediment pesticides. Through monitoring and coordination with stakeholders, DWR will ensure that current water quality standards (e.g., D-1641) and guidance agreements are met.

4.2 Fish

The proposed Project is specifically designed to improve habitat conditions for Delta Smelt by increasing habitat connectivity and food web interactions in the Cache Slough Complex and lower estuary. By similar logic, the proposed Project may also improve habitat conditions for other native fishes, such as Longfin Smelt (*Spirinchus thaleichthys*), Sacramento Splittail (*Pogonichtys macrolepidotus*) and rearing juvenile salmonids.

The proposed Project is not expected to have any effect on emigrating juvenile Chinook Salmon (*Onchorhyncus tshawytshca*) and/or steelhead (*O. mykiss*) in the upper estuary during this time period. The proposed Project would not affect listed winter- or spring-run adult Chinook Salmon migration, but adult fall-run Chinook can occur in the project area. The Yolo Bypass Fish Monitoring Program (YBFMP) has observed only four adult fall-run Chinook salmon in the fyke trap catch in September, with the majority of catch in October and November. Due to the known straying of Chinook salmon into the Yolo Bypass, CDFW has been operating an upstream fyke trap below Wallace Weir since 2014. In 2018, CDFW did observe fall-run Chinook Salmon mortality in the immediate project area during late September, however, it is uncertain if these were an indirect result of the flow action increasing temperatures and decreasing dissolved oxygen. More investigation of the mortalities of these fish is warranted. In fall 2019, CDFW plans to operate the new and more efficient Fish Rescue Facility at Wallace Weir to more closely monitor straying effects to managed flow actions. Green Sturgeon (*Acipenser medirostris*) have never been observed in the Yolo Bypass during the proposed flow action time period.

4.3 Wetlands

The Yolo Bypass is well-recognized as a major center for future restoration of wetland habitat in northern California. The Yolo Bypass also harbors the state operated 16,000-acre Yolo Bypass Wildlife Area that consists of several managed and perennial wetlands. It is anticipated that this flow action will be beneficial to both managed and natural wetland habitats along the flow corridor, as it will improve nutrient inputs and connectivity between the main channel and shallow inter-tidal habitats.

4.4 Recreation

The lower Yolo Bypass Toe Drain below Lisbon Weir is a navigable waterway. It is anticipated that the flow action will have little effect on boating or recreational use as these flows will be within the channel capacity and well below the higher flows observed in the winter and spring during floodplain inundation periods.

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USFWS. See U.S. Fish and Wildlife Service.

Attachment A. North Delta Flow Action Planning Meeting Contacts

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Tom & Perry Charter	landowner			
Ridge Cut				
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Attachment B. Draft Work Plan for Monitoring and Assessment of Proposed North Delta Flow Action, 2019

Appendix C. North Delta Flow Action 2019 Fact Sheet