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Unimpaired Flow Analysis

Erin Heydinger

Sites

Unimpaired Flow Standard: Background

- The State Water Board is responsible for adopting and updating the Water Quality Control Plan for the Delta (Bay-Delta Plan)
  - Water quality
  - Flow requirements
- Two processes:
  - December 2018: State Board adopted lower San Joaquin flow objectives and revised Delta salinity objectives
  - State Board also considering Plan amendments focused on the Sacramento River and tributaries

Unimpaired Flow Standard: Background

- The Bay-Delta Plan uses an "unimpaired flow" requirement
  - Unimpaired flow: natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds
- Sets a percent or a range of percent unimpaired flows that must be met
- Lower San Joaquin: 40 percent unimpaired flows required from February to June, with an "adaptive range" of 30 to 50 percent
- 55 percent starting point recommended for Sacramento River

Unimpaired Flow Standard: Sites

- Question: what would an unimpaired flow standard on the Sacramento River mean for the Sites project?
- Modeling team evaluated implementing this standard using two methods:
  - 55 percent unimpaired required in the Sacramento Valley
  - 55 percent unimpaired required in local tributaries
- Difference in methodology is due to uncertainty for how the requirement would be implemented

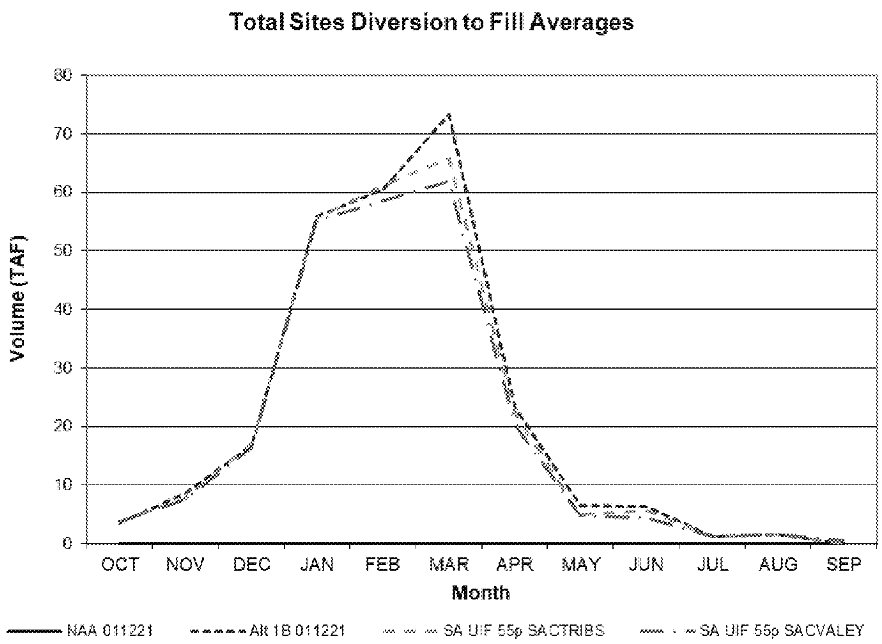
Unimpaired Flow Standard: Sites

- Question: what would an unimpaired flow standard on the Sacramento River mean for the Sites project?
- Modeling team evaluated implementing this standard using two methods:
  - 55 percent unimpaired required in the Sacramento Valley
  - 55 percent unimpaired required in local tributaries
- Difference in methodology is due to uncertainty in how the requirement would be implemented

Unimpaired Flow Standard: Sites

Parameter	Water Year Type	ALT1B	ALT1B Local UIF	ALT1B Sac Valley UIF
Diversion (TAF)	Long-term	255	244 (-4%)	234 (-8%)
	Dry and Critically Dry	104	90 (-13%)	85 (-18%)
Release (TAF)	Long-term	234	224 (-4%)	214 (-8%)
	Dry and Critically Dry	404	382 (-5%)	370 (-8%)

Unimpaired Flow Standard: Sites



Unimpaired Flow Standard: Sites

- Caveats:
  - Analysis assumes other operations stay consistent
    - State Water Project
    - Central Valley Project
  - Assumes Sites is not responsible to "meet" requirement (i.e. release water)
  - Assumes Delta conditions do not change significantly
    - Sites can only divert when the Delta is in excess
- Next steps:
  - Continue evaluating diversion criteria as mechanism to protect aquatic species
  - Discuss specifics for implementation of unimpaired flow standard in Sacramento Valley with State Board staff
  - Use analysis as needed to better understand implications of requirement as detail is added

Questions?

Sites

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 9/13/2021 1:50:26 PM
To: Rob Kunde [rkunde@wrmwsd.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Jeff Davis [jdavis@sgpwa.com]
Subject: Oroville and Folsom Storage Levels with Sites
Attachments: Sites-OrovilleFolsomStorage-92021.pdf

Hi Rob,

I wanted to close the loop with you on a question you brought up recently on Oroville (and possibly Folsom?) storage levels with and without Sites. I've attached here four charts showing Folsom and Oroville storage levels. There are two graphs per reservoir – one showing long-term average and the other showing dry and critically dry years. We see very modest changes to overall storage levels in both Folsom and Oroville. I will note that we see larger differences in Folsom under Alternative 3, but that Reclamation is still pinpointing the way they would operate Folsom with Sites in place, so the changes may not be as large in actual operations.

Please let me know if this gets at your question and if you'd like to have a follow-up call. Also cc'ing Jeff Davis here because I understand the action item from the last Environmental Planning and Permitting ad hoc workgroup meeting had both of you listed requesting follow-up.

Thanks!
Erin

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hdrinc.com/follow-us

Sites Reservoir Project
Revised Draft EIR/Supplemental Draft EIS
Public Meetings

Implementation Plan

DRAFT v9.14.2021

Contents

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I. Introduction: The Draft EIR/EIS public comment period is 60 days and is expected to begin on Friday, October 22, 2021, and end on Thursday, December 23, 2021. If a request to extend the Draft EIR/EIS public comment period is received, the comment period will be extended to [DATE]. One in-person Draft EIR/EIS public meeting and two virtual Draft EIR/EIS public meetings are tentatively scheduled for November 2021. Comment collection details are included below in Section IV. One in-person stakeholder meeting with landowners was held on August 20, 2021. Landowner meeting details are included in Section XI.

The following dates, times, and locations have been identified for the Draft EIR/EIS public meetings.

Table 1. Schedule

Type	Date & Time	Location
Virtual Public Meeting	Tuesday, November 16, 2021 2 to 4pm	Zoom Webinar
In-Person Public Meeting	Wednesday, November 17, 2021 6 to 8pm	American Legion/VFW Hall 230 Oak St., Maxwell, CA 95955
Virtual Public Meeting	Thursday, November 18, 2021 6 to 8pm	Zoom Webinar

Staff who have a role during the public meetings as identified in Tables 6 and 7 need to join the Zoom Webinar for the virtual public meetings and arrive at the venue for the in-person meeting 30 minutes prior to the meeting start time.

II. Notifications: The public will be notified of the meeting dates, times, and locations via the notification methods and channels listed in the table below. The responsibility for posting or distributing the notice is identified along with the suggested target date(s) for posting or distributing.

Table 2. Notifications

Notification	Responsible	Target Date(s) for Post/Distribution
Notice of Availability	Reclamation	October 22, 2021
Joint Reclamation/Authority Press Release	Communications Team/Reclamation	October 22, 2021
Phone Calls – Elected Officials/Agencies	Government Affairs Team	October 22, 2021
Postcard Mailer (Landowners, NGOs, etc.)	Environmental Team/Reclamation	October 22, 2021
Website Update	Communications Team/Reclamation	October 15, 2021 for Authority to post document; October 22, 2021 for Reclamation to post document
E-blasts	Communications Team	October 22, 2021; reminder prior to public meetings; and before end of comment period
Newspaper Display Advertisements (Chico Enterprise Record; Red Bluff Daily News; Woodland Daily	Communications Team	On or after October 22, 2021 (dates will vary based on newspaper publication schedule)

Table 2. Notifications

Notification	Responsible	Target Date(s) for Post/Distribution
Democrat; Appeal-Democrat; Tri-County News; Pioneer Review; Record Searchlight; Sacramento Business Journal; Sacramento Bee)		
Social Media	Communications Team/Reclamation (paid social media)	October 22, 2021; reminder prior to public meetings; and before end of comment period
Flier	Communications Team	October 22, 2021
JPA Member Communication (version of flier or e-blast)	Communications Team	October 22, 2021
Information Repositories	Environmental Team	October 15, 2021

Notices will include language directing participants to contact the project team for reasonable accommodations.

III. Meeting Format:

a. ***Virtual Public Meetings:*** The virtual public meetings will be conducted via Zoom Webinar and will consist of a project presentation, Q&A session, and formal public comment component to accept verbal comments.

The project presentation will be delivered at the beginning of the meetings. A project overview will be provided first, followed by technical team members providing an overview of key topic areas (based on list of posters below). After the presentation, the team will take Q&A for a set period of time. Technical consultants can leave the meeting once the Q&A concludes. Following the Q&A, the moderator, Kim Floyd, will kick off the formal public comment session. Official public comments will be received verbally during the formal public comment session (written comments would be submitted via the accepted methods of mail and email). Instructions on how to provide public comments will be discussed at the beginning of the meetings and again after the project presentation. If there are participants who have their hand raised and have not been called on yet to provide their comments at the time the virtual public meetings are scheduled to conclude, the virtual public meetings will remain open until all participants who raised their hand prior to the scheduled end time have been given the opportunity to provide their comments.

Participants who are logged in to Zoom Webinar online can raise their hand by clicking on the hand icon. Participants who call in on the phone can dial *9 to raise their hand. When a participant raises their hand using either method, the moderator can see that a hand is raised, call on that participant, and enable the participant to complete the unmute process to ask a question or provide a comment during the virtual public meetings.

Zoom Webinar has a Q&A feature that allows participants to submit written questions, which will be viewable to only the host and panelists, unless the host or a panelist make the question public to the rest of the attendees. The question can be answered verbally and/or answered in writing through the Q&A feature. All questions will be answered verbally to ensure attendees who are participating by phone can hear the answer. The Q&A feature will be enabled to collect written questions, and the chat function will be disabled.

Since staff will need to be in contact with each other to manage the virtual public meetings, a Microsoft Teams chat session or a messaging platform can be used for internal, back-end communications.

Zoom Webinar: Zoom Webinar is the recommended platform for the virtual public meetings due to its ease of use and simple user interface, general familiarity by the public, and built-in controls. Zoom Webinar can support up to 10,000 participants and allow participants to dial in with their standard telephone, computer, or smartphone to participate. Zoom Webinar allows participation without registration or downloads, including a phone-in option for those who may not have Internet access. Unlike a Zoom Meeting that can be subject to hijacking or "conference bombing," Zoom Webinar has additional controls, whereas the webinar host controls all audio, video, and screen-sharing functions. Participants do not have access to these controls.

Agenda: Based on the format outlined above, the proposed agenda for the virtual public meetings will be as follows:

Table 3. Virtual Public Meeting Agenda

Item	Presenter(s)	Time
Project Presentation	TBD	30 minutes
Q&A	TBD	45 minutes
Formal Public Comment Session	Kim Floyd, Moderator	45 minutes

b. ***In-Person Public Meeting:*** The in-person public meeting will consist of a project presentation, staffed informational poster stations, and a formal public comment component to accept verbal comments.

Tables will be set up for attendees to sign in for the meetings and provide their contact information. Attendees can also choose to sign up to receive future project updates. At this location, staff will explain the meeting format and required COVID-19 safety measures.

The meeting with begin with a project presentation. Following the project presentation, the open house information stations will be opened. Poster stations that cover the topics listed in Table 7 will be staffed by project team members who will be available to engage in one-on-one conversations with the public and answer questions. When the formal public comment session is initiated, the staffed information stations will close.

If there are not many verbal comments, the staffed informational poster stations could be reopened and/or the project presentation could be repeated.

COVID-19 Precautions: The in-person public meeting will be conducted as safely as possible and in accordance with Colusa County requirements and facility standards. Signage at the entrance will direct any COVID safety precautions required for participation. Masks will be kept at the sign-in tables to provide to attendees as requested. Hand sanitizer will be placed at the sign-in tables and written comment station. Venue staff or the project team will wipe down high-touch areas during the meetings, which could include the presentation podium, microphones, shared pens, etc. If the meeting venue has doors that open to the outside, the doors can be kept open for increased air circulation.

Agenda: Based on the format outlined above, the proposed agenda for the in-person public meeting will be as follows:

Table 4. In-Person Public Meeting Agenda

Item	Presenter(s)	Time
Project Presentation	TBD	30 minutes
Open House Information Stations	TBD	45 minutes
Formal Public Comment Session	Kim Floyd, Moderator	45 minutes

IV. Comment Collection:

a. ***Virtual Public Meetings:*** During the virtual public meetings, verbal public comments can be submitted via audio when individuals are called upon and their microphone is unmuted. The moderator will call on individuals in the order they raised their hand to speak and ask each person to state and spell their name for the record. Speakers will be asked to limit their comments to three minutes. A court reporter will transcribe verbal comments. Written public comments will be accepted by mail and email throughout the public comment period.

b. ***In-Person Public Meeting:*** During the in-person public meeting, public comments can be submitted via two methods: (1) in writing via printed comment forms; and (2) verbal comments during the open house and formal public comment session transcribed by a court reporter.

A comment station will be provided for the public to have a dedicated space to write comments. Written comments could be collected in a box similar to a voting box. This ensures comment privacy or anonymity, if desired. The comment station will be staffed by the project team to ensure the written comments are secure. Written public comments will also be accepted by mail and email throughout the public comment period.

Individuals will sign up to provide their comments verbally during the formal public comment session. The moderator will call on individuals in the order they signed up and ask each person to state and spell their name for the record; to consider is whether elected officials would be allowed to provide their comments first. Speakers will be asked to limit their comments to three minutes. During the open house, the court reporter will be available to collect verbal comments in a semi-private setting for individuals who do not wish to speak their comment in front of an audience during the formal public comment session. The court reporter could be stationed in a separate room or a quiet corner of the meeting room during the open house.

V. Language Interpretation and Translation:

Spanish interpretation is not planned for the virtual public meetings; however, a Spanish interpreter will be available at the in-person public meeting.

The project presentation will be translated and recorded in Spanish, and the recording will be posted to the project website. The Executive Summary, press release, project fact sheet, and community guide will also be translated into Spanish.

VI. Section 508 Compliance:

Closed captioning during the virtual public meetings is needed for Section 508 compliance. Closed captioning will be generated by Zoom (CC live transcription).

VII. **Recording:** The virtual public meetings will be recorded. The recording of the project presentation portion or the entire virtual public meetings could be posted to the project website. The in-person public meeting will not be recorded.

VIII. **Informational Materials:** A variety of informational materials will be developed to support the Draft EIR/EIS public comment period and meetings. The materials will provide information and address anticipated stakeholder concerns and questions. The type, quantity, format, and topics for the informational materials are listed in the table below. Materials will be posted to the project website in advance of the meetings. Materials will also be mailed upon request to individuals without access to Internet or computer. Other methods for providing the informational materials are also listed.

Table 5. Informational Materials

Material	Quantity/ Format	Availability	Topics
Fact Sheet	Two-page fact sheet	• Project website • In-person public meeting • Information repositories	General project overview, alternatives, environmental review process, schedule for reviewing document, text box or call out box on how to effectively comment
Posters	7 (topics could be combined to further reduce number of posters)	• Project website • In-person public meeting • Information repositories	*Potential poster topics:* 1. Location, project overview, alternatives 2. Resource areas analyzed 3. Environmental analysis – water quality 4. Environmental analysis – fisheries 5. Environmental analysis – terrestrial and wetlands 6. Environmental analysis – local impacts (traffic, noise, air quality) 7. Environmental review process
Project Presentation	1	• Project website (recording) • Virtual public meetings • In-person public meeting	Project overview, alternatives, environmental analysis, environmental review process
Draft EIR/EIS Community Guide	1 (4 pages)	• Project website • In-person public meeting • Information repositories	Project overview, key elements of the environmental analysis provided in the Draft EIR/EIS
FAQs	1	• Project website	

IX. **Dry-Run Practice Sessions:** Several dry-run practice sessions will be held prior to the public meetings. The initial dry run for the virtual public meetings will include a run through of the technology and an opportunity for the project team to practice using the technology. Subsequent dry runs could include an overview of the meeting format and logistics; familiarization with informational materials; a run through of the PowerPoint presentation; and a dry run of potential public interactions in a Q&A setting. A team debrief can be conducted after each public meeting to discuss what went well and what could be improved.

X. **Documentation:** A summary of outreach activities will be developed and will include meeting noticing, materials developed, number of meeting attendees, list of representative groups and media who identified themselves during the meetings, and general comments heard. Court reporters will prepare a transcript of verbal comments provided at the public meetings.

Table 6. Virtual Public Meeting Roles and Staffing

Role	Responsibilities	Staffing
Zoom Webinar Host	• Schedule, manage, and host the virtual meetings • Control in-session features: starting, recording, and ending the webinars • Designate moderator as co-host • Designate slide sharer, presenters, chat monitor, and court reporter as panelists • Ensure live transcription is turned on • Promote countdown clock to panelist following presentation and time each speaker providing a comment • Run countdown clock • Confirm recordings of webinars and list of webinar attendees are saved	• Host: • Alternate host:
Slide Sharer	• Share and advance slides	• Primary: • Back up:
Meeting Moderator (Co-Host)	• Provide an introduction for the virtual public meetings • Call on participants who have hand raised to ask a question or provide a comment and unmute participants • Remove speaking abilities and lower hand of participant once allotted comment time is over or if participant is done speaking prior to end of allotted time • Moderator will share their camera when speaking	• Primary: Kim Floyd • Back up:
Presenters and Q&A Responders	• Deliver presentation • Answer questions • Presenters will share their camera when speaking	• •
Q&A Monitor	• Monitor Q&A feature for written questions • Organize written questions and read questions out loud	• Primary: • Back up/technical support:
Court Reporter	• Prepare transcript for each virtual meeting	• TBD

Table 7. In-Person Public Meeting Roles and Staffing

	Station	Materials	Equipment	Staffing
N/A	Floating Staff	N/A		• Moderator: Kim Floyd •
1	Welcome Station	• Welcome sign • COVID-19-related conduct sign • Sign-in sheet • Room layout handout • Speaker request card • Comment form	• (1-2) Chairs • (1-2) Tables • (8) Clipboards • Pens • (2) Sign holders • Acrylic brochure holders	•
2	Project Overview & Alternatives	• Location, project overview, alternatives poster • Fact sheet • Comment form	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
3	Water Quality	• Environmental analysis – water quality poster • Community guide • Comment form	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
4	Fisheries	• Environmental analysis – fisheries poster • Community guide • Comment form	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
5	Terrestrial & Wetlands	• Environmental analysis – terrestrial and wetlands) • Community guide • Comment form	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
6	Local Impacts	• Environmental analysis – local impacts (traffic, noise, air quality) poster	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
7	Environmental Review Process	• Environmental review process poster • Fact sheet • Comment form	• (1) Easel • (1) Chair • (1) Table • (1) Clipboard	•
8	Public Comment Station	• Comment form • Comment table signs	• (2-3) Tables • (8-12) Chairs • (8) Clipboards • (1) Comment box	• • TBD (Court reporter) • TBD (Spanish interpreter)

			• Pens • (2) Tabletop easels • Acrylic brochure holders	

Table 8. In-Person Meeting Materials

Item	Quantity	Responsibility
Meeting Materials		
• Sign-in sheet (8 names per sheet)		K&A
• Room layout handout		K&A
• Speaker request card		K&A
• Comment form (on colored paper)		K&A
• Comment table sign	2	
• Court reporter sign	1	
• COVID-19-related conduct sign	2	
• Comment box	1	
• Manila envelopes for completed sign-in sheets and comment forms	4	
• Clipboards	22	
• Digital voice recorder and extra batteries	1	
• Pens	30	
• Easels	8	
• Tabletop easels	2	
• Sign holders	2	
• Acrylic brochure holders	3	
• Nametags	For team	
• Blank nametag, inserts, holders	8	
• Internal room layout reference sheet	3	
• Event box	1	
• Painter's tape	1	
• Duct tape	1	
• Stopwatch	1	
• Comment timekeeping signs	1 set	
• Tablecloths	10	
• Extension cord	1	
• Power surge	1	
• Face masks		
• Hand sanitizer		
• Sanitizing wipes		
Informational Materials		
• Fact sheets	200	K&A
• Posters	8	K&A
• Community guide	50	K&A
• Draft EIS Copies	1	

• Draft EIS Executive Summary	10	
• Presentation slides	10	
Venue Equipment		
• Tables	~10	Venue
• Chairs	~40	Venue
• Podium	1	Venue
A/V Equipment		
• Screen	1	
• Projector	1	
• Microphones	2	

XI. **Landowner Meeting:** One in-person stakeholder meeting with landowners was held on August 20, 2021. The landowner meeting was held at the Sites Project Authority Office in Maxwell. The purpose was to review Draft EIR/EIS highlights and answer questions. Formal comments were not accepted during the landowner meeting, and this was made clear to participants.

CVP/SWP Deliveries Table

Deliveries (TAF/year) (change from No Project Alternative conditions)[a]	ALT1B 011221		ALT1B No Fremont Weir criteria		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun		ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	
	Historic Climate		Historic Climate		Historic Climate		Historic Climate		Historic Climate	
CVP Deliveries	11	29	13	35	14	33	11	31	9	20
NOD Ag	0	5	1	7	1	7	0	6	0	4
NOD M&I	0	0	1	2	1	z	0	0	0	0
SOD Ag	10	24	11	25	12	26	11	26	9	17
SOD M&I	1	0	1	0	1	0	0	0	1	0
Subtotal - CVP Operational Flexibility *(Diff from Alt A1 CVP values)*	**8**	**19**	**11**	**25**	12	23	**9**	**21**	**7**	**10**
CVP Refuge Water Supply	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**
NOD (Level 2)	1	2	2	2	1	2	1	1	1	2
SOD (Level 2)	0	0	0	0	0	0	0	0	0	0
SWP Deliveries	-2	0	-2	-13	-3	-13	3	15	-4	-2
SWP SOD Ag (Table A)	0	1	-2	-3	-2	-3	1	5	0	1
SWP SOD M&I (Table A)	-1	1	-5	-11	-6	-13	4	14	-2	-2
SWP SOD Interruptible (Article 21)	-1	-1	5	1	5	3	-2	-4	-1	-1
Total change in CVP/SWP Deliveries with CVP Operational Flexibility	10	31	13	24	13	23	15	48	7	20
Total change in CVP/SWP Deliveries without CVP Operational Flexibility	2	12	2	-1	2	0	7	26	0	10

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Authority Deliveries Table

Deliveries (TAF/year)	ALT1B 011221		ALT1B No Fremont Weir criteria		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun		ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun	
(change from No Project Alternative conditions) [a]	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Authority PWA Deliveries	**119**	**286**	**137**	**328**	**137**	**328**	**109**	**266**	**119**	**287**
NOD	29	60	32	68	32	68	27	58	29	62
SOD	91	226	104	260	104	260	82	208	89	225
CVP Operational Flexibility	**8**	**19**	**11**	**25**	**12**	**23**	**9**	**21**	**7**	**10**
Sub-Total Supplemental Deliveries for Water Supply	**127**	**305**	**148**	**353**	**148**	**351**	**117**	**287**	**125**	**297**
Refuge Water Supply	**20**	**34**	**23**	**40**	**23**	**40**	**19**	**31**	**20**	**33**
NOD (Level 4)	5	6	5	7	5	7	5	6	5	6
SOD (Level 4)	15	27	18	32	18	32	14	25	15	27
Yolo Bypass Habitat Water Supply	**36**	**21**	**43**	**28**	**44**	**29**	**33**	**12**	**35**	**17**
Total Authority Deliveries	**184**	**359**	**214**	**421**	**215**	**420**	**169**	**329**	**180**	**347**
Percentage of Total Authority Deliveries										
Authority PWA Deliveries - North of Delta	16%	17%	15%	16%	15%	16%	16%	18%	16%	18%
Authority PWA Deliveries - South of Delta	49%	63%	49%	62%	49%	62%	48%	63%	50%	65%
CVP Deliveries - Operational Flexibility	4%	5%	5%	6%	5%	6%	5%	6%	4%	3%
Refuge Water Supply	11%	9%	11%	9%	11%	9%	11%	9%	11%	10%
Yolo Bypass Habitat Water Supply	20%	6%	20%	7%	20%	7%	20%	4%	20%	5%

Consideration of Incidental Change to CVP and SWP Deliveries										
Incidental Change to CVP and SWP Deliveries without CVP Operational Flexibility	2	12	2	-1	2	0	7	26	0	10
Total Authority, CVP and SWP Deliveries	186	371	216	420	217	419	176	356	180	357
Incremental Change as a Percentage of Total Authority Deliveres	1%	3%	1%	0%	1%	0%	4%	8%	0%	3%
Incremental Change as a Percentage of Total Authority, CVP and SWP Deliveres	1%	3%	1%	0%	1%	0%	4%	7%	0%	3%

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Storage Table

Storage Increases (TAF) (above No Project Alternative conditions)[a]	ALT1B 011221		ALT1B No Fremont Weir criteria		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun		ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Additional end-of-September storage	**50**	**72**	**62**	**91**	**62**	**91**	**43**	**61**	**60**	**96**
Trinity	0	0	0	0	0	0	0	0	0	0
Shasta	28	39	38	57	37	57	21	31	36	58
CVP Storage	*25*	*31*	*35*	*50*	*34*	*50*	*19*	*23*	*34*	*51*
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values	*18*	*21*	*28*	*40*	*27*	*40*	*12*	*13*	*27*	*41*
Storage exchanged from Sites	*3*	*9*	*3*	*8*	*3*	*8*	*3*	*7*	*3*	*7*
Oroville	12	21	12	18	13	18	13	23	14	25
SWP Storage	*-6*	*-16*	*-8*	*-21*	*-7*	*-21*	*-3*	*-14*	*-4*	*-13*
Sites Delta Participants Storage	*17*	*36*	*20*	*40*	*20*	*40*	*17*	*36*	*18*	*38*
Folsom	9	12	12	15	12	15	8	8	9	13
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values	*6*	*7*	*9*	*10*	*9*	*10*	*5*	*3*	*6*	*8*
Percentage of Total Additional End-of-September Storage										
Portion of total additional end-of-September storage										
Trinity	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shasta	57%	55%	61%	63%	60%	63%	50%	50%	61%	60%
Oroville	24%	29%	20%	20%	20%	20%	32%	37%	24%	26%
Folsom	19%	16%	20%	16%	20%	17%	19%	13%	15%	13%

Notes:

[a] *Values shown are the net change between the Project Alternative and No Project Alternative*

Results are dependent on storage allocations (see storage allocation table)

Sites Releases Table

Releases (TAF/year)	ALT1B 011221		ALT1B No Fremont Weir criteria		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun		ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Releases for Authority PWA Deliveries - North of Delta	29	60	32	68	32	68	27	58	29	62
Assumed transfer from North of Delta to South of Delta	6	6	6	6	6	6	6	6	6	6
Releases for Authority PWA Deliveries - South of Delta	105	250	117	280	117	279	95	232	103	251
Releases for CVP Deliveries - Operational Flexibility	28	26	35	36	35	35	24	20	26	25
Releases for Refuge Water Supply	24	38	28	46	28	46	22	33	24	38
Releases for Yolo Bypass Habitat Water Supply	41	24	50	33	50	33	38	14	41	19
Total Releases	**234**	**404**	**269**	**469**	**269**	**468**	**212**	**364**	**229**	**402**
Percentage of Total Releases from Sites										
Releases for Authority PWA Deliveries - North of Delta	12%	15%	12%	15%	12%	15%	13%	16%	13%	16%
Assumed transfer from North of Delta to South of Delta	3%	2%	2%	1%	2%	1%	3%	2%	3%	2%
Releases for Authority PWA Deliveries - South of Delta	45%	62%	44%	60%	43%	60%	45%	64%	45%	62%
Releases for CVP Deliveries - Operational Flexibility	12%	7%	13%	8%	13%	8%	11%	6%	11%	6%
Releases for Refuge Water Supply	10%	9%	10%	10%	10%	10%	10%	9%	10%	9%
Releases for Yolo Bypass Habitat Water Supply	18%	6%	19%	7%	19%	7%	18%	4%	18%	5%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Fills Table

Fills (TAF/year)	ALT1B 011221		ALT1B No Fremont Weir criteria		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May		ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun		ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Fills for Authority PWA Deliveries - North of Delta	43	16	47	27	46	27	41	15	43	18
Fills for Authority PWA Deliveries - South of Delta	115	43	129	67	129	67	104	36	114	44
Fills for CVP Deliveries - Operational Flexibility	29	16	36	25	36	24	25	10	27	14
Fills for Refuge Water Supply	26	11	30	15	30	16	23	7	25	10
Fills for Yolo Bypass Habitat Water Supply	43	18	52	28	52	28	39	9	42	12
Total Fill	**255**	**104**	**293**	**162**	**293**	**162**	**232**	**76**	**250**	**98**
Percentage of Total Fills										
Fills for Authority PWA Deliveries - North of Delta	17%	15%	16%	17%	16%	17%	18%	19%	17%	18%
Fills for Authority PWA Deliveries - South of Delta	45%	41%	44%	41%	44%	41%	45%	47%	45%	45%
Fills for CVP Deliveries - Operational Flexibility	11%	16%	12%	15%	12%	15%	11%	13%	11%	15%
Fills for Refuge Water Supply	10%	11%	10%	10%	10%	10%	10%	9%	10%	10%
Fills for Yolo Bypass Habitat Water Supply	17%	17%	18%	17%	18%	17%	17%	12%	17%	12%

Notes:

Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT1B 011221	ALT1B No Fremont Weir criteria	ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Apr-May	ALT1B No Fremont Weir criteria, Wilkins Slough 10,700 cfs Oct-Jun	ALT1B No Fremont Weir criteria, Pulse Protection Oct-Nov, Wilkins Slough 10,700 cfs Dec-Jun
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate
Authority PWA Deliveries - North of Delta	256	256	256	256	256
TCCA	*138*	*138*	*138*	*138*	*138*
GCID	*31*	*31*	*31*	*31*	*31*
RD108	*25*	*25*	*25*	*25*	*25*
Other Sacramento Valley	*62*	*62*	*62*	*62*	*62*
Authority PWA Deliveries - South of Delta	788	788	788	788	788
CVP Deliveries - Operational Flexibility	91	91	91	91	91
Refuge Water Supply	124	124	124	124	124
Yolo Bypass Habitat Water Supply	120	120	120	120	120
Dead Pool Storage	120	120	120	120	120
Total Storage	**1499**	**1499**	**1499**	**1499**	**1499**
Percentage of Total Storage Capacity					
Authority PWA Deliveries - North of Delta	17%	17%	17%	17%	17%
Authority PWA Deliveries - South of Delta	53%	53%	53%	53%	53%
CVP Deliveries - Operational Flexibility	6%	6%	6%	6%	6%
Refuge Water Supply	8%	8%	8%	8%	8%
Yolo Bypass Habitat Water Supply	8%	8%	8%	8%	8%
Dead Pool Storage	8%	8%	8%	8%	8%

Notes:

Results are dependent on storage allocations

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 9/15/2021 4:48:08 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]; Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Subject: FW: Alt 3BR description
Attachments: Sites Reclamation Alternative 3BR description.docx

Flag: Follow up

FYI. Just got a writeup of Alt 3BR. Looks similar to the email Rob sent over a few months back. They are holding American River constant to 90% vs. the baseline and basically preserving their entire investment amount in Shasta (I assume for coldwater pool).

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: King, Vanessa M <vking@usbr.gov>
Sent: Wednesday, September 15, 2021 4:40 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>
Cc: Sumer, Derya <dsumer@usbr.gov>
Subject: Alt 3BR description

Hi Erin,

Please see the attached description of Alt 3BR. Let me know if you have any questions.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

Sites Reclamation Alternative 3BR model:

Model filename: NODOS_USBR2020_CALSIM_MMv4_ALT3BR_032321

This model was derived from the Sites Authority Alternative 3 model.

The Sites Authority Alternative 3 model:

Model filename: NODOS_SPJPA2020_CALSIM_MMv4_ALT3_020121

The Sites Authority Alternative 3 model is documented in detail in the Sites Reservoir Project RDEIR/SDEIS in Chapter 2 – Project Description and Alternatives, and Appendix 5A – Surface Water Resources Modeling of Alternatives.

Differences between Sites Reclamation Alternative 3BR and Authority Alternative 3 models:

The Reclamation model includes three modifications to the Authority model:

- Sites-Shasta storage exchange operation was removed in the Reclamation model
- Shasta Lake "reserve storage" operation was added in the Reclamation model to compliment the Sites CVP Op Flex storage quantity assumed
- American River July flow operations less than 3,000 CFS were constrained to within 90% of the No Action Alternative

Shasta Lake "reserve storage" operation

In Alternative 3 and 3BR, 345 TAF (25%) of Sites storage capacity is allocated to CVP Op Flex operations. Excess flows are diverted and stored in Sites. A portion of this new supply is managed in the Sites CVP Op Flex storage capacity. Releases from this storage are used to supplement the supply conditions of the CVP and benefit the CVP through increase water deliveries and increased storage conditions in other CVP reservoirs, especially Shasta Lake. Adding a Shasta Lake "reserve storage" operation to compliment the Sites CVP Op Flex storage quantity provides for controlling how much of the releases from the Sites CVP Op

Flex storage is used to increase storage conditions in Shasta Lake. For Alternative 3BR, the Shasta Lake "reserve storage" is assumed to be 345 TAF. This reserve storage is preserved through every timestep of Shasta Lake operations and constrains how much of Shasta Lake storage is considered for water supply based delivery allocations and balancing of storage between CVP reservoirs.

American River July flow operations

In Sites alternatives (Authority Alternative 1A and Alternative 3) with CVP Op Flex operations, a significant amount of release from Sites to supplement the supply conditions of the CVP occur in July. In many years of the simulation this release tends to offset releases from Folsom Lake. The model could be refined to more seamlessly integrate Sites CVP Op Flex into the CVP operational rules and operations as portrayed in the CalSIm II model; however this would take a significant amount of effort and guidance from Reclamation, specifically CVP operators. As an intermediate solutions, constraints were added to the model to maintain American River July flow operations less than 3,000 CFS to within 90% of the No Action Alternative.

Sites September 2021 Update Executive Briefing

Report Generated on Wednesday, September 8, 2021
Created by the Project Controls Team

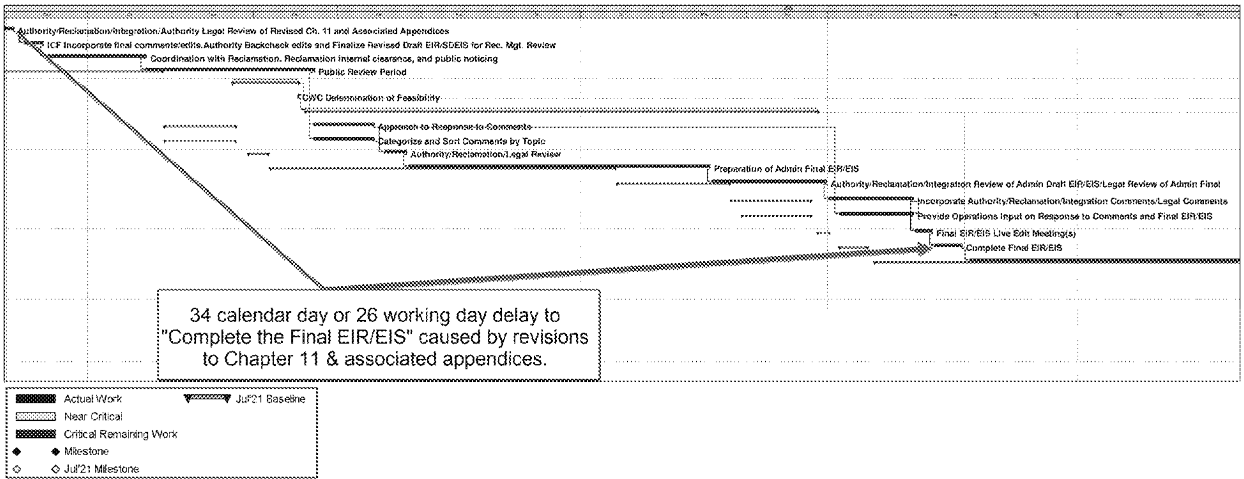
Deliverables Performance Analysis

Deliverable Performance Analysis for Amendment 2 activities by discipline. The variance column indicates calendar days delayed (Red) or calendar days gained (Green) between July 2021 and September 2021 updates.

Discipline	Deliverable	Variance Between July'21 and September'21 Updates in Calendar Days
Operations Deliverable	Full Operations Analysis Complete	Deliverable Completed
Operations Deliverable	Appendices for EIR/EIS	Deliverable Completed
Environmental Deliverable	Release Revised Draft EIR/ Supplemental Draft EIS for Public Review	-50
Environmental Deliverable	Authority review of Draft Environmental Feasibility Report for CWC	Deliverable Completed
Engineering Deliverable	Develop Class 4 Cost Estimate including Mitigation Measures	Deliverable Completed
Engineering Deliverable	Constructability Analysis	Deliverable Completed
Engineering Deliverable	CWC Determination of Feasibility	0
Permitting Deliverable	Submit Delineation to USACE	Deliverable Completed
Permitting Deliverable	Submit 404 Application	0
Permitting Deliverable	Deadline for Signatures on Final PA	0
Permitting Deliverable	Submit Final Admin Draft BA	Deliverable Completed
Permitting Deliverable	Submit Revised Admin Draft BA to Reclamation for NMFS Review	0
Permitting Deliverable	Reclamation Submit BA to USFWS & NMFS	-16
Permitting Deliverable	Submit 401 Application - Conditional Approval	0

Critical Path Analysis

The critical path continues to run through the Final EIR/EIS which shows a delay of 34 calendar days compared to the July 2021 Bi-Monthly Update. The delay is caused by revisions to Chapter 11 and associated appendices.



Risk Analysis

The lack of schedule detail in the Sites Planning Schedule is preventing the risk adjusted schedule from producing a valuable determination of estimated completion, duration, and cost. The upcoming effort to develop the Sites Master Schedule will provide the detail that is necessary to generate the risk adjusted schedule.

The Sites Risk Matrix shows the customizable probability & impact scale.

Description	Probability	Schedule Impact	Cost Impact	Color
Very Low	5%	7 days	$1,000	
Low	25%	30 days	$10,000	
Medium	50%	60 days	$100,000	
High	75%	90 days	$1,000,000	
Very High	95%	180 days	$10,000,000	

The Sites Risk Register shows the ID's, descriptions, risk factors, risk score, mitigation status and assigned schedule activities.

Even...	Type	Description	%	Dur	$	Score	Mitigation	Status	Activities
SR001	Risk	Reclamation needs to initiate Section 106 consultation with SHPO; Authority/integration cannot do this unless delegated by Reclamation, which is unlikely. Reclamation schedule has the final PA completed on 1/11/2023	Medium	Medium	Very Low	[illegible]		Unmitigated	[illegible]
SR002	Risk	Risk No.002 Reclamation unlikely to initiate formal Section 7 (ESA) consultation	High	Very High	Very High	20		Unmitigated	[illegible]
SR003	Risk	Risk No.003 Reclamation review takes more than 30 days	Medium	High	Very Low	[illegible]		Unmitigated	[illegible]
SR004	Risk	Risk No.004 Reclamation review takes more than 30 days	Medium	High	Very Low	[illegible]		Unmitigated	[illegible]
SR005	Risk	Risk No.005 Reclamation needs to initiate Section 7 consultation with USFWS and NMFS	High	Very High	Very High	20		Unmitigated	[illegible]
SR006	Risk	Risk No.006 SWRCB will not accept pre-application packet and will require final CEQA document to be complete before application will be accepted	Medium	Medium	Low	[illegible]		Mitigated	[illegible]

Studies Reported (climate - scenario):
- Historic Climate - ALT 1B 011221
- WSIP 2030 Climate - ALT 1B WSIP2030 040121
- WSIP 2070 Climate - ALT 1B WSIP2070 040121

Sites Metrics Tabs/Tables:
- CVP/SWP Deliveries Table
- Authority Deliveries Table
- Storage Table
- Sites Releases Table
- Sites Fills Table
- Sites Storage Allocation Table

Sites Economic Metrics Tabs/Tables:
- CVP Supply Changes
  - Summary Results (CVP Op Flex)
  - Summary Results (Total CVP Op Flex and Other Changes)
- CVP Storage End-of-September Increase
  - Summary Results (CVP Op Flex)
  - Summary Results (Sites-Shasta Exchange)
  - Summary Results (Total CVP Op Flex, Sites-Shasta Exchange and Other Changes)
- SWP Supply Changes
- PWA Water Supply Increases
- WSIP Level 4 Refuge Water Supply Increases
- WSIP Yolo Bypass Flow Increases

Notes
- CVP Op Flex results are determined through comparison of results between Project Alternative and comparable Alternative without Federal Investment
- Results south of the Delta are presented summurized by both 40-30-30 and 60-20-20 year classifications

CVP/SWP Deliveries Table

Deliveries (TAF/year) (change from No Project Alternative conditions) [a]	ALT 1B 011221		ALT 1B WSIP2030 040121		ALT 1B WSIP2070 040121	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate	
CVP Deliveries	11	29	7	3	13	42
NOD Ag	0	5	-2	-1	-2	0
NOD M&I	0	0	0	0	0	0
SOD Ag	10	24	8	4	13	39
SOD M&I	1	0	0	0	1	2
Subtotal - CVP Operational Flexibility *(Diff from Alt A1 CVP values)*	**8**	**19**	**5**	**6**	**3**	**5**
CVP Refuge Water Supply	1	2	0	-1	0	-1
NOD (Level 2)	1	2	1	0	1	0
SOD (Level 2)	0	0	-1	0	0	-1
SWP Deliveries	-2	0	4	-3	10	-7
SWP SOD Ag (Table A)	0	1	1	0	3	0
SWP SOD M&I (Table A)	-1	1	-4	-3	3	-7
SWP SOD Interruptible (Article 21)	-1	-1	7	0	4	0
Total change in CVP/SWP Deliveries with CVP Operational Flexibility	10	31	11	-1	23	33
Total change in CVP/SWP Deliveries without CVP Operational Flexibility	2	12	6	-7	20	28

Notes:

[a] *Values shown are the net change between the Project Alternative and No Project Alternative*

Results are dependent on storage allocations (see storage allocation table)

Authority Deliveries Table

Deliveries (TAF/year) (change from No Project Alternative conditions) [a]	ALT 1B 011221		ALT 1B WSIP2030 040121		ALT 1B WSIP2070 040121	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate	
Authority PWA Deliveries	**119**	**286**	**140**	**302**	**155**	**270**
NOD	29	60	37	68	48	55
SOD	91	226	103	234	107	215
CVP Operational Flexibility	**8**	**19**	**5**	**6**	**3**	**5**
Sub-Total Supplemental Deliveries for Water Supply	**127**	**305**	**145**	**308**	**158**	**275**
Refuge Water Supply	**20**	**34**	**17**	**24**	**15**	**23**
NOD (Level 4)	5	6	5	7	5	7
SOD (Level 4)	15	27	11	17	10	17
Yolo Bypass Habitat Water Supply	**36**	**21**	**36**	**22**	**31**	**25**
Total Authority Deliveries	**184**	**359**	**198**	**354**	**204**	**323**
Percentage of Total Authority Deliveries						
Authority PWA Deliveries - North of Delta	16%	17%	19%	19%	23%	17%
Authority PWA Deliveries - South of Delta	49%	63%	52%	66%	53%	66%
CVP Deliveries - Operational Flexibility	4%	5%	2%	2%	2%	1%
Refuge Water Supply	11%	9%	9%	7%	7%	7%
Yolo Bypass Habitat Water Supply	20%	6%	18%	6%	15%	8%
Consideration of Incidental Change to CVP and SWP Deliveries						
Incidental Change to CVP and SWP Deliveries without CVP Operational Flexibility	2	12	6	-7	20	28
Total Authority, CVP and SWP Deliveries	186	371	204	347	224	351
Incremental Change as a Percentage of Total Authority Deliveres	1%	3%	3%	-2%	10%	9%
Incremental Change as a Percentage of Total Authority, CVP and SWP Deliveres	1%	3%	3%	-2%	9%	8%

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Storage Table

Storage Increases (TAF) (above No Project Alternative conditions) [a]	ALT 1B 011221		ALT 1B WSIP2030 040121		ALT 1B WSIP2070 040121	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate	
Additional end-of-September storage	**50**	**72**	**51**	**70**	**51**	**68**
Trinity	0	0	0	0	0	0
Shasta	28	39	36	48	35	47
CVP Storage	*25*	*31*	*32*	*34*	*29*	*32*
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values)	*18*	*21*	*30*	*44*	*25*	*33*
Storage exchanged from Sites	*3*	*9*	*5*	*14*	*6*	*15*
Oroville	12	21	10	14	11	14
SWP Storage	*-6*	*-16*	*-8*	*-11*	*-1*	*0*
Sites Delta Participants Storage	*17*	*36*	*18*	*25*	*12*	*14*
Folsom	9	12	5	8	4	8
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values)	*6*	*7*	*5*	*8*	*2*	*3*
Percentage of Total Additional End-of-September Storage						
Portion of total additional end-of-September storage						
Trinity	0%	0%	0%	0%	0%	0%
Shasta	57%	55%	71%	68%	69%	69%
Oroville	24%	29%	19%	20%	22%	20%
Folsom	19%	16%	10%	12%	8%	11%

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Sites Releases Table

Releases (TAF/year)	ALT 1B 011221		ALT 1B WSIP2030 040121		ALT 1B WSIP2070 040121	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate	
Releases for Authority PWA Deliveries - North of Delta	29	60	37	68	48	55
Assumed transfer from North of Delta to South of Delta	6	6	6	7	6	7
Releases for Authority PWA Deliveries - South of Delta	105	250	118	253	121	243
Releases for CVP Deliveries - Operational Flexibility	28	26	30	21	31	24
Releases for Refuge Water Supply	24	38	19	27	17	27
Releases for Yolo Bypass Habitat Water Supply	41	24	42	25	36	29
Total Releases	**234**	**404**	**253**	**401**	**259**	**385**
Percentage of Total Releases from Sites						
Releases for Authority PWA Deliveries - North of Delta	12%	15%	15%	17%	18%	14%
Assumed transfer from North of Delta to South of Delta	3%	2%	2%	2%	2%	2%
Releases for Authority PWA Deliveries - South of Delta	45%	62%	47%	63%	47%	63%
Releases for CVP Deliveries - Operational Flexibility	12%	7%	12%	5%	12%	6%
Releases for Refuge Water Supply	10%	9%	8%	7%	7%	7%
Releases for Yolo Bypass Habitat Water Supply	18%	6%	17%	6%	14%	7%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Fills Table

Fills (TAF/year)	ALT 1B 011221		ALT 1B WSIP2030 040121		ALT 1B WSIP2070 040121	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate	
Fills for Authority PWA Deliveries - North of Delta	43	16	50	23	60	28
Fills for Authority PWA Deliveries - South of Delta	115	43	132	55	133	60
Fills for CVP Deliveries - Operational Flexibility	29	16	31	18	31	17
Fills for Refuge Water Supply	26	11	31	12	28	11
Fills for Yolo Bypass Habitat Water Supply	43	18	33	12	29	10
Total Fill	**255**	**104**	**277**	**121**	**281**	**127**
Percentage of Total Fills						
Fills for Authority PWA Deliveries - North of Delta	17%	15%	18%	19%	21%	22%
Fills for Authority PWA Deliveries - South of Delta	45%	41%	48%	45%	47%	47%
Fills for CVP Deliveries - Operational Flexibility	11%	16%	11%	15%	11%	14%
Fills for Refuge Water Supply	10%	11%	11%	10%	10%	9%
Fills for Yolo Bypass Habitat Water Supply	17%	17%	12%	10%	10%	8%

Notes:

Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT 1B 011221	ALT 1B WSIP2030 040121	ALT 1B WSIP2070 040121
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2030 Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) WSIP 2070 Climate
Authority PWA Deliveries - North of Delta	256	256	256
TCCA	*138*	*138*	*138*
GCID	*31*	*31*	*31*
RD108	*25*	*25*	*25*
Other Sacramento Valley	*62*	*62*	*62*
Authority PWA Deliveries - South of Delta	788	788	788
CVP Deliveries - Operational Flexibility	91	91	91
Refuge Water Supply	124	161	161
Yolo Bypass Habitat Water Supply	120	83	83
Dead Pool Storage	120	120	120
Total Storage	**1499**	**1499**	**1499**
Percentage of Total Storage Capacity			
Authority PWA Deliveries - North of Delta	17%	17%	17%
Authority PWA Deliveries - South of Delta	53%	53%	53%
CVP Deliveries - Operational Flexibility	6%	6%	6%
Refuge Water Supply	8%	11%	11%
Yolo Bypass Habitat Water Supply	8%	6%	6%
Dead Pool Storage	8%	8%	8%

Notes:

Results are dependent on storage allocations

CVP Supply Changes attributable to Federal Investment (CVP Op Flex)

Summary Results (CVP Op Flex)

	Sacramento Valley 40-30-30 Index Year Class Averages			San Joaquin Valley 60-20-20 Index Year Class Averages	
	Sacramento Valley 40-30-30 Index Occurrence	CVP Op Flex NOD Supply (TAF/year)	CVP Op Flex SOD Supply (TAF/year)	San Joaquin Valley 60-20-20 Index Occurrence	CVP Op Flex SOD Supply (TAF/year)
Historic Climate - ALT 1B 011221					
Long-Term Average	100.0%	1	7	100.0%	7
Dry/Critically Dry	37.0%	3	16	35.8%	17
Wet	32.1%	0	4	29.6%	1
Above Normal	13.6%	0	1	19.8%	0
Below Normal	17.3%	0	-4	14.8%	2
Dry	22.2%	5	20	16.0%	19
Critically Dry	14.8%	0	10	19.8%	15
WSIP 2030 Climate - ALT 1B WSIP2030 040121					
Long-Term Average	100.0%	2	3	100.0%	3
Dry/Critically Dry	34.6%	4	2	40.7%	2
Wet	30.9%	0	0	25.9%	0
Above Normal	13.6%	0	10	19.8%	8
Below Normal	21.0%	1	3	13.6%	4
Dry	19.8%	4	3	18.5%	3
Critically Dry	14.8%	5	1	22.2%	1
WSIP 2070 Climate - ALT 1B WSIP2070 040121					
Long-Term Average	100.0%	0	3	100.0%	3
Dry/Critically Dry	39.5%	1	4	49.4%	4
Wet	32.1%	0	2	18.5%	6
Above Normal	12.3%	0	5	21.0%	8
Below Normal	16.0%	0	0	11.1%	-20
Dry	24.7%	2	8	14.8%	9
Critically Dry	14.8%	-2	-3	34.6%	2

Notes:

Values shown are the net change between the Project Alternative and comparable Alternative without Federal Investment

Net change due to Federal Investment is accounted for as CVP Op Flex

Values are based on contract years (Mar-Feb for CVP)

Results are dependent on storage allocations (see storage allocation table)

CVP Supply Changes

Summary Results (Total CVP Op Flex and Other Changes)

	Sacramento Valley 40-30-30 Index Year Class Averages			San Joaquin Valley 60-20-20 Index Year Class Averages	
	Sacramento Valley 40-30-30 Index Occurrence	CVP NOD Supply Changes (TAF/year)	CVP SOD Supply Changes (TAF/year)	San Joaquin Valley 60-20-20 Index Occurrence	CVP SOD Supply Changes (TAF/year)
Historic Climate - ALT 1B 011221					
Long-Term Average	100.0%	0	10	100.0%	10
Dry/Critically Dry	37.0%	5	24	35.8%	27
Wet	32.1%	-3	1	29.6%	-1
Above Normal	13.6%	-2	11	19.8%	7
Below Normal	17.3%	-1	-3	14.8%	-4
Dry	22.2%	9	36	16.0%	24
Critically Dry	14.8%	-1	6	19.8%	30
WSIP 2030 Climate - ALT 1B WSIP2030 040121					
Long-Term Average	100.0%	-2	8	100.0%	8
Dry/Critically Dry	34.6%	-2	5	40.7%	10
Wet	30.9%	-4	-6	25.9%	4
Above Normal	13.6%	-1	33	19.8%	3
Below Normal	21.0%	1	20	13.6%	21
Dry	19.8%	-3	-2	18.5%	5
Critically Dry	14.8%	0	14	22.2%	15
WSIP 2070 Climate - ALT 1B WSIP2070 040121					
Long-Term Average	100.0%	-2	14	100.0%	14
Dry/Critically Dry	39.5%	1	41	49.4%	23
Wet	32.1%	-4	1	18.5%	10
Above Normal	12.3%	-2	-4	21.0%	2
Below Normal	16.0%	-2	-11	11.1%	6
Dry	24.7%	0	35	14.8%	11
Critically Dry	14.8%	2	51	34.6%	28

Notes:

Values shown are the net change between the Project Alternative and No Project Alternative

Values are based on contract years (Mar-Feb for CVP)

Results are dependent on storage allocations (see storage allocation table)

CVP Supply Changes

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	CVP NOD Supply Changes (TAF/year)	San Joaquin Valley 60-20-20 Index	CVP SOD Supply Changes (TAF/year)
1922	AN	-2	W	0
1923	BN	1	AN	7
1924	CD	-3	CD	0
1925	D	-6	BN	-55
1926	D	60	D	307
1927	W	-2	AN	-15
1928	AN	0	BN	10
1929	CD	4	CD	21
1930	D	-7	CD	-1
1931	CD	0	CD	0
1932	D	0	AN	0
1933	CD	0	D	0
1934	CD	-4	CD	0
1935	BN	-5	AN	-11
1936	BN	1	AN	3
1937	BN	3	W	-53
1938	W	-7	W	0
1939	D	1	D	14
1940	AN	-5	AN	-1
1941	W	-7	W	0
1942	W	-6	W	0
1943	W	-4	W	0
1944	D	-5	BN	5
1945	BN	-10	AN	0
1946	BN	0	AN	1
1947	D	14	D	113
1948	BN	0	BN	37
1949	D	-8	BN	-56
1950	BN	6	BN	8
1951	AN	-1	AN	9
1952	W	-2	W	-3
1953	W	-5	BN	-11
1954	AN	-2	BN	15
1955	D	-1	D	-6
1956	W	-3	W	-3
1957	AN	0	BN	1
1958	W	-6	W	5
1959	BN	-1	D	-21
1960	D	-6	CD	10
1961	D	84	CD	81
1962	BN	-3	BN	-2
1963	W	-12	AN	19
1964	D	1	D	-2
1965	W	0	W	3
1966	BN	0	BN	-5
1967	W	0	W	-2
1968	BN	0	D	-10
1969	W	0	W	0
1970	W	0	AN	-5
1971	W	0	BN	1
1972	BN	-1	D	0
1973	AN	-1	AN	73
1974	W	-3	W	-2
1975	W	-4	W	4
1976	CD	2	CD	12
1977	CD	-5	CD	81
1978	AN	-3	W	-1
1979	BN	-2	AN	3
1980	AN	-2	W	0
1981	D	-9	D	12
1982	W	-4	W	33
1983	W	-3	W	48
1984	W	0	AN	13
1985	D	-1	D	4
1986	W	-1	W	-57
1987	D	58	CD	351
1988	CD	-17	CD	-46
1989	D	-7	CD	-33
1990	CD	2	CD	9
1991	CD	0	CD	0
1992	CD	0	CD	-3
1993	AN	-5	W	3
1994	CD	7	CD	-2
1995	W	0	W	0
1996	W	-3	W	0
1997	W	-3	W	1
1998	W	-1	W	0
1999	W	-1	AN	-6
2000	AN	-5	AN	16
2001	D	-3	D	21
2002	D	-7	D	-114

CVP Supply Changes

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	CVP NOD Supply Changes (TAF/year)	San Joaquin Valley 60-20-20 Index	CVP SOD Supply Changes (TAF/year)
1922	AN	-2	AN	6
1923	BN	68	BN	109
1924	CD	-5	CD	-9
1925	BN	-1	BN	-17
1926	D	-1	CD	0
1927	W	0	AN	-127
1928	BN	-7	BN	10
1929	CD	3	D	16
1930	D	-2	D	-127
1931	CD	11	CD	141
1932	D	2	AN	6
1933	CD	-3	D	-13
1934	CD	-9	CD	14
1935	BN	-8	AN	-7
1936	BN	-3	AN	9
1937	BN	-2	W	5
1938	W	-8	W	-11
1939	D	0	D	41
1940	AN	-2	AN	90
1941	W	-5	W	2
1942	W	-8	W	5
1943	AN	-4	W	0
1944	D	-1	BN	16
1945	BN	-6	AN	0
1946	AN	3	AN	33
1947	D	0	CD	6
1948	BN	-4	D	201
1949	D	-14	D	-101
1950	D	-9	BN	28
1951	W	-2	AN	-4
1952	W	-2	W	5
1953	AN	-2	BN	12
1954	AN	-2	BN	7
1955	D	6	D	-15
1956	W	-2	W	-1
1957	BN	1	D	-3
1958	W	-11	W	0
1959	BN	-1	CD	4
1960	D	4	CD	-8
1961	D	-23	CD	57
1962	D	-6	BN	-22
1963	W	-5	AN	6
1964	D	3	CD	5
1965	W	0	W	0
1966	BN	-3	D	-20
1967	W	-6	W	4
1968	BN	-4	D	16
1969	W	0	W	-2
1970	W	0	BN	8
1971	W	0	BN	-24
1972	BN	0	D	15
1973	AN	15	AN	44
1974	W	-6	AN	0
1975	AN	-3	AN	0
1976	CD	-1	CD	2
1977	CD	-2	CD	0
1978	W	-9	W	0
1979	BN	-2	AN	0
1980	AN	-2	W	10
1981	D	-3	D	16
1982	W	-6	W	1
1983	W	-3	W	9
1984	W	-2	AN	3
1985	BN	-7	D	0
1986	W	-19	W	-24
1987	D	-5	CD	37
1988	CD	-8	CD	3
1989	BN	1	CD	-1
1990	CD	2	CD	8
1991	CD	-2	CD	0
1992	CD	16	CD	10
1993	AN	-6	W	55
1994	CD	-4	CD	-8
1995	W	0	W	0
1996	W	-3	W	-9
1997	W	-1	W	28
1998	W	-3	W	0
1999	W	-1	AN	-9
2000	AN	-2	BN	102
2001	D	2	D	28
2002	BN	2	D	20

CVP Supply Changes

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	CVP NOD Supply Changes (TAF/year)	San Joaquin Valley 60-20-20 Index	CVP SOD Supply Changes (TAF/year)
1922	AN	-2	AN	-33
1923	D	-1	BN	108
1924	CD	0	CD	-81
1925	D	-3	D	14
1926	D	5	CD	17
1927	AN	0	BN	17
1928	BN	-5	D	-18
1929	CD	1	CD	34
1930	D	3	CD	15
1931	CD	0	CD	0
1932	D	0	AN	107
1933	CD	4	D	163
1934	CD	1	CD	0
1935	BN	-12	AN	-45
1936	AN	0	AN	0
1937	BN	-5	W	5
1938	W	-14	W	3
1939	D	8	CD	7
1940	W	-4	AN	-1
1941	W	-7	W	3
1942	W	-7	W	2
1943	W	-5	AN	-3
1944	D	-12	D	6
1945	D	-6	BN	18
1946	BN	-7	BN	21
1947	D	-5	CD	-13
1948	BN	-3	D	-178
1949	D	-1	D	97
1950	BN	5	D	40
1951	W	0	BN	6
1952	W	-4	W	0
1953	AN	-2	BN	-31
1954	AN	0	D	21
1955	D	14	CD	16
1956	W	6	W	20
1957	BN	-1	D	-5
1958	W	-19	W	0
1959	BN	-1	CD	0
1960	D	10	CD	46
1961	D	2	CD	109
1962	D	-7	D	-4
1963	W	-6	AN	-6
1964	D	2	CD	35
1965	W	0	AN	-43
1966	BN	0	CD	64
1967	W	-8	W	4
1968	BN	-1	CD	-14
1969	W	-1	W	12
1970	W	0	BN	1
1971	W	0	D	-13
1972	BN	3	CD	-36
1973	AN	-1	AN	2
1974	W	-6	AN	-2
1975	AN	-2	AN	13
1976	CD	15	CD	58
1977	CD	6	CD	-22
1978	W	-1	W	0
1979	BN	4	AN	35
1980	AN	1	W	38
1981	D	-8	D	7
1982	W	-8	W	1
1983	W	-4	W	61
1984	W	-1	BN	0
1985	D	-6	CD	54
1986	W	-2	AN	9
1987	D	-3	CD	7
1988	CD	-1	CD	0
1989	D	-2	CD	0
1990	CD	0	CD	1
1991	CD	0	CD	0
1992	CD	0	CD	469
1993	AN	-6	AN	21
1994	CD	-4	CD	-4
1995	W	-3	W	0
1996	W	-3	AN	-12
1997	W	0	AN	-18
1998	W	-3	W	0
1999	W	2	AN	3
2000	AN	-9	BN	-87
2001	D	9	CD	47
2002	BN	-2	CD	-16

Storage End-of-September Increase attributable to Federal Investment (CVP Op Flex)

Summary Results (CVP Op Flex)

	Sacramento Valley 40-30-30 Index Year Class Averages		
	Sacramento Valley 40-30-30 Index Occurrence	Shasta Lake End-of-September Storage Increase (TAF)	Folsom Lake End-of-September Storage Increase (TAF)
Historic Climate - ALT 1B 011221			
Long-Term Average	100.0%	18	6
Dry/Critically Dry	37.0%	21	7
Wet	32.1%	-1	0
Above Normal	13.6%	37	19
Below Normal	17.3%	33	4
Dry	22.2%	28	2
Critically Dry	14.8%	10	13
WSIP 2030 Climate - ALT 1B WSIP2030 040121			
Long-Term Average	100.0%	30	5
Dry/Critically Dry	34.6%	44	8
Wet	30.9%	0	0
Above Normal	13.6%	56	7
Below Normal	21.0%	36	6
Dry	19.8%	47	10
Critically Dry	14.8%	40	6
WSIP 2070 Climate - ALT 1B WSIP2070 040121			
Long-Term Average	100.0%	25	2
Dry/Critically Dry	39.5%	33	3
Wet	32.1%	3	1
Above Normal	12.3%	50	1
Below Normal	16.0%	27	2
Dry	24.7%	48	4
Critically Dry	14.8%	9	1

Notes:

Values shown are the net change between the Project Alternative and comparable Alternative without Federal Investment

Net change due to Federal Investment is accounted for as CVP Op Flex

Storage End-of-September Increase

Summary Results (Sites-Shasta Exchange)

Sacramento Valley 40-30-30 Index Year Class Averages		
	Sacramento Valley 40-30-30 Index Occurrence	Shasta Lake End-of-September Storage Increase (TAF)
Historic Climate - ALT 1B 011221		
Long-Term Average	100.0%	3
Dry/Critically Dry	37.0%	9
Wet	32.1%	0
Above Normal	13.6%	0
Below Normal	17.3%	0
Dry	22.2%	5
Critically Dry	14.8%	14
WSIP 2030 Climate - ALT 1B WSIP2030 040121		
Long-Term Average	100.0%	5
Dry/Critically Dry	34.6%	14
Wet	30.9%	0
Above Normal	13.6%	0
Below Normal	21.0%	0
Dry	19.8%	14
Critically Dry	14.8%	14
WSIP 2070 Climate - ALT 1B WSIP2070 040121		
Long-Term Average	100.0%	6
Dry/Critically Dry	39.5%	15
Wet	32.1%	0
Above Normal	12.3%	0
Below Normal	16.0%	0
Dry	24.7%	18
Critically Dry	14.8%	10

Notes:

Values shown are the net change Sites-Shasta Exchane from the Project Alternative

Storage End-of-September Increase

Summary Results (Total CVP Op Flex, Sites-Shasta Exchange and Other Changes)

Sacramento Valley 40-30-30 Index Year Class Averages			
	Sacramento Valley 40-30-30 Index Occurrence	Shasta Lake End-of-September Storage Increase (TAF)	Folsom Lake End-of-September Storage Increase (TAF)
Historic Climate - ALT 1B 011221			
Long-Term Average	100.0%	28	9
Dry/Critically Dry	37.0%	39	12
Wet	32.1%	1	3
Above Normal	13.6%	47	21
Below Normal	17.3%	41	7
Dry	22.2%	26	15
Critically Dry	14.8%	60	7
WSIP 2030 Climate - ALT 1B WSIP2030 040121			
Long-Term Average	100.0%	36	5
Dry/Critically Dry	34.6%	48	8
Wet	30.9%	13	0
Above Normal	13.6%	69	11
Below Normal	21.0%	31	5
Dry	19.8%	55	12
Critically Dry	14.8%	38	3
WSIP 2070 Climate - ALT 1B WSIP2070 040121			
Long-Term Average	100.0%	35	4
Dry/Critically Dry	39.5%	47	8
Wet	32.1%	17	2
Above Normal	12.3%	73	1
Below Normal	16.0%	16	3
Dry	24.7%	70	13
Critically Dry	14.8%	9	0

Notes:

Values shown are the net change between the Project Alternative and No Project Alternative

Storage End-of-September Increase

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	Shasta Lake End-of-September Storage Increase (TAF)	Folsom Lake End-of-September Storage Increase (TAF)
1922	AN	47	30
1923	BN	35	10
1924	CD	36	9
1925	D	52	20
1926	D	-106	-21
1927	W	6	2
1928	AN	49	0
1929	CD	86	3
1930	D	122	51
1931	CD	-40	23
1932	D	13	0
1933	CD	32	3
1934	CD	-35	0
1935	BN	49	10
1936	BN	56	7
1937	BN	72	31
1938	W	0	0
1939	D	61	13
1940	AN	56	0
1941	W	0	0
1942	W	0	0
1943	W	17	-3
1944	D	86	25
1945	BN	24	11
1946	BN	21	8
1947	D	-9	-1
1948	BN	-44	-13
1949	D	15	6
1950	BN	23	7
1951	AN	31	4
1952	W	-13	13
1953	W	0	0
1954	AN	66	17
1955	D	-13	8
1956	W	0	0
1957	AN	70	33
1958	W	0	0
1959	BN	87	0
1960	D	103	33
1961	D	-18	17
1962	BN	16	-2
1963	W	-20	-7
1964	D	29	66
1965	W	0	24
1966	BN	66	-9
1967	W	0	0
1968	BN	84	0
1969	W	0	0
1970	W	3	0
1971	W	0	0
1972	BN	60	27
1973	AN	75	23
1974	W	0	0
1975	W	0	0
1976	CD	114	13
1977	CD	153	12
1978	AN	0	0
1979	BN	26	9
1980	AN	21	100
1981	D	83	31
1982	W	0	0
1983	W	0	0
1984	W	-6	-2
1985	D	40	13
1986	W	23	43
1987	D	-166	-12
1988	CD	-114	-10
1989	D	27	1
1990	CD	78	5
1991	CD	98	-12
1992	CD	122	10
1993	AN	30	9
1994	CD	191	26
1995	W	0	0
1996	W	0	5
1997	W	15	0
1998	W	0	0
1999	W	0	1
2000	AN	72	19
2001	D	113	18
2002	D	26	7

Storage End-of-September Increase

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	Shasta Lake End-of-September Storage Increase (TAF)	Folsom Lake End-of-September Storage Increase (TAF)
1922	AN	73	26
1923	BN	-63	4
1924	CD	-37	-2
1925	BN	33	-9
1926	D	-85	-9
1927	W	101	0
1928	BN	35	0
1929	CD	86	1
1930	D	107	27
1931	CD	85	8
1932	D	28	-10
1933	CD	2	-4
1934	CD	-25	1
1935	BN	20	7
1936	BN	10	3
1937	BN	23	7
1938	W	0	10
1939	D	164	24
1940	AN	35	0
1941	W	7	-6
1942	W	12	3
1943	AN	45	0
1944	D	126	19
1945	BN	17	10
1946	AN	17	0
1947	D	33	4
1948	BN	0	-29
1949	D	3	-2
1950	D	-16	-34
1951	W	0	0
1952	W	0	0
1953	AN	69	13
1954	AN	45	0
1955	D	89	18
1956	W	71	-12
1957	BN	58	12
1958	W	15	4
1959	BN	99	1
1960	D	86	31
1961	D	-42	28
1962	D	21	-2
1963	W	5	1
1964	D	64	20
1965	W	4	1
1966	BN	39	0
1967	W	0	0
1968	BN	87	0
1969	W	28	13
1970	W	12	2
1971	W	7	-4
1972	BN	45	27
1973	AN	85	0
1974	W	9	-7
1975	AN	74	23
1976	CD	116	11
1977	CD	-8	10
1978	W	5	-13
1979	BN	39	21
1980	AN	167	51
1981	D	70	40
1982	W	0	4
1983	W	0	0
1984	W	1	0
1985	BN	53	17
1986	W	28	-1
1987	D	100	14
1988	CD	44	1
1989	BN	27	0
1990	CD	35	-1
1991	CD	71	7
1992	CD	58	4
1993	AN	33	10
1994	CD	28	6
1995	W	0	0
1996	W	2	0
1997	W	1	0
1998	W	0	0
1999	W	10	0
2000	AN	120	0
2001	D	130	20
2002	BN	11	8

Storage End-of-September Increase

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	Shasta Lake End-of-September Storage Increase (TAF)	Folsom Lake End-of-September Storage Increase (TAF)
1922	AN	105	0
1923	D	120	0
1924	CD	5	0
1925	D	58	7
1926	D	69	11
1927	AN	0	0
1928	BN	-3	0
1929	CD	105	-2
1930	D	53	0
1931	CD	1	2
1932	D	-22	0
1933	CD	-138	-27
1934	CD	-188	0
1935	BN	-126	0
1936	AN	21	0
1937	BN	49	8
1938	W	46	0
1939	D	84	111
1940	W	-13	0
1941	W	-2	0
1942	W	-3	0
1943	W	24	0
1944	D	88	15
1945	D	36	31
1946	BN	16	0
1947	D	-13	6
1948	BN	-17	4
1949	D	66	1
1950	BN	3	1
1951	W	-5	0
1952	W	19	12
1953	AN	125	-2
1954	AN	87	0
1955	D	142	1
1956	W	0	1
1957	BN	-12	7
1958	W	32	15
1959	BN	93	0
1960	D	166	0
1961	D	14	-3
1962	D	4	1
1963	W	26	0
1964	D	98	21
1965	W	137	1
1966	BN	28	0
1967	W	29	1
1968	BN	55	0
1969	W	40	7
1970	W	-5	0
1971	W	12	0
1972	BN	102	1
1973	AN	56	0
1974	W	4	0
1975	AN	53	1
1976	CD	27	-4
1977	CD	34	0
1978	W	37	0
1979	BN	45	20
1980	AN	125	9
1981	D	142	8
1982	W	26	8
1983	W	0	0
1984	W	1	0
1985	D	85	9
1986	W	19	0
1987	D	41	8
1988	CD	-6	-2
1989	D	16	1
1990	CD	51	1
1991	CD	59	7
1992	CD	148	20
1993	AN	22	0
1994	CD	13	0
1995	W	0	0
1996	W	1	-1
1997	W	0	0
1998	W	0	0
1999	W	7	0
2000	AN	136	0
2001	D	149	26
2002	BN	-27	0

SWP Supply Changes

Summary Results

	Sacramento Valley 40-30-30 Index Year Class Averages		San Joaquin Valley 60-20-20 Index Year Class Averages	
	Sacramento Valley 40-30-30 Index Occurrence	SWP SOD Supply Changes (TAF/year)	San Joaquin Valley 60-20-20 Index Occurrence	SWP SOD Supply Changes (TAF/year)
Historic Climate - ALT 1B 011221				
Long-Term Average	100.0%	-2	100.0%	-2
Dry/Critically Dry	37.0%	0	35.8%	2
Wet	32.1%	-11	29.6%	-16
Above Normal	13.6%	19	19.8%	18
Below Normal	17.3%	-6	14.8%	-10
Dry	22.2%	7	16.0%	5
Critically Dry	14.8%	-9	19.8%	0
WSIP 2030 Climate - ALT 1B WSIP2030 040121				
Long-Term Average	100.0%	4	100.0%	4
Dry/Critically Dry	34.6%	-3	40.7%	13
Wet	30.9%	-6	25.9%	6
Above Normal	13.6%	20	19.8%	-1
Below Normal	21.0%	21	13.6%	-17
Dry	19.8%	-6	18.5%	30
Critically Dry	14.8%	1	22.2%	-2
WSIP 2070 Climate - ALT 1B WSIP2070 040121				
Long-Term Average	100.0%	10	100.0%	10
Dry/Critically Dry	39.5%	-7	49.4%	4
Wet	32.1%	10	18.5%	-1
Above Normal	12.3%	30	21.0%	30
Below Normal	16.0%	38	11.1%	19
Dry	24.7%	2	14.8%	14
Critically Dry	14.8%	-23	34.6%	-1

Notes:

Values shown are the net change between the Project Alternative and No Project Alternative

Values are based on contract years (Jan-Dec for SWP)

Results are dependent on storage allocations (see storage allocation table)

SWP Supply Changes

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	San Joaquin Valley 60-20-20 Index	SWP SOD Supply Changes (TAF/year)
1922	AN	W	-3
1923	BN	AN	14
1924	CD	CD	59
1925	D	BN	-68
1926	D	D	-19
1927	W	AN	22
1928	AN	BN	-19
1929	CD	CD	-51
1930	D	CD	2
1931	CD	CD	28
1932	D	AN	-38
1933	CD	D	-74
1934	CD	CD	16
1935	BN	AN	-61
1936	BN	AN	-7
1937	BN	W	-31
1938	W	W	-11
1939	D	D	25
1940	AN	AN	0
1941	W	W	1
1942	W	W	0
1943	W	W	0
1944	D	BN	-20
1945	BN	AN	54
1946	BN	AN	13
1947	D	D	120
1948	BN	BN	-111
1949	D	BN	70
1950	BN	BN	17
1951	AN	AN	-1
1952	W	W	-33
1953	W	BN	0
1954	AN	BN	0
1955	D	D	-3
1956	W	W	-304
1957	AN	BN	4
1958	W	W	64
1959	BN	D	5
1960	D	CD	2
1961	D	CD	-38
1962	BN	BN	6
1963	W	AN	1
1964	D	D	-5
1965	W	W	-16
1966	BN	BN	0
1967	W	W	-36
1968	BN	D	-10
1969	W	W	0
1970	W	AN	0
1971	W	BN	1
1972	BN	D	-3
1973	AN	AN	263
1974	W	W	15
1975	W	W	13
1976	CD	CD	-18
1977	CD	CD	-14
1978	AN	W	-28
1979	BN	AN	31
1980	AN	W	19
1981	D	D	10
1982	W	W	0
1983	W	W	0
1984	W	AN	0
1985	D	D	16
1986	W	W	0
1987	D	CD	37
1988	CD	CD	-95
1989	D	CD	24
1990	CD	CD	0
1991	CD	CD	5
1992	CD	CD	-8
1993	AN	W	-24
1994	CD	CD	47
1995	W	W	22
1996	W	W	-17
1997	W	W	0
1998	W	W	-13
1999	W	AN	0
2000	AN	AN	3
2001	D	D	8
2002	D	D	-4

SWP Supply Changes

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	San Joaquin Valley 60-20-20 Index	SWP SOD Supply Changes (TAF/year)
1922	AN	AN	3
1923	BN	BN	-85
1924	CD	CD	24
1925	BN	BN	-79
1926	D	CD	10
1927	W	AN	-313
1928	BN	BN	116
1929	CD	D	15
1930	D	D	-20
1931	CD	CD	34
1932	D	AN	-9
1933	CD	D	1
1934	CD	CD	-34
1935	BN	AN	37
1936	BN	AN	17
1937	BN	W	-4
1938	W	W	-57
1939	D	D	106
1940	AN	AN	0
1941	W	W	4
1942	W	W	1
1943	AN	W	0
1944	D	BN	18
1945	BN	AN	5
1946	AN	AN	-41
1947	D	CD	12
1948	BN	D	18
1949	D	D	-3
1950	D	BN	-145
1951	W	AN	-65
1952	W	W	27
1953	AN	BN	-9
1954	AN	BN	-57
1955	D	D	34
1956	W	W	0
1957	BN	D	-25
1958	W	W	-60
1959	BN	CD	9
1960	D	CD	-83
1961	D	CD	108
1962	D	BN	-20
1963	W	AN	32
1964	D	CD	-32
1965	W	W	13
1966	BN	D	3
1967	W	W	59
1968	BN	D	55
1969	W	W	3
1970	W	BN	67
1971	W	BN	0
1972	BN	D	254
1973	AN	AN	332
1974	W	AN	-5
1975	AN	AN	-4
1976	CD	CD	28
1977	CD	CD	-116
1978	W	W	-4
1979	BN	AN	-8
1980	AN	W	-1
1981	D	D	-14
1982	W	W	12
1983	W	W	24
1984	W	AN	0
1985	BN	D	-1
1986	W	W	111
1987	D	CD	-50
1988	CD	CD	-6
1989	BN	CD	-2
1990	CD	CD	18
1991	CD	CD	65
1992	CD	CD	-20
1993	AN	W	1
1994	CD	CD	0
1995	W	W	-1
1996	W	W	-4
1997	W	W	-2
1998	W	W	0
1999	W	AN	0
2000	AN	BN	2
2001	D	D	-12
2002	BN	D	38

SWP Supply Changes

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	San Joaquin Valley 60-20-20 Index	SWP SOD Supply Changes (TAF/year)
1922	AN	AN	4
1923	D	BN	0
1924	CD	CD	-31
1925	D	D	-11
1926	D	CD	-6
1927	AN	BN	70
1928	BN	D	31
1929	CD	CD	-2
1930	D	CD	-22
1931	CD	CD	4
1932	D	AN	-7
1933	CD	D	20
1934	CD	CD	34
1935	BN	AN	-34
1936	AN	AN	1
1937	BN	W	6
1938	W	W	-86
1939	D	CD	75
1940	W	AN	25
1941	W	W	0
1942	W	W	1
1943	W	AN	-2
1944	D	D	1
1945	D	BN	84
1946	BN	BN	7
1947	D	CD	-43
1948	BN	D	111
1949	D	D	13
1950	BN	D	11
1951	W	BN	43
1952	W	W	0
1953	AN	BN	6
1954	AN	D	0
1955	D	CD	-44
1956	W	W	25
1957	BN	D	29
1958	W	W	-14
1959	BN	CD	-8
1960	D	CD	-45
1961	D	CD	4
1962	D	D	-26
1963	W	AN	15
1964	D	CD	11
1965	W	AN	51
1966	BN	CD	78
1967	W	W	16
1968	BN	CD	-10
1969	W	W	17
1970	W	BN	-4
1971	W	D	0
1972	BN	CD	67
1973	AN	AN	221
1974	W	AN	34
1975	AN	AN	4
1976	CD	CD	-1
1977	CD	CD	-196
1978	W	W	-6
1979	BN	AN	58
1980	AN	W	2
1981	D	D	-11
1982	W	W	25
1983	W	W	-1
1984	W	BN	0
1985	D	CD	-8
1986	W	AN	21
1987	D	CD	1
1988	CD	CD	-75
1989	D	CD	69
1990	CD	CD	-8
1991	CD	CD	101
1992	CD	CD	-74
1993	AN	AN	17
1994	CD	CD	-45
1995	W	W	-5
1996	W	AN	94
1997	W	AN	10
1998	W	W	0
1999	W	AN	1
2000	AN	BN	-29
2001	D	CD	1
2002	BN	CD	144

PWA Water Supply Increases

Summary Results

	Sacramento Valley 40-30-30 Index Year Class Averages				San Joaquin Valley 60-20-20 Index Year Class Averages		
	Sacramento Valley 40-30-30 Index Occurrence	PWA NOD Ag Supply (TAF/year)	PWA SOD Ag Supply (TAF/year)	PWA SOD M&I Supply (TAF/year)	San Joaquin Valley 60-20-20 Index Occurrence	PWA SOD Ag Supply (TAF/year)	PWA SOD M&I Supply (TAF/year)
Historic Climate - ALT 1B 011221							
Long-Term Average	100.0%	29	3	88	100.0%	3	88
Dry/Critically Dry	37.0%	60	6	220	35.8%	6	204
Wet	32.1%	7	0	0	29.6%	0	5
Above Normal	13.6%	6	0	0	19.8%	1	22
Below Normal	17.3%	22	1	38	14.8%	2	62
Dry	22.2%	54	7	229	16.0%	5	171
Critically Dry	14.8%	68	6	206	19.8%	7	231
WSIP 2030 Climate - ALT 1B WSIP2030 040121							
Long-Term Average	100.0%	37	3	100	100.0%	3	100
Dry/Critically Dry	34.6%	68	7	227	40.7%	6	210
Wet	30.9%	16	0	0	25.9%	0	4
Above Normal	13.6%	14	0	0	19.8%	0	16
Below Normal	21.0%	32	3	102	13.6%	2	74
Dry	19.8%	72	7	238	18.5%	6	203
Critically Dry	14.8%	64	6	213	22.2%	6	216
WSIP 2070 Climate - ALT 1B WSIP2070 040121							
Long-Term Average	100.0%	48	3	104	100.0%	3	104
Dry/Critically Dry	39.5%	55	6	209	49.4%	6	189
Wet	32.1%	41	0	0	18.5%	0	11
Above Normal	12.3%	44	0	0	21.0%	0	12
Below Normal	16.0%	44	4	137	11.1%	2	58
Dry	24.7%	60	7	230	14.8%	4	129
Critically Dry	14.8%	48	5	173	34.6%	6	215

Notes:

Values are based on contract years (Mar-Feb for NOD or Jan-Dec for SOD)

Results are dependent on storage allocations (see storage allocation table)

PWA Water Supply Increases

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	PWA NOD Ag Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	PWA SOD Ag Supply (TAF/year)	PWA SOD M&I Supply (TAF/year)
1922	AN	9	W	0	0
1923	BN	11	AN	1	39
1924	CD	124	CD	12	417
1925	D	0	BN	7	233
1926	D	18	D	2	68
1927	W	8	AN	0	0
1928	AN	10	BN	0	0
1929	CD	94	CD	11	384
1930	D	29	CD	5	164
1931	CD	77	CD	0	0
1932	D	32	AN	2	63
1933	CD	19	D	1	52
1934	CD	16	CD	1	43
1935	BN	58	AN	3	100
1936	BN	39	AN	2	55
1937	BN	31	W	4	123
1938	W	3	W	0	0
1939	D	101	D	8	281
1940	AN	3	AN	0	0
1941	W	3	W	0	0
1942	W	3	W	0	0
1943	W	9	W	0	0
1944	D	106	BN	4	132
1945	BN	9	AN	2	69
1946	BN	10	AN	0	4
1947	D	51	D	11	358
1948	BN	4	BN	0	11
1949	D	38	BN	9	310
1950	BN	47	BN	1	25
1951	AN	9	AN	0	0
1952	W	7	W	0	0
1953	W	8	BN	0	0
1954	AN	4	BN	0	0
1955	D	87	D	9	292
1956	W	7	W	0	0
1957	AN	12	BN	0	0
1958	W	3	W	0	0
1959	BN	12	D	1	25
1960	D	106	CD	6	211
1961	D	48	CD	14	459
1962	BN	11	BN	0	4
1963	W	3	AN	0	0
1964	D	90	D	5	188
1965	W	14	W	0	0
1966	BN	10	BN	1	23
1967	W	0	W	0	0
1968	BN	7	D	1	30
1969	W	9	W	0	0
1970	W	13	AN	0	0
1971	W	10	BN	0	0
1972	BN	45	D	0	4
1973	AN	8	AN	0	0
1974	W	3	W	0	0
1975	W	6	W	0	0
1976	CD	128	CD	8	266
1977	CD	95	CD	12	408
1978	AN	3	W	0	0
1979	BN	11	AN	0	18
1980	AN	7	W	0	0
1981	D	6	D	2	64
1982	W	3	W	0	0
1983	W	0	W	0	0
1984	W	10	AN	0	0
1985	D	11	D	1	54
1986	W	37	W	0	0
1987	D	107	CD	11	384
1988	CD	17	CD	11	367
1989	D	26	CD	1	53
1990	CD	16	CD	1	42
1991	CD	95	CD	2	69
1992	CD	42	CD	3	96
1993	AN	3	W	0	0
1994	CD	96	CD	10	331
1995	W	0	W	0	0
1996	W	3	W	0	0
1997	W	11	W	0	0
1998	W	0	W	0	0
1999	W	8	AN	0	0
2000	AN	3	AN	0	0
2001	D	105	D	12	412
2002	D	14	D	12	393

PWA Water Supply Increases

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	PWA NOD Ag Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	PWA SOD Ag Supply (TAF/year)	PWA SOD M&I Supply (TAF/year)
1922	AN	9	AN	0	0
1923	BN	58	BN	4	126
1924	CD	97	CD	13	423
1925	BN	10	BN	6	198
1926	D	22	CD	1	40
1927	W	12	AN	0	0
1928	BN	12	BN	0	13
1929	CD	86	D	10	339
1930	D	41	D	3	112
1931	CD	77	CD	0	0
1932	D	9	AN	2	61
1933	CD	12	D	2	58
1934	CD	17	CD	2	76
1935	BN	48	AN	2	57
1936	BN	41	AN	1	43
1937	BN	37	W	3	91
1938	W	5	W	0	0
1939	D	96	D	13	436
1940	AN	35	AN	0	0
1941	W	3	W	0	0
1942	W	5	W	0	0
1943	AN	8	W	0	0
1944	D	145	BN	10	341
1945	BN	34	AN	0	6
1946	AN	28	AN	0	0
1947	D	16	CD	8	278
1948	BN	6	D	4	122
1949	D	37	D	6	196
1950	D	33	BN	1	23
1951	W	37	AN	0	0
1952	W	7	W	0	0
1953	AN	10	BN	0	0
1954	AN	6	BN	0	0
1955	D	112	D	12	419
1956	W	11	W	0	0
1957	BN	12	D	2	83
1958	W	8	W	0	0
1959	BN	13	CD	6	198
1960	D	125	CD	4	132
1961	D	42	CD	10	326
1962	D	54	BN	3	114
1963	W	3	AN	0	0
1964	D	82	CD	10	353
1965	W	34	W	0	0
1966	BN	37	D	5	161
1967	W	3	W	0	0
1968	BN	12	D	2	72
1969	W	9	W	0	0
1970	W	47	BN	0	0
1971	W	35	BN	0	0
1972	BN	95	D	4	126
1973	AN	32	AN	0	0
1974	W	7	AN	0	0
1975	AN	7	AN	0	0
1976	CD	129	CD	12	402
1977	CD	93	CD	9	297
1978	W	32	W	0	0
1979	BN	35	AN	3	94
1980	AN	12	W	0	0
1981	D	43	D	5	175
1982	W	5	W	0	0
1983	W	0	W	0	0
1984	W	10	AN	0	0
1985	BN	44	D	6	198
1986	W	75	W	0	0
1987	D	145	CD	12	397
1988	CD	15	CD	11	374
1989	BN	27	CD	0	6
1990	CD	16	CD	3	106
1991	CD	94	CD	1	41
1992	CD	30	CD	1	43
1993	AN	3	W	0	0
1994	CD	96	CD	12	393
1995	W	2	W	0	0
1996	W	3	W	0	0
1997	W	47	W	0	0
1998	W	0	W	0	0
1999	W	8	AN	0	0
2000	AN	3	BN	0	0
2001	D	145	D	12	406
2002	BN	31	D	4	148

PWA Water Supply Increases

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	PWA NOD Ag Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	PWA SOD Ag Supply (TAF/year)	PWA SOD M&I Supply (TAF/year)
1922	AN	12	AN	0	0
1923	D	107	BN	7	250
1924	CD	82	CD	7	222
1925	D	10	D	4	126
1926	D	18	CD	2	55
1927	AN	58	BN	0	0
1928	BN	28	D	4	140
1929	CD	12	CD	5	171
1930	D	38	CD	4	149
1931	CD	57	CD	0	0
1932	D	3	AN	2	56
1933	CD	15	D	2	68
1934	CD	17	CD	3	89
1935	BN	53	AN	4	130
1936	AN	46	AN	0	0
1937	BN	48	W	5	160
1938	W	30	W	0	0
1939	D	68	CD	11	381
1940	W	84	AN	0	0
1941	W	5	W	0	0
1942	W	6	W	0	0
1943	W	42	AN	0	0
1944	D	146	D	11	389
1945	D	31	BN	3	90
1946	BN	43	BN	5	185
1947	D	12	CD	6	216
1948	BN	28	D	3	108
1949	D	33	D	4	151
1950	BN	21	D	1	21
1951	W	81	BN	0	0
1952	W	9	W	0	0
1953	AN	31	BN	0	0
1954	AN	27	D	0	0
1955	D	123	CD	9	309
1956	W	63	W	0	0
1957	BN	31	D	5	172
1958	W	39	W	0	0
1959	BN	91	CD	6	198
1960	D	69	CD	7	248
1961	D	29	CD	9	295
1962	D	54	D	4	145
1963	W	22	AN	0	0
1964	D	68	CD	10	343
1965	W	35	AN	0	0
1966	BN	28	CD	5	179
1967	W	5	W	0	0
1968	BN	84	CD	4	132
1969	W	11	W	0	0
1970	W	87	BN	0	0
1971	W	104	D	0	0
1972	BN	54	CD	6	198
1973	AN	97	AN	0	0
1974	W	80	AN	0	0
1975	AN	31	AN	0	0
1976	CD	157	CD	11	382
1977	CD	47	CD	7	228
1978	W	57	W	0	0
1979	BN	38	AN	0	19
1980	AN	81	W	0	0
1981	D	89	D	7	226
1982	W	7	W	0	0
1983	W	0	W	0	0
1984	W	41	BN	0	0
1985	D	100	CD	9	307
1986	W	94	AN	0	0
1987	D	28	CD	12	395
1988	CD	18	CD	11	356
1989	D	28	CD	3	111
1990	CD	16	CD	1	43
1991	CD	95	CD	1	35
1992	CD	48	CD	3	108
1993	AN	32	AN	0	0
1994	CD	13	CD	11	372
1995	W	46	W	0	0
1996	W	3	AN	0	0
1997	W	86	AN	0	0
1998	W	0	W	0	0
1999	W	38	AN	0	0
2000	AN	27	BN	0	0
2001	D	145	CD	11	360
2002	BN	24	CD	4	138

Level 4 Refuge Water Supply Increases

Summary Results

	Sacramento Valley 40-30-30 Index Year Class Averages				San Joaquin Valley 60-20-20 Index Year Class Averages		
	Sacramento Valley 40-30-30 Index Occurrence	Sacramento Refuge Supply (TAF/year)	San Joaquin Refuge Supply (TAF/year)	Tulare Lake Refuge Supply (TAF/year)	San Joaquin Valley 60-20-20 Index Occurrence	San Joaquin Refuge Supply (TAF/year)	Tulare Lake Refuge Supply (TAF/year)
Historic Climate - ALT 1B 011221							
Long-Term Average	100.0%	5	12	3	100.0%	12	3
Dry/Critically Dry	37.0%	6	21	6	35.8%	23	6
Wet	32.1%	0	1	0	29.6%	0	0
Above Normal	13.6%	9	2	1	19.8%	11	3
Below Normal	17.3%	8	20	5	14.8%	12	3
Dry	22.2%	8	24	7	16.0%	27	7
Critically Dry	14.8%	4	17	5	19.8%	19	6
WSIP 2030 Climate - ALT 1B WSIP2030 040121							
Long-Term Average	100.0%	5	9	2	100.0%	9	2
Dry/Critically Dry	34.6%	7	13	4	40.7%	17	5
Wet	30.9%	0	0	0	25.9%	0	0
Above Normal	13.6%	9	0	0	19.8%	4	1
Below Normal	21.0%	9	21	6	13.6%	10	3
Dry	19.8%	8	21	6	18.5%	21	5
Critically Dry	14.8%	6	2	0	22.2%	13	4
WSIP 2070 Climate - ALT 1B WSIP2070 040121							
Long-Term Average	100.0%	5	7	2	100.0%	7	2
Dry/Critically Dry	39.5%	7	13	4	49.4%	13	4
Wet	32.1%	0	0	0	18.5%	0	0
Above Normal	12.3%	9	0	0	21.0%	1	0
Below Normal	16.0%	7	15	5	11.1%	6	2
Dry	24.7%	7	19	6	14.8%	7	3
Critically Dry	14.8%	6	2	1	34.6%	16	5

Notes:

Values are based on contract years (Mar-Feb)

Results are dependent on storage allocations (see storage allocation table)

Level 4 Refuge Water Supply Increases

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	Sacramento Refuge Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	San Joaquin Refuge Supply (TAF/year)	Tulare Lake Refuge Supply (TAF/year)
1922	AN	9	W	0	0
1923	BN	10	AN	38	10
1924	CD	7	CD	7	2
1925	D	7	BN	15	4
1926	D	2	D	3	1
1927	W	0	AN	3	0
1928	AN	8	BN	0	3
1929	CD	9	CD	28	5
1930	D	7	CD	7	2
1931	CD	0	CD	0	0
1932	D	1	AN	3	2
1933	CD	0	D	8	2
1934	CD	1	CD	5	1
1935	BN	9	AN	35	10
1936	BN	8	AN	14	3
1937	BN	9	W	0	0
1938	W	0	W	0	0
1939	D	10	D	52	14
1940	AN	9	AN	8	3
1941	W	0	W	0	0
1942	W	0	W	0	0
1943	W	0	W	0	0
1944	D	10	BN	41	11
1945	BN	10	AN	20	7
1946	BN	8	AN	15	4
1947	D	4	D	5	1
1948	BN	5	BN	10	2
1949	D	6	BN	7	3
1950	BN	5	BN	4	0
1951	AN	9	AN	0	0
1952	W	0	W	0	0
1953	W	0	BN	3	0
1954	AN	8	BN	0	0
1955	D	10	D	47	11
1956	W	0	W	0	0
1957	AN	3	BN	0	0
1958	W	0	W	0	0
1959	BN	10	D	33	10
1960	D	10	CD	41	14
1961	D	8	CD	12	3
1962	BN	7	BN	5	3
1963	W	0	AN	6	3
1964	D	7	D	27	6
1965	W	0	W	0	0
1966	BN	7	BN	44	11
1967	W	0	W	0	0
1968	BN	10	D	24	6
1969	W	0	W	0	0
1970	W	0	AN	0	0
1971	W	0	BN	14	4
1972	BN	10	D	24	7
1973	AN	7	AN	0	0
1974	W	0	W	0	0
1975	W	0	W	0	0
1976	CD	11	CD	48	14
1977	CD	7	CD	17	5
1978	AN	10	W	0	0
1979	BN	10	AN	21	5
1980	AN	10	W	0	0
1981	D	9	D	36	7
1982	W	0	W	0	0
1983	W	0	W	0	0
1984	W	0	AN	0	0
1985	D	10	D	51	14
1986	W	0	W	0	0
1987	D	9	CD	35	14
1988	CD	7	CD	21	6
1989	D	7	CD	10	3
1990	CD	0	CD	3	1
1991	CD	1	CD	8	2
1992	CD	2	CD	17	5
1993	AN	10	W	0	0
1994	CD	7	CD	38	12
1995	W	0	W	0	0
1996	W	0	W	0	0
1997	W	0	W	0	0
1998	W	0	W	0	0
1999	W	0	AN	0	0
2000	AN	10	AN	16	7
2001	D	10	D	30	8
2002	D	9	D	18	5

Level 4 Refuge Water Supply Increases

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	Sacramento Refuge Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	San Joaquin Refuge Supply (TAF/year)	Tulare Lake Refuge Supply (TAF/year)
1922	AN	9	AN	0	0
1923	BN	10	BN	35	9
1924	CD	6	CD	0	0
1925	BN	10	BN	0	0
1926	D	0	CD	9	2
1927	W	0	AN	0	0
1928	BN	10	BN	31	12
1929	CD	9	D	0	0
1930	D	10	D	0	0
1931	CD	0	CD	0	0
1932	D	3	AN	0	0
1933	CD	3	D	0	0
1934	CD	3	CD	0	0
1935	BN	10	AN	2	0
1936	BN	10	AN	0	0
1937	BN	9	W	0	0
1938	W	0	W	0	0
1939	D	9	D	4	2
1940	AN	9	AN	0	0
1941	W	0	W	0	0
1942	W	0	W	0	0
1943	AN	9	W	0	0
1944	D	10	BN	36	8
1945	BN	11	AN	33	7
1946	AN	8	AN	0	0
1947	D	0	CD	38	11
1948	BN	0	D	7	1
1949	D	10	D	0	0
1950	D	5	BN	0	0
1951	W	0	AN	0	0
1952	W	0	W	0	0
1953	AN	10	BN	0	0
1954	AN	9	BN	0	0
1955	D	9	D	30	11
1956	W	0	W	0	0
1957	BN	10	D	27	6
1958	W	0	W	0	0
1959	BN	10	CD	13	4
1960	D	11	CD	34	11
1961	D	10	CD	29	14
1962	D	6	BN	7	2
1963	W	0	AN	0	0
1964	D	10	CD	47	11
1965	W	0	W	0	0
1966	BN	10	D	36	8
1967	W	0	W	0	0
1968	BN	10	D	36	7
1969	W	0	W	0	0
1970	W	0	BN	0	0
1971	W	0	BN	0	0
1972	BN	10	D	33	7
1973	AN	5	AN	0	0
1974	W	0	AN	0	0
1975	AN	9	AN	0	0
1976	CD	10	CD	26	4
1977	CD	7	CD	0	0
1978	W	0	W	0	0
1979	BN	10	AN	26	6
1980	AN	9	W	0	0
1981	D	9	D	36	7
1982	W	0	W	0	0
1983	W	0	W	0	0
1984	W	0	AN	0	0
1985	BN	10	D	28	11
1986	W	0	W	0	0
1987	D	9	CD	35	12
1988	CD	9	CD	0	0
1989	BN	0	CD	10	5
1990	CD	6	CD	0	0
1991	CD	3	CD	0	0
1992	CD	2	CD	0	0
1993	AN	10	W	0	0
1994	CD	10	CD	0	0
1995	W	0	W	0	0
1996	W	0	W	0	0
1997	W	0	W	0	0
1998	W	0	W	0	0
1999	W	0	AN	0	0
2000	AN	9	BN	0	0
2001	D	10	D	36	10
2002	BN	10	D	47	11

Level 4 Refuge Water Supply Increases

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	Sacramento Refuge Supply (TAF/year)	San Joaquin Valley 60-20-20 Index	San Joaquin Refuge Supply (TAF/year)	Tulare Lake Refuge Supply (TAF/year)
1922	AN	9	AN	0	0
1923	D	10	BN	34	12
1924	CD	9	CD	0	0
1925	D	11	D	0	0
1926	D	0	CD	8	2
1927	AN	9	BN	0	0
1928	BN	0	D	15	9
1929	CD	6	CD	0	0
1930	D	0	CD	19	8
1931	CD	0	CD	0	0
1932	D	2	AN	0	0
1933	CD	0	D	0	0
1934	CD	3	CD	0	0
1935	BN	11	AN	2	1
1936	AN	8	AN	0	0
1937	BN	9	W	0	0
1938	W	0	W	0	0
1939	D	9	CD	35	12
1940	W	0	AN	0	0
1941	W	0	W	0	0
1942	W	0	W	0	0
1943	W	0	AN	0	0
1944	D	10	D	20	9
1945	D	9	BN	19	5
1946	BN	10	BN	4	2
1947	D	0	CD	12	4
1948	BN	0	D	5	2
1949	D	10	D	0	0
1950	BN	0	D	3	1
1951	W	0	BN	0	0
1952	W	0	W	0	0
1953	AN	10	BN	0	0
1954	AN	9	D	0	0
1955	D	11	CD	30	8
1956	W	0	W	0	0
1957	BN	10	D	20	8
1958	W	0	W	0	0
1959	BN	10	CD	26	6
1960	D	11	CD	35	12
1961	D	0	CD	26	12
1962	D	6	D	0	0
1963	W	0	AN	0	0
1964	D	10	CD	30	8
1965	W	0	AN	0	0
1966	BN	2	CD	27	7
1967	W	0	W	0	0
1968	BN	10	CD	37	11
1969	W	0	W	0	0
1970	W	0	BN	0	0
1971	W	0	D	0	0
1972	BN	10	CD	15	5
1973	AN	6	AN	0	0
1974	W	0	AN	0	0
1975	AN	9	AN	0	0
1976	CD	10	CD	13	3
1977	CD	8	CD	0	0
1978	W	0	W	0	0
1979	BN	10	AN	13	4
1980	AN	9	W	0	0
1981	D	9	D	19	5
1982	W	0	W	0	0
1983	W	0	W	0	0
1984	W	0	BN	0	0
1985	D	10	CD	30	8
1986	W	0	AN	0	0
1987	D	10	CD	30	11
1988	CD	9	CD	8	3
1989	D	0	CD	15	4
1990	CD	9	CD	0	0
1991	CD	1	CD	0	0
1992	CD	3	CD	0	0
1993	AN	10	AN	0	0
1994	CD	10	CD	0	0
1995	W	0	W	0	0
1996	W	0	AN	0	0
1997	W	0	AN	0	0
1998	W	0	W	0	0
1999	W	0	AN	0	0
2000	AN	9	BN	0	0
2001	D	11	CD	22	7
2002	BN	10	CD	31	11

Yolo Bypass Flow Increases

Summary Results

Sacramento Valley 40-30-30 Index Year Class Averages		
	Sacramento Valley 40-30-30 Index Occurrence	Yolo Bypass Flow Increases (TAF/season)
Historic Climate - ALT 1B 011221		
Long-Term Average	100.0%	36
Dry/Critically Dry	37.0%	21
Wet	32.1%	54
Above Normal	13.6%	47
Below Normal	17.3%	26
Dry	22.2%	26
Critically Dry	14.8%	12
WSIP 2030 Climate - ALT 1B WSIP2030 040121		
Long-Term Average	100.0%	36
Dry/Critically Dry	34.6%	22
Wet	30.9%	46
Above Normal	13.6%	48
Below Normal	21.0%	39
Dry	19.8%	27
Critically Dry	14.8%	15
WSIP 2070 Climate - ALT 1B WSIP2070 040121		
Long-Term Average	100.0%	31
Dry/Critically Dry	39.5%	25
Wet	32.1%	35
Above Normal	12.3%	38
Below Normal	16.0%	34
Dry	24.7%	29
Critically Dry	14.8%	18

Notes:

Results are dependent on storage allocations (see storage allocation table)

Yolo Bypass Flow Increases

Historic Climate - ALT 1B 011221

Year	Sacramento Valley 40-30-30 Index	Yolo Bypass Flow Increases (TAF/season)
1922	AN	72
1923	BN	0
1924	CD	0
1925	D	29
1926	D	0
1927	W	53
1928	AN	0
1929	CD	0
1930	D	38
1931	CD	0
1932	D	0
1933	CD	0
1934	CD	0
1935	BN	38
1936	BN	0
1937	BN	31
1938	W	71
1939	D	0
1940	AN	25
1941	W	72
1942	W	72
1943	W	72
1944	D	70
1945	BN	46
1946	BN	0
1947	D	0
1948	BN	30
1949	D	0
1950	BN	0
1951	AN	61
1952	W	72
1953	W	72
1954	AN	72
1955	D	30
1956	W	38
1957	AN	24
1958	W	72
1959	BN	72
1960	D	65
1961	D	0
1962	BN	32
1963	W	46
1964	D	0
1965	W	42
1966	BN	18
1967	W	48
1968	BN	48
1969	W	72
1970	W	16
1971	W	72
1972	BN	48
1973	AN	48
1974	W	72
1975	W	48
1976	CD	72
1977	CD	0
1978	AN	43
1979	BN	0
1980	AN	66
1981	D	32
1982	W	48
1983	W	24
1984	W	24
1985	D	72
1986	W	72
1987	D	48
1988	CD	52
1989	D	0
1990	CD	0
1991	CD	0
1992	CD	24
1993	AN	36
1994	CD	0
1995	W	48
1996	W	48
1997	W	47
1998	W	24
1999	W	72
2000	AN	72
2001	D	46
2002	D	46

Yolo Bypass Flow Increases

WSIP 2030 Climate - ALT 1B WSIP2030 040121

Year	Sacramento Valley 40-30-30 Index	Yolo Bypass Flow Increases (TAF/season)
1922	AN	61
1923	BN	61
1924	CD	0
1925	BN	0
1926	D	0
1927	W	24
1928	BN	59
1929	CD	0
1930	D	44
1931	CD	0
1932	D	0
1933	CD	0
1934	CD	0
1935	BN	68
1936	BN	37
1937	BN	37
1938	W	46
1939	D	48
1940	AN	42
1941	W	48
1942	W	70
1943	AN	61
1944	D	49
1945	BN	58
1946	AN	0
1947	D	0
1948	BN	0
1949	D	44
1950	D	0
1951	W	16
1952	W	70
1953	AN	70
1954	AN	42
1955	D	64
1956	W	36
1957	BN	0
1958	W	70
1959	BN	70
1960	D	0
1961	D	0
1962	D	37
1963	W	64
1964	D	0
1965	W	0
1966	BN	34
1967	W	34
1968	BN	24
1969	W	70
1970	W	0
1971	W	70
1972	BN	48
1973	AN	27
1974	W	64
1975	AN	70
1976	CD	8
1977	CD	57
1978	W	38
1979	BN	62
1980	AN	55
1981	D	71
1982	W	48
1983	W	48
1984	W	40
1985	BN	53
1986	W	48
1987	D	54
1988	CD	63
1989	BN	0
1990	CD	0
1991	CD	24
1992	CD	0
1993	AN	54
1994	CD	27
1995	W	48
1996	W	48
1997	W	31
1998	W	48
1999	W	70
2000	AN	42
2001	D	27
2002	BN	52

Yolo Bypass Flow Increases

WSIP 2070 Climate - ALT 1B WSIP2070 040121

Year	Sacramento Valley 40-30-30 Index	Yolo Bypass Flow Increases (TAF/season)
1922	AN	42
1923	D	60
1924	CD	0
1925	D	26
1926	D	0
1927	AN	14
1928	BN	0
1929	CD	40
1930	D	0
1931	CD	0
1932	D	0
1933	CD	0
1934	CD	0
1935	BN	68
1936	AN	0
1937	BN	71
1938	W	48
1939	D	0
1940	W	16
1941	W	31
1942	W	40
1943	W	47
1944	D	41
1945	D	71
1946	BN	66
1947	D	0
1948	BN	0
1949	D	34
1950	BN	0
1951	W	16
1952	W	48
1953	AN	61
1954	AN	42
1955	D	29
1956	W	16
1957	BN	31
1958	W	64
1959	BN	70
1960	D	0
1961	D	0
1962	D	48
1963	W	31
1964	D	0
1965	W	16
1966	BN	23
1967	W	38
1968	BN	0
1969	W	48
1970	W	16
1971	W	16
1972	BN	48
1973	AN	27
1974	W	16
1975	AN	61
1976	CD	48
1977	CD	43
1978	W	48
1979	BN	59
1980	AN	49
1981	D	71
1982	W	48
1983	W	71
1984	W	31
1985	D	70
1986	W	0
1987	D	24
1988	CD	24
1989	D	48
1990	CD	0
1991	CD	0
1992	CD	24
1993	AN	45
1994	CD	38
1995	W	48
1996	W	48
1997	W	31
1998	W	48
1999	W	31
2000	AN	42
2001	D	59
2002	BN	0

FOR IMMEDIATE RELEASE
September 18, 2017

Contact: Janet Barbieri
Sites Project Authority
530-919-9306

Erin Curtis
Bureau of Reclamation
916-978-5101

SITES PROJECT COMMENT PERIOD EXTENDED
PUBLIC MEETINGS ON DRAFT ENVIRONMENTAL REVIEW DOCUMENTS RESCHEDULED

MAXWELL, CA—The Sites Project Authority (Authority) and U.S. Bureau of Reclamation (Reclamation) – lead agencies for the Sites Project – have extended the public review and comment period for the Draft Environmental Impact Report/Environmental Impact Statement (Draft EIR/EIS) by an additional 64 days. The comment period on the draft environmental documents will close on January 15, 2018.

The comment period extension will provide the public and agencies additional time to review and submit comments on the environmental analysis for the proposed Sites Project. In extending the comment period, the Authority is also announcing the rescheduling of two public meetings previously planned for September 26 and 28, 2017.

The new meeting dates are:

Tuesday, December 5, 2017
1:00 p.m. – 3:00 p.m.
Embassy Suites: 100 Capitol Mall, Old Sacramento Ballroom, Sacramento, CA 95814

Thursday, December 7, 2017
6:00 p.m. – 8:00 p.m.
Sites Project Authority Office: 122 Old Highway 99 West, Maxwell, CA 95955

The public meetings will provide information and an opportunity to learn more about the Sites Project and submit comments on the draft environmental documents.

The Draft EIR/EIS evaluates and describes the environmental effects and proposed mitigation measures associated with construction and operation of the Sites

Reservoir and associated facilities. Reclamation anticipates publishing their Notice of Availability for the Draft EIR/EIS comment period extension in the Federal Register by the end of this week.

The Sites Project is the culmination of decades of planning to optimize water supplies and deliveries throughout California and provide direct and real benefits to instream flows and the Sacramento-San Joaquin Delta (Delta) ecosystem. The 1.3 to 1.8 million acre-foot offstream surface water storage project is being advanced to greatly increase the reliability of statewide water supplies for environmental, agricultural and urban uses.

The Authority is comprised of several Northern California public agencies who are motivated to build local water sustainability in a way that helps the state meet its overall water system needs.

The 154-day Draft EIR/EIS public review period provides an opportunity for regulatory agencies and the public to comment on the adequacy and completeness of the environmental analyses and proposed mitigation measures, helping inform project development.

The Draft EIR/EIS and more information about the environmental review process can be found online at: https://www.sitesproject.org/environmental-review/. Public comments can be emailed to: EIR-EIS-Comments@SitesProject.org.

For questions about the Sites Project or public meetings please contact: Janet Barbieri, Sites Project Authority, at 530-919-9306.

###

The Sites Project is an innovative and environmentally-focused offstream water storage solution. It creates a unique opportunity for direct and real benefits to instream flows, the Delta ecosystem, and water supply.

There are currently 32 participants in the Sites Project. The following compose the Sites Project Authority: Colusa County Water District, County of Colusa, County of Glenn, Glenn-Colusa Irrigation District, Maxwell Irrigation District, Orland-Artois Water District, Placer County Water Agency/City of Roseville, Proberta Water District, Reclamation District 108, Tehama-Colusa Canal Authority, Western Canal Water District, Westside Water District.

Follow the Sites Project on social media @SitesProject.

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 9/21/2021 9:55:57 AM
To: Luu, Henry [henry.luu@hdrinc.com]; Carlson, Nik [nik.carlson@aecom.com]; jeff.herrin@aecom.com
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

He's getting cost and benefit mixed up. What we're looking for is a way to show that the benefit of the water is greater than $350/AF in 2030. The costs that we were presenting early this month were $860/AF. So another way of looking at it is if their value isn't at least $860/AF, why would they be invested in the project? We need his help to demonstrate that the **value** is greater than $350/AF, not the cost.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Tuesday, September 21, 2021 9:42 AM
To: Carlson, Nik <nik.carlson@aecom.com>; Jeff Herrin <Jeff.Herrin@aecom.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

All, see Robert's follow-up to responses. Regarding his second paragraph I think this is just a difference between the CWC model and Sites model…any thoughts on approach in clarifying this?

Nik – can you provide clarification to Robert's 3rd paragraph re: transportation cost? I think he's stuck on the lack of escalation.

Thanks,
Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Robert Cheng <RCheng@cvwd.org>
Sent: Tuesday, September 21, 2021 8:14 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Henry,

Thanks for the prompt response to my questions. I think that I understand the explanations except the conveyance cost, where I'm not fully comprehending the comment that the conveyance cost is a cost and benefit, so therefore any changes would "zero" out. I realize that a primary goal for this exercise is to provide information to the CWC, but I can't help but feel that these figures will be cited elsewhere.

For example, we have figures of $300/af cited for 2030 and $750/af cited for 2045 as long-term average undelivered costs, but when we look at the affordability slides presented during the M&I workshops , a figure of $860/af was cited at Knights Landing. As we get closer to the point when we need to discuss the cost issues with our Boards, I hope that we can keep all these figures straight and offer simple explanations if we get asked.

So back to the transportation cost, I'm still unclear on the explanation. When I think about this from an utility perspective, if I have to pay $148/af in 2030 $, it would be hard for me to explain that I'm still paying the same in 2045 $. Maybe I'm not looking at this in the way it was intended, so any assistance that you might be able to provide in educating me would be appreciated.

Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Monday, September 20, 2021 3:59 PM
To: Robert Cheng <RCheng@cvwd.org>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Robert, responses are below in red text:

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Thank you,
Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Robert Cheng <RCheng@cvwd.org>
Sent: Monday, September 20, 2021 9:33 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

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Robert

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Sent: Sunday, September 19, 2021 4:54 PM
To: Randall Neudeck <rneudeck@mwdh2o.com>; Bob Tincher <bobt@sbvmwd.com>; jdavis@sgpwa.com; Robert Cheng <RCheng@cvwd.org>; AFlores (AFlores@zone7water.com) <AFlores@zone7water.com>
Cc: Jerry Brown <jbrown@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Jeff Herrin <Jeff.Herrin@aecom.com>; Carlson, Nik <nik.carlson@aecom.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
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Hello Sites Project members,

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1. Metropolitan Water District (43 TAF) – Brandon Goshi
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Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)

	South of Delta Deliveries ($/AF)					
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conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

Information Request: Please review the above Table 1 default unit water benefit values and answer the questions below. Our technical staff are available to discuss the questions in further detail if necessary. Any supporting documentation for the responses (e.g. references to IWMP) and even approximate answers will be helpful. This is a time-sensitive request and we would appreciate an expedited response. <u>Please note that the benefit value (supply cost) is for end-use location deliveries and not the cost from its origin</u>.

Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

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3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:

a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?

b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

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7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?

a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

Please let us know your availabilities if a meeting is desired.
Thank you for your support,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Carlson, Nik [nik.carlson@aecom.com]
Sent: 9/21/2021 10:40:36 AM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]; Luu, Henry [henry.luu@hdrinc.com]; jeff.herrin@aecom.com
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: Re: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Re: Benefit Value > Cost/Price of Water.
Nicely stated Erin. As you clarified, the key point is that we need the **full** economic benefit of the water (i.e. including its use value) above and beyond its purchase cost.
In simplified economic terms.
Benefit value = Purchase Cost + Consumer Surplus (e.g. avoided emergency shortage additional costs, added net willingness to pay value etc.)

Re: Conveyance Energy Costs in 2030 and 2045
Two possible points of clarification:
(1) Benefit Cost values in 2030 and 2045 are shown in constant 2021 (current) dollar terms i.e. without inflation. CWC and our analysis is conservatively assuming that the future conveyance cost is expected to increase only at the rate of inflation.
(2) As mentioned in our responses, changes in the conveyance energy cost projections will not have an overall effect on our BCA results as they result in **both** benefit value and O&M cost increases that will offset each other.

~ Nik

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Date: Tuesday, September 21, 2021 at 9:56 AM
To: Luu, Henry <henry.luu@hdrinc.com>, Carlson, Nik <nik.carlson@aecom.com>, Herrin, Jeff <jeff.herrin@aecom.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>, Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: [EXTERNAL] RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

He's getting cost and benefit mixed up. What we're looking for is a way to show that the benefit of the water is greater than $350/AF in 2030. The costs that we were presenting early this month were $860/AF. So another way of looking at it is if their value isn't at least $860/AF, why would they be invested in the project? We need his help to demonstrate that the **value** is greater than $350/AF, not the cost.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Tuesday, September 21, 2021 9:42 AM
To: Carlson, Nik <nik.carlson@aecom.com>; Jeff Herrin <Jeff.Herrin@aecom.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

All, see Robert's follow-up to responses. Regarding his second paragraph I think this is just a difference between the CWC model and Sites model…any thoughts on approach in clarifying this?

Nik – can you provide clarification to Robert's 3rd paragraph re: transportation cost? I think he's stuck on the lack of escalation.

Thanks,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Robert Cheng <RCheng@cvwd.org>
Sent: Tuesday, September 21, 2021 8:14 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Henry,

Thanks for the prompt response to my questions. I think that I understand the explanations except the conveyance cost, where I'm not fully comprehending the comment that the conveyance cost is a cost and benefit, so therefore any changes would "zero" out. I realize that a primary goal for this exercise is to provide information to the CWC, but I can't help but feel that these figures will be cited elsewhere.

For example, we have figures of $300/af cited for 2030 and $750/af cited for 2045 as long-term average undelivered costs, but when we look at the affordability slides presented during the M&I workshops , a figure of $860/af was cited at Knights Landing. As we get closer to the point when we need to discuss the cost issues with our Boards, I hope that we can keep all these figures straight and offer simple explanations if we get asked.

So back to the transportation cost, I'm still unclear on the explanation. When I think about this from an utility perspective, if I have to pay $148/af in 2030 $, it would be hard for me to explain that I'm still paying the same in 2045 $. Maybe I'm not looking at this in the way it was intended, so any assistance that you might be able to provide in educating me would be appreciated.

Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Monday, September 20, 2021 3:59 PM
To: Robert Cheng <RCheng@cvwd.org>
Cc: Petya Vasileva <PVasileva@cvwd.org>
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Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Sent: 9/21/2021 12:37:27 PM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]; Carlson, Nik [nik.carlson@aecom.com]
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Luu, Henry [henry.luu@hdrinc.com]; jeff.herrin@aecom.com; steve.micko@jacobs.com; Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis
Attachments: ParticipantDeliveries_rev09_4scn__ALT1B_011221_vs_ALT1B_WSIP2030_040121_vs_ALT1B_WSIP2070_040121.pdf

Hi all,

Please see the attached for the participant deliveries by WYT for Alt 1B and WSIP results.

Rob

From: Leaf, Rob/SAC
Sent: Monday, September 20, 2021 12:53 PM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Carlson, Nik <nik.carlson@aecom.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>; Luu, Henry <henry.luu@hdrinc.com>; Herrin, Jeff <jeff.herrin@aecom.com>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Thanks Erin,

We will put together a similar water deliveries PDF showing Alt 1B at historical climate hydrology and WSIP 2030 and 2070 for your review.

Good insight on the 14% - that makes sense. Maybe a general communication on salinity costs would help clear up the misconception. You have been working on that topic – anything we should make sure to include in response?

Rob

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Monday, September 20, 2021 12:43 PM
To: Carlson, Nik <nik.carlson@aecom.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>; Luu, Henry <henry.luu@hdrinc.com>; Herrin, Jeff <jeff.herrin@aecom.com>
Subject: [EXTERNAL] RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

We have provided the participants the water delivery PDF, but it was probably 6 months ago. I think something similar would be good for 2030 and 2070.

I'm guessing that the 14% losses come from the misconception that the are getting 10,000 AF of water released every single year, which I think is their participation level in the project. So if they are seeing 8,600 AFY on average, they assume we are releasing 10 TAFY which results in the 14% carriage water costs.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Carlson, Nik <nik.carlson@aecom.com>
Sent: Monday, September 20, 2021 12:36 PM
To: Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>; Luu, Henry <Henry.Luu@hdrinc.com>; Herrin, Jeff <jeff.herrin@aecom.com>
Subject: Re: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

I have added some responses (in red) and consolidated Rob's prior comments below. **Rob/Jeff** please review and confirm if you think my responses make sense.

~ Nik

From: Robert Cheng <RCheng@cvwd.org>
Sent: Monday, September 20, 2021 9:33 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Henry,

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- Would you be able to provide the water delivery table by water year type (associated with the table below)? Rob: Erin, please confirm that we have provided the deliveries by WYT for the Alt 1B DEIR modeling to the participants (see attachment). We can prepare a similar report for the WSIP 2030 and WSIP 2070 model results. Would that be sufficient?
- In determining the annual escalation factor between 2030 and 2045, it appears that an escalation factor of 4.8% was applied to Wet and AB years was used, 5.9% was applied to BN and Dry years, and 7.45% was used for Critical year. Can you please confirm whether this is correct, and if so, what was the logic for the different escalation rates? Nik: WSIP unit values for 2030 and 2045 were determined by CWC staff based on their modelling of past water transfer prices and other economic modelling (e.g. SWAP). The precise approach and assumptions that CWC used in its development is unknown but it is presumed that the increase in 2045 benefit valuation includes consideration of the water availability/cost effects under full SGMA implementation.
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- Am I looking at the delivery volume of 8,600 af to mean that we are incurring a 14% carriage loss across the Delta (on a long-term average basis)? Rob: I don't see where 14% comes from. What other information has been provided regarding carriage losses? Nik: Note the economic feasibility (benefit-cost analysis) is ultimately seeking unit benefit values ($/AF) for the end-user location deliveries for its economic benefit determination. CalSim analysis of the project operations for the WSIP application accounts for projected carriage losses in its estimates of the corresponding water quantities received by end-users. As a result, the carriage loss factor (and similarly incurred conveyance costs) may be relevant consideration for translating water transfer purchases if the sales prices are based on the seller's releases and terms of delivery.
- When are you looking to receive the participants' responses? [TBD - Henry]

Thanks,
Robert

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Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hello Sites Project members,

The project team has been hard at work coordinating with CWC staff/reviewers to ensure we are preparing a document that is compliant and meets the needs for the Commission's feasibility determination. We are at a point where your input is needed – the team is requesting participant-specific information demonstrating the expected use and economic benefit of the project's future water supply increases. This information is needed to show the project's economic feasibility for securing WSIP funding. Any information regarding your agency's valuation of Sites water supplies and related water quality benefits is greatly appreciated. This solicitation is targeted towards the top five SOD members with the largest water demand from the Project because we believe your input will have a greater influence on the economic analysis. Solicitated member Agency/District and a couple of potential contacts that may be able to assist are:

1. Metropolitan Water District (43 TAF) – Brandon Goshi
2. San Bernardino Valley Municipal Water District (18.4 TAF)
3. San Gorgonio Pass Water Agency (12.0 TAF)
4. Coachella Valley Water District (8.6 TAF) – Zoe Rodriguez Del Rey
5. Zone 7 Water Agency (8.6 TAF)

Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)

	South of Delta Deliveries ($/AF)					
	Wet	AB	BN	Dry	Critical	**LT Avg.**
2030	$225	$282	$295	$314	$397	$300
Conveyance	$148	$148	$148	$148	$148	$148
Total (2030)	**$373**	**$430**	**$443**	**$462**	**$544**	**$448**
2045	$456	$573	$698	$743	$1,165	$750
Conveyance	$148	$148	$148	$148	$148	$148

Total (2045)	**$604**	**$720**	**$846**	**$891**	**$1,313**	**$898**

conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

Information Request: Please review the above Table 1 default unit water benefit values and answer the questions below. Our technical staff are available to discuss the questions in further detail if necessary. Any supporting documentation for the responses (e.g. references to IWMP) and even approximate answers will be helpful. This is a time-sensitive request and we would appreciate an expedited response. Please note that the benefit value (supply cost) is for end-use location deliveries and not the cost from its origin.

Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:
a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?
b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

6. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?
a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

Please let us know your availabilities if a meeting is desired.
Thank you for your support,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

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From: Arsenijevic, Jelica [Jelica.Arsenijevic@hdrinc.com]
Sent: 9/21/2021 1:05:30 PM
To: Spranza, John [john.spranza@hdrinc.com]
CC: Vondergeest, Michael [Michael.Vondergeest@icf.com]; Alicia Forsythe [aforsythe@sitesproject.org]; Webber, Lisa [Lisa.Webber@icf.com]
Subject: Sites: Willow and Walker Creek Siphons

Hey ya'll
Per this mornings discussion, I was going to reach out to Henry to get more info on the Walker and Willow Creek siphons. However, in *reviewing Appendix 2C of the EIR / EIS- Construction Means, Methods, and Assumptions,* I think we have more than enough information to review/consider . In my mind, the work described below would not be considered a "maintenance" activity, but am open to thoughts.

The Walker Creek Siphon and Willow Creek Siphon construction would include the following:

- Construct a staging area and provide site access.
- Place construction materials at staging areas.
- Transport materials to the Project Site
- Build a bypass around the existing siphon to allow the flow of water in the canal while the new siphon is built in the dry. This may involve sheet pile cut off walls.
- Build the new siphon.
- Demolish the old siphon.
- Cut through the bypass to allow water flow through the GCID Main Canal through the new siphon.
- Remove the bypass and bring the site to pre-construction conditions.
- Perform site restoration once construction is completed.

Not sure if we need more info (can reach out to Henry as originally planned) or a separate discussion. Reference to this specific siphon work may need to stay in the 404/401 applications.

Jelica Arsenijevic
Environmental Project Manager

Due to COVID-19, I will be working from home. Please contact me via cell # listed below. Be safe out there!

HDR
2379 Gateway Oaks Drive, Suite 200
Sacramento, CA 95833
D 916-679-8854
M 209-329-6897

Jelica.Arsenijevic@hdrinc.com

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From: Luu, Henry [Henry.Luu@hdrinc.com]
Sent: 9/21/2021 1:40:36 PM
To: Robert Cheng [RCheng@cvwd.org]
CC: Petya Vasileva [PVasileva@cvwd.org]; Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis
Attachments: CVWD_Deliveries_rev09_4scn__ALT1B_011221_vs_ALT1B_WSIP2030_040121_vs_ALT1B_WSIP2070_040121.pdf

Hi Robert,

Attached for reference is a draft water deliveries table for CVWD.

I think a quick conversation with the technical team may help provide clarity on the lingering items. Can you provide us with your availability in the next couple of days, so we can setup a 30-min chat to ensure you have what you need to help answer the questions?

Thank you,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Robert Cheng <RCheng@cvwd.org>
Sent: Tuesday, September 21, 2021 8:14 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Henry,

Thanks for the prompt response to my questions. I think that I understand the explanations except the conveyance cost, where I'm not fully comprehending the comment that the conveyance cost is a cost and benefit, so therefore any changes would "zero" out. I realize that a primary goal for this exercise is to provide information to the CWC, but I can't help but feel that these figures will be cited elsewhere.

For example, we have figures of $300/af cited for 2030 and $750/af cited for 2045 as long-term average undelivered costs, but when we look at the affordability slides presented during the M&I workshops , a figure of $860/af was cited at Knights Landing. As we get closer to the point when we need to discuss the cost issues with our Boards, I hope that we can keep all these figures straight and offer simple explanations if we get asked.

So back to the transportation cost, I'm still unclear on the explanation. When I think about this from an utility perspective, if I have to pay $148/af in 2030 $, it would be hard for me to explain that I'm still paying the same in 2045 $. Maybe I'm not looking at this in the way it was intended, so any assistance that you might be able to provide in educating me would be appreciated.

Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Monday, September 20, 2021 3:59 PM

To: Robert Cheng <RCheng@cvwd.org>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Robert, responses are below in red text:

- Would you be able to provide the water delivery table by water year type (associated with the table below)?

Yes – staff is working on preparing the requested data and will be provided tomorrow (9/21).

- In determining the annual escalation factor between 2030 and 2045, it appears that an escalation factor of 4.8% was applied to Wet and AB years was used, 5.9% was applied to BN and Dry years, and 7.45% was used for Critical year. Can you please confirm whether this is correct, and if so, what was the logic for the different escalation rates?

The WSIP unit values for 2030 and 2045 were determined by CWC staff based on their modelling of past water transfer prices and other economic modelling (e.g. SWAP). The precise approach and assumptions that CWC used in its development is unknown but it is presumed that the increase in 2045 benefit valuation includes consideration of the water availability/cost effects under full SGMA implementation.

- For the conveyance cost of $148/af, what was the delivery point that was used (to SL Reservoir or somewhere else)? Why is there no escalation of these costs between 2030 and 2045?

The conveyance energy projections conservatively use post 2030 constant energy price assumption. Note that the conveyance energy cost applies on both sides of the benefit cost analysis "ledger" (i.e. as both a cost expense and benefit increase) as a result it nets out in the benefit-cost calculation. It is the "base" supplied water value that is more important for the economic feasibility determination.

- Am I looking at the delivery volume of 8,600 af to mean that we are incurring a 14% carriage loss across the Delta (on a long-term average basis)?

The current model results show a 18% carriage loss, however there are on-going discussions with Reclamation and DWR on this topic. The economic feasibility (benefit-cost analysis) is ultimately seeking unit benefit values ($/AF) for the end-user location deliveries for its economic benefit determination. CalSim analysis of the project operations for the WSIP application accounts for projected carriage losses in its estimates of the corresponding water quantities received by end-users. As a result, the carriage loss factor (and similarly incurred conveyance costs) may be relevant consideration for translating water transfer purchases if the sales prices are based on the seller's releases and terms of delivery.

- When are you looking to receive the participants' responses?

Ideally we would like to have responses and supporting data by the end of this week (COB 9/24). We would appreciate having this information as soon as possible, so that we can validate with CWC staff and submit the Final Feasibility Report next month (October 2021).

Thank you,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Robert Cheng <RCheng@cvwd.org>
Sent: Monday, September 20, 2021 9:33 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Henry,

I am routing this document internally for review and response. In the meantime, I had a few questions regarding the cost table.

- Would you be able to provide the water delivery table by water year type (associated with the table below)?
- In determining the annual escalation factor between 2030 and 2045, it appears that an escalation factor of 4.8% was applied to Wet and AB years was used, 5.9% was applied to BN and Dry years, and 7.45% was used for Critical year. Can you please confirm whether this is correct, and if so, what was the logic for the different escalation rates?
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- Am I looking at the delivery volume of 8,600 af to mean that we are incurring a 14% carriage loss across the Delta (on a long-term average basis)?
- When are you looking to receive the participants' responses?

Thanks,
Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Sunday, September 19, 2021 4:54 PM
To: Randall Neudeck <rneudeck@mwdh2o.com>; Bob Tincher <bobt@sbvmwd.com>; jdavis@sgpwa.com; Robert Cheng <RCheng@cvwd.org>; AFlores (AFlores@zone7water.com) <AFlores@zone7water.com>
Cc: Jerry Brown <jbrown@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Jeff Herrin <Jeff.Herrin@aecom.com>; Carlson, Nik <nik.carlson@aecom.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

External e-mail: Do not click on links or open attachments unless you recognize the sender and you know the content is safe.

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Please let us know your availabilities if a meeting is desired.
Thank you for your support,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Alicia Forsythe [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=A6CDF06A7E904B65BAA21702A82AD329-AFORSYTHE]
Sent: 9/21/2021 1:54:06 PM
To: John Spranza (john.spranza@hdrinc.com) [john.spranza@hdrinc.com]; Heydinger, Erin [Erin.Heydinger@hdrinc.com]; Steve Micko (Steve.Micko@jacobs.com) [Steve.Micko@jacobs.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]; Hendrick, Mike [Mike.Hendrick@icf.com]; Jim Lecky (jim.Lecky@icf.com) [jim.Lecky@icf.com]; Greenwood, Marin [Marin.Greenwood@icf.com]; Hassrick, Jason [Jason.Hassrick@icf.com]; Taylor Davies [tdavies@sitesproject.org]
Subject: RE: Sites - Prep For CDFW Meeting

Hi all – Here's the key issues for our CDFW discussions. We don't need to go through each one of these – just that these are the ones out there and that we are generally focusing on in the near term.

- Diversion Criteria / Flow Related

1. Wilkins Slough Flow Criteria (remaining months)
2. Diversions in Dry and Critically Dry Years
3. Implementation of Pulse Flow Protection
4. Beneficial entrainment in the Fremont Weir Notch
5. Spring reductions in Sacramento River flows when not diverting

- Generally Habitat Restoration / Compensation Related

1. Possible effects to rearing habitat
2. Delta smelt food abundance effects
3. Longfin smelt mitigation seems lows

- Addressed

1. Temperature and DO of Prop 1 releases into the Yolo Bypass could impact Delta Smelt – Resolved with impact and mitigation measure in RDEIR/SDEIS

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

-----Original Appointment-----
From: Alicia Forsythe
Sent: Monday, September 20, 2021 3:01 PM
To: Alicia Forsythe; John Spranza (john.spranza@hdrinc.com); Heydinger, Erin; Steve Micko (Steve.Micko@jacobs.com); Leaf, Rob/SAC; Hendrick, Mike; Jim Lecky (jim.Lecky@icf.com); Greenwood, Marin; Hassrick, Jason; Taylor Davies
Subject: Sites - Prep For CDFW Meeting
When: Tuesday, September 21, 2021 12:00 PM-1:00 PM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

Microsoft Teams meeting

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+1 916-538-7066,,197629403# United States, Sacramento

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From: Alicia Forsythe [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=A6CDF06A7E904B65BAA21702A82AD329-AFORSYTHE]
Sent: 9/21/2021 1:55:47 PM
To: Jerry Brown [jbrown@sitesproject.org]
Subject: FW: [EXTERNAL] RE: Revised EIS project description

See below. Reclamation wants new modeling to release the Draft EIR/EIS.

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: King, Vanessa M <vking@usbr.gov>
Sent: Tuesday, September 21, 2021 1:16 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>; Barbara, Vincent F <vbarbara@usbr.gov>; Hunt, Shane D <shunt@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Revised EIS project description

Hi Ali,

I've asked our staff to provide comments on the revised project description by Thursday, but from an initial look, I don't expect we'll have any significant concerns.

However, after meeting with management today about Chapter 11, we've decided we're not comfortable moving forward with the draft EIS without including analysis that better supports the anadromous fish benefits, such as revising the modeling to include some/all of the operations described in the project description. We recognize that this may impact our ability to release the draft EIS before your December WSIP deadline, and would be happy to have a discussion with you on how to proceed.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, September 21, 2021 10:03 AM
To: King, Vanessa M <vking@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>

Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Revised EIS project description

Thanks Vanessa. Happy to help and let me know if there are any questions on our suggested changes on the Chapter 2 text. We really tried to make as few changes as possible and focused on those things that we felt would raise concerns with the public, that didn't quite work that way or that we couldn't explain to the public.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

---

From: King, Vanessa M <vking@usbr.gov>
Sent: Tuesday, September 21, 2021 9:06 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Revised EIS project description

Hi Ali,

Thanks for sending us your comments. We will review and respond as quickly as possible. We are meeting with management today to discuss Chapter 11, and I expect that we will be able to provide an update on that at the biweekly meeting today.

On the schedule, we agree that an October 22 release date is no longer feasible. If we were to get final versions of the documents this Friday, we may be able to release the document by November 5, assuming the DC briefings are scheduled on our requested timeline.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, September 21, 2021 6:07 AM
To: King, Vanessa M <vking@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>;

Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: [EXTERNAL] RE: Revised EIS project description

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Hi Vanessa – Thanks for the revisions to the Project Description. We have a few additional edits and clarifications. Most are editorial to conform to the document style. We have used comment bubbles for anything of substance to share our thought process and why we made the change. We are happy to schedule a call this week to talk through these last changes if you would like.

We are clearly very off schedule for the RDEIR/SDEIS release. We are unsure of what we are going to report to our Board at our joint meeting tomorrow as making an October 22 release date for the EIS seems unlikely now. Can Reclamation review these changes and get us back this text and Chapter 11 in the next few days?

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: King, Vanessa M <vking@usbr.gov>
Sent: Wednesday, September 15, 2021 12:10 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Dekar, Melissa D <mdekar@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>
Subject: Revised EIS project description

Hi Ali and Laurie,

The EIS project description with Reclamation's revisions is attached. Please let us know if you would like to set up a call to discuss any of these revisions.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: Alicia Forsythe [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=A6CDF06A7E904B65BAA21702A82AD329-AFORSYTHE]
Sent: 9/21/2021 1:59:30 PM
To: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
CC: Spranza, John [john.spranza@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: RE: [EXTERNAL] RE: Revised EIS project description

Lets talk on the 3 pm meeting. I've elevated to Jerry so he is aware.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Tuesday, September 21, 2021 1:28 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Revised EIS project description

I assume we will talk about this at 3pm but let me know if you would like me to schedule a meeting

From: King, Vanessa M <vking@usbr.gov>
Sent: Tuesday, September 21, 2021 1:16 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>; Barbara, Vincent F <vbarbara@usbr.gov>; Hunt, Shane D <shunt@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Revised EIS project description

Hi Ali,

I've asked our staff to provide comments on the revised project description by Thursday, but from an initial look, I don't expect we'll have any significant concerns.

However, after meeting with management today about Chapter 11, we've decided we're not comfortable moving forward with the draft EIS without including analysis that better supports the anadromous fish benefits, such as revising the modeling to include some/all of the operations described in the project description. We recognize that this may impact our ability to release the draft EIS before your December WSIP deadline, and would be happy to have a discussion with you on how to proceed.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, September 21, 2021 10:03 AM
To: King, Vanessa M <vking@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Revised EIS project description

Thanks Vanessa. Happy to help and let me know if there are any questions on our suggested changes on the Chapter 2 text. We really tried to make as few changes as possible and focused on those things that we felt would raise concerns with the public, that didn't quite work that way or that we couldn't explain to the public.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

---

From: King, Vanessa M <vking@usbr.gov>
Sent: Tuesday, September 21, 2021 9:06 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Revised EIS project description

Hi Ali,

Thanks for sending us your comments. We will review and respond as quickly as possible. We are meeting with management today to discuss Chapter 11, and I expect that we will be able to provide an update on that at the biweekly meeting today.

On the schedule, we agree that an October 22 release date is no longer feasible. If we were to get final versions of the documents this Friday, we may be able to release the document by November 5, assuming the DC briefings are scheduled on our requested timeline.

Thanks,

Vanessa

Vanessa King

Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, September 21, 2021 6:07 AM
To: King, Vanessa M <vking@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: [EXTERNAL] RE: Revised EIS project description

Hi Vanessa – Thanks for the revisions to the Project Description. We have a few additional edits and clarifications. Most are editorial to conform to the document style. We have used comment bubbles for anything of substance to share our thought process and why we made the change. We are happy to schedule a call this week to talk through these last changes if you would like.

We are clearly very off schedule for the RDEIR/SDEIS release. We are unsure of what we are going to report to our Board at our joint meeting tomorrow as making an October 22 release date for the EIS seems unlikely now. Can Reclamation review these changes and get us back this text and Chapter 11 in the next few days?

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: King, Vanessa M <vking@usbr.gov>
Sent: Wednesday, September 15, 2021 12:10 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Dekar, Melissa D <mdekar@usbr.gov>; Mosley, Michael I <mmosley@usbr.gov>
Subject: Revised EIS project description

Hi Ali and Laurie,

The EIS project description with Reclamation's revisions is attached. Please let us know if you would like to set up a call to discuss any of these revisions.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

File Provided Natively

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 9/21/2021 4:53:28 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Jerry Brown [jbrown@sitesproject.org]; Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Spranza, John [john.spranza@hdrinc.com]
Subject: Modeling Schedule for Discussion w Reclamation
Attachments: EIS-ExampleModelingSchedule.docx

Hi all,

Attached is an example best-case schedule that we can share with Reclamation. I think 6 weeks for modeling is extremely aggressive, but it's what we're showing in our BA schedule. I also included actual dates from this spring to give a context. The second page includes a graphic on how some of the models interact, which might be helpful for non-modelers to see that we can't run all of these in parallel – they rely on output from each other.

Erin

Erin Heydinger, PE, PMP
Project Manager
Water/Wastewater

HDR
2379 Gateway Oaks Dr, #200
Sacramento, CA 95833
D 916.679.8863 M 651.307.9758

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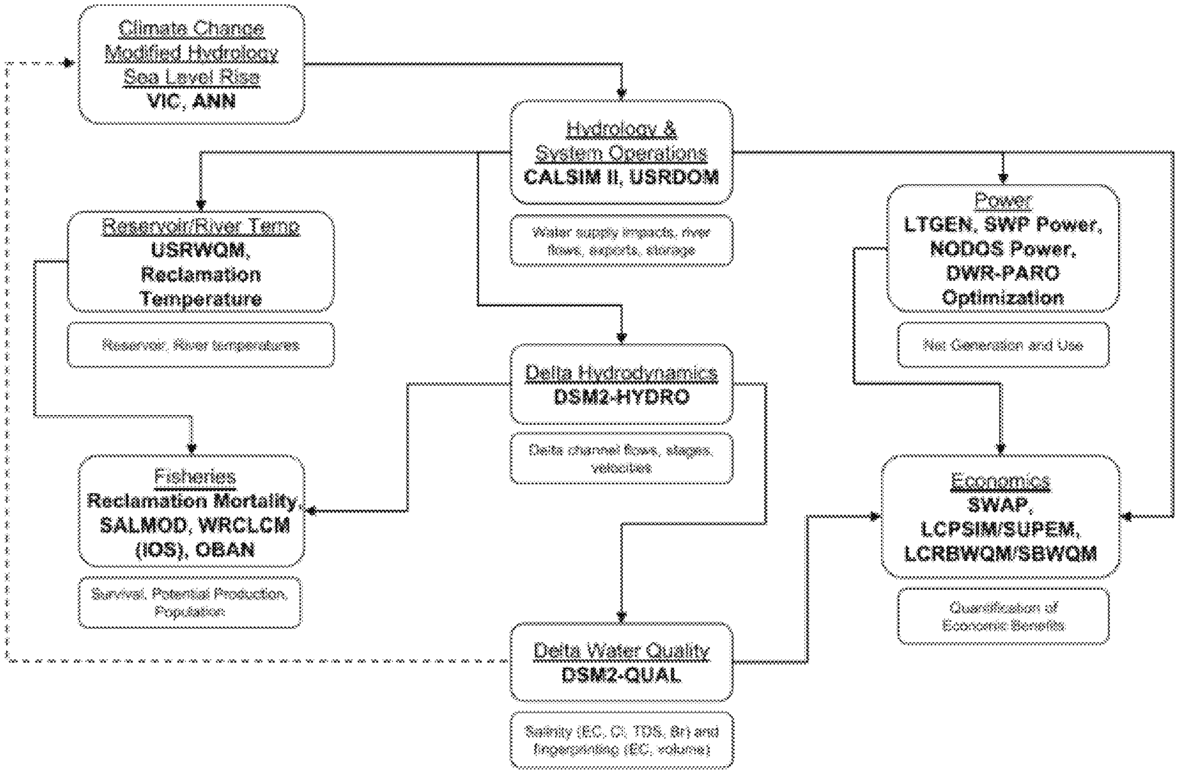
Best-Case Modeling Schedule

	Duration	Schedule (if started today)
CalSim II – Revised Criteria	1 week	9/22-10/1
CalSim II – Final Results	2 weeks	10/1-10/15
All other modeling:		
Climate Change (CalSim) USRDOM HEC-5Q & RecTemp DSM2 (Hydro & Qual) Fish Mortality (Anderson & Martin) SALMOD IOS* OBAN* Mercury* Reservoir Water Quality Suitable Habitat Analysis Power	6 weeks (best case and without holidays)	10/18-11/26
Documentation/Appendices**	4 weeks (best case and without holidays)	11/29-12/24
*Requires subconsultant to Jacobs **Does not include review time		

Actual Schedule (2021 RDEIR/SDEIS):

- Final Alt 3 criteria received from Reclamation and run in CalSim on 2/1
- DSM2/HEC5Q received 2/13
- Climate change received 2/18
- USRDOM received 2/24
- Anderson, Martin, IOS, OBAN received 2/26/21
- SALMOD received 3/19
- Mercury received 3/31
- Power received 4/7
- Reservoir temperature received 4/15
- IOS received 4/22
- Floodplain inundation received 4/29
- Suitable habitat analysis received 5/9
- Last appendix received 6/23
- **Total time: 4.75 months (3 months for modeling)**

Analytical Framework –
System (feasibility, system-level impacts)



From: Luu, Henry [Henry.Luu@hdrinc.com]
Sent: 9/21/2021 5:18:32 PM
To: Carlson, Nik [nik.carlson@aecom.com]; jeff.herrin@aecom.com
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Nik and Jeff,

Bob Tincher (SBVMWD) would also like additional insight re: questions. Can we accommodate a meeting with him tomorrow (Wednesday) between 4pm-5pm (I'm thinking 30-mins)?

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566
hdrinc.com/follow-us

-----Original Message-----
From: Bob Tincher <bobt@sbvmwd.com>
Sent: Tuesday, September 21, 2021 5:12 PM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Subject: Re: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Henry,

The meeting would be helpful. How about Wed afternoon after the Sites meeting?

Thanks,
Bob

From: "Luu, Henry" <Henry.Luu@hdrinc.com>
Date: Tuesday, September 21, 2021 at 5:06 PM
To: Bob Tincher <bobt@sbvmwd.com>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Bob,

We were hoping your team had some of this information readily available, and ideally responses and supporting data can be provided by the end of this week (COB 9/24). If that is a stretch, then as soon as possible so that we can validate the information with CWC staff before submitting the Final Feasibility Report next month (October 2021). If you think it will be helpful, I can setup a meeting with our technical staff to provide additional insight on our approach in addressing this item; I would only need input on your availability to schedule this meeting.

Thank you,
Henry H. Luu, PE
D 916.679.8857 M 916.754.7566
hdrinc.com/follow-us

-----Original Message-----
From: Bob Tincher <bobt@sbvmwd.com<mailto:bobt@sbvmwd.com>>
Sent: Tuesday, September 21, 2021 4:35 PM
To: Luu, Henry <Henry.Luu@hdrinc.com<mailto:Henry.Luu@hdrinc.com>>
Subject: Re: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Henry,

I was not able to attend the meeting where this was discussed. When are our answers due back to you?

Thanks,

Bob
Robert M. Tincher, P.E., M.S.

Chief Water Resources Officer/Deputy General Manager San Bernardino Valley Municipal Water District
380 E. Vanderbilt Way
San Bernardino, CA 92408
Cell 909.226.2812

From: "Luu, Henry" <Henry.Luu@hdrinc.com<mailto:Henry.Luu@hdrinc.com>>
Date: Sunday, September 19, 2021 at 4:54 PM
To: Randall Neudeck <rneudeck@mwdh2o.com<mailto:rneudeck@mwdh2o.com>>, Bob Tincher <bobt@sbvmwd.com<mailto:bobt@sbvmwd.com>>, Jeff Davis <jdavis@sgpwa.com<mailto:jdavis@sgpwa.com>>, Robert Cheng <RCheng@cvwd.org<mailto:RCheng@cvwd.org>>, "AFlores (AFlores@zone7water.com<mailto:AFlores@zone7water.com>)" <AFlores@zone7water.com<mailto:AFlores@zone7water.com>>
Cc: Jerry Brown <jbrown@sitesproject.org<mailto:jbrown@sitesproject.org>>, Joe Trapasso <jtrapasso@sitesproject.org<mailto:jtrapasso@sitesproject.org>>, "Heydinger, Erin" <Erin.Heydinger@hdrinc.com<mailto:Erin.Heydinger@hdrinc.com>>, Jeff Herrin <Jeff.Herrin@aecom.com<mailto:Jeff.Herrin@aecom.com>>, "Carlson, Nik" <nik.carlson@aecom.com<mailto:nik.carlson@aecom.com>>, "Leaf, Rob/SAC" <Rob.Leaf@jacobs.com<mailto:Rob.Leaf@jacobs.com>>
Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hello Sites Project members,

The project team has been hard at work coordinating with CWC staff/reviewers to ensure we are preparing a document that is compliant and meets the needs for the Commission's feasibility determination. We are at a point where your input is needed - the team is requesting participant-specific information demonstrating the expected use and economic benefit of the project's future water supply increases. This information is needed to show the project's economic feasibility for securing WSIP funding. Any information regarding your agency's valuation of Sites water supplies and related water quality benefits is greatly appreciated. This solicitation is targeted towards the top five SOD members with the largest water demand from the Project because we believe your input will have a greater influence on the economic analysis. Solicitated member Agency/District and a couple of potential contacts that may be able to assist are:

1. Metropolitan Water District (43 TAF) - Brandon Goshi
2. San Bernardino Valley Municipal Water District (18.4 TAF)
3. San Gorgonio Pass Water Agency (12.0 TAF)
4. Coachella Valley Water District (8.6 TAF) - Zoe Rodriguez Del Rey
5. Zone 7 Water Agency (8.6 TAF)

Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)

South of Delta Deliveries ($/AF)

Wet

AB

BN

Dry

Critical

LT Avg.

2030

$225

$282

$295

$314

$397

$300

Conveyance

$148

$148

$148

$148

$148

$148

Total (2030)

$373

$430

$443

$462

$544

$448

2045

$456

$573

$698

$743

$1,165

$750

Conveyance

$148

$148

$148

$148

$148

$148

Total (2045)

$604

$720

$846

$891

$1,313

$898

Note: $148/AF conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

Information Request: Please review the above Table 1 default unit water benefit values and answer the questions below. Our technical staff are available to discuss the questions in further detail if necessary. Any supporting documentation for the responses (e.g. references to IWMP) and even approximate answers will be helpful. This is a time-sensitive request and we would appreciate an expedited response. Please note that the benefit value (supply cost) is for end-use location deliveries and not the cost from its origin.

Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:

a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?

b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

6. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?

a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

Please let us know your availabilities if a meeting is desired.
Thank you for your support,
Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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us<https://nam12.safelinks.protection.outlook.com/?url=http%3A%2F%2Fhdrinc.com%2Ffollow-
us&data=04%7C01%7CHenry.Luu%40hdrinc.com%7C29dad4935a454c0e233108d97d5d9d7c%7C3667e201cbdc48b39b425d2
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I6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=VTS73OKPAY%2F1scWnGoXve6mTRQBGCnl8I6avpEriG%2Bo%3D&reserved
=0>

From: Greenwood, Marin [Marin.Greenwood@icf.com]
Sent: 9/22/2021 8:12:49 AM
To: steve.micko@jacobs.com
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]; Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Subject: RE: SPJPA Sites: Additional Sensitivity Run

Thanks, Steve, I'll let you know if I have any questions.

MARIN GREENWOOD | **ICF** | marin.greenwood@icf.com | **+1.530.400.8081 mobile**

From: Micko, Steve/SAC <Steve.Micko@jacobs.com>
Sent: Tuesday, September 21, 2021 18:03
To: Greenwood, Marin <Marin.Greenwood@icf.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; John Spranza <John.Spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Subject: SPJPA Sites: Additional Sensitivity Run

Hi Marin,

Reed developed an EI ratio timeseries for one additional sensitivity run.

You may access these timeseries data here:

- Link: Diversion Criteria - 2021
- Spreadsheet name:

SPJPA_Sites_Act_EI_Ratio_NAA_ALT1A_ALT1B_ALT2_011221_ALT3_020121_ALT1B_MAM_WS107k_ALT1B_NoFW_MAM_WS107k_ALT1B_NoFW_NoPP_Oct-Jun_WS107k_ALT1B_NoFW_Oct-Nov_PP_Dec-Jun_WS107k.xlsx

- New data are posted in column K.

I will post positive entrainment and suitable habitat area in the next day or two.

Please let me know if you have any questions.

Best,
Steve

Steve Micko, PE | Jacobs | Project Manager
O:916.286.0358 | M:408.834.6614 | Steve.Micko@jacobs.com
2485 Natomas Park Drive Suite 600 | Sacramento, CA 95833

From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 9/22/2021 8:56:40 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Jerry Brown [jbrown@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Spranza, John [john.spranza@hdrinc.com]
Subject: RE: Modeling Schedule for Discussion w Reclamation

Exactly – I am assuming that we will still have the same review process with Reclamation that will prolong the schedule.

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Wednesday, September 22, 2021 8:52 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Jerry Brown <jbrown@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

So in total, we believe this effort would take about 9 months to a year. About 4.5 months for modeling. Then about 7-9 months for redrafting and reviewing the document. I think there is some overlap in some of the modeling and EIR/EIS work. It's not all sequential. But not a ton of overlap.

This is why we are starting this effort now in prep for the final eir/EIS.

Ali

————————
Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Tuesday, September 21, 2021 5:12:37 PM
To: Jerry Brown <jbrown@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

Yes, and they should know that – they were provided the admin draft Chapter 11 and all appendices on June 1st and we are still trying to resolve their comments/concerns.

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, September 21, 2021 5:10 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

Yikes, that's way too much to do in 3 weeks

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Date: Tuesday, September 21, 2021 at 5:05 PM
To: "Heydinger, Erin" <erin.heydinger@hdrinc.com>, Jerry Brown <jbrown@sitesproject.org>, Alicia Forsythe <aforsythe@sitesproject.org>, "Spranza, John" <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

Using the current scope of work for Amendment 3 and factoring in the prior experience of getting the draft ready for publication, the attached provides the list of chapters/appendices that would need to be updated based on revised modeling results and the time it will take to get the work done.

Laurie

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Tuesday, September 21, 2021 5:01 PM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <John.Spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

This is also just to point out that it's not just "3 weeks of work" as Vince said – it's an extensive effort to re-model the project. Vince has suggested a couple of times that if we can shift the schedule slightly we can accommodate this change. That is not the case.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

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From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, September 21, 2021 4:59 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

So our point is that we're already pushing the schedule very hard to meet the plan for getting the BA in by Feb '22. I don't really think we'll need this but its good to have in the hip pocket just in case.

From: "Heydinger, Erin" <Erin.Heydinger@hdrinc.com>
Date: Tuesday, September 21, 2021 at 4:53 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>, Jerry Brown <jbrown@sitesproject.org>, Laurie Warner Herson <laurie.warner.herson@phenixenv.com>, "Spranza, John" <john.spranza@hdrinc.com>
Subject: Modeling Schedule for Discussion w Reclamation

Hi all,

Attached is an example best-case schedule that we can share with Reclamation. I think 6 weeks for modeling is extremely aggressive, but it's what we're showing in our BA schedule. I also included actual dates from this spring to give a context. The second page includes a graphic on how some of the models interact, which might be helpful for non-modelers to see that we can't run all of these in parallel – they rely on output from each other.

Erin

Erin Heydinger, PE, PMP
Project Manager

Water/Wastewater

HDR
2379 Gateway Oaks Dr, #200
Sacramento, CA 95833
D 916.679.8863 M 651.307.9756

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From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 9/22/2021 10:02:22 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Jerry Brown [jbrown@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Spranza, John [john.spranza@hdrinc.com]
Subject: RE: Modeling Schedule for Discussion w Reclamation
Attachments: Chapters to Update Based on Revised Modeling (2).docx

All - I have updated the list of chapters/appendices to remove those shown in track changes and have refined the anticipated schedule so it's less conservative and may allow for some overlap. I think Erin's comparative schedule from 2021 is a good reference. We did overlap the preparation of Chapter 11 and related analyses with modeling and it took 4-5 months for a rough draft of Ch 11 to be submitted on June 1st. It's taken another 3 months for review and prepare revised draft(s). The review period should be shorter for revised chapters/appendices but I still think Reclamation will need a month to provide comments and ICF will need another month to finalize and resubmit for Reclamation executive review.

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Wednesday, September 22, 2021 8:52 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Jerry Brown <jbrown@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

So in total, we believe this effort would take about 9 months to a year. About 4.5 months for modeling. Then about 7-9 months for redrafting and reviewing the document. I think there is some overlap in some of the modeling and EIR/EIS work. It's not all sequential. But not a ton of overlap.

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Ali

————————
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Sent: Tuesday, September 21, 2021 5:12:37 PM
To: Jerry Brown <jbrown@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

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Sent: Tuesday, September 21, 2021 5:10 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

Yikes, that's way too much to do in 3 weeks

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Date: Tuesday, September 21, 2021 at 5:05 PM
To: "Heydinger, Erin" <erin.heydinger@hdrinc.com>, Jerry Brown <jbrown@sitesproject.org>, Alicia Forsythe <aforsythe@sitesproject.org>, "Spranza, John" <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

Using the current scope of work for Amendment 3 and factoring in the prior experience of getting the draft ready for publication, the attached provides the list of chapters/appendices that would need to be updated based on revised modeling results and the time it will take to get the work done.

Laurie

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Tuesday, September 21, 2021 5:01 PM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <John.Spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

This is also just to point out that it's not just "3 weeks of work" as Vince said – it's an extensive effort to re-model the project. Vince has suggested a couple of times that if we can shift the schedule slightly we can accommodate this change. That is not the case.

Erin

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From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, September 21, 2021 4:59 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

So our point is that we're already pushing the schedule very hard to meet the plan for getting the BA in by Feb '22. I don't really think we'll need this but its good to have in the hip pocket just in case.

From: "Heydinger, Erin" <Erin.Heydinger@hdrinc.com>
Date: Tuesday, September 21, 2021 at 4:53 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>, Jerry Brown <jbrown@sitesproject.org>, Laurie Warner Herson <laurie.warner.herson@phenixenv.com>, "Spranza, John" <john.spranza@hdrinc.com>
Subject: Modeling Schedule for Discussion w Reclamation

Hi all,

Attached is an example best-case schedule that we can share with Reclamation. I think 6 weeks for modeling is extremely aggressive, but it's what we're showing in our BA schedule. I also included actual dates from this spring to give a context. The second page includes a graphic on how some of the models interact, which might be helpful for non-modelers to see that we can't run all of these in parallel – they rely on output from each other.

Erin

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From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 9/22/2021 10:07:24 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Michel et al summary
Attachments: Michel et al 2021 Brief, 2021-0922.docx; Michel et al 2021 nonlinearflow_highlighted.pdf

Ali,
Attached is a summary of key points for the Michel paper as well as a highlighted copy of the document. Key points and takeaways are bulleted and page referenced for your use. The one important point to keep in mind is that this paper looked at juvenile fall-run and spring-run outmigration as they are most closely associated with the times when managed flows occur within the Sacramento River. This makes sense because study's intent was to look at flow-survival relationships with the goal of giving resource managers guidance and information when they are," designing flows intended to help salmon without clear guidance on flow targets." The best time to do that for outmigrants is when there are managed flows in the system (i.e., spring pulse flows, bypass requirements, BiOp requirements, etc), and those primarily occur in the spring.

This does not mean that the benefits are limited to the spring and fall-runs, only that the study focused on them. Winter run and steelhead have outmigration periods that occur July – March and November through June, respectively, and it is assumed that they have a similar flow-survivability relationship to that of the spring and fall runs. This is the argument CDFW has used for wanting to extend 10,700 flow protections at Wilkins slough to all year, and why the comments you received last night were correct about the Michel paper, but lacking the overall context of its applicability to overall outmigration in the system. I have included a figure from del Rosario in the brief that shows all of the runs migration period.

Happy to jump on a call to walk you though this.
John

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Senior Ecologist / Regulatory Specialist

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Summary of key concepts for Michel et al, 2021 Nonlinear survival of imperiled fish informs managed flows in a highly modified river.

Goal

Identifying the shape of the flow–biology relationship to determining the environmental consequences of flow regulation. This is to better understand flow-survival relationships with the goal of giving resource managers guidance and information when they are, " designing flows intended to help salmon without clear guidance on flow targets" (pg 1).

Methods

Used spring outmigration survival data from 2436 acoustic-tagged juvenile Chinook salmon from studies spanning differing water years (2013–2019) to extract actionable information on the flow–survival relationship.

- The study focuses on outmigrants when there are managed flows in the system (i.e., spring pulse flows, bypass requirements, BiOp requirements, etc) (pgs 8-9)
- This period of time coincides with peak hatchery releases and peak natural-origin outmigration of fall-run Chinook salmon, the stock that supports an important commercial and recreational fishery, as well as peak outmigration of ESA threatened wild spring-run Chinook salmon smolts from Sacramento River tributaries. (pg 16)
- Spring-run Chinook salmon populations historically spawn at high elevations and therefore experience slower growth rates and delayed outmigration timing compared to other listed Chinook salmon populations (e.g., winter run and steelhead) which pass knights landing between October and April[1] and November through June, respectively (Figure 1).
- Study Reach: Deer Creek to the Feather River confluence with the Sacramento River
- Compiled all the available spring period (15th March–15th June) acoustic tagging data for the Sacramento River and selected fish that were released upstream of the study reach (pg 5)
- Tagged fish were from six different years, including wild and hatchery fish, and fish from three of the four Sacramento River Chinook salmon populations ((pg 6)
- Flow relationship was centered around the average date of peak spring juvenile salmon outmigration (April 19th, based on 2005–2019 expanded juvenile salmon capture data from USFWS's Red Bluff rotary screw traps (pg 8) as well as managed spring pulse flows.
- To estimate the realized water budget for the spring flow relationship the author multiplied the sum of the mean daily flow estimates (cfs) from 15th March to 15th June from the Keswick Dam gauge (pg 8)
- 15 April–15 May is the peak spring outmigration period for Spring and Fall Run (pg 11)

Findings

The flow–survival relationship was best described by a step function, with three flow thresholds that we defined as minimum (4259 cfs), historic mean (10,712 cfs), and high (22,872 cfs). There was a 6.3-fold increase in survival from flows below 4259 cfs (0.03) to flows between 4259 and 10,712 cfs (0.189). There was a 2.7-fold increase in survival from flows between 4259 and 10,712 cfs to flows above 10,712 cfs (0.508). Overall, there was a 16.9-fold increase in survival from flow below 4259 to flows above 10,712 cfs (figure 6) (pg 10).

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[1] Del Rosario et al, 2013. Migration Patterns of Juvenile Winter-run-sized Chinook Salmon (Oncorhynchus tshawytscha)through the Sacramento–San Joaquin Delta

- The authors identified an optimal threshold of 10,712 cfs, which they labeled historic mean, as it is similar to the long-term average of natural spring flow conditions under which Chinook salmon have evolved in this system (pg 11)
- Wild smolts were underrepresented in this analysis due to the difficultly in capturing adequately sized individuals for tagging, and the results presented are likely driven largely by survival dynamics of hatchery fish (pg 16)
- While this study is limited to fall and spring-run juvenile migration during the spring managed flow time period, similar flow-survivability relationships would be likely in other salmonid species such as winter-run and steelhead as they are in the system as well (Figure 1). This is the argument CDFW has used for wanting to extend 10,700 flow protections at Wilkins slough to all year

Figure 1: Central Valley salmon with multiple life stages of all four runs of salmon and steelhead in the freshwater landscape year-round. This variation spreads extinction risk within populations, across evolutionarily significant units, and brings resilience to populations. Source: CH2M Hill for the California Rice Promotion Board

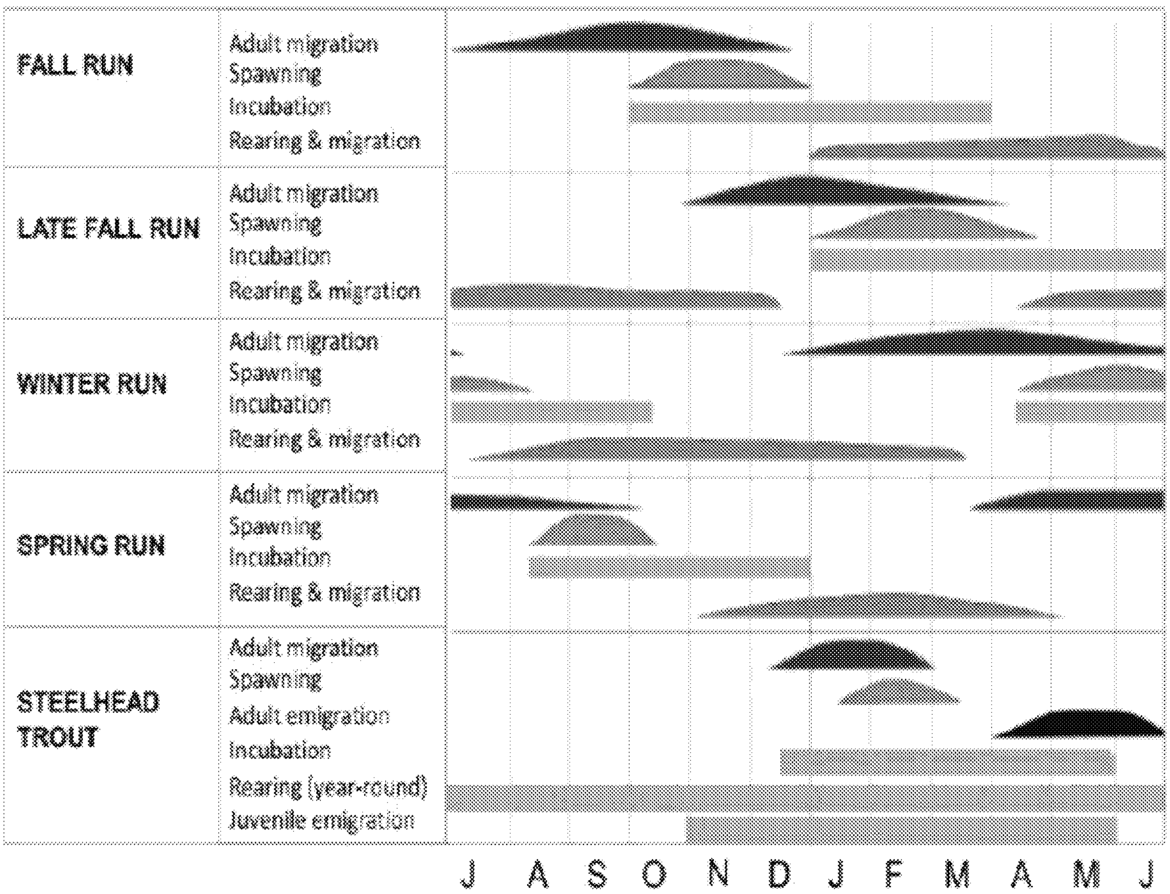


Fig. 3. Survival as a function of flow. Survival estimates (points) with 95% confidence intervals (bars) for groups at 5% quantile bins of experienced flow, plotted at the median value of bins (in cfs) on the x-axis. Flow experienced per fish is indicated by vertical tick marks along the x-axis.

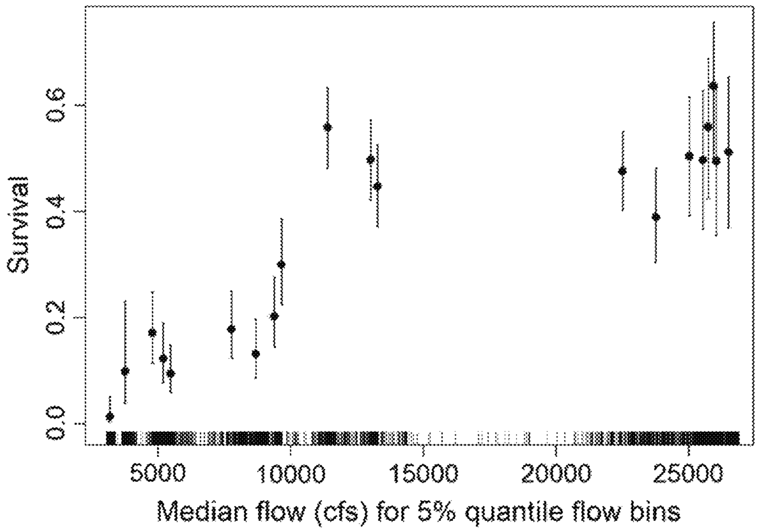
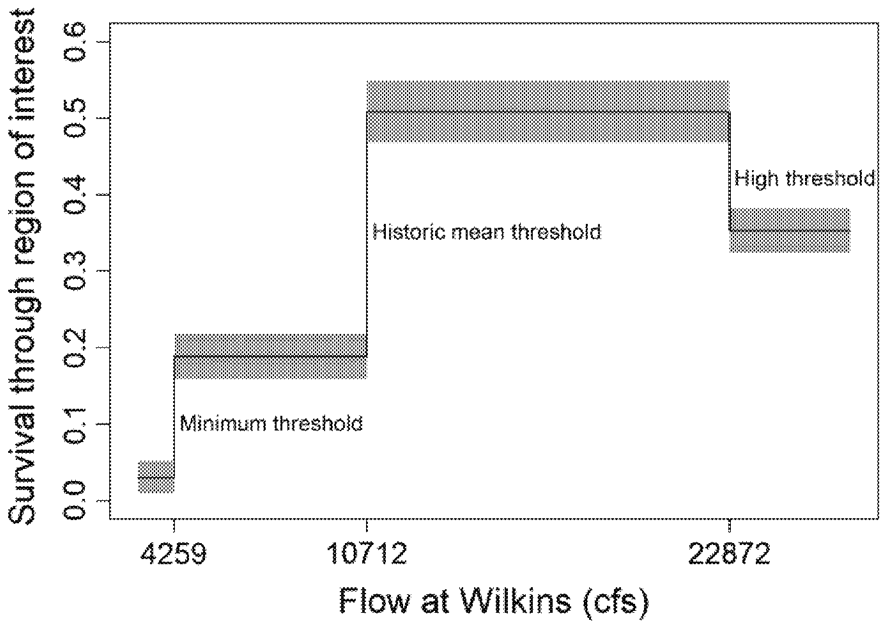


Fig. 6. Thresholds of predicted survival as a function of flow at Wilkins Slough. Predictions are based on the model averaged parameters from the most parsimonious triple threshold models, with mean thresholds at 4259, 10,712, and 22,872 cfs, with 95% confidence intervals (gray fill).


Survival through region of interest
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Minimum threshold
Historic mean threshold
High threshold
4259
10712
22872
Flow at Wilkins (cfs)

esa ECOSPHERE

FRESHWATER ECOLOGY

Nonlinear survival of imperiled fish informs managed flows in a highly modified river

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Citation: Michel, C. J., J. J. Notch, F. Cordoleani, A. J. Ammann, and E. M. Danner. 2021. Nonlinear survival of imperiled fish informs managed flows in a highly modified river. Ecosphere 12(5):e03498. 10.1002/ecs2.3498

Abstract. Water is a fundamental resource in freshwater ecosystems, and streamflow plays a pivotal role in driving riverine ecology and biodiversity. Ecologically functional flows, managed hydrographs that are meant to reproduce the primary components of the natural hydrograph, are touted as a potential way forward to restore ecological functions of highly modified rivers, while also balancing human water needs. A major challenge in implementing functional flows will be establishing the shape of the managed hydrograph so as to optimize improvements to the ecosystem given the limited resources. Identifying the shape of the flow–biology relationship is thus critical for determining the environmental consequences of flow regulation. In California's Central Valley, studies have found that increased streamflow can improve survival of imperiled juvenile salmon populations during their oceanward migration. These studies have not explored the potential nonlinearities between flow and survival, giving resource managers the difficult task of designing flows intended to help salmon without clear guidance on flow targets. We used an information theoretic approach to analyze migration survival data from 2436 acoustic-tagged juvenile Chinook salmon from studies spanning differing water years (2013–2019) to extract actionable information on the flow–survival relationship. This relationship was best described by a step function, with three flow thresholds that we defined as minimum (4259 cfs), historic mean (10,712 cfs), and high (22,872 cfs). Survival varied by flow threshold: 3.0% below minimum, 18.9% between minimum and historic mean, 50.8% between historic mean and high, and 35.3% above high. We used these thresholds to design alternative hydrographs over the same years that included an important component of functional flows: spring pulse flows. We compared predicted cohort migration survival between actual and alternative hydrographs. Managed hydrographs with pulse flows that targeted high survival thresholds were predicted to increase annual cohort migration survival by 55–132% without any additions to the water budget and by 79–330% with a modest addition to the water budget. These quantitative estimates of the biological consequences of different flow thresholds provide resource managers with critical information for designing functional flow regimes that benefit salmon in California's highly constrained water management arena.

Key words: California; flow regulation; functional flows; migration; resource management; salmon; survival; telemetry.

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Introduction

In rivers, natural flow regimes are directly linked with ecological processes that govern the life history of aquatic organisms, and are a major determinant of biodiversity (Bunn and Arthington 2002). Identifying the shapes of flow–ecology relationships is therefore critical for determining the biological consequences of water withdrawal or flow regulation on the ecosystem and to establish well-informed water management rules and recommendations (Rosenfeld 2017). Water resource use and development in watersheds has altered natural flow regimes, which in turn has altered riverine ecosystems, and is generally acknowledged to have considerable negative impacts on native biota (Pringle et al. 2000). As water resources become increasingly overtaxed due to population growth and climate change (Tanaka et al. 2006, Palmer et al. 2008), the task of balancing human and ecosystem needs will become more urgent and politically charged (Arthington et al. 2018). More than ever, objective, science-based approaches are needed for informing the development of water resource allocation targets (Petts 2009).

Few freshwater systems illustrate the management challenges of balancing environmental resources with the restoration of a collapsing ecosystem better than California's Central Valley (CCV) watershed. Here, water is heavily regulated as it supports a multi-billion dollar agricultural economy as well as tens of millions of urban and suburban water users (Speir et al. 2015). The ecosystem is vastly different than it was historically, with many native fish populations diminishing, and increasingly extreme climatic events impacting water availability (Hanak and Lund 2012). Researchers at the nonpartisan Public Policy Institute of California have suggested that restoration of native fish populations and general ecosystem health in the CCV is unattainable under the current regulatory status quo (Mount et al. 2019). These same authors propose that ecosystem-based management of the CCV is a potential way forward. Two key changes would be the adoption of ecologically functional flows (Yarnell et al. 2015, 2020) and an ecosystem water budget. Functional flows are managed hydrographs that are meant to reproduce the primary components of the natural, unimpaired hydrograph so as to restore related geomorphic, biogeochemical, or ecological functions, while also balancing human water needs. An ecosystem water budget is essentially a water right for the environment: a set amount of water than may be allocated as resource managers see fit to improve the condition of the ecosystem. If these two key changes were implemented throughout the CCV, one of the major challenges will be establishing the shape and magnitude of the managed hydrograph so as to optimize improvements to the ecosystem, given a fixed water budget. A key part of this challenge is predicting the biotic responses to different flow targets.

In the CCV, hydrologic infrastructure and water management have strongly modified the hydrograph of most river systems, including the Sacramento River, resulting in reduced winter and spring discharges (Brown and Bauer 2009). The spring rainfall and snowmelt recession is a critical facet of the CCV Mediterranean-type flow regime, and alterations to this hydrograph strongly affect riverine species which have evolved to use high spring flows resulting from winter and spring rain-fed and snowmelt runoff (Yarnell et al. 2010). Among them, CCV Chinook salmon (*Oncorhynchus tshawytscha*) populations have been particularly impacted by water management infrastructure and altered flow regimes (Yoshiyama et al. 1998, Kimmerer 2008). Of the five historic Chinook salmon populations in the CCV, one has been extirpated, one is listed as endangered, one is listed as threatened, and the other two are listed as Species of Concern under the Endangered Species Act (ESA).

One of the primary impacts of the water management infrastructure and altered flow regimes in the CCV on salmon is the reduction in spring outmigration (i.e., seaward) survival of juvenile salmon (Kjelson et al. 1981, Notch et al. 2020). Importantly, the survival bottleneck at this life stage has significant repercussions throughout the Chinook salmon lifecycle (Michel 2019). Therefore, one vital aspect for implementation of functional flows in the CCV is to assess how they will impact juvenile Chinook salmon during their spring outmigration to the Pacific Ocean. One promising component of proposed functional flows in the CCV is the implementation of spring pulse flows (Yarnell et al. 2015), as these may recreate the ideal outmigration conditions salmon historically benefitted from.

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To date, studies have found strong, positive linear relationships between survival and flow in CCV rivers (Kjelson et al. 1981, Zeug et al. 2014, Henderson et al. 2019, Notch et al. 2020). However, when environmental resources are also commercially important for competing needs, this creates a problem: How to allocate limited resources if the only guidance managers have is that more is better for the population or ecosystem process in question? This difficulty often results from the statistical techniques traditionally used by ecologists, which by design only reveal linear relationships between populations or ecosystem processes and the environment. Yet, these relationships are rarely linear (Hunsicker et al. 2016, Rosenfeld 2017), and these nonlinearities can play a critical role in the population or ecosystem dynamics. Several studies have shown that nonlinear responses of ecosystems to environmental resource changes could initiate catastrophic regime shifts and local population extinction events (Scheffer et al. 2001). Therefore, it is important to explore possible nonlinearities between environmental resources and ecosystem processes, with the particular objective of finding information that is more actionable to resource managers. This is especially pertinent to Pacific salmon stocks that are often found in the middle of constrained resource management arenas (Munsch et al. 2020).

We investigated the link between flow variations in the Sacramento River, the primary Chinook salmon river in the CCV watershed, and outmigration survival of juvenile Chinook salmon. We also evaluated hypothetical outmigration survival rates in the context of alternative flow regimes. We addressed the following questions: (1) Is there evidence of nonlinearity in the flow–survival relationship in the Sacramento River? (2) If so, how can knowledge of the nonlinear relationship be used to enact ecologically functional flows that benefit juvenile Chinook salmon? Finally, we weigh the efficacy of two different alternative flow regimes on increasing population-level Chinook salmon outmigration survival rates.

Methods

Study area

The Sacramento River is the largest river in California and supports the second largest population complex of Chinook salmon on the U.S. West Coast. However, the Sacramento River has been severely altered from its historic state, with major dams constructed throughout its watershed, extensive water diversions in place for municipal, industrial, and agricultural uses, and diking for flood control and land reclamation. Shasta Reservoir and its downstream forebay Keswick Reservoir are key components in the interface between human alterations and the ecosystem in the Sacramento River. These reservoirs block passage to historic salmonid spawning and rearing habitat upstream and also regulate downstream flow. During all months, the large majority of streamflow in the Sacramento River is regulated by reservoir operations, which alters the seasonal patterns of the natural hydrograph, including the homogenization and reduction of flows during some critical salmon rearing and migration periods (Brown and Bauer 2009), as well as altering other environmental conditions, such as water temperature and turbidity.

All of the juvenile winter-run Chinook salmon (ESA endangered status), significant portions of the juvenile spring-run Chinook salmon (ESA threatened status), and juvenile fall/late-fall-run Chinook salmon (ESA species of concern) must navigate a portion of the Sacramento River with several large-scale, and hundreds of small-scale, water diversions. In the late spring, when a large portion of these juveniles outmigrate, natural seasonal reductions in tributary inputs coincide with increases in water diversions; the cumulative impacts of which result in incrementally lower flows in the more downstream reaches, until the confluence with the Feather River, the largest tributary of the Sacramento River (Fig. 1). This pattern is primarily expressed in a region (hereafter "region of interest") extending from the last major tributary before the Feather River on the upper end, the confluence with Deer Creek (Tehama County, river kilometer [rkm–distance from the Pacific Ocean by way of river] 425), to the Feather River confluence on the lower end (Sutter County, rkm 204; Fig. 2). We presume that detrimental impacts of low flows are primarily expressed in this region, where flows in the late spring are often the lowest of the year. In addition, flows in this region are considerably lower relative to the portions of the Sacramento

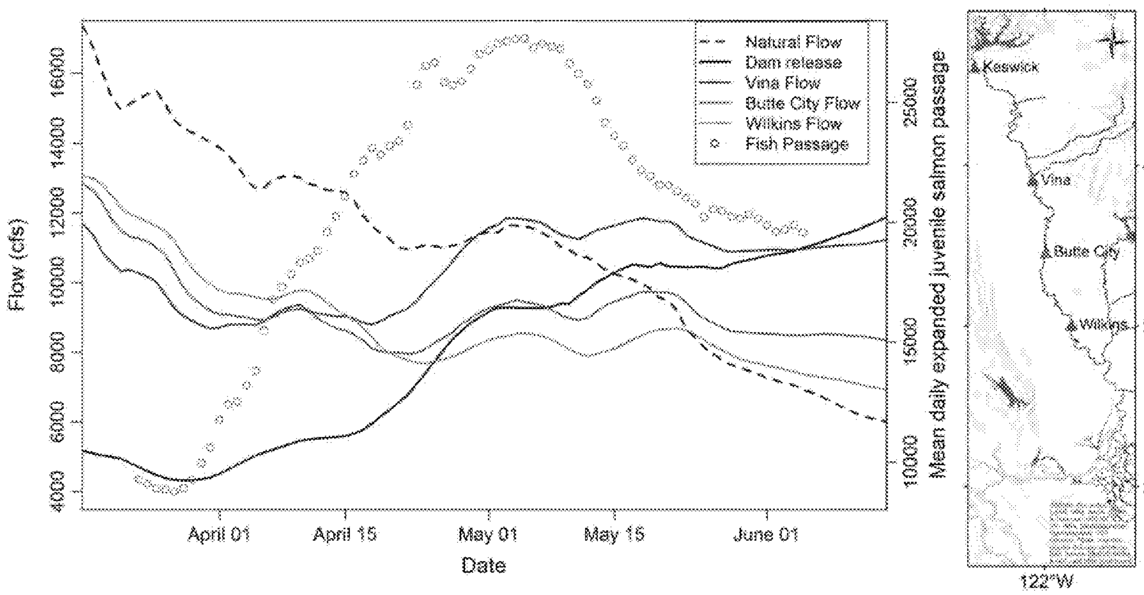

Fig. 1. Mean daily Sacramento River hydrographs for the spring period from 2000 to 2019, (excluding those classified as wet: 2006, 2011, 2017, 2019), mean daily natural hydrograph (dashed line), and mean daily expanded juvenile salmon passage (gray points, data from USFWS Red Bluff rotary screw traps, 38 rkm upstream of the region of interest). Flow levels (in cfs) are plotted through time at several gauges along the river, starting from Keswick gauge (dam release: USGS station number 11370500) on the upstream end to Wilkins Slough gauge (USGS station number 11390500) on the downstream end (color legend inset has gauges listed in order from upstream to downstream). The mean daily natural flow regime is the sum of the full natural flow statistic on the California Data Exchange Center (http://cdec.water.ca.gov) for the Bend Bridge (BND) gauging station, along with the daily flow from Mill Creek (USGS 11381500) and Deer Creek (USGS 11383500) gauges. It is therefore representative of the estimated full natural flow entering the region of interest. A 10-d moving average smoothing has been applied to all hydrographs and fish passage data. All stream gauges are operated by either USGS, US Bureau of Reclamation, or California Department of Water Resources.

River upstream and downstream, both of which are not characteristic of historic conditions. The survival rate of acoustic-tagged juvenile Chinook salmon in certain sections of this region is the lowest on the Sacramento River (Michel et al. 2015, Notch et al. 2020).

Study fish and season

The large majority of juvenile Chinook salmon in the Sacramento River rear and outmigrate during the winter or spring months (Fisher 1994). Historically, these seasons typically provided adequate flows and cool water temperatures to allow for juveniles to rear in, and transit through, downstream regions. At present, flows are only occasionally adequate for outmigration or off-channel rearing in most years. This is primarily due to reduced reservoir releases in order to store water for use in the summer months, after the outmigration window (Sturrock et al. 2020). In the winter and early spring, flows increase in the downstream direction from Keswick to Wilkins Slough until mid-April (Fig. 1), driven by tributary inflows that greatly exceed diversions. After mid-April, there is an inversion in this pattern, and flows are substantially lower at Wilkins Slough compared to Keswick (Fig. 1), resulting from cumulative diversions greatly exceeding tributary inflows during the agricultural irrigation season. It is during this same mid- to late spring period, after the inversion, that a significant portion of natural-origin juvenile salmon outmigrate through this region (Fig. 1). In addition, most CCV juvenile Chinook salmon

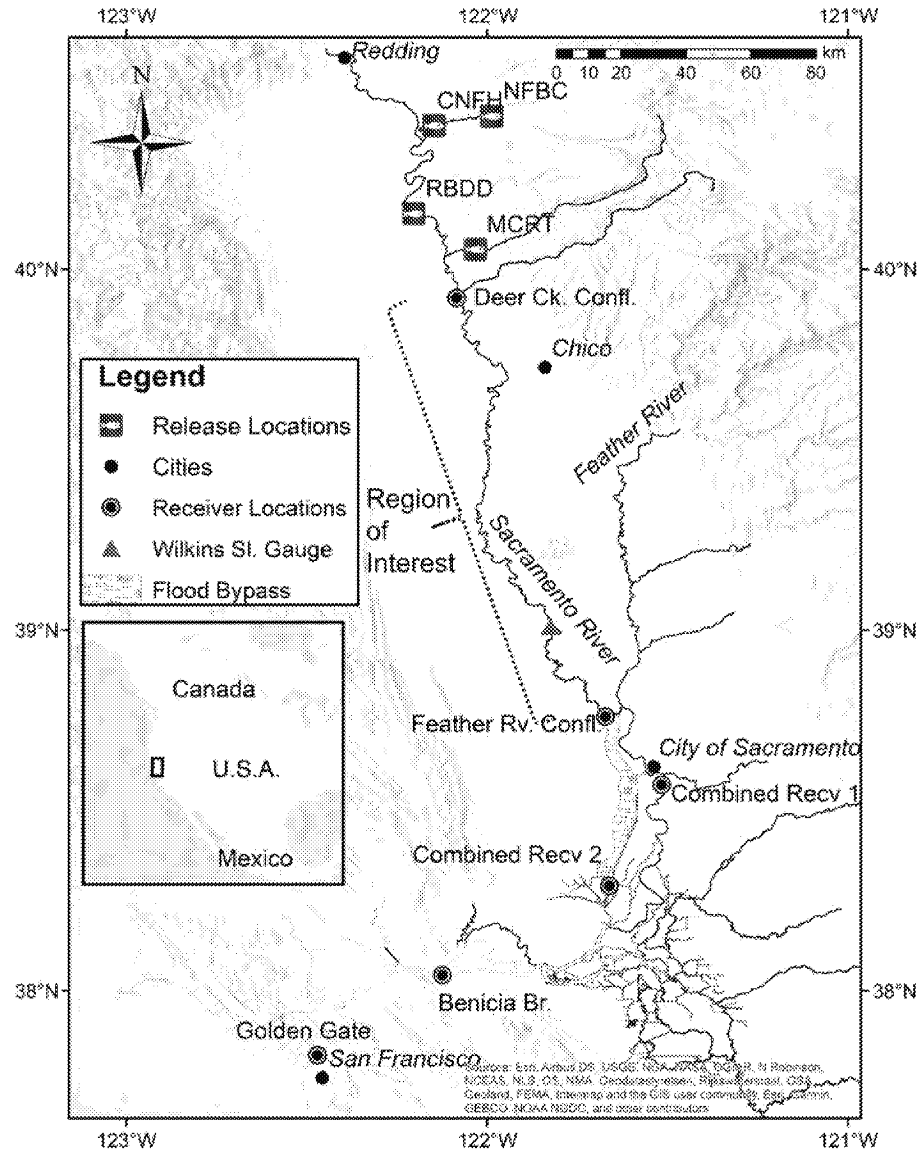

Fig. 2. Study area, release locations, and receiver locations. Region of interest spans from the confluence with Deer Creek to the confluence with Feather River. Release location abbreviations are CNFH, Coleman National Fish Hatchery; NFBC, North Fork Battle Creek; RBDD, Red Bluff Diversion Dam; and MCRT, Mill Creek rotary screw trap.

hatchery releases also peak in spring (Huber and Carlson 2015), during which their outmigration survival rates also appear to be sensitive to flow rates (Zeug et al. 2020).

Acoustic telemetry studies investigating the survival and movement of juvenile salmon in the Sacramento River have proliferated in recent years (Michel et al. 2015, Cordoleani et al. 2018, Notch et al. 2020). We compiled all the available spring period (15th March–15th June) acoustic tagging data for the Sacramento River and selected fish that were released upstream of the region of interest (above rkm 425): 3402 in total. Of those fish, only fish that were known to have entered the region of interest played a large role in parameterization of the flow–survival relationship explored in this analysis. Fish that did not appear to survive to the region of interest may have simply not been detected entering the region and therefore play a small role in the parameterization of the flow–survival relationship. The number of fish that were known to enter the region of interest amounted to 2436 acoustic-tagged fish from six different years, including wild and hatchery fish, and fish from three of the four Sacramento River Chinook salmon populations (Table 1).

Acoustic telemetry

Wild fish were collected using rotary screw traps deployed in the Sacramento River and Mill Creek, while hatchery fish were collected from hatchery raceways. Fish were tagged using similar methods across years and populations as described by Deters et al. (2010). Acoustic tags were surgically implanted into the coelomic cavity of the anesthetized fish and closed using one or two interrupted sutures, depending on tag model. Wild fish were allowed to recover in a net pen for approximately 12 h post-surgery and released on-site after sunset. Hatchery fish were allowed to recover for up to 24 h post-surgery and released on-site, or trucked to a release location using an aerated hatchery transport tanker. All release sites were located at least 25 rkm upstream of the region of interest (Fig. 2), such that by the time fish arrived to the region of interest any potential influences of handling, trucking, or release site on survival should have largely been expressed and should have little to no effect on survival estimates in the region of interest.

All fish were tagged and tracked using the Juvenile Salmon Acoustic Telemetry System (McMichael et al. 2010). Tags were programmed to transmit at three-, five-, or ten-second intervals depending on tag type, enabling them to function for a minimum of 27, 32, and 52 d, respectively. Tag size depended on the study population and ranged in size from 10.5 mm long × 5.2 mm high × 3.0 mm wide to 10.7 mm long × 5.0 mm high × 2.8 mm wide. The transmissions from the tags were detected and the unique tag number recorded by autonomous receivers from different manufacturers (ATS [Isanti, Minnesota, USA], Teknologic [Edmonds, Washington, USA] or Lotek Wireless [Newmarket, Ontario, Canada]). All receiver locations had two or more receivers to maximize detection probability. In an effort to reduce the tag burden in study fish, a maximum 5% tag-to-fish weight ratio was observed. This allowed for fish as small as 75 mm to be tagged and released. Fish tagged ranged from 75 to 120 mm fork length (mean 86.8, standard deviation [SD] 5.8).

Table 1. Wild and hatchery tagged fish groups included in our analysis from 2013 to 2019.

Population	Origin	Year	Release dates	Release location	*N*	Genetic population origin
Mill Creek	Wild	2013	Mid-April to mid-May	MCRT	48	74% CCV fall-run 26% CCV spring-run
Coleman	Hatchery	2013	Mid-April	CNFH	285	100% CCV fall-run
Mill Creek	Wild	2015	Mid-April to mid-May	MCRT	110	44% CCV fall-run 56% CCV spring-run
Coleman	Hatchery	2016	Early-April to late-April	CNFH	540	100% CCV fall-run
Mill Creek	Wild	2017	Mid-April to late-April	MCRT	24	100% CCV fall-run
Coleman	Hatchery	2017	Early-April to late-April	CNFH	370	100% CCV fall-run
Sacramento River	Wild†	2017	June 6	RBDD	33	100% CCV fall-run
Sacramento River	Wild†	2018	Early-May to early-June	RBDD	207	100% CCV fall-run
Livingston Stone	Hatchery	2019	March 26	NFBC	199	100% Sacramento winter-run
Coleman	Hatchery	2019	April 11	CNFH	140	100% CCV fall-run
Coleman	Hatchery	2019	Late-May	RBDD	480	100% CCV fall-run
Total		2013–2019	Late-March to early-June		2436	

Notes: CCV, California's Central Valley. Release locations are further described in Fig. 2. Genetic population assignments made using protocols outlined in Clemento et al. (2011).

† Fish captured in rotary screw traps in the Sacramento River and tagged were assumed to be wild, although some hatchery fish may have been misidentified and incidentally tagged.

Cormack-Jolly-Seber model

We used the Cormack-Jolly-Seber (CJS) model for live recaptures within Program MARK (White and Burnham 1999) using the RMark package (Laake 2013) in R statistical software (vers. 3.6.1; R Core Team 2019) to estimate survival as well as to assess the fit of different flow relationships with survival. For species that express an obligate migratory behavior such as Chinook salmon, a spatial form of the CJS model can be used, in which recaptures (i.e., tagged fish detected downstream from release) occur along a migratory corridor. The model determines if a fish not detected at a given receiver location was ever detected at any receiver downstream of that specific receiver, thus enabling calculation of maximum-likelihood estimates for detection probability of all receiver locations (p), survival (Φ), and 95% confidence intervals for both (Lebreton et al. 1992).

If a predator consumes an acoustic-tagged salmon and swims downstream past the next receiver location, the CJS model would incorrectly assign that fish as having survived the reach in which it was consumed. In the river above tidal influence, Chinook salmon express obligate anadromy and do not typically travel upstream (i.e., against current) once migration has begun; any movements in the upstream direction are likely predator movements. We therefore used the entirety of detection data available in the Sacramento River for each year (>12 receiver locations per year) to truncate the detection history of each fish to only include detections leading up to the first upstream movement, if one occurred.

We then subset the remaining detection data to only include receiver locations that bookend the region of interest. After release, the first receiver location was at the Deer Creek confluence (rkm 425), at the upstream end of the region of interest. The second receiver location was located just below or above the Feather River confluence depending on the year (rkm 204 or 211, respectively), and therefore, the reach between these receiver locations encompassed the entire region of interest (Fig. 2). We also included additional receiver locations further downstream in the detection history to allow for an estimation of detection probability at the Feather River confluence location. However, during high flow events, such as in 2017 and 2019, a portion of the Sacramento River spilled into a flood bypass located just upstream of the Feather River confluence (Fig. 2). Since this introduced a secondary migration route, we used a combination of receivers at the end of the bypass (located at Liberty Island, Solano County) and receivers in the mainstem Sacramento River (located at City of Sacramento, Sacramento County) to create a synthetic recapture event in the detection history, ensuring both potential routes were covered. These data were only included in the analysis to better estimate detection probability at the end of the region of interest. Finally, we also used two downstream receiver locations to further improve detection probability estimation, one at Benicia Bridge (Contra Costa County, rkm 52) and at the Golden Gate, the entrance to the Pacific Ocean (rkm 1).

Flow–survival relationship

Each fish was assigned a value equal to the mean flow over the entire travel time from passing the Deer Creek confluence to first detection at the Feather River confluence. For fish not detected at the Feather River confluence (either due to mortality upstream, or imperfect detection probability; representing 75.3% of all fish), we imputed travel time by creating probability density functions (p.d.f.s) from all known travel times for each tagging group (i.e., rows in Table 1) using kernel density estimation ("density" function in R statistical software). We then imputed travel time by randomly selecting a point along the p.d.f. for that fish's tagging group. We used flow values from the United States Geological Survey's (USGS) Sacramento River at Wilkins Slough gauging station (USGS station number 11390500). This location was nearest to the downstream end of the region of interest and represented the minimum flows that fish would experience during the late spring period (15th April and later; Fig. 1).

We created an initial CJS model by grouping fish based on 5% quantile bins of the flows they experienced. These survival groups, parameterized in the model by dummy variables, were allowed to only impact survival estimates of the region of interest (i.e., reach 2: Deer Creek confluence to Feather River confluence, Φ_{reach2}).

To explore nonlinearity in the flow–survival relationship, we employed model selection using the Bayesian Information Criterion (BIC) to assess the parsimony of different flow–survival modeling structures. We created multiple CJS models that allowed the relationship between flow and survival in the region of interest (reach 2: Deer Creek confluence to Feather River confluence) to take linear, log-linear, polynomial, cubic spline curve, and threshold (i.e., step function) forms. We used flow values for individual fish as individual covariates in the first four model types and as a grouping variable (dummy variable) for the threshold model. We also explored the potential for multiple thresholds in the flow–survival relationship. For all models, detection probability was allowed to vary by receiver location and tagging group. More details on the flow–survival modeling effort can be found in Appendix S1.

Spring pulse flow scenarios and theoretical survival improvements

Where we found strong evidence of a nonlinear flow–survival relationship, we assessed different management strategies that could use this information to improve cohort outmigration survival of salmon in the Sacramento River. We generated two hypothetical implementations of pulse flows during the spring period for the study years (2013–2019). The first implementation scenario allowed for sustained flows that would result in the highest survival rates based on the nonlinear flow–survival relationship. Sustained flows were centered around the average date of peak spring juvenile salmon outmigration (April 19th, based on 2005–2019 expanded juvenile salmon capture data from USFWS's Red Bluff rotary screw traps, https://www.fws.gov/redbluff/rbdd_biweekly_final.html) and scheduled to last as long as possible given the water budget. The second scenario represented an adaptive management implementation of spring pulse flows: Following a substantial increase in daily catch rates at the Red Bluff rotary screw traps, flows were temporarily increased (for four days) to the levels that would result in the highest survival rates based on the nonlinear flow–survival relationship. The maximum number of four-day pulse flow events was enacted given the available water budget. Days with substantial increases in catch rates at the rotary screw traps are proximate estimates of periods of peak outmigration of juvenile salmon, and we estimated these days to be when both (1) total expanded catch exceeded 10,000 juvenile salmon and (2) the increase was more than one standard deviation over the mean from the previous 10 d. Finally, we used two water budgets for these scenarios: a realized water budget (which consisted of the totality of water released from Keswick Dam during the spring of each year) and an ecosystem water budget, which added 150 thousand acre-feet (TAF) to the realized water budget each year.

We used the expanded combined daily catch of all runs of Chinook salmon for determining peak outmigration triggers. Expansion factors were based on capture efficiency trials operated by USFWS Red Bluff Office, and the resulting expanded total catch numbers represent the total number of fish passing the screw trap at Red Bluff. The rotary screw traps are 38 river kilometers upstream of the region of interest and therefore approximately represent the daily number of fish entering the region of interest during their outmigration. The screw traps are operated continuously, except during the passage of significant numbers of hatchery fish or during storm conditions (B. Poytress, *personal communication*). As a result, some spring sampling days are missing from our study period. Furthermore, some days of significant hatchery fish catches were also removed from the dataset; these days were identified as days when expanded daily catch total surpassed 80,000 fish.

To estimate the realized water budget, we multiplied the sum of the mean daily flow estimates (cfs) from 15th March to 15th June from the Keswick Dam gauge (USGS station number 11370500) by 1.983×10^{-3} to convert to volume (TAF). To benefit outmigrating salmon, the nonlinear flow–survival targets from the most parsimonious CJS model would need to be realized at the Wilkins Slough gauge, so we estimated a daily net change between Keswick Dam and Wilkins Slough. This approximates the net difference between water inputs (tributaries) and water exports (water diversions) between the Keswick Dam and Wilkins Slough at a daily time step. Finally, all alternative flow regimes had three important regulatory constraints: (1) minimum Keswick flows of 3250 cfs (National Marine Fisheries Service 2009 Biological Opinion and

Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project: NMFS 2009 BiOp), (2) maximum Keswick flow reduction rate of 15% per day (U.S. Bureau of Reclamation 2008 Central Valley Project Biological Assessment), and (3) no alteration to any daily Keswick releases that were deemed to be for flood control (>20,000 cfs).

We then modeled the impact of the different flow implementation scenarios on cohort outmigration survival of spring-outmigrating juvenile Chinook salmon. We used parametric bootstrapping, where the pertinent logit-transformed survival distribution from the CJS model (given flow levels at Wilkins Slough for that day) was resampled corresponding to the expanded daily total catch at the Red Bluff screw traps. We estimated the mean logit-scale survival from the totality of samples across all days of the spring period, and then re-scaled (inverse-logit transform). For missing daily catch values, we imputed catch using a linear interpolation of the time series. Finally, to provide a baseline for assessing the potential survival gains of each scenario, we estimated the cohort outmigration survival for the status quo (using the observed spring hydrograph in the years 2013–2019).

Results

We found strong evidence of nonlinearity in the flow–survival relationship (CJS model with grouping based on 5% quantile flow bins, Fig. 3). Survival was positively related to flow for values up to 10,000 cfs, followed by a sharp increase in survival near 10,000 cfs, at which point survival asymptotes at approximately 50%.

Out of 724,567 models we tested, the triple threshold models were the most parsimonious, with 12 that were within two BIC points of the top model. We estimated survival parameters and threshold values (4259, 10,712, and 22,872 cfs) from these 12 models using model averaging. The threshold models were substantially better supported than any of the other model types tested (ΔBIC > 29). Furthermore, these threshold models, as well as all polynomial and spline models, were better supported than the linear, log-linear, and full models (ΔBIC > 146), indicating strong support of a nonlinear flow–survival relationship.

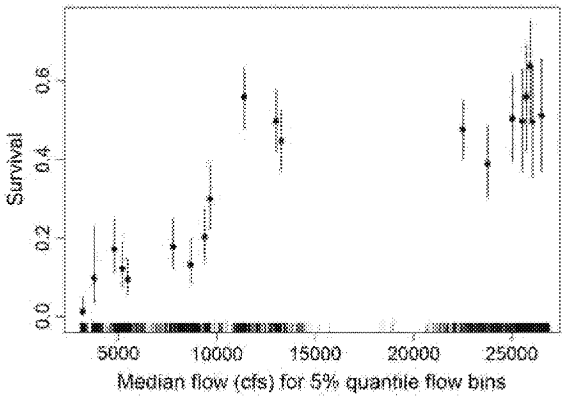

Fig. 3. Survival as a function of flow. Survival estimates (points) with 95% confidence intervals (bars) for groups at 5% quantile bins of experienced flow, plotted at the median value of bins (in cfs) on the x-axis. Flow experienced per fish is indicated by vertical tick marks along the x-axis.

In order to better understand model fit across the range of potential flow thresholds, for each flow value tested in the threshold models, we estimated the mean BIC of all models that included that flow value as one of its thresholds (Fig. 4). With similar results to the model selection exercise, models with flow thresholds around 4259, 10,712, and 22,872 cfs had strong support (i.e., lower mean BIC). We labeled these minimum (4259 cfs), historic mean (10,712 cfs), and high (22,872 cfs). The historic mean threshold had highest support of the three thresholds

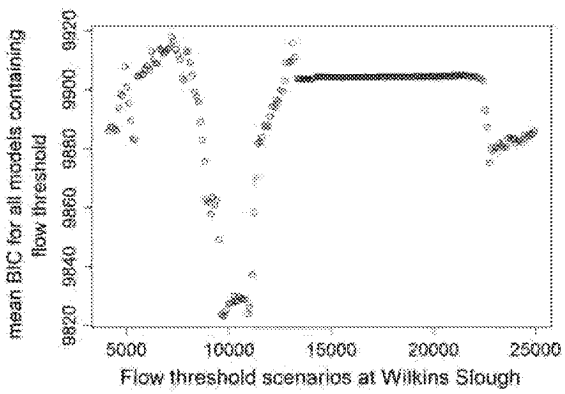

Fig. 4. Mean BIC scores per threshold value as a function of flow. A lower BIC value indicates a stronger supported model.

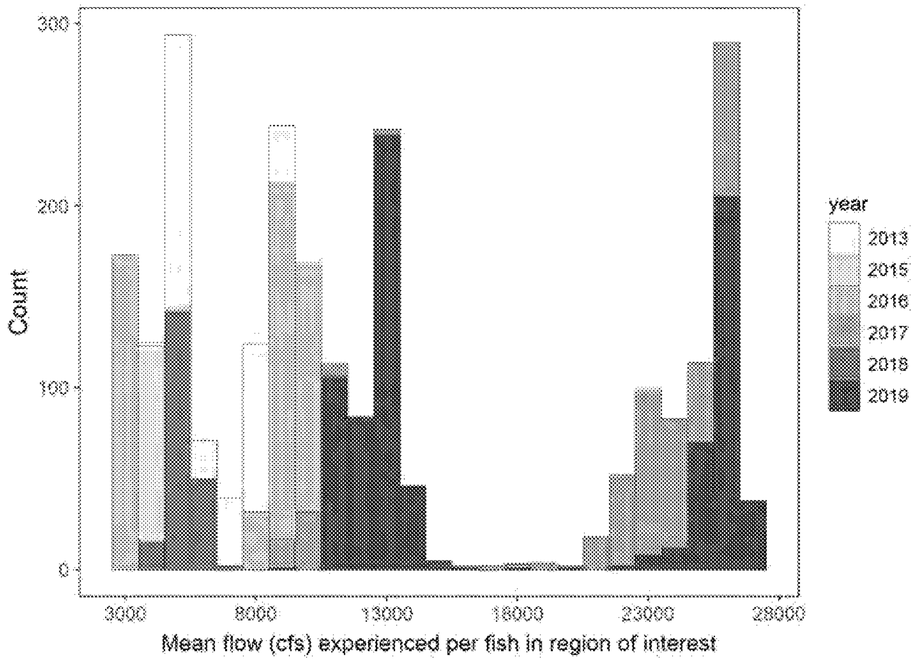

Fig. 5. Frequency of flow values used in analysis by year. Values are mean flow (cfs, as measured at Wilkins Slough gauge), both empirical and imputed, for all fish. Flow bin sizes are 1000 cfs, and bar colors indicate the relative number of fish by year for each flow bin.

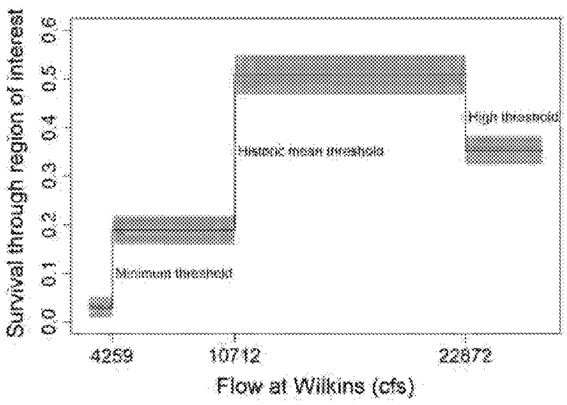

Fig. 6. Thresholds of predicted survival as a function of flow at Wilkins Slough. Predictions are based on the model averaged parameters from the most parsimonious triple threshold models, with mean thresholds at 4259, 10,712, and 22,872 cfs, with 95% confidence intervals (gray fill).

(Fig. 4). Few fish experienced flow values between approximately 14,000 and 21,000 cfs (Fig. 5), and therefore, model fit did not vary significantly with thresholds found in this range.

We used model averaged parameter estimates to predict survival for the range of flow values (Fig. 6). There was a 6.3-fold increase in survival from flows below 4259 cfs (0.03) to flows between 4259 and 10,712 cfs (0.189). There was a 2.7-fold increase in survival from flows between 4259 and 10,712 cfs to flows above 10,712 cfs (0.508). Overall, there was a 16.9-fold increase in survival from flow below 4259 to flows above 10,712 cfs. Finally, survival decreased above the 22,872 cfs threshold to 0.353. Survival was significantly different between groups, with non-overlapping 95% confidence intervals. The 22,872 cfs threshold may be an artifact of lower detection efficiencies associated with fish utilizing additional high flow migration routes with less receiver coverage.

We compared modeled cohort outmigration survival rates among five different water release scenarios for five water years with the modeled survival rates for actual flows (Fig. 7). Water years 2013 (dry), 2014 and 2015 (critical), and 2016 and 2018 (below normal) represent three classes of water supply scarcity in the Sacramento River Basin (http://cdec.water.ca.gov/re

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portapp/javareports?name=WSIHIST). For dry year 2013 and below normal years 2016 and 2018, the three alternative scenarios using the available water budget resulted in survival rate increases ranging from 55% to 98%, while the scenarios with an additional 150 TAF resulted in survival rates increases ranging from 79% to 119%.

For critical years 2014 and 2015, the realized water budgets were not sufficient to allow for the alternative release scenarios, beyond just maintaining flows above the low flow threshold for as long as possible (resulting in survival rate increases of 83% and 132%, respectively). Scenarios using an additional 150 TAF resulted in survival rate increases ranging from 130% to 330%.

Discussion

Streamflow is a master variable in stream ecology, influencing biological and physical habitat characteristics, and if not managed properly, flow alteration can be a serious threat to freshwater ecosystems. Yet, water management decisions continue to be poorly informed by environmental research (Davies et al. 2013, Horne et al. 2016). In the Sacramento River Basin, surface water demands exceed supplies in all but the wettest years (Grantham and Viers 2014), and there is a pressing need to optimally allocate those limited resources to meet management objectives, including ecosystem benefits. We identified threshold responses in salmon outmigration survival across a range of observed instream flow rates. These relationships are valuable tools for updating water management practices aimed at balancing competing demands. Applying our minimum threshold (4259 cfs) as a lower critical flow boundary for spring flows could result in a 6.3-fold increase in outmigration survival. Flows above the historic mean threshold (10,712 cfs) could provide an additional 2.7-fold increase in survival. Flows above this threshold could be enacted when the resources are available, especially if coordinated with hatchery releases or peak wild salmon migration periods. All else being equal, these survival gains could result in concomitant increases in adult escapement. These modeled survival benefits justify the need to identify ways to exceed these flow thresholds more consistently and for longer periods during the spring months.

High flows promote favorable outmigration conditions for Chinook salmon juveniles, resulting in increased survival to the ocean (Connor et al. 2003, Smith et al. 2003). We identified an optimal threshold of 10,712 cfs, which we labeled historic mean, as it is similar to the long-term average of natural spring flow conditions under which Chinook salmon have evolved in this system (Fig. 1). One potential mechanism for this threshold is high flows typically increase water turbidity, which may aid juveniles in evading predators (Gregory and Levings 1998). Alternatively, it is known that outmigrating juveniles move at higher speeds with higher flow (Berggren and Filardo 1993), limiting their exposure time to predators and other hazards. Movement speeds and survival rates of wild Chinook salmon juveniles in this section of the river are strongly correlated (Notch et al. 2020). Therefore, to determine whether movement speeds may be one of the mechanisms driving the 10,712 cfs threshold, we conducted a post hoc analysis of fish travel times through the region of interest as grouped by the flow threshold boundaries. A Kruskal–Wallis test indicated significant differences in travel time distributions between the groups ($P < 0.001$), and a Dunn's multiple comparison test indicated that travel times for fish experiencing flows between 10,712 and 22,872 cfs were significantly shorter than for fish experiencing all other flow levels (Fig. 8).

Flow levels above the historic mean threshold represent normal spring time flows under natural runoff and streamflow conditions up until approximately 15th May (Fig. 1). Yet, from 1993 to 2019 such flows were only achieved in 37% of days during the 15 April–15 May peak outmigration period, and only 10% of days in below average water years (Fig. 9), and were even less likely to occur later in the spring (Fig. 10). In late spring (after approximately 15 April), tributary flows subside and demand for agricultural water deliveries increase dramatically, a combination that creates progressively diminished instream flow in downstream reaches (Fig. 1). Sturrock et al. (2020) found that under current water management regimes, the low flows and high water temperatures that occur in the late spring are selective forces against the later-migrating smolt

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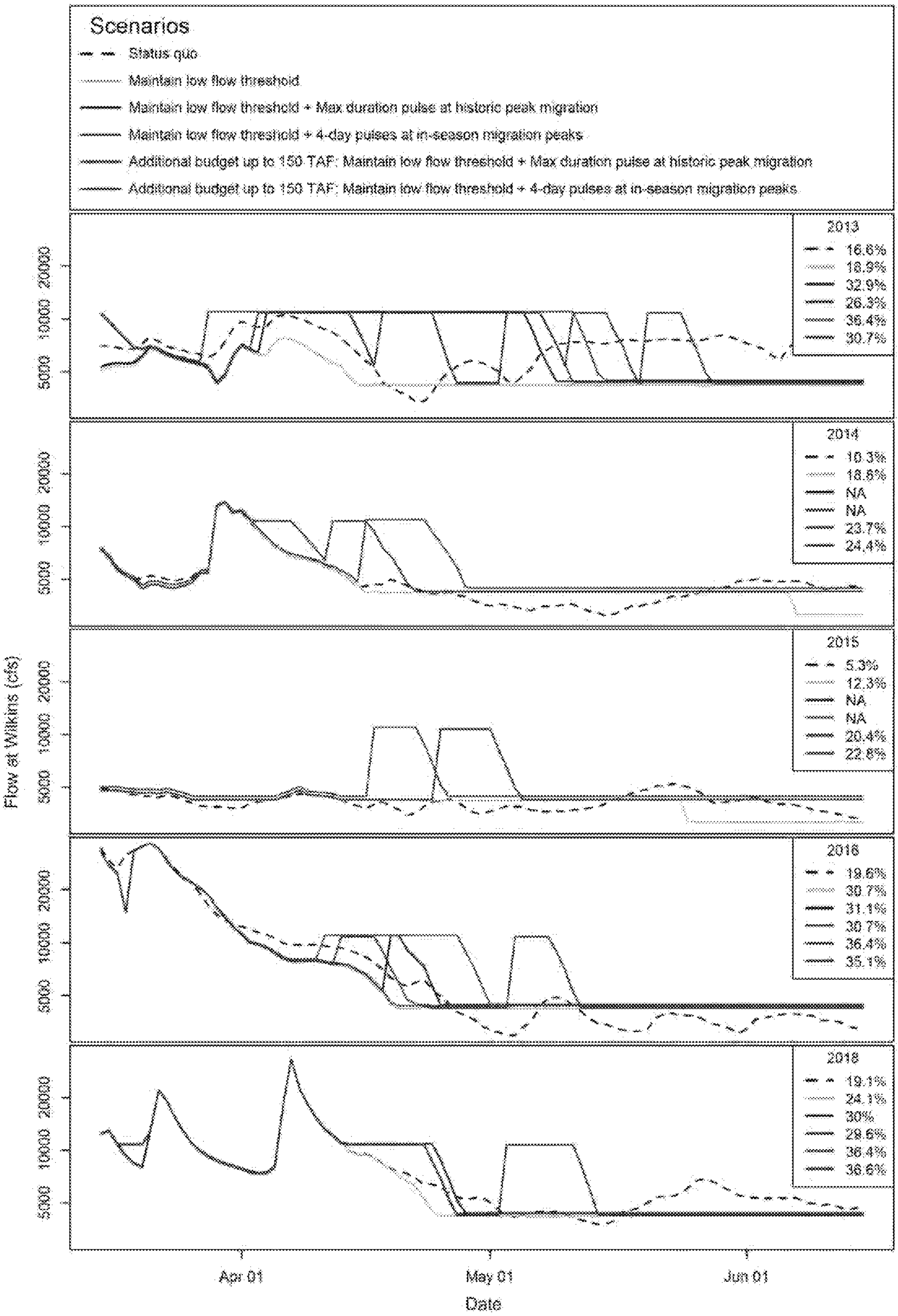

Fig. 7. Alternative flow scenario hydrographs using the flow–survival nonlinearities found in this study. Predicted cohort spring outmigration survival based on flow scenarios and daily fish passage at Red Bluff rotary

Fig. 7. Continued
screw traps are depicted in figure legends. Scenarios for 2017 and 2019 water years are not depicted, as wet conditions in those years precluded the need for pulse flows. In the historic drought years of 2014 and 2015, pulse flows were not possible based on realized water budget (NA for respective survival estimates in legend).

juvenile life-history type (>75 mm fork length [FL]). The implementation of spring pulse flows above the 10,712 cfs threshold could be a powerful tool to restore functional parts of the natural flow regime during critical periods of the salmon life history, and ultimately, the increased heterogeneity of flows may promote increased population diversity.

The mechanism driving the lower flow threshold (4259 cfs) is unclear. Anecdotal observations indicate that under certain low flow conditions, sections of the Sacramento River may have increased habitat heterogeneity, in particular with regard to pools and riffles where predator ambush habitat is likely created (C. J. Michel, *personal observation*). Flow influences other important environmental variables, such as water temperature, that might also have nonlinear

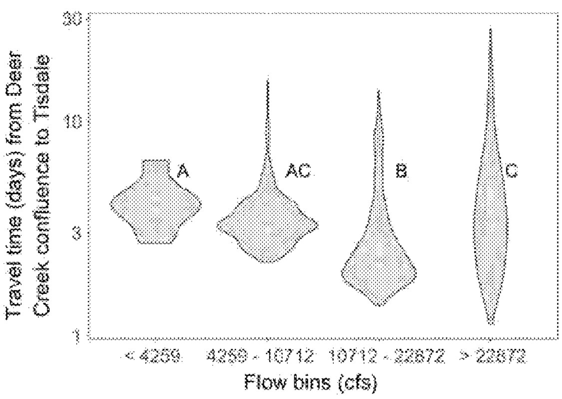

Fig. 8. Distribution of fish travel times (log-scale) through the area of interest as a function of flows experienced with respects to the flow thresholds. Travel time is calculated for fish detected both at Deer Creek confluence and at Tisdale (rkm 269), representing the upper 74% of the region of interest. Travel times to the end of the region of interest (Feather River confluence) were not used as too few fish remained in the <4259 cfs group to accurately represent travel times for that group. Letters within the plot frame indicate significant differences between travel time distributions from a Dunn's multiple comparison test, at the 0.05 level.

relationships with survival. Because temperature and flow are highly correlated (flow and temperature experienced for these fish as measured at Wilkins Slough had a Pearson's correlation coefficient of 0.93) and flow is the most persistent driver of survival in the CCV (Henderson et al. 2019, Notch et al. 2020), we did not include temperature in this analysis. At very low flows during the latter end of the spring period, water temperature in the lower Sacramento River can approach the thermal tolerance of juvenile Chinook salmon. For fish outmigrating during flows lower than the low flow threshold, mean water temperature experienced was 19.9°C (0.5 SD) as measured at the Wilkins Slough gauge. At this temperature, salmon health and vulnerability to predation can be affected and ultimately lead to lowered survival (Marine and Cech 2004, Miller et al. 2014, Lehman et al. 2017, Michel et al. 2020). During most years, spring outmigration flows are above the lower threshold, and these unfavorable conditions are usually only observed during years of drought (e.g., 1994, 2013–2015; Fig. 10). However, in recent years, spring flows below this lower threshold have occurred in years of near average precipitation (i.e., 2016, 2018; Fig. 10), likely resulting from a complex suite of factors, including reservoir management strategies for conserving cold water for endangered winter-run Chinook salmon, and increasing water deliveries for out-of-stream uses during the summer months.

Of the models we tested, the threshold models had strongest support, possibly because they allow for a sharp transition between survival levels as a result of small changes in flow across some ecologically important value. For example, exceeding a given threshold can lead to river bank overflow, which activates seasonal floodplains, providing juvenile salmon an alternative downstream migration route. This is the hypothesized mechanism for the high threshold (22,872 cfs): Tisdale Weir, within the region of interest, overtops at approximately this flow value, allowing fish to enter the Sutter Bypass. Survival decreased at flows above this

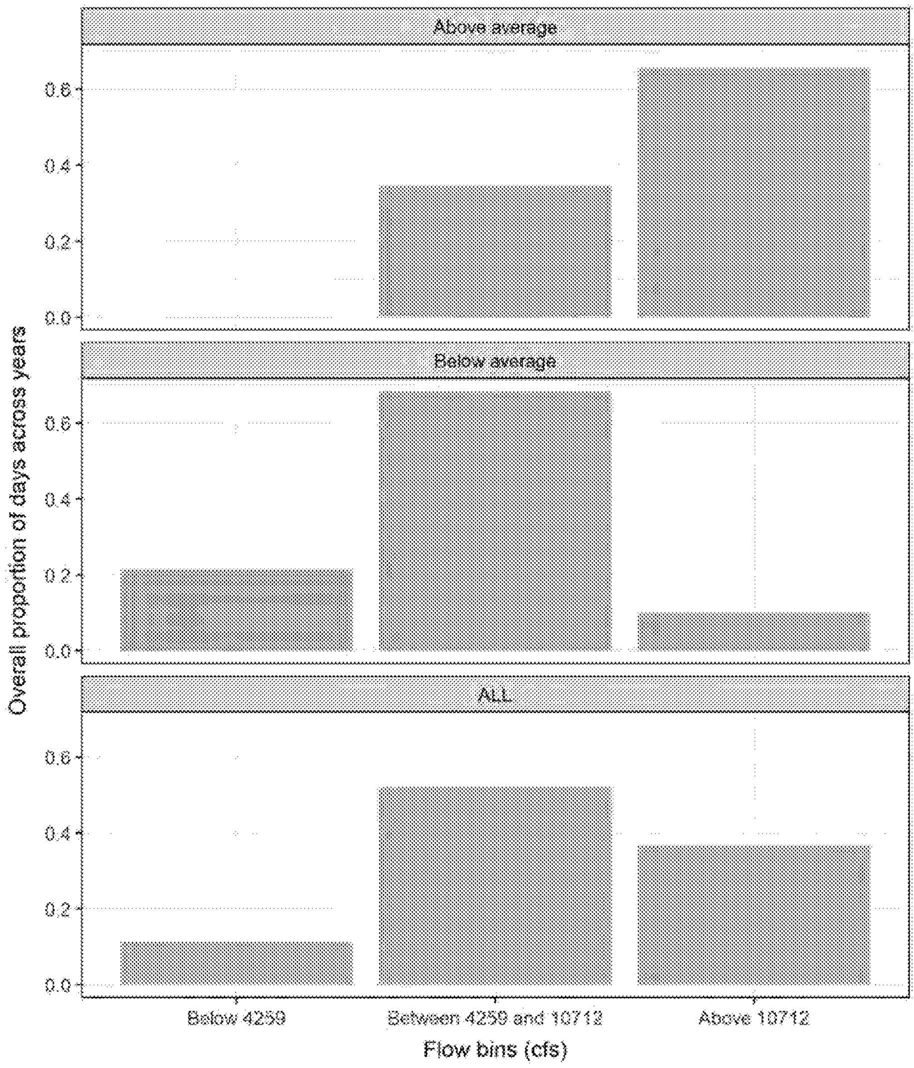

Fig. 9. Proportion of daily flows at Wilkins Slough that fall below, between, or above the two lower flow thresholds from 15th April to 15th May period from 1993 to 2019, split out by above average (i.e., wet and above normal) and below average (i.e., below normal, dry, and critically dry) water years, according to the Water Year Hydrologic Classification Index for the Sacramento Valley (http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST).

threshold, which could be evidence that fish utilizing this alternate route experienced decreased survival compared to fish remaining in the Sacramento River. While flood bypasses are generally considered to be high-quality rearing habitat for juvenile salmon (Sommer et al. 2001), there is little known about the relative survival of fish utilizing these habitats. Travel times for fish above the high threshold were significantly higher and are more widely distributed than for fish just below this threshold (Fig. 8), with fish taking up to 27 d to transit the region of interest. These slower moving fish may have been delayed as a result of spending time on floodplains, and their increased exposure time to potential stressors may explain their decreased survival in comparison to fish just below the high threshold that could not access the floodplains. This is consistent with the results of a similar study

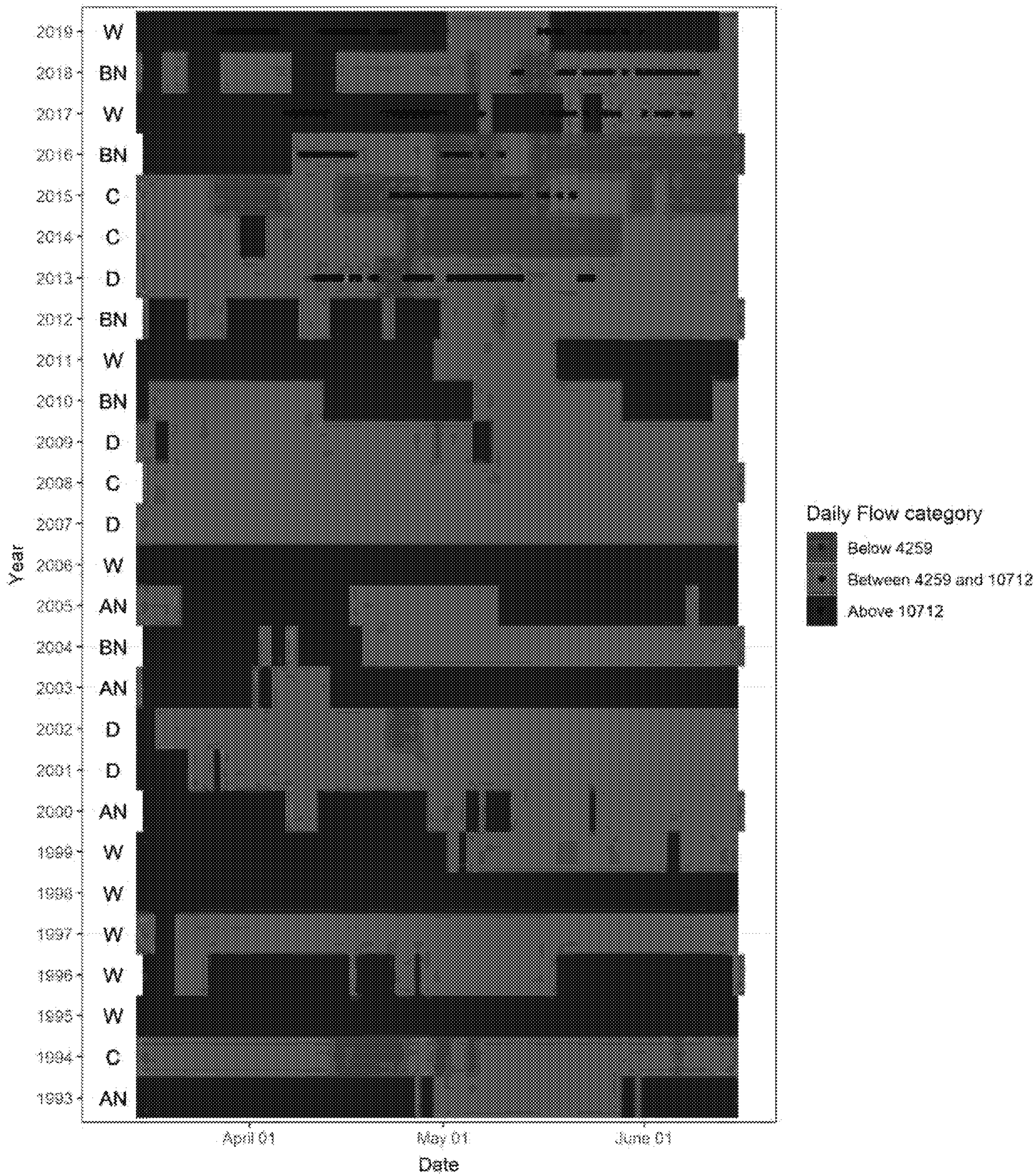

Fig. 10. Classification of flow values into the below 4259 cfs, between 4259 and 10,712 cfs, and above 10,712 cfs categories for each day of the spring outmigration period (15th March–15th June) for the years 1993–2019. Flow values are as measured at USGS Wilkins Slough gauging station on the Sacramento River. Black points represent days when acoustic-tagged fish were entering the region of interest. Text within box indicates the Water Year Hydrologic Classification Index for the Sacramento Valley (http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST); year type codes are W, wet; AN, above normal; BN, below normal; D, dry; and C, critically dry.

where survival per day was similar between release groups that traveled through a floodplain compared to those that traveled through the mainstem river, and yet due to longer travel times through the floodplain, the floodplain groups experienced overall lower survival rates (Pope et al. 2018). It should again be noted that the detection probability of fish utilizing the bypass route is likely lower, which could be a confounding driver of the high threshold.

The alternative flow regimes indicated that substantial survival gains over the status quo were possible by leveraging the thresholds we identified. These flow scenarios lead to increases in annual outmigration survival ranging between 57% and 130% without additions to the water budget and increases ranging from 79% to 330% with a modest 150 TAF addition to the water budget (Fig. 7). There were no clear and consistent differences in survival between the historic peak migration pulse flow scenario and the four-day adaptive pulse flow scenario, whether with the realized water budget or with the additional environmental water budget. We included an additional scenario where flows mimicked the status quo hydrograph, but flows were not allowed to dip below the minimum threshold, which alone led to substantial gains in survival in the Critical Dry water years 2014 and 2015 (Fig. 7). Adaptive pulse flow scenarios may be preferable to a single-pulse, fixed calendar date scenario in ways not measured in this study. For example, the adaptive implementation will be more responsive to hydrologic or biotic nuances of a given year and promote more diversity in outmigration timing.

Our analysis is consistent with many studies concluding that flow is a strong driver for Chinook salmon smolt spring outmigration survival. This period of time coincides with peak hatchery releases and peak natural-origin outmigration of fall-run Chinook salmon, the stock that supports an important commercial and recreational fishery, as well as peak outmigration of ESA threatened wild spring-run Chinook salmon smolts from Sacramento River tributaries. Spring-run Chinook salmon populations historically spawn at high elevations and therefore experience slower growth rates and delayed outmigration timing compared to other Chinook salmon populations (Yoshiyama et al. 1998). This delayed outmigration timing makes them particularly vulnerable to low flows in the late spring. Further, these late outmigrants are subject to asynchronous flow conditions between natal streams (when their initial downstream migration is triggered by snow melt or spring freshets in the tributary) and the mainstem Sacramento River, where they experience periods of low managed flows. Restoring the functionality of the spring flow regime during wild smolt outmigration is a critical step toward promoting sustainable fisheries (Jager and Rose 2003), as well as restoring a threatened population of salmon.

Other CCV native fish species may require different flow conditions during the spring, potentially creating water management conflicts. For example, high flows and cold water from dam releases may have detrimental impacts on threatened green sturgeon (*Acipenser medirostris*) in the Sacramento River (Zarri et al. 2019). Similarly, endangered winter-run Chinook salmon rely on cold water released from Shasta Reservoir during egg development in the summer, which is contingent on water operations that allow sufficient cold water availability in Shasta Reservoir for the summer months (Martin et al. 2017). Increasing spring flows for the benefit of fall-run and threatened spring-run Chinook salmon requires carefully balancing the needs of other protected species in the Sacramento River.

Our study focused on the flow–survival relationship for the smolt outmigration life history, as it was based on acoustically tagged fish, and tag size constraints precluding the tagging of smaller juveniles. However, other juvenile life-history types, namely fry and parr (approximately <55 mm and 55–75 mm FL, respectively), are important contributors to CCV Chinook salmon populations (Sturrock et al. 2020). While higher winter and spring flows also benefit fry and parr life histories (Sturrock et al. 2015, 2020), the flow thresholds defined in this study are for smolt outmigration and are likely not directly compatible with fry and parr life histories, which need flows appropriate for rearing. In addition, wild smolts were underrepresented in this analysis due to the difficultly in capturing adequately sized individuals for tagging, and the results we present are likely driven largely by survival dynamics of hatchery fish. Nonetheless, targeting ecologically functional flows that mimic the shape of the historic flow regime under which these fish evolved should also benefit these other populations and promote life-history diversity.

Our study identifies key thresholds in the flow–survival relationships that can help water and fisheries managers evaluate trade-offs associated with different water management options that are, by law, supposed to balance instream and out-of-stream management objectives. We recommend that future studies attempt flow experiments to verify that migrating salmon would benefit as predicted from managed flow augmentation (such as pulse flows). It is likely that such pulse flows will engendered larger cohort-wide survival gains than predicted here: Flow pulses are known to promote juvenile Chinook salmon to initiate their downstream migration (Sykes et al. 2009), allowing a larger portion of the population to take advantage of the associated improvements in survival. Courter et al. (2016) used managed flow releases in the Yakima River, Washington, to show the positive impact of increased flow on Chinook salmon smolt survival, which was then used to implement a minimum flow target. Experimental pulse flows may also help decouple the mechanisms driving increased survival, because increased flows through reservoir releases may not affect temperature and turbidity the same as storm-related flow increases. Ultimately, functional flows in CCV should include a spring pulse flow component that mimics the characteristics of spring freshets and snowmelt events of a natural flow regime. These will benefit outmigrating smolts and also engender many other benefits to the ecosystem (Poff et al. 1997, Kiernan et al. 2012).

This is timely research as the frequency of drought events is predicted to increase in the CCV, creating additional stress to already vulnerable salmon populations (Yates et al. 2008). Munsch et al. (2019) showed a truncation of fish size and outmigration timing of juvenile Chinook salmon from the Sacramento River during warmer springs, which could lead to lower ocean survival. This highlights the influence of climate change on salmon species phenology and dynamics and the need for new flow management policies that include the potential impacts of future climate warming. In the Sacramento River, finding functional flows that could simulate ecologically critical aspects of the natural spring flow regime, especially in increasingly common dry water years, is a critical step in ensuring the resiliency of juvenile Chinook salmon and other native fish species into the 21st century.

Acknowledgments

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Data Availability

The data that support the findings of this study are openly available from the National Oceanic and Atmospheric Administration's ERDDAP data server at: https://oceanview.pfeg.noaa.gov/erddap/tabledap/FED_JSATS_detects.html. The authors report no conflict of interest.

Supporting Information

Additional Supporting Information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/ecs2.3498/full

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 9/22/2021 10:30:57 AM
To: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Jerry Brown [jbrown@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Modeling Schedule for Discussion w Reclamation

From the permitting side of the equation we have the following items to consider:

1) Reclamation would likely stop the BA until we have the modeling results and can start re-analyzing the effects.
2) The Section 106 would also likely stop until we get a revised and Reclamation approved project description
3) The water availability analysis for the water right uses the CalSim outputs and would be delayed until we get that
4) The ITP would likely be delayed as will given the current approach of using the same modeling analysis in both the BA and ITP

John Spranza

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From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Tuesday, September 21, 2021 5:13 PM
To: Jerry Brown <jbrown@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

Yes, and they should know that – they were provided the admin draft Chapter 11 and all appendices on June 1st and we are still trying to resolve their comments/concerns.

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, September 21, 2021 5:10 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

Yikes, that's way too much to do in 3 weeks

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Date: Tuesday, September 21, 2021 at 5:05 PM
To: "Heydinger, Erin" <erin.heydinger@hdrinc.com>, Jerry Brown <jbrown@sitesproject.org>, Alicia Forsythe <aforsythe@sitesproject.org>, "Spranza, John" <john.spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

Using the current scope of work for Amendment 3 and factoring in the prior experience of getting the draft ready for publication, the attached provides the list of chapters/appendices that would need to be updated based on revised modeling results and the time it will take to get the work done.

Laurie

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Tuesday, September 21, 2021 5:01 PM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <John.Spranza@hdrinc.com>
Subject: RE: Modeling Schedule for Discussion w Reclamation

This is also just to point out that it's not just "3 weeks of work" as Vince said – it's an extensive effort to re-model the project. Vince has suggested a couple of times that if we can shift the schedule slightly we can accommodate this change. That is not the case.

Erin

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From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, September 21, 2021 4:59 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: Re: Modeling Schedule for Discussion w Reclamation

So our point is that we're already pushing the schedule very hard to meet the plan for getting the BA in by Feb '22. I don't really think we'll need this but its good to have in the hip pocket just in case.

From: "Heydinger, Erin" <Erin.Heydinger@hdrinc.com>
Date: Tuesday, September 21, 2021 at 4:53 PM
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Subject: Modeling Schedule for Discussion w Reclamation

Hi all,

Attached is an example best-case schedule that we can share with Reclamation. I think 6 weeks for modeling is extremely aggressive, but it's what we're showing in our BA schedule. I also included actual dates from this spring to give a context. The second page includes a graphic on how some of the models interact, which might be helpful for non-modelers to see that we can't run all of these in parallel – they rely on output from each other.

Erin

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Sent: 9/22/2021 1:32:50 PM
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CC: Alicia Forsythe [aforsythe@sitesproject.org]; Linda Fisher (linda.fisher@hdrinc.com) [linda.fisher@hdrinc.com]; Briard, Monique [Monique.Briard@icf.com]
Subject: RDEIR/SDEIS

Hi Nicole,

We had a meeting with Reclamation this morning and they agreed that we need to be pencils down by next Friday (i.e., document in Richard's hands). That would assume a federal register date of 11/12 and a CEQA release of 11/5. Meanwhile, we need to get final edits to the project description confirmed with Reclamation and approved by Ali. We also need to add some qualitative language to Chapter 11 about anadromous fish benefits – my assumption is that this will be coordinated with the aquatics team. Finally, Reclamation would like to see if there is a way to add quantitative info by next week – apparently Jacobs is doing some modeling under Reclamation's direction. We are not sure this can be added but Ali/Erin will coordinate with Jacobs. If included, it may be in the form of an appendix.

I think any new text will be limited to the edits to Ch 2, Ch 11 and the executive summary. I confirmed with Vanessa that the revised purpose she sent last week is still appropriate so I think that is the only update to Ch 1 and should be done.

I would like you to think about logistics. We will not be concerned about formatting and hope to have revised language agreed upon before dropping it into the document. I think we should discuss this soon so we can let the rest of the team know if there are other constraints/issues so we can be ready to get this out.

Thank you,

Laurie

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CC: Briard, Monique [monique.briard@icf.com]; Leaf, Rob/SAC (Rob.Leaf@jacobs.com) [Rob.Leaf@jacobs.com]; Jerry Brown [jbrown@sitesproject.org]
Subject: Sites Project Fishery Resources Discussion Group

Greetings,

The Sites project has continued to refine its diversion criteria and aquatic's mitigation and the Authority would like to schedule a meeting to discuss these changes with this group. If you would like to attend please take a moment to provide your availability using the Doodle poll link below by COB Monday September.

https://doodle.com/poll/gikmydyhitsabc7z?utm_source=poll&utm_medium=link

Thank you.

John

John Spranza, MS, CCN
Senior Ecologist / Regulatory Specialist

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CC: Carlson, Nik [nik.carlson@aecom.com]; Luu, Henry [Henry.Luu@hdrinc.com]; Joe Trapasso [jtrapasso@sitesproject.org]; steve.micko@jacobs.com
Subject: Model Uncertainty Follow Up

Hi Jeff,

Reed is looking is looking at CalSim uncertainty – sounds like there was something drafted already that they can send over shortly (today or tomorrow).

For climate change uncertainty, the Jacobs team could write a couple of paragraphs discussion uncertainty with the climate change hydrology and generally describe why the Sites project benefits can likely still be met even if the projected hydrology isn't quite accurate. Please let us know if you think that will help address the comment or if it's not needed.

Thanks!
Erin

Erin Heydinger, PE, PMP
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Subject: RE: RDEIR/SDEIS

Hi Laurie,

Can we get final edits to the project description and Chapter 11 qualitative language about anadromous fish benefits this Friday?

If so, then it seems like the form of the quantitative info and when we would get it next week becomes the critical path. I'd need to better understand the details to know if we can meet 10/1.

- For example, if there are pages of text or new sections in chapters and we get it next Thursday, I'm not sure how realistic it is to provide a full document by 10/1.
- But, if it's a new appendix in numerical order with the other appendices and has a single mention in a chapter, and we get it next Monday, then we could probably make 10/1.

Can you help me understand why the CEQA release and a federal register date remain different?

Cheers, Nicole

NICOLE L. WILLIAMS
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From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Wednesday, September 22, 2021 1:33 PM
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Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Linda Fisher (linda.fisher@hdrinc.com) <linda.fisher@hdrinc.com>; Briard, Monique <Monique.Briard@icf.com>
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Thank you,

Laurie

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Sent: 9/22/2021 2:40:01 PM
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Subject: RE: RDEIR/SDEIS

Hi Nicole – Let's talk tomorrow. Ali has a meeting scheduled tomorrow morning and I will have more information at that time. However, the October 1 date is firm.

From: Williams, Nicole <Nicole.Williams@icf.com>
Sent: Wednesday, September 22, 2021 2:30 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Linda Fisher (linda.fisher@hdrinc.com) <linda.fisher@hdrinc.com>; Briard, Monique <Monique.Briard@icf.com>
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Cheers, Nicole

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From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Wednesday, September 22, 2021 1:33 PM
To: Williams, Nicole <Nicole.Williams@icf.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Linda Fisher (linda.fisher@hdrinc.com) <linda.fisher@hdrinc.com>; Briard, Monique <Monique.Briard@icf.com>
Subject: RDEIR/SDEIS

Hi Nicole,

We had a meeting with Reclamation this morning and they agreed that we need to be pencils down by next Friday (i.e., document in Richard's hands). That would assume a federal register date of 11/12 and a CEQA release of 11/5. Meanwhile, we need to get final edits to the project description confirmed with Reclamation and approved by Ali. We also need to add some qualitative language to Chapter 11 about anadromous fish benefits – my assumption is that this will be coordinated with the aquatics team. Finally, Reclamation would like to see if there is a way to add quantitative info by next week – apparently Jacobs is doing some modeling under Reclamation's direction. We are not sure this can be added but Ali/Erin will coordinate with Jacobs. If included, it may be in the form of an appendix.

I think any new text will be limited to the edits to Ch 2, Ch 11 and the executive summary. I confirmed with Vanessa that the revised purpose she sent last week is still appropriate so I think that is the only update to Ch 1 and should be done.

I would like you to think about logistics. We will not be concerned about formatting and hope to have revised language agreed upon before dropping it into the document. I think we should discuss this soon so we can let the rest of the team know if there are other constraints/issues so we can be ready to get this out.

Thank you,

Laurie

Laurie Warner Herson
Principal/Owner
Phenix
Environmental Planning

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From: Kevin Spesert [kspesert@sitesproject.org]
Sent: 9/22/2021 4:22:44 PM
To: Jeff Sutton (jsutton@tccanal.com) [jsutton@tccanal.com]
Subject: Fwd: Sen Dodd Town Hall

FYI

From: Kevin Spesert <kspesert@sitesproject.org>
Sent: Wednesday, September 22, 2021 4:11 PM
To: Jerry Brown; Keith Dunn (keithdunn@me.com); 'Sara Katz'
Subject: Sen Dodd Town Hall

Interesting Town Hall sponsored by Sen Dodd regarding climate change and drought…It includes Wade Crowfoot, Jay Ziegler, and Joaquin Esquivel.

They talk take about water storage starting at about 38:00 thru about 48:00…

The basic discussion was that new water storage we not help outside of "targeted surface storage….right kind of storage". They all doubled down on groundwater recharge is where we should be focusing our efforts. Jay Ziegler was the only person to mention Sites and his comments on Sites was pretty bland.

It is interesting in listing to their discussion in that they are using a lot of narrative that we have been using for Sites. "21st Century water management problems with 20th Century infrastructure…water from atmospheric rivers as a savings account…etc" but in the context of groundwater recharge and not projects Sites.

It is unfortunate that Sec Crowfoot did you say anything about Sites

https://youtube.com/watch?v=mbIkXqWCeYA&feature=share

Kevin Spesert
External Affairs Manager
Sites Project Authority
Phone (530) 632-4071

From: Jerry Brown [jbrown@sitesproject.org]
Sent: 9/22/2021 5:26:40 PM
To: Kevin Spesert [kspesert@sitesproject.org]
CC: Keith Dunn (keithdunn@me.com) [keithdunn@me.com]; Sara Katz [skatz@katzandassociates.com]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Sen Dodd Town Hall

I think Jay's comments were fair. We need to produce our environmental document (now scheduled for November 14, 2021) so that folks like JAy EDF and others can make their assessment and take a position. With the work we've done with CDFW it will be hard to argue strongly that we're not being protective of the environment.

I think sites would be in the category that Wade was referencing "the right storage"

I am most concerned with Joaquin's comments and the fact that he has not accepted our offering to brief him on the sites project as we have done with all of the other state water board members.

Sent from my iPhone

On Sep 22, 2021, at 4:11 PM, Kevin Spesert <kspesert@sitesproject.org> wrote:

Interesting Town Hall sponsored by Sen Dodd regarding climate change and drought…It includes Wade Crowfoot, Jay Ziegler, and Joaquin Esquivel.

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It is interesting in listing to their discussion in that they are using a lot of narrative that we have been using for Sites. "21st Century water management problems with 20th Century infrastructure…water from atmospheric rivers as a savings account…etc" but in the context of groundwater recharge and not projects Sites.

It is unfortunate that Sec Crowfoot did you say anything about Sites

https://youtube.com/watch?v=mbIkXqWCeYA&feature=share

Kevin Spesert
External Affairs Manager
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From: Herrin, Jeff [jeff.herrin@aecom.com]
Sent: 9/23/2021 4:47:22 AM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]
CC: Carlson, Nik [nik.carlson@aecom.com]; Luu, Henry [Henry.Luu@hdrinc.com]; Joe Trapasso [jtrapasso@sitesproject.org]; steve.micko@jacobs.com
Subject: RE: Model Uncertainty Follow Up

That should address the comment.

Thank you Erin.

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Wednesday, September 22, 2021 5:24 PM
To: Herrin, Jeff <jeff.herrin@aecom.com>
Cc: Carlson, Nik <nik.carlson@aecom.com>; Luu, Henry <Henry.Luu@hdrinc.com>; Joe Trapasso <jtrapasso@sitesproject.org>; steve.micko@jacobs.com
Subject: [EXTERNAL] Model Uncertainty Follow Up

Hi Jeff,

Reed is looking is looking at CalSim uncertainty – sounds like there was something drafted already that they can send over shortly (today or tomorrow).

For climate change uncertainty, the Jacobs team could write a couple of paragraphs discussion uncertainty with the climate change hydrology and generally describe why the Sites project benefits can likely still be met even if the projected hydrology isn't quite accurate. Please let us know if you think that will help address the comment or if it's not needed.

Thanks!
Erin

Erin Heydinger, PE, PMP
Project Manager
Water/Wastewater

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From: Luu, Henry [Henry.Luu@hdrinc.com]
Sent: 9/23/2021 3:08:10 PM
To: jeff.herrin@aecom.com; Carlson, Nik [nik.carlson@aecom.com]
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis
Attachments: SitesCWCquestions-CVWD.docx

Jeff and Nik, see attached responses from CVWD.

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Robert Cheng <RCheng@cvwd.org>
Sent: Thursday, September 23, 2021 2:45 PM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Zoe Rodriguez del Rey <ZRodriguezdelRey@cvwd.org>; Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Henry,

I am attaching CVWD's responses to the survey questions. These answers were addressed largely by Zoe, and I addressed question 1.

Let me know if you have any questions,
Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Sunday, September 19, 2021 4:54 PM
To: Randall Neudeck <rneudeck@mwdh2o.com>; Bob Tincher <bobt@sbvmwd.com>; jdavis@sgpwa.com; Robert Cheng <RCheng@cvwd.org>; AFlores (AFlores@zone7water.com) <AFlores@zone7water.com>
Cc: Jerry Brown <jbrown@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Jeff Herrin <Jeff.Herrin@aecom.com>; Carlson, Nik <nik.carlson@aecom.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

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Hello Sites Project members,

The project team has been hard at work coordinating with CWC staff/reviewers to ensure we are preparing a document that is compliant and meets the needs for the Commission's feasibility determination. We are at a point where your input is needed – the team is requesting participant-specific information demonstrating the expected use and economic benefit of the project's future water supply increases. This information is needed to show the project's economic feasibility for securing WSIP funding. Any information regarding your agency's valuation of Sites water supplies and related water quality benefits is greatly appreciated. This solicitation is targeted towards the top five SOD members with the largest water demand from the Project because we believe your input will have a greater influence on the economic analysis. Solicitated member Agency/District and a couple of potential contacts that may be able to assist are:

1. Metropolitan Water District (43 TAF) – Brandon Goshi
2. San Bernardino Valley Municipal Water District (18.4 TAF)
3. San Gorgonio Pass Water Agency (12.0 TAF)
4. Coachella Valley Water District (8.6 TAF) – Zoe Rodriguez Del Rey
5. Zone 7 Water Agency (8.6 TAF)

Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)						
	South of Delta Deliveries ($/AF)					
	Wet	AB	BN	Dry	Critical	**LT Avg.**
2030	$225	$282	$295	$314	$397	$300
Conveyance	$148	$148	$148	$148	$148	$148
Total (2030)	**$373**	**$430**	**$443**	**$462**	**$544**	**$448**
2045	$456	$573	$698	$743	$1,165	$750
Conveyance	$148	$148	$148	$148	$148	$148
Total (2045)	**$604**	**$720**	**$846**	**$891**	**$1,313**	**$898**

conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

Information Request: Please review the above Table 1 default unit water benefit values and answer the questions below. Our technical staff are available to discuss the questions in further detail if necessary. Any supporting documentation for the responses (e.g. references to IWMP) and even approximate answers will be helpful. This is a time-sensitive request and we would appreciate an expedited response. <u>Please note that the benefit value (supply cost) is for end-use location deliveries and not the cost from its origin</u>.

Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:
 a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?
 b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

6. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?
 a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

Please let us know your availabilities if a meeting is desired.
Thank you for your support,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

   Although CVWD has not performed a detailed analysis of the cost for replacement supplies to augment the loss in SWP Table A reliability (due to the Endangered Species Act and other regulatory constraints), we benchmark our replacement supply unit costs against the figures provided for California WaterFix, which was $1,040 - $1,290 (delivered, 2018 $). I'm not sure exactly how the costs for the Sites water were derived as I was told they were calculated using the CWC methodology, but seem to be a bit low as compared to the CWF costs. Other available alternative water sources (recycling and desalination of agricultural drain water, assuming if they may be technically feasible, would most likely be to cost more than the value of CWF supply).

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

   CVWD plans to use Sites Reservoir supplies to meet increasing water demands from projected population, housing, and associated commercial growth in the Coachella Valley. Through an agreement with the Metropolitan Water District of Southern California (MWD), CVWD's Sites water will be exchanged for MWD's Colorado River water to be delivered and recharged at two groundwater replenishment facilities located within the two main groundwater production subbasins of the Coachella Valley. These have been designated as medium-priority basins that must be sustainably managed under the Sustainable Groundwater Management Act (SGMA). Sites water will be a key supply during drought periods, when allocations of other imported supplies may be low, to prevent unreasonable overdraft and ensure that the subbasins are sustainably managed.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:

   CVWD and partner Agencies, including SOD participant Desert Water Agency, are in the process of finalizing the Water Management Plans for the two main groundwater productions subbasins (Indio and Mission Creek Subbasins). The Department of Water Resources (DWR) has approved these Water Management Plans as Alternative Plans under SGMA. The updates to the plans, which will be finalized and submitted to DWR by January 1, 2022, include both groundwater balances and future water demand and supply projections for the subbasins.

   a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?

      The Water Management Plans (SGMA Alternative Plans) consider the Agencies' current and projected future water supplies to evaluate the ability to meet projected future water demands while sustainably managing the groundwater subbasins under changing climate conditions. Sites Reservoir Project deliveries, including CVWD's and DWA's participation *levels, are included in the portfolio of future water supplies needed to meet those projected future demands and avoid long-term overdraft of the subbasins.*

b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

Potential alternate projects/sources include developing additional recycled water, which will require identifying additional users and pursuing successful change petitions for discharge points. A change petition filed for CVWD's Water Reclamation Plant 4 received substantial opposition from environmental NGOs, since it will reduce flows to the Salton Sea, and has not yet been resolved. The Agencies could also pursue additional conservation but since these are voluntary programs, the amount of water conservation that can be successfully achieved to meet any supply gap is highly uncertain.

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

   No

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

   No WQ benefits expected based on agreements with MWD that deliver Colorado River water for Sites water.

6. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

   Unknown, has not been analyzed.

7. During the past eight-year period (2013 to 2021) what water shortages has your agency the experienced? How did your agency meet its water supply needs?

   None. Conjunctive use of imported surface water supplies and groundwater has allowed CVWD to increase storage in wet years and utilize groundwater in storage during dry years while avoiding shortages or long-term overdraft.

   a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

      None available

From drought to deluge: spatiotemporal variation in migration routing, survival, travel time and floodplain use of an endangered migratory fish

Dalton J. Hance*[1], Russell W. Perry[1], Adam C. Pope[1], Arnold J. Ammann [2], Jason L. Hassrick [3], Gabriel Hansen[1]

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Abstract

We developed a novel statistical model to relate the daily survival and migration dynamics of an endangered anadromous fish to river flow and water temperature during both extreme drought and severe flooding in an intensively managed river system. Our Bayesian temporally-stratified multistate mark-recapture model integrates over unobserved travel times and route transitions to efficiently estimate covariate relationships and includes an adjustment for telemetry tag battery failure. We applied the model to acoustic-tagged juvenile Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) and found that survival decreased with decreasing river flows and increased water temperatures. We found that fish were likely to enter a large floodplain during flood conditions and that survival in the floodplain was comparable to the mainstem Sacramento River. Our study demonstrates the response of an endangered anadromous fish population to extreme spatial and temporal variability in habitat accessibility and quality. The general model framework we introduce here can be applied to telemetry of migratory fish through systems with multiple routes to efficiently estimate spatiotemporal variation in survival, travel time, and routing.

Keywords: BAYESIAN STATISTICS, RIVERS, ANADROMOUS SPECIES, TELEMETRY, STATISTICAL ANALYSIS

Introduction

Populations of anadromous salmonids evolved in the context of significant spatial and temporal variation in riverine habitat. This variability includes daily, seasonal, and interannual fluctuations in discharge, temperature, and habitat accessibility; each of which may have different impacts on fish survival and behavior across the riverscape. Understanding how critical life stages of anadromous fish respond to riverine environmental conditions over a broad range of spatial and temporal variability is necessary to identify limiting factors to the persistence or recovery of populations as historically extreme hydrologic conditions become more common. Here we use a novel statistical model to track the daily survival and migration dynamics of an endangered anadromous fish in an intensively managed river system in the context of both extreme drought and flooding.

California, USA, is host to distinct climatic conditions as well as a unique population of Chinook Salmon (*Oncorhynchus tshawytscha*): the Sacramento River winter-run. Prior to the mid-20th century, winter-run Chinook Salmon spawned in the cold spring-fed headwaters of the Sacramento River and emigrated through the Sacramento River and California Delta (the Delta) – a low gradient area of extensive freshwater floodplain and marsh. This fish evolved in the Mediterranean climate of the Sacramento River basin that features a regular pattern of dry summers and wet winters. California's climate has one of the largest interannual variances in precipitation in North America (Dettinger, 2016) leading to commensurate interannual variability in migratory and rearing habitat. Winter-run Chinook Salmon have persisted through the Sacramento basin's history of both regular droughts and large floods (Earle, 1993) and both extremes are expected to become more common in future years (Swain et al., 2018). Overlain on this geographical and climatic template of variability is the history of human development of

California's land and water. The construction of Shasta and Keswick dams in the 1940s limited spawning habitat for winter-run Chinook Salmon to a small cold-water reach downstream of Keswick Dam. These dams are one part of an extensive water storage and delivery system that includes the modified Delta through which juvenile winter-run Chinook Salmon must migrate. The Delta consists of a complex network of natural and man-made channels largely disconnected from the historical floodplain and includes channels that are designed, in part, to move water from the Sacramento River to large federal and state pumping stations in the interior Delta (south of the mainstem Sacramento River) that redirect freshwater for agricultural and municipal use. Migrating juvenile salmon may take one of several routes through the Delta and survival and travel times for other runs of Chinook Salmon are known to vary among various Delta migration routes and with changing discharge (Perry et al., 2018). One major exception to the history of floodplain disconnection is the Yolo Bypass, a 24 000 ha leveed floodplain located to the west of the city of Sacramento that is designed to divert floodwaters away from urban areas, but which is only flooded in 60% of years (Suddeth Grimm and Lund, 2016). Juvenile Chinook Salmon rearing in Yolo Bypass have shown enhanced growth and survival (Katz et al., 2017; Sommer et al., 2001; Takata et al., 2017) and actively migrating smolts released directly into Yolo Bypass had survival comparable to fish released into the mainstem Sacramento River (Johnston et al., 2018; Pope et al., 2021). However, the probability that run-of-river Chinook Salmon will enter the Yolo Bypass when it is flooding and survival of fish that volitionally enter the Yolo Bypass over a range of flow conditions have not been established.

In this paper, we analyze multiple years of telemetry data on juvenile winter-run Chinook Salmon to generate reach-specific estimates of survival, travel time and routing probabilities in relation to daily flows and temperatures in the Delta. Our study evaluates winter-run Chinook

Salmon survival in the Delta and – when accessible – the Yolo Bypass over a broad range of conditions as it spans a period including both intense drought and extreme flooding. As with similar studies, individual tagged fish were detected imperfectly at telemetry stations spread throughout the study area. To estimate the effect of temporally stratified covariates on survival, individually varying travel times, and imperfect detection, we expanded the temporally stratified Cormack-Jolly-Seber (TSCJS) migration model of Hance et al. (2019) to a multistate context where alternative migration routes represent different "states". This temporally stratified multistate mark-recapture model (TSMS) allowed us to efficiently estimate daily reach-specific travel times, survival, and routing probabilities by integrating over all possible reach-entry times for undetected fish. Our model also incorporated data on tag battery failures to account for the influence of premature tag failure on survival estimates.

Materials and Methods

While our TSMS model can be generally applied to any system where individually-marked migratory fish can distribute among multiple routes and with varying travel times, in the following sections we describe this model in terms of the specifics of the Sacramento river system. In the first two subsections, we describe the study area and telemetry data collection. In the next two subsections, we detail how telemetry data were condensed into summary statistics and formally define the general TSMS probability model. In the final two subsections, we describe how we parameterized and implemented the model to answer questions about juvenile winter-run Chinook Salmon survival and routing in the Delta.

Study Area

Although tagged fish were monitored between the upper Sacramento River (river kilometer (rkm) 551) to Golden Gate Bridge (rkm 0), we focused on modelling survival through the Delta, defined here as Yolo Bypass and the channels of the Sacramento River below the city of Knights Landing (rkm 222) downstream as far as Chipps Island (rkm 71) (Figure 1). We conducted our study in the late winter and early spring of 2014 through 2018, a period encompassing one of the most intense drought water years (2014) in the last 1 200 years (Griffin and Anchukaitis, 2014) and the record wettest water year (2017) for the northern Sacramento River which saw extensive flooding including the dramatic partial failure of the Oroville Dam (White et al., 2019). Our model was constructed to estimate reach- and route-specific survival and travel times among five main migration routes: the mainstem Sacramento River (route A), Yolo Bypass (route B), Sutter Slough (route C), Steamboat Slough (route D), and Georgiana Slough (route E) (Figure 1). We divided the Delta into these distinct routes because these routes have been previously investigated for other runs of Sacramento-origin Chinook Salmon and because fish routing and survival through these routes can be affected by resource management actions (Perry et al. 2018). Fish that enter Georgiana Slough have lower survival and greater migration duration than those remaining in the mainstem Sacramento and higher risk of entrainment in state (the State Water Project, SWP) and federal (the Central Valley Project, CVP) water export facilities (Newman and Brandes, 2010; Perry et al., 2010). Fish that enter Sutter and Steamboat Sloughs avoid the entrance to Georgiana Slough and the predation and entrainment risks of the interior Delta and survive at similar rates to fish that remain in the mainstem Sacramento River (Perry et al. 2018). However, there may be differences between these two routes because of additional channel junctions and potentially more tortuous migrations for fish that enter Sutter Slough as opposed to Steamboat Slough.

Our study also investigates use of the Yolo Bypass by actively migrating Chinook Salmon smolts. The Yolo Bypass is an engineered floodplain that is only accessible to downstream migrating fish when the Sacramento River stage exceeds the 10.2 m height of the 2.9 km long Fremont Weir. The Yolo Bypass floodplain contains valuable habitat for rearing (Katz et al. 2017, Takata et al. 2017) and actively migrating juvenile Chinook Salmon (Johnston et al. 2018, Pope et al. 2021). Migrating fish that enter the Yolo Bypass avoid entrainment in the interior Delta and telemetered fish released directly into the Yolo Bypass have been demonstrated to have survival similar to those released directly into the Sacramento River (Johnston et al. 2018, Pope et al. 2021). During large flood events, the Yolo Bypass can carry up to four times more water than the mainstem Sacramento River (Suddeth Grimm and Lund, 2016). During our study, the Fremont Weir overtopped for 15, 75, and 2 days during the years 2016, 2017, and 2018 respectively and the discharge of Yolo Bypass during overtopping events ranged from 4% to 280% of the discharge of the mainstem Sacramento River.

Our telemetry network monitored fish at discrete locations throughout the Sacramento River and Delta. Each monitoring station consisted of either two or more acoustic receivers of the juvenile salmon acoustic telemetry system type (JSATS; McMichael et al., 2010). Testing showed detection efficiencies of over 85% at receiver to tag distances of 135m in average flow and weather conditions (Ammann, 2020). The exact brand and location of receivers for monitoring stations varied from year-to-year, but for most locations the same general vicinity was monitored each year. For example, in 2014 receivers for the city of Sacramento were mounted on Tower Bridge (rkm 172), in 2015 they were moved the I-80 bridge (rkm 170) and in the remaining years were present on both bridges. In all these cases, we treated these slight shifts as the same location year-over-year. In other cases, some locations were not monitored in some years because the telemetry network was expanded over the course of the study. For example, Chipps Island (rkm 71) was not monitored in 2014 and 2015 and the receivers above (rkm 215) and below Fremont Weir (rkm 210) were only in place for 2017 and 2018. Damage to acoustic receivers also resulted in loss of monitoring capability for at least part of the monitoring period in some locations. For example, receivers in Georgiana Slough near the divergence from the mainstem Sacramento were offline for much of the monitoring period in 2016, 2017, and 2018.

Fish tagging and release

Juvenile winter-run Chinook Salmon were obtained from Livingston Stone National Fish Hatchery, a conservation hatchery that sources winter-run Chinook Salmon broodstock from a fish trap at the base of Keswick Dam. These natural-origin adults are crossed in the hatchery to maximize genetic diversity. Hatchery juveniles are released at a pre-smolt size to experience some of the same ecological interactions as natural-origin juveniles. Hatchery releases typically coincide with a storm event which is hypothesized to increase survival due to increased river flow and water turbidity resulting in a time window of release from late January to early March (NMFS, 2009).

Fish size and the number of acoustic-tagged fish released varied among the five years of this study (Table 1). Acoustic tags weighed 310 mg with dimensions of 10.8 x 5.3 x 3 mm and were set to a pulse rate interval of 10 seconds (Advanced Telemetry Systems, Isanti, MN). Tags were randomly sampled from a single purchase order and implanted into fish following standard surgical protocols (Liedtke et al., 2012). Mean tag burden (percent of tag weight/fish weight) by year ranged from 2.9 to 4.1%. With one exception, acoustic tags were surgically implanted into fish 1-3 days prior to their release and one or two releases were conducted at the same location within two days of each other. In 2018, the second release of 237 fish was held for 13 days after tagging to avoid releasing fish in low flow conditions. After the post-surgical holding period in the hatchery, fish were transported to one of two release sites near the city of Redding (rkm 542 or rkm 540). Acoustic tagged fish were released at the same time as non-acoustic tagged hatchery pre-smolts (140 000 to 200 000). Most releases occurred in early February, excepting 2018 when releases occurred in early and mid-March.

Each year, additional acoustic tags (n = 36 in 2014, 32 in 2015 and 30 in 2016-2018) from the same batch of tags as implanted in fish were randomly-sampled, activated, and monitored in ambient river water for up to 83 days to estimate each tag's battery life. Each day, the total number of tags still operating and the number of tags that failed were recorded. Based on these data, the Kaplan-Meier (KM) estimator was used to estimate the daily tag survival function for each year. This non-parametric estimator - commonly used in time-to-event analyses, including examples of active-tag mark-recapture in fishes (Cowen and Schwarz, 2005) - estimates the probability a tag is still operating at time t.

Summarizing telemetry data as capture histories

Telemetry data were processed in three steps. First, receiver data were screened for false positive detections. Second, screened data were summarized into detection events. Third, individual fish movement patterns were examined to identify potential predation events. False positives were removed using a filter similar to Deng et al. (2017). We grouped the acoustic telemetry data into "detection events" defined as the set of consecutive detections of an individual tag at a given telemetry station uninterrupted by detection at any other telemetry station and separated by less than 60-minutes. Detection events were summarized by receiver location, first and last time of detection. Finally, predation events were identified using the methods of Perry et al. (2018), who adapted the methods of Gibson et al. (2015). Potential predation of tagged smolts was identified using hierarchical clustering of several movement metrics calculated on the acoustic tag detection history of known predators and the study fish.

Tag histories of study fish that were grouped with known predators were examined to identify if and when the tag transitioned from smolt-like to predator-like behavior. Any detections after this point were censored (i.e. removed from the data) for the purpose of creating capture histories (Perry et al. 2018).

To create capture histories, general telemetry receiver locations were treated as capture (detection) opportunities and enumerated consistently across years based on the most extensive telemetry network deployed. Reaches were defined as the section of river between subsequent capture opportunities (Figure 2). The release site was treated as capture opportunity (k) 0 in route (r) A (mainstem Sacramento River) and Knights Landing was capture opportunity 1 in route A ($k = 1$, $r =$ A). The first possibility for fish to diverge from the Sacramento River was to enter the Yolo Bypass which could happen at any point along the 2.9 km Fremont Weir, but only when the river stage exceeded 9.8 m. Receivers above ($k = 2$, $r =$ A) and below ($k = 3$, $r =$ A) the Fremont Weir bracketed this transition reach. Fish that entered Yolo Bypass had one capture opportunity within the Yolo Bypass near the base of the Toe Drain (rkm 120, $k = 4, r =$ B) before their next opportunity at Rio Vista Bridge in the Sacramento River (rkm 98, $k = 9, r =$ A). Fish that did not enter Yolo Bypass had three more capture opportunities in the mainstem Sacramento before encountering Sutter and Steamboat Sloughs ($k = 7$). This capture opportunity consisted of telemetry receivers in the respective entrances of Sutter ($r =$ C) and Steamboat ($r =$ D) Sloughs, as well as receivers just downstream of the junctures within the mainstem Sacramento. Fish that entered Sutter and Steamboat Sloughs also had their next capture opportunity at Rio Vista. The final opportunity for divergence from the mainstem Sacramento was into Georgiana Slough (rkm 119, $k = 8, r =$ E). Multiple receivers were maintained in lower Georgiana Slough as well as other channels of the interior Delta including the Mokelumne River.

Detections on these receivers were pooled into a single capture opportunity defined as the interior Delta ($k = 9, r = \text{E}$). The penultimate capture opportunity for all routes was at Chipps Island ($k = 10, r = \text{A}$) which marks the entrance of Suisin Bay and the end of the Delta. Because Chipps Island was not monitored in all years, we included a final capture opportunity at Benicia Bridge ($k = 11, r = \text{A}$).

From the records of telemetry station detections we created a 2×12 capture history matrix for each individual: $\boldsymbol{C}_{\boldsymbol{i},\boldsymbol{h}} = \begin{bmatrix} x_{i,h,0} & \cdots & x_{i,h,11} \\ y_{i,h,0} & \cdots & y_{i,h,11} \end{bmatrix}$ where $x_{i,h,k}$ was the observed state (migration route) of individual h of year i on capture opportunity k if the individual was captured and 0 otherwise. $y_{i,h,k}$ was the observed stratum (day) of individual h of year i on capture opportunity k if the individual was captured and 0 otherwise. In the event of multiple detections at a capture opportunity, we used the timestamp and telemetry station of the last detection to determine the stratum and state. The capture history matrices were compiled into a set of matrices ($\mathbf{M}_{\boldsymbol{i},\boldsymbol{j},\boldsymbol{k},\boldsymbol{q},\boldsymbol{r}}$) and a set of vectors ($\mathbf{L}_{\boldsymbol{i},\boldsymbol{k},\,\boldsymbol{r}}$) with respective elements summarizing the data as follows: $m_{i.j,k,q,r,s,t}$ was the number of individuals of year i last captured at opportunity j in route q on day s that were next captured at opportunity k in route r on day t; $l_{i,k,r,t}$ was the number of individuals of year i last captured at opportunity k in route r on day t and not captured again. Our model requires setting a maximum number of strata for which fish can be detected, which we denote T. The latest detection of any fish in our study was 63 days after release, therefore we set $T = 70$ for all years to account for the possibility that fish migrated out after 63 days but were not detected. Thus, $\mathbf{M}_{\boldsymbol{i},\boldsymbol{j},\boldsymbol{k},\boldsymbol{q},\boldsymbol{r}}$ were each 70×70 matrices of counts of capture pairs with rows corresponding to the s index (departure day) and columns to the t index (arrival day) and $\mathbf{L}_{\boldsymbol{i},\boldsymbol{k},\,\boldsymbol{r}}$ were each 70-element vectors of counts of fish last detected on day t.

Mathematical model

To describe the TSMS model, we adopted and expanded upon the notation of the TSCJS model described in Hance et al. (2019). We define the model generally here and describe our specific parameterization in the following section. The TSMS describes a data generating process (Figure 2) starting with an initial release of fish that survive, arrive over time, are distributed, and detected ("captured") at capture opportunities that mark the transition between subsequent downstream reaches and routes. Like most space-for-time mark recapture models, our model assumes unidirectional movement of fish and does not allow for fish captured at a downstream station to return to an upstream station. Our model is defined in terms of the following parameters:

- $\phi_{i,j,r,s}$ is the probability an individual released in year i that passed capture opportunity j of route r on day s survived to the capture opportunity $j+1$.
- $\alpha_{i,j,r,s,t}$ is the probability of a surviving individual in year i that passed capture opportunity j of route r on day s arriving at capture opportunity $j+1$ on day t, where $\alpha_{i,j,r,s,t} = 0$ for $s > t$, $\alpha_{i,j,r,s,t} > 0$ for $s \leq t$ and $\sum_{t=s}^{T} \alpha_{i,j,r,s,t} = 1$ where T is the final day of the monitoring period.
- $\hat{\delta}_{i,t}$ is the probability an acoustic telemetry tag battery in year i is still active on day t, where $0 \leq \hat{\delta}_t \leq 1$. Here, we used the KM estimate based on time to failure of test-tags in each year and treat as a known parameter.
- $\psi_{i,j,q,r,s}$ and $\psi'_{i,k,q,r,t}$ are the probabilities an individual released in year i entered route r from route q ("routing probabilities") on day s or t, respectively. The distinction between ψ and ψ' is that our model allows individuals to transition between routes either immediately after ($\psi_{j,q,r,s}$) or immediately before a capture opportunity ($\psi'_{k,q,r,t}$

), where $\psi_{j/k,q,r,s/t} \geq 0$ and $\sum_{r=q}^{R} \psi_{j/k,q,r,s/t} = 1$. Note: in the following we define our model generally, but in practice for each reach only one type of transition should be possible to avoid issues of parameter identifiability.

- $p_{i,k,r,t}$ is the probability an individual released in year i that arrived at capture opportunity k of route r on day t was captured (detected).

Our model integrates over all possible arrival dates and routes for undetected fish using two recursive intermediary parameters (Hance et al. 2019). The first set of recursive terms is used to define the probability of each pair of captures with no other intervening captures. That is, $\lambda_{i,j,k,q,r,s,t}$ is the probability an individual of year i released (or detected) at capture opportunity j in route q on day s survived to capture opportunity k in route r and arrived on day t with an active tag having passed each station between j and k undetected:

$$\lambda_{i,j,k,q,r,s,t} = \sum_{w=1}^{R} \left(\psi_{i,j,q,w,s}\phi_{i,j,w,s}\alpha_{i,j,w,s,t}\psi'_{i,k,w,r,t}\right)\frac{\hat{\delta}_{i,t}}{\hat{\delta}_{i,s}} \text{ for } k = j+1, \text{ and } = \sum_{w=1}^{R}\left(\sum_{u=s}^{T}\lambda_{i,j,k-1,q,w,s,u}(1-p_{i,k-1,q,u})\sum_{v=1}^{R}\left(\psi_{i,k-1,w,v,u}\phi_{i,k-1,v,u}\alpha_{i,k-1,v,u,t}\psi'_{i,k,v,r,t}\right)\frac{\hat{\delta}}{\hat{\delta}}\right) \text{ for } k > j+1 \quad (1)$$

The second recursive term defines the probability of not being detected again after the last detection and includes the possibilities that a fish died or the tag battery failed at some point prior to the last capture. That is, $\chi_{i,k,r,t}$ is the probability an individual of year i was last released (or detected) at capture opportunity k in route r on day t. Letting $\chi_{i,K,r,t} = 1$, we have:

$$\chi_{i,k,r,t} = \sum_{w=1}^{R} \psi_{i,k,r,w,t} \left((1-\phi_{i,k,w,t}) + \phi_{i,k,w,t} \sum_{u=t}^{T} \alpha_{i,k,w,t,u} \left[\sum_{v=1}^{R} \left(\psi'_{i,k+1,w,v,t}(1-p_{i,k+1,v,u})\chi_{i,k+1,v,t}\right)\frac{\hat{\delta}_{i,u}}{\hat{\delta}_{i,t}} + \left(1-\frac{\hat{\delta}_{i,u}}{\hat{\delta}_{i,t}}\right) \right] \right) \quad (2)$$

Letting $\boldsymbol{M}$ and $\boldsymbol{L}$ denote the entire set of summary statistic matrices and $\boldsymbol{\theta}$ denote the entire set of parameters, the observed data likelihood can be written as:

$$\Pr(\boldsymbol{M},\boldsymbol{L} \mid \boldsymbol{\theta}) \propto \prod_{i=1}^{Y}\prod_{j=0}^{K-1}\prod_{k=j+1}^{K}\prod_{q=1}^{R}\prod_{r=1}^{R}\prod_{s=1}^{T}\prod_{t=s}^{T}(\lambda_{i,j,k,q,r,s,t}p_{i,k,r,t})^{m_{i,j,k,q,r,s,t}} \times \prod_{i=1}^{Y}\prod_{k=0}^{K}\prod_{r=1}^{R}\prod_{t=1}^{T}\chi_{i,k,r,t}{}^{l_{i,k,r,t}} \quad (3)$$

Although we defined the model generally, in our application, transitions between routes were highly constrained leading to a limited number of unique combinations of routes and capture occasions (Figure 2). Given this highly constrained system we only calculated the terms of the likelihood that were possible given the structure of Delta's channel network. Additionally, to avoid identifiability issues due to missing telemetry receivers in 2014 through 2016, travel time from above Fremont Weir to Feather River was parameterized as a single reach rather than two separate reaches.

Parameterization

We parameterized our model to investigate the effects of temporally stratified environmental covariates on survival, travel times, migration routing, and detection probabilities.

Based on other Central Valley Chinook Salmon stocks (Perry et al. 2018), we hypothesized that discharge would have a positive effect on survival and negative effect on mean travel time and on detection. We also hypothesized that maximum daily water temperatures would have a negative effect on survival (Baker et al., 1995; Notch et al., 2020) and that the ratio of exported water (freshwater removed from the Delta by state and federal pumping facilities) to Delta inflow would have a negative effect on survival for fish that reached the Interior Delta (NMFS, 2009). To investigate these hypotheses, we downloaded discharge and temperature data from U.S. Geological Survey (USGS) streamflow gages throughout the Delta (USGS, 2020). Flow in the channels of the Delta downstream of Fremont Weir and upstream of Cache Slough are highly correlated (Perry et al. 2018), so for all reaches above Rio Vista and below Vernalis, excluding Yolo Bypass, we used tidally-filtered flows at Freeport (USGS Gage 11447650). When the Yolo Bypass is flooding there is a large discontinuity in Sacramento River flows upstream and downstream of the Feather River, as well as near the city Rio Vista due to floodwaters reentering the Sacramento River through Cache Slough (Figure 1). To account for the discontinuities caused by the flooding of the Yolo Bypass, we used Fremont Weir stage height for reaches from Knights Landing to Feather River, and flow in Yolo Bypass (USGS 11453000) for the Yolo Bypass reaches. For reaches below Rio Vista, we used Rio Vista flows (USGS 11455420). We used Freeport flow for the Interior Delta reaches. We only had complete temperature records for the entire study period for the Sacramento River at Freeport and for the Yolo Bypass. Based on exploratory analyses of the partial temperature records from other gaging stations, we opted to use the temperature at Freeport for all reaches except for Yolo Bypass. Lastly, we used the daily ratio of Delta exports to Delta inflow from Dayflow (CNRA 2020) to investigate the effect of water export on survival through the Interior Delta.

While our main objective was to estimate the effect of temporally stratified covariates on survival, travel timing and routing through the Delta, we accounted for fish that may have passed Knights Landing undetected. We modelled survival to and arrival timing at Knight's Landing independently for each yearly release, except for 2018 where two releases of fish occurred 11 days apart. This resulted in 6 terms for survival ($\phi_{i,0,1}$), where i refers to each year except for $i\ =\ 5, 6$ which denotes the first and second releases of 2018, respectively. We modelled arrival timing ($\alpha_{i,0,1,t}$) at Knights Landing using a lognormal kernel with daily lognormal mean-zero process error with separate variances for each year: $\alpha_{i,0,1,t} \propto \frac{1}{t\ -\ 0.5} e^{\left(\frac{-(\log(t-0.5)+\mu_{i,0,1})^2}{2\sigma^2_{i,0,1}} + \epsilon_{i,t}\right)}$, where $\mu_{i,0,1}$ is log-mean travel time, and $\sigma^2_{i,0,1}$ is the log-variance of travel time for group i and $\epsilon_{i,t}$ are normally distributed random effects. (Hance et al. 2019).

With three exceptions, survival probabilities for all reaches downstream of Knights Landing were modelled as:

$$\text{logit}(\phi_{i,k,r,s}) = \beta_{0,k,r} + \beta_{1,k,r} Flow_{i,k,r,s} + \beta_{2,k,r} TempMax_{i,k,r,s} \quad (4)$$

where k and r index the occasion and route of each survival reach, $\beta_{0,k,r}$ is the intercept for logit-survival, $\beta_{1,k,r}$ is the effect of reach-specific flow ($Flow_{i,k,r,s}$) for day s of year i (Table 2) and $\beta_{2,k,r}$ is the effect of maximum daily temperature ($TempMax_{i,k,r,s}$) for day s of year i. For the Interior Delta Reach ($k\ = 9, r = E$), we added an additional term, $+\ \beta_{3,9,5} E/I_{i,s}$, which is the effect of the daily export import ratio on survival. For the Sacramento River route reach extending from the receivers above and below Fremont Weir ($k\ = 2, r = A$) we set survival to 1. This is because receivers were only deployed in these locations for the 2017 and 2018 study years and because when the Fremont Weir is overtopping fish can enter Yolo Bypass at any point along the 2.9 km weir in effect making the entire reach part of Yolo Bypass. Lastly, for the final reach ($k = 10, r = A$), from Chipps Island to Benicia we set survival to a constant across years and days and interpret this parameter as joint survival to and detection at Benicia.

Arrival probabilities at each capture occasion downstream of Knights Landing were modeled using a lognormal kernel with a temporally stratified log-mean travel time and a constant log-variance across years and days for each reach. Enforcing the constraint that arrival probabilities sum to one, we defined:

(5) $$\alpha_{i,k,r,s,t} \propto \frac{1}{t-s+0.5} e^{\left(\frac{-(\log(t-s+0.5)+\mu_{i,k,r,s})^2}{2\sigma^2_{k,r}}\right)}$$

and related log-mean travel time for each reach to the daily discharge on the day of entry to the reach:

(6) $$\mu_{i,k,r,s} = \gamma_{0,k,r} + \gamma_{1,k,r} Flow_{i,k,r,s}$$

We modelled daily routing probabilities based on the flow of the Sacramento River. Fish had four opportunities to diverge from the mainstem Sacramento. The first opportunity was to enter the Yolo Bypass via the Fremont Weir which was only accessible when the Sacramento River stage at the Fremont Weir exceeded 9.8 meters which only occurred in the 2016, 2017 and 2018 study years. We defined the probability of entering Yolo Bypass as:

(7) $$\psi_{B,i,t} = I(Overtop)_{i,t} * \text{logit}^{-1}(\zeta_{B,0} + \zeta_{B,1} Exceedance_{i,t})$$

where $I(Overtop)_{i,t}$ is an indicator variable equals 1 if the Fremont Weir was overtopping and 0 otherwise and $Exceedance_{i,t}$ is feet above 10.2 m (33.5 feet). The next three opportunities to diverge from the Sacramento River were always available and for these we used a similar logistic regression formulation:

$$\psi_{X,i,t} = \text{logit}^{-1}(\zeta_{X,0} + \zeta_{X,1} Flow_{i,t}) \quad (8)$$

to define $\psi_{C,i,t}$, $\psi_{D,i,t}$, $\psi_{E,i,t}$ as the probabilities of entering Sutter, Steamboat, and Georgiana Sloughs respectively and conditional on not having entered other routes. Here, $Flow_{i,t}$ is Freeport flow for all three junctions. Because the entrances to Sutter and Steamboat Sloughs are fewer than 3 km distant we treated this junction as a three-way divergence and set the probability of entering Sutter Slough as $\psi_{C,i,t}$, the probability of entering Steamboat as $(1-\psi_{C,i,t})\psi_{D,i,t}$, and the probability of remaining in the Sacramento as $(1-\psi_{C,i,t})(1-\psi_{D,i,t})$. Lastly, we set routing probabilities in equation (3) such that fish in Yolo, Sutter, and Steamboat routes returned to the mainstem Sacramento River at Rio Vista and fish in Interior Delta returned to the mainstem at Chipps Island.

Finally, detection probabilities at all capture occasions in each year were modelled on location-specific flow using the logit-link with year-specific regression coefficients to reflect changes in hydrophone receivers across years:

$$\text{logit}(p_{i,k,r,t}) = \xi_{i,0,k,r} + \xi_{i,1,k,r} Flow_{i,k,r,t} \quad (9)$$

Detection probabilities during known receiver outages and missing receiver locations had capture probability set to zero for those time periods. We list these receiver outages in Table 2.

To understand the interaction between survival, travel times, and routing probabilities throughout the Delta, we used our model to estimate a set of derived parameters that summarized overall and route specific survival throughout the entire Delta. We used a modified form of the recursive term $\lambda_{i,1,10,1,1,s,t}$ to calculate the probability of a fish departing Knights Landing ($j = 1, q = 1$) on each day s surviving to Chipps Island ($k = 10, r = 1$) by removing the $(1 - p)$ terms from each step of the recursion. This allowed us to calculate the overall probability of survival through the Delta for fish passing Knights Landing on each day. We calculated similar summary metrics to estimate overall route specific survivals.

We coded the model in the Stan probabilistic programming language (Carpenter et al., 2017). Flow and temperature covariates were standardized by subtracting the mean and dividing by the standard deviation. We used weakly-informative priors for parameters with a small number of more informative priors. Under complex likelihood structures such as ours, weakly informative and informative priors can increase computational efficiency and reduce type I error rates (Lemoine, 2019). Priors were chosen using graphical checks to encompass a broad but reasonable range of parameter values given the constraint of the logit transformation and 70-day monitoring period. In general, priors for the terms of the logit-link functions were Student's t-distributions with 7 degrees of freedom and standard deviation of 2 for intercept terms and 1 for slope terms. Normal priors were chosen for the terms of μ with mean 0 to 4 and standard deviation of 1 to 2. Half-normal priors with standard deviation of 1 were used for log-variance terms of the travel time distribution. More informative priors were chosen for a handful of locations to mitigate identifiability issues related to travel times. For example, priors for the 2.7 km reach spanning the Fremont Weir were chosen to put more weight on the likelihood of travel times of a day or less. We ran 4 chains with a warmup of 1000 iterations and a sampling of 1000 iterations for a total of 4000 posterior samples. We assessed the adequacy of the fitted model using posterior predictive checks (PPCs). We sampled 1000 draws from the joint posterior distribution and simulated the entire data generating process to create a set of replicated capture histories. We compared the observed data to the distribution of the replicated data for multiple summary statistics: 1) the total number of individuals never recaptured after release in each year, 2) the total number of individuals captured in each route and capture occasion combination in each year, and 3) the total number of individuals captured on each day in each route on each capture occasion.

Results

We verified convergence of the posterior sampler to a stationary distribution through both graphical and statistical summaries. The Gelman-Rubin statistic ($\hat{R}$) for all fundamental parameters of the model was less than 1.01 and the number of effective samples ranged from 1 385 to 11 492 (mean 5 149). The PPCs indicated adequate, but imperfect fit to the data across multiple dimensions[1]. The observed number of fish never detected after release for each year was within the 90% posterior predictive interval (PPI) for all five years. The observed number detected in each possible state at each capture occasion fell within the 90% PPI for 58 of 67 state-by-occasion combinations. In three cases, the lower bound of the PPI exceeded the observed number of fish detected with a maximum undershoot of 11 (120 observed vs 131 lower bound predicted at $k = 10, r = A$ in 2016). In six cases, the upper bound of the PPI was less than the observed data with a maximum overshoot of 16 (96 observed vs 80 upper bound predicted at Benicia $k = 11, r = A$ in 2018). The observed number detected on each day in each state at each capture occasion fell within the 90% PPI for 94% of PPIs that contained non-zero values.

The range of daily flows and temperatures observed during our study were representative of the historical range (Figure 3). For the months of February through April, flows at Freeport

[1] Fig. S9a-s

ranged from 142 to 2 724 m^3s^{-1}, respectively less than the 1st percentile and greater than 99th percentile of the 88-year (1930-2018) record. Maximum daily water temperatures at Freeport for the same duration ranged from 9 to 22.7 °C, respectively less than the 7th percentile and greater than 99th percentile of the 57-year (1961-2018) record.

Although we did not estimate covariate relationships for the upper Sacramento River from release to Knights Landing, we observed substantial year-to-year variability in survival and travel time to Knights Landing. Survival probability was highest for this reach in 2016 at 0.58 with a 90% credible interval (CI) of [0.54, 0.62], and lowest for the first release of 2018 at 0.24 (90% CI: [0.20, 0.28]). Fish released during extreme high flows of 2017 had the second highest survival (0.54 90% CI: [0.50, 0.58]), but also had much longer travel times with peak arrival day not occurring until 42 days after release[2]. The release group in 2017 also exhibited the earliest tag failure with 10% of tags expected to have failed by day 42 and over 50% by day 66[3]. This combination of unusually long delay in arrival at Knights Landing and the earliest expected tag failure in 2017 resulted in the largest effect of the tag-life correction for this year.

Baseline survival was relatively high for all reaches below Knights Landing, except for the interior Delta reach. For all reaches outside of the interior Delta, the intercept term for the logistic-link function of survival was greater than zero which can be interpreted as a baseline survival (i.e. at average discharge and maximum temperature) of greater than 50% (Figure 4). For these reaches, the posterior mean of baseline survival ranged from 0.69 to greater than 0.99, with all but three reaches greater than 0.85 (03A, 08C, 08D). In contrast the posterior mean for baseline survival through the Interior Delta was 0.37 (90% CI: [0.17, 0.62]). The posterior mean

[2] Fig. S1
[3] Fig. S2

joint probability of surviving from Chipps Island to Benicia Bridge and being detected was 0.65 (90% CI: [0.61, 0.68]).

Daily discharge tended to have a positive effect on survival in most reaches. The posterior mean was greater than zero for all reaches except for reach 03A, the mainstem Sacramento from below Fremont Weir to the Feather River (Figure 4). The 90% CI also overlapped zero for reaches of the Yolo Bypass route (reaches 03B and 08B), for Georgiana Slough to the Interior Delta (reach 08E) and for the penultimate reach of the Sacramento Route (09A). The latter two reaches are tidally influenced, which may explain the lack of influence of increasing discharge on survival (Perry et al., 2018). In all remaining reaches, discharge was estimated to have a positive impact on survival (Figure 5), with the strongest effects apparent in the reaches between the City of Sacramento and Rio Vista (05A through 08A and 08D) which transition from unidirectional flow to bidirectional tidal flow as discharge decreases (Perry et al., 2018). In contrast to the findings of Perry et al. (2018), we found a positive effect of discharge on survival for the Interior Delta to Chipps Island reach (09E). We found no effect for the export-inflow ratio on survival for the Interior Delta reach.

Maximum daily temperature tended to have a negative effect on survival. Although the point estimate for the effect of temperature was negative for all but two reaches, the 90% CI included positive values for all but two reaches (Figure 4) which means we cannot rule out a small or negligible effect for increasing temperature on survival in these reaches. The two reaches for which temperature had a strong negative effect were both in the northern Delta: reach 03A from the Fremont Weir to Feather River and 04A from the Feather River to the City of Sacramento. For these reaches we found that, given a fixed discharge and after accounting for the scaling of the temperature variable, the odds of survival decreased by approximately 70% (

$e^{(-\frac{4.75}{3.58})}$ = 0.27, 90% CI:[0.15, 0.47]) and 45% (0.55 [0.37, 0.81]) respectively for each degree C increase in daily maximum temperature (Figure 6). The combination of observed flow and temperature conditions resulted in declining survival in most reaches by mid-March to early April in all years except 2017 and 2018[4].

Daily discharge also affected median travel time. Increasing discharge was associated with decreased travel times in most reaches (Figure 7). For the first Yolo Bypass reach (03B) and Sutter Slough (08C) the posterior mean was negative but the 90% CI overlapped zero. We found differences in effect of discharge on travel time between Knights Landing and the Feather River between the two parameterizations of the model imposed by the lack of receivers above and below Fremont Weir in 2014 through 2016. In 2014 through 2016, when we modelled travel time from the upstream end of Fremont Weir to Feather River we found a strong negative effect of discharge (stage height at Fremont Weir). This result may have been driven by a small number of long observed travel times between Knights Landing and the Feather River, particularly in 2015, when three fish had observed travel times of 25, 18, and 11 days, respectively. Contrastingly, increased stage height was associated with increased travel times between the downstream end of Fremont Weir and Feather River for 2017 and 2018 (Figure 8). This likely reflects an alteration to the hydrodynamics of this section of river when the Yolo Bypass overtopped and floodwaters from the Feather River were directed towards and over the Fremont Weir, particularly in 2017. The association of increased discharge with decreased travel times in the remaining reaches correspond with the findings of Perry et al. (2018) for late-fall run Chinook Salmon. We found the longest travel times for fish in the first reach of Yolo Bypass to

[4] Fig. S3

the base of the Toe Drain with a median travel time at mean flows of 10.1 days (90% CI [7.6, 14.1]). The second longest travel times were for fish traversing the Interior Delta with a median travel time at mean flows of 6 days (90% CI: [5.4, 6.8] days) to Chipps Island.

Lastly, we found that routing probability into Yolo Bypass increased with increasing stage height above the Fremont Weir, and routing probability into Steamboat and Georgiana Sloughs decreased with increasing Sacramento River flows (Figure 9). The odds of entering Yolo Bypass (Route B) increased 15 fold (90% CI [7.2, 32.8]) for each foot of river stage above the Fremont Weir with the probability increasing from 0.28 (90% CI: [0.20, 0.36]) at one foot (0.3 m) above to 0.84 (90% CI: [0.76, 0.91]) at two feet (0.6 m) (Figure 10). We found no effect of increasing discharge on the probability of entering Sutter Slough (Route C) where the posterior mean for the change in the log-odds associated with discharge was near zero (-0.05) and the 90% CI contained both negative and positive values: [-0.3, 0.2]. We found a weak effect of increasing discharge on the odds of entering Steamboat (Route D) and Georgiana Sloughs (Route E), where the odds decreased by a factor of 0.74 and 0.80 respectively for each 734.5 m^3s^{-1} increase in Sacramento River discharge. However, the 90% CI for the change in log-odds associated with discharge overlapped zero for Georgiana Slough [-0.5, 0.05] thus we cannot rule out a weaker or even no effect of discharge.

Overall survival for winter run Chinook from Knights Landing to Chipps Island varied within and between years with a general trend of declining survival for fish arriving at Knights Landing later in the year (Figure 11). The greatest daily overall survival probability occurred during periods when the Fremont Weir was overtopped and Yolo Bypass became available, particularly in 2017 when sustained high flows and relative cool water temperatures result in daily survivals which remained greater than or equal to the maximum estimated daily survival in all other years throughout the migration period. Overall survival approached 0 for later dates of arrival at Knights Landing for all other years, but the decline began soonest in the drought year of 2015 when overall survival fell below 0.25 by late February. The timing of optimal overall survival in any given year was generally coincident with the highest flows of that year which occurred relatively early in 2015 (mid-February) and relatively late in 2018 (early-April). However, low discharge alone did not necessarily result in low survival; for example, in 2016 the lowest flows of the study period occurred during late February (Figure 3) but while overall survival during this period was lower than during the high flows of March it was also much higher than during the low-flow period beginning in April (Figure 11). This pattern can be attributed to the differences in maximum daily water temperature between early and late lower flow periods. Survival from Knights Landing to Chipps Island by route was similar for all routes except for the Interior Delta which was lower than other routes for most days in most years, excepting the high flow periods of 2016, 2017 and 2018 when survival through the Interior Delta was comparable to survival through other routes[5].

Discussion

Sacramento River winter-run Chinook Salmon have persisted in a river system characterized by significant daily, seasonal and interannual variability in river flow and water temperature including a history of both extreme droughts and flood. This temporal variability interacts with a spatial variability in migratory habitat including a large floodplain that is currently only accessible during high flows, and several distributary channels including channels that are part of a large municipal and agricultural water export system. Here, we developed a

[5] Fig. S8

novel statistical mark-recapture model that estimated daily survival, travel-time and routing probabilities throughout the Sacramento River and Delta in the context of extreme drought and record floods. This analysis highlights the extreme spatiotemporal variability in survival and migration dynamics of this endangered salmon population at the southern extent of the species range. Interannual variability in river flows and water temperature during our 5-year study matched the extremes of the long-term record, while seasonal variability influenced reach-specific environmental conditions and the availability of some routes as a migration corridor. This temporal variability influenced how migrating juvenile salmon distributed among the complex branching network of river channels, floodplains, and tidal sloughs and the location-specific conditions that ultimately affected their survival. Acoustic telemetry techniques allowed us to track individuals through this spatiotemporal habitat mosaic, and we extended available mark-recapture models to leverage the detailed information contained in these data.

A diversity of populations with different life history characteristics, the so-called portfolio effect, has been shown to support more stable salmon population trajectories over time (Carlson and Satterthwaite, 2011; Schindler et al., 2010). Yet the winter run of Chinook salmon consists of just one population, posing significant risk of extinction for this endangered species. In addition to a diversity of populations, our study illustrates how spatiotemporal variability in available habitat forms another important dimension of the portfolio effect. Use of different migration routes by juvenile salmon "spreads the risk" to the population as a whole from detrimental conditions in a given route. Furthermore, we found that migration times varied significantly among migration routes, spreading out the population not only in space but also in time, which can be important for timing at ocean entry to correspond with marine food availability (Hassrick et al., 2016). The Yolo Bypass featured prominently in this spatiotemporal diversity, as juvenile salmon using this route took the longest to migrate through the Delta yet experienced comparable survival to other migration routes and presumably exposed fish to favorable growing conditions (Sommer et al., 2001). Consequently, use of different migration routes with different migration times distributes the arrival timing of individuals in the estuary and near-shore ocean environment. Given our findings that survival depends on conditions that individuals experience at a given location and time, and that ocean entry timing can influence survival to adulthood (Scheuerell et al., 2009), our study illustrates how spatiotemporal variability can arise among individuals within a single population in a way that can act as a buffer against catastrophic events that might otherwise affect the population as a whole.

Our results add to a growing body evidence about the threat of severe drought to the persistence of Sacramento-river salmon populations. Our results show that during drought years, winter-run Chinook Salmon smolts face a low probability of surviving the later they enter the Delta (defined here as beginning at Knights Landing). Similar to previous studies (Newman and Brandes, 2010; Perry et al., 2010), we found that during conditions of low flows and relatively cool water fish that entered the interior Delta had significantly lower survival than those taking other routes. However, during low flow conditions and relatively warmer temperatures we found that survival in all routes was poor. For example, overall survival dropped below 25% for fish arriving at Knights Landing after March 1st in 2015. To the extent this mortality was driven by water temperature, we found the strongest evidence of a correlation with maximum daily water temperature in the upper Delta between Knights Landing and the city of Sacramento. This finding is similar to that of (Singer et al., 2020) who found a survival probability for the reach between the cities of Sacramento and Hood of less than 20% for fall-run and spring-run Chinook Salmon smolts released in April of 2014. Thus our study shows that in addition to the potential impacts of current water delivery infrastructure and operations on winter-run sized Chinook Salmon that enter the interior Delta, natural resource management and policymakers should be aware of the potential threats to Chinook Salmon of actions that decrease flows and increase water temperatures in the upper Delta (e.g. Perry and Pope, 2018). However, it is important to point out that our results only apply to smolt-sized winter-run Chinook Salmon that arrive at Knights Landing in the late winter and early spring. In most years, the majority of winter-run Chinook Salmon disperse from the upper Sacramento River in November through January (del Rosario et al., 2013), and non-natal rearing including in the Delta is a significant component of winter-run Chinook Salmon life histories (Phillis et al., 2018).

Despite poor overall survival conditions in droughts years, our results also demonstrate the adaptability of winter run Chinook Salmon to extreme hydrological conditions. We found that while overall survival through the Delta was generally low during the drought years of 2014 and 2015, specific conditions allowed for brief periods of relatively higher survival. For example, in 2015 fish that arrived at Knights Landing between February 8^{th} and 12^{th} experienced an overall survival through the Delta of between 0.52 and 0.64 (90% uncertainty interval) coincident with a pulse of higher flows. We found that approximately 50% of the release group for that year arrived at Knights Landing in this interval and were able to take advantage of this relatively brief period of improved conditions. In contrast, cumulative Delta survival for fish migrating in 2017 remained high throughout the 70-day monitoring period, and arrival timing at Knights Landing for this year was more protracted with most fish arriving over a two week period in mid-March. In each year, the peak of arrival timing at Knights Landing for our release groups corresponded with periods of high survival, but with large differences in migration dynamics. If the untagged conservation hatchery fish released at the same time as our study fish responded to the hydrological conditions of these years in a similar manner, then it is possible that winter-run Chinook in 2015 were able to avoid high mortality by shifting migration timing earlier. In doing so, however, these fish may have sacrificed opportunities for growth afforded to the cohort of 2017 (Munsch et al., 2019).

Our study also quantified the probability of entering and surviving through a large intermittently accessible floodplain for an experimental release of Chinook Salmon representative of the run-of-river population. We found that winter-run Chinook Salmon had a greater probability of entering Yolo Bypass than remaining in the Sacramento River when the Fremont Weir was overtopping by more than 1.25 feet. This value was exceeded for 13 days in 2016 and 56 days in 2017. Fish that entered Yolo Bypass had a probability of survival equivalent to those that remained in the mainstem Sacramento despite a longer residence time. Thus, our findings for volitionally entering smolts confirms experiments where actively migrating smolts were released directly into Yolo Bypass or with experimental releases near Yolo Bypass timed to coincide with a flood event (Johnston et al. 2018, Pope et al. 2021). While these pioneering studies demonstrated the potential value of the Yolo Bypass as a migratory corridor, these studies did not establish to what degree the run-of-river population might use the Yolo Bypass route over a range of flood conditions. The fish in our study were released well upstream of Yolo Bypass and so their arrival timing and probability of entering Yolo Bypass are potentially more representative of the run-of-river population. Because juvenile Chinook Salmon rearing in Yolo Bypass may experience enhanced growth (Sommer et al. 2001a, 2005; Katz et al. 2017; Takata et al. 2017) and avoid channels that enter the interior Delta, our findings demonstrate the importance of improving access to this route for migrating winter-run Chinook Salmon.

Although the diverging network channel structure of the Sacramento River and Delta may seem somewhat unique relative to the single migration pathway representative of many other river corridors, our temporally stratified multistate modeling framework can be applied to many situations in which fish use space differentially. Dams on regulated rivers often have multiple passage routes, and lake or near-shore ocean environments may have different migratory pathways among which individuals can be distinguished using telemetry techniques (Holbrook et al., 2015; Skalski et al., 2009). Our analytical framework can link demographic parameters that depend on where fish are in the system of interest (e.g. reach-specific survival, travel times and/or rates of transition between migratory pathways) to temporally variable covariates. Most other mark-recapture analyses have resorted to summarizing temporal covariates over individuals within release groups, resulting in considerable loss of information. However, Perry et al. (2018) used an approach analogous to ours to estimate the effect of time-varying covariates on juvenile salmon demographics. In their model, they used a complete data likelihood and Monte Carlo simulation to impute travel times and integrate over unobserved covariate values for undetected individuals. In contrast, by discretizing time into temporal strata, our model analytically integrates over all possible strata and covariate values when fish are not detected at a particular sampling occasion. Although both models represent different techniques for tackling the same problem, our model is more computationally efficient because it is implemented in Stan and is better suited to large data sets or spatially complex settings. Our model also offers more flexibility in parameterizing arrival probabilities and accounts for the probability of tag failure. In contrast, our model is unable to account for individual-level covariates (e.g. fish size) whereas the methods of Perry et al. (2018) naturally accommodates individual covariates. Similarly, while we accounted for tag failure using the relatively simple

KM estimator the possibility for more robust implementations exists. For example, the terms of equations (1) and (2) that account for tag-failure could be modelled using parametric forms such as Weibull or Gompertz curves (Townsend et al., 2006). The model could be further improved by treating tag failure probabilities as parameters to be estimated jointly using equation (3) combined with an ancillary model for the tag-failure data rather than simply using the tag-failure estimates as known quantities.

While our results are broadly similar to findings for other runs of Chinook salmon migrating through the Sacramento River Delta, some of our findings are in conflict with those of other studies. We identified a weak relationship between river flow and routing at two of the key channel junctions in the Delta and no relationship at a third. Perry et al. (2018) found that routing probability of juvenile late fall Chinook salmon into Sutter and Steamboat Slough was positively related to river flow and routing into Georgiana Slough was inversely related to river flow. We found a similar, but weaker relationship at Georgiana Slough, but found that routing into Steamboat was also negatively related to flow. These daily scale relationships are driven by hourly tidal forcing and reverse flows that are dampened as river inflow increases (Perry et al., 2015). In addition, these relationships are important for managed river flows because decreasing river flow increases the proportion of population entering Georgiana Slough, diverting fish to the interior Delta where survival is low and where they may encounter pumping stations. Similarly, Perry et al. (2018) found no effect for river flow on survival through the Interior Delta, whereas in our study we found relatively high survival for fish during the extreme high flows of 2017 and for some of 2016. Thus, the relationships in this study could have potential management implications. We believe that low detection probabilities and loss of monitoring capabilities in some years likely limited our ability to effectively quantify routing relationships that are known to be driven by physical processes. For example, the receivers in Georgiana Slough were lost in two of the five years and in one year had detection probabilities < 0.5[6]. Although downstream receivers in this route provide information on mean detection probability, the lack of daily detections and associated flows at the time of detection when fish entered Georgiana Slough likely hampered the ability to quantify the effect of flow on routing probability. Finally, our study in contrast to previous studies included reaches further north in the Sacramento Delta, particularly the reaches from Fremont Weir to Feather River. In these reaches we estimated long travel times and relatively low survival over a short distance, particularly during high flows or high temperatures. This area of the Sacramento River includes a major confluence with the Feather River as well as the Sutter and Yolo Bypasses. While this area has not previously been identified as a region of high mortality for Chinook salmon (but see Singer et al. 2020), our results show that under certain conditions survival in this area may be quite poor.

Our study sheds light on factors affecting demographic performance of hatchery-origin winter run Chinook Salmon that are intended to support recovery of wild populations. Whether our results can be used to draw inference on the wild population itself depends on the extent to which hatchery-origin fish serve as surrogates for wild fish and the degree of spatiotemporal overlap in the migration dynamics of these two populations. Toward this end, genomic techniques to identify wild juvenile winter run among mixed-stock catches (Meek et al., 2020) are being integrated into monitoring programs to explicitly estimate annual production of juvenile winter run leaving the Delta and entering the ocean (Johnson et al., 2017). These efforts

[6] Fig. S6

should help contextualize our findings and together will provide important insights about management actions needed to recover this imperiled species.

Author statements

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Competing interests statement

Competing interests: The authors declare there are no competing interests.

Contributors statement

DJH: Conceptualization, Methodology, Formal analysis, Software, Visualization, Writing - Original Draft **RWP:** Conceptualization, Supervision, Project administration, Writing – Review & Editing **ACP:** Conceptualization, Data Curation **AJA:** Investigation, Resources, Data Curation **JLH:** Investigation, Resources, Data Curation

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Data availability statement

The data, R and Stan code necessary to replicate our results are provided as a supplemental file. Data are provided in rds format and include a list of processed capture histories and covariates.

Ethics Approval

All work with fish was reviewed and approved by the University of California's Institutional Animal Care and Use Committee (KIERJ1604_A3 and DANNE1905), California Department of Fish and Wildlife permits (SC-13029, CESA MOU ID: Lindley_SRWR CHN_CVSR CHN_CCC Coho_LS_DS_12/31/2018) and National Oceanic and Atmospheric Fisheries Section 10 permits (1112-2, 17299-2M, 17299-3M).

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Figures for: From drought to deluge: variation in survival and riverine habitat use of an endangered migratory fish across spatial and temporal scales

Figure 1: Map of the Sacramento River and Sacramento-San Joaquin Delta showing the location of acoustic telemetry receiving stations (filled black circles) used to detect migrating acoustic tagged juvenile salmon from 2014 through 2018. Telemetry stations are labeled by sampling occasion in each migration route (01-11, A-#; see Table 2 and Fig. 2). These telemetry stations divide the Delta into seventeen discrete reaches (shown by numbered shaded regions). Yolo Bypass (reaches 03B and 08B) is only accessible when the Fremont weir overtops, which only occurred in 2016, 2017, and 2018. Data and maps

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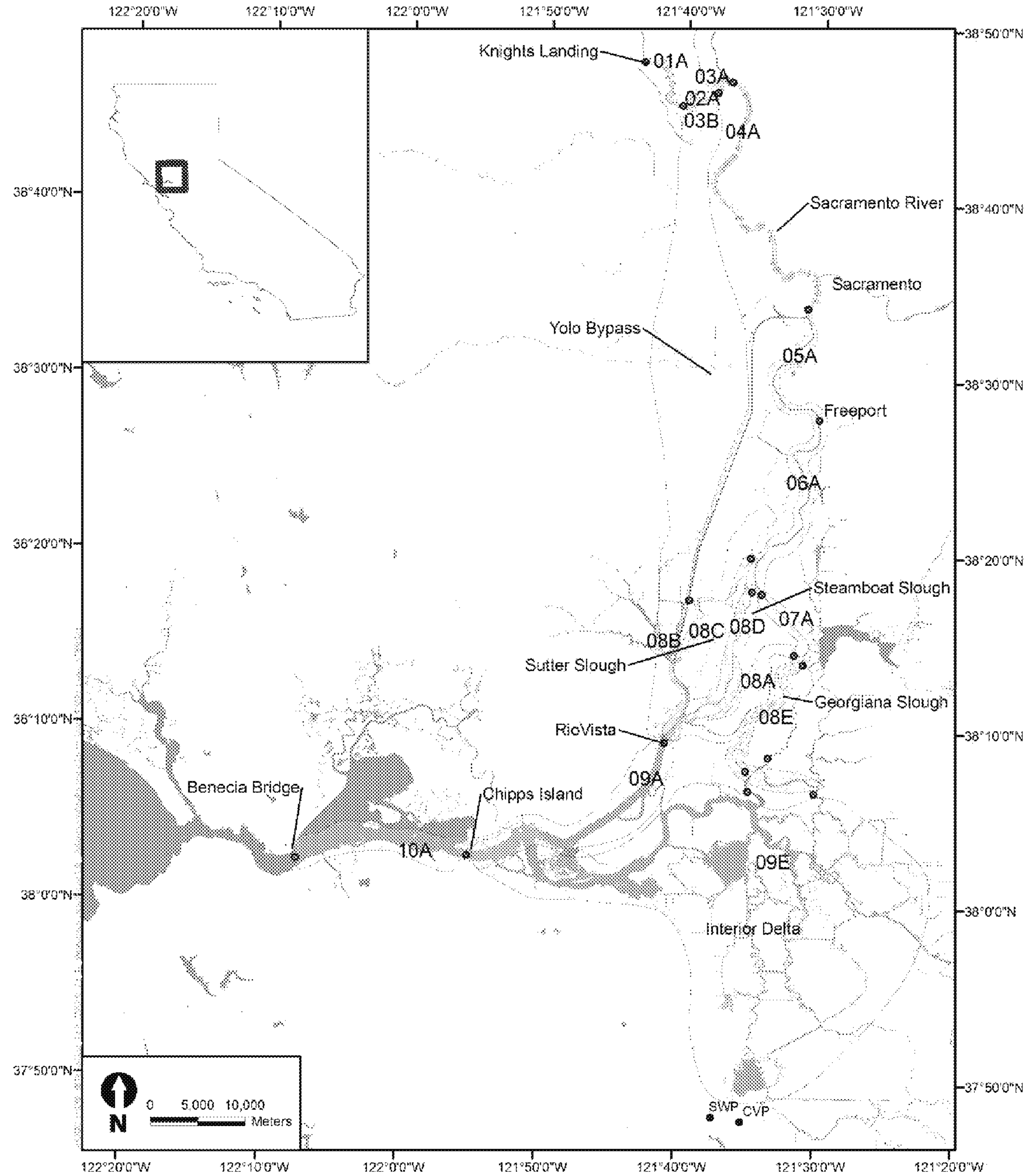


Figure 2: General schematic of the multi-state mark-recapture model with parameters indexed by capture opportunity (k) and by state (migration route, r). Parameters include reach-specific survival probabilities ($\phi_{k,r}$), site-specific detection probabilities ($p_{k,r}$) and routing probabilities from the Sacramento River to route r (ψ_r). The model begins with a release of N_0 acoustic-tagged winter-run Chinook near the city of Redding in each year. The last survival term $\phi^{\ddagger}_{A,10}$ is interpreted as the joint probability of surviving from Chipps Island to Benicia Bridge and being detected at Benicia Bridge.

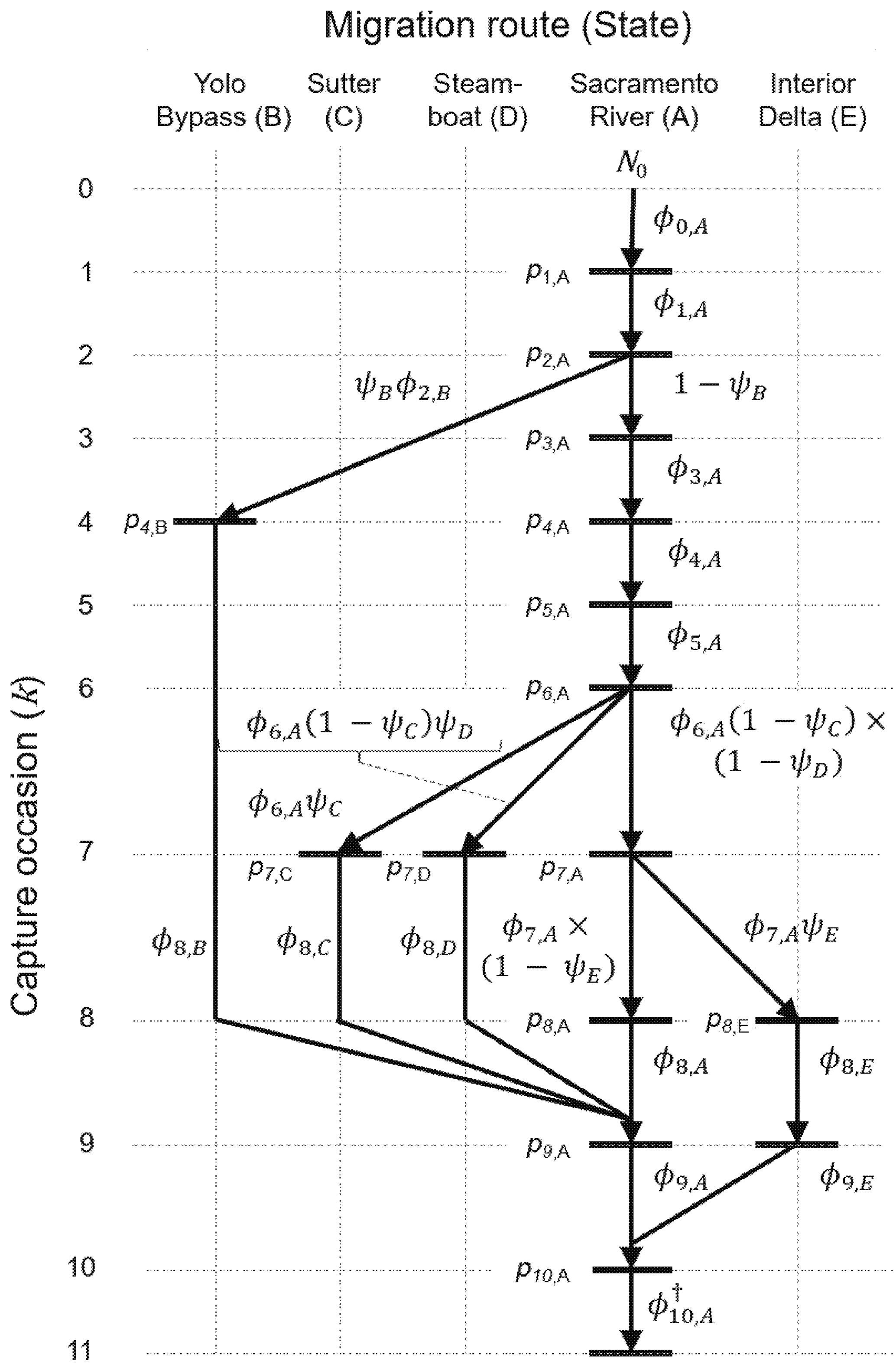

Migration route (State)
Yolo Bypass (B)
Sutter (C)
Steam-boat (D)
Sacramento River (A)
Interior Delta (E)
Capture occasion (k)
N_0
$\phi_{0,A}$
$p_{1,A}$
$\phi_{1,A}$
$p_{2,A}$
$\psi_B\phi_{2,B}$
$1-\psi_B$
$p_{3,A}$
$\phi_{3,A}$
$p_{4,B}$
$p_{4,A}$
$\phi_{4,A}$
$p_{5,A}$
$\phi_{5,A}$
$p_{6,A}$
$\phi_{6,A}(1-\psi_C)\psi_D$
$\phi_{6,A}(1-\psi_C)\times(1-\psi_D)$
$\phi_{6,A}\psi_C$
$p_{7,C}$
$p_{7,D}$
$p_{7,A}$
$\phi_{8,B}$
$\phi_{8,C}$
$\phi_{8,D}$
$\phi_{7,A}\times(1-\psi_E)$
$\phi_{7,A}\psi_E$
$p_{8,A}$
$p_{8,E}$
$\phi_{8,A}$
$\phi_{8,E}$
$p_{9,A}$
$\phi_{9,A}$
$\phi_{9,E}$
$p_{10,A}$
$\phi^{\dagger}_{10,A}$
0
1
2
3
4
5
6
7
8
9
10
11

Figure 3: Daily discharge and daily maximum temperature observed at Freeport during 2014-2018 over a 70 day migration window from the first date of acoustic tagged fish release in each year. The limits of the shaded area represent the daily minimum and maximum record from 88 year (1930-2018) and 57 year (1961-2018) period of record for discharge and temperature respectively.

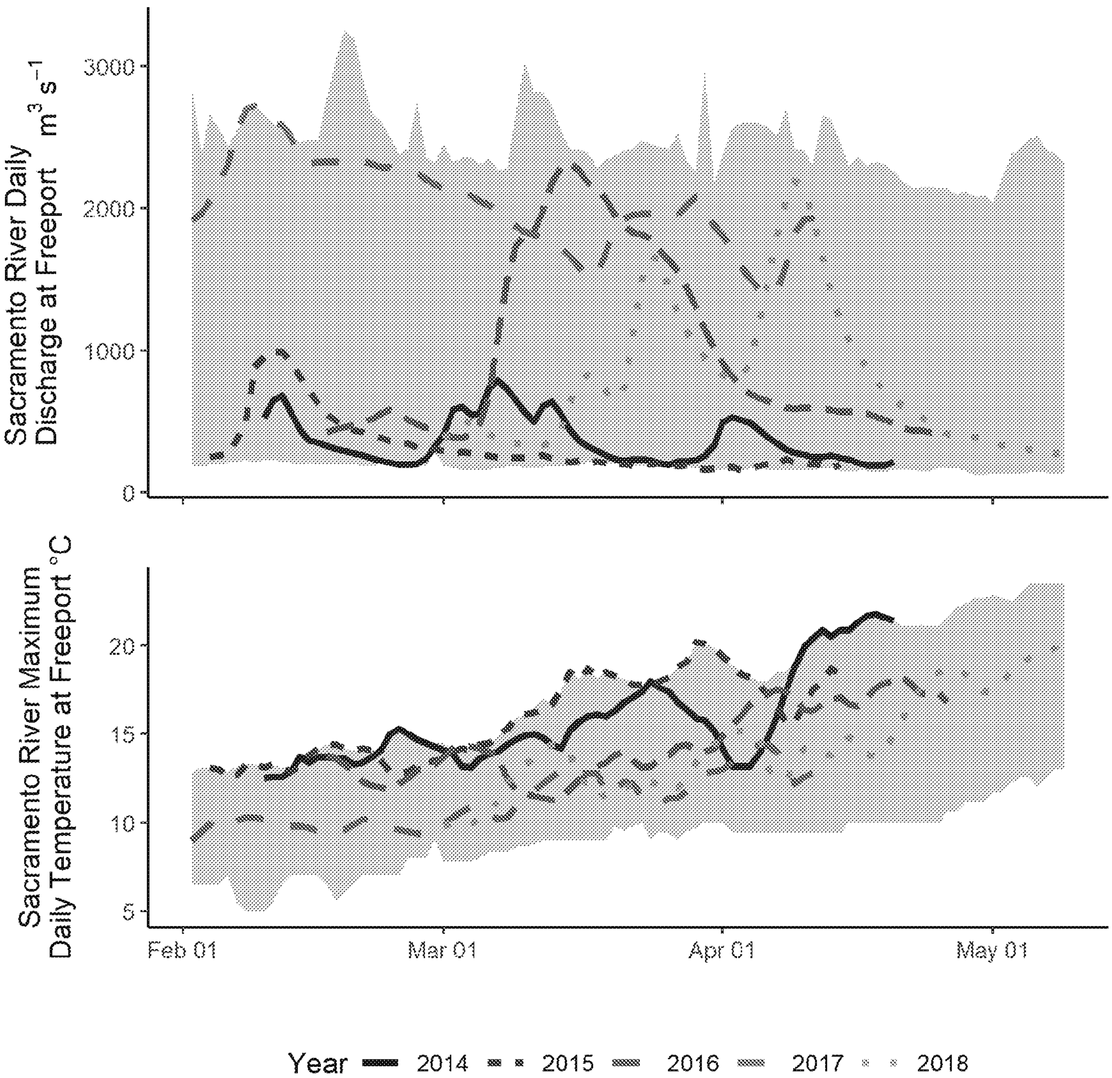


Figure 4: Summary of posterior distributions of parameters for the effects of discharge, maximum daily temperature and export-import ratio on survival in each reach of the Sacramento River Delta for acoustic tagged hatchery-reared winter run Chinook salmon. Parameter estimates are based on the logit-link of survival. Discharge is the centered and scaled reach-specific mean daily discharge. Max Temp is the centered and scaled maximum daily water temperature at Freeport for all reaches except 03B and 08B which used Yolo Bypass maximum daily water temperature. EI Ratio is the daily ratio of exported water to inflow.

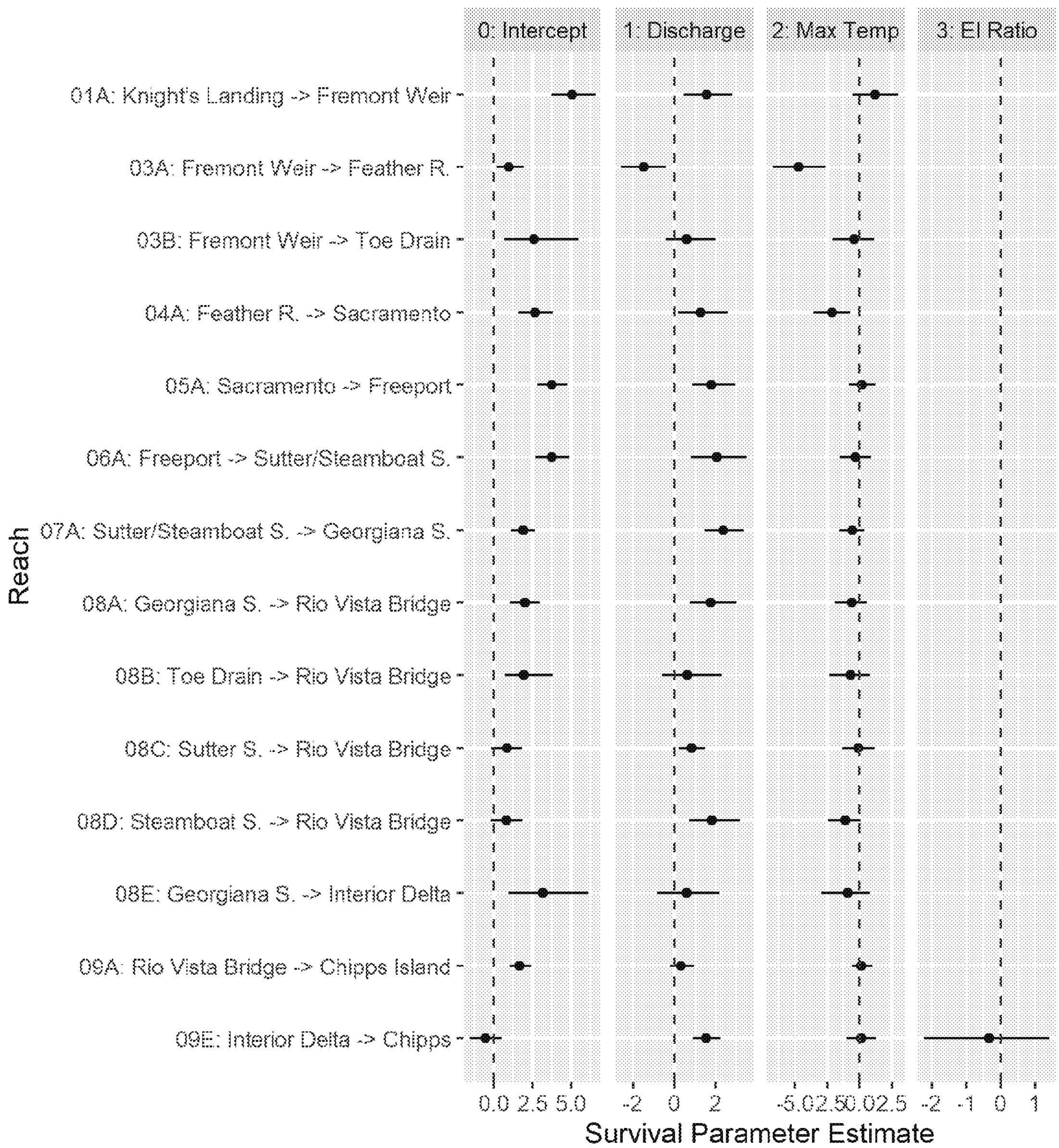


Figure 5: Relationship between discharge and survival probabilities for hatchery-reared winter run Chinook salmon migrating through the Sacramento River Delta from 2014 through 2018. Lines denote the posterior mean and shaded area the 90% uncertainty interval. The x-axis extends from the minimum to maximum observed daily value during the study period. The discharge covariate used in the model differed among reaches: for reaches 01A and 03A we used Fremont Weir stage height, for reaches 03B and 08B we use Yolo Bypass flow, for reaches 09A we used Rio Vista flow, for all other reaches we used tidally averaged flows at Freeport.

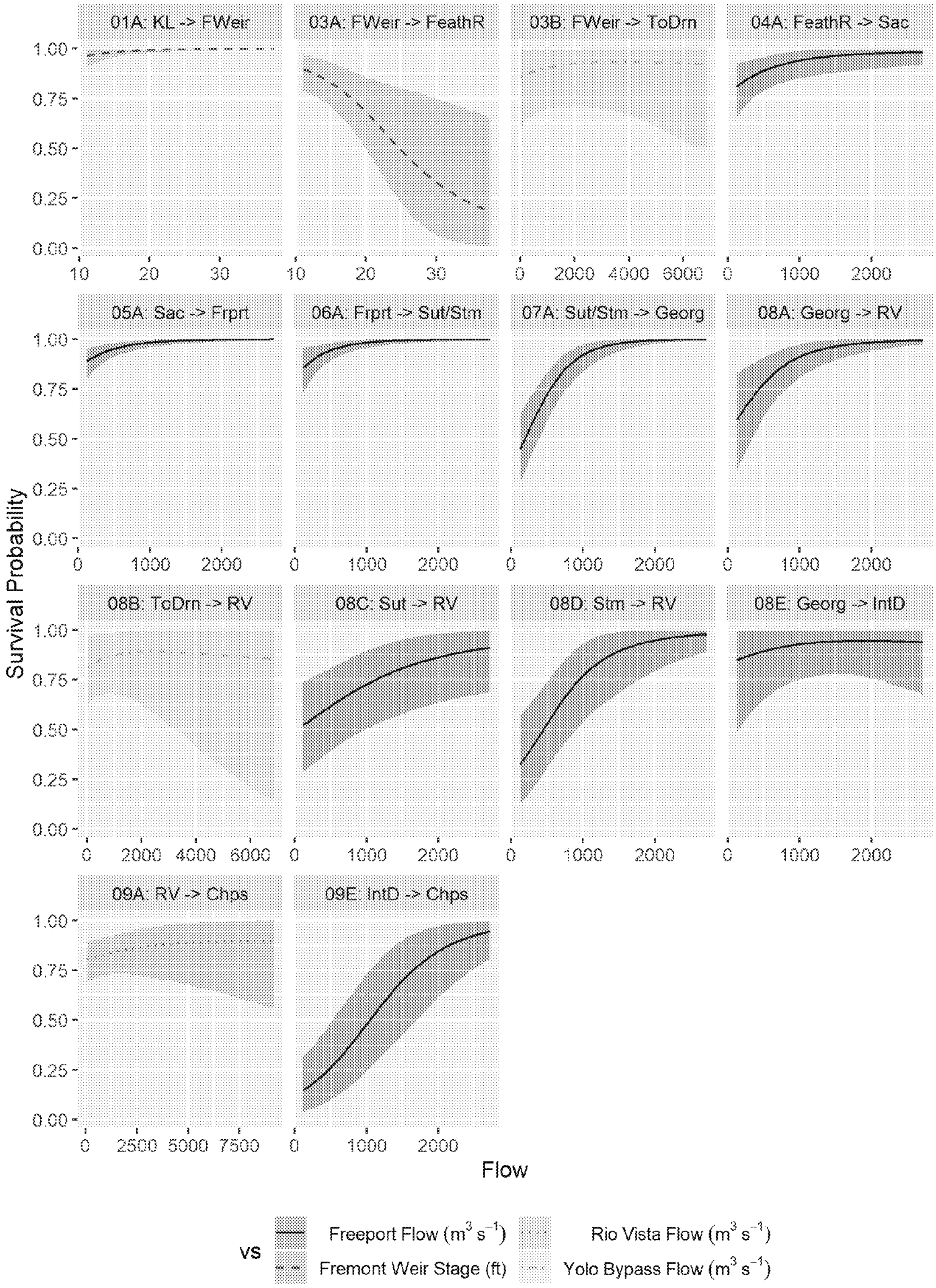

01A: KL -> FWeir
03A: FWeir -> FeathR
03B: FWeir -> ToDrn
04A: FeathR -> Sac
05A: Sac -> Frprt
06A: Frprt -> Sut/Stm
07A: Sut/Stm -> Georg
08A: Georg -> RV
08B: ToDrn -> RV
08C: Sut -> RV
08D: Stm -> RV
08E: Georg -> IntD
09A: RV -> Chps
09E: IntD -> Chps
Survival Probability
Flow
vs
Freeport Flow (m^3 s^-1)
Fremont Weir Stage (ft)
Rio Vista Flow (m^3 s^-1)
Yolo Bypass Flow (m^3 s^-1)

Figure 6: Relationship between water temperature and survival probabilities for hatchery-reared winter run Chinook salmon migrating through the Sacramento River Delta from 2014 through 2018. Lines denote the posterior mean and shaded area the 90% uncertainty interval. The x-axis extends from the minimum to maximum observed daily value during the study period.

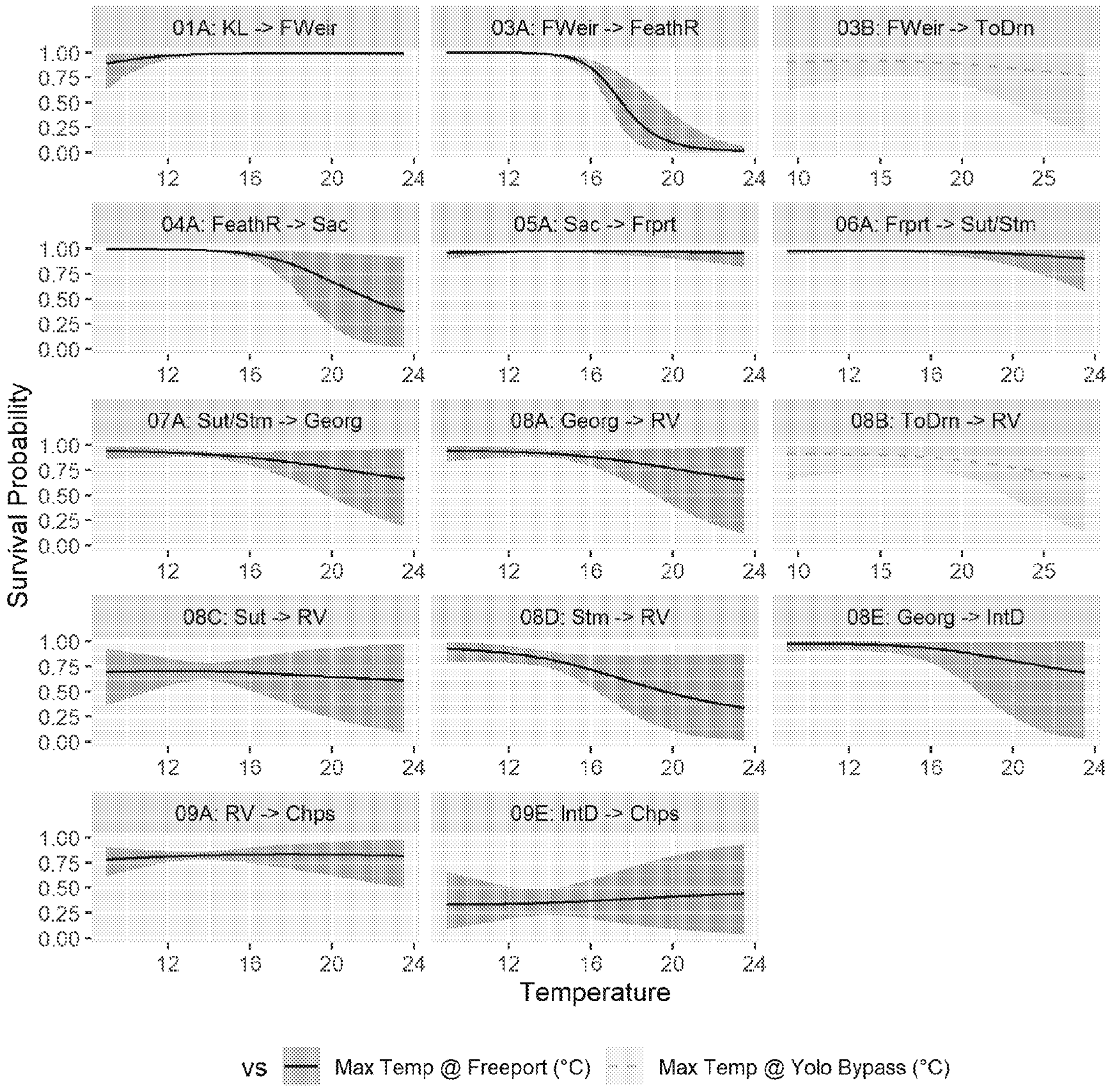


Figure 7: Summary of posterior distributions of parameters for the effect of discharge on median travel time through each reach of the Sacramento River Delta for acoustic tagged hatchery-reared winter run Chinook salmon. Parameter estimates are based on the log-mean of lognormally distributed travel times. Discharge is the centered and scaled reach-specific mean daily discharge.

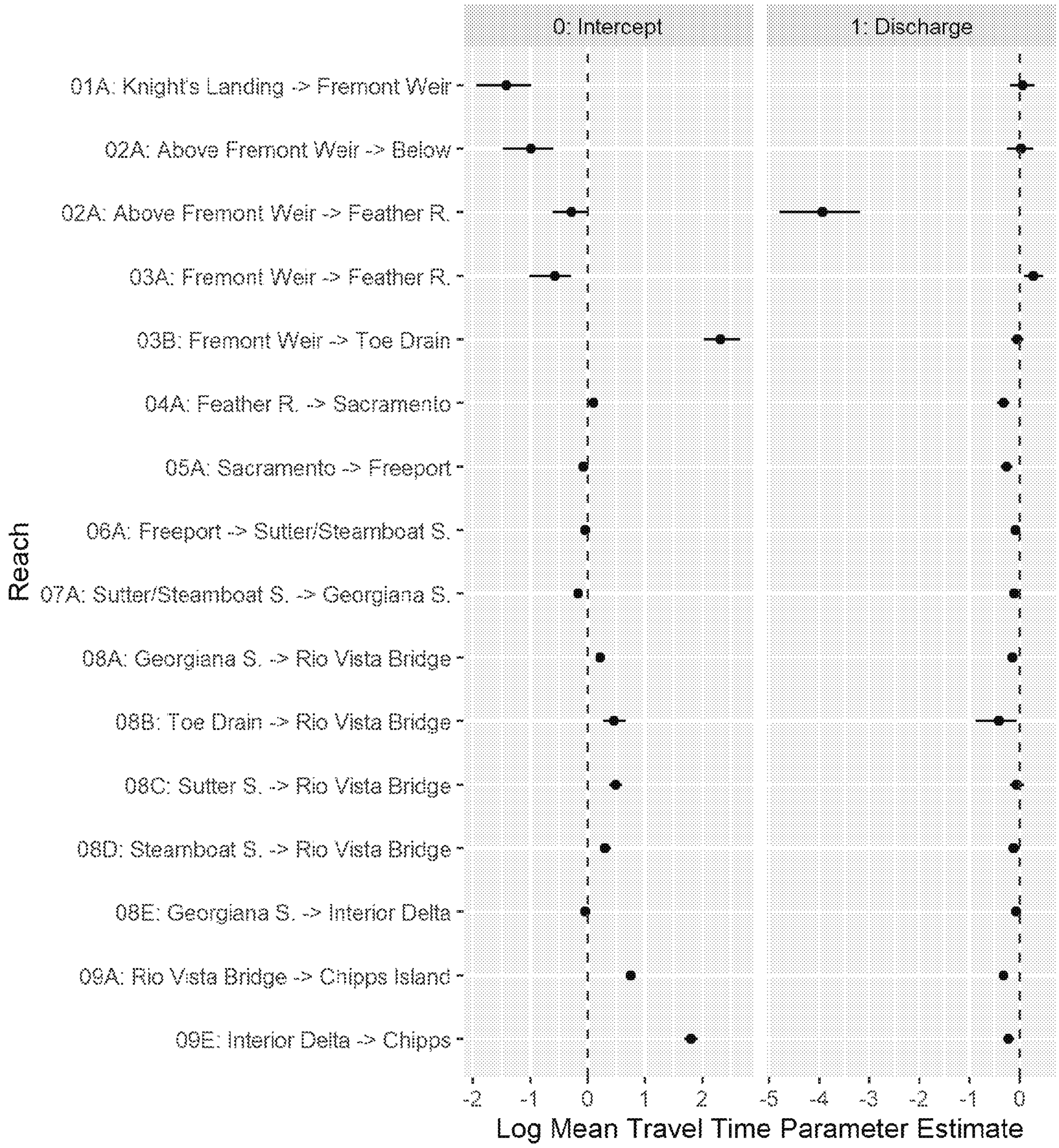


Figure 8: Relationship between discharge and median travel times for hatchery-reared winter run Chinook salmon migrating through the Sacramento River Delta from 2014 through 2018. Lines denote the posterior mean and shaded area the 90% uncertainty interval. The x-axis extends from the minimum to maximum observed daily value during the study period. The discharge covariate used in the model differed among reaches: for reaches 01A and 03A we used Fremont Weir stage height, for reaches 03B and 08B in the Yolo Bypass we use Yolo Bypass flow, for reaches 09A we used Rio Vista flow, for all other reaches we used tidally averaged flows at Freeport.

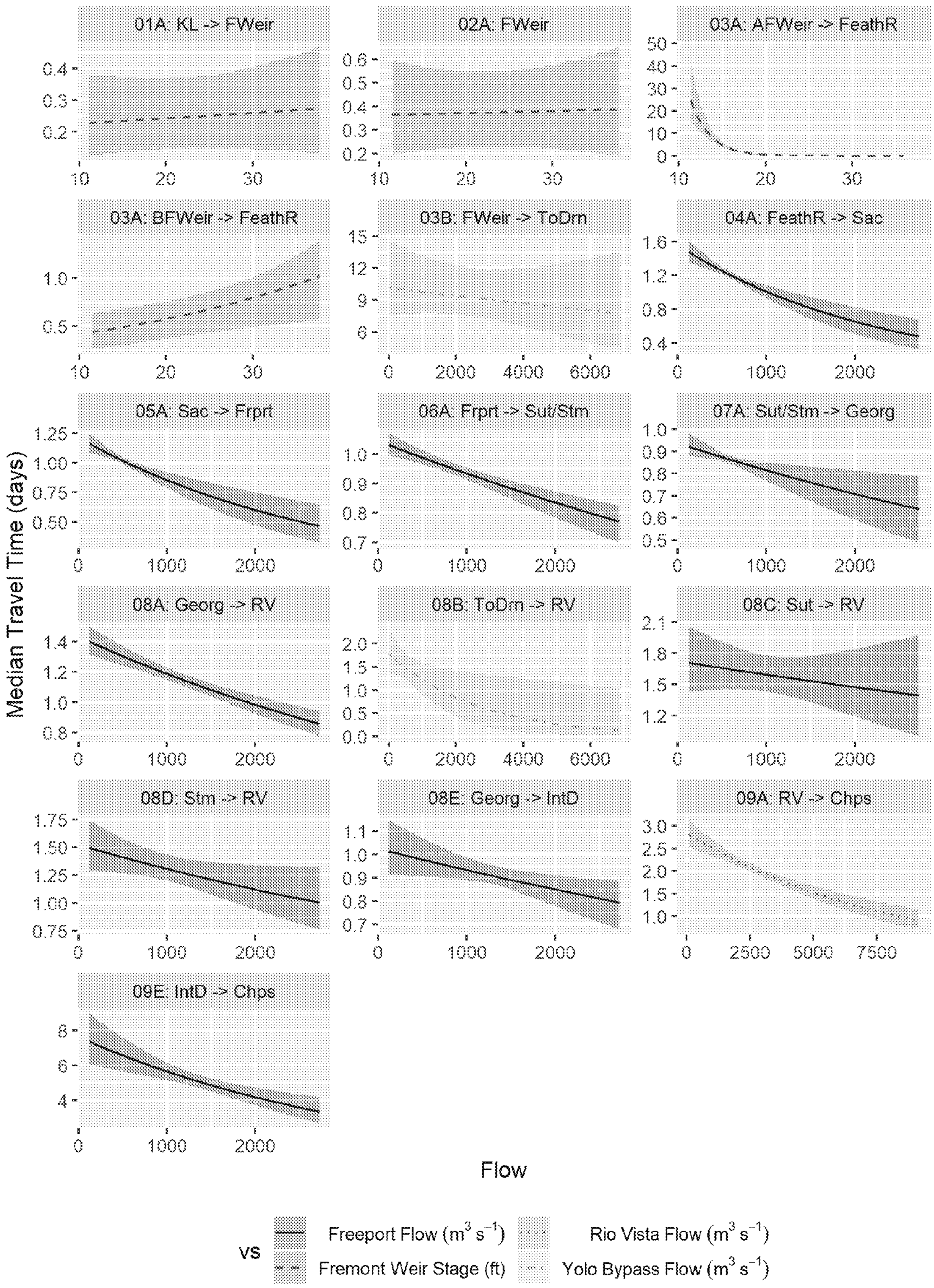

01A: KL -> FWeir
02A: FWeir
03A: AFWeir -> FeathR
03A: BFWeir -> FeathR
03B: FWeir -> ToDrn
04A: FeathR -> Sac
05A: Sac -> Frprt
06A: Frprt -> Sut/Stm
07A: Sut/Stm -> Georg
08A: Georg -> RV
08B: ToDrn -> RV
08C: Sut -> RV
08D: Stm -> RV
08E: Georg -> IntD
09A: RV -> Chps
09E: IntD -> Chps
Median Travel Time (days)
Flow
vs
Freeport Flow (m³ s⁻¹)
Fremont Weir Stage (ft)
Rio Vista Flow (m³ s⁻¹)
Yolo Bypass Flow (m³ s⁻¹)

Figure 9: Summary of posterior distributions of parameters for the effect of proportion of flow entering each channel on routing probability at each transition point of major routes through the Sacramento River Delta for acoustic tagged hatchery-reared winter run Chinook salmon. Parameter estimates are based on the logit-link of routing probability. For Yolo Bypass, discharge is the river stage above the Fremont Weir (equal to 0 when Fremont Weir is not overtopping), for the other three junctions discharge is daily mean Freeport flow.

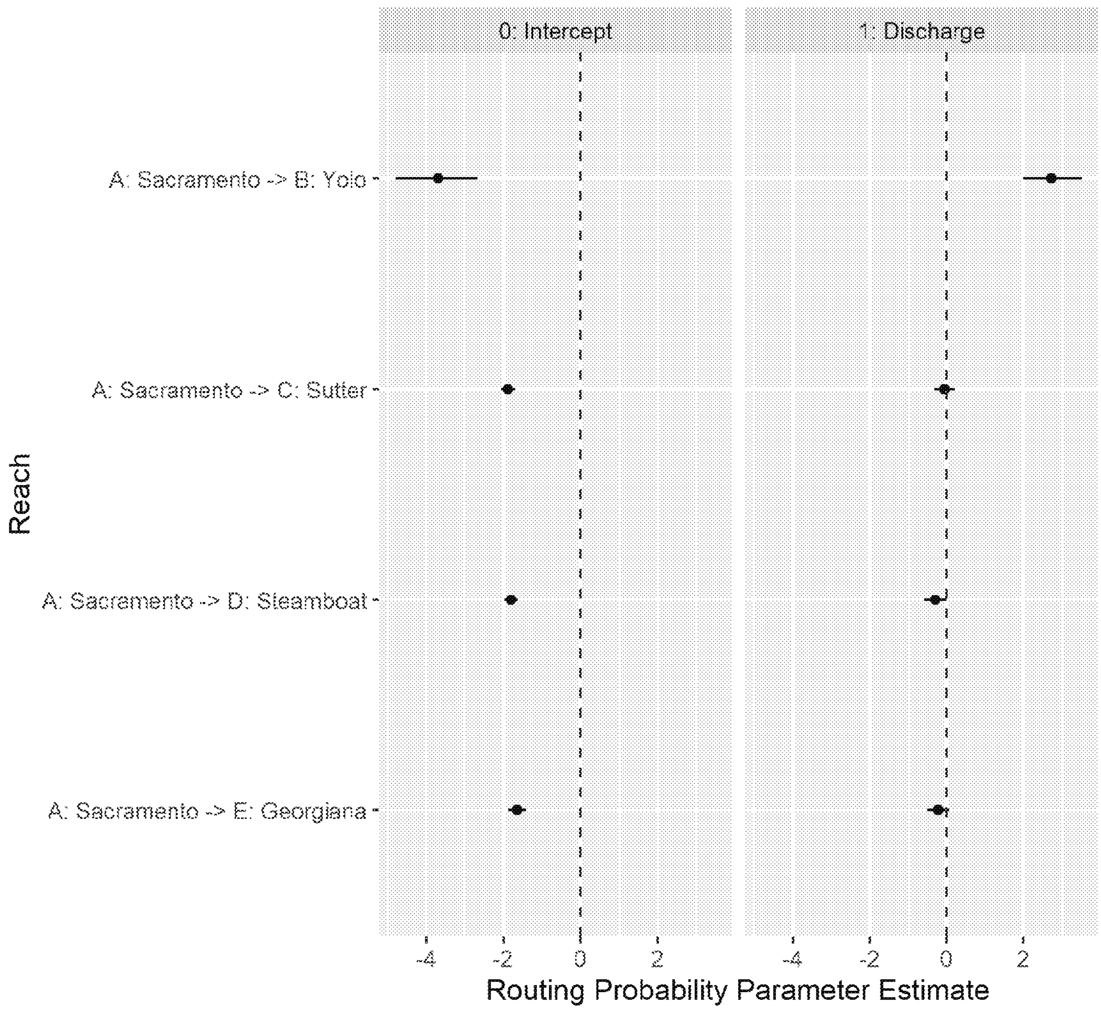


Figure 10: Relationship between discharge and routing probabilities for hatchery-reared winter run Chinook salmon migrating through the Sacramento River Delta from 2014 through 2018. Lines denote the posterior mean and shaded area of the 90% uncertainty interval. The x-axis extends from the minimum to maximum observed daily value during the study period.

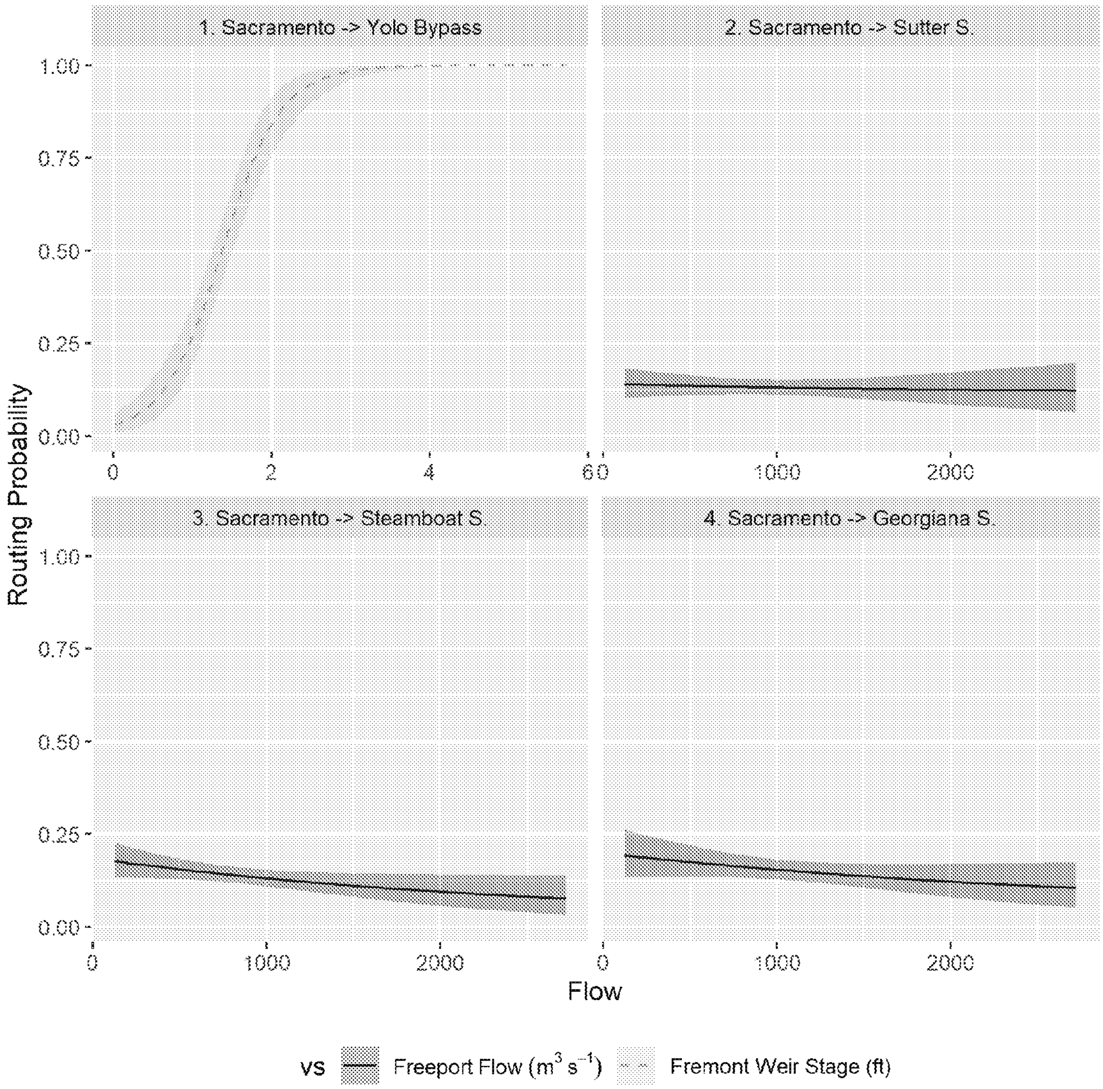
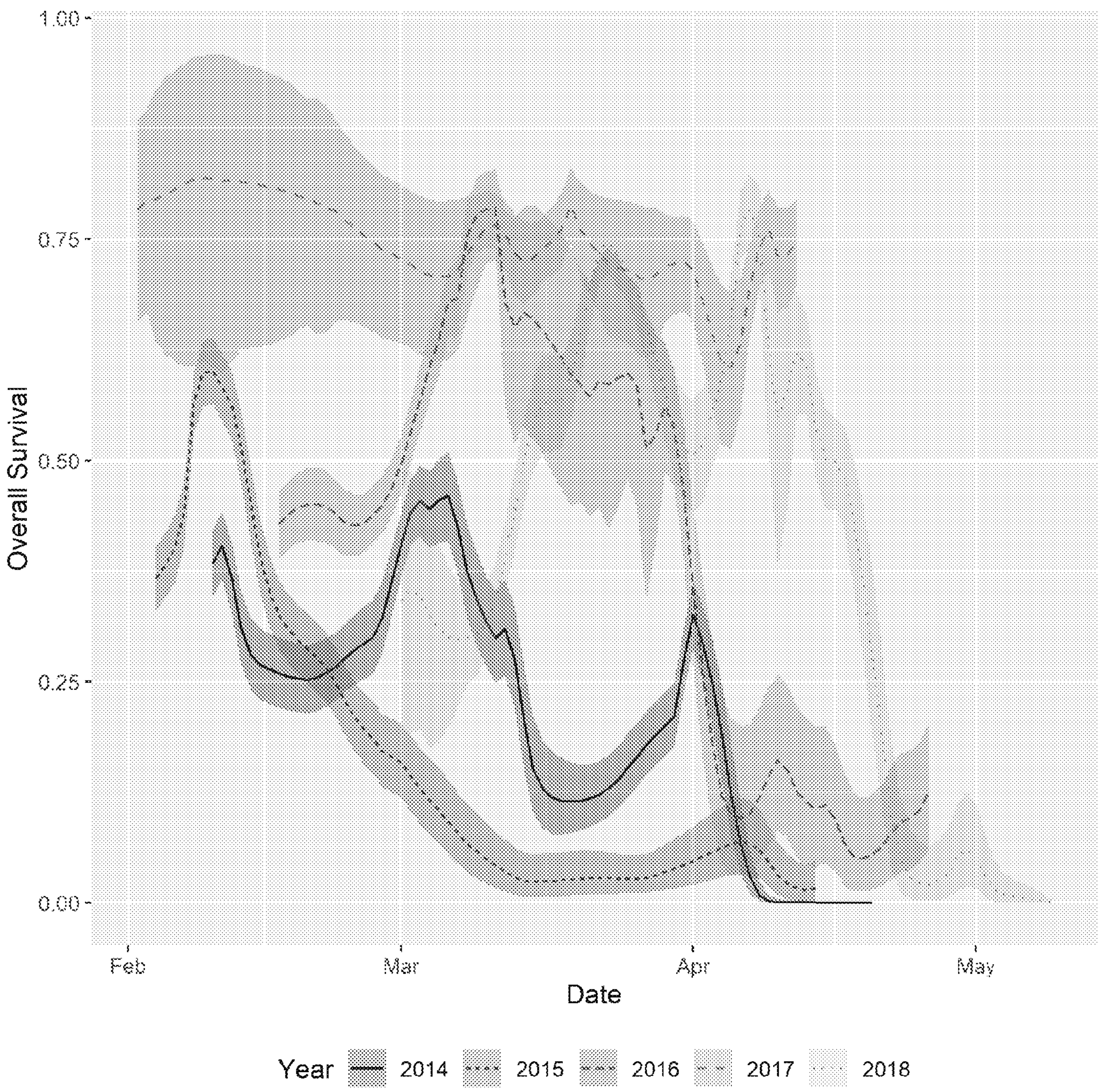


Figure 11: Overall survival through the Sacramento River Delta from Knights Landing to Chipps Island for winter run Chinook salmon based on day of passage at Knights Landing. Overall survival is calculated by summing through all possible daily survival, arrival day and routing probabilities through downstream reaches. The shaded area represents the 90% uncertainty interval.



Tables for: From drought to deluge: variation in survival and riverine habitat use of an endangered migratory fish across spatial and temporal scales

Table 1: Release groups of hatchery-reared winter run Chinook Salmon released in the Sacramento River for evaluation of survival, travel time, and routing. Release RKM is the river kilometer from the Golden Gate Bridge.

Year	Release Date	Release RKM	n	Average Weight (SD) (g)	Average Length (SD) (mm)
2014	Feb 10	551.3	358	9.4 (2.4)	94.5 (7.7)
2015	Feb 04	551.3	249	10.5 (1.9)	99.5 (5.9)
2015	Feb 06	551.3	318	10.5 (2)	100.5 (6.2)
2016	Feb 17	540.3	285	9.4 (1.7)	95.5 (5.4)
2016	Feb 18	540.3	285	9.2 (1.5)	95.4 (4.9)
2017	Feb 02	551.3	569	9.1 (2.4)	93.1 (7.6)
2018	Mar 01	540.3	361	16.5 (4.8)	111.9 (10.2)
2018	Mar 13	540.3	237	10.7 (2.5)	97.5 (6.9)

Table 2: Reaches of the Sacramento River for the temporally stratified multistate mark-recapture model. Survival covariates describes which combinations of flow and temperatures variables were used to estimate survival probability. The flow covariate for each reach was also used to model log-mean travel time to the next reach and the probability of detection upon entering the reach. Periods when the entrance to a reach was not monitored due to expansion of the telemetry network over time or due to damage to the acoustic receivers is noted.

Reach	Survival Covariates	Notes
00A: Release to Knight's Landing	NA	
01A: Knight's Landing to Fremont Weir	Fremont Weir Stage + Freeport Max Temperature	
02A: Fremont Weir	NA	Above Fremont Weir only monitored in 2017 and 2018; outage from 04/04 - 04/06 in 2018
03A: Fremont Weir to Feather R.	Fremont Weir Stage + Freeport Max Temperature	Below Fremont Weir only monitored in 2017 and 2018; outage from 03/23 - 03/29 & 04/04 - 04/06 in 2018
03B: Fremont Weir to Toe Drain	Yolo Bypass Flow + Yolo Bypass Max Temperature	
04A: Feather R. to City of Sacramento	Freeport Flow + Freeport Max Temperature	Feather R. receiver outage from 02/02 - 03/36 in 2017
05A: Sacramento to Freeport	Freeport Flow + Freeport Max Temperature	
06A: Freeport to Sutter/Steamboat S.	Freeport Flow + Freeport Max Temperature	Freeport receiver outage from 02/04 - 02/23 in 2015
07A: Sutter/Steamboat S. to Georgiana S.	Freeport Flow + Freeport Max Temperature	
08A: Georgiana S. to Rio Vista Bridge	Freeport Flow + Freeport Max Temperature	Sacramento R. below Georgiana S. receiver outage for all of 2016, after 03/13 in 2017, and from 03/22 - 04/16 in 2018
08B: Toe Drain to Rio Vista Bridge	Yolo Bypass Flow + Yolo Bypass Max Temperature	Yolo Bypass only monitored in 2016 - 2018
08C: Sutter S. to Rio Vista Bridge	Freeport Flow + Freeport Max Temperature	Sutter S. receiver outage from 02/02 - 03/07 in 2017
08D: Steamboat S. to Rio Vista Bridge	Freeport Flow + Freeport Max Temperature	

08E: Georgiana S. to Interior Delta	Freeport Flow + Freeport Max Temperature	Georgiana Slough entrance receiver outage for all 2016 and 2017
09A: Rio Vista Bridge to Chipps Island	Rio Vista Flow + Freeport Max Temperature	
09A: Rio Vista Bridge to Benecia	Rio Vista Flow + Freeport Max Temperature	Chipps Island not monitored in 2014 and 2015
09E: Interior Delta to Chipps Island	Freeport Flow + Freeport Max Temperature + Exports/Inflow	
09E: Interior Delta to Benecia	Freeport Flow + Freeport Max Temperature + Exports/Inflow	Chipps Island not monitored in 2014 and 2015
10A: Chipps Island to Benecia	NA	

From: Micko, Steve/SAC [Steve.Micko@jacobs.com]
Sent: 9/23/2021 4:53:25 PM
To: Greenwood, Marin [Marin.Greenwood@icf.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]; Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Subject: RE: SPJPA Sites: Additional Sensitivity Run

Hi Marin,

I've posted suitable floodplain habitat acreages from this run to the same link.
You may find these data in column H of the spreadsheet below:

- SPJPA_Sites_HabitatAcreageByMonthWYT_AllRegions__NAA_ALT1B_ALT1B_MAM_WS107k__NoFre_MAM_WS107k__NoFre_NoPPZ_OctJun_WS107k_NoFre_OctNovPPZ_DecJunWS107k.xlsx

Please let me know if you have any questions.

Best,
Steve

From: Greenwood, Marin <Marin.Greenwood@icf.com>
Sent: Wednesday, September 22, 2021 8:13 AM
To: Micko, Steve/SAC <Steve.Micko@jacobs.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Subject: [EXTERNAL] RE: SPJPA Sites: Additional Sensitivity Run

Thanks, Steve, I'll let you know if I have any questions.

MARIN GREENWOOD | **ICF** | marin.greenwood@icf.com | **+1.530.400.8081 mobile**

From: Micko, Steve/SAC <Steve.Micko@jacobs.com>
Sent: Tuesday, September 21, 2021 18:03
To: Greenwood, Marin <Marin.Greenwood@icf.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; John Spranza <John.Spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Subject: SPJPA Sites: Additional Sensitivity Run

Hi Marin,

Reed developed an EI ratio timeseries for one additional sensitivity run.

You may access these timeseries data here:

- Link: Diversion Criteria - 2021
- Spreadsheet name:
SPJPA_Sites_Act_EI_Ratio_NAA_ALT1A_ALT1B_ALT2_011221_ALT3_020121_ALT1B_MAM_WS107k_ALT1B_NoFW_MAM_WS107k_ALT1B_NoFW_NoPP_Oct-Jun_WS107k_ALT1B_NoFW_Oct-Nov_PP_Dec-Jun_WS107k.xlsx
    - New data are posted in column K.

I will post positive entrainment and suitable habitat area in the next day or two.

Please let me know if you have any questions.

Best,
Steve

Steve Micko, PE | Jacobs | Project Manager
O:916.286.0358 | M:408.834.6614 | Steve.Micko@jacobs.com
2485 Natomas Park Drive Suite 600 | Sacramento, CA 95833

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From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 9/24/2021 7:02:05 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Sites - Chapter 2 and Chapter 11 Status

Thanks - sent basically the same email yesterday with no reply. I did coordinate with Melissa on schedule and after discussing with Nicole had them push the Final EIR/EIS to October 2022, with the ROD at the end of the year.

On Sep 24, 2021, at 6:55 AM, Alicia Forsythe <aforsythe@sitesproject.org> wrote:

Hi Vanessa and Melissa – I just wanted to check in on the status of edits to Chapter 2 and the remaining concerns with Chapter 11. We were hoping to get these just as soon as possible to keep things moving.

Also, we are working on the qualitative text for Chapter 11 and expect to have that to you later today.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Alicia Forsythe [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=A6CDF06A7E904B65BAA21702A82AD329-AFORSYTHE]
Sent: 9/24/2021 7:06:08 AM
To: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Linda Fisher [Linda.Fisher@hdrinc.com]
Subject: RE: Sites - SDEIS Briefing Materials

I think this looks good. Lets go with the earlier dates to keep the pressure on the schedule.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Thursday, September 23, 2021 8:27 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Linda Fisher <Linda.Fisher@hdrinc.com>
Subject: Fwd: Sites - SDEIS Briefing Materials

I think this aligns with the Amendment 3 work plan, except for the date of the ROD. I was assuming end of year or early 2023. Any comments ?

Begin forwarded message:

From: "Dekar, Melissa D" <mdekar@usbr.gov>
Date: September 23, 2021 at 7:47:54 AM PDT
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Cc: "King, Vanessa M" <vking@usbr.gov>
Subject: Sites - SDEIS Briefing Materials

Hi Laurie,

I'm revisiting the SDEIS briefing materials and wanted to talk with you about the schedule. Given the delay in getting the document out, I'm wondering if we want to go ahead and discuss adjustments to future milestones that are reported in our NEPA schedule for the briefing. Here's what's currently included and some adjustments in red for your consideration. We'd like to provide a realistic schedule and coordinate with you to ensure we're messaging the same dates.

Milestone	Date
Notice of Preparation	November 5, 2001

Notice of Intent	November 9, 2001
Scoping Period End	January 25, 2002
Notice of Preparation	February 2, 2017
Draft EIS/EIR Notice of Availability	August 18, 2017
Supplemental Draft EIS/Revised Draft EIR Notice of Availability	~~September 3, 2021~~ November 12, 2021
Final EIS/EIR Notice of Availability	July 15, 2022 Consider adjusting to September 15, 2022
Record of Decision	August 26, 2022 Consider adjusting to November 15, 2022

Talk soon,
Melissa

Melissa Dekar
Natural Resources Specialist
Environmental Compliance and Conservation Branch, CGB-152
2800 Cottage Way, Sacramento, CA, 95825
Interior Region 10, Bureau of Reclamation
916-978-6153 mdekar@usbr.gov

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 9/24/2021 8:02:40 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Lecky, Jim [jim.Lecky@icf.com]; Hendrick, Mike [Mike.Hendrick@icf.com]; Angela Bezzone [bezzone@mbkengineers.com]; steve.micko@jacobs.com; Marc VanCamp [Vancamp@mbkengineers.com]
Subject: RE: Sites Project Briefing for EBMUD

Mike and I just reviewed the PPT and to make the presentation flow slightly better we moved his 4 slides that covered the aquatic effects from the Modeling Results section to the RDEIR/SDEIS Aquatic Impact Determinations. This keeps all the biological effects in one location.

I also wanted to note that although Marin is on the agenda, he is not on the meeting invite will not be attending, we have Mike and Jim from the ICF team.

John Spranza

D 916.679.8858 M 818.640.2487

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, September 23, 2021 6:23 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Lecky, Jim <jim.Lecky@icf.com>; Hendrick, Mike <Mike.Hendrick@icf.com>; Angela Bezzone <bezzone@mbkengineers.com>; steve.micko@jacobs.com; Marc VanCamp <Vancamp@mbkengineers.com>
Subject: RE: Sites Project Briefing for EBMUD

Hi all – I took a look at the presentation and made a few changes (I am finishing up one figure now that froze my adobe, so technically, almost done). I think we're ready for the meeting tomorrow morning. Thanks all for getting all of this together!

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Wednesday, September 22, 2021 2:47 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Lecky, Jim <jim.Lecky@icf.com>; Hendrick, Mike <Mike.Hendrick@icf.com>; Angela Bezzone <bezzone@mbkengineers.com>; steve.micko@jacobs.com; Marc VanCamp <Vancamp@mbkengineers.com>
Subject: RE: Sites Project Briefing for EBMUD

Hi all,

Linked here is a folder with the agenda and presentation for Friday's meeting with EBMUD. I put placeholders in for various sections and assigned people for content in those sections. Steve – as I note in the presentation there are some slides in the "bullpen" you can pull from if they're helpful. Please try to make any changes by midday tomorrow so we can review before the meeting Friday morning.

Link: EBMUD

Thanks!
Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

-----Original Appointment-----
From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, September 14, 2021 3:06 PM
To: Alicia Forsythe; Alicia Forsythe; Spranza, John; Heydinger, Erin; Jim Lecky (jim.Lecky@icf.com); Setka, Jose; Hendrick, Mike; Angela Bezzone; steve.micko@jacobs.com; Marc VanCamp
Cc: Leaf, Rob/SAC; Tam, Lena; Workman, Michelle; Bray, Benjamin; Tognolini, Michael
Subject: Sites Project Briefing for EBMUD
When: Friday, September 24, 2021 9:00 AM-11:00 AM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

Agenda will follow as we get closer to the meeting.

Microsoft Teams meeting

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Or call in (audio only)
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Phone Conference ID: 330 000 561#
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Learn More | Meeting options

From: Carlson, Nik [nik.carlson@aecom.com]
Sent: 9/24/2021 10:03:25 AM
To: Luu, Henry [Henry.Luu@hdrinc.com]; jeff.herrin@aecom.com
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: Re: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Henry I will review the responses this afternoon and will try to see if I can tie in any information obtained from their website and provide follow responses to try and prompt any more specific details and/or documentation from the District.

~ Nik

From: Luu, Henry <Henry.Luu@hdrinc.com>
Date: Thursday, September 23, 2021 at 3:10 PM
To: Herrin, Jeff <jeff.herrin@aecom.com>, Carlson, Nik <nik.carlson@aecom.com>
Cc: Joe Trapasso <jtrapasso@sitesproject.org>, Heydinger, Erin <Erin.Heydinger@hdrinc.com>, Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: [EXTERNAL] FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Jeff and Nik, see attached responses from CVWD.

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Robert Cheng <RCheng@cvwd.org>
Sent: Thursday, September 23, 2021 2:45 PM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Cc: Zoe Rodriguez del Rey <ZRodriguezdelRey@cvwd.org>; Petya Vasileva <PVasileva@cvwd.org>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hi Henry,

I am attaching CVWD's responses to the survey questions. These answers were addressed largely by Zoe, and I addressed question 1.

Let me know if you have any questions,
Robert

From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Sunday, September 19, 2021 4:54 PM
To: Randall Neudeck <rneudeck@mwdh2o.com>; Bob Tincher <bobt@sbvmwd.com>; jdavis@sgpwa.com; Robert Cheng <RCheng@cvwd.org>; AFlores (AFlores@zone7water.com) <AFlores@zone7water.com>
Cc: Jerry Brown <jbrown@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Jeff Herrin <Jeff.Herrin@aecom.com>; Carlson, Nik <nik.carlson@aecom.com>; Leaf,

Rob/SAC <Rob.Leaf@jacobs.com>
Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

External e-mail: Do not click on links or open attachments unless you recognize the sender and you know the content is safe.

Hello Sites Project members,

The project team has been hard at work coordinating with CWC staff/reviewers to ensure we are preparing a document that is compliant and meets the needs for the Commission's feasibility determination. We are at a point where your input is needed – the team is requesting participant-specific information demonstrating the expected use and economic benefit of the project's future water supply increases. This information is needed to show the project's economic feasibility for securing WSIP funding. Any information regarding your agency's valuation of Sites water supplies and related water quality benefits is greatly appreciated. This solicitation is targeted towards the top five SOD members with the largest water demand from the Project because we believe your input will have a greater influence on the economic analysis. Solicitated member Agency/District and a couple of potential contacts that may be able to assist are:

1. Metropolitan Water District (43 TAF) – Brandon Goshi
2. San Bernardino Valley Municipal Water District (18.4 TAF)
3. San Gorgonio Pass Water Agency (12.0 TAF)
4. Coachella Valley Water District (8.6 TAF) – Zoe Rodriguez Del Rey
5. Zone 7 Water Agency (8.6 TAF)

Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)

	South of Delta Deliveries ($/AF)					
	Wet	AB	BN	Dry	Critical	**LT Avg.**
2030	$225	$282	$295	$314	$397	$300
Conveyance	$148	$148	$148	$148	$148	$148
Total (2030)	**$373**	**$430**	**$443**	**$462**	**$544**	**$448**
2045	$456	$573	$698	$743	$1,165	$750
Conveyance	$148	$148	$148	$148	$148	$148
Total (2045)	**$604**	**$720**	**$846**	**$891**	**$1,313**	**$898**

conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

Information Request: Please review the above Table 1 default unit water benefit values and answer the questions below. Our technical staff are available to discuss the questions in further detail if necessary. Any supporting documentation for the responses (e.g. references to IWMP) and even approximate answers will be helpful. This is a time-sensitive request and we would appreciate an expedited response. Please note that the benefit value (supply cost) is for end-use location deliveries and not the cost from its origin.

Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:
a. What is the Sites Reservoir project's role/priority as a long-term water source in your future water supply planning?
b. Can you identify the alternate projects/sources that would be used to meet future supply needs (or reduce demand) if the Sites Reservoir is not built?

4. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

5. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

6. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?
a. Are any estimates/examples of the water shortage costs to the District and/or its users available? Please provide any available information on any past water transfers (unit cost, quantity and source) or other emergency drought cost estimates.

Please let us know your availabilities if a meeting is desired.
Thank you for your support,

Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

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From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 9/24/2021 11:44:25 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Hendrick, Mike [Mike.Hendrick@icf.com]; Lecky, Jim [jim.lecky@icf.com]
CC: Williams, Nicole [Nicole.Williams@icf.com]
Subject: Anadromous fish benefits language.

Please see below for the language Jim, Mike and I worked up.

The additional water supply provided by Sites reservoir provides opportunities for improved management of salmonid habitat, particularly in the Sacramento River above Red Bluff Diversion Dam. By exchanging Sites' water for CVP water, Reclamation has an additional tool to maintain and improve habitat for salmonid spawning, incubation, rearing, and migration. By delivering water to CVP contractors from Sites Reservoir, Reclamation may maintain additional supply in Shasta Reservoir, which may then be allocated in real-time management scenarios to protect and enhance the cold-water pool, which is essential for temperature control in the salmonid spawning reaches below Keswick Dam during dry and critical years. The additional supply may also provide a resource for maintaining fall flows to maintain spawning redds that persist in the wetted margins of the river. In years when storm events are weak and pulse flows are minimal, this additional supply could be used to manufacture a spring pulse flow to assist juvenile salmonids in completing their migration from the upper Sacramento River to the Delta and out to sea.

As each water-year progresses, predictions of water-year type becomes more certain. By March, water managers have a reliable expectation of the availability of water supply for the remainder of the year and can include consideration of this additional supply in managing their environmental benefits to anadromous fish.

The Project also provides an additional capability to address expected changes in precipitation and runoff patterns expected to result from climate change. As discussed in Chapter 28, *Climate Change* is expected to result in more intense storms and an increased likelihood of multi-year droughts. While long term averages in precipitation are not expected to change, more precipitation is expected to fall as rain, resulting in a decreased snowpack and changes in run-off patterns. These changes will likely present challenges to the Reclamation to capture and store water from these storm events. The ability the Project to capture and store water that cannot be captured and stored by Reclamation creates flexibility to provide environmental benefits to anadromous fish in the upper Sacramento River under changing climate scenarios.

John Spranza, MS, CCN
Senior Ecologist / Regulatory Specialist

HDR
2379 Gateway Oaks Drive, Suite 200
Sacramento, CA 95833
D 916.679.8858 M 818.640.2487
john.spranza@hdrinc.com

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From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 9/24/2021 12:22:28 PM
To: Spranza, John [john.spranza@hdrinc.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: GGS effects review

Thanks John. I think this is okay for Yolo Bypass. You note CBD as well but not how flows would be adjusted to accommodate GGS in the CBD. We may potentially shift releases more towards October/November since that's when there's capacity in the CBD. Is there GGS habitat along the drain? My recollection is that there is. I think we could be okay because we would be operating to minimize flooding. Something to consider though.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

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From: Spranza, John <John.Spranza@hdrinc.com>
Sent: Thursday, September 23, 2021 10:39 AM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: GGS effects review

Hey Erin,
I thought I would send this over to you for review as it makes some statements about limiting our releases in certain areas to avoid effects to GGS.

4.1.1.1 *Hydrologic Effects*

Hydrologic modeling indicates that with the Project, the CBD, and Yolo Bypass could experience considerable increases in flows in October and moderate increases in November, which could affect giant gartersnakes (Jacobs Engineering 2021) during their dormant period (early October to early April) when they require upland refugia that do not experience flooding. To minimize flooding in October and November in Yolo Bypass, the Sites Reservoir would be operated to maintain summer flows within the Toe Drain, Tule Canal, and other channels. During the remainder of the giant gartersnake dormant period (December through March), the Project would result in low to moderate decreases in flows. These decreases would not adversely affect giant gartersnakes and could potentially be beneficial if they leave areas dry that would normally flood in the winter, providing additional suitable winter refugia for the species.

During their active period (generally April through September), giant gartersnakes require aquatic habitat with nearby uplands. During the first months of the giant gartersnake active period (April through July), the Project would result in moderate decreases in Yolo Bypass flows. This could adversely affect the species by reducing aquatic habitat during these months. During the latter months of the snake's active period (August through September), the Project would result in considerable increases in Yolo Bypass flows. If the increased flows inundate suitable areas for supporting aquatic giant gartersnake habitat with sufficient upland refugia nearby, the increased flows could have a beneficial effect on the species, particularly in dry years

John Spranza, MS, CCN
Senior Ecologist / Regulatory Specialist

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john.spranza@hdrinc.com

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From: King, Vanessa M [vking@usbr.gov]
Sent: 9/25/2021 10:44:55 AM
To: As-Salek, Junaid [JAsSalek@usbr.gov]; Melvin, Zana L [zmelvin@usbr.gov]; Westcot, Cathy [Cathy.Westcot@hdrinc.com]; Joe Trapasso [jtrapasso@sitesproject.org]
CC: Larson, Steven N [snlarson@usbr.gov]; Kabir, Jobaid N [jkabir@usbr.gov]
Subject: Re: Urgent!!! Signatures for SITES
Attachments: 1.a-Sites_FAA_SCOPE OF PROJECT WORK_Amd1_rev_signed.pdf

Hi all,

The signed SOW is attached. Please let me know if anything else is needed from me. Thanks for everyone's hard work on this.

Thanks,

Vanessa

Vanessa King
Hydrologist and Interim Project Manager for Sites Reservoir Project
Bureau of Reclamation, Interior Region 10 · California-Great Basin, Division of Planning
Office: 916-978-5077

From: As-Salek, Junaid <JAsSalek@usbr.gov>
Sent: Saturday, September 25, 2021 10:30 AM
To: Melvin, Zana L <zmelvin@usbr.gov>; Westcot, Cathy <Cathy.Westcot@hdrinc.com>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: Urgent!!! Signatures for SITES

Mike,

Please check the email-chain below. Jobaid will call you now.

Our Acquisition needs (1) a signed 424B from the Recipient, (2) a signed agreement from Joe of the Recipient, and
(3)a signed SOW from PM Vanessa.

Thanks,

Junaid

From: Melvin, Zana L <zmelvin@usbr.gov>
Sent: Saturday, September 25, 2021 10:03 AM
To: As-Salek, Junaid <JAsSalek@usbr.gov>; Westcot, Cathy <Cathy.Westcot@hdrinc.com>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: RE: [EXTERNAL] Re: Signatures for SITES

We will need a signed 424B and a signed SOW.

From: As-Salek, Junaid <JAsSalek@usbr.gov>
Sent: Saturday, September 25, 2021 9:55 AM
To: Melvin, Zana L <zmelvin@usbr.gov>; Westcot, Cathy <Cathy.Westcot@hdrinc.com>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: Re: [EXTERNAL] Re: Signatures for SITES

Thanks Zana and Cathy.

Zana,

Please send me a copy of the fully executed agreement when it is available.

Have a nice weekend!

-Junaid

From: Melvin, Zana L <zmelvin@usbr.gov>
Sent: Saturday, September 25, 2021 9:46 AM
To: Westcot, Cathy <Cathy.Westcot@hdrinc.com>; As-Salek, Junaid <JAsSalek@usbr.gov>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: RE: [EXTERNAL] Re: Signatures for SITES

Hi Cathy,

We were just informed that S. Marc Staunton signed the agreement on yesterday. Thanks again for all of your help.

From: Westcot, Cathy <Cathy.Westcot@hdrinc.com>
Sent: Saturday, September 25, 2021 8:38 AM
To: Melvin, Zana L <zmelvin@usbr.gov>; As-Salek, Junaid <JAsSalek@usbr.gov>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: Re: [EXTERNAL] Re: Signatures for SITES

Joe will be available later today to sign.

Cathy Westcot, PMP
Project Controls

HDR
2379 Gateway Oaks #200
Sacramento, CA 95833
M: 916-213-3076

From: Melvin, Zana L <zmelvin@usbr.gov>
Sent: Saturday, September 25, 2021 8:32:57 AM
To: Westcot, Cathy <Cathy.Westcot@hdrinc.com>; As-Salek, Junaid <JAsSalek@usbr.gov>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>

Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: RE: [EXTERNAL] Re: Signatures for SITES

Good Morning Cathy,

Yes, we would need Joe's signature. We are in the process of finalizing the Amendment. Thanks again.

From: Westcot, Cathy <Cathy.Westcot@hdrinc.com>
Sent: Saturday, September 25, 2021 8:14 AM
To: As-Salek, Junaid <JAsSalek@usbr.gov>; jtrapasso (jtrapasso@sitesproject.org) <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Melvin, Zana L <zmelvin@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: [EXTERNAL] Re: Signatures for SITES

Junaid,

Who's signature will you need, Joe Trapasso's?

Cathy Westcot, PMP
Project Controls

HDR
2379 Gateway Oaks #200
Sacramento, CA 95833
M: 916-213-3076

From: As-Salek, Junaid <JAsSalek@usbr.gov>
Sent: Saturday, September 25, 2021 8:09:11 AM
To: Westcot, Cathy <cathy.westcot@hdrinc.com>
Cc: Larson, Steven N <snlarson@usbr.gov>; King, Vanessa M <vking@usbr.gov>; Melvin, Zana L <zmelvin@usbr.gov>; Kabir, Jobaid N <jkabir@usbr.gov>
Subject: Re: Signatures for SITES

Cathy,

Are you available for signatures today?

Thanks,

Junaid

From: Melvin, Zana L <zmelvin@usbr.gov>
Sent: Saturday, September 25, 2021 7:35 AM
To: King, Vanessa M <vking@usbr.gov>
Cc: Larson, Steven N <snlarson@usbr.gov>; As-Salek, Junaid <JAsSalek@usbr.gov>
Subject: Signatures for SITES

Good Morning Vanessa,

I'm checking to see if the recipient is available for signatures today? Please advise. Thanks again.

Zana L. Melvin
Grants Management Specialist
Financial Assistance Branch, Division of Acquisition Services
— BUREAU OF —
RECLAMATION
Interior Region 10 - California Great Basin
2800 Cottage Way, Room E-1815
Sacramento, CA 95825
Office: (916) 978-5136
E-mail: zmelvin@usbr.gov

SITES JOINT POWERS AUTHORITY SCOPE OF PROJECT

Site Reservoir Program

Recipient
Sites Project Authority
122 Old Highway 99 West
Maxwell, CA 95955
530-438-2309

Recipient Point of Contact (POC)
Joe Trapasso
Sites Program Operations Manager
122 Old Highway 99 West
Maxwell, CA 95955
530-387-1102/jtrapasso@sitesproject.org

Recipient Personnel (Other than POC)
Jerry Brown
Executive Director
122 Old Highway 99 West
925-260-7417/jbrown@sitesproject.org

1. Executive Summary

The Sites Project Authority (Authority) will lead the efforts to continue the development of the California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) compliance approach and documentation through the recirculation and finalization of the Environmental Impact Report/Environmental Impact Statement (EIR/EIS) by utilizing the WIIN Act Federal funding. The Authority will also continue to develop the major project permits that are expected to be on the project's critical path schedule with submittal of the Biological Assessment, Water Right application, Incidental Take Permit (ITP), Section 106 Permit, and begin preparation of several other permits by December 2021.

2. Project Description:

The Sites Reservoir is proposed to be an off-stream reservoir that will be filled by pumping water from the Sacramento River. The project includes the Sites Reservoir and new facilities to integrate with both the existing Tehama-Colusa Canal (TC Canal) and Glenn-Colusa Irrigation District (GCID) Main Canal. Once constructed, the Sites Reservoir will be one of the state's largest reservoirs and will significantly increase surface water storage in the Sacramento Valley. The project's facilities will be independently owned and operated by the Authority under its own water rights and other regulatory requirements, in cooperation with United States Bureau of

Reclamation (Reclamation) and the California Department of Water Resources (DWR) in their operation of the Central Valley Project (CVP) and State Water Project (SWP), respectively.

WIIN Act funding will allow the project to continue development of the environmental documents and permits. The project scope is funding-limited and deliverables are identified based on the level of funding available to the project. The scope identified in the sections below will allow the Sites Project Authority to develop a revised draft EIR/EIS and begin to prepare essential project permit applications.

Amendment 1:

The Sites Project Authority will also respond to public comments and develop a final EIR/EIS. Additional project permit applications will be drafted or finalized and submitted.

3. Tasks/Objectives:

Describe the objectives of the project activities funded under this agreement

Task 1 – Environmental Planning: Revised Draft EIR/EIS for Public Comment

In August 2017, the Authority and Reclamation jointly issued a Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Project pursuant to their respective lead agency obligations under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). The preparation of the joint EIR/EIS was originally initiated by the DWR and Reclamation in 2001. A Notice of Intent (NOI) to prepare an EIS under NEPA was published in the Federal Register (Volume 66, Number 218) on November 9, 2001. An initial Notice of Preparation (NOP) to prepare an EIR for the NODOS Project was issued by the DWR, as the CEQA lead agency at that time, on November 5, 2001. Data collection, including biological and cultural resources field studies, was undertaken and a Preliminary Administrative Draft Environmental Impact Report (ADEIR) was completed in May 2014.

Subsequently, the Authority assumed the role of the CEQA lead agency in lieu of DWR and issued a Supplemental NOP on February 2, 2017. Reclamation continued in the federal lead agency role for the Project. Preparation of the joint Draft EIR/EIS relied substantially on DWR's 2014 ADEIR and the results of the much earlier field surveys as the basis for the 2017 analysis. The Draft EIR/EIS was circulated for public review and comments between August 14, 2017 and January 15, 2018. Over 141 comments letters and/or emails were received on the Draft EIR/EIS along with comments received at two public hearings held during the public review period. Between March 2019 and September 2019, Authority and Reclamation staff coordinated in the approach and initial drafting of responses to the comments received.

On October 1, 2019, this work was put on hold while the Authority's Ad Hoc Value Planning Workgroup undertook a value planning effort to "right size" the project based on the needs of its membership and feedback from permitting agencies. The Ad Hoc Value Planning Workgroup completed their effort and prepared the Sites Project Value Planning Alternatives Appraisal Report (Report). The Report addresses additional project alternatives identified through a screening process that considered total project cost, impacts on landowners, impacts on traffic and public safety, ability to meet participant demands, ability to provide public benefits to the State, relative magnitude of environmental impacts, and the estimated cost per acre-foot of water delivered. The alternatives considered by the Authority generally have smaller reservoir footprints and reduced diversions from the Sacramento River into Sites Reservoir than were proposed under Alternative D, evaluated as the preferred project in the 2017 Draft EIR/EIS. The new alternatives also include an updated approach to conveyance, including elimination of the Delevan Intake on the Sacramento River and associated pipeline. Instead, the revised alternatives propose release via a new pipeline to the Colusa Basin Drain and/or the Sacramento River near Dunnigan, California. This reconfiguration provides substantial cost savings and avoids the Delevan Wildlife Refuge. The location of the new pipeline is outside of the original project footprint and will affect other landowners and jurisdictions compared to the prior alternatives.

Based on these substantial changes and in consultation with the Authority's CEQA legal counsel, the Authority has determined that the Draft EIR should be revised to analyze the environmental effects of the new alternatives and recirculated for public review, consistent with CEQA. This would:

- provide full and open disclosure and provide the opportunity for the public to comment on the new alternatives;
- allow for a full description of the revised preferred project and the alternatives, including the modeled operational scenario and incorporation of the modeled baseline;
- update the environmental baseline to incorporate changes that have occurred in the physical environment since the DWR surveys;
- provide the ability to address recent federal decisions related to ROC on LTO, the BiOps and the COA;
- provide a more robust approach to addressing issues raised during the public review of the 2017 Draft EIR/EIS; and,
- promote informed decision-making by the Authority and other governmental agencies with approval authority over the Project.

Reclamation, as the NEPA lead agency, must also decide how to move forward with the EIS. NEPA (40 C.F.R. § 1502.9(c) provides for the supplementation of a Draft EIS if there are:

- Substantial changes in the proposed action that are relevant to environmental concerns, or
- Significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

Authority and Reclamation staff are working cooperatively on a joint path forward. The current assumption - given the substantially different project alternatives and to incorporate the recent ROC on LTO, BiOps and COA in operational modeling – is that NEPA compliance would require preparation of a Supplemental Draft EIS. Authority staff and consultants will continue to meet on a regular basis with Reclamation to confirm the NEPA approach and EIS process.

The Authority will lead the efforts to continue the development of the CEQA/NEPA compliance approach and documentation and will maintain the CEQA administrative record. There will also be ongoing efforts to assist Reclamation in the determination of environmental feasibility and to support the Authority's process in screening alternatives for potential environmental effects. This task includes effort associated with this document as well as coordination with legal counsel and assumes all document development will be performed by the Authority and will be reviewed by Reclamation, as appropriate.

The environmental team will develop an Environmental Document Work Plan for the Revised Draft EIR/EIS which will build on the work previously completed for the 2017 Draft EIR/EIS and to respond to the comments received on that document. The team will revisit the comments received on the 2017 Draft EIR/EIS and the draft master responses to comments and prepare a list of information needs which would strengthen the prior EIR/EIS analysis. They will prepare a recommended approach for how the integral thematic issues raised by commenters will be addressed in the recirculated document. Based on their findings, the team will identify preliminary list of technical studies and modeling that may be needed and required timeframes for completion in order to meet the proposed Public Draft release date as part of the Environmental Document Work Plan.

Sites staff and the consulting team will refine alternatives to be analyzed in the revised Draft EIR/EIS and recommend to the Reservoir Committee and Authority Board the preferred alternative. The environmental team will work with the engineering team and operations modeling team to confirm and refine the configuration, construction, and operation for the preferred alternative, and any other alternative chosen for analysis in the recirculated document. The team will develop a complete project description in collaboration with the engineering and operations teams.

Once the project description has been developed, the environmental team will proceed with the EIR/EIS analysis for construction and operations, including cumulative and climate change sections. The team will prepare a complete Administrative Draft for the Authority and Reclamation's review. The Authority will release the Revised Draft EIR/Supplemental Draft EIS for public review and comments and will issue required public notices. Reclamation will be responsible for facilitating publication of the Federal Register notice.

The Authority will prepare for and complete public hearings during the public comment period as required under CEQA and NEPA. Throughout the public comment period, the environmental team will categorize and sort comments by topic and will begin to develop an approach to the response to comments.

Amendment 1:
In Amendment 1, the Authority will continue to work with Reclamation in the completion of CEQA and NEPA documentation. Sites staff and the environmental consulting team will work with Reclamation staff to define and analyze an additional alternative, Alternative 3, which allows for an increase share (up to 25%) of federal investment. With the release of the Revised Draft EIR/Supplemental Draft EIS, continued efforts will focus on the preparation of the Final EIR/EIS. The team will develop an approach and finalize responses to Public comments and prepare the Administrative Final EIR/EIS. After review and incorporation of input from Reclamation, legal counsel and other team members, the environmental team will complete a Final EIR/EIS to support the project approval process.

Completion of the CEQA process will also require preparation of a Mitigation Monitoring and Reporting Program (MMRP), Findings of Fact and Statement of Overriding Considerations. The environmental team will support the Authority in preparing these documents. Assuming project approval, the environmental team will also support the Authority in the preparation of a Notice of Determination (NOD). The environmental team will also support Reclamation in completion of the NEPA process, including supporting documentation for the Record of Decision (ROD). Throughout the public review of the Revised Draft EIR and the Supplemental Draft EIS and Final EIR/EIS process, the Authority and consultants will be managing document retention and filing to support the administrative record for the project.

Major Tasks:
- Prepare Draft Environmental Work Plan
- Prepare Draft EIR/EIS Project Description Chapter
- Prepare Revised Admin Draft EIR/EIS
- Prepare Revised Public Draft EIR/EIS

Amendment 1 Major Tasks:
- Finalize Response to Public Comments
- Perform Analysis of Alternative 3
- Prepare Admin Final EIR/EIS
- Prepare Administrative Record for Final EIR/EIS
- Prepare Final EIR/EIS MMRP
- Support Findings, NOD

Task 2 – Project Permitting

The Authority will continue to develop the major project permits that are expected to be on the project's critical path schedule. This effort assumes work on the Federal Endangered Species Act (ESA) compliance (Biological Assessment [BA]), the National Historic Preservation Act compliance (Section 106 Programmatic Agreement), the California Endangered Species Act (CESA) compliance (i.e., State 2081 Incidental Take Permit), the US Army Corps of Engineers' (USACE) Section 404 permit and 408 permission, the Regional Water Control Board's Clean Water Act 401 permit, an Encroachment Permit for the Central Valley Flood Protection Board (CVFPB), and work associated with obtaining a water right for the Project under State water right law.

The Authority's permitting team will conduct early coordination work to facilitate achievement of the permitting milestones in the proposed schedule and will support development of the project description of the preferred alternative that can be used for the permit applications. The team will assess the Project's terrestrial and aquatic based impacts. This would include coordination with the operations modeling team to provide inputs and review outputs to develop an assessment of the effect of up to three operating scenarios on aquatic resources, utilizing available lifecycle models. They will support refinement of mitigation opportunities and potential adaptive management plans to offset negative effects of the chosen operations scenarios.

During this work period, the permitting team will work to develop a joint BA that includes the preferred project description and analysis, agreed upon changes from Reclamation and U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) comments, and revised modeling output analysis and effects of the construction and operation on ESA listed species. This work will include work towards the development of a Mitigation Plan and an Adaptive Management Plan to be included in the Administrative Draft BA. The permitting team will coordinate with USACE on Section 404/408 and 404(b)(1) and the wetland delineation requirements and approach, the CVFPB on State Plan of Flood requirements as well as facilitating an agreement with Reclamation and the USACE on the federal lead for ESA and Section 106 consultations.

Amendment 1:
In Amendment 1, the Authority will continue permitting agency coordination and development of the key project permits and supporting documentation as described above. This would include the following

Major Tasks:

- Prepare Mitigation Planning for Admin Draft BA
- Prepare Adaptive Management Plan
- Prepare Terrestrial Analysis
- Prepare Incidental Take Permit (ITP) for Construction and Submit to CDFW
- Prepare Incidental Take Permit (ITD) for Operations and Submit to CDFW

- Prepare Section 106 Permit and Submit to SHPO
- Work with Reclamation for LEDPA Analysis for 404 Application

Amendment 1 Major Tasks:

- Begin the preparation of the Admin Draft BA
- Finalize ITP for Construction and Submit to CDFW
- Finalize ITP for Operations and Submit to CDFW
- Finalize Section 106 Permit and Submit to SHPO
- Prepare CVFPB Encroachment Permit
- Permitting and Environmental Monitoring for Geotechnical Exploration

Amendment 1 Sub-Tasks:

- Prepare Mitigation Planning for Draft BA and ITP
- Finalize Adaptive Management Plan for Draft BA and ITP
- Finalize Terrestrial Analysis for Draft BA and ITP
- Prepare Fisheries Analysis for Draft BA and ITP
- Coordination with Permitting Agency Staff

4. Benefits:

The Sites Reservoir Project will offer several benefits to California on the state, regional, and local level. The benefits listed below include the Sites Project Authority's overall project objectives. The project described in the application for Financial Assistance is required to progress the overall project and, therefore, these benefits:

- **Improve Water Supply and Water Supply Reliability**. The water stores and released from Sites Reservoir will allow for improved water supply and reliability for participants in the project and California on the state, regional, and local level.

- **Provide Incremental Level 4 Water Supply for Refuges**. The State has committed to invest in Incremental Level 4 water supply for refuges at an undetermined level. Level 4 refuge demand is located primarily south of the Sacramento-San Joaquin Delta (Delta).

- **Improve the Survival of Anadromous Fish.** The Sites Project Authority is supportive of actions that benefit salmon, steelhead, and other anadromous fish species of concern in the Sacramento River watershed. Exchanges with the Bureau of enables the conservation of the coldwater pool in Shasta and Folsom Lakes. The species benefit from improved coldwater pool management, lower river water temperatures and supplemental flows to prevent the dewatering of redds.

- **Enhance the Delta Ecosystem**. Water released from Sites Reservoir would be conveyed to the Yolo Bypass toe drain to convey biomass to the Delta to help supply food for Delta smelt.

- **Provide Opportunities for Recreation.** State funding will support the construction of new recreation facilities, including Stone Corral Recreation Area on the east side of the reservoir, a boat ramp on the west side of the reservoir, and the Peninsula Hills Recreation Area on the west side of the reservoir.

- **Provide Flood Damage Reduction.** Once completed, Sites Dam will reduce the likelihood of flooding in the Stone Corral Creek watershed, and Golden Gate Dam will improve flood damage reduction for extreme events on Funks Creek.

5. Environmental and Cultural Resources Compliance

All projects being considered for award funding require compliance with the National Environmental Policy Act (NEPA) before any ground-disturbing activity may begin. Compliance with all applicable state, Federal and local environmental, cultural, and paleontological resource protection laws and regulations is also required. These may include, but are not limited to, the Clean Water Act (CWA), the Endangered Species Act (ESA), National Historic Preservation Act (NHPA), consultation with potentially affected tribes, and consultation with the State Historic Preservation Officer (SHPO).

The Authority will ensure that all relevant Environmental and Cultural Resource compliance activities are completed prior to any ground-disturbing activities.

6. Project Schedule

Schedule and List of Deliverables

Task No.	Task Title	Deliverables	Estimated Start Dates	Estimated Completion Dates
01	Environmental Planning	Draft Env Work Plan	2/1/2020	4/30/2020
01	Environmental Planning	Annotated Outline	4/1/2020	8/31/2020
01	Environmental Planning	Draft EIR/EIS for Public Review	9/1/2020	**9/30/2021**
01A	**Environmental Planning**	**Alternative 3 Analysis**	**2/1/2021**	**5/30/2021**
01A	**Environmental Planning**	**Admin Final EIR/EIS**	**10/1/2021**	**6/30/2022**
02	Project Permitting	Mitigation Plan	4/1/2020	1/30/2021
02	Project Permitting	Adaptive Management Plan	4/1/2020	1/30/2021
02	Project Permitting	ITP- CESA (Sec 2081)	11/1/2020	12/31/2021
02	Project Permitting	Section 106	9/1/2020	12/31/2021
02A	**Project Permitting**	**Draft BA**	**2/1/2021**	**11/30/2021**
02A	**Project Permitting**	**404/401 Permit Application**	**2/1/2021**	**12/30/2021**
02A	**Project Permitting**	**Draft Water Right Application**	**2/1/2021**	**12/30/2021**

7. Budget:

Provide Budget Table and Narrative as Attachments to this document.

See Attachment A

8. Pre-Award Incurrence of Costs:

It is anticipated this project will receive pre-award incurrence of cost beginning January 1, 2020.

9. Cost Sharing Requirement

Funding Sources	Original Funding Amount	Amendment 1	Total Funding Amount
Non-Federal Entities			
Participation Partners	$ 3,340,382	$ 3,609,844	$ 6,950,226
Non-Federal Subtotal:	$ 3,340,390	$ 3,609,844	$ 6,950,226
Requested Reclamation Funding:	$ 3,000,000	$ 3,500,000	$ 6,500,000
Total Project Funding:	$ 6,340,382	$ 7,109,844	$13,450,226

REQUIRED FORMS:

- **SF-424**
- **SF-424 A or B (NON CONSTRUCTION)**
- **SF-424 C or D (CONSTRUCTION)**
- **BUDGET TABLE**
- **BUDGET NARRATIVE (with supporting documentation as indexed attachments)**
- **SF-LLL (Lobbying Form)**
- **Single Audit, or Independent Audit Statement - IAW 2 CFR 200 Subpart F Audit Requirements**

VANESSA KING Digitally signed by VANESSA KING
Date: 2021.09.25 10:42:37 -07'00'

Vanessa King, Project Manager

From: Melvin, Zana L [zmelvin@usbr.gov]
Sent: 9/25/2021 11:09:32 AM
To: Jerry Brown [jbrown@sitesproject.org]; Joe Trapasso [jtrapasso@sitesproject.org]
CC: Larson, Steven N [snlarson@usbr.gov]
Subject: RE: [EXTERNAL] Re: Signatures for SITES
Attachments: Amendment R20AC00105 for Signature.pdf

Hi Joe,

Per our conversation, please sign and return. Thanks again for all of your help.

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Saturday, September 25, 2021 11:00 AM
To: Melvin, Zana L <zmelvin@usbr.gov>; Joe Trapasso <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>
Subject: Re: [EXTERNAL] Re: Signatures for SITES

Oops sorry. I was thinking a different document. I have been authorized to sign but I'd need to make sure Joe has reviewed and is okay before I can sign. I'm sure Joe will weigh in sometime today and I'm available to sign.

From: "Melvin, Zana L" <zmelvin@usbr.gov>
Date: Saturday, September 25, 2021 at 10:48 AM
To: Jerry Brown <jbrown@sitesproject.org>, Joe Trapasso <jtrapasso@sitesproject.org>
Cc: "Larson, Steven N" <snlarson@usbr.gov>
Subject: RE: [EXTERNAL] Re: Signatures for SITES

Hi Jerry,

Will you or Joe be signing the Amendment?

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Saturday, September 25, 2021 10:35 AM
To: Melvin, Zana L <zmelvin@usbr.gov>; Joe Trapasso <jtrapasso@sitesproject.org>
Cc: Larson, Steven N <snlarson@usbr.gov>
Subject: [EXTERNAL] Re: Signatures for SITES

Thanks for the reminder. Done

From: "Melvin, Zana L" <zmelvin@usbr.gov>
Date: Saturday, September 25, 2021 at 7:42 AM
To: Joe Trapasso <jtrapasso@sitesproject.org>, Jerry Brown <jbrown@sitesproject.org>

Cc: "Larson, Steven N" <snlarson@usbr.gov>
Subject: Signatures for SITES

Good Morning,

I'm checking to see if anyone is available for signatures today? We are in the process of completing the Amendment. Please advise. Thanks again.

Zana L. Melvin
Grants Management Specialist
Financial Assistance Branch, Division of Acquisition Services
— BUREAU OF —
RECLAMATION
Interior Region 10 - California Great Basin
2800 Cottage Way, Room E-1815
Sacramento, CA 95825
Office: (916) 978-5136
E-mail: zmelvin@usbr.gov

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

AMENDMENT 0001

TO

ASSISTANCE AGREEMENT R20ACO0105

Acceptance of this Amendment to the above Assistance Agreement in accordance with the terms and conditions contained herein is hereby made on behalf of Sites Reservoir Project Planning.

BY: *Joe Trapasso*

DATE: September 25, 2021

NAME AND TITLE OF SIGNER
Joe Trapasso, Program Operations Manager

A. PURPOSE OF THIS AMENDMENT:

The purpose of the amendment is to:

- Add funds to increase the total estimated amount of the agreement
- Amend the statement of work
- Extend the period of performance to allow time complete NEPA and permitting activities

All other terms and conditions remain unchanged.

B. ADJUSTMENT OF AGREEMENT SCOPE OF WORK AND/OR BUDGET:

As a result of this amendment, there are changes to both the scope of work and budget, see attachments.

C. ADJUSTMENT OF THE TOTAL ESTIMATED AMOUNT:

As a result of this amendment, the total estimated amount of the Agreement is increased by $7,109,844, from $6,340,382 to $13,450,226.

D. NOTICE OF CHANGE IN FUNDS OBLIGATED:

The total amount of funding obligated for this Agreement remains $6,340,382.00.

E. ADJUSTMENT TO COMPLETION DATE:

As a result of this amendment, the period of performance is changed from August 11, 2020 through December 31, 2021 to August 11, 2020 through June 30, 2022.

F. ATTACHMENTS:

Attachment 1 – Budget Review
Attachment 2 – Scope of Work Revision

BUDGET ANALYSIS

Agreement #	R20AC00105-01
Recipient Name	Sites Joint Powers Authority
Project Title	Sites Reservoir Project Planning-**AMENDMENT**
Total Project Cost	$13,450,226
Federal Share	$ 6,500,000
Non-Federal Share	$ 6,950,226
Grants Management Specialist	Steven Larson
Grants Officer	Steven Larson
Date	09/19/2021

Project Information

The amended scope of work for this amended Agreement is attached as **Exhibit 1**.

Budget Evaluation

The following is an evaluation of the estimated amended budget. The original pricing/rates have not changed from the approved budget, the only increase was in the level of effort; with the addition of tasks, the manhours increased. Since most Federal financial assistance agreements are cost-reimbursable, the budget provided is for estimation purposes only. Final costs incurred under the budget categories listed may be higher or lower than the estimated costs. The Recipient needs to be aware of and understand that reimbursement will only occur for actual costs associated with the approved budget elements.

All costs incurred by the Recipient under this amended Agreement must be in accordance with any pre-award clarifications conducted between Recipient and Reclamation, and the terms and conditions of the Agreement. There are no changes to the contract or rates from the original approved budget for this amendment. The original agreement utilized a blended rate for multiple years knowing in advance the scope of work would cover multiple years. This includes pre-award incurrence of costs, for which the types of costs and start date must be included in the agreement. Final determination of the allowability, allocability, or reasonableness of costs incurred under this amended Agreement is the responsibility of the Grants Officer.

Junaid As-Salek, Technical Representative, provided a thorough and technical evaluation of the direct cost elements listed in the amended budget estimate and supporting documentation provided by Recipient. The Sites Authority will continue to work with Reclamation in the completion of California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) documentation. Sites staff and the environmental consulting team will work with Reclamation staff to define and analyze an additional alternative, Alternative 3, which allows for an increase share (up to 25%) of federal investment. With the release of the Revised Draft Environmental Impact Report (EIR)/Supplemental Draft Environmental Impact Statement (EIS), continued efforts will focus on the preparation of the Final EIR/EIS. The team will develop an approach and finalize responses to Public comments and prepare the Administrative Final EIR/EIS. After review and incorporation of input from Reclamation, legal counsel and other team members, the environmental team will complete a Final EIR/EIS to support the project approval process. The evaluation confirmed that the project can be completed as required under the amended Agreement and that all recommended direct cost elements are allocable and reasonable as to type, quantity, and quality of the specific cost element. Any cost elements questioned by the Technical Representative and/or Grants Officer are identified and discussed in the applicable cost element section below.

The Technical Evaluation for this Agreement is attached as **Exhibit 2**.

Allowability, Allocability, and Reasonableness of Costs:

Costs incurred for the performance of this Agreement must be allowable, allocable to the project, and reasonable as defined through 2 CFR 200 Subpart E – Cost Principles. All costs allowed by the grants officer meet the following requirements: any costs which do not meet the requirements have been removed from the budget and are not part of the estimate.

Allowable (2 CFR 200.403)	Allocable (2 CFR 200.405)	Reasonable (2 CFR 200.404)
• Necessary and reasonable for the performance of the Federal award Allocable to the award • Conform to limitations or exclusions identified in 2 CFR 200 or in the Federal award • Consistent with the recipient's policies and procedures • Treated consistently (i.e., a cost may not be assigned to a Federal award as a direct cost if any other cost incurred for the same purpose has been allocated to the Federal award as an indirect cost) • Determined in accordance with generally accepted accounting principles (GAAP), unless otherwise stated in 2 CFR 200 • Not included in any other federally-funded programs • Adequately documented	• Goods or services are chargeable or assignable to the Federal award in accordance with relative benefits received • Cost is incurred specifically for the Federal award • If the cost benefits both the Federal award and non-Federal work of the recipient, and can be distributed proportionally • The cost is necessary is assignable in part to the Federal award	• Cost is generally recognized as ordinary and necessary for the operation of the recipient or proper and efficient performance of the Federal award. • Restraints or requirements exist for factors as: sound business practices; arm's-length bargaining; Federal, state, local, tribal, and other laws and regulations; and terms and conditions of the Federal award. • Cost matches market prices for comparable goods or services for the geographic area. • Individuals involved in the purchase or acquisition acted responsibly and ethically in consideration of the non-Federal entity, its employees, the public at large, and the Federal Government. • The recipient does not significantly deviate from its established practices and policies regarding the incurrence of costs

1. Contractual- Amended

The project's amended budget is summarized in the following tables and depicts the overall cost increase caused by the increase of man-hours only. The man-hours are a total for the entire length of the agreement. Tables 1 through 7 depict the increase in cost by Firm and task. The Recipient's proposed budget amendment and budget narrative are attached as **Exhibit 3**, the Budget calculations are **Exhibit 4**.

Table 1-SUMMARY

SITES RESERVOIR

BUDGET ITEM DESCRIPTION	ORIGINAL TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
Contractual Services			
HDR	$ 1,274,081	$ 1,008,149	$ 2,282,230
ICF-E Environmental Planning	$ 2,573,001	$ 1,963,857	$ 4,536,858
ICF-F Permitting	$ 2,493,300	$ 2,637,838	$ 5,131,138
Other			
CDFW Permitting Support	$ -	$ 1,500,000	$ 1,500,000
TOTAL ESTIMATED COSTS	$ 6,340,382	$ 7,109,844	$ 13,450,226

Table 2

Budgeted Cost by Firm

Firm	Activity Name	Budgeted Cost
HDR	Task 1 - Environmental Planning	$ 428,080
HDR	Task 2 - Project Permitting	$ 580,070
Total HDR		$ 1,008,150
ICF - E	Task 1 - Environmental Planning	$ 1,963,857
ICF - F	Task 2 - Project Permitting	$ 2,637,837
Total ICF		$ 4,601,694
Other	Other - CDFW Permitting Support	$ 1,500,000
Total Project		**$ 7,109,844**

Budgeted Cost by Task

Firm	Activity Name	Budgeted Cost
HDR		$ 428,080
ICF-E		$ 1,963,857
	Task 1 - Environmental Planning	$ 2,391,937
HDR		$ 580,070
ICF - F		$ 2,637,837
Other		$ 1,500,000
	Task 2 - Project Permitting	$ 4,717,907
	Total	**$ 7,109,844**

The project will continue to consist of two major tasks, Environmental Planning and Project Permitting, but the amendment will take the Revised Admin Draft EIR/EIS and complete the CEQA and NEPA documentation along with finalizing and the submittal of required permits. Below is a summary of the costs by Task and Firm.

Table 3

HDR Summary Original

BUDGET ITEM DESCRIPTION	COMPUTATION		COMPUTATION	Quantity Type	ORI TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
	$/Unit	Quantity	Quantity				
Salaries and Wages							
Environmental Lead	$ 225.00	2700	750		$ 607,500.00	$ 168,750.00	$ 776,250.00
Environmental Lead	$ 225.00	0	750		$ -	$ 168,750.00	$ 168,750.00
Permitting Lead	$ 268.71	1800	2065		$ 483,678.00	$ 554,886.15	$ 1,038,564.15
Environmental Support	$ 194.64	450	250		$ 87,588.00	$ 48,660.00	$ 136,248.00
Env Permitting Support	$ 159.39	598	421		$ 95,315.22	$ 67,103.19	$ 162,418.41
Operations Lead	$ 165.15	0	0		$ -	$ -	$ -
TOTAL DIRECT COSTS					**$ 1,274,081**	**$ 1,008,149**	**$ 2,282,231**

Table 4

HDR TASK 1 Original

BUDGET ITEM DESCRIPTION	COMPUTATION $/Unit	COMPUTATION Quantity	COMPUTATION Quantity	Quantity Type	ORI TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
Salaries and Wages							
Environmental Lead	$ 225.00	2700	750		$ 607,500	$ 168,750	$ 776,250
Environmental Lead	$ 225.00	0	750		$ -	$ 168,750	$ 168,750
Permitting Lead	$ 268.71	0	0		$ -	$ -	$ -
Environmental Support	$ 194.64	450	250		$ 87,588	$ 48,660	$ 136,248
Env Permitting Support	$ 159.39	470	263		$ 74,913	$ 41,920	$ 116,833
Operations Lead	$ 165.15	0	0		$ -	$ -	$ -
TOTAL DIRECT COSTS					**$ 770,001**	**$ 428,080**	**$ 1,198,081**

Table 5

HDR Task 2 Original

BUDGET ITEM DESCRIPTION	COMPUTATION $/Unit	COMPUTATION Quantity	COMPUTATION Quantity	Quantity Type	ORI TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
Salaries and Wages							
Environmental Lead	$ 225.00	0			$ -	$ -	$ -
Permitting Lead	$ 268.71	1800	2065		$ 483,678	$ 554,886	$ 1,038,564
Environmental Support	$ 194.64	0			$ -	$ -	$ -
Env Permitting Support	$ 159.39	128	158		$ 20,402	$ 25,184	$ 45,586
Operations Lead	$ 165.15	0			$ -	$ -	$ -
TOTAL DIRECT COSTS					**$ 504,080**	**$ 580,070**	**$ 1,084,150**

Table 6

ICF TASK 1 **Original**

BUDGET ITEM DESCRIPTION	COMPUTATION		COMPUTATION	Quantity Type	ORI TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
	$/Unit	Quantity	Quantity				
Salaries and Wages							
Sr Project Director	$ 323.33	350	250		$ 113,166	$ 80,833	$ 193,998
Sr Project Director	$ 310.87	175	120		$ 54,402	$ 37,304	$ 91,707
Project Director	$ 266.34	1700	1200		$ 452,778	$ 319,608	$ 772,386
Project Director	$ 192.54	870	660		$ 167,510	$ 127,076	$ 294,586
Managing Consultant	$ 189.52	2642	1010		$ 500,712	$ 191,415	$ 692,127
Managing Consultant	$ 189.52	0	1010		$ -	$ 191,415	$ 191,415
Sr Consultant III	$ 181.12	2100	1605		$ 380,352	$ 290,698	$ 671,050
Sr Consultant II	$ 176.81	100	100		$ 17,681	$ 17,681	$ 35,362
Sr Consultant III	$ 171.68	170	130		$ 29,186	$ 22,318	$ 51,504
Sr Consultant II	$ 143.22	880	700		$ 126,034	$ 100,254	$ 226,288
Sr Consultant II	$ 133.18	200	200		$ 26,636	$ 26,636	$ 53,272
Sr Consultant II	$ 129.51	210	210		$ 27,197	$ 27,197	$ 54,394
Associate Consultant I	$ 120.49	770	645		$ 92,777	$ 77,716	$ 170,493
Sr Consultant I	$ 116.74	350	302		$ 40,859	$ 35,255	$ 76,114
Assistant Consultant	$ 107.47	120	100		$ 12,896	$ 10,747	$ 23,643
Assistant Consultant	$ 103.50	115	100		$ 11,903	$ 10,350	$ 22,253
Sr Consultant II	$ 103.32	3000	0		$ 309,960	$ -	$ 309,960
Sr Consultant II	$ 103.32	0	2300		$ -	$ 237,636	$ 237,636
Assistant Consultant	$ 96.93	2100	1600		$ 203,553	$ 155,088	$ 358,641
Admin Technician	$ 77.15	70	60		$ 5,401	$ 4,629	$ 10,030
TOTAL DIRECT COSTS					**$ 2,573,001**	**$ 1,963,857**	**$ 4,536,859**

Table 7

ICF TASK 2 **Original**

BUDGET ITEM DESCRIPTION	COMPUTATION		COMPUTATION	Quantity Type	ORI TOTAL COST	AMEND 1 TOTAL COST	TOTAL COST
	$/Unit	Quantit y	Quantity				
Salaries and Wages							
Sr Project Director	$ 323.33	55	50		$ 17,783	$ 16,167	$ 33,950
Sr Project Director	$ 310.87	60	60		$ 18,652	$ 18,652	$ 37,304
Technical Director	$ 267.39	1415	1400		$ 378,357	$ 374,346	$ 752,703
Project Director	$ 248.78	80	80		$ 19,902	$ 19,902	$ 39,805
Technical Director	$ 229.00	400	420		$ 91,600	$ 96,180	$ 187,780
Sr Consultant III	$ 206.14	300	310		$ 61,842	$ 63,903	$ 125,745
Sr Technical Analyst	$ 205.81	180	190		$ 37,046	$ 39,104	$ 76,150
Technical Director	$ 196.89	1500	1500		$ 295,335	$ 295,335	$ 590,670
Project Director	$ 192.54	1600	1700		$ 308,064	$ 327,318	$ 635,382
Managing Consultant	$ 189.52	180	190		$ 34,114	$ 36,009	$ 70,122
Sr Consultant III	$ 171.68	800	850		$ 137,344	$ 145,928	$ 283,272
Sr Consultant III	$ 168.26	650	800		$ 109,369	$ 134,608	$ 243,977
Managing Consultant	$ 166.32	120	150		$ 19,958	$ 24,948	$ 44,906
Sr Consultant III	$ 161.44	160	190		$ 25,830	$ 30,674	$ 56,504
Sr Consultant II	$ 157.38	1050	1120		$ 165,249	$ 176,266	$ 341,515
Sr Consultant II	$ 140.45	725	790		$ 101,826	$ 110,956	$ 212,782
Sr Consultant II	$ 133.18	160	200		$ 21,309	$ 26,636	$ 47,945
Sr Consultant II	$ 126.94	140	190		$ 17,772	$ 24,119	$ 41,890
Sr Consultant II	$ 120.47	340	400		$ 40,960	$ 48,188	$ 89,148
Sr Consultant I	$ 116.74	799	850		$ 93,275	$ 99,229	$ 192,504
Assistant Consultant	$ 111.66	200	240		$ 22,332	$ 26,798	$ 49,130
Sr Consultant I	$ 110.07	120	150		$ 13,208	$ 16,511	$ 29,719
Assistant Consultant	$ 107.47	120	135		$ 12,896	$ 14,508	$ 27,405

Assistant Consultant	$ 106.74	220	250		$ 23,483	$ 26,685	$ 50,168
Assistant Consultant	$ 103.50	40	50		$ 4,140	$ 5,175	$ 9,315
Sr Consultant II	$ 103.32	550	600		$ 56,826	$ 61,992	$ 118,818
Associate Consultant I	$ 102.95	350	370		$ 36,033	$ 38,092	$ 74,124
Associate Consultant	$ 98.18	1700	1700		$ 166,906	$ 166,906	$ 333,812
Associate Consultant III	$ 95.49	950	950		$ 90,716	$ 90,716	$ 181,431
Associate Consultant I	$ 89.35	180	190		$ 16,083	$ 16,977	$ 33,060
Associate Consultant I	$ 83.15	160	180		$ 13,304	$ 14,967	$ 28,271
Associate Consultant III	$ 82.49	80	85		$ 6,599	$ 7,012	$ 13,611
Associate Consultant II	$ 81.49	100	150		$ 8,149	$ 12,224	$ 20,373
Admin Technician	$ 77.15	57	80		$ 4,398	$ 6,172	$ 10,570
Associate Consultant II	$ 66.87	220	241		$ 14,711	$ 16,116	$ 30,827
Associate Consultant II	$ 66.07	120	129		$ 7,928	$ 8,523	$ 16,451
TOTAL DIRECT COSTS					**$ 2,493,300**	**$ 2,637,838**	**$ 5,131,138**

2. Contractual-Other

The Sites Authority entered into an agreement with the California Department of Fish and Wildlife (CDFW), for a total of $2,841,328, of which the Authority is committing to spend $1, 500,000 during this financial agreement. The CDFW will assist in obtaining permits, participate in the development of conservation measures and any additional technical support as needed and as the budget allows. The complete scope of work is detailed in **Exhibit 5**. The State of California, Department of Personnel Administration (DPA) is the controlling agency responsible for negotiating State employee salaries. The salaries identified in the CDFW agreement for each classification are within the pay scale ranges established by DPA.

Positions	Monthly Salary Range	
	Low	High
Senior Environmental Scientist (Supervisor)	$9,785	$12,165
Environmental Program Manager	$11,315	$14,066
Senior Environmental Scientist (Specialist)	$7,336	$9,126
Environmental Scientist	$6,375	$7,926
Senior Hydraulic Engineer	$10,301	$12,892
Associate Governmental Program Analyst	$5,545	$6,942

The various pay scale ranges for every State job classification can be found at the following website: http://www.calhr.ca.gov/Pay%20Scales%20Library/PS_Sec_17.pdf). Each bargaining unit negotiates a contract with the State regarding the terms and conditions of employment including pay and benefits. Information about the State collective bargaining process and the specific bargaining unit contracts are public information. Maximum Salary Projections may progress from Range A through C on the pay scale.

GRANTS OFFICER DETERMINATION:

The budgeted costs of $13,450,226 for this agreement have been determined allowable, allocable, and reasonable by the Grants Officer based on the analysis of the budget and supporting documentation, the technical evaluation determination regarding the quantity, quality, and type of cost elements budgeted, and adjustments made during budget clarifications.

SIGNATURES

PREPARED BY:

X

Name: Same as GO

Date:

GRANTS OFFICER:

X

Name: Steven Larson

Date:

Attachments:

Exhibit List:

- Exhibit 1: Sites_FAA_SCOPE OF PROJECT WORK_Amd1_rev
- Exhibit 2: Technical Evaluation-Amended
- Exhibit 3: Budget Narrative_Amd1
- Exhibit 4: Budget Calculations
- Exhibit 5: Attachment_Executed CDFW Staffing Standard Agreement

SITES JOINT POWERS AUTHORITY SCOPE OF PROJECT

Site Reservoir Program

Recipient

Sites Project Authority
122 Old Highway 99 West
Maxwell, CA 95955
530-438-2309

Recipient Point of Contact (POC)

Joe Trapasso
Sites Program Operations Manager
122 Old Highway 99 West
Maxwell, CA 95955
530-387-1102/jtrapasso@sitesproject.org

Recipient Personnel (Other than POC)

Jerry Brown
Executive Director
122 Old Highway 99 West
925-260-7417/jbrown@sitesproject.org

1. Executive Summary

The Sites Project Authority (Authority) will lead the efforts to continue the development of the California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) compliance approach and documentation through the recirculation and finalization of the Environmental Impact Report/Environmental Impact Statement (EIR/EIS) by utilizing the WIIN Act Federal funding. The Authority will also continue to develop the major project permits that are expected to be on the project's critical path schedule with submittal of the Biological Assessment, Water Right application, Incidental Take Permit (ITP), Section 106 Permit, and begin preparation of several other permits by December 2021.

2. Project Description:

The Sites Reservoir is proposed to be an off-stream reservoir that will be filled by pumping water from the Sacramento River. The project includes the Sites Reservoir and new facilities to integrate with both the existing Tehama-Colusa Canal (TC Canal) and Glenn-Colusa Irrigation District (GCID) Main Canal. Once constructed, the Sites Reservoir will be one of the state's largest reservoirs and will significantly increase surface water storage in the Sacramento Valley. The project's facilities will be independently owned and operated by the Authority under its own water rights and other regulatory requirements, in cooperation with United States Bureau of

Reclamation (Reclamation) and the California Department of Water Resources (DWR) in their operation of the Central Valley Project (CVP) and State Water Project (SWP), respectively.

WIIN Act funding will allow the project to continue development of the environmental documents and permits. The project scope is funding-limited and deliverables are identified based on the level of funding available to the project. The scope identified in the sections below will allow the Sites Project Authority to develop a revised draft EIR/EIS and begin to prepare essential project permit applications.

Amendment 1:

The Sites Project Authority will also respond to public comments and develop a final EIR/EIS. Additional project permit applications will be drafted or finalized and submitted.

3. Tasks/Objectives:

Describe the objectives of the project activities funded under this agreement

Task 1 – Environmental Planning: Revised Draft EIR/EIS for Public Comment

In August 2017, the Authority and Reclamation jointly issued a Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Project pursuant to their respective lead agency obligations under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). The preparation of the joint EIR/EIS was originally initiated by the DWR and Reclamation in 2001. A Notice of Intent (NOI) to prepare an EIS under NEPA was published in the Federal Register (Volume 66, Number 218) on November 9, 2001. An initial Notice of Preparation (NOP) to prepare an EIR for the NODOS Project was issued by the DWR, as the CEQA lead agency at that time, on November 5, 2001. Data collection, including biological and cultural resources field studies, was undertaken and a Preliminary Administrative Draft Environmental Impact Report (ADEIR) was completed in May 2014.

Subsequently, the Authority assumed the role of the CEQA lead agency in lieu of DWR and issued a Supplemental NOP on February 2, 2017. Reclamation continued in the federal lead agency role for the Project. Preparation of the joint Draft EIR/EIS relied substantially on DWR's 2014 ADEIR and the results of the much earlier field surveys as the basis for the 2017 analysis. The Draft EIR/EIS was circulated for public review and comments between August 14, 2017 and January 15, 2018. Over 141 comments letters and/or emails were received on the Draft EIR/EIS along with comments received at two public hearings held during the public review period. Between March 2019 and September 2019, Authority and Reclamation staff coordinated in the approach and initial drafting of responses to the comments received.

On October 1, 2019, this work was put on hold while the Authority's Ad Hoc Value Planning Workgroup undertook a value planning effort to "right size" the project based on the needs of its membership and feedback from permitting agencies. The Ad Hoc Value Planning Workgroup completed their effort and prepared the Sites Project Value Planning Alternatives Appraisal Report (Report). The Report addresses additional project alternatives identified through a screening process that considered total project cost, impacts on landowners, impacts on traffic and public safety, ability to meet participant demands, ability to provide public benefits to the State, relative magnitude of environmental impacts, and the estimated cost per acre-foot of water delivered. The alternatives considered by the Authority generally have smaller reservoir footprints and reduced diversions from the Sacramento River into Sites Reservoir than were proposed under Alternative D, evaluated as the preferred project in the 2017 Draft EIR/EIS. The new alternatives also include an updated approach to conveyance, including elimination of the Delevan Intake on the Sacramento River and associated pipeline. Instead, the revised alternatives propose release via a new pipeline to the Colusa Basin Drain and/or the Sacramento River near Dunnigan, California. This reconfiguration provides substantial cost savings and avoids the Delevan Wildlife Refuge. The location of the new pipeline is outside of the original project footprint and will affect other landowners and jurisdictions compared to the prior alternatives.

Based on these substantial changes and in consultation with the Authority's CEQA legal counsel, the Authority has determined that the Draft EIR should be revised to analyze the environmental effects of the new alternatives and recirculated for public review, consistent with CEQA. This would:

- provide full and open disclosure and provide the opportunity for the public to comment on the new alternatives;
- allow for a full description of the revised preferred project and the alternatives, including the modeled operational scenario and incorporation of the modeled baseline;
- update the environmental baseline to incorporate changes that have occurred in the physical environment since the DWR surveys;
- provide the ability to address recent federal decisions related to ROC on LTO, the BiOps and the COA;
- provide a more robust approach to addressing issues raised during the public review of the 2017 Draft EIR/EIS; and,
- promote informed decision-making by the Authority and other governmental agencies with approval authority over the Project.

Reclamation, as the NEPA lead agency, must also decide how to move forward with the EIS. NEPA (40 C.F.R. § 1502.9(c) provides for the supplementation of a Draft EIS if there are:

- Substantial changes in the proposed action that are relevant to environmental concerns, or
- Significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

Authority and Reclamation staff are working cooperatively on a joint path forward. The current assumption - given the substantially different project alternatives and to incorporate the recent ROC on LTO, BiOps and COA in operational modeling – is that NEPA compliance would require preparation of a Supplemental Draft EIS. Authority staff and consultants will continue to meet on a regular basis with Reclamation to confirm the NEPA approach and EIS process.

The Authority will lead the efforts to continue the development of the CEQA/NEPA compliance approach and documentation and will maintain the CEQA administrative record. There will also be ongoing efforts to assist Reclamation in the determination of environmental feasibility and to support the Authority's process in screening alternatives for potential environmental effects. This task includes effort associated with this document as well as coordination with legal counsel and assumes all document development will be performed by the Authority and will be reviewed by Reclamation, as appropriate.

The environmental team will develop an Environmental Document Work Plan for the Revised Draft EIR/EIS which will build on the work previously completed for the 2017 Draft EIR/EIS and to respond to the comments received on that document. The team will revisit the comments received on the 2017 Draft EIR/EIS and the draft master responses to comments and prepare a list of information needs which would strengthen the prior EIR/EIS analysis. They will prepare a recommended approach for how the integral thematic issues raised by commenters will be addressed in the recirculated document. Based on their findings, the team will identify preliminary list of technical studies and modeling that may be needed and required timeframes for completion in order to meet the proposed Public Draft release date as part of the Environmental Document Work Plan.

Sites staff and the consulting team will refine alternatives to be analyzed in the revised Draft EIR/EIS and recommend to the Reservoir Committee and Authority Board the preferred alternative. The environmental team will work with the engineering team and operations modeling team to confirm and refine the configuration, construction, and operation for the preferred alternative, and any other alternative chosen for analysis in the recirculated document. The team will develop a complete project description in collaboration with the engineering and operations teams.

Once the project description has been developed, the environmental team will proceed with the EIR/EIS analysis for construction and operations, including cumulative and climate change sections. The team will prepare a complete Administrative Draft for the Authority and Reclamation's review. The Authority will release the Revised Draft EIR/Supplemental Draft EIS for public review and comments and will issue required public notices. Reclamation will be responsible for facilitating publication of the Federal Register notice.

The Authority will prepare for and complete public hearings during the public comment period as required under CEQA and NEPA. Throughout the public comment period, the environmental team will categorize and sort comments by topic and will begin to develop an approach to the response to comments.

Amendment 1:
In Amendment 1, the Authority will continue to work with Reclamation in the completion of CEQA and NEPA documentation. Sites staff and the environmental consulting team will work with Reclamation staff to define and analyze an additional alternative, Alternative 3, which allows for an increase share (up to 25%) of federal investment. With the release of the Revised Draft EIR/Supplemental Draft EIS, continued efforts will focus on the preparation of the Final EIR/EIS. The team will develop an approach and finalize responses to Public comments and prepare the Administrative Final EIR/EIS. After review and incorporation of input from Reclamation, legal counsel and other team members, the environmental team will complete a Final EIR/EIS to support the project approval process.

Completion of the CEQA process will also require preparation of a Mitigation Monitoring and Reporting Program (MMRP), Findings of Fact and Statement of Overriding Considerations. The environmental team will support the Authority in preparing these documents. Assuming project approval, the environmental team will also support the Authority in the preparation of a Notice of Determination (NOD). The environmental team will also support Reclamation in completion of the NEPA process, including supporting documentation for the Record of Decision (ROD). Throughout the public review of the Revised Draft EIR and the Supplemental Draft EIS and Final EIR/EIS process, the Authority and consultants will be managing document retention and filing to support the administrative record for the project.

Major Tasks:
- Prepare Draft Environmental Work Plan
- Prepare Draft EIR/EIS Project Description Chapter
- Prepare Revised Admin Draft EIR/EIS
- Prepare Revised Public Draft EIR/EIS

Amendment 1 Major Tasks:
- Finalize Response to Public Comments
- Perform Analysis of Alternative 3
- Prepare Admin Final EIR/EIS
- Prepare Administrative Record for Final EIR/EIS
- Prepare Final EIR/EIS MMRP
- Support Findings, NOD

Task 2 – Project Permitting

The Authority will continue to develop the major project permits that are expected to be on the project's critical path schedule. This effort assumes work on the Federal Endangered Species Act (ESA) compliance (Biological Assessment [BA]), the National Historic Preservation Act compliance (Section 106 Programmatic Agreement), the California Endangered Species Act (CESA) compliance (i.e., State 2081 Incidental Take Permit), the US Army Corps of Engineers' (USACE) Section 404 permit and 408 permission, the Regional Water Control Board's Clean Water Act 401 permit, an Encroachment Permit for the Central Valley Flood Protection Board (CVFPB), and work associated with obtaining a water right for the Project under State water right law.

The Authority's permitting team will conduct early coordination work to facilitate achievement of the permitting milestones in the proposed schedule and will support development of the project description of the preferred alternative that can be used for the permit applications. The team will assess the Project's terrestrial and aquatic based impacts. This would include coordination with the operations modeling team to provide inputs and review outputs to develop an assessment of the effect of up to three operating scenarios on aquatic resources, utilizing available lifecycle models. They will support refinement of mitigation opportunities and potential adaptive management plans to offset negative effects of the chosen operations scenarios.

During this work period, the permitting team will work to develop a joint BA that includes the preferred project description and analysis, agreed upon changes from Reclamation and U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) comments, and revised modeling output analysis and effects of the construction and operation on ESA listed species. This work will include work towards the development of a Mitigation Plan and an Adaptive Management Plan to be included in the Administrative Draft BA. The permitting team will coordinate with USACE on Section 404/408 and 404(b)(1) and the wetland delineation requirements and approach, the CVFPB on State Plan of Flood requirements as well as facilitating an agreement with Reclamation and the USACE on the federal lead for ESA and Section 106 consultations.

Amendment 1:

In Amendment 1, the Authority will continue permitting agency coordination and development of the key project permits and supporting documentation as described above. This would include the following

Major Tasks:

- Prepare Mitigation Planning for Admin Draft BA
- Prepare Adaptive Management Plan
- Prepare Terrestrial Analysis
- Prepare Incidental Take Permit (ITP) for Construction and Submit to CDFW
- Prepare Incidental Take Permit (ITD) for Operations and Submit to CDFW

- Prepare Section 106 Permit and Submit to SHPO
- Work with Reclamation for LEDPA Analysis for 404 Application

Amendment 1 Major Tasks:

- Begin the preparation of the Admin Draft BA
- Finalize ITP for Construction and Submit to CDFW
- Finalize ITP for Operations and Submit to CDFW
- Finalize Section 106 Permit and Submit to SHPO
- Prepare CVFPB Encroachment Permit
- Permitting and Environmental Monitoring for Geotechnical Exploration

Amendment 1 Sub-Tasks:

- Prepare Mitigation Planning for Draft BA and ITP
- Finalize Adaptive Management Plan for Draft BA and ITP
- Finalize Terrestrial Analysis for Draft BA and ITP
- Prepare Fisheries Analysis for Draft BA and ITP
- Coordination with Permitting Agency Staff

4. Benefits:

The Sites Reservoir Project will offer several benefits to California on the state, regional, and local level. The benefits listed below include the Sites Project Authority's overall project objectives. The project described in the application for Financial Assistance is required to progress the overall project and, therefore, these benefits:

- **Improve Water Supply and Water Supply Reliability**. The water stores and released from Sites Reservoir will allow for improved water supply and reliability for participants in the project and California on the state, regional, and local level.

- **Provide Incremental Level 4 Water Supply for Refuges**. The State has committed to invest in Incremental Level 4 water supply for refuges at an undetermined level. Level 4 refuge demand is located primarily south of the Sacramento-San Joaquin Delta (Delta).

- **Improve the Survival of Anadromous Fish.** The Sites Project Authority is supportive of actions that benefit salmon, steelhead, and other anadromous fish species of concern in the Sacramento River watershed. Exchanges with the Bureau of enables the conservation of the coldwater pool in Shasta and Folsom Lakes. The species benefit from improved coldwater pool management, lower river water temperatures and supplemental flows to prevent the dewatering of redds.

- **Enhance the Delta Ecosystem**. Water released from Sites Reservoir would be conveyed to the Yolo Bypass toe drain to convey biomass to the Delta to help supply food for Delta smelt.

- **Provide Opportunities for Recreation.** State funding will support the construction of new recreation facilities, including Stone Corral Recreation Area on the east side of the reservoir, a boat ramp on the west side of the reservoir, and the Peninsula Hills Recreation Area on the west side of the reservoir.
- **Provide Flood Damage Reduction.** Once completed, Sites Dam will reduce the likelihood of flooding in the Stone Corral Creek watershed, and Golden Gate Dam will improve flood damage reduction for extreme events on Funks Creek.

5. Environmental and Cultural Resources Compliance

All projects being considered for award funding require compliance with the National Environmental Policy Act (NEPA) before any ground-disturbing activity may begin. Compliance with all applicable state, Federal and local environmental, cultural, and paleontological resource protection laws and regulations is also required. These may include, but are not limited to, the Clean Water Act (CWA), the Endangered Species Act (ESA), National Historic Preservation Act (NHPA), consultation with potentially affected tribes, and consultation with the State Historic Preservation Officer (SHPO).

The Authority will ensure that all relevant Environmental and Cultural Resource compliance activities are completed prior to any ground-disturbing activities.

6. Project Schedule

Schedule and List of Deliverables

Task No.	Task Title	Deliverables	Estimated Start Dates	Estimated Completion Dates
01	Environmental Planning	Draft Env Work Plan	2/1/2020	4/30/2020
01	Environmental Planning	Annotated Outline	4/1/2020	8/31/2020
01	Environmental Planning	Draft EIR/EIS for Public Review	9/1/2020	**9/30/2021**
01A	**Environmental Planning**	**Alternative 3 Analysis**	**2/1/2021**	**5/30/2021**
01A	**Environmental Planning**	**Admin Final EIR/EIS**	**10/1/2021**	**6/30/2022**
02	Project Permitting	Mitigation Plan	4/1/2020	1/30/2021
02	Project Permitting	Adaptive Management Plan	4/1/2020	1/30/2021
02	Project Permitting	ITP- CESA (Sec 2081)	11/1/2020	12/31/2021
02	Project Permitting	Section 106	9/1/2020	12/31/2021
02A	**Project Permitting**	**Draft BA**	**2/1/2021**	**11/30/2021**
02A	**Project Permitting**	**404/401 Permit Application**	**2/1/2021**	**12/30/2021**
02A	**Project Permitting**	**Draft Water Right Application**	**2/1/2021**	**12/30/2021**

7. Budget:

Provide Budget Table and Narrative as Attachments to this document.

See Attachment A

8. Pre-Award Incurrence of Costs:

It is anticipated this project will receive pre-award incurrence of cost beginning January 1, 2020.

9. Cost Sharing Requirement

Funding Sources	**Original Funding Amount**	**Amendment 1**	**Total Funding Amount**
Non-Federal Entities			
Participation Partners	$ 3,340,382	$ 3,609,844	$ 6,950,226
Non-Federal Subtotal:	$ 3,340,390	$ 3,609,844	$ 6,950,226
Requested Reclamation Funding:	$ 3,000,000	$ 3,500,000	$ 6,500,000
Total Project Funding:	$ 6,340,382	$ 7,109,844	$13,450,226

REQUIRED FORMS:

- **SF-424**
- **SF-424 A or B (NON CONSTRUCTION)**
- **SF-424 C or D (CONSTRUCTION)**
- **BUDGET TABLE**
- **BUDGET NARRATIVE (with supporting documentation as indexed attachments)**
- **SF-LLL (Lobbying Form)**
- **Single Audit, or Independent Audit Statement - IAW 2 CFR 200 Subpart F Audit Requirements**

Sites Reservoir

Sites September 2021 Update Executive Briefing

Report Generated on Wednesday, September 8, 2021
Created by the Project Controls Team

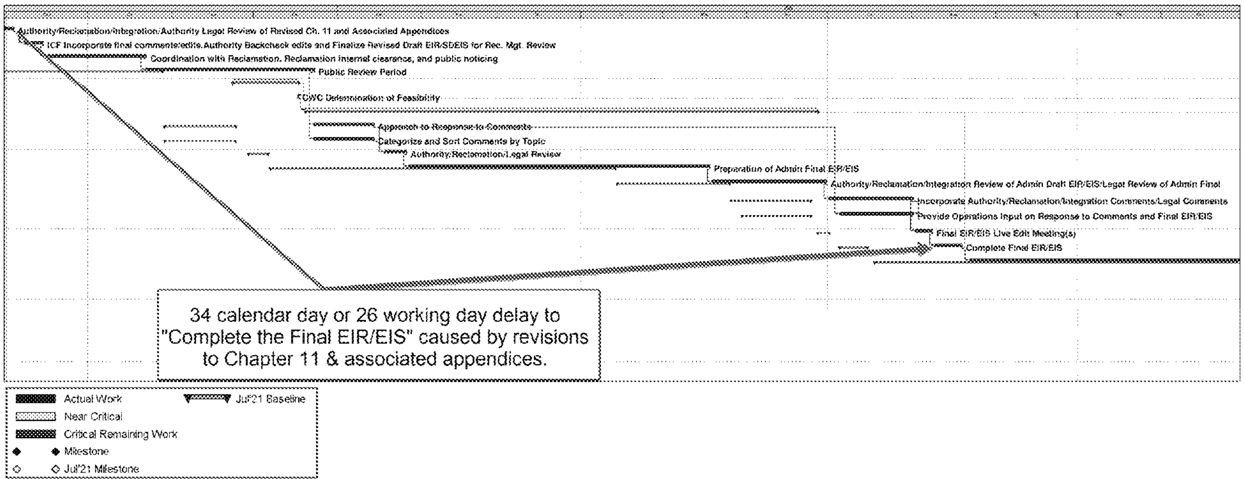
Deliverables Performance Analysis

Deliverable Performance Analysis for Amendment 2 activities by discipline. The variance column indicates calendar days delayed (Red) or calendar days gained (Green) between July 2021 and September 2021 updates.

Discipline	Deliverable	Variance Between July'21 and September'21 Updates in Calendar Days
Operations Deliverable	Full Operations Analysis Complete	Deliverable Completed
Operations Deliverable	Appendices for EIR/EIS	Deliverable Completed
Environmental Deliverable	Release Revised Draft EIR/ Supplemental Draft EIS for Public Review	-50
Environmental Deliverable	Authority review of Draft Environmental Feasibility Report for CWC	Deliverable Completed
Engineering Deliverable	Develop Class 4 Cost Estimate including Mitigation Measures	Deliverable Completed
Engineering Deliverable	Constructability Analysis	Deliverable Completed
Engineering Deliverable	CWC Determination of Feasibility	0
Permitting Deliverable	Submit Delineation to USACE	Deliverable Completed
Permitting Deliverable	Submit 404 Application	0
Permitting Deliverable	Deadline for Signatures on Final PA	0
Permitting Deliverable	Submit Final Admin Draft BA	Deliverable Completed
Permitting Deliverable	Submit Revised Admin Draft BA to Reclamation for NMFS Review	0
Permitting Deliverable	Reclamation Submit BA to USFWS & NMFS	-16
Permitting Deliverable	Submit 401 Application - Conditional Approval	0

Critical Path Analysis

The critical path continues to run through the Final EIR/EIS which shows a delay of 34 calendar days compared to the July 2021 Bi-Monthly Update. The delay is caused by revisions to Chapter 11 and associated appendices.



Sites Reservoir

Risk Analysis

The lack of schedule detail in the Sites Planning Schedule is preventing the risk adjusted schedule from producing a valuable determination of estimated completion, duration, and cost. The upcoming effort to develop the Sites Master Schedule will provide the detail that is necessary to generate the risk adjusted schedule.

The Sites Risk Matrix shows the customizable probability & impact scale.

Description	Probability	Schedule Impact	Cost Impact	Color
Very Low	5%	7 days	$1,000	
Low	25%	30 days	$10,000	
Medium	50%	60 days	$100,000	
High	75%	90 days	$1,000,000	
Very High	95%	180 days	$10,000,000	

The Sites Risk Register shows the ID's, descriptions, risk factors, risk score, mitigation status and assigned schedule activities.

Even...	Type	Description	%	Dur	$	Score	Mitigation	Status	Activities
SR001	Risk	Reclamation needs to initiate Section 106 consultation with SHPO; Authority/integration cannot do this unless delegated by Reclamation, which is unlikely. Reclamation schedule has the final PA completed on 1/11/2023	Medium	Medium	Very Low	[illegible]		Unmitigated	[illegible]
SR002	Risk	Risk No.002 Reclamation unlikely to initiate formal Section 7 (ESA) consultation	High	Very High	Very High	20		Unmitigated	[illegible]
SR003	Risk	Risk No.003 Reclamation review takes more than 30 days.	Medium	High	Very Low	[illegible]		Unmitigated	[illegible]
SR004	Risk	Risk No.004 Reclamation review takes more than 30 days	Medium	High	Very Low	[illegible]		Unmitigated	[illegible]
SR005	Risk	Risk No.005 Reclamation needs to initiate Section 7 consultation with USFWS and NMFS	High	Very High	Very High	20		Unmitigated	[illegible]
SR006	Risk	Risk No.006 SWRCB will not accept pre-application packet and will require final CEQA document to be complete before application will be accepted	Medium	Medium	Low	[illegible]		Mitigated	[illegible]

Sites Reservoir WSIP Feasibility Report

Request for Information for Economic Benefit Analysis

San Bernardino Valley Municipal Water District

Purpose for Investment in Sites Reservoir

The San Bernardino Valley Municipal Water District (Valley District) service area is prone to long droughts. The region experienced a 20-year local drought from 1945-65 and is currently in the midst of a longer, local drought that began around 1998 and shows no signs of retreat. Tree ring studies have indicated that California experienced droughts lasting hundreds of years and no one knows, for certain, when, or how much, it will rain in the future. For that reason, Valley District has been working to develop a strong, "uncertainty-proof" water supply portfolio that includes increased investment in its imported supply through the State Water Project, such as Sites Reservoir, as well as local investments in demand reduction, recycled water and stormwater capture.

The recently completed *Upper Santa Ana River Watershed Integrated Regional Urban Water Management Plan* demonstrates that the proposed water supply portfolio is able to provide a reliable water supply based upon past hydrology, a simulated 30-year drought and the estimated flat population projections over the next 25 years. That said, the proposed water supply portfolio has not been compared to a mega-drought lasting hundreds of years nor has it been evaluated against the anticipated ultimate water demand for our region beyond the Urban Water Management Plan horizon. These, and other, uncertainties have created a desire to invest as much as possible into a robust water supply portfolio that is hopefully able to overcome all of the possible uncertainties. The Sites Reservoir is a very important part of this proposed water supply portfolio.

Sites Helps Restore Lost Supply

The Valley District region will have invested $1 billion into the State Water Project when the bonds have been completely paid. The supply, or return, from that investment has been declining since the late 1990's due to environmental restrictions intended to help endangered fish populations. These restrictions have reduced the return on this investment by about 20%; the Sites Project is estimated to restore between 12% and 17% of this lost supply.

Alternatives to Sites

Valley District views each of its proposed water supplies as important because they each have their own level of uncertainty. For example, given our local history with drought, Valley District's proposed stormwater capture program is predicted to produce an inconsistent return. Some years, stormwater capture will provide a significant amount of water but most years it will provide a marginal supply. Similarly, the Sites Reservoir Project provides more water in dry years and less water in wet years. Both stormwater capture and Sites Reservoir have their own level of uncertainty but, together, they complement each other by providing their water supply during times when the other project is not providing much water supply. Our overall goal is a diverse water supply portfolio that helps overcome the variety of uncertainties we face.

If Sites Reservoir were not built, Valley District would have less supplemental water supply for its region which would reduce water supply reliability. There is no other project in the State of California that can replace the multiyear storage and dry year water supply that Sites offer.

If the Sites Reservoir were not to move forward, Valley District would experience a decline in the reliability of its water supply portfolio and would look to develop another water supply. The most likely source would be additional recycled water. However, due to environmental needs/requirements in the Santa Ana River, much of the region's recycled water is already pledged to the River and may not be available to recycle. While the region does not have any additional planned recycled water projects to provide a cost comparison, it is anticipated that any additional increase in recycled water without adequate dilution from high quality imported water would likely require some level of costly desalination to meet the existing groundwater basin water quality standards. Recycled water cost can reach the thousands of dollars per acre-foot.

What if Conditions are Better than Expected?

Valley District's approach to investing in various water supplies to help overcome uncertainties could result in surplus water should the uncertainties be less severe. In consideration of this possibility, Valley District already has agreements, in place, to sell surplus water to its neighboring, regional water agencies such as the San Gorgonio Pass Water Agency and the Metropolitan Water District of Southern California. Should these agencies have sufficient supplies, surplus water could be made available to other areas of the state that are in need.

Storage the Great Equalizer for Drought

The State of California is prone to drought; the great equalizer to overcome drought is storage. The Sites Reservoir provides the State of California an opportunity to increase its amount of storage but these projects are expensive and require a combination of state and local investment. Valley District is one of the agencies that is willing to invest in this important project for the State of California. While Valley District's investment will be primarily for the benefit of its ratepayers, the investment could also be beneficial to others in the State of California if local uncertainties are less severe than anticipated. The Sites Reservoir is a generational opportunity to construct an asset that will serve generations to come.

Authority Land Management Committee Meeting Minutes

Date: July 9, 2021 **Location:** Maxwell / Virtual

Time: 3:00pm – 5:00pm

Leader:	Supervisor Gary Evans	**Recorder:**	Conner McDonald

Purpose: Update on activities associated with the project mitigation cost estimate, Section 106 permitting, geotechnichal investigations, and real estate activites

Attendees:

Supervisor Gary Evans (Colusa)
Supervisor Ken Hahn (Glenn)
Jeff Sutton (TCCA)
Logan Dennis (GCID)

Mike Azevedo (Colusa)
Thad Bettner (GCID)
Jerry Brown (Sites)
Kevin Spesert (Sites)
Ali Forsythe (Sites)

Conner McDonald (HDR)
Henry Luu (HDR)
Jeriann Alexander (Fugro)
Pete Rude (Jacobs)
Jeff Smith (Jacobs)
Mark Twede (Jacobs)
Derek Morley (Geosyntec)
Brian Martinez (Geosyntec)
Larry Fishman (Vanderweil)
Jeff Herrin (AECOM)
Howard Michael (AECOM)
Michael Smith (AECOM)
Michael Forrest (AECOM)

Agenda:

Discussion Topic	**Topic Leader**	**Time Allotted**
• Introductory Remarks	Evans	3 minutes
• Meeting Minutes & Action Item Follow Up	Evans	2 minutes
• Review updated project mitigation cost estimate • **Requested Action:** Feedback/Direction	Forsythe	30 minutes
• Discussion on Section 106 activites • **Requested Action:** Feedback/Direction	Forsythe	20 minutes
• Review of proposed Amendment 3 workplan geotechnical investigations locations • **Requested Action:** Feedback/Direction	Luu	40 minutes
• Amendment 3 Real Estate approach/considerations • **Requested Action:** Feedback/Direction	Spesert	20 minutes

• Action Items and Closing Comments	Evans	5 minutes

Agenda Item #1 – Introductory Remarks – Supervisor Gary Evans

Meeting called to order at 3:00pm by Supervisor Gary Evans.

Kevin Spesert confirmed Attendees.

Attendees introduced themselves.

Agenda Item #2 – Meeting Minutes & Action Item Follow-Up – Supervisor Gary Evans

Meeting Minutes from prior meeting have been reviewed.

Agenda Item #3 – Review of Updated Project Mitigation Cost Estimate – Ali Forsythe

Ali Forsythe presented on the Mitigation Cost Estimate, providing background on how the cost was arrived at. The mitigation activities will have an effect on land activities, and the estimate will be refined over time, with the current estimate providing a good anticipated cost.

The current mitigation estimate is based upon the 2016 Technical Memo that was part of the USBR process. This memo looked at specific resources and all impacts; added greenhouse gas emissions; and considered broad categories, monitored over time.

In developing the current estimate, the Project Team worked with the EIR / EIS Team, and looked at all mitigation measures – upfront versus long-term monitoring versus construction. These costs were placed where they most logically fit, and the 2016 Memo was used as the basis.

There were changes to the Terrestrial and Land Cover sections, based on outreach to Westervelt, RES, Wildlands, to determine current cost with regard to mitigation bank credits in today's market. ASFMRA was also used as a resource to confirm land value numbers. The mitigation ratio is determined by negotiations with agencies during the permit process.

Ali Forsythe presented a table identifying the resources, and planning-level cost estimates, totaling $562,477,300, and compared this cost estimate to the 2020 Value Planning Estiamte of $540,000,000, identifying the line-item changes between the two.

USBR undertakes mitigation in a different manner than others would – USBR mitigation costs are based upon land acquisition costs. Sites' process will differ from the USBR process. Sites will have lifecycle costs for mitigation; and the estimate assumes a suite of mitigation options, including both on-site and use of a mitigation bank.

At this time, there is not land access to conduct surveys – land has been mapped by aerial desktop surveys, and information is coarse. When land access is possible, there will be much work to ground truth what has been identified, and refine the mitigation needs.

The Committee asked how the removal of the Delevan Pipeline from the proposed project features affects the Project's mitigation needs.

Ali Forsythe advised that much of the costs for the Delevan Pipeline were assumed as temporary impacts (construction-related) for Giant Garter Snake, and not accounted for in the 2016 costs.

The Committee asked if the cost estimate could be refined via obsersations of the land made from the public right-of-way.

Ali Forsythe advised that the agencies will want surveys that occur on the actual ground being affected.

With regard to Terrestrial Wildlife Resourses / Wildlife Habitat, credit stacking is applied where applicable. With regard to Vernal Pool Brachiopods, the cost assumes presence, with the modeled habitat to be verified, and confirmed for presence/absence.

With regard to Agricultural Lands, the variation from the Value Planning Estimate is currently estimated at +$15M.

With regard to next steps, the Project Team will continue to refine effects, refine assumptions, minimize impacts through design refinements, work with agencies to solidify ratios, and conduct surveys as access becomes available.

Agenda Item #4 – Review of Proposed Amendment 3 Workplan Geotechnical Investigation Locations – Henry Luu

Henry Luu introduced the topic, and advised that the Project Team has been working to refine the geotech needs since the last discussion of this matter, and hopes to have a good idea of the anticipated geotech needs by the end of July, with the primary focus being on the geotech work required for permitting and water right certainty.

Jeriann Alexander presented on the geotech effort, and advised that there has been geotechnical data collected to support the engineering feasibility studies, allowing for concept assessments, preliminary alternatives evaluations, development of preliminary cost estimates, and identification of scope for future design-level data collection. These efforts have not been sufficient to complete engineering analysis and design, gain regulatory acceptance, or refine construction cost estimating.

The design-level field data collection is envisioned to support the engineering design of all project elements, support refined construction cost estimates, facilitate development of construction drawings, answer jurisdictional versus non-jurisdictional questions, and garner jurisdictional acceptance.

Jeriann Alexander presented on the anticipated investigation areas of the GCID Headworks, Sites Reservoir Dams and associated facilities, and the Dunnigan Pipeleline; with the anticipated types of investigations including geologic mapping, utility locating, geophysics, CPTs, borings, piezometers, well tests, test pits, trenching, and test-fill.

The proposed Amendment 3 work has been categorized into Phase I and Phase II, with Phase I focusing on limited data collection for specific features, and Phase II focusing on data collection for overall 30% design.

Agenda Item #5 – Discussion of Section 106 Activites – Ali Forsythe

Ali Forsythe advised that the Section 106 activities have land implications. NHPA requires agencies to consult regarding the potential effects on cultural resources. USBR has agreed to be the lead federal agency responsible for Section 106 compliance for the project.

The basic steps in the Section 106 process include initiation, identification of historic properties, assessment of the Project on the identified resources, and resolution of adverse effects to the identified properties.

Project effects are difficult to determine as there is a large project footprint, land without access permission, and multiple alternatives. Under this scenario, a Programmatic Agreement is the right mechanism to address the 106 needs. The Agreement will outline the procedures for identifying and considering historic properties that could be affected by the Project, and will include any proposed plans, inventories, evaluations, mitigation measures, and reporting that is agreed to.

USBR has sent correspondence to the appropriate parties, and is revising a draft agreement provided by the Authority. Biweekly coordination calls are being conducted to advance this effort. Based on the anticipated schedule, the parties hope to develop a general consensus by early 2022, and have the agreement prepared for signature at that time.

The plan will require engagement with Landowners, and there will be a need to talk with Landowners prior to the rule coming out.

Cemetery Relocation has been considered as part of this process.

Agenda Item #6 – Amendment 3 Real Estate Approach / Considerations – Kevin Spesert

Kevin Spesert presented on the real estate approach and considerations for Amendment 3, and advised that the real estate process builds upon the field work from prior years, and the Real Estate Policy that was approved by the Committee and the Board.

For the upcoming Amendment 3, it is anticipated that there will be field work occurring on both public lands and private lands. Private Landowners are all unique individuals, and process the negotiations for access permission in their own ways. Negotiations with Landowners can be very complex, and require long lead times. The Project can move only as fast as the Landowners are comfortable to do so, and the Team must respect their timeframe and involvement. Some Landowners will not allow access to field work locations.

The right-of-entry program from Amendment 3 will be similar to that of the past. Compensation will be a component of access to private lands. Depending on the number of activities proposed, some levels of compensation may be much more than in the past. Compensation is an important component in the negotiation process, and has resulted in collaborative discussions with Landowners.

In addition to the geotechnical work considerations, Landowners will have logistical requirements, and activities that are not workable for them. Access routes, timing, seasonality, project work schedule, wildfire risk, tenants, agricultural operations, harvest, livestock, and go / no-go areas are all considerations and terms of the negotiations. Landowners set these terms and the negotiation schedule. The Project Team wants to ensure that all discussions with Landowners are done collaboratively, and with respect to the Landowner's time, terms, and conditions.

Kevin Spesert advised that option agreements may be useful in offering additional options to the Project and Landowners, and may help provide some certainty in land delivery.

Conner McDonald presented on the use of option agreements in land acquisition-negotiation, and advised that such agreements allow the opportunity, with a willing Landowner, to agree to terms regarding purchase rights for necessary lands. Such agreements have a focused and specific use, but could also be used as a vehicle for field access, if amenable to the Landowner.

Kevin Spesert advised that the next steps for the Real Estate Team involve planning for the upcoming field activities, developing a plan and approach for the right-of-entry program, and considering a plan and approach with regard to option agreements. This planning will be based upon the successes of the 2019 and 2020 field work campaigns. The Team has built collaborative relationships with the Landowners and the Community from Day 1, and this gives an enhanced opportunity to discuss field access.

Agenda Item #7 – Action Items and Closing Comments – Supervisor Gary Evans

The meeting was adjourned at 5:16pm.

Ad Hoc Operations and Engineering Workgroup

September 17, 2021

Sites

Introductions and Opening Remarks

Rob Kunde and Mike Azevedo

Sites

Operations Plan – Preliminary Input

Erin Heydinger

Background

- Objective of the Operations Plan:
  - Identifies the overall operational process, facilities, and mechanism
  - Explains the annual operations cycle
- Began development of the Operations Plan in 2019
  - Created annotated outline
  - Postponed further development until there was further certainty
    - Value planning
    - Updated operations modeling
- Today's objective: provide input on overall content and annual operating process

E5 E6 E7 E8 E9

Proposed Content

1. Introduction and Approach
2. Planning, Accounting, and Reporting
    a. Annual Operating Plan
    b. Monthly and Daily Accounting and Reporting
    c. Year-End Accounting and Reporting
    d. Periodic Synthesis Reporting
3. Diversions to Sites Reservoir
    a. Diversion and Conveyance Facilities
    b. Diversion Criteria
    c. Diversion Orders

Slide 5

E5 ADD LOSSES TO ALL SECTIONS. where does annual cycle fit in?
Erin, 9/17/2021

E6 tracking for exchanges
Erin, 9/17/2021

E7 consider a cheat sheet? or updated animation?
Erin, 9/17/2021

E8 delta/carriage losses
Erin, 9/17/2021

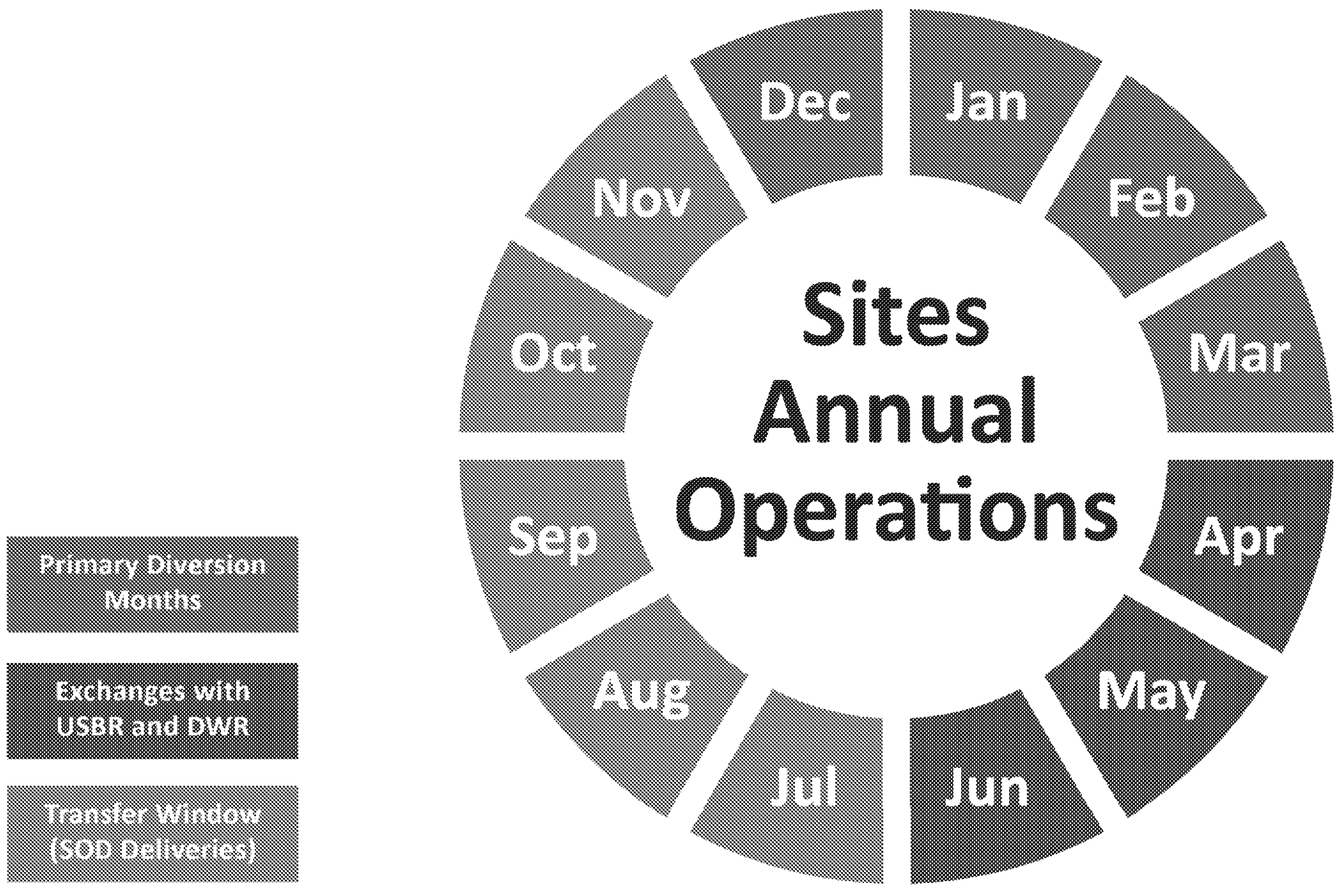
E9 Erin, 9/17/2021

Proposed Content (cont.)

4. Storage in Sites Reservoir
   a. Losses from Storage
   b. Dead Pool
   c. Storage Allocation, Leasing, and Transfers
5. Releases from Sites Reservoir
   a. Release and Conveyance Facilities
   b. Release Orders
6. GCID and TCCA Coordination
7. CVP and SWP Cooperative Operations and Exchanges
8. CDFW Coordination
9. Flood Control and Health and Safety Considerations
   1. Emergencies
   2. Flood Control Considerations
   3. Recreation Considerations and Notifications
   4. DWR Coordination
10. Changes to the Operations Plan

Do you think anything is missing?

Initial Input: Annual Operations Cycle



January
- Initial requests for Sites water provided by participants for delivery or transfer
- Coordination with GCID and TCCA on diversions

February
- Coordination with GCID and TCCA on diversions
- Final requests for Sites water releases before transfer window (further requests accommodated when possible)

March
- Sites begins releasing water for DWR and Reclamation exchanges
- Coordination with GCID and TCCA on diversions
- Coordination with CDFW on Prop 1 water deliveries
- Some releases for NOD use

April
- Final requests for Sites water releases to SOD (further requests accommodated when possible)
- Releases for NOD purposes
- Coordination with CDFW on Prop 1 water deliveries

May
- SOD participants notify DWR of final Sites requests for season
- Peak release month for exchange water
- Releases for NOD purposes
- Prop 1 water schedule finalized with CDFW

June
- Peak month for water backed into Oroville and Shasta
- Releases for NOD use
- Carriage water costs determined (proposed)

July
- Transfer window opens, SOD deliveries begin
- Water exchanged into Shasta and Oroville begins to release
- Key month: Coordination with TCCA, CBD, DWR on releases to river
- Coordination with Reclamation and DWR on exports
- Releases for NOD use

August
- Exports for SOD use
- Yolo Bypass Prop 1 deliveries
- Key month: Coordination with TCCA, CBD, DWR on releases to river
- Coordination with Reclamation and DWR on exports
- Releases for NOD use

September
- Exports for SOD use
- Key month: Coordination with TCCA, CBD, DWR on releases to river
- Yolo Bypass Prop 1 deliveries
- Coordination with Reclamation and DWR on exports
- Releases for NOD use

October
- Exports for SOD use
- Continued coordination with TCCA, CBD, DWR, Reclamation on releases and deliveries
- Releases for NOD use

November
- Last month for SOD exports
- Coordination with GCID and TCCA on diversions
- Releases for NOD use

December
- Coordination with GCID and TCCA on diversions

Initial Input: Annual Operations Cycle

Does the proposed timing for initial and final requests work for your agency?

Initial requests in January, final request in February for water before July, April for transfer window

NOD Participants: what months are you most likely to use your Sites water? E10

Modeling shows peak in April, May, June

SOD Participants: how much does carriage water impact annua E11 equest for deliveries?

Proposing final carriage water costs to be determined in June

Slide 9

E10 GCID peak in May, RD108 peak in May, TC - likely April thru Aug/Sept, maybe October, Maybe March
Erin, 9/17/2021

E11 What about prioritization? Releases iniitially requested vs. later? Check w JP. Idea: final requests get priority over later access to conveyance.
Erin, 9/17/2021

Next Steps

- Continue to draft Operations Plan, Version 1
- Receive workgroup feedback on components of the draft in October
- Version 1 completed in November
- Version 2 developed during Amendment 3 after the Project has a Final EIR/EIS, permits, operating agreements with DWR and Reclamation

Questions?

Sites

Unimpaired Flow Analysis

Erin Heydinger

Sites

Background

- The State Water Board is responsible for adopting and updating the Water Quality Control Plan for the Delta (Bay-Delta Plan)
  - Water quality
  - Flow requirements
- Proceeding in two phases:
  - Phase 1: State Board adopted lower San Joaquin flow objectives and revised Delta salinity objectives in December 2018
  - Phase 2: State Board also considering Plan amendments focused on the Sacramento River and tributaries

Background (cont)

- The Bay-Delta Plan uses an "unimpaired flow" requirement
  - Unimpaired flow: natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds
- Sets a percent or a range of percent unimpaired flows that must be met
- Lower San Joaquin: 40 percent unimpaired flows required from February to June from major tributaries, with an "adaptive range" of 30 to 50 percent
- 55 percent year-round starting point recommended for Sacramento River tributaries, Delta inflow, and Delta outflow

How it Would Affect Sites

- Question: what would an unimpaired flow standard on the Sites diversions mean for the Sites Project?
- Modeling team evaluated implementing this standard on Sites diversions using two methods:
  - 55 percent unimpaired required in the Sacramento Valley
  - 55 percent unimpaired required in local tributaries
- Difference in methodology is due to uncertainty in how the requirement would be implemented by the SWRCB

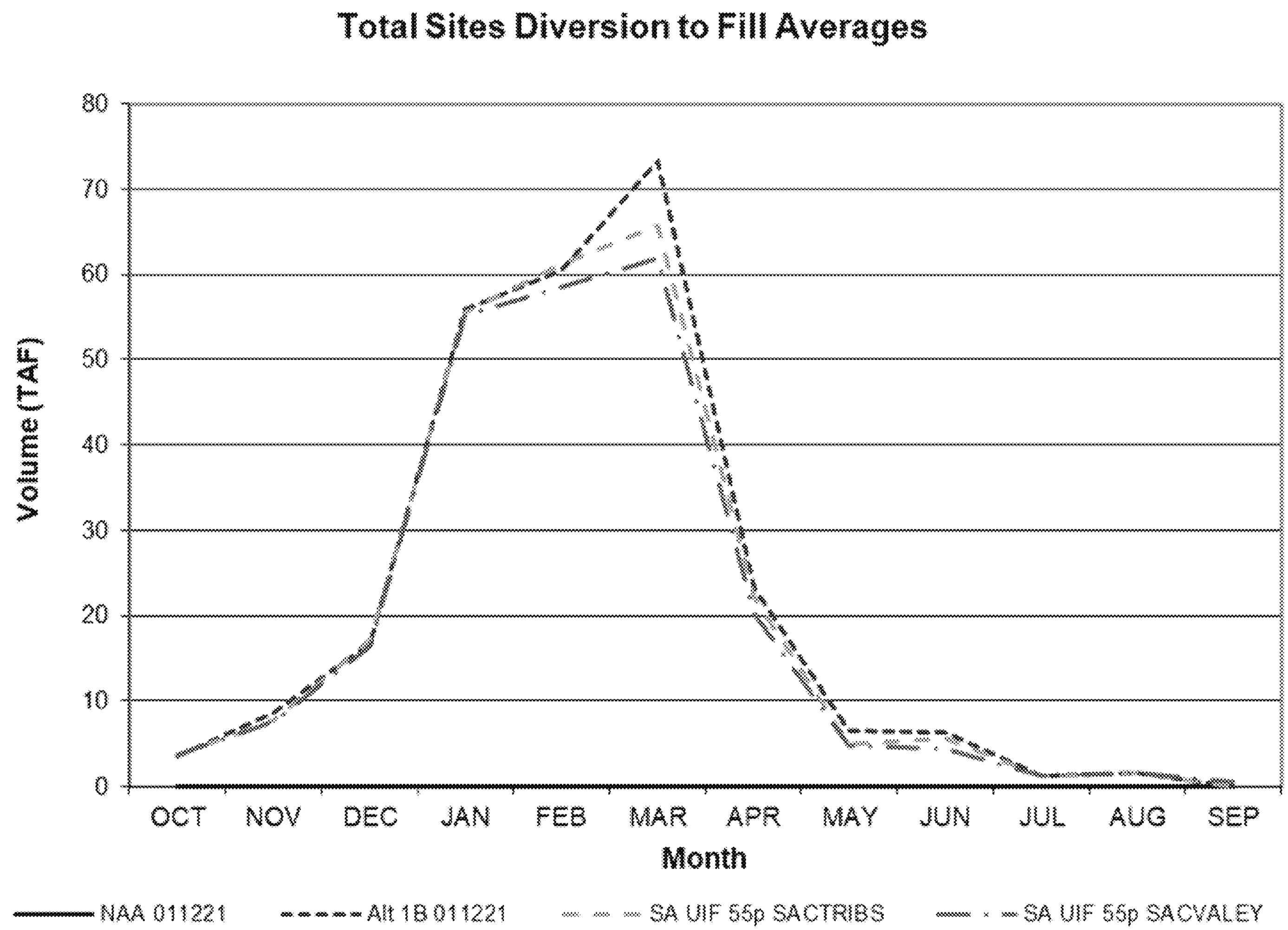
Limitations of Analysis

- Limitations and Caveats:
  - Analysis assumes other operations stay consistent (i.e. not meeting unimpaired flow standard)
    - State Water Project
    - Central Valley Project
  - Assumes Sites is not responsible to "meet" requirement (i.e., release water)
  - Assumes Delta conditions do not change significantly
    - Sites can only divert when the Delta is in excess
- Analysis applies State Board proposal to Sites diversions only
- Because of the limits of the analysis, we do not propose to use the unimpaired flow standard in lieu of existing diversion criteria

Results

Parameter	Water Year Type	ALT1B	ALT1B Local UIF	ALT1B Sac Valley UIF
Diversion (TAF)	Long-term	255	244 (-4%)	234 (-8%)
	Dry and Critically Dry	104	90 (-13%)	85 (-18%)
Release (TAF)	Long-term	234	224 (-4%)	214 (-8%)
	Dry and Critically Dry	404	382 (-5%)	370 (-8%)

Results


Total Sites Diversion to Fill Averages
80
70
60
50
40
30
20
10
0
Volume (TAF)
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Month
NAA 011221
Alt 1B 011221
SA UIF 55p SACTRIBS
SA UIF 55p SACVALEY

Next Steps

- Share results with State Board staff and discuss any follow-on analysis
  - May become part of the Project's Water Availability Analysis
    - Requires input from SWRCB on how standard would be implemented
  - Potential revisions based on discussions with State Board staff
- Prepare memo describing analysis assumptions and results
  - Distribute as requested
    - NGOs have specifically asked how an unimpaired flow criteria would affect the Project

Questions?

Sites

Review Status of Final WSIP Feasibility Report

Henry Luu

Sites

Purpose: Secure State Funding

- Eligible public benefits from WSIP application were $1,008M
- CWC made a maximum conditional eligibility determination (MCED) of **$816M**
- Adjusted the MCED to **$836M**
- $40M in early funding
- Remaining funds for construction are contingent on a feasibility determination by the CWC
- WSIP Feasibility Report is basis for determination

Required contents within the WSIP Feasibility Report

- Project Objectives
- Project Description
- Technical Feasibility (operations focus)
- Economic Feasibility (cost/economic benefits/BCR)
- Financial Feasibility (SCRB cost allocation)
- Environmental Feasibility
- Constructability

CWC Coordination

- CWC staff reviewed the Draft WSIP Feasibility Report and provided comments focused on the economic and financial feasibility discussions
- The project team is working on addressing reviewer comments in preparation of the Final WSIP Feasibility Report
  - Will be seeking input from select members on expected use and economic benefit of the project's future water supply increases

Member Solicitation List

- Metropolitan Water District
- San Bernardino Valley Municipal Water District
- San Gorgonio Pass Water Agency
- Coachella Valley Water District
- Zone 7 Water Agency

Status Update

- Total **public benefit** is **$928M**
  - Higher than CWC adjusted MCED of $836M
  - Meets requirement for 50% minimum ecosystem benefits
  - Public benefit-cost ratio is **1.11**
  - Potential justification for additional WSIP funding (if it becomes available)

- The project team will utilize input from members to complete analysis of the Project benefit-cost ratio and finalize the WSIP Feasibility Report

Next Steps

- Complete updates to the WSIP Feasibility Report and work with CWC staff/reviewers to ensure the product is compliant and meets the needs for the Commission's feasibility determination
- Submit Final CWC Feasibility Report in October 2021
  - CWC staff plans to bring consideration of feasibility for the Sites Project to the December 15, 2021 meeting.
- This is a **checkbox** for determination of feasibility and demonstrate continued funding eligibility
  - not a final commitment (negotiations still to follow)

Staff is seeking this Workgroup's recommendation to authorize the Executive Director to approve submittal of the Final WSIP Feasibility Report to the CWC

Questions?

Sites

Thank You!

Next Meeting: Thursday, October 7th

Sites

Sites

Draft - Predecisional Working Document - For Discussion Purposes Only

From: Marcia Kivett [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=189D06A7F517441AA28325857F394D13-MKIVETT]
Sent: 9/27/2021 11:47:15 AM
To: Scott De Moss [sdemoss@countyofglenn.net]
CC: gcboard@countyofglenn.net
BCC: Marcia Kivett [MKivett@sitesproject.org]
Subject: FW: Glenn County - Sites

Good Morning,

Jerry will be in Maxwell on October 5th and was wondering if you had availability on that day to meet in-person? He can meet you in your office at 12:00 or 4:00. If not, I can set up a call on October 7th at 3:00 or 4:00, October 8th at 4:00.

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Scott De Moss <SDeMoss@countyofglenn.net>
Date: Monday, September 27, 2021 at 8:30 AM
To: Jerry Brown <jbrown@sitesproject.org>
Subject: RE: Glenn County - Sites

Jerry,

Hope things are going well. I am not sure of you schedule, but I have some time in the next couple of weeks. I have time on October 6th in the morning, on October 7th in the afternoon, and October 8th in the afternoon as well. Please let me know what will work best for you.

Thank you,

Scott

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Thursday, September 23, 2021 11:51 AM
To: Scott De Moss <SDeMoss@countyofglenn.net>
Subject: Glenn County - Sites

Hi Scott – There's a few things that seem to be areas we need to coordinate on in the near term so I wanted to see if we could touch base soon:

1. Rebalancing and Sites Participation
2. Discussions between Glenn and Colusa County Supervisors regarding Sites
3. EIR/EIS rollout – local effects (jobs, roads, recreation)

4. Authority dues for next year

Can I have Marcia contact your assistant to set a meeting to discuss these and any topics of interest to you?

Jerry

Sent: 9/27/2021 4:10:05 PM
To: Heydinger, Erin [Erin.Heydinger@hdrinc.com]; Spranza, John [john.spranza@hdrinc.com]
Subject: RE: GGS effects review

Hi Erin – I would expect GGS in the CBD. Its likely good habitat for them as its slow moving water.

I think our releases will be fine for GGS as they won't change the operations of the CBD. Wont change the water surface elevation in the CBD.

John should weigh in more, but I don't see a

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Friday, September 24, 2021 12:22 PM
To: Spranza, John <john.spranza@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: GGS effects review

Thanks John. I think this is okay for Yolo Bypass. You note CBD as well but not how flows would be adjusted to accommodate GGS in the CBD. We may potentially shift releases more towards October/November since that's when there's capacity in the CBD. Is there GGS habitat along the drain? My recollection is that there is. I think we could be okay because we would be operating to minimize flooding. Something to consider though.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Spranza, John <John.Spranza@hdrinc.com>
Sent: Thursday, September 23, 2021 10:39 AM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: GGS effects review

Hey Erin,
I thought I would send this over to you for review as it makes some statements about limiting our releases in certain areas to avoid effects to GGS.

4.1.1.1 *Hydrologic Effects*

Hydrologic modeling indicates that with the Project, the CBD, and Yolo Bypass could experience considerable increases in flows in October and moderate increases in November, which could affect giant gartersnakes (Jacobs Engineering

2021) during their dormant period (early October to early April) when they require upland refugia that do not experience flooding. To minimize flooding in October and November in Yolo Bypass, the Sites Reservoir would be operated to maintain summer flows within the Toe Drain, Tule Canal, and other channels. During the remainder of the giant gartersnake dormant period (December through March), the Project would result in low to moderate decreases in flows. These decreases would not adversely affect giant gartersnakes and could potentially be beneficial if they leave areas dry that would normally flood in the winter, providing additional suitable winter refugia for the species.

During their active period (generally April through September), giant gartersnakes require aquatic habitat with nearby uplands. During the first months of the giant gartersnake active period (April through July), the Project would result in moderate decreases in Yolo Bypass flows. This could adversely affect the species by reducing aquatic habitat during these months. During the latter months of the snake's active period (August through September), the Project would result in considerable increases in Yolo Bypass flows. If the increased flows inundate suitable areas for supporting aquatic giant gartersnake habitat with sufficient upland refugia nearby, the increased flows could have a beneficial effect on the species, particularly in dry years

John Spranza, MS, CCN
Senior Ecologist / Regulatory Specialist

HDR
2379 Gateway Oaks Drive, Suite 200
Sacramento, CA 95833
D 916.679.8858 M 818.640.2487
john.spranza@hdrinc.com

hdrinc.com/follow-us
hdrinc.com/follow-us

From: Marcia Kivett [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=189D06A7F517441AA28325857F394D13-MKIVETT]
Sent: 9/28/2021 11:14:52 AM
To: Kimberly Filosena [kfilosena@TNC.ORG]; Jay_Ziegler@TNC.ORG; Ann Hayden [ahayden@edf.org]; Maurice Hall [mhall@edf.org]; Anthony Saracino (anthony@asaracino.com) [anthony@asaracino.com]
BCC: Marcia Kivett [MKivett@sitesproject.org]
Subject: Sites Reservoir Meeting Request

Good Morning,

Jerry asked me to set up a discussion with this group regarding the EIR/ITP Diversion Criteria and continued discussion on the Enviro Water Manager. Please select your availability here – https://doodle.com/poll/cvkp2euubcnavkpv?utm_source=poll&utm_medium=link.

Thank you for your consideration.

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Thayer, Reed/SAC[Reed.Thayer@jacobs.com]
Sent: Tue 9/28/2021 1:02:52 PM (UTC-07:00)
To: Heydinger, Erin[erin.heydinger@hdrinc.com]
Cc: Alicia Forsythe[aforsythe@sitesproject.org]; Leaf, Rob/SAC[Rob.Leaf@jacobs.com]; steve.micko@jacobs.com[steve.micko@jacobs.com]
Subject: Additional Diversion Criteria Scenarios
Attachment: SitesMetrics_rev20_ScenCharts_5scn_ALT1B_011221_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_011221_OM_ALT1B_011221_MAM_WS10700_OF_WS6000.pdf
Attachment: NODOS_Trend_Reporting_rev48dpcy_DV6_MultiClim_CALSIM_NAA_ALT1B_011221_ALT1B_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_OM_WS10700_ALT1B_MAM_WS10700_OF_WS6000.xlsm

Erin,
We have analyzed three additional diversion criteria scenarios, which are described in the table below. A Trend Reporting spreadsheet and Sites Metrics report are attached.

Simulation name	Model ID (in Trend Reporting)	Fremont Weir diversion criterion	Bend Bı flow p diversio
ALT1B 011221	Alt 1B 011221	Prioritize the Fremont Weir Notch, Yolo Bypass preferred alternative, flow over weir within 10% when spill range between 600 cfs and 6,000 cfs; First 600 cfs of spill are protected within 1%	Protec qu preci genera events in river than s operatic from C May. event, fro Sacram would c c
ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000	Alt 1B 011221 MM WS10.7 OF WS 8		
ALT1B 011221 Oct-May WS 10,700	Alt 1B 011221 OM WS10700		
ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	Alt 1B 011221 MM WS10.7 OF WS 6		

Reed Thayer, PE | Jacobs | Water Resources Engineer
O: 916.286.0228 | M: 831.233.2141 | reed.thayer@jacobs.com
2485 Natomas Park Dr, Ste 600 | Sacramento, CA 95833 | USA

File Provided Natively

Sites Project and EBMUD

September 22, 2021

Sites

Agenda

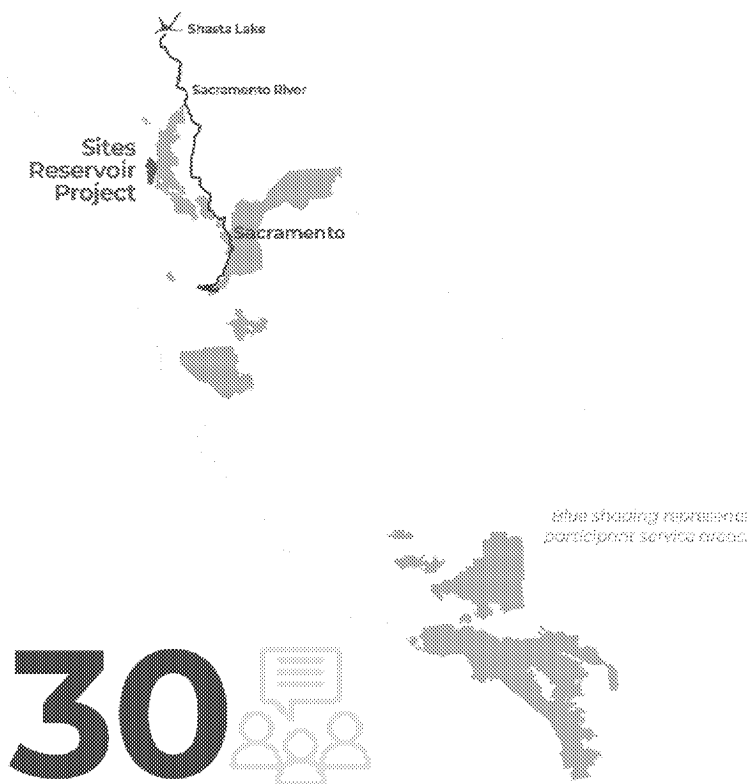
1. Introductions
2. Meeting Overview
3. Project Overview
   a) Facilities
   b) Operations
4. Modeling Approach
5. Analysis Results
6. RDEIR/SDEIS Aquatic Impact Determinations
7. Planning and Permitting Considerations/Schedule
8. Additional Topics
9. Action Items and Next Steps

Project Overview

Ali Forsythe/Erin Heydinger

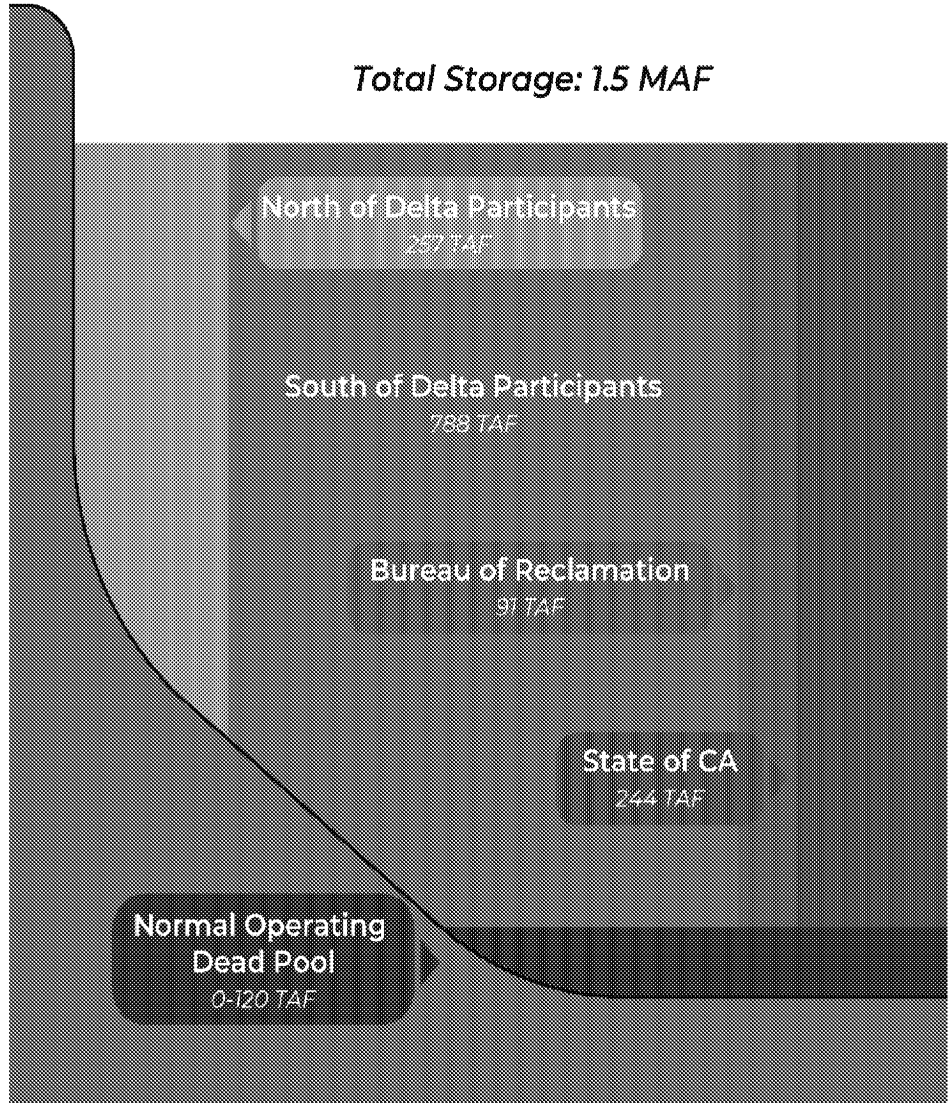
Sites

What is the Sites Project?

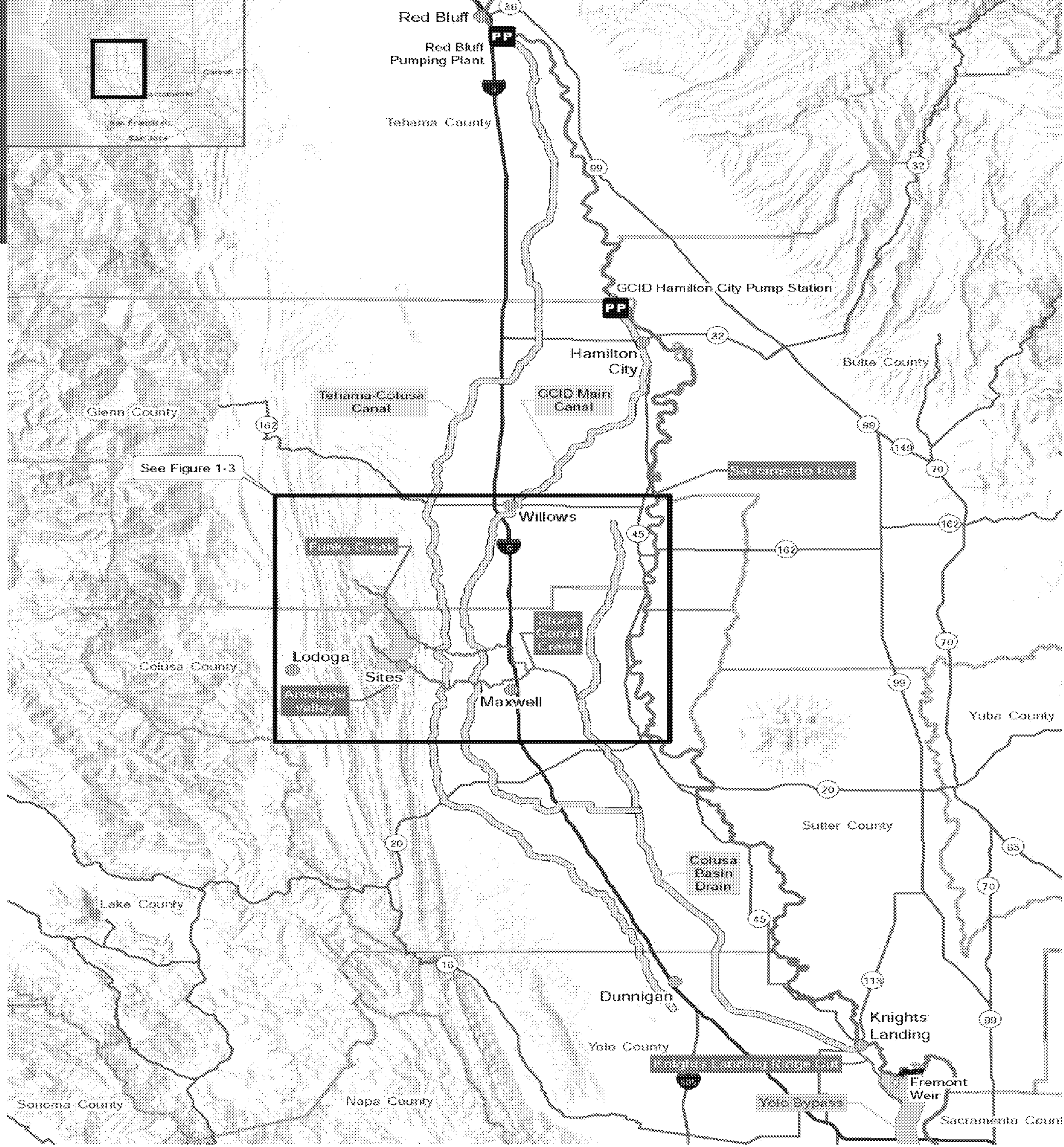


30 participants

span California

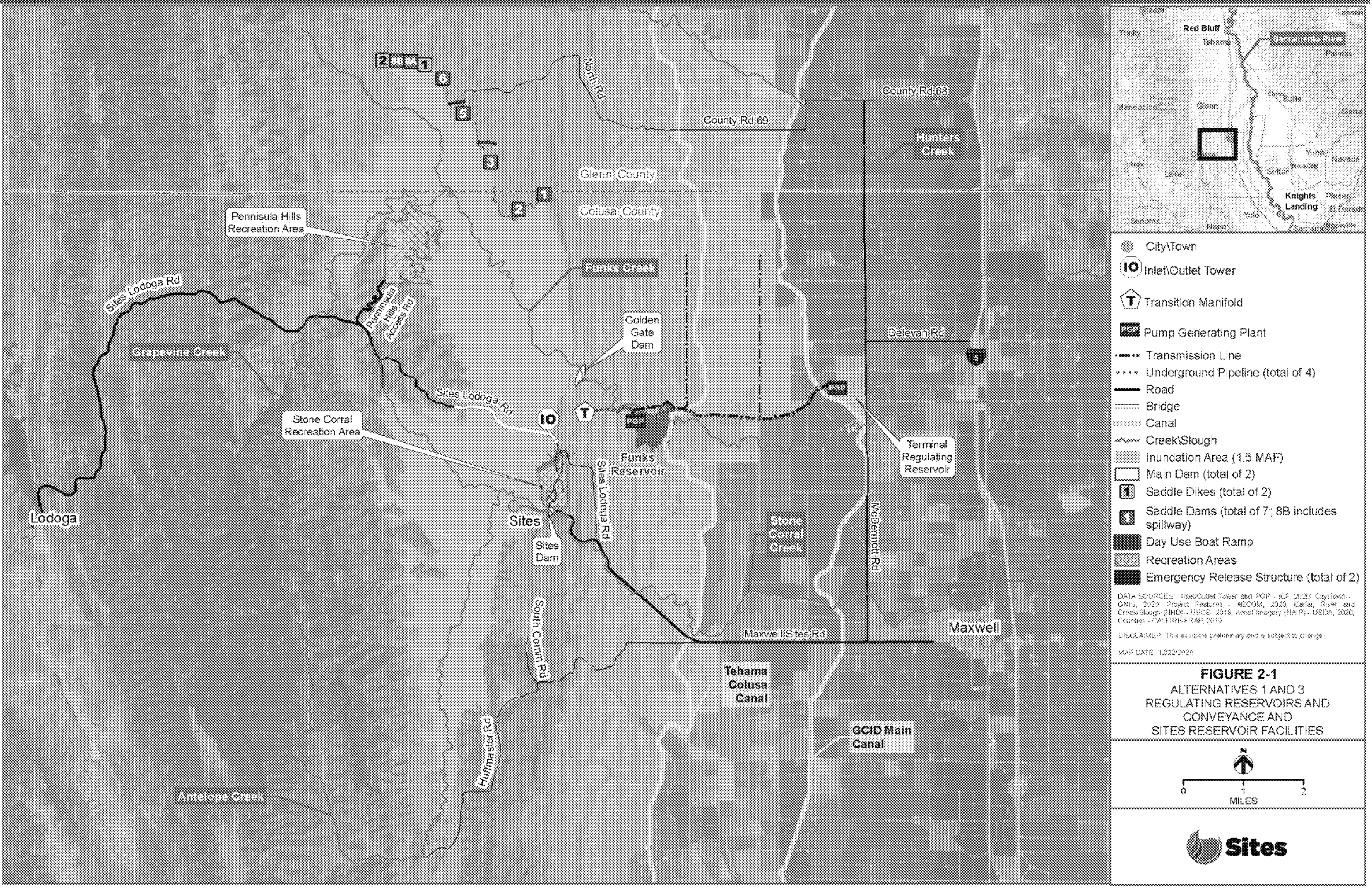


Regional Area

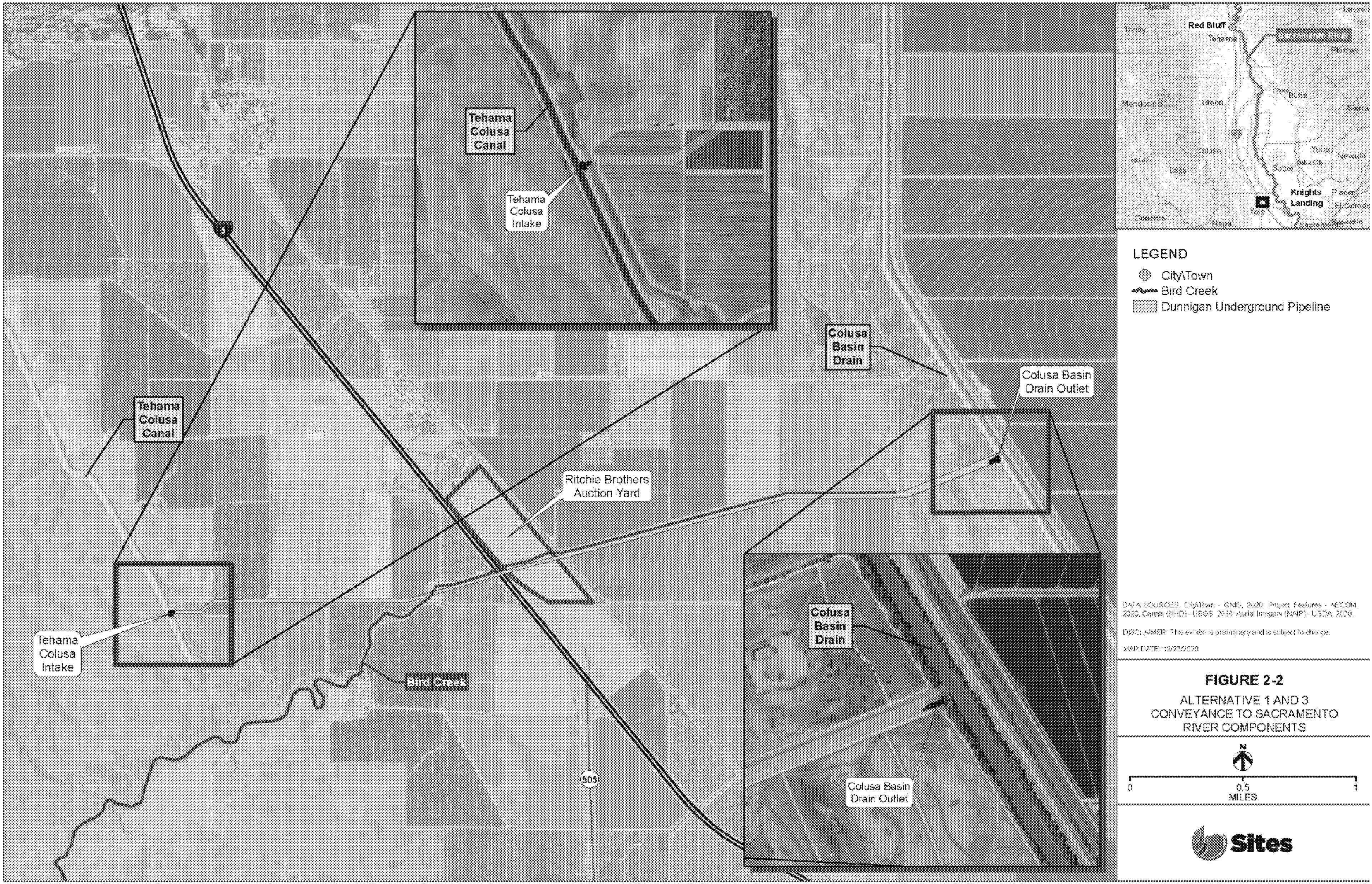


Not to scale

Alt 1 – Authority's Preferred Project



Alt 1 – Authority's Preferred Project



Operations

- Junior diverter – Diverting after all senior water rights and water quality and flow requirement are met
- Diverting during "excess conditions" (as determined by Reclamation and DWR)
- Diversion locations in priority:
  1. Red Bluff Pumping Plant into the Tehama-Colusa Canal: 2,100 cfs for Sites
  2. Hamilton City Pump Station into the GCID Main Canal: 1,800 cfs for Sites
- Diversions when Sacramento River not fully appropriated (September 1 to June 15)

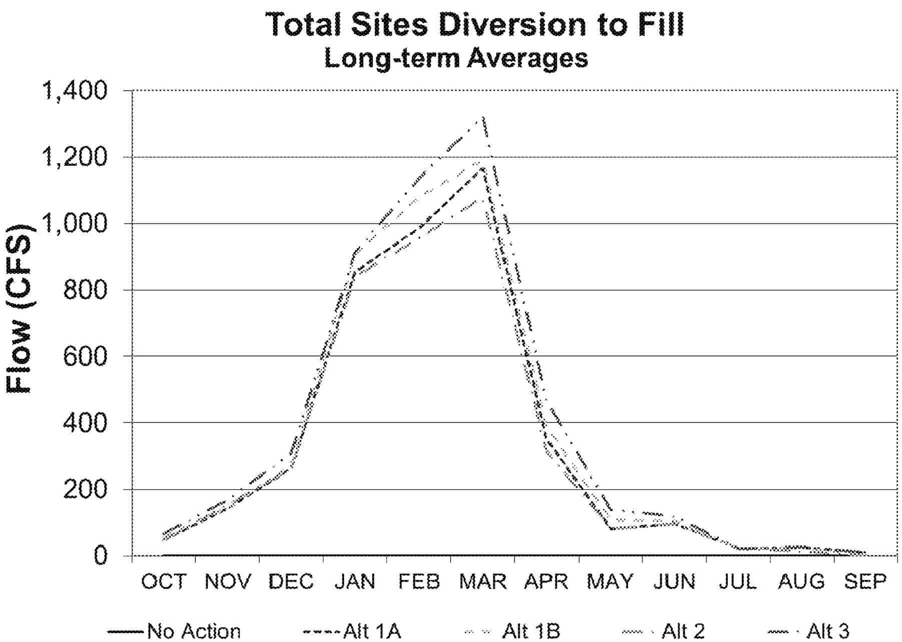
Operations (cont.)

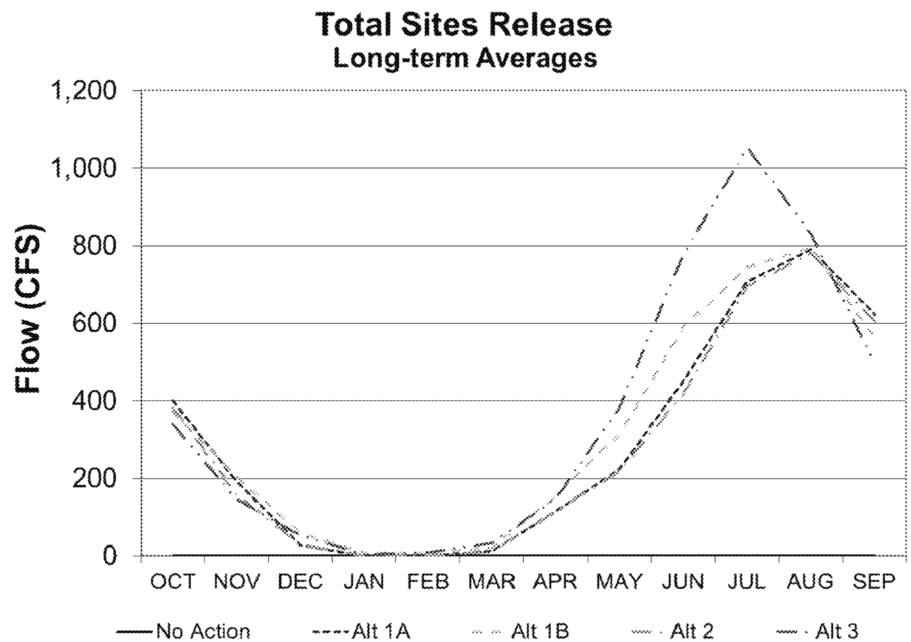
- Diversion Criteria
  - Wilkins Slough Bypass flow requirements:
    - 10,700 cfs March/April/May
    - 5,000 cfs all other months
  - Pulse flow protection
  - Fremont Weir Notch Protection
    - Objective is to limit changes to frequency and duration of spills

Operations (cont)

- Releases
  - TC Canal
  - GCID Canal
  - North Delta (Yolo Bypass)
  - South of Delta
- Exchanges
  - Reclamation
  - DWR
- Exports through the Delta

Diversions and Releases





Modeling Approach

Steve Micko

Sites

Modeling Approach

- Regulatory Environment
  - 2019 BiOps and 2020 SWP ITP
- Modeling Framework
  - CalSim II
  - Hydrodynamics
  - Water Temperature
  - Aquatics

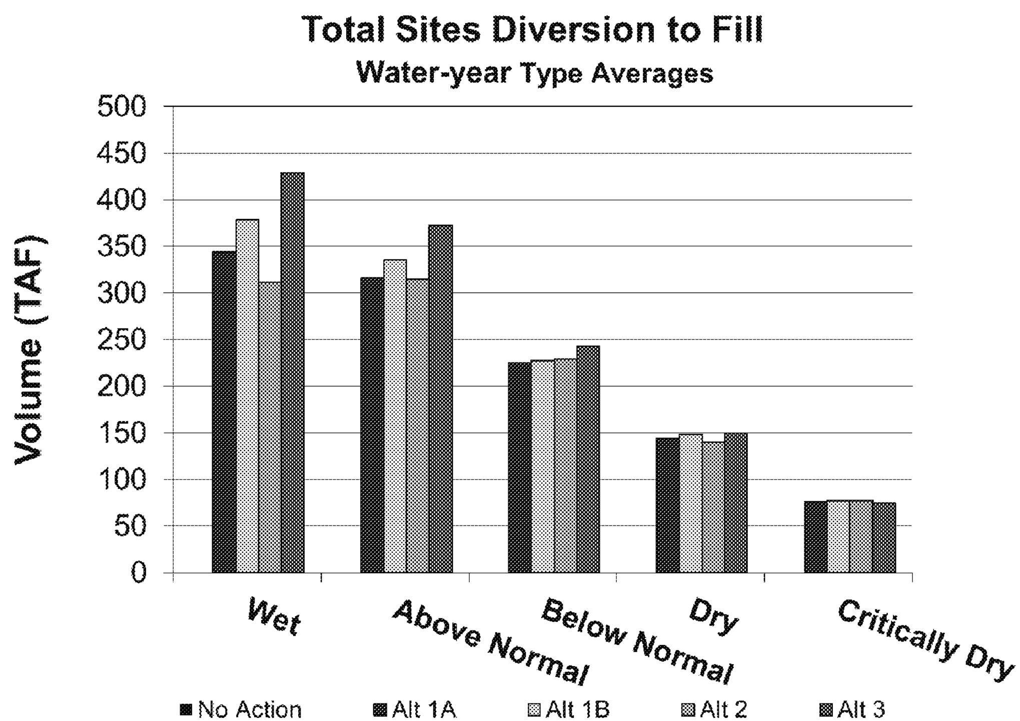
Modeling Results

Steve Micko

Sites

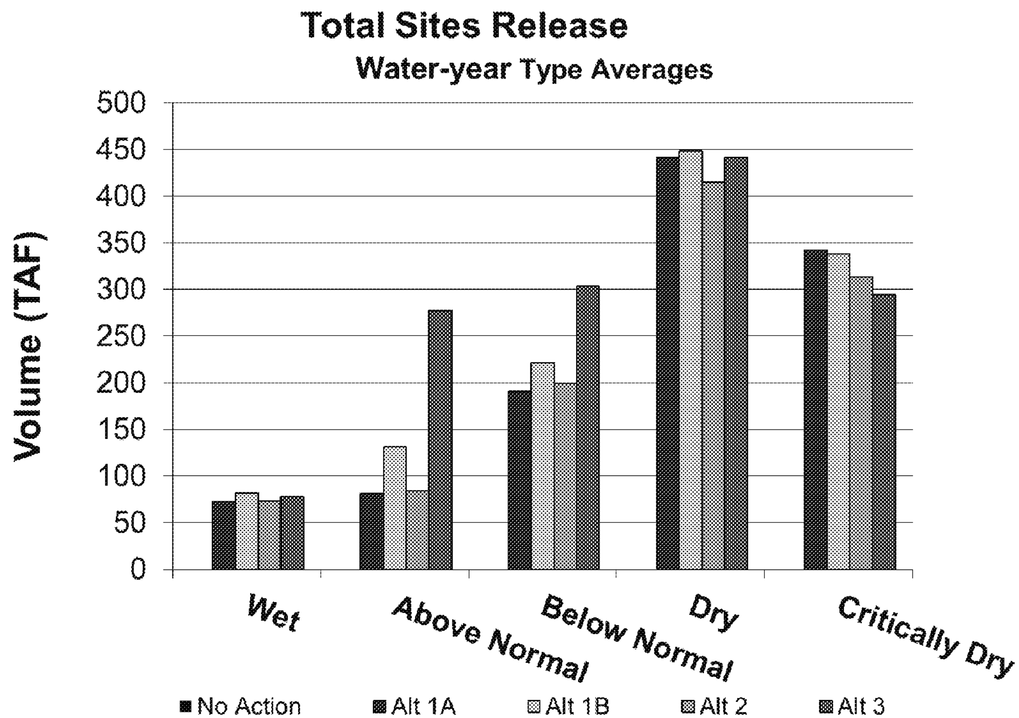
Modeling Results - Diversions

- Diversions occur in Wet and Above Normal Years

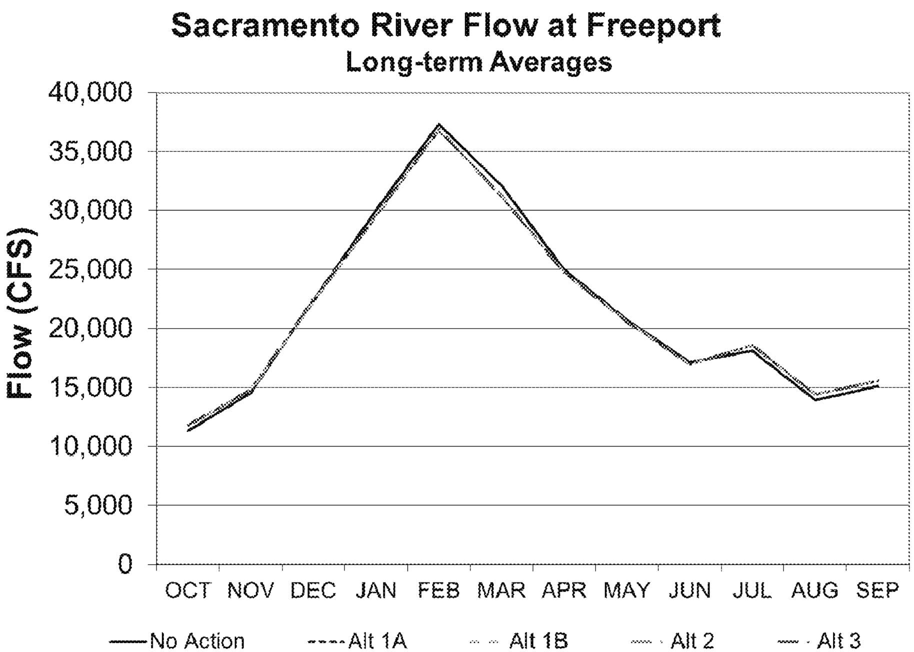


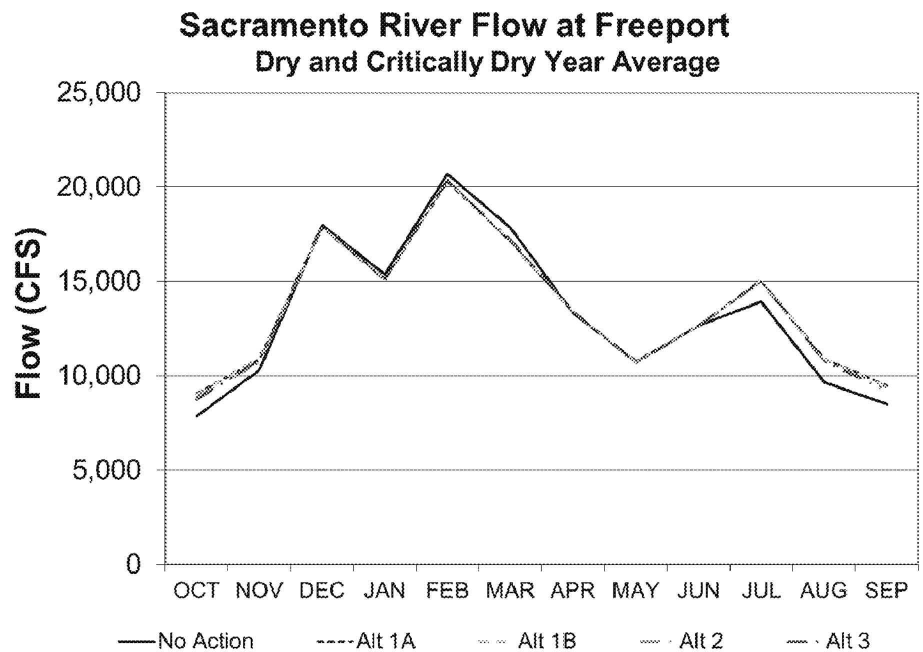
Modeling Results - Releases

- Releases in Dry and Critically Dry years

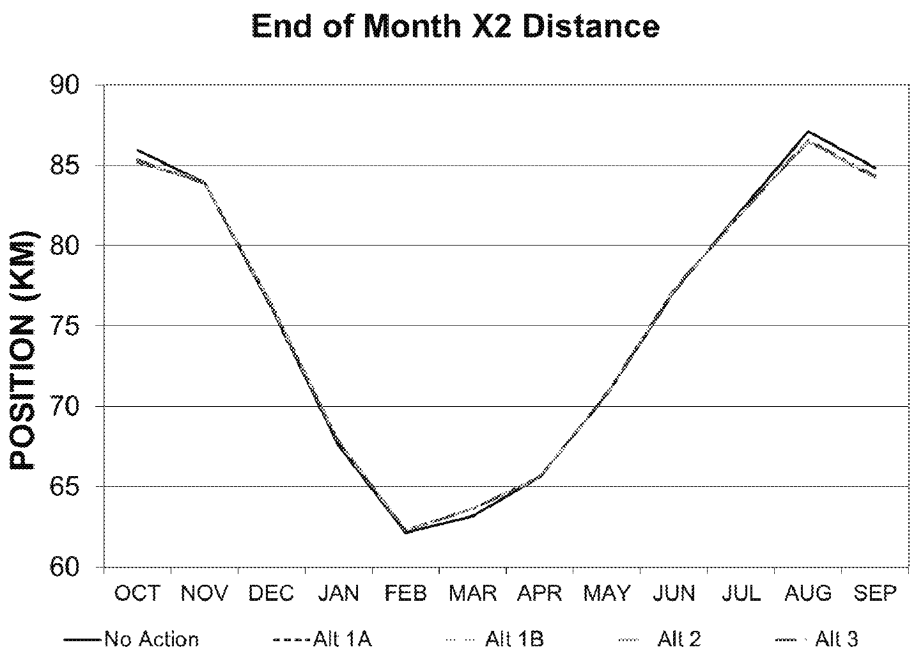


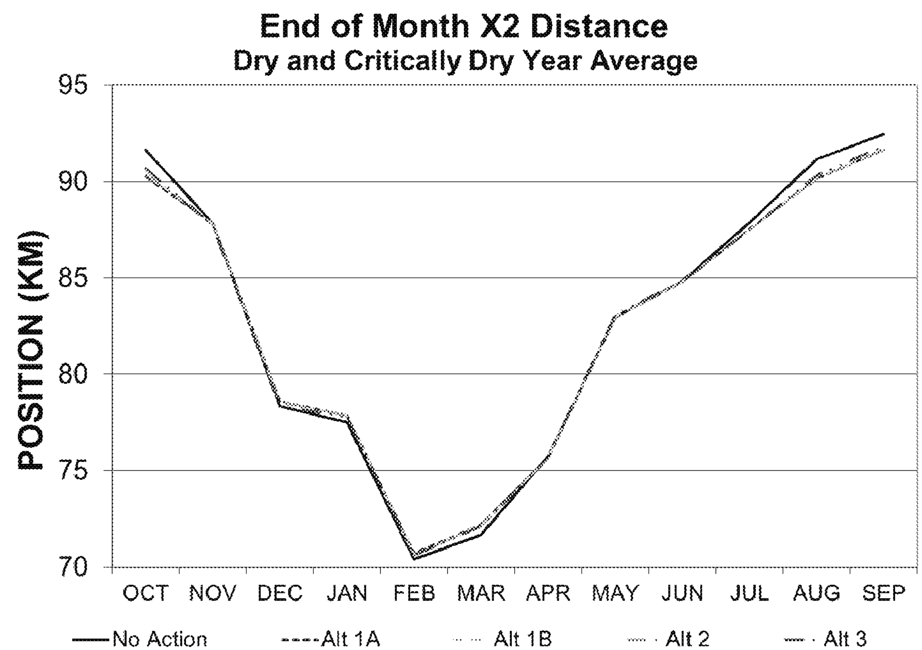
Modeling Results – Sac River at Freeport





Modeling Results – X2





RDEIR/SDEIS Aquatic Impact Determinations

Mike Hendrick/John Spranza

Sites

Aquatic Resources Evaluation – Near-Field Effect Analysis

- Near-Field Effects Analysis associated with salmon, sturgeon:
  - Entrainment through screens (Red Bluff and Hamilton City intakes)
  - Screen Impingement
  - Predation (Red Bluff and Hamilton City intakes, at Dunnigan Pipeline (Alt 2))
  - Stranding behind screens
  - Attraction to Reservoir Discharge and Pipeline Entry (Alt 2)

Key species analyzed:

- Winter-run Chinook salmon
- Spring-run Chinook salmon
- Fall-run/late fall-run Chinook salmon
- CCV steelhead
- White sturgeon
- Green Sturgeon
- Longfin smelt
- Delta smelt

Aquatic Resources Evaluation – Far-Field Effects Analysis

Far-Field Effects Analysis associated with salmon, sturgeon, and smelt:

- Temperature Effects (Sacramento, Feather, American (as appropriate))
- Flow-Related Effects
  - Redd Scour Entombment
  - Redd Dewatering
  - Spawning and Egg Incubation
  - Adult Migration and Holding
- Habitat Weighted Usable Area (Spawning, Rearing)
- Juvenile Stranding

Key species analyzed:

- Winter-run Chinook salmon
- Spring-run Chinook salmon
- Fall-run/late fall-run Chinook salmon
- CCV steelhead
- White sturgeon
- Green Sturgeon
- Longfin smelt
- Delta smelt

Aquatic Resources Evaluation - Far-Field Effects Analysis (cont.)

Far-Field Effects Analysis associated with salmon, sturgeon, and smelt:

- Floodplain Inundation and Access
  - Yolo Bypass and Fremont Weir Spill Flow and Days of Yolo Bypass Inundation
  - Yolo Bypass Inundated Area
  - Sutter Bypass and Fremont Weir Spill Flow and Duration
  - Sutter Bypass Inundated Area
- Migration Flow-Survival
- Sites Reservoir Release Effects
  - Temperature Effects
  - Water Quality Effects

Key species analyzed:

- Winter-run Chinook salmon
- Spring-run Chinook salmon
- Fall-run/late fall-run Chinook salmon
- CCV steelhead
- White sturgeon
- Green Sturgeon
- Longfin smelt
- Delta smelt

Aquatic Resources Evaluation - Far-Field Effects Analysis (cont.)

Far-Field Effects Analysis associated with salmon, sturgeon, and smelt:

- Delta
  - Juvenile Through-Delta Survival
  - Juvenile Rearing Habitat
  - South Delta Entrainment

Key species analyzed:

- Winter-run Chinook salmon
- Spring-run Chinook salmon
- Fall-run/late fall-run Chinook salmon
- CCV steelhead
- White sturgeon
- Green Sturgeon
- Longfin smelt
- Delta smelt

CEQA Findings for Aquatic Biological Resources

- Based on analysis and discussions with agencies two areas of effect resulted in the need for mitigation associated with aquatic biological resources

Effect Area	Impacts Requiring Mitigation	Significant and Unavoidable Impacts
Operations Effects on Winter-Run, Spring-Run, Fall-Run/Late Fall-Run Chinook Salmon and Central Valley Steelhead	All Alts – Implement Wilkins Slough Flow Protection Criteria whereby Project diversions would not occur from March through May of all water year types if flows in the Sacramento River at Wilkins Slough are below or would be reduced below 10,700 cubic feet per second	None
Operations Effects on Delta Smelt	All Alts – Evaluate and prevent potential detrimental water temperature and dissolved oxygen effects to Delta Smelt associated with moving Colusa Basin Drain water through the Yolo Bypass by monitoring and ceasing flows through the Yolo Bypass if detrimental effects are projected to occur	None

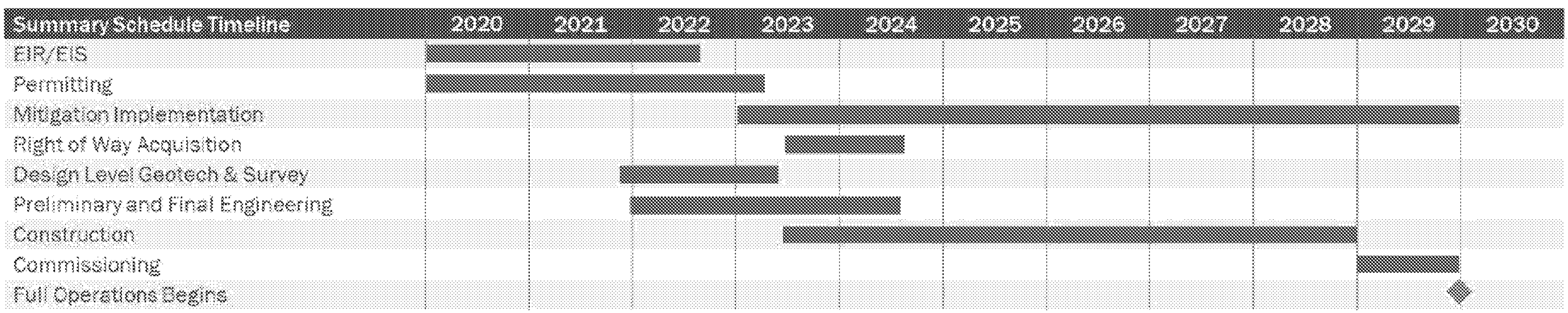
Planning & Permitting Considerations and Schedule

Ali Forsythe/John Spranza

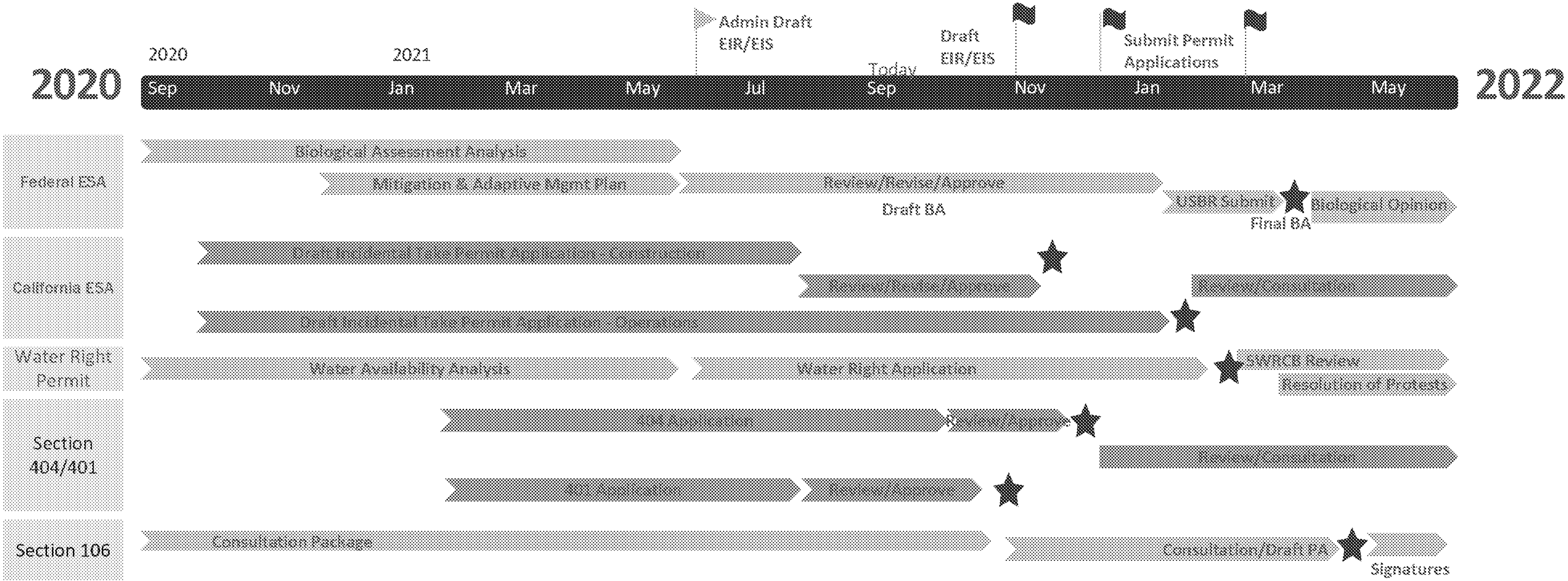
Sites

Schedule Through 2030

- Current schedule of overall key project components
- Final EIR/EIS and ESA consultation with the agencies may lag slightly based on recent discussions focused on exchanges



Current Permit and Coordination Schedule



Additional Topics

Sites

Action Items and Next Steps

Sites

Thank you!

Sites

Sent: Wed 9/29/2021 11:05:24 AM (UTC-07:00)
To: John Spranza (john.spranza@hdrinc.com)[john.spranza@hdrinc.com]; Heydinger, Erin[Erin.Heydinger@hdrinc.com]
Subject: FW: Additional Diversion Criteria Scenarios
Attachment: SitesMetrics_rev20_ScenCharts_5scn_ALT1B_011221_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_011221_OM_ALT1B_011221_MAM_WS10700_OF_WS6000.pdf
Attachment: NODOS_Trend_Reporting_rev48dpcy_DV6_MultiClim_CALSIM_NAA_ALT1B_011221_ALT1B_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_OM_WS10700_ALT1B_MAM_WS10700_OF_WS6000.xlsm

John – FYI. I have an email into Erin to see if we should get this out to the internal team.

I see us walking through these results tomorrow and then focusing on Fremont Weir and how to move forward with Fremont Weir.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Sent: Tuesday, September 28, 2021 1:03 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; steve.micko@jacobs.com
Subject: Additional Diversion Criteria Scenarios

Erin,
We have analyzed three additional diversion criteria scenarios, which are described in the table below. A Trend Reporting spreadsheet and Sites Metrics report are attached.

Simulation name	Model ID (in Trend Reporting)	Fremont Weir diversion criterion	Bend Br flow p diversio
ALT1B 011221	Alt 1B 011221	Prioritize the Fremont Weir Notch, Yolo Bypass preferred alternative, flow over weir within 10% when spill range between 600 cfs and 6,000 cfs; First 600 cfs of spill are protected within 1%	Protec qu preci genera events in river than s operatio from C May. event, fro Sacram
ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000	Alt 1B 011221 MM WS10.7 OF WS 8		
ALT1B 011221 Oct-May WS 10,700	Alt 1B 011221 OM WS10700		
ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	Alt 1B 011221 MM WS10.7 OF WS 6		

			would c c

Reed Thayer, PE | Jacobs | Water Resources Engineer
O: 916.286.0228 | M: 831.233.2141 | reed.thayer@jacobs.com
2485 Natomas Park Dr, Ste 600 | Sacramento, CA 95833 | USA

File Provided Natively

From: Spranza, John[John.Spranza@hdrinc.com]
Sent: Wed 9/29/2021 1:57:12 PM (UTC-07:00)
To: Lecky, Jim[jim.lecky@icf.com]; Hendrick, Mike[Mike.Hendrick@icf.com]; Greenwood, Marin[Marin.Greenwood@icf.com]; Chris Fitzer (CFitzer@esassoc.com)[CFitzer@esassoc.com]; Hassrick, Jason (Jason.Hassrick@icf.com)[Jason.Hassrick@icf.com]
Cc: Alicia Forsythe[aforsythe@sitesproject.org]
Subject: FW: Additional Diversion Criteria Scenarios
Attachment: SitesMetrics_rev20_ScenCharts_5scn_ALT1B_011221_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_011221_OM_ALT1B_011221_MAM_WS10700_OF_WS6000.pdf
Attachment: NODOS_Trend_Reporting_rev48dpcy_DV6_MultiClim_CALSIM_NAA_ALT1B_011221_ALT1B_ALT1B_011221_MAM_WS10700_OF_WS8000_ALT1B_OM_WS10700_ALT1B_MAM_WS10700_OF_WS6000.xlsm

FYI

John Spranza
D 916.679.8858 M 818.640.2487

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Tuesday, September 28, 2021 1:10 PM
To: Spranza, John <John.Spranza@hdrinc.com>
Subject: FW: Additional Diversion Criteria Scenarios

FYI – here are the results from the scenarios CDFW asked us to run.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Sent: Tuesday, September 28, 2021 1:03 PM
To: Heydinger, Erin <erin.heydinger@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Micko, Steve/SAC <Steve.Micko@jacobs.com>
Subject: Additional Diversion Criteria Scenarios

Erin,
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Simulation name	Model ID (in Trend Reporting)	Fremont Weir diversion criterion	Bend Br flow p diversio

ALT1B 011221	Alt 1B 011221	Prioritize the Fremont Weir Notch, Yolo Bypass preferred alternative, flow over weir within 10% when spill range between 600 cfs and 6,000 cfs; First 600 cfs of spill are protected within 1%	Protec qu preci genera events in river than s operatio from C May. event, fro Sacram would c
ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000	Alt 1B 011221 MM WS10.7 OF WS 8		
ALT1B 011221 Oct-May WS 10,700	Alt 1B 011221 OM WS10700		
ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	Alt 1B 011221 MM WS10.7 OF WS 6		

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CVP/SWP Deliveries Table

Deliveries (TAF/year) (change from No Project Alternative conditions) [a]	ALT1B 011221		ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000		ALT1B 011221 Oct-May WS 10,700		ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
CVP Deliveries	**11**	**29**	**7**	**21**	**6**	**18**	**9**	**21**
NOD Ag	0	5	-1	3	0	4	-1	4
NOD M&I	0	0	0	0	0	0	0	0
SOD Ag	10	24	7	18	6	14	9	17
SOD M&I	1	0	0	0	0	0	0	0
Subtotal - CVP Operational Flexibility *(Diff from Alt A1 CVP values)*	**8**	**19**	**4**	**11**	3	8	**6**	**11**
CVP Refuge Water Supply	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
NOD (Level 2)	1	2	1	2	1	2	1	2
SOD (Level 2)	0	0	0	0	0	0	0	0
SWP Deliveries	**-2**	**0**	**0**	**1**	**2**	**16**	**7**	**9**
SWP SOD Ag (Table A)	0	1	0	1	1	5	1	3
SWP SOD M&I (Table A)	-1	1	-2	-2	2	13	1	4
SWP SOD Interruptible (Article 21)	-1	-1	2	2	-1	-2	4	2
Total change in CVP/SWP Deliveries with CVP Operational Flexibility	10	31	8	24	9	35	17	32
Total change in CVP/SWP Deliveries without CVP Operational Flexibility	2	12	4	13	6	27	10	21

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Authority Deliveries Table

Deliveries (TAF/year) (change from No Project Alternative conditions) [a]	ALT1B 011221		ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000		ALT1B 011221 Oct-May WS 10,700		ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Authority PWA Deliveries	**119**	**286**	**105**	**254**	**101**	**245**	**111**	**268**
NOD	29	60	27	56	26	54	28	58
SOD	91	226	78	198	75	191	83	209
CVP Operational Flexibility	**8**	**19**	**4**	**11**	**3**	**8**	**6**	**11**
Sub-Total Supplemental Deliveries for Water Supply	**127**	**305**	**109**	**265**	**104**	**253**	**117**	**279**
Refuge Water Supply	**20**	**34**	**17**	**27**	**17**	**27**	**18**	**29**
NOD (Level 4)	5	6	5	5	4	5	5	6
SOD (Level 4)	15	27	13	22	13	22	14	24
Yolo Bypass Habitat Water Supply	**36**	**21**	**32**	**13**	**31**	**9**	**32**	**13**
Total Authority Deliveries	**184**	**359**	**159**	**305**	**152**	**290**	**168**	**321**
Percentage of Total Authority Deliveries								
Authority PWA Deliveries - North of Delta	16%	17%	17%	18%	17%	19%	17%	18%
Authority PWA Deliveries - South of Delta	49%	63%	49%	65%	49%	66%	50%	65%
CVP Deliveries - Operational Flexibility	4%	5%	3%	4%	2%	3%	4%	3%
Refuge Water Supply	11%	9%	11%	9%	11%	9%	11%	9%
Yolo Bypass Habitat Water Supply	20%	6%	20%	4%	20%	3%	19%	4%

Consideration of Incidental Change to CVP and SWP Deliveries								
Incidental Change to CVP and SWP Deliveries without CVP Operational Flexibility	2	12	4	13	6	27	10	21
Total Authority, CVP and SWP Deliveries	186	371	163	318	157	317	178	342
Incremental Change as a Percentage of Total Authority Deliveres	1%	3%	3%	4%	4%	9%	6%	6%
Incremental Change as a Percentage of Total Authority, CVP and SWP Deliveres	1%	3%	2%	4%	4%	9%	6%	6%

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Storage Table

Storage Increases (TAF) (above No Project Alternative conditions) [a]	ALT1B 011221		ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000		ALT1B 011221 Oct-May WS 10,700		ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Additional end-of-September storage	**50**	**72**	**30**	**38**	**35**	**49**	**41**	**60**
Trinity	0	0	0	0	0	0	0	0
Shasta	28	39	12	13	17	21	21	31
CVP Storage	*25*	*31*	*9*	*5*	*14*	*13*	*18*	*23*
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values)	*18*	*21*	*2*	*-5*	*7*	*2*	*11*	*13*
Storage exchanged from Sites	*3*	*9*	*3*	*7*	*3*	*9*	*3*	*8*
Oroville	12	21	11	20	11	19	13	21
SWP Storage	*-6*	*-16*	*-4*	*-11*	*-4*	*-12*	*-3*	*-11*
Sites Delta Participants Storage	*17*	*36*	*15*	*31*	*15*	*32*	*16*	*33*
Folsom	9	12	7	6	8	9	7	7
Subtotal - CVP OpFlex Storage (Diff from Alt A1 CVP values)	*6*	*7*	*3*	*1*	*4*	*4*	*4*	*2*
Percentage of Total Additional End-of-September Storage								
Portion of total additional end-of-September storage								
Trinity	0%	0%	0%	0%	0%	0%	0%	0%
Shasta	57%	55%	40%	33%	48%	44%	50%	52%
Oroville	24%	29%	38%	52%	30%	39%	32%	36%
Folsom	19%	16%	22%	15%	22%	17%	18%	12%

Notes:

[a] Values shown are the net change between the Project Alternative and No Project Alternative

Results are dependent on storage allocations (see storage allocation table)

Sites Releases Table

Releases (TAF/year)	ALT1B 011221		ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000		ALT1B 011221 Oct-May WS 10,700		ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	
	Average	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**	**Average**	**Dry and Critical**
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Releases for Authority PWA Deliveries - North of Delta	29	60	27	56	26	54	28	58
Assumed transfer from North of Delta to South of Delta	6	6	5	6	6	6	6	6
Releases for Authority PWA Deliveries - South of Delta	105	250	92	218	88	213	96	229
Releases for CVP Deliveries - Operational Flexibility	28	26	24	20	23	19	26	23
Releases for Refuge Water Supply	24	38	21	31	20	30	21	32
Releases for Yolo Bypass Habitat Water Supply	41	24	37	15	35	11	37	15
Total Releases	**234**	**404**	**206**	**347**	**198**	**334**	**214**	**364**
Percentage of Total Releases from Sites								
Releases for Authority PWA Deliveries - North of Delta	12%	15%	13%	16%	13%	16%	13%	16%
Assumed transfer from North of Delta to South of Delta	3%	2%	3%	2%	3%	2%	3%	2%
Releases for Authority PWA Deliveries - South of Delta	45%	62%	45%	63%	44%	64%	45%	63%
Releases for CVP Deliveries - Operational Flexibility	12%	7%	12%	6%	12%	6%	12%	6%
Releases for Refuge Water Supply	10%	9%	10%	9%	10%	9%	10%	9%
Releases for Yolo Bypass Habitat Water Supply	18%	6%	18%	4%	18%	3%	17%	4%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Fills Table

Fills (TAF/year)	ALT1B 011221		ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000		ALT1B 011221 Oct-May WS 10,700		ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	
Fills for Authority PWA Deliveries - North of Delta	43	16	38	13	38	11	40	15
Fills for Authority PWA Deliveries - South of Delta	115	43	102	31	97	26	107	36
Fills for CVP Deliveries - Operational Flexibility	29	16	25	10	24	8	26	12
Fills for Refuge Water Supply	26	11	22	6	21	5	23	6
Fills for Yolo Bypass Habitat Water Supply	43	18	38	9	36	5	38	10
Total Fill	**255**	**104**	**225**	**69**	**216**	**56**	**234**	**79**
Percentage of Total Fills								
Fills for Authority PWA Deliveries - North of Delta	17%	15%	17%	19%	18%	20%	17%	19%
Fills for Authority PWA Deliveries - South of Delta	45%	41%	45%	44%	45%	47%	46%	46%
Fills for CVP Deliveries - Operational Flexibility	11%	16%	11%	15%	11%	15%	11%	15%
Fills for Refuge Water Supply	10%	11%	10%	9%	10%	9%	10%	8%
Fills for Yolo Bypass Habitat Water Supply	17%	17%	17%	13%	17%	10%	16%	13%

Notes:

Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT1B 011221	ALT1B 011221 Mar-May WS 10,700, Oct-Feb WS 8,000	ALT1B 011221 Oct-May WS 10,700	ALT1B 011221 Mar-May 10,700, Oct-Feb WS 6,000
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD) Historic Climate
Authority PWA Deliveries - North of Delta	256	256	256	256
TCCA	*138*	*138*	*138*	*138*
GCID	*31*	*31*	*31*	*31*
RD108	*25*	*25*	*25*	*25*
Other Sacramento Valley	*62*	*62*	*62*	*62*
Authority PWA Deliveries - South of Delta	788	788	788	788
CVP Deliveries - Operational Flexibility	91	91	91	91
Refuge Water Supply	124	124	124	124
Yolo Bypass Habitat Water Supply	120	120	120	120
Dead Pool Storage	120	120	120	120
Total Storage	**1499**	**1499**	**1499**	**1499**
Percentage of Total Storage Capacity				
Authority PWA Deliveries - North of Delta	17%	17%	17%	17%
Authority PWA Deliveries - South of Delta	53%	53%	53%	53%
CVP Deliveries - Operational Flexibility	6%	6%	6%	6%
Refuge Water Supply	8%	8%	8%	8%
Yolo Bypass Habitat Water Supply	8%	8%	8%	8%
Dead Pool Storage	8%	8%	8%	8%

Notes:

Results are dependent on storage allocations

File Provided Natively

From: Luu, Henry [Henry.Luu@hdrinc.com]
Sent: 9/30/2021 11:50:45 AM
To: Carlson, Nik [nik.carlson@aecom.com]; jeff.herrin@aecom.com
CC: Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: FW: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Nik and Jeff, responses from San Gorgonio is below in my initial email (red text). Not much, but hoping we can make it work...

Thanks,
Henry H. Luu, PE
D 916.679.8857 M 916.754.7566

hdrinc.com/follow-us

From: Lance Eckhart Pass Agency <leckhart@sgpwa.com>
Sent: Thursday, September 30, 2021 9:19 AM
To: Luu, Henry <Henry.Luu@hdrinc.com>
Subject: RE: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Lance Eckhart, PG, CHG
General Manager/Chief Hydrogeologist
San Gorgonio Pass Water Agency
1210 Beaumont Ave.
Beaumont CA 92223
leckhart@sgpwa.com

Cheryle Stiff – Executive Assist.
(951) 845-2577
cstiff@sgpwa.com

From: Jeff Davis <jdavis@sgpwa.com>
Sent: Tuesday, September 21, 2021 10:07 AM
To: Lance Eckhart Pass Agency <leckhart@sgpwa.com>
Cc: Thomas Todd <ttodd@sgpwa.com>
Subject: Fw: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

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From: Luu, Henry <Henry.Luu@hdrinc.com>
Sent: Sunday, September 19, 2021 4:53 PM
To: Randall Neudeck <rneudeck@mwdh2o.com>; Bob Tincher <bobt@sbvmwd.com>; Jeff Davis <jdavis@sgpwa.com>; Robert Cheng <RCheng@cvwd.org>; AFlores (AFlores@zone7water.com) <AFlores@zone7water.com>
Cc: Jerry Brown <jbrown@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Heydinger, Erin

<Erin.Heydinger@hdrinc.com>; Jeff Herrin <Jeff.Herrin@aecom.com>; Carlson, Nik <nik.carlson@aecom.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: Sites Reservoir WSIP Feasibility Report - request for information to complete the economic benefit analysis

Hello Sites Project members,

The project team has been hard at work coordinating with CWC staff/reviewers to ensure we are preparing a document that is compliant and meets the needs for the Commission's feasibility determination. We are at a point where your input is needed – the team is requesting participant-specific information demonstrating the expected use and economic benefit of the project's future water supply increases. This information is needed to show the project's economic feasibility for securing WSIP funding. Any information regarding your agency's valuation of Sites water supplies and related water quality benefits is greatly appreciated. This solicitation is targeted towards the top five SOD members with the largest water demand from the Project because we believe your input will have a greater influence on the economic analysis. Solicitated member Agency/District and a couple of potential contacts that may be able to assist are:

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Table 1: WSIP Technical Reference Values for SOD Deliveries by Water Year (2021$)

	South of Delta Deliveries ($/AF)					
	Wet	AB	BN	Dry	Critical	**LT Avg.**
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Conveyance	$148	$148	$148	$148	$148	$148
Total (2030)	**$373**	**$430**	**$443**	**$462**	**$544**	**$448**
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Total (2045)	**$604**	**$720**	**$846**	**$891**	**$1,313**	**$898**

conveyance cost estimated for southern SOD participants. Zone 7 conveyance cost is $15/AF.

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Economic Benefits vs Prices: Note that water users will likely obtain economic benefits above and beyond its retail price (e.g. avoided water shortage costs during emergency drought periods). As a result the economic benefit of the Sites deliveries will be greater than its supply cost (or the cost for alternative supply or replacement water).

Questions:

1. Are the TR unit values in the above Table 1 representative of your agency's water value for future (2030 and 2045) imported water supplies from Sites Reservoir? If not, please indicate how your agency's water benefit valuation differ and why they more accurately represent your circumstances.

a. Prices are fine. They may shift around. This year we paid $600/AF for transfer water. You may want to use Yuba or DWR Dry Year Program prices as an analog or benchmark.

2. How will your agency use Sites Reservoir supplies to address any future water shortage conditions (especially during emergency drought events/periods)? Please provide any information on the magnitude and value of the expected avoided shortage and/or water use benefits.

a. This will help some of our direct connect customers with a water tratement plant but we are primarily a groundwater agency. We plan on using Sites for conjunctive use and local basin storage so if we do our jobs right, we will already have local water in critical dry years.

3. Does your agency have water balance or other future water need/supply data from your current long-term water supply planning? More specifically:

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- Important component in our UWMP which addresses projected supply challenges

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c. Spot market, long-term transfers of project and non-project water

3. Has your agency performed any supply benefit/cost analysis for its supplied water and/or future water supply options? Please provide any estimate of your expected supply costs for your next best alternative water supply options.

a. no

4. Would the future Sites Reservoir supplies be expected to be used to improve future water quality of the agency's future deliveries (e.g. blending with Colorado or recycled water supplies)? Please provide any information on the type and magnitude of any such water quality benefits.

a. It may help buffer salt build up but presently, no.

5. What relationship/relevance does your current water retail prices have on your water use value and/or supply costs?

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7. During the past eight-year period (2013 to 2021) what water shortages has your agency experienced? How did your agency meet its water supply needs?

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- Began to invest in local recharge facilities, purchased long term lease of non-project water, pursue long-term transfers, budget for locally banked water when available.

Please let us know your availabilities if a meeting is desired.
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Thanks Henry.

FYI I working to draft up an outline of the candidate discussion points for our justification of higher benefit values with some of the information we have and/or can be culled from the District Water Management Plans. Once I have my rough outline I plan to discuss with Jeff to determine the best presentation strategy and focus of effort in justifying higher water values.

If we don't receive anything from Brandon this week I am going to focus on putting what we have for Metropolitan so that hopefully prompt him to pass on some of the information that they have at hand.

~ Nik

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Date: Thursday, September 30, 2021 at 11:50 AM
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