Appendix G to Final Report: Meeting Records

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Prepared by:

AECOM

300 Lakeside Drive, Suite 400
Oakland, CA 94612
aecom.com

Prepared for:

Monterey Peninsula Water Management District
In cooperation with California American Water

Meeting Record - TRC Meeting No. 1

Agenda and Meeting Notes

(Notes from the meeting are provided in Italics)

Project:	Los Padres Dam and Reservoir Alternatives and Sediment Management Study
Subject:	Technical Review Committee Meeting No. 1 – Study Preparation
Date:	Thursday, August 03, 2017
Time	9:00 AM to 3:00 PM
Location:	AECOM at the Kaiser Center, 300 Lakeside Drive, Suite 400, Oakland, CA 94612 – Bella Vista Room
Attendees:	*Ethan Bell, Stillwater (by phone)* *Madeleine Bray, AECOM* *Joel Casagrande, NMFS* *Shawn Chartrand, Balance* *Brian Cluer, NMFS* *Larry Hampson, MPWMD* *Shannon Leonard, AECOM* *Dennis Michniuk, CDFW (by phone)* *Kealie Pretzlav, Balance* *John Roadifer, AECOM* *Dave Stoldt, MPWMD (by phone)* *Jon Stead, AECOM* *Kevan Urquhart, MPWMD* *Marcin Whitman, CDFW*

Objectives

1. Provide a forum for transfer of information, discussion, and collaboration among participants;
2. Review the existing physical, biological, and operational parameters that influence alternatives formulation at Los Padres Dam (LPD) and Reservoir;
3. Review and complete a list of potential alternatives for further evaluation; and
4. Confirm how alternatives will be evaluated in the next phases of this alternatives study.

Format

This is a working meeting. Consultant team will present material and facilitate open discussion, evaluation, and participation by all attendees. There will be an opportunity to order lunch at the beginning of the meeting or you can bring your own. A WebEx audio/visual link will be provided but attendance in person is strongly encouraged.

Agenda

1. Welcome and administrative business

    a. Introductions

    Introductions occurred for all attendees present and on the phone at the beginning of the meeting. Attendees are listed above.

    b. Opening statements *(slide 3)*

i. *Larry (MPWMD) – This is an important project for water supply and the steelhead population in the area. The project poses implications for the rest of the channel and the Monterey Peninsula.*

ii. *Jon (AECOM) –Consultant Team's general scope of work is to provide technical information for the existing Los Padres Dam and surrounding conditions and to analyze various alternatives for sediment management. The presentation summarizes background information and alternatives discussed in the draft Study Preparation Technical Memorandum prepared by Consultant Team. However, the intent of the meeting is to allow an initial discussion and transfer of information between involved parties. All parties were reminded to review the technical memorandum for accuracy of background information and inclusion of relevant data sources and provide comments by August 11th.*

2. Summary of existing conditions *(slides 5-60)*

   a. Los Padres Dam, Reservoir, and contributing watershed *(slides 6-17)*

      i. *The Los Padres contributing watershed is primarily in public land with only 0.3% being developed land. The existing dam and reservoir were discussed and relevant features noted including the spillway and outlet works. In 2015, a floating surface collector was installed which includes penetration through the dam to collect steelhead and release them to an area just below the plunge pool (see slide 10).*

      ii. *It was noted that NAVD88 shall be used for this project moving forward. Previously, NGVD was used at Los Padres, so all elevation information should be checked for accuracy and consistency.*

      iii. *The capacity of Los Padres Reservoir has decreased since the original construction due to sediment accumulation (see slide 11 for capacities in acre-feet). During Consultant Team's site visit this year, photos were taken showing a significant increase of sediment accumulation since 2016 following fires and heavy rain (slide 12).*

      iv. *It was noted that the 2017 bathymetric survey is incomplete as some areas of the reservoir were too shallow to access during the survey. A topographic survey will be conducted by Cal State Monterey in the fall of this year (2017) once the reservoir level drops to determine the current conditions and loss of storage.*

v. *The stage storage curve was discussed and relevant elevations clarified (see slide 14). It was noted that the elevation of the fish bypass pipe should be included on the stage storage curve.*

vi. *In past dry years, large debris has been an issue with clogging the outlet pipe when the water surface elevation was drawn down very low. Divers were required to remove the debris once water elevations were restored. Historically, fine sediment has not caused clogging of the outlet.*

vii. *Low flow conditions and the impact to reservoir operations were discussed.*

b. Carmel River response reaches (*slides 18-25)*

i. *Five reaches were considered for the Carmel River response. The characteristics and potential to move sediment for each reach were briefly discussed and are detailed in the TM.*

ii. *The Carmel River Lagoon (Reach 5) was discussed in further detail. Historically, when the sandbar was allowed to breach naturally, the surrounding neighborhoods have been flooded prior to breaching. Now the lagoon is frequently breached manually to prevent flooding. Flooding of the neighborhood now occurs under two conditions: 1) when the river is at flood stage and overtops the levees on the north side of the river or when local inflow cannot pass to the river; 2) when mechanical breaching is not possible due to an extreme high swell event. Otherwise, the beach is mechanically breached to prevent a local flood.*

The lagoon is sometimes mechanically closed in order to maintain water quality. It is estimated that the lagoon fails at least one of three water quality indices (dissolved oxygen, temperature, salinity) 80% of the time. Past studies have shown that the offshore environment drives the height of the sandbar and that fluctuations in the amount of sand transport to the mouth of the river have not been observed to affect the height and location of the barrier beach; however, fluctuations in sand transport to the river mouth appear to affect the width of the beach (perpendicular to the coast). It was noted that it should not be assumed that the lagoon will be managed in the future as it has in the past because the county intends to build a wall to reduce flooding, in which case artificial breaching may no longer be necessary.

iii. *There is a proposed project to remove the levee on the south side of the river upstream of Highway 1 and elevate Highway 1 across the river. The project is intended to reconnect the floodplain on the south side of the river and allow high flows to scour the south arm of the lagoon. This project is* *partially funded but has not completed all permitting. It was noted that the initial sediment transport model developed for this project was more sensitive to changes in flood slope surface than changes to original profile (discussed further below).*

c. Hydrology and water quality *(slides 26-37)*

i. *MPWMD currently has seven water year classifications. Consultant Team proposed to narrow these to 5 classifications ("above normal" and "below normal" will be considered "normal"). MPWMD agreed that the classifications could be simplified for this study and noted that there is little difference between what is called "wet" and "extremely wet" but there is a significant difference between "dry" and "critically dry." The classifications and runoff at San Clemente Dam were shown for years 1999-2015 (see slide 27). MPWMD will send data from 2016 and 2017 to Consultant Team to include in this table.*

ii. *Reservoir inflow is measured monthly by MPWMD upstream of Los Padres Dam. MPWMD will send more recent data to Consultant Team to add to graph (see slide 28). It was noted that dry years build on each other (and vice versa for wet years), so the data should not be considered on an annual basis but rather in the context of previous years. Instantaneous flows were also discussed and MPWMD noted that the dam has no meaningful impact on the peaks in these measured flows as they are functionally unimpaired.*

iii. *It was noted that the 10 year flood flows are likely higher than predicted in the analysis presented (see slide 31). MPWMD to send comments on analysis for peak of flow at Los Padres Dam gage. Consultant Team to update graph on slide 30 and in TM to ensure legend is accurate.*

iv. *Currently, riparian pumping outside of the MPWMD boundary is not monitored as the area is out of the MPWMD's jurisdiction. These diversions may be significant relative to the amount of water that reaches the river in dry times, but there is currently no way to measure the volume.*

v. *Water quality and the impact on steelhead migration was discussed (see slides 32-36 for graphs showing temperature and dissolved oxygen measurements above and below Los Padres Reservoir). It was noted that a plot of the temperature difference between above and below Los Padres Reservoir may be more instructive than plots of the two locations overlain on top of each other. However, these measurements can be biased as the temperature downstream of the dam is controlled in part by where water is being released from (high or low in the reservoir). MPWMD noted that prior* *to removal of San Clemente Dam, the last 10 years of data showed significant downward trend of river temperatures, and this has continued to decrease post dam removal. Dissolved oxygen levels and hydrogen sulfide levels decrease after dry cycles as there is less organic material. It was also noted that DO levels are low in the small portion of the channel (riprap area) immediately downstream of the outlet but that these water quality parameters largely recover by the time the water rejoins the main Carmel River channel.*

d. Additional geomorphic considerations *(slide 38)*

These considerations are discussed in the TM. All parties should review the TM and comment on any relevant considerations that have not been addressed.

e. Regulatory setting *(slides 39-40)*

The regulatory drivers for this project were briefly discussed and are summarized in the presentation slides and TM.

f. Water rights and water supply function *(slides 41-44)*

i. Cal-Am's current license allows 2,179 AFY of storage at Los Padres Reservoir and Order 95-10 requires that an equal amount of withdrawal downstream of the dam be carried out at the lowest point possible. There is a requirement to release a minimum of 5 cfs from the reservoir while storing. But there are no instream flow requirements for downstream withdrawals under this license. Once WR 95-10 is satisfied, Cal-Am may need to petition the SWRCB to change the point of re-diversion described in the license (i.e., from the former San Clemente Dam site to points downstream). Need to determine if an effective yield will be assigned to what comes out of LPD.

ii. A desalination project is expected to be in place circa May 2019.

iii. MPWMD has water rights for the New Los Padres Dam (20808B) and two permits (20808A, and 20808C) for Aquifer Storage and Recovery that are subject to instream flow requirements. Permit 20808B could be modified for a replacement water supply for LPD. However, as a new dam has not been built there is no licensure for this permit and a petition for extension will be necessary in 2020. It was noted that a new pipeline that would allow more water to be transferred to the Aquifer Storage and Recovery program will be implemented by the end of 2017.

iv. *Riparian water rights are not currently restricted by instream flow requirements; however, riparian diverters are subject to the doctrine of reasonable use, which limits the use of water to that quantity reasonably required for beneficial purposes. Such purposes include uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.*

v. *Pure Water Monterey is a project that will take unused water from wastewater, agricultural operations, and urban stormwater and reclaim up to 3,500 AFY to be treated and stored in Seaside Basin and up to 5,000 AFY to treated and used for agricultural irrigation in the Salinas Valley. Water stored in the Seaside Basin will then by recovered by Cal-Am to offset a portion of its unauthorized water use from the Carmel River on a one-for-one basis.*

g. Carmel River steelhead biology *(slides 45-60)*

i. *Counts show a decline in the number of adults returning to the former San Clemente Dam but no clear trend at the Los Padres Dam trap. Additionally, most counts before 1994 at San Clemente Dam were estimated by stopping flow in the ladder, counting how many fish were present in each bay, and applying a factor to estimate the number that passed during the period since the previous count. . Thus, San Clemente Dam data prior to 1994 may not be as reliable. It should be noted that ratios between counts at San Clemente Dam and Los Padres Dam between 1962 to 1966 and 1972 to 1975 varied from a difference of 0.2% to 98.2%.*

ii. *CDFW has surveyed three sites upstream of LPD that could help characterize the area. There are also some earlier reports for the upstream area from 1990. Survey data following 2014 has not been released (draft only). MPWMD to send reports/data to Consultant Team and NMFS as available.*

iii. *Brown trout was discussed as the main predator of steelhead in the reservoir area. Brown trout predation may increase in the reservoir. It may be that removing the reservoir would help to decrease the brown trout population, but this is not certain as there are many unknowns and populations are difficult to predict.*

iv. *Striped bass may have been introduced into the system as early as 2001. Schools of striped bass have been documented in the lagoon and striped bass have been sighted as far upstream as the Carmel River Reroute channel.*

v. *New Zealand mud snails have been confirmed in the lower river downstream of the Narrows.*

3. Summary of previous and ongoing studies *(slides 61-71)*

   a. *San Clemente Sediment Transport Studies (slide 62)*

      i. *The San Clemente model represented aggradation well but showed little degradation.*

   b. *LPD Sediment Removal Feasibility Study (slide 63-66)*

      i. *This study offered a potential upstream site and potential downstream site for sediment disposal. The proposed upstream haul road and storage and stabilization of a significant volume of material in the steep terrain is probably not feasible. Additionally, hauling material away on public ROW is problematic both logistically and for economic reasons.*

   c. *LPD and Reservoir Long-Term Strategic and Short-Term Tactical Plan (slide 67)*

      i. *Certain alternatives were eliminated due to "fatal flaw" criteria attributed to NMFS requirements, but it is unclear exactly where the language attributed to NMFS came from. NMFS has consistently preferred off channel storage rather than a new main stem dam.*

   d. *Los Padres Dam Fish Passage Feasibility Studies (slide 68)*

      i. *Ongoing study in which Consultant Team and other attendees are involved.*

   e. *Water and Steelhead Habitat Availability Analysis (slide 69)*

      i. *MPWMD is working with the USGS to calibrate a watershed and operations model. Calibration is expected to be completed in late August 2017. In addition, a final version of an Instream Flow Incremental Method study for the Carmel River is expected to be completed by fall 2017.*

   f. *Carmel River Basin Study – Climate Change (slide 70)*

      i. *The study will include five climate change assumptions with various scenarios to produce a suite of alternatives to reduce effects of climate change in the river basin. The study is in the contracting phase and will begin in September 2017 with one of the initial tasks to create a climate change model. The model will involve Salinas Valley Basin, Monterey Peninsula, and Carmel Valley Basin.*

   g. *Carmel River Fishery Science Study (slide 71)*

4. Status update on reservoir sediment characterization *(slides 72-76)*

   a. *Consultant Team performed sediment field investigation in mid-July. During the field investigation, recent sediment deposition was noted at the upstream end of the river, preventing the barge from accessing that area to complete the most upstream of the borings. Seven of eight planned borings were completed. Samples are currently undergoing lab testing. Report to come in September. Consultant Team has photos of sediment accumulation at the upstream end of the reservoir that could be shared with other parties by request.*

   b. *Preliminary review suggests that fire related sediment cannot be distinguished from other sediment in the cores taken from the reservoir. USGS study on sediment accumulation rates using stable isotopes may get more funding in the future and provide additional information.*

5. Status update on sediment transport analysis *(slides 77-101)*

   a. *The channel evolution model has been set up with basic assumptions and scenarios to be developed and expanded on in upcoming weeks. The model uses different abrasion coefficients and stores stratigraphy for cycles of aggradation and degradation to improve accuracy.*

   b. *Six reaches have been identified for the model based on tributary locations, but this can be adapted to match with project reaches. It was noted that the upstream area of model is constrained by one source of data.*

   c. *Nodes are currently set 500m apart but can be narrowed to 250m apart if necessary. Cross sections used in model are an average of available cross sections between nodes to ensure that model is not biased to one section just because it is closest to a given node.*

   d. *The choice of hydrology dictates the outcome of the model. Rather than base model on historic cycle of floods, Consultant Team recommends constructing a randomized distribution of flows based on historic data. If this alternative is used, it is important to communicate that resulting hydrographs are derived from real data/historic events.*

   e. *The trend in percent flow in the mainstem originating in tributaries is decreasing, while the contribution from the watershed above Los Padres Reservoir is increasing.*

f. *A previous model by MPWMD did not show a link between upland pumping of percolating groundwater and flow or storage in the alluvial aquifer downstream.*

g. *Consultant Team recommends using grain size distribution data set used by URS in previous studies. The more recent data lacks resolution or is inaccurate in some cases. If older data is used, some sensitivity analysis should be incorporated. Consultant Team to provide GSD data curves from new data for TRC consideration.*

h. *Some discussion about whether the model can be used to predict the current condition from a past condition. For a long term model (50 year model) the simulation is less sensitive to the initial condition. The historical profile from 1984 could be used as the initial condition. MPWMD to provide 1984 profile with new datum.*

i. *MPWMD and Normandeau are going to the field next week to obtain new cross-sections and determine if they have changed significantly.*

j. *River banks have been hardscaped or compacted and can assume minor bank erosion for alternative analysis.*

k. *Consultant Team has collected bedload and suspended sediment data to develop rating curves under episodic conditions. Historic hydrographs will be chosen for different conditions and suspended sediment will be analyzed to determine fish mortality. Consultant Team requested 15 minute data from multiple gages from MPWMD to be used in this analysis.*

l. *A decision will need to be made about what grain size cutoff will be modeled. Consultant Team to use Wilcock-Crowe function to determine this.*

m. *Three basic scenarios include no action, no sediment passing, and reservoir depletion (see slide 99). For each scenario, Consultant Team will either run 2-3 historic record simulations or 100 random hydrograph simulations depending on determined method.*

6. Review of preliminary alternatives *(slides 102-123)*

a. No action – *Alternative 1 (slide 104)*

b. Dam removal – *Alternative 2 (slides 105-109)*

i. *Full or partial dam removal may be feasible. In partial dam removal, left abutment material would be left to be moved by natural processes. This would limit the volume of material to be hauled and decrease project time.*

ii. *The existing dam is constructed with local materials. The upstream face contains rocks/cobbles. The rest of the dam consists of a transition zone and silty sand with gravel. Seepage has occurred near the left spillway wall where there is a high point in the foundation. This may pose some issues if the dam crest is raised.*

iii. *The sediment could be disposed in permanent areas as well as areas allowing capture and entrainment. There is potential for a disposal site upstream of the face of the dam, within the footprint of the existing reservoir, in which all material is kept below the spillway crest elevation. Access and haul roads will be a key factor in determining feasibility of disposal areas.*

c. Dredge sediment – *Alternative 3 (slides 110-112)*

i. *This alternative is a reservoir maintenance alternative and should be renamed as such.*

ii. *Alternative 3a involves placing the dredged material on Cal-Am property and builds on previous MWH study.*

iii. *Alternative 3b involves placing dredged material off Cal-Am property. Suitable locations off Cal-Am property have not been identified.*

iv. *Need to determine how this alternative will be approached from a maintenance perspective. Should determine the average annual sediment load expected.*

d. Storage expansion – *Alternative 4 (slides 113-117)*

i. *The maximum normal water surface elevation is limited by the boundary of Ventana Wilderness and Danish Creek. The recent LiDAR shows this point as El. 1060 ft. Previous surveys show lower elevation here, however, aggradation and observation of coarse material throughout river may explain this elevation raise.*

ii. *Four options within this alternative were discussed and are detailed in the presentation slides.*

iii. *DSOD involvement is a major consideration in this alternative. If DSOD requires stability or seismic analysis it is possible that inadvertent issues with the dam may arise.*

iv. *Due diligence is key for dam expansion alternative to ensure that NMFS and other decision-making bodies have enough information to make an informed opinion of alternatives.*

e. Sediment management program – *Alternative 5 (slides 118-123)*

  i. *Five options within this alternative were discussed and are detailed in the presentation slides.*

  ii. *Onsite disposal alternatives for sediment management are similar to dredging disposal sites.*

  iii. *MPWMD noted that spawning gravel placed downstream is removed quickly by natural processes. MPWMD to send Consultant Team project reports for these placements.*

  iv. *Two alternative alignments were discussed for the sluicing alternative (slide 122). Some outlet modification may be necessary depending on proposed alignment. Storm conditions for sluicing would need to be determined in alternative analysis. Additionally, implication on channel profile and water quality would need to be assessed. Debris management would need to be evaluated with this option.*

  v. *Consultant Team could model sluicing alternative as separate model.*

  vi. *DSOD would require review for building tunnel but would not require dam to be reanalyzed for this alternative. Tunnel may actually help dam reach drawdown requirements for PMF.*

7. Review of preliminary evaluation criteria *(2:40-3:20) (slides 124-135)*

a. Evaluation process

  i. *Possible to give alternatives a score by criteria or look at metrics (i.e. dollars or values) and then normalize those values.*

  ii. *Weighting criteria can be difficult as different parties involved may weight criteria differently. This may or may not be included.*

b. Preliminary criteria

  i. *Engineering criteria based mostly on RFP. It was noted that some criteria may need to be documented but may not be considered "decision criteria." Rather than "need for DSOD approval," which may be common to all alternatives, may reword this criterion as "Does the alternative require measures to address dam stability that are not primary to the alternative?"*

ii. *Geomorphic criteria will be based primarily on the sediment transport model outputs. Rather than "sediment transport monitoring feasibility" may reword this criteria as "will sediment be released greater than the annual load, vs. just releasing the natural, annual sediment load, as related to flood liability issues."*

iii. *The importance of legal feasibility was discussed. If an alternative is not possible due to legal constraints, this should be determined before detailed analysis.*

iv. *Impacts from San Clemente have changed perspective of community and thus community response should be considered in criteria.*

v. *Biological criteria will be scored in terms of magnitude, duration, and number of episodes. Scope states that only steelhead will be considered at this level of analysis. There is some unpredictability in the brown trout data. TRC should determine which species (if any) other than steelhead will be considered in analysis. Some reasonable cutoff must be determined to keep within scope.*

vi. *Riparian user access to water may cause some backlash as access is currently enhanced during the dry season by Los Padres releases.*

vii. *"Do you have to replace water supply?" should be added to water supply criteria. Would be yes for no action because eventually the reservoir fills.*

viii. *How much effect each alternative will have on water rights may vary- may not be a yes/no criteria. How complicated each petition process is may also be a relative criterion to consider.*

8. Cost considerations *(slides 136-139)*

   a. *Table of cost considerations from recent projects is in TM for review (see slide 137). NMFS noted some inaccuracies. NMFS to provide comments to TM and Consultant Team to resolve.*

   b. *Relative production of one-way access road versus two-way access road was noted. Additionally, could not likely operate a 24 hour haul road in the project area due to proximity of some residences.*

9. Conclusion

   a. Identify data gaps

i. Quantitative data for steelhead – analysis can move forward with data available

ii. Brown trout behavior unpredictable – should keep the analysis simple

iii. Detailed information about inflow/outflow – should compare between alternatives rather than focus on hard data/numbers

The table below summarizes the status of data gaps recently evaluated for the project.

Item No.	Description	Purpose	Proposed Action	Decision Date	Decision Participants	Status
9	Accumulated sediment characteristics	Characterizing sediments will help understand mobilization and transport, as well as potential dredging or excavation feasibility and cost	LP Alternatives Study includes a geotechnical investigation to help characterize accumulated sediments	2/16/2017	J. Stead, L. Hampson	Done
11	Quantitative data to compare steelhead habitat upstream of Los Padres Dam to other areas in the watershed	Comparing benefits of dam removal to benefits of summer flow releases from reservoir, for steelhead	Analysis will move forward with available data	8/3/2017	TRC Meeting Attendees	Done
12	Anticipated response of brown trout in Los Padres Reservoir to dam removal	Evaluating potential for nonnative dispersal following dam removal	Keep analysis simple based on limited information available	8/3/2017	TRC Meeting Attendees	Done
13	Detailed information regarding inflow, outflow, and operations of reservoir in various water year types	Understanding the performance of each alternative during various water- year types.	This was intended to be more something compared among alternatives rather than documentation of exact numbers	8/3/2017	TRC Meeting Attendees	Done
14	Surface Bed Material Characterization of the Carmel River, Monterey County, California: Pebble Count Data Compilation, Collection, and Recommendations (Eischeid 1998)	Sediment transport model	L. Hampson to scan and provide to AECOM	7/10/2017	J. Stead, L. Hampson	Done
10	Sediment transport data plotted in Matthews 1987 (MPWMD TM 87-13) and mentioned in Hampson 1997 for water years 1984-1986	Sediment transport model	L. Hampson to check	2/16/2017	J. Stead	In Progress

b. Summary of next steps and action items

The table below documents recent and incomplete project action items, including those from the TRC Meeting. Please review and note your action items, or notify Jon Stead if an item has already been completed or is misrepresented.

No.	Date	Action	Primary Responsible Firm/Org.	Primary Responsible Individual	Due Date	Status
19	8/3/2017	Provide comment on or additional information to reevaluate flood frequency analysis shown for Los Padres Dam gage on slide 31 of TRC M1 presentation, and Table 2-6 and Figure 2-22 on p. 2-49 of the draft Study Preparation TM.	MPWMD	L. Hampson	8/11/2017	Done
22	8/3/2017	Provide grant reports on gravel augmentation conducted by MPWMD.	MPWMD	K. Urquhart	8/18/2017	Done
25	8/3/2017	Provide grain size distribution curves from latest data evaluated for use in sediment transport analyses, to evaluate adequacy as compared to data in URS 2012.	Balance	S. Chartrand	8/11/2017	Superseded
3	3/10/2017	Provide MPWMD report analyzing evapotranspiration and losses from reservoir storage.	MPWMD	L. Hampson	3/17/2017	In Progress
4	3/10/2017	Provide full size pdf of Los Padres Reservoir original ground topography.	MPWMD	L. Hampson	3/17/2017	In Progress
11	6/28/2017	Provide sediment transport data plotted in Matthews 1987 (MPWMD TM 87-13) and mentioned in Hampson 1997 for water years 1984-1986 to AECOM.	MPWMD	L. Hampson	7/14/2017	In Progress
14	7/10/2017	Review Study Preparation TM and provide comments.	MPWMD, Cal-Am, and TRC	All	8/11/2017	In Progress
17	8/3/2017	Provide most recent (WY 2016 and WY 2017) data to update water year classification shown in Slide 27 of TRC M1 presentation and Table 2-4 on p. 2-45 of the draft Study Preparation TM with current information.	MPWMD	L. Hampson	8/11/2017	In Progress
18	8/3/2017	Provide most recent reservoir inflow measurements to update graphs shown in Slide 28 of TRC M1 presentation and Figure 2-18 on p. 2-44 of the draft Study Preparation TM with current information.	MPWMD	L. Hampson	8/11/2017	In Progress
24	8/3/2017	Provide corrections as needed to Cost Considerations table, slide 137 in TRC M1 presentation and Table 3-1 on p. 3-2 of the draft Study Preparation TM	NMFS	B. Cluer	8/11/2017	In Progress
15	7/31/2017	Provide geotechnical data from Los Padres Dam and Reservoir and New Los Padres Dam that was obtained during development of NLP project.	MPWMD	L. Hampson	8/15/2017	In Progress
21	8/3/2017	Provide 15 minute data for entire period of record for multiple gages in the watershed to inform sediment transport analysis. Additional details emailed to L. Hampson August 4.	MPWMD	L. Hampson	8/18/2017	In Progress
23	8/3/2017	Provide 1984 Carmel River profile in new datum.	MPWMD	L. Hampson	8/18/2017	In Progress
16	8/3/2017	Add elevation of fish bypass inlet to future stage-storage curves.	AECOM	J. Stead	9/29/2017	In Progress
20	8/3/2017	Correct legend (San Clemente Dam to Robles del Rio) on graph shown on slide 30 of TRC M1 presentation and Figure 2-22 on p. 2-49 of the draft Study Preparation TM	AECOM	J. Stead	9/29/2017	In Progress

The table below documents decisions made at the TRC Meeting.

No.	Date	Subject/ Feature	Reference	Decision
1	8/3/2017	TRC M2	TRC M1	TRC Meeting No. 2 is tentatively scheduled for January 18th.

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Technical Review Committee Meeting No. 1

AECOM at the Kaiser Center, 300 Lakeside Drive, Suite 400, Oakland, CA – Bella Vista Room

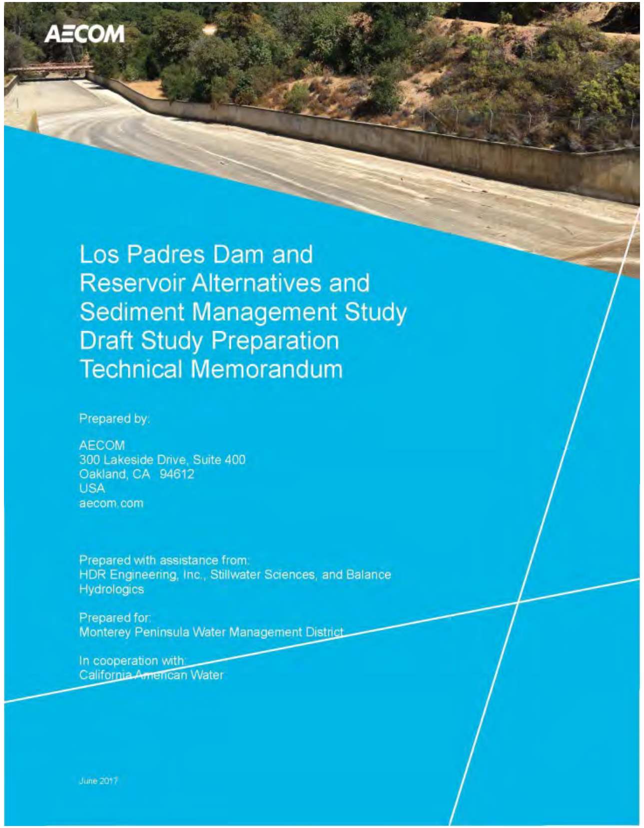
August 3, 2017

Monterey Peninsula Water Management District

California American Water

Welcome & Administrative Business

- Introductions
- Opening statements
- Lunch orders Specialty's CAFÉ & BAKERY



Meeting Objectives

- Provide forum for transfer of information, discussion, and collaboration
- Review existing conditions that influence alternatives formulation at Los Padres Dam (LPD) and Reservoir
- Review a list of potential alternatives for further evaluation
- Confirm how alternatives will be evaluated

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Agenda

1. Summary of existing conditions
2. Summary of previous and ongoing studies
3. Status update on reservoir sediment characterization
4. Status update on sediment transport analysis
5. Review of preliminary alternatives
6. Review of preliminary evaluation criteria
7. Cost considerations
8. Review and wrap up

Summary of regulatory, physical, biological, and operational parameters influencing alternatives formulation

EXISTING CONDITIONS

Monterey Peninsula Water Management District

California American Water

Existing Conditions

LPD, Reservoir, & Contributing Watershed

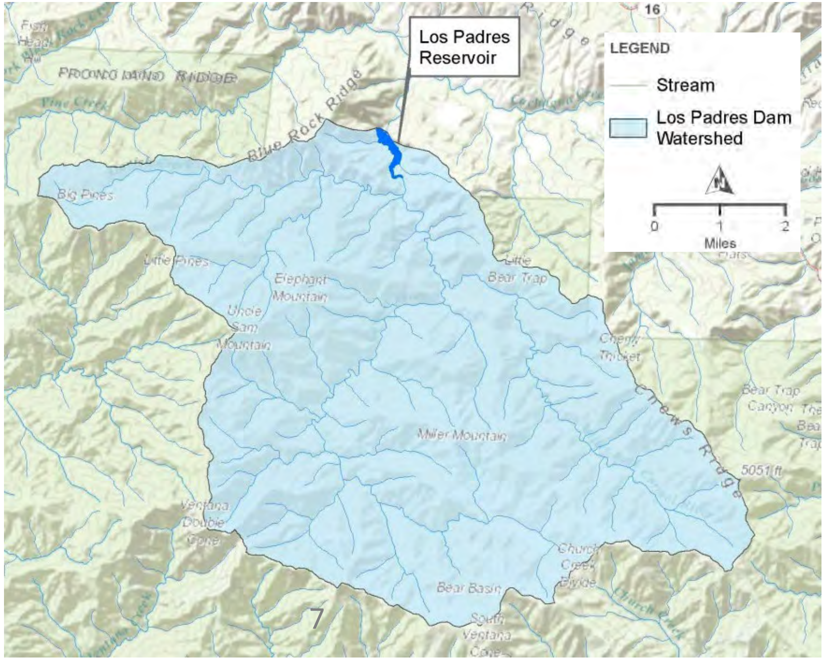
Monterey Peninsula Water Management District

California American Water

Existing Conditions

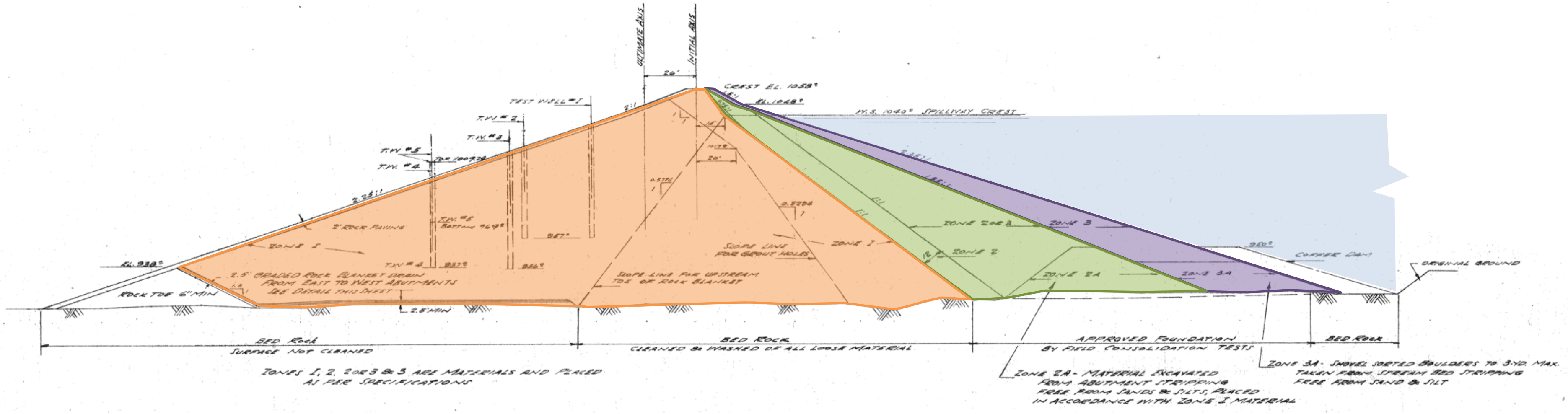
Los Padres Contributing Watershed

- 45-square-mile area
- Rural (0.3% developed), National Forest, and Ventana Wilderness
- Mean basin elevation 3,000 ft. (920 to 5,050 ft.)
- Mean annual precipitation 39 in.
- Steep and prone to episodes of erosion
- Burned several times in the past few decades
  - 1977 Marble-Cone fire
  - 1999 Kirk Complex fire
  - 2008 Basin Complex fire
  - 2016 Soberanes fire



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Existing Conditions
Los Padres Dam



- Constructed in 1949
- 148-ft. high, 570-ft. long, earth fill dam
- Spillway 100 ft. wide, 600 ft. long
- Outlets include 30-in. pipe (≈30 cfs) and fish bypass (≈ 15 cfs)

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Existing Conditions

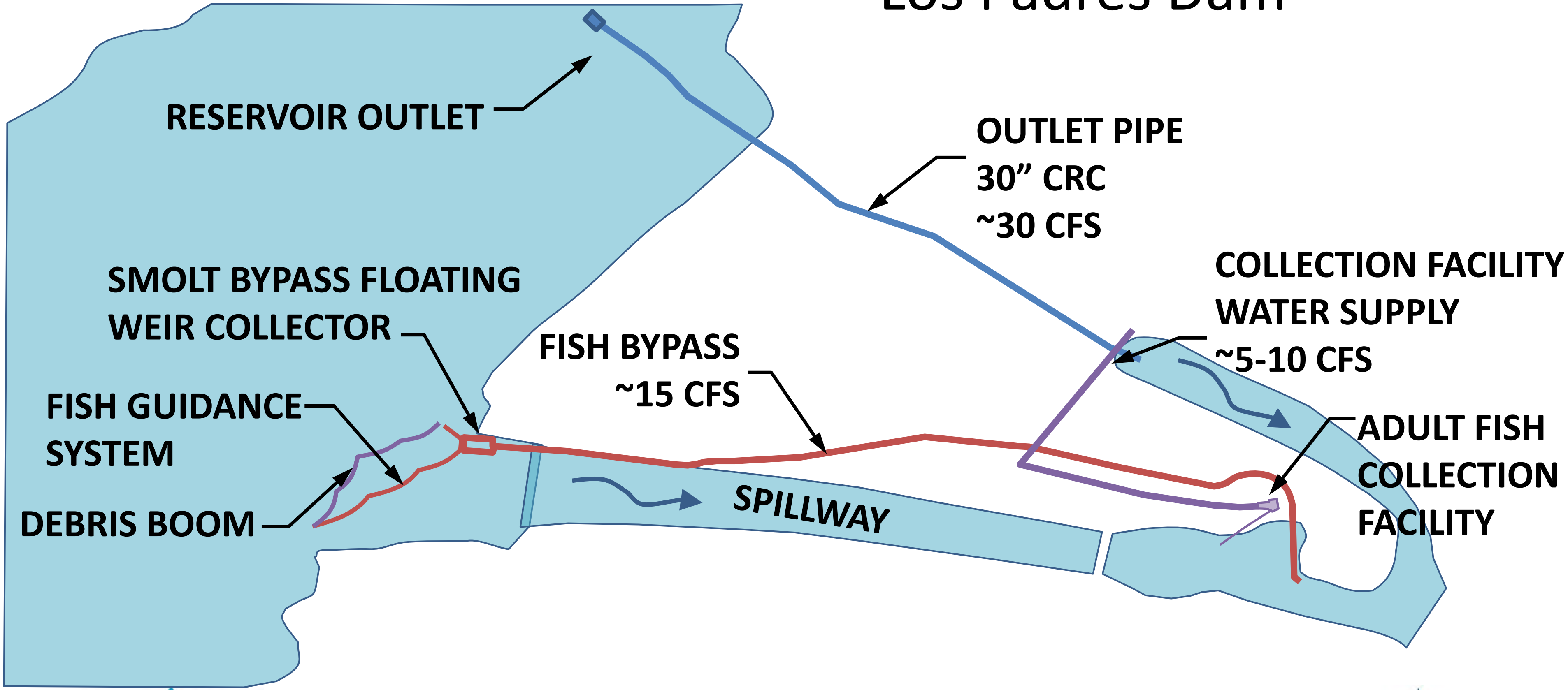
Los Padres Dam

Monterey Peninsula Water Management District

California American Water

Existing Conditions

Los Padres Dam

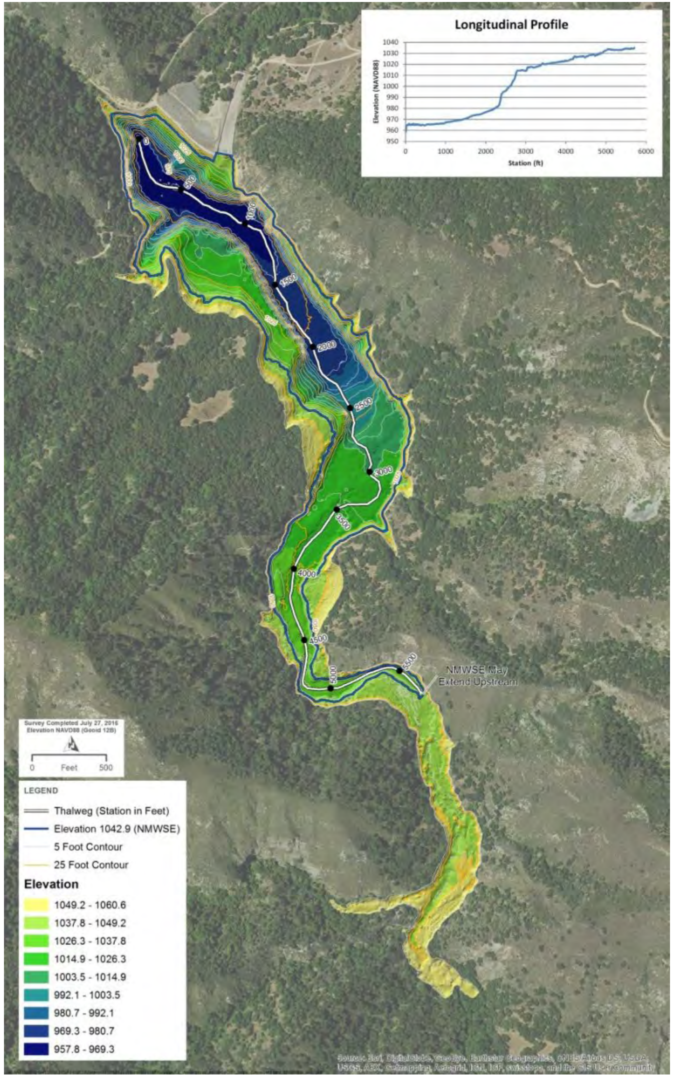


Monterey Peninsula Water Management District

California American Water

Existing Conditions
Los Padres Reservoir

- Original capacity of 3,030 AF
- 2008 storage at 1,786 AF
- 2016 storage at 1,810 AF
- 2017 storage reduced following fire and heavy rains



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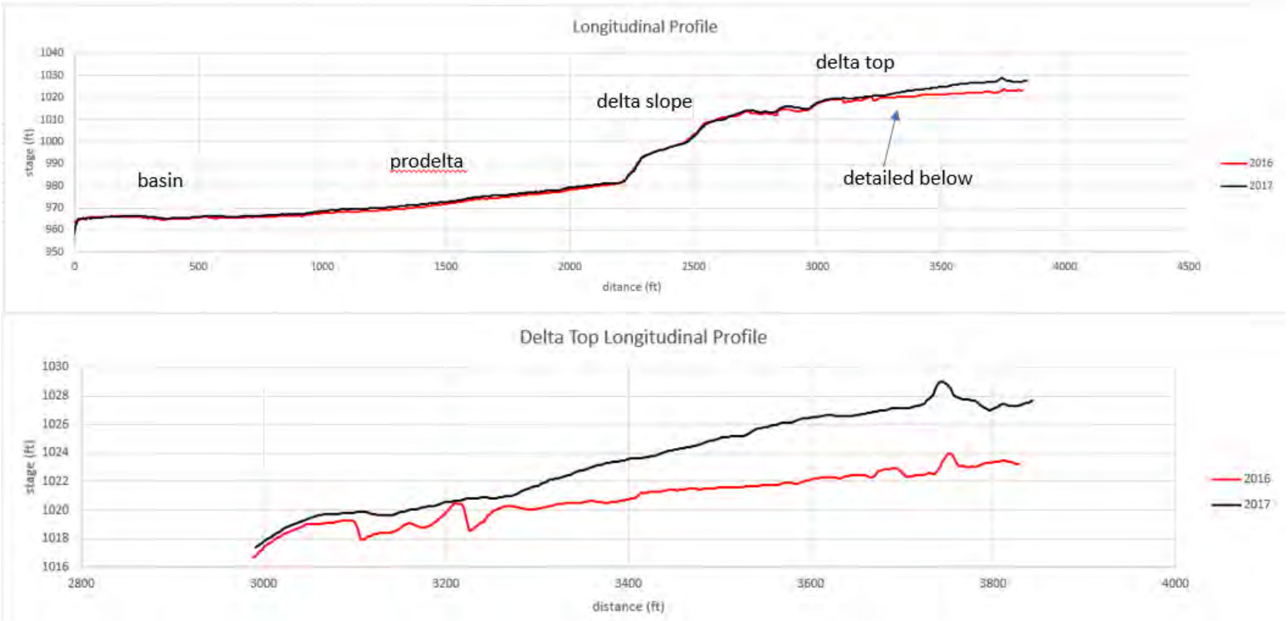
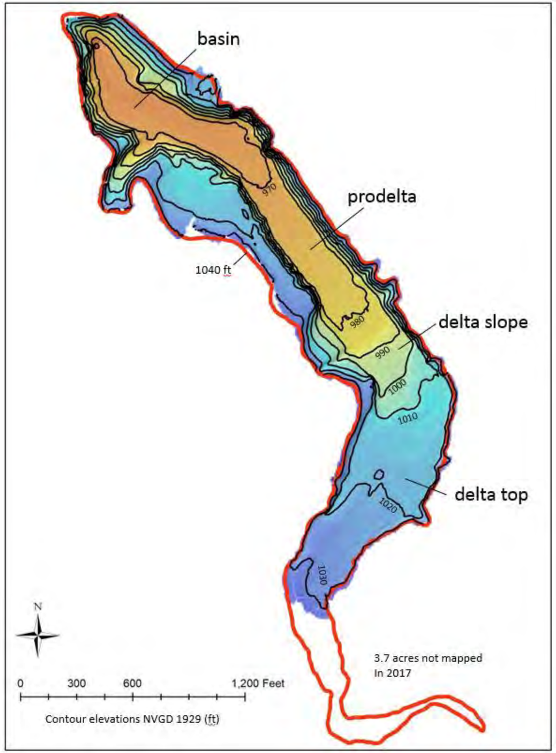
Existing Conditions
Los Padres Reservoir

Existing Conditions - Los Padres Reservoir

- Aggradation on delta top WY 2017 (Kvitek et al., preliminary, unpublished)
  - Delta slope, prodelta and basin virtually unchanged since 2008



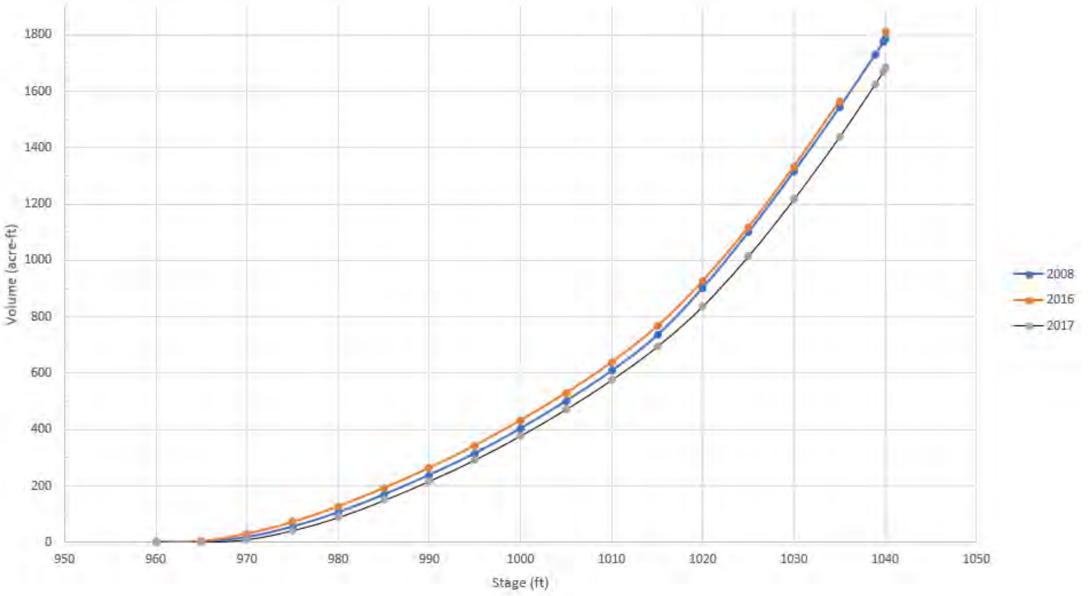


Monterey Peninsula Water Management District

Existing Conditions - Los Padres Reservoir

- Stage storage (2017 values preliminary, Kvitek et al., unpublished)

Elevation (ft, NAVD88)	2016 Area (ac)	2017 Area (ac)	2016 Vol. (ac-ft)	2017 Vol. (ac-ft)
953.13 (low level outlet)	0.00	-	0.0	-
1,022.93 (high level outlet)	35.38	32.8	927	838
1,042.65 (Spillway Crest, Normal Maximum Water Surface)	51.14	48.0	1,810	1,684
1,060.83 (Dam Crest Elevation)	78.65	-	3,009	-



Basin Area Emergency Response team predicted 80 AF if 10-year storm

Monterey Peninsula Water Management District

California American Water

Existing Conditions
Los Padres Reservoir

- > 40% capacity lost to sedimentation
- Usable capacity approximately 1,450 AF
  - Lowest levels unacceptable quality for release, or
  - Not recoverable due to outlet clogging
- Annual storage volume loss (21 AFY) significantly affected by 1977 Marble-Cone fire
- Storage small relative to median annual inflow (28,000 AFY)
  - Typically fills and spills each winter
  - Results in uncontrolled state
  - Little flood storage or attenuation

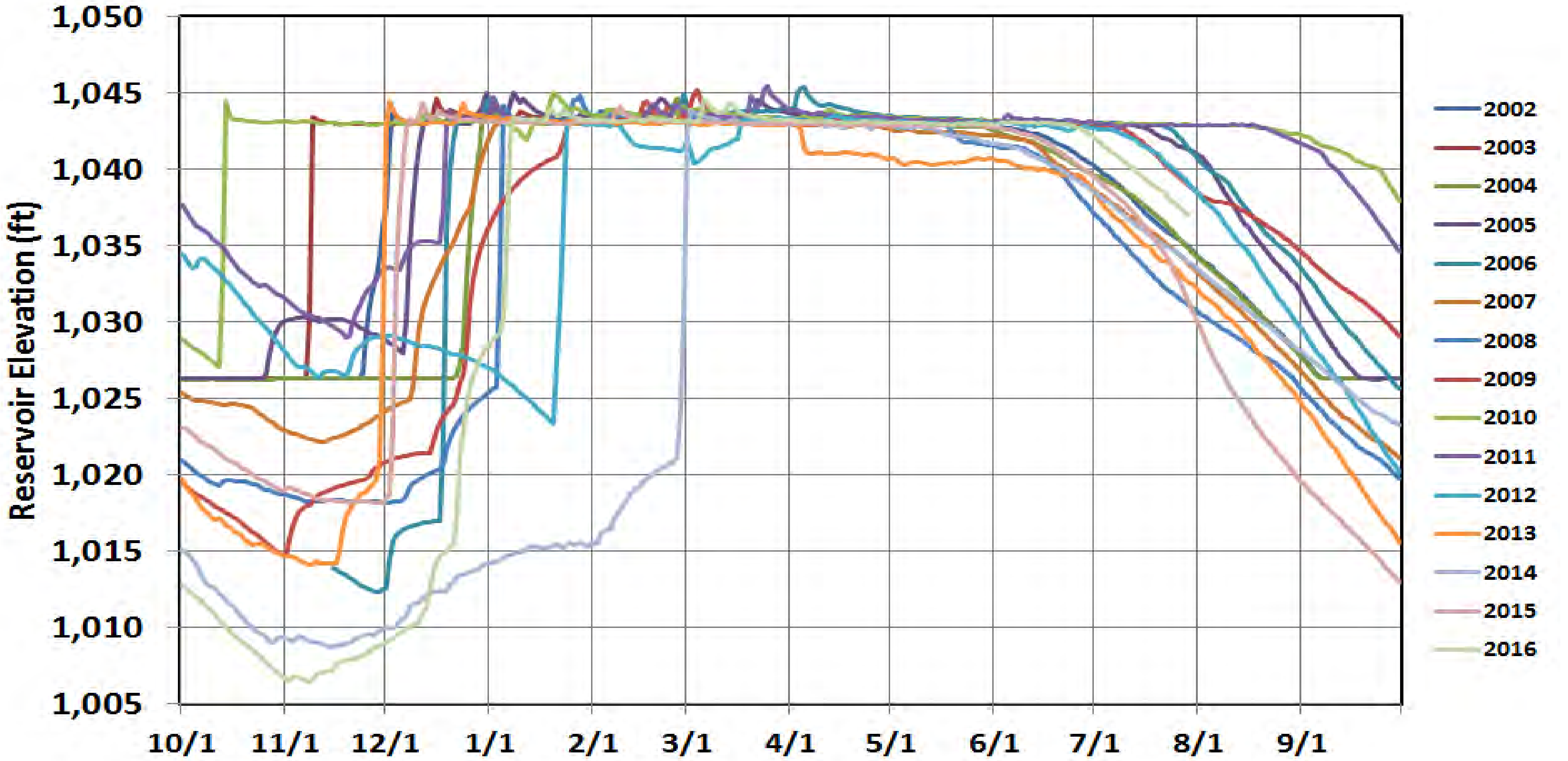
Existing Conditions
Los Padres Reservoir

- Low flow operations
  - Maximize surface flow to the extent feasible from June through December
  - MOA with CDFW, MPWMD, and Cal-Am revisited each year to set anticipated flow releases
  - Objective to enhance fish habitat in lower Carmel River
  - Typical operations
    - Max ops flow: ≈45 cfs
    - Typical ops flow: ≈15-20 cfs
    - Min instream flow: 5 cfs (when available)

Monterey Peninsula Water Management District

Existing Conditions

Los Padres Reservoir



Monterey Peninsula Water Management District

California American Water

Existing Conditions - Carmel River Response Reaches

- Canyon (Upper) Reach
  - Reach 1
  - Reach 2
- Alluvial (Lower) Reach
  - Reach 3
  - Reach 4
  - Reach 5

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Existing Conditions - Carmel River Response Reaches

- Canyon (Upper) Reach, Los Padres Dam (RM 25) downstream to Tularcitos Creek (RM 16)
  - Steep, confined, dominated by bedrock outcrop control
  - More capacity to transport sediment than there is supply
  - Tributary inputs of sediment are highly episodic
  - Active channel alluvial deposits typically shallow, frequently scoured and re-deposited, and coarser than in the downstream alluvial reach

Monterey Peninsula Water Management District

California American Water

Existing Conditions - Carmel River Response Reaches

- Canyon Reach
  - Reach 1 (Los Padres Dam to former San Clemente Dam)
    - Steep, V-shaped canyons underlain by metamorphic and granitic rocks
    - Gravel-cobble stream, with limited areas of sand and silt
    - Cachagua and Pine creeks are main tributaries
    - Low-lying housing in proximity to Carmel River near Cachagua Creek


Cachagua Creek

Existing Conditions - Carmel River Response Reaches

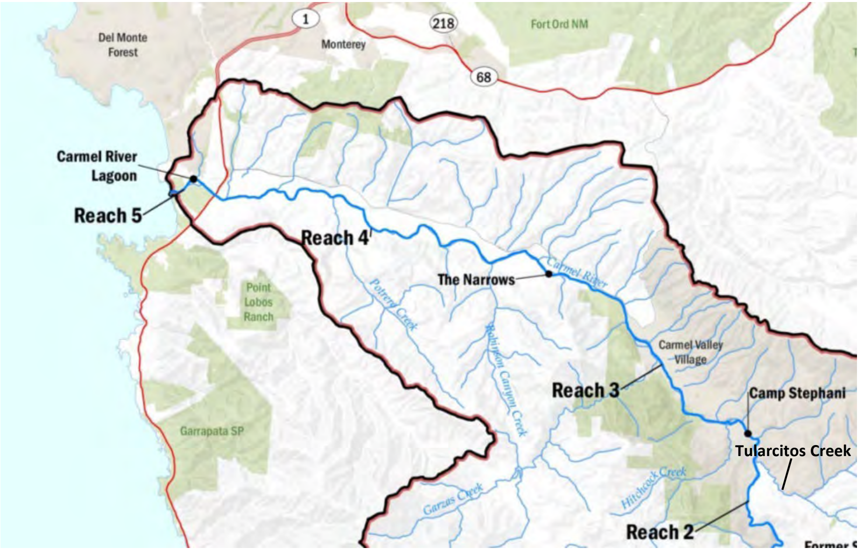
Canyon Reach - Reach 2 (former San Clemente Dam to Tularcitos Creek)

Reach 2 at Sleepy Hollow Bridge

- Alluvium deepens near Sleepy Hollow Bridge at RM 17.3 and reaches depth of ≈ 50 ft. near downstream end
- With removal of San Clemente Dam, able to capture some stored sediment
- Some uncertainty regarding long-term response to dam removal
- Between episodes of erosion, armored gravel-cobble bed with riffles, runs, and deep pools

Existing Conditions - Carmel River Response Reaches

- Alluvial (Lower) Reach, Tularcitos Creek (RM 16) downstream to Pacific Ocean
  - Reach 3, Tularcitos Creek to the Narrows (RM 9.8)
  - Reach 4, the Narrows to the Carmel River Lagoon
  - Reach 5, the Lagoon to the Pacific Ocean



Tularcitos Creek

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Existing Conditions - Carmel River Response Reaches

- Alluvial Reach
  - Reaches 3 and 4
    - 1920-1970, wide, shallow, meandering → to moderately incised, less-sinuous, single-thread
    - Banks mostly unconsolidated sand, gravel, nearly half hardened
    - Housing, development, and bridges
    - Degradation up to 15 feet
    - Valley widens, transport ability diminishes
    - Alluvium progressively deepens to >200 feet
    - Episodic erosion and sand deposition

Reach 3

Monterey Peninsula Water Management District

California American Water

Existing Conditions - Carmel River Response Reaches

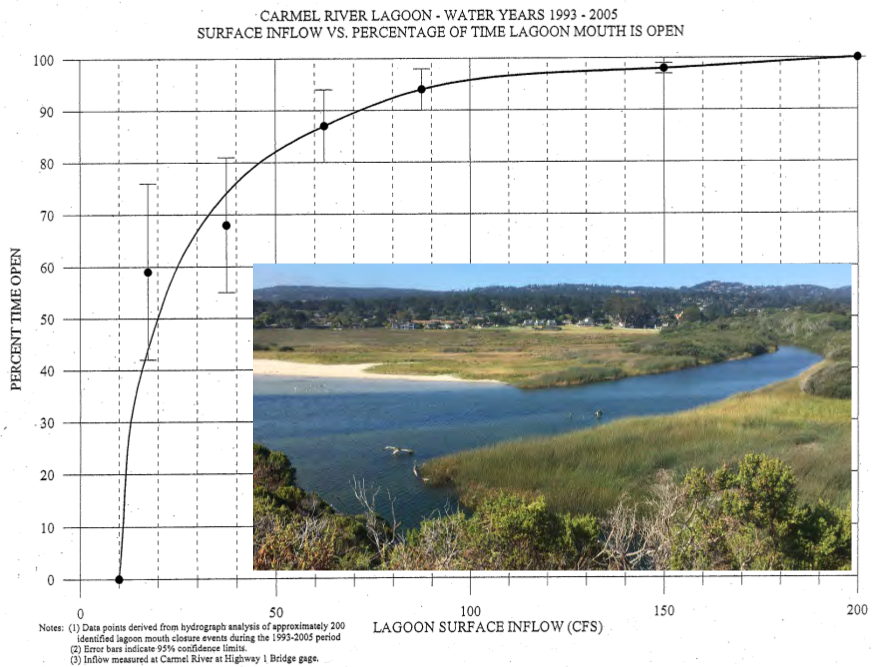
Reach 4
Narrows to Carmel
River Lagoon

Monterey Peninsula Water Management District

California American Water

Existing Conditions
Carmel River Response Reaches

- Carmel River Lagoon
  - Summer and fall, levels static
  - Fills after winter runoff
  - Once full, breaches (or Public Works breaches)
  - Open through early spring
  - As flows decrease mouth closes



Existing Conditions
Hydrology

- Water year classification based on annual runoff computed from the long-term, reconstructed, unimpaired flow record at San Clemente Dam site
  - Extremely Wet - flows exceeded 12.5% of time
  - Wet - flows exceeded between 12.5 and 25% of time
  - Above Normal - flows exceeded between 25 and 37.5% of time
  - Normal - flows exceeded between 37.5 and 62.5% of time
  - Below Normal - flows exceeded between 62.5 and 75% of time
  - Dry - flows exceeded between 75 and 87.5% of time
  - Critically Dry - flows exceeded < 87.5% of time

Existing Conditions

Hydrology

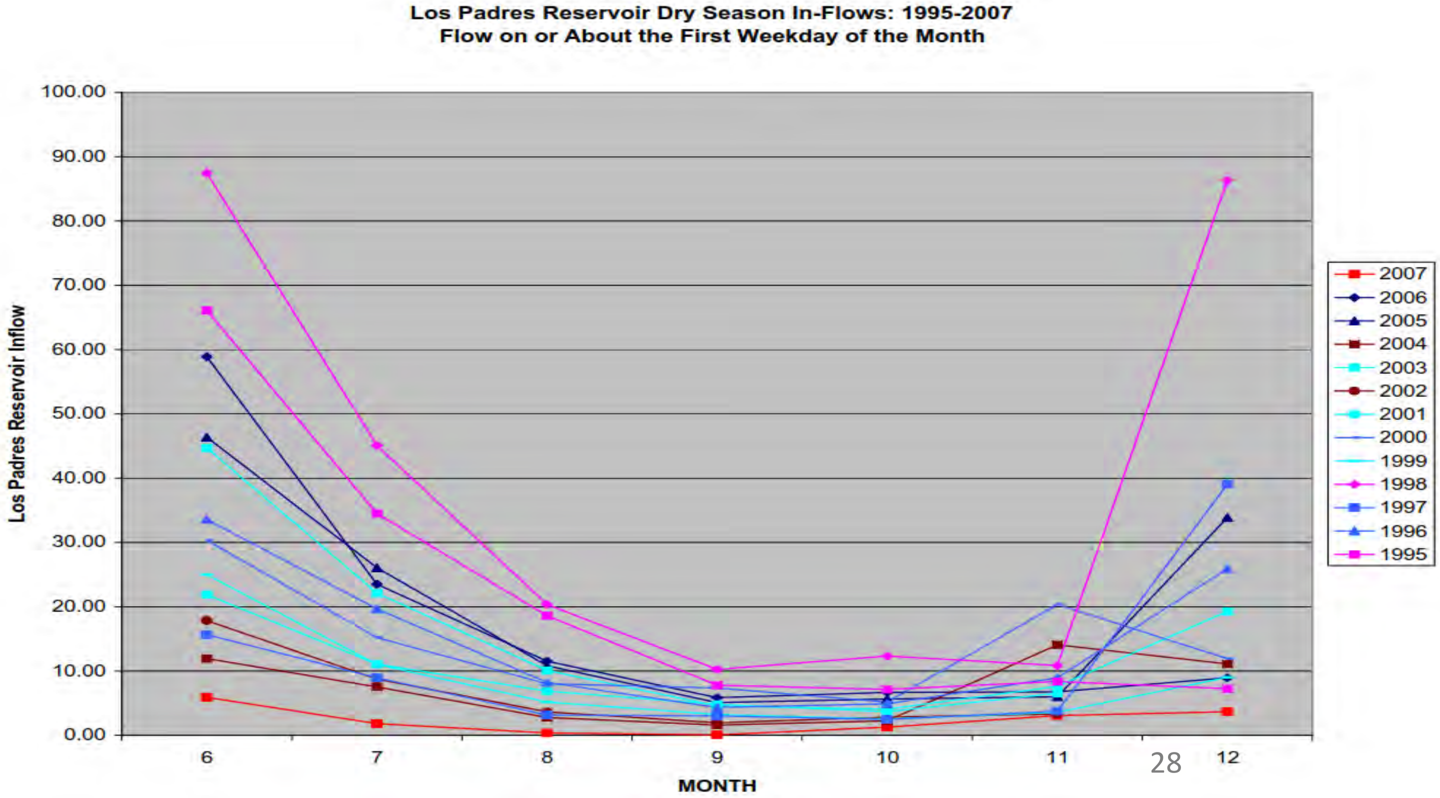
Water Year	Runoff at San Clemente Dam (acre-feet)	Classification
1999	51,222	Normal
2000	73,499	Above Normal
2001	44,981	Normal
2002	30,888	Below Normal
2003	59,434	Normal
2004	36,910	Below Normal
2005	112,153	Wet
2006	107,217	Wet
2007	12,542	Critically Dry
2008	49,017	Normal
2009	47,506	Normal
2010	98,419	Above Normal
2011	101,769	Wet
2012	20,025	Dry
2013	27,303	Dry
2014	6,970	Critically Dry
2015	22,209	Dry
2016	44,923	Normal
2017	196,359*	Extremely Wet

* Projected values used for September 2017

Existing Conditions

Hydrology

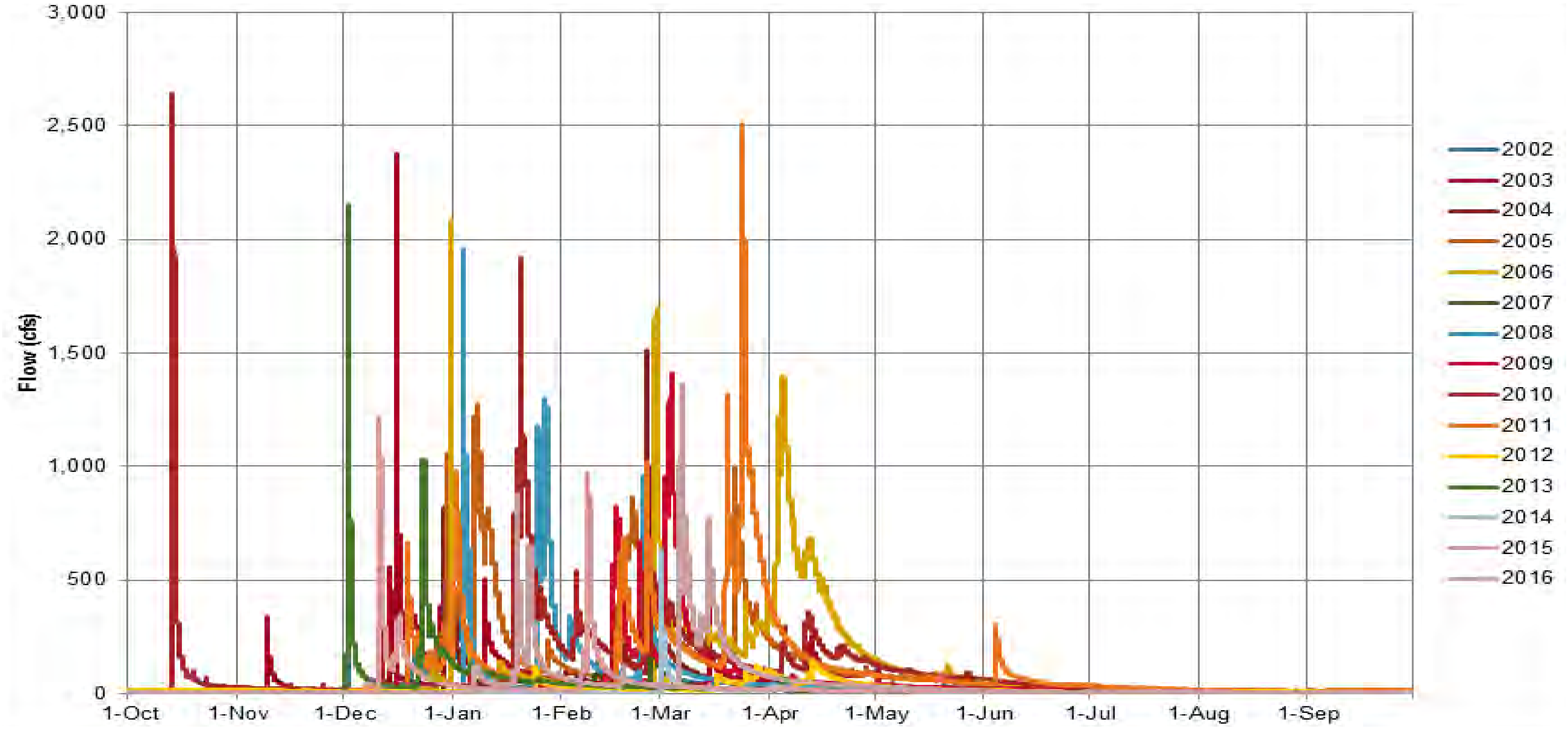
Reservoir inflow measured monthly by MPWMD upstream of LPD



Existing Conditions

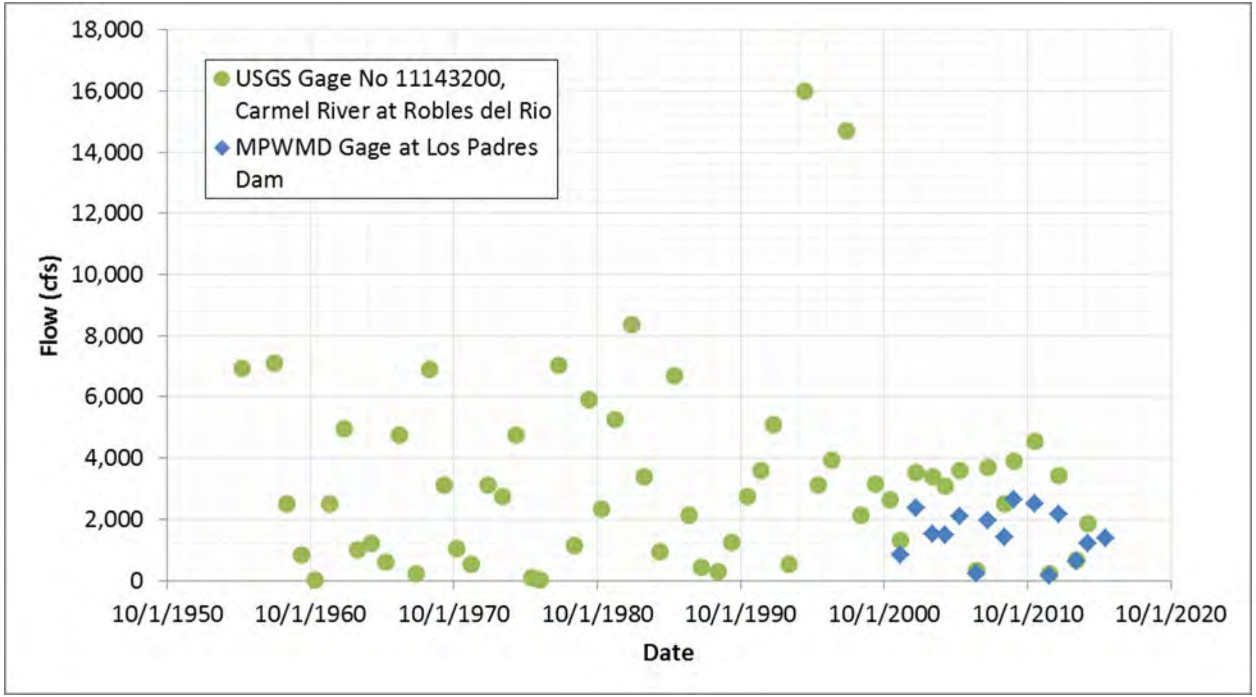
Hydrology

Instantaneous flows at MPWMD gage below LPD (WY 2002-2016)



Existing Conditions
Hydrology

Flood frequency analysis USGS Robles del Rio and MPWMD at LPD (Bulletin 17B)



Existing Conditions - Hydrology

Flood frequency analysis, USGS Robles del Rio, and MPWMD at LPD

Robles del Rio

Recurrence Interval (years)	Annual Exceedance Probability (%)	Peak Discharge (cfs)
2	50	2,400
5	20	5,500
10	10	8,100
20	5	10,700
50	2	14,100
100	1	16,800

Los Padres Dam
January 8, 2017
Estimated 3,000 cfs

Los Padres Dam

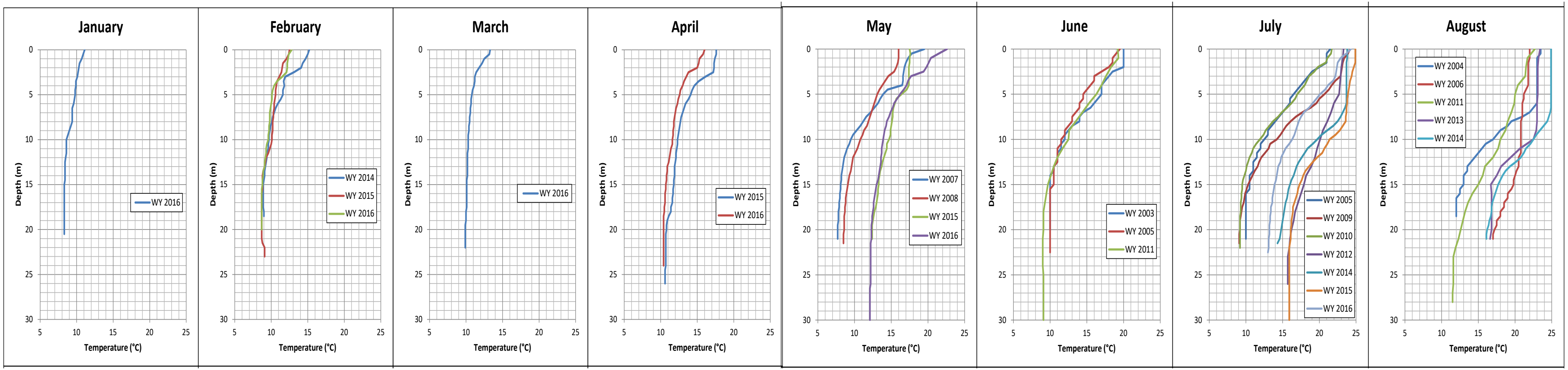
Recurrence Interval (years)	Annual Exceedance Probability (%)	Peak Discharge (cfs) Bulletin 17b	Peak Discharge (cfs) Basin Area Reduction
2	50	1,500	700
5	20	3,200	1,600
10	10	4,500	2,400
20	5	5,800	3,100
50	2	7,600	4,100
100	1	8,900	4,900

Monterey Peninsula Water Management District

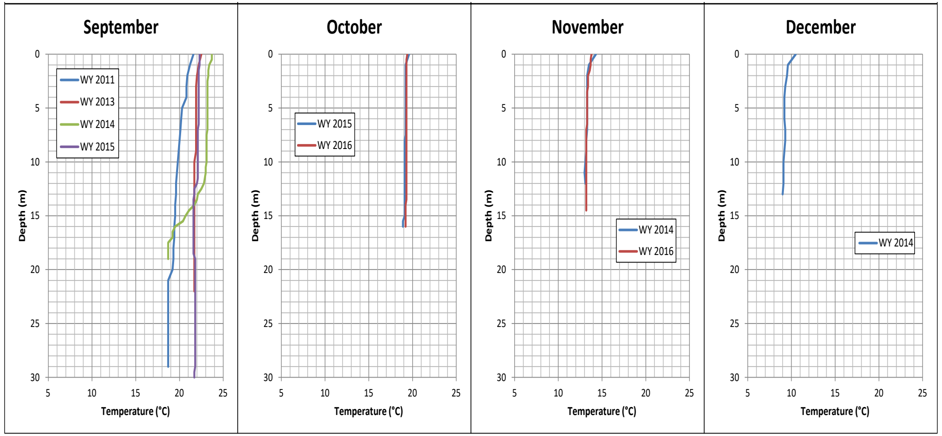
Existing Conditions – Water Quality

- Available data
  - Los Padres Reservoir
    - Temperature
    - Dissolved oxygen
  - Semi-monthly surface water quality since 1991 (temperature, DO, CO_2, pH, conductivity, salinity, and turbidity)
    - Below Los Padres Reservoir
    - Below the former San Clemente Reservoir at the Sleepy Hollow Weir
    - Carmel River Lagoon
  - Continuous temperature monitoring at six locations from above Los Padres Reservoir to Lagoon
  - Vertical salinity, DO, and temperature measurements in Lagoon

Existing Conditions – Water Quality



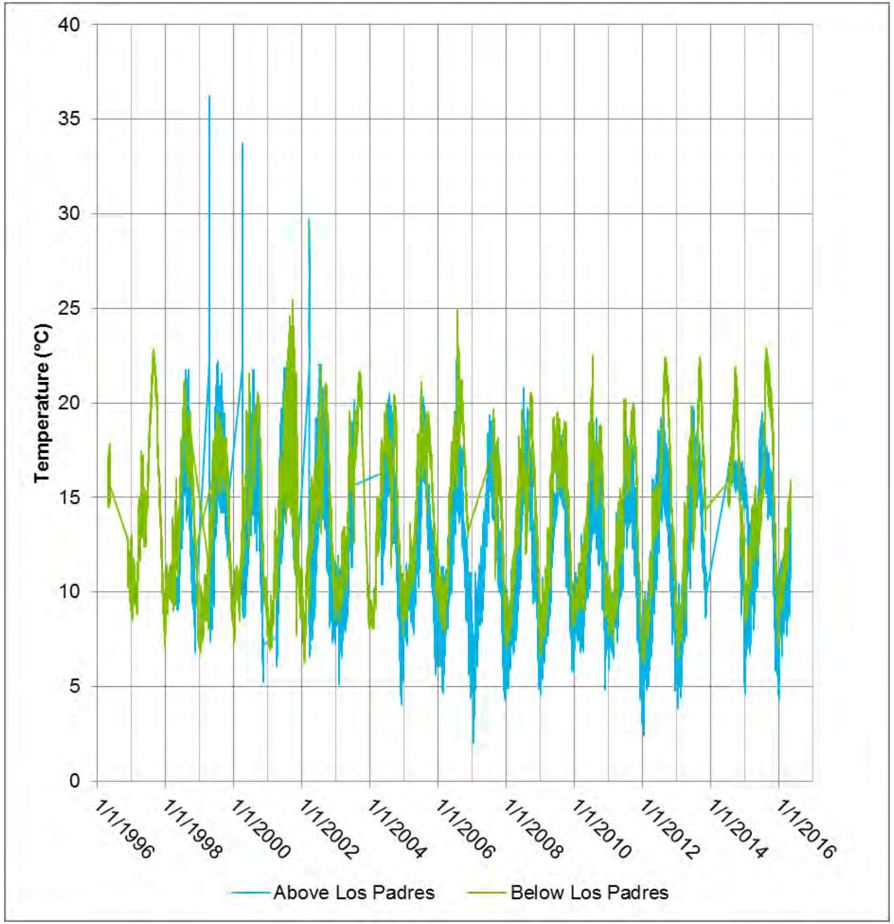
- Los Padres Reservoir Water Temperature Profiles
  - Juvenile steelhead (Central Valley) mortality at chronic temperatures >25 °C (Myrick and Cech 2001)
  - Behavioral changes in stratified pools at 22 ° C (Nielsen et al. 1994)



Monterey Peninsula Water Management District

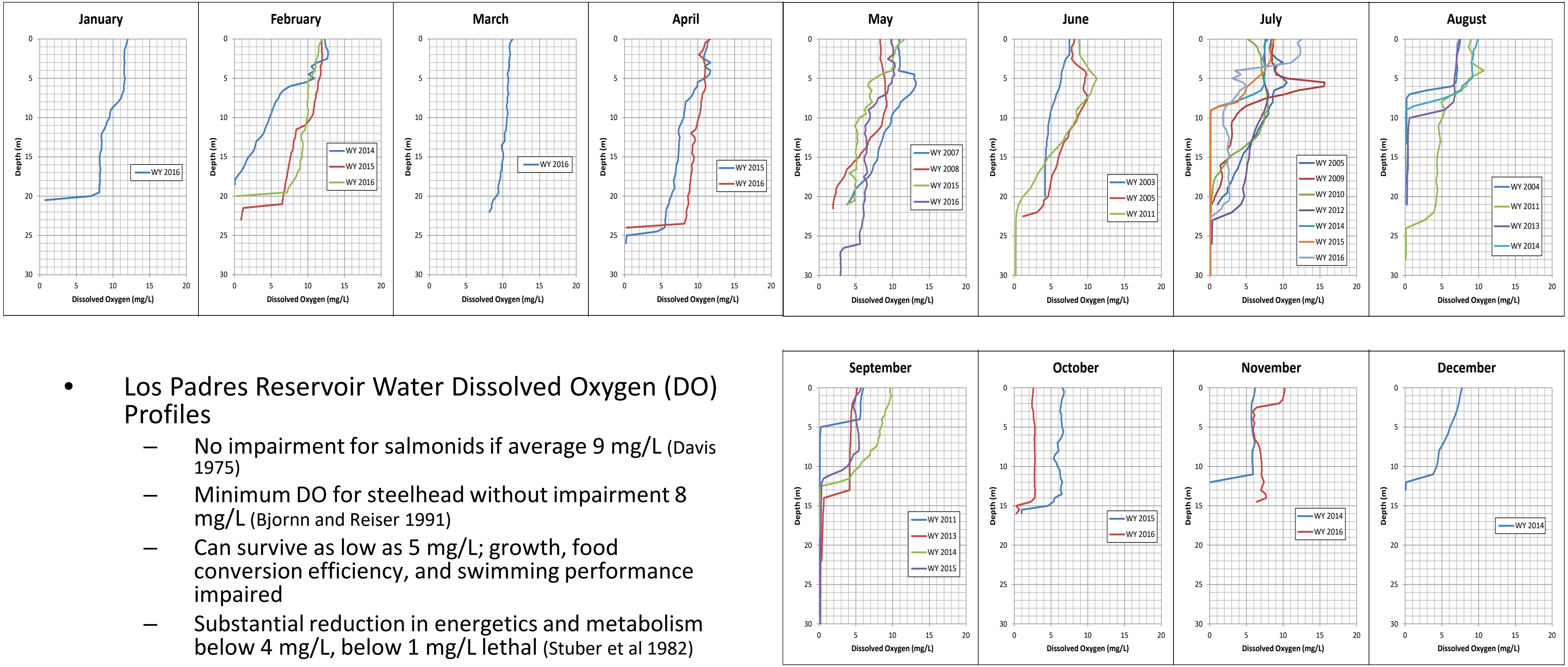
Existing Conditions – Water Quality

- Carmel River water temperature above and below Los Padres Reservoir



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Existing Conditions – Water Quality



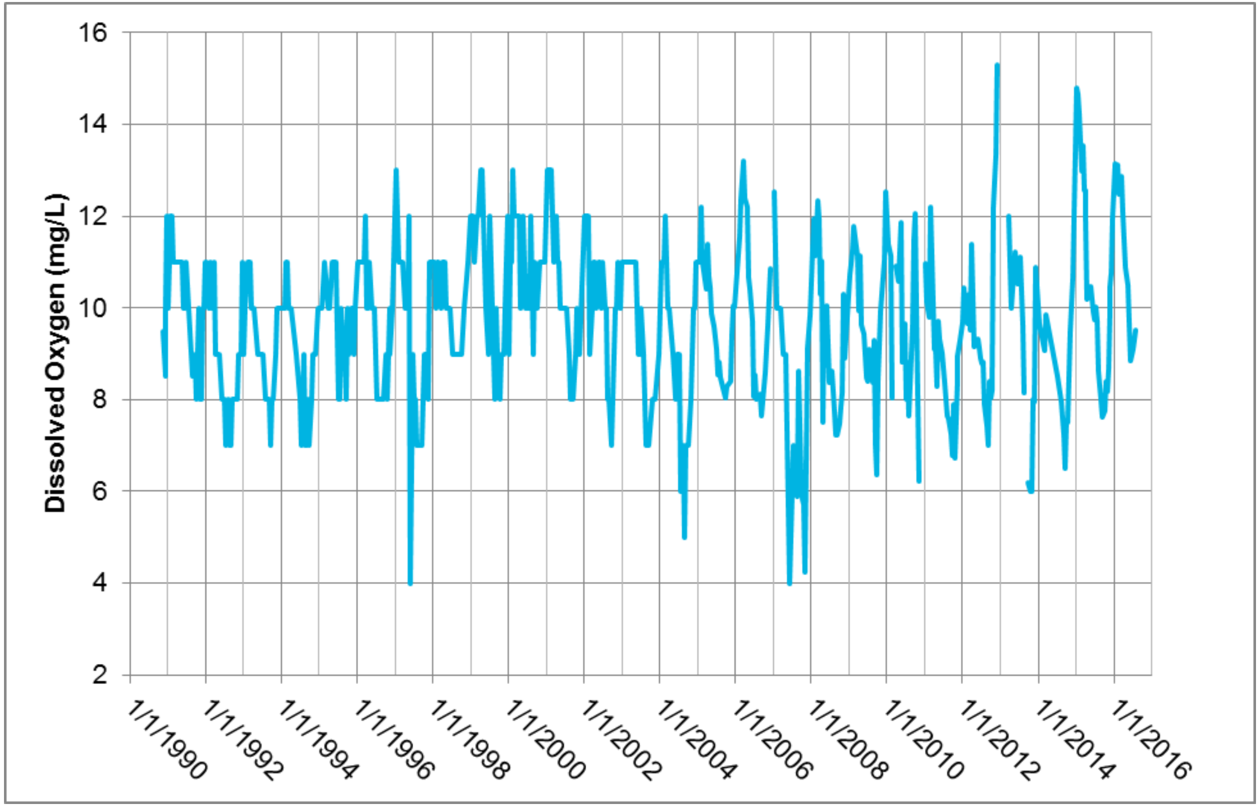
- Los Padres Reservoir Water Dissolved Oxygen (DO) Profiles
  - No impairment for salmonids if average 9 mg/L (Davis 1975)
  - Minimum DO for steelhead without impairment 8 mg/L (Bjornn and Reiser 1991)
  - Can survive as low as 5 mg/L; growth, food conversion efficiency, and swimming performance impaired
  - Substantial reduction in energetics and metabolism below 4 mg/L, below 1 mg/L lethal (Stuber et al 1982)

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Existing Conditions – Water Quality

- Carmel River DO below Los Padres Reservoir



Existing Conditions – Water Quality

- Chronic poor water quality in Lagoon, especially in fall
- High fall temperatures and episodically detectable hydrogen sulfide below Los Padres Dam
- Temperatures measured above Los Padres Reservoir are generally a few degrees cooler, as compared to below the reservoir
- DO below Los Padres Reservoir generally above 8 mg/l, minimum level for steelhead without causing impairment, but sometimes as low as 4 milligrams per liter

Existing Conditions
Additional Geomorphic Data and Considerations

- Additional data sources listed in Study Preparation TM
  - Past Geomorphic Analyses of the Carmel River
  - Past Analyses of Fire Effects
  - Active Channel Data
  - Sedimentation Rates and Reservoir Trap Efficiency
  - Flood Maps
  - River-Bank Structural Protection
- Please review and let us know if there are others we should consider!

Existing Conditions - Regulatory Setting

- California Public Utilities Commission regulation mandates Cal-Am serve its customers
- Annual operations Memorandum of Agreement (MOA) among Cal-Am, MPWMD, and CDFW
- Actions taken by NMFS and the SWRCB may currently be main regulatory drivers for change at Los Padres Dam and Reservoir

Existing Conditions
Regulatory Setting

- NMFS
  - S-CCC steelhead is listed as federally Threatened and critical habitat is present
  - Conservation Agreement with Cal-Am to reduce operational impacts on steelhead
  - 2001 and 2013 letters to Cal-Am outline opposition to maintaining LPD without modification
  - To avoid take of steelhead NMFS (2013) recommends
    - Dam removal, or
    - Unimpeded, safe, and effective upstream and downstream migration of all life stages

Existing Conditions
Water Rights

- **Riparian Water Rights** give landowners with parcels physically touching a water source rights to use water from that source as long as it has not been appropriated by another party
  - Includes parcels overlying alluvial aquifers with flow in known and definite subterranean channels
  - Permit from SWRCB is not required to exercise riparian rights
- **Appropriative Water Rights** allow for water diversion at one point and beneficial use at a separate point
  - **Pre-1914 Water Rights** are appropriative rights acquired before the effective date of the Water Commissions Act (December 19, 1914)
  - **Post-1914 Water Rights** are appropriative rights issued after the creation of the Water Commissions Act
    - Obtaining post-1914 water rights requires a SWRCB permit

Existing Conditions
Water Rights

Cal-Am Water Rights

- Pre-1914 and Riparian Rights
  - 1,137 AFY Pre-1914 Rights, 60 AFY Riparian Rights
  - No instream flow requirements
- 1985 (License 11866)
  - 3,030 AFY to Los Padres and San Clemente reservoirs
  - Later reduced to 2,179 AFY due to siltation in Los Padres Reservoir
  - Minimum flow of 5 cfs below Los Padres Dam at all times, unless lower amounts allowed during dry periods
- 1995 (Order WR 95-10)
  - States Cal-Am's legal water rights (3,376 AFY) and actual annual diversion (14,106 AFY)
  - Mandates that Cal-Am find an alternative supply for 10,730 AFY
- 2009 (Order WR 2009-060)
  - Established a deadline of December 31, 2016 for implementation of Order WR 95-10
- 2013 (Permit 21330)
  - 1,488 AFY from San Clemente Reservoir and 26 wells in the Carmel River Watershed
- 2016 (Order WR 2016-0016)
  - Extended the deadline for implementation of Order WR 95-10 to December 31, 2021

Existing Conditions
Water Rights

MPWMD Water Rights

- 1995 (Decision 1632 and Permit 20808)
  - 24,000 AFY for the New Los Padres Dam
- 1998 (Order WR 98-04)
  - Amended Decision 1632 - clarified diversion periods for New Los Padres Project, updated construction start date
  - Limited direct diversions and rediversions of water from Carmel River by Cal-Am and MPWMD combined to 16,000 AFY (but did not apply to diversions to storage)
- 2007 (Permits 20808 A,B,C)
  - Permit 20808 was split into three permits
    - 20808A: 2,426 AFY diverted at San Clemente Reservoir and 26 wells in the Carmel River Watershed, held jointly by MPWMD and Cal-Am
    - 20808B: 18,674 AFY for the New Los Padres Dam, held by MPWMD
    - 20808C: 2,900 AFY from the Carmel River Watershed, held jointly by MPWMD and Cal-Am
  - All three permits are required to be licensed by 2020
  - Restated 16,000 AFY diversion limit established in WR 98-04

Existing Conditions

Water Rights – all values in AFY unless otherwise noted

Notes

- Instream flow requirements apply to License 11866, Permits 20808A, 20808B, 20808C, 21330, and most Table 13 water rights.

* Held jointly by Cal-Am & MPWMD

** Permitted or proposed amounts

	Entity	Face value	Yield	Max. Diversion Rate (cfs)
Cal-Am	Pre-1914	1,137	1,137	1.6
	Riparian	60	60	0.1
	Lic. 11866	3,030	2,179	2.0
	Permit 21330	1,488	400	2.6
	Subtotal Cal-Am	**5,715**	**3,776**	**6.3**
MPWMD	Permit 20808A*	2,426	730	6.7
	Permit 20808B	18,764	unknown	42.0
	Permit 20808C*	2,900	870	8.0
	Subtotal MPWMD	**24,090**	**1,600**	**56.7**
	Subtotal Cal-Am and MPWMD	**29,805**	**5,376**	**63.0**
Table 13**		1,256	low	4.3
Other riparian		2,200	2,200	3.6
	Grand Total	**33,261**	**7,576**	**70.9**

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Existing Conditions
Carmel River Steelhead Biology

- Largest run in S-CCC DPS during years of high rainfall
- Likely source population to smaller drainages, which may not persist without strays
- Unique - both interior and coastal population attributes

Monterey Peninsula Water Management District

California American Water

Existing Conditions

Carmel River Steelhead Biology - Abundance

- Historical population estimates range between 1,500 and 12,000 adults annually
- Population monitoring indicates steady decline (with wide fluctuations)
- NMFS (2012) estimates Carmel Basin habitat could support 4,000 adults annually
  - 2,000 upstream of LPD
  - 1,000 between LPD and former San Clemente Dam
  - 1,000 downstream of San Clemente Dam
- Dettman and Kelley (1986) estimate 45% of adults spawn downstream of former San Clemente Dam

Monterey Peninsula Water Management District

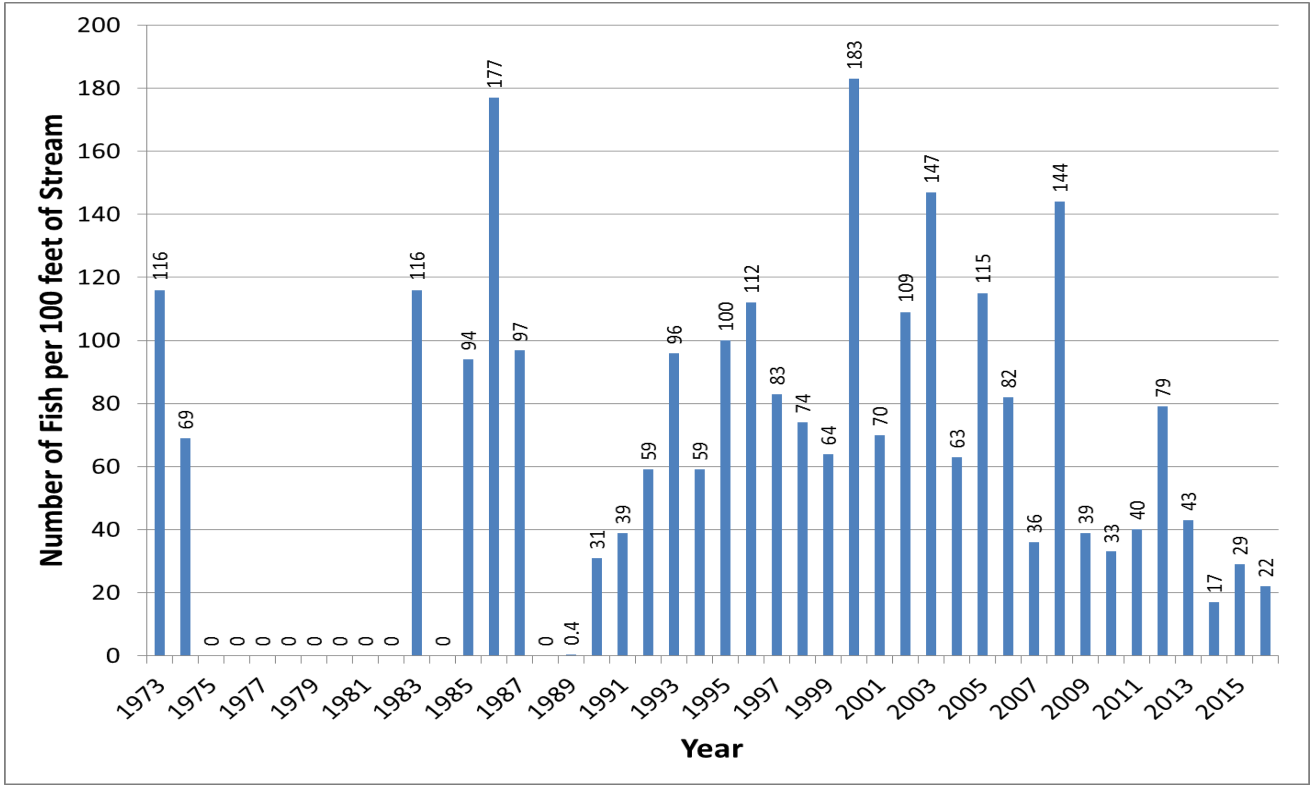
California American Water

Existing Conditions

Carmel River Steelhead Biology - Abundance

Juvenile steelhead density estimates in Carmel River (1973-2016)

CDFW and MPWMD 3 pass electrofishing surveys show large annual fluctuations, periods of absence during droughts, and a generally declining trend from 2000 to 2013



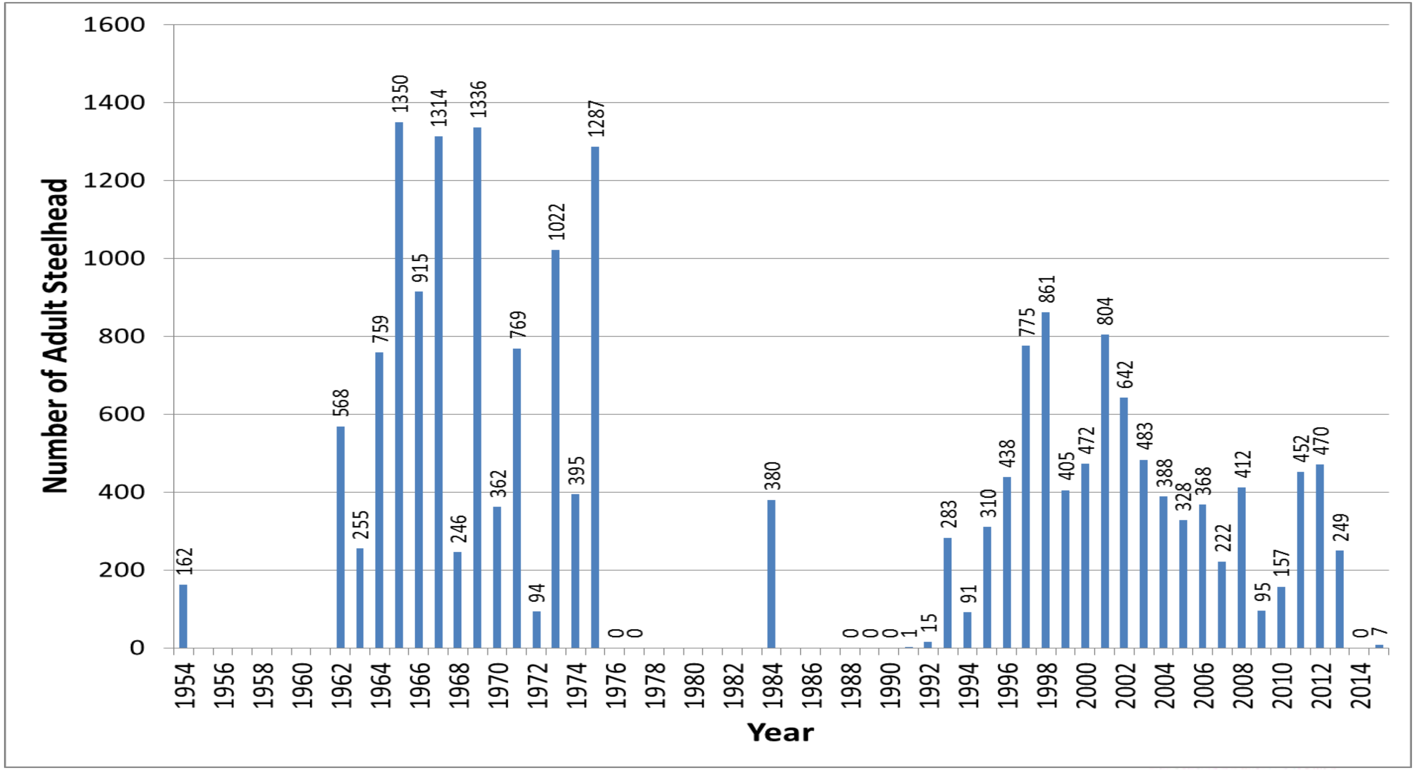
Monterey Peninsula Water Management District

Existing Conditions

Carmel River Steelhead Biology - Abundance

Adults steelhead counts at San Clemente Dam (1954-2015)

Removal of Old Carmel River and San Clemente dams may result in more steelhead returning to this location



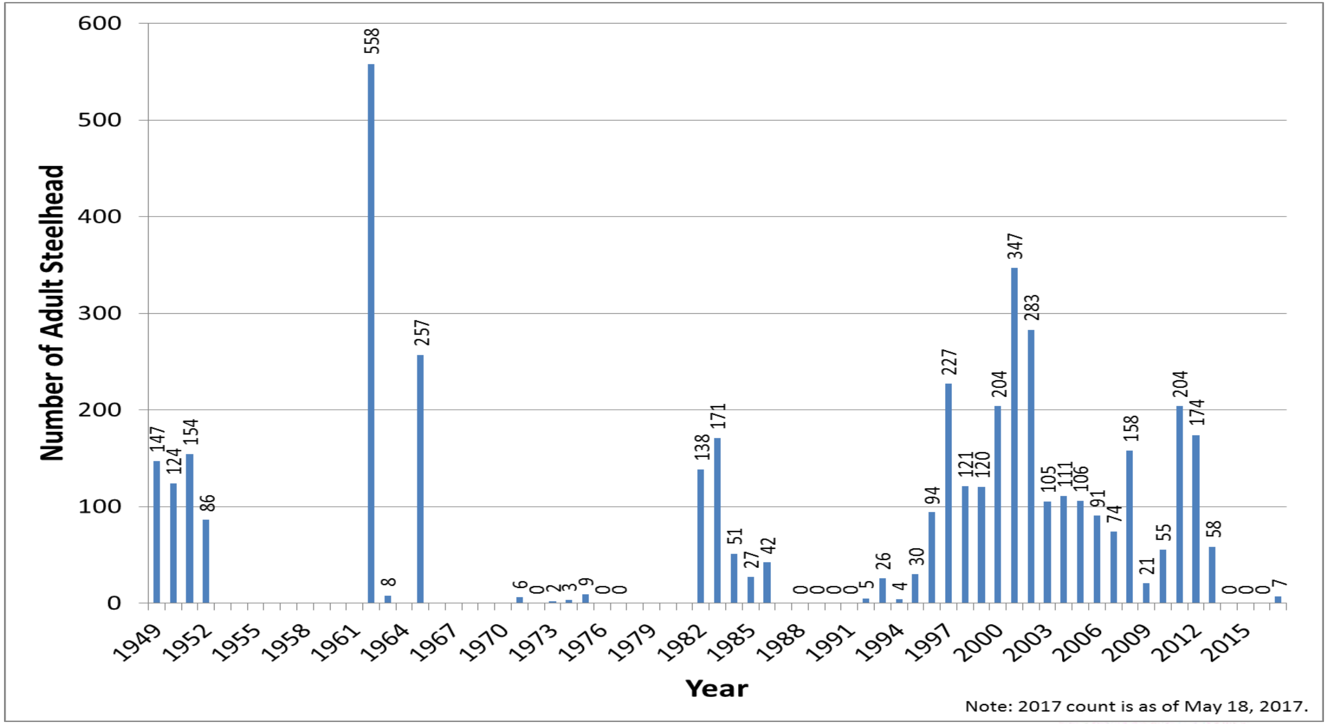
Monterey Peninsula Water Management District

Existing Conditions

Carmel River Steelhead Biology -Abundance

Adult steelhead counts at LPD (1949-2017)

- Several years with no captures were drought years
- Data before 1993 may be unreliable
- More reliable since automatic counter in 1993, and new ladder and trap in 1999



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Existing Conditions

Carmel River Steelhead Biology - Abundance

- Life history of steelhead upstream of LPD not well understood
  - Some portion of the population appears to maintain anadromy
  - Juvenile density estimates range from 3,351 to 4,688 fish per mile

Carmel River upstream of Bruce Fork, 1/28/2004

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

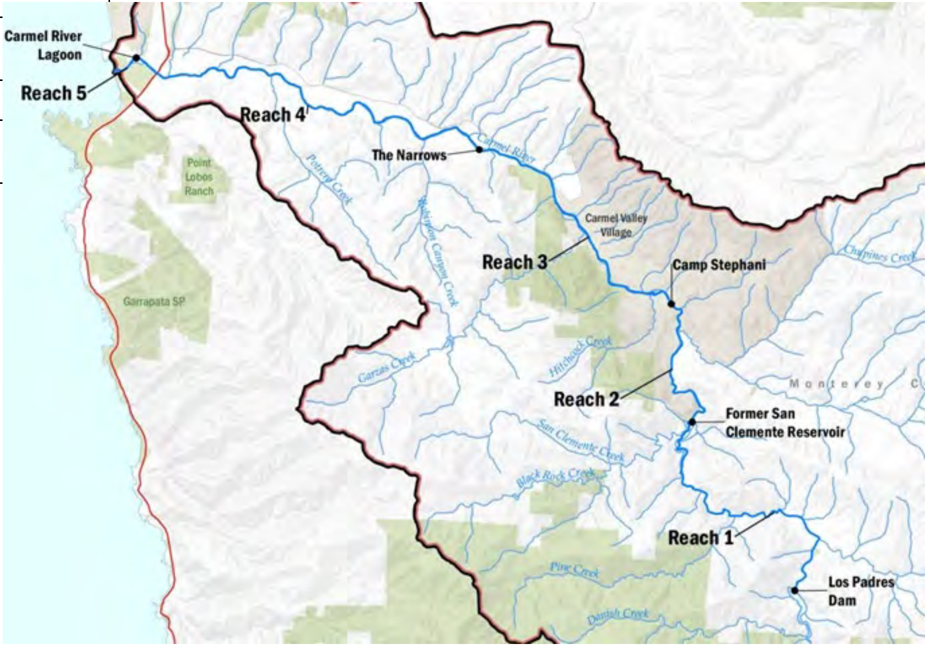
Existing Conditions

Carmel River Steelhead Biology – Habitat Accessibility

Reach[1]	Length accessible (miles)	Proportion of total accessible habitat (%)
Response Reach 1	5.4	7
Response Reach 2, 3, and 4	16.9	22
Total in mainstem Carmel River downstream Los Padres Dam	21.9	30
Tributaries to Carmel River downstream Los Padres Dam	38.0	51
Total downstream Los Padres Dam	59.9	81
Carmel River and tributaries upstream of Los Padres Dam	14.4	19
Total in watershed	**74.3**	

Carmel River Watershed accessible to steelhead

Sources: MPWMD 2004, MPWMD unpublished data

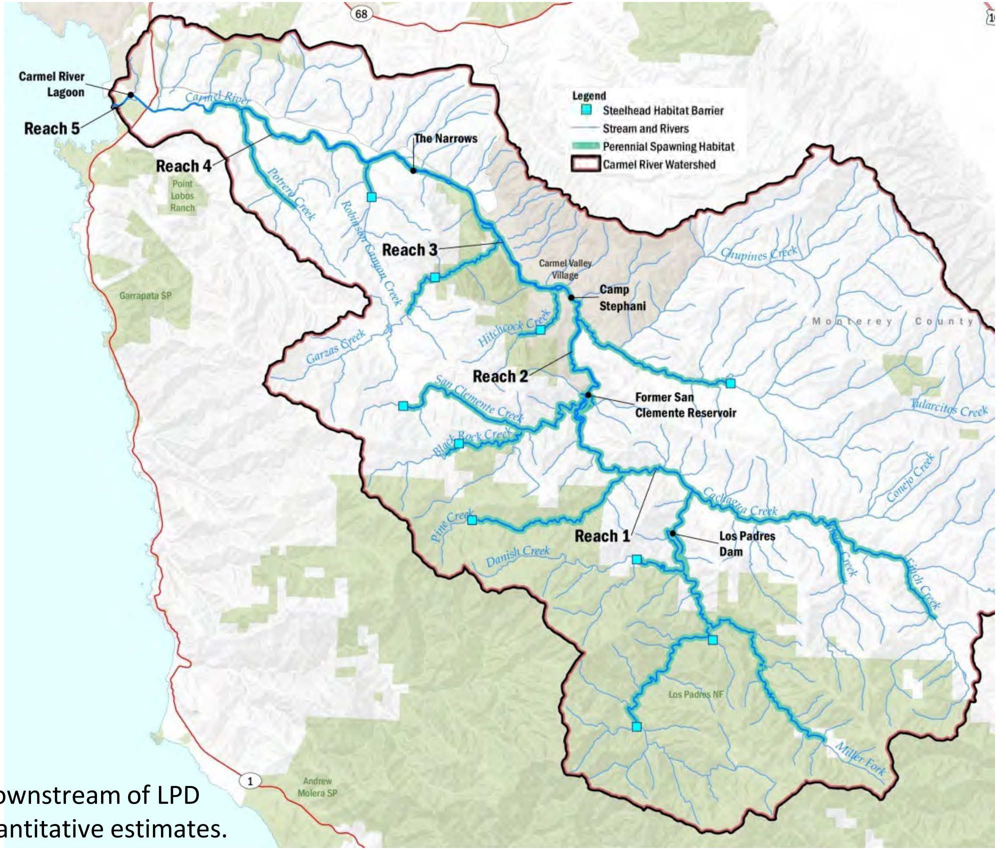


Monterey Peninsula Water Management District

Existing Conditions

Carmel River Steelhead Biology – Spawning Habitat

- Related to instream flow (accessibility)
  - Normal (or wetter) water years, 74.3 miles
    - 28.7 miles in mainstem
    - 34.8 miles in primary tributaries
    - 10.8 miles in secondary
  - Low-water years more restricted to mainstem
- Related to spawning gravel
  - 50% upstream of LPD
  - 40% mainstem downstream of LPD
  - Remainder in tributaries to lower mainstem



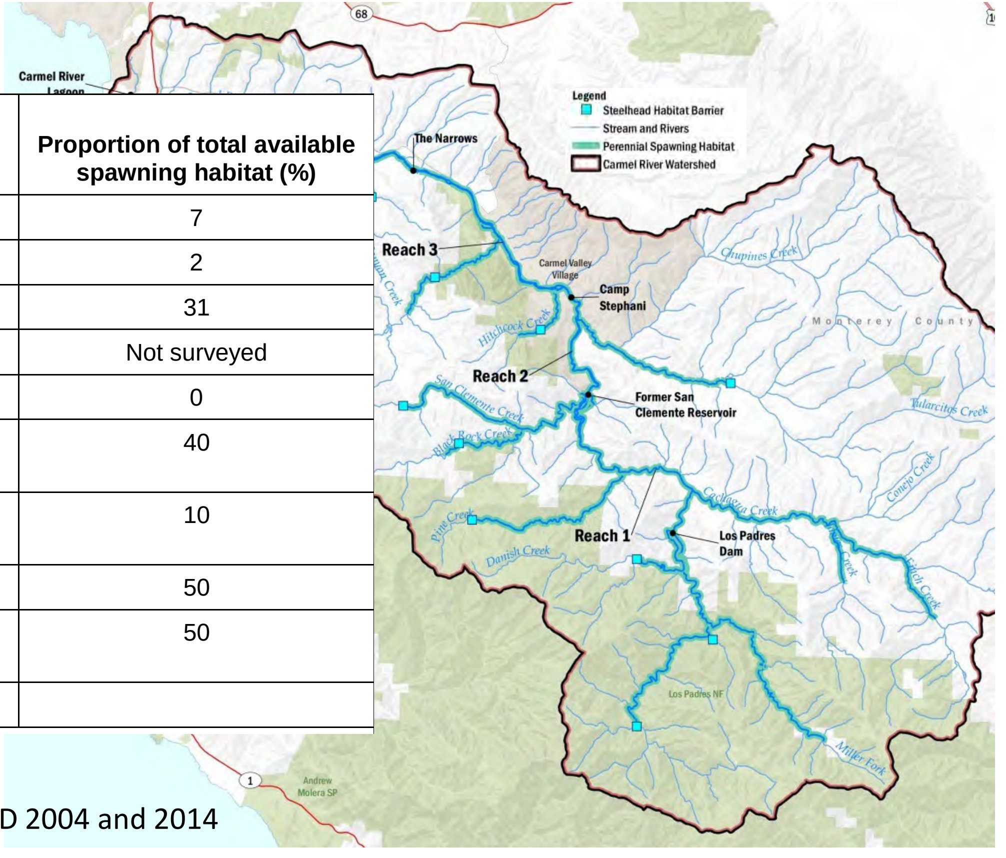
MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

MPWMD 2004 and 2014
Spawning habitat distribution downstream of LPD may be underrepresented in quantitative estimates.

Existing Conditions

Carmel River Steelhead Biology – Spawning Habitat

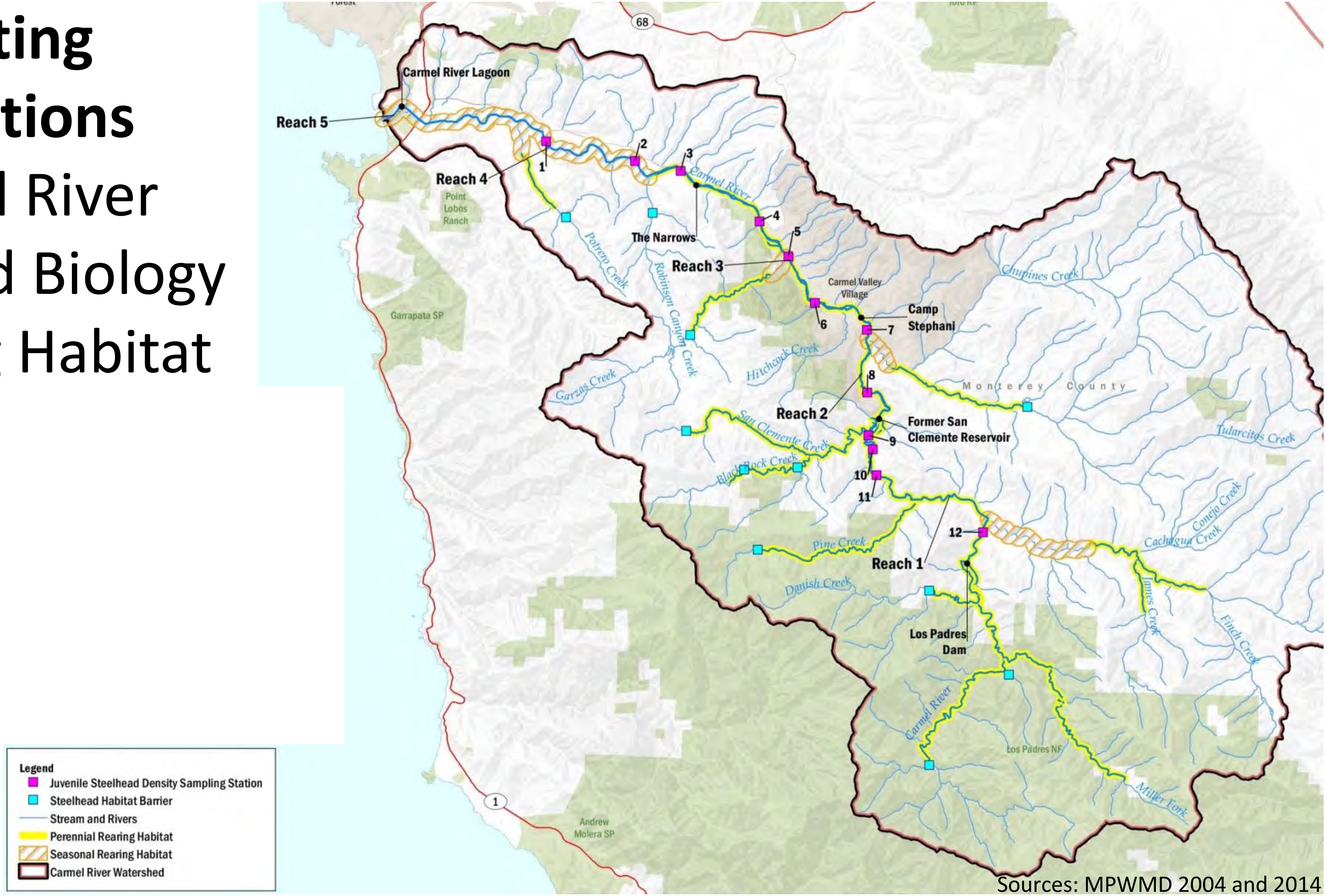
Reach[1]	Estimated spawning habitat (ft^2)	Estimated number of potential redds	Proportion of total available spawning habitat (%)
Response Reach 1	10,751	215	7
Response Reach 2	2,439	49	2
Response Reach 3	45,445	909	31
Response Reach 4	Not surveyed	Not surveyed	Not surveyed
Response Reach 5	0	0	0
Total in mainstem Carmel River downstream Los Padres Dam	58,635	1,173	40
Tributaries to Carmel River downstream Los Padres Dam[2]	14,657	292	10
Total downstream Los Padres Dam	73,292	1,465	50
Carmel River and tributaries upstream of Los Padres Dam	72,272	1,446	50
Total in watershed	**145,564**	**2,911**	



Sources: MPWMD 2004 and 2014

Monterey Peninsula Water Management District

Existing Conditions
Carmel River Steelhead Biology - Rearing Habitat

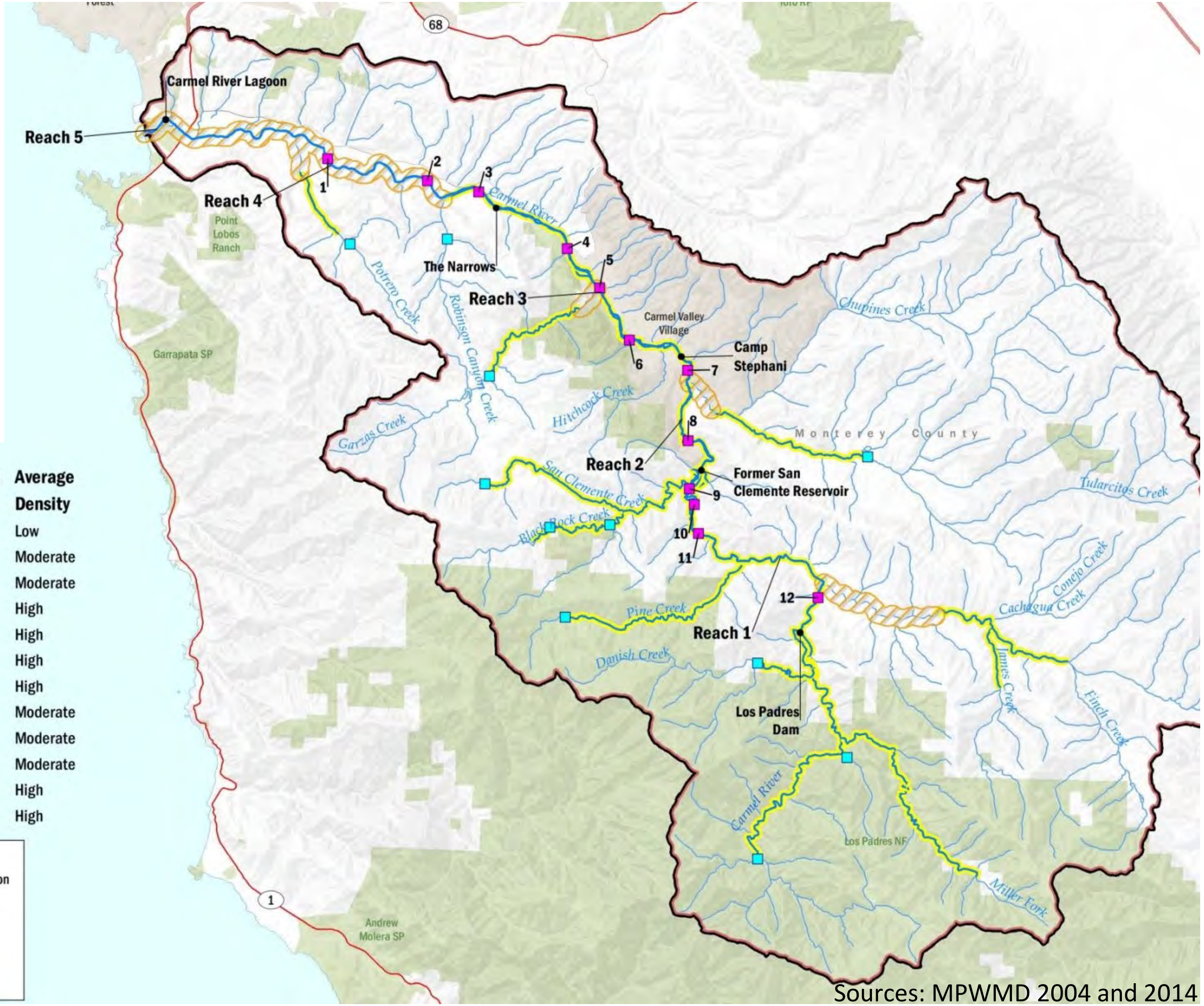


Monterey Peninsula Water Management District

Sources: MPWMD 2004 and 2014

Existing Conditions
Carmel River Steelhead Biology - Rearing Habitat

Station Number	Juvenile Steelhead Density Sampling Station	Average Density
1	Valley Greens Br.	Low
2	Red Rock (Mid Valley)	Moderate
3	Scarlett Narrows	Moderate
4	Garland Park	High
5	Boronda	High
6	DeDamp Park	High
7	Stonepine Resort	High
8	Sleepy Hollow	Moderate
9	SCR Lower Delta	Moderate
10	SCR Upper Delta	Moderate
11	Los Compadres	High
12	Cachagua	High



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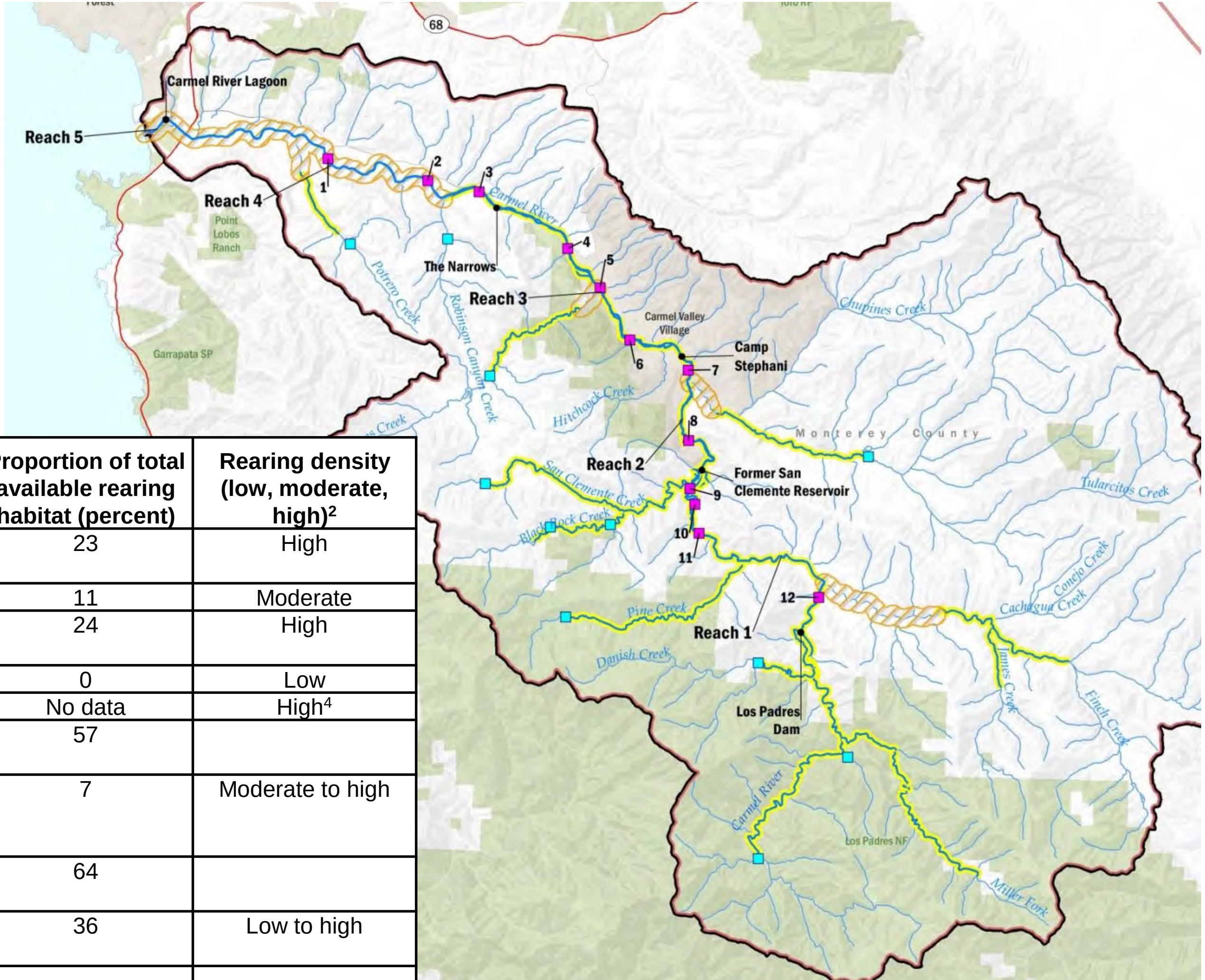
Sources: MPWMD 2004 and 2014

Existing Conditions Carmel River Steelhead Biology - Rearing Habitat



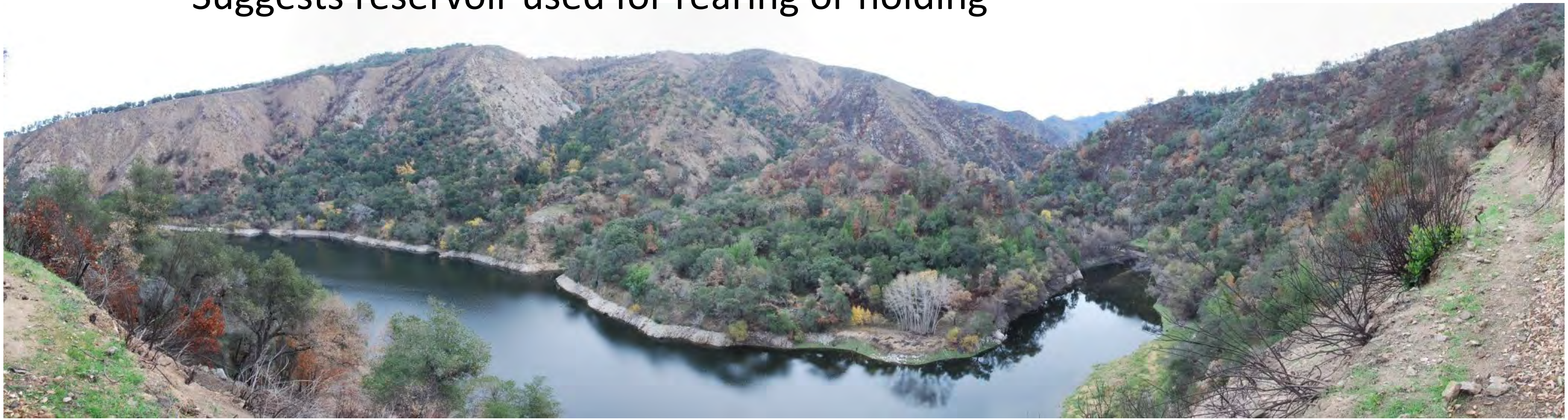
Reach[1]	Estimated age 1+ rearing habitat (ft^2)	Proportion of total available rearing habitat (percent)	Rearing density (low, moderate, high)[2]
Response Reach 1 (at 5–16 cfs)	590,553	23	High
Response Reach 2 (at 5.6 cfs)[3]	284,787	11	Moderate
Response Reach 3 (at 5.6 to 8.5 cfs)	629,562	24	High
Response Reach 4	Seasonally dry	0	Low
Response Reach 5	No data	No data	High[4]
Total in mainstem Carmel River downstream Los Padres Dam	1,469,093	57	
Tributaries to Carmel River downstream Los Padres Dam[5,6]	180,421	7	Moderate to high
Total downstream Los Padres Dam	1,649,514	64	
Carmel River and tributaries upstream of Los Padres Dam[6]	937,623	36	Low to high
Total in watershed	**2,587,137**		

Sources: Alley & Associates 2014, MPWMD 2004, MPWMD 2015a, Snider 1983

Existing Conditions

Carmel River Steelhead Biology – Los Padres Reservoir

- Limited information on juvenile steelhead occurrence in, and emigration through, Los Padres Reservoir
- MPWMD (2015) trapped juveniles upstream and downstream of Los Padres Reservoir in 1996 and 1999
  - More smolts caught downstream than upstream
  - Suggests reservoir used for rearing or holding



Existing Conditions

Carmel River Steelhead Biology – Predators

- Distribution of predators in river and reservoir is relatively unknown
- Brown trout present in reservoir, upstream, and downstream

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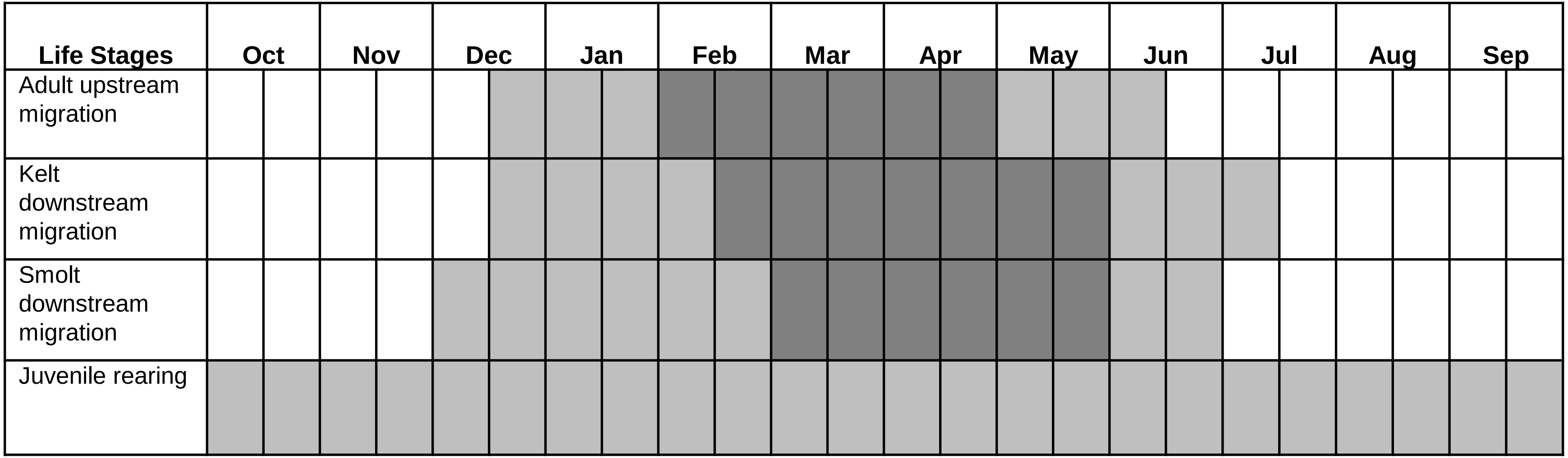
Existing Conditions

Carmel River Steelhead Biology – Migration Timing

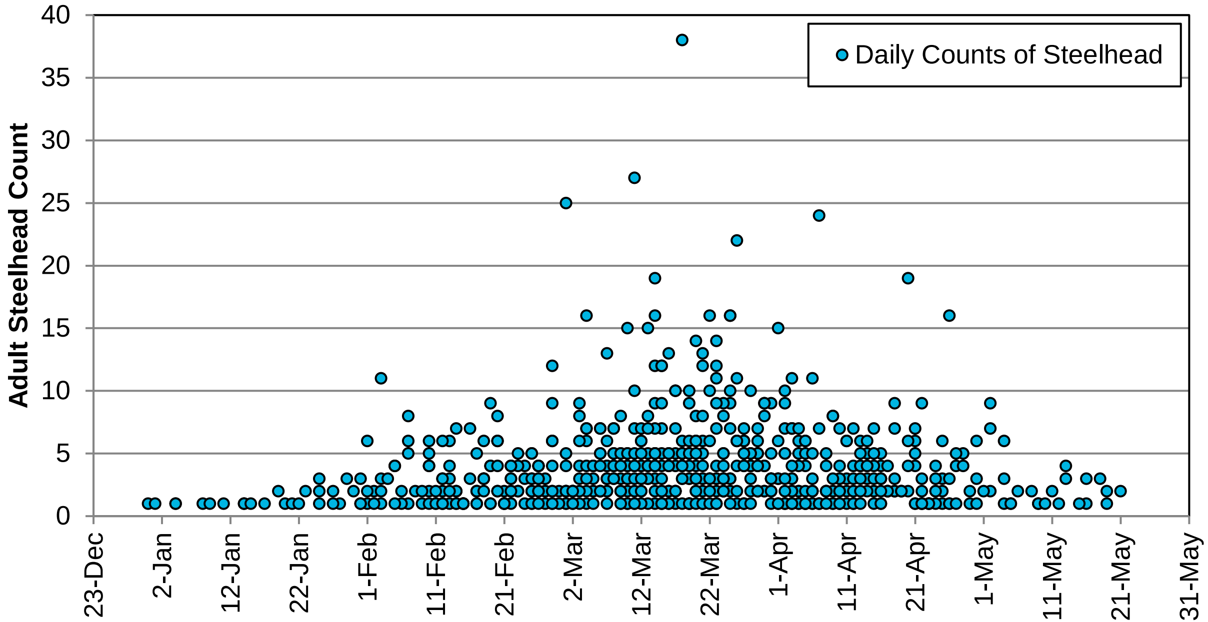


Light gray cells represent the general period of anticipated migration, while dark gray cells indicate the anticipated periods of peak migration.

Existing Conditions

Carmel River Steelhead Biology – Migration Timing

- Adult migration correlated with
  - Breaching of the Carmel River Lagoon
  - Minimum migration flows
  - Attraction flows (e.g., attraction from the ocean into the river mouth)
  - Other physical and biological factors



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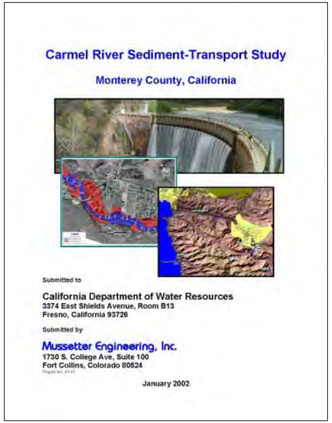
Summary of previous and ongoing studies directly relevant to the Alternatives Study

PREVIOUS AND ONGOING STUDIES

Previous and Ongoing Studies

San Clemente Sediment Transport Studies

- MEI, 2001-2007, release of up to 1,500 AF
  - Sediment transported quickly (6-41 years) through Upper (Canyon) Reach
  - Releases > historic input likely result in aggradation and raise flood elevations in Lower (Alluvial) Reach
  - Model allowed significant aggradation but little degradation during supply-limited periods (scour depths ≤ 1 ft.)
  - Conservative approach - periods of degradation could result in deeper channel that could store sediment without significantly raising flood elevations


Carmel River Sediment-Transport Study
Monterey County, California

Submitted to
California Department of Water Resources
3374 East Shields Avenue, Room B13
Fresno, California 93726

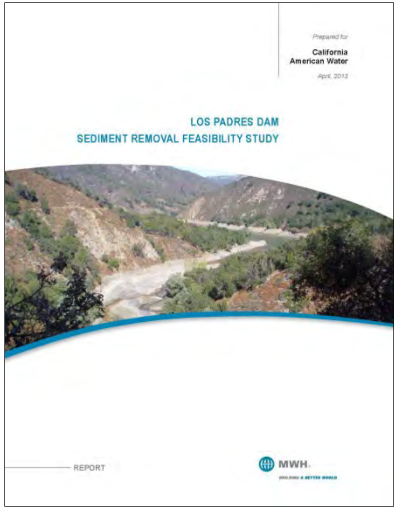
Submitted by
Mussetter Engineering, Inc.
1730 S. College Ave, Suite 100
Fort Collins, Colorado 80524

January 2002

Previous and Ongoing Studies

LPD Sediment Removal Feasibility Study

- MWH, 2013, investigated sediment management options
  - Sediment re-routing, drawdown flushing, reservoir emptying, and siphoning impractical because of LPD configuration, design, and operational constraints
  - Mechanical removal only feasible strategy
  - Estimated costs ranged between
    - $53K and $112K per recovered AF of storage,
    - For a total project cost between $47M and $90M,
    - And a total storage capacity between 2,228 AF and 2,920 AF
  - Construction durations ranged between 6 and 7 years
  - Fish passage improvements were not included



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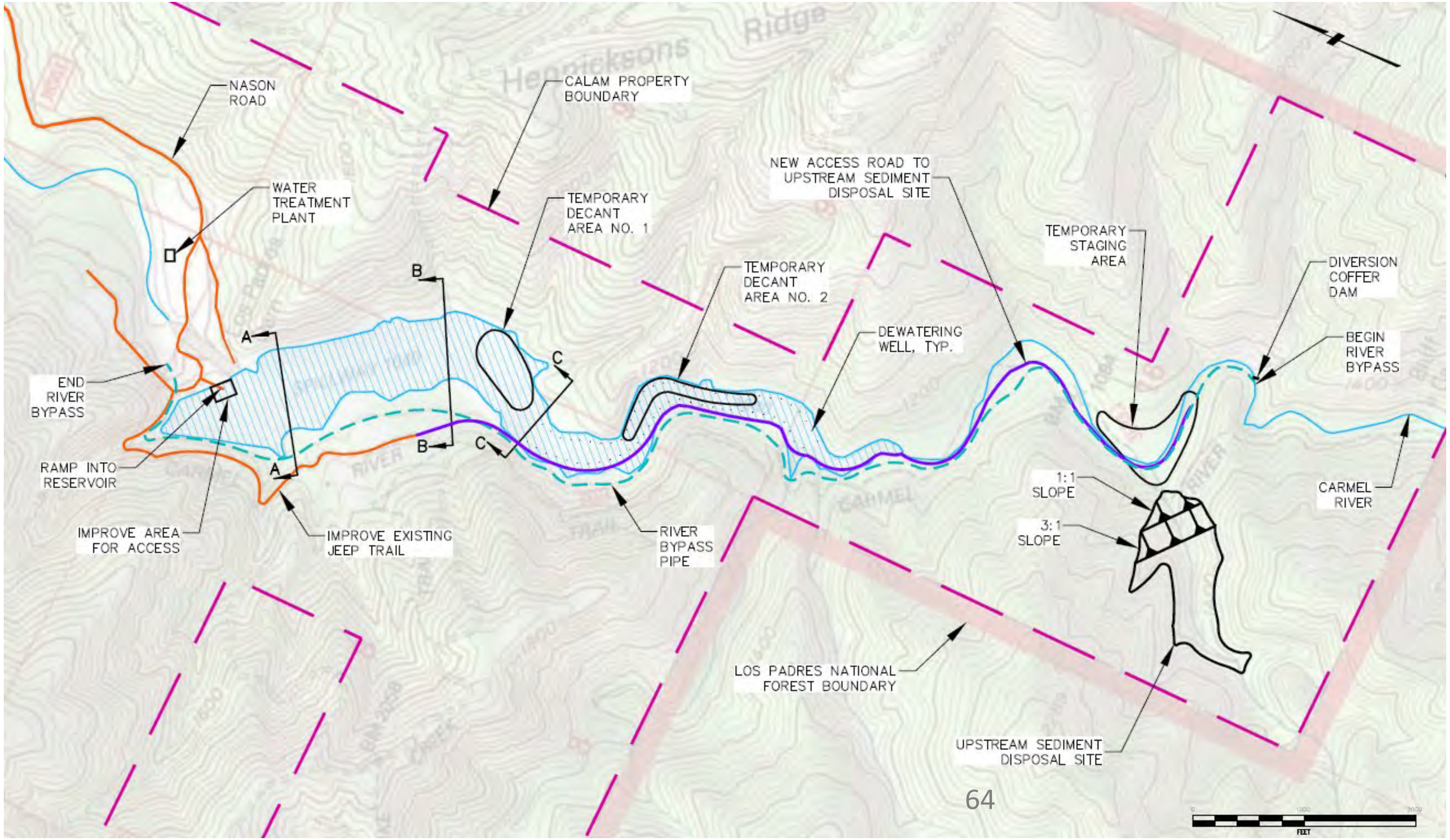
Previous and Ongoing Studies

LPD Sediment Removal Feasibility Study

Potential upstream disposal site



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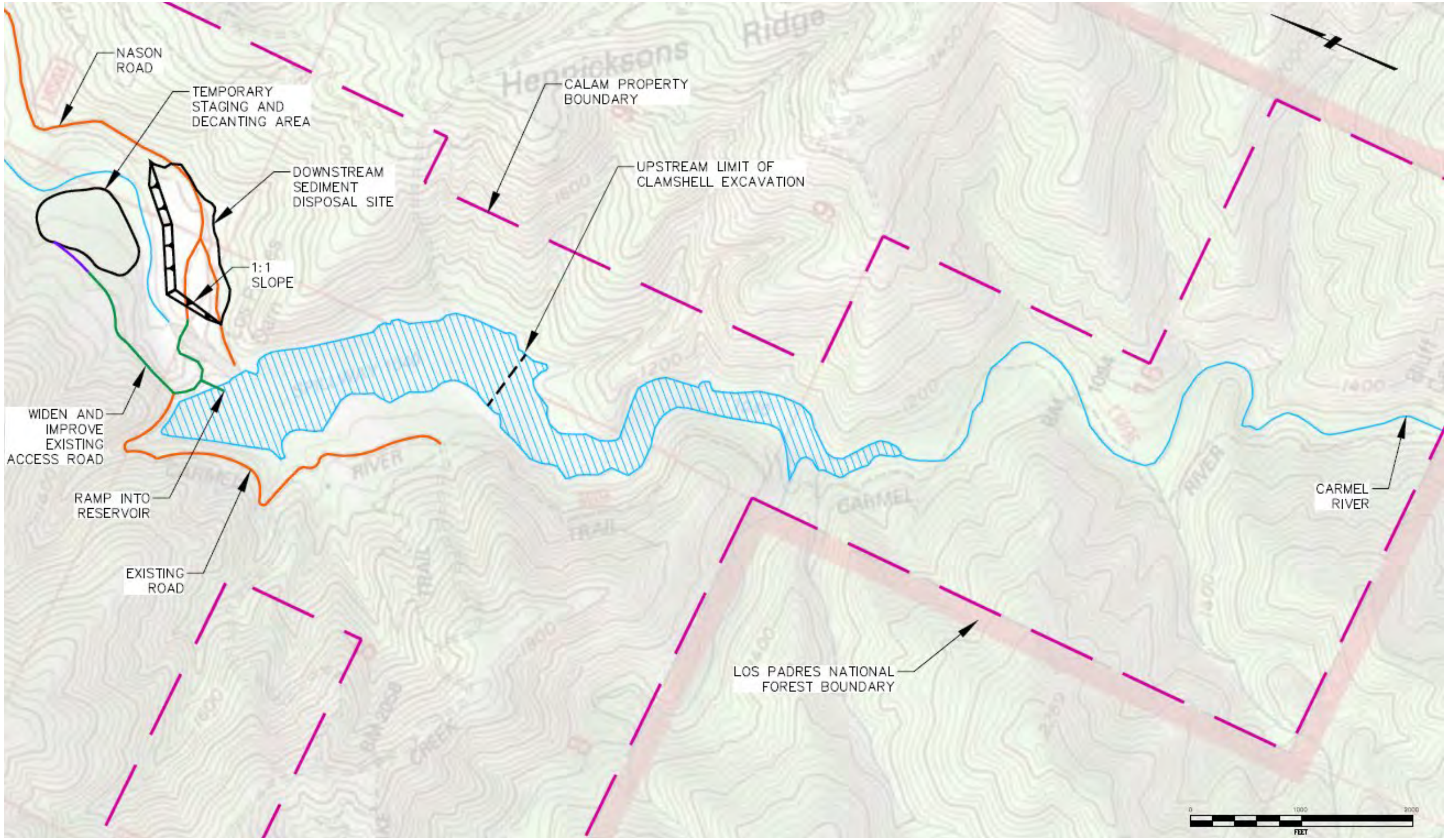
Previous and Ongoing Studies

LPD Sediment Removal Feasibility Study

Potential downstream disposal site



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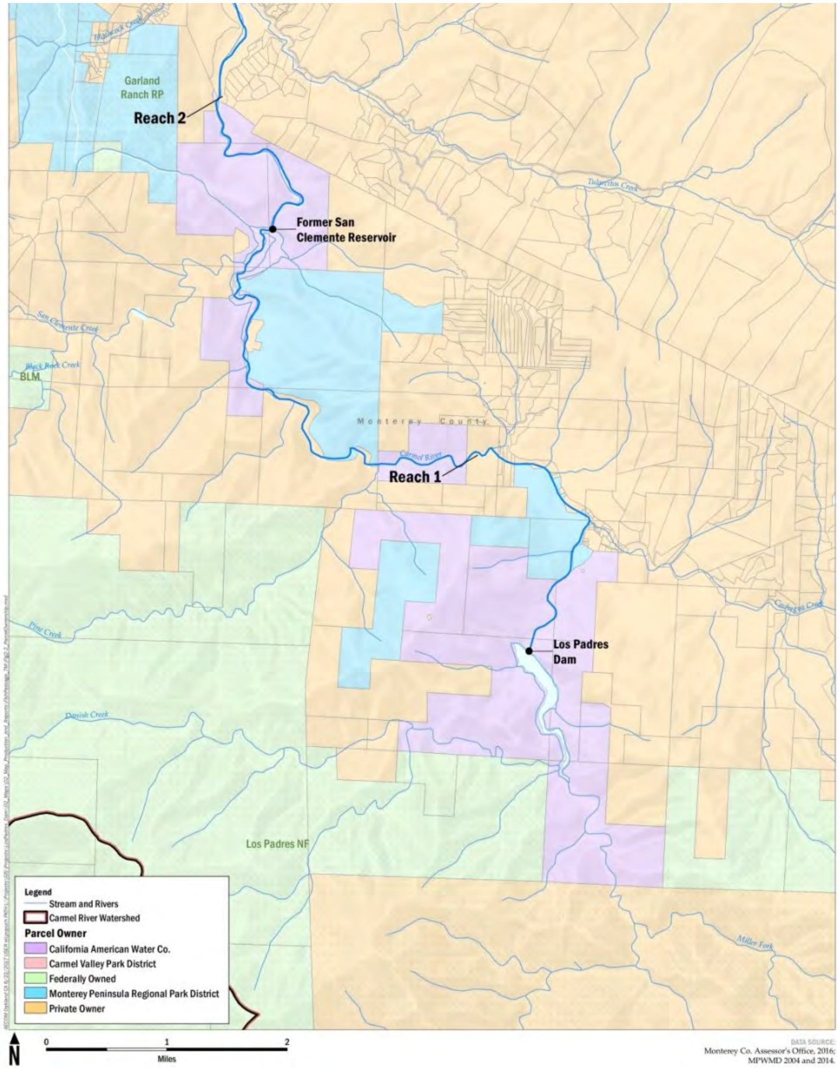
Previous and Ongoing Studies

LPD Sediment Removal Feasibility Study

- Other disposal options may be available
- Hauling material is a significant driver of cost
- Hauling on public ROW is problematic



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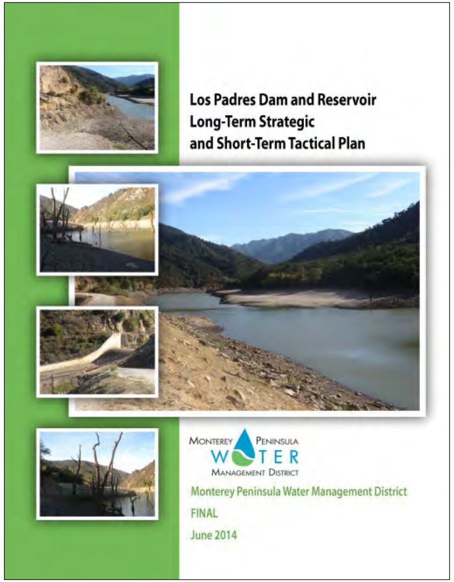
Previous and Ongoing Studies

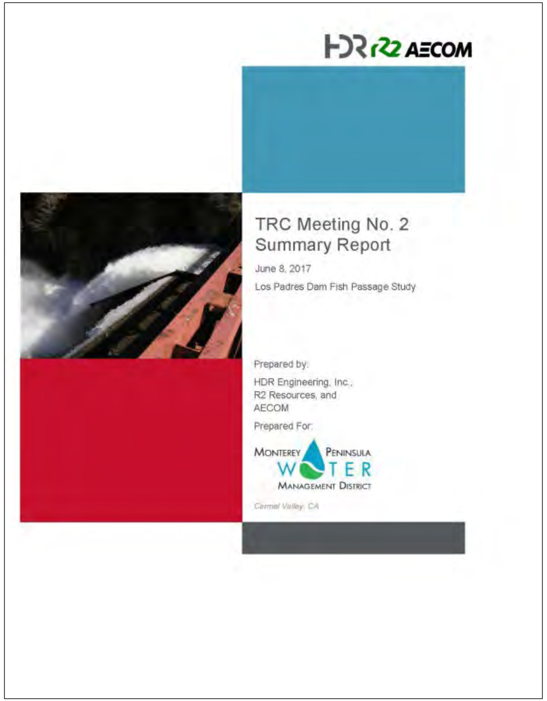
LPD and Reservoir Long-Term Strategic and Short-Term Tactical Plan

- Shibatani et. al, 2014, assed water resource development and management options for upper Carmel River
  - Identified new, off-channel storage combined with removal of LPD as best option
  - Eliminated other options due to environmental fatal flaws
    - Los Padres Reservoir storage enhancements
    - LPD removal
    - New, lower LPD and Reservoir
  - Environmental fatal-flaw criteria attributed to NMFS:
    - Alternatives that "1) wouldn't return fish passage in the mainstem to its original state (a long-standing desire of NMFS); 2) wouldn't provide the capability for increased flow releases from storage (another NMFS requirement); and 3) would require fully petitioning the SWRCB for a new water right."



Previous and Ongoing Studies
Los Padres Dam Fish Passage Feasibility Study

- HDR, R2, and AECOM, 2016-present, investigating permanent fish passage facilities at LPD
  - Purpose to inform the feasibility, potential for success, level of effort, and cost of implementing passage at LPD
  - Overlap among the consultant teams and TRC members for the Los Padres Fish Passage and Alternatives studies
  - Results of the Fish Passage Study will be primary information considered in the Los Padres Alternatives Study regarding fish passage for alternatives that retain LPD and Reservoir


HDR R2 AECOM

TRC Meeting No. 2
Summary Report

June 8, 2017

Los Padres Dam Fish Passage Study

Prepared by:
HDR Engineering, Inc.,
R2 Resources, and
AECOM

Prepared For:
Monterey Peninsula Water Management District

Carmel Valley, CA

Monterey Peninsula Water Management District

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Previous and Ongoing Studies

Water and Steelhead Habitat Availability Analysis

- MPWMD's Carmel River Basin Hydrologic Model, a linked surface flow and groundwater model using GSFLOW coupled to MODFLOW, is being calibrated by USGS
  - Flow duration analyses will be provided for the following scenarios to be included in the Los Padres Alternatives Study:
    - Existing Conditions
    - Storage Depletion
    - Existing Storage
    - Dam Removal
    - Recover Storage, Modified Operations
    - Expand Storage
- MPWMD will also assess how alternatives affect steelhead habitat availability using an IFIM model developed for the Carmel River

USGS science for a changing world

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Previous and Ongoing Studies

Carmel River Basin Study – Climate Change

- MPWMD and US Bureau of Reclamation, 2017-present, potentially developing a downscaled climate change model for the basin
  - Water availability analysis for various climate scenarios
  - Adaptation strategies
  - Alternative(s) from the Los Padres Alternatives Study may be evaluated assuming a different climate
  - MPWMD would provide flow duration analyses for each scenario to compare alternatives in the LP Alternatives Study

Previous and Ongoing Studies

Carmel River Fishery Science Study

- NOAA Fisheries, 2015-present, Carmel River steelhead studies
  - PIT-tagging to examine limiting factors and estimate smolt production as a performance metric for river management
  - Annual State of the Steelhead Fishery report to assess population response to ongoing conservation actions and freshwater conditions
  - Evaluation of direct impacts of Los Padres Dam on smolt production and overall steelhead population
  - Tagging above LPD has not yet begun

NOAA FISHERIES

Update on the Los Padres Reservoir sediment characterization work

RESERVOIR SEDIMENT CHARACTERIZATION

Reservoir Sediment Characterization – Update

- Mobilization, demobilization, and drilling, July 11 – 17, 2017

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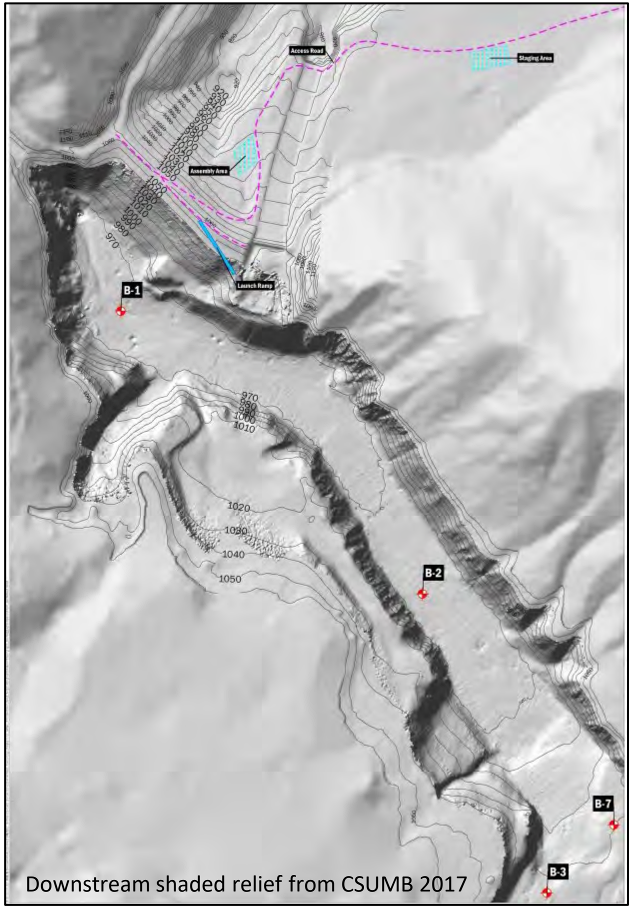
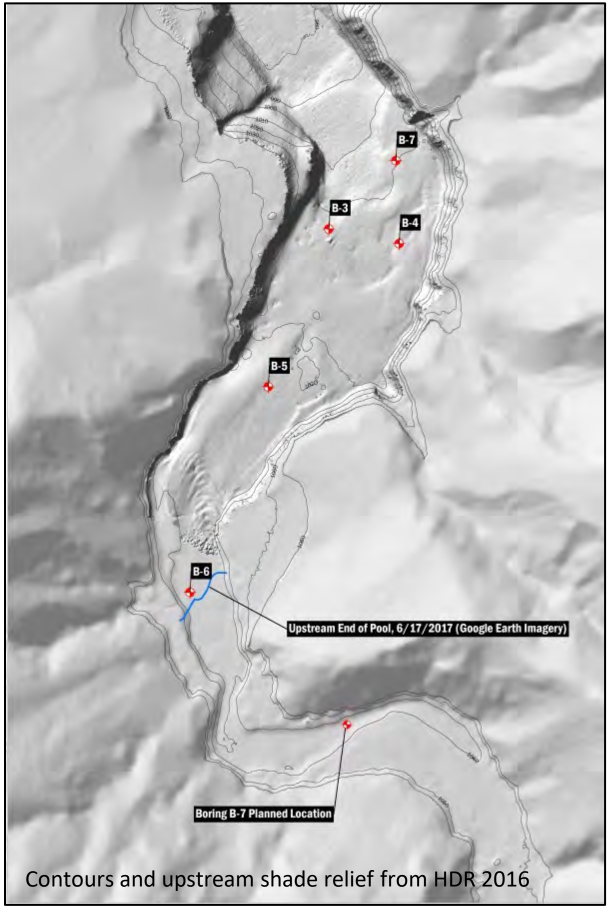
Reservoir Sediment Characterization – Update

- Seven borings in 2017



Downstream shaded relief from CSUMB 2017



Contours and upstream shade relief from HDR 2016

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Reservoir Sediment Characterization – Update

Boring	Water Depth (ft)	Boring Depth (ft)	Interpreted Lake Sediment Thickness (ft)	Lake Bed el. (2016 Bathy, ft)	Lake Bed el. (2017 Bathy, ft)	Lake Bed el. (Boring, ft)	Original Ground el. (1947 Topo, ft)	Original Ground el. (Boring, ft)
B-1	74.5	33.5	29.5	965.8	968.5	968.4	930-940	939
B-2	65.0	23.0	21.0	974.1	978.3	977.9	950	957
B-3	25.0	36.5	27.0	1015.9	1018.7	1017.9	980-990	991
B-4	24.5	31.5	> 31.5	1015.5	1018.7	1018.4	965.0	< 987
B-5	16.5	47.0	46.5	1021.4	1026.6	1026.4	970.0	980
B-6	7.0	52.4	46.0	1026.6	NA	1035.9	980.0	990
B-7	30.0	56.0	45.0	1010.0	1012.8	1012.9	970.0	968
Water Surface el. (NAVD 88, ft)					1042.9			

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Reservoir Sediment Characterization – Update

- Analytical and geotechnical samples with labs

- Characterization results (draft report) available by September

Update on sediment transport analysis and next steps

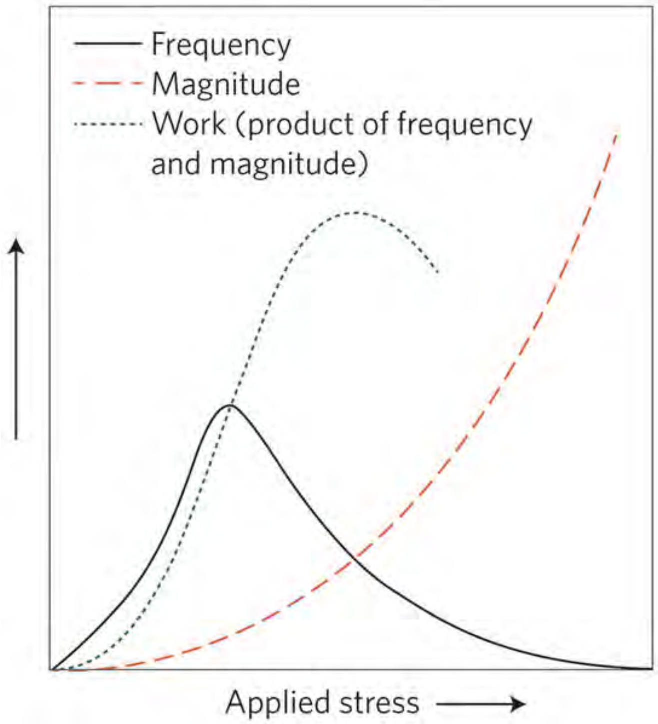
SEDIMENT TRANSPORT ANALYSIS

Sediment Transport Analysis

1. Update on status of model set-up
2. Review the basic scenarios that we will run
3. Discuss how to expand the scenarios we will run
4. Questions we would like to address before model set-up is complete

Sediment Transport Analysis - Model Set-Up

- Model explores:
  - Wolman and Miller, 1960
  - Howard, 1982
  - Bull, 1991



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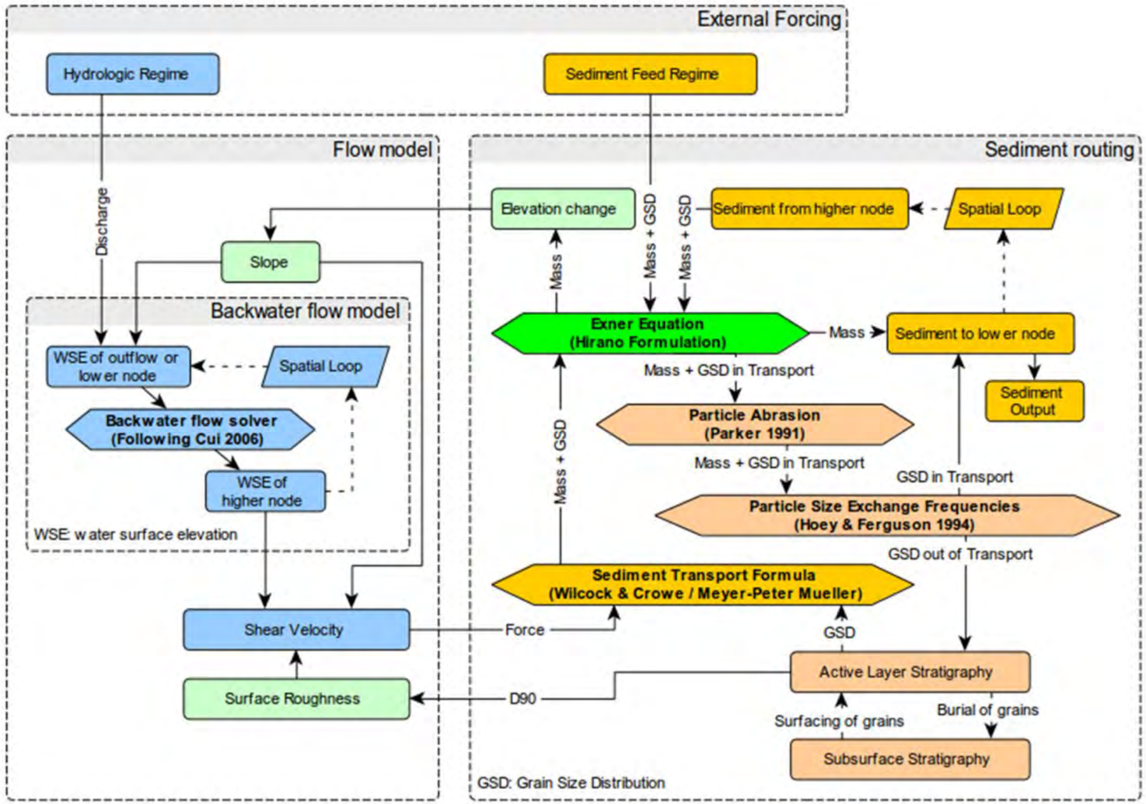
Sediment Transport Analysis - Model Set-Up

- Model workflow diagram



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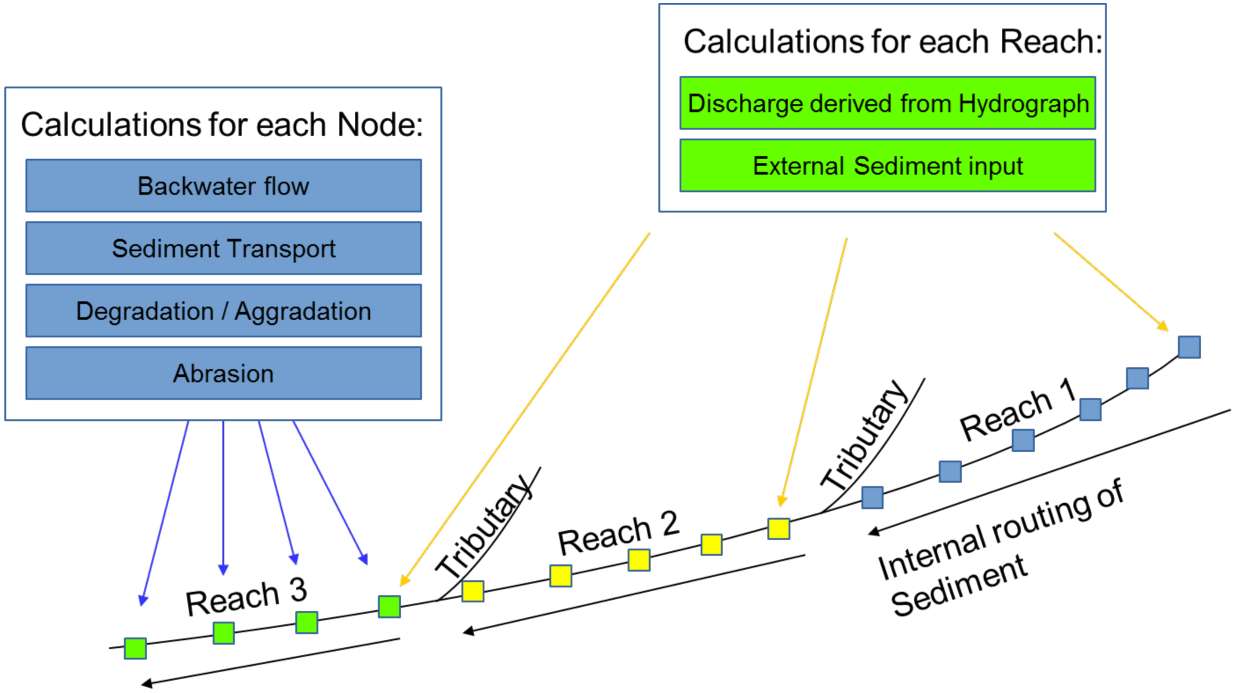
Sediment Transport Analysis - Model Set-Up

- Model workflow diagram



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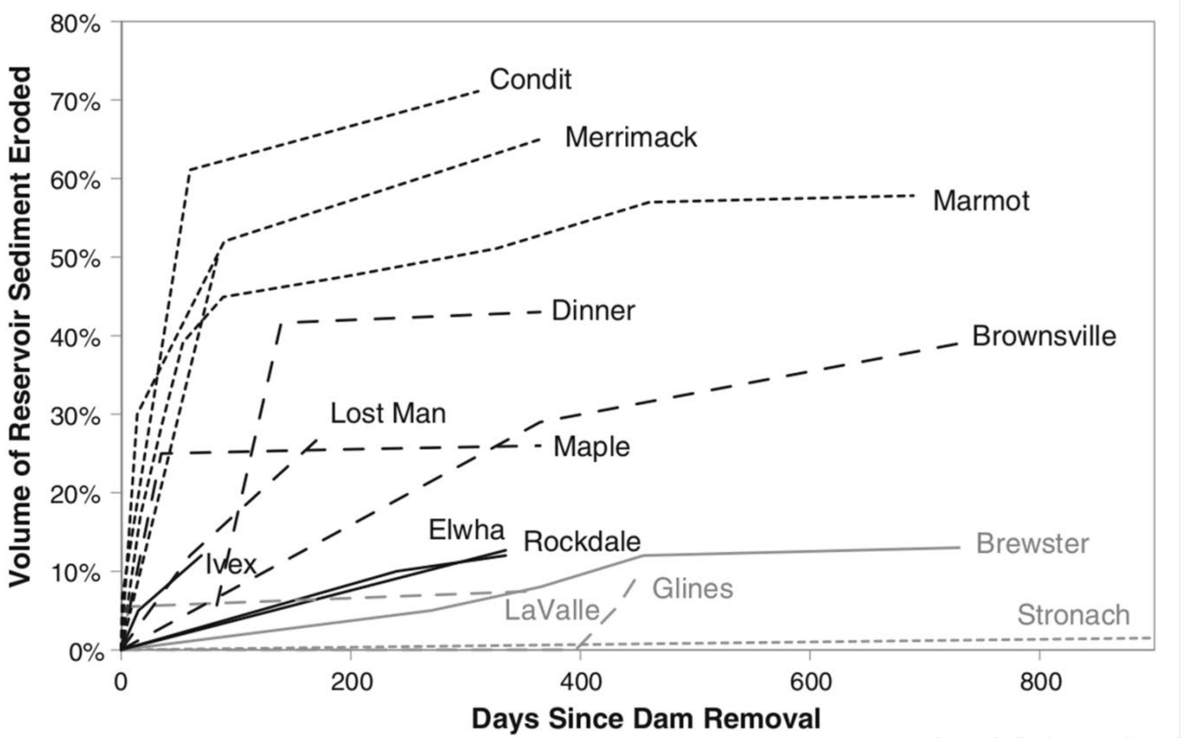
Sediment Transport Analysis - Model Set-Up

- Reservoir sediment evacuation



Grant, G. E., & Lewis, S. L. (2015)

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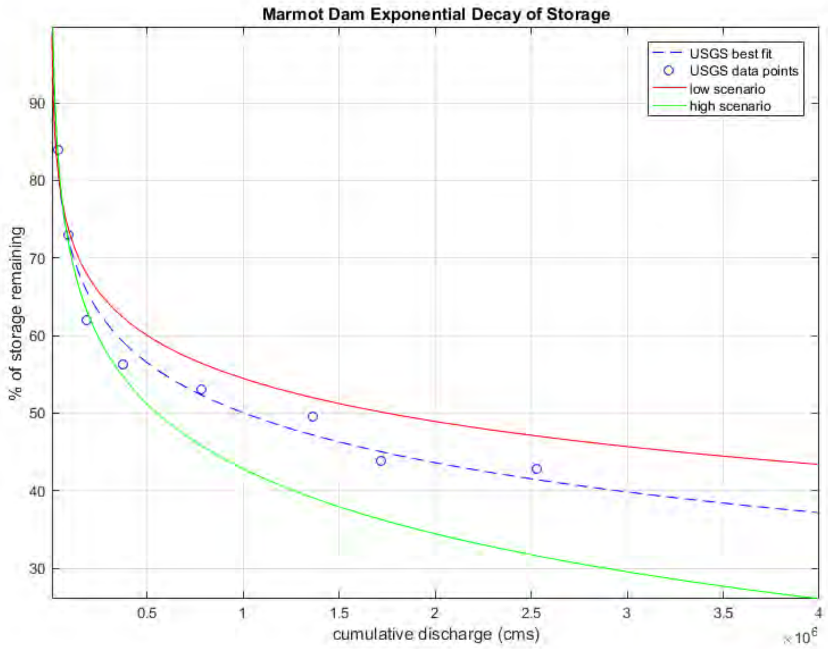
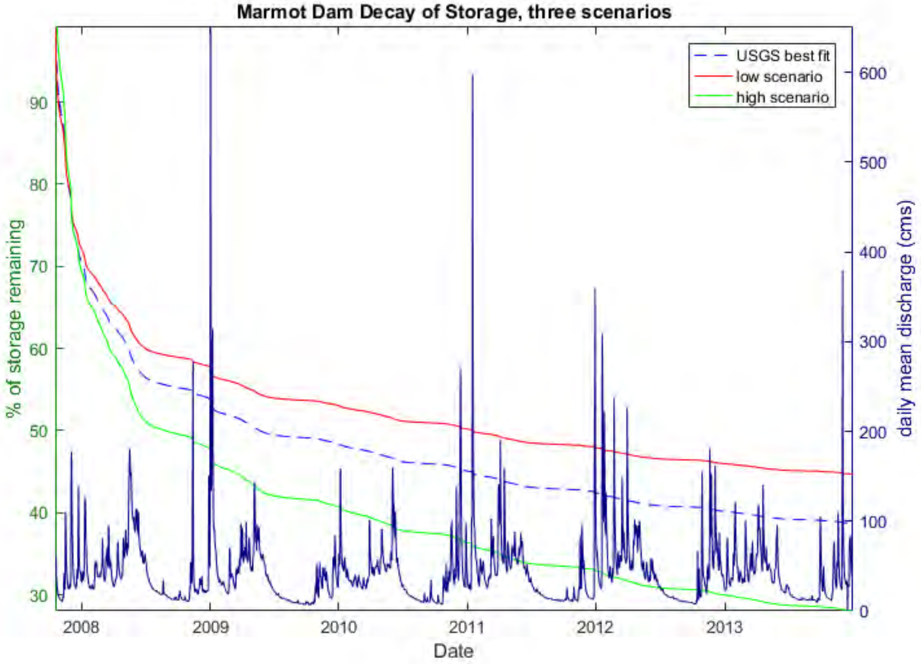
Sediment Transport Analysis - Model Set-Up





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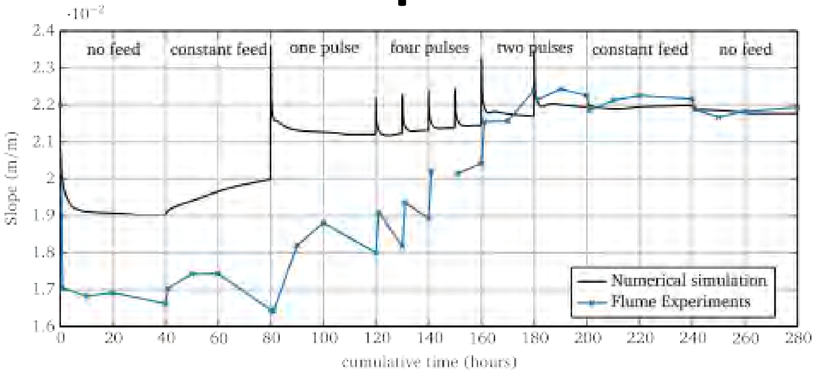
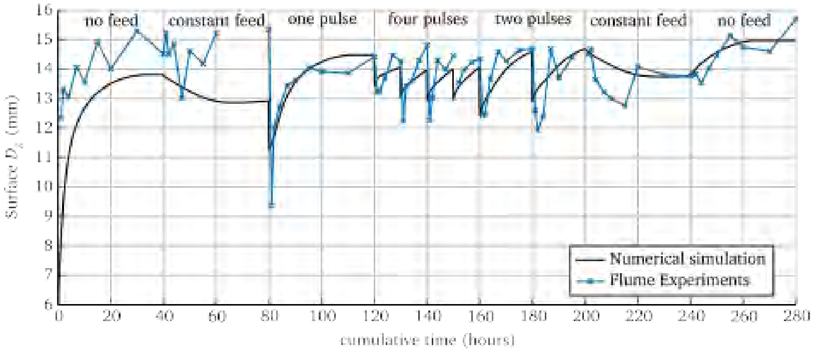
Sediment Transport Analysis - Model Set-Up

Slope



Geometric Mean Grain Size



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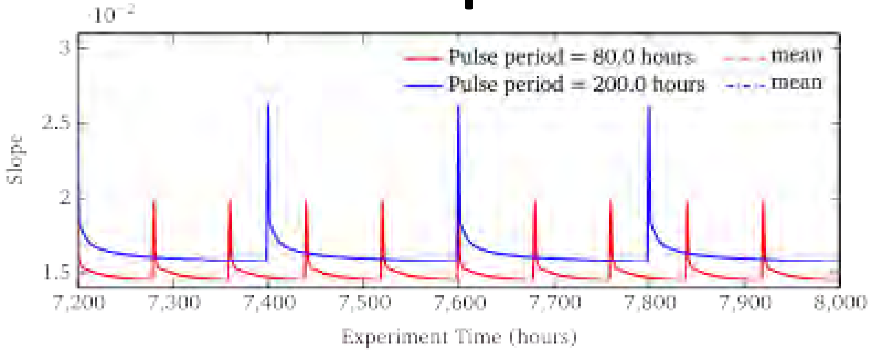
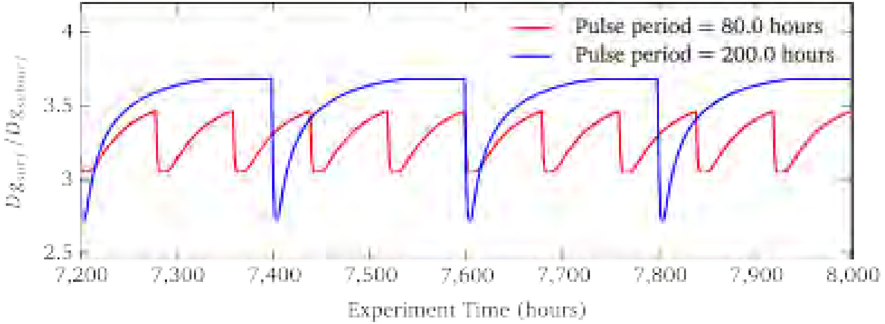
Sediment Transport Analysis - Model Set-Up

Slope



Armor Ratio



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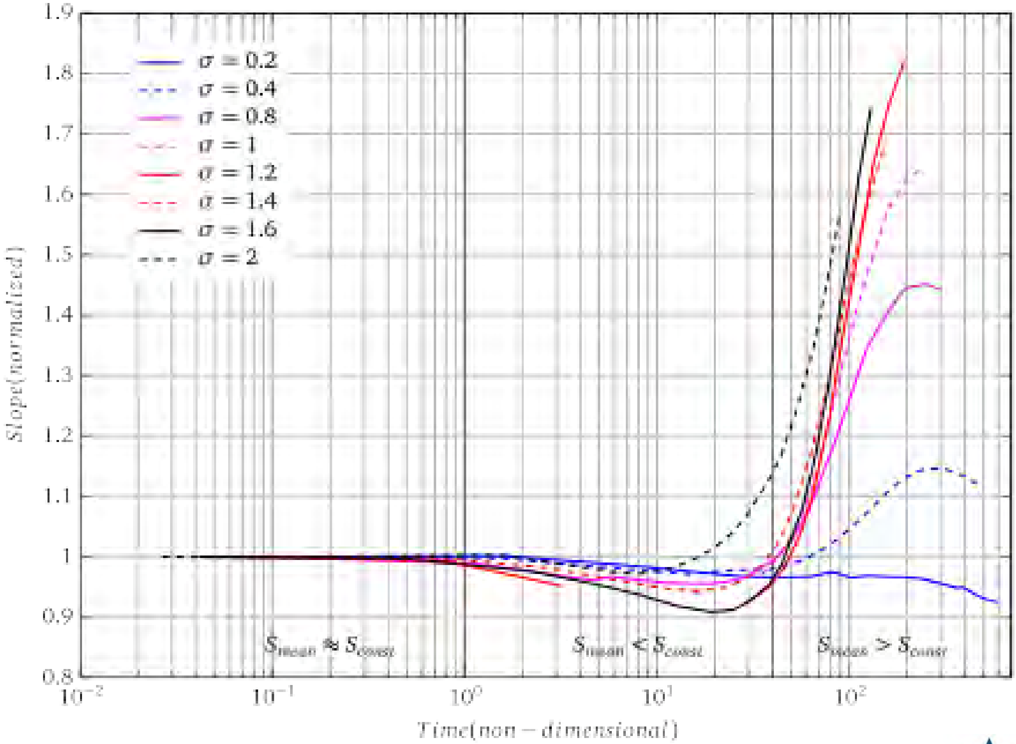
Sediment Transport Analysis - Model Set-Up

- Timescale of slope response to supply perturbations



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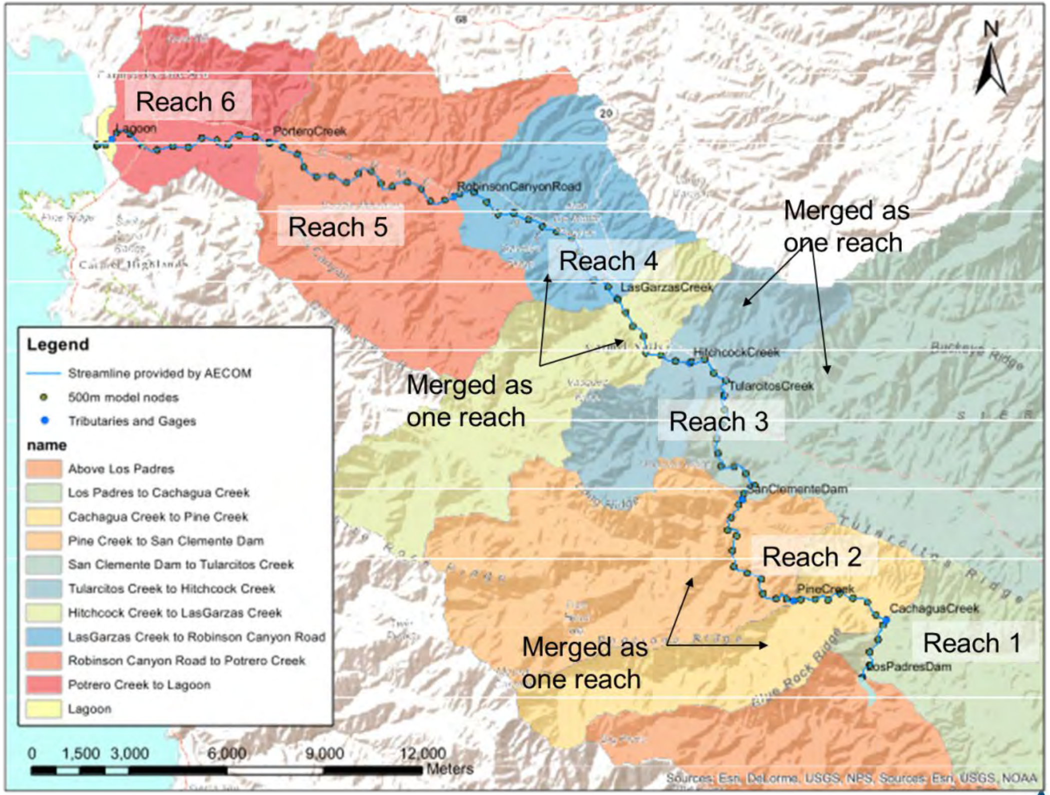
Sediment Transport Analysis - Model Set-Up

- Model reaches and boundaries



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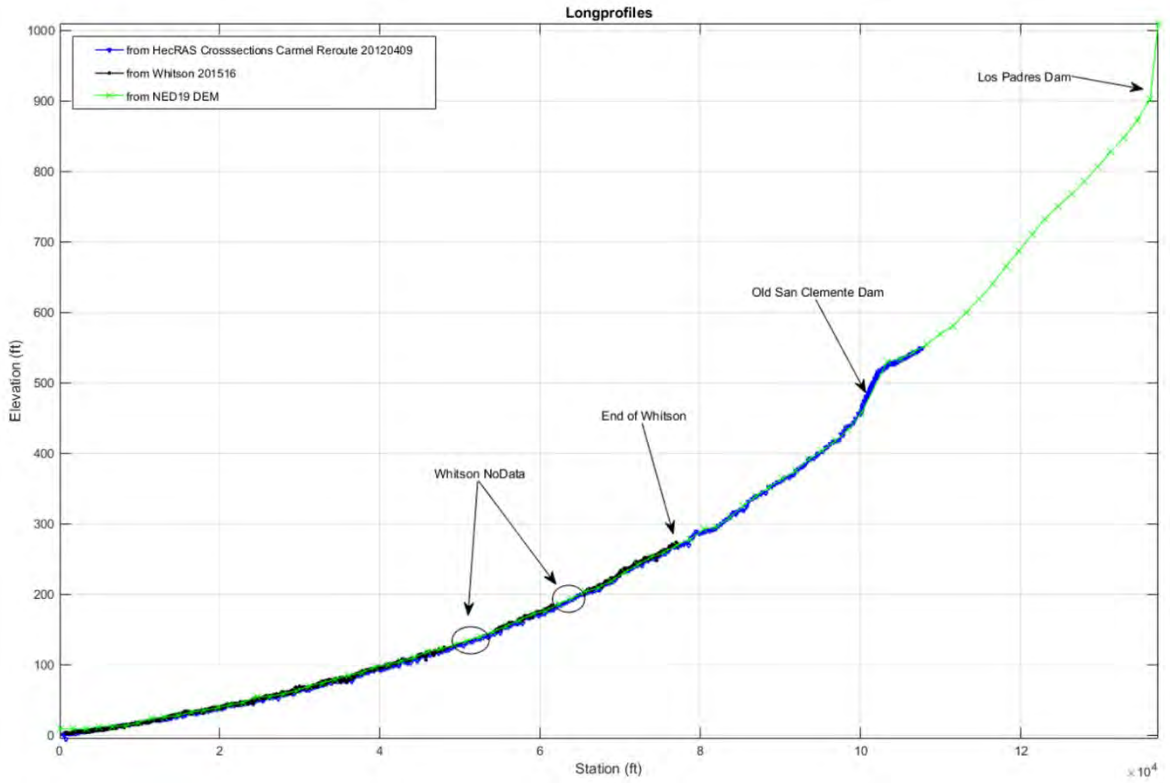
Sediment Transport Analysis - Model Set-Up

- Longitudinal profile
  - Lagoon to OSCD: 2012 and 2015
  - OSCD to Los Padres: 2010-2011: NED13 (Use LiDAR to develop newer DEM?)



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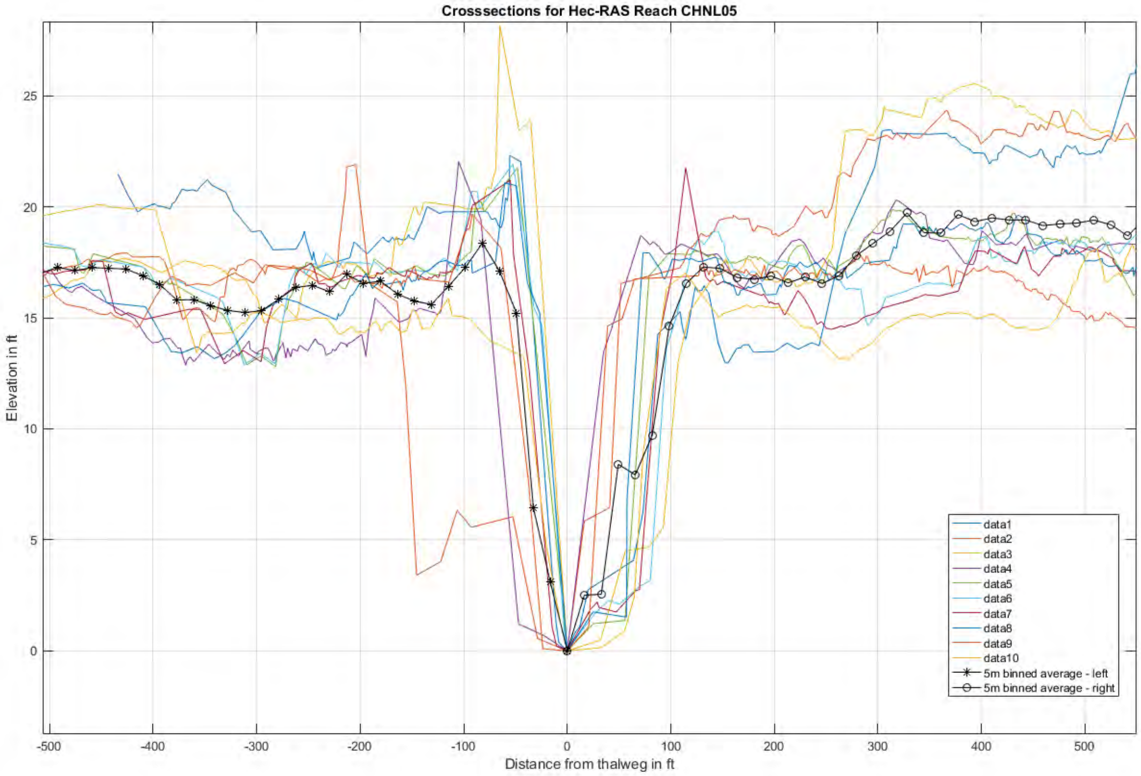
Sediment Transport Analysis - Model Set-Up

- Cross-sections
  - HEC-RAS (2012)
  - Average x-s for all sections in reach



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Sediment Transport Analysis - Model Set-Up

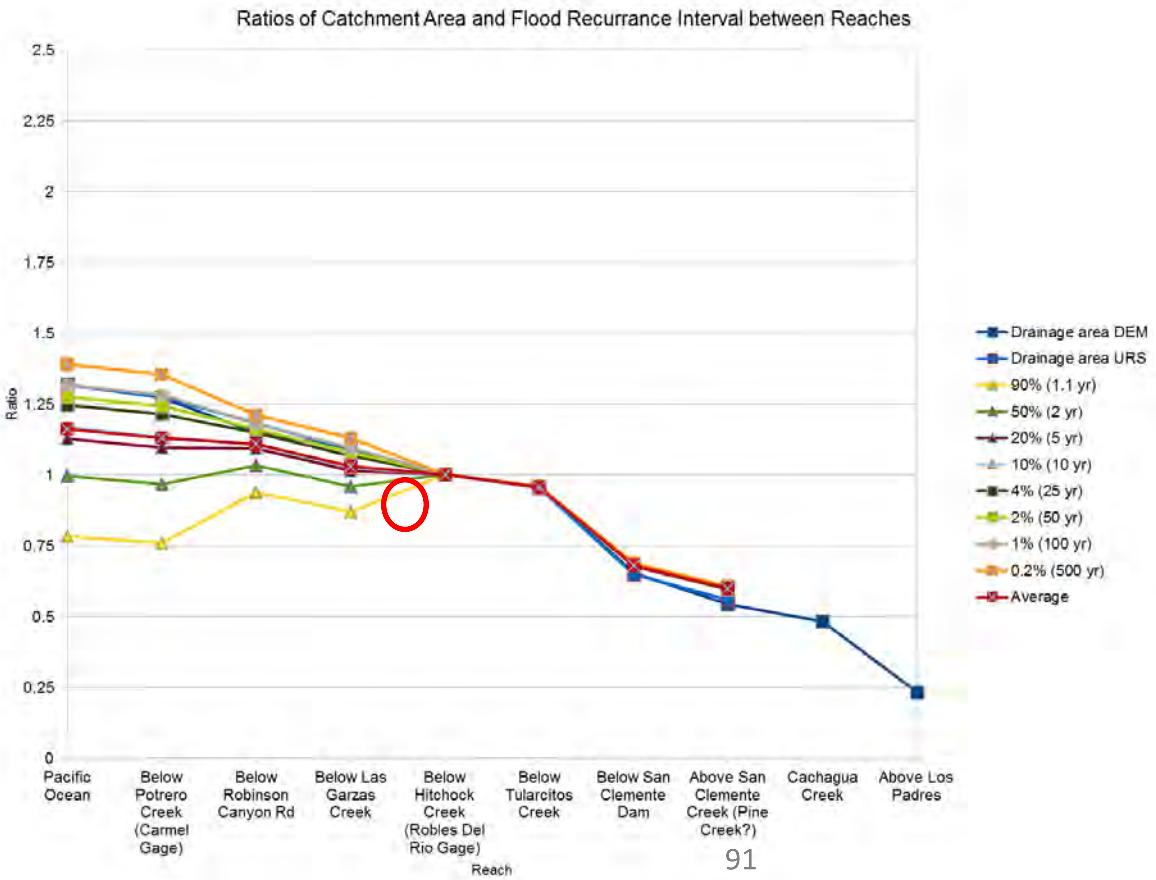
- Hydrology
  - Use existing hydrologic information

Table 2-3
Additional flood flows in the Carmel River

Site	Drainage area (sq mi)	Peak discharges in Carmel River (cfs)							
		90% (1.1 yr)	50% (2 yr)	20% (5 yr)	10% (10 yr)	4% (25 yr)	2% (50 yr)	1% (100 yr)	0.2% (500 yr)
Pacific Ocean	254	357	2,326	6,139	9,800	15,073	19,000	23,300	33,500
Below Potrero Creek (Carmel Gage)	246	347	2,260	5,965	9,500	14,684	18,500	22,700	32,600
Below Robinson Canyon Rd	228	428	2,413	5,952	9,300	13,913	17,300	20,900	29,200
Below Las Garzas Creek	210	397	2,241	5,527	8,600	12,899	16,100	19,400	27,200
Below Hitchock Creek (Robles Del Rio Gage)	193	457	2,337	5,451	8,400	12,107	14,900	17,700	24,100
Below Tularcitos Creek	184	438	2,239	5,222	8,000	11,578	14,300	16,900	23,100
Below San Clemente Dam	125	309	1,581	3,687	5,700	8,256	10,200	12,100	16,600
Above San Clemente Creek	108	272	1,391	3,244	4,999	7,205	8,918	10,655	14,592
White denotes values directly taken from FIS.									
Yellow denotes flow interpolated between values in FIS.									
Green denotes flows determined from USGS gage data and PEAKFQ program (using data through 2009). Carmel River gage statistics (Bulletin 17B, WY1963-WY2009): mean = 3.2918, standard deviation = 0.5643, skew = -0.666. Robles del Rio gage statistics (Bulletin 17B, WY1956-WY2009): mean = 3.3148, standard deviation = 0. 4919, skew = -0.661.									
Blue denotes flows extrapolated via watershed area									

Sedimen Transport Analysis - Model Set-Up

- Hydrology
  - Distribution of flows



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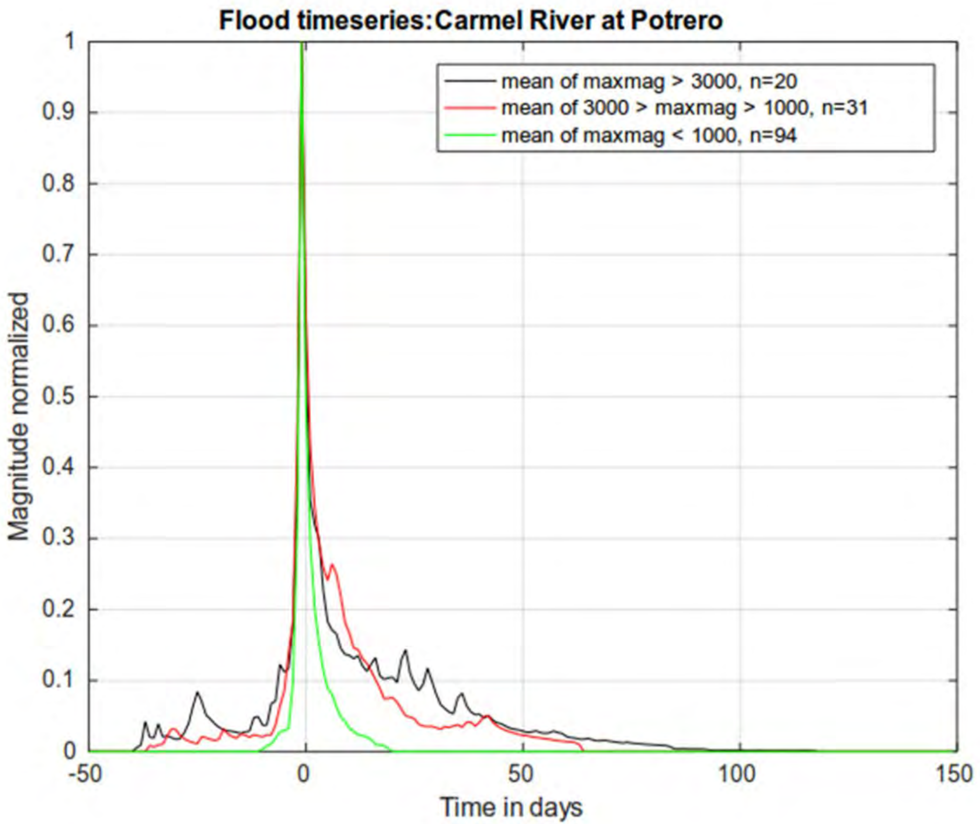
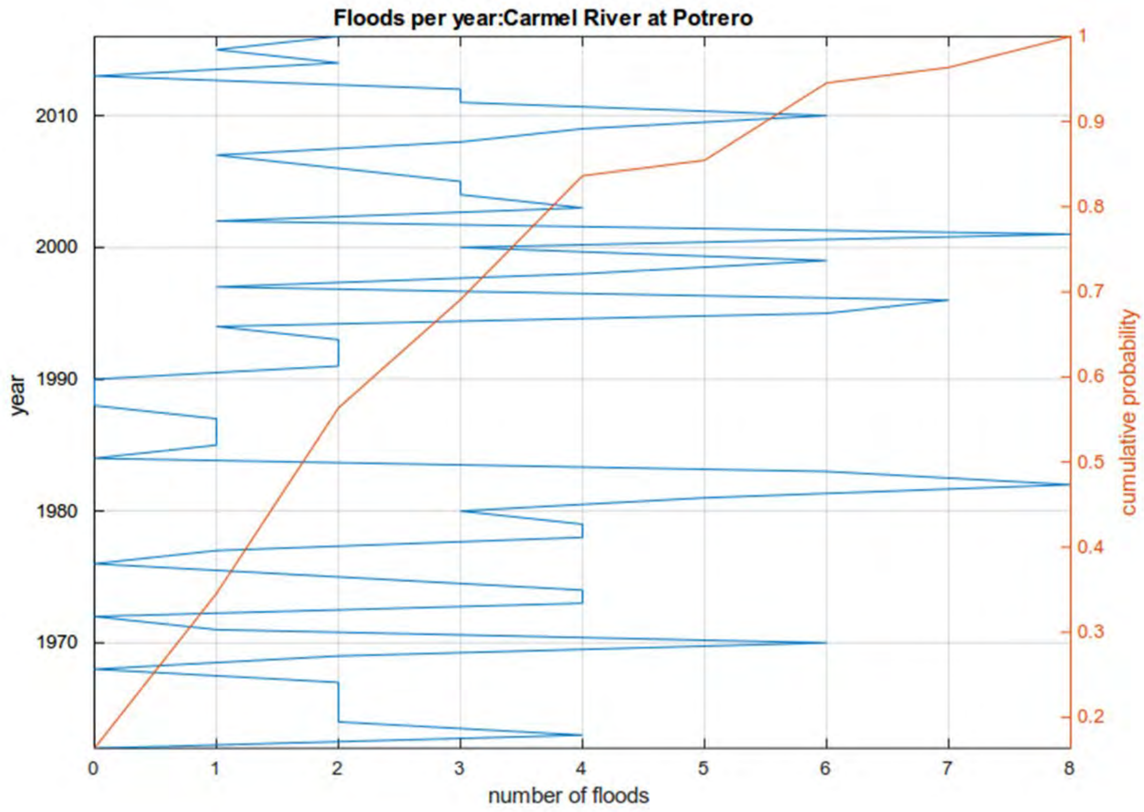
Sediment Transport Analysis - Model Set-Up

- Hydrology
  - Build normalized hydrographs
  - Use the existing hydrologic condition scheme



Sediment Transport Analysis - Model Set-Up

- Hydrology
  - Construct random distribution of flows based on basin hydrology



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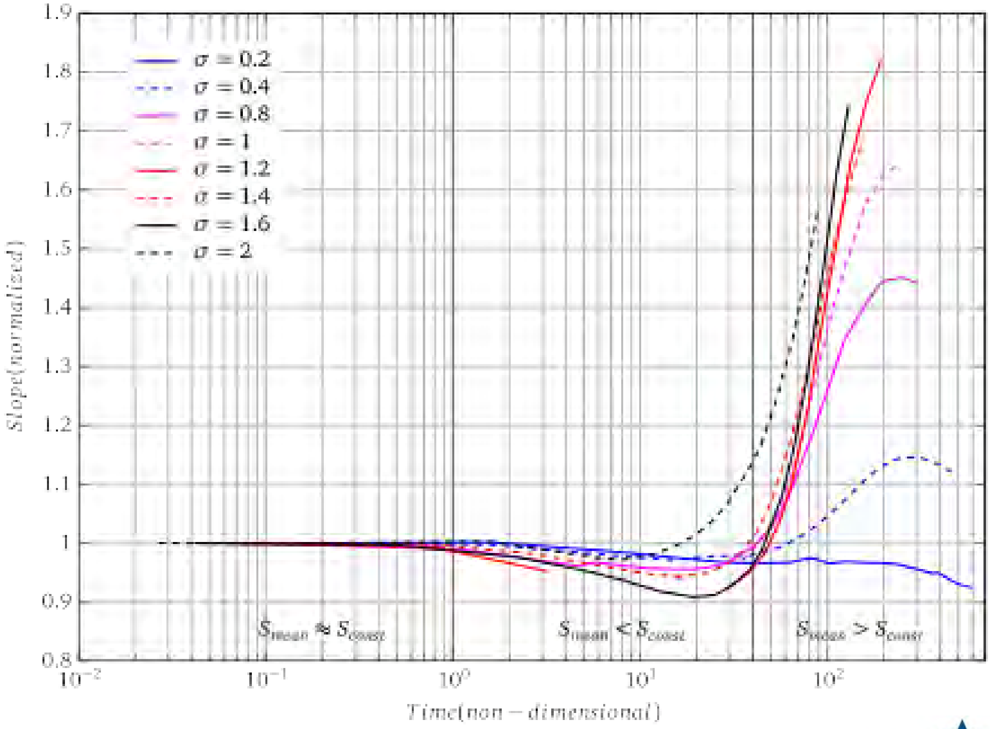
Sedimen Transport Analysis - Model Set-Up

- Organize results based on existing hydrologic condition scheme



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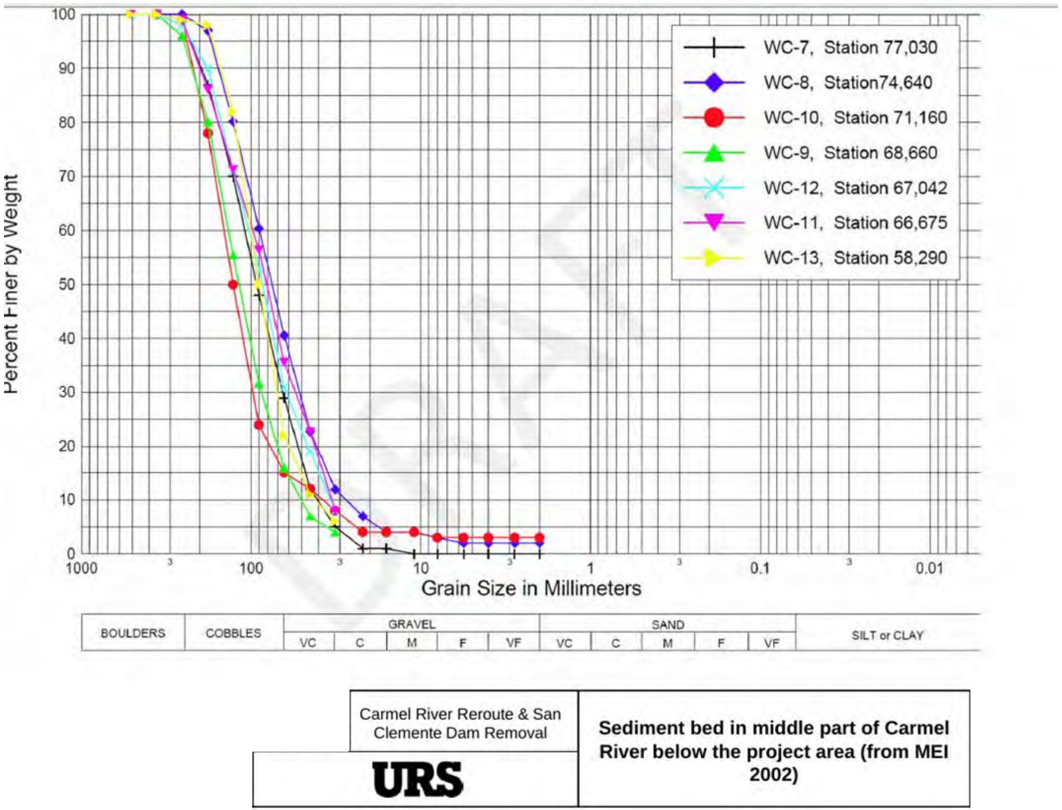
Sediment Transport Analysis - Model Set-Up

- GSD
  - Trade-offs between existing and newer texture data



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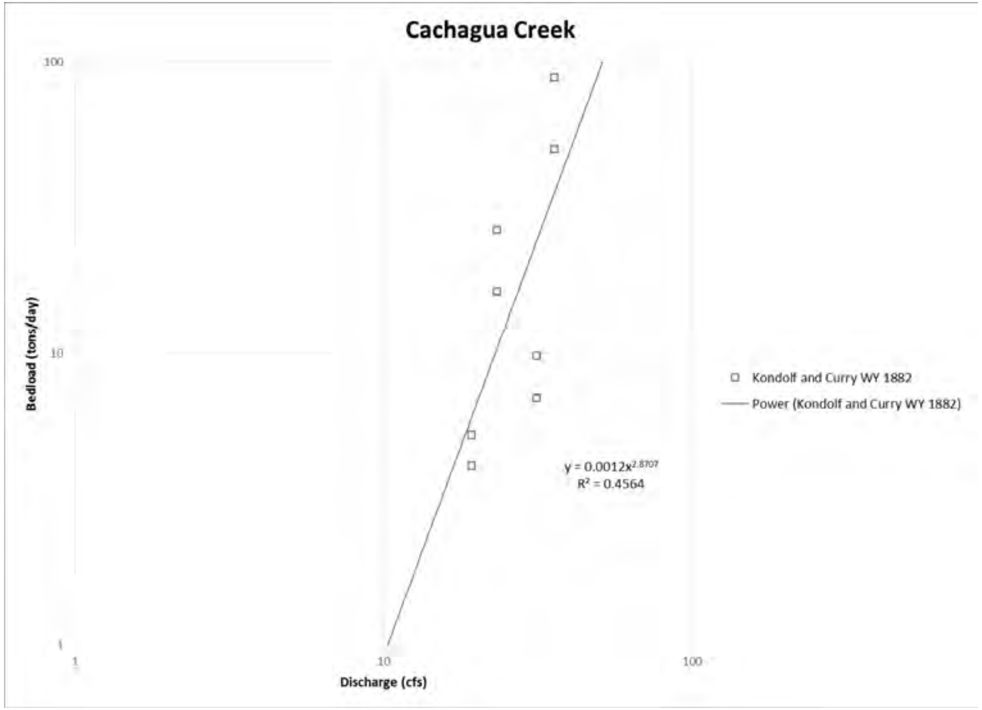
Sediment Transport Analysis - Model Set-Up

- Boundary condition bedload rating curves
  - Bedload rating curves completed for tributaries and mainstem, almost done with episodic curves



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Sediment Transport Analysis - Model Set-Up

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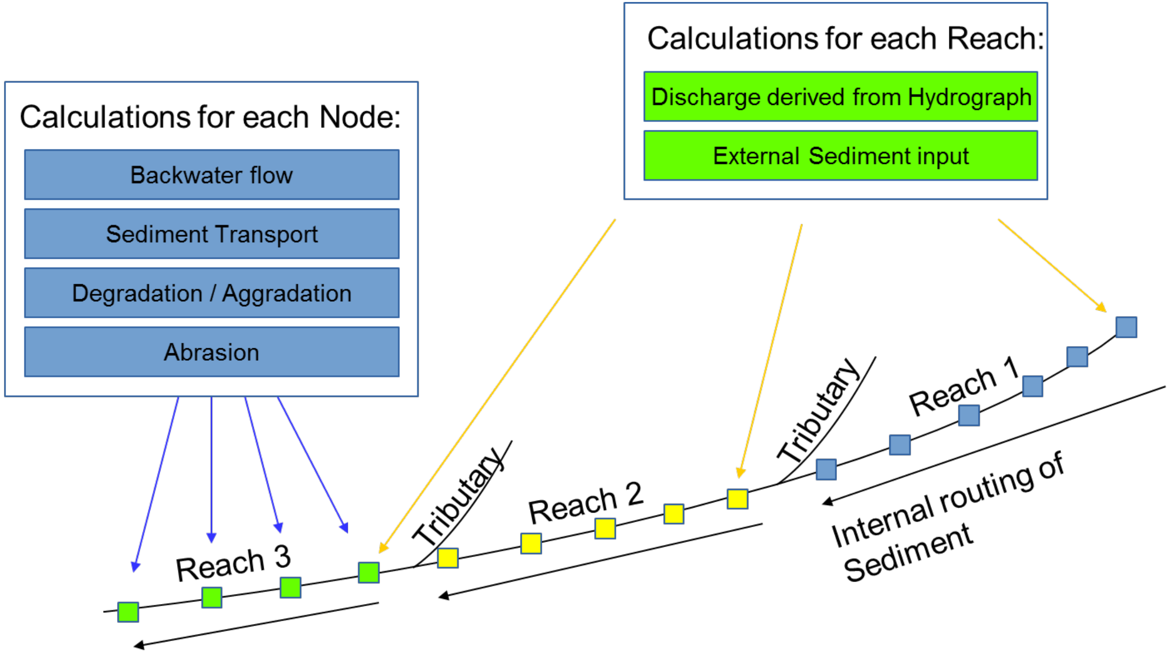

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Sediment Transport Analysis – Basic Scenarios

1. Existing and future effects from the No Action Alternative:
   - Sediment may or may not pass the dam in all years
2. Existing and future effects from alternatives that do not involve passage of sediment:
   - Downstream sediment deficit due to conditions at LPD
3. Effects on the active channel from increased sediment transport past LPD

Sediment Transport Analysis – Basic Scenarios

No Action

- Bedload may or may not pass LPD
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

No Sed. Pass

- No bedload supply from LPD
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

Res. Depletion

- Several different depletion scenarios
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

Sediment Transport Analysis – Questions to address

1. Input hydrographs:
   - Business as usual – follow methodology of MEI and/or URS?
   - Mussetter (2006)
     - o 41 years of record (RR)
     - o Wet and dry scenarios (starting record at 1978 vs. 1985)
   - URS (2013)
     - 51 years of record (RR)
     - Lagoon WSE as downstream boundary condition
   - Proposed random distribution of floods, informed by gage records

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Sediment Transport Analysis – Questions to address

2. Bed surface/subsurface sediment gradations:
    - Los Padres to OSCD
    - OSCD downstream

Review of preliminary alternatives for further evaluation

PRELIMINARY ALTERNATIVES

Preliminary Alternatives - Alternatives Categories

- No Action (Alternative 1)
- Dam Removal (Alternative 2)
- Dredge and Place (Alternative 3)
- Storage Expansion (Alternative 4)
- Sediment Management (Alternative 5)

Preliminary Alternatives - No Action (Alternative 1)

- Reservoir allowed to continue to accumulate sediment

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Preliminary Alternatives - Dam Removal (Alternative 2)

- Phased (multi-year) removal by elevation not feasible
  - Requires an operating spillway, which is not feasible
- Full or partial embankment removal feasible
- Embankment volume of 463,130 CY (DSOD)
  - Permanent storage vs. storage that could eventually be accessed by high storm flows

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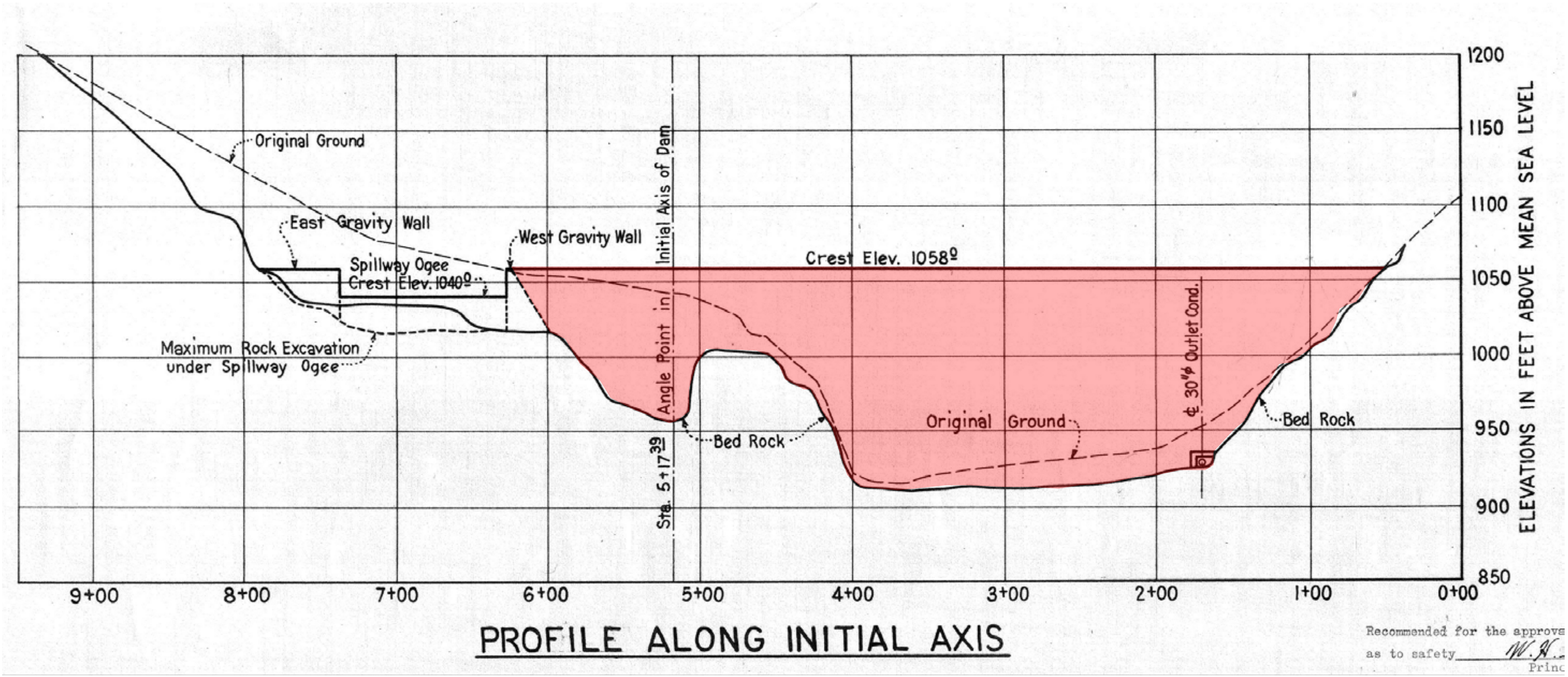
Preliminary Alternatives - Full Dam Removal



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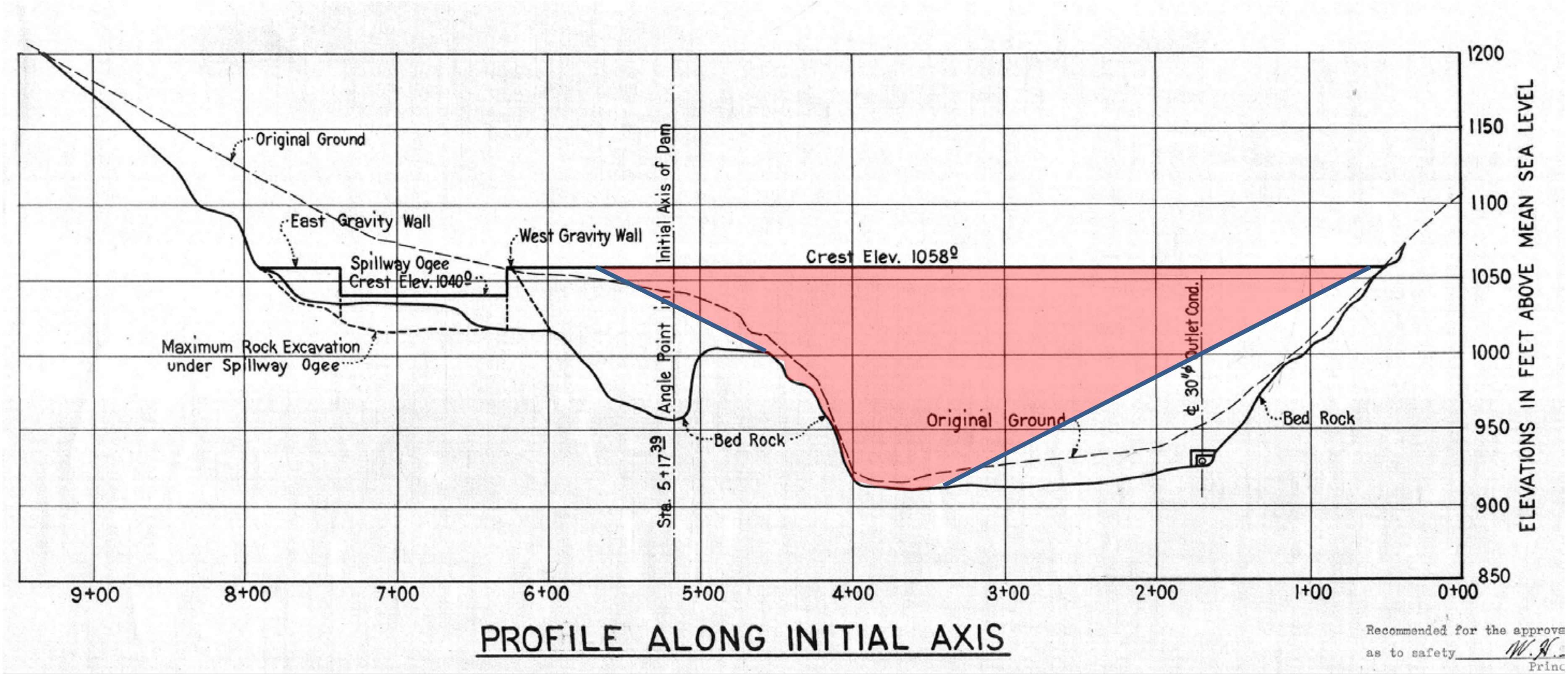
Preliminary Alternatives - Partial Dam Removal



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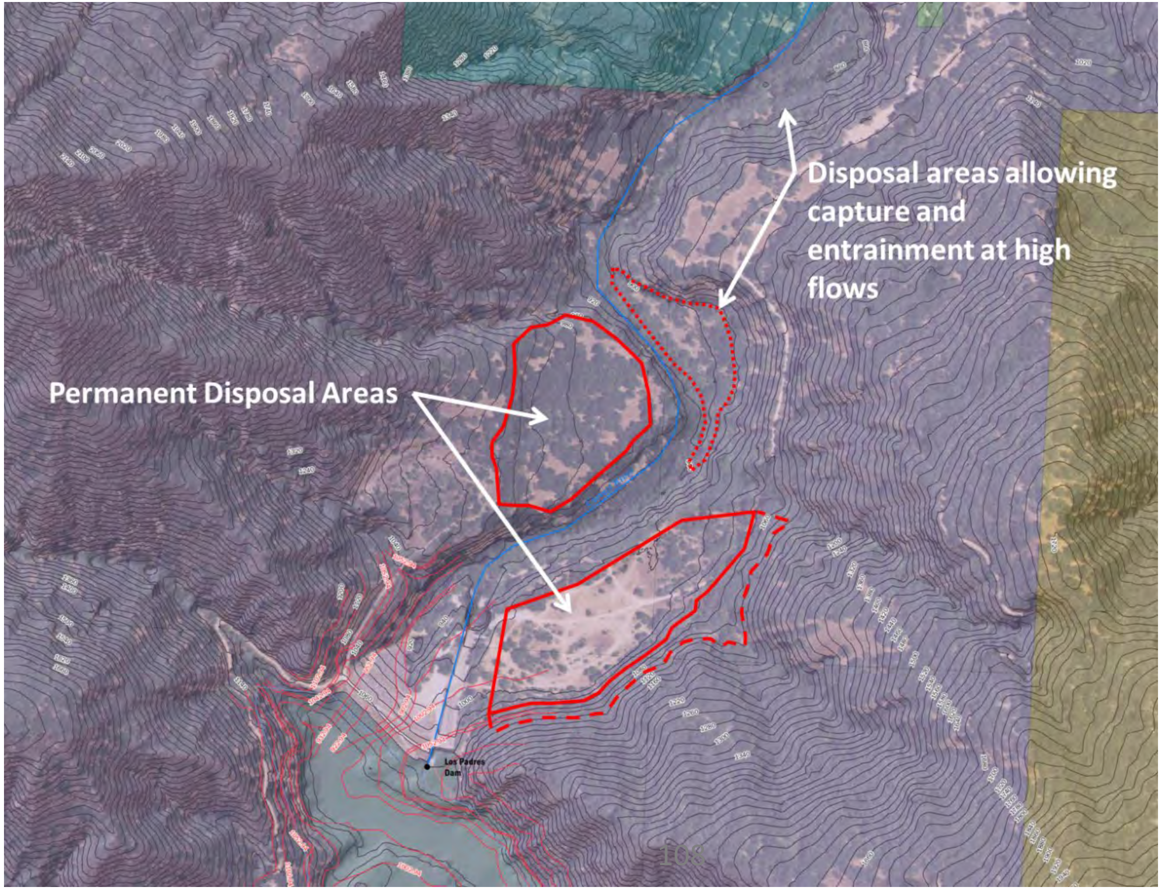
Preliminary Alternatives - Dam Removal

- Sediment disposal
  - Permanent disposal areas
  - Disposal areas allowing capture and entrainment



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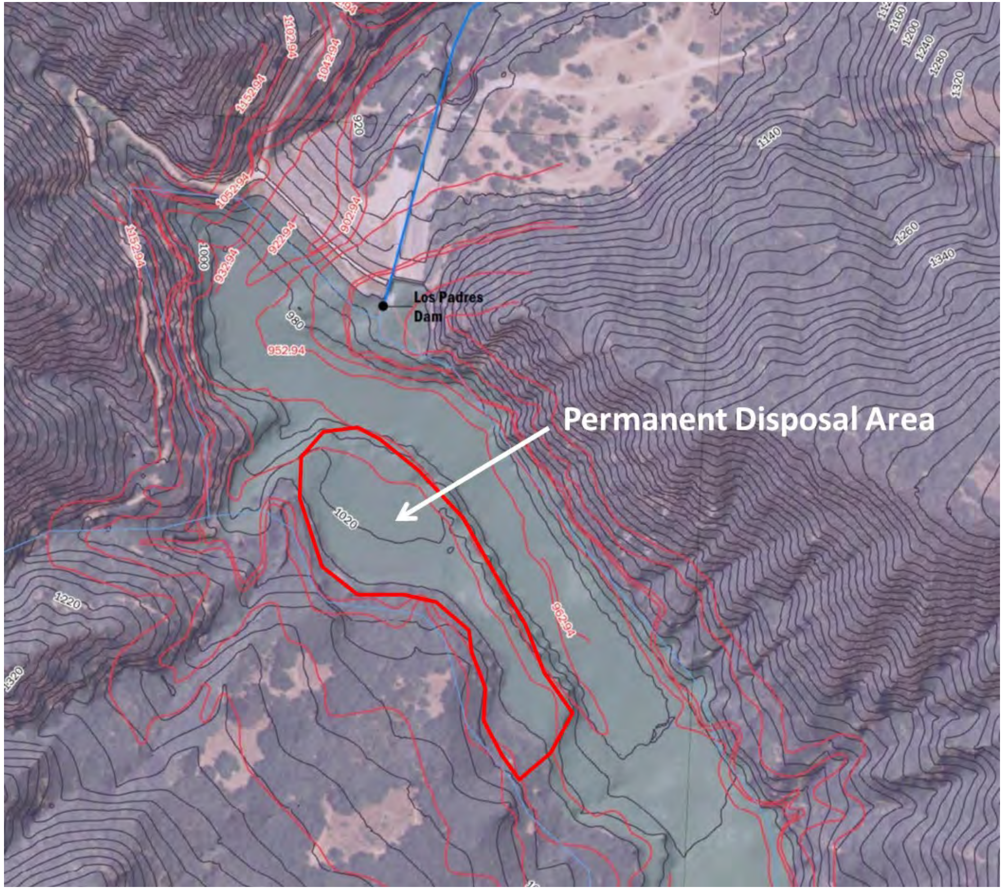
Preliminary Alternatives - Dam Removal

- Sediment disposal
  - Permanent disposal within reservoir footprint



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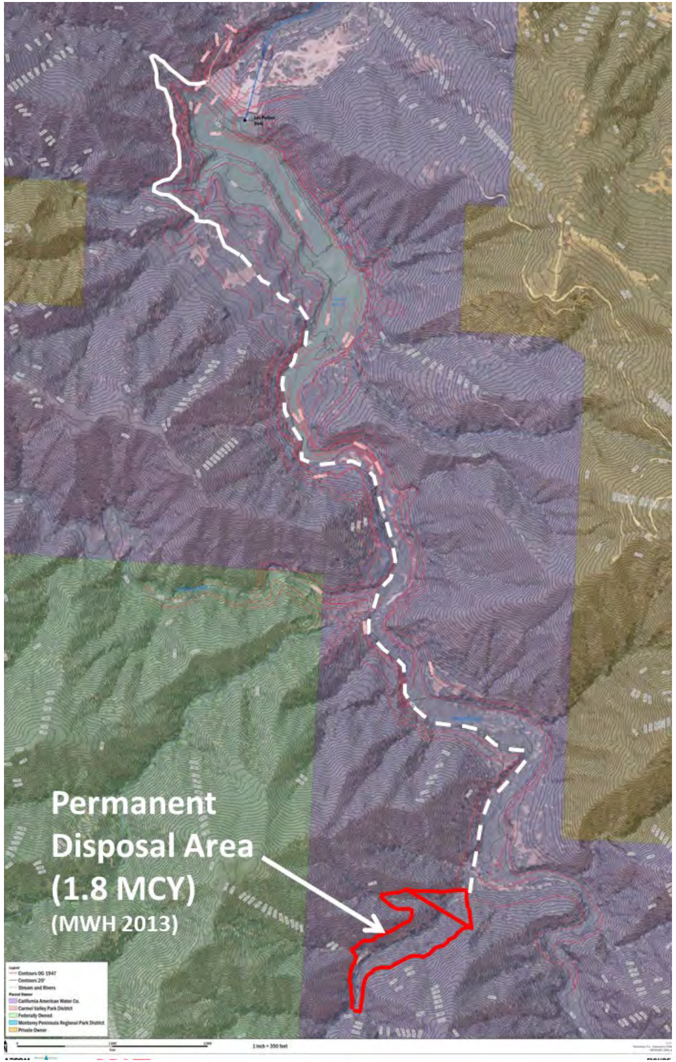
Preliminary Alternatives - Dredge and Place (Alternative 3)

- Alternative 3a – Place on Cal-Am Property
  - builds on MWH 2013 study
- Alternative 3b - Place off Cal-Am Property
  - Have not identified any reasonable locations as of yet
- Reservoir Sediment
  - 2.1 MCY in reservoir (MWH 2013)
  - 16,000 – 34,000 CY/year (MWH 2013)
- Dredging methods
  - Slurry dredging of fines likely not feasible due to inadequate volume of water
  - Fines most likely dredged using clamshell
  - Coarse sediment removed using conventional earthmoving equipment

Preliminary Alternatives - Dredge and Place Upstream on Cal-Am Property (Alternative 3a)

- Requires access road along left side of reservoir and channel
  - Improve approx. 0.5 miles of existing road
  - New road approx. 1.3 miles in length
- Disposal area is 320 feet high
  - Not really feasible for equipment to place with narrow valley



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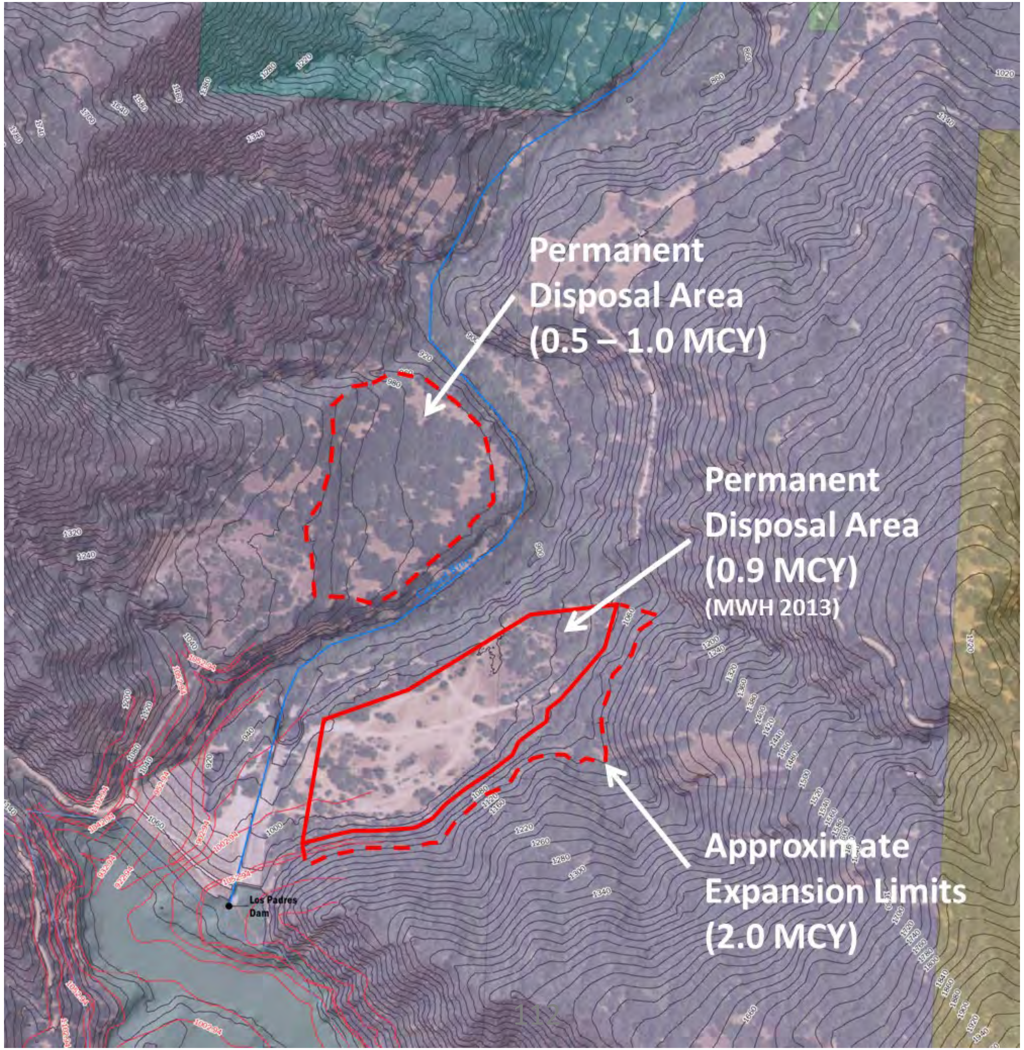
Preliminary Alternatives - Dredge and Place Downstream on Cal-Am Property (Alternative 3b)

- Feasible
- Left side of channel would require an access road improvements



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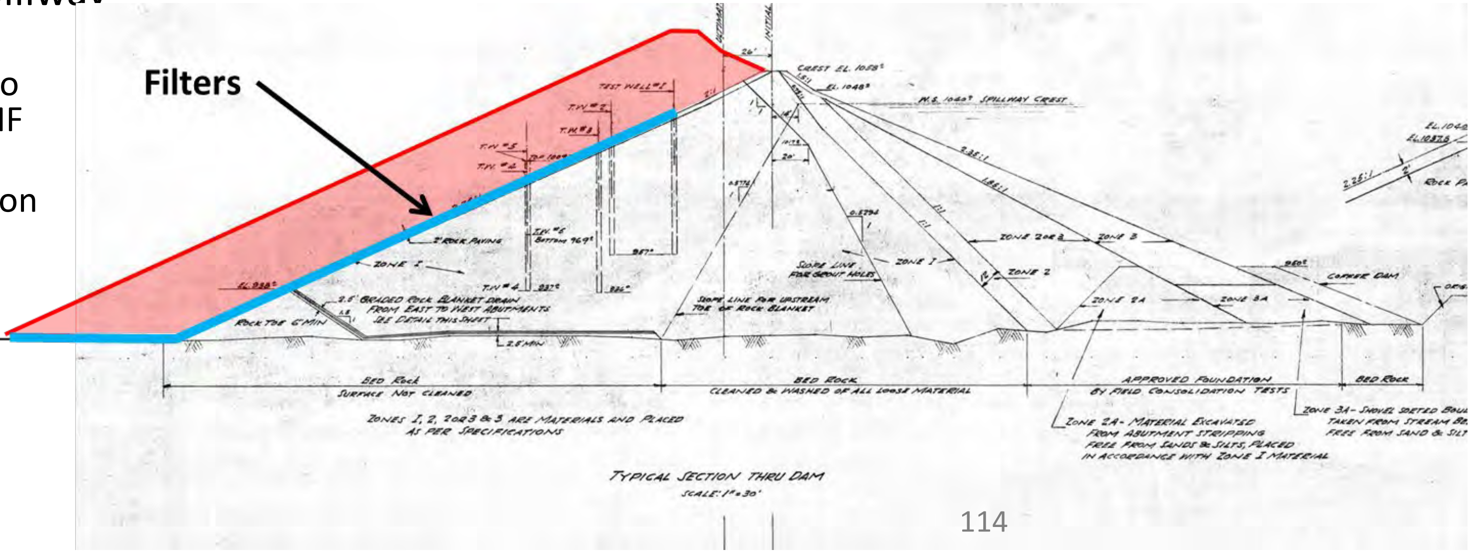
Preliminary Alternatives - Storage Expansion (Alternative 4)

- Four alternatives
  - Alternative 4a - Expand with Dam Raise
  - Alternative 4b - Expand with Rubber Dam
  - Alternative 4c - New Dam Downstream
  - Alternative 4d - Combination
- Maximum normal water elevation for raise is 1,055.5 feet
  - 12.6-foot raise over current spillway crest
  - Limited by boundary of Ventana Wilderness at Danish Creek (El. 1,060 ft)
  - Allows for 100-year flood (4.5 feet above spillway crest) to pass spillway without flooding wilderness
- Current storage estimated at 1,810 AF at spillway crest (1,042.9 ft)

Preliminary Alternatives - Expand with Dam Raise (Alternative 4a)

- 12.6 foot raise (of spillway crest)
  - Could require 32.1 feet of freeboard (crest el. 1084 or 23 to 24-foot raise)
- Increase of 736 AF to bring storage up to 2,546 AF
- Updated stability and seismic deformation analysis required
  - Could result in need to add filters on downstream side
- Would require spillway modification
  - Passage of up to HMR 58/59 PMF
  - New dam crest would depend on how spillway modified
- Would require outlet modification



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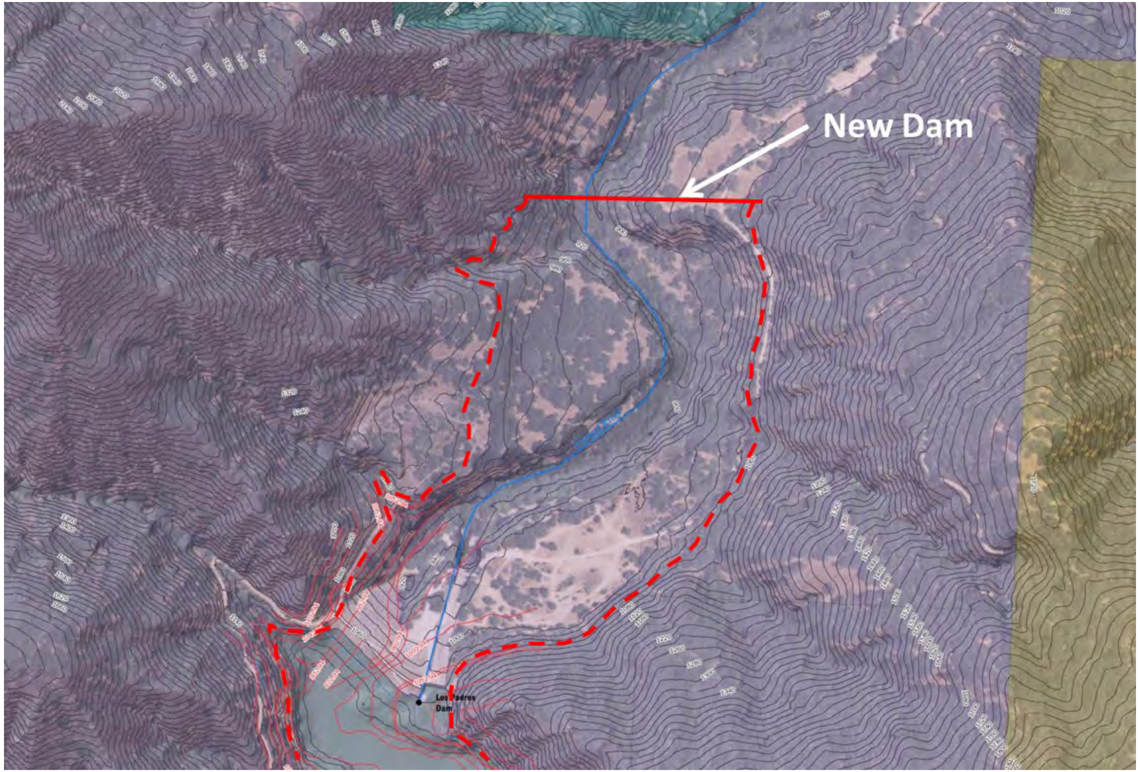
Preliminary Alternatives - Expand with Rubber Dam in Spillway Crest (Alternative 4b)

- 12.6 foot raise
- Increase of 736 AF, bringing storage up to 2,546 AF
- Potential for this to require spillway mod for up to HMR 58/59 PMF
- Would require raising dam crest (maybe 10 feet)
- Updated stability and seismic deformation analysis likely
- Could result in need to add filters on downstream side

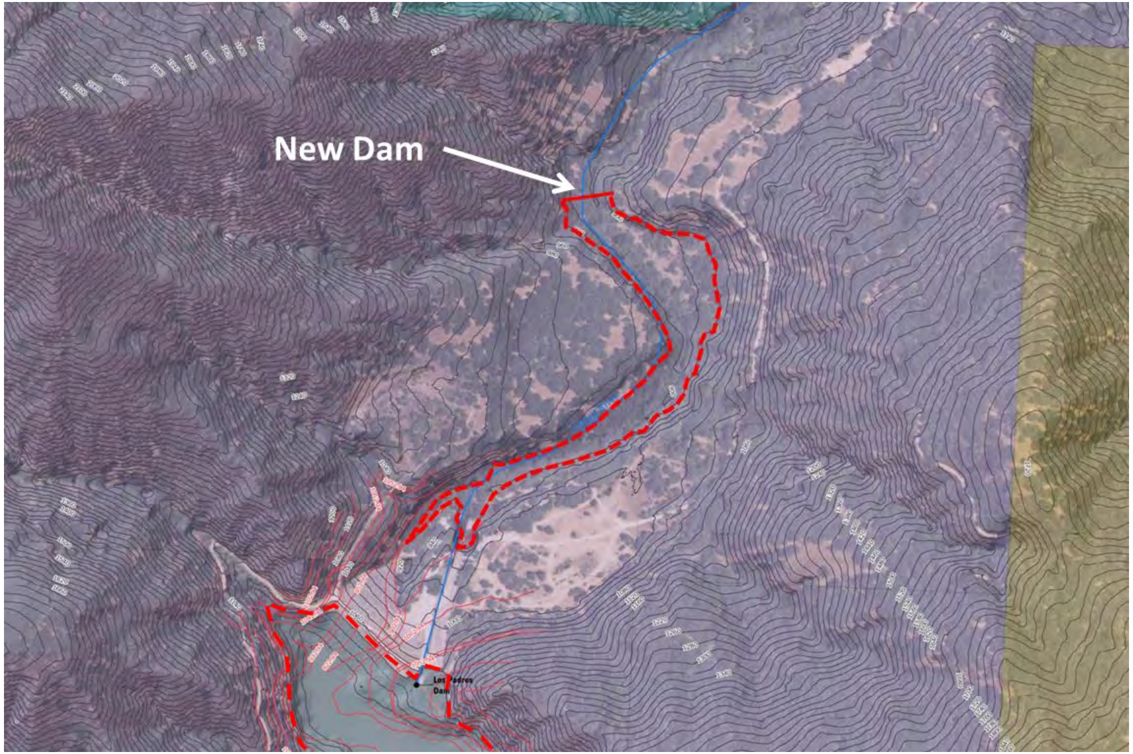
Preliminary Alternatives - New Dam Downstream (Alternative 4c)

- Spillway crest elevation 1,055.6 feet (12.6 feet above existing spillway crest)
- Increase of 6,329 AF to bring total storage up to 8,139 AF
- Dam Type
  - Roller Compacted Concrete
  - Earthfill with possible reuse of some existing LPD materials



Preliminary Alternatives – Combination (Alternative 4d)

- 12.6 foot raise (either dam raise or rubber dam in spillway) + 40-foot-high downstream dam
- Increase of 946 AF to bring total storage up to 2,756 AF
- Would have the same considerations as Alternatives 4a and 4b
- Downstream dam would have very shallow pool that would result in increased water temperatures

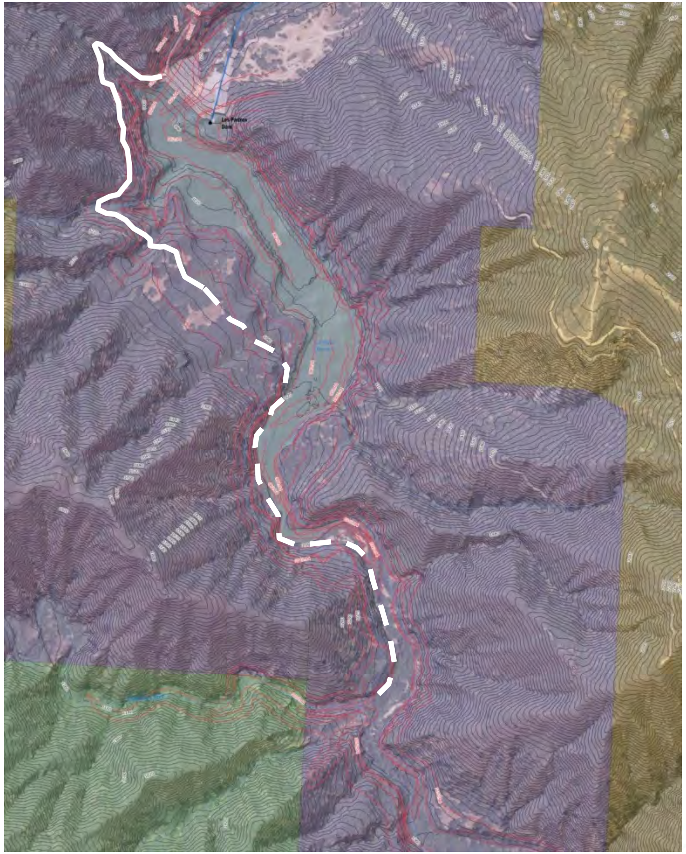


Preliminary Alternatives - Sediment Management (Alternative 5)

- Would be considered for alternatives:
  - Retaining existing dam
  - Expanding storage
- Five alternatives
  - Alt 5a - Periodic dredging and on site disposal
  - Alt 5b - Periodic dredging and placement downstream for entrainment during high flows
  - Alt 5c - Constructing a sediment capture area in reservoir
  - Alt 5d - Sluicing fine sediment during high flows
  - Alt 5e - Constructing a bypass tunnel for incoming sediment
- 16,000 – 34,000 CY/year (MWH 2013)

Preliminary Alternatives – Periodic Dredging and Onsite Disposal (5a) or Placement Downstream for Entrainment During High Flows (5b)

- Mechanical dredging would occur during low water years when coarse upper sediment is accessible
- Hydraulic dredging of fine sediment is likely impractical
  - Not enough available water during summer
  - Likely short windows when dredged material could be released into river flows during winter
- Clamshell dredging is feasible
  - Very inefficient
  - Would require decanting area



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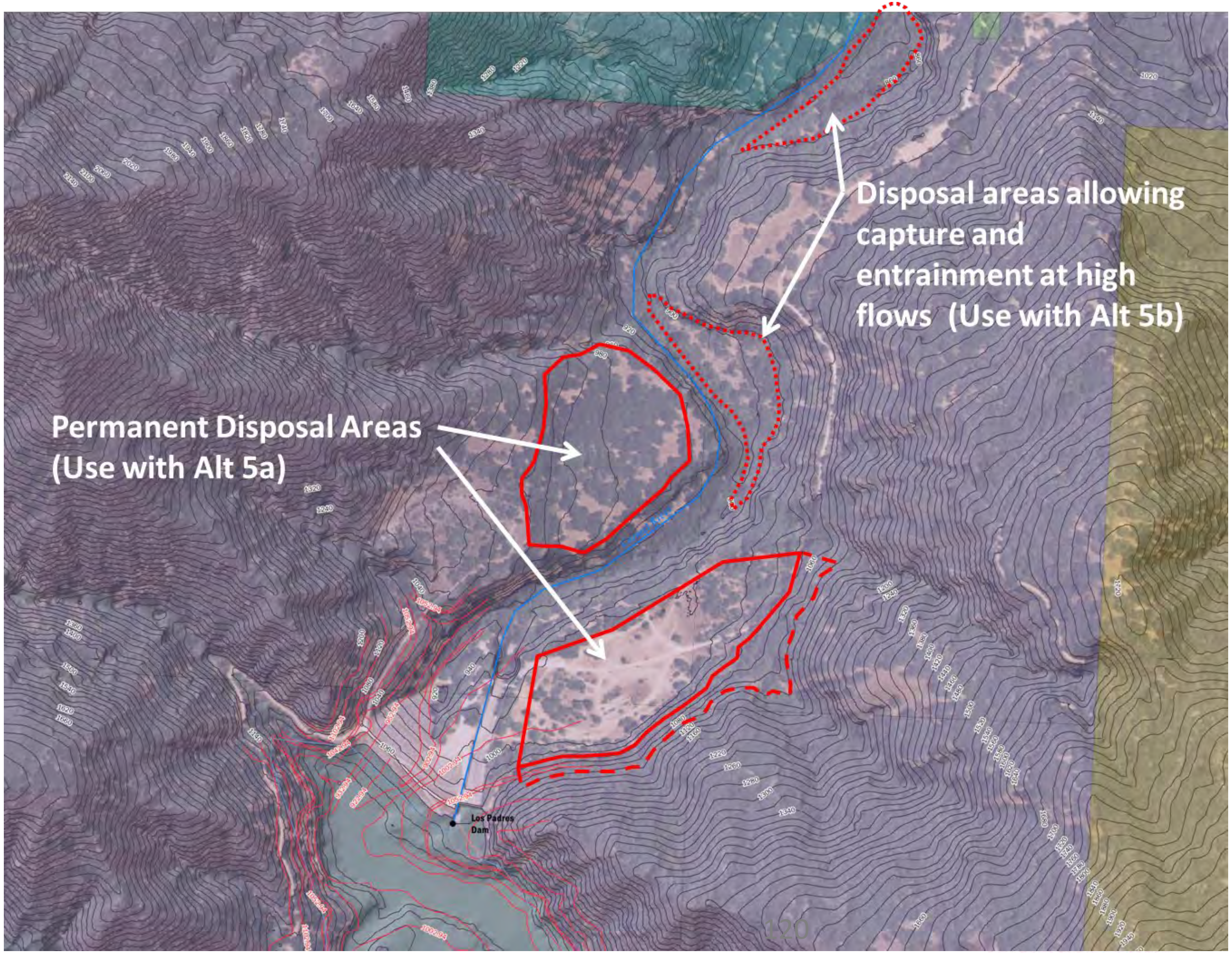
Preliminary Alternatives – Periodic Dredging and Onsite Disposal (5a) or Placement Downstream for Entrainment During High Flows (5b)



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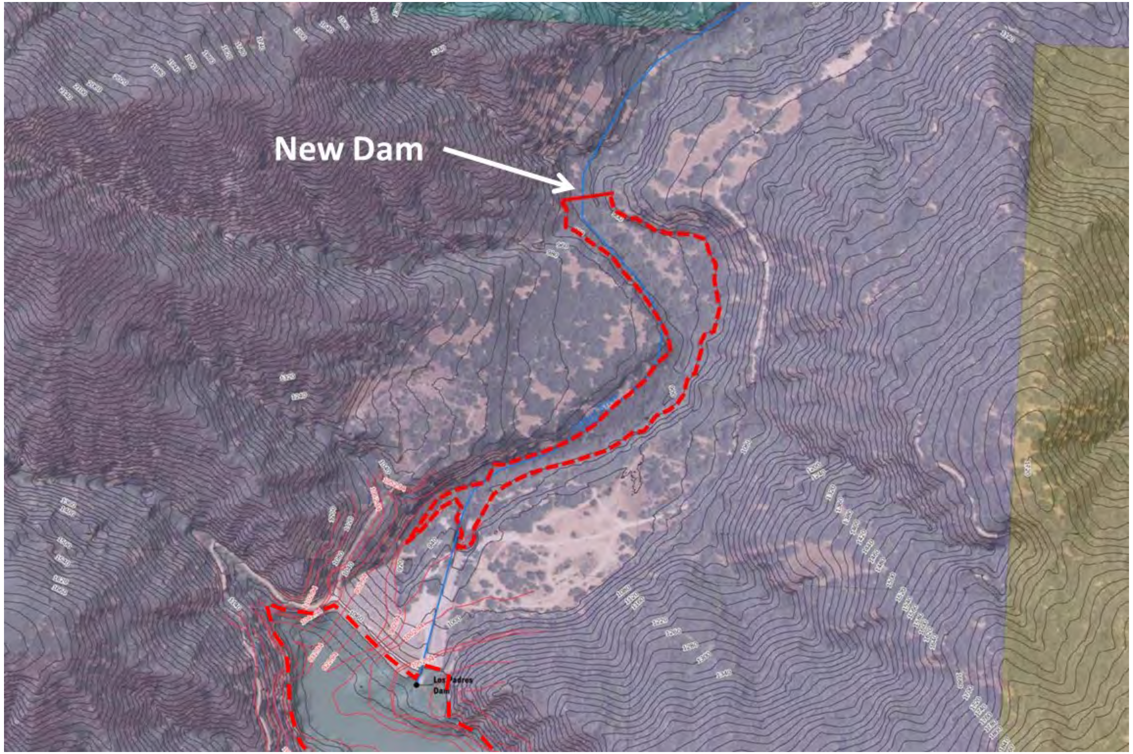
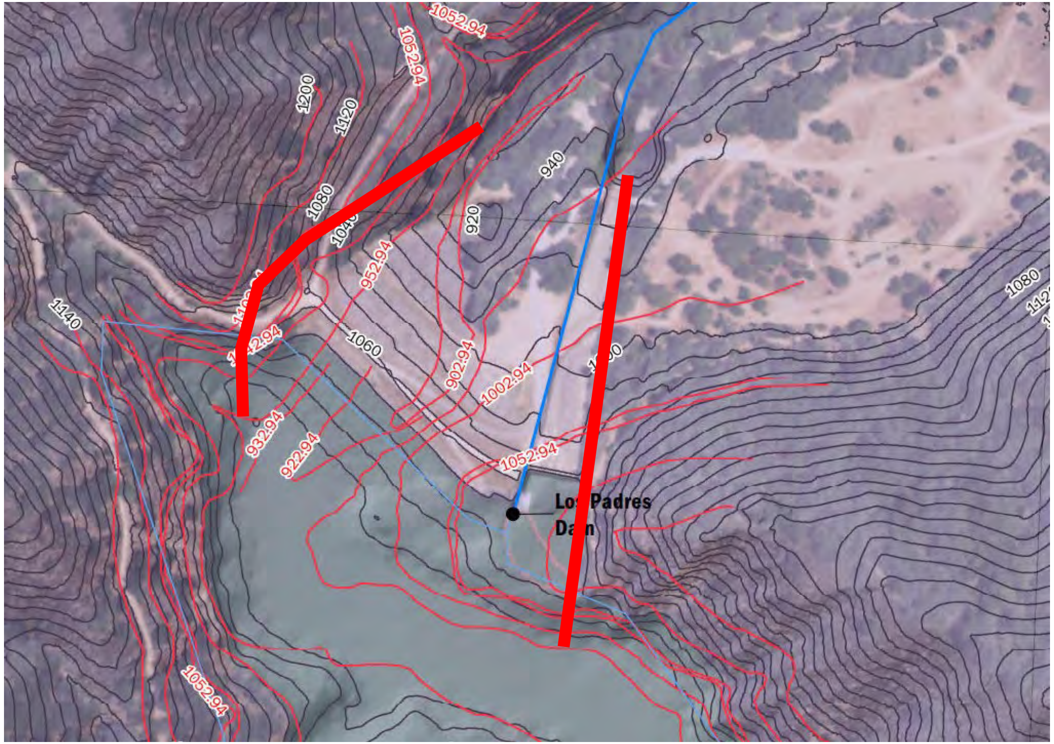
Preliminary Alternatives – Sediment Capture Area (Alternative 5c)

- Would likely be combined with Periodic Dredging and Onsite Disposal (5a)/Placement Downstream for Entrainment During High Flows (5b) when excavating coarse sediment



Preliminary Alternatives – Sluicing of Fine Sediment (Alternative 5d) and Bypass Tunnel (Alternative 5e)

- Sluicing of fine sediment most effective when reservoir is drawn down
- Requires bypass tunnel for either 5d or 5e
- Alignment could be either on right or left abutments
- Would only be operated during high water years when reservoir could be refilled after large storm flows have passed
- Bypass tunnel around entire reservoir not practical



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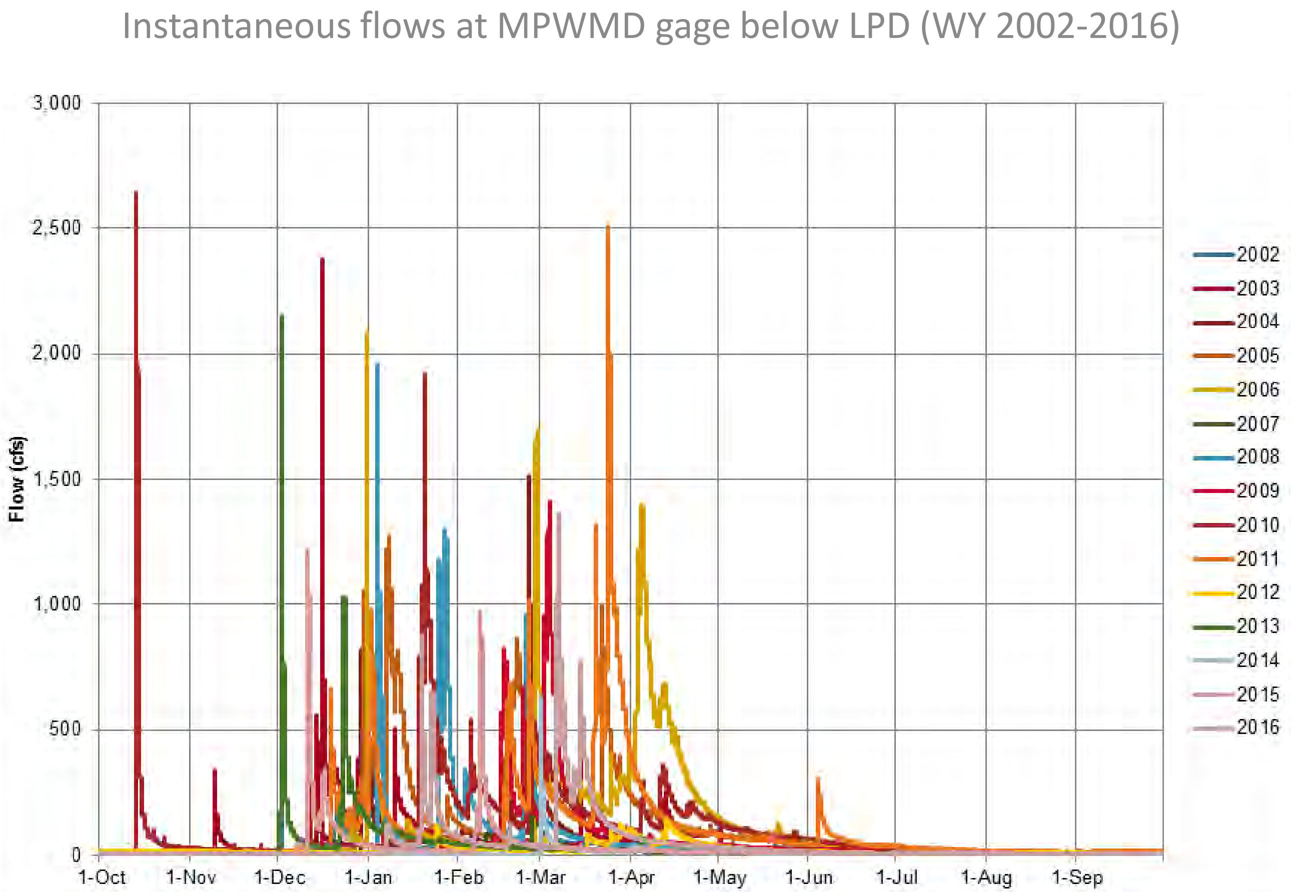
Preliminary Alternatives – Sluicing of Fine Sediment (Alternative 5d) and Bypass Tunnel (Alternative 5e)



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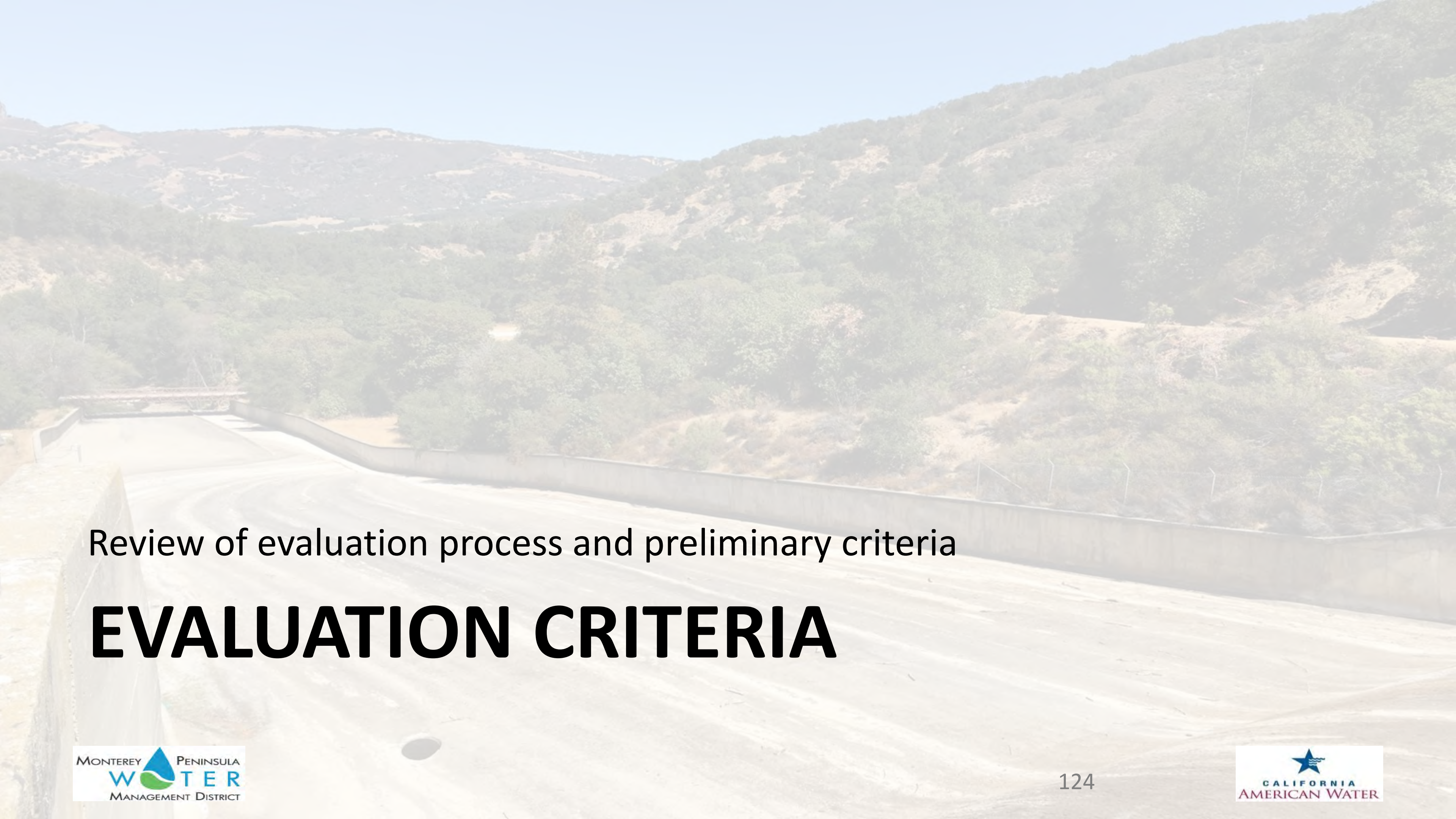

Review of evaluation process and preliminary criteria

EVALUATION CRITERIA

Evaluation Criteria - Process

Multiple-Criteria Analysis

Weight	Default Choice	Alternative #1	Alternative #2	Alternative #3
Criteria #1	1	0		
Criteria #2	1	0		
Criteria #3	1	0		
Totals				

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Evaluation Criteria - Process

Multiple-Criteria Analysis – Examples

Perspective	Categories	Factors	Criteria	Units of Measure	P or N*	FP-1	FP-2	FP-3	FP-4	FP-5
						Initial Alternatives				
						Floodplain Initial Alternatives				
A.	**Implementation/Technical Feasibility**									
	Costs	Upfront Costs	Capital Improvement Costs	dollars	N	$193,380,000	$191,430,000	$193,730,000	$217,060,000	$265,850,000
			Land Costs	dollars	N	$15,300,000	$19,800,000	$19,800,000	$27,300,000	$36,300,000
			Subtotal	dollars	N	$208,380,000	$210,930,000	$213,230,000	$244,060,000	$301,850,000
		Long-Term Costs	O&M	dollars/year	N	$606,000	$646,000	$646,000	$721,000	$846,000
	Time to Build	Timeline	Construction	months	N	40	40	40	45	52
B.	**Objectives/Benefits Achievement**									
	Fish Habitat & Passage	Floodplain Characteristics	Shallow Water Habitat Quality	rating: 1 (poor), 3 (good)	P	1	3	3	2	1
			Rearing habitat (>1.0 feet inundation at 2,500 cfs)	acres	P	373	482	481	585	762
		Passage Conditions for Adult Chinook Salmon	Artificial structures in migratory path	number of structures	N	2	2	2	2	2
			Total number of steps at structures	number of jumps	N	12	12	12	12	12
		Passage Conditions for Juvenile Chinook Salmon	Fish Screens along migratory path	number of screens	N	1	1	1	1	1
			Potential predation sites	number of artificial structures	N	3	3	3	3	3

Evaluation Criteria - Process

Multiple-Criteria Analysis – Examples

Perspective	Category	Factor	Criteria	Units of Measure	High numbers are Positive or Negative?	Alternatives: Alternative 1: No Action	Alternative 5: Passive Flow Management	Alternative 6: Active Flow Management	Alternative 7: Recreate a Confluence Valley
A.	Goals Achievement								
	Water Supply & Storage	Water Supply & Storage	Typical annual yield	ac-ft/yr	P	75	550	550	550
			Change in water supply over existing levels	ac-ft/yr	P	-75	400	400	400
			Change in water storage over existing levels	ac-feet	P	0	590	590	590
	Steelhead Habitat & Passage	Passage	Steelhead access to upstream of Dam	qualitative (1-10; 10=best conditions)	P	0	6	5	10
			Steelhead access to upper creek (from upstream of Dam)	qualitative (1-10; 10=best conditions)	P	0	6	6	8
			Steelhead access to tributary creeks (from upstream of Dam)	qualitative (1-10; 10=best conditions)	P	0	1	1	9
			Conditions for downstream steelhead migration (from wherever adult upstream migrants have access), particularly juveniles, including risk of predation	qualitative (1-10; 10=best conditions)	P	0	8	6	9
		Habitat	Quality and quantity of on-site steelhead habitat	qualitative (1-10; 10=best conditions)	P	1	8	4	10
			Impact to downstream spawning/rearing habitat (incl. sediment and water quality)	qualitative (1-10; 10=best conditions)	P	1	7	6	10

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Evaluation Criteria - Process

- Define evaluation criteria
- Weight criteria (optional)
- Describe alternatives
- Score alternatives for each criterion
- Multiply each score by the criteria weight (optional)
- Sum the score-weight products for each alternative
- Optimize alternatives

Evaluation Criteria - Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Need for DSOD Approval (yes/no)
- Cost/Schedule Implication of Dam Safety Mitigation (quantitative)
- Estimated Construction Cost (qualitative moving to quantitative)
- Estimated Construction Timeline (qualitative moving to quantitative)
- Estimated Operations and Maintenance Cost (qualitative moving to quantitative)
- Area of Permanent Impacts (quantitative)
- Area of Temporary Impacts (quantitative)

Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Increase in Potential Flooding Near Developed Properties (quantitative)
- Sediment Transport Monitoring Feasibility (yes/no)
- Sediment Transport Prediction Certainty (qualitative)
- Sediment Management Adaptability (qualitative)

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Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Upstream Adult Steelhead Passage (qualitative)
- Downstream Adult Steelhead Passage (qualitative)
- Upstream Juvenile Steelhead Passage (qualitative)
- Downstream Juvenile Steelhead Passage (qualitative)
- Short-Term Effects on Steelhead Present During Sediment Release (qualitative)
- Proportion of Steelhead Affected by Short-Term Sediment Release (qualitative)
- Changes to Instream Pool Volume (qualitative)
- Changes in Spawning Habitat (qualitative)
- Changes in Floodplain Habitat Access (qualitative)

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Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Duration of Negative Habitat Effects (qualitative)
- Migration Period Flow Availability (quantitative)
- Rearing Period Flow Availability (quantitative)
- Spawning Habitat Availability (quantitative)
- Rearing Habitat Availability (quantitative)
- Quality of Rearing Habitat Upstream of Los Padres Dam (qualitative)
- Ecosystem Connectivity (qualitative)
- *Attraction, Passage, and Flows for Nontarget Species
- Quality of Water Passed Downstream (qualitative)

*Consider for removal from criteria list

Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Maximum Potential Water Yield at Los Padres Reservoir (quantitative)
- Los Padres Reservoir Storage Capacity (quantitative)
- Future Los Padres Reservoir Storage Capacity (quantitative)

Evaluation Criteria – Preliminary Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights

- Effects to Cal-Am and MPWMD Water Rights (yes/no)
- Water Right Petition Process (qualitative)

Review of recent dam removal projects and costs

COST CONSIDERATIONS

Cost Considerations – Recent Projects

Dam decommissioning/removal costs often driven by character and volume of accumulated sediment

- Physical removal vs. evacuation
- Elwha & Glines Canyon
  - Natural river flows flushed 40% of 35 MCY
  - Flood & water supply mitigation >60% of $200M cost
- Matilija
  - Flood and water supply mitigation >65% of estimated $80M cost
- San Clemente
  - Relocation of 2.5 MCY of sediment onsite 50% of $65M cost

Dam	Year	River	Dam Height (ft)	Accumulated Sediment Volume (CY)	Accumulated Sediment Composition	% of reservoir sediment mobilized	Time to mobilize sediment	Construction Cost
Marmot	2007	Sandy, OR	50	980,000	~50% gravel, 50% sand	40%	3 months	~$15M(1)
Savage Rapids	2009	Rogue, OR	40	200,000	~70% sand, 30% gravel	Data on sediment not readily available	2 years for sediment to reach furthest d'stream reach	~$40M
Condit	2011	White Salmon, WA	125	2.5 million	~60% sand, 35% silt & clay, 5% gravel	~50%	15 weeks	~$37M
Elwha	2011–2012	Elwha, WA	108	6 million	~70% silt and clay, 25% sand, 5% gravel	~40%	2 years	~$200M in various construction contracts (2)
Glines Canyon	2011–2014	Elwha, WA	210	29 million	~50% silt & clay, 35% sand, 15% gravel	~40%	2 years	
San Clemente	2012-2015	Carmel, CA	105	2.5 million	~60% fines; 40% coarse	sediment removed	sediment removed	~$65M
Matilija	-	Matilija, CA	168	7 million	~43% silt & clay, 32% sand, 25% coarse	-	-	~$80M (3)

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Cost Considerations – Sediment Removal

- Key consideration for dredging and sediment removal
  - Accumulated sediment character and volume (similar to dam removal)
  - Proximity to disposal locations (hauling costs)
  - Construction access (new or improved access roads, size limitations)
  - Streamflow during instream construction (size and cost of diversion and dewatering)
  - One-time removal to recover storage at Los Padres Reservoir estimated between $47M and $90M (MWH 2013)

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Cost Considerations – Dam Improvements

- Key cost considerations for reservoir expansion
  - Local geology (extent and cost of excavation and stability improvements)
  - Age and type of existing dam (drives feasibility and extent of improvements for a modification)
  - Construction access (new or improved access roads, size limitations)
  - Biological and cultural resources in project footprint (mitigation costs)
  - Water rights (cost of replacement water)

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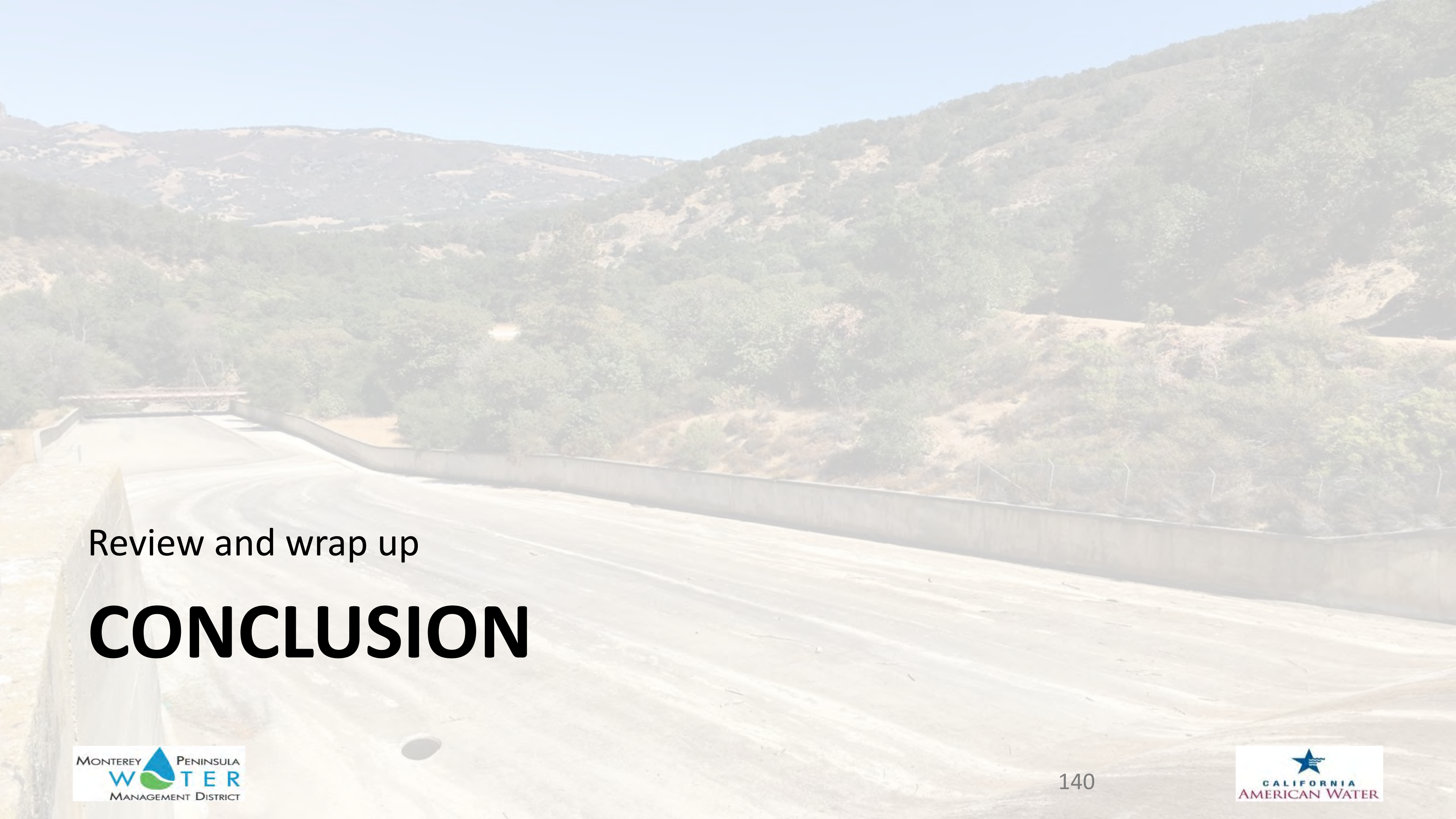

Review and wrap up

CONCLUSION

Conclusion

- Information needs
- Decisions
- Action items
- Next meeting date
  - Indicated in project schedule January 16
  - If Thursdays are preferable, January 18?

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Conclusion – Information Needs

Item No.	Description	Purpose	Proposed Action	Decision Date	Decision Participants	Status
9	Accumulated sediment characteristics	Characterizing sediments will help understand mobilization and transport, as well as potential dredging or excavation feasibility and cost	LP Alternatives Study includes a geotechnical investigation to help characterize accumulated sediments	2/16/2017	J. Stead, L. Hampson	In Progress
10	Sediment transport data plotted in Matthews 1987 (MPWMD TM 87-13) and mentioned in Hampson 1997 for water years 1984-1986	Sediment transport model	L. Hampson to check	2/16/2017	J. Stead	In Progress
14	Surface Bed Material Characterization of the Carmel River, Monterey County, California: Pebble Count Data Compilation, Collection, and Recommendations (Eischeid 1998)	Sediment transport model	L. Hampson to scan and provide to AECOM.	7/10/2017	J. Stead, L. Hampson	In Progress
11	Quantitative data to compare steelhead habitat upstream of Los Padres Dam to other areas in the watershed	Comparing benefits of dam removal to benefits of summer flow releases from reservoir, for steelhead				
12	Anticipated response of brown trout in Los Padres Reservoir to dam removal	Evaluating potential for nonnative dispersal following dam removal				
13	Detailed information regarding inflow, outflow, and operations of reservoir in various water year types	Understanding the performance of each alternative during various water- year types.				

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Agenda and Meeting Notes

(Notes from the meeting are provided in Italics)

Project:	Los Padres Dam and Reservoir Alternatives and Sediment Management Study
Subject:	Technical Review Committee Meeting No. 2 – Study Preparation
Date:	Thursday, January 18, 2018
Time	8:00 AM to 2:00 PM
Location:	AECOM at the Kaiser Center, 300 Lakeside Drive, Suite 400, Oakland, CA 94612 – Bella Vista Room
Attendees:	*Ethan Bell, Stillwater (by phone)* *Joel Casagrande, NMFS* *Trish Chapman, SCC* *Shawn Chartrand, Balance* *Brian Cluer, NMFS* *Ian Crooks, Cal-AM (by phone)* *David Crowder, NMFS (by phone)* *Aman Gonzalez, Cal-Am (by phone)* *Larry Hampson, MPWMD* *Dave Highland, CDFW* *Shannon Leonard, AECOM* *Katie McLean, AECOM* *Matthew Michie, CDFW (by phone)* *Dennis Michniuk, CDFW* *Kealie Pretzlav, Balance* *John Roadifer, AECOM* *Kevan Urquhart, MPWMD* *Marcin Whitman, CDFW*

Objectives

1. Provide a forum for transfer of information, discussion, and collaboration among participants;
2. Review the Sediment Characterization Technical Memorandum and the Alternatives Descriptions Technical Memorandum;
3. Review the sediment transport model spin up run and trial run results; and
4. Decide which alternatives to model and how many hydrologic scenarios to model per alternative.

Format

This is a working meeting. Consultant team will present material and facilitate open discussion, evaluation, and participation by all attendees. There will be an opportunity to order lunch at the beginning of the meeting or you can bring your own. A WebEx audio/visual link will be provided but attendance in person is strongly encouraged.

Agenda

1. Welcome and administrative business

   a. Introductions

   Introductions occurred for all attendees present and on the phone at the beginning of the meeting. Attendees are listed above.

   b. Opening statements

i. *Larry (MPWMD) initiated a conversation about CDFW's comment letter on the draft Alternatives Descriptions Technical Memorandum, which included a section regarding the ongoing decision-making process for the long-term future of Los Padres Dam and Reservoir. CDFW presented two primary concerns in the letter: (1) several ongoing studies will likely affect the development of the Dam and Reservoir alternatives, so the alternative development that is currently underway cannot take the results of these studies into consideration, and (2) the simultaneous and separate development of the fish passage alternatives and the Dam and Reservoir alternatives without a plan for combining these studies makes comparison of all alternatives difficult and could lead to error in decision-making.*

1. *Concern #1: Data Gaps and Ongoing Studies*

   a. *There are 3 ongoing studies that will fill critical data gaps:*

      i. *The Basin Model: This model is being calibrated by USGS and is necessary to determine the effects of several scenarios (existing conditions, dam removal, changes in reservoir operations) on the Carmel River flow regime.*

         1. ***Action Item**: Larry will check with Rich (USGS) for an update on the model's calibration and an estimate of when it will be ready.*

      ii. *Instream Flow Incremental Methodology (IFIM): Normandeau has completed the model, and David Crowder (NMFS) has asked to review it. MPWMD needs mean daily flow data from the Basin Model as an input for this model. Normandeau can run the model in about a week once input data is ready.*

      iii. *PIT tagging study: This study will show through-reservoir survival. Kevan (MPWMD) noted that this study will likely not be complete for at least 2 years.*

   b. *The TRC discussed additional ongoing studies that would be advantageous to consider during alternatives development:*

      i. *Carmel River Basin Study: Reclamation is conducting this study to predict water supplies and demands (e.g., municipal, agricultural, environmental), and will consider climate change and social/demographic factors. This study is expected to be ready in 3 years.*

ii. Climate Model: This study is expected to be ready in about a year and will be important to consider in developing Los Padres Dam and Reservoir alternatives.

c. Joel (NMFS) noted that NMFS shares CDFW's concerns about these data gaps existing while alternative development continues.

d. The TRC agreed that the Dam and Reservoir alternatives development and decision-making should not be rushed and that, given the data gaps and ongoing study timelines, it is not realistic to make a decision about Los Padres Dam and Reservoir in 5 years. A longer timeline is needed for alternative development.

*e. **Action Item**: Larry will facilitate a conference call to adjust the project schedule. Attendees will include Cal-Am, NMFS (Joel will be point of contact), CDFW (Dennis will be point of contact), MPWMD, Dave Stoldt.*

2. Concern #2: Separate Development of Fish Passage and Dam/Reservoir Alternatives

a. One reason for keeping these studies separate for now is the possibility of two phases of action at Los Padres Dam and Reservoir: a fish passage retrofit, which could be implemented relatively quickly and would benefit steelhead in the near-term, followed years later by dam removal, which is expected to progress much more slowly through planning and design phases (likely on the order of decades). Fish passage improvements could be considered a multi-decade "interim" solution while planning for dam removal continues on a slower timeline.

i. If this approach were used, the first phase of action at Los Padres Dam (fish passage improvement) could also include construction of a sluiceway that would help transport reservoir sediment prior to dam removal.

ii. Marcin (CDFW) brought up a concern that the public may not be willing to accept the cost of fish passage improvement knowing that the dam will ultimately be removed.

iii. Removal of San Clemente Dam took about 25 years, and there are two additional challenges to removing Los Padres Dam that could potentially extend the timeline for Los Padres: (1) permitting and mitigating for the increased flood *risks associated with Los Padres Dam removal (San Clemente was able to show negligible flood impacts, which may not be the case for Los Padres), and (2) Cal-Am needs to maintain municipal water supply, and it's not clear how that water supply would be maintained if Los Padres Dam is removed.*

b. *Larry agreed with CDFW that MPWMD should develop a formal process for combining the studies (fish passage alternatives, Dam and Reservoir alternatives, IFIM, Basin Model).*

2. Review of Sediment Characterization Technical Memorandum *(Slides 6-27)*

   a. *Borings were intended to go through reservoir sediment to original alluvium. There is some uncertainty if two of the borings (B1 and B2) reached the original alluvium. B1 may have reached materials from the construction of Los Padres Dam. (Slide 8)*

   b. *For dam removal alternative, determining the original elevation of the river bed will be important. This information is available on the as-built drawings for the dam.*

   c. *Pebble count data shows that the sand that has been deposited in the upstream end of the reservoir, as expected, has a top layer of coarser particles (gravel and cobbles) forming an armor that becomes smaller in size as you move from upstream to downstream (Slides 12-13). More detailed sediment distribution data would be needed to determine how much coarse material (gravel and small cobble) could be dredged from the upstream end of the reservoir and placed downstream to be picked up by high flows.*

   d. *It was anticipated that the borings might show an obvious sediment deposit resulting from the Marble Cone fire, but this was not observed.*

   e. *If Zone 1 sediment (fine-grained) is entrained during flood flows (through a sluicing tunnel or following dam removal), it could end up trapped on a floodplain or it could travel out of the system if it remains in the channel. Larry asked if the dam is removed, how much sediment would aggrade and how much would be flushed out of the system? Shawn (Balance) responded that the current sediment transport model was not built to answer this question with respect to fine sediment, but Balance could do a literature review to make a rough estimate.*

   f. *Between 2008 and 2017, the delta front (at the head of the reservoir) built up with roughly 9-10 feet of sediment (Slide 19). During that period, relatively little fine sediment built up in the lower reservoir. It is likely that most of this aggradation occurred between 2016 and 2017.*

g. *The majority of coarse material in the reservoir is likely sand (Slide 23). Current estimates are 1.1-1.6 million tons of coarse material, of which only 200,000-330,000 is gravel or larger, and there is very little cobble. Gravel and larger material is layered in Zone 3, and cobble likely isn't present except at the very upstream end of Zone 3. This could make it challenging to harvest material for placement downstream to enhance steelhead habitat as a large volume of material would need to be processed to separate the gravel that could be used for spawning.*

h. *The Marble Cone fire resulted in a large amount of fine sediment being deposited in the reservoir. There was a drought in 1977 prior to the fire, and the reservoir was drawn down to unusually low levels. After the fire, there was a very wet year (1978) that caused rapid refilling of the reservoir and distribution of fine sediment all the way through the reservoir to the dam.*

3. Review of Alternatives Descriptions Technical Memorandum *(Slides 29-74)*

    a. *Larry asked what is Cal-Am's estimate for the remaining lifespan of Los Padres Dam?*

        i. ***Action Item**: Aman (Cal-Am) will follow up with Larry to answer this.*

    b. *Dam and Reservoir Alternative 1: No Sediment Management (Slide 35)*

        i. *Sediment input from the Marble Cone fire was 590 acre-feet. Sediment input from other fires has been significantly lower because other fires burned significantly less area.*

        ii. *Cal-Am currently cannot meet its license condition to release 5 cubic feet per second during many years. Larry asked what actions NMFS and CDFW would take if the number of years in which Cal-Am cannot meet this release requirement increases, which would occur under Alternative 1 as the reservoir capacity continues to decrease.*

            1. *Dave (CDFW): the agencies would have to consider the importance of summer releases when determining whether to require Cal-Am to adjust operations.*

            2. *Brian (NMFS): NMFS' response would be consistent with the NMFS/Cal-Am MOA.*

    c. *Dam and Reservoir Alternative 2: Dam Removal (Slides 36-40)*

        i. *The TRC discussed whether the term "not feasible" or "prohibitively expensive" is more appropriate for certain alternatives (e.g., phased dam removal, dam notching, stabilizing sediment in place).*

ii. *The TRC discussed temporarily stabilizing sediment in place, as was done at Matilija. There are significant differences between Los Padres and Matilija in that the fine sediment in Matilija was excavated and the sediment that was stabilized was coarser sediment upstream that was stabilized to a level above the stream that was meant to prevent movement of that sediment unless flood flows were occurring. Stabilizing the fine sediment in Los Padres Reservoir would be different and very difficult if even feasible.*

iii. *Sluicing wasn't acceptable at San Clemente because NMFS had concerns about impacts on fish and landowners had concerns about property impacts. This may ultimately make sluicing infeasible at Los Padres as well, but the TRC pointed out that, as a technical committee, they should not be evaluating or eliminating alternatives based on potential public pushback.*

iv. *For any options that involve moving sediment downstream, it will be important to anticipate Cal-Am's liability.*

   1. *Trish (SCC) described that when SCC and Cal-Am decided on dam removal as the preferred alternative, they took steps to build a record of their decisions that could be used in case Cal-Am was sued. Trish also recommended taking active steps to mitigate impacts downstream in advance of flooding and sedimentation (similar to what is planned for Matilija).*

   2. *Larry responded that the MPWMD council will need to look into the liability risks associated with each alternative.*

   3. *There should be a precedent for how to handle the legal risks associated with reintroduction of sediment downstream of a dam. Debris dam removal projects could be helpful to understand these risks on a smaller scale.*

   4. ***Action Item**: Larry will ask the Metropolitan Water District to share examples and lessons learned from their projects that have involved public response to sediment reintroduction.*

   5. *The TRC agreed that, while anticipation of public reaction should not factor into the evaluation of the Dam and Reservoir alternatives, there should be an attempt to understand and anticipate the public response to sedimentation impacts downstream.*

v. *The duration of water quality impacts associated with sluicing following dam removal would be 1 year, while those associated with dredging would be several years. This should be considered when evaluating impacts on fish.*

vi. *After dam removals, the initial rate of sediment evacuation has been observed to occur much more quickly than models have predicted. The observed volume of sediment evacuated has been similar to modeled predictions. During the years following dam removal, reservoir sediments that were not initially flushed downstream are transported mostly during storm events, when suspended sediment levels are already high.*

d. *Dam and Reservoir Alternative 3: Restore Reservoir Capacity (Slides 41-46)*

i. *Moving sediment from the excavation site to the disposal site would require considerable road improvements and extension of the existing road along the left reservoir bank or shoreline. A single lane road with turnouts would be sufficient, but any road improvement or extension in this area will be challenging and expensive.*

ii. *The MWH 2013 study concluded that the downstream on-site disposal location alternative was not large enough to store all of the excavated sediment. However, by increasing sediment height in the downstream disposal site location, John (AECOM) found that all of the sediment currently trapped in the reservoir could be stored on-site.*

e. *Dam and Reservoir Alternative 4: Storage Expansion (Slides 47-58)*

i. *The TRC discussed why a rubber dam could be an acceptable alternative, but not a dam raise. CDFW's objective when selecting their list of 5 alternatives was to preserve a range of alternatives (from dam removal to storage expansion), and to keep only the most acceptable storage expansion alternative. A rubber dam is preferable to a dam raise because fish passage facilities would be less impacted, and a rubber dam provides more operational flexibility that can be used to optimize habitat for redds. NMFS and CDFW also do not want to see permanent storage expansion as the preferred alternative.*

1. *Larry said he would emphasize to the MPWMD Board that NMFS and CDFW do not want permanent storage expansion as the preferred alternative.*

ii. *The TRC discussed the alternatives that would involve construction of a new Los Padres Dam downstream from the existing dam (Alternatives 4c and 4d).There was consensus that these alternatives should be discarded. Alternatives 4c and 4d would eliminate between 500 and 3,000 feet of steelhead spawning habitat downstream of Los Padres Dam. Costs would likely be on the same order of magnitude as dredging before taking fish passage into consideration. The 3,000 acre-foot dam option under Alternative 4c and any combination of options under*

Alternative 4d would also require two sets of fish passage facilities, which would add cost and increase adverse impacts to steelhead.

f. *Sediment Management Option 1: Periodic Sediment Removal Off-Site (Slide 60)*

g. *Sediment Management Option 2: Periodic Sediment Removal and Placement Downstream of LPD (Slides 61-63)*

   i. *Option 2 would not allow for removal of the expected annual sediment load, and therefore the reservoir would continue to lose storage capacity if Option 2 alone was implemented. Option 2 would need to be combined with another Sediment Management Option to maintain or increase reservoir storage capacity.*

   ii. *The TRC discussed the possible outcomes of placing reservoir sediment downstream. On one hand, the high proportion of fine sediments could aggrade in existing spawning habitat. On the other hand, reservoir sediment reintroduction could help with river incision downstream, and it would be beneficial to have additional material at the beach.*

   iii. *AECOM estimated that the placement site (Site D) would be inundated at 10-year flood flows and above. Additional modeling would be needed to refine this estimate.*

   iv. *Access to Site D for sediment placement could be an issue. One option could be to deposit the sediment from Nason Road, where it would fall downhill and create a "debris slide."*

h. *Sediment Management Option 3: Sluicing Tunnel (Slides 64-65)*

   i. *Option 3 would require opening the sluiceway and drawing down the reservoir ahead of large storms. Instead of the reservoir spilling during the storm, the sluiceway would be opened ahead of the storm.*

   ii. *Keeping the sluiceway clear of debris could be a challenge, and debris management would need to be considered in the design of the sluiceway.*

   iii. *During events up to approximately a 20-year storm, water flowing through the sluice tunnel would be open channel flow, and thus not injurious to fish. However, while drawing down the reservoir through the sluice tunnel, the tunnel would be in pressure flow. Fish that pass from the reservoir through the sluice tunnel during drawdown could be exposed to pressures that could cause injury.*

i. *Sediment Management Option 4: Bypass Tunnel (Slide 66)*

i. *AECOM recommended that this option be discarded due to the very high construction costs, the significant engineering challenges, and the lack of sediment transport benefit compared to Option 3, which would be considerably less expensive.*

4. Review sediment transport model spin up run and trial run results *(slides 76-123)*

   a. *Since August, Balance has been working with John Lear (MPWMD) to incorporate the Basin Model's hydrology into Balance's sediment transport model. Balance has also looked more closely at all available grain size distribution information for Carmel River and obtained raw data from Doug Smith at CSUMB.*

   b. *Spin up run: Balance compared their model to existing models of Carmel River sediment transport.*

      i. *The biggest uncertainty in the model has been characterizing the subsurface sediment. This is an important piece of information because the model is sensitive to subsurface sediment grain size.*

      ii. *The model had been predicting significant erosion (10-15 feet) below the Narrows, where the sand/gravel transition occurs.*

         1. *Larry has 1984 and 2016/2017 profiles. Maximum degradation at one location (Steinbeck hole) was 12 feet. On average, it was 2.5 to 6 feet between 1984 and 2016 in the lower 12 miles. The bed has since aggraded as a result of San Clemente Dam removal.*

         2. ***Action Item**: Larry will send profiles to Shawn.*

      iii. *Balance adjusted the subsurface D90 grain sizes below the Narrows to 50 centimeters to prevent unrealistic erosion in sediment starving conditions. This adjustment removed the erosion effect downstream of the Narrows. Balance is now comfortable with their estimate of surface and subsurface grain size distribution. The observed 2.5 to 6 feet of degradation observed between 1984 and 2016 is also consistent with model results using the updated subsurface grain sizes, which adds confidence that this adjustment was appropriate.*

   c. *Trial runs*

      i. *The rate of sediment depletion from reservoir is initially very high following dam removal. (Slide 92)*

      ii. *Balance ran 80 random simulations with 3 storage decay scenarios and 4 types of hydrographs. (Slide 97)*

iii. *The erodibility of the constructed San Clemente project reach is very important in modeling sediment transport downstream. If the reach is characterized as less erodible, the model shows sediment building up upstream of the San Clemente "kink." If the reach is characterized as more erodible, sediment does not build up in this "kink" and is instead transported downstream.*

   1. *The TRC agreed that the constructed San Clemente project reach is not very erodible. There is a buried sill at the upstream end of the cut to prevent headcut. The downstream portion of the reach, particularly the last 500 feet, has a high density of boulders. Both of these elements contribute to the reach being non-erodible.*

   2. *The TRC noted that, since removal of San Clemente Dam, there has been a high level of sediment transport through the constructed San Clemente project reach. However, this is considered a short-term effect. In the long term the constructed San Clemente project reach will have low erodibility, and the model should reflect that.*

iv. *Shawn showed the results of several simulations. Storage decay scenarios, hydrographs, and the erodibility of the constructed San Clemente project reach were variables in the simulations presented.*

v. *In 80 simulations, Los Padres Reservoir depleted to between 5% and 50% of current sediment levels over 50 years. Near complete (5% of current stored volume) reservoir emptying occurred in 40-50 years under high depletion rate scenarios. Reservoir depletion leveled off at 50% of current stored volume in 50 years of simulation under low depletion rate scenarios.*

vi. *Larry noted that sediment input into Los Padres Reservoir likely occurs episodically rather than chronically. There are large pulses of sediment followed by long periods of very low sediment input.*

vii. *Brian asked that the annual reservoir depletion volume be scaled based on the Los Padres average sedimentation rate with and without the Marble Cone fire.*

viii. *Doug Smith (CSUMB) is measuring cross sections at the Carmel River Reroute site every year. He may also be measuring cross sections and profiles above the reservoir. There is a lot of interest in characterizing the long-term changes resulting from removal of San Clemente Dam.*

ix. *Brian noted that some of the scenarios show a transport rate of zero at the constructed San Clemente project reach, which doesn't fit with realistic expectations.*

1. ***Action Item**: The TRC agreed that it would be useful to try to break the model result where transport rates fall to zero.*

5. Discuss which alternatives to model and how many hydrologic scenarios to model per alternative *(slides 124-126)*

   a. *Question 1: Does BESMo project a comparable downstream response to that provided by URS with SRH-1D for the CRRDR planning?*

      i. *The spin up run was done to gain confidence in Balance's model moving forward.*

      ii. *The spin up run is consistent with prior model results.*

      iii. *The TRC discussed a concern with the premise of this question: There is no empirical data to evaluate the accuracy of the URS model, yet we're measuring our confidence in Balance's model by comparing it with the URS model. What if the URS model is inaccurate? It would be better to verify URS's model against empirical data before using it to inform Balance's model.*

      iv. *The TRC did not reach a consensus on this question.*

      v. ***Action Item**: Larry will facilitate a call with Brian and Balance to address this question.*

   b. *Question 2a: Are the logarithmic decay scenarios appropriate to represent the sediment release from Los Padres Reservoir?*

      i. ***Action Item**: Brian will provide guidance to Shawn on this question.*

   c. *Question 2b: Is the constructed San Clemente project reach relatively erodible or non-erodible?*

      i. *The TRC agreed that the constructed San Clemente project reach is relatively non-erodible.*

   d. *Question 3a: How and which alternatives are we simulating?*

      i. *The TRC discussed simulating the following alternatives:*

         1. *Releasing only natural background supply (i.e., if there was no dam in place and no accumulated sediment).*

2. *Baseline/existing conditions (i.e., Los Padres Dam is in place and sediment is accumulating in the reservoir). This was flagged as a critical scenario to simulate.*

3. *Alternative 2 (Dam removal/sediment evacuation). For this alternative, the TRC would need to decide if the model should include sluicing or dredging prior to dam removal. Trish recommended a sluicing tunnel as this appears to be a relatively inexpensive way to gain a relatively large amount of storage.*

4. *Option 2 (Periodic sediment removal and placement downstream of LPD) and Option 3 (Sluicing tunnel).*

ii. *The scope currently includes simulation of 3 alternatives. The TRC recommended that at least one additional alternative be modeled. Shawn estimated that it would cost approximately $10,000 to simulate an additional alternative.*

iii. ***Action Item**: The TRC will hold a conference call to decide how many alternatives total should be modeled, and to decide which alternatives should be modeled.*

e. *Question 3b: How to batch scenarios (i.e., how do we classify hydrograph types)?*

i. *The TRC recommended looking at the URS model to see how it addressed this question. The historical record was used for the URS model, but the model did not include multiple starting points. The Mussetter model used 41 starting points for 41 years of record. But the Mussetter approach is not compatible with our question. Balance is simply asking how to classify results so they can be more easily digested and contextualized. Our recommendation is to base results on hydrologic condition, e.g. v. wet, wet, avg. dry, v. dry., or/and based on sediment supply rate from los padres: e.g. high, avg. low*

ii. *The TRC did not reach a consensus on how to batch scenarios.*

iii. ***Action Item**: Balance will draft a recommendation for how to batch the scenarios and share it with the TRC for approval or input.*

f. *Question 4: Special requests for presentation/summary of results?*

i. *Shawn plans to show the median response for all cases, plus 90^{th} and 10^{th} percentile responses. He also plans to show as much as possible on maps.*

ii. *The TRC did not have additional requests for the presentation or summary of the sediment transport model data.*

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6. Conclusion

a. Summary of next steps and action items

The table below documents recent and incomplete project action items, including those from the TRC Meeting. Please review and note your action items, or notify Katie McLean if an item has already been completed or is misrepresented.

			Primary Responsible			
No.	**Date**	**Action**	**Firm/Org.**	**Individual**	**Due Date**	**Status**
3	3/10/2017	Provide MPWMD report analyzing evapotranspiration and losses from reservoir storage.	MPWMD	L. Hampson	3/17/2017	Abandoned
11	6/28/2017	Provide sediment transport data plotted in Matthews 1987 (MPWMD TM 87-13) and mentioned in Hampson 1997 for water years 1984-1986 to AECOM.	MPWMD	L. Hampson	7/14/2017	Abandoned
33	9/14/2017	Provide any available hydrogen sulfide data or algae data from Los Padres Reservoir or downstream.	Cal-Am	A. Gonzales	9/22/2017	Abandoned
23	8/3/2017	Provide 1984 Carmel River profile in new datum.	MPWMD	L. Hampson	8/18/2017	Done
27	9/13/2017	Request Cal-Am conduct test of maximum controlled release in 2017 as reservoir is filling. Possibly test maximum controlled release at multiple water surface elevations.	MPWMD	L. Hampson	9/27/2017	Done
40	1/18/2018	Share 1984 and 2016/2017 profiles with Consultant team.	MPWMD	L. Hampson	1/29/2018	Done
41	1/18/2018	Facilitate a conference call with Brian and Balance to address whether BESMo projects a comparable downstream response to that provided by URS with SRH-1D for the CRRDR planning.	MPWMD	L. Hampson	1/29/2018	Done
37	1/18/2018	Facilitate a conference call to adjust the project schedule and to decide which alternatives should be simulated in the sediment transport model. Attendees will include Cal-Am, NMFS (Joel will be point of contact), CDFW (Dennis will be point of contact), MPWMD, Dave Stoldt.	MPWMD	L. Hampson	2/2/2018	Done
45	1/18/2018	Some scenarios show a transport rate of zero at the constructed San Clemente project reach. Balance will try to break this model result, which doesn't fit with realistic expectations.	Balance	S. Chartrand	2/6/2018	Done
24	8/3/2017	Provide corrections as needed to Cost Considerations table, slide 137 in TRC M1 presentation and Table 3-1 on p. 3-2 of the draft Study Preparation TM	NMFS	B. Cluer	8/11/2017	In Progress
26	9/6/2017	Provide 2 years of CDFW creel survey data from Los Padres Reservoir to consultant team.	CDFW	D. Michniuk	9/15/2017	In Progress
36	1/18/2018	Ask Rich (USGS) for a status update on the Basin Model's calibration and an estimate of when it will be ready.	MPWMD	L. Hampson	2/15/2018	In Progress
38	1/18/2018	Determine Cal-Am's estimate for the remaining lifespan of Los Padres Dam. Share this estimate with Larry.	Cal-Am	A. Gonzales	2/15/2018	In Progress
39	1/18/2018	Ask Metropolitan Water District to share examples and lessons learned from their projects that have involved public response to sediment reintroduction.	MPWMD	L. Hampson	2/15/2018	In Progress
42	1/18/2018	Provide guidance to Balance on the following sediment transport model question: Are the logarithmic decay scenarios appropriate to represent the sediment release from Los Padres Reservoir?	NMFS	B. Cluer	2/15/2018	In Progress
43	1/18/2018	Draft a recommendation for how to batch scenarios and share with TRC for input and/or approval.	Balance	S. Chartrand	2/15/2018	In Progress
44	1/18/2018	Scale annual reservoir depletion volume based on the Los Padres average sedimentation rate with and without the Marble Cone fire.	Balance	S. Chartrand	2/15/2018	In Progress

The table below documents decisions made at the TRC Meeting.

No.	Date	Subject/ Feature	Reference	Decision
2	1/18/2018	Project Timeline	TRC M2	A longer project timeline is needed for alternative development given ongoing studies (Basin Model, IFIM) that were originally expected to have been completed by now.
3	1/18/2018	Bypass Tunnel	TRC M2	Sediment Management Option 4 (Bypass Tunnel) will be eliminated from the Los Padres Dam and Reservoir Alternatives and Sediment Management Study.
4	1/18/2018	Sediment Transport Model	TRC M2	The constructed San Clemente project reach will be considered non-erodible in Balance's sediment transport model.
5	1/18/2018	Sediment Transport Model	TRC M2	The TRC agreed that more than 3 scenarios should be simulated in Balance's sediment transport model.
6	1/18/2018	Downstream Dam	TRC M2	The TRC recommended that the new downstream dam alternatives (Alternative 4c [New Dam Downstream] and 4d [Expand with Combination]) should be eliminated.
7	1/24/2018	Downstream Dam	MPWMD Water Supply Planning Committee	The MPWMD Water Supply Planning Committee agreed to eliminate the new downstream dam alternative (Alternatives 4c and 4d) from the Los Padres Dam and Reservoir Alternatives and Sediment Management Study.

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Technical Review Committee Meeting No. 2

AECOM at the Kaiser Center, 300 Lakeside Drive, Suite 400, Oakland, CA – Bella Vista Room

January 18, 2018

Welcome & Administrative Business

- Introductions
- Opening statements
- Lunch orders

Specialty's CAFÉ & BAKERY

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

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Meeting Objectives

- Provide a forum for transfer of information, discussion, and collaboration among participants;
- Review the Sediment Characterization Technical Memorandum and the Alternatives Descriptions Technical Memorandum;
- Review the sediment transport model spin up run and trial run results; and
- Decide which alternatives to model and how many hydrologic scenarios to model per alternative.

Agenda

1. Review of Sediment Characterization Technical Memorandum
2. Review of Alternatives Descriptions Technical Memorandum
3. Review sediment transport model spin up run and trial run results
4. Discuss which alternatives to model and how many hydrologic scenarios to model per alternative
5. Review and wrap up

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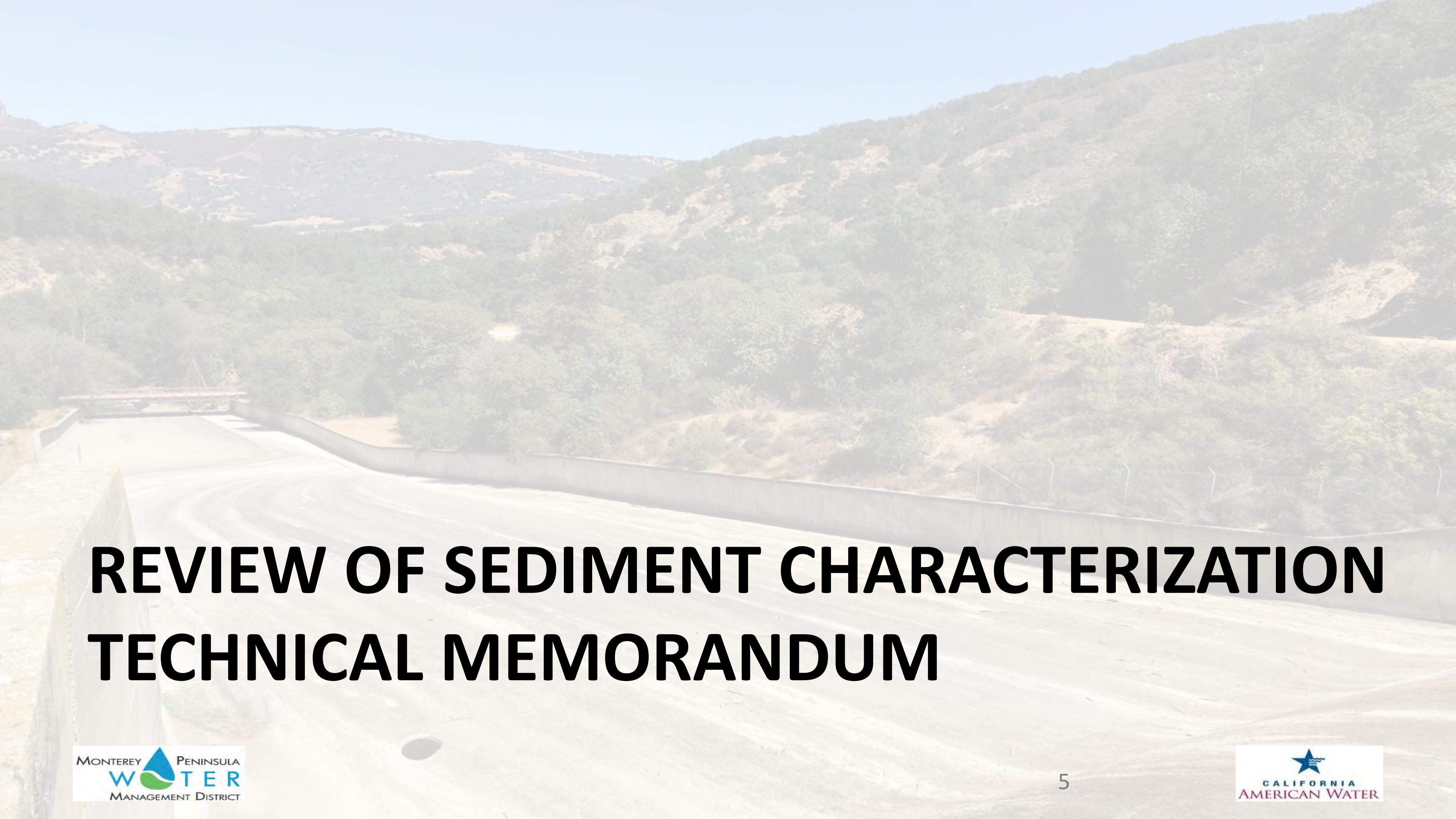


REVIEW OF SEDIMENT CHARACTERIZATION TECHNICAL MEMORANDUM

Sedimentation Characterization TM
Purpose and Scope

Purpose: Obtain, analyze, and characterize sediment accumulated in Los Padres Reservoir

Field Investigations:

- 4 previous soil borings in Los Padres reservoir in 2015
- 7 new soil borings in Los Padres Reservoir (July 2017)
- Geotechnical and chemical laboratory testing of selected sediment samples
- Upstream reconnaissance “pedestrian” survey

Results:

- Characterization of sediment types and distribution
- Calculation of sediment volumes
- Analysis of sediment chemistry

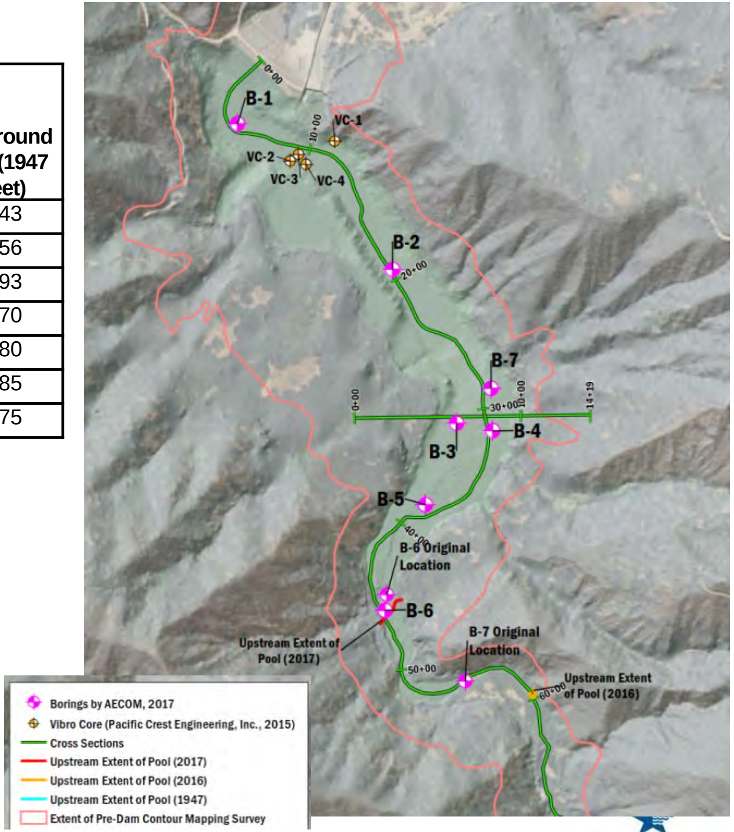
Sediment Characterization TM

Field Investigation - Borings

Sediment Characterization TM

Field Investigation - Borings

Boring Number	Water Depth (feet)	Boring Depth (feet)	Sediment Thickness (feet)	Lake Bed Elevation (2017 Bathymetry, feet)	Lake Bed Elevation (Boring, feet)	Original Ground Elevation (Boring, feet)	Original Ground Elevation (1947 Topo, feet)
B-1	74.5	33.5	29.5	969.5	968.4	939	933 – 943
B-2	65.0	23.0	21.0	978.3	977.9	957	946 – 956
B-3	25.0	36.5	27.0	1,018.7	1,017.9	991	983 – 993
B-4	24.5	31.5	> 31.5	1,018.7	1,018.4	< 986	965 – 970
B-5	16.5	47.0	46.5	1,026.6	1,026.4	980	970 – 980
B-6	7.0	52.4	46.0	NA	1,035.9	990	980 – 985
B-7	30.0	56.0	45.0	1,012.8	1,012.9	968	965 – 975



VC-1 through VC-4

- ranged from 14 to 18 feet deep
- 12.5 to 17.5 feet very soft silt with organics overlying 0.5 to 6 feet of interbedded silt and sand

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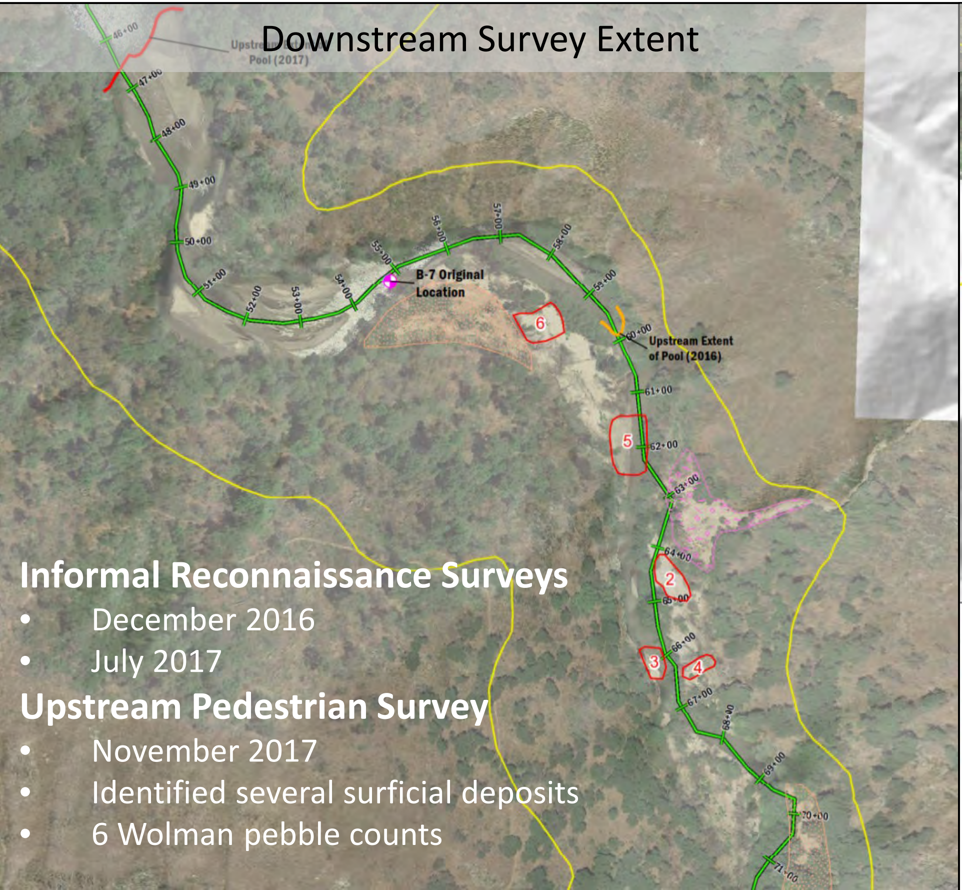
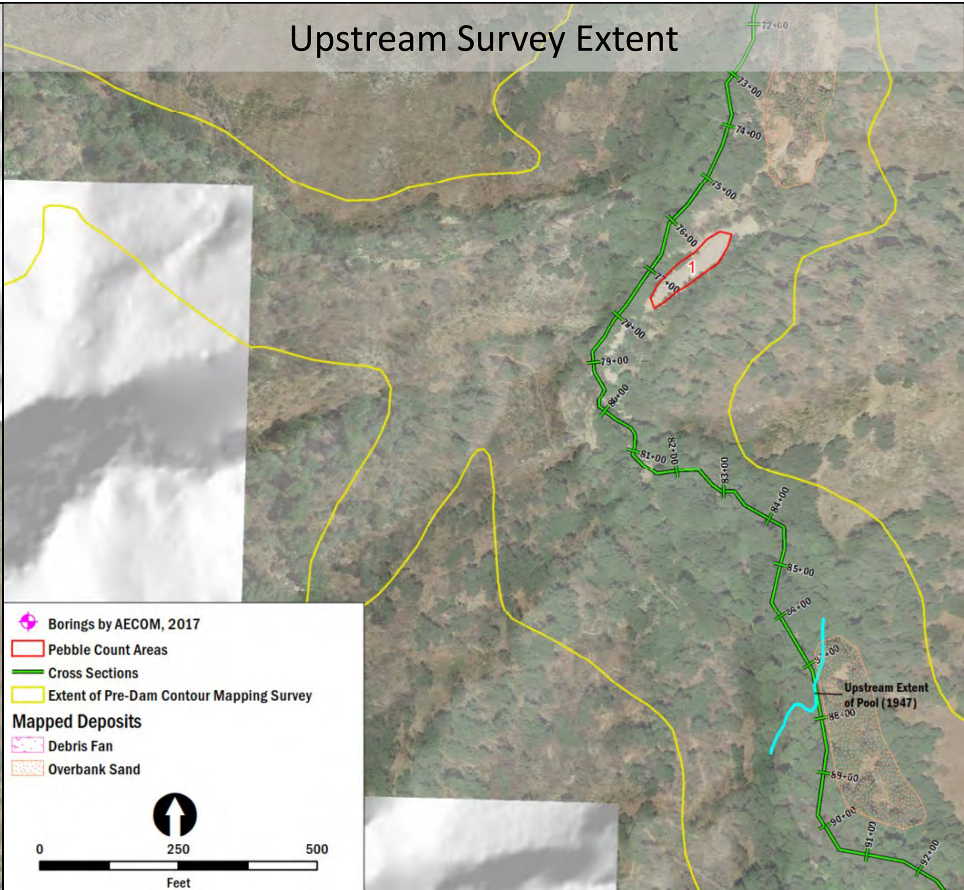
Sediment Characterization TM

Field Investigation – Upstream Reconnaissance

Downstream Survey Extent



Upstream Survey Extent



Informal Reconnaissance Surveys

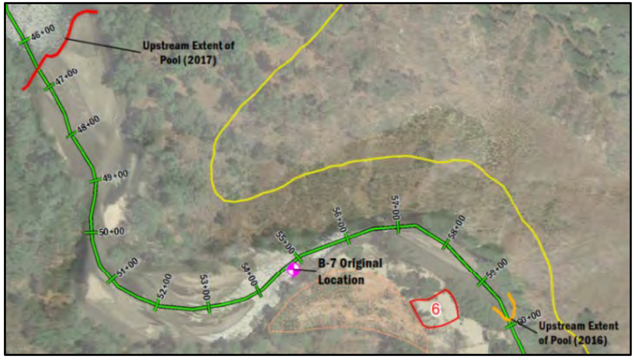
- December 2016
- July 2017

Upstream Pedestrian Survey

- November 2017
- Identified several surficial deposits
- 6 Wolman pebble counts

Sediment Characterization TM

Field Investigation – Upstream Reconnaissance

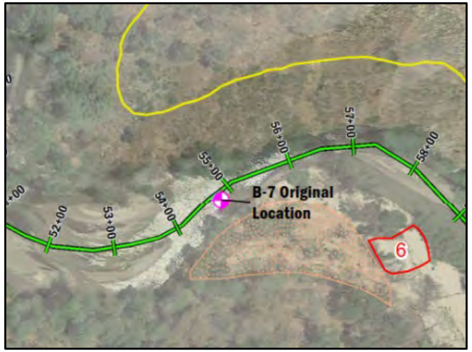


Monterey Peninsula Water Management District

California American Water

Sediment Characterization TM

Field Investigation – Upstream Reconnaissance

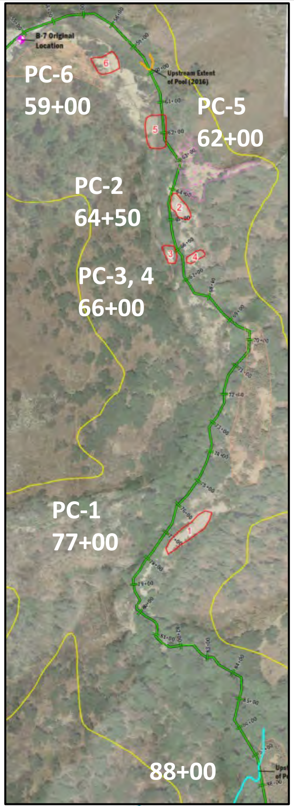


Monterey Peninsula Water Management District

California American Water

Sediment Characterization TM

Field Investigation – Upstream Reconnaissance



PC-1

PC-2

PC-5

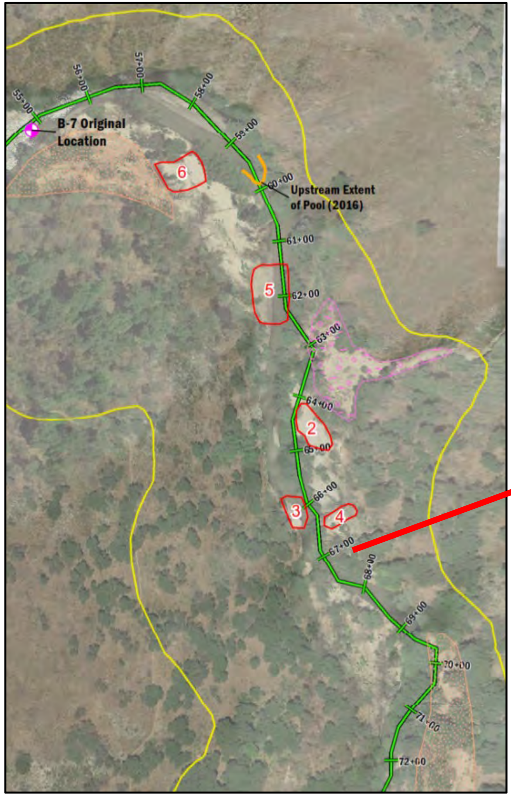
Description	Size (mm)	Pebble Count Number					
		1	2	3	4	5	6
Fines	<0.06	-	-	-	6	-	-
Fine sand	0.06-0.25	18	11	2	36	2	9
Coarse sand	0.25-2	22	31	25	9	33	44
Fine gravel	2-12	28	36	43	21	55	41
Coarse gravel	12-64	30	22	37	23	10	20
Small cobble	64-128	16	8	9	10	2	1
Large cobble	128-255	-	-	-	-	-	-
Boulder	>255	1	-	-	-	-	-
Total Count		115	108	116	105	102	115

Monterey Peninsula Water Management District

California American Water

Sediment Characterization TM

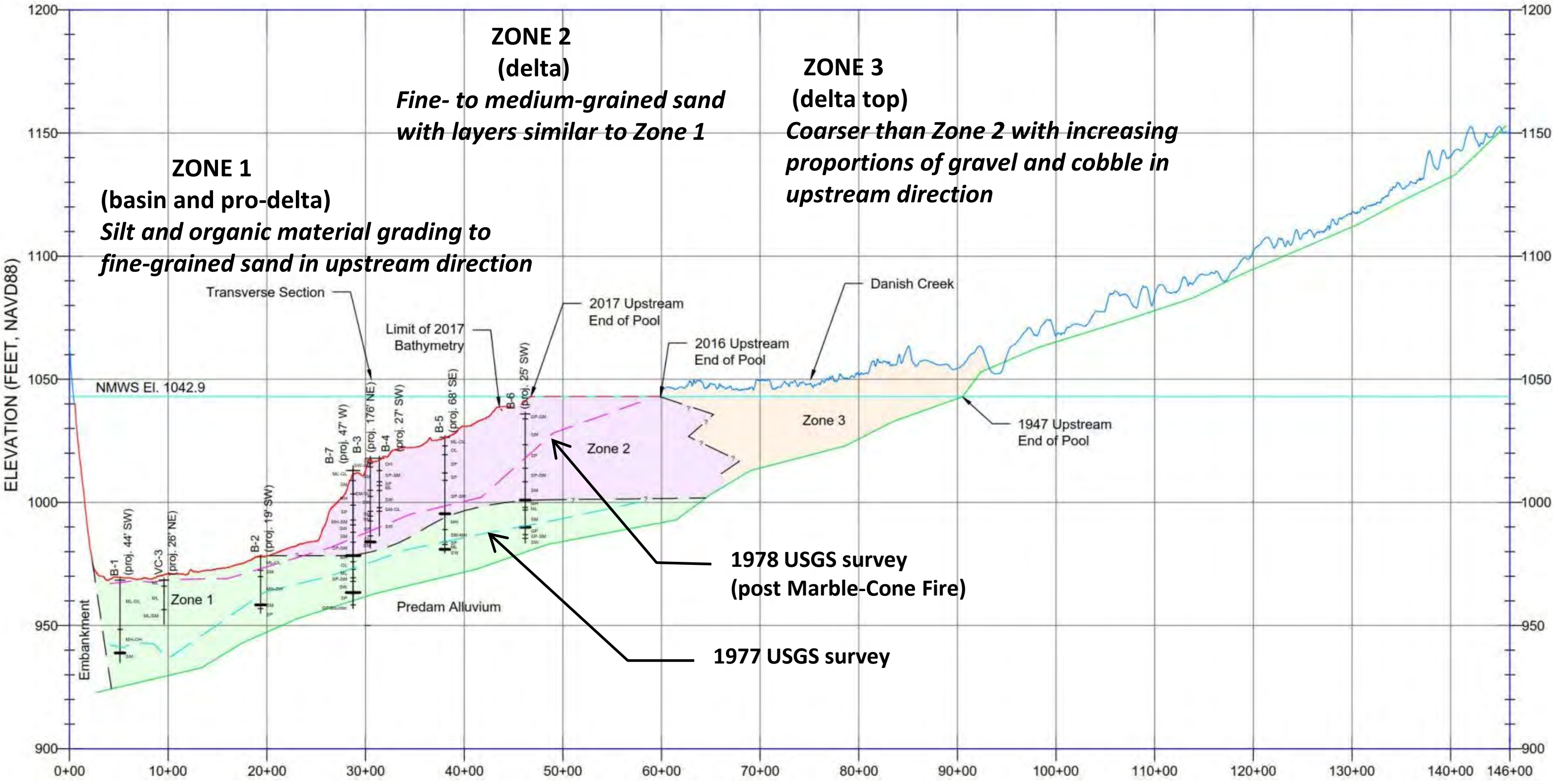
Field Investigation – Upstream Reconnaissance



Typical Armoring

Sediment Characterization TM

Results – Sediment Types & Distribution



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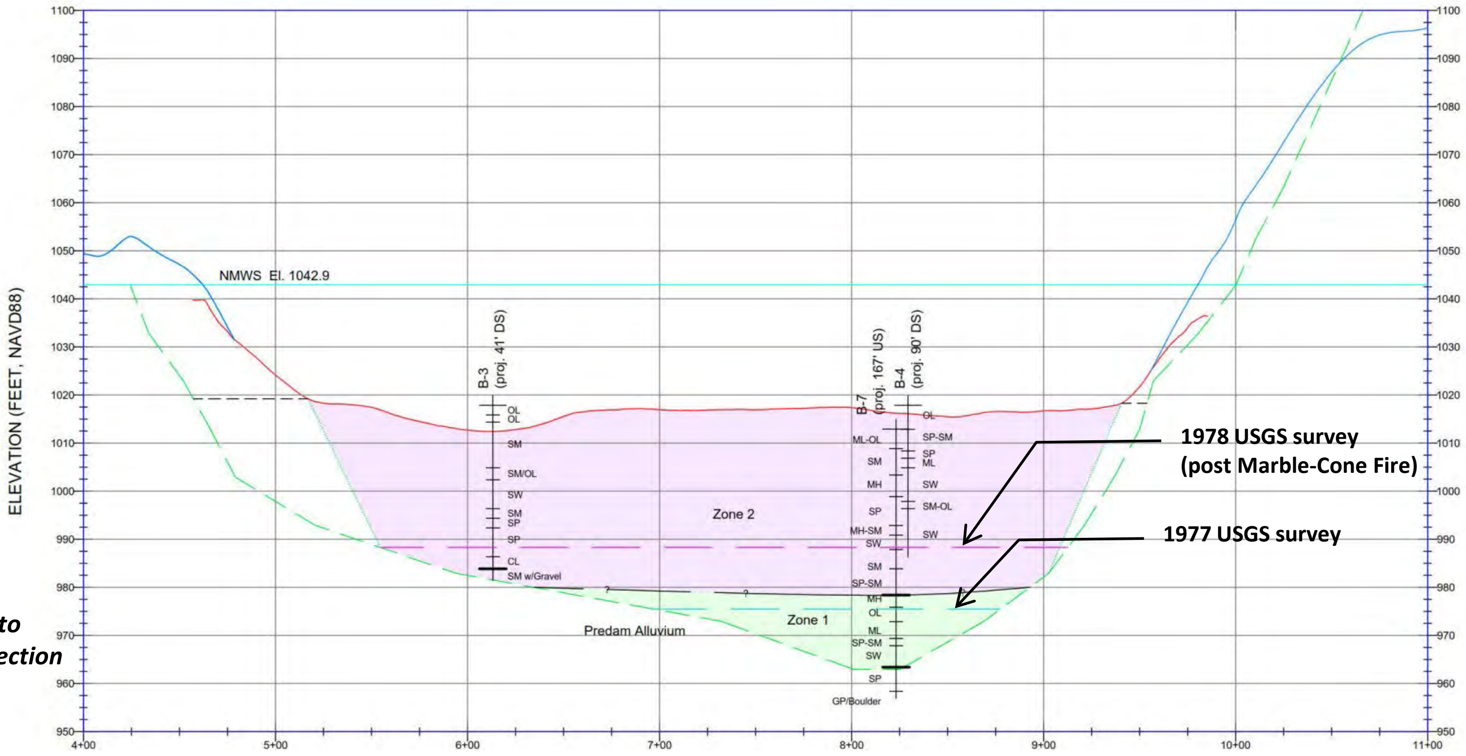
Sediment Characterization TM

Results – Sediment Types & Distribution

ZONE 2
(delta)
Fine- to medium-grained sand with layers similar to Zone 1

ZONE 1
(basin and pro-delta)
Silt and organic material grading to fine-grained sand in upstream direction



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Sediment Characterization TM

Results – Sediment Types & Distribution

Zone 1 Variation in USCS Classification of Sediment

Boring	Length (feet)						
	Zone 1	Gravel	Sand	Silt	Silt/Organic	Organic	Clay
B-1	30.0	0.0	0.0	0.0	30.0	0.0	0.0
B-2	19.5	0.0	2.5	0.0	17.0	0.0	0.0
B-5	14.5	0.0	1.0	13.5	0.0	0.0	0.0
B-6	11.0	0.0	7.5	3.5	0.0	0.0	0.0
B-7	20.0	0.0	11.0	6.0	0.0	3.0	0.0
Total Length	**95.0**	**0.0**	**22.0**	**23.0**	**47.0**	**3.0**	**0.0**
Percent Total	**100%**	**0%**	**23%**	**24%**	**50%**	**3%**	**0%**

23% **77%**

Sediment Characterization TM

Results – Sediment Types & Distribution

Zone 2 Variation in USCS Classification of Sediment

Boring	Length (feet)						
	Zone 1	Gravel	Sand	Silt	Silt/Organic	Organic	Clay
B-3	34.0	1.0	25.5	2.5	0.0	0.0	2.0
B-4	31.5	0.0	23.0	1.5	2.0	0.0	5.0
B-5	31.0	0.0	24.0	3.5	0.0	0.0	3.5
B-6	35.0	0.0	35.0	0.0	0.0	0.0	0.0
B-7	34.5	0.0	26.0	0.0	4.5	4.0	0.0
Total Length	**163.0**	**1.0**	**133.5**	**7.5**	**6.5**	**4.0**	**10.5**
Percent Total	**100%**	**1%**	**82%**	**5%**	**4%**	**3%**	**6%**

1% **82%** **17%**

Sediment Characterization TM

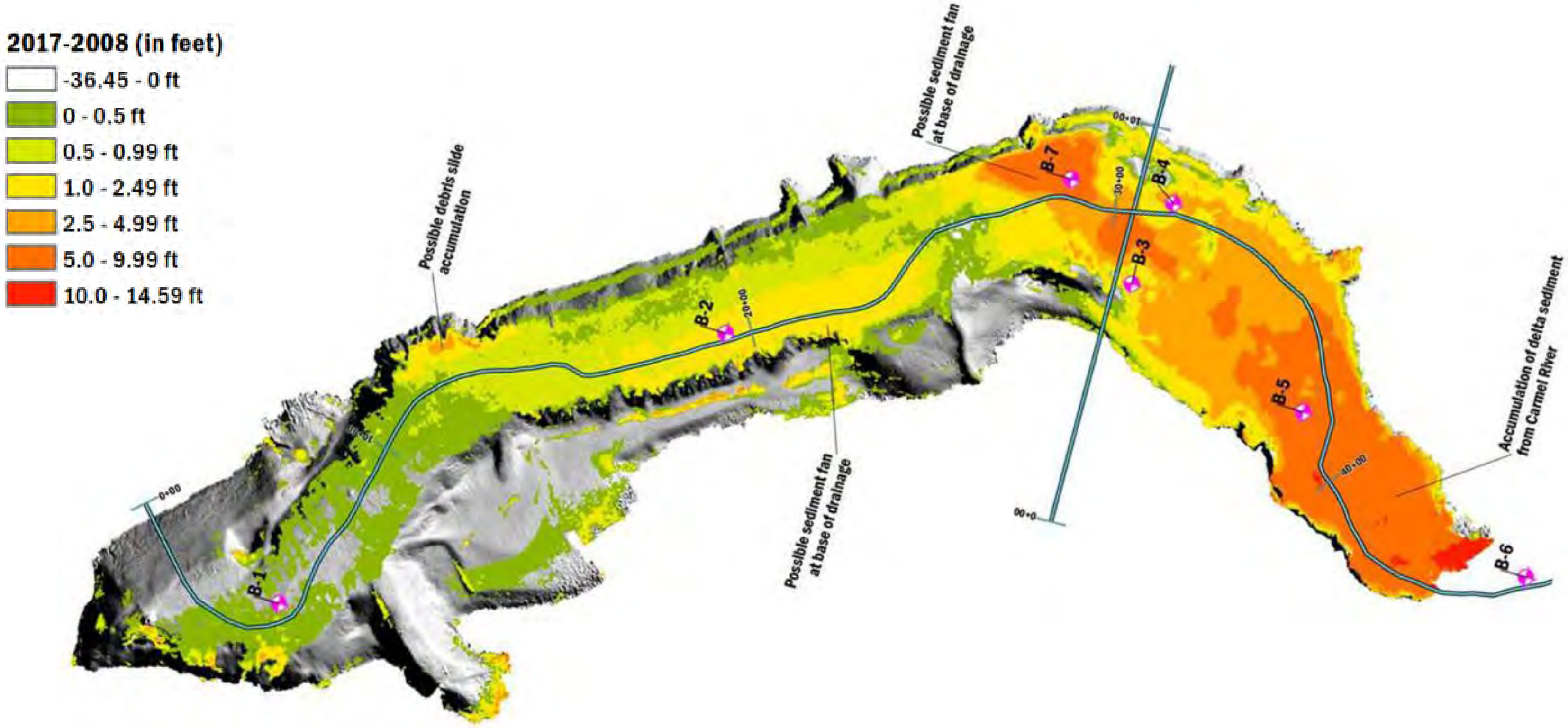
Results – Sediment Types & Distribution

Zone 3 Sediment

- Based on upstream reconnaissance as previously described
- Lower Zone 3: sand portions similar to Zone 2, but less fine-grained lake sediment and more coarse alluvium
- Upper Zone 3: above higher reservoir pool level, likely higher proportion of gravel and cobble sized sediment
- Test pits and borings needed to better characterize Zone 3 sediment

Sediment Characterization TM

Results – Other Sediment Types & Distribution



MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Sediment Characterization TM

Results – Sediment Volumes

Description	Initial Approach Quantity (acre-feet)	End Area Approach Quantity (acre-feet)	Adjusted[1] End Area Approach Quantity (acre-feet)
Reservoir capacity at NMWS (1947)	3,030	2,957	
New original reservoir capacity	—	2,644	2,709
Reservoir capacity that did not exist	—	313	321
Reservoir capacity at NMWS (2017)	1,598	1,562	1,601
Sediment volume below NMWS	1,472	1,083	1,110
Sediment volume above NMWS	160	156	160
Total sediment volume	1,632	1,249	1,270
Volume of Zone 1	385	332	340
Volume of Zone 2	816	675	692
Volume of Zone 3 below NMWS	271	76	78
Volume of Zone 3 above NMWS	160	156	160

Note:
[1] Adjustment = 1.0247 × End Area Approach Quantity

Initial Approach
Comparison of:
- **digitized 1947 contours**
- **2016 LiDAR**
- **2017 Bathymetry**

End Area Approach
- **undertaken as a result of finding inconsistency between 1947 contours and 2016 LiDAR and 2017 bathymetry**

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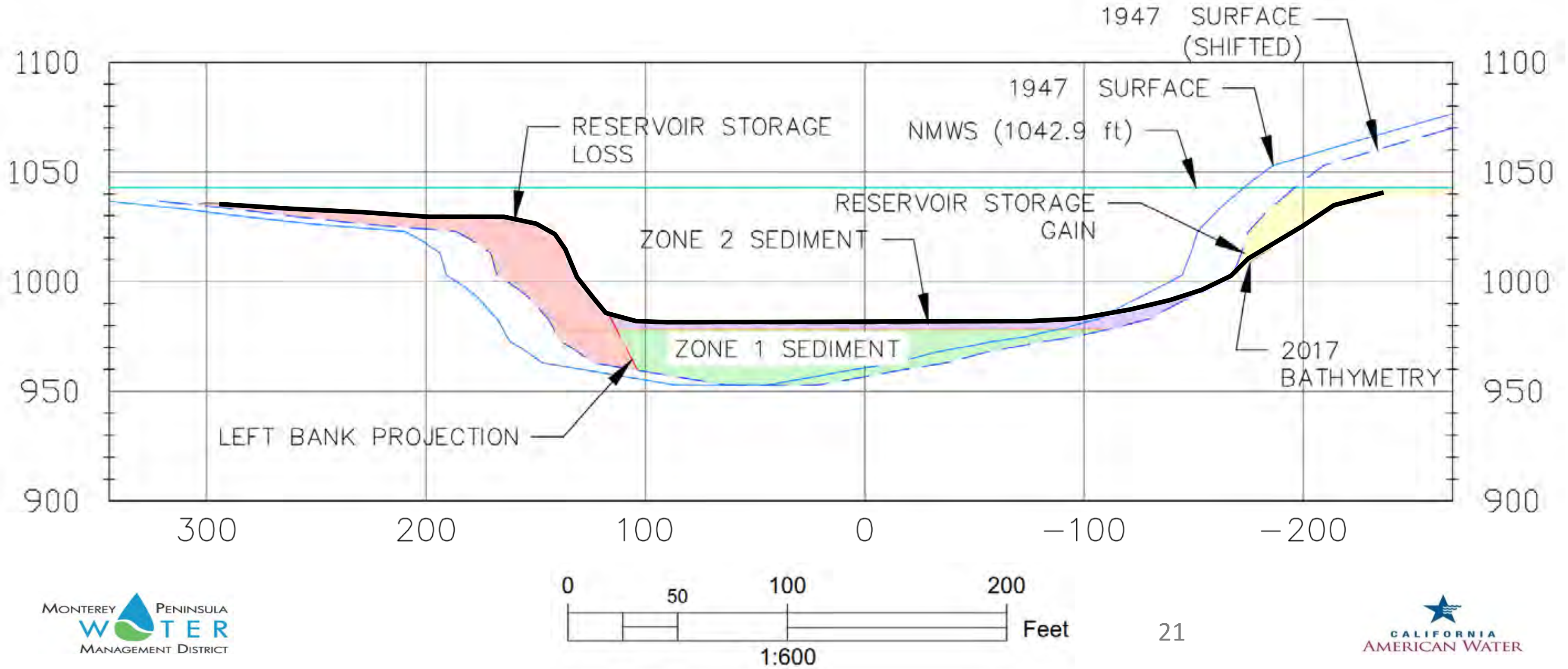
Sediment Characterization TM
Results – Sediment Volumes

Volume Calculation



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Sediment Characterization TM

Results – Sediment Volumes

Estimated Sediment Size-Class by Zone

based on USCS classification, laboratory gradation results, and engineering judgment

Area	Percent				
	Cobble /Gravel (4.75 – 300 mm)	Sand (0.075 – 4.75 mm)	Silt (< 0.075 mm)	Clay (< 0.075 mm)	Organics (n/a)
Zone 1	2 – 5	25 – 35	50 – 60	8 – 15	5 – 10
Zone 2	5 – 10	65 – 75	15 – 25	2 – 5	<2
Zone 3 (Below NMWS)	25 – 35	60 – 70	5 – 15	0 – 5	<2
Zone 3 (Above NMWS)	35 – 45	55 – 65	0 – 10	0 – 5	<2

Range of Dry Unit Weight by Zone

Area	Range of Dry Unit Weight (pcf)	Basis of Range of Dry Unit Weight
Zone 1	30 – 50	Laboratory tests on borings VC-1 through 4 and B-1
Zone 2	60 – 75	Blow count data, published correlations, and judgment
Zone 3 (Below NMWS)	90 – 110	Published literature and engineering judgment
Zone 3 (Above NMWS)	90 – 110	Published literature and engineering judgment

Sediment Characterization TM

Results – Sediment Volumes

Estimated Tonnage of Sediment by Grain-Size-Class

Area	Tons							
	Finer – Low Unit Weight				Coarser – Higher Unit Weight			
	Gravel +	Sand	Silt	Clay	Gravel +	Sand	Silt	Clay
Zone 1	4,400	55,500	133,300	28,900	18,500	129,600	185,100	37,000
Zone 2	45,200	587,800	226,100	45,200	101,700	836,500	169,600	22,600
Zone 3 (Below NMWS)	38,200	76,400	38,200	0	56,100	102,800	28,000	0
Zone 3 (Above NMWS)	109,800	172,500	31,400	0	153,300	230,000	0	0
Total	197,600	892,200	429,000	74,100	329,600	1,298,900	382,700	59,600

1,270 AF of sediment in reservoir is estimated to include:

Fines (silt and clay) 440,000 to 500,000 tons
Coarse (sand, gravel, and cobble) 1,090,000 to 1,630,000 tons

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Sediment Characterization TM
Results – Sediment Chemistry

Background – Wildfires and Sediment Chemistry

- Wildfire-impacted watershed with Marble-Cone Fire (1977), Kirk Complex Fire (1999), Basin Complex Fire (2008), and Soberanes Fire (2016)
- Physical and chemical changes to soils with fire
- Increased sedimentation

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

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Sediment Characterization TM

Results – Sediment Chemistry

Methods

- 19 samples collected
- Sample locations varied in depth and soil types
- Analyzed for polycyclic aromatic hydrocarbons (PAHs), metals, and nutrients

Note: No sampling upstream or downstream of Los Padres Reservoir, but sediment chemistry testing was done in San Clemente Reservoir in 2002.

Sediment Characterization TM

Results – Sediment Chemistry

Results

- Nutrients and cations enriched from fires (no toxicity)
- Chromium, nickel, zinc: low risk to sensitive and special-status aquatic species (near threshold)
  - Not typically enriched during wildfires
  - Likely reflect natural background concentrations
- Arsenic: potential exposure to workers during deep excavations
  - PPE or limited work hours may be needed

Sediment Characterization TM

Results – Sediment Chemistry

No anticipated atypical issues with:

- Protection of workers handling reservoir sediment
- Sediment release during flooding events
- Sediment disposal in upland locations
- Sediment placement along Carmel River

REVIEW OF ALTERNATIVES DESCRIPTIONS TECHNICAL MEMORANDUM

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Alternatives Descriptions TM

Purpose

Develop alternatives for Los Padres Dam and Reservoir, and sediment management options that could be used in combination with the alternatives.

Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic dredging
2. Sediment sluicing through a new sluicing tunnel
3. Constructing a new bypass tunnel to transport sediment around the reservoir

Alternatives Descriptions TM
Dam Alternatives and Sediment Management Options

Each Dam alternative and sediment management option was developed with enough detail to address:

- Alternative location
- Complexity
- Longevity
- Potential impacts and benefits
- Relative cost (very low to very high)

Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Relative Costs:

- Based on a 60-year planning horizon (design, permit, construct, operate)
- Order-of-magnitude Costs (does not include costs for fish passage)
  - Very low $0 to $19M
  - Low $10M to $30M
  - Moderate $30M to $70M
  - High $70M to $150M
  - Very High > $150M

Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic dredging
2. Sediment sluicing through a new sluicing tunnel
3. Constructing a new bypass tunnel to transport sediment around the reservoir

Alternatives Descriptions TM
Alternative 1: No Sediment Management

Alternative Description

- No action taken to manage existing sediment accumulation or future sediment inputs
- Baseline for comparing alternatives

Expected Outcomes

- Past sedimentation rates
  - 70 years including post Marble-Cone fire 1,110 AF = 15.9 AF/year
  - 69 years without post Marble-Cone fire 520 AF = 7.5 AF/year
- Remaining 1,600 AF would be filled in approximately 100 - 210 years

Relative Cost

- Very Low (<$10M) assuming no significant improvements required for LPD over 60-year planning horizon

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California American Water

Alternatives Descriptions TM

Alternative 2: Dam Removal

Alternative Description

- Breaching of dam not feasible – dam to large; would result in unsafe dam failure
- Phased dam removal not feasible – would require new spillway each phase
- Full height removal in a single season is only practicable dam removal option
  - Alternative 2a: full dam removal. ~460,000 CY of excavation
  - Alternative 2b: partial dam removal. ~300,000 CY of excavation
  - Requires removal of Zone 1 and 2 sediment prior to dam removal
    - High water quality degradation if sediment left in place until flood flows
    - Stabilization of sediment in place is not feasible
    - Removal of sediment by dredging/mechanical removal or through sluicing tunnel

Alternatives Descriptions TM

Alternative 2: Dam Removal

Construction Duration

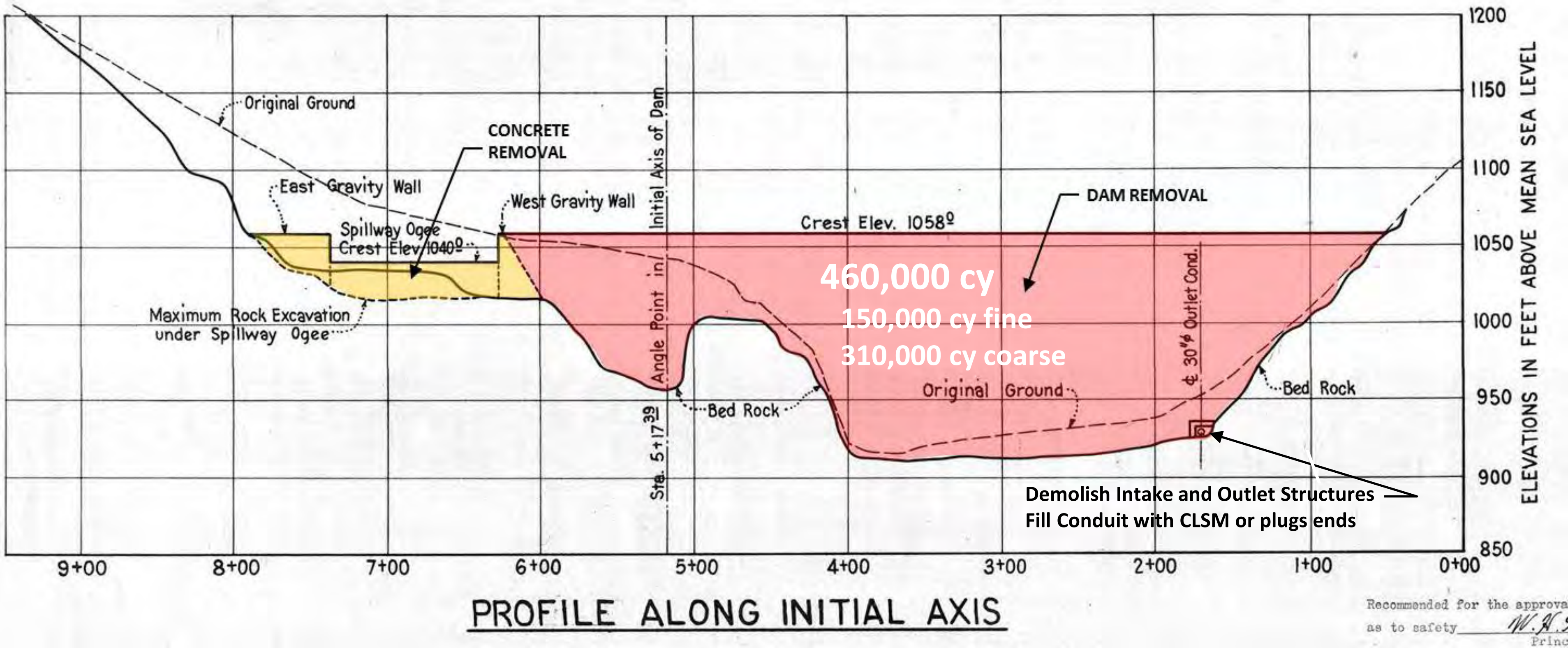
- 5 construction seasons if sluicing used to remove Zone 1 and Zone 2
- 7 construction seasons if dredging used to remove sediment

Relative Cost

- Judged to be moderate ($30M to $70M) if sluicing used
- Judged to be high ($70M to $150M) if dredging used

Alternatives Descriptions TM

Alternative 2a: Full Dam Removal



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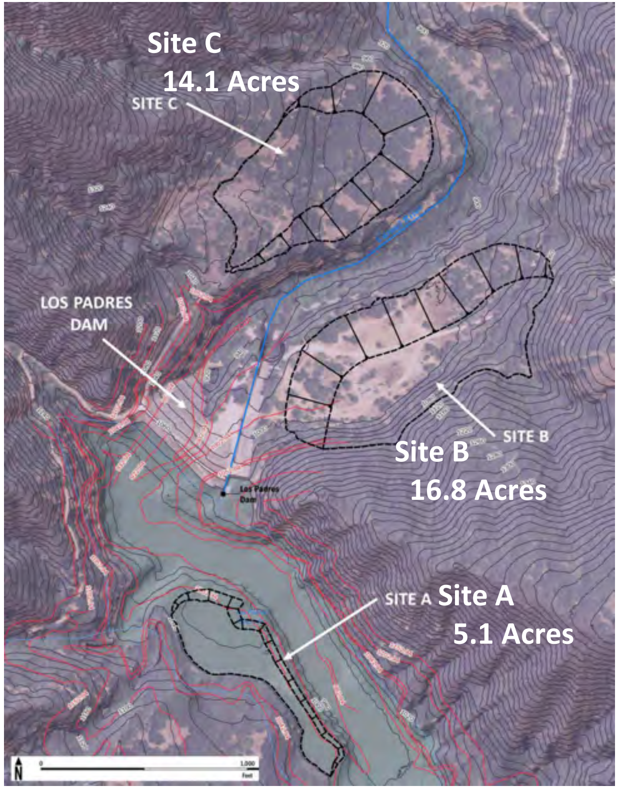
Alternatives Descriptions TM

Alternative 2a: Full Dam Removal

Table 2-1 Storage Capacity of Disposal Sites B and C

Fill Height (feet)	Site B			Site C		
	Elevation (feet)	Incremental Volume (CY)	Cumulative Volume (CY)	Elevatio n (feet)	Incremental Volume (CY)	Cumulativ e Volume (CY)
40	1,020	460,000	460,000	1,000	200,000	200,000
80	1,060	600,000	1,060,000	1,040	360,000	560,000
120	1,100	580,000	1,640,000	1,080	420,000	980,000



Full Dam Removal with Dredging Zone 1 and Zone 2

Zone 1	550,000 CY
Zone 2	1,120,000 CY
Dam	460,000 CY
Total	2,130,000 CY

- Bulkage and shrinkage not considered
- Zone 3 allowed to move downstream

Site A 107,000 CY at NMWS El. 1042.9 feet

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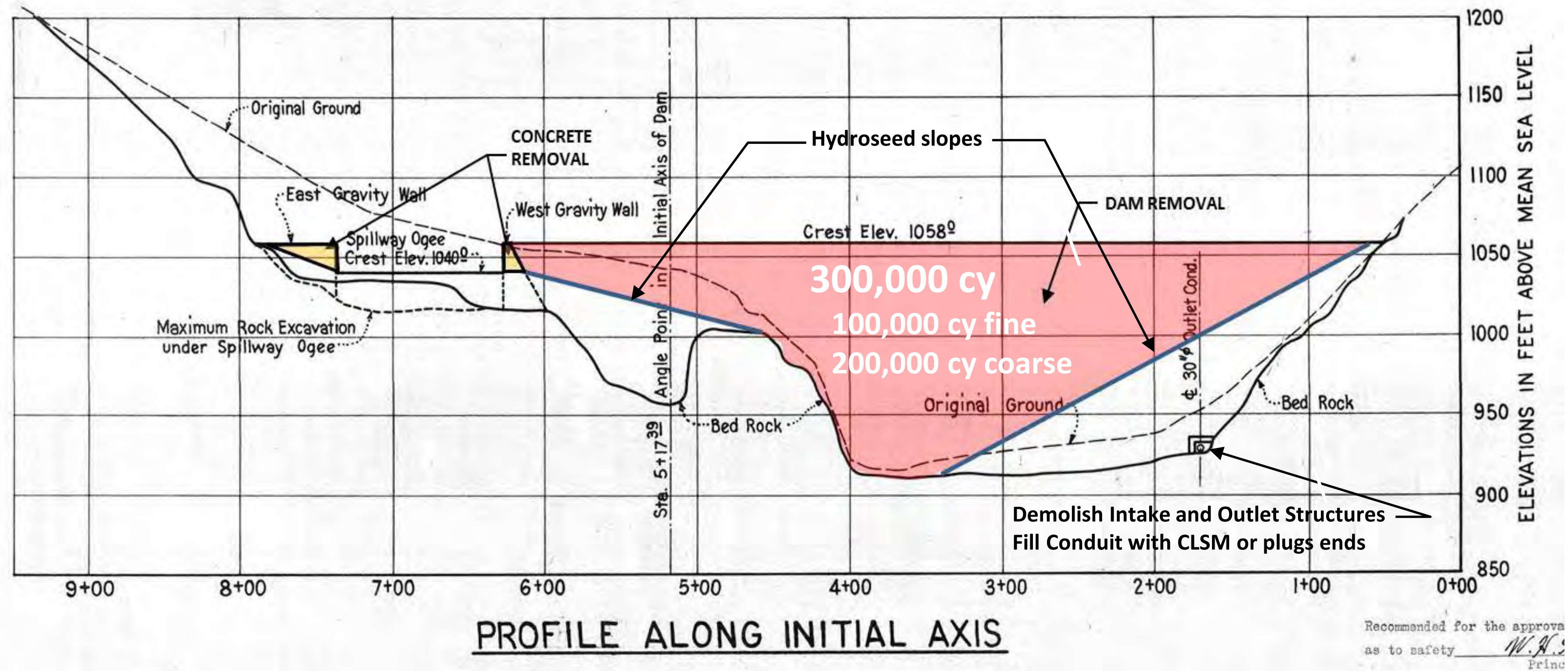
Alternatives Descriptions TM

Alternative 2b: Partial Dam Removal



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

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Alternatives Descriptions TM

Alternative 3: Restore Reservoir Capacity

Alternative Description

- Alternative 3a: Dredge and place **on** California American Water (Cal-Am) property
- Alternative 3b: Dredge and place **off** Cal-Am property – Not practicable

Construction Duration

- 7 construction seasons

Relative Cost

- Judged to be high ($70M to $150M)

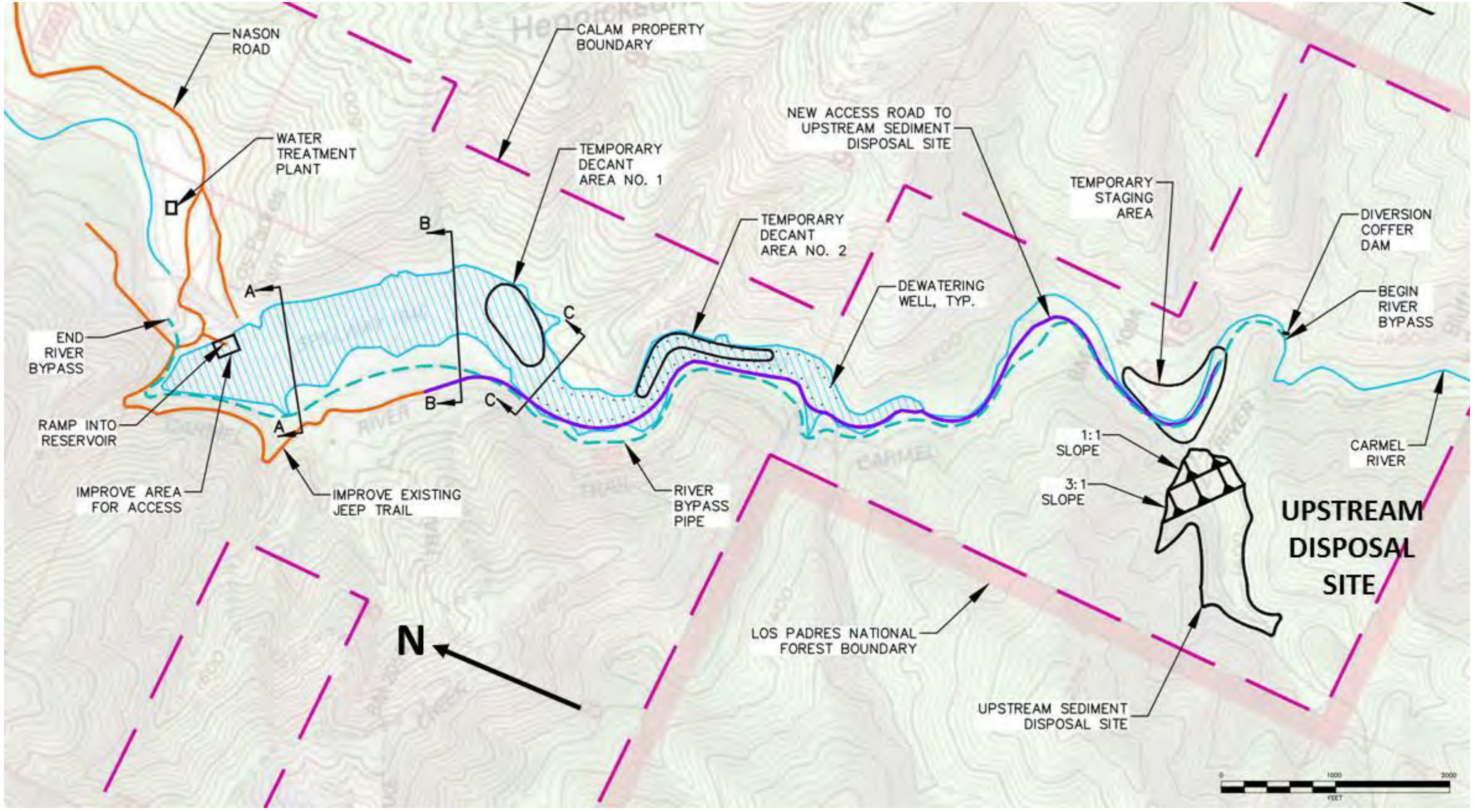
Alternatives Descriptions TM

Alternative 3a: Dredge and Place **on** Cal-Am Property

- MWH (2013) Upstream site <u>not</u> practicable
  - Length of new access road along Carmel River channel (about 1 mile)
  - 390-foot rise from channel to top of site; too steep
  - Soil-cement containment dike with 1H:1V slope
  - Difficulty of providing reliable permanent storm drainage across disposal site

Alternatives Descriptions TM

Alternative 3a: Dredge and Place **on** Cal-Am Property



Monterey Peninsula Water Management District

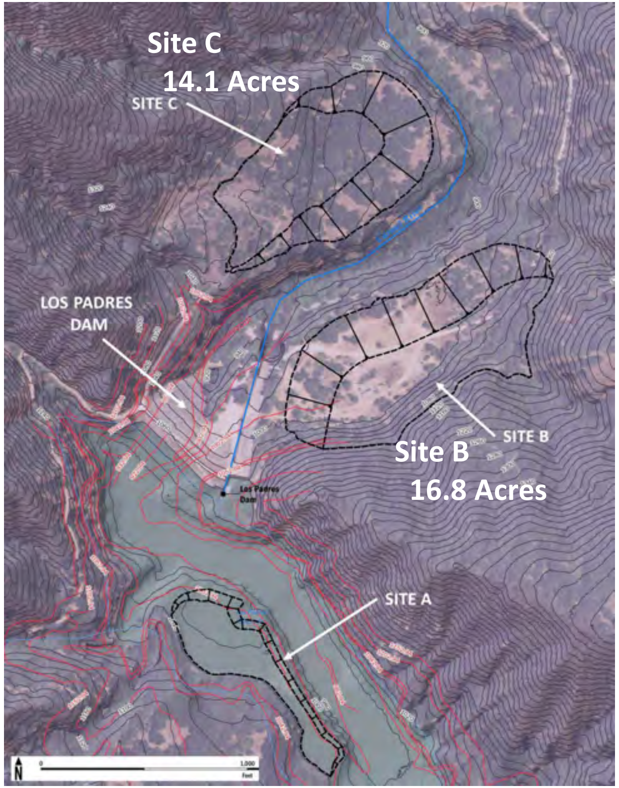
California American Water

Alternatives Descriptions TM

Alternative 3a: Dredge and Place **on** Cal-Am Property

Table 2-1 Storage Capacity of Disposal Sites B and C

Fill Height (feet)	Site B			Site C		
	Elevation (feet)	Incremental Volume (CY)	Cumulative Volume (CY)	Elevation (feet)	Incremental Volume (CY)	Cumulative Volume (CY)
40	1,020	460,000	460,000	1,000	200,000	200,000
80	1,060	600,000	1,060,000	1,040	360,000	560,000
120	1,100	580,000	1,640,000	1,080	420,000	980,000



Dredging Zone 1 and Zone 2

Zone 1 550,000 CY
Zone 2 1,120,000 CY
Zone 3 380,000 CY
Total 2,050,000 CY

- Bulkage and shrinkage not considered

Site A - Not used because it would reduce reservoir capacity

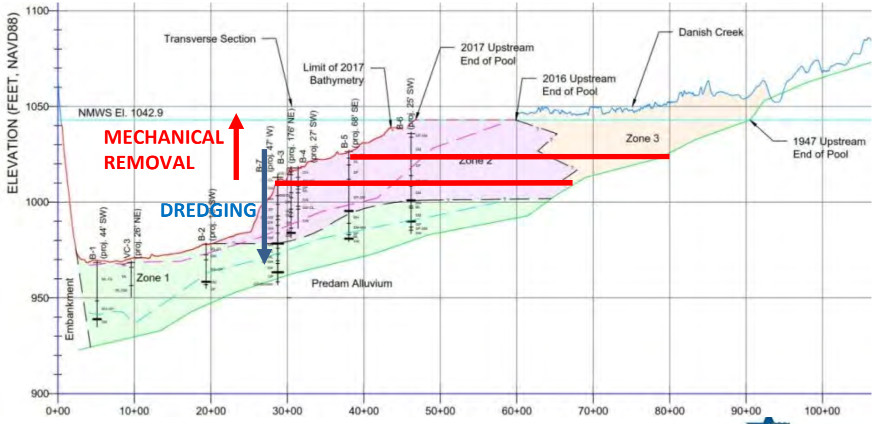
Alternatives Descriptions TM

Alternative 3a: Dredge and Place **on** Cal-Am Property

Table 2-2 Days of Availability of Sediment for Dry Excavation by Elevation (2002 to 2016)

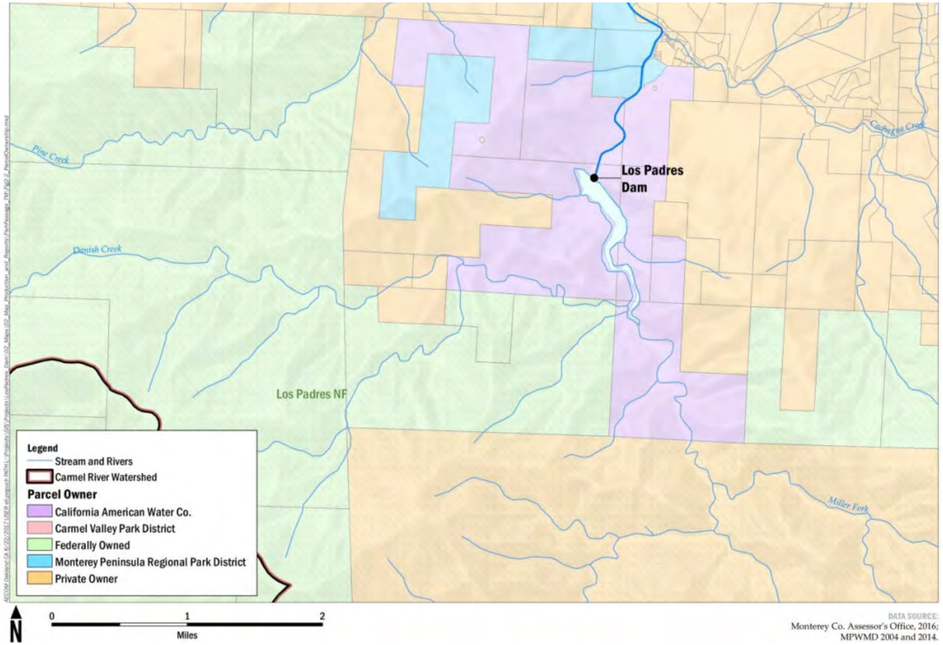
Days Below El.	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Years of Access
1,042.9	153	39	184	127	95	190	199	175	20	98	183	170	253	161	115	15
1,037.9	124	39	150	110	71	151	179	122	13	59	161	137	221	137	98	15
1,032.9	96	38	125	73	53	117	151	90	12	8	121	111	191	125	96	15
1,027.9	0	0	0	0	34	89	117	82	0	0	24	91	163	113	86	9
1,022.9	0	0	0	0	33	0	69	57	0	0	0	74	141	72	83	7
1,017.9	0	0	0	0	18	0	0	3	0	0	0	19	101	9	79	6
1,012.9	0	0	0	0	0	0	0	0	0	0	0	0	41	0	54	2
1,007.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Days of record	**365**	**126**	**365**	**365**	**321**	**365**	**365**	**365**	**365**	**365**	**365**	**365**	**365**	**365**	**302**	

Typical operations of LPR allow for some dry excavation in all years.



Alternatives Descriptions TM

Alternative 3b: Dredge and Place **off** Cal-Am Property



No practicable sites identified

Monterey Peninsula Water Management District

California American Water

Alternatives Descriptions TM

Alternative 4: Storage Expansion

Alternative Description

- Increase storage capacity of Los Padres Reservoir through modification of existing dam, a new dam downstream of the existing dam, or both
- Maximum normal water surface of expanded reservoir 1,052.5 feet (9.6-foot raise)
  - 1,060.0 feet (current el. at Ventana Wilderness boundary)
    - 7.5 feet (depth of water above spillway crest for 100-year storm)

- Sub-Alternatives 4a
  - Alternative 4a: Expand with Dam Raise
  - Alternative 4b: Expand with Rubber Dam
  - Alternative 4c: New Downstream Dam
  - Alternative 4d: Expand with Combination

Monterey Peninsula Water Management District

California American Water

Alternatives Descriptions TM

Alternative 4a: Expand with Dam Raise

Description

- Raise dam on downstream side for NMWS El. 1,052.5
- Increase current storage from 1,601 AF to 2,187 AF (586 AF increase)
- Dam raise designed for dam to meet current seismic stability criteria
- Requires modification to spillway and outlet works

Construction Duration

- 2 construction seasons
  - 1st construction season – dam raise
  - 2nd construction season – modification to spillway and outlet works

Relative Cost

- Judged to be moderate ($30M to $70M)

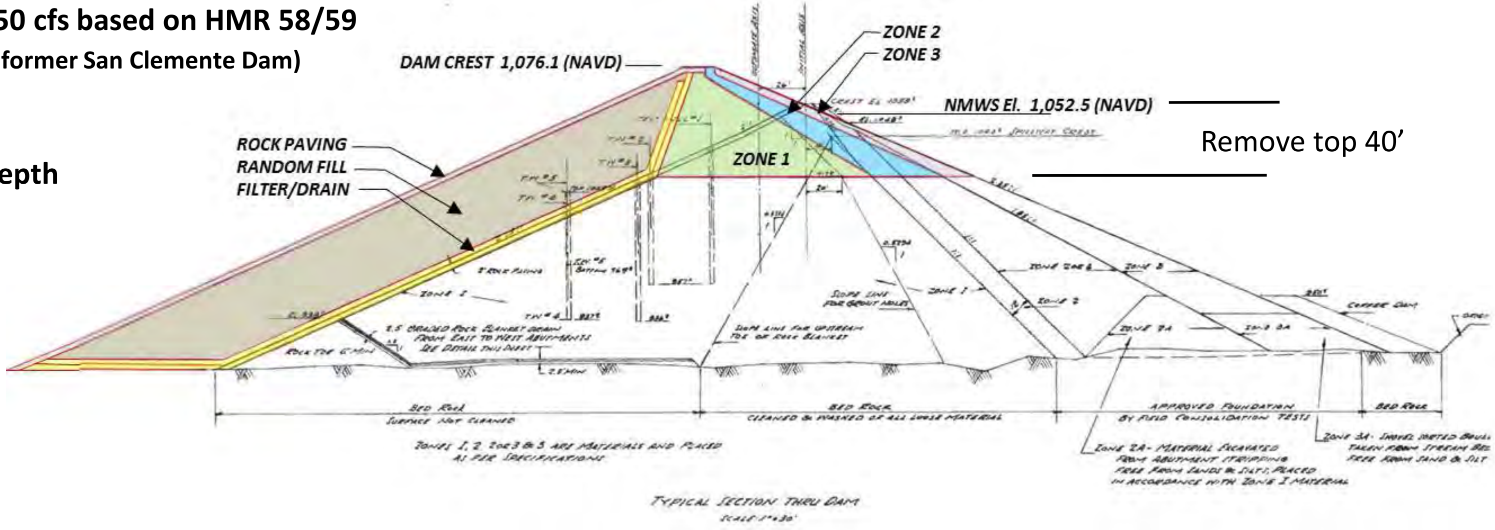
Alternatives Descriptions TM

Alternative 4a: Expand with Dam Raise

Dam Crest Elevation

- **Current PMF of 31,579 cfs based on HMR 36**
- **Updated PMF est of 42,250 cfs based on HMR 58/59**
  (pro-rated based on PMFs for former San Clemente Dam)

1,052.5 Spillway crest
+ 21.5 est. PMF water depth
+ 2.0 freeboard
1,076.1 feet



Material Sources

- **Zone 1 from alluvial fan deposits at the top of terrace deposits that form base of disposal sites A, B, and C**
- **Zone 2, Zone 2, Random Fill from coarse sediment in upstream LPD and terrace gravels under alluvial fan deposits**
- **Filter/Drain potentially processed from coarse sediment in LPD or imported from commercial sources**

Alternatives Descriptions TM

Alternative 4a: Expand with Dam Raise

Spillway Modifications

- Raise spillway crest 9.6 feet and raise right and left gravity walls 15.6 feet
- Chute wall would likely also need to be raised
- Left gravity wall could require post-tensioned anchoring to meet seismic requirements

Outlet Works Modifications

- Confirm operability of upstream slide gate and hydraulic operating system for 9.6 additional feet of reservoir head
- Modify high-level outlet to extend through spillway modifications
- Confirm that DSOD emergency drawdown criteria can be satisfied through the combined high- and low-level outlets
    - Drain 50 percent of the reservoir capacity in 7 days, and
    - Drain the entire reservoir in 20 days

Alternatives Descriptions TM

Alternative 4b: Expand with Rubber Dam

Description

- Install rubber dam on spillway crest to allow temporary NMWS El. 1,052.5
- Temporarily Increase current storage from 1,601 AF to 2,187 AF (586 AF increase) at end of precipitation season
- Requires modification to spillway
- Requires small downstream dam raise; dam may require additional modification to meet current seismic stability criteria

Construction Duration

- 1 construction season

Relative Cost

- Judged to be low ($10M to $30M) to moderate ($30M to $70M)

Alternatives Descriptions TM

Alternative 4b: Expand with Rubber Dam

Obermeyer Gate at Salinas River Diversion Facility

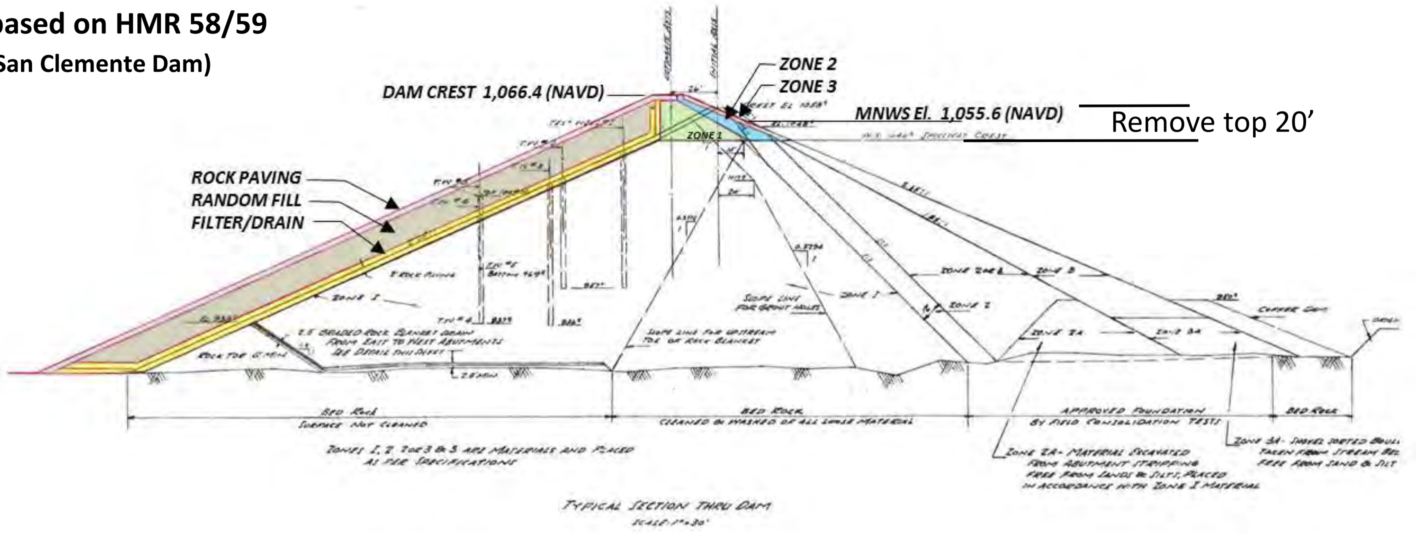
Alternatives Descriptions TM

Alternative 4b: Expand with Rubber Dam

Dam Crest Elevation

- **Current PMF of 31,579 cfs based on HMR 36**
- **Updated PMF est of 42,250 cfs based on HMR 58/59**
  (pro-rated based on PMFs for former San Clemente Dam)

	1,042.9	Spillway crest
+	21.5	est. PMF water depth
+	2.0	freeboard
	1,066.4	feet



Material Sources

- **Zone 1 from alluvial fan deposits at the top of terrace deposits that form base of disposal sites A, B, and C**
- **Zone 2, Zone 2, Random Fill from coarse sediment in upstream LPD and terrace gravels under alluvial fan deposits**
- **Filter/Drain potentially processed from coarse sediment in LPD or imported from commercial sources**

Alternatives Descriptions TM

Alternative 4b: Expand with Rubber Dam

Spillway Modifications

- Modify crest to install rubber dam such that spillway capacity is not reduce when rubber dam is lowered
- Likely need to raise right and left gravity walls 3.9 feet
- Left gravity wall could require post-tensioned anchoring to meet seismic requirements

Outlet Works Modifications

- Modify high-level outlet to extend through spillway modifications
- Confirm that DSOD emergency drawdown criteria can be satisfied through the combined high- and low-level outlets
  - Drain 50 percent of the reservoir capacity in 7 days, and
  - Drain the entire reservoir in 20 days

Alternatives Descriptions TM

Alternative 4c: New Dam Downstream

Description

- Construct new dam approximately 3,000 feet downstream of existing LPD
- Narrowest location downstream of current dam within Cal-Am property
- Maximum storage 7,529 AF at NMWS 1,052.5 feet (increase of 5,928 AF)
- Requires modification to spillway and likely to dam

Construction Duration

- 7,529 AF RCC 4 const. seasons Embankment 5 const. seasons
- 3,000 AF RCC 3 const. seasons Embankment 4 const. seasons

Relative Cost

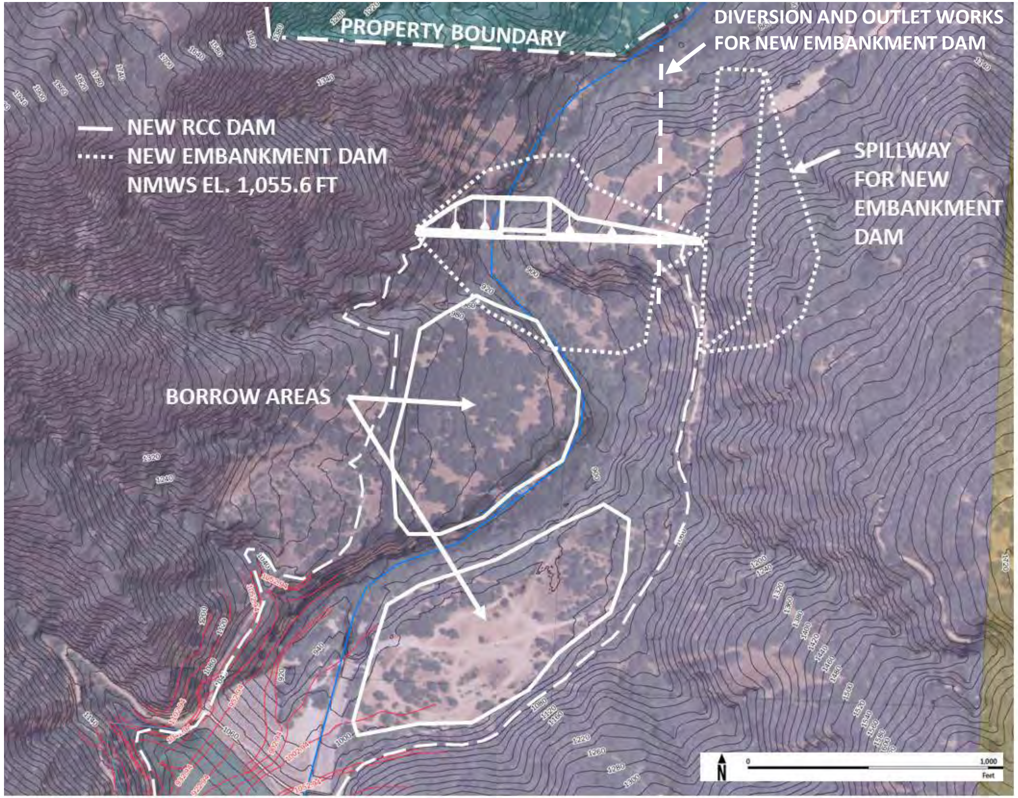
- 7,529 AF RCC high ($70M to $150M) Embankment very high (>$150M)
- 3,000 AF RCC moderate ($30M to $70M) Embankment high ($70M to $150M)

Alternatives Descriptions TM

Alternative 4c: New Dam Downstream

Table 2-3 Summary of Potential New Dams Downstream of Los Padres Dam

NMWS (feet)	Storage Capacity (AF)	Dam Height (feet)	Embankment Dam Volume (CY)	RCC Dam Volume (CY)
1,007	3,000	152	1,100,000	230,000
1,042.9	6,311	193	2,100,000	400,000
1,052.5	7,529	203	2,400,000	460,000



Material Sources for Embankment dam

- Similar to Alternatives 4a and 4b
- Existing dam materials would also be used
- The required volume plus reserve may not be present for 7,529 AF reservoir

Material Sources for RCC dam

- Aggregate from terrace gravel and underlying rock
- Cement and flyash would need to be imported

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Alternatives Descriptions TM

Alternative 4d: Expand with Combination

Description

- Install new RCC dam downstream combined with Alternative 4a or 4b
- New downstream dam height restricted about 45 feet high
  - New dam storage capacity of about 200 AF for total project storage of 2,387 AF (total increase of 786 AF)
  - Maintains freeboard of 100-year event plus 2 feet between existing LPD outlet and NMWS of new dam
- RCC used to allow flood flows to pass over spillway crest built into dam

Construction Duration

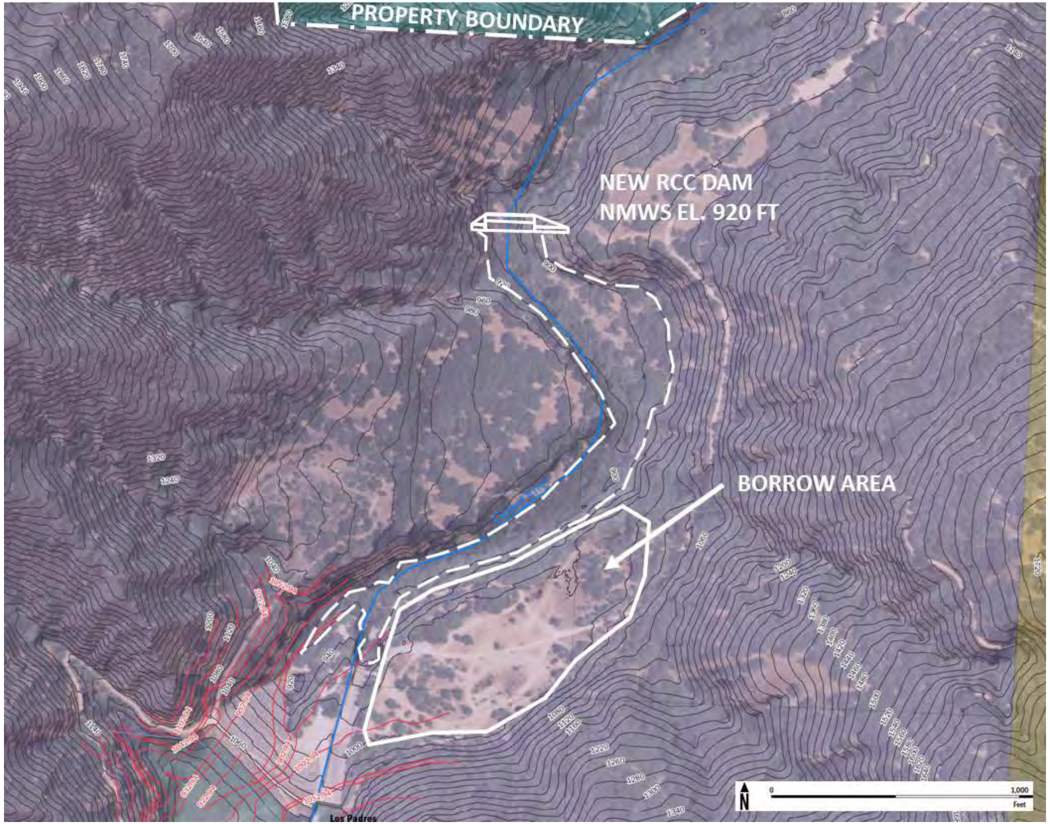
- 2 to 3 construction seasons

Relative Cost

- Judged to be moderate ($30M to $70M)

Alternatives Descriptions TM

Alternative 4d: Expand with Combination



Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic dredging
2. Sediment sluicing through a new sluicing tunnel
3. Constructing a new bypass tunnel to transport sediment around the reservoir

Alternatives Descriptions TM

Option 1: Periodic Sediment Removal Off-Site

Description

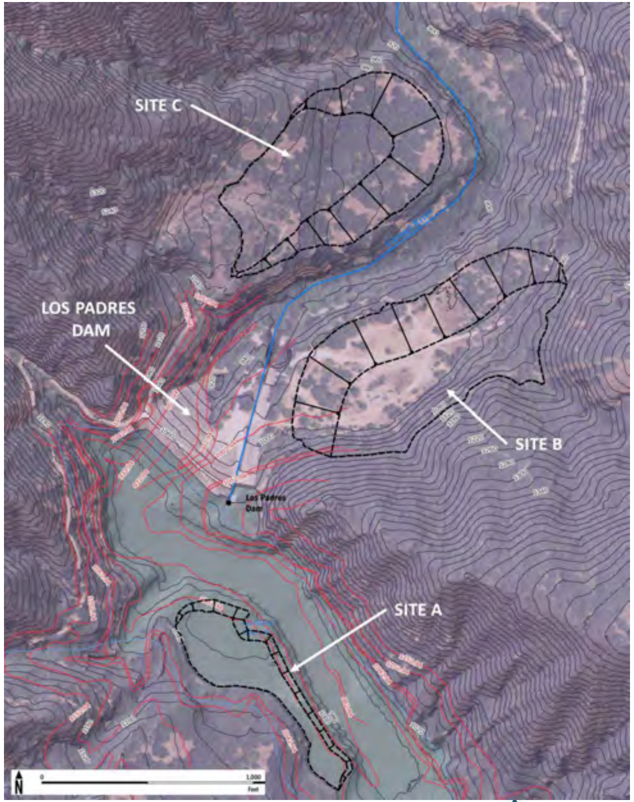
- Excavation of ~60,750 CY every 5 years of Zone 2 and 3 sediment from upstream half of reservoir
  - Most sediment currently being trapped appears to be Zone 2 and 3
  - Based on 7.5 AF/year an estimated 12,150 CY of Zone 2 and 3 sediment is trapped each year
- Reconstruct access road to upstream each time
- Hauling for placement in Disposal Sites B and C

Construction Duration

- One 3-month construction season every five years

Relative Cost

- Judged to be moderate ($30M to $70M)



Alternatives Descriptions TM

Option 2: Periodic Sediment Removal & Placement Downstream of LPD

Description

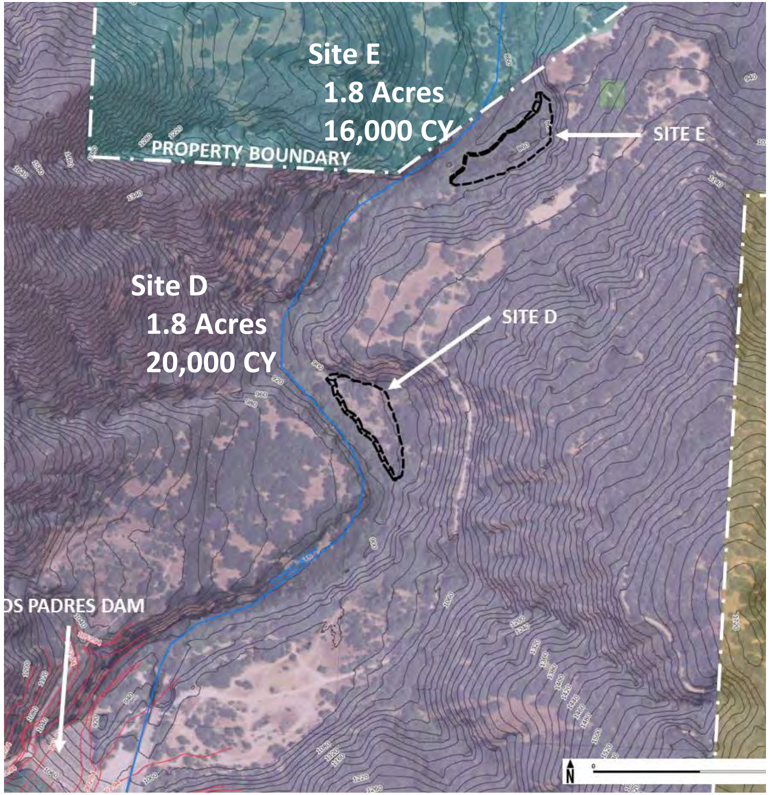
- Clear Sites D and E (current flood plain terraces)
- Excavate ~36,000 CY every 10 years of Zone 3 sediment from upstream half of reservoir
  - Based on 7.5 AF/year an estimated 4,050 CY of Zone 3 sediment is trapped each year
- Hauling for placement in Sites D and E
- Option 2 could be combined with Option 1

Construction Duration

- One 1-month construction season every five years

Relative Cost

- Judged to be low ($10M to $30M)



Alternatives Descriptions TM

Option 2: Periodic Sediment Removal & Placement Downstream of LPD

Table 3-1 Peak Flood Depth and Velocity for Various Flood Events at Site D

Manning's n	Event	2-year	5-year	10-year	20-year	50-year	100-year
	Flow (cfs) (AECOM 2017a)	1,500	3,200	4,500	5,800	7,600	8,900
	Channel Depth (feet)	13.5					
0.045	Flow normal depth (feet)	7.24	9.62	10.93	12.02	13.30	**14.11**
0.07		8.54	11.35	12.90	**14.19**	**15.70**	**16.66**
0.1		9.77	12.98	**14.74**	**16.22**	**17.95**	**19.04**
0.045	Average flow velocity in channel (feet/second)	10.30	12.45	13.56	14.44	15.45	16.08
0.07		7.39	8.94	9.73	10.37	11.09	11.54
0.1		5.66	6.84	7.45	7.94	8.49	8.83

- **Used simple Manning's calculations to estimate accessibility of Sites D and E to flood flows**
- **Result indicate that 10-year or greater flows required to fully access Sites D and E**
- **The reliability of Sites D and E to provide desired function would require:**
    - **Removal of existing armor of boulders**
    - **Grading to shape areas for greater access by flood flows**

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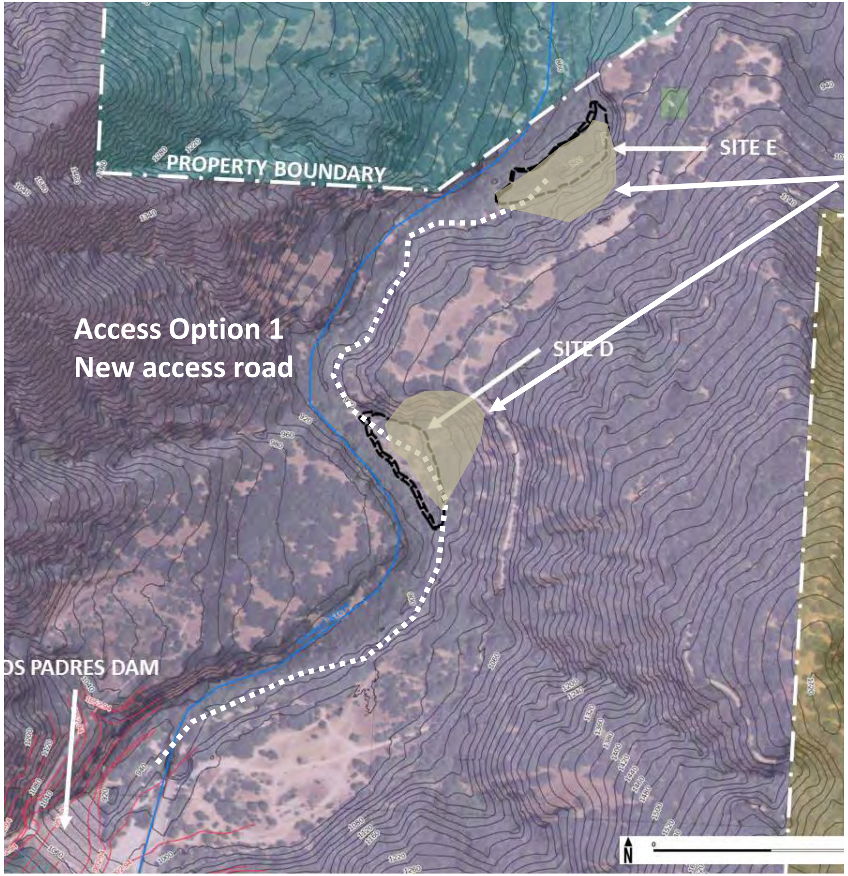
Alternatives Descriptions TM

Option 2: Periodic Sediment Removal & Placement Downstream of LPD



Access Option 2
Dump from Nason Road to produce "debris slides"

Alternatives Descriptions TM

Option 3: Sluicing Tunnel

Description

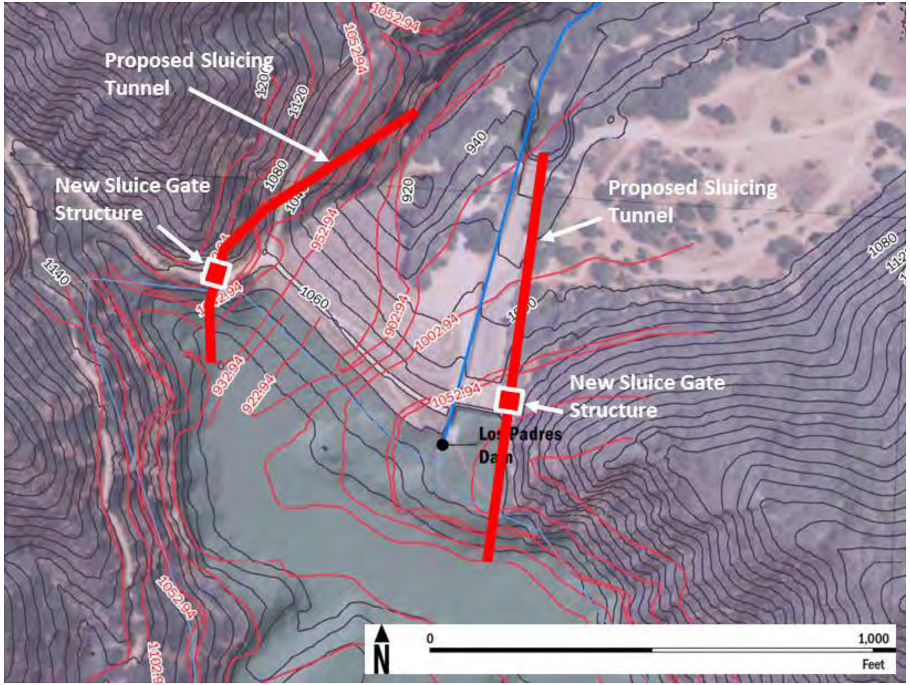
- Install approx. 900-foot long tunnel through either left or right abutment
- Flush sediment during wet water years
- Assuming majority of Zone 1 and Zone 2 sediment can be flushed, reservoir capacity would be 2,600 AF; actual capacity would be less and would be based on the size of channel that would result in the reservoir sediment

Construction Duration

- 2 construction seasons

Relative Cost

- Judged to be low ($10M to $30M)



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Alternatives Descriptions TM

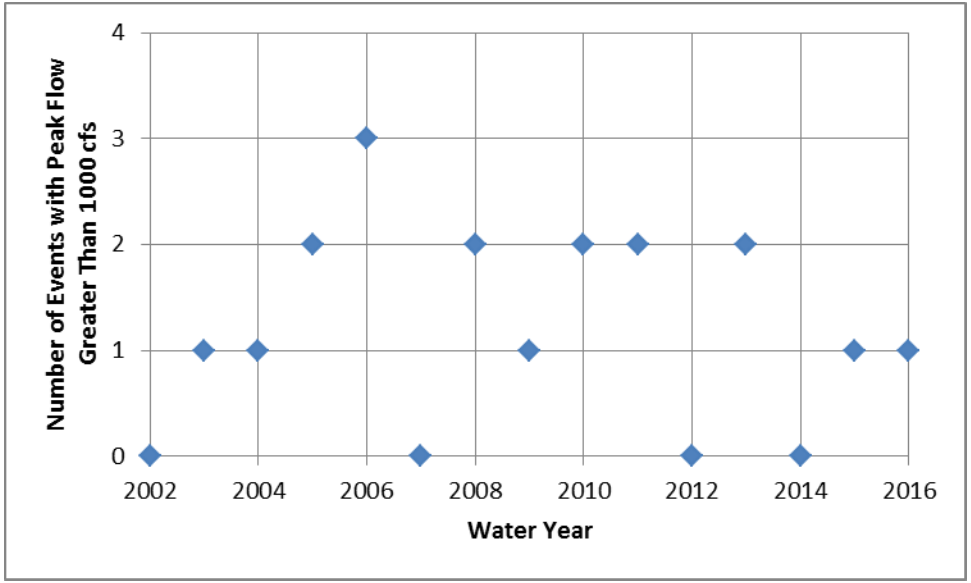
Option 3: Sluicing Tunnel

- Simple calculations assuming uniform flow in horseshoe tunnels suggest:
  - 12-foot tunnel would pass 5-year (3,200 cfs)
  - 13.5-foot tunnel would pass 10-year (4,500 cfs)
  - 15-foot tunnel would pass 20-year (5,800 cfs)

- Minimum flushing flows
  - Determined based on sediment transport analyses
  - Assuming 1,000 cfs could have flushed 11 of past 15 years

- Reservoir refilling
  - About 6.5 days to refill reservoir at 200 cfs
  - Minimum stream flows maintained through releases from low level outlet

- Sluicing tunnel would have to consider large amount that comes down from watershed



Alternatives Descriptions TM

Option 4: Bypass Tunnel

Description

- Construct ~7,000-foot bypass tunnel
- Tunnel sizes of 13 feet to 16.5 feet to pass 5-year (3,200 cfs) to 20-year (5,800 cfs) storm events
- Bypass tunnel would convey sand and finer sediment during high-flow events
- 15,000 cy settling basin upstream of the intake would trap coarser sediment, requiring cleanout every 5 years on average

Construction Duration

- 3 construction seasons

Relative Cost

- Judged to be very high (>$150M)

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Alternatives Descriptions TM
Summary of Relative Cost, Storage Capacity, and Schedule

Alternative/ Option	Description	Relative Cost [a, b]	Storage Capacity in 60 Years (AF): Low Sedimentation Rate (7.53 AFY)	Storage Capacity in 60 Years (AF): High Sedimentation Rate (15.86 AFY)	60-Year Implementation [c]
1a	No Sediment Management	Very Low	1,150	650	– – O 60-year
2a + 3a	Full Dam Removal + Dredge Zone 1 & Zone 2	High	0	0	D&P 5-year C 7-year O 48-year
2a + SM-3	Full Dam Removal + Sluicing Tunnel	Moderate	0	0	D&P 5-year C 5-year O 50-year
2b + SM-3	Partial Dam Removal + Sluicing Tunnel	Moderate	0	0	D&P 5-year C 5-year O 50-year
3a	Dredge and Place on Cal-Am Property	High	2,300	1,900	D&P 3-year C 6-year O 51-year
3b	Dredge and Place off Cal-Am Property	not practicable			
4a	Raise LPD	Moderate	1,700	1,400	D&P 5-year C 2-year O 53-year
4b	Rubber Dam in LPD Spillway	Low	1,700	1,400	D&P 5-year C 1-year O 54-year
4c (RCC)	New 7.5 TAF RCC Dam Downstream of LPD	High	7,100	6,600	D&P 5-year C 4-year O 51-year
4c (Emb)	New 7.5 TAF Embankment Dam Downstream of LPD	Very High	7,100	6,600	D&P 5-year C 5-year O 50-year
4c (RCC)	New 3.0 TAF RCC Dam Downstream of LPD	Moderate	2,500	2,000	D&P 5-year C 3-year O 52-year
4c (Emb)	New 3.0 TAF Embankment Dam Downstream of LPD	High	2,500	2,000	D&P 5-year C 4-year O 51-year
4d	Combo 4c + 4a or 4b	Moderate	2,100	1,600	D&P 5-year C 3-year O 52-year
SM-1	Periodic Sediment Removal to Offsite Disposal Site	Moderate	1,600	1,100	D&P 3-year C 5-year O 57-year
SM-2	Periodic Sediment Removal and Placement Downstream	Very Low	1,200	700	D&P 3-year C 5-year O 57-year
SM-3	Sluicing Tunnel	Low	1,800	1,800	D&P 5-year C 2-year O 53-year
SM-4	Bypass Tunnel	Very High	1,400	1,200	D&P 5-year C 4-year O 51-year

[a] Relative cost does not include implementation of fish passage improvements
[b] Very Low ($0-10M), Low ($10-30M), Moderate ($30-70M), High ($70-150M), Very High (>$150M)
[c] D&P (Design and Permitting), C (Construction), O (Operation)

Alternatives Descriptions TM

Dam Safety Considerations

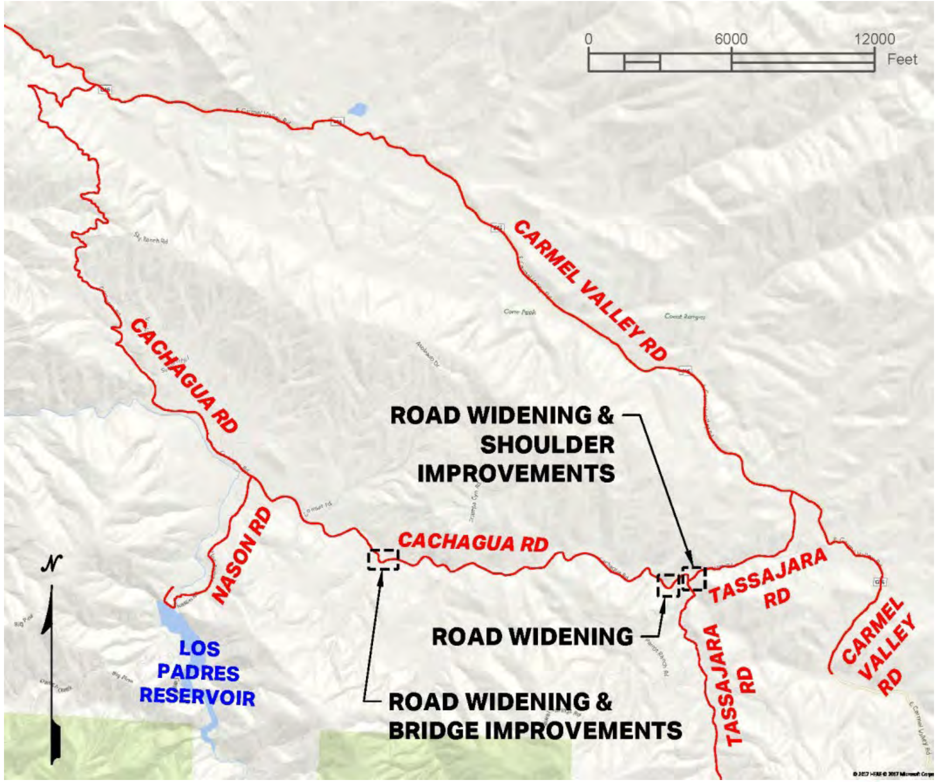
Alternative/ Option	Alternative/Option Description	Considerations
1a	No Sediment Management	Reservoir could fully fill with sediment; outlet needs to remain operational
2a + 3a	Full Dam Removal + Dredge Zone 1 & Zone 2	No effect; DSOD would approve design
2a + SM-3	Full Dam Removal + Sluicing Tunnel	No effect; DSOD would approve design
2b + SM-3	Partial Dam Removal + Sluicing Tunnel	No effect; DSOD would approve design; confirm stability of remaining dam
3a	Dredge and Place on Cal-Am Property	No direct effect on safety of LPD; confirm stability of Disposal Site B
4a	Raise LPD	Improvements designed to current standards; DSOD approves design
4b	Rubber Dam in LPD Spillway	
4c (RCC)	New 7.5 TAF RCC Dam Downstream of LPD	
4c (Emb)	New 7.5 TAF Embankment Dam Downstream of LPD	
4c (RCC)	New 3.0 TAF RCC Dam Downstream of LPD	
4c (Emb)	New 3.0 TAF Embankment Dam Downstream of LPD	
4d	Combo 4c + 4a or 4b	
SM-1	Periodic Sediment Removal to Offsite Disposal Site	No direct effect on safety of LPD; confirm stability of Disposal Site C
SM-2	Periodic Sediment Removal and Placement Downstream	No effect
SM-3	Sluicing Tunnel	No direct effect on LPD safety; DSOD would approve design/operation
SM-4	Bypass Tunnel	No effect

Alternative/Options 1a, 3a, SM-1, SM-2, SM-3, SM-4 assume that no future changes required to existing dam. Future potential for modification of spillway for HMR 58/59 PMF and evaluating (potential upgrading embankment) to meet current seismic standards are possible.

Alternatives Descriptions TM

Impact on Local Residents from Construction Traffic Considerations

- Based on San Clemente Dam removal project we know that construction traffic to LPD will be a serious concern to residents
- During SCD design some improvements where determined to be needed for construction traffic
- Vehicles mobilizing equipment and off-hauling or importing materials would likely need to be guided by pilot cars
- Likely restricted hours for mobilizing and hauling materials



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Alternatives Descriptions TM

Impact on Local Residents from Construction Traffic Considerations

Alternative/ Option	Alternative/Option Description	Number of construction seasons of impact	Off-haul of materials	Import of materials
1a	No Sediment Management	0	No	No
2a + 3a	Full Dam Removal + Dredge Zone 1 & Zone 2	7	Yes for demo	No
2a + SM-3	Full Dam Removal + Sluicing Tunnel	5	Yes for demo	Yes, minor for sluice tunnel
2b + SM-3	Partial Dam Removal + Sluicing Tunnel	5	Yes for demo	Yes, minor for sluice tunnel
3a	Dredge and Place on Cal-Am Property	6	No	No
4a	Raise LPD	2	Minimal	Possibly 2,300 – 3,000 loads filter/drain
4b	Rubber Dam in LPD Spillway	1	Minimal	Possibly 2,100 – 2,800 loads of filter/drain
4c (RCC)	New 7.5 TAF RCC Dam Downstream of LPD	4	Yes for demo	4,000 loads of flyash and cement
4c (Emb)	New 7.5 TAF Embankment Dam Downstream of LPD	5	Yes for demo	Possibly 15,000 – 20,000 loads of filter/drain
4c (RCC)	New 3.0 TAF RCC Dam Downstream of LPD	3	Yes for demo	2,000 loads of flyash and cement
4c (Emb)	New 3.0 TAF Embankment Dam Downstream of LPD	4	Yes for demo	Possibly 6,300 – 8,300 loads of filter/drain
4d	Combo 4c + 4a or 4b	3	Minimal	300 loads of flyash and cement Possibly 2,100 – 2,800 loads of filter/drain
SM-1	Periodic Sediment Removal to Offsite Disposal Site	5	No	No
SM-2	Periodic Sediment Removal and Placement Downstream	5	No	No
SM-3	Sluicing Tunnel	2	No	Yes, minor for sluice tunnel
SM-4	Bypass Tunnel	4	No	Yes, greater than for sluice tunnel

- Construction traffic each season would include mob/demob, personnel, supplies
- Off-haul and import of materials would occur over 1 to 3 seasons depending on alternative

Alternatives Descriptions TM

Summary of Sustainability Considerations

Alternative	Description	Starting Capacity (AF)	Years until Full (15.9 AF/year)[a]	Years until Full (7.5 AF/year)[b]
1a	No Sediment Management	1,600	100	210
2a + 3a	Full Dam Removal + Dredge Zone 1 & Zone 2	N/A	∞	∞
2a + SM-3	Full Dam Removal + Sluicing Tunnel	N/A	∞	∞
2b + SM-3	Partial Dam Removal + Sluicing Tunnel	N/A	∞	∞
3a	Dredge and Place on Cal-Am Property	2,708	169	357
4a	Raise LPD	2,187	137	288
4b	Rubber Dam in LPD Spillway	2,187	137	288
4c (RCC)	New 7.5 TAF RCC Dam Downstream of LPD	7,529	474	997
4c (Emb)	New 7.5 TAF Embankment Dam Downstream of LPD	7,529	474	997
4c (RCC)	New 3.0 TAF RCC Dam Downstream of LPD	3,000	189	400
4c (Emb)	New 3.0 TAF Embankment Dam Downstream of LPD	3,000	189	400
4d	Combo 4c + 4a or 4b	2,386	150	314

[a] Sedimentation rate calculation includes Marble Cone fire

[b] Sedimentation rate calculation excludes Marble Cone fire

Option	Description	Removal Volume (CY)	Removal Frequency (years)	Removal Duration (months)
SM-1	Periodic Sediment Removal to Offsite Disposal Site	60,750	5	2-3
SM-2	Periodic Sediment Removal & Placement Downstream	36,000	10	1
SM-3	Sluicing Tunnel	1,000	2	N/A
SM-4	Bypass Tunnel	Less than SM-3	N/A	N/A

Alternatives Descriptions TM

Summary of Geomorphology Considerations

Alternative	Description	Will coarse sediment continue to be trapped upstream of LPD?	Will there be a change in the amount of river channel?
1a	No Sediment Management	Yes	No change
2a	Full Dam Removal	No	Increase
2b	Partial Dam Removal	No	Increase
3a	Dredge and Place on Cal-Am Property	Yes	No change
4a	Raise LPD	Yes	Increase
4b	Rubber Dam in LPD Spillway	Yes	No change
4c	New Dam Downstream of LPD	Yes	Decrease
4d	Combo 4c + 4a or 4b	Yes	Decrease

Option	Description	Will coarse sediment continue to be trapped upstream of LPD?
SM-1	Periodic Sediment Removal to Offsite Disposal Site	Yes, but SM-1would move to Site B or Site C
SM-2	Periodic Sediment Removal & Placement Downstream	Degree of coarse sediment reintroduction would vary depending on storm flows
SM-3	Sluicing Tunnel	Degree of coarse sediment reintroduction would vary depending on sluice tunnel management
SM-4	Bypass Tunnel	Sand would bypass downstream. Gravel and cobbles would be handled as in SM-1 or SM-2

Alternatives Descriptions TM

Summary of Steelhead Considerations

Alt.	Description	BGS Affected?	Effects on U/S Passage	Effects on amount of riverine habitat	Effects on spawning gravel D/S of LPD	Effects on Streamflow
1a	No Sediment Management	Yes – sedimentation will impact BGS function in 50-105 years	New/improved upstream passage required*	No change	No change	As reservoir fills with sediment, loss of ability to enhance summer rearing habitat through flow releases.
2a	Full Dam Removal	N/A – fully volitional D/S passage	Fully volitional U/S passage	Gain of 9,000 feet	Increase	Loss of ability to enhance summer flows, potential decrease in rearing habitat due to increase in length of channel that dries in summer.
2b	Partial Dam Removal					
3a	Dredge and Place on Cal-Am Property	Yes – sedimentation will eventually impact BGS function	New/improved upstream passage required*	No change	No change	Additional dry season releases of ~3cfs/day, increase in quality and quantity of summer rearing habitat
4a	Raise LPD	Yes – increase in water surface elevation would require modification of BGS	New/improved upstream passage required*	Loss of about 300 feet	No change	Additional dry season releases of ~1.6cfs/day, increase in quality and quantity of summer rearing habitat
4b	Rubber Dam in LPD Spillway	Yes – increase in water surface elevation would require modification of BGS	New/improved upstream passage required*	Temporary inundation of about 300 feet	No change	Additional dry season releases of ~1.6cfs/day, increase in quality and quantity of summer rearing habitat
4c	New Dam Downstream of LPD	Yes – current facilities incompatible, would require replacement. Larger reservoir increases passage risks	New facilities required	Loss of 3,000 feet (7.5 TAF dam); 500 feet (3 TAF dam)	No change	Additional dry season releases of 13-16cfs/day, increase in quality and quantity of summer rearing habitat
4d	Combo 4c + 4a or 4b	Yes – increase in water surface elevation would require modification of BGS, new facilities required at D/S dam. Multiple reservoirs increase passage risks	New facilities required	Loss of 3,000 feet	No change	Additional dry season releases of 2.1cfs/day, increase in quality and quantity of summer rearing habitat

* Fish passage alternatives are currently being evaluated through the Los Padres Fish Passage Feasibility Study

Alternatives Descriptions TM

Summary of Steelhead Considerations

Option	Description	Beneficial Effects on D/S Habitat	Harmful Effects on Steelhead
SM-1	Periodic Sediment Removal to Offsite Disposal Site	None	None
SM-2	Periodic Sediment Removal & Placement Downstream	Increase in coarse sediment	None
SM-3	Sluicing Tunnel	May increase coarse sediment	Entrainment in sluice tunnel, effects associated with increased suspended sediment (mortality, injury, reduced ability to encounter prey, burial of redds)
SM-4	Bypass Tunnel	None	Entrainment in bypass tunnel, effects associated with increased suspended sediment (mortality, injury, reduced ability to encounter prey, burial of redds)

SEDIMENT TRANSPORT MODEL

Review the sediment transport model spin up run and trial run results

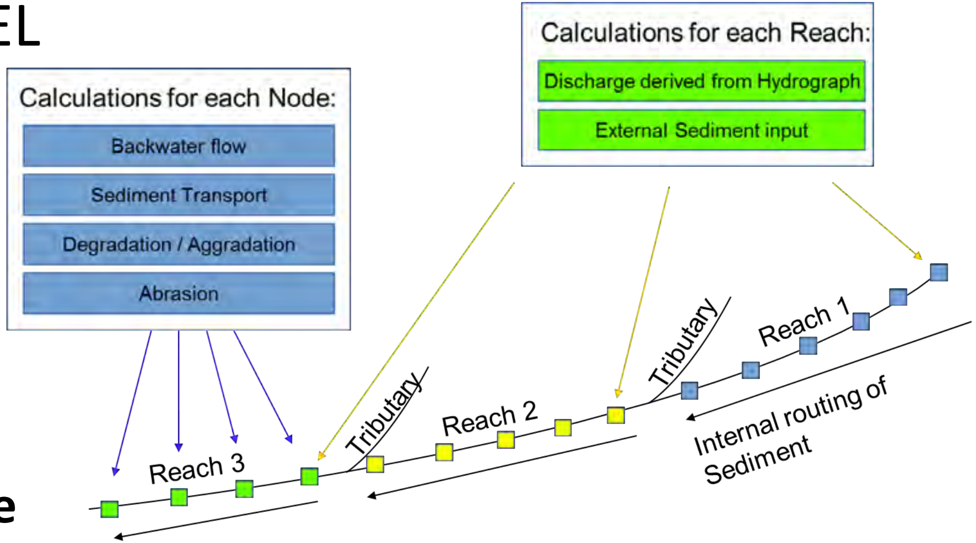
Decide which alternatives to model, how many hydrologic scenarios to model per alternative

MODEL DESCRIPTION

- Developed to simulate affect of large sediment pulses on mountain streams
- Focus on simulating many different scenarios to explore most likely outcome*

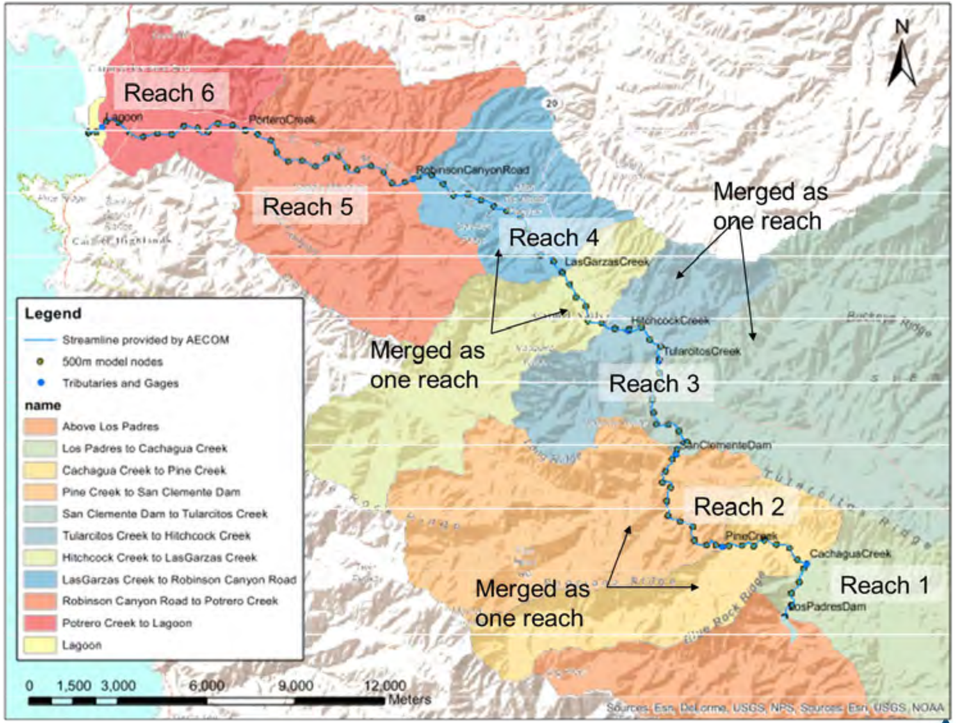
MODEL ADAPTATION TO CARMEL

- **Incorporated MPWMD hydrology**
- **Incorporated recent sediment texture data***
- **Incorporated updated tributary sediment supply curves**
- **Incorporated recent profile change at former San Clemente site**
- **Peaking factor for bedload estimation**



BESMo
Bedload Scenario Model

MODEL DOMAIN



Model reaches and boundaries

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BESMo
Bedload Scenario Model

GOALS FOR THIS MEETING

1. Review BESMo spin up and trial run results
2. Decide which dam alternatives to model and how many hydrologic scenarios to model per alternative
   - Goal is to provide a "most likely" channel evolution trajectories for different hydrologic conditions
   - Key is to identify hydrologic classification and number of runs to target in total – e.g. 50 simulations per alternative

QUESTIONS TO ADDRESS DURING THIS MEETING

1. Spin up :
   - Does BESMo project a comparable downstream response to that provided by URS with SRH-1D for the CRRDR planning?
2. Trial :
   - Are the logarithmic decay scenarios appropriate to represent the sediment release from the Los Padres Reservoir?
   - Is the constructed San Clemente project reach relatively erodible or non-erodible?

QUESTIONS TO ADDRESS DURING THIS MEETING

3. Alternatives:
   - How and which alternatives are we simulating?
   - How to batch scenarios? – i.e. how do we classify hydrograph types?
4. Presentation of results:
   - Special requests for presentation/summary of results?

BESMo Channel Evolution of the Carmel River
to Compare Against CRRDR Simulations

BESMo Channel Evolution of the Carmel River

Spin up Run - Model Differences

	URS (SRH-1D)	BESMo
Node distribution	Every Hec-Ras Cross-section	500m apart
Subsurface Representation	3 Layers (active + 2 subsurface)	100 Layers (active + 99 subsurface)
Sediment transport mechanics	Wu et al (2000)	Wilcock & Crowe (2003)
Model time step duration	Between 1 and 0.1 hours	5 minutes

Changes in model function from earlier presentations:

- We implemented abrasion in BESMo, but simulations showed that uncertainty in initial grain sizes is greater than the effect of abrasion. We chose to keep the model simpler by excluding abrasion.
- We tested simulations using Engelund & Hansen (1969) when sand > 40% and Wilcock & Crowe (2003) otherwise, but this resulted in too much erosion below tributaries due to the switch between lump transport (E&H) and size class based transport (W&C) and different thresholds of movement. We only use W&C now.

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BESMo Channel Evolution of the Carmel River

Spin up Run - Scenario Differences

	URS (SRH-1D)	BESMo
Time covered	51 years (1957-2008)	53 years (1963-2016)
Modelled distance	From San Clemente Dam plus 7,500 ft upstream to Lagoon: approx. 107,000 ft	From San Clemente Dam (plus 3,200 ft non-erodable boundary*) to Lagoon: approx. 103,200 ft (1000 mm at 1 m depth)
Hydrology	Daily flow record, Reach differences from flood rating curves.	Same approach*, different reaches and time frame of daily flood record
	Lagoon boundary condition: 2.85 ft water elevation.	Same approach
	No flood peaking factor	Peaking factor of 1.3 at flood days
Sediment supply	Tributary rating curves: Potrero, Robinson, Las Garcas, Hitchcock, Tularcitos	Same approach*, updated rating curves provided by Balance Hydraulics
Initial Particle Sizes	Distributions from MEI 2002 (per cross-section data)	MEI 2002 data, 2015 Data from Douglas Smith (CCoWS)

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* Even if we chose the same approach, we did not use the URS data. Our implementation in BESMo might differ.

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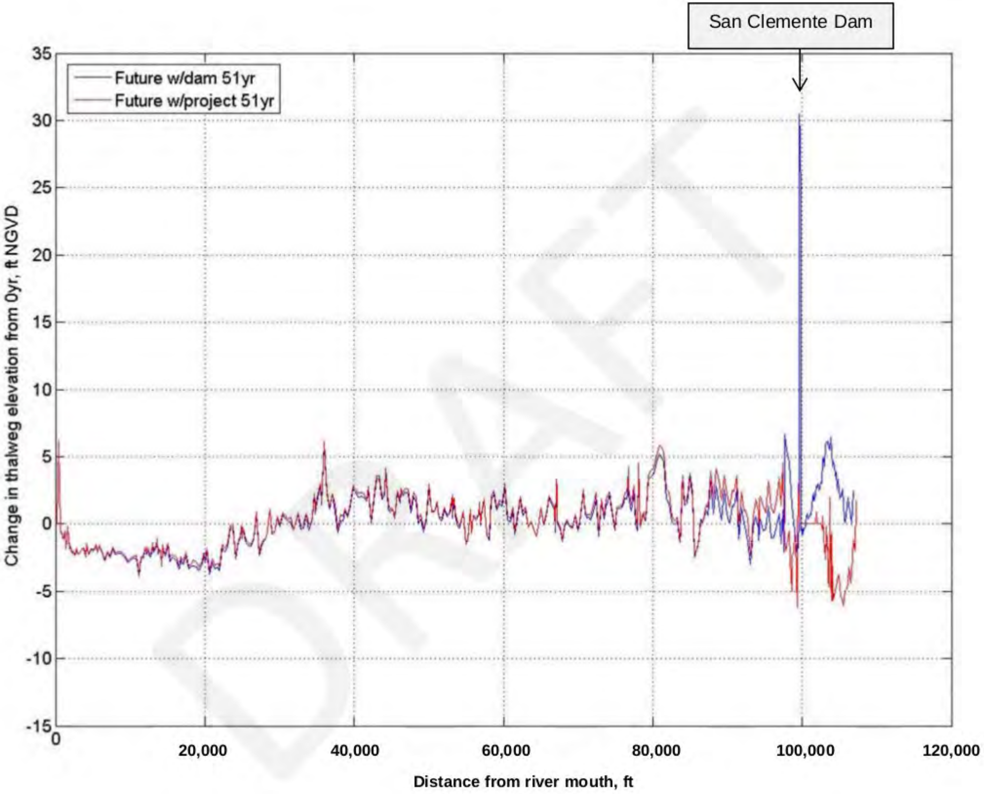
BESMo Channel Evolution of the Carmel River

Spin up Run – Profile Prediction

Original **URS** plot:
Future w/dam 51yr (blue)



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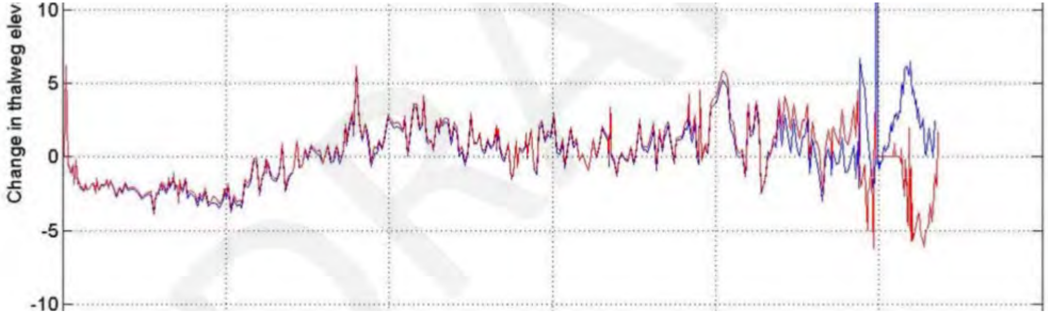
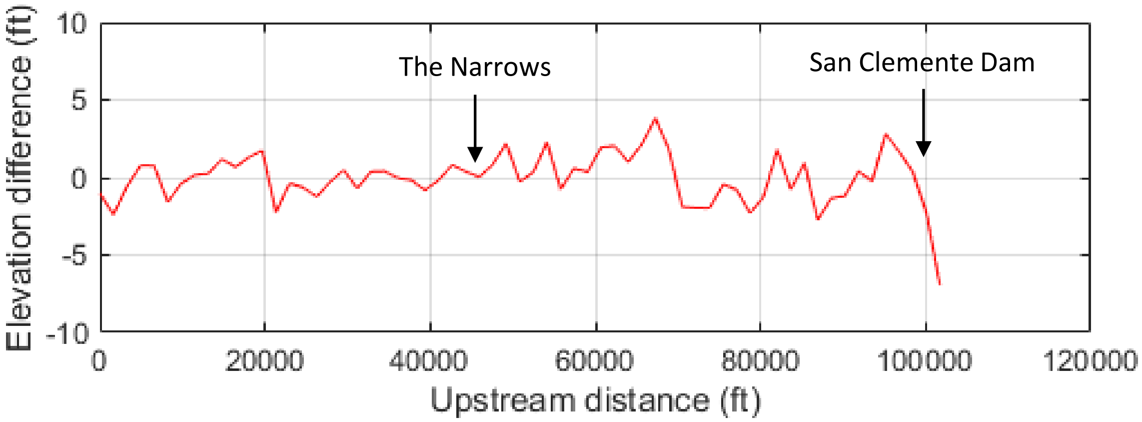
BESMo Channel Evolution of the Carmel River

Spin up Run – Profile Prediction

Original **URS** plot:
Future w/dam 51yr (blue)



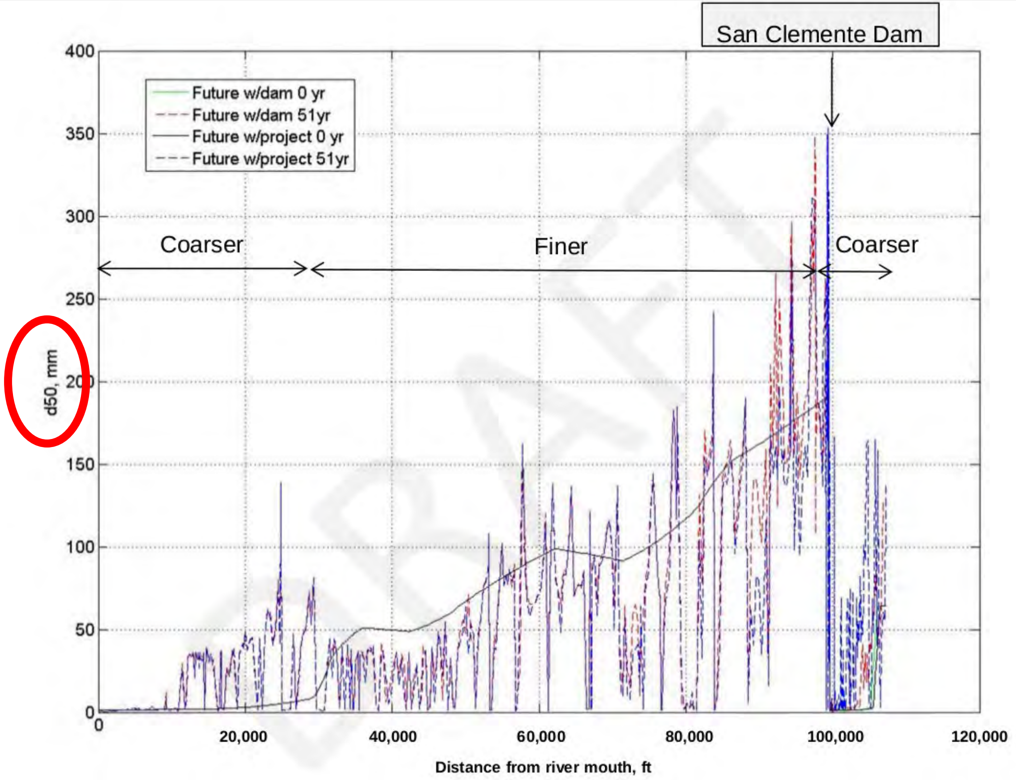
BESMo



BESMo Channel Evolution of the Carmel River

Spin up Run – Particle Size Prediction

Original **URS** plot:
Future w/dam 51yr (blue)



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BESMo Channel Evolution of the Carmel River

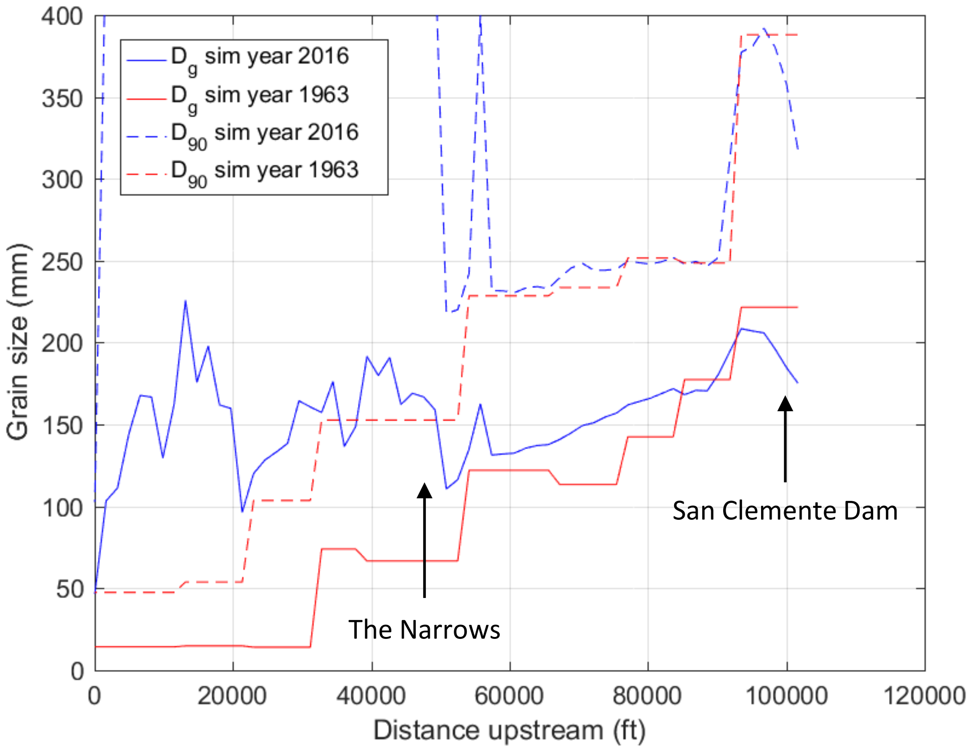
Spin up Run – Particle Size Prediction

BESMo

Bed gets coarser everywhere except below San Clemente creek

→ Highly armored bed

We increased the subsurface grain sizes below the 'Narrows' to prevent unrealistic erosion in sediment starving conditions



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

BESMo Channel Evolution of the Carmel River

Spin up Run - Conclusions

- Both models are different in spatial scale and input data
- The uncertainty in initial particle size distributions is very large (especially the lack of subsurface data)
- Erosion and deposition occur on similar scales and in similar locations
- Particle size is predicted to become much coarser in BESMo

BESMo Channel Evolution of the Carmel River
Los Padres Storage Decay Simulations

- Same model calibration as in spin up run
- Initial long profile from 2015/16 survey
- Sediment feed:
  - More tributaries
  - Storage decay from Los Padres
  - Only bedload simulated: particle sizes smaller than sand were removed from initial reservoir volume
- Hydrology:
  - Simulated 50 years of floods
  - Flood magnitudes, frequencies, and shapes determined randomly matching distributions from historical dataset

BESMo Channel Evolution of the Carmel River

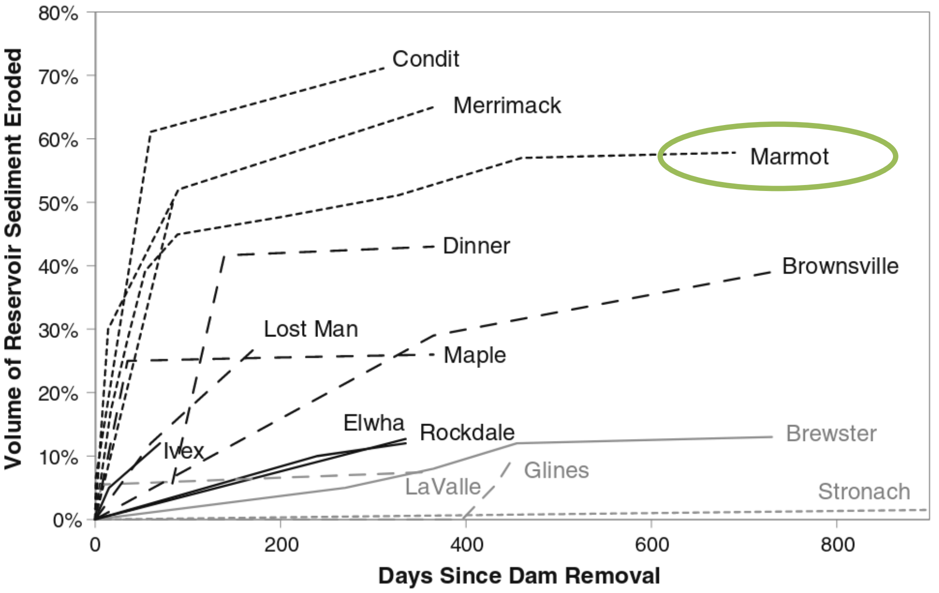
to Evaluate Los Padres Alternative

BESMo Channel Evolution of the Carmel River

Reservoir Erosion as Logarithmic Decay

- Empirical data supports approximating reservoir erosion as logarithmic decay

- Especially in cases where the sand content is high (dashed lines: sand > 55%)

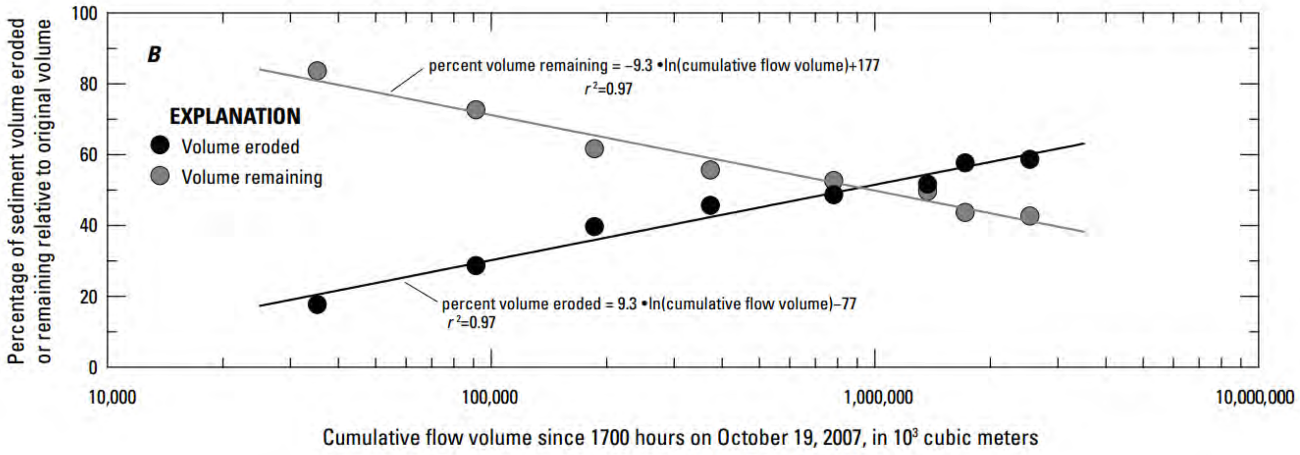


Grant, G. E., & Lewis, S. L. (2015). The Remains of the Dam: What Have We Learned from 15 Years of US Dam Removals?. In *Engineering Geology for Society and Territory-Volume 3* (pp. 31-35). Springer, Cham.

BESMo Channel Evolution of the Carmel River

Reservoir Erosion as Logarithmic Decay

- Marmot dam: Logarithmic decay as function of cumulative discharge

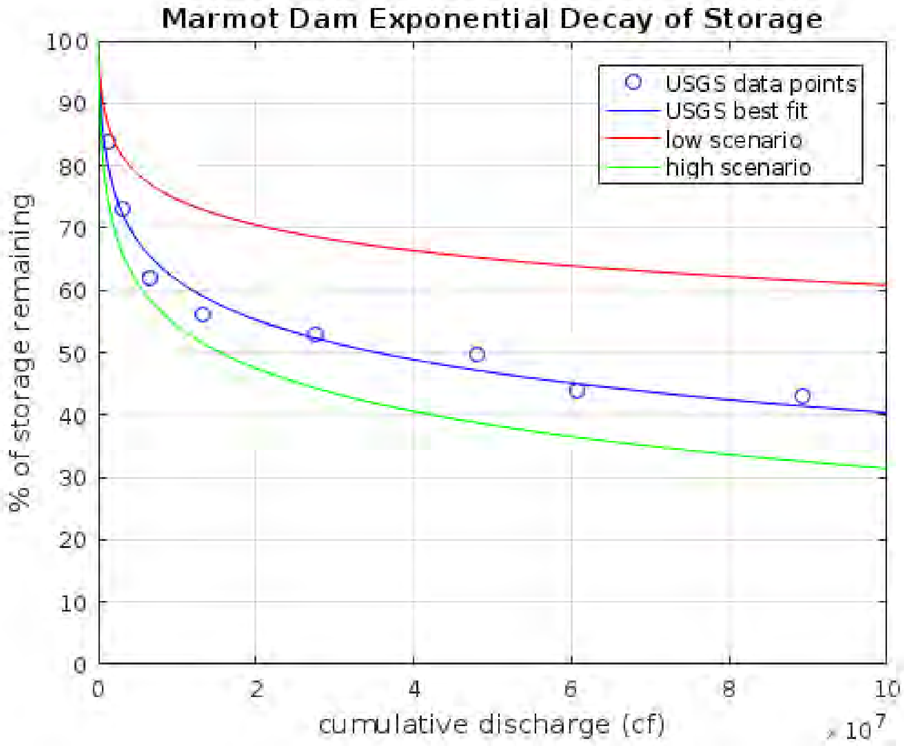


Major, J. J., O'Connor, J. E., Podolak, C. J., Keith, M. K., Grant, G. E., Spicer, K. R., ... & Rhode, A. (2012). *Geomorphic response of the Sandy River, Oregon, to removal of Marmot Dam*. US Department of the Interior, US Geological Survey.

BESMo Channel Evolution of the Carmel River
Los Padres Storage Decay Simulations

Three supply scenarios:

- **Low** (visual fit)
- **Best fit** (Marmot Dam)
- **High** (visual fit)



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BESMo Channel Evolution of the Carmel River

Hydrograph Simulation

Simulated discharge based on 'Near Carmel' USGS historical data

1. Random yearly maximum flow based on discharge analysis (HEC-SSP)

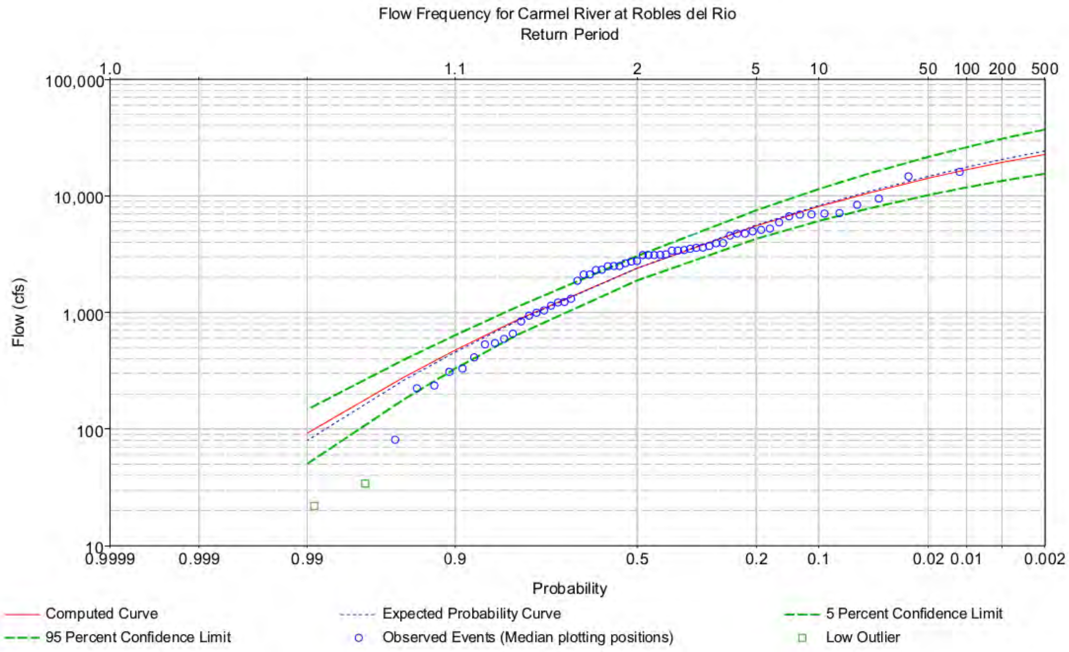
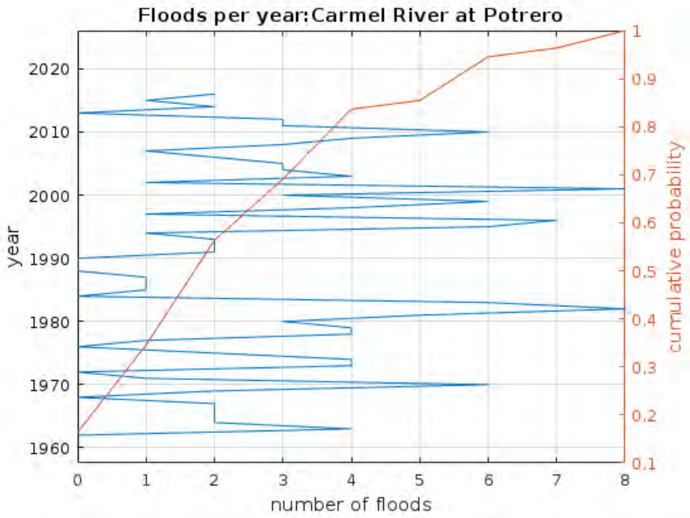


Figure 2-22. Flow Frequency for USGS Robles del Rio Gauge No. 11143200

BESMo Channel Evolution of the Carmel River
Hydrograph Simulation

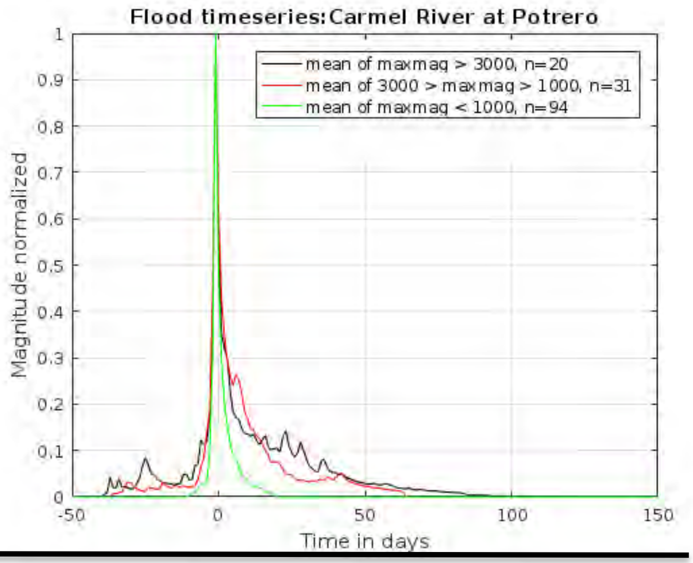
2. Random number of floods per year

Magnitude of flood events as ratio to maximum yearly flow (from historical data)



3. Flood shape from historical record

Classified by maximum daily mean discharge



4. Calendar day of floods based on probabilities from historical record

BESMo Channel Evolution of the Carmel River

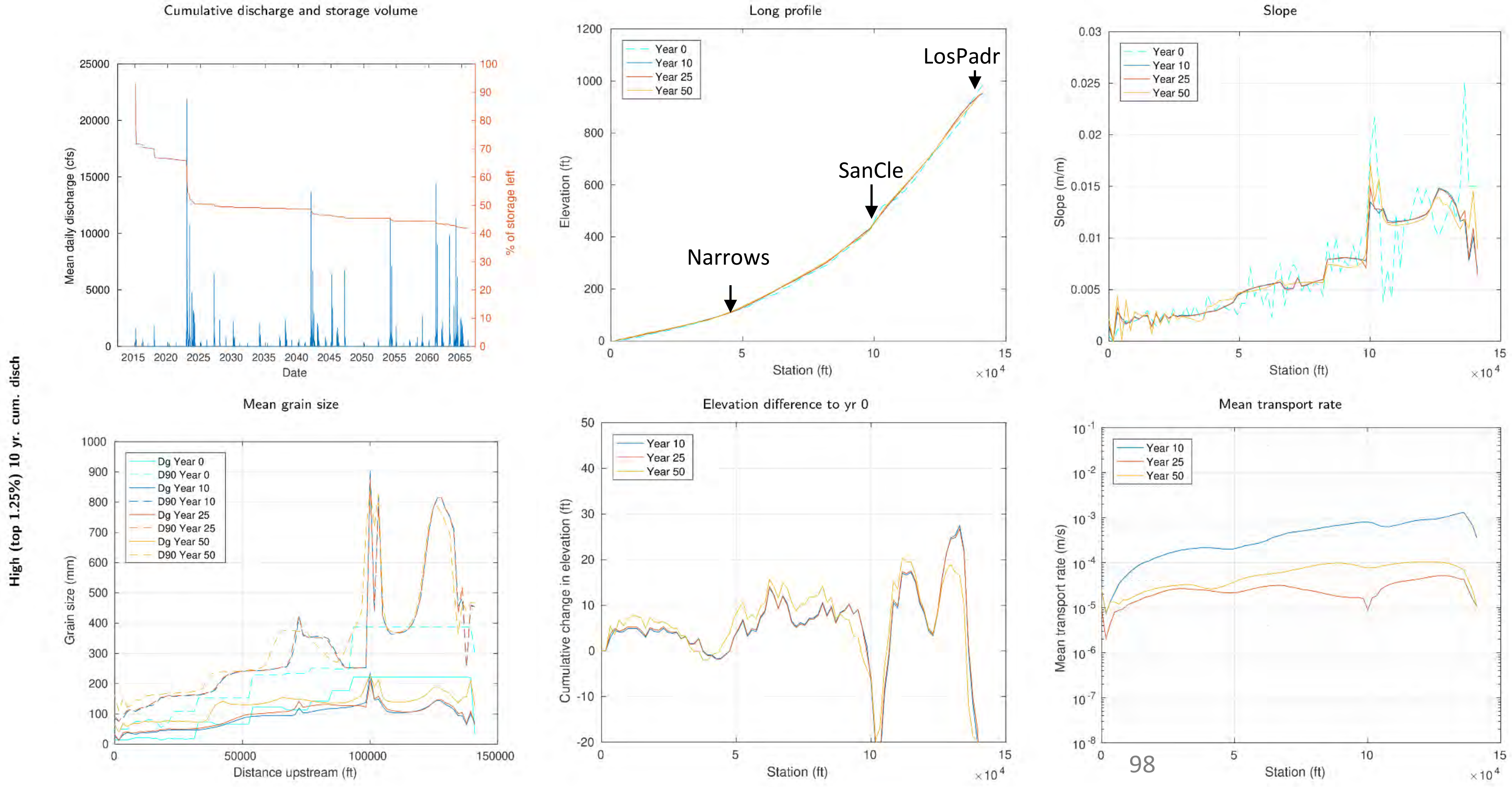
Trail Run Results

- 3 storage decay scenarios
  - Visual **low** fit scenario
  - USGS **best fit** scenario
  - Visual **high** fit scenario
- 4 types of hydrographs sampled from 80 random simulations
  - 1 x **High** 10 year cumulative discharge (top 1.25% of random samples)
  - 2 x **Average** 10 year cumulative discharge (top 25% and bottom 25%)
  - 1 x **Low** 10 year cumulative discharge (bottom 1.25%)

  (The same flood record is simulated for the separate decay scenarios)

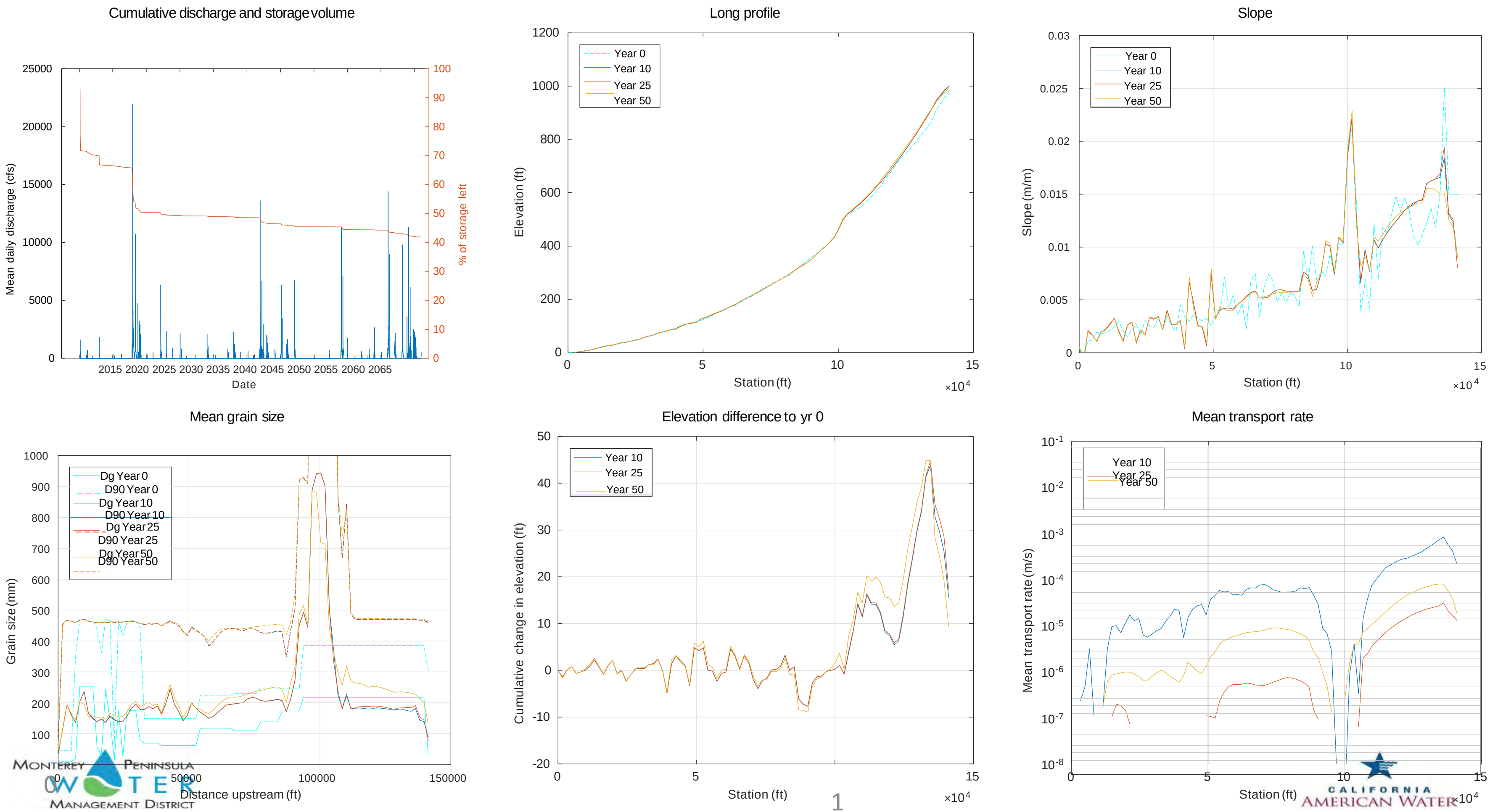
All combinations: 12 Simulations

Low Storage Decay & Very **High** 10 Year Cumulative Discharge – CRRDR Erodible



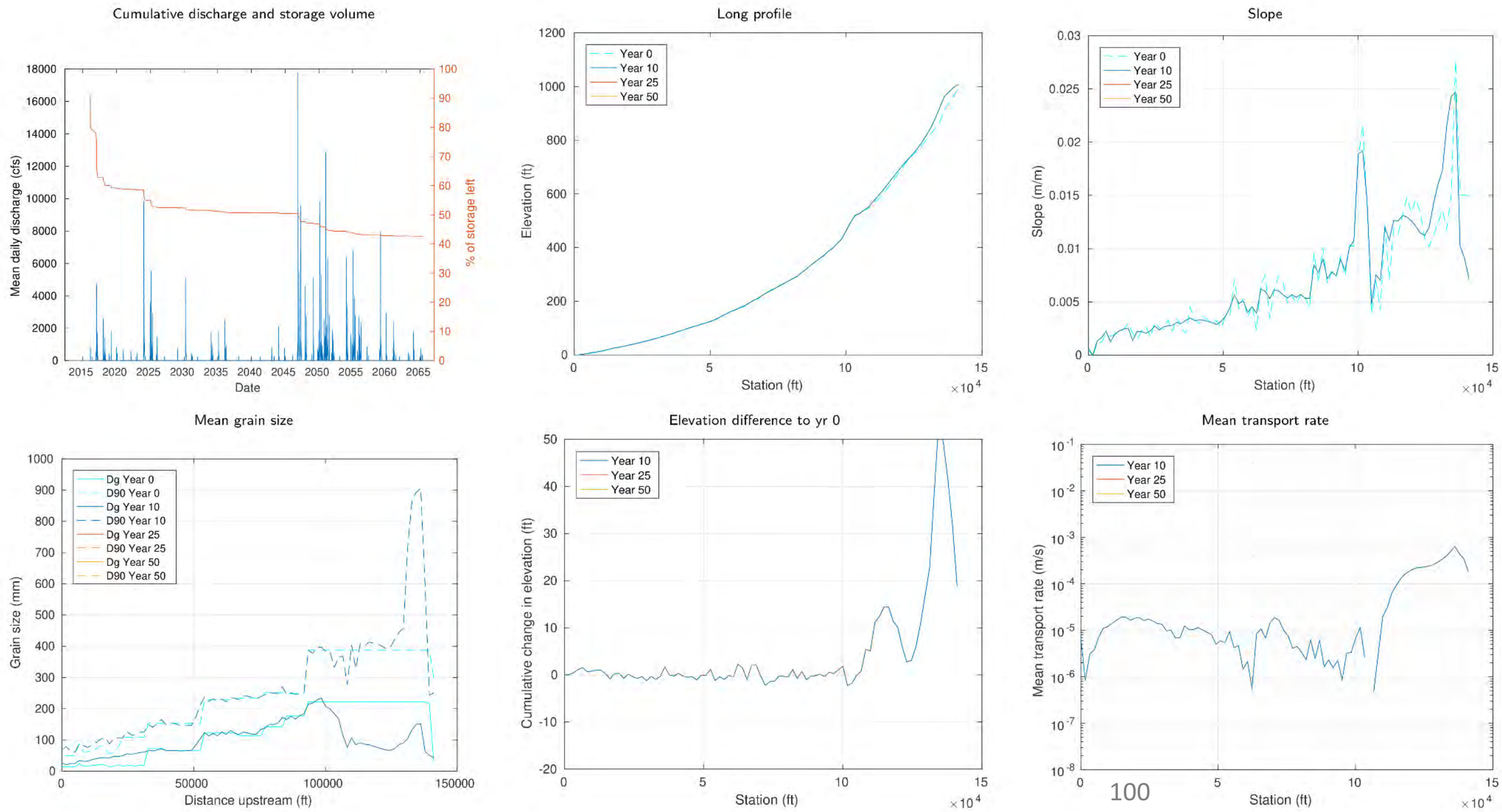
Low Storage Decay & Very **High** 10 Year Cumulative Discharge – CRRDR Non-erodible

High (top 1.25%) 10 yr. cum. disch



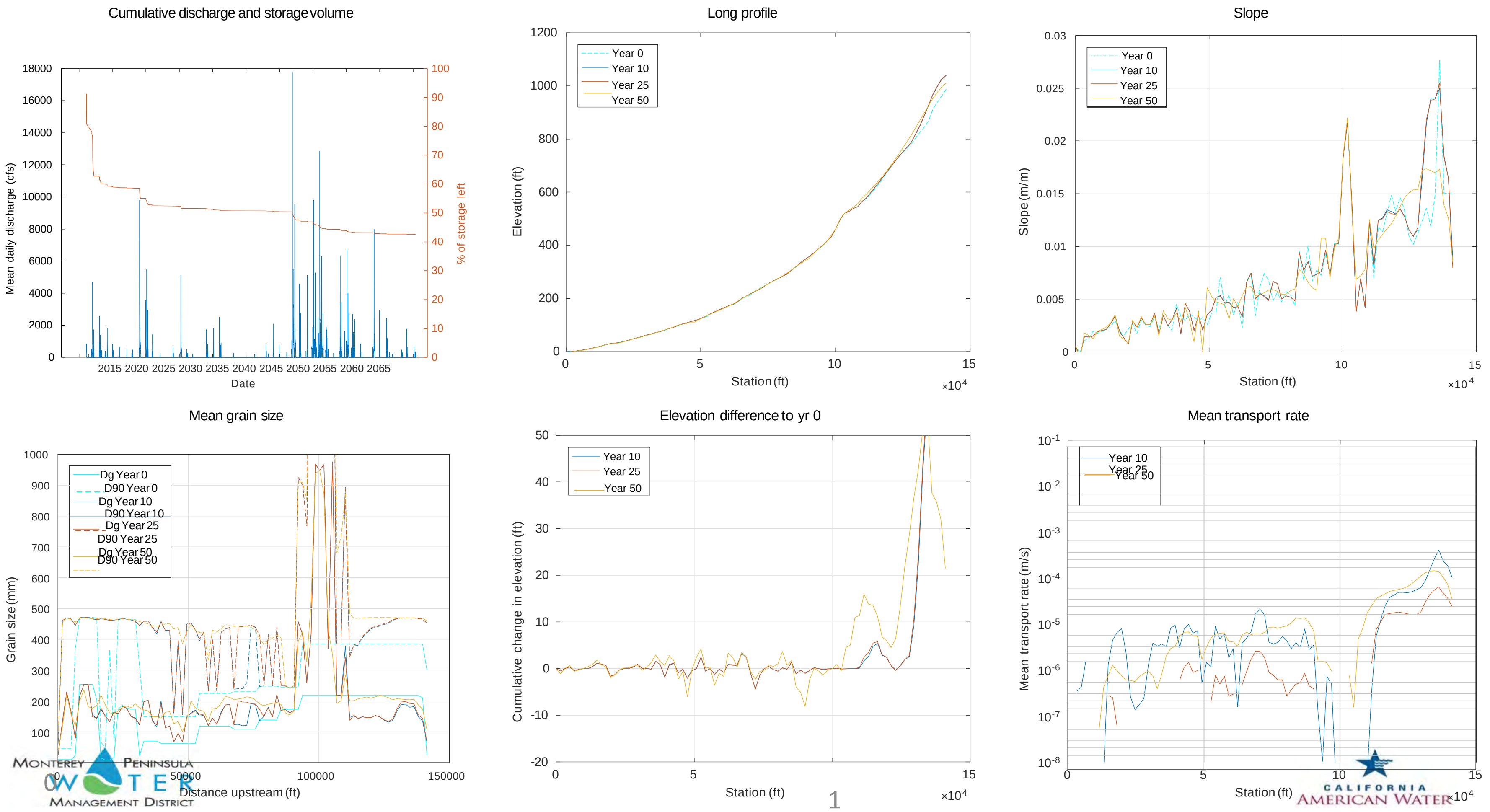
Low Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Erodible

Average (top 25%) 10 yr. cum. disch



Low Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Non-erodible

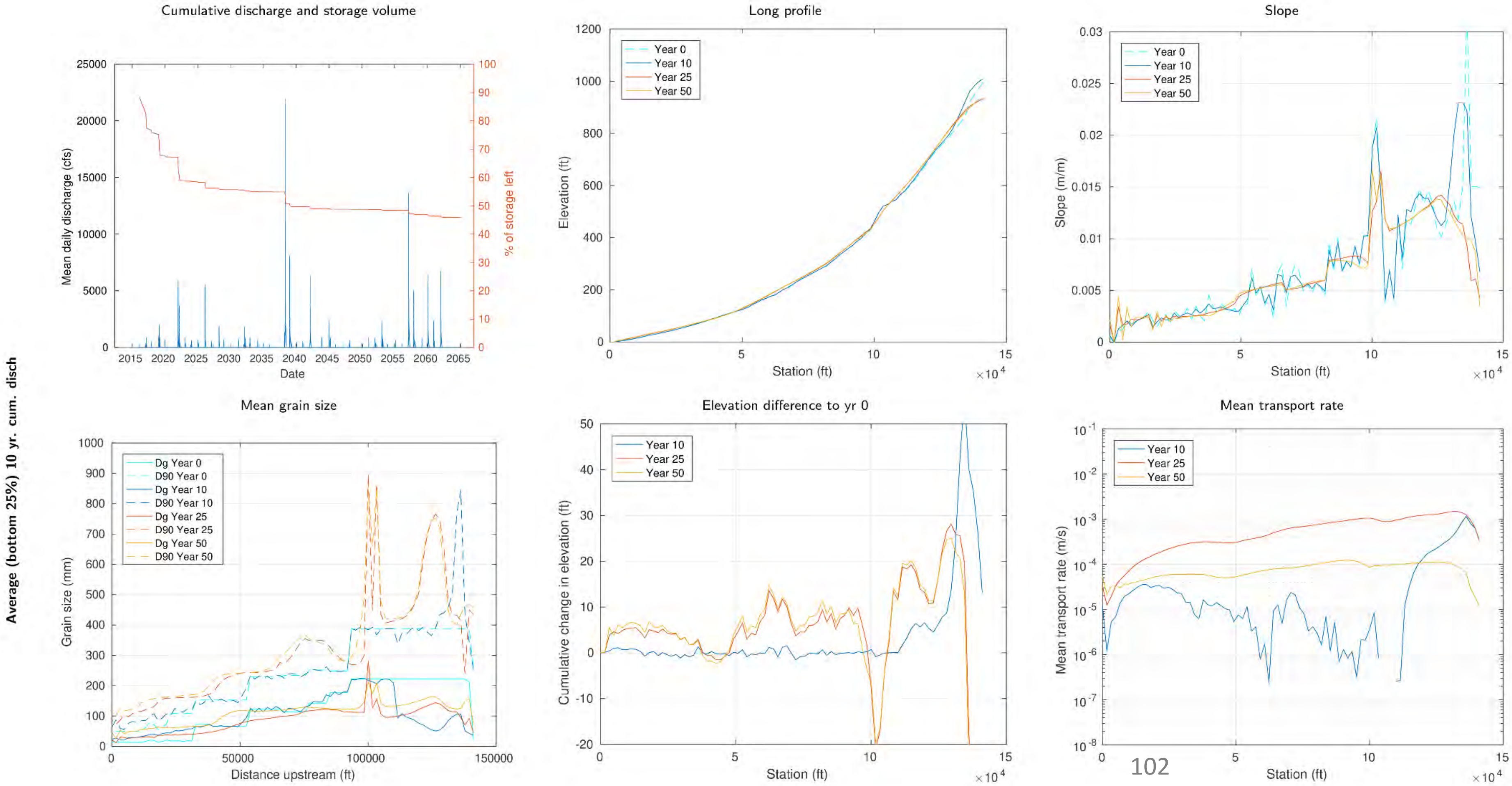
Average (top 25%) 10 yr. cum. disch



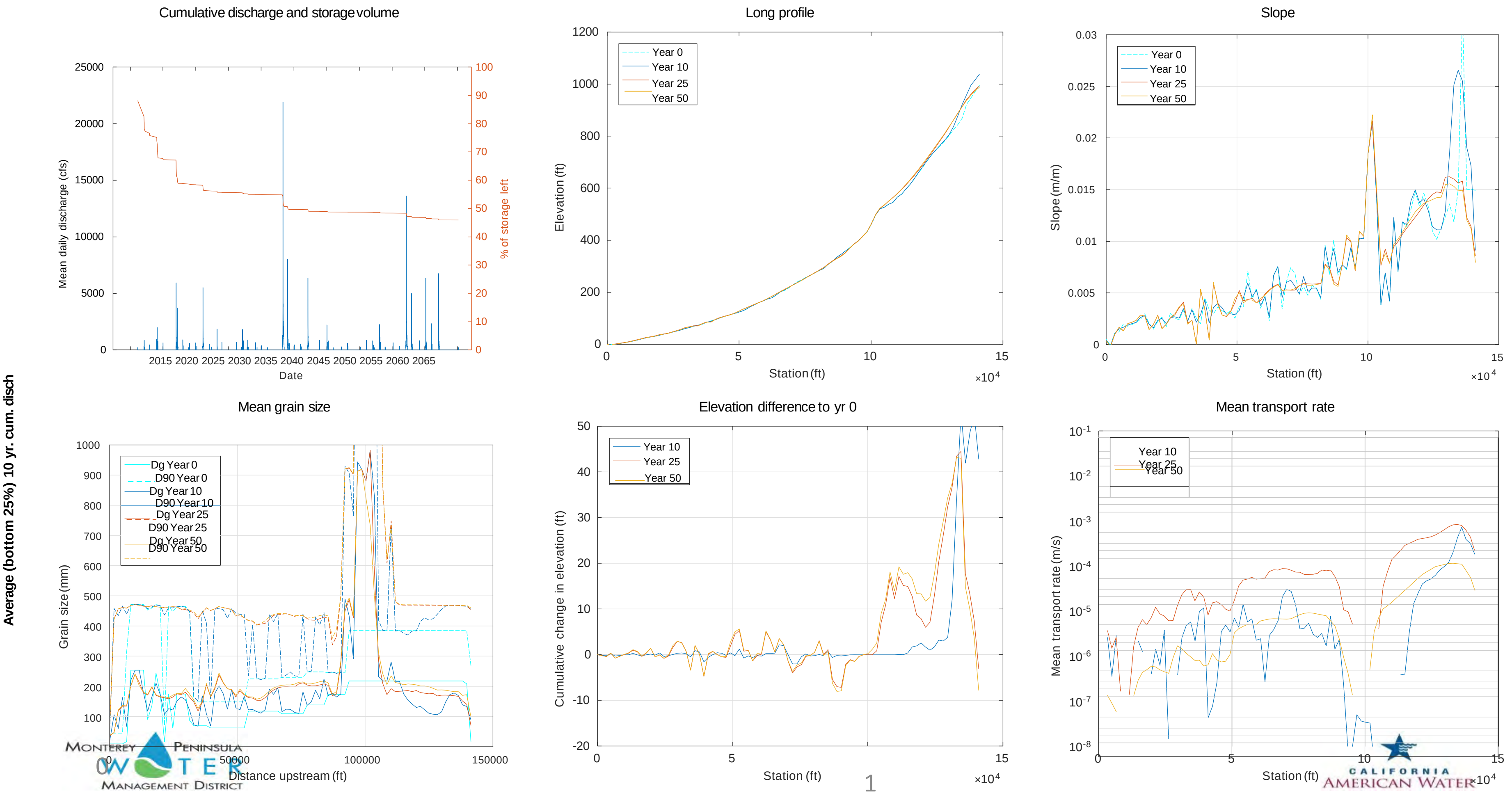
MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Low Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Erodible

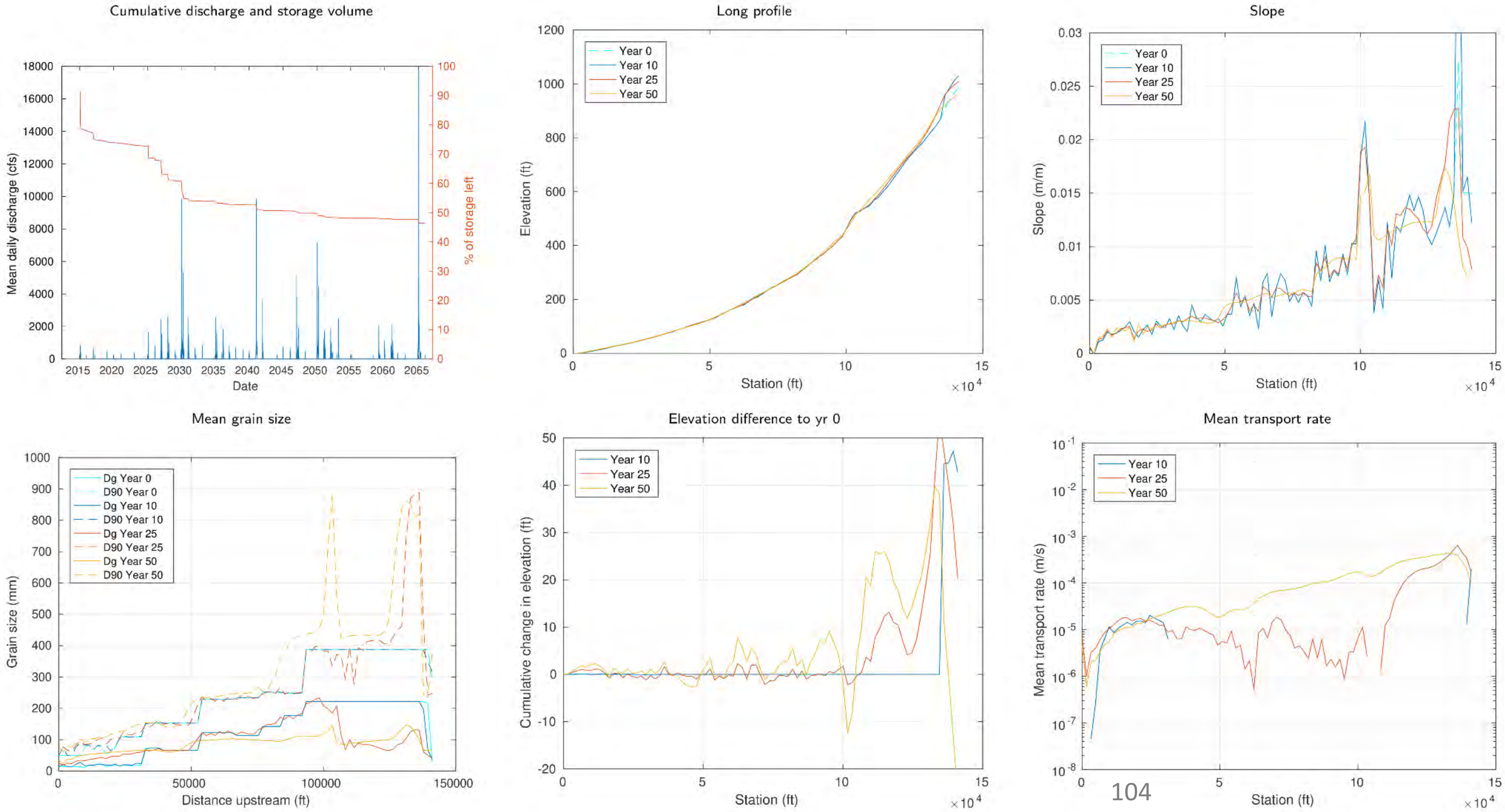


Low Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Non-erodible



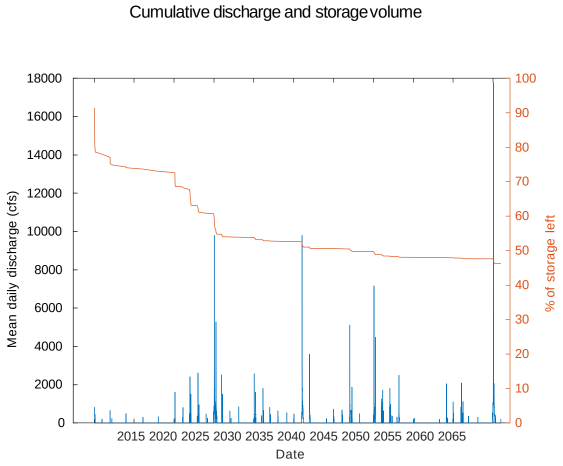
Low Storage Decay & Very **Low** 10 Year Cumulative Discharge – CRRDR Erodible

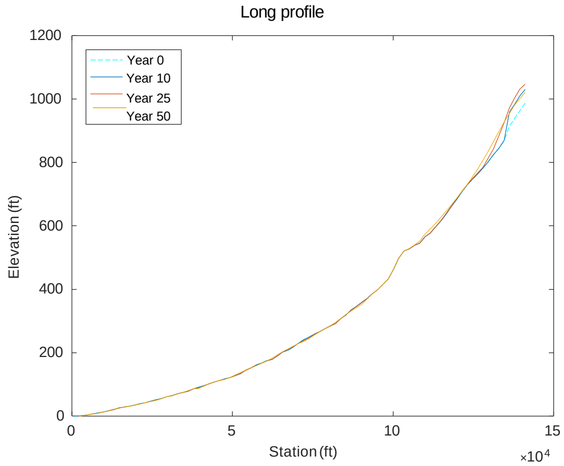
Low (bottom 1.25%) 10 yr. cum. disch

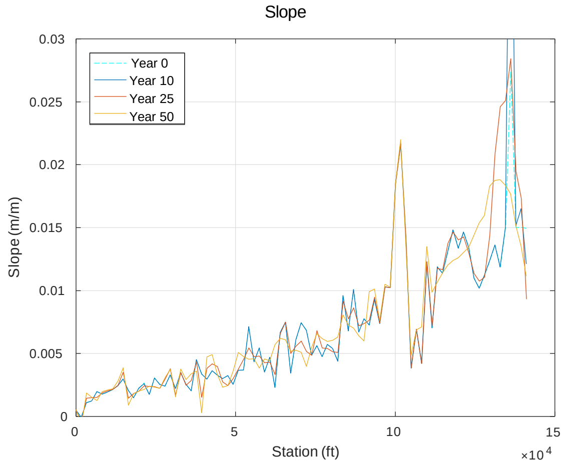


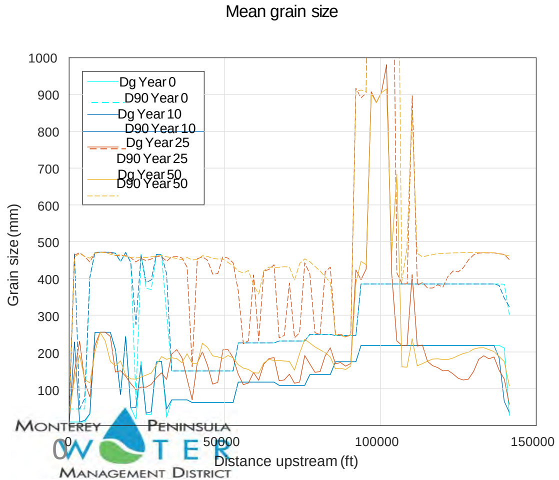
Low Storage Decay & Very **Low** 10 Year Cumulative Discharge – CRRDR Non-erodible

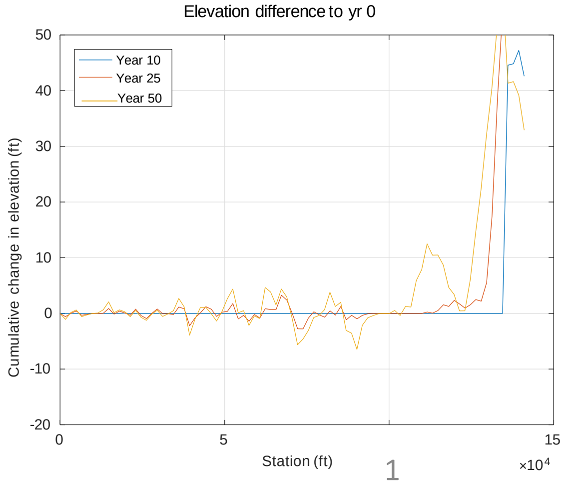
Low (bottom 1.25%) 10 yr. cum. disch

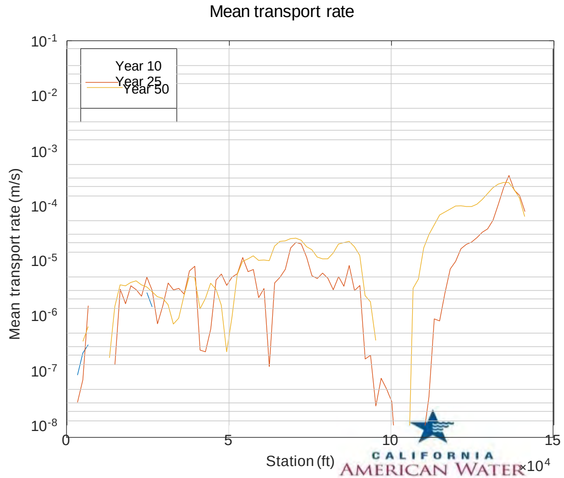






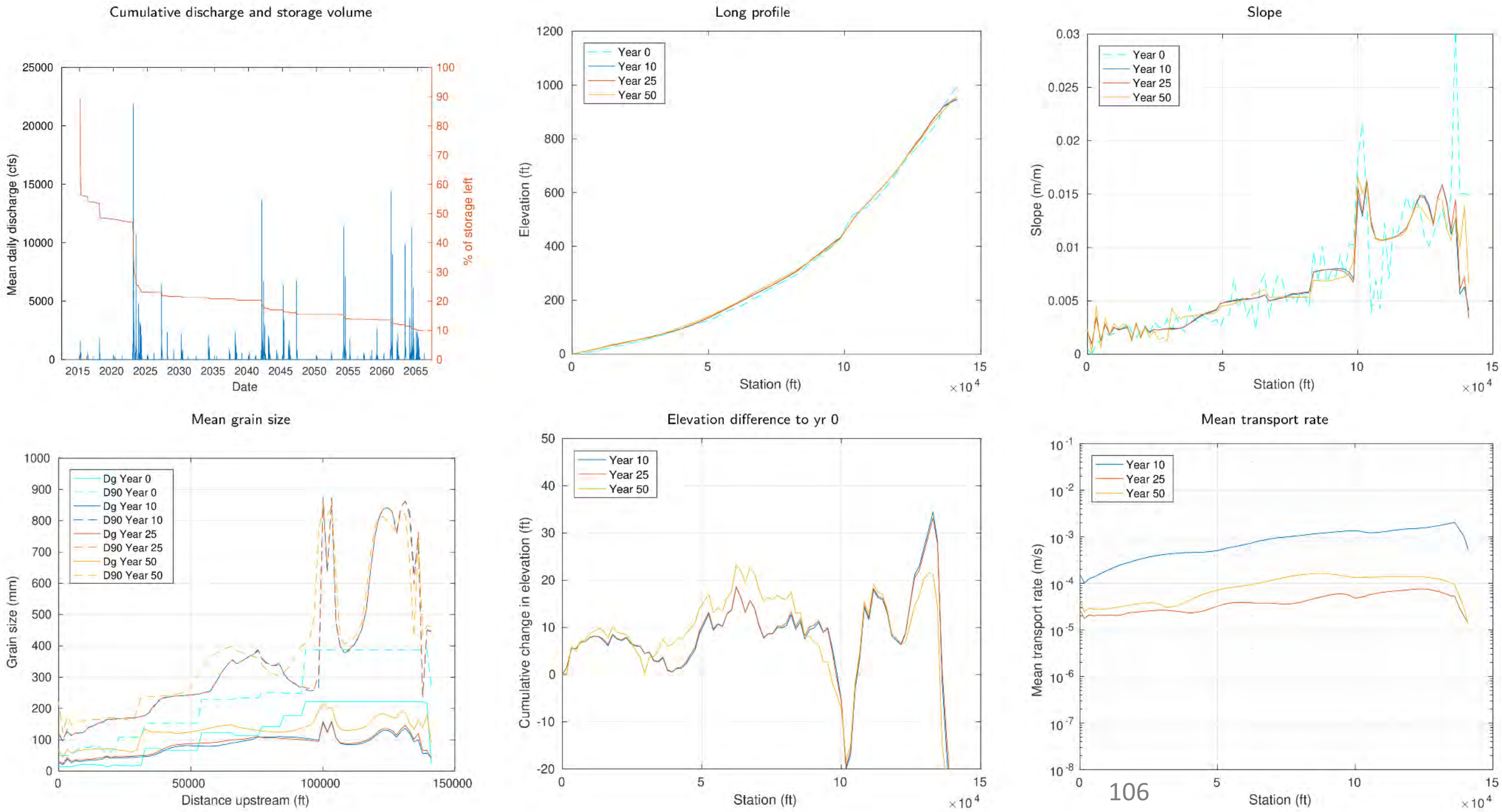




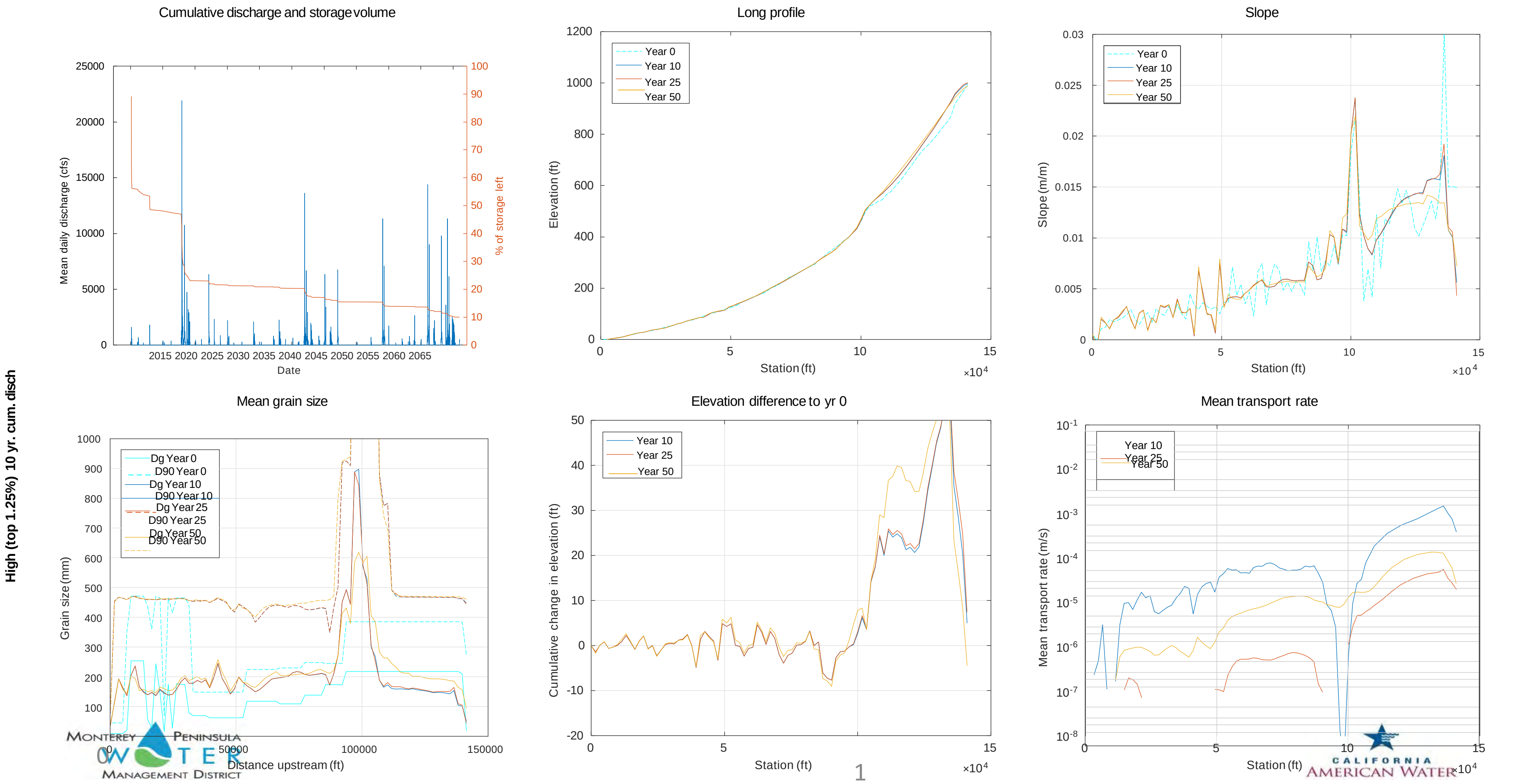


USGS best fit Storage Decay & Very **High** 10 Year Cumulative Discharge – CRRDR Erodible

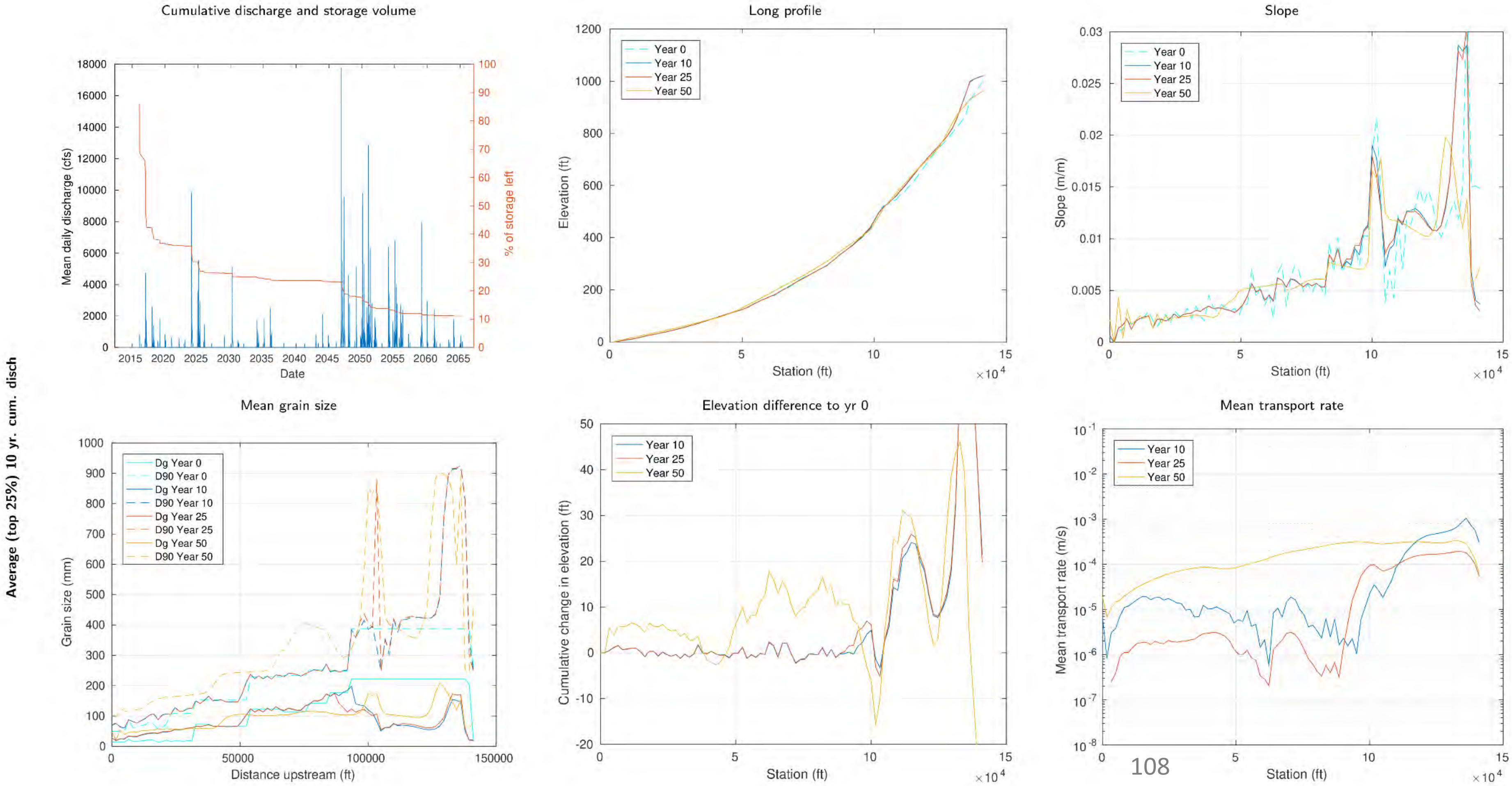
High (top 1.25%) 10 yr. cum. disch



USGS best fit Storage Decay & Very **High** 10 Year Cumulative Discharge – CRRDR Non-erodible

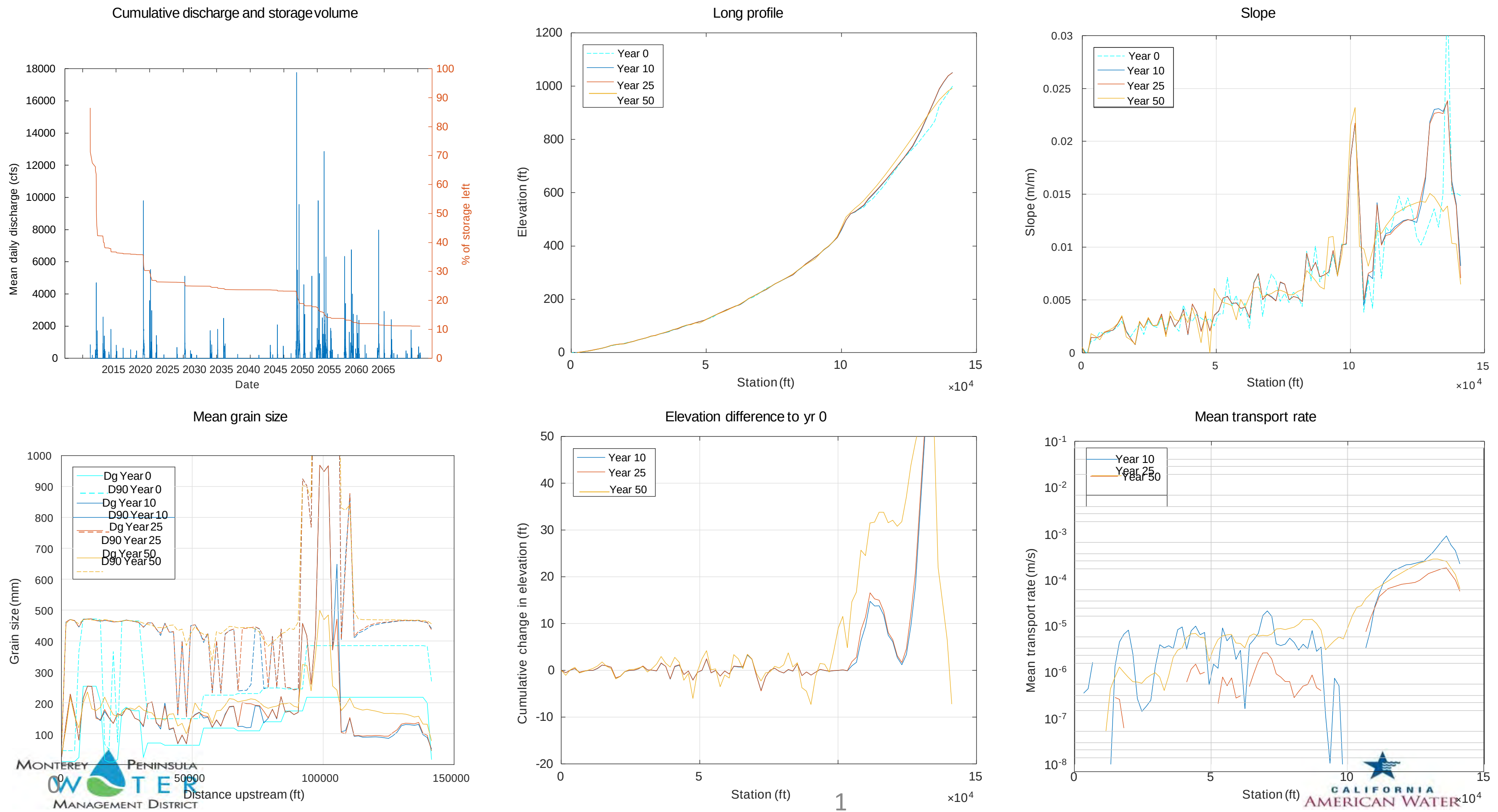


USGS best fit Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Erodible



USGS best fit Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Non-erodible

Average (top 25%) 10 yr. cum. disch



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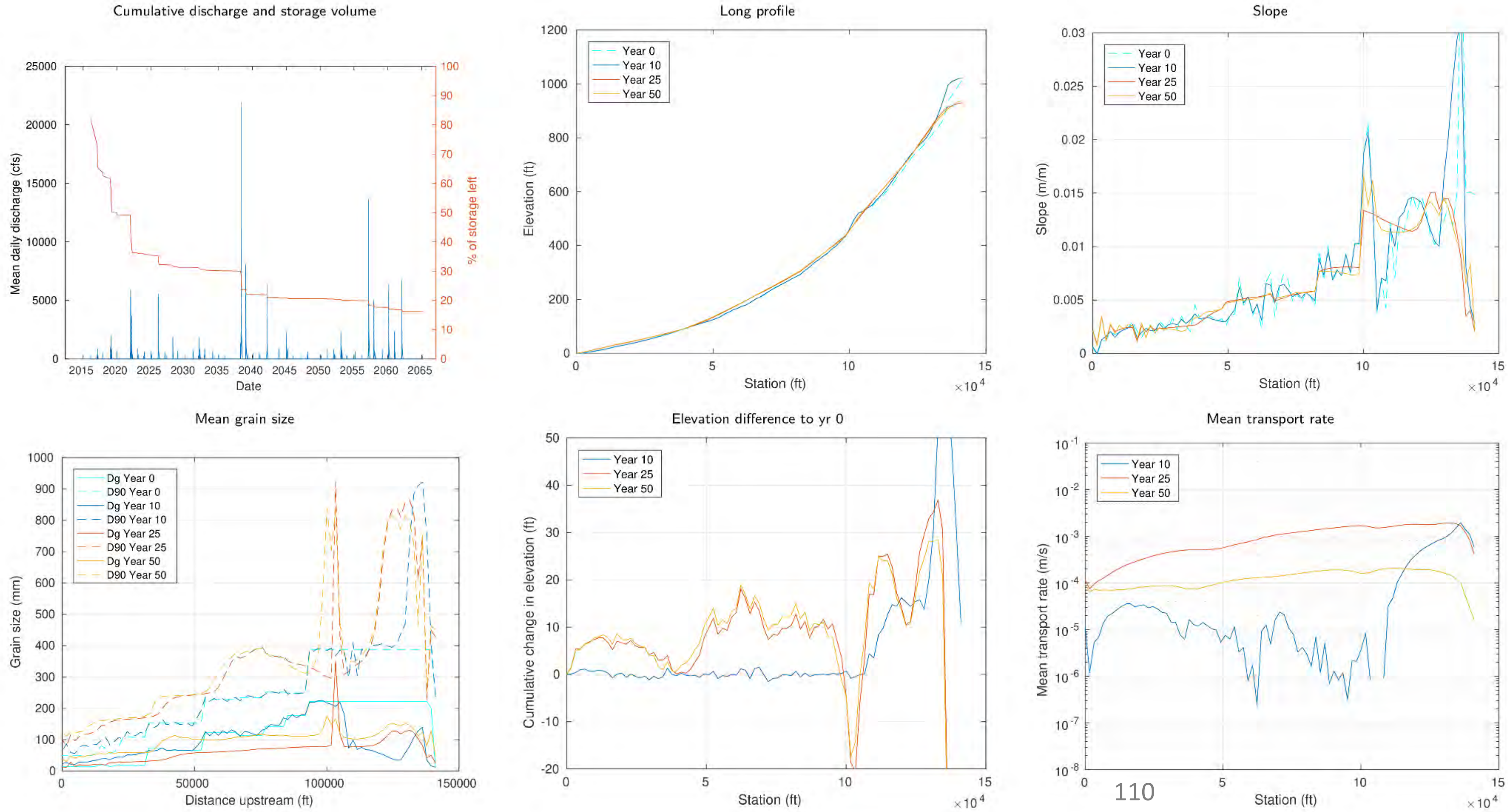
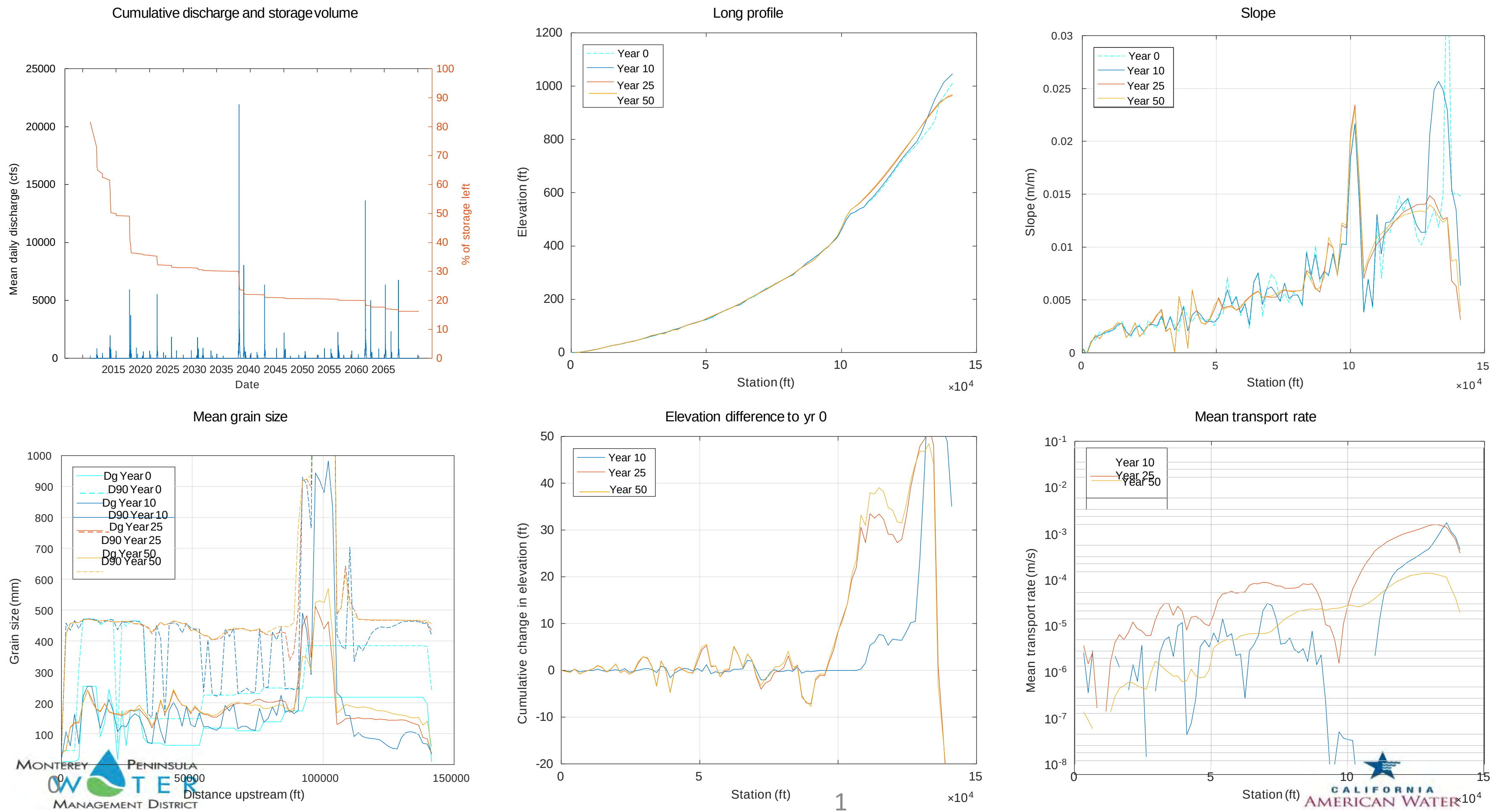
USGS best fit Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Erodible

Average (bottom 25%) 10 yr. cum. disch



USGS best fit Storage Decay & **Average** 10 Year Cumulative Discharge – CRRDR Non-erodible

Average (bottom 25%) 10 yr. cum. disch

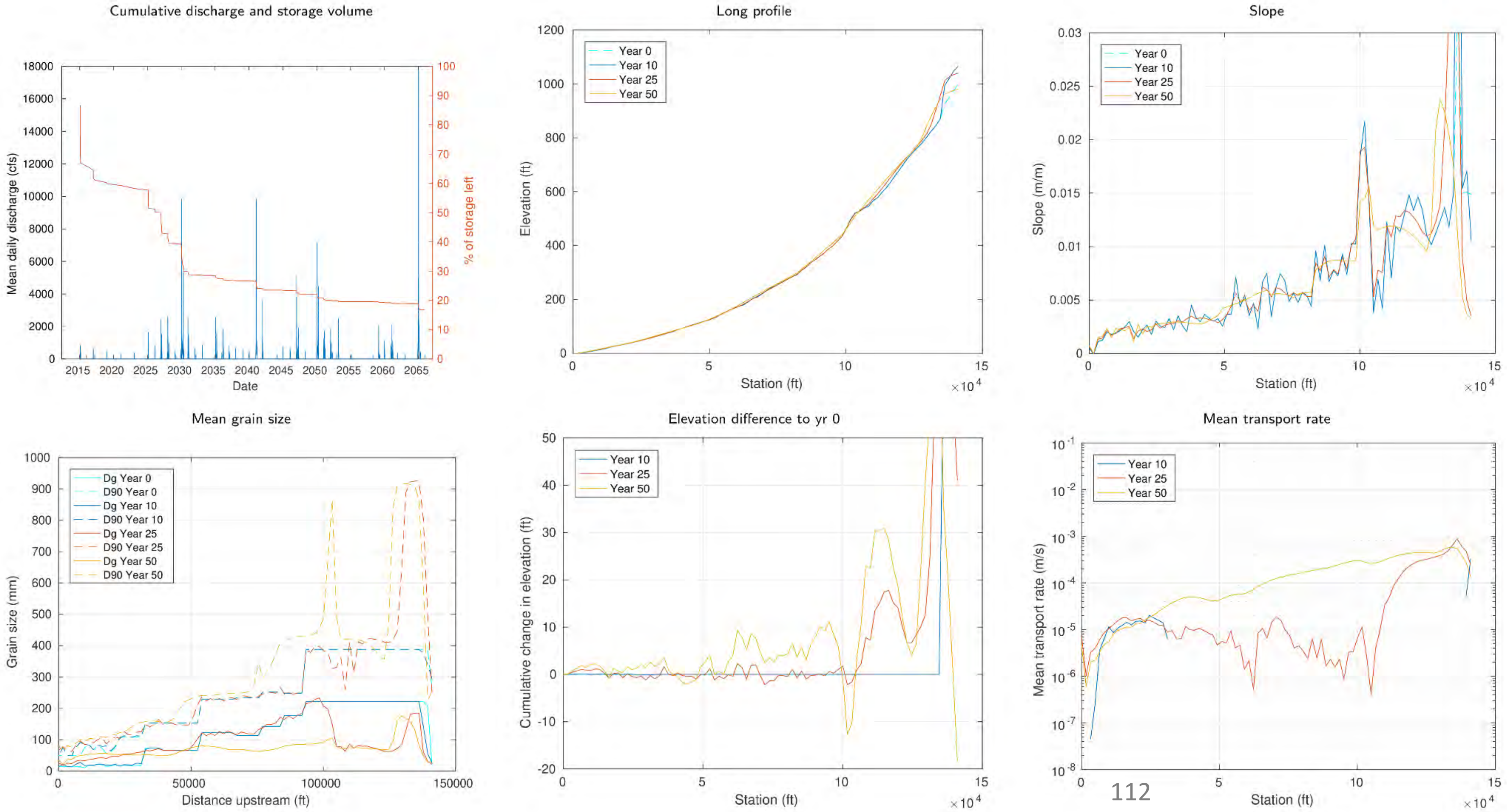


MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

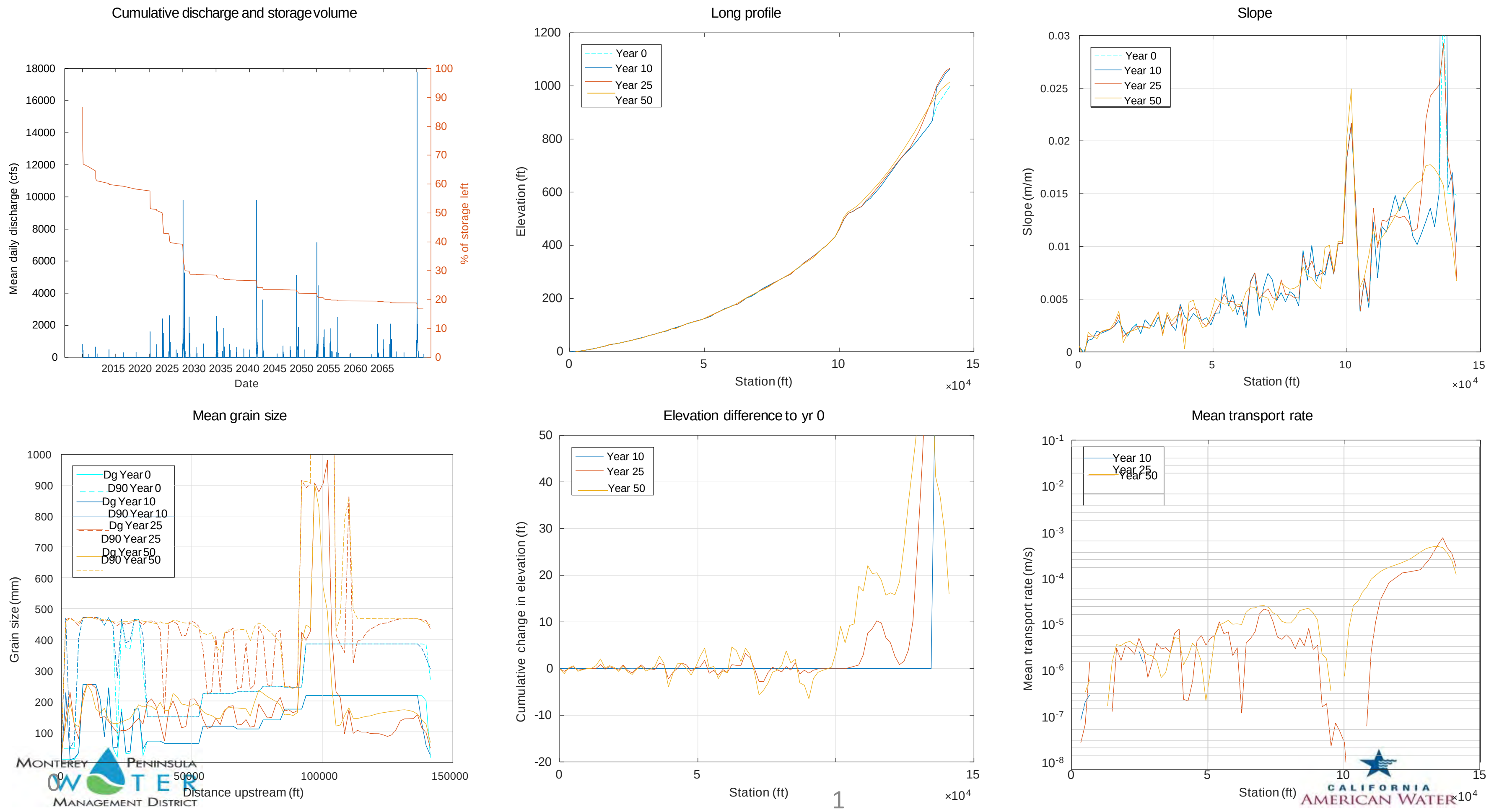
USGS best fit Storage Decay & Very **Low** 10 Year Cumulative Discharge – CRRDR Erodible

Low (bottom 1.25%) 10 yr. cum. disch



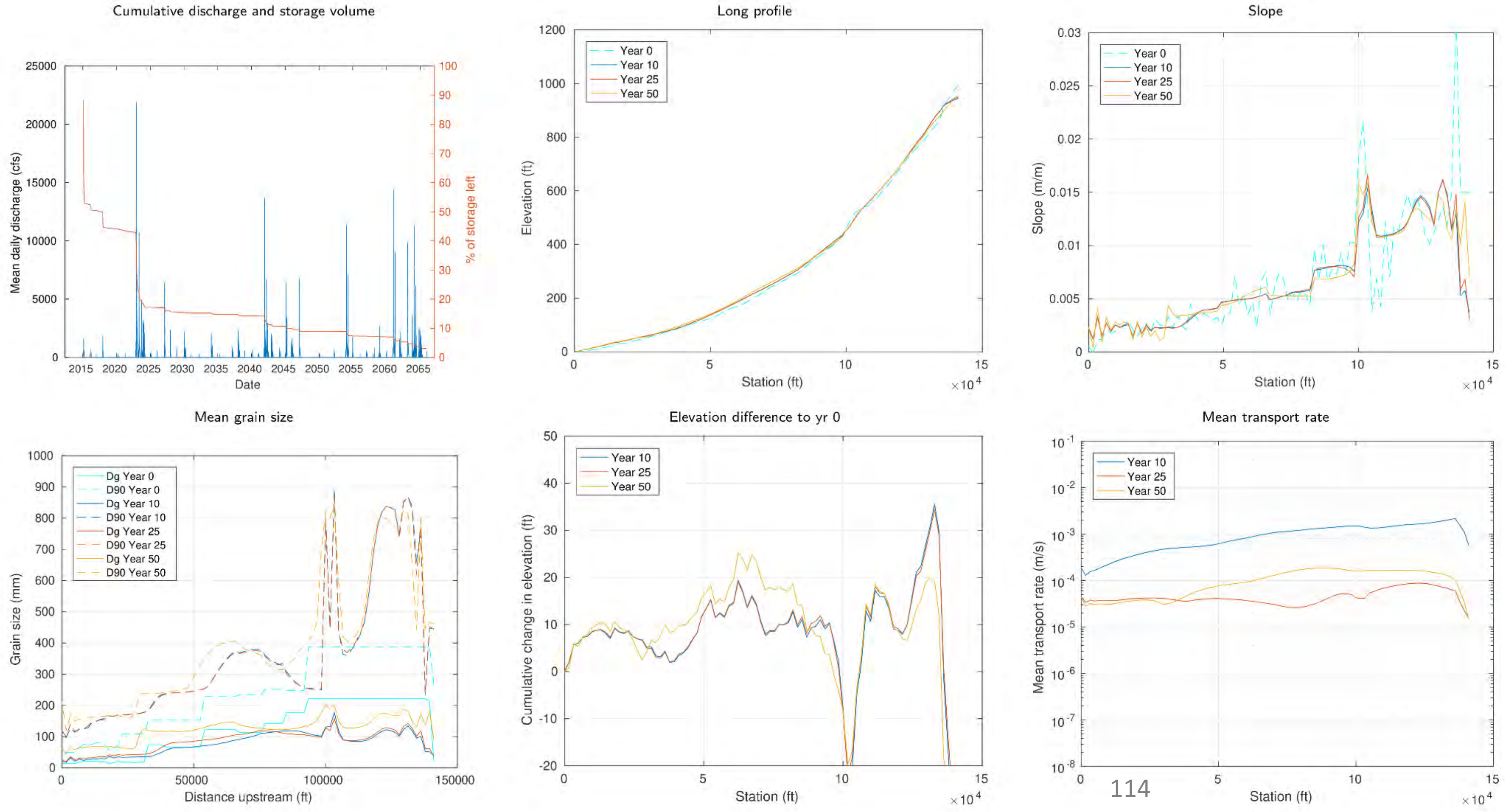
USGS best fit Storage Decay & Very **Low** 10 Year Cumulative Discharge – CRRDR Non-erodible

Low (bottom 1.25%) 10 yr. cum. disch



High Storage Decay & Very **High** 10 Year Cumulative Discharge – CRRDR Erodible

High (top 1.25%) 10 yr. cum. disch



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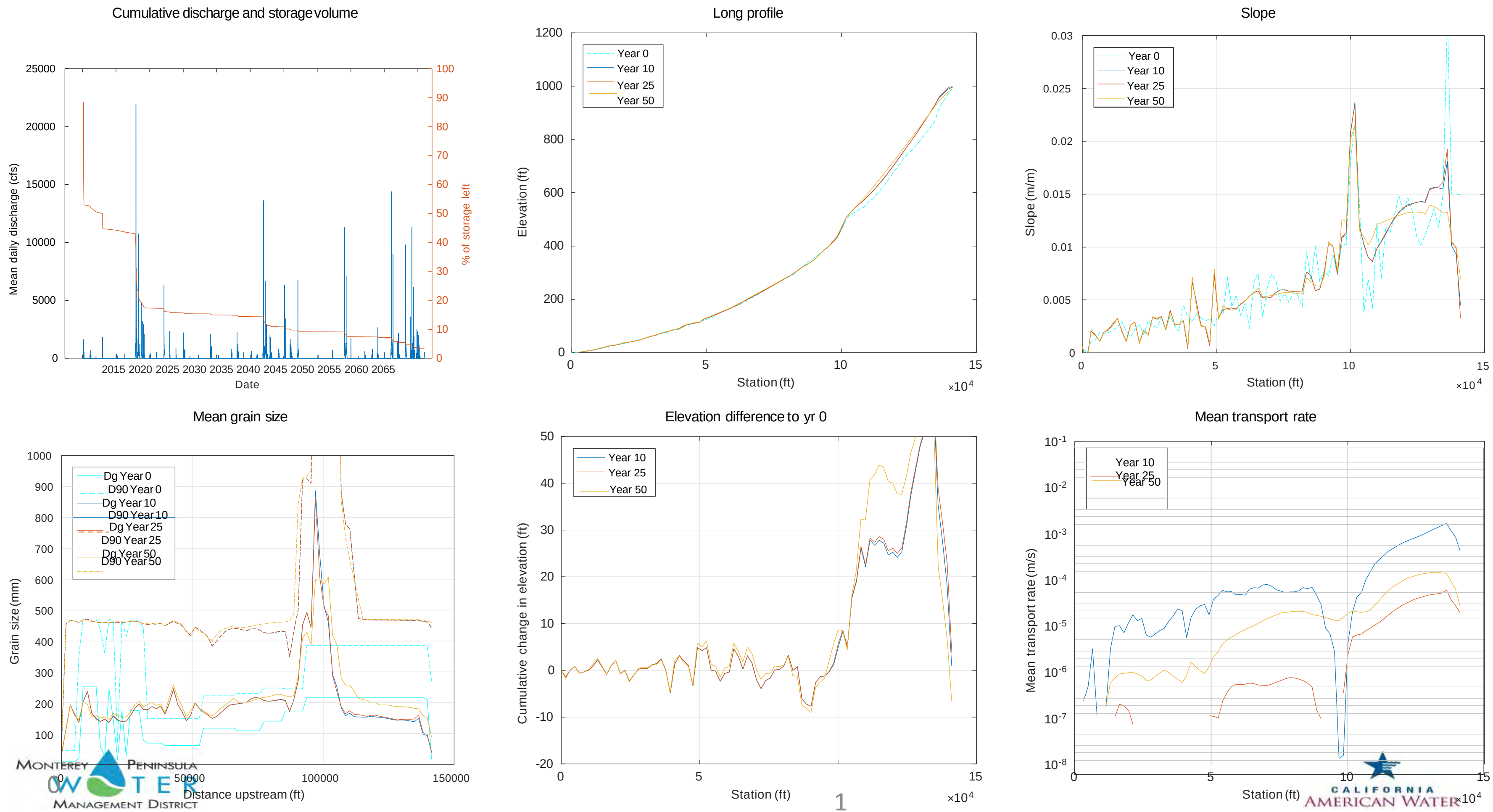

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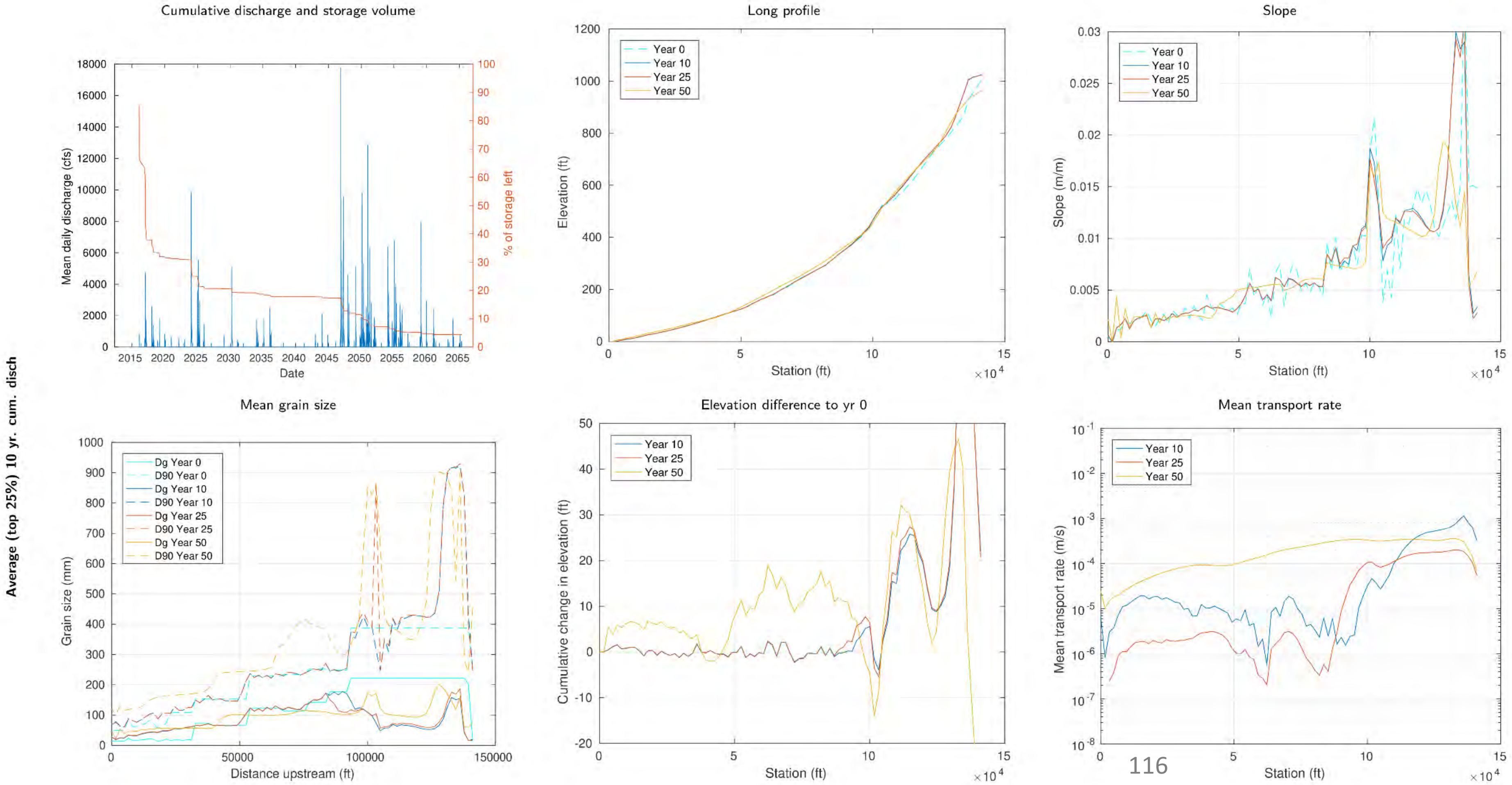

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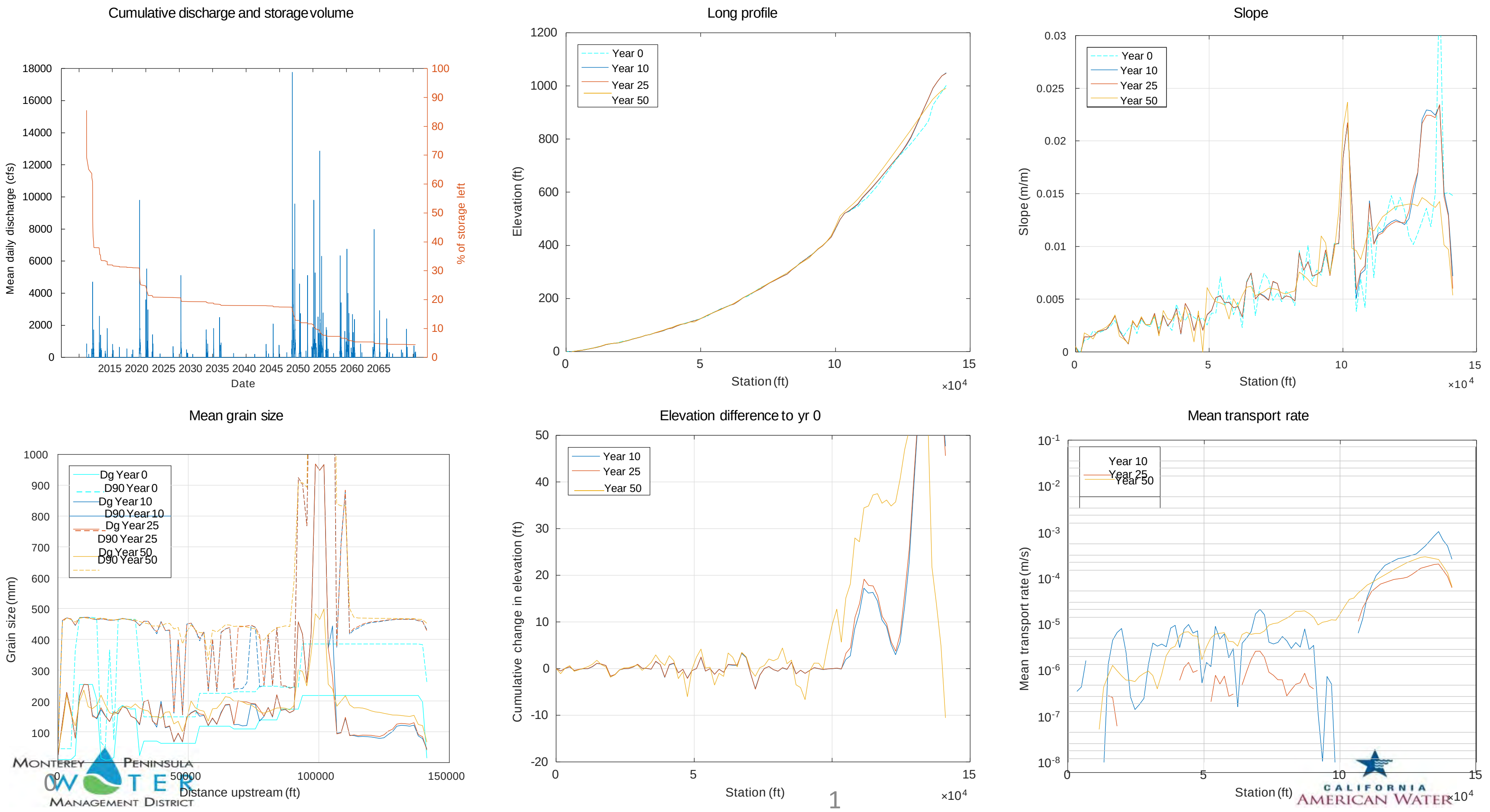
Average (top 25%) 10 yr. cum. disch



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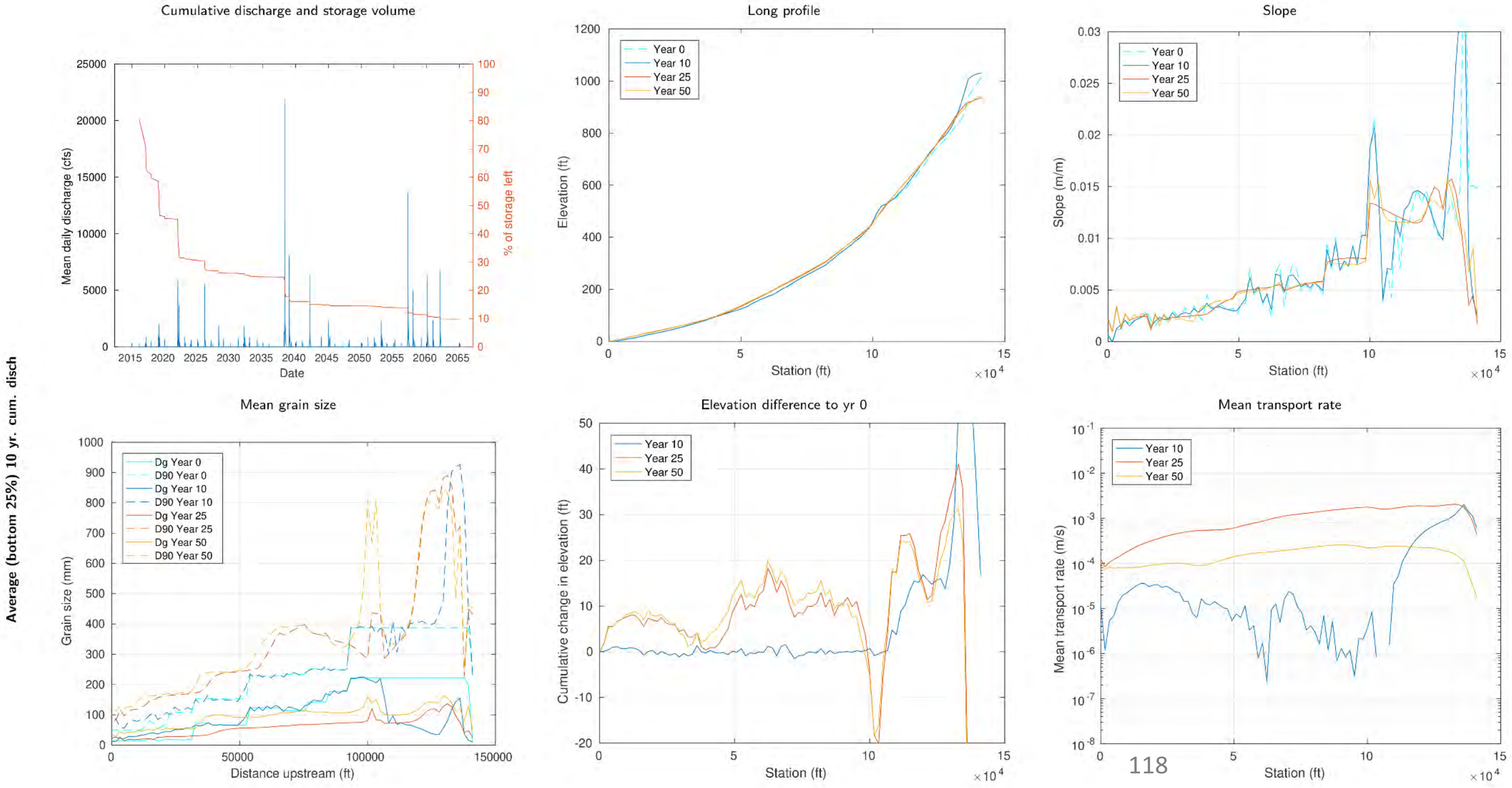

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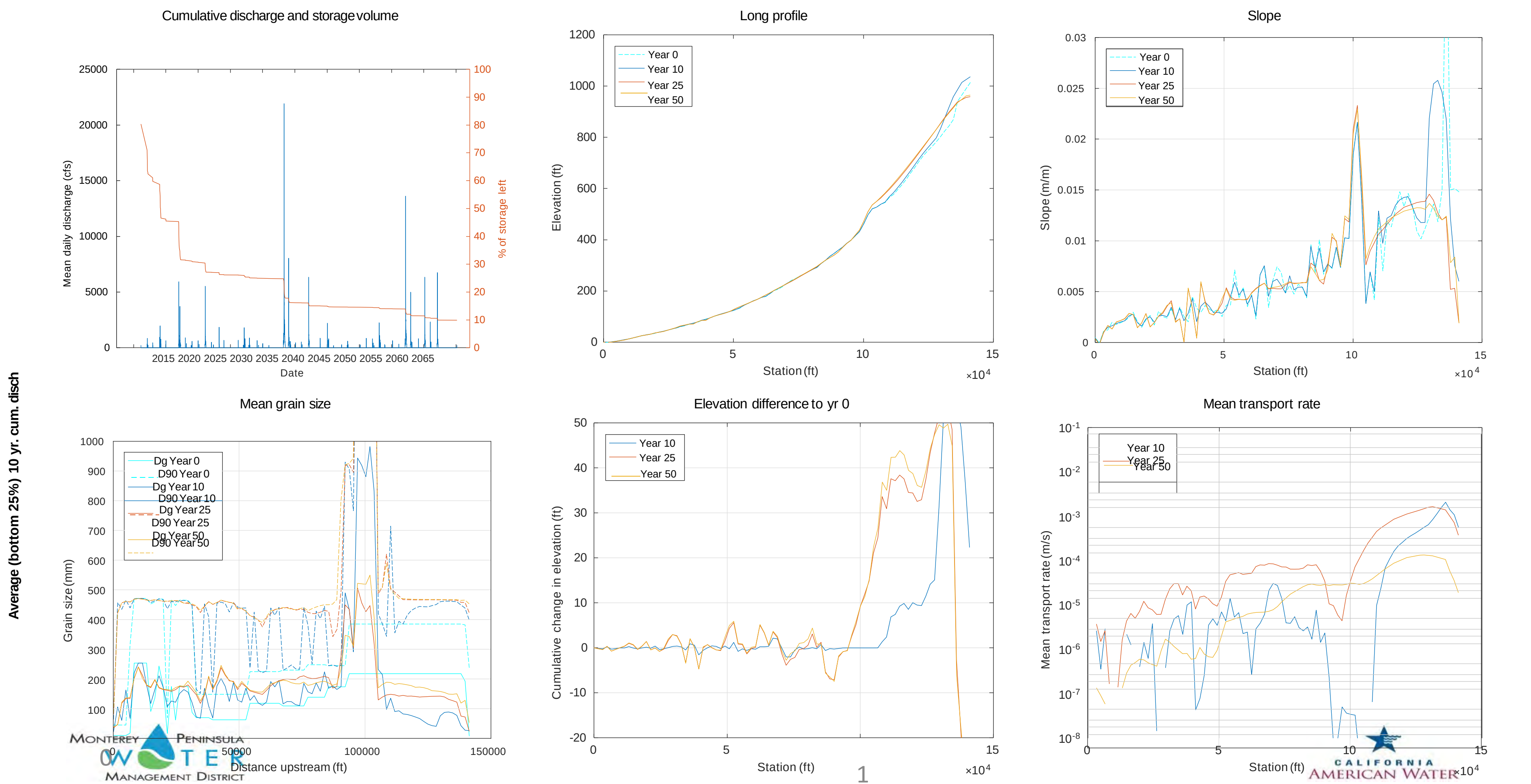
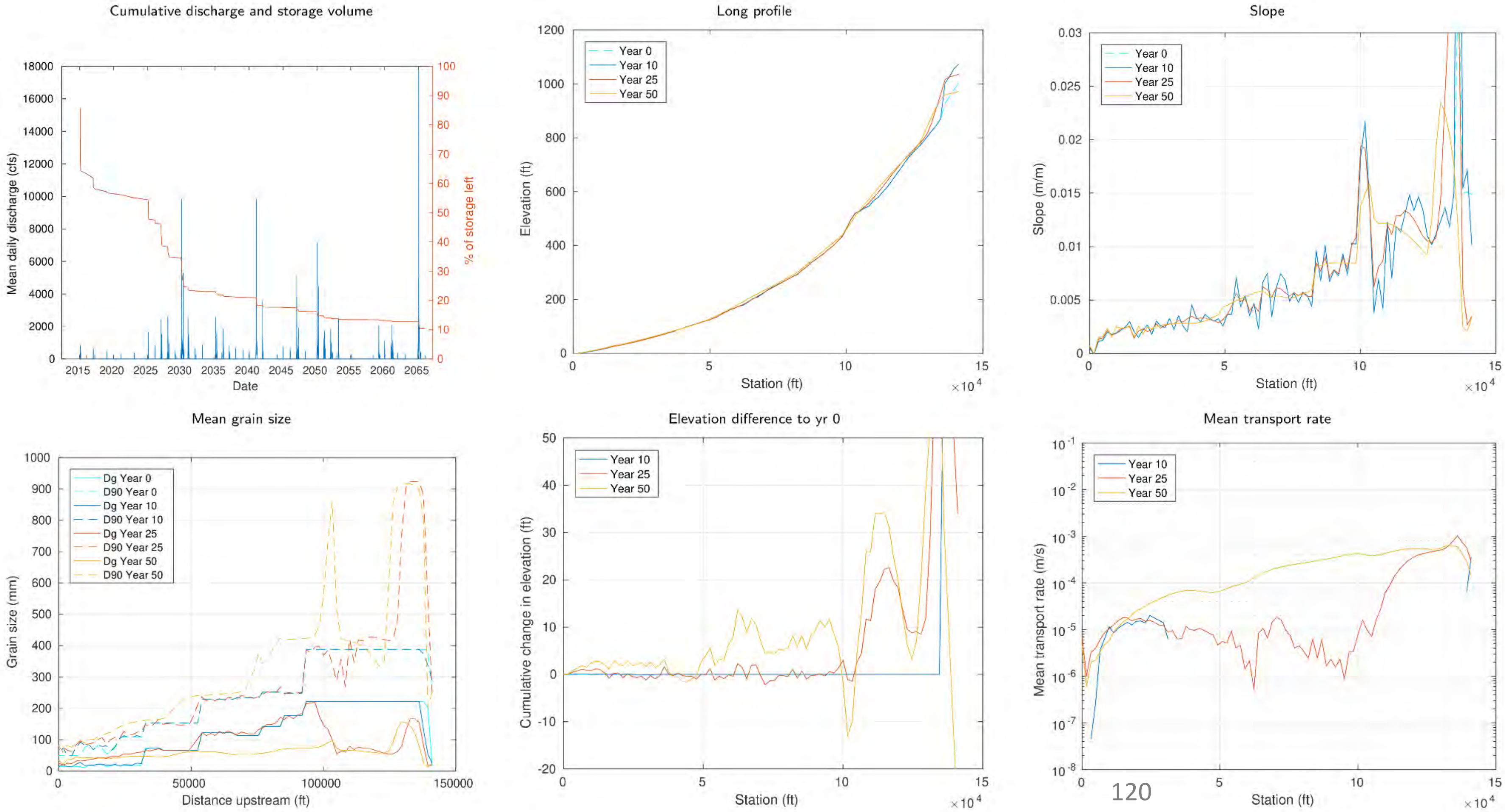


High Storage Decay & Very **Low** 10 Year Cumulative Discharge – CRRDR Erodible

Low (bottom 1.25%) 10 yr. cum. disch



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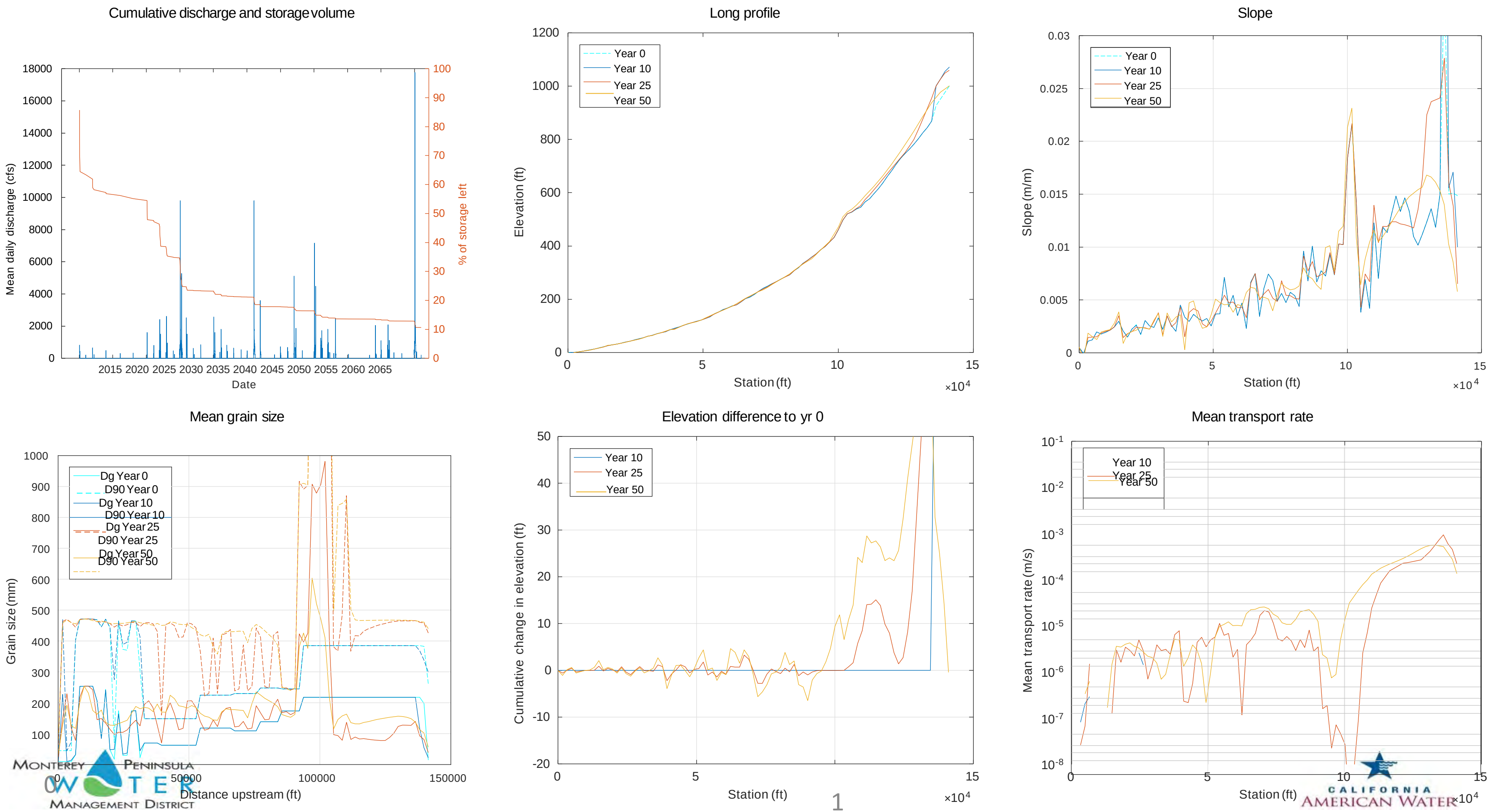


BESMo Channel Evolution of the Carmel River
Trail Run Conclusions

- No overbank representation and rectangular channel:
  - Interpret reach averaged storage volumes instead of elevation change
- Early large floods (within 10 years) cause rapid profile changes
  - But: little change in the following 40 years.
  - Profile change during these 10 years is larger than the total profile changes over 50 years in the less extreme hydrographs
- Low and avg. 10 year discharge scenarios show similar profile adjustments
- All runs show:
  - Only the largest floods move significant amounts of material past the former San Clemente Dam site
  - A lot of fine material will be stored between Los Padres and San Clemente
  - Lower and middle reaches mainly convey the sediment

BESMo Channel Evolution of the Carmel River

Trail Run Conclusions

- If CRRDR is non-erodible, the site is a sediment sink through the first 25 years of the 50-year simulation time period

QUESTIONS TO ADDRESS DURING THIS MEETING

1. Spin up :
   - Does BESMo project a comparable downstream response to that provided by URS with SRH-1D for the CRRDR planning?
2. Trial :
   - Are the logarithmic decay scenarios appropriate to represent the sediment release from the Los Padres Reservoir?
   - Is the constructed San Clemente project reach relatively erodible or non-erodible?

QUESTIONS TO ADDRESS DURING THIS MEETING

3. Alternatives:
   - How and which alternatives are we simulating?
   - How to batch scenarios? – i.e. how do we classify hydrograph types?
4. Presentation of results:
   - Special requests for presentation/summary of results?

BESMo
Bedload Scenario Model

Basic scenarios we will run

No Action

- Bedload may or may not pass LPD
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

No Sed Pass

- No bedload supply from LPD
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

Res. Depletion

- Several different depletion scenarios
- Different hydrologic scenarios
  - 2 to 3 using gaged records
  - 100 using random hydrographs

Monterey Peninsula Water Management District

California American Water

Review and wrap up

CONCLUSION

Conclusion

- Information needs
- Decisions
- Action items

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Conclusion

Current Schedule

- 4/27/2018: Draft geomorphic effects TM
- 6/11/2018: Draft steelhead impacts TM
- **7/12/2018: TRC Meeting No. 2B**
- 9/6/2018: Final geomorphic effects TM
- 9/20/2018: Final steelhead impacts TM
- 10/30/2018: Draft Alternatives TM
- **11/28/2018: TRC Meeting No. 3**
- 2/20/2019: Draft Final Report
- 5/1/2019: Final Report

Meeting Record

Project:	Los Padres Dam and Reservoir Alternatives and Sediment Management Study
Subject:	Technical Review Committee Meeting No. 2b - Review, Effects to Steelhead, Next Steps
Date:	Thursday, October 28, 2021
Time	10:00 AM to 3:00 PM
Location:	Virtual - MS Teams
Attendees:	Ethan Bell, Stillwater David Boughton, NMFS Joel Casagrande, NMFS Beverly Cheney, MPWMD Thomas Christensen, MPWMD Christopher Cook, Cal-Am Ian Crooks, Cal-Am David Crowder, NMFS Mike Garello, HDR Seth Gentzler, AECOM Aman Gonzalez, Cal-Am Cory Hamilton, MPWMD Larry Hampson, MPWMD Mandy Ingham, NMFS Jonathan Lear, MPWMD Shannon Leonard, AECOM Matthew Michie, CDFW Dennis Michniuk, CDFW Tim O'Halloran, Cal-Am Haley Ohms, NMFS Jonathan Stead, AECOM Andres Ticlavilca, NMFS

Notes

The purpose of the meeting notes is to document questions raised, comments provided, action items, and decisions. The primary content of the meeting is outlined below (from the meeting agenda) and detailed in the attached presentation and is not repeated in the notes.

1. Welcome (10:00-10:15)
    a. Introductions
    b. Opening statements
2. Background review (10:15-10:40)
    a. Overview of past milestones
    b. Related studies
    c. Existing conditions
    d. Sediment characterization
3. Short break (10:40-10:55)
4. Background review (continued, 10:55-11:45)
    a. Alternatives Descriptions
        i. Conceptual alternatives

A rubber bladder dam alone would restore reservoir capacity approximately equal to the current 2,179 AF water right.

Water Right 20808B is used for a portion of the Aquifer Storage and Recovery project (ASR). MPWMD assumes that increased water rights associated with increased storage would be used similarly.

ii. Sediment management options

Action Item (AECOM): Confirm sedimentation rate used for calculations supporting SM-1. Slide 46 suggests the rate used was 7.5 AF/year which excludes the post-Marble-Cone-Fire sedimentation episode. With Marble Cone Fire rate is 15.9 AF/year and other calculations (or BESMo sediment transport mode) may have used an intermediate (e.g., approximately 11 AF/year) rate. These calculations will be confirmed or updated during the next design phase.

b. Sediment Effects

5. Lunch (11:45-12:15)
6. Effects to steelhead (12:15-1:15)

MPWMD biologist(s) noted that some of the information shown in slide 64, rearing habitat distribution, may not reflect current understanding. For example, Danish Creek and Miller Fork are not entirely perennial and experienced some dry-back in 2021. These and some of the other tributaries may best be described as intermittent, in which case rearing habitat may be seasonal. They sometimes dry near their mouths. Action Item (AECOM): AECOM and MPWMD to coordinate regarding potential updates to the rearing habitat figure.

MPWMD biologist(s) noted that we have an incomplete understanding of the extent and quality of steelhead habitat upstream of Los Padres Dam and that additional study of that habitat may be warranted. NMFS also thinks spawning and rearing habitat upstream of Los Padres Reservoir should be quantified.

MPWMD requested that the steelhead analysis link the theoretical increase in winter rearing habitat in Reach 1 associated with a raise in bed elevation and improved access to floodplain habitat be linked to a specific flood recurrence interval, or that this relationship somehow be described in more detail. (This and other comments likely to be addressed with revisions to the Effects to Steelhead TM have been noted in a separate matrix for consideration when revising the draft Effects to Steelhead TM, pending receipt of written comments due December 1, 2021.)

MPWMD asked whether there are examples of sluicing at dams in coastal California. The group discussed the Alameda Creek Diversion Dam, although it is much smaller than Los Padres, and a paper (Kondolf et al. 2014) describing multiple examples of sluicing was posted to the chat (and later distributed to meeting participants).

David Boughton described a general sense coming from current research that steelhead with the anadromous genotype living above reservoirs may take up an adfluvial life history instead of seeking the ocean. At Los Padres, some of the tagged fish that entered the reservoir moved back upstream but the tag detector upstream of Los Padres has been removed. NMFS is still monitoring tags downstream of Los Padres.

Haley Ohms added that most fish that passed to downstream of Los Padres passed via the spillway and in many years depths over the spillway are not favorable for downstream passage.

NMFS clarified that, regarding upstream passage, there are issues including delay and managed passage is inferior to dam removal when it comes to fish passage.

MPWMD biologist(s) pointed out that in 2007 a major landslide upstream of Los Padres Reservoir blocked access to the upper Carmel River. Although it was fixed through human intervention, had the slide occurred further upstream in the designated wilderness, intervention would not have been possible. A slide like this could limit access to habitat upstream of Los Padres Reservoir.

Regarding brown trout predation in Los Padres Reservoir, although no specific data is available form Los Padres, a study by Stillwater at Soda Springs Reservoir documented substantial predation. Action Item: AECOM Team to share the Soda Springs Reservoir predation study report with meeting participants.

7. Short break (1:15-1:30)
8. Evaluation criteria and matrix (1:30-2:00)
    a. Review criteria
    b. Present matrix

Some participants are unfamiliar with the type of multi-factor criteria analysis evaluation matrix proposed for use in the Study. Due to time constraints, the mechanics of the matrix were not reviewed in detail during the meeting, although it has been provided in Excel format and Jon Stead mentioned that he could set up a breakout meeting to review the mechanics of this tool.

David Crowder noted his experience with similar matrices on previous projects and that, although they are a useful tool, they are not a panacea. He noted that it is important to keep perspective of biological and project goals, which set the stage for how to weight the criteria in the matrix.

Mandi asked the group about the relative importance of water supply and requested clarification about how any additional storage/capacity would be utilized (for pertinent alternatives/options). Action Item (AECOM): Follow up with Cal-Am and MPWMD regarding how additional water would be used.

9. Discuss alternatives (2:00-2:40)
   a. Open discussion, guided by slides as needed, to obtain TRC thoughts related to:
      i. Considerations for the alternatives?
      ii. Thoughts on evaluation criteria?
      iii. Alternatives to be eliminated?
      iv. Key information for further development?

Larry Hampson pointed out that sluicing (as it pertains dam removal) relies on unpredictable river flows while dredging is predictable. However, he also mentioned that for long term sediment management with dam remaining in place, sluicing may be more sustainable than mechanical dredging and having the river do the work is more effective.

A question was raised about whether there would be debris issues with sluicing. Debris racks are sometimes included on sluice gates at other locations. The AECOM Team clarified that the tunnel is conceptualized to be 12-15 feet wide, so could pass much debris, but that the need for debris racks had not yet been considered for this project.

MPWMD posited that it would not fund addition of a rubber bladder dam alone, without other storage or sediment management action. MPWMD would consider that a Cal-Am led project to maintain the existing water right, and that the water would be released under the current MOU.

Larry Hampson suggested that perhaps sustainability should be one of the evaluation criteria, because, for example, regular excavation is not very sustainable over time. Joel Casagrande said he also is concerned about sustainability.

Regarding access via the jeep trail, it was a treacherous ride before the landslide took out that road and its use should be evaluated critically. There may be a back way into the head of the reservoir via a road cut for a fire line. Fire risk from equipment and trucks using wilderness access roads should also be considered.

Mandy Ingham stated the importance of water availability.

David Boughton summarized the considerations, for steelhead, as the cost of passage through the reservoir vs. the benefits of the additional dry season flow that the reservoir may provide. NMFS is conducting an analysis of infiltration of dry season flows in the alluvial reach, a work in progress, that seems to suggest that the CRBHM may over-predict low flows in the lower river. For David, this raises uncertainty regarding the additional dry season flow that would be available in the lower river with additional storage. It was pointed out that the CDO pumping comes into effect on January 1, 2020, and the impact of that we will be able to see the impact of that within a year.

Thomas Christensen posed some questions about dam removal: (1) Can we live with dry back in the lower Carmel River? How much? (2) Can we live with increased flood risk? (3) Can we live with loss of existing water rights?

David Boughten stated that, based on his preliminary review of existing data, expanded reservoir capacity may not lead to more water in the lowest reaches of the Carmel River during dry periods. D. Boughton shared two graphs in working draft form comparing output from the CRBHM to measured gage data which indicate that the CRBHM underpredicts infiltration in the alluvial sections of the Carmel River. The graphs are attached to these meeting notes, although the graphs should be considered part of the discussion and deliberation but are not a final product and have not been through quality control review.

Jon Stead noted that many steelhead streams in central California have lower, alluvial reaches (e.g., Alameda Creek, Russian River tributaries) that historically dried in the late summer. At times these alluvial reaches may have served primarily as migratory corridors, yet some of these streams had large steelhead runs where the run was sustained by habitat in the upper watershed.

Andres Ticlavilca requested that the uncertainty of low flow predictions from the CRBHM should be stated in the Effects to Steelhead TM. Action Item: MPWMD will provide content for a discussion of that uncertainty in the TM.

MPWMD confirmed that the predictions form the CRBHM of inflow to Los Padres Reservoir are more certain than flow in the lower river due to incomplete data related to riparian groundwater pumping. It was agreed that the model is only one tool available to inform alternatives at Los Padres.

Inflow to Los Padres Reservoir can be as low as 0.5 cfs, based on regular measurements, and that there is uncertainty regarding how that flow would propagate downstream without Los Padres Dam and Reservoir in place, especially considering riparian groundwater pumping.

Thomas Christensen suggested including an appendix with measurements of reservoir inflow in the steelhead TM.

Mandy Ingham points out that a decision regarding Los Padres should not be limited by illegal pumping if that is what makes dam removal infeasible but Larry Hampson points out not all the pumping is illegal and that riparian pumpers can divert 50 percent of flow during the dry season (June 1 to November 30) downstream of the Don Juan Bridge during normal years, more during dry years.

Cory Hamilton notes that (1) the public would not respond well to the sight of stranded juvenile steelhead dying due to dry-back in the lower river, (2) some of the tributaries are a bit perched and an increase in the mainstem's bed elevation due to sediment deposition may improve tributary connectivity, and (3) he can provide input related to the distribution of rearing habitat as shown in the figures. Action Item (AECOM): AECOM and MPWMD to coordinate regarding potential updates to the rearing habitat figure.

Some barriers shown on the habitat distribution map may have been removed.

Although Thomas Christensen raised concerns about potential challenges associated with permitting use of a sluice tunnel for dam removal, the group decided the sluice tunnel should be retained for now. Thomas also asked about the feasibility of a rubber bladder dam without major structural improvements, and whether that alternative is low cost when all the DSOD and dam safety considerations are included, something that the AECOM Team will continue to evaluate.

At the end of the meeting, in an effort to reduce the number of alternatives under consideration, it was agreed that for now (1) SM-1 and SM-2 would be collapsed into a single sediment management option to be managed adaptively and (2) only full dam removal would be considered at this time, with acknowledgement that partial dam removal would have similar benefits at a lower cost and could be addressed as a value engineering step later in the process if dam removal is preferred.

This discussion concluded at about 3:45 pm, after the scheduled end time for the meeting and after some participants had left.

10. Document decisions (2:40-2:50)

There was not an opportunity to review action items or decisions at the end of the meeting, but action items and decisions were captured in the notes above and are summarized from the project log here.

Action Items from TRC Meeting 2b

No.	Date	Action	Primary Responsible		Due Date	Status
			Firm/Org.	Individual		
60	10/28/2021	Confirm sedimentation rate used for calculations supporting SM-1 in Alternatives Descriptions TM.	AECOM	J. Stead	11/12/2021	In Progress
61	10/28/2021	Initiate coordination w/ MPWMD (Cory) regarding potential updates to rearing habitat distribution figure.	AECOM	J. Stead	11/12/2021	In Progress
62	10/28/2021	Share the Soda Springs Reservoir predation study report with TRC Meeting 2b participants.	AECOM	J. Stead	11/5/2021	Done
63	10/28/2021	Provide content for discussion of uncertainty of CRBHM regarding low flow predictions.	MPWMD	T. Christensen	12/1/2021	In Progress
64	10/28/2021	Coordinate with Cal-Am and MPWMD to determine if there is a storage expansion driver coming from Cal-Am, in addition to digging into how Los Padres affects overall water supply across the peninsula, and develop better understanding of how additional water would be used.	AECOM	J. Stead	11/19/2021	In Progress

Decisions from TRC Meeting 2b

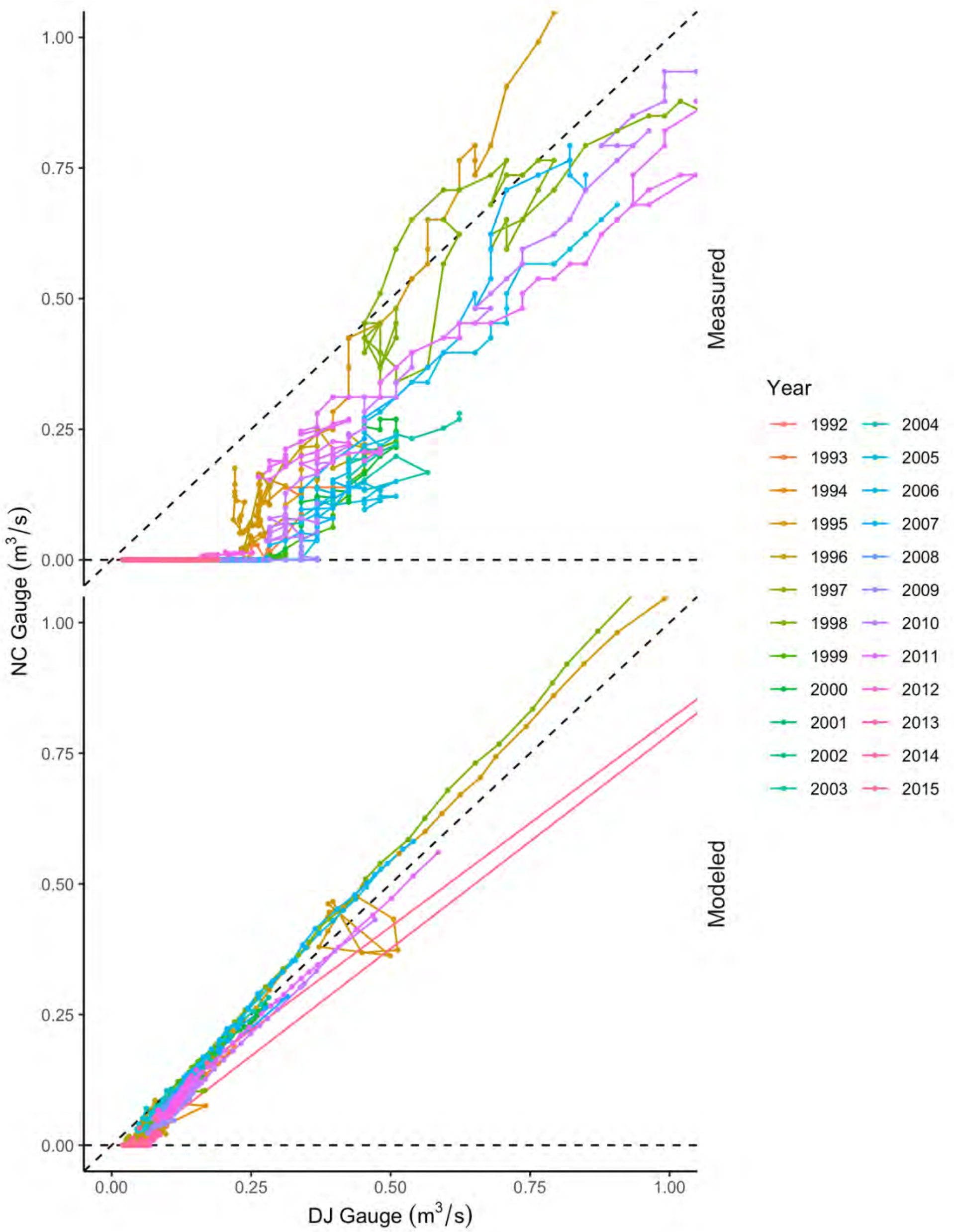
No.	Date	Subject/ Feature	Reference	Decision
14	10/28/2021	Sluice Tunnel	TRC M2b	Retain the sluice tunnel alternative(s) for now.
15	10/28/2021	Sediment Management	TRC M2b	SM-1 and SM-2 from the Alternatives Descriptions TM will be collapsed into a single alternative to be managed adaptively.
16	10/28/2021	Dam Removal	TRC M2b	Only full dam removal will be considered at this time, with acknowledgement that partial dam removal would have similar benefits at a lower cost and could be addressed as a value engineering step later in the process if dam removal is preferred.

Comments on draft Effects to Steelhead TM noted at Meeting 2b

Comment No.	Reviewer	Page No.	Section/ Item	Comment
1	Larry Hampson		From TRC M2b	MPWMD requested that the steelhead analysis link the theoretical increase in winter rearing habitat in Reach 1 associated with a raise in bed elevation and improved access to floodplain habitat be linked to a specific flood recurrence interval, or that this relationship somehow be described in more detail. This comment has been noted for consideration when revising the draft Effects to Steelhead TM.
2	Andres Ticlavilca, Mandy Ingham		From TRC M2b	Steelhead TM must describe uncertainty regarding water availability and CRBHM low flow predictions in the lower Carmel River.
3	Thomas Christensen		From TRC M2b	Consider including an appendix with measurements of reservoir inflow in the steelhead TM, in the context of uncertainty regarding dry season flow.
4	Thomas Christensen and Joel Casagrande		From TRC M2b	Spawning habitat upstream of LPR is not well documented, and neither is the perennial rearing habitat.
5	Larry Hampson		From TRC M2b	Please note if/where sluicing operations are occurring in other California watersheds
6	David Boughton		From TRC M2b	The 75% "lost" in reservoir does take into account antenna detection efficiency.
7	David Boughton		From TRC M2b	NMFS thinks that o.mykiss with anadromous gene that are ups of LPR are more likely to become resident in reservoir ("repurposed to adfluvial")- so reservoir is a sink for anadromous production
8	David Boughton		From TRC M2b	David stated that we could summarize/frame the entire issue as, "water availability in lower river versus "loss" in reservoir."

11. Next steps (2:50-3:00)

Written comments on draft Effects to Steelhead TM due December 1, 2021.



Infiltration between the Don Juan gauge (DJ) and the Near Carmel gauge (NC) during low-flow season. Each line shows the trajectory of a year's July-September hydrograph in phase-space (simultaneous state of flow at each gauge); dots show the flow on each successive day. Since flows generally decline during this time period, Jul 1 flows are in the upper right corner of each panel, and Sep 30 flows are in the lower left corner. The angled dashed line shows what the trajectory would be if flows were always the same at each gauge (no loss or gain of water between the gauges). Points below the dashed line indicate water loss between the two gauges; points above indicate water gain. The top panel shows daily flow as measured at each gauge, and illustrates a consistent loss of ~0.25 m^3/s in late summer during dry years. The bottom panel shows flow as modeled by the CRBHM for the "Calibrated NOAA Historic" scenario, at River Miles 13 and 6, the closest IFIM reach to each gauge (River Miles 11.8 and 3.2 for DJ and NC, respectively). The bottom panel shows that infiltration is consistently underestimated by the CRBHM.

Attachment B - Meeting Presentation Slides

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Technical Review Committee Meeting 2b
Review, Effects to Steelhead, and Next Steps

Virtual via MS Teams

October 28, 2021
10:00 am to 3:00 pm

Welcome

- Introductions

Study Objectives

Key questions

- Are Carmel River steelhead better off with or without Los Padres Dam and Reservoir?
- Is Los Padres Reservoir critical for water supply on the Monterey Peninsula? Is it feasible to expand reservoir capacity and what effects would this have on water supply and the environment?
- Are there feasible alternatives to manage existing sediment deposition and future sediment inflow to the reservoir?
- What would be the geomorphic response of the Carmel River be to management actions considered, and will there be an increased erosion and/or flood risk?

Meeting Objectives

Transfer of information, discussion, and collaboration

- Discuss draft Effects to Steelhead TM
- Obtain input for use in identifying and possibly reformulating alternatives for next design phase

Meeting Agenda

- Review background information
  - Past meetings, related studies, & past TMs
- Effects to Steelhead TM
  - Present summary & discuss
- Evaluation criteria & matrix
  - Review criteria
  - Present matrix
- Discuss alternatives
  - i. Considerations?
  - ii. Thoughts on evaluation criteria?
  - iii. Alternatives to be eliminated?
  - iv. Key information for further development?
- Document decisions
- Next steps

Overview of Past Milestones

BACKGROUND REVIEW

Past Study Meetings and Technical Memoranda

- 2017 (Jun): Draft Study Preparation TM
- 2017 (Aug): TRC Meeting 1
  - Existing conditions, evaluation criteria
- 2017 (Oct): Final Study Preparation & Draft Sediment Characterization TMs
- 2017 (Nov): Alternatives Descriptions TM
- 2018 (Jan): TRC Meeting 2a
  - Sediment characterization, alternatives descriptions, and transport model kick-off
- 2018 (Nov): Final Sediment Characterization TM
- 2018 (Feb) through 2019 (Feb): Sediment Transport Modeling
  - Iterative process with multiple TRC reviews, calls, & presentations

Technical Review Committee Meetings

Meeting 1

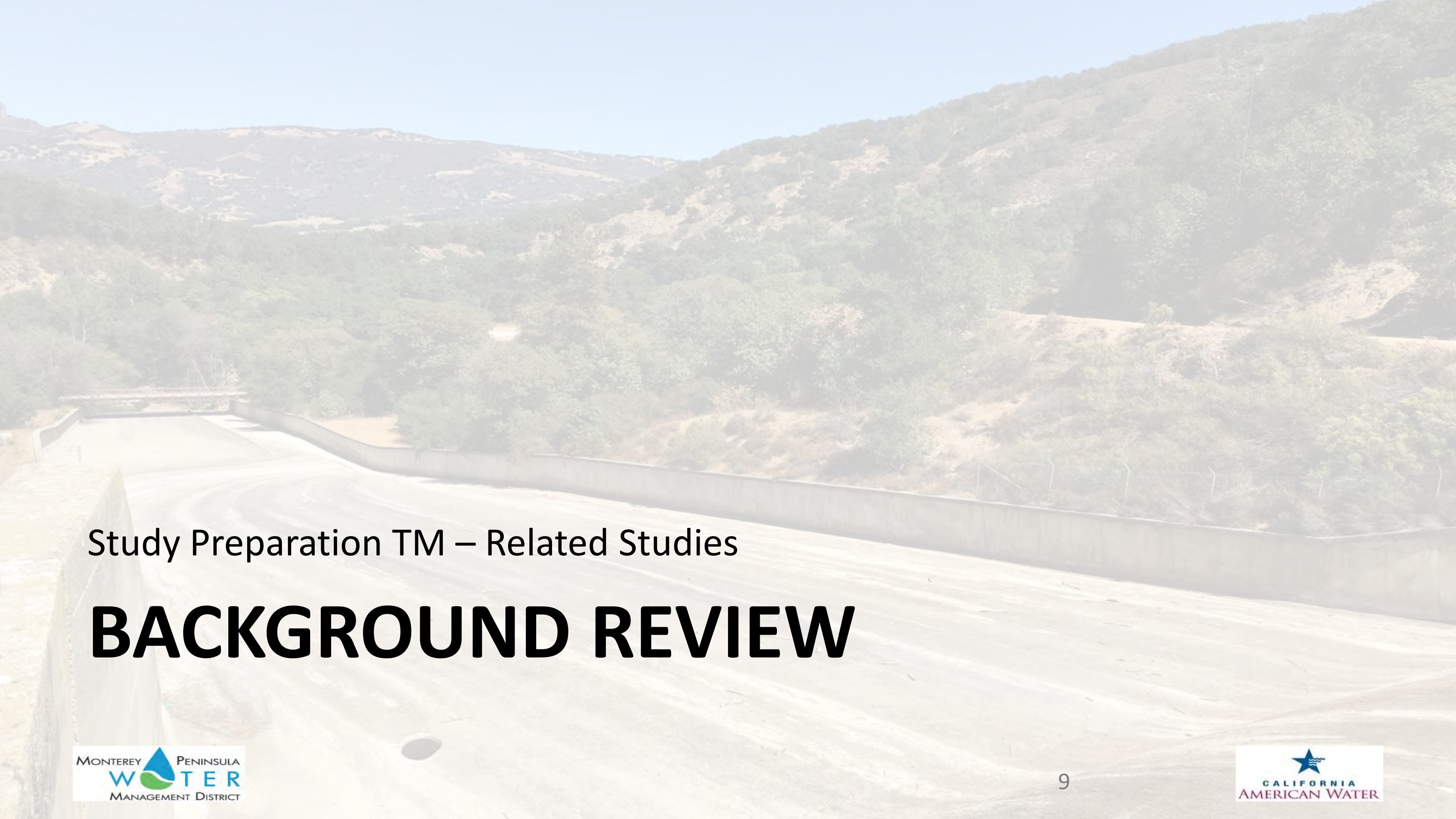
Background info & evaluation criteria

- Ethan Bell, Stillwater (by phone)
- Madeleine Bray, AECOM
- Joel Casagrande, NMFS
- Shawn Chartrand, Balance
- Brian Cluer, NMFS
- Larry Hampson, MPWMD
- Shannon Leonard, AECOM
- Dennis Michniuk, CDFW (by phone)
- Kealie Pretzlav, Balance
- John Roadifer, AECOM
- Dave Stoldt, MPWMD (by phone)
- Jon Stead, AECOM
- Kevan Urquhart, MPWMD
- Marcin Whitman, CDFW

Meeting 2a

Sediment characterization, alternatives, & transport model considerations

- Ethan Bell, Stillwater (by phone)
- Joel Casagrande, NMFS
- Trish Chapman, SCC
- Shawn Chartrand, Balance
- Brian Cluer, NMFS
- Ian Crooks, Cal-AM (by phone)
- David Crowder, NMFS (by phone)
- Aman Gonzalez, Cal-Am (by phone)
- Larry Hampson, MPWMD
- Dave Highland, CDFW
- Shannon Leonard, AECOM
- Katie McLean, AECOM
- Matthew Michie, CDFW (by phone)
- Dennis Michniuk, CDFW
- Kealie Pretzlav, Balance
- John Roadifer, AECOM
- Kevan Urquhart, MPWMD
- Marcin Whitman, CDFW



Study Preparation TM – Related Studies

BACKGROUND REVIEW

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Related Studies

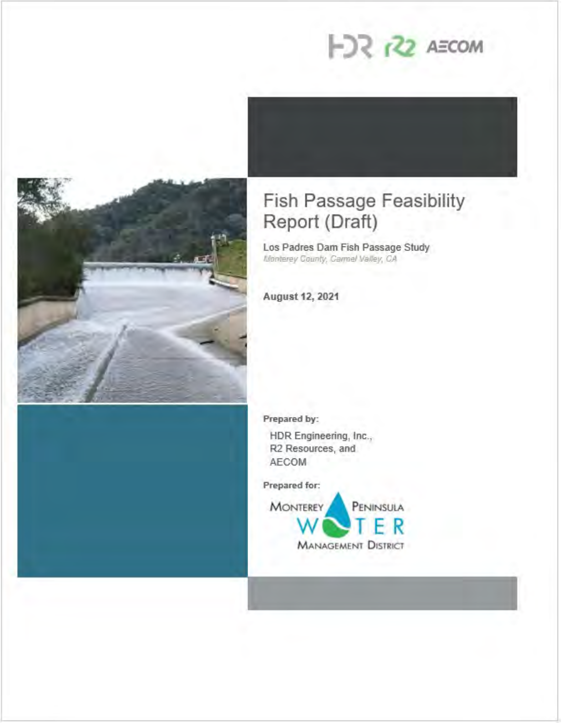
Water and Steelhead Habitat Availability Analyses

- Carmel River Basin Hydrologic Model (CRBHM), a linked surface flow and groundwater model using GSFLOW coupled to MODFLOW
  - Developed with TRC in 2019-2021
  - Iterative process with multiple TRC reviews, calls, & presentations
  - Flow duration analyses and other model output to be included in the Alternatives Study
- CRBHM hydrographs run through IFIM model developed for the Carmel River to compare steelhead habitat among alternatives

Related Studies

Los Padres Dam Fish Passage Feasibility Study

- Investigated (2016-2021) permanent fish passage facilities at LPD
  - Informs the feasibility, potential for success, level of effort, and cost of implementing passage at existing LPD
  - Two alternatives identified for further consideration
  - Primary information considered in the Los Padres Alternatives Study regarding fish passage



Related Studies

Carmel River Fishery Science Study

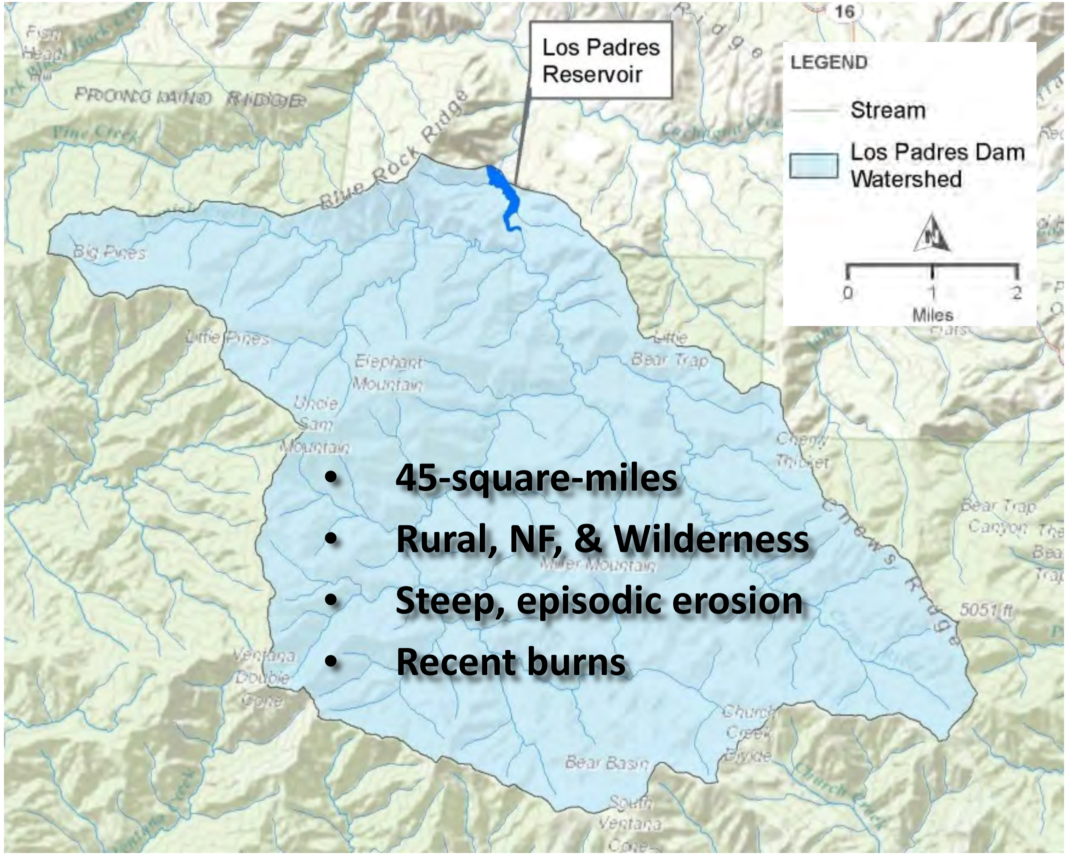
- NOAA Fisheries, 2015-present, Carmel River steelhead studies
  - PIT-tagging to examine limiting factors and estimate smolt production as a performance metric for river management
  - Annual State of the Steelhead Fishery report to assess population response to ongoing conservation actions and freshwater conditions
  - Evaluation of direct impacts of Los Padres Dam on smolt production and overall steelhead population
  - Annual reports through 2020 provide preliminary results

Study Preparation TM – Existing Conditions

BACKGROUND REVIEW

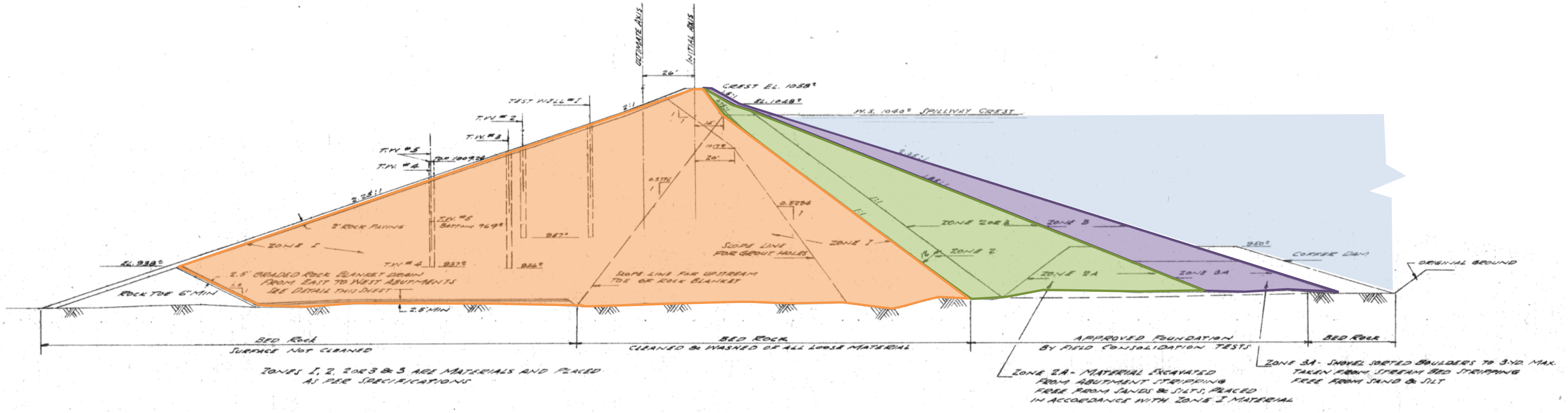
Existing Conditions

LPD, Reservoir, & Contributing Watershed



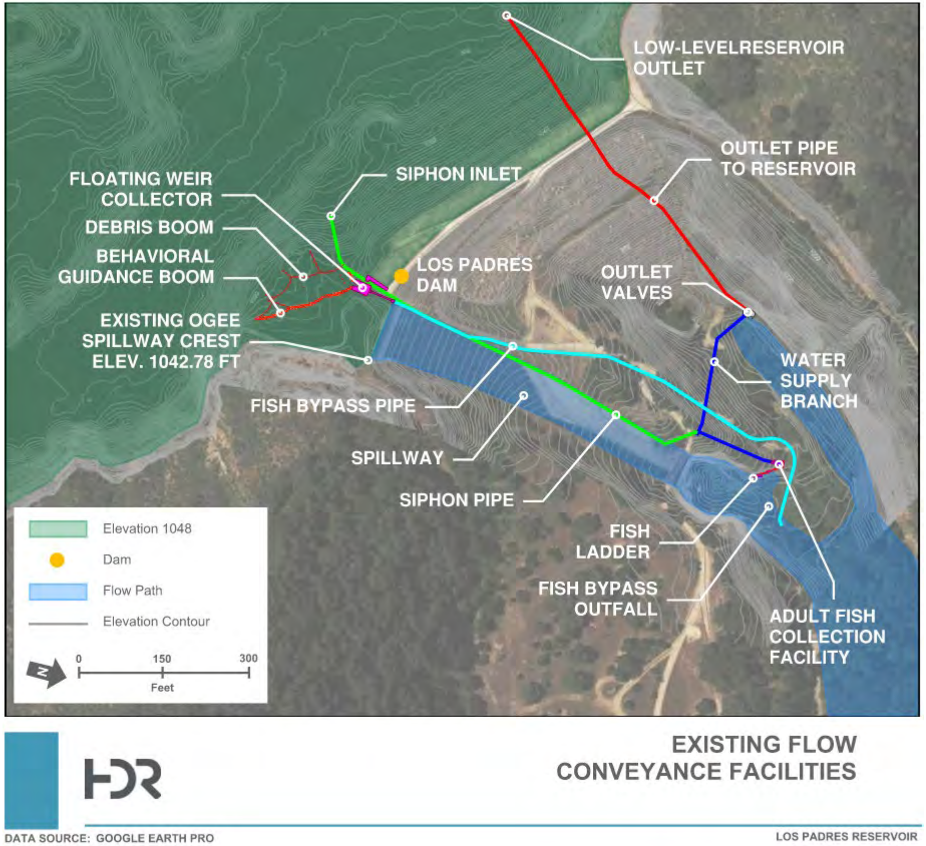
- 45-square-miles
- Rural, NF, & Wilderness
- Steep, episodic erosion
- Recent burns

Existing Conditions
Los Padres Dam



- Constructed in 1949
- 148-ft. high, 570-ft. long, earth fill dam
- Spillway 100 ft. wide, 600 ft. long
- Outlets include 30-in. pipe (≈ 30 cfs) and fish bypass (≈ 15 cfs)

Existing Conditions
Los Padres Dam



- 2019 and subsequent landslides mostly blocked low-level outlet
- Siphon installed 2020
- New outlet planned for construction 2022

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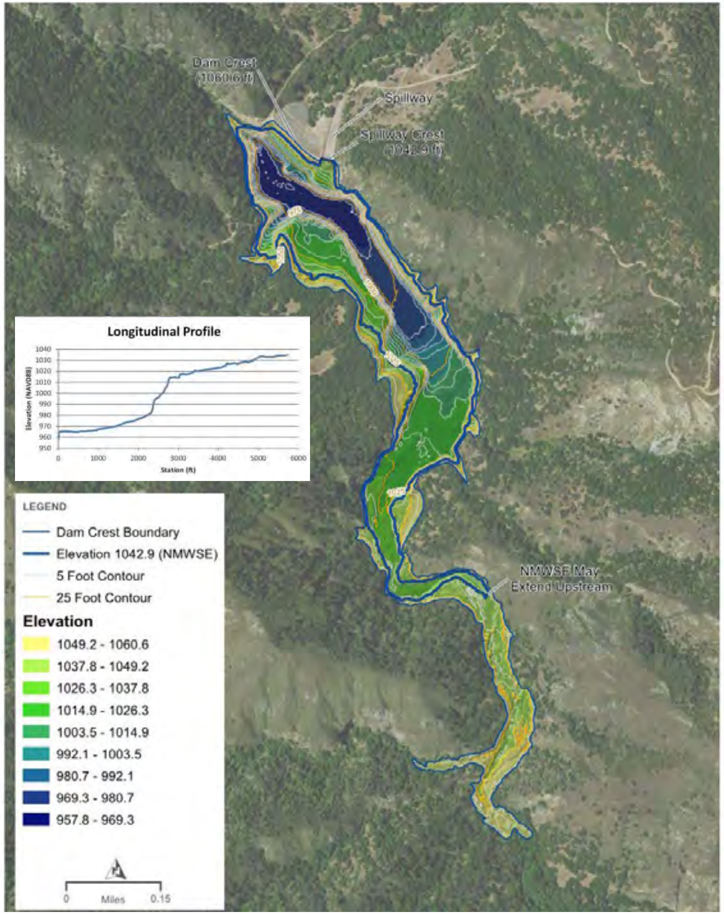
Existing Conditions
Los Padres Reservoir

- Original capacity of 2,720 AF
  - Revised from 3,030 AF
- 2017 storage reduced following fire and heavy rains
  - Calculated at 1,600 AF
- Further reductions have occurred



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Existing Conditions

Los Padres Reservoir

Existing Conditions
Los Padres Reservoir

Low Flow Operations

- Maximize surface flow June through December
- Enhance fish habitat in lower Carmel River
  - Max ops flow: ≈45 cfs
  - Typical ops flow: ≈15-20 cfs
  - Min instream flow: 5 cfs (when available)

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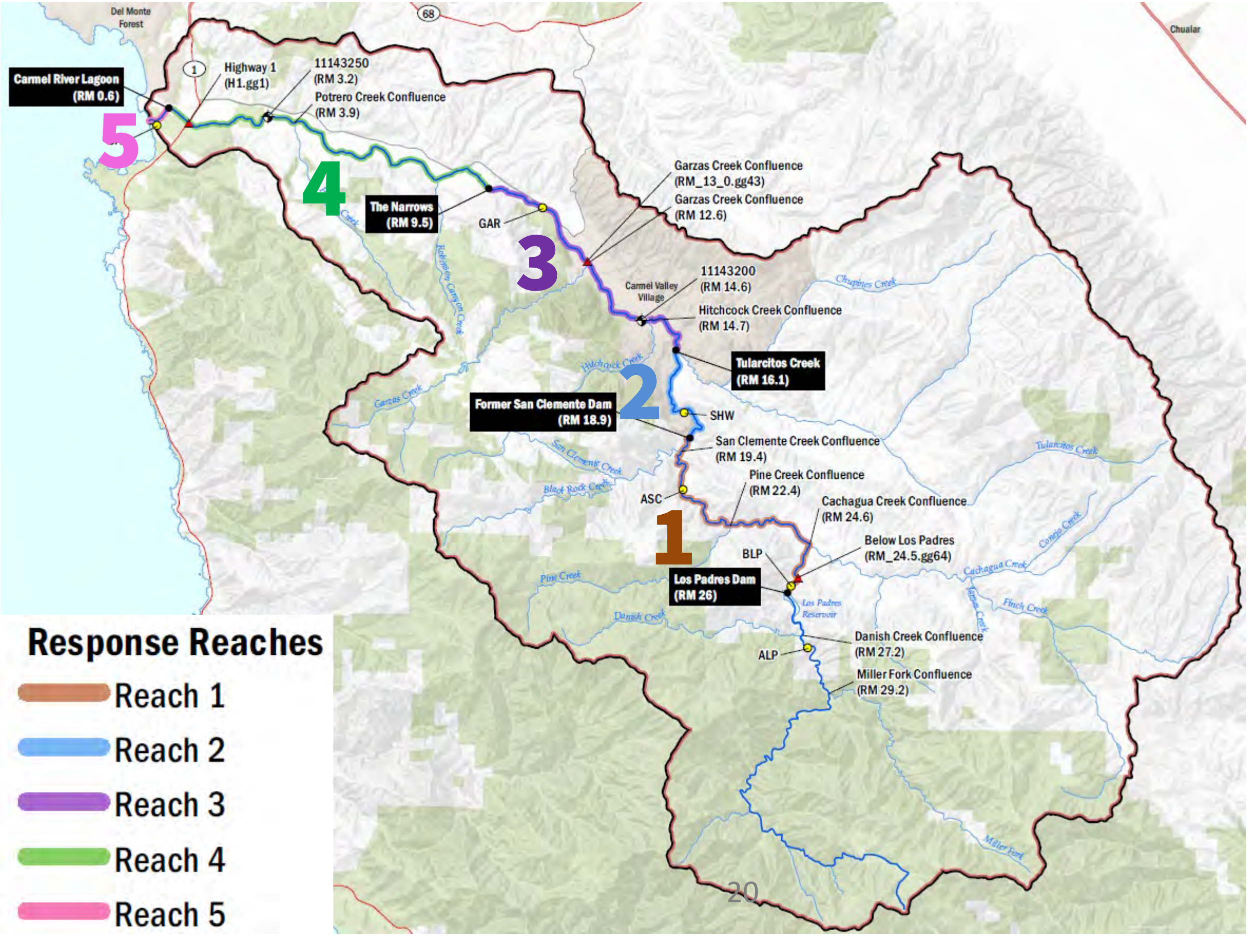
Existing Conditions - Response Reaches

- Canyon (Upper) Reach
  - Reaches 1 & 2
- Alluvial (Lower) Reach
  - Reaches 3 & 4
- Lagoon
  - Reach 5



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Existing Conditions - Carmel River Response Reaches

- Canyon (Upper) Reach, Los Padres to Tularcitos Creek
  - Steep, confined, bedrock control
  - Sediment supply limited
  - Episodic tributary inputs
  - Shallow alluvial deposits frequently scoured
  - Coarser than downstream alluvial reach

Existing Conditions - Carmel River Response Reaches

- Alluvial Reach
  - 1920-1970, wide & meandering → moderately incised, single-thread
  - Banks unconsolidated sand, gravel, nearly half hardened
  - Development & bridges
  - Degradation up to 15 feet
  - Valley widens, transport-limited
  - Alluvium deepens to >200 feet
  - Episodic erosion and sand deposition

Reach 3

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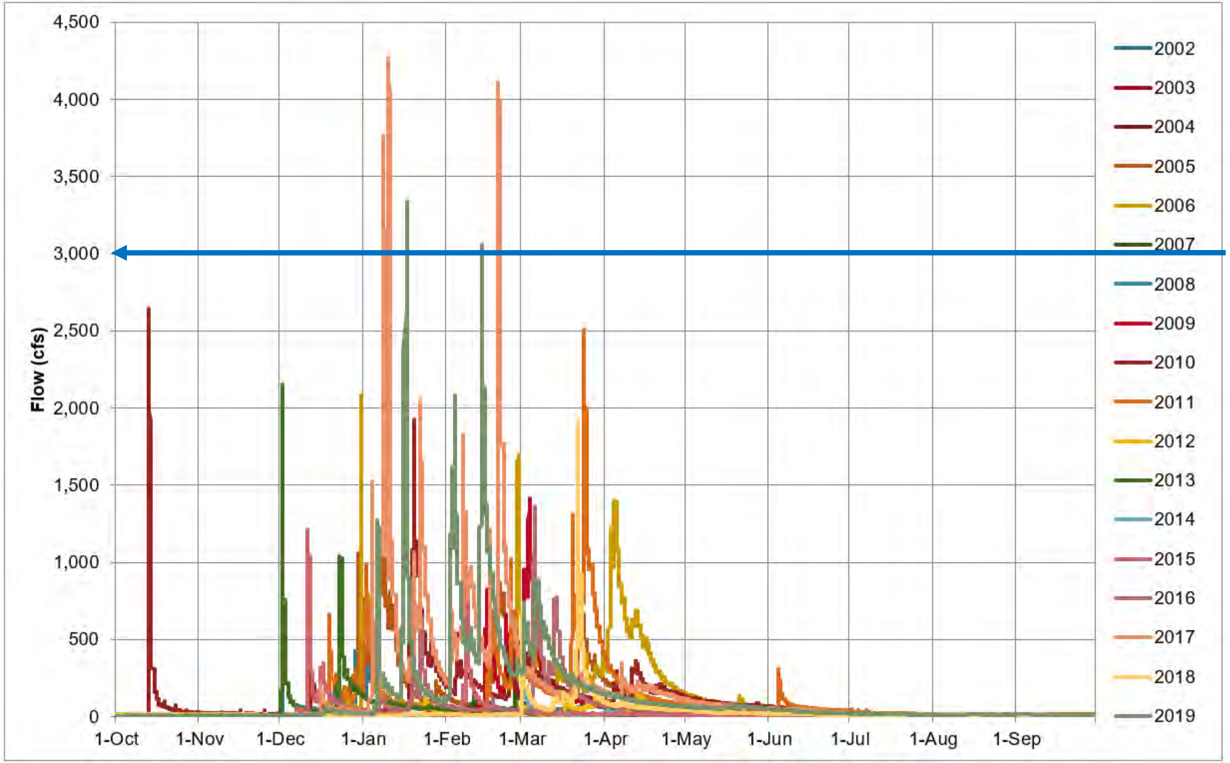
Existing Conditions

Hydrology

Instantaneous flows below LPD



3,000 cfs, 1/8/2017

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Existing Conditions

Additional Data Sources and Considerations in TM

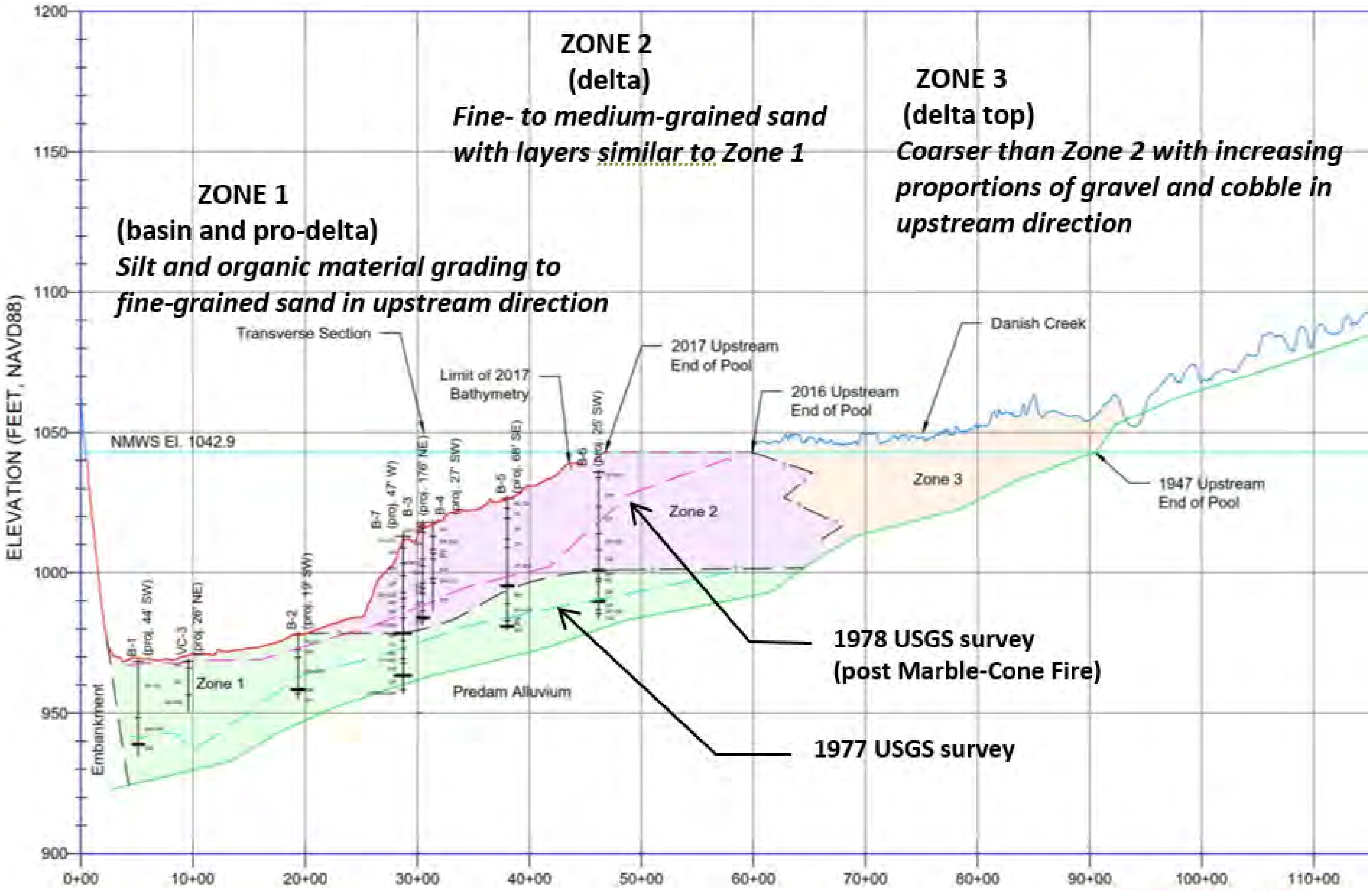
- Water quality & temperature
- Geomorphic & fire effects analyses
- Active channel data & sedimentation rates
- Flood maps & bank protection
- Regulatory setting & water rights

Sediment Characterization TM

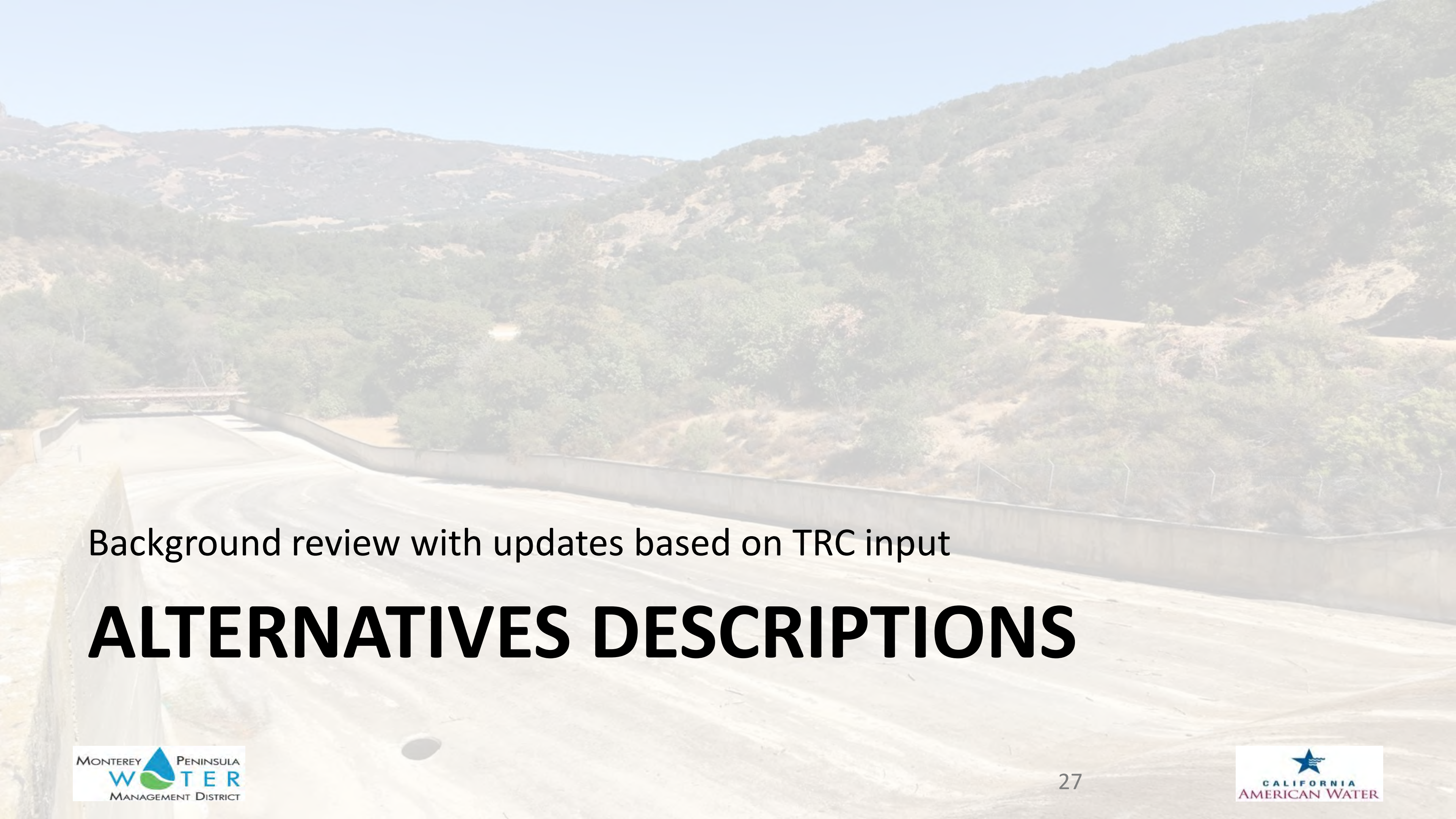
BACKGROUND REVIEW

Reservoir Sediment Characterization TM

- 2017 Field Investigation
- 3 zones w/complex boundaries
- Original, 2,720 AF capacity reduced to 1,600 AF (2017)



Monterey Peninsula Water Management District



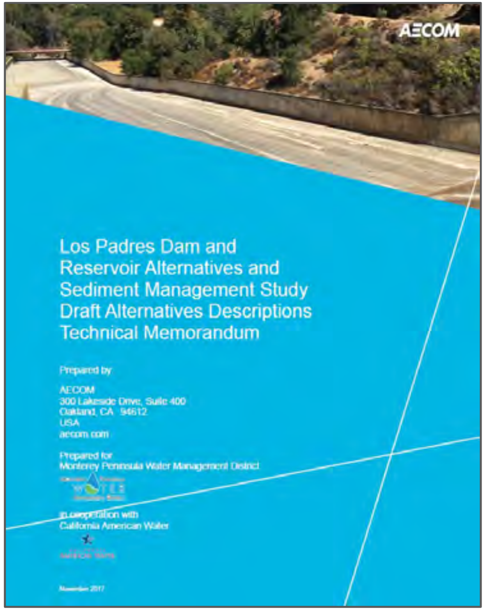
Background review with updates based on TRC input

ALTERNATIVES DESCRIPTIONS

Alternatives Descriptions TM

Summary

- Described alternative concepts in 2017 for Los Padres Dam and Reservoir, and sediment management options that could be used in combination with the alternatives
- Presented to the TRC and discussed at TRC meeting 2a (2018)
- Comments received verbally at TRC Meeting 2a (see meeting notes) and in writing from NMFS, CDFW, and MPWMD
- Alternative development to be informed by:
  - Alts. Descriptions TM & comments
  - Final (2018) Sediment Characterization TM
  - Final Sediment Effects TM
  - Effects to Steelhead TM
  - TRC Meeting 2B (this meeting)



Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam/Reservoir Alternatives

1. No sediment action
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam/Reservoir Alternatives

1. No sediment action
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic Zone 2/3 excavation to uplands
2. Periodic Zone 3 excavation to floodplain
3. Sediment sluicing through a new sluicing tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

Developed with enough detail to address:

- Alternative location
- Complexity
- Longevity
- Potential impacts and benefits
- Relative cost (very low to very high)

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Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam/Reservoir Alternatives

1. No sediment action
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic Zone 2/3 excavation to uplands
2. Periodic Zone 3 excavation to floodplain
3. Sediment sluicing through a new sluicing tunnel
4. ~~Constructing a new bypass tunnel to transport sediment around the reservoir~~

Consensus based on TRC Mtg 2A discussions and TM comments to **remove from further consideration** (high impact/cost)

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Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment action
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic Zone 2/3 excavation to uplands
2. Periodic Zone 3 excavation to floodplain
3. Sediment sluicing through a new sluicing tunnel

Alternatives Descriptions TM

Alternative 1: No Sediment Action

1. **Description**
   - No action taken to manage existing sediment accumulation or future sediment inputs
   - Baseline for comparing alternatives

2. **Ongoing Sedimentation**
   - Past sedimentation rates
     - 70 years including post Marble-Cone fire   1,110 AF = 15.9 AF/year
     - 69 years without post Marble-Cone fire   520 AF = 7.5 AF/year
   - Remaining 1,600 AF would be filled in approximately 100 - 210 years

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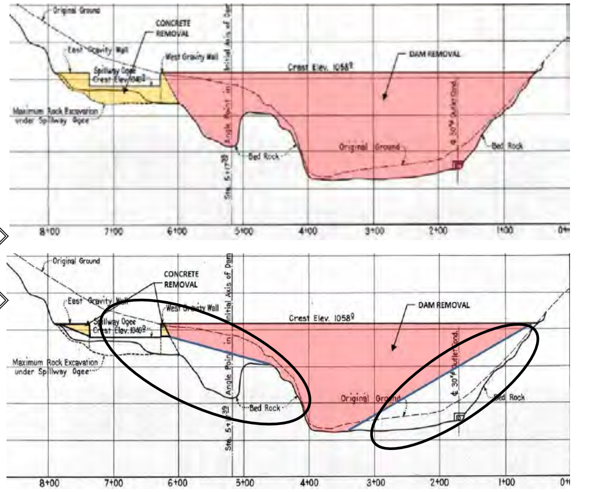
Alternatives Descriptions TM

Alternative 2: Dam Removal

1. Description

- Full height removal in a single season is only practicable dam removal option
  - Alt. 2a: full removal ~460K CY excavation
  - Alt. 2b: partial removal ~300K CY excavation
  - Includes removal of Zone 1 and 2 sediment prior to dam removal (1.7M CY)
    - High water quality degradation if sediment left in place until flood flows
    - Stabilization of sediment in place is not feasible
    - Removal of sediment by dredging/mechanical removal <u>or</u> through sluicing tunnel



Alternatives Descriptions TM

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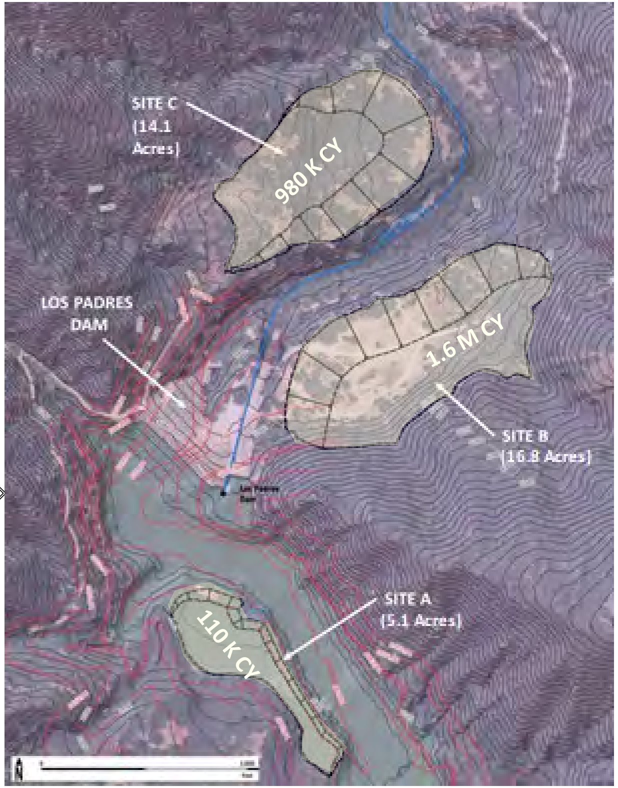

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Alternatives Descriptions TM

Alternative 3: Restore Reservoir Capacity

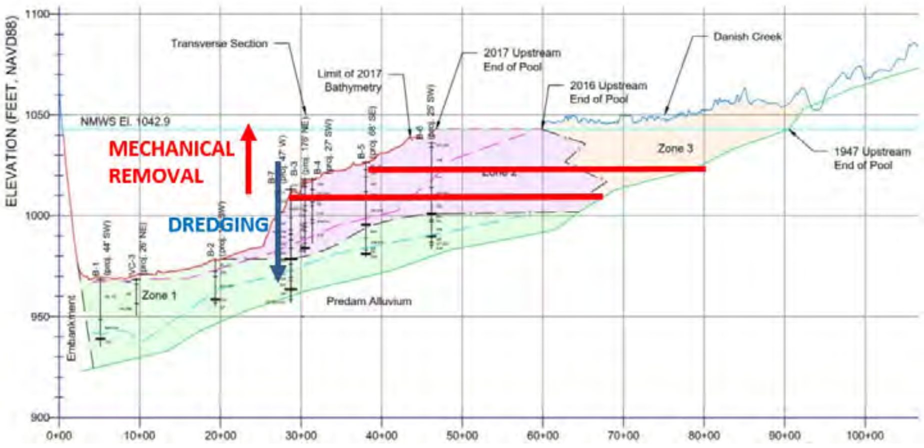
1. **Description**
   - Dredge accumulated sediment to original capacity
   - Combination of mechanical dredging and conventional excavation
   - Could take up seven (7) construction seasons

Barge Mounted Excavator

Alternatives Descriptions TM

Alternative 3: Restore Reservoir Capacity

1. **Description**
   - Mechanical dredging (Zone 1 & part of Zone 2) with clamshell or long-reach excavator
   - Conventional excavation of part of Zone 2 and all of Zone 3



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Alternatives Descriptions TM

Alternative 3: Restore Reservoir Capacity

1. **Description**
   - Dredge accumulated sediment to original capacity
   - Mechanical dredging and conventional excavation
   - Disposal options considered for onsite (3a) ~~and offsite (3b)~~
   - Onsite disposal areas same as dam removal alternative, although additional decanting areas required upstream of the dam

Consensus based on TM conclusions and subsequent discussion to **remove from further consideration** (no reasonable offsite locations)

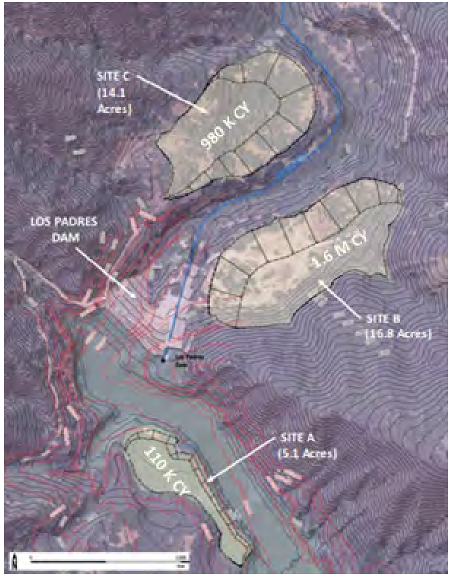
Monterey Peninsula Water Management District

California American Water

Alternatives Descriptions TM

Alternative 3: Restore Reservoir Capacity

1. **Description**
   - Dredge accumulated sediment to original capacity
   - Mechanical dredging and conventional excavation
   - Disposal options considered for onsite (3a) ~~and offsite (3b)~~
   - Onsite disposal areas same as dam removal alternative, although additional decanting areas required upstream of the dam

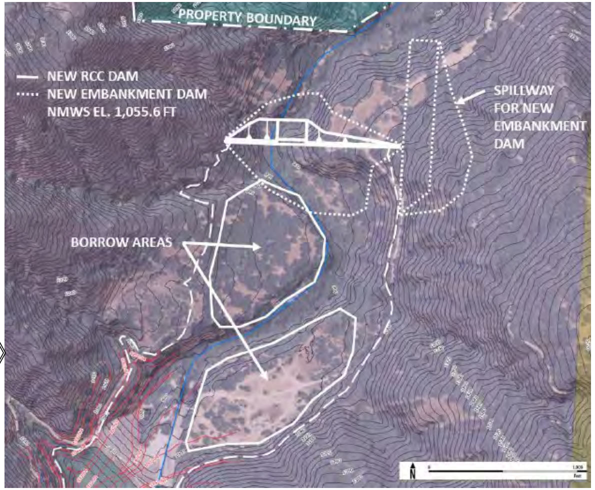


Alternatives Descriptions TM

Alternative 4: Storage Expansion

1. Description

- Increase storage capacity of Los Padres Reservoir through:
  - Modification of existing dam (4a/b)
  - New dam downstream of the existing dam (4c)
  - Or combination of above (4d)



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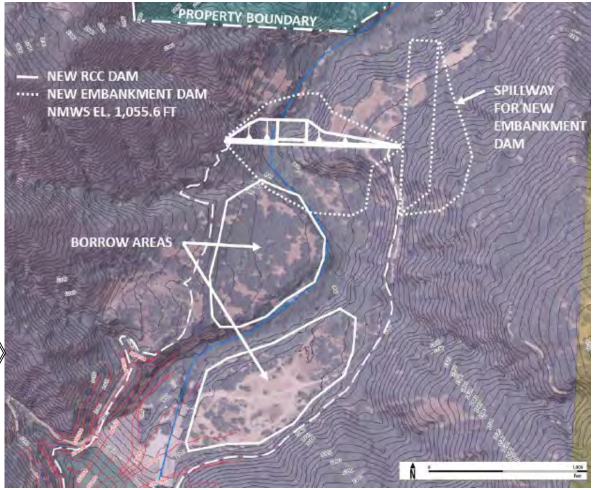
Alternatives Descriptions TM

Alternative 4: Storage Expansion

1. Description

- Increase storage capacity of Los Padres Reservoir through:
  - Modification of existing dam (4a/b)
  - ~~New dam downstream of the existing dam (4c)~~
  - ~~Or combination of above (4d)~~



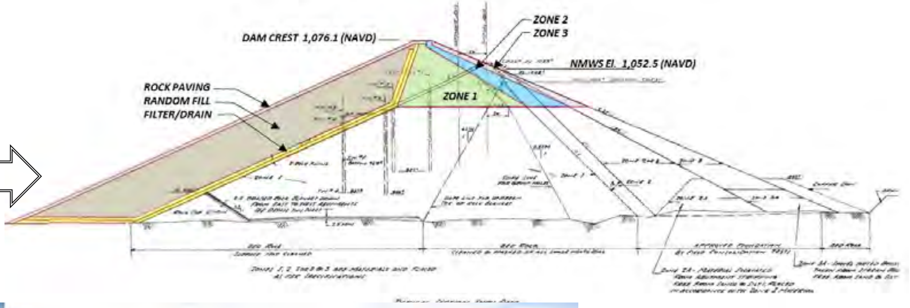
Consensus based on TRC Mtg 2A discussions and TM comments to **remove from further consideration** (high impact/cost)

Alternatives Descriptions TM

Alternative 4: Storage Expansion

1. Description

- Increase storage capacity of Los Padres Reservoir through:
  - Modification of existing dam
- Raise could be accomplished by:
  - Embankment dam raise (4a)
  - Rubber bladder dam (4b)



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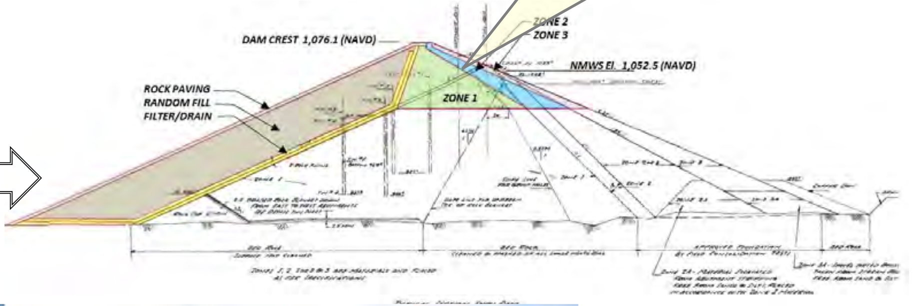
Alternatives Descriptions TM

Alternative 4: Storage Expansion

TRC Mtg 2A discussions and TM comments request to **remove from further consideration** (less flexibility/high impact/cost)

1. Description

- Increase storage capacity of Los Padres Reservoir through:
  - Modification of existing dam
- Raise could be accomplished by:
  - ~~Embankment dam raise (4a)~~
  - Rubber bladder dam (4b)



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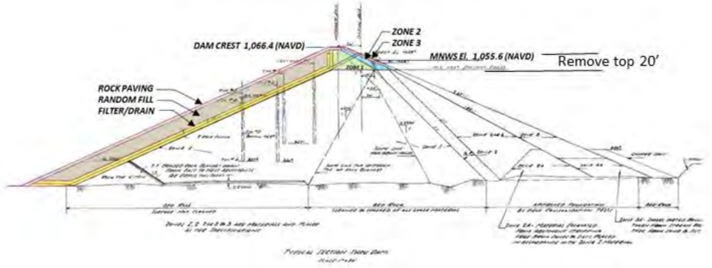
Alternatives Descriptions TM

Alternative 4: Storage Expansion

1. **Description**
   - Increase storage capacity of Los Padres Reservoir through:
     - Modification of existing dam with bladder dam
     - Allows for temporarily increased storage from 1,601 AF to 2,187 AF (586 AF increase) at end of precipitation season
     - Requires modification to spillway
     - Requires small downstream dam raise; dam may require additional modification to meet current seismic stability criteria



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Alternatives Descriptions TM

Dam Alternatives and Sediment Management Options

Dam and Reservoir Alternatives

1. No sediment action
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic Zone 2/3 excavation to uplands
2. Periodic Zone 3 excavation to floodplain
3. Sediment sluicing through a new sluicing tunnel

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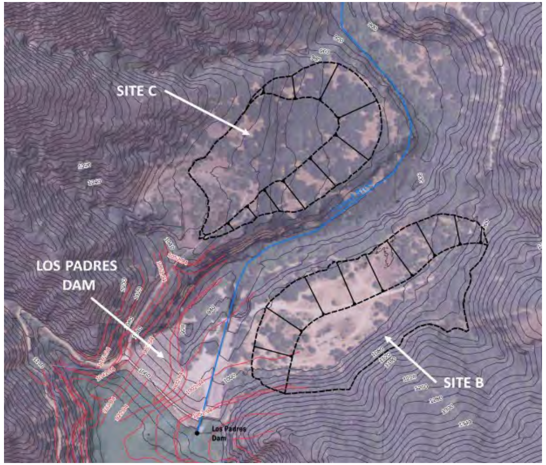
Alternatives Descriptions TM

SM Option 1: Periodic Zone 2/3 Excavation to Uplands

1. Description

- Excavate ~60,750 CY every 5 years of Zone 2 and 3 sediment from upstream half of reservoir
  - Most sediment currently being trapped appears to be Zone 2 and 3
  - Based on 7.5 AF/year an estimated 12,150 CY of Zone 2 and 3 sediment is trapped each year
- Reconstruct access road to upstream each time
- Hauling for permanent placement in Disposal Sites B and C
- One 3-month construction season every five years
- Could be incorporated as option to Alternative 3 Restore Storage Capacity



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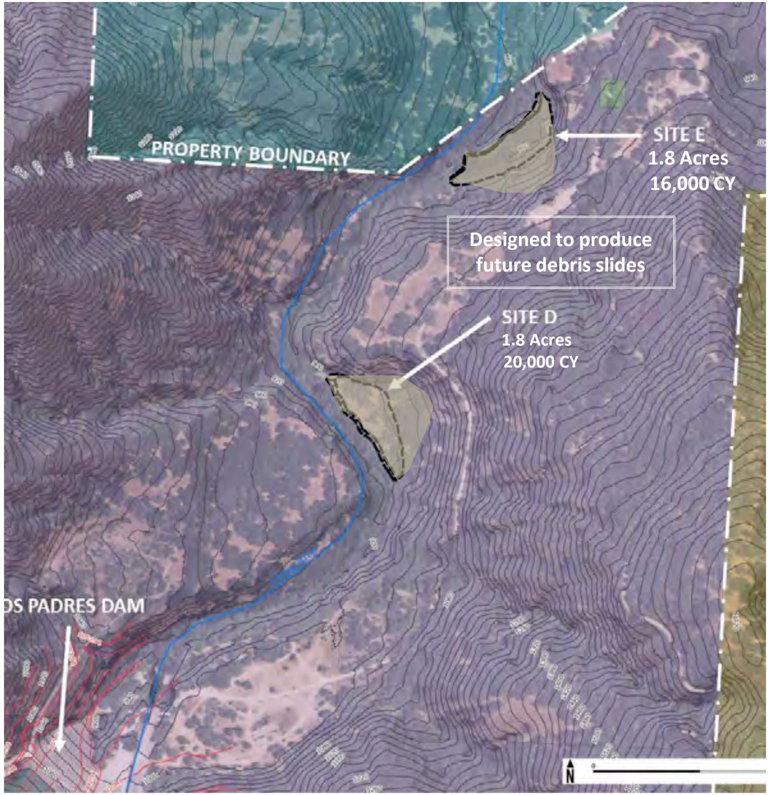
Alternatives Descriptions TM

SM Option 2: Periodic Zone 3 Excavation to Floodplain

1. Description

- Excavate ~36,000 CY every 10 years of Zone 3 sediment from upstream half of reservoir
- Clear Sites D and E (current flood plain terraces) for temporary sediment storage/reintroduction to River
- Reconstruct access road to upstream each time
- Hauling for placement in Sites D and E
- One 1-month construction season every five years
- Could be combined with SM Option 1 and/or incorporated as option to Alternative 3 Restore Storage Capacity



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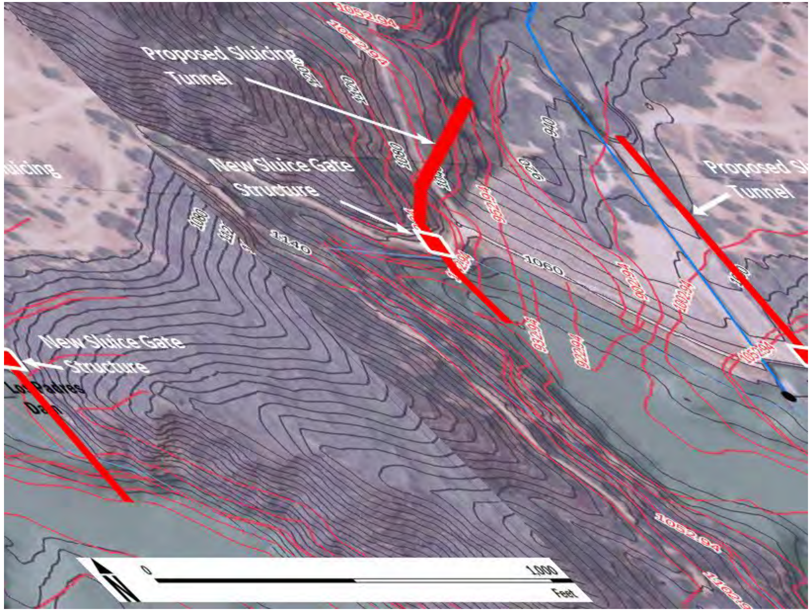
Alternatives Descriptions TM

Option 3: Sluicing Tunnel

1. Description

- Install approx. 900-foot long tunnel through either left or right abutment
- Flush sediment during wet water years
- Assuming majority of Zone 1 and Zone 2 sediment can be flushed, reservoir capacity would be 2,600 AF



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Alternatives – Next Steps

Name	Dam/Reservoir Action	Sediment Action	Notes
No Sediment Action (Alt. 1)	-	-	Remaining 1,600 AF would be filled in approximately 100 - 210 years
Dam/Sediment Removal (Alt. 2)	Dam removal	Dredge accumulated fine sediment (Z1/Z2)	Could consider partial removal (Alt. 2b) in later value engineering; Relatively high cost
Dam Removal with Sediment Flush (Alt. 2)	Dam Removal	Flush fine sediment via sluice tunnel (Z1/Z2)	Depends on acceptance of WQ impacts
Restore Reservoir Capacity (3a)	-	Dredge accumulated fine sediment (Z1/Z2) and excavate coarse sediment (Z2/Z3)	Could take up to 7 years to restore capacity
Storage Expansion (4b)	Raise with bladder dam & spillway improvements	-	Provides operational flexibility and relatively low cost (for action alternatives)
Recover Reservoir Capacity with Excavation to Uplands (SM1)	-	Excavate accumulated fine and coarse sediment (Z2/Z3), place in uplands	Periodic sediment removal about every 5 years
Recover Reservoir Capacity with Excavation to Floodplain (SM2)	-	Excavate accumulated coarse sediment (Z3), place in floodplain	Periodic sediment removal, smaller quantities than SM1 but with sediment transport benefits
Recover Reservoir Capacity with Sluice Tunnel (SM3)	Add sluicing tunnel and gate structure	Sluice accumulated sediments during wet years (Z1/Z2)	Depends on acceptance of WQ impacts

* Alternatives where dam remains may involve fish passage related improvements

Sediment Effects TM – Sediment transport model (BESMo)

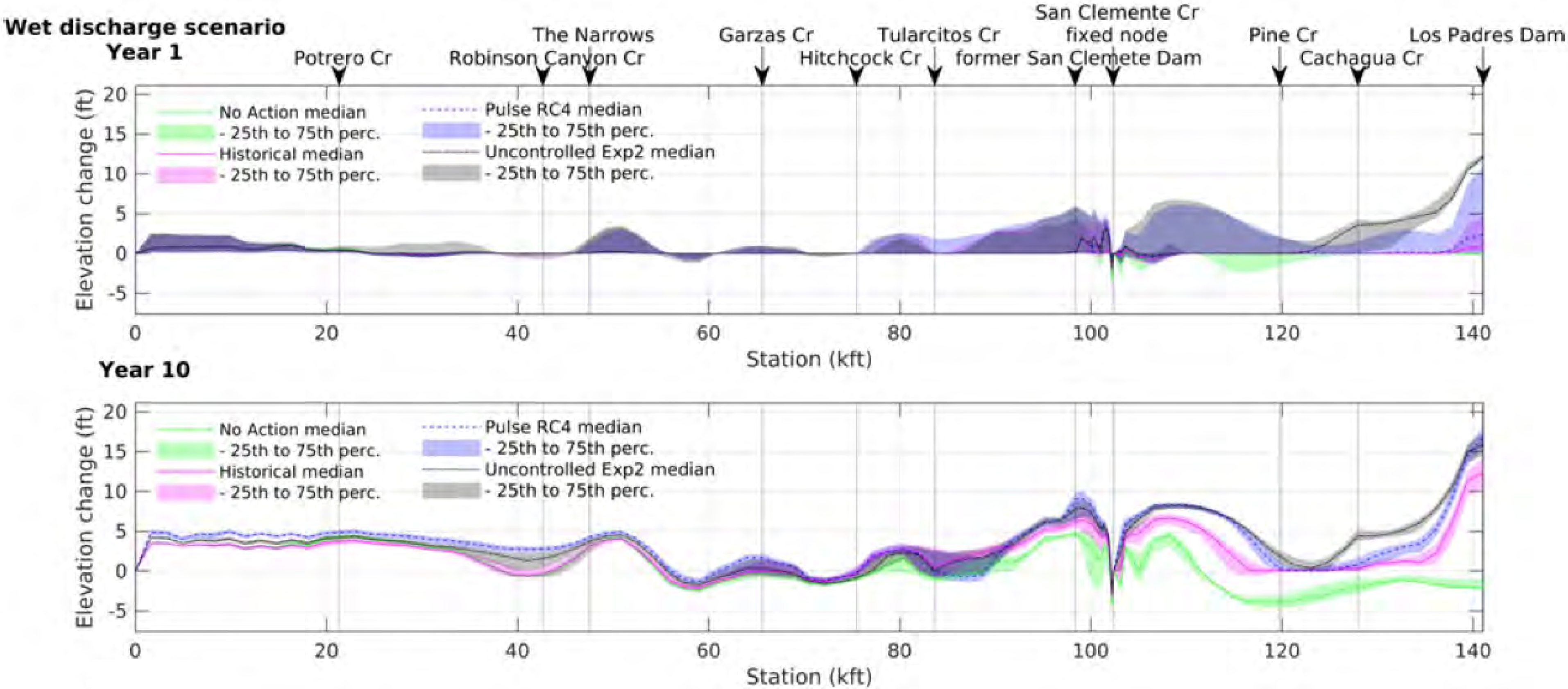
BACKGROUND REVIEW

Sediment Transport Analysis

1. TRC heavily involved in model development
2. BESMo (1D morphodynamic sediment transport model; for large sediment pulses in rivers)
3. 4 sediment scenarios:
   – No Action
   – Historical Supply
   – Pulsed Supply
   – Uncontrolled Supply
4. 300 60-year Hydrographs: 100 each of "wet", "average", and "dry"
5. Sediment storage is translated to bed elevation changes by proportionally (deposition)/equally (erosion) distributing sediment based on the average reach-based cross-sectional shape

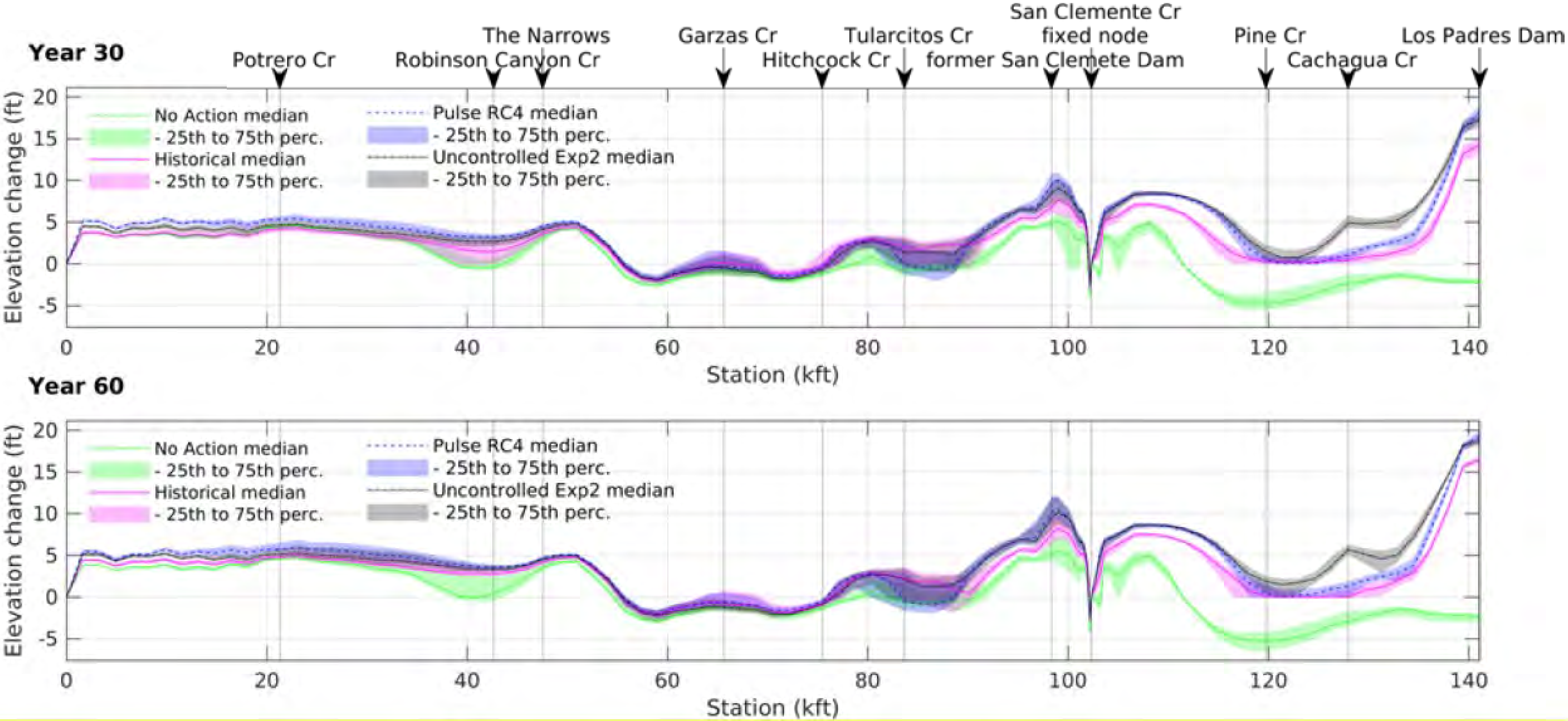
Sediment Transport Results

- Bed Elevation Change for Wet Hydrographs



Sediment Transport Results

- Bed Elevation Change for Wet Hydrographs



Sediment Transport Results

- Consistency of spatial trends between the 4 supply scenarios means results can be used to plan for outcomes related actions at Los Padres Dam
- Temporal trends are related to the timing and magnitude of floods
- By year 60, in 3 sediment release scenarios, 4 to 6 feet of net deposition on the lowermost 30,000 feet; Carmel Valley Village reach is particularly sensitive to the timing and sequencing of future large floods
- Represents an increased risk of increased flooding in developed areas
- Also brings benefits of more frequently activated side and alternate channels and natural construction of in-channel habitat elements and features
- Recommend evaluating increased risks with increased benefits when selecting feasible mitigation actions

Overview and Discussion of Draft Effects to Steelhead TM

EFFECTS TO STEELHEAD

Effects to Steelhead - Purpose

- Preliminary, high-level analysis of conceptual alternatives
- Inform further development of concepts (in upcoming Task 4, Alternatives Development)
- Guide later evaluation of more-developed alternatives
- Identify where additional information may be needed

Carmel River Steelhead - Status

- Largest S-CCC DPS (ESA Threatened) run during years of high rainfall
- Likely source population to smaller drainages, which may not persist without strays
- Unique - both interior & coastal population attributes

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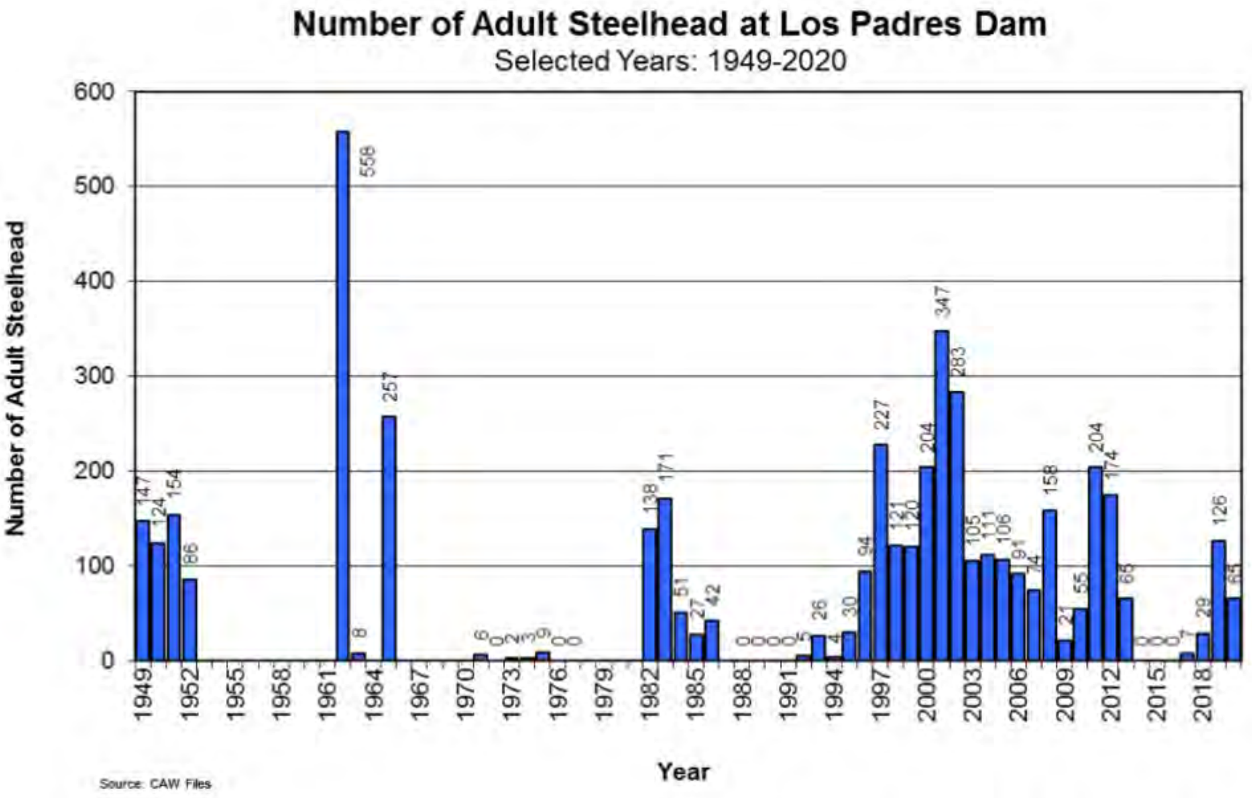
Carmel River Steelhead – Historical Abundance

- Historical population estimates 1,500 - 12,000 adults annually
- Monitoring indicates steady decline (with wide fluctuations)
- NMFS (2012) estimates basin could support 4,000 adults annually
  - 2,000 upstream of LPD
  - 1,000 between LPD and former San Clemente Dam
  - 1,000 downstream of San Clemente Dam

Carmel River Steelhead – Recent Abundance

- Several no-captures were drought years
- Pre-1993 may be unreliable
- More reliable since automatic counter in 1993, & new ladder and trap in 1999



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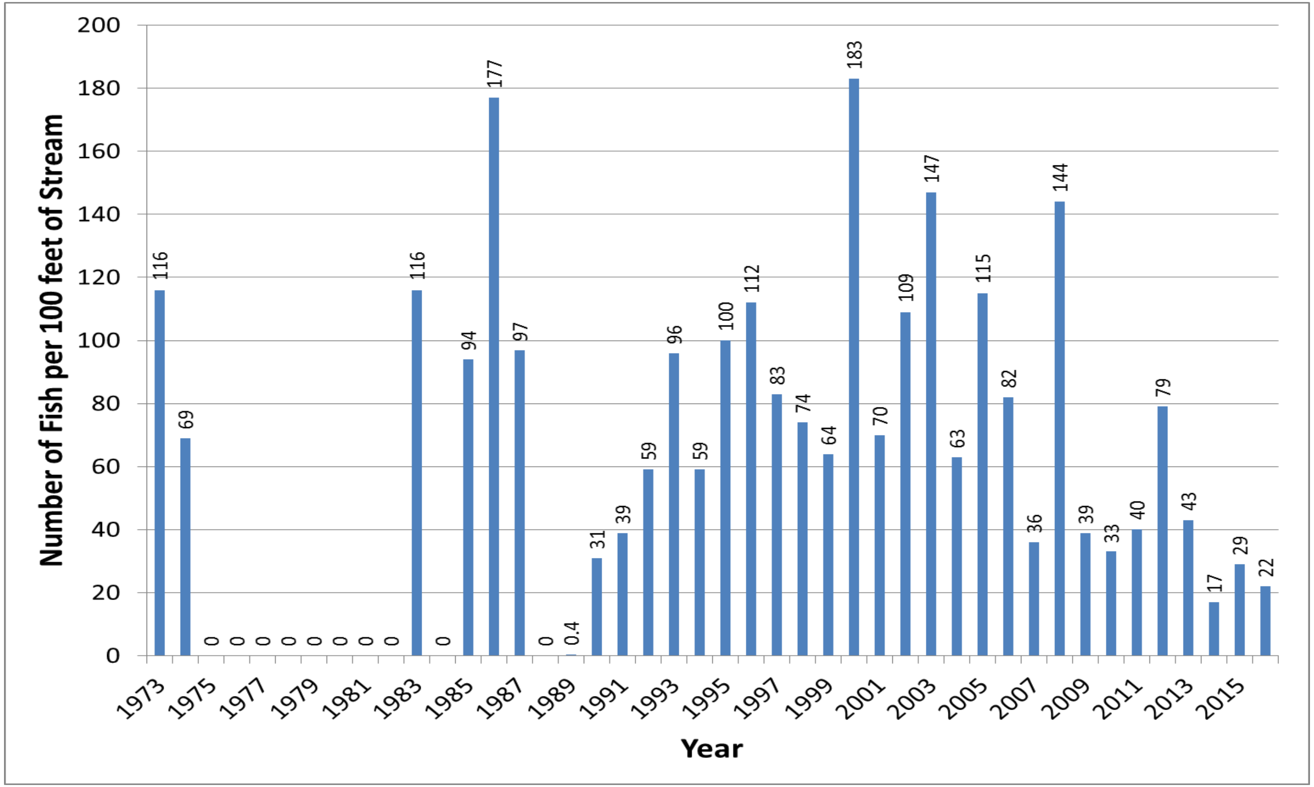
Carmel River Steelhead – Recent Abundance

CDFW & MPWMD e-fishing surveys

- Large annual fluctuations
- Periods of absence during droughts
- Generally declining trend from 2000 to 2014

Juvenile steelhead density estimates



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Carmel River Steelhead – Recent Abundance

- Life history upstream of LPD not well understood
  - Anadromous and resident fish
  - Drought refugia - high juvenile densities following prolonged drought (Boughton et al. 2020)


Carmel River upstream of Bruce Fork, 1/28/2004

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Carmel River Steelhead – Los Padres Reservoir

Limited information on juvenile steelhead occurrence in, and emigration through, Los Padres Reservoir

- Of 345 downstream migrants, 25% detected downstream of Los Padres (Boughton et al. 2020)
- More smolts caught downstream than upstream (1996 & 1999), suggesting reservoir used for rearing or holding (MPWMD 2015)
- CDFW (1995) found *O. mykiss* >250 mm FL suggesting adfluvial life history

Los Padres Reservoir

Carmel River Steelhead – Spawning Habitat

- Spawning Habitat
  - 50% upstream of LPD
  - 40% mainstem downstream of LPD
  - Remainder in tributaries to lower mainstem

Note- not all tributaries surveyed. Spawning habitat distribution downstream of LPD may be underrepresented in quantitative estimates.

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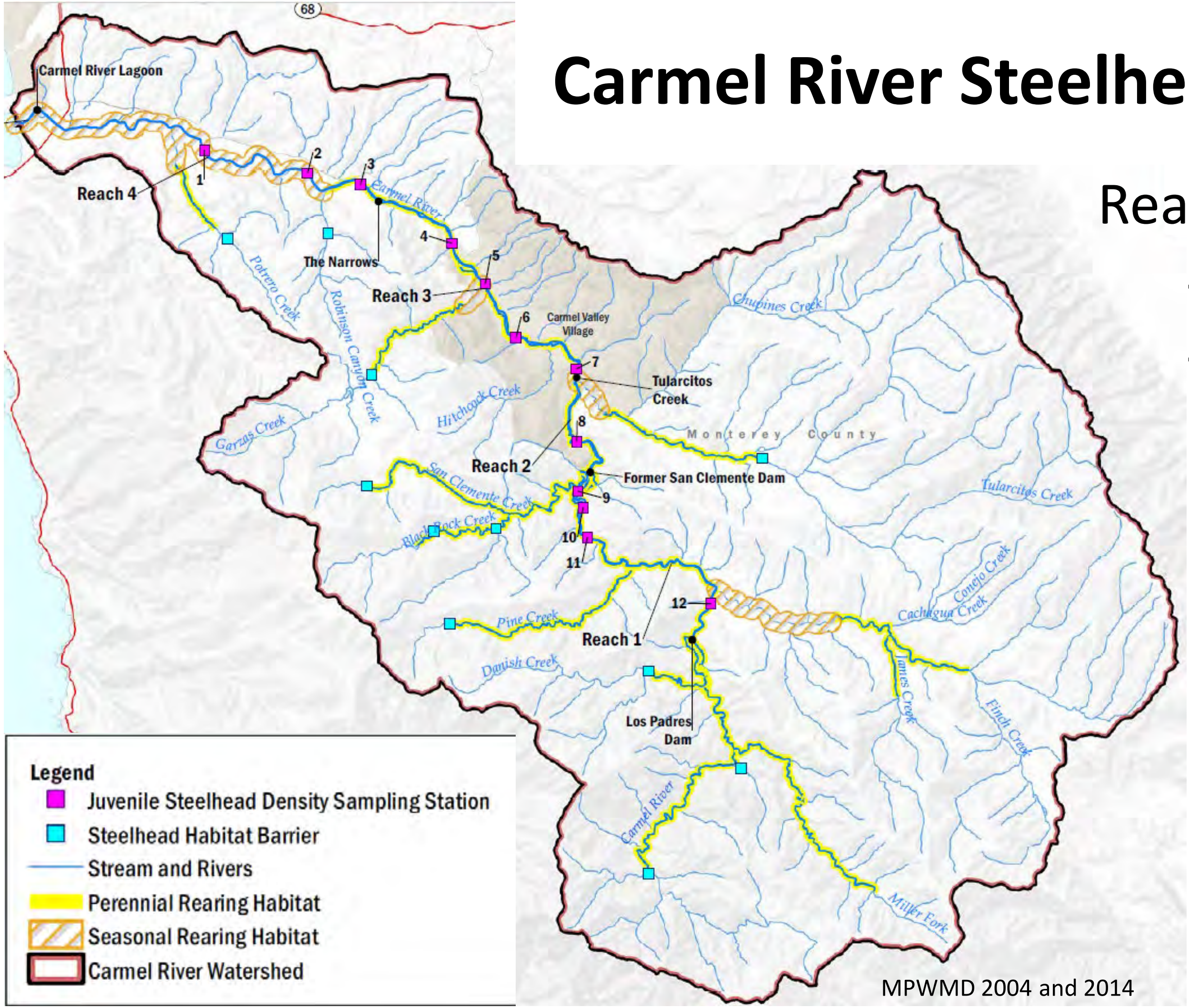
MPWMD 2004 and 2014

Carmel River Steelhead - Rearing Habitat



MPWMD 2004 and 2014

Rearing Habitat

- 36% upstream of LPD
- 64% downstream of LPD in mainstem and tributaries

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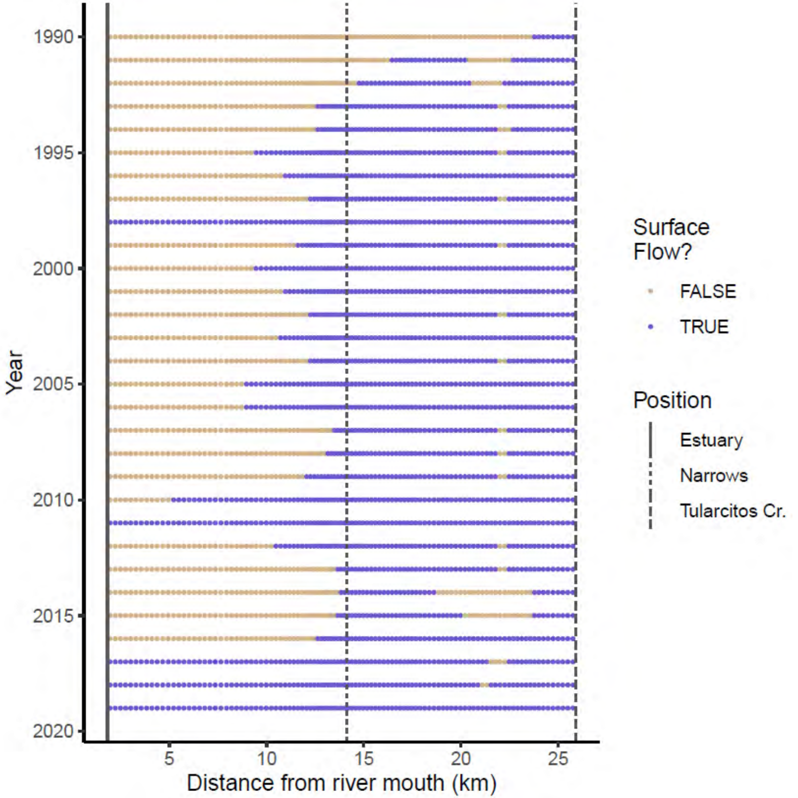
Carmel River Steelhead – Rearing Habitat

Maximum extent of dry channel each year, as inferred by NOAA from records of fish relocations (Ohms et al. 2021)

The lower portion of the Carmel River consistently dries up in all but the wettest years



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Effects to Steelhead - Approach

Assess implications of alternatives and options on steelhead, including the following:

Alternative/Option	Description
1	Los Padres Dam Remains (No Sediment Management)
2	Dam Removal
3	Restore Reservoir Capacity (Sediment Management)
4	Storage Expansion (Bladder Dam)
SM-1	Periodic Sediment Removal to Offsite Disposal Site
SM-2	Periodic Sediment Removal and Placement Downstream
SM-3	Sluicing Tunnel

Effects to Steelhead - Approach

- Short-term impacts of implementing the alternative
- Long-term effects of the alternative on:
  - habitat availability
  - passage from the ocean through the reservoir area
  - water quality in the reservoir
  - quantity and quality of water and sediment releases from the reservoir

Carmel River Reach 3

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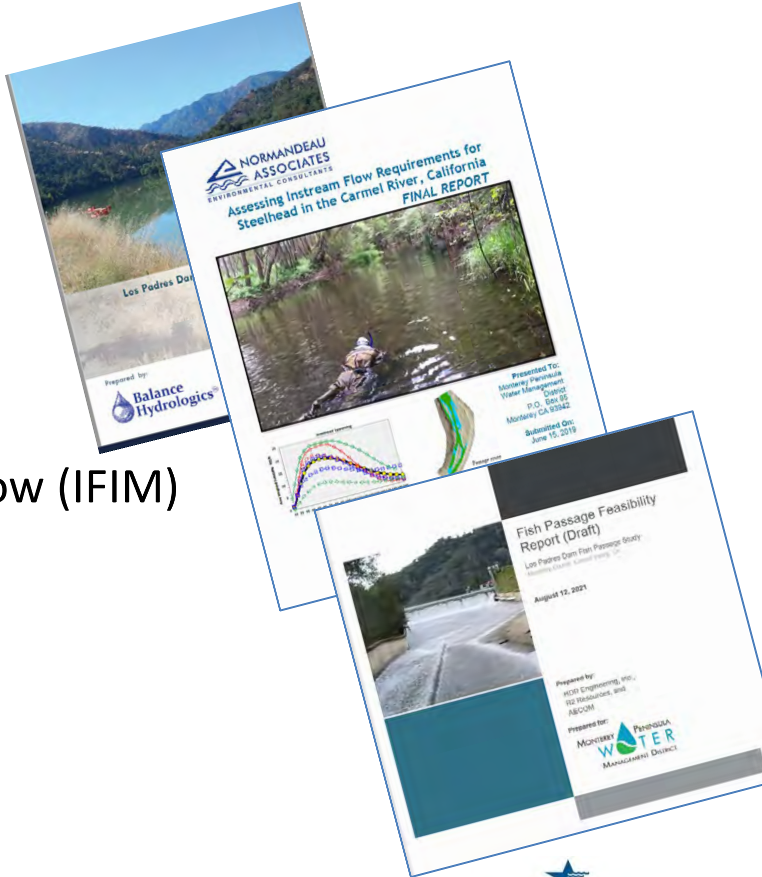
Effects to Steelhead – Response Variables

- Bedload Sediment Transport
  - Sediment Effects TM
- Suspended Sediment
  - Sediment rating curves & previous projects
- Water Availability
  - Watershed hydrology (CRBHM)
  - Steelhead habitat in relation to instream flow (IFIM)
- Water Temperature
  - General monitoring data
- Fish Passage
  - Los Padres Fish Passage Study



Effects to Steelhead – Bedload Sediment Transport

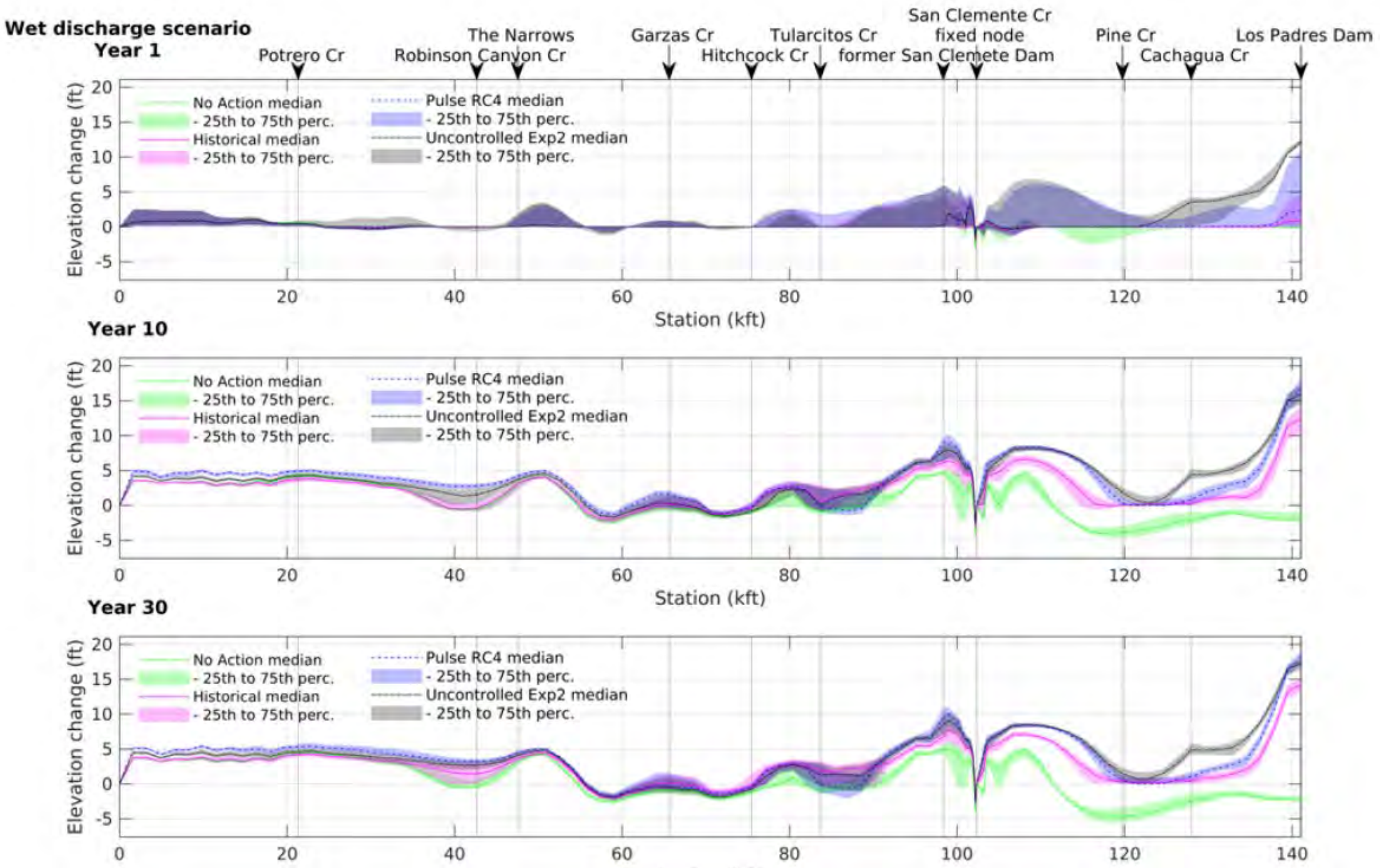
BESMo scenarios considered :

1. **No Action Simulation:** No change to the present operation or configuration of LPD or LPR. Applies to Alternatives 1, 3, and 4.

2. **Uncontrolled Supply Simulation:** Sediment accumulated in LPR is rapidly transported to the downstream mainstem Carmel River according to sediment evacuation functions developed with data from similar types of previously completed projects. Applies to Alternative 2.

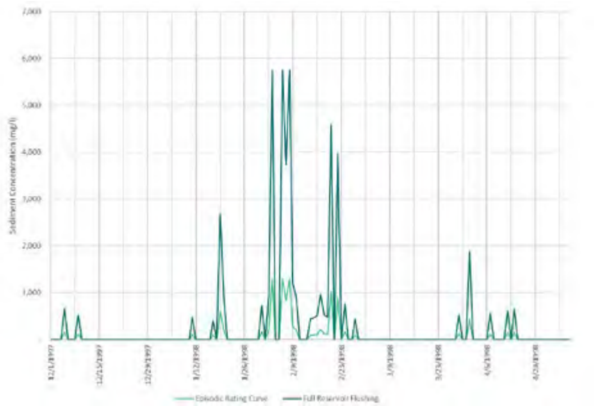
3. **Pulsed Supply Simulation:** Sediment accumulated in LPR and the background historical supply is bypassed to the downstream mainstem Carmel River through a bypass tunnel. Applies to SM-2 and SM-3.

Effects to Steelhead – Bedload Sediment Transport



Effects to Steelhead – Suspended Sediment (SM-3)

- Spreadsheet analysis of available flows and sediment rating curves
- Estimate potential suspended sediment concentrations and durations
  - using the daily flow hydrograph from the CRBHM for Alternative 2.
- Concentrations assessed based on Newcombe and Jensen (1996) Severity of Ill Effects (SEV) analysis
- 5,800 mg/L peak over several days from Zone 1 sediment
- Based on literature review of previous dam removal projects potentially peak concentrations greater than 49,000 mg/L for 2-5 days.



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Effects to Steelhead – Suspended Sediment (SM-3)

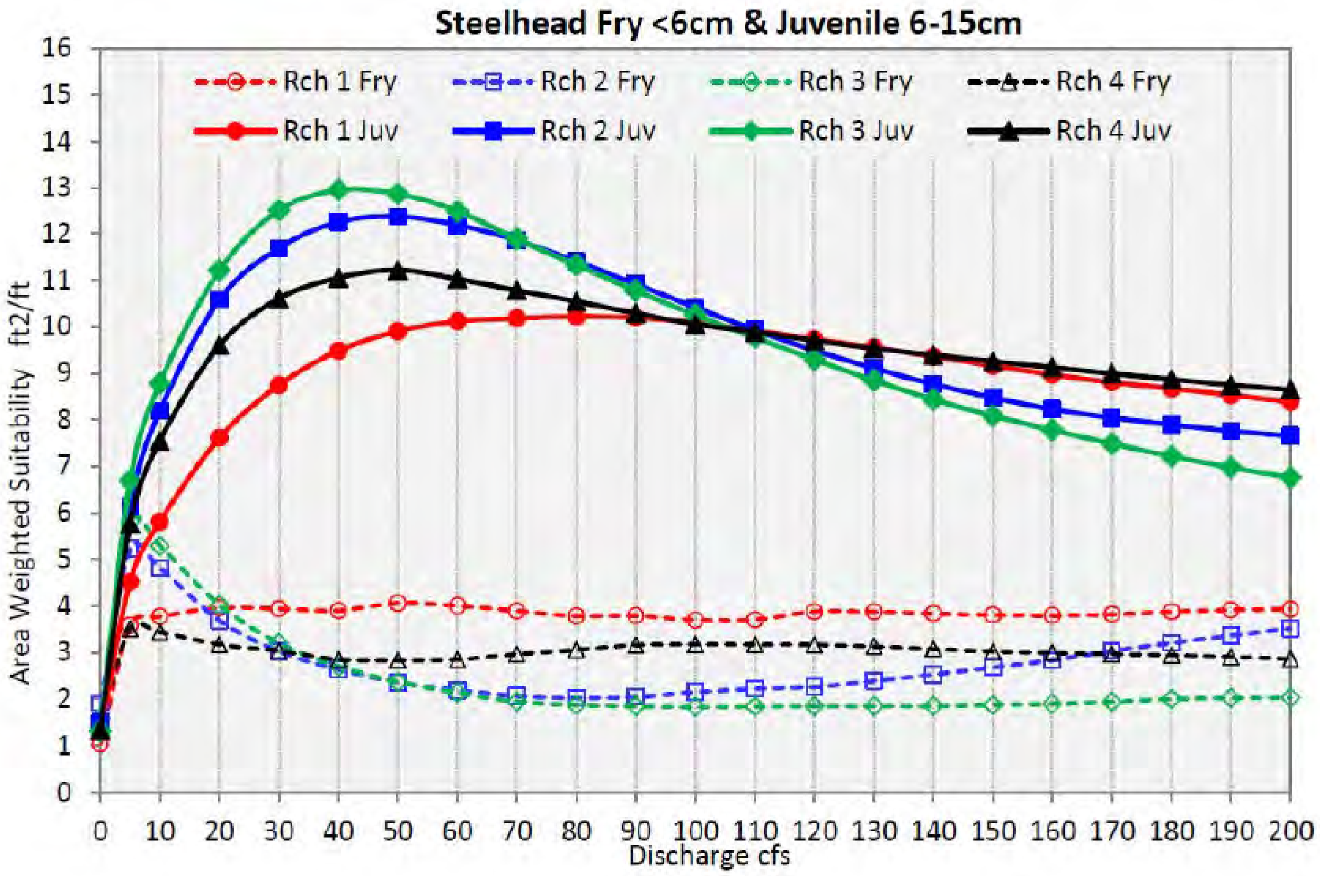
Table 5 Summary of Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Steelhead in the Carmel River Downstream of LPD during Sluicing Events Producing 5,800 mg/L of Suspended Sediment Concentrations for 3 Days

Life Stage	Total Exposure (hours)	Total CD (mg-hr/L)	SEV	Effects
Adult	72	417,600	10	0 to 20% mortality; increased predation; moderate to severe habitat degradation
Eggs and alevins			13	>60 to 80% mortality
Fry and juveniles			10	0 to 20% mortality; increased predation; moderate to severe habitat degradation

Table 6 Summary of Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Steelhead in the Carmel River Downstream of LPD during Sluicing Events Producing 49,000 mg/L of Suspended Sediment Concentrations for 3 Days

Life Stage	Total Exposure (hours)	Total CD (mg-hr/L)	SEV	Effects
Adult	72	3,528,000	11	>20 to 40% mortality
Eggs and alevins			14	>80 to 100% mortality
Fry and juveniles			11	>20 to 40% mortality

Effects to Steelhead – Steelhead habitat and flows



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Water Availability- Spatial Patterns

Station Number	Juvenile Steelhead Density Sampling Station	Average Density
1	Valley Greens Br.	Low
2	Red Rock (Mid Valley)	Moderate
3	Scarlett Narrows	Moderate
4	Garland Park	High
5	Boronda	High
6	DeDamp Park	High
7	Stonepine Resort	High
8	Sleepy Hollow	Moderate
9	SCR Lower Delta	Moderate
10	SCR Upper Delta	Moderate
11	Los Compadres	High
12	Cachagua	High

Water Availability- Importance of lower river

- Lower reaches support the fastest observed growth in watershed;
- Slower growth is observed in the tributaries and upper mainstem;
- Larger juveniles more likely to become anadromous;
- Supporting flows and suitable conditions in the lower river are critical to maintain anadromous steelhead production.

(Ohms and Boughton 2019; Arriaza et al. 2017; Phillis et al. 2016; Satterthwaite et al. 2009; Hayes et al. 2008)

Carmel River at Steinbeck Pool

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Effects to Steelhead – Water Availability

Carmel River Basin Hydrologic Model CRBHM (Christensen et al. 2021) scenarios:

- **LPD Remains, Cease and Desist Order, No Sediment Management:** Applies to *Alternative 1*.
- **Remove LPD:** Applies to *Alternative 2*.
- **Restore Reservoir Capacity:** Dredged LPR (excluding the rubber dam). Assumes that a new water right above CDO limit. Applies to *Alternative 3*.
- **Storage Expansion (Rubber Dam):** Dredged LPR and rubber dam. Assumes that a new water right above CDO limit. Applies to *Alternative 4*.

Water Availability

Extent of Carmel River Flows (**0.5 cfs**) in July through September under LPD Project Alternatives during **Normal Years**

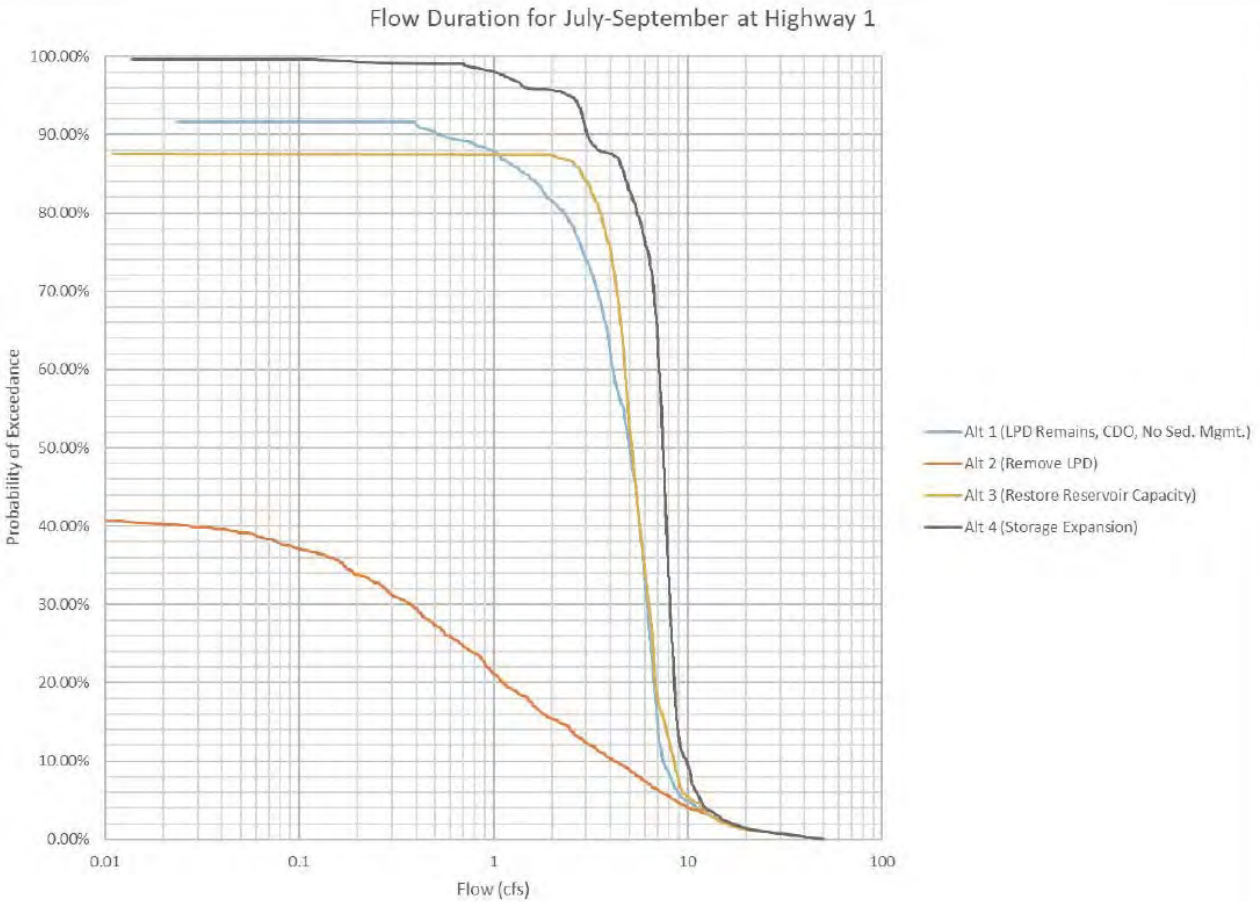
Water Availability

Extent of Carmel River Flows (**3 cfs**) in
July through September under LPD
Project Alternatives during **Normal Years**

Water Availability

Extent of Carmel River Flows (**5 cfs**) in July through September under LPD Project Alternatives during **Normal Years**

Water Availability- all water years



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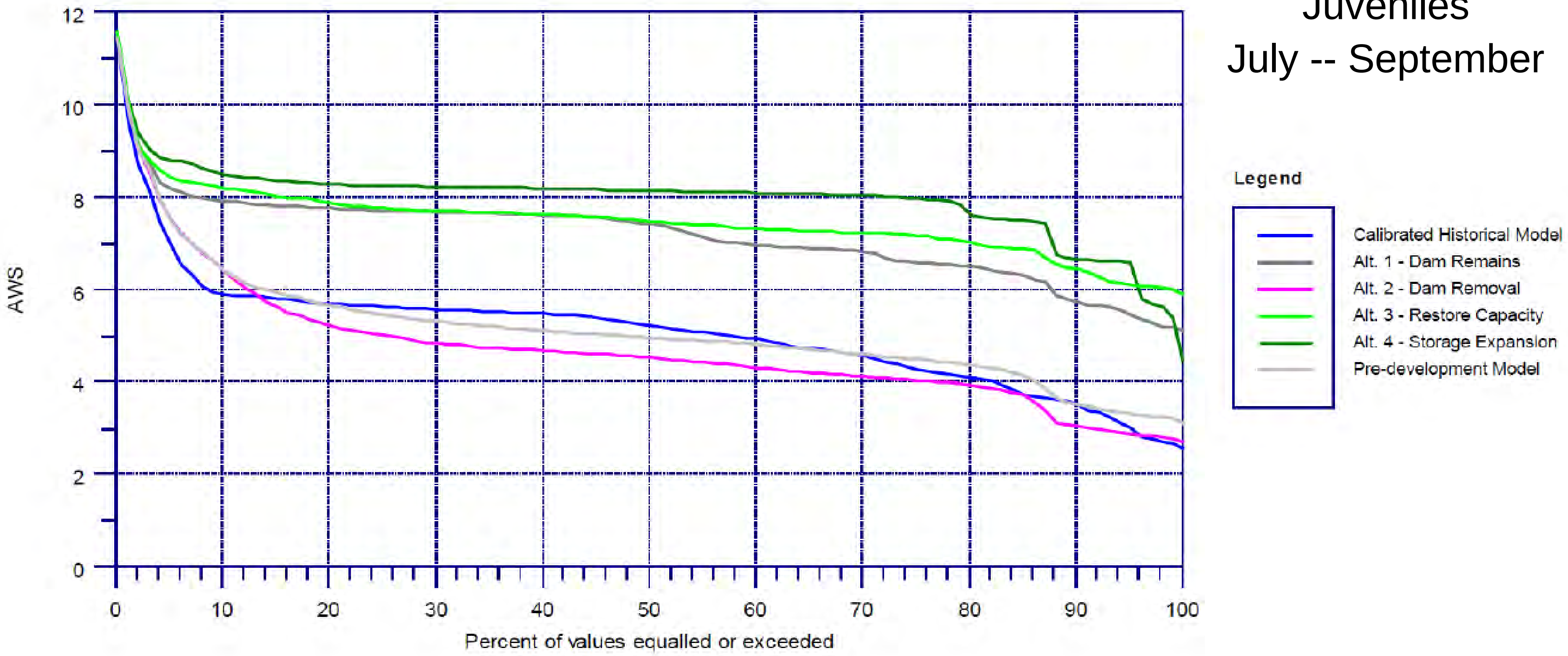
Effects to Steelhead – Steelhead habitat and flows

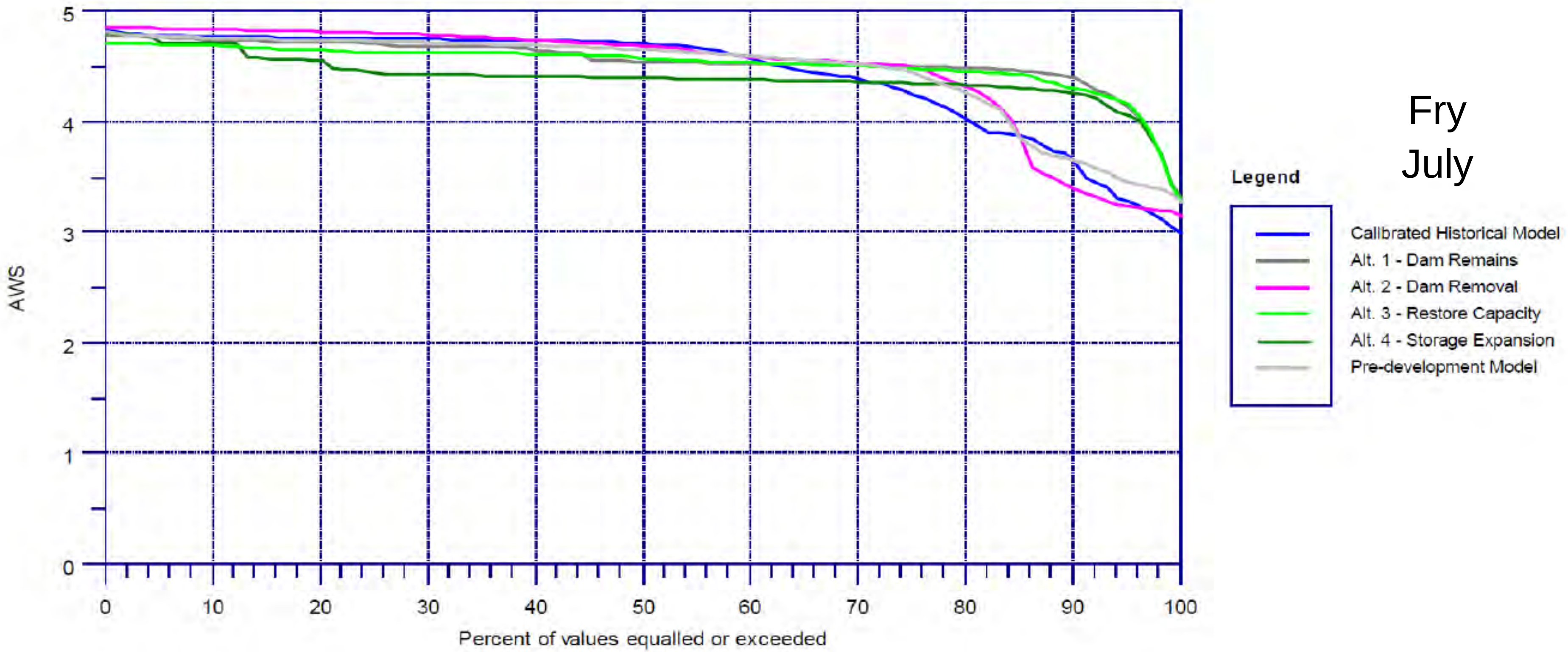
Instream Flow Incremental Methodology (IFIM) from Normandeau (2019) applied to CRBHM scenarios to produce habitat duration analysis (Normandeau 2021)



Juveniles

July -- September

Effects to Steelhead – Steelhead habitat and flows



Fry
July

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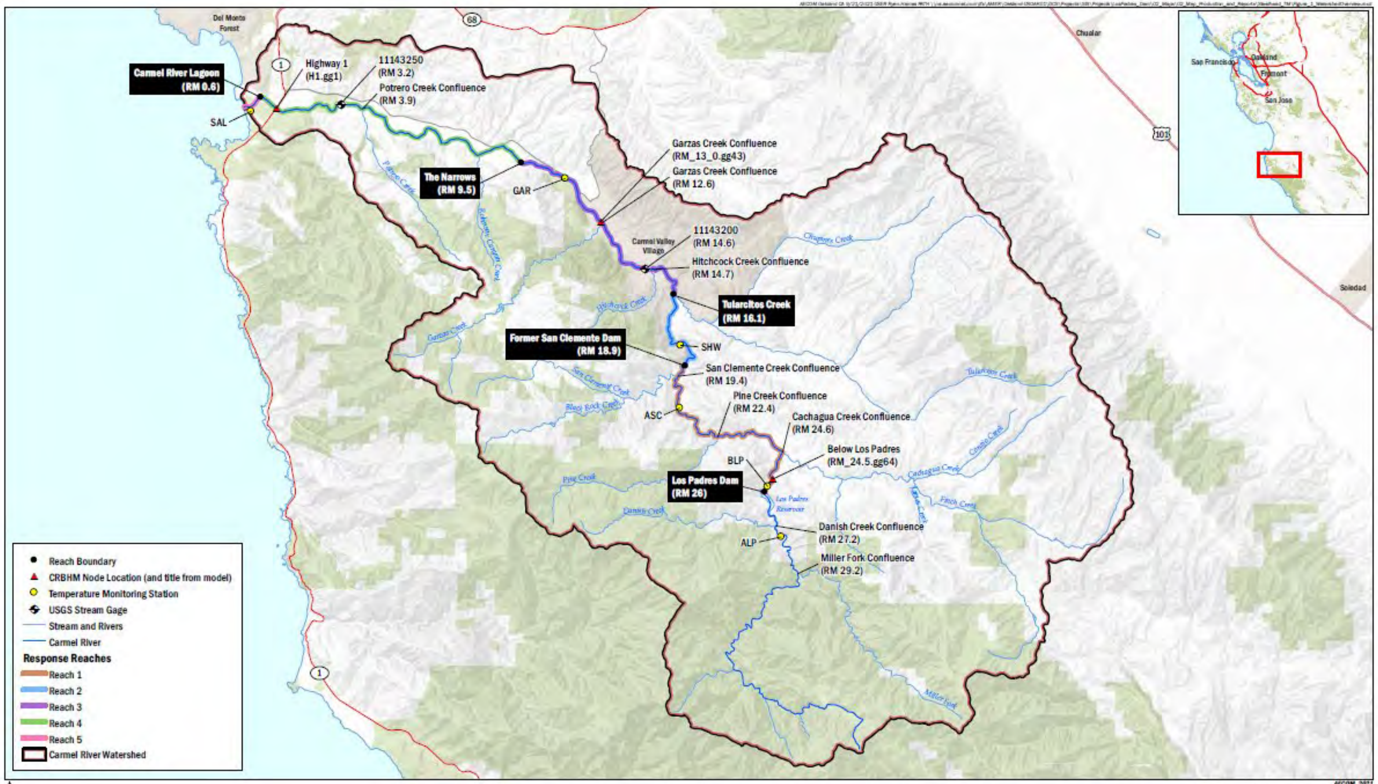
Effects to Steelhead – Water Temperature

- Qualitative assessment of alternatives
- Based on water temperature monitoring data



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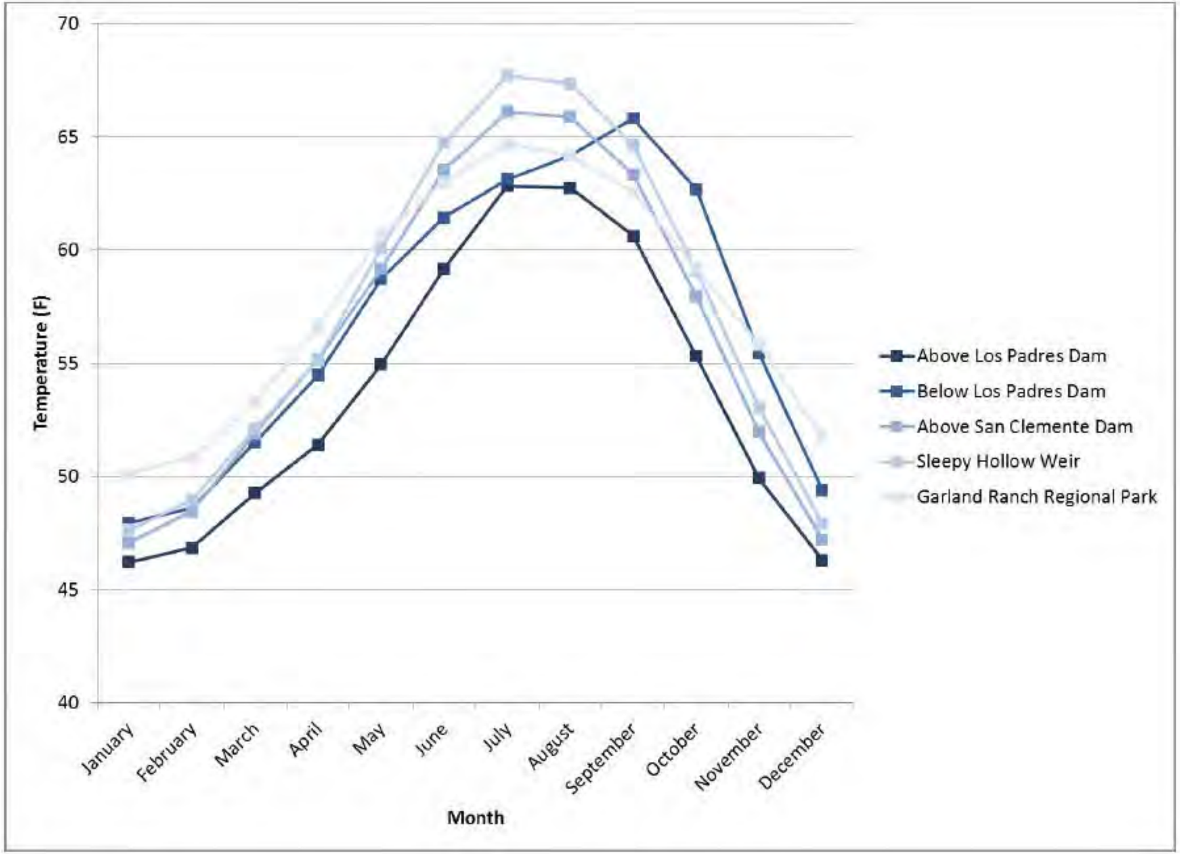
Effects to Steelhead – Water Temperature



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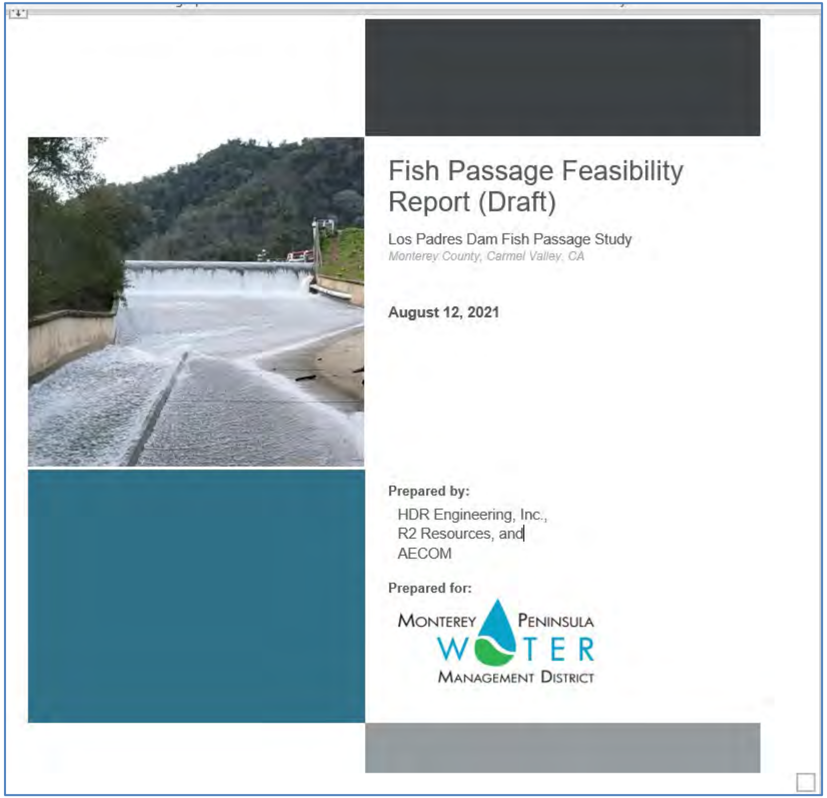
Effects to Steelhead – Fish Passage

- Fish Passage Feasibility Report (HDR et al. 2021) Alternatives 1, 3, and 4.
- Two upstream passage alternatives:
  - Alternative U1 (technical fish ladder)
  - Alternative U8 (trap and transport – replace)
- Two downstream passage alternatives:
  - Alternative D1 (floating surface collector [FSC]
  - Alternative D8 (spillway modification and FWC with 30 cfs attraction flow).
- Alternative 2 assumes dam removal, with volitional fish passage


Fish Passage Feasibility Report (Draft)

Los Padres Dam Fish Passage Study

Monterey County, Carmel Valley, CA

August 12, 2021

Prepared by:

HDR Engineering, Inc.,
R2 Resources, and
AECOM

Prepared for:

Monterey Peninsula Water Management District

Monterey Peninsula Water Management District

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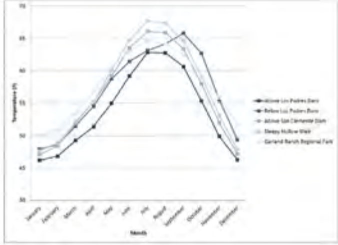
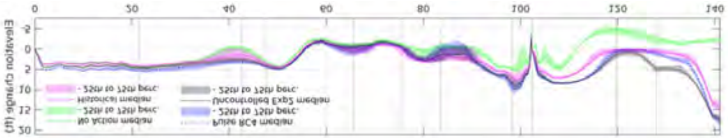
Effects to Steelhead – Fish Passage

- Fish Passage Feasibility Report (HDR et al. 2021)
- Boughton et al. (2020) found that 75 percent of monitored downstream-migrating juveniles were “lost” in the reservoir

Los Padres Reservoir

Summary





	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 (LPD Remains, No Sediment Management, CDO)	Lack of sediment transport from upstream of LPD would result in decreased spawning habitat and decreased habitat complexity	Water availability similar to that under existing conditions, gradually reducing as LPR capacity decreases (excepting inclusion of SM-1, SM-2, or SM-3)	Suboptimal water temperatures in the summer months and the continued blockage of thermal refugia upstream of LPR	• Adult and smolt passage facilities • No upstream passage for juvenile steelhead • Migration through reservoir
Alternative 2 (Dam Removal)	Restore natural sediment transport, resulting in increased habitat complexity and increased spawning habitat downstream of LPD	Decreased water availability during summer months, resulting in decreased wetted habitat relative to existing conditions	Restore a natural thermal regime to the Carmel River downstream of LPD, providing access to thermal refugia habitat upstream of LPR	• Fully volitional upstream and downstream fish passage for all steelhead life stages • No reservoir migration
Alternative 3 (Restore Reservoir Capacity)	Lack of sediment transport from upstream of LPD (excepting inclusion of SM-2) would result in decreased spawning habitat and decreased habitat complexity	Increased water availability to augment summer flows, resulting in more wetted habitat during the summer months when compared to Alternatives 1 and 2	Suboptimal water temperatures in the summer months and the continued blockage of thermal refugia upstream of LPR	• Adult and smolt passage facilities • No upstream passage for juvenile steelhead • Migration through reservoir
Alternative 4 (Storage Expansion)	Lack of sediment transport from upstream of LPD (excepting inclusion of SM-2), resulting in decreased spawning habitat and decreased habitat complexity	Increased water availability during the summer, which would result in more wetted habitat and increased connectivity of the Carmel River downstream of LPD relative to all other dam and reservoir alternatives	Suboptimal water temperatures in the summer months and the continued blockage of thermal refugia upstream of LPR	• Adult and smolt passage facilities • No upstream passage for juvenile steelhead • Migration through reservoir

Present and discuss preliminary evaluation matrix

EVALUATION CRITERIA & MATRIX

Evaluation Criteria & Matrix

- Preliminary evaluation criteria presented to the TRC at Meeting 1 and in draft Study Preparation TM
- Criteria were revised based on feedback
- Next Steps:
  - Present draft evaluation matrix without scores at TRC Meeting 2B
  - Discuss matrix at TRC Meeting 2B
  - Prepare matrix scores for Alternatives Development TM
  - Evaluate alternatives at TRC Meeting 3
  - Include alternatives refinements in Final Report

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Evaluation Criteria & Matrix - Process

- Define evaluation criteria
- Weight criteria (optional)
- Describe alternatives
- Score alternatives for each criterion
- Multiply each score by the criteria weight (optional)
- Sum the score-weight products for each alternative
- Optimize alternatives

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Measures needed to address dam stability that are not primary to the alternative to obtain DSOD approval? (yes/no)
- Cost/Schedule Implication of Dam Safety Mitigation (semi-quantitative)
- Estimated Construction Cost (qualitative)
- Estimated Construction Timeline (qualitative)
- Estimated Operations and Maintenance Cost (qualitative)
- Area of Permanent Impacts (quantitative)
- Area of Temporary Impacts (quantitative)

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Increase in Potential Flooding Near Developed Properties for an Event of Interest (semi-quantitative)
- Sediment release greater than the natural load? (yes/no)
- Sediment Transport Prediction Certainty (qualitative)
- Sediment Management Adaptability (qualitative)

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Upstream Adult Steelhead Passage (qualitative)
- Downstream Adult Steelhead Passage (qualitative)
- Upstream Juvenile Steelhead Passage (qualitative)
- Downstream Juvenile Steelhead Passage (qualitative)
- Short-Term Effects on Steelhead Present During Sediment Release (qualitative)
- Proportion of Steelhead Affected by Short-Term Sediment Release (qualitative)
- Changes to Instream Pool Volume (qualitative)
- Changes in Spawning Habitat (qualitative)
- Changes in Floodplain Habitat Access (qualitative)

Monterey Peninsula Water Management District

California American Water

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Duration of Negative Habitat Effects (qualitative)
- Migration Period Flow Availability (quantitative)
- Rearing Period Flow Availability (quantitative)
- Spawning Period Flow Availability (quantitative)
- Spawning Habitat Availability (quantitative)
- Rearing Habitat Availability (quantitative)
- Quality of Rearing Habitat Upstream of Los Padres Dam (qualitative)
- Ecosystem Connectivity (qualitative)
- Attraction, Passage, and Flows for Nontarget Species (qualitative)
- Quality of Water Passed Downstream (qualitative)

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Maximum Potential Water Yield at Los Padres Reservoir (quantitative)
- Los Padres Reservoir Storage Capacity (quantitative)
- Future Los Padres Reservoir Storage Capacity (quantitative)
- Replacement Water Supply Needed? (yes/no)
- Reservoir Availability for Fire Response (qualitative)

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Need for Petition to Change Water Rights (yes/no)
- Effects on Cal-Am and MPWMD Water Rights (qualitative)
- Water Right Petition Process (qualitative)

Monterey Peninsula Water Management District

California American Water

Evaluation Criteria & Matrix – Revised Criteria

Engineering	Geomorphic	Biological	Water Supply	Water Rights	Community Response

- Anticipated Community Objection (qualitative)

Evaluation Criteria & Matrix – Matrix

- Switch to Excel…

Discussion to clarify high-priority alternatives and those to remove

DISCUSS ALTERNATIVES

Alternatives – Next Steps

Name	Dam/Reservoir Action	Sediment Action	Notes
No Sediment Action (Alt. 1)	-	-	Remaining 1,600 AF would be filled in approximately 100 - 210 years
Dam/Sediment Removal (Alt. 2)	Dam removal	Dredge accumulated fine sediment (Z1/Z2)	Could consider partial removal (Alt. 2b) in later value engineering; Relatively high cost
Dam Removal with Sediment Flush (Alt. 2)	Dam Removal	Flush fine sediment via sluice tunnel (Z1/Z2)	Depends on acceptance of WQ impacts
Restore Reservoir Capacity (3a)	-	Dredge accumulated fine sediment (Z1/Z2) and excavate coarse sediment (Z2/Z3)	Could take up to 7 years to restore capacity
Storage Expansion (4b)	Raise with bladder dam & spillway improvements	-	Provides operational flexibility and relatively low cost (for action alternatives)
Recover Reservoir Capacity with Excavation to Uplands (SM1)	-	Excavate accumulated fine and coarse sediment (Z2/Z3), place in uplands	Periodic sediment removal about every 5 years
Recover Reservoir Capacity with Excavation to Floodplain (SM2)	-	Excavate accumulated coarse sediment (Z3), place in floodplain	Periodic sediment removal, smaller quantities than SM1 but with sediment transport benefits
Recover Reservoir Capacity with Sluice Tunnel (SM3)	Add sluicing tunnel and gate structure	Sluice accumulated sediments during wet years (Z1/Z2)	Depends on acceptance of WQ impacts

* Alternatives where dam remains may involve fish passage related improvements

Considerations – No Sediment Action

1. Downstream behavioral guidance system (BGS)	Sediment delta eventually impacts the function of BGS.
2. Steelhead migration	Fish passage improvements needed for upstream and downstream passage over LPD and through LPR.
3. Downstream channel geometry and steelhead habitat	Lack of transport of spawning gravels and channel degradation continues downstream of LPD. Long-term channel aggradation of 2-5 ft in the lower reaches.
4. Streamflow effects on steelhead	As reservoir storage is reduced, available water for summer releases decreases.
5. Compliance with SWRCB water rights permit conditions	Ability to release 5 cfs may decrease. Potential for SWRCB to reduce Cal-Am's water rights commensurate with available storage.
6. Water supply for the Monterey Peninsula	Ability to release and re-divert flow in downstream reaches may decrease.
7. Dam safety	Sedimentation may block required outlet works for drawdown. Reduced reservoir volume may increase the elevation of the PMF necessitating dam crest and spillway improvements.

Considerations – Dam Removal

1. Existing reservoir sediment	Assume removal of Zones 1 and 2 sediment for implementation. If excavated or dredged, need disposal sites. If sluiced, need tunnel.
2. Steelhead passage and river habitat in the reservoir area	Allows volitional passage in river channel. Restores riverine and riparian habitats. Adds about 1 mile of stream. Reduces non-native predator habitat.
3. Future public ownership of property	Adjacent public lands make potential future public ownership more feasible.
4. Downstream sediment effects	Long-term aggradation downstream of LPD similar to historical degradation. Long-term channel aggradation 1-2 ft more than Alt. 1 in the lower reaches.
5. Streamflow effects on steelhead	Reservoir storage is eliminated and removes available water for summer releases.
6. Water rights and municipal water supply	Likely termination of License 11866 and amendments to other orders. Summer diversions will be affected. Other appropriative water rights unaffected.
7. Construction traffic	Impacts on local residents from increased traffic on narrow winding roads. Improvements at sharp curves and load-restricted bridges may be needed. 7 construction seasons (includes sediment removal).
8. Dam safety	No effect on dam safety if removal is completed in 1 construction season.

Considerations – Restore Reservoir Capacity

1. Dam safety	Does not affect dam safety
2. DSOD requirements for disposal containment	DSOD may want stability analysis of disposal sites adjacent to dam abutments or the spillway (Site B)
3. Sustainability	Once project is completed, capacity would be increased over current conditions for perhaps 70 years
4. Construction traffic	Impacts on local residents from increased traffic on narrow winding roads. Improvements at sharp curves and load-restricted bridges may be needed. 7 construction seasons.
5. Downstream channel geometry and steelhead habitat	Lack of transport of spawning gravels and channel degradation continues downstream of LPD. Long-term channel aggradation of 2-5 ft in the lower reaches.
6. Steelhead migration	Fish passage improvements needed for upstream and downstream passage over LPD and through LPR.
7. Water supply	Potential to increase dry season releases by 3 cfs. Potential for improved in-stream habitat and additional downstream diversions.
8. Water rights	No water rights reductions; potential to petition for an increase.

Considerations – Expand Reservoir Capacity

1. Dam safety	Requires DSOD approval
2. Sustainability	Rubber Dam concept adds 586 AF of storage and perhaps 40 years of additional storage over existing
3. Construction traffic	Impacts on local residents from increased traffic on narrow winding roads. Improvements at sharp curves and load-restricted bridges may be needed. 1 construction season (assuming no sediment removal).
4. Downstream channel geometry and steelhead habitat	Lack of transport of spawning gravels and channel degradation continues downstream of LPD. Long-term channel aggradation of 2-5 ft in the lower reaches.
5. Steelhead migration	Fish passage improvements needed for upstream and downstream passage over LPD and through LPR.
6. Water availability	Potential to increase dry season releases by 1.6 cfs.
7. Water supply	Potential for improved in-stream habitat and additional downstream diversions.
8. Water rights	Need to petition for increased water rights.

Considerations – Sediment Management

1. Dam safety	No effect on dam safety.
2. DSOD requirements	DSOD will review and approve sluice tunnel design. Dredging and excavation not likely to require review and approval.
3. Sustainability	Dredging/excavation activities would need to repeat every 5 years or so. Sluicing could operate every 2 years or so.
4. Fire/landslides in the watershed	Sluicing provides an opportunity to manage sediment for fire/landslide induced episodic events. Dredging/excavation are similar, but somewhat less effective.
5. Downstream aquatic habitat benefits	If Zone 3 material is placed in downstream created debris slides, could be a source of spawning gravels to resupply the river.
6. Harmful effects on steelhead	Dredging/excavation would cause reservoir suspended sediment to increase. Sluicing would increase suspended sediment concentrations in the river. Fish could be entrained in sluice tunnel or dredging activities. Redds could be buried during sediment pulses.
7. Downstream channel geometry and floods	Dredging maintains lack of transport of spawning gravels and continues channel degradation downstream of LPD. Excavation and placement in debris slides and sluicing would reverse downstream degradation and result in long-term channel aggradation 1-2 ft more than Alt. 1 in the lower reaches.

Record decisions & any alternatives eliminated

DOCUMENT DECISIONS

Monterey Peninsula Water Management District

California American Water

Alternatives Development

- Second design phase begins now
- Develop up to 5 alternatives emerging from TRC Meeting 2b
  - Focus on uncertainties re: impacts, benefits, costs, environmental compliance, and permitting
  - Define operational characteristics
  - Communicate design intent
- Previously identified alternatives may be dropped or modified

Alternatives – Next Steps

Name	Dam/Reservoir Action	Sediment Action	Notes
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Recover Reservoir Capacity with Sluice Tunnel (SM3)	Add sluicing tunnel and gate structure	Sluice accumulated sediments during wet years (Z1/Z2)	Depends on acceptance of WQ impacts

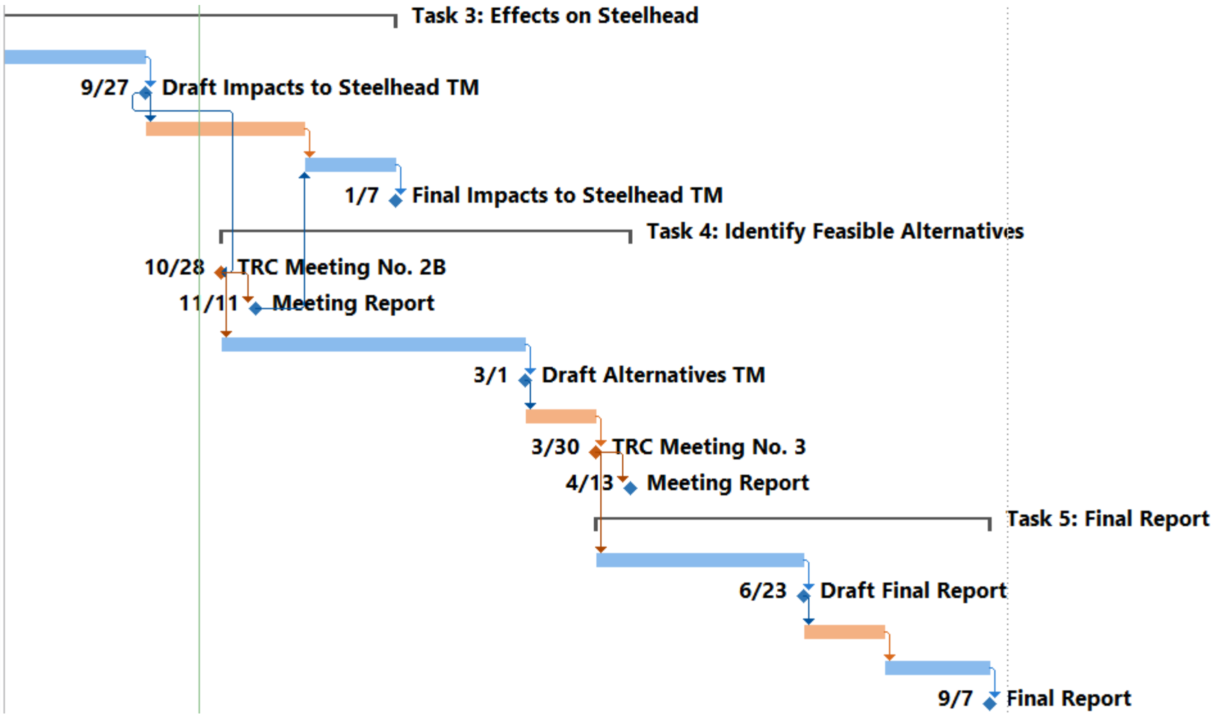
* Alternatives where dam remains may involve fish passage related improvements

Next Steps

CONCLUSION

Study Schedule

Task 3: Effects on Steelhead	**Fri 1/7/22**
Prepare Draft Steelhead TM	Mon 9/27/21
Draft Impacts to Steelhead TM	Mon 9/27/21
TRC Review of Draft Steelhead TM	Wed 12/1/21
Revise Impacts to Steelhead TM	Fri 1/7/22
Final Impacts to Steelhead TM	Fri 1/7/22
Task 4: Identify Feasible Alternatives	**Wed 4/13/22**
TRC Meeting No. 2B	Thu 10/28/21
Meeting Report	Thu 11/11/21
Task 4-2: Alternatives Development	Tue 3/1/22
Draft Alternatives TM	Tue 3/1/22
TRC Review Alternatives TM	Wed 3/30/22
TRC Meeting No. 3	Wed 3/30/22
Meeting Report	Wed 4/13/22
Task 5: Final Report	**Wed 9/7/22**
Prepare Draft Final Report	Thu 6/23/22
Draft Final Report	Thu 6/23/22
TRC Review of Draft Final Report	Tue 7/26/22
Prepare Final Report	Wed 9/7/22
Final Report	Wed 9/7/22



MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Future Study Meetings and Technical Memoranda

- Dec. 1, 2021 – Comments on Steelhead TM due
- Jan. 7, 2022 – Final Steelhead TM
- March 1, 2022 – Alternatives Development TM
- March 30, 2022 – TRC Meeting No. 3
- Jun. 23, 2022 – Draft Report
- Sep. 7, 2022 – Final Report

Meeting Record

Project:	Los Padres Dam and Reservoir Alternatives and Sediment Management Study
Subject:	Technical Review Committee Meeting No. 3 - Alternatives Development
Date:	Tuesday, April 26, 2022
Time	10:00 AM to 3:00 PM
Location:	Virtual - MS Teams
Attendees:	Krissy Atkinson, CDFW Ethan Bell, Stillwater Joel Casagrande, NMFS Thomas Christensen, MPWMD Megan Collins, AECOM Chris Cook, Cal-Am Ian Crooks, Cal-Am David Crowder, NMFS Mark Gard, CDFW Mike Garello, HDR Seth Gentzler, AECOM Aman Gonzalez, Cal-Am Cory Hamilton, MPWMD Larry Hampson, MPWMD Mandy Ingham, NMFS Jonathan Lear, MPWMD Dennis Michniuk, CDFW Chad Mitcham, USFWS Tim O'Halloran, Cal-Am Jon Stead, AECOM

Attachments

Attachment A - Meeting Presentation
Attachment B - Clarification of Cost to Sluice Sediment Prior to Dam Removal
Attachment C - Water Rights Summary from Study Preparation TM

Notes

The purpose of the meeting notes is to document questions raised, comments provided, action items, and decisions. The primary content of the meeting is outlined below (from the meeting agenda) and detailed in the attached presentation (Attachment A) and is not repeated in the notes.

1. Welcome
    a. Introductions
    b. Opening statements
2. Background review
    a. Overview of past milestones & related studies
    b. Evolution and reduction of alternatives
3. Alternatives Development TM
    a. Updated and most relevant existing conditions
    b. Alt. 1 No Sediment Action
4. Alternatives Development TM (continued)
    a. Alt. 2 Dam & Sediment Removal

Water supply is a key issue. Larry noted that water supply projects have been cut in half since the 1980's and there are very limited new projects. MPWMD asked whether Cal-Am knew if the State Water Resources Control Board (SWRCB) would be ok with formally moving the point of diversion associated with the Los Padres water right downstream, recognizing that dam removal would be beneficial for habitat. Cal-Am confirmed that it has not had a conversation with SWRCB and is not confident that the water right could be maintained in the absence of LPD (Los Padres Dam) and reservoir. It was agreed that this is a major uncertainty and that those conversations should begin if dam removal remains on the table. MPWMD does not have a robust replacement water supply and the cost of developing additional water will be substantial.

Cal-Am asked about permitting costs and AECOM clarified that the Opinion of Probably Construction Costs (OPCC)s developed in the Alternatives Development TM do not include permitting or others soft costs. All of the alternatives are complex and will require a substantial permitting effort.

b. Alt. 3 Storage Expansion & Dredging

CDFW mentioned the potential applicability of a sluice pipe to deliver Zone 3 sediment to Disposal Sites D and E in the floodplain and suggested looking at examples including the US Army Corps of Engineers' project on the Yuba River and the US Bureau of Reclamation's project on Clear Creek in the Central Valley.

Larry Hampson emphasized that the alternatives should consider how to return sediment to the river downstream of Los Padres Dam.

There was some discussion about temperature stratification in the reservoir and the effects of Los Padres Reservoir (LPR) on temperature downstream. AECOM described some of the patterns that have been observed, which are described in the Effects to Steelhead TM and the Study Preparation TM. Water availability is believed to have a more limiting effect on steelhead production in the lower Carmel River than temperature.

CDFW asked whether raising the spillway gates would inundate spawning and rearing habitat upstream of the reservoir. AECOM clarified that the gates would typically be raised post-spawning, that some rearing habitat could be inundated, but that effect has not been quantified.

Cal-Am asked whether the spillway modifications included modifications to address the new PMF and whether the cost estimate accounts for that and AECOM clarified that it does.

c. Alt. 4 Recover Storage Capacity with Excavation

Regarding cost escalation over time, Cal-Am noted that LPD was constructed in the 1940s for $1.6M.

Cory Hamilton pointed out that if the dam remains in place more storage is needed than is currently available and therefore Alternative 4 should be eliminated.

AECOM pointed out that recurring sediment removal is not a cost-effective way to manage sediment in LPR.

5. Alternatives Development TM (continued) (12:35-1:00)
   a. Alt. 5 Recover Storage Capacity with Sluice Tunnel

      A question was raised about how long it would take to empty the reservoir prior to sluicing with elevated streamflow. AECOM agreed to investigate this.

      A question was raised about how debris would be managed and whether it would be an issue for the sluice tunnel. AECOM responded that with a 15-foot-wide tunnel much of the debris would pass through, but more consideration of debris would be needed during design. Debris management could include debris racks near the tunnel or further upstream and/or selective clearing and grubbing in areas where sediment is most likely to mobilize. Regardless of any engineered solution, debris would need to be managed adaptively, with an adaptive management plan in place.

      A question was asked regarding whether the entire reservoir would be emptied to construct the sluice tunnel. AECOM confirmed that the reservoir would be emptied to construct the upstream end of the tunnel and like other alternatives that require emptying the reservoir during construction, flows would be limited to run-of-the-river during those construction seasons, without ability to meter out stored water.

      MPWMD pointed out that downstream flood risk mitigation was a key resolution at San Clemente Dam. A project at Los Padres involving an increased sediment load should include analysis of the potential increase in flood risk due to sediment load. This will be a high-profile issue for downstream residents. AECOM pointed out that we have not developed or updated a flood model for this analysis, but other projects have included mitigating flood risk when they enter design phase. San Clemente compared the project alternatives against a future no project as opposed to existing conditions.

CDFW asked whether a sluice tunnel was included, or could be included, with the dam removal alternative. There was some discussion of the relative cost of tunnel construction compared to sediment removal and AECOM noted (here and during later discussion) that the cost of the sluice tunnel is close to the cost of sediment excavation and inclusion of a sluice tunnel to remove sediment prior to dam removal may not result in a savings. Following the meeting, AECOM sent an email explaining this in more detail (Attachment B). In summary, the cost of dam removal could be reduced if more fine sediment was left in place to move downstream after dam removal but constructing an engineered feature like the sluice tunnel to allow for controlled sediment release prior to dam removal may not significantly reduce the cost of dam removal at Los Padres due to the width of the dam and length of the tunnel (900 feet).

NMFS acknowledged that the sluice tunnel is not a good environment for fish and asked how they would be excluded from the tunnel. AECOM proposed that there is no practical way to prevent fish from being entrained in the sluice tunnel during its operation. CDFW suggested potentially using a behavioral barrier such as that used at Georgiana Slough in the Sacramento/San Joaquin River Delta. Upon further discussion the group seemed to agree that a behavioral barrier would not work during a sluicing event when the river is running high and the reservoir is drained and appears more as a raging river than a slow-moving water body.

MPWMD pointed out that timing may be important for sluice tunnel operation. AECOM agreed and noted that on another project the first storms of the season were identified as the most favorable for sluicing, before adults complete their upstream migration and before spawning has occurred.

b. Field questions regarding design intent of alternatives presented

6. Alternatives Comparison and Discussion
   a. Present several comparisons

There was some discussion about whether it was appropriate to have sediment accumulation associated with the Marble Cone Fire included in the average deposition rate. Some noted that with more fires in the future, it may be appropriate to keep the MCF volume in the calculation.

NMFS suggested that the dam-in alternatives (Alternatives 1, 3, 4, and 5) should include the sum of the fish passage O&M costs over the planning horizon for a more realistic comparison with dam removal and estimated that would add $25M to each alternative.

MPWMD noted that the $82M fish passage construction cost may be decreased with additional analysis and MPWMD and others do not necessarily favor the most expensive of the fish passage alternatives.

CDFW asked whether the alternatives line up with IFIM models of spawning and rearing habitat. CDFW is looking for ways to quantify the habitat effects. AECOM clarified that the IFIM results are described in the Effects to Steelhead TM but also that NMFS had advised to not rely heavily in the IFIM results. The biggest change in amount of habitat would likely be restoration of the reservoir footprint to steelhead spawning and rearing habitat. Other changes mostly affect water availability and access to habitat.

Regarding Alternative 1, it was clarified that this alternative includes the major fish passage improvements. It was noted that it may be appropriate to reflect this in the alternative name. There seemed to be some consensus that it would not make sense to spend heavily on fish passage improvements to retain a reservoir if the storage is disappearing or if the passage improvements could be removed or made ineffective once another alternative is implemented. However, it was also suggested that implementation of Alternative 1 would allow for more time to evaluate other changes to the dam and reservoir.

Regarding water rights, AECOM shared a summary of existing water rights from the Study Preparation TM (Attachment C). Also, from Slide 35 (Attachment A):

- LPR has 2,179 AF water right (Cal-Am WR 95-10)
  - Cal-Am pumping ≈ 9,700 AF
  - LPR right ≈ 22% of municipal supply
- Retaining WRs a priority for municipal supply
  - Cal-Am could apply for new point of diversion in lower river
  - Aquifer stores many times more than 2,179 AF
- Replacement water could cost 40-times more
  - $140-$150 per AF: production from Carmel River
  - $5,800-$6,000 per AF: desalination

At several points during the meeting discussion turned to water rights and replacement water supplies. NMFS pointed out that dam removal would require replacement water for municipal supply and without the dam the mitigation for the current pumping (summer releases) would be lost. NMFS suggested that these costs should be captured in the analysis. MPWMD estimated the capital costs of water replacement could be $7,500/acre-foot or $16M million. Cal-Am pointed out that there are many factors involved in estimating the cost of water. Ultimately, it was agreed that coordination with the SWRCB would be needed to determine whether the permitted point of diversion associated with the LPR water right could be formally relocated to the lower rover, and the extent to which replacement water would be needed and that coordination will take time.

CDFW asked whether the loss of wetted habitat for Alternative 2 indicated on slide 119 accounted for the increase in riverine habitat in the dam and reservoir footprint. AECOM confirmed it does not and that that will be considered going forward.

CDFW asked whether temperature modeling had been conducted and AECOM confirmed it has not. AECOM gave an overview of how temperature is addressed in the analysis and reminded the group that those details are described in the Effects to Steelhead TM.

The discussion moved back to replacing lost water supply and mitigating the pumping in a dam removal scenario. The group discussed some possibilities that may warrant further investigation including upcoming changes in pumping and treatment capabilities, changes to the Aquifer Storage and Recovery project, and desalinization. MPWMD noted that riparian water users can pump the river dry downstream of Garland Park and that their cumulative pumping adds up to the release from Los Padres.

CDFW asked whether water conservation and reuse could address the replacement water issue. Water users on the Monterey Peninsula already pay and conserve more than most and there is a water reuse program in place (Pure Water Monterey).

7. Conclusion
    a. Confirm meeting outcomes

    Everyone agreed to eliminate Alternative 4 because of its high cost and lack of corresponding benefits.

    NMFS reiterated that it is not a fan of Alternative 1. NMFS thinks it would be difficult to spend so much on fish passage without addressing the sediment issue. It was noted that there should be an improvement from the current condition.

NMFS suggested discussing whether downstream fish passage modifications would trigger analysis of dam safety using the updated PMF with the DSOD.

AECOM prompted the group to think about what questions need to be answered to select a preferred alternative.

CDFW asked whether a fish assemblage study had been completed and whether there are nonnative centrarchids in LPR. The group clarified that no specific study has been conducted but much is known about fish species presence and distribution from MPWMD's regular monitoring. MPWMD confirmed that brown trout are the primary nonnative predator observed in the watershed, and mostly in and around LPD but not at other locations. Striped bass are the other known predator with regular presence in the lower river, but not upstream of San Clemente Creek.

MPWMD summarized the following big picture questions:

- Are steelhead better off with or without the dam and reservoir (and it was noted that NMFS is working on a population model that will inform this question)?
- What will replace the water associated with the LPR water right of the dame is removed (or [unstated] what will replace the summer release from LPR if the point of diversion is moved, to mitigate for the pumping)?
- More analysis to understand the impacts and benefits of the sluice tunnel?

MPWMD suggested it would be better to use the $82M associated with fish passage for Alternative 1 to find a new water supply than to build improved fish passage and then end up removing it if the dam eventually comes out. NMFS said it would help if there was an effort to secure water rights for steelhead from the SWRCB.

There was some discussion of what would trigger an evaluation of dam safety using the PMF. AECOM clarified that any modification of the dam requiring DSOD approval could trigger a revised PMF.

b. Next steps

Action Items and Decisions

No specific action items were noted at the meeting other than for reviewers to provide written comments on the Draft Alternatives Development TM by May 10, 2022.

A single decision was recorded in the project decision log based on discussion at the meeting: Alternative 4 will not be carried forward for additional consideration.

Attachment A - Meeting Presentation

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Technical Review Committee Meeting No. 3
Alternatives Development

Virtual via MS Teams

Tuesday, April 26, 2022
10:00 am to 3:00 pm

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Welcome

- Introductions
- Format
  - Short morning and afternoon breaks
  - Longer lunch break

Meeting Objectives

Transfer of information, discussion, and collaboration

- Facilitate understanding of alternatives presented in Draft Alternatives Development TM
- Obtain TRC input on advantages and disadvantages of the alternatives and actions
- Identify most favorable actions and alternatives for presentation in draft Final Report

Meeting Agenda

- Limited Background Review
  - Evolution of alternatives
- Alternatives Development TM
- Alternative Comparisons
- Discussion
  - White board
  - Consider uncertainties
  - Consider decisions
    - Identify most favorable alternatives & actions
    - Eliminate unfavorable for greater focus
- Conclusion

Monterey Peninsula Water Management District

California American Water

Overview of Past Milestones

BACKGROUND REVIEW

Past Study Technical Memoranda

- 2017
  - Draft Study Preparation
  - Final Study Preparation & Draft Sediment Characterization
  - Alternatives Descriptions
- 2018
  - Nine Interim Sediment Effects (BESMo)
  - Final (Revised) Sediment Characterization
  - Draft Sediment Effects
- 2019
  - Final Sediment Effects
- 2021
  - Draft Effects to Steelhead
- 2022
  - Final Effects to Steelhead
  - Alternatives Development

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Past Study Meetings

- 2017 (Aug): TRC Meeting 1
  - Existing conditions, evaluation criteria
- 2018 (Jan): TRC Meeting 2a
  - Sediment characterization, alternatives descriptions, and transport model (BESMo) kick-off
- 2018: Sediment Transport Modeling
  - Iterative process with multiple TRC reviews, calls, & presentations
- 2019 – 2020: Carmel River Basin Hydrologic Model (CRBHM) Development with TRC
  - Several presentations and virtual meetings
- 2021 (Oct): TRC Meeting 2b
  - Review, Effects to Steelhead, Next Steps

Primary Study TRC Meetings

Meeting 1

Background info & evaluation criteria

- Ethan Bell, Stillwater (by phone)
- Madeleine Bray, AECOM
- Joel Casagrande, NMFS
- Shawn Chartrand, Balance
- [illegible]
- [illegible]
- Shannon Leonard, AECOM
- Dennis Michniuk, CDFW (by phone)
- Kealie Pretzlav, Balance
- John Roadifer, AECOM
- Dave Stoldt, MPWMD (by phone)
- Jon Stead, AECOM
- Kevan Urquhart, MPWMD
- Marcin Whitman, CDFW

Meeting 2a

Sediment characterization, alternatives, & transport model considerations

- Ethan Bell, Stillwater (by phone)
- Joel Casagrande, NMFS
- Trish Chapman, SCC
- Shawn Chartrand, Balance
- [illegible]
- [illegible] (by phone)
- [illegible] (by phone)
- Aman Gonzalez, Cal-Am (by phone)
- Larry Hampson, MPWMD
- Dave Highland, CDFW
- Shannon Leonard, AECOM
- Katie McLean, AECOM
- Matthew Michie, CDFW (by phone)
- Dennis Michniuk, CDFW
- Kealie Pretzlav, Balance
- John Roadifer, AECOM
- Kevan Urquhart, MPWMD
- Marcin Whitman, CDFW

Meeting 2b

Virtual - Review, Effects to Steelhead, Next Steps

- Ethan Bell, Stillwater
- David Boughton, NMFS
- Joel Casagrande, NMFS
- Beverly Chaney, MPWMD
- Thomas Christensen, MPWMD
- Ian Crooks, Cal-AM
- Christopher Cook, Cal-Am
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- Aman Gonzalez, Cal-Am
- Cory Hamilton, MPWMD
- Larry Hampson, MPWMD
- Mandy Ingham, NMFS
- Jonathan Lear, MPWMD
- Shannon Leonard, AECOM
- Matthew Michie, CDFW
- Dennis Michniuk, CDFW
- Tim O'Halloran, Cal-Am
- Haley Ohms, NMFS
- Andres Ticlavilca, NMFS

Thank You!

Related Studies

BACKGROUND REVIEW

Related Studies

Water and Steelhead Habitat Availability Analyses

- Carmel River Basin Hydrologic Model (CRBHM)
  - Linked surface and groundwater
  - Iterative process with a dozen TRC reviews, calls, & presentations (2019-2020)
- IFIM model runs with CRBHM hydrographs to compare steelhead habitat among alternatives
- Output from both models included in Effects to Steelhead TM

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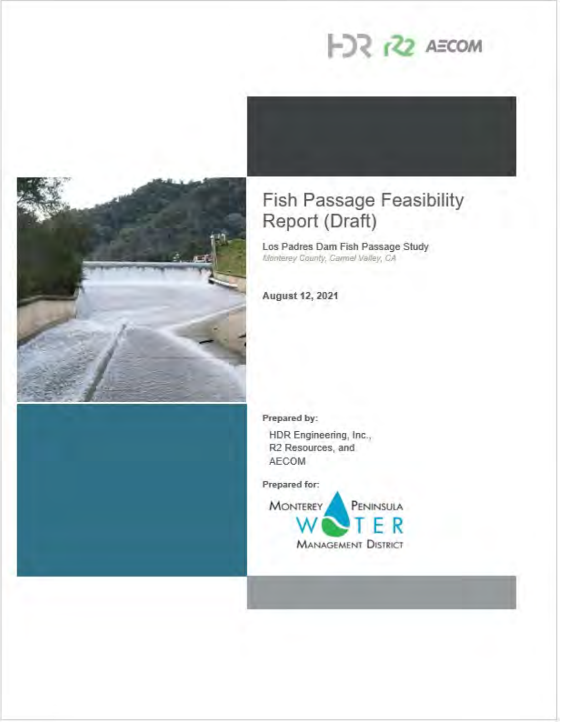
USGS science for a changing world

California American Water

Related Studies

Los Padres Dam Fish Passage Feasibility Study

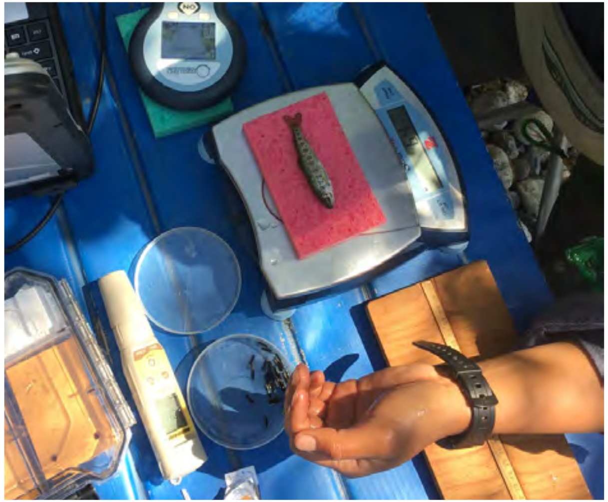
- Permanent passage facilities at LPD
  - Feasibility of passage at existing LPD
  - Two alternatives for further consideration
  - Primary information considered regarding fish passage



Related Studies

Carmel River Fishery Science Study

- Examined limiting factors and smolt production
- Impacts of LPD on smolt production & steelhead population
- Findings (2021) considered in Effects to Steelhead TM



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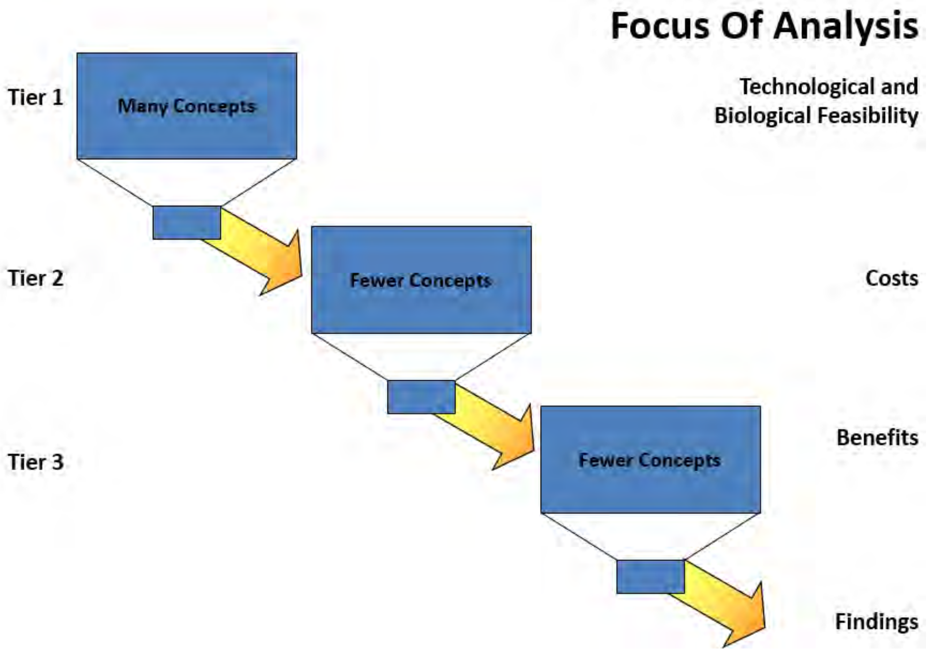
Evolution of Alternatives

BACKGROUND REVIEW

Evolution of Alternatives

- Alternatives Study is an iterative process
- Concepts are presented, refined, and reformulated
- Related studies are not a 1:1 comparison
- We are making progress!



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Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
3. Restore reservoir capacity
4. Storage expansion

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - 2a – Full dam removal
   - 2b – Partial dam removal
3. Restore reservoir capacity
   - 3a – Dredge & place on Cal-Am property
   - 3b – Dredge & place off Cal-Am property
4. Storage expansion
   - 4a – Dam raise
   - 4b – Rubber dam
   - 4c – New dam downstream
   - 4d – Expand with combination

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - 2a – Full dam removal
   - 2b – Partial dam removal
3. Restore reservoir capacity
   - 3a – Dredge & place on Cal-Am property
   - ~~3b – Dredge & place off Cal-Am property~~
4. Storage expansion
   - 4a – Dam raise
   - 4b – Rubber dam
   - 4c – New dam downstream
   - 4d – Expand with combination

Consensus based on TM conclusions and subsequent discussion to **remove from further consideration** (no reasonable offsite locations)

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - 2a – Full dam removal
   - 2b – Partial dam removal
3. Restore reservoir capacity
   - 3a – Dredge & place on Cal-Am property
   - ~~3b – Dredge & place off Cal-Am property~~
4. Storage expansion
   - ~~4a – Dam raise~~
   - 4b – Rubber dam
   - 4c – New dam downstream
   - 4d – Expand with combination

TRC Mtg 2A discussions and TM comments request to **remove from further consideration** (less flexibility/high impact/cost)

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

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Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - 2a – Full dam removal
   - 2b – Partial dam removal
3. Restore reservoir capacity
   - 3a – Dredge & place on Cal-Am property
   - ~~3b – Dredge & place off Cal-Am property~~
4. Storage expansion
   - ~~4a – Dam raise~~
   - 4b – Rubber dam
   - ~~4c – New dam downstream~~
   - ~~4d – Expand with combination~~

Consensus based on TRC Mtg 2A discussions and TM comments to **remove from further consideration** (high impact/cost)

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. Constructing a new bypass tunnel to transport sediment around the reservoir

Evolution of Alternatives - Alternatives Descriptions TM

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - 2a – Full dam removal
   - 2b – Partial dam removal
3. Restore reservoir capacity
   - 3a – Dredge & place on Cal-Am property
   - ~~3b – Dredge & place off Cal-Am property~~
4. Storage expansion
   - ~~4a – Dam raise~~
   - 4b – Rubber dam
   - ~~4c – New dam downstream~~
   - ~~4d – Expand with combination~~

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel
4. ~~Constructing a new bypass tunnel to transport sediment around the reservoir~~

Consensus based on TRC Mtg 2A discussions and TM comments to **remove from further consideration** (high impact/cost/limited benefit)

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Evolution of Alternatives – TRC Meeting 2b

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - Full dam removal
   - Partial dam removal
3. Restore reservoir capacity
   - Dredge & place on Cal-Am property
4. Storage expansion
   - Rubber dam

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel

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Evolution of Alternatives

Alternatives		Actions					Notes
		Remove dam	Dredge fine sediment	Sluice tunnel	Excavate coarse & fine sediment	Rubber bladder dam	
1	No Sediment Action						Alt. 1 from Descriptions TM
2	Dam Removal w/ Dredging	✓	✓				Alt. 2a from Descriptions TM (Zone 3 left to naturally transport downstream); Partial removal & sluicing could be included later
3	Storage Expansion		✓		✓	✓	Alt. 4b from Descriptions TM plus all sediment removed (like CRBHM & Alt. 3a from Descriptions TM); Rubber bladder dam or sediment removal could both be stand-alone actions
4	Recover Capacity w/ Excavation				✓		Includes excavation to uplands (SM1) and excavation to floodplain (SM2), managed adaptively
5	Recover Capacity w/ Sluicing			✓			SM3 from TM

Evolution of Alternatives

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   - – Full dam removal
   - – Partial dam removal
3. Restore reservoir capacity
   - – Dredge & place on Cal-Am property
4. Storage expansion
   - – Rubber dam

SM-1 and SM-2 combined, to be managed adaptively

Sediment Management Options

1. Periodic dredging to uplands
2. Periodic dredging to floodplain
3. Sediment sluicing through new tunnel

Evolution of Alternatives

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   – Full dam removal
   – ~~Partial dam removal~~
3. Restore reservoir capacity
   – Dredge & place on Cal-Am property
4. Storage expansion
   – Rubber dam

Limited cost savings and disadvantage of leaving spillway in river canyon (could be reconsidered during design)

Sediment Management Options

1. Periodic dredging to uplands and floodplain
2. Sediment sluicing through new tunnel

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Evolution of Alternatives

Dam and Reservoir Alternatives

1. No sediment management
2. Dam removal
   – Full dam removal
3. Restore reservoir capacity
   – Dredge & place on Cal-Am property
4. Storage expansion
   – Rubber dam

Sediment Management Options

1. Periodic dredging to uplands and floodplain
2. Sediment sluicing through new tunnel

Combined 3 and 4, two compatible actions to increase storage, in a single alternative.

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Evolution of Alternatives – Alternatives Development TM

Dam, Reservoir, and Sediment Management Alternatives

1. No Sediment Action
2. Dam & Sediment Removal
3. Storage Expansion & Dredging
4. Recover Storage Capacity with Excavation
5. Recover Storage Capacity with Sluice Tunnel

	Actions				
	Remove dam	Remove fine	Sluice tunnel	Remove coarse	Rubber bladder dam
1					
2	✓	✓			
3		✓		✓	✓
4				✓	
5			✓		

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Evolution of Alternatives – Relationship to Past Works

Alternatives Development TM (this document)	Effects to Steelhead TM (AECOM and Stillwater 2022)	Draft Fish Passage Feasibility Report (HDR et al. 2021)	IFIM Time Series Scenario (Normandeau 2019)	Basin Model Scenario (CRBHM) (see AECOM and Stillwater 2022)	Sediment Transport Scenario (BESMo) (Balance Hydrologics and UBC 2019)	Alternatives Descriptions TM (AECOM 2017)
Alternative 1 (No Sediment Action): No action is taken to manage existing or future s	Alternative 1 (No Sediment Action): No action is taken to manage existing or	U1, Technical Fish Ladder – Adult, or U8, Trap and Transport – Replace; and	Current Los Padres (CDO and ASR): incorporates CRBHM model for	Current Los Padres: Model configured to represent CDO	No Action Simulation: No action is taken at LPD or LPR. Coarse sediment	Alternative 1 (No Sediment Action): No action is taken to manage existing or
Alterna Capacity with Sluice Tunnel): Install a sluice tunnel through the east abutment that would be used to flush sediment from the reservoir during wet water years.	Sluicing Tunnel: Tunnel through dam abutment to sluice reservoir sediment during storm events.	U8, Trap and Transport – Replace; and D1, Floating Surface Collector or D8, Spillway Modification (D5) and Existing FWC with 30 cfs Attraction Flow (D7).	outcome would be somewhere between "Current Los Padres" scenario and "Los Padres Expanded Storage - Dredging" scenarios.	but outcome would be somewhere between "Current Los Padres" and "Los Padres Expanded Storage" scenarios.	bedload from LPR deposits are introduced into the river. Assumes a sluice tunnel with 5,000 cfs capacity and a minimum sluice flow of 500 to 1,500 cfs.	Sluicing Tunnel: Tunnel through dam abutment to sluice reservoir sediment during storm events.

Alternatives Development TM (this TM)	Effects to Steelhead TM (AECOM and Stillwater Sciences 2022)	Fish Passage Feasibility Report (HDR et al. 2021)	IFIM Time Series (Normandeau 2019)	Basin Model Scenario (AECOM and Stillwater Sciences 2022)	BESMo (Balance Hydrologics and UBC 2019)	Alternatives Descriptions TM (AECOM 2017b)
Alternative 1 (No Sediment Action)	Alternative 1	U1 or U8, and D1 or D8	Alternative 1	Current Los Padres	No Action	Alternative 1
Alternative 2 (Dam and Sediment Removal)	Alternative 2	Volitional, no facilities	Alternative 2	Remove LPD	Closest to Historical Supply, but between that and Uncontrolled Supply	Alternative 2a
Alternative 3 (Storage Expansion and Dredging)	Alternative 4	U1 or U8, and D1 or D8	Alternative 4	LPR Expanded Storage	No Action	Alternatives 4b and 3a
Alternative 4 (Recover Storage Capacity with Excavation)	SM1 and SM2	U1 or U8, and D1 or D8	Not specifically addressed – between Current Los Padres and Los Padres Expanded Storage		Not specifically addressed – between No Action and Pulsed Supply	SM1 and SM2
Alternative 5 (Recover Storage Capacity with Sluice Tunnel)	SM3	U1 or U8, and D1 or D8	Not specifically addressed – between Current Los Padres and Los Padres Expanded Storage		Pulsed Flow Simulation	SM3

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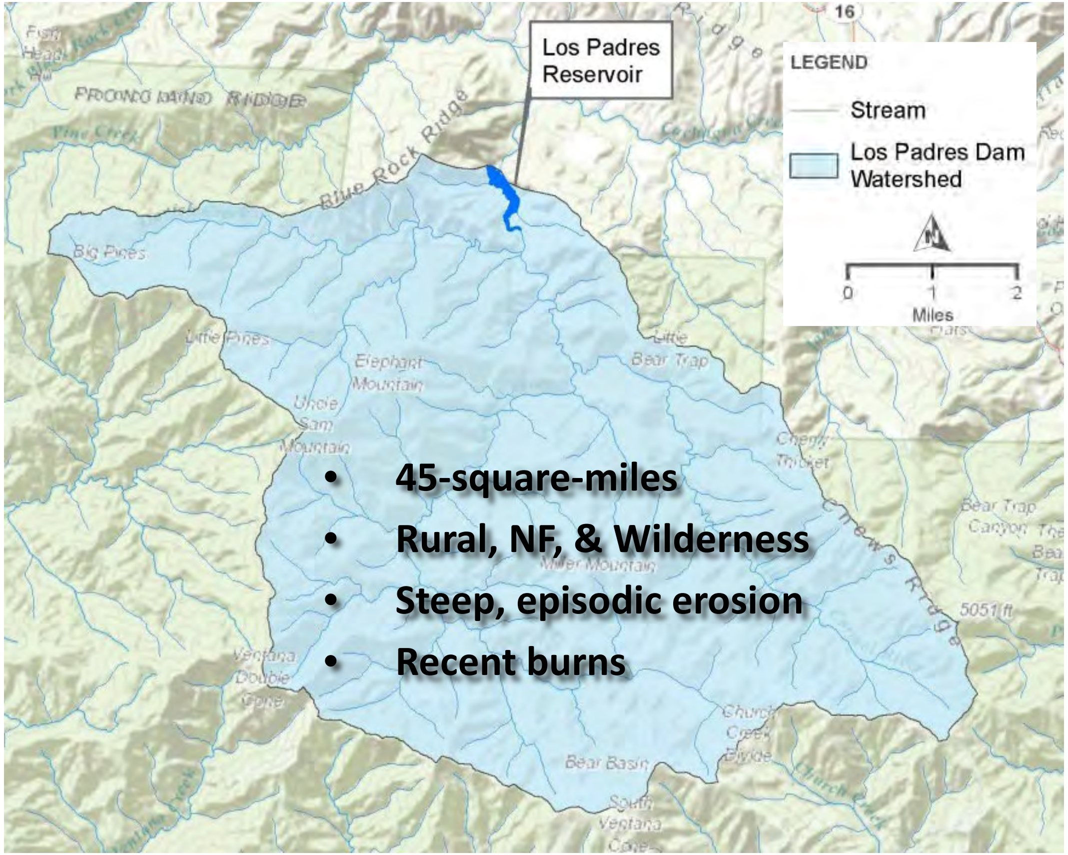
Existing Conditions

ALTERNATIVES DEVELOPMENT TM

Existing Conditions

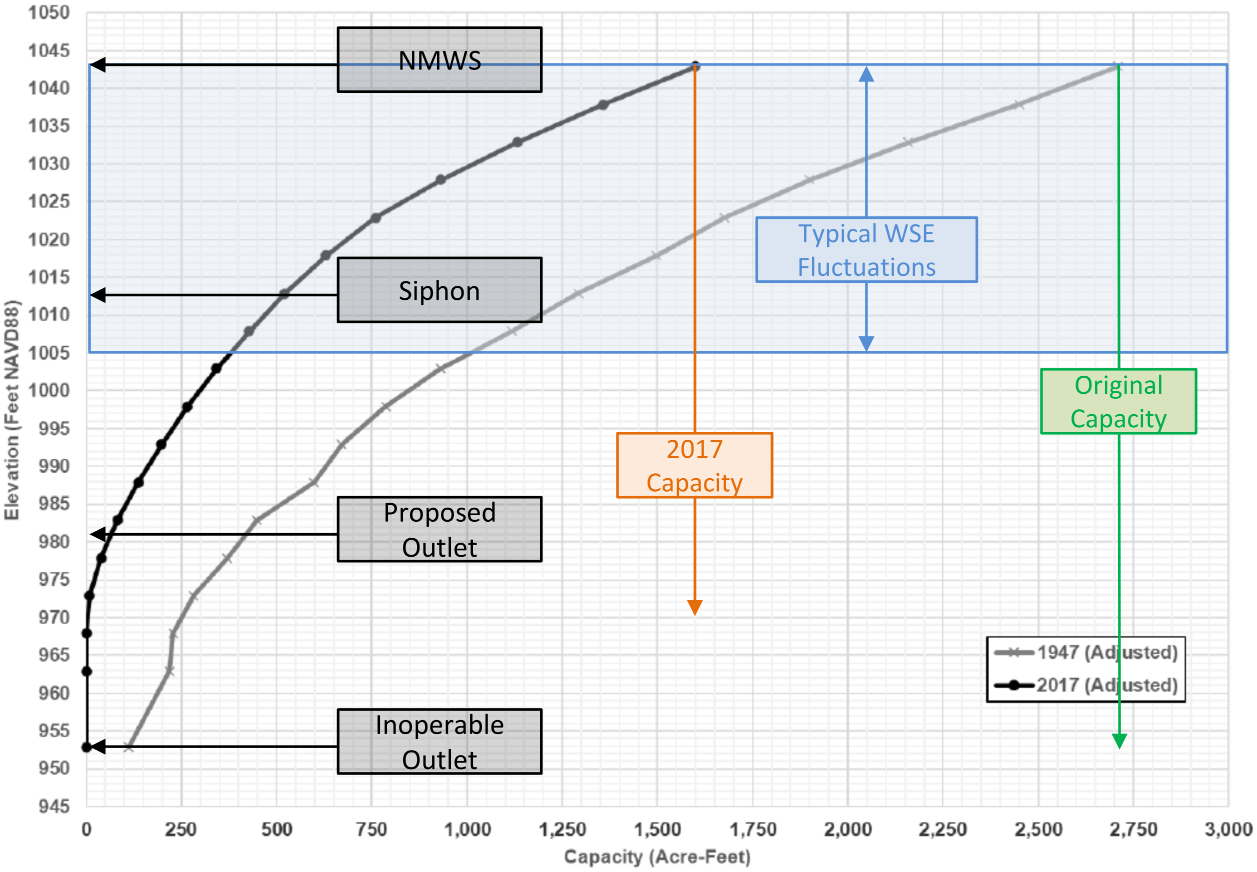
LPD, Reservoir, & Contributing Watershed



- 45-square-miles
- Rural, NF, & Wilderness
- Steep, episodic erosion
- Recent burns

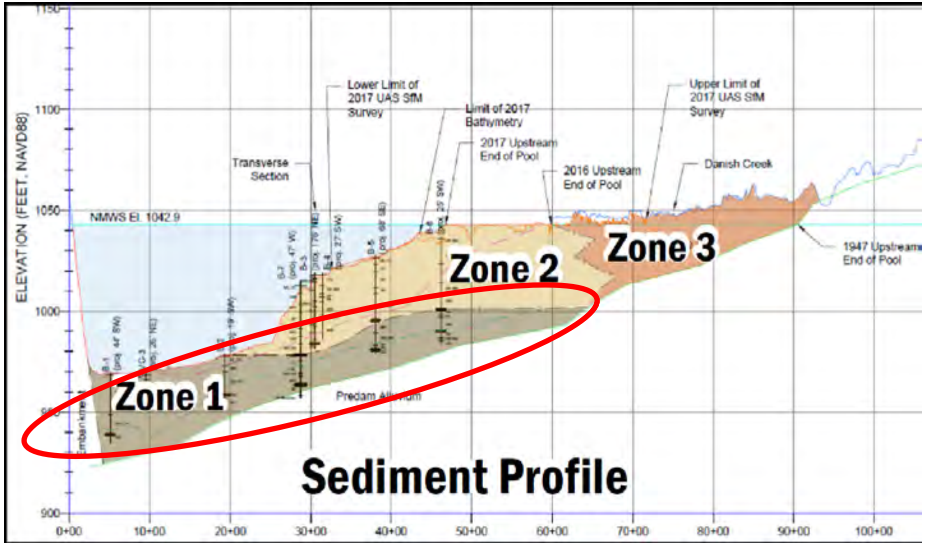
Reservoir Capacity

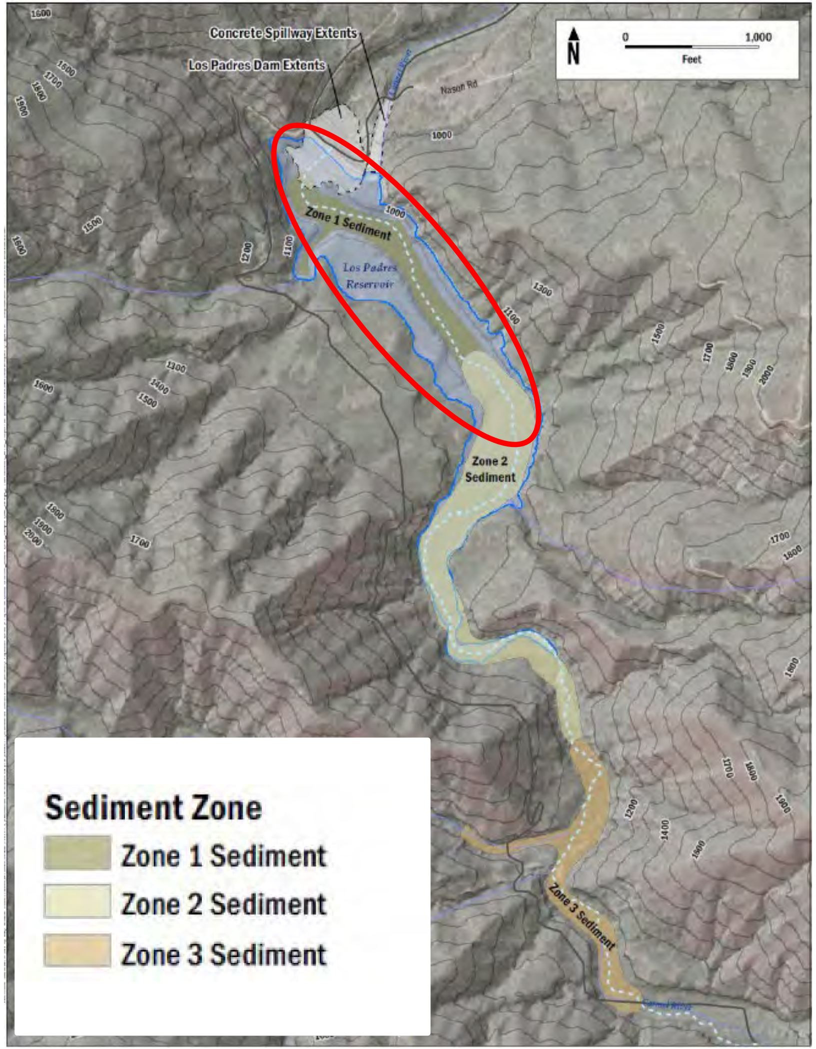
Stage-storage based on latest information



Accumulated Sediment

Area	Quantity (AF)	Quantity (CY)	Characterization
Zone 1	340	550,000	Organics, silt, clay, fine sand
Zone 2	701	1,130,000	Predominately silt and sand
Zone 3 below NMWS	79	127,000	Sand and coarser materials
Zone 3 above NMWS	138	223,000	
Total Sediment Volume	**1,258**	**2,030,000**	





Accumulated Sediment

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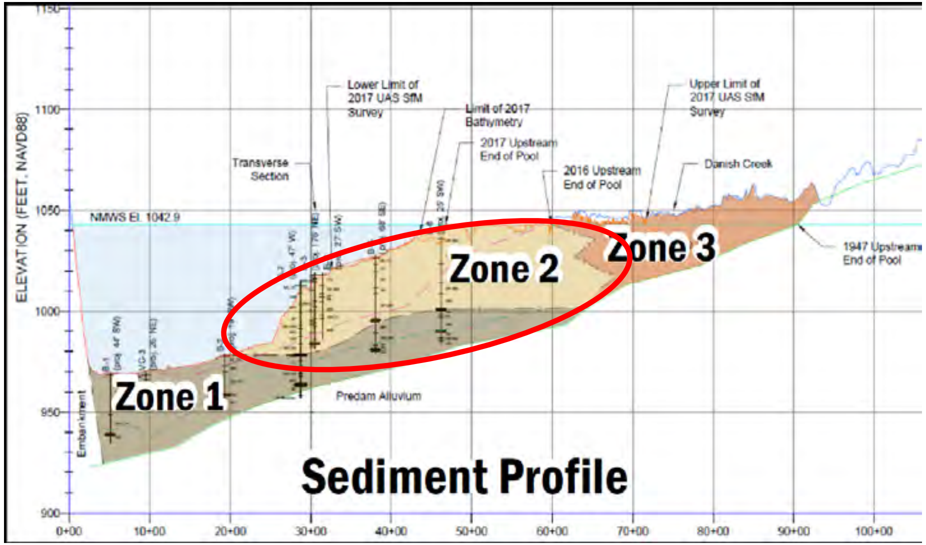

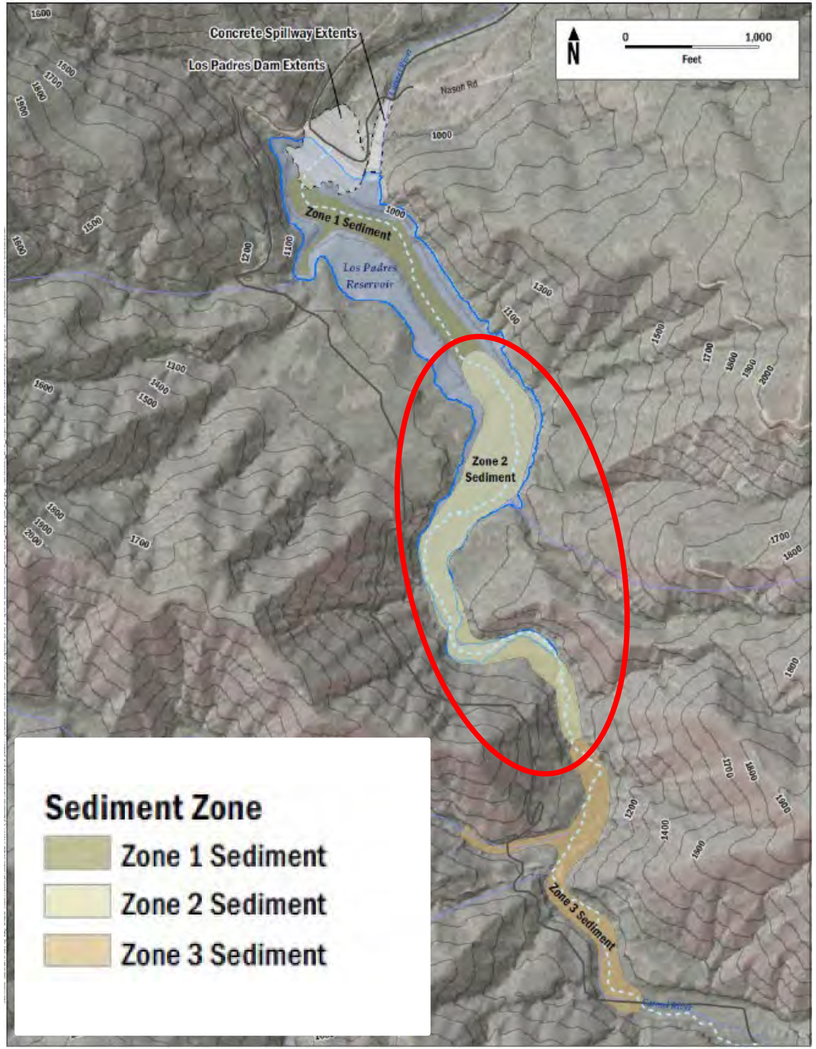

Accumulated Sediment

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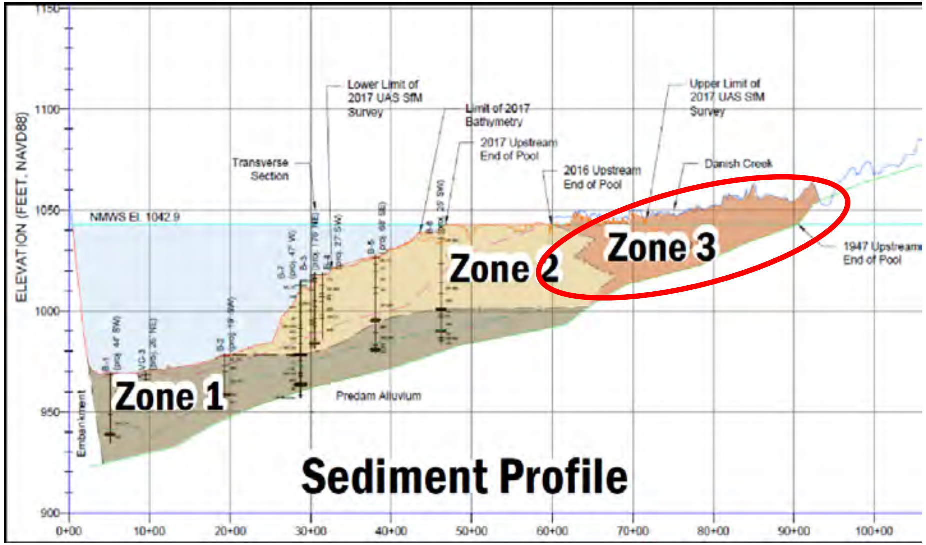
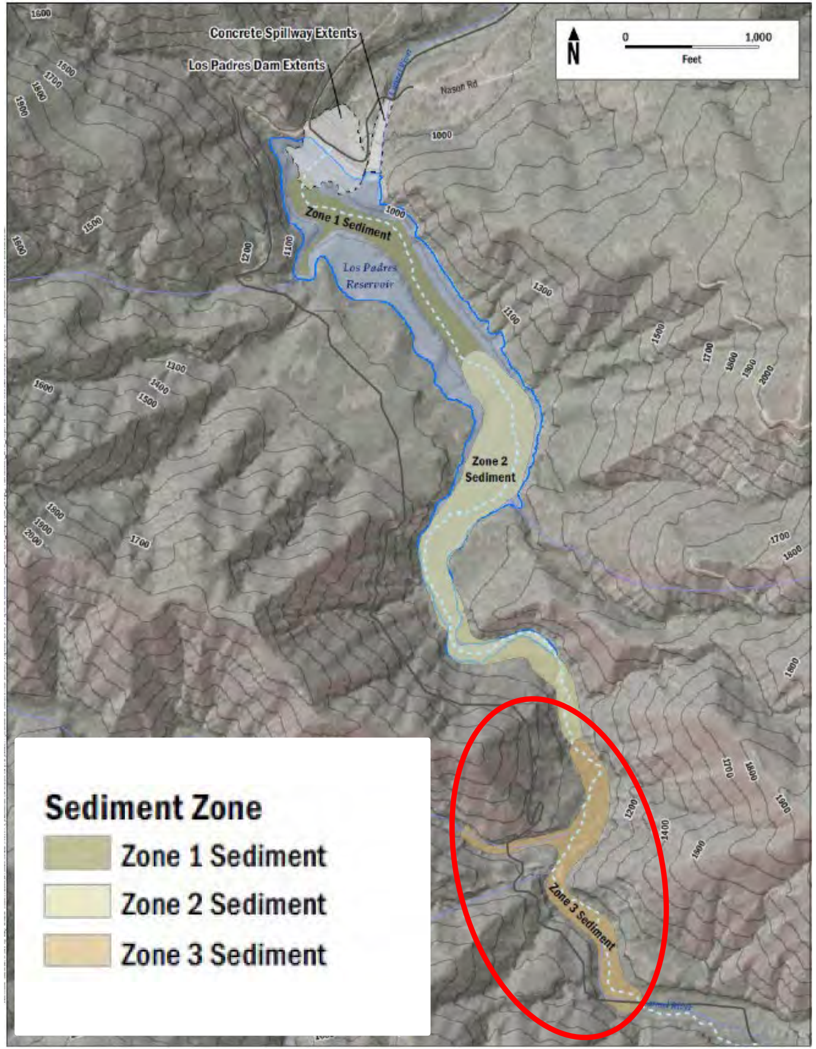




Sediment Deposition Rate

- Sediment Accumulation Rate = 18 AFY = total accumulated sediment ÷ 70 years of accumulation (includes sediment above NMWS)
- Storage Loss Rate = 16 AFY = (original capacity – 2017 capacity) ÷ 70 years
- Both rates include Marble Cone Fire and subsequent extreme precipitation

Description	Quantity (AF)
Original 1947 reservoir capacity at NMWS	2,720
2017 reservoir capacity at NMWS	1,601
Sediment volume below NMWS	1,120
Sediment volume above NMWS	138
Total sediment volume	**1,258**

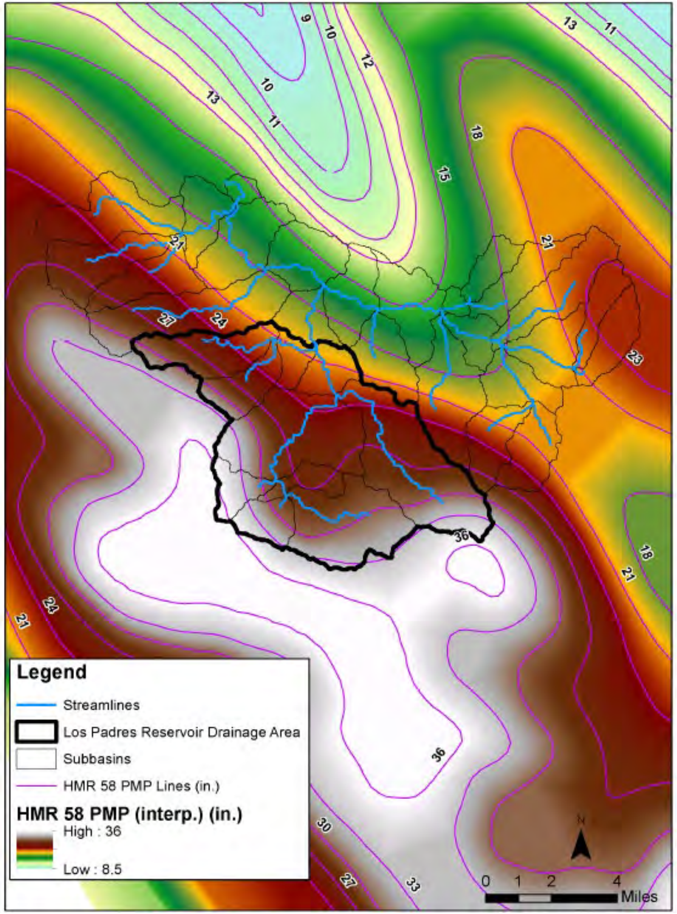
Significance of the Los Padres Water Right

- LPR has 2,179 AF water right (Cal-Am WR 95-10)
  - Cal-Am pumping ≈ 9,700 AF
  - LPR right ≈ 22% of municipal supply
- Retaining WRs a priority for municipal supply
  - Cal-Am could apply for new point of diversion in lower river
  - Aquifer stores many times more than 2,179 AF
- Replacement water could cost 40-times more
  - $140-$150 per AF: production from Carmel River
  - $5,800-$6,000 per AF: desalination

Summary data provided by MPWMD, April 2022

Probable Maximum Flood (PMF)

- Considers runoff from probable maximum precipitation
- LPD designed based on NOAA's Hydrometeorological Report (HMR) 36
- More conservative criteria (HMR 58 & 59) likely required for storage expansion
- HMR 36 PMF ≈ 32,000 cfs
- HMR 58/59 PMF ≈ 66,000 cfs
- Preliminary analysis to guide conceptual design suggests overtopping during PMF



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Alternatives Development TM – Alternative 1

NO SEDIMENT ACTION

Alternative 1 – No Sediment Action

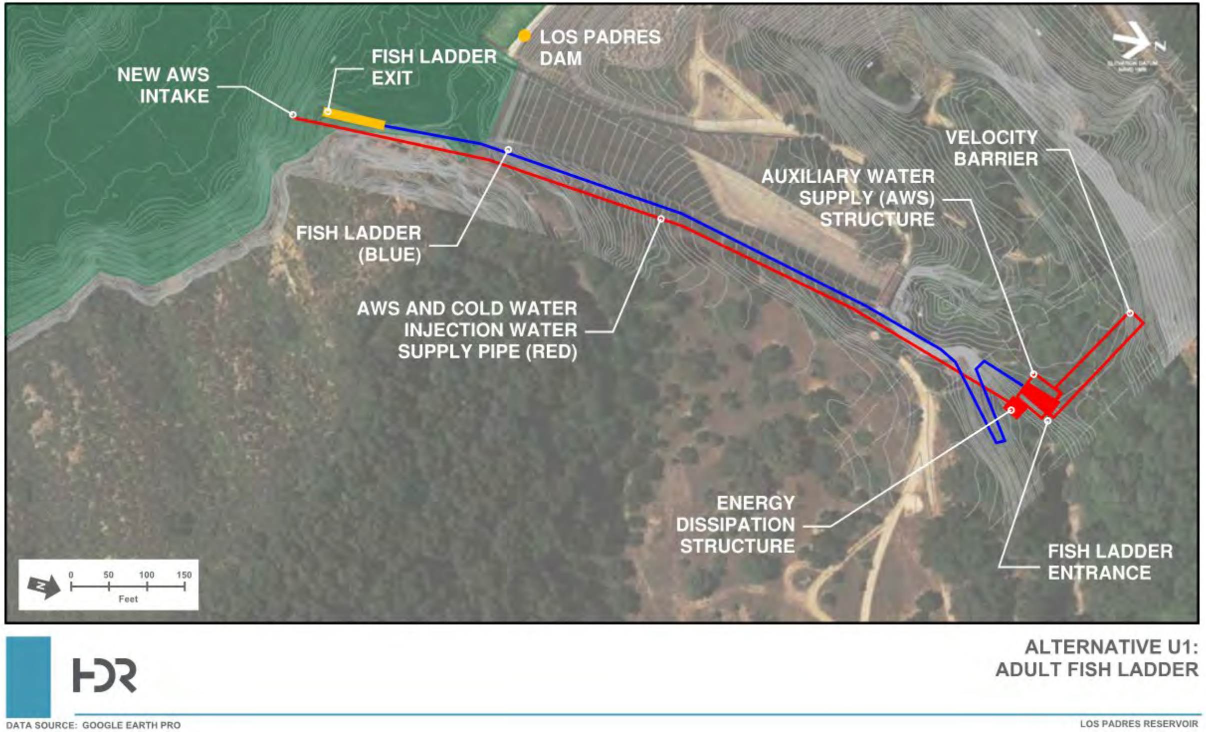
- No action to:
  - manage incoming or accumulated sediment
  - maintain or increase reservoir storage

- Gradual decrease in ability to store and release water
  - Reservoir substantially filled by 2115 (93 years)
- Includes fish passage improvements (HDR et al. 2021) required by existing MOU (NMFS 2017)

No Sediment Action (Alt. 1) Fish Passage

- Assumes upstream passage via:
  - Fish ladder

    -or-
  - New trap and transport facilities
- Same assumption for all dam-in alternatives



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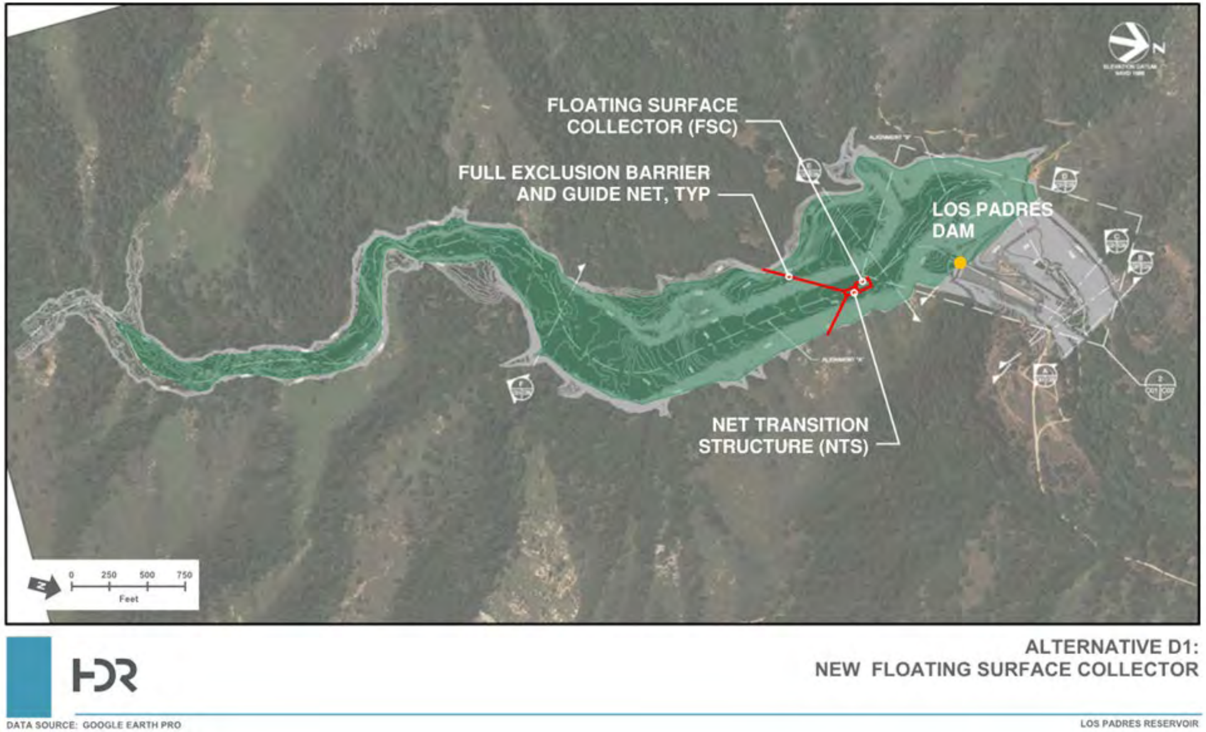
No Sediment Action (Alt. 1) Fish Passage

- Assumes downstream passage via:
  - New floating surface collector

    -or-
  - Spillway modification & existing collector with 30 cfs attraction flow
- Same assumption for all dam-in alternatives



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No Sediment Action (Alt. 1) Construction Cost

- No construction costs other than fish passage
  - $82.1M
  - Highest combined cost of upstream and downstream passage options from HDR et al. 2021
- Same assumption for all dam-in alternatives

Fish Passage Alternative	Anticipated Cost
UPSTREAM FISH PASSAGE	
U1: Technical Fish Ladder - Adult	
Capital cost	$49.1 M
U8: Trap and Transport – Replace	
Capital cost	$12.0 M
DOWNSTREAM FISH PASSAGE	
D1: Floating Surface Collector – New	
Capital cost	$33.0 M
D8: Spillway Modifications (D5) and Existing FWC with 30 cfs Attraction (D7)	
Capital cost	$12.7 M

No Sediment Action (Alt. 1) O&M

- Continuation of existing annual O&M at ≈ $0.4M
- Passage improvements O&M between $0.4 and $0.8M (HDR et al. 2021)
- Same assumption for all dam-in alternatives

Fish Passage Alternative	Anticipated Cost
UPSTREAM FISH PASSAGE	
U1: Technical Fish Ladder - Adult	
Annual operation, maintenance, and monitoring cost	$208,000
U8: Trap and Transport – Replace	
Annual operation, maintenance, and monitoring cost	$392,000
DOWNSTREAM FISH PASSAGE	
D1: Floating Surface Collector – New	
Annual operation, maintenance, and monitoring cost	$390,000
D8: Spillway Modifications (D5) and Existing FWC with 30 cfs Attraction (D7)	
Annual operation, maintenance, and monitoring cost	$180,000

No Sediment Action (Alt. 1) Uncertainties

- Future rate of sediment accumulation
  - Past may not represent future
  - Based on trends in hydrology and wildfire, difficult to know when another large influx of sediment may occur
  - Potential effect on fish passage improvements
- Applicability of more conservative PMF (HMR 58/59) to fish passage alternatives
- Impact of sediment accumulation on water rights

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No Sediment Action (Alt. 1)
Advantages & Disadvantages

- Advantages
  - Fish passage improvements cost is relatively low
  - Least impact to local traffic and noise

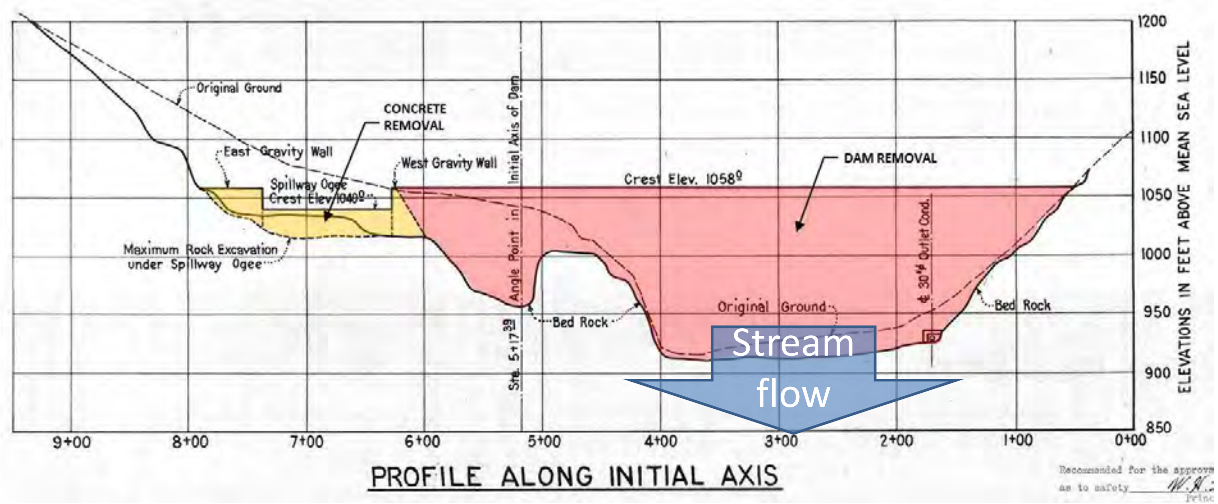
- Disadvantages
  - Gradual reduction in storage and associated benefits of dry-season release
  - No geomorphic benefits until dam is overtopped with sediment
  - Managed fish passage and reservoir effects on steelhead and ecosystem

Alternatives Development TM – Alternative 2

DAM & SEDIMENT REMOVAL

Alternative 2 – Dam & Sediment Removal

- Removal of LPD
- Dry excavation of Zones 1 and 2 sediment
- Disposal at Sites A, B, and C
- Diversion & dewatering May 15 to Oct 15
- Zone 3 sediment left in place to move downstream



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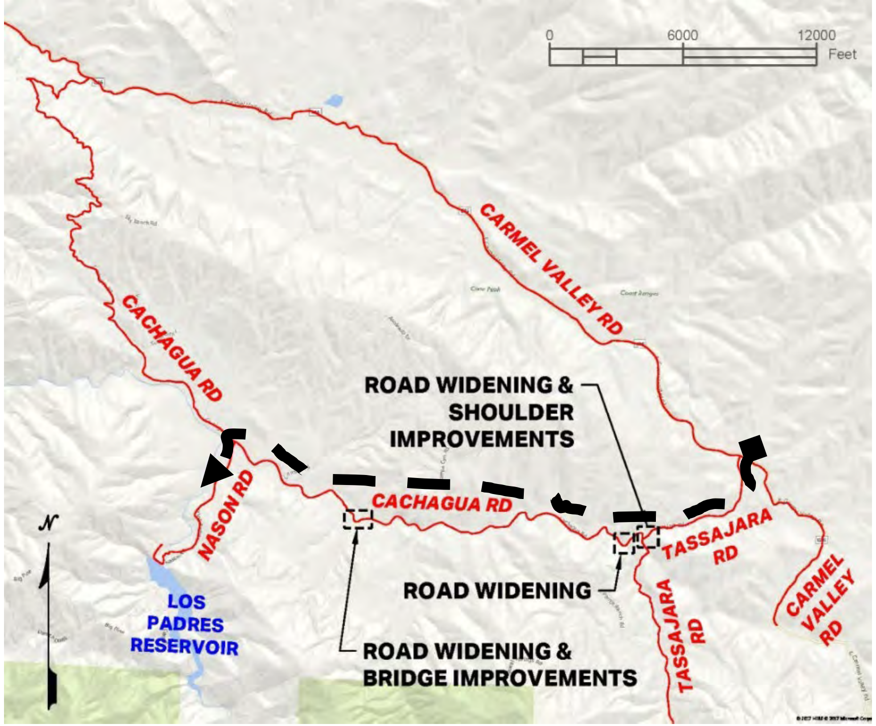
Dam & Sediment Removal (Alt. 2)

Access Improvements

- Localized public road improvements for equipment mobilization & material delivery
- Traffic control for haul trucks
- Same road improvements for subsequent alternatives



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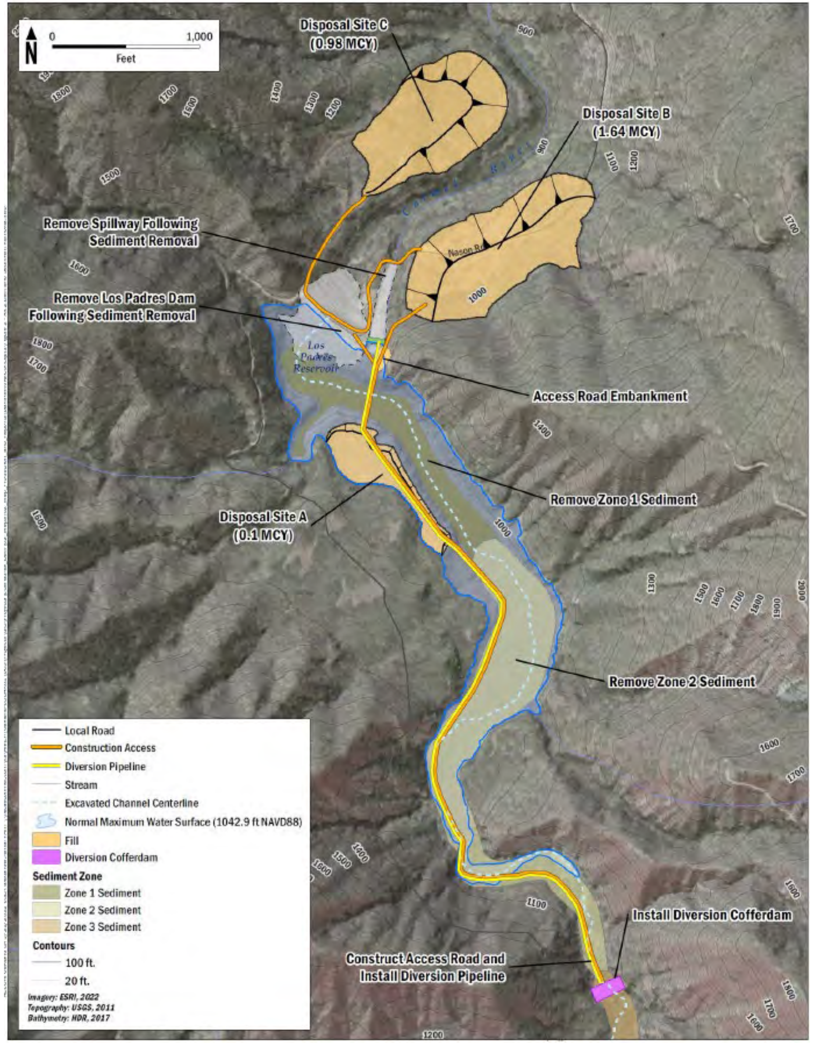
Dam & Sediment Removal (Alt. 2)

Access Improvements – Year 1

- On-site construction access
  - Upgrade/replace spillway bridge
  - Widen & extend road from dam crest to Disposal Site C
  - Improve ramp to reservoir
  - 0.25-mile road along eastern dam embankment to Disposal Site B
  - 1.25-mile access route (each year) over accumulated sediment



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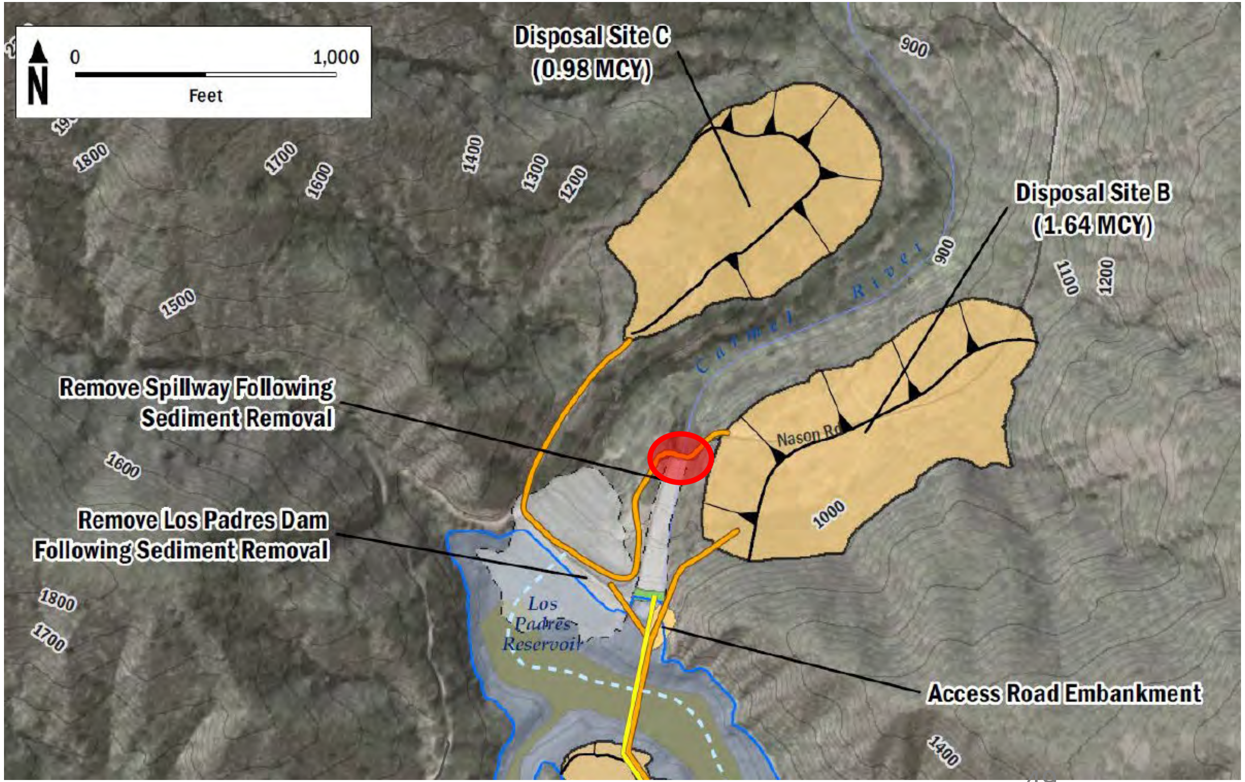
Dam & Sediment Removal (Alt. 2) Access

Replace spillway bridge



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Dam & Sediment Removal (Alt. 2) Access

Replace spillway bridge

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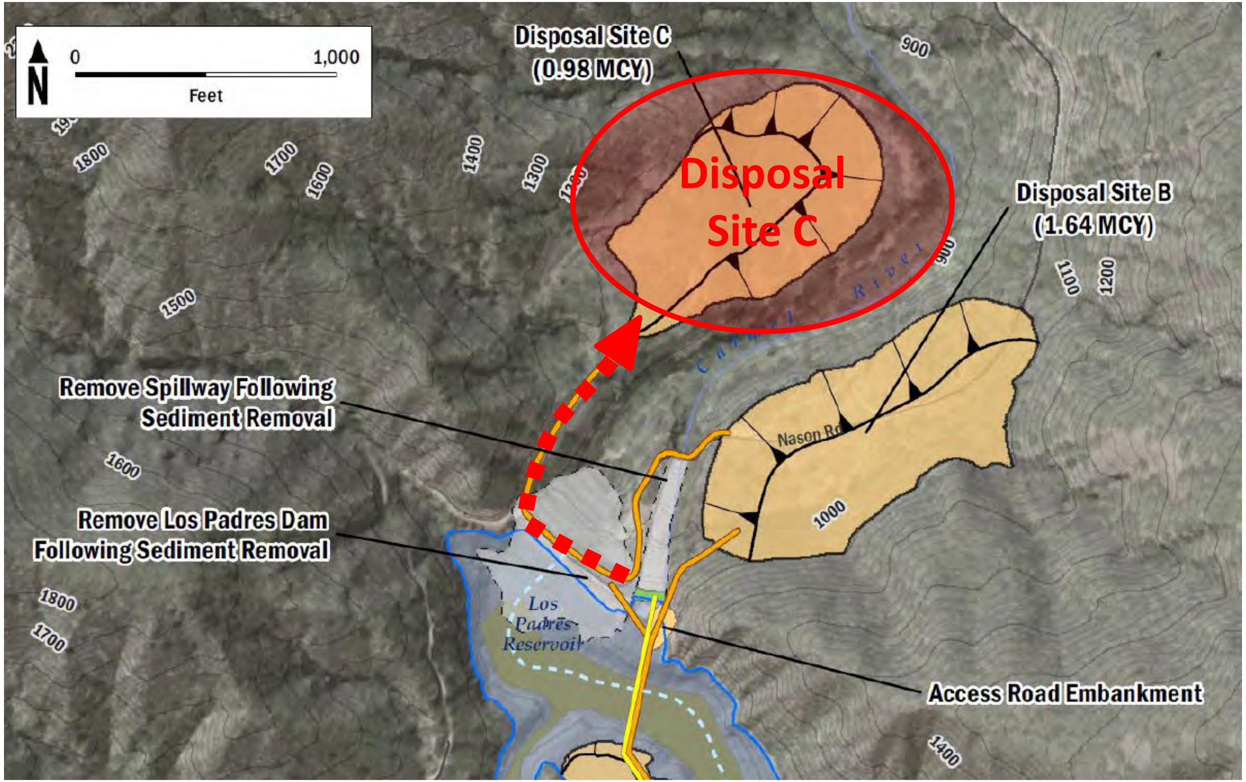
Dam & Sediment Removal (Alt. 2) Access

Widen & extend road from dam crest to Disposal Site C



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Dam & Sediment Removal (Alt. 2) Access Improvements

Widen & extend road from dam crest to Disposal Site C

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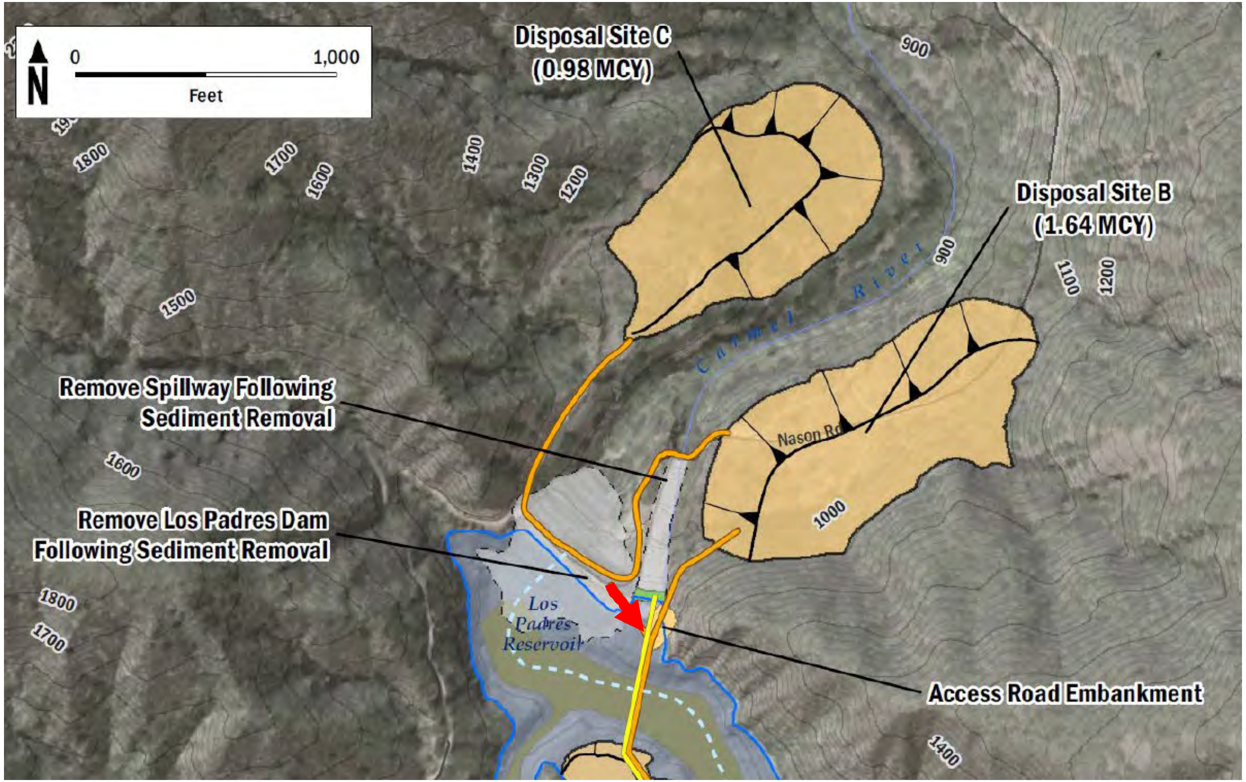
Dam & Sediment Removal (Alt. 2) Access Improvements

Improve ramp to reservoir



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Dam & Sediment Removal (Alt. 2) Access Improvements

Improve ramp to reservoir

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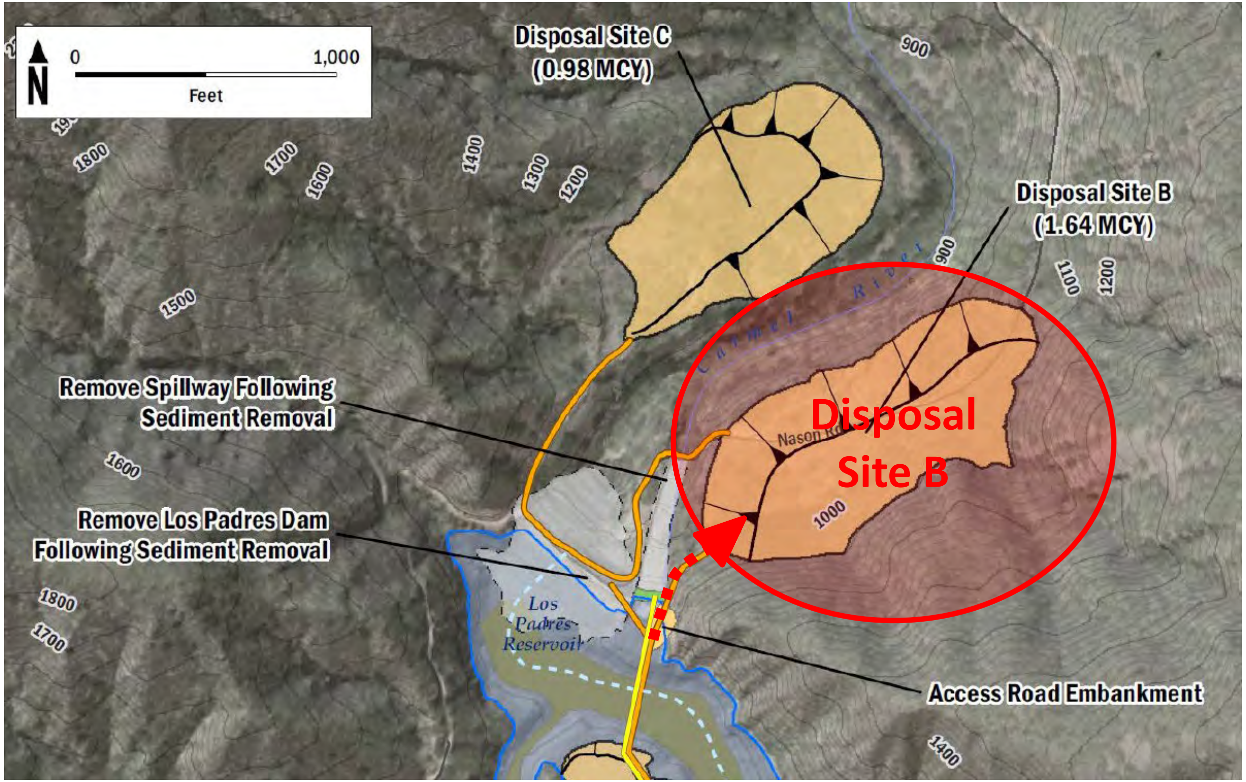
Dam & Sediment Removal (Alt. 2) Access Improvements

0.25-mile road along eastern dam embankment to Disposal Site B



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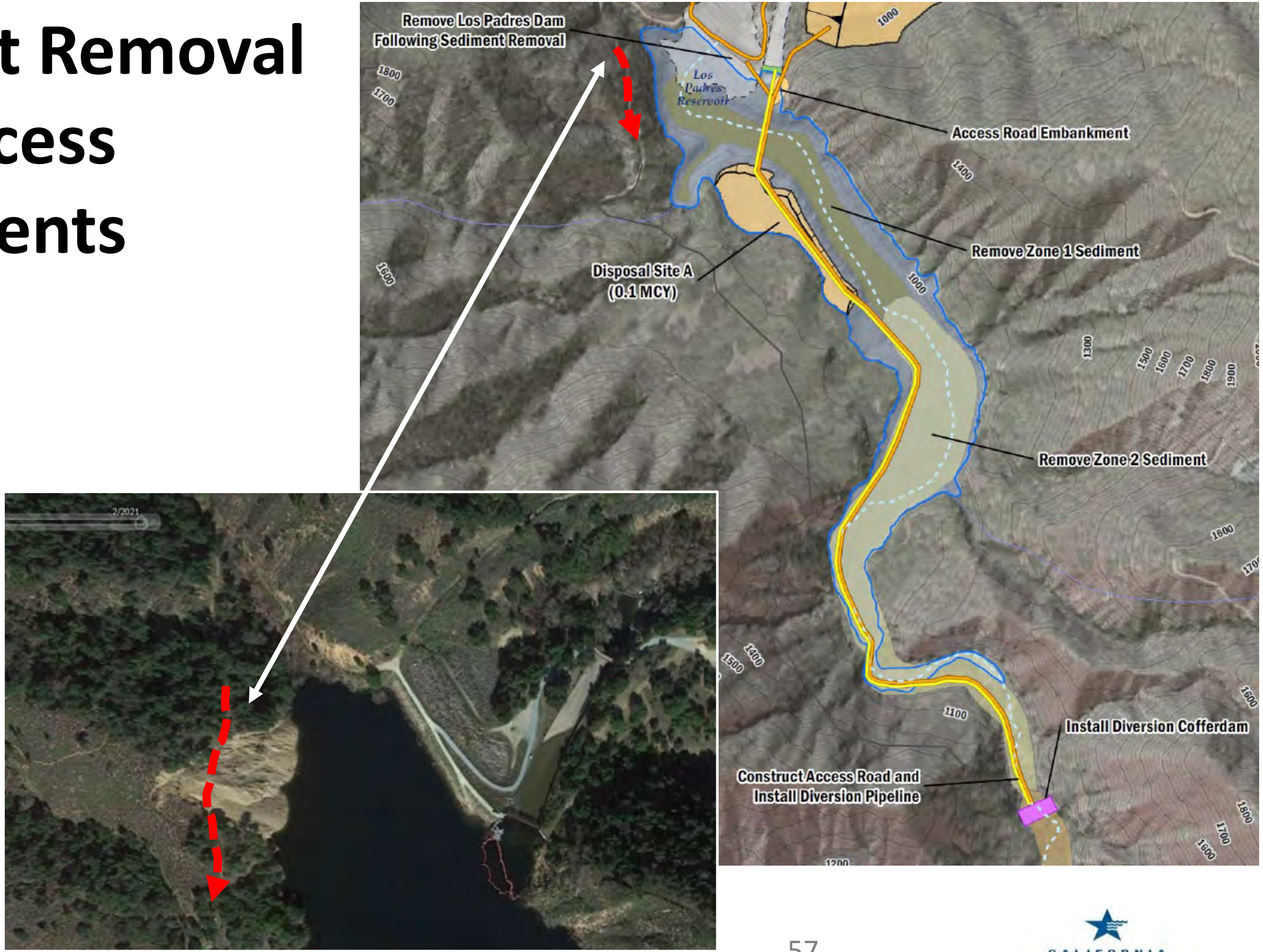
Dam & Sediment Removal (Alt. 2) Access Improvements

0.25-mile road along eastern dam embankment to Disposal Site B

Dam & Sediment Removal (Alt. 2) Access Improvements

- Access to upstream project extent constrained



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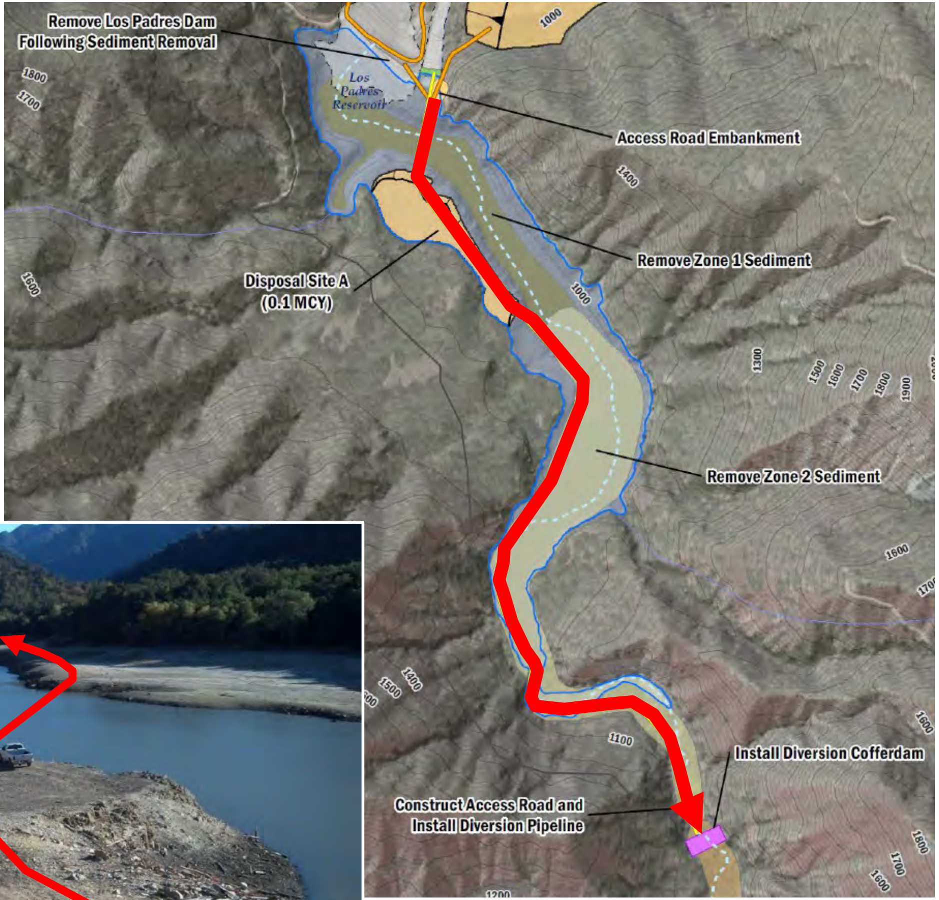
Dam & Sediment Removal (Alt. 2) Access Improvements

- 1.25-mile access route (**each year**) over accumulated sediment
- Dewatering & displacement fill bridge between terraces



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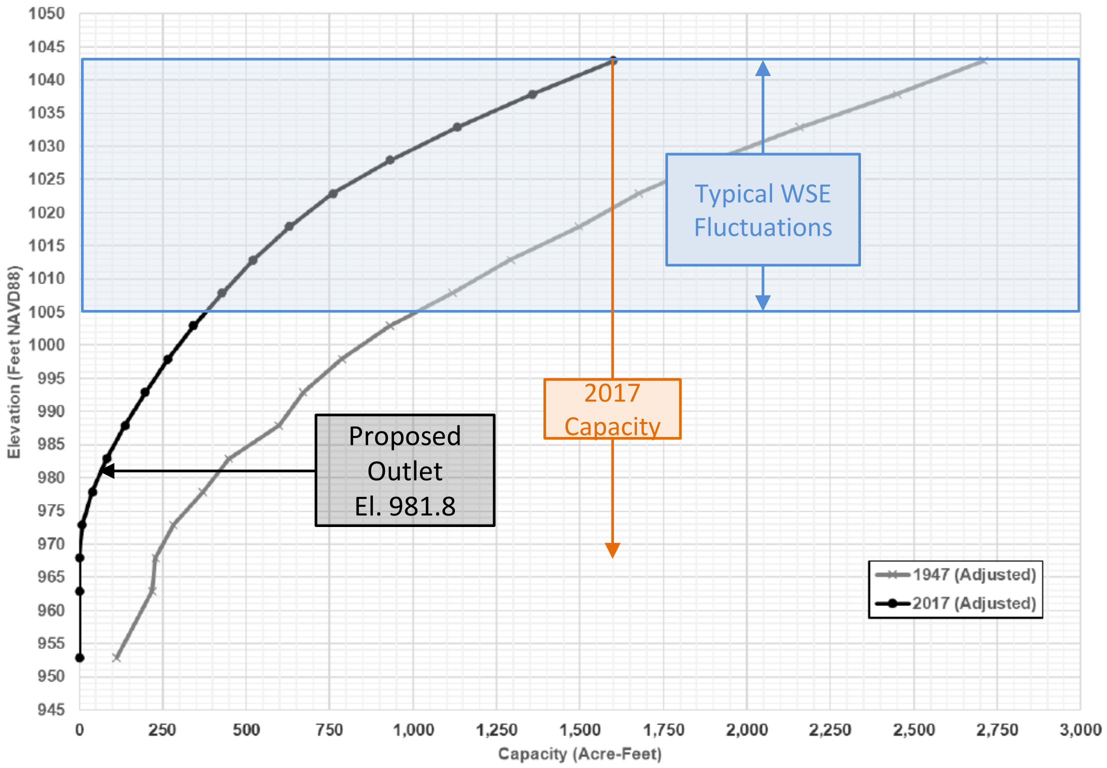
Dam & Sediment Removal (Alt. 2)

- Zone 1 & 2 sediment removed (yrs 1-3) prior to dam removal (yr 4) to protect water quality
- Draw down reservoir to El. 981.8 (3 weeks) each year
  - Fish capture & relocation
  - Water treatment system



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Dam & Sediment Removal (Alt. 2)

- Once access is established, install streamflow bypass (Yr. 1):
  - Temporary diversion structure near upstream extent of work
    - Earthen berm, at-grade sheet piles, & gated intake
    - Partially removed each winter
  - Pipe from diversion structure to LPD
  - Similar to diversion at San Clemente Dam removal

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Dam & Sediment Removal (Alt. 2)

- Construction Yrs. 2 and 3
  - Repeat dewatering (1 month prior) and streamflow diversion
  - Excavate Zone 1 and 2 sediments
    - Manage water in work area
    - Work sediment to remove water
    - Dispose in Sites B & C

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Dam & Sediment Removal (Alt. 2)

- Construction Yr. 4
  - Repeat dewatering (1 month) and streamflow bypass
  - Remove LPD (5 months)
    - Dispose in Sites A, B, & C
  - Grade control and habitat restoration features
  - Remove diversion & bypass

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Cost Assumptions

- AACE Class 5 (+50% to -25%)
- Mobilization and general requirements: 10%
- Contractor general conditions: 10%
- Contractor bonds: 3%
- Contractor OH & profit: 15%
- State taxes (material and equipment): 7.25%
- 50% design and construction contingency
- 2022 US dollars

Dam & Sediment Removal (Alt. 2)
Cost and O&M

- Cost
  - $95M
  - 42% dam removal and restoration
  - 58% sediment removal and disposal
- O&M limited to post-construction regulatory monitoring

Dam & Sediment Removal (Alt. 2)
Uncertainties

- Likelihood of approval to release accumulated sediment (could reduce cost)
- Outcome of water rights negotiations
- Need to mitigate flood risk if restore annual bedload
- Typical design & construction uncertainties
  - E.g., geotechnical, roads, active vs. passive restoration assessments needed

Los Padres Dam
January 8, 2017
3,000 cfs (estimated)

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Dam & Sediment Removal (Alt. 2)

Advantages & Disadvantages

- Advantages
  - Relatively low cost (no engineered fish passage)
  - Restores natural processes (passage & ecosystem restoration)
  - Eliminates long-term O&M
  - Volitional passage, coldwater refugia, restored habitat in reservoir area
- Disadvantages
  - No ability to release flows for steelhead rearing in dry-season
  - Must renegotiate water rights or pay for replacement water

Alternatives Development TM – Alternative 3

STORAGE EXPANSION & DREDGING

Alternative 3 – Storage Expansion & Dredging

- Pneumatic (rubber bladder) gates on spillway crest
  - Gates raised (9.6’) to capture additional water for dry-season release
  - Embankment dam raise to accomodate updated PMF
- Wet dredging Zones 1, 2, & part Zone 3 sediments
  - Fine sediment to Sites B and C
  - Coarser material to Sites D and E to be eroded over time
- Fish passage improvements

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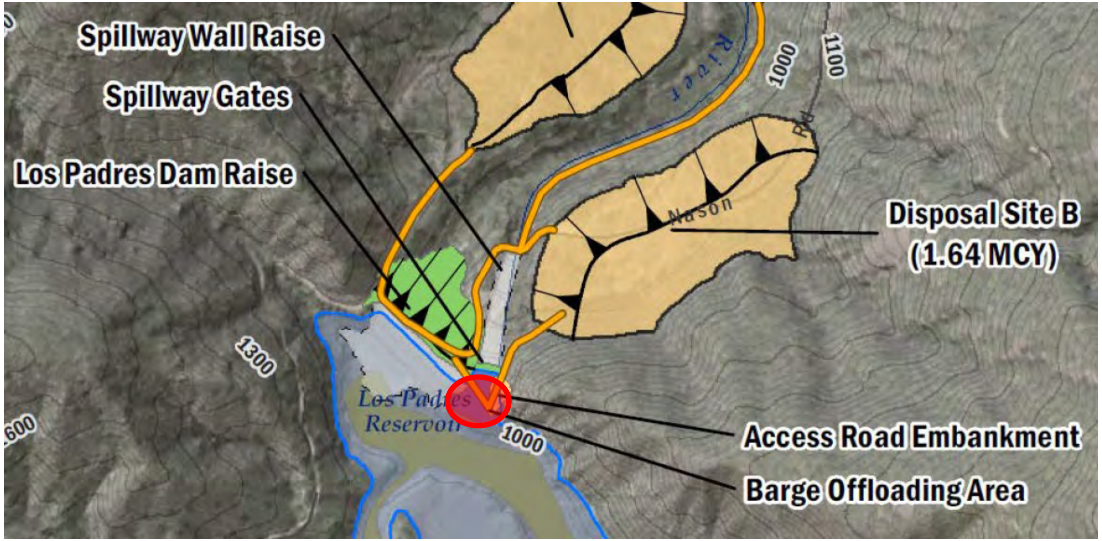
Storage Expansion & Dredging (Alt. 3)

Access Improvements

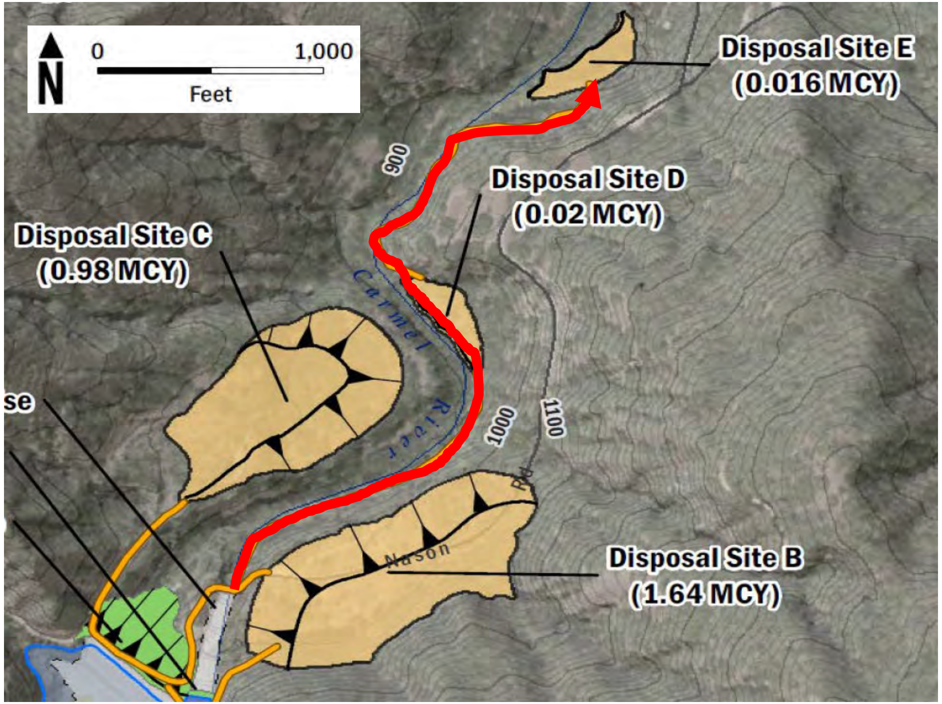
- All access improvements described previously except access road on reservoir sediments to upstream
- Reservoir retains water
- Sediment accessed via barge
- Offloading area on existing terrace



Storage Expansion & Dredging (Alt. 3)

Access Improvements

- Access Disposal Sites D and E along river
  - Site prep to improve streamflow access to coarse sediment
    - Minimize impacts to steelhead habitat or, alternatively
  - Slide sediment off Nason road, probably with less frequent mobilization



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Storage Expansion & Dredging (Alt. 3)
Spillway Modifications

- Gates on spillway crest raise surface 9.6 feet
  - Increases storage 625 AF, from 1,601 AF to 2,226 AF
  - Raised in spring when inflow allows downstream release concurrent with increase in storage

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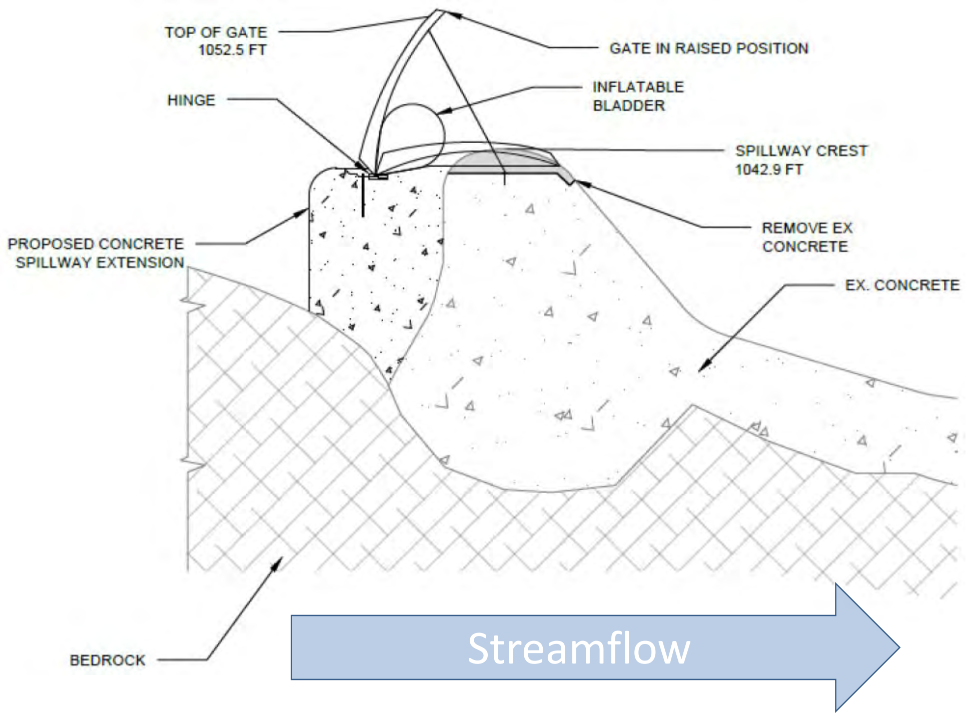
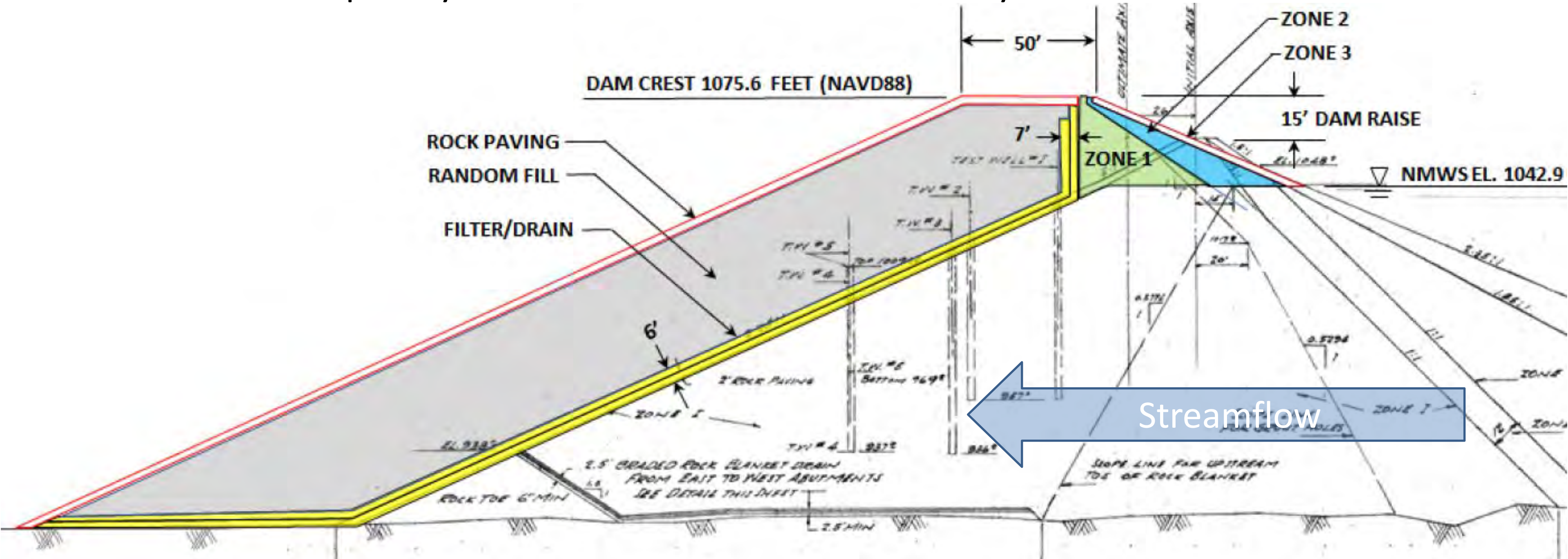
Storage Expansion & Dredging (Alt. 3)
Spillway Modifications

- Reconstruct crest to:
  - Provide flat base
  - Extend 12 feet into reservoir
- Raise walls for higher PMF
- Operational rules, seepage, stability, and seismic deformation analyses likely required during design
  - May indicate additional dam improvements



Storage Expansion & Dredging (Alt. 3)
Dam Embankment Raise

- 15-foot dam raise for higher PMF
  - Dam width increased 50 feet on downstream side
  - Less if spillway crest widened or relaced with labyrinth



Storage Expansion & Dredging (Alt. 3)

Outlet Works

- Primary outlet works mostly unaffected
  - Outlet already far enough downstream
    - Possibly extend concrete encasement
  - Proposed intake not likely affected
  - Evaluate ability to:
    - Operate under additional head
    - Drain to DSOD standards
- Evaluate effect of head on other outlet works

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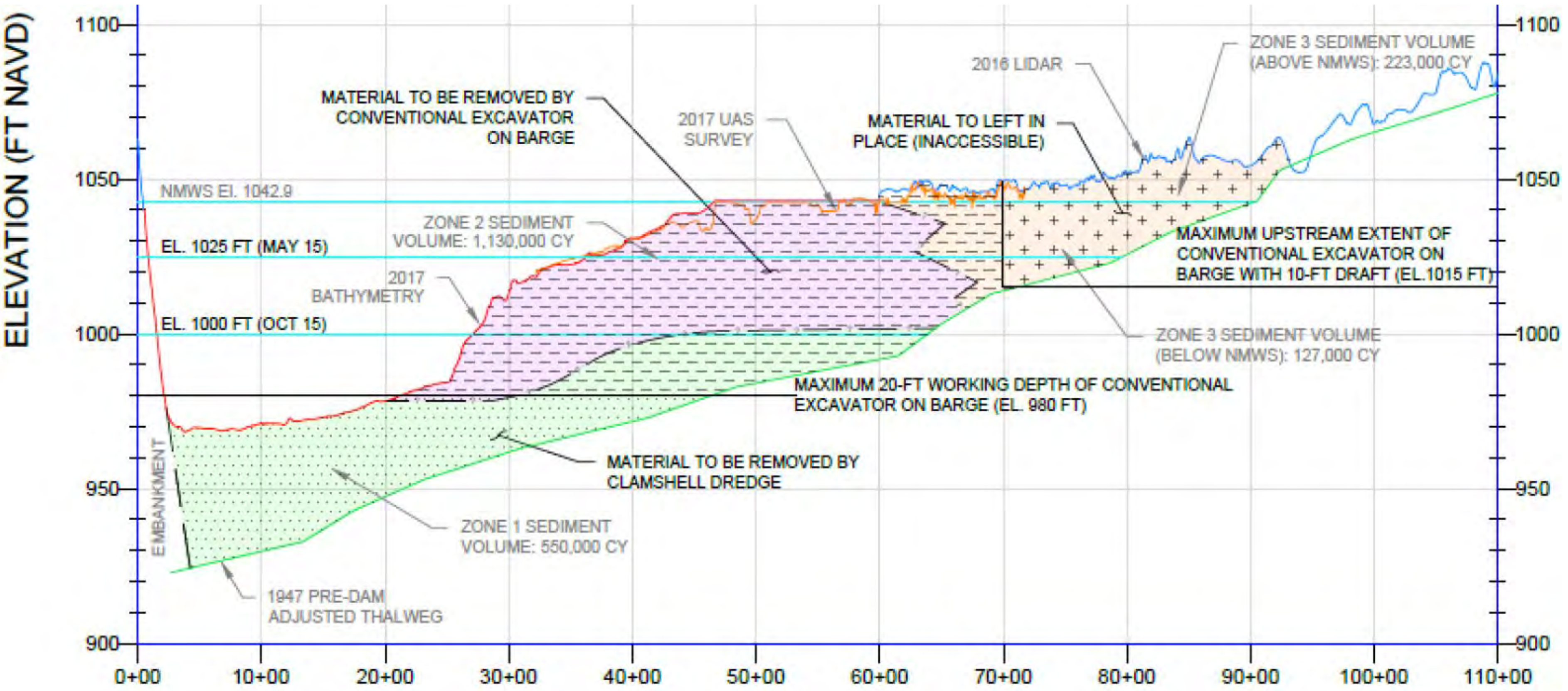
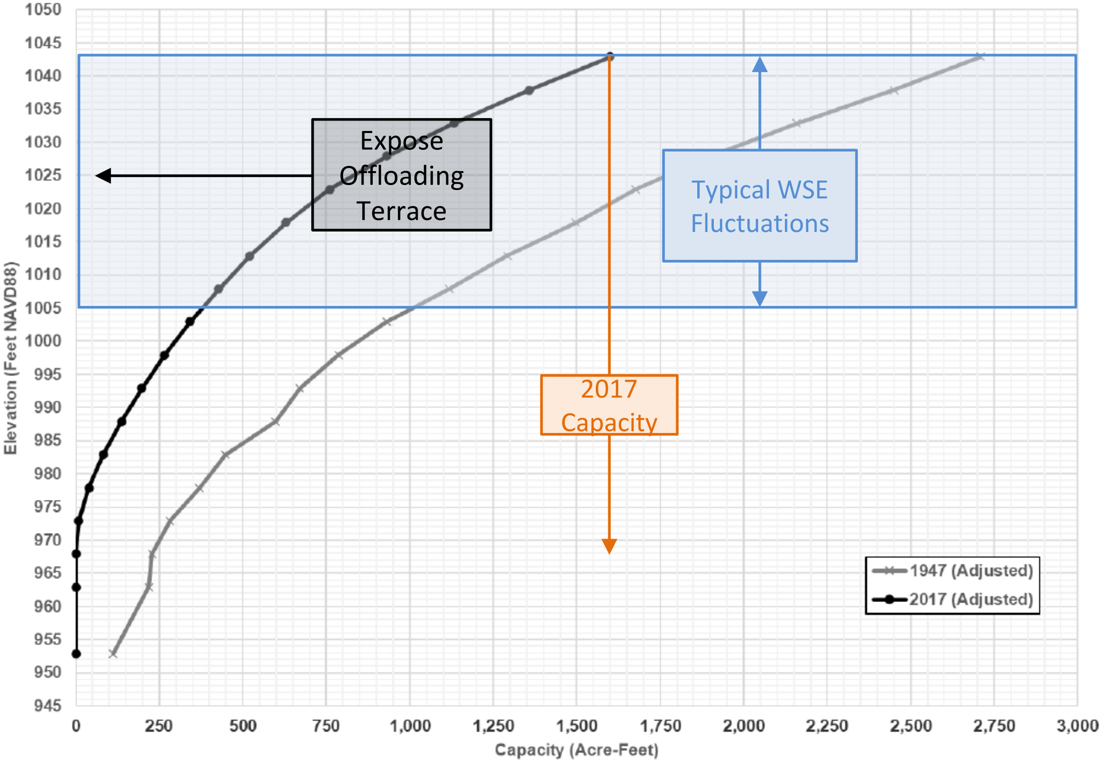
Storage Expansion & Dredging (Alt. 3)



Storage Expansion & Dredging (Alt. 3)

- Year 1
  - Prior to May 15
    - Access improvements
    - Prepare Disposal Sites B & C
    - Lower reservoir to 1,025 feet to expose offloading area



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Storage Expansion & Dredging (Alt. 3)

- Year 1 (May 15-Oct 15)
  - Assemble flexi-floats and excavator on barge
  - Begin removing Zone 2 & 3 sediment (5 months)
  - Prepare floodplain Disposal Sites D and E
- Year 2
  - Lower reservoir to expose offloading area
  - Assemble barge, continue removing Zone 2 & 3 sediment (5 months)

Storage Expansion & Dredging (Alt. 3)

- Year 3
  - Lower reservoir to expose offloading area
  - Complete Zone 1, 2 & 3 sediment by barge-mounted excavator (3 months)
  - Reconfigure flexi-floats for clamshell dredge (0.5 months)
  - Remove Zone 1 & 2 sediments by clamshell dredge (1.5 months)
- Year 4
  - Lower reservoir to expose offloading area
  - Complete removal of Zone 1 & 2 sediments by clamshell dredge (4 months)

Storage Expansion & Dredging (Alt. 3)

Hauling and Sediment Disposal

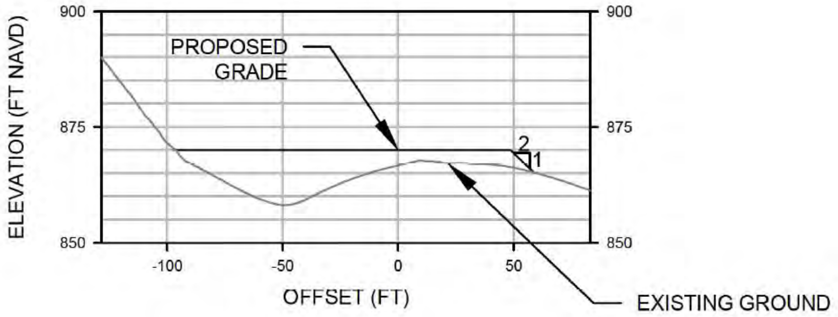
Location	Storage Capacity Cumulative Volume (CY)	Acreage (acres)	Maximum Fill Height (feet)
Site B	1,640,000	16.8	120
Site C	980,000	14.1	120
Site D	20,000	1.8	20
Site E	16,000	1.8	15

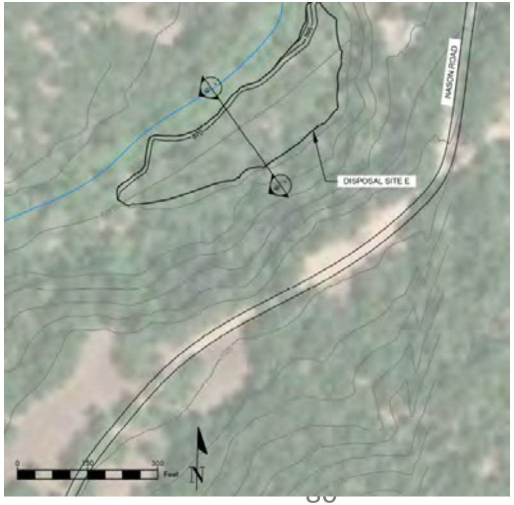
- All material could be placed at Sites B & C
  - Sediment dry times key to cost and duration
  - Dry-time & strength testing during design to reduce risk of delays & confirm slopes and allowable water content
- Coarser material could be placed at Sites D and E for erosion during high flow

Storage Expansion & Dredging (Alt. 3)

Hauling and Sediment Disposal

- Sediment expected to mobilize from Sites D & E in 10-to-20-year flood flow
  - More frequently with more prep
- Accessed along river
- Cleared of trees and graded
- Debris slide option less reliable





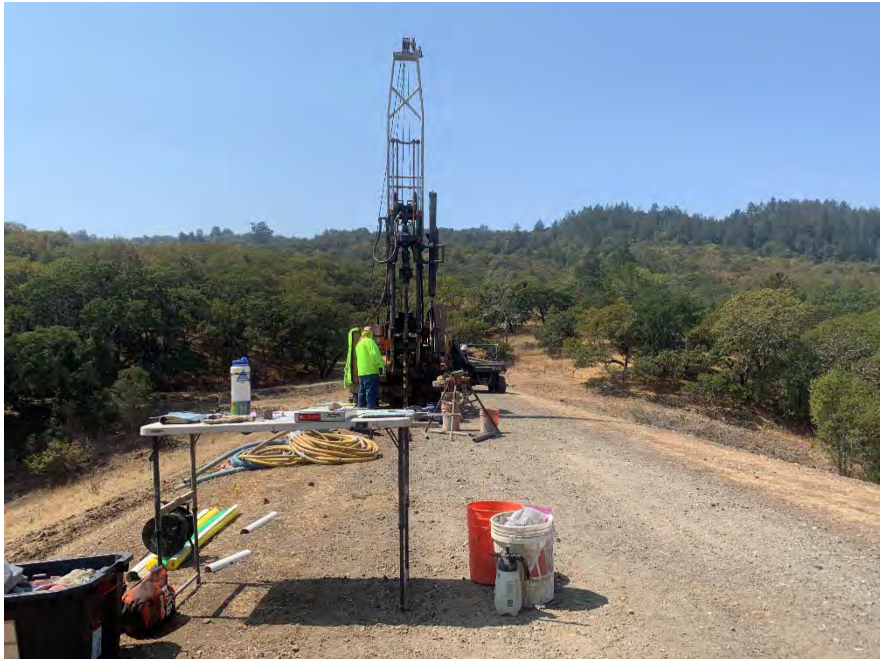
Storage Expansion & Dredging (Alt. 3)
Cost & O&M

- Cost
  - $100M
  - 66% for sediment removal and disposal
  - Up to an additional $82M for fish passage
- O&M
  - Operations plan during design to define monitoring design and procedures & timing of gate operation and summer flow releases
  - Increase O&M budget by $50K
  - Fish passage O&M up to $780K

Storage Expansion & Dredging (Alt. 3)

Uncertainties

- Geologic baseline to support analyses for dam embankment raise
  - Drilling investigation with multiple holes in dam
  - Updated analysis may result in higher peak ground accelerations
  - Results could lead to additional modifications
- Coordination with proposed fish passage improvements
- Extent of effects of access to Disposal Sites D and E on steelhead habitat



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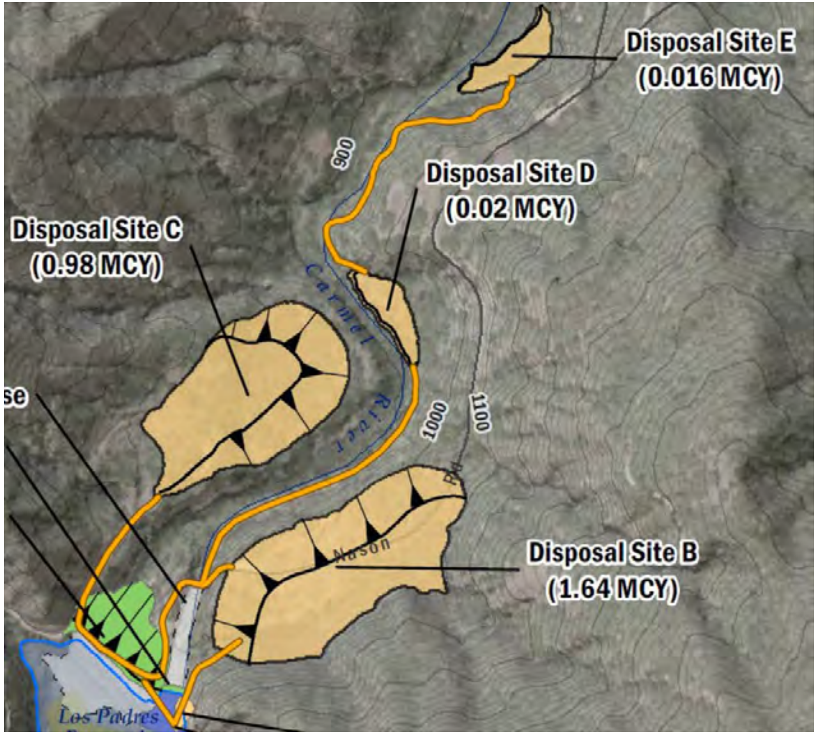
Storage Expansion & Dredging (Alt. 3)
Advantages & Disadvantages

- Advantages
  - Preserves water rights with possibility to negotiate increase
  - Greatest storage capacity and increase in downstream dry-season releases
    - 1.7 cfs per day for spillway gates
    - 3.3 cfs per day for removing sediment
- Disadvantages
  - Second highest cost
  - Biggest impact to local traffic
  - Limited or no geomorphic benefit
  - Managed fish passage and reservoir effects on steelhead and ecosystem

Storage Expansion & Dredging (Alt. 3)
Possible Changes to Consider

- Inclusion of Disposal Sites D & E for Alt. 3 dredging (and Alt. 4 if retained)?
  - Is disturbance for access worth it?
  - Approximate $250K for site preparation and access



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Storage Expansion & Dredging (Alt. 3)
Possible Changes to Consider

- Inclusion of Disposal Sites D & E for Alt. 3 dredging (and Alt. 4 if retained)?

Location	Storage Capacity Cumulative Volume (CY)	Acreage (acres)	Maximum Fill Height (feet)	Proposed Finished Elevation (feet NAVD88)
Site B	1,640,000	16.8	120	1,100
Site C	980,000	14.1	120	1,080
Site D	20,000	1.8	20	905
Site E	16,000	1.8	15	870

- In 2014 MPWMD placed ~1,000 CY of gravel
  - Gravel also placed by MPWMD and Cal-Am in other years (~4,000 CY since 1993)
  - Placed gravel has been observed moving downstream and used for spawning

Storage Expansion & Dredging (Alt. 3)
Possible Changes to Consider

Retain both sediment removal and spillway gates?

- Spillway Gates

  $30M[1]

  + 625 AF

  + 1.7 cfs

- Dredging

  $70M[1]

  +1,120 AF

  + 3.1 cfs

- Together

  $100M[1]

  +1,817 AF

  + 5.0 cfs[2]

[1] Plus cost of fish passage improvements

[2] Includes additional dredging up to high summer reservoir elevations with gates

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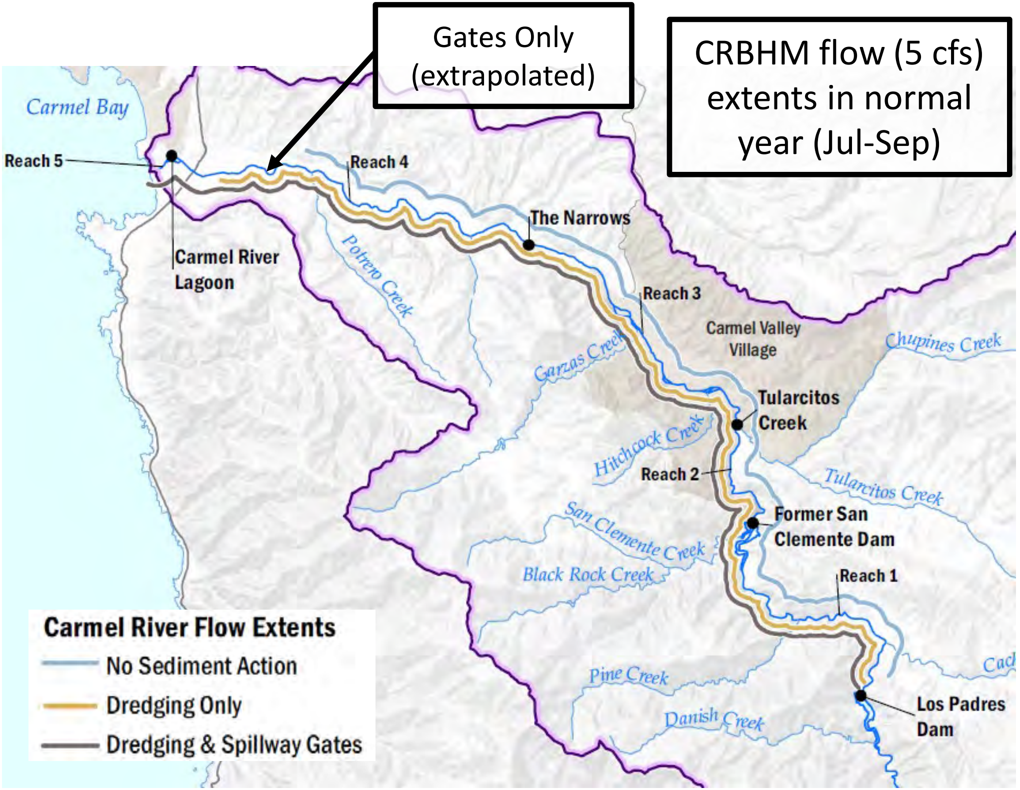
Storage Expansion & Dredging (Alt. 3)

Possible Changes to Consider

Storage Expansion & Dredging (Alt. 3): retain both sediment removal and spillway gates?

- No action needed to maintain >3 cfs to estuary
- Differences appear when looking at extent of channel with >5 cfs



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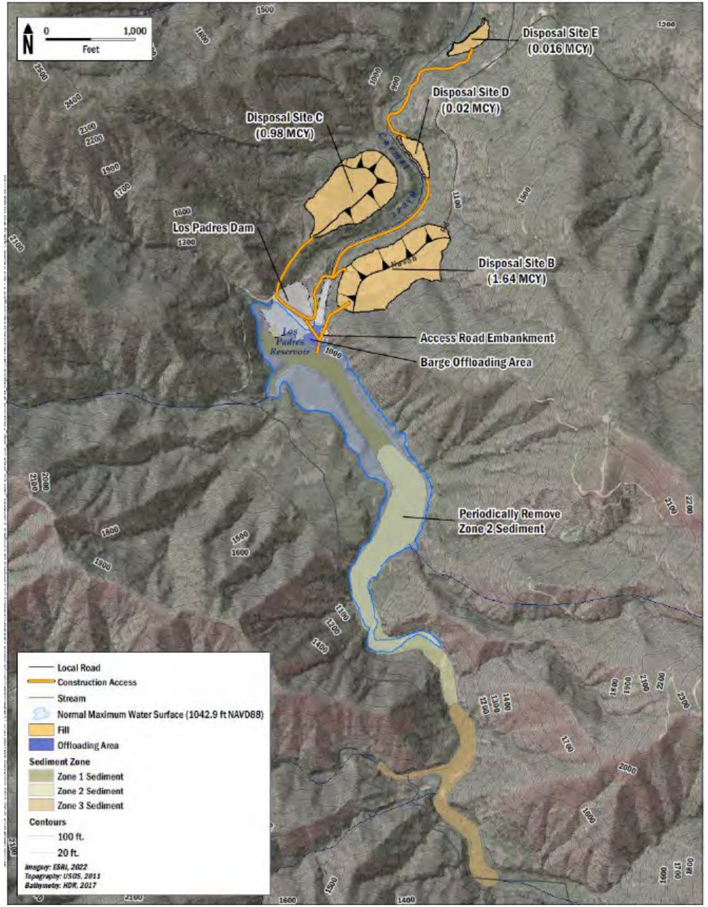
Alternatives Development TM – Alternative 4

RECOVER STORAGE CAPACITY WITH EXCAVATION

Alternative 4 – Recover Storage Capacity with Excavation

- Periodic dredging to <u>maintain</u> or recover storage
  - 4a - removal every 5 years
  - 4b - removal every 10 years
- Disposal at Sites B and C
- Future dredging potentially reaching Zone 3 for placement at Sites D and E
- Fish passage improvements



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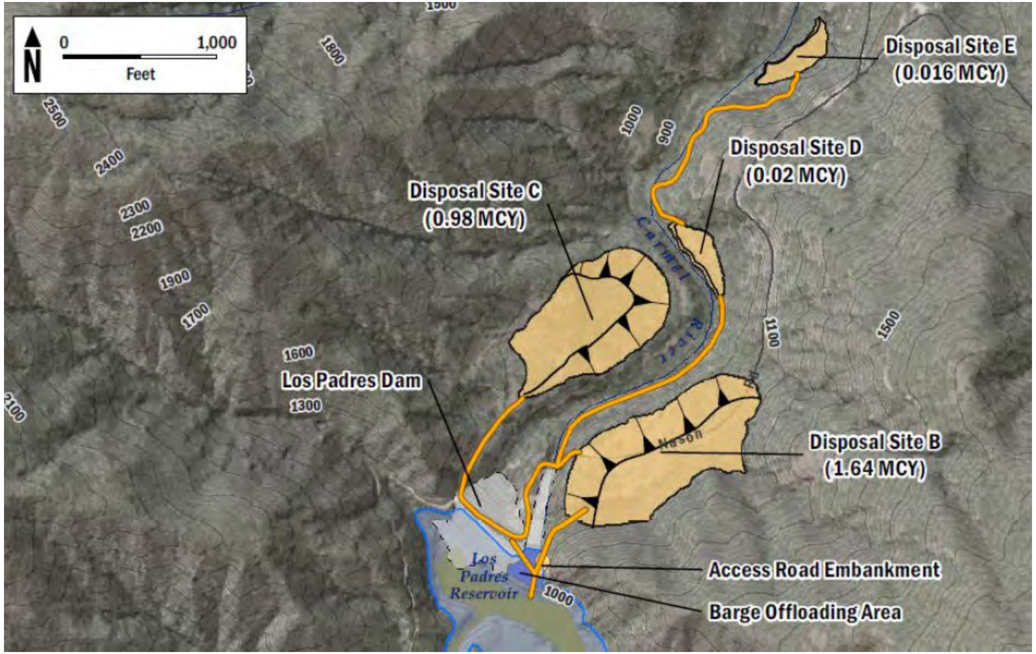
Recover Storage Capacity with Excavation (Alt. 4) Access Improvements

- Same as Alt. 3, Storage Expansion & Dredging
  - Public road improvements
  - Spillway bridge
  - Ramp to reservoir
  - Disposal Sites B & C from dam
  - Disposal Sites D & E along river (maybe)



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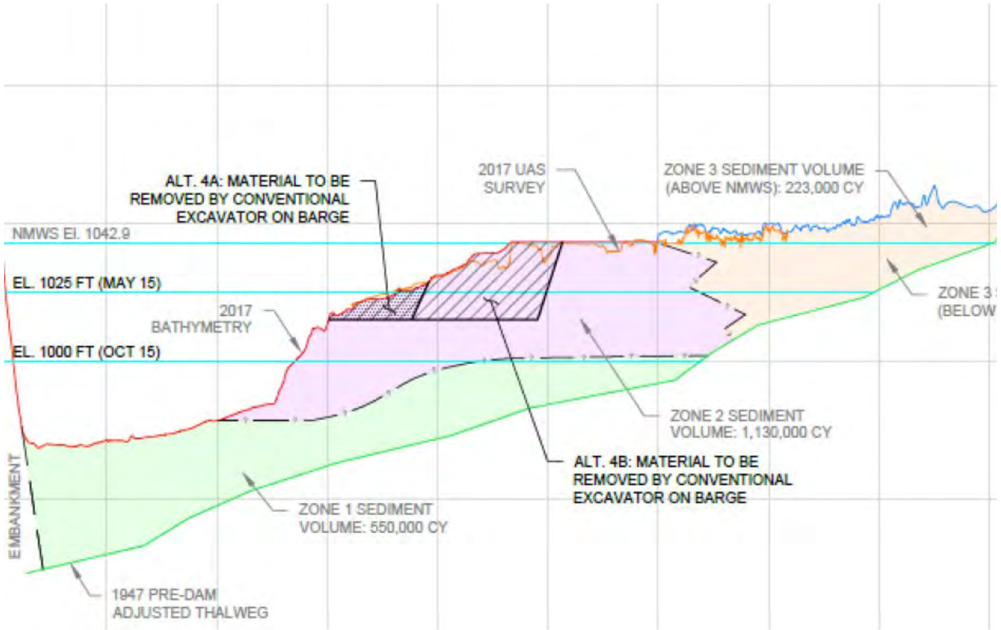
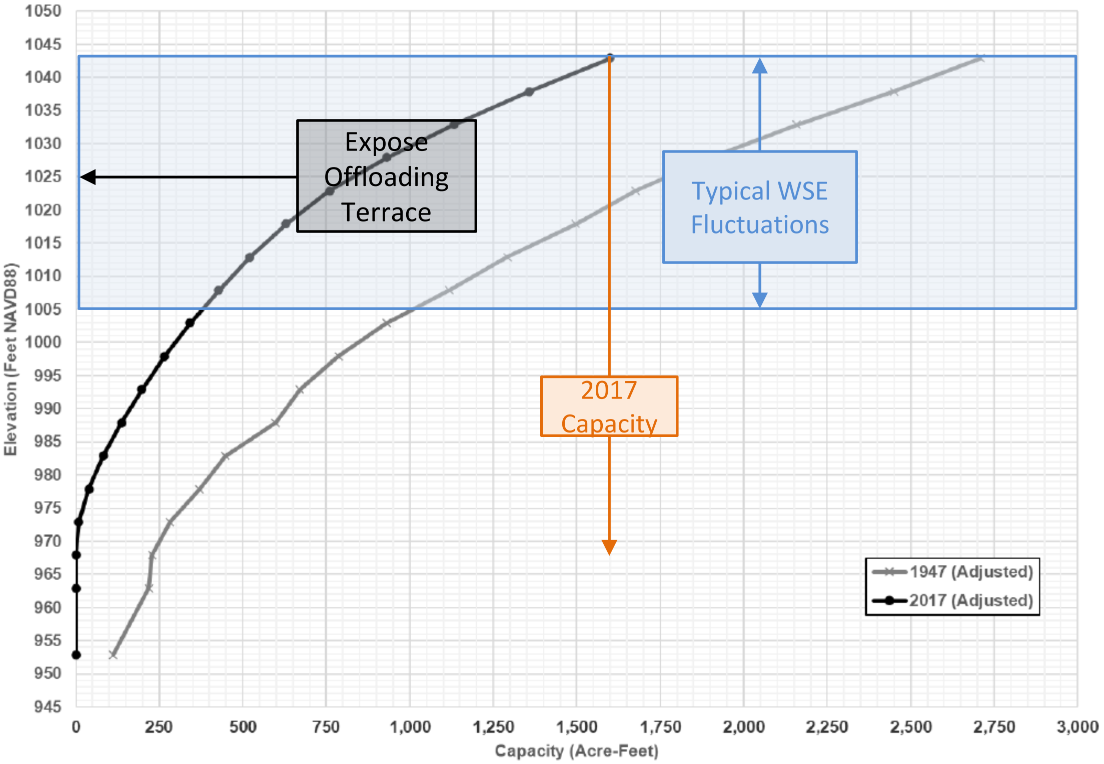
Recover Storage Capacity with Excavation (Alt. 4) Sediment Removal

- Barge-mounted excavator
  - Access over dewatered reservoir not a practical recurring action
- Maintain current capacity
  - 4a: remove 90 AF every 5 years
  - 4b: remove 180 AF every 10 years
- Can not initially access Zone 3 coarser sediment
  - Sediment will fill in between bouts of removal



Recover Storage Capacity with Excavation (Alt. 4) Sediment Removal



- Each removal event (prior to May 15)
  - Access improvements
  - Prepare Disposal Sites B & C
  - Lower reservoir to 1,025 feet to expose offloading area

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Recover Storage Capacity with Excavation (Alt. 4) Sediment Removal

- Each removal event (May 15-Oct 15)
  - Prep offloading area
  - Assemble flexi-float and excavator on barge
  - Construct access to Disposal Sites D & E (if needed)
  - Remove sediment
    - 4a: 90 AF (1.5 months)
    - 4b: 290 AF (3 months)
  - Flexible schedule

Recover Storage Capacity with Excavation (Alt. 4)
Hauling & Sediment Disposal

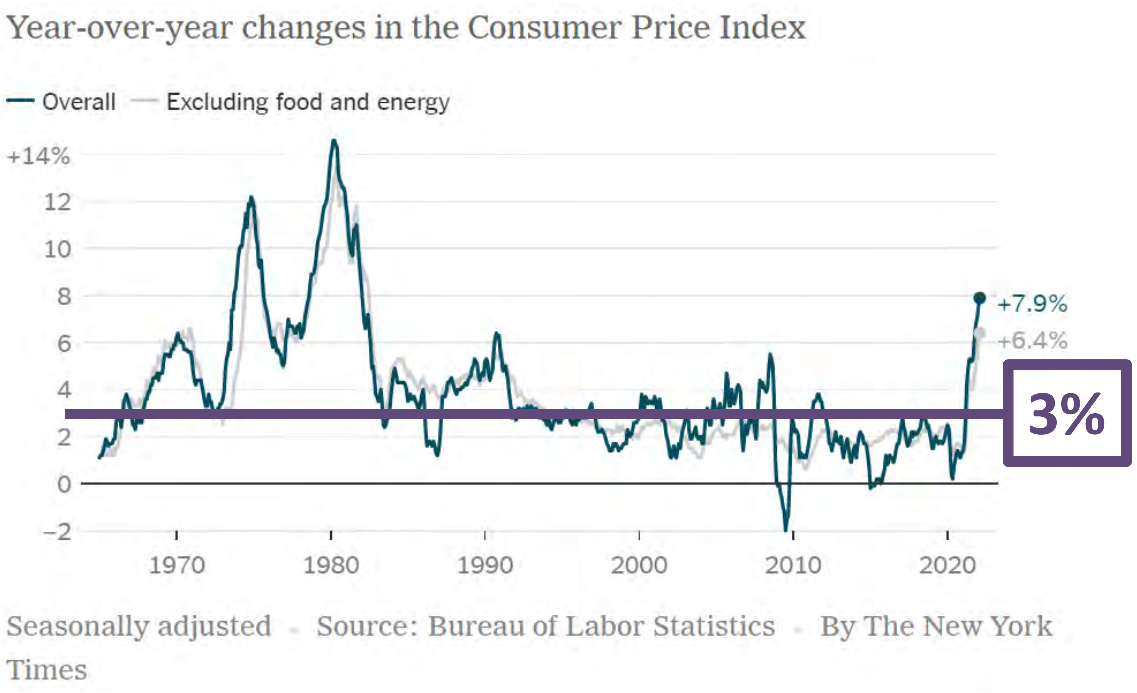
- Primary disposal at Sites B & C
- Subsequent bouts of sediment removal may access Zone 3 sediment which could be placed at Sites D and E
- Repeat approximately every 5 or 10 years
- Managed adaptively

Recover Storage Capacity with Excavation (Alt. 4) Cost and O&M

- Alt. 4b (10-year recurrence) Cost
  - $14M (one removal event)
  - $196M over 50-year planning horizon (6 recurrences)
  - 3% annual escalation
  - Up to an additional $82M for fish passage
- O&M
  - Operations plan during design to define monitoring design and procedures & timing of sediment removal
    - Manage adaptively & following episodic events
  - Increase O&M budget by $80K
  - Fish passage O&M up to $780K

Recover Storage Capacity with Excavation (Alt. 4) Uncertainties

- Long-term rate of cost escalation & cost of future, recurring sediment removal
- Sediment dry-time and strength
- Typical design & construction uncertainties



Recover Storage Capacity with Excavation (Alt. 4) Advantages & Disadvantages

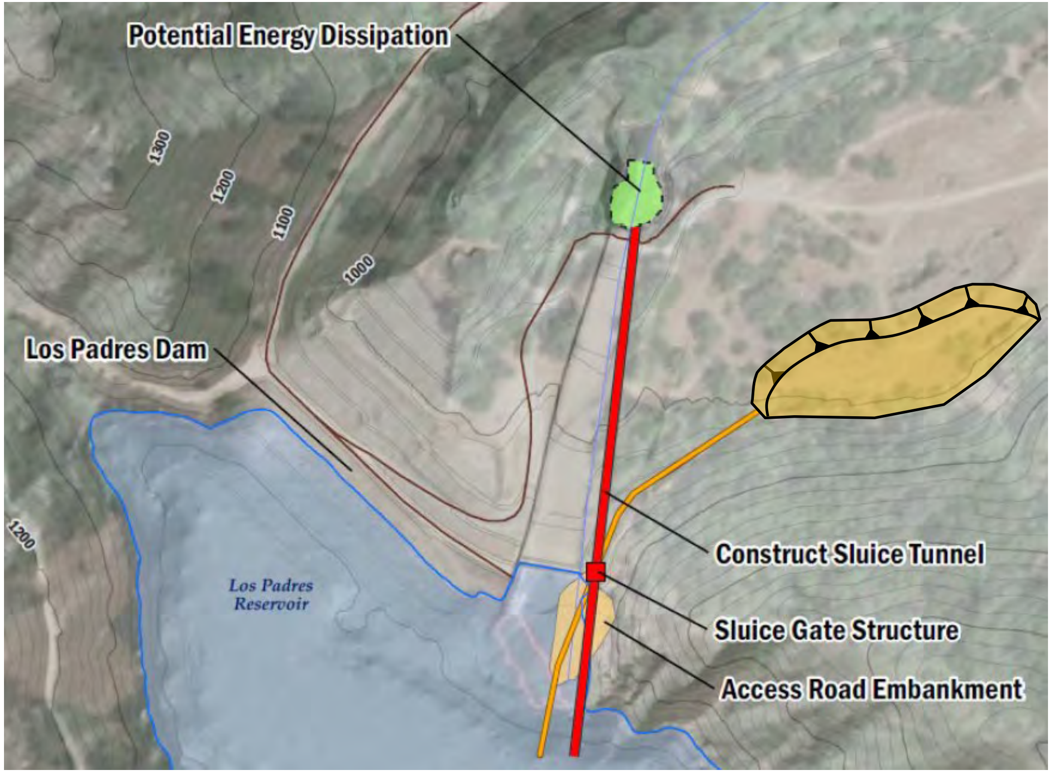
- Advantages
  - Maintains water rights and downstream summer release
  - Could be managed adaptively to respond to episodic deposition or recover more storage
- Disadvantages
  - Highest cost and would continue to accrue
  - Little or no geomorphic benefit downstream
  - Managed fish passage and reservoir effects on steelhead and ecosystem

Alternatives Development TM – Alternative 5

RECOVER STORAGE CAPACITY WITH SLUICE TUNNEL

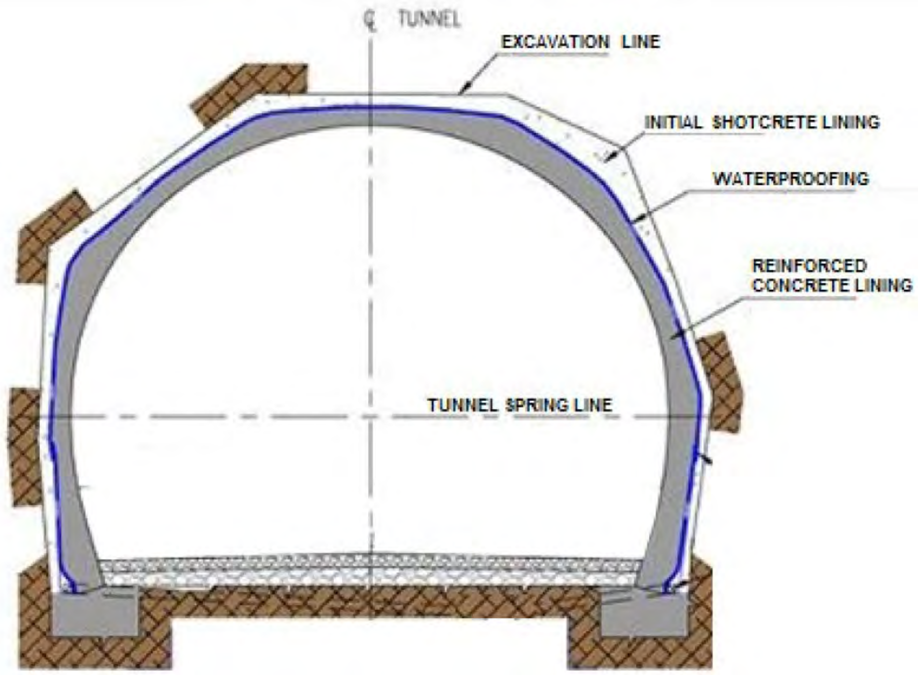
Alternative 5 – Recover Storage Capacity with Sluice Tunnel

- Tunnel through eastern abutment
  - Flush, then sluice, sediment during high flow
- Public road improvements
- Disposal of tunnel debris at Site B
- Fish passage improvements



Recover Storage Capacity with Sluice Tunnel (Alt. 5)

- 900 feet long
- 3.54% slope
- 15 feet wide to pass 5-year flood (3,200 cfs)
- Reinforced concrete liner
- Vertical gate shaft



Recover Storage Capacity with Sluice Tunnel (Alt. 5)
Sluicing Concept

- Sediment evacuation under full drawdown conditions
  - Flushing or sluicing
  - No functional difference
- Sluicing duration and interruption to normal operations minimized with careful forecasting and management
- Shorter duration of higher flows (sediment naturally moving) carry proportionally more sediment than longer durations of lower flows
- Design studies and O&M manual would outline one approach to sediment management
- Adaptation based on operator experience would be needed to optimize procedures

Recover Storage Capacity with Sluice Tunnel (Alt. 5) Example

Recover Storage Capacity with Sluice Tunnel (Alt. 5) Example

Streamflow

Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Example

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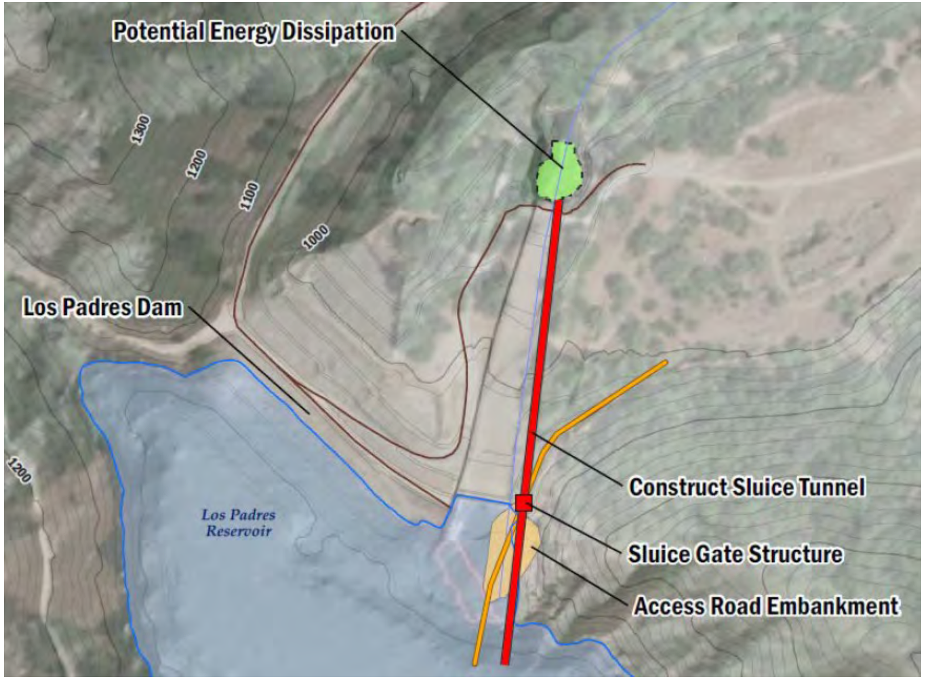
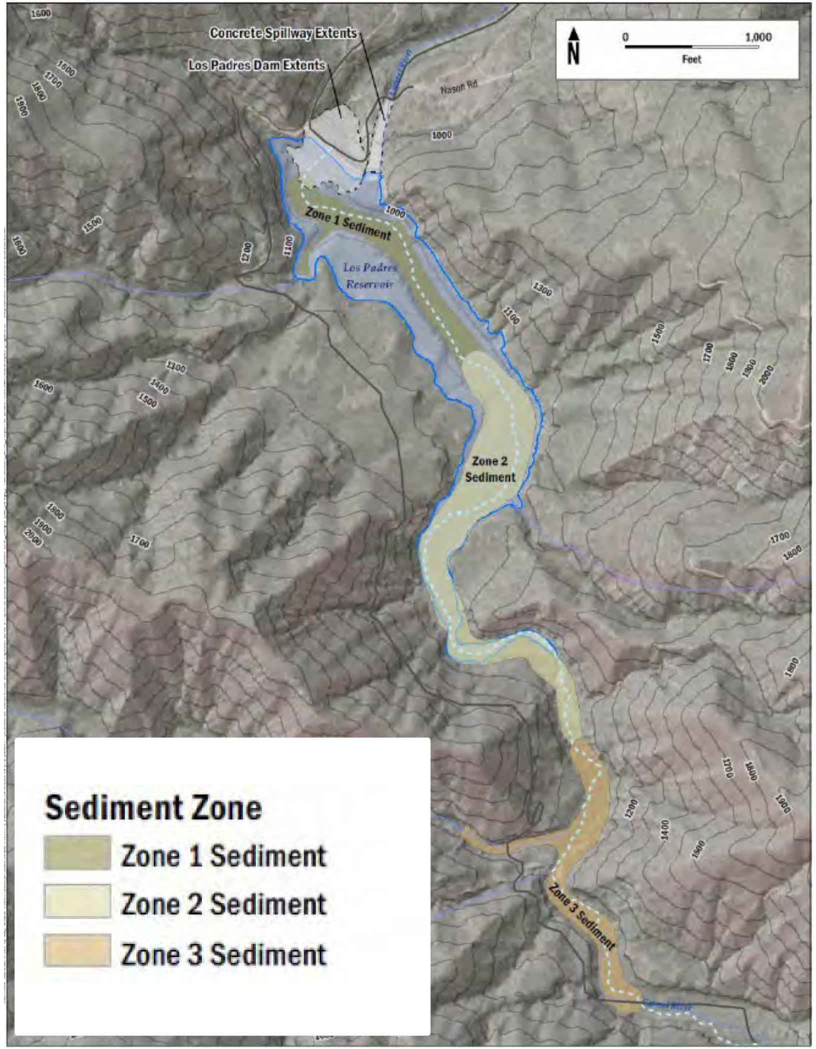
Recover Storage Capacity with Sluice Tunnel (Alt. 5)





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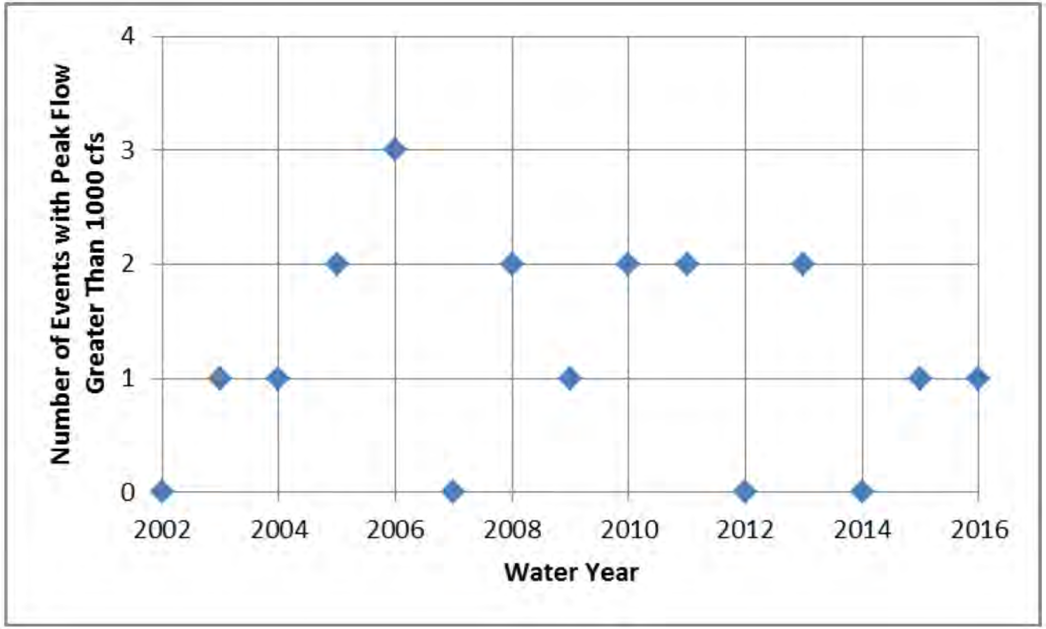
Recover Storage Capacity with Sluice Tunnel (Alt. 5)

- >1,000 cfs flushing flows most years
- With Zone 1 and Zone 2 sediment flushed
  - Reservoir capacity up to 2,600 AF
  - 6.5 days to refill with 200 cfs inflow
- Less frequent or shorter sluicing to maintain capacity



Recover Storage Capacity with Sluice Tunnel (Alt. 5)

- Drilling and blast excavation methods
  - Drill holes, load explosives & detonate
  - Ventilate, remove blasted & loosened rock
  - Install concrete lining

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Recover Storage Capacity with Sluice Tunnel (Alt. 5)

- Year 1
  - Access improvements & prep Disposal Site B
  - Construct sluice gate shaft and downstream portion of tunnel
- Year 2
  - Empty reservoir completely with diversion, dewatering, and treatment systems
  - Complete upstream portion of tunnel

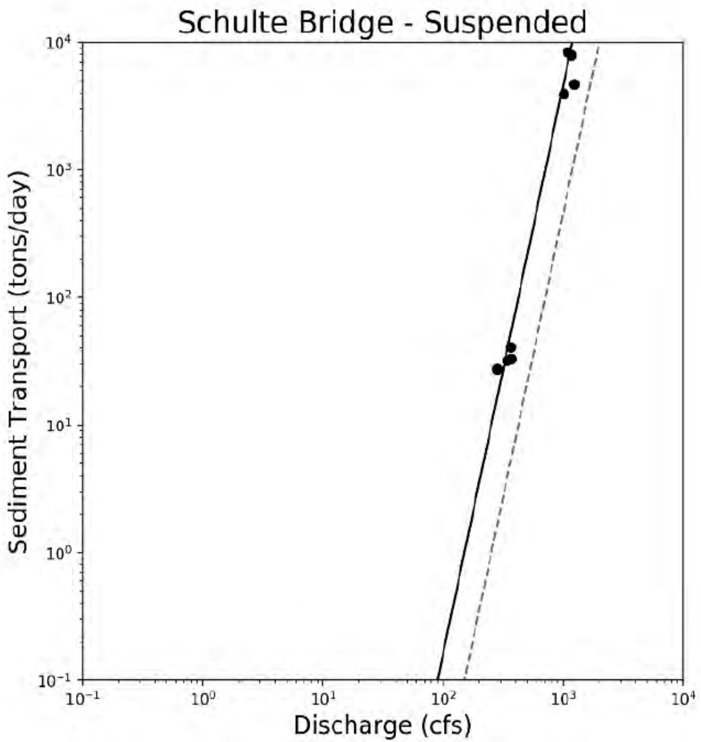
Recover Storage Capacity with Sluice Tunnel (Alt. 5)
Cost and O&M

- Cost
  - $60M
  - Up to $82M for fish passage
- O&M
  - Operations plan during design to define monitoring design, procedures & timing
    - Manage adaptively & operate <u>during</u> episodic events
  - Increase O&M budget by $50K
  - Fish passage O&M up to $780K

Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Uncertainties

- Impact on steelhead population and feasibility of approvals and permitting
- Quantity of coarse sediment entrained in sluice tunnel
  - Need to mitigate flood risk associated with restoring annual bedload sediment transport
- Update dam based on revised PMF
- Coordination with proposed fish passage improvements
- Typical design & construction uncertainties



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Similarities and differentiators among alternatives

ALTERNATIVES COMPARISON

Alternatives Construction Cost Comparison

Alternative No.	Alternative Name	Alternative OPCC: Non-sediment OPCC	Alternative OPCC: Sediment Removal OPCC	Fish Passage OPCC	Total
1	No Sediment Action	—	—	$82,100,000	$82,100,000
2	Dam and Sediment Removal	$41,910,000	$52,760,000	—	$94,670,000
3	Storage Expansion and Dredging	$30,430,000	$69,520,000	$82,100,000	$182,050,000
4	Recover Storage Capacity with Excavation (50-year total)	—	$195,720,000	$82,100,000	$277,820,000
5	Recover Storage Capacity with Sluice Tunnel	—	$60,380,000	$82,100,000	$142,480,000

- Recurring excavation has highest cost which would continue to escalate and accrue, and does not convey comparable benefits

Alternatives Sustainability Comparison

1. No action kicks the can down the road
2. Dam removal eliminates long-term O&M and relies on restored natural processes
3. Storage expansion and/or dredging resets (at least) the clock
4. Recurring excavation is least sustainable action alternative
5. Sluice tunnel provides enduring solution but with ongoing O&M

Alternative No.	Alternative Name	Total
1	No Sediment Action	$82,100,000
2	Dam and Sediment Removal	$94,670,000
3	Storage Expansion and Dredging	$182,050,000
4	Recover Storage Capacity with Excavation (50-year total)	$277,820,000
5	Recover Storage Capacity with Sluice Tunnel	$142,480,000

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Alternatives Comparison
Cost of Sediment Management

- Recurring removal (Alt. 4 Recover Storage Capacity with Excavation) is expensive

Alternative No.	Alternative Name	Sediment Removal OPCC*	Duration of Sediment Benefit
2	Dam and Sediment Removal	$52,760,000	Forever
3	Storage Expansion and Dredging	$69,520,000	~ 100 years
4	Recover Storage Capacity with Excavation (50-year total)	$195,720,000	~ 50 years
5	Recover Storage Capacity with Sluice Tunnel	$60,380,000	≥ 50 years

* Excludes fish passage a non-sediment removal costs

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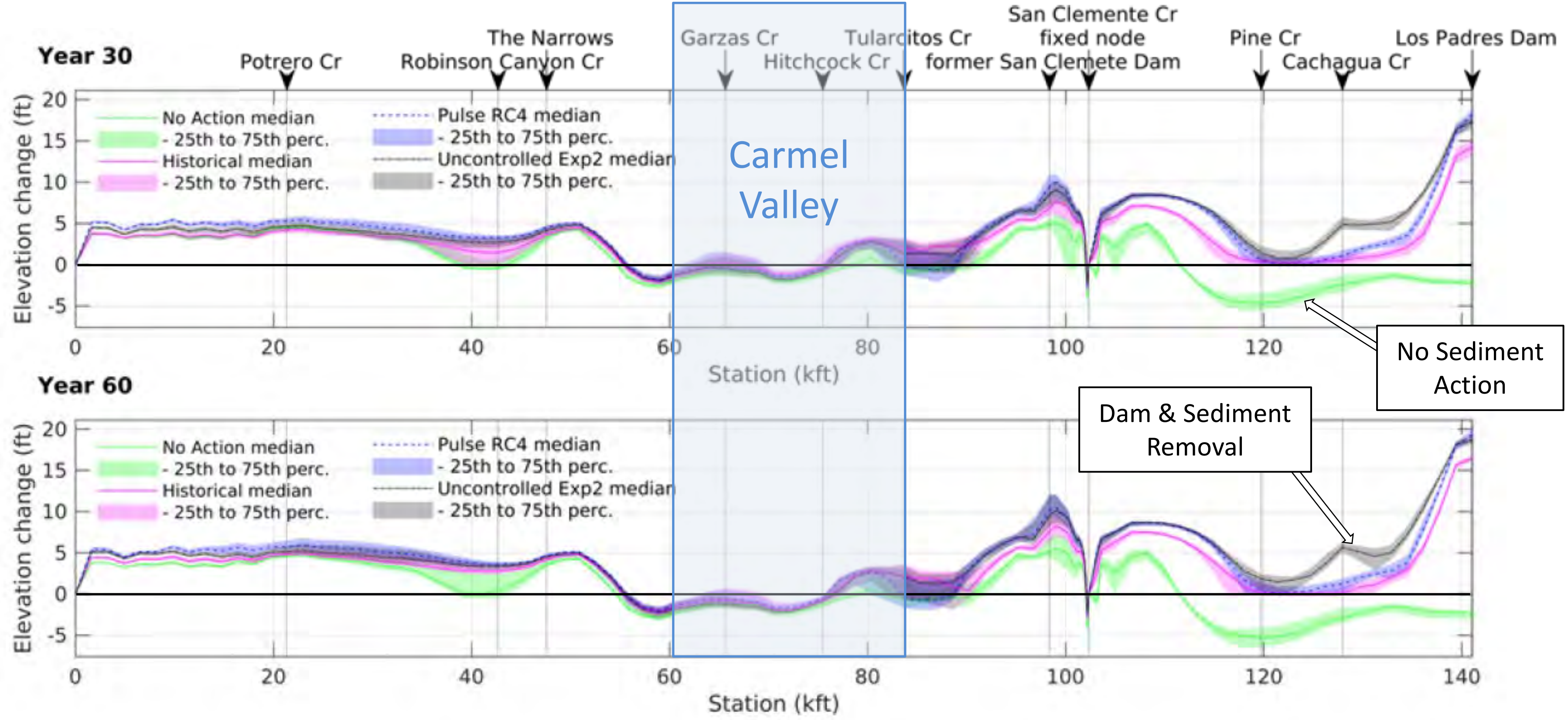
Alternatives Geomorphic & Flood Risk Comparison

Bed elevation change for wet hydrographs



Alternatives Storage & Summer Release Comparison

No.	Alternative Name	Change in Storage	Change in Dry-Season (6 months) Release
1	No Sediment Action	-1,601 AF gradually over ~100 years	-4.4 cfs (-8.8 AF/day) gradually over ~100 years
2	Dam and Sediment Removal	-1,601 AF	-4.4 cfs (-8.8 AF/day)
3	Storage Expansion and Dredging	+625 AF with gates +1,120 AF with dredging +1,817 AF with both	+1.7 cfs (+3.4 AF/day) with gates +3.1 cfs (+6.1 AF/day) with dredging +5.0 cfs (+10.0 AF/day) with both
4	Recover Storage Capacity with Excavation (50-year total)	0 (assumes no change)	0 (assumes no change)
5	Recover Storage Capacity with Sluice Tunnel	+1,000 AF (potentially)	+2.8 cfs (+5.5 AF/day) (potentially)

Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage design confidence; no upstream juvenile passage; migration through reservoir
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration
Alternative 3 Storage Expansion and Dredging	+ / - Potential for introduction of coarse sediment uncertain	+ / + More wetted summer habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir
Alternative 4 Recover Storage Capacity with Excavation	- / + Limited or no transport of bedload from upstream of LPD	+ / - Maintains current storage and summer flow augmentation	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / + Managed passage; no upstream juvenile passage; migration through reservoir
Alternative 5 Recover Storage Capacity with Sluice Tunnel	+ / - Potential for bedload transport from upstream of LPD	+ / - More wetted summer habitat but considerable uncertainty	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir

Legend
+ / + Best
+ / - Better
- / + Worse
- / - Worst

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Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage design confidence; no upstream juvenile passage; migration through reservoir
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration
Alternative 3 Storage Expansion and Dredging	+ / - Potential for introduction of coarse sediment uncertain	+ / + More wetted summer habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir
Alternative 5 Recover Storage Capacity with Sluice Tunnel	+ / - Potential for bedload transport from upstream of LPD	+ / - More wetted summer habitat but considerable uncertainty	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir

Legend
+ / + Best
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- / + Worse
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Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage design confidence; no upstream juvenile passage; migration through reservoir
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration
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Legend
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Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage design confidence; no upstream juvenile passage; migration through reservoir
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Alternative 3 Storage Expansion and Dredging	+ / - Potential for introduction of coarse sediment uncertain	+ / + More wetted summer habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir
Alternative 5 Recover Storage Capacity with Sluice Tunnel*	+ / + Bedload transport from upstream of LPD	+ / + More wetted summer habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir

*Hypotheitical ranking assuming that all benefits assumed for the sluice tunnel are confirmed.

Legend
+ / + Best
+ / - Better
- / + Worse
- / - Worst

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Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage
Alternative 1 No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage design confidence; no upstream juvenile passage; migration through reservoir
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration
Alternative 3 Storage Expansion and Dredging	+ / - Potential for introduction of coarse sediment uncertain	+ / + More wetted summer habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir
Alternative 4 Recover Storage Capacity with Excavation	- / + Limited or no transport of bedload from upstream of LPD	+ / - Maintains current storage and summer flow augmentation	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / + Managed passage; no upstream juvenile passage; migration through reservoir
Alternative 5 Recover Storage Capacity with Sluice Tunnel	+ / - Potential for bedload transport from upstream of LPD	+ / - More wetted summer habitat but considerable uncertainty	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir

Legend
+ / + Best
+ / - Better
- / + Worse
- / - Worst

Confirm understanding & high-priority alternatives, document decisions

DISCUSS ALTERNATIVES

Discussion

- Questions & clarifications?

Consider Uncertainty

- Does uncertainty for multiple alternatives need to be resolved prior to a decision?
  - Decision delayed for further study of multiple alternatives

    - or -

- Can a decision be made despite uncertainty?
  - Additional design studies focus on the preferred alternative

Consider Uncertainty

- Does sluice tunnel warrant additional study?
  - Fine sediment transport model
  - Reservoir evacuation study
  - Mass balance calculations
  - Develop expectations regarding operations and effects
- For dam removal or sluice tunnel, flood model?
- For dam removal or declining storage, engage Water Board regarding water rights?
- For dam-in alternatives:
  - Geotechnical investigation?
  - Engage DSOD regarding implications of PMF for fish passage or other modifications?

Consider Decisions

- Identify most favorable alternatives & actions
- Eliminate unfavorable for greater focus
  - AECOM Team recommends eliminating Alt. 4, Recover Storage Capacity with Excavation
  - Elimination of Alt. 5, Recover Storage Capacity with Sluice Tunnel, may reduce time until a decision
    - If retained, additional study likely needed before decision
  - Alt. 3, Storage Expansion & Dredging
    - Eliminate spillway gates for simplified operations
    - Eliminate or reduce dredging for lower-cost alternative to moderately increase storage

Next Steps

CONCLUSION

Confirm Meeting Outcomes

- Highest priority alternatives and actions
- Alternatives and actions eliminated
- Key uncertainties
- TRC guidance for draft final report
  - Written comments on current TM due May 10

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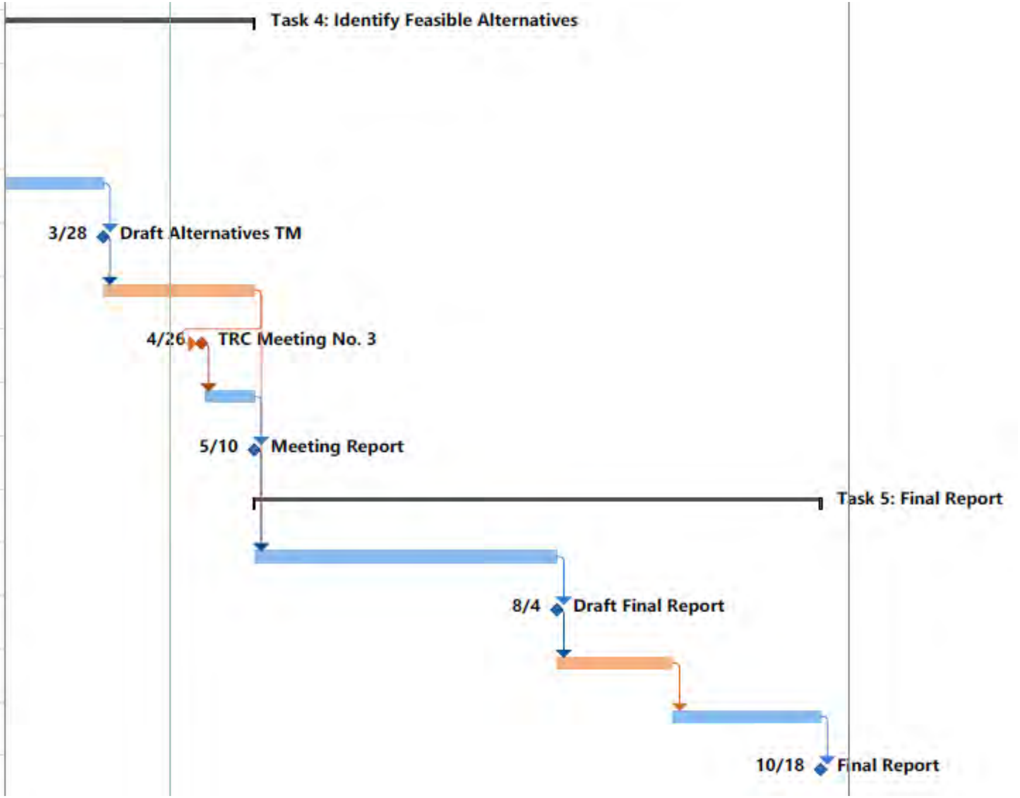
Study Schedule

Task 4: Identify Feasible Alternatives	**128 days**	**Tue 5/10/22**
TRC Meeting No. 2B	0 days	Thu 10/28/21
Meeting Report	0 days	Thu 11/11/21
Task 4-2: Alternatives Development	97 days	Mon 3/28/22
Draft Alternatives TM	0 days	Mon 3/28/22
TRC Review Alternatives TM	31 days	Tue 5/10/22
TRC Meeting No. 3	0 days	Tue 4/26/22
Prepare Meeting Report	10 days	Tue 5/10/22
Meeting Report	0 days	Tue 5/10/22
Task 5: Final Report	**112 days**	**Tue 10/18/22**
Prepare Draft Final Report	60 days	Thu 8/4/22
Draft Final Report	0 days	Thu 8/4/22
TRC Review of Draft Final Report	22 days	Tue 9/6/22
Prepare Final Report	30 days	Tue 10/18/22
Final Report	0 days	Tue 10/18/22



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Future Milestones

- May 10, 2022, comments on Draft Alternatives Development TM
- August 4, 2022: Draft Alternatives Study Final Report
  - Comments due September 6, 2022
- October 18, 2022: Alternatives Study Final Report

References

- NMFS (National Marine Fisheries Service). 2017. Memorandum of Agreement between California American Water, National Marine Fisheries Service, and the Conservancy 2017.
- HDR (HDR Engineering, Inc.), R2 Resources, and AECOM. 2021. Fish Passage Feasibility Report (Draft), Los Padres Dam Fish Passage Study, Monterey, California. Prepared for Monterey Peninsula Water Management District. August.

Attachment B - Cost Clarification

From: Stead, Jon
To: "Mandy Ingham - NOAA Federal"; "David Crowder"; "Chad_Mitcham@fws.gov"; "Brian Cluer - NOAA Federal"; "Michniuk, Dennis@Wildlife"; "Joel Casagrande"; Beverly Chaney (Beverly@mpwmd.net); "Larry Hampson"; "Ian Crooks"; "Atkinson, Kristine@Wildlife"; "Aman Gonzalez"; "Thomas Christensen"; Gard, Mark@Wildlife; Christopher Cook; "Jonathan Lear"; "Cory Hamilton"; "Tim P O"Halloran"
Cc: Mike Garello <Mike.Garello@hdrinc.com> ; "Dave Stoldt"; Gentzler, Seth; Collins, Megan (Megan.Collins@aecom.com)
Subject: Los Padres Alternatives Study TRC Meeting [cost clarification]
Date: Wednesday, April 27, 2022 3:43:00 PM
Attachments: image001.png
2022.04.26 LP Alts TRC M3 pres FINAL.pdf

Hi Everyone,

Thank you for your participation and helpful feedback during the workshop yesterday. The presentation is attached for your reference and I wanted to take this opportunity to clarify a statement I made during the meeting that you may have found confusing.

During the workshop Mark asked a couple of questions about the use of a sluice tunnel in combination with dam removal as a method of reducing costs associated with sediment removal prior to dam removal. In response to one of Mark's questions, I mentioned that the cost of constructing the sluice tunnel is near the cost of excavating the fine sediment prior to dam removal. Given that the first bullet on slide 65 lists "Likelihood of approval to release accumulated sediment (could reduce cost)" as an uncertainty associated with dam removal Alternative 2, this may have confused the issue.

Currently, Alternative 2 includes dry excavation of Zones 1 and 2 sediment prior to dam removal. Zone 3 would be left in place to move downstream following removal of the dam. Another approach would be to excavate only the minimum amount of sediment necessary to access and remove the dam, and leave a large portion of the Zone 1 and 2 fine sediment in place to move downstream after dam removal, as is currently proposed for Zone 3 sediment. This approach could reduce the cost of Alternative 2 substantially but would expose the accumulated sediment to transport throughout the full range of streamflows that occur after dam removal (unless grading is used to excavate and place some volume of material strategically). Maybe there would be a significant storm soon after dam removal that would move a lot of the sediment, but if not, it could erode gradually and result in a prolonged water quality impact at lower flows.

Another approach, similar to proposals in play for Searsville and Matilija dam removal projects, is to construct a mechanism (such as our Los Padres sluice tunnel) that can be prepared in advance of dam removal and then operated during a major runoff event to evacuate sediment from the reservoir prior to initiating other aspects of the dam removal construction project. In some cases analysis has shown that this would greatly reduce the cost of sediment management during a specific dam removal project. However, every site is different and has its own considerations and constraints.

Los Padres is an earthen dam while Matilija and Searsville are concrete dams. Earthen dams tend to be much wider than concrete dams, and the sluice tunnel conceptualized for Los Padres would be 900 feet long. The tunnels through the concrete dam structures proposed at Searsville and Matilija are closer to 40-50 feet in length. The sluice tunnel OPCC at Los Padres is $60M while the cost of the proposed sediment excavation prior to dam removal is $53M. Due to its length, it may be that there is no real savings associated with constructing the sluice tunnel to remove sediment prior to dam removal at Los Padres. While there would be a savings if more sediment were left in place to move downstream after dam removal, that approach may not allow for a controlled release of sediment during high flows and instead the impacts could occur for over a longer duration. Although there has been no final answer regarding fine sediment release, we tend to think that it is more likely to be accepted if it is a short duration during high flows than if it is a long duration over variable flows.

In summary, the cost of dam removal could be reduced if more fine sediment was left in place to move downstream after dam removal but constructing an engineered feature like the sluice tunnel to allow for controlled sediment release prior to dam removal may not significantly reduce the cost of dam removal at Los Padres, at least based on what we know so far. I hope this clarifies some of the statements I made about this yesterday.

We will follow up with meeting notes.

Kind Regards,

Jonathan Stead
Senior Project Ecologist
Environmental Planning and Permitting
1-510-874-3058
jon.stead@aecom.com
he/him

AECOM
300 Lakeside Drive, Suite 400, Oakland, California 94612
T 1-510-893-3600 F 1-510-874-3268

Attachment C - Water Rights Summary

Cal-Am and MPWMD Carmel River Water Rights

From Los Padres Dam and Reservoir Alternatives and Sediment Management Study, Study Preparation Technical Memorandum, AECOM 2017

Cal-Am holds riparian, pre-1914 appropriative, and post-1914 appropriative water rights; and the MPWMD holds post-1914 appropriative water rights. Riparian water rights allow landowners whose parcels physically touch a water source to have a right to use water from that source as long as it has not been appropriated by another party. Appropriative water rights allow for water diversion at one point and beneficial use at a separate point. These rights do not require that the water right holder owns land adjacent to the water source. Pre-1914 water rights are appropriative rights acquired before the effective date of the Water Commissions Act (December 19, 1914). The Water Commissions Act formalized water appropriation in California and centralized appropriative water rights records under the SWRCB. Appropriative water rights issued after the creation of the Water Commissions Act are called post-1914 water rights. Obtaining post-1914 water rights requires the application for a permit from the SWRCB, and applicants must provide information on where and how the water will be used, and when and how it will be diverted.

The following list, as well as Table 2-2, summarizes Cal-Am's water rights in the Carmel River Watershed:

Pre-1914 and Riparian Rights: Cal-Am has rights to 1,137 AFY from pre-1914 rights and 60 AFY from riparian rights. These rights are not subject to meeting instream flow requirements.

1985: SWRCB licensed Cal-Am (License 11866, Permit 7130A) to divert up to 3,030 AFY to Los Padres Reservoir and San Clemente Reservoir between October 1 of each year through May 31 of the following year for municipal, domestic, industrial, and recreational use. License 11866 requires Cal-Am to release and maintain a flow of greater than or equal to 5 cfs in the Carmel River channel directly below the outlet structure of the Los Padres Dam at all times during which water is being stored under this license. There are no instream flow requirements for downstream withdrawals under this license.

1995: SWRCB issued Order WR 95-10 to settle a number of complaints that had been filed against Cal-Am for its diversion of water from the Carmel River.

1. This order states that Cal-Am has a legal right to 3,376 AFY total in the Carmel River Watershed (1,137 AFY from pre-1914 appropriative rights, 60 AFY from riparian rights, and 2,179 AFY from License 11866). The 2,179 AFY was a reduction in Cal-Am's original right to divert 3,030 AFY from the Carmel River under License 11866. This reduction was due to siltation at Los Padres Reservoir.
2. This order further states that Cal-Am's actual total annual diversion is equal to 14,106 AFY.
3. This order mandates that Cal-Am find an alternative supply for 10,730 AFY of water, and pending the implementation of an alternative water supply, limit its diversions from Carmel Valley to 11,284.8 AFY.

1998: SWRCB issued Order WR 98-04, which amended WR 95-10. Modifications to the original order included requirements for Cal-Am to maximize production from the Seaside aquifer, minimize diversions from the Seaside aquifer under certain flow conditions, satisfy water demands by extracting water from its most downstream wells, conduct feasibility studies on shifting water deliveries to different existing sources, provide monthly reports on water diversion and pumping, and provide quarterly water budget reports.

2009: SWRCB issued a cease-and-desist order (Order WR 2009-060) to Cal-Am that established a compliance timeline for cessation of Cal-Am's unlawful diversions from the Carmel River by December 31, 2016. This order was a follow-up to WR 95-10, and required Cal-Am to reduce its total diversion to 3,376 AFY and limit diversion to Los Padres Reservoir to 2,179 AFY. Conditions 1 through 3 of the order stated the following:

1. "Cal-Am shall diligently implement actions to terminate its unlawful diversions from the Carmel River and shall terminate all unlawful diversions from the river no later than December 31, 2016."

2. "Cal-Am shall not divert water from the Carmel River for new service connections or for any increased use of water at existing service addresses resulting from a change in zoning or use…"

3. Cal-Am shall adjust its diversions from the Carmel River in accordance with the outlined minimal reductions.

2013: SWRCB issued Permit 21330 to Cal-Am to divert up to 1,488 AFY from the Carmel River at San Clemente Reservoir, and at 26 wells that draw from the Carmel River Watershed.

2016: SWRCB issued Order WR 2016-0016, which amended WR 2009-060. WR 2016-0016 extended the deadline for Cal-Am to terminate unlawful diversion from the Carmel River to December 31, 2021. WR 2016-0016 also allows for an ongoing diversion level as long as specified progress toward alternative supplies is met, but sharply drops allowable diversions should the progress toward these supplies slip.

Cal-Am is planning, for the long term, to replace the 10,730 AFY diverted from the Carmel Valley Aquifer with water produced via desalination, initially with the project identified as the Coastal Water Project (Cal-Am et al. 2009), and now with the MPWSP and others (SWRCB Order 2016-0016).

The following list, as well as Table 2-2, summarizes MPWMD's water rights in the Carmel River Watershed:

1995: SWRCB issued Decision Number 1632 and Permit 20808 to the MPWMD for 24,000 AFY for the New Los Padres Dam, which was proposed to be about 1,800 feet downstream of the existing Los Padres Dam. This water right contained minimum instream flow requirements for flow below the New Los Padres Dam, at the Carmel River Narrows and Lagoon, and at a new San Clemente Dam. In 1995, a public vote failed on a bond issue to finance the New Los Padres Dam, and the dam was never built.

1998: SWRCB issued Order WR 98-04, which amended Decision 1632. Modifications to the original decision included clarifying diversion periods for the New Los Padres Project, updating the construction start date, and limiting the total diversion of water in the Carmel River by Cal-Am and MPWMD combined to 16,000 AFY, or "such lesser amount identified in the Supplemental EIR [Environmental Impact Report] on the Carmel River Dam as annual beneficial use requirements associated with total project yield or the Cal-Am production limit."

2007: Permit 20808 was subsequently split into three water rights permits: 20808A, 20808B, and 20808C. All three permits are due for relicensing by the SWRCB by 2020. Diversion rights associated with Permit 20808 are junior to all other rights along the Carmel River. The 16,000 AFY diversion limit on Cal-Am and MPWMD diversions established in WR 98-04 were restated in these permits. Although Cal-Am and MPWMD's combined water rights exceed 16,000 AFY (see Table 2-2), the instream flow requirements applied to License 11866 and Permits 20808A, 20808B, and 20808C, and the instantaneous diversion rate requirements in Permits 20808A, 20808B, and 20808C, will effectively restrict total annual diversions to less than 16,000 AFY.

Permits 20808A and 20808C are jointly held between MPWMD and Cal-Am for diversion of excess winter season flows to storage in the Seaside Groundwater Basin (ASR). Permit 20808A allows for diversion of up to 2,426 AFY from the Carmel River at San Clemente Reservoir, and at 26 wells that draw from the Carmel River Watershed. Permit 20808C allows for diversion of up to 2,900 AFY from the Carmel River Watershed.

Permit 20808B is held by MPWMD for up to 18,674 AFY.

Table 2-1. Cal-Am and MPWMD Water Rights in the Carmel River Watershed

California American Water (Cal-Am)	**Water Rights (AFY)**
Appropriative Right (Pre-1914)	1,137
Riparian Right	60
Appropriative Right (WR 95-10)	2,179
Appropriative Right (Permit 21330)	1,488
Monterey Peninsula Water Management District (MPWMD)	
Appropriative Right (Permit 20808A*)	2,426
Appropriative Right (Permit 20808B)	18,674
Appropriative Right (Permit 20808C*)	2,900
Total	**28,864**

Notes:

* These water rights are held jointly by Cal-Am and MPWMD.

AFY = acre-feet per year
Cal-Am = California American Water
MPWMD = Monterey Peninsula Water Management District

Meeting Record

Project:	Los Padres Dam and Reservoir Alternatives and Sediment Management Study
Subject:	Technical Review Committee Meeting No. 4 – Update Alternatives & Evaluation
Date:	Wednesday, December 14, 2022
Time	9:00 AM to noon
Location:	Virtual - MS Teams
Attendees:	Kristine Atkinson, CDFW David Boughton, NMFS Joel Casagrande, NMFS Thomas Christensen, MPWMD Christopher Cook, Cal-Am Ian Crooks, Cal-Am Mark Gard, CDFW Seth Gentzler, AECOM Aman Gonzalez, Cal-Am Cory Hamilton, MPWMD Maureen Hamilton, MPWMD Larry Hampson, MPWMD Mandy Ingham, NMFS Jonathan Lear, MPWMD Katie McLean, AECOM Tim O'Halloran, MPWMD Jon Stead, AECOM

Attachments

Attachment A - Meeting Presentation

Objective

Incorporate updated dam safety and steelhead information into alternatives analysis.

Format

Working meeting: presentation material will be used to facilitate open discussion, evaluation, and participation by all attendees.

Notes

The purpose of the meeting notes is to document questions raised, comments provided, action items, and decisions. The primary content of the meeting is outlined below (from the meeting agenda) and detailed in the attached presentation (Attachment A) and is not repeated in the notes.

1. Welcome
    a. Introductions

        Introductions were provided including for one new study participant, Maureen Hamilton, the new District Engineer with the MPWMD

2. Changes to address dam safety input
    a. Review of remaining alternatives with updates, including cost

Slides were presented summarizing alternatives from the Draft Final Report, with updates to alternatives 1 and 5 to address dam safety input

3. Effects of streamflow on steelhead production
David Boughten presented slides summarizing NOAA's quantitative analysis of effects of flow on steelhead production in the Carmel River.

<u>Main Points (Attachment A, slide 66 of 83):</u>

- Spring flow drives parr size, which affects density via self-thinning
- Summer flow drives bottleneck in capacity, via wetted area
- Self-thinning an important underlying process
- Different scenario methods give similar results on average (empirical vs BHM, bias-correction methods)
- Summer flow in Lower Valley has big effect due to large parr
- Dam removal improves headwater production but is offset by poorer production downstream due to lower summer flows
- Reservoir dredging and perfect CDO improve production relative to current situation, but so does unimpaired flow, mostly because these scenarios all have greater production in the Lower Valley
- Begs some questions about distribution of large parr, role of Estuary and Lower Valley habitat
- We focused on flow; scenarios have many other effects on fish

<u>Other Notes</u>

The analysis considers, if all other variables are held constant, how the flow effect on the steelhead population would differ (over last 25 years) under flow scenarios different from the observed.

Regarding continuous streamflow in 2019, the 2019 water year in the Carmel River watershed was wetter than some parts of California and was classified as extremely wet. For comparison, in 2017 there were 32 inches of rain and in 2019 there were 30.9 inches of rain.

Population probably saturated when there were 500 spawners counted, which represents about 1,000 in the river. Beyond that, additional spawners may not have resulted in increased productivity.

Spring flow was the best predictor of the size of parr at the end of summer. Summer flow was the best predictor of density (more summer flow was correlated with reduced densities), driven by self-thinning during the spring. Lower valley tends to

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have larger fish and lower densities. Spring flow was not very different between baseline (observed/current conditions) and dam removal.

Productivity is somewhat decoupled from streamflow, except for spring flow rate and maintaining some flow in summer to connect habitat.

Under the high infiltration scenario, in dry years dam removal scenario had lower summer median flow than the baseline. Dam removal's effect was most pronounced on summer median flow. This effect can be mitigated by reduced summer pumping/keeping the water table in the lower river high in the summer.

All future scenarios using the CRBHM (which assumes reduced pumping to CDO levels) showed at least 40 additional spawners per year. The only empirical scenario with a steelhead population response worse than the baseline was dam removal without reduced pumping.

4. Review of alternatives comparison with updates

   Slides were presented summarizing the alternatives comparisons in the Draft Final Report with updates for dam safety.

5. Discussion of potential changes to final report

   Based on recent expression of TRC sentiment and for reasons noted in slides, a decision was made to Move Alt. 5 (Recover Storage Capacity with Sluice Tunnel) to Section 4 (Alternatives Eliminated). T. Christensen added that residents of Cachagua would likely oppose Alt. 5.

   Based on recent expression of TRC sentiment and for reasons noted in slides, a conditional decision was made to move Alternative 1 (Fish Passage, No Sediment Action) to Section 4. Multiple NMFS staff expressed strong support for the change. A. Gonzales eventually agreed with the decision but was concerned that, given the considerable time (years – decades) it will take to select, permit, and finance a preferred alternative, the change might not reflect the status quo (interim fish passage improvements without sediment management in the reservoir) that will persist over the short-term. Others pointed out that with >$100M of dam safety and fish passage improvements and a presumed design life of >50 years, Alternative 1 does not reflect the status quo. It was agreed that the change would be made but that it would be qualified with thoughtful language regarding long- and short-term actions and the relevance of the alternatives in that context. The group also agreed that Alternative 1 may be used as a point of comparison in the future but that it does not need to be in Section 5 to perform that function.

6. Conclusion (11:40-12:00)
    a. Confirm meeting outcomes

       Meeting decisions were entered into the project's decision log as shown below.

No.	Date	Subject/ Feature	Reference	Decision
19	12/14/2022	Final Report	TRC M4	Move Alt. 5 (Recover Storage Capacity with Sluice Tunnel) to Section 4 (Alternatives Eliminated).
20	12/14/2022	Final Report	TRC M4	Move Alternative 1 (Fish Passage, No Sediment Action) to Section 4. Qualify with thoughtful language regarding long- and short-term actions and the relevance of the alternatives in that context.

    b. Next steps
       M. Ingham asked about public and tribal input, how the results of the study and the final report would be shared, and whether there would be any public engagement workshops. It was agreed that that is beyond the scope of the current meeting and would be discussed at another time.

Los Padres Dam and Reservoir Alternatives and Sediment Management Study

Technical Review Committee Meeting No. 4
Update Alternatives & Evaluation
Virtual via MS Teams

Wednesday, December 14, 2022
9:00 am to Noon

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Welcome

- Introductions
  - New participants?
- Format
  - 3-hour meeting
  - Break if needed
  - Informal presentations w/ discussion
  - Additional time for discussion at end

Meeting Objectives

Transfer of information, discussion, and collaboration

- Incorporate updated dam safety and steelhead information into alternatives analysis
- Confirm potential changes to draft final report

Meeting Agenda

- Changes to address dam safety
  - Updates to remaining alternatives
  - Cost updates
- Effects of streamflow on steelhead production
- Review alternatives comparison with updates
- Potential changes to final report
  - Move Alt. 5 (Recover Storage Capacity with Sluice Tunnel) to Section 4 (Alternatives Eliminated)?
  - Move Alternative 1 (Fish Passage, No Sediment Action) to Section 4?
- Conclusion

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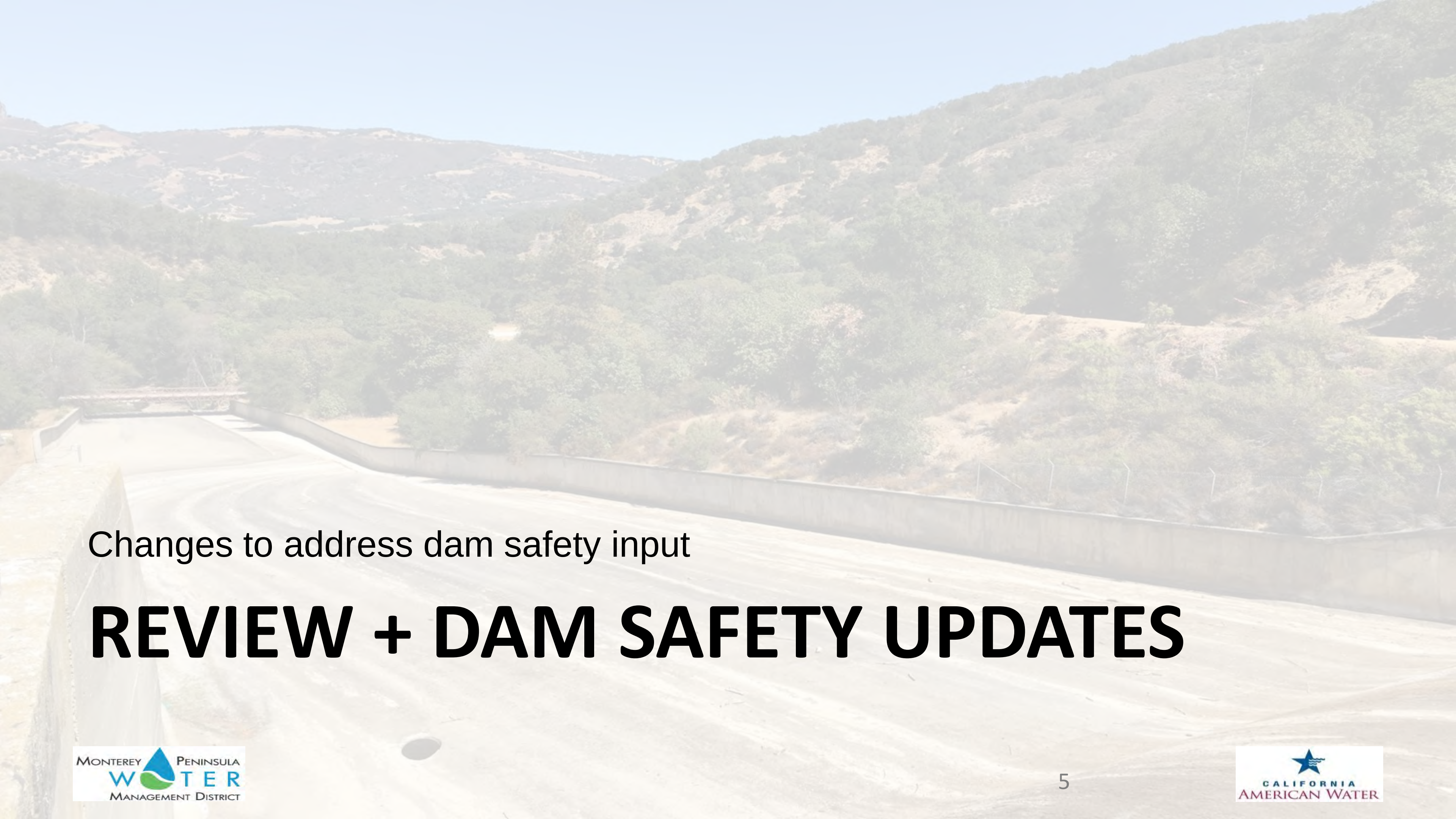

Changes to address dam safety input

REVIEW + DAM SAFETY UPDATES

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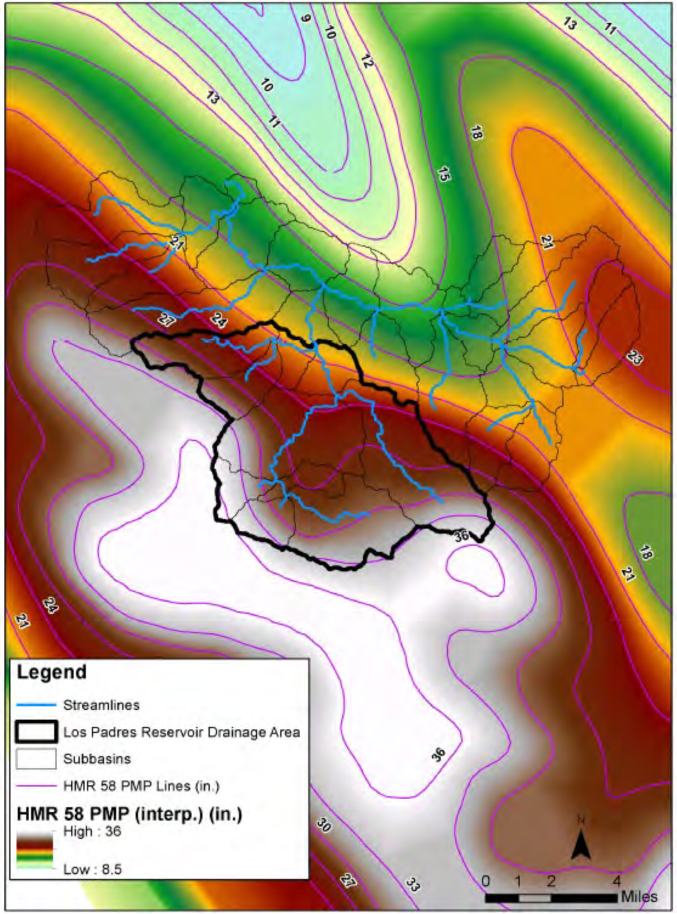
Probable Maximum Flood (PMF)

- Dam and spillway do not meet PMF criteria
  - LPD designed based on outdated HMR 36 PMF criteria
  - Modern HMR 58/59 PMF >twice the design PMF
  - Preliminary analysis suggests overtopping during PMF
- Improvements to address PMF already included in Alt. 3 (Storage Expansion & Dredging)
  - Spillway wall height
  - Embankment height



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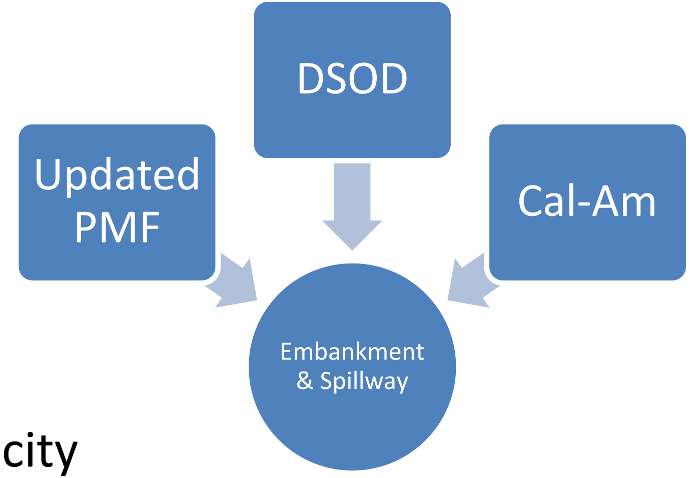
PMF – Input from DSOD & Cal-Am

- Call with CA Division of Safety of Dams (DSOD)
  - Confirmation of safety improvements with spillway gates (Alt. 3)
  - Additional actions likely trigger DSOD safety review using new PMF
    - Spillway modification (e.g., downstream passage)
    - Sluice tunnel (Alt. 5)
- Cal-Am Safety Division
  - Spillway undersized
  - Planning detailed geotechnical, structural, and condition assessment
  - Any alternative that retains LPD should address new PMF
- Add improvements to Alts. 1 (Fish Passage, No Sediment Action) and 5 (Recover Storage Capacity with Sluice Tunnel)



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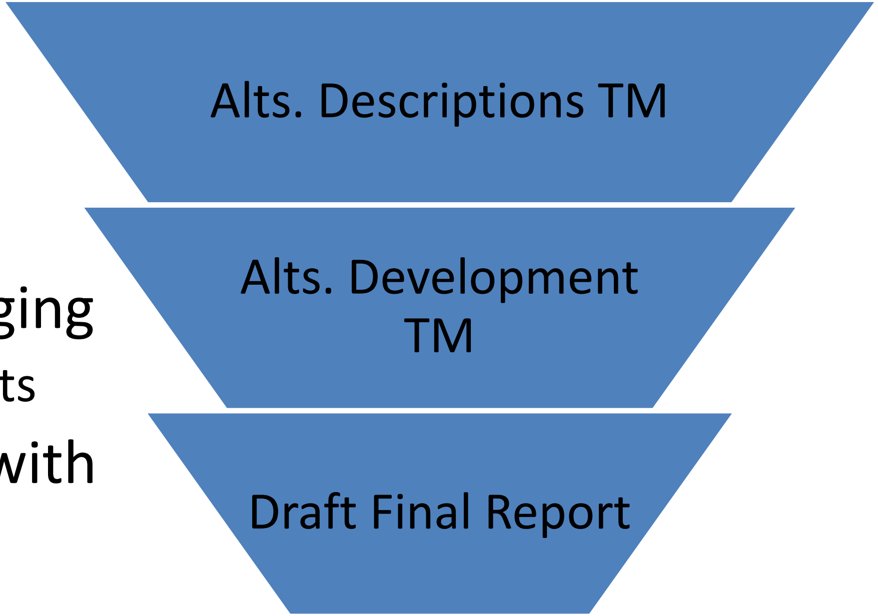
Alternatives Remaining under Consideration

- Alt. 1 - Fish Passage, No Sediment Action
  - Add safety improvements
- Alt. 2 - Dam & Sediment Removal
  - Safety improvements not applicable
- Alt. 3 - Storage Expansion & Dredging
  - Already includes safety improvements
- Alt. 5 - Recover Storage Capacity with Sluice Tunnel
  - Add safety improvements



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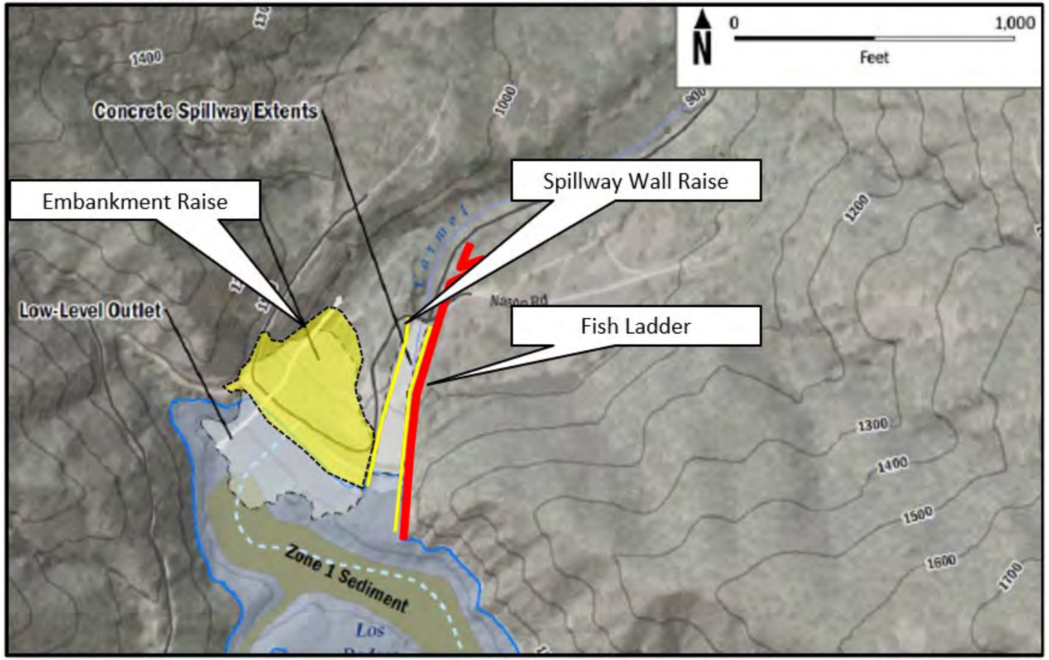
Alternative 1 - Fish Passage, No Sediment Action

REVIEW + DAM SAFETY UPDATES

Fish Passage, No Sediment Action (Alt. 1)

Overview

- No action to:
  - manage incoming or accumulated sediment
  - maintain or increase reservoir storage
- Gradual decrease in ability to store and release water
  - Reservoir substantially filled by 2115 (93 years)
- Includes fish passage improvements required by existing MOU
- Includes dam safety improvements (new)
  - Spillway walls & embankment height

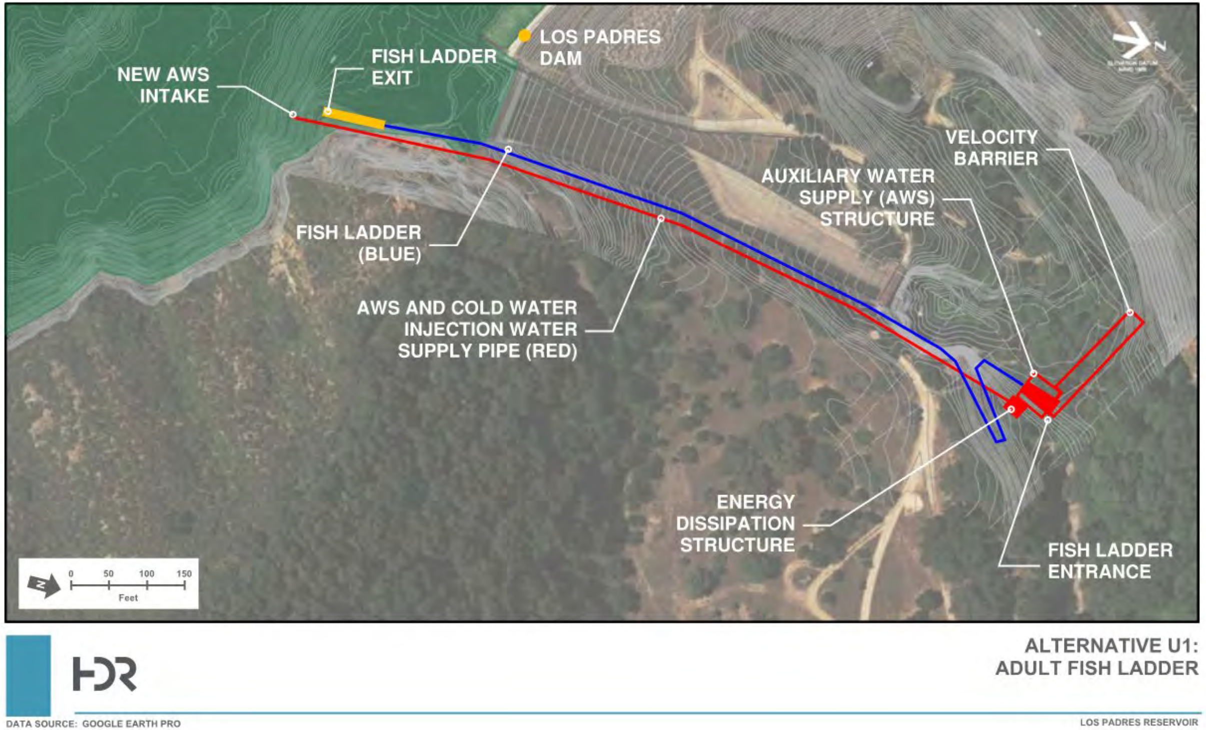


Fish Passage, No Sediment Action (Alt. 1)

Upstream Passage

- Assumes:
  - Fish ladder

    -or-
  - New trap and transport facilities
- Same assumption for all dam-in alternatives

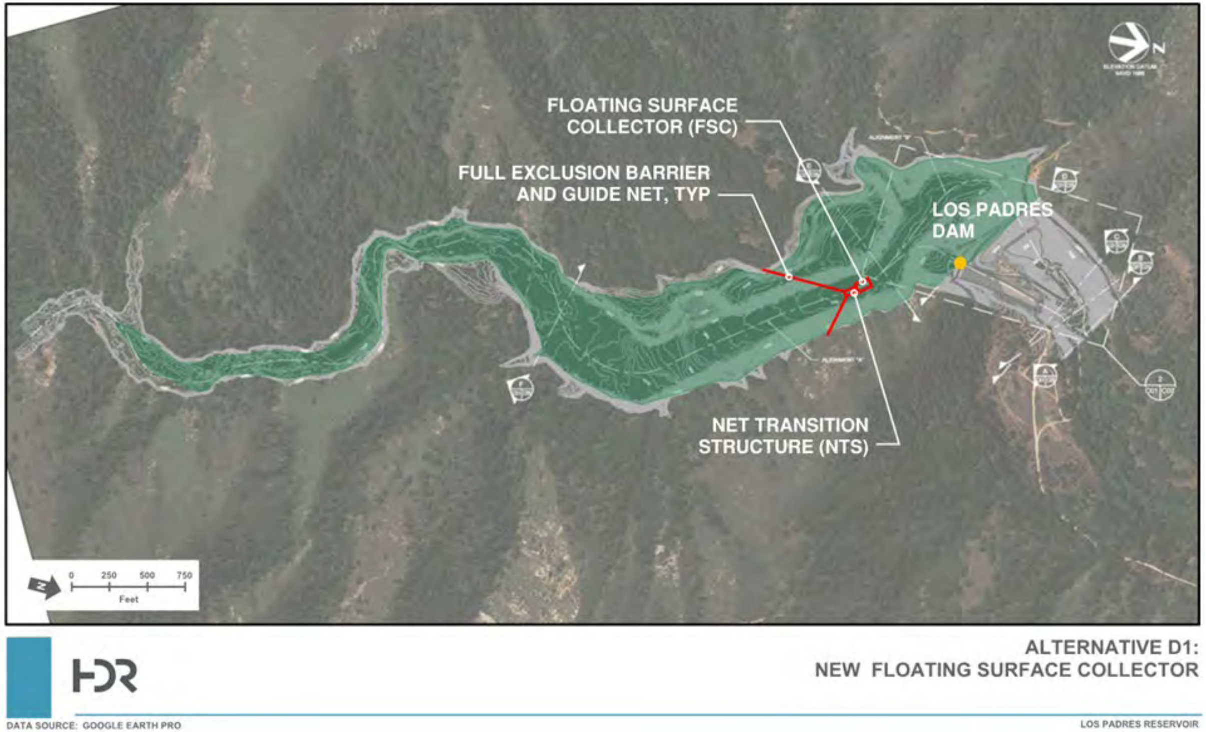


Fish Passage, No Sediment Action (Alt. 1)

Downstream Passage

- Assumes:
  - New floating surface collector

    -or-
  - Spillway modification & existing collector with 30 cfs attraction flow
- Same assumption for all dam-in alternatives



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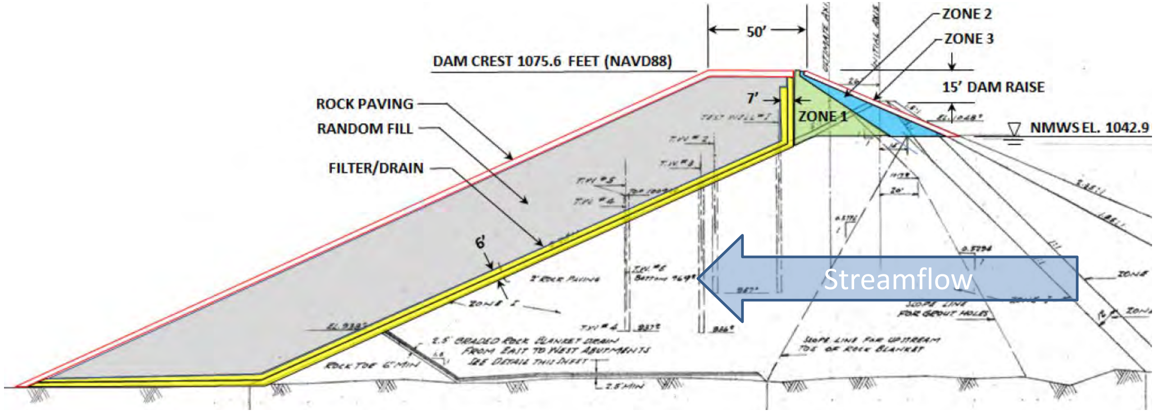
Fish Passage, No Sediment Action (Alt. 1)

Dam Safety Improvements

- To accommodate higher PMF:
  - Spillway walls raise
  - Dam embankment (15-foot) raise



  - Similar improvement for all dam-in alternatives
  - Improvements to spillway weir type/geometry could limit embankment raise

Fish Passage, No Sediment Action (Alt. 1)

Construction Cost

- Total Cost $104M
  - Fish passage $82.1M
    - Highest combined cost of upstream and downstream passage options from HDR et al. 2021
    - Same assumption for all dam-in alternatives
  - Added cost of dam safety improvements $21.9M

ITEM #	LINE ITEM	DESCRIPTION	ESTIMATE	
1	Mobilization/Demobilization	Percentage of construction activities (10%)	$	1,034,000
2	Site Preparation	Access improvements	$	550,000
3	Spillway Wall Raise	Raise spillway walls to accommodate updated PMF	$	1,050,000
4	Dam Embankment Raise	Raise dam embankment to accommodate updated PMF	$	8,740,000
		Subtotal	$	11,374,000
		General Conditions (10%)	$	1,140,000
		Bond (3%)	$	350,000
		General Contractor's OH and Profit (15%)	$	1,710,000
		Total Construction Cost	$	14,574,000
		Contingency (50%)	$	7,290,000
		TOTAL W/ CONTINGENCY	**$**	**21,870,000**

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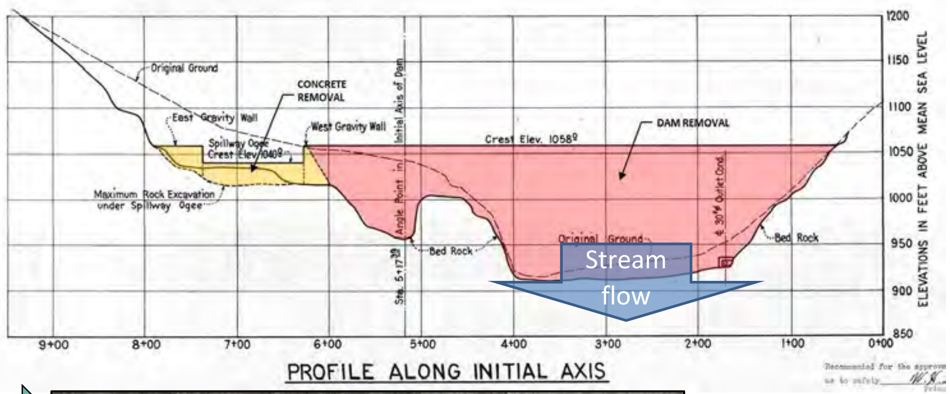
Alternative 2 – Dam and Sediment Removal

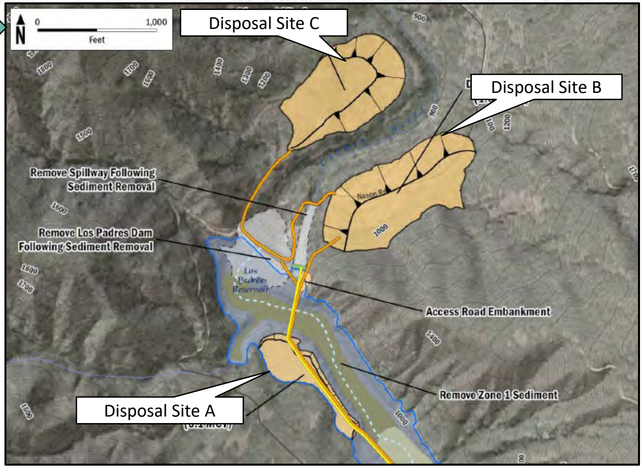
REVIEW (NO UPDATES)

Dam & Sediment Removal (Alt. 2)

Overview

- Removal of LPD
- Dry excavation of Zones 1 and 2 sediment
- Diversion & dewatering May 15 to Oct 15
- Disposal at Sites A, B, and C
- Zone 3 sediment left in place to move downstream





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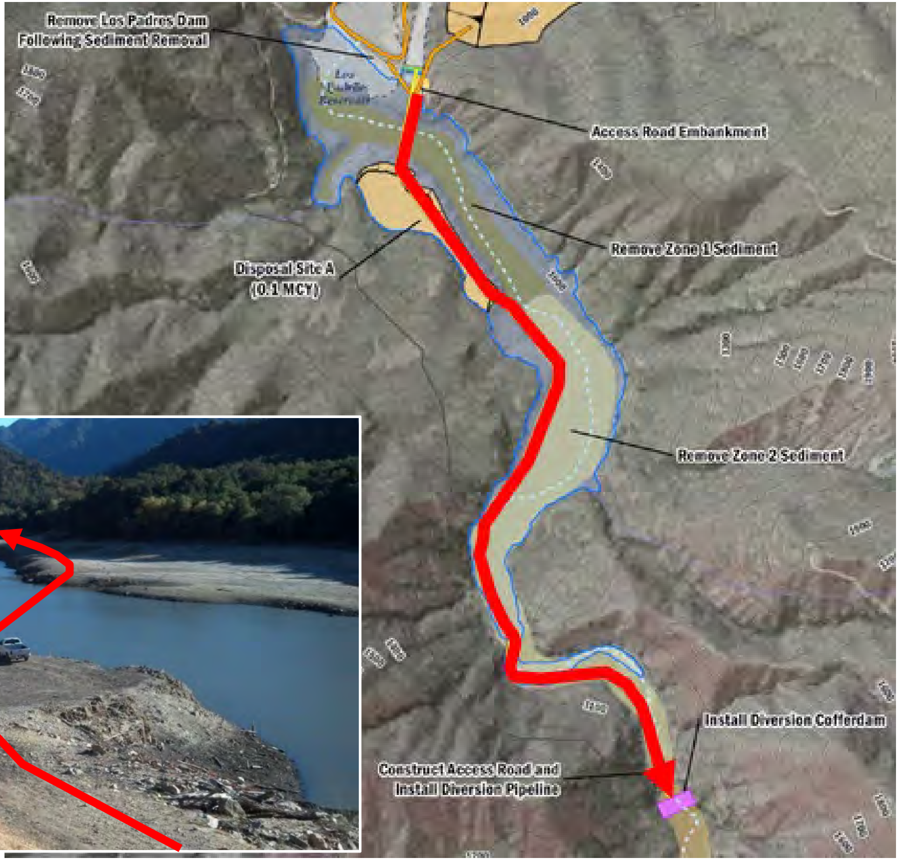
Dam & Sediment Removal (Alt. 2)

Reservoir Access

- 1.25-mile access route (each year) over accumulated sediment
- Dewatering & displacement fill bridge between terraces
- Turbidity measures in place



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Dam & Sediment Removal (Alt. 2)

Sediment Removal

- Once access is established, install streamflow bypass (Yr. 1):
  - Temporary diversion structure near upstream extent of work
    - Earthen berm, at-grade sheet piles, & gated intake
    - Partially removed each winter
  - Pipe from diversion structure to LPD
  - Similar to diversion at San Clemente Dam removal

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Dam & Sediment Removal (Alt. 2)

Sediment Removal

- Construction Yrs. 2 and 3
  - Repeat dewatering (1 month prior) and streamflow diversion
  - Excavate Zone 1 and 2 sediments
    - Manage water in work area
    - Work sediment to remove water
    - Dispose in Sites B & C

Dam & Sediment Removal (Alt. 2)

Sediment & Dam Removal

- Construction Yr. 4
  - Repeat dewatering (1 month) and streamflow bypass
  - Remove LPD (5 months)
    - Dispose in Sites A, B, & C
  - Grade control and habitat restoration features
  - Remove diversion & bypass

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Dam & Sediment Removal (Alt. 2)

Construction Cost

- Total Cost $95M
  - 42% dam removal and restoration
  - 58% sediment removal /disposal

LINE ITEM #	LINE ITEM	DESCRIPTION	ESTIMATE
1	Mobilization/Demobilization	(10%)	$ 4,490,000
2	Site Preparation	Clearing & grubbing, work pads, access improvements, new access through	$ 5,820,000
3	Dam Removal	Demolition of dam, spillway and outletworks; haul and place concrete	$ 9,660,000
4	Reservoir Restoration	vegetation	$ 7,270,000
5	Sediment Removal	Sediment removal (1.7M CY) in the dry, hauling and placement at disposal sites	$ 22,070,000
		Subtotal	$ 49,310,000
		General Conditions (10%)	$ 4,940,000
		Bond (3%)	$ 1,480,000
		General Contractor's OH and Profit (15%)	$ 7,400,000
		Total Construction Cost	$ 63,130,000
		Contingency (50%)	$ 31,570,000
		TOTAL W/ CONTINGENCY	**$ 94,700,000**

Alternative 3 - Storage Expansion & Dredging

REVIEW (NO UPDATES)

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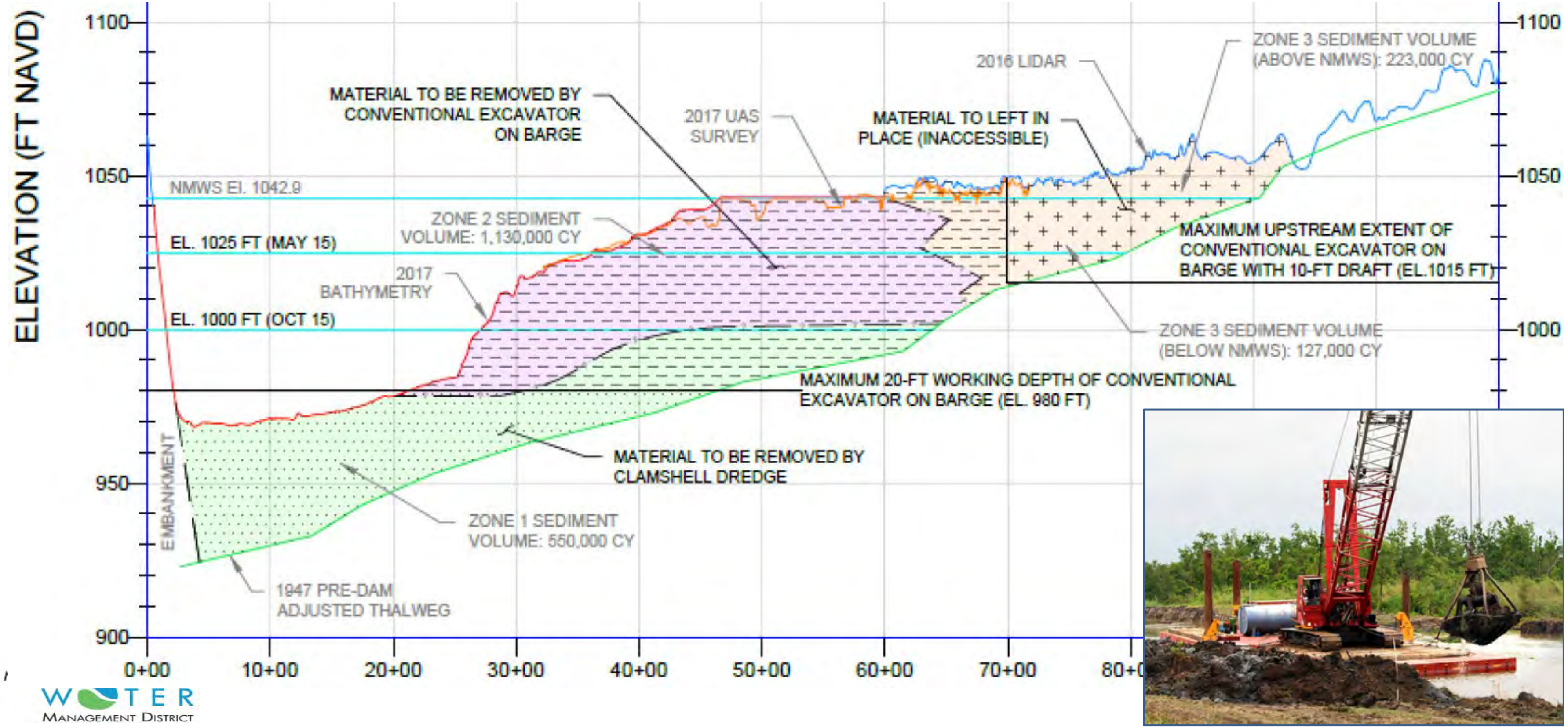
Storage Expansion & Dredging (Alt. 3)

Overview

- Wet dredging Zones 1, 2, & part Zone 3 sediments
  - Fine sediment to Sites B and C
  - Coarser material to Sites D and E to be eroded over time
- Pneumatic (rubber bladder) gates on spillway crest
  - Gates raised (9.6') to capture additional water for dry-season release
  - Embankment dam raise to accommodate updated PMF
- Dam Safety Improvements
- Fish passage improvements

Storage Expansion & Dredging (Alt. 3)

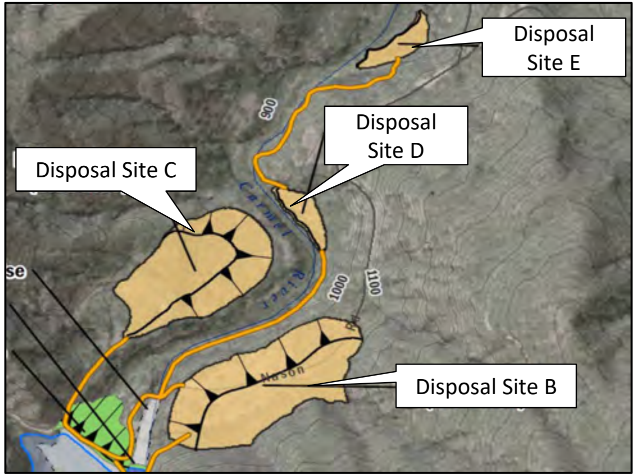
Wet Dredging



Storage Expansion & Dredging (Alt. 3)

Sediment Disposal

Location	Storage Capacity Cumulative Volume (CY)	Acreage (acres)	Maximum Fill Height (feet)
Site B	1,640,000	16.8	120
Site C	980,000	14.1	120
Site D	20,000	1.8	20
Site E	16,000	1.8	15

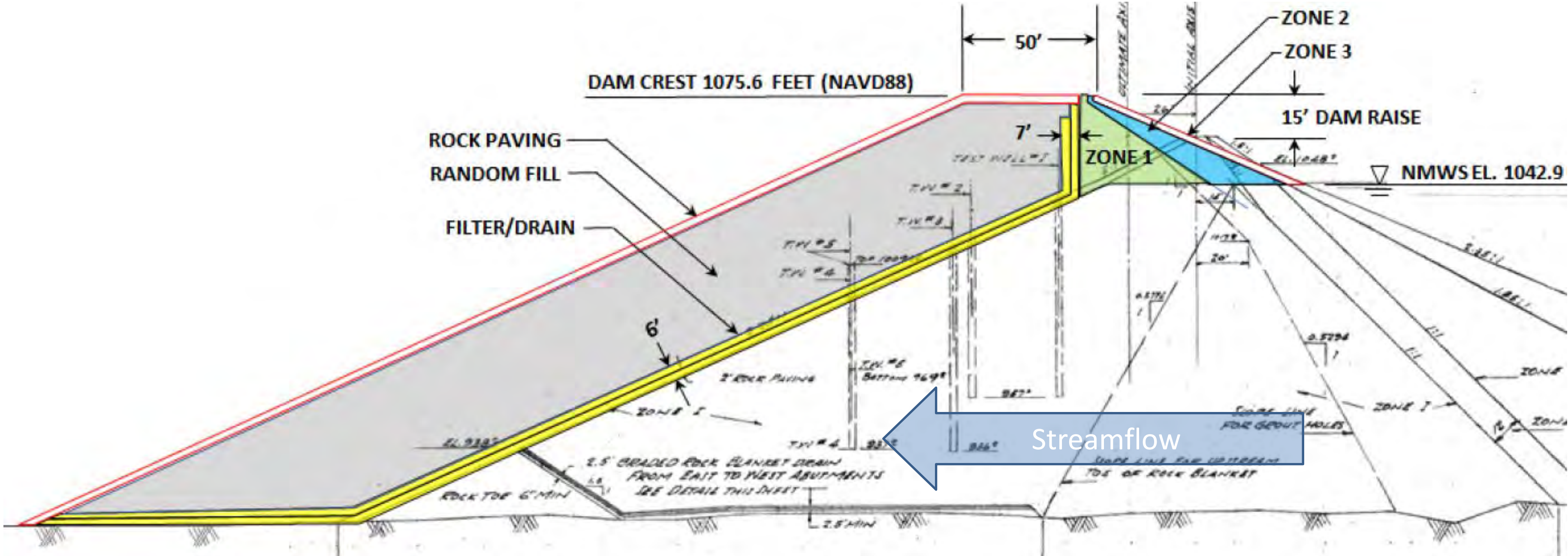


- All material could be placed at Sites B & C
  - Sediment dry times key to cost and duration
  - Dry-time & strength testing during design to reduce risk of delays & confirm slopes and allowable water content
- Coarser material could be placed at Sites D and E for erosion during high flow

Storage Expansion & Dredging (Alt. 3)

Dam Embankment Raise

- 15-foot dam raise for higher PMF
  - Dam width increased 50 feet on downstream side
  - Less if spillway crest widened or relaced with labyrinth



Storage Expansion & Dredging (Alt. 3)

Spillway Modifications

- Gates on spillway crest raise surface 9.6 feet
  - Increases storage 625 AF, from 1,601 AF to 2,226 AF
  - Raised in spring when inflow allows downstream release concurrent with increase in storage

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Storage Expansion & Dredging (Alt. 3)

Construction Cost

- Total Cost $183M
  - Fish Passage $82M
  - Dam/Spillway Improvements $101M
    - 66% for sediment removal/disposal

LINE ITEM #	LINE ITEM	DESCRIPTION	ESTIMATE
1	Mobilization/Demobilization	Percentage of construction activities (10%)	$ 4,800,000
2	Site Preparation	Clearing & grubbing, work pads, access improvements	$ 3,130,000
3	Spillway Modifications and Gate Installation	Spillway crest modification, wall raise, gate and control system installation	$ 4,100,000
4	Dam Embankment Raise	Embankment raise, filter/drain, surface rock paving	$ 8,740,000
5	Sediment Removal	Sediment removal (1.9M CY) in the wet, hauling and placement at disposal sites	$ 31,970,000
		Subtotal	$ 52,740,000
		General Conditions (10%)	$ 5,280,000
		Bond (3%)	$ 1,590,000
		General Contractor's OH and Profit (15%)	$ 7,920,000
		Total Construction Cost	$ 67,530,000
		Contingency (50%)	$ 33,770,000
		TOTAL W/ CONTINGENCY	**$ 101,300,000**

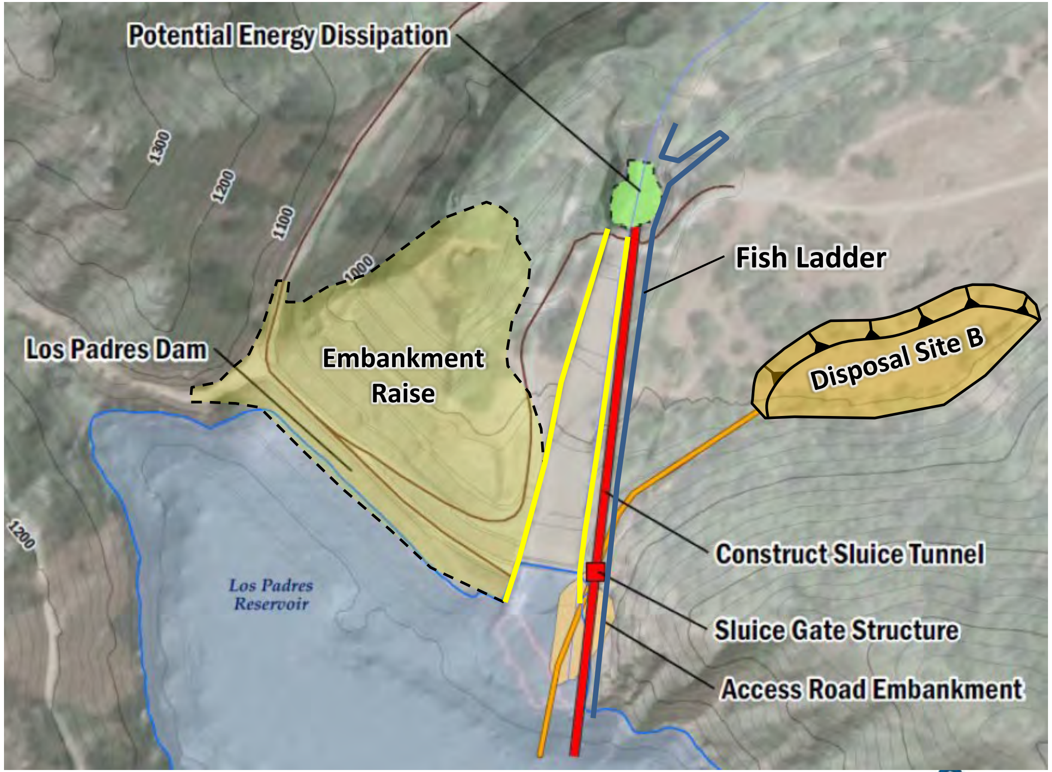
Alternative 5 - Recover Storage Capacity with Sluice Tunnel

REVIEW + DAM SAFETY UPDATES

Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Overview

- Tunnel through eastern abutment
  - Flush, then sluice, sediment during high flow
- Disposal of tunnel debris at Site B
- Fish passage improvements (ladder one option)
- Dam safety improvements (new)



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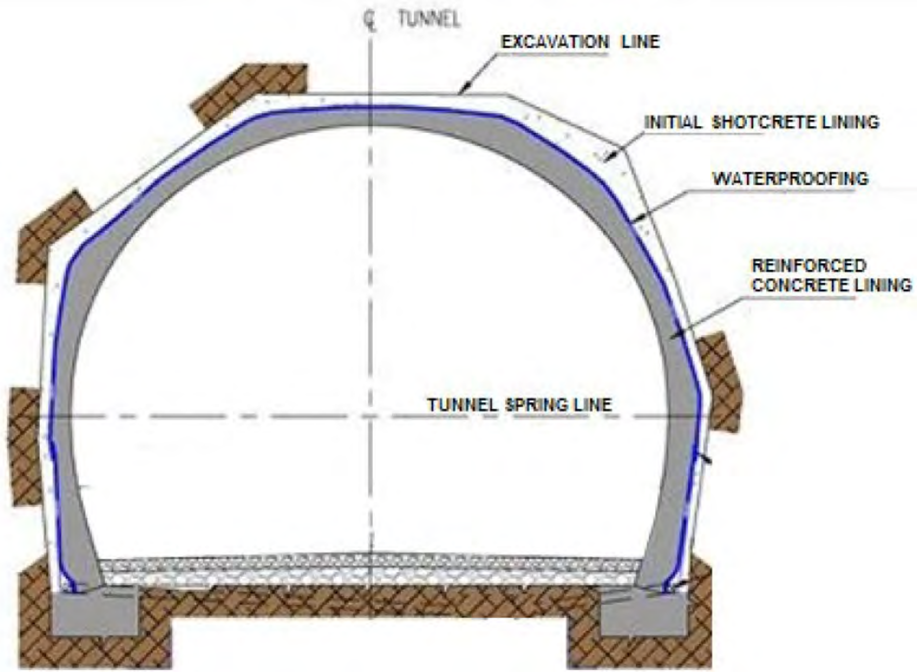
Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Sluice Tunnel

- 900 feet long
- 3.54% slope
- 14 feet wide to pass the 20-year flood (4,600 cfs)
- Reinforced concrete liner
- Vertical gate shaft



Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Sluicing Operations

- Sediment evacuation under full drawdown conditions
  - Flushing or sluicing
  - No functional difference
- Sluicing duration and interruption to normal operations minimized with thoughtful forecasting and management
- Design studies and O&M manual would outline approach to sediment management
- Adaptation based on operator experience would be needed to optimize procedures

Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Tunnel Drilling

- Drilling and blast excavation methods
  - Drill holes, load explosives & detonate
  - Ventilate, remove blasted & loosened rock
  - Install concrete lining

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Recover Storage Capacity with Sluice Tunnel (Alt. 5)

Construction Cost

- Total Cost $164M
  - Fish Passage $82M
  - Tunnel Improvements $60.9M
  - Dam Safety Improvements $20.7M

LINE ITEM #	LINE ITEM	DESCRIPTION	ESTIMATE
1	Mobilization/Demobilization	Percentage of construction activities (10%)	$ 2,890,000
2	Site Preparation	Clearing & grubbing, work pads, access improvements	$ 880,000
3	Construct Sluice Tunnel	lining, gate structure, and intake/outfall portals	$ 27,830,000
4	Site Restoration	Removal of temporary access and hydroseed disposal area	$ 110,000
		Subtotal	$ 31,710,000
		General Conditions (10%)	$ 3,180,000
		Bond (3%)	$ 960,000
		General Contractor's OH and Profit (15%)	$ 4,760,000
		Total Construction Cost	$ 40,610,000
		Contingency (50%)	$ 20,310,000
		TOTAL W/ CONTINGENCY	**$ 60,920,000**

Effects of streamflow on steelhead production (David Boughton)

STREAMFLOW & STEELHEAD

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SW Fisheries
Science Center

Hydrologic scenarios for the Carmel River steelhead population

David Boughton

14 December 2022

How did steelhead production respond to the historical flow regime?

How would steelhead production respond to a different flow regime?

What metric of the historical flow regime most strongly predicts steelhead production?

How would this metric have been different under various hydrologic scenarios?
(from Basin Hydrologic Model)

What is the predicted effect on steelhead production?

Carmel Steelhead and Carmel River Flow

- Conceptual framework
- Parr model
- Spawner model
- Hydrologic scenarios
- Population response to hydrologic scenarios

Carmel Steelhead and Carmel River Flow

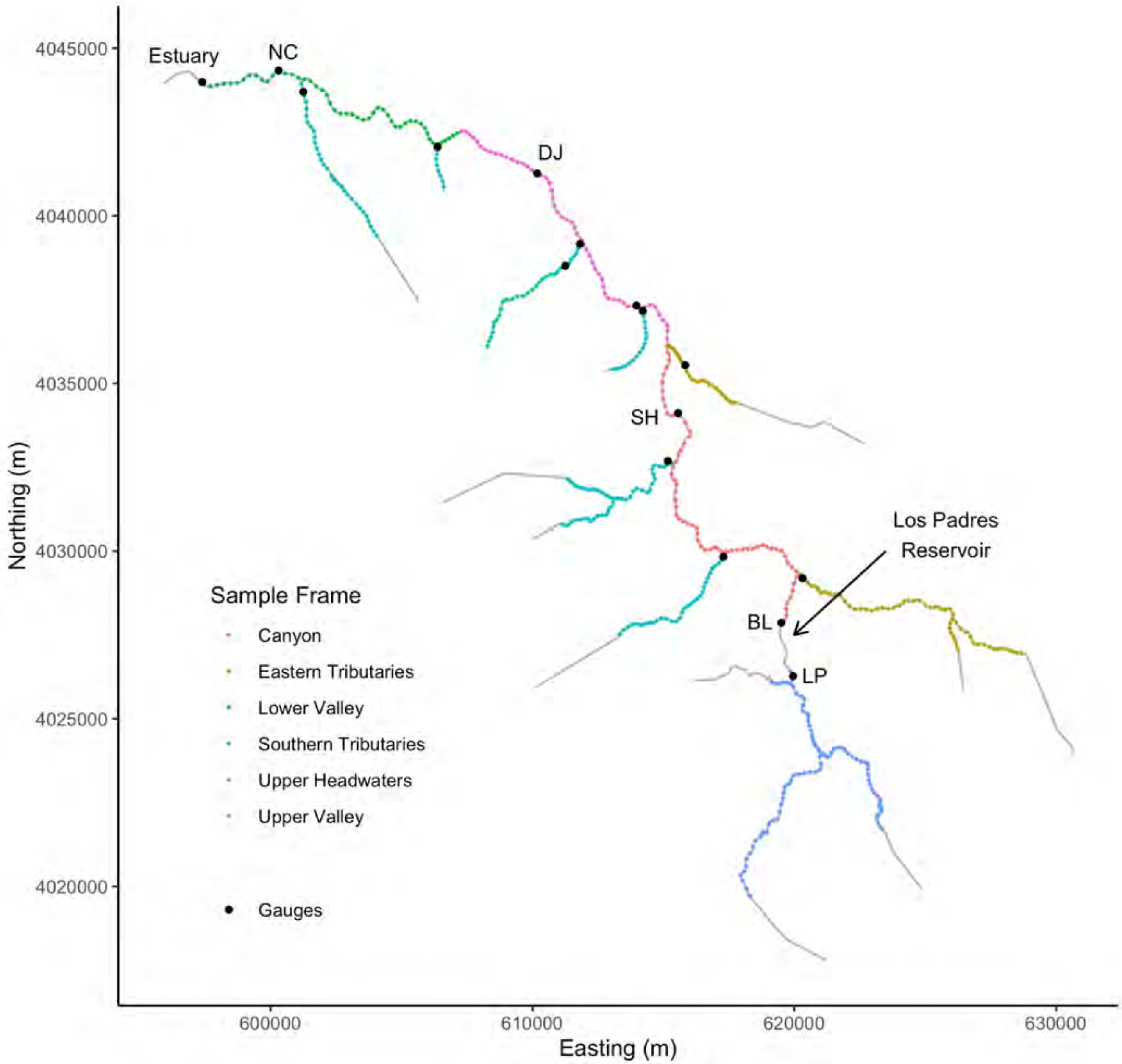
- Conceptual framework
- Parr model
- Spawner model
- Hydrologic scenarios
- Population response to hydrologic scenarios

Overall strategy:

- Data-driven
- Statistical regression for accuracy
- Generalized additive models for flexibility in estimating effects
- Predictors based on ecological concepts for resilience
- Retrospective approach for scenarios holds all else constant (Baseline scenario, 1993 – 2015)

Steelhead production estimated for Process Domains:

Spatially identifiable areas characterized by distinct suites of geomorphic and hydrologic processes (natural and anthropogenic) governing physical habitat structure.


Estuary
NC
DJ
SH
Los Padres
Reservoir
BL
LP
Northing (m)
4045000
4040000
4035000
4030000
4025000
4020000
Easting (m)
600000
610000
620000
630000
Sample Frame
Canyon
Eastern Tributaries
Lower Valley
Southern Tributaries
Upper Headwaters
Upper Valley
Gauges

Parr
Model

Spawner
Model

Wet
Season

End of Dry
Season

2 & 3 Years
Later

Spawning
Adults

Parr N
Parr Size

Spawning
Adults

Flow Metric
(Spring vs Summer)
(High vs Median vs Low)

Carmel Steelhead and Carmel River Flow

- Conceptual framework
- Parr model
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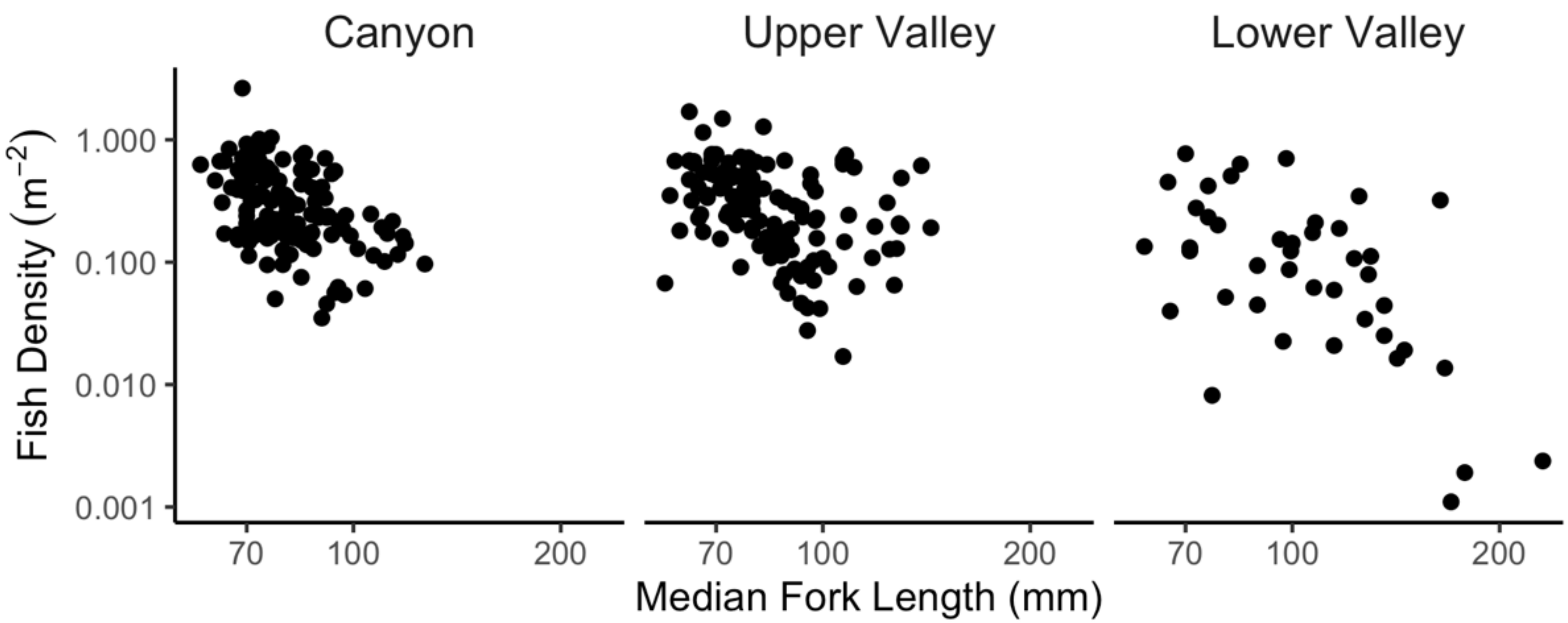
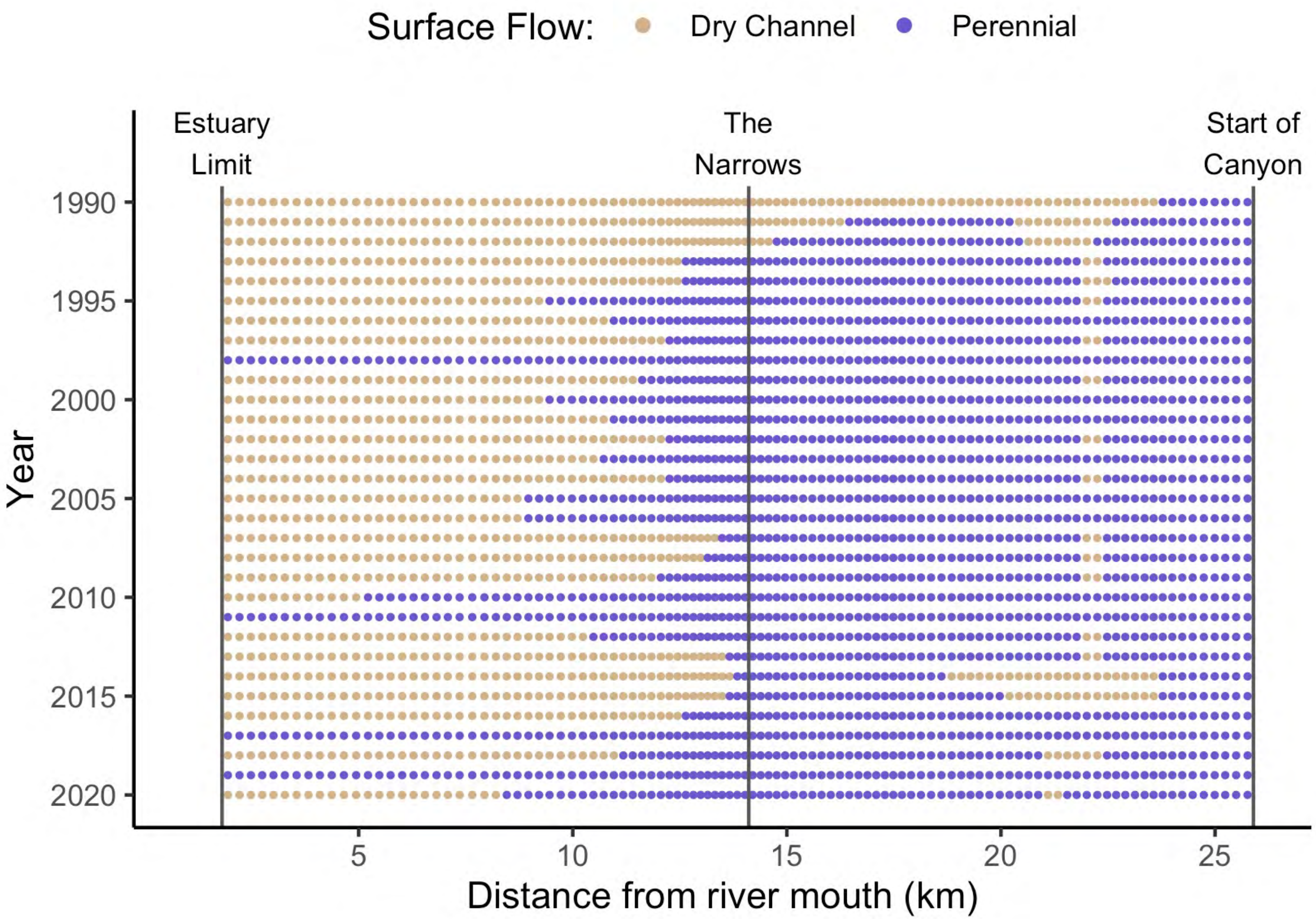
- Population response to hydrologic scenarios

Self-thinning in parr data



Dry Map



Surface Flow: Dry Channel Perennial
Estuary Limit
The Narrows
Start of Canyon
Year
1990
1995
2000
2005
2010
2015
2020
5
10
15
20
25
Distance from river mouth (km)

Parr model:

ln(Fish Density) = Process Domain + random effect of Year + random effect of Reach + s(Flow) + s(Spawners) + s(Rescues)

Fish Length = Process Domain + random effect of Year + random effect of Reach + s(Flow) + s(Spawners) + s(Rescues)

Wetted Width = Process Domain + s(Year) + random effect of Reach + s(Flow)

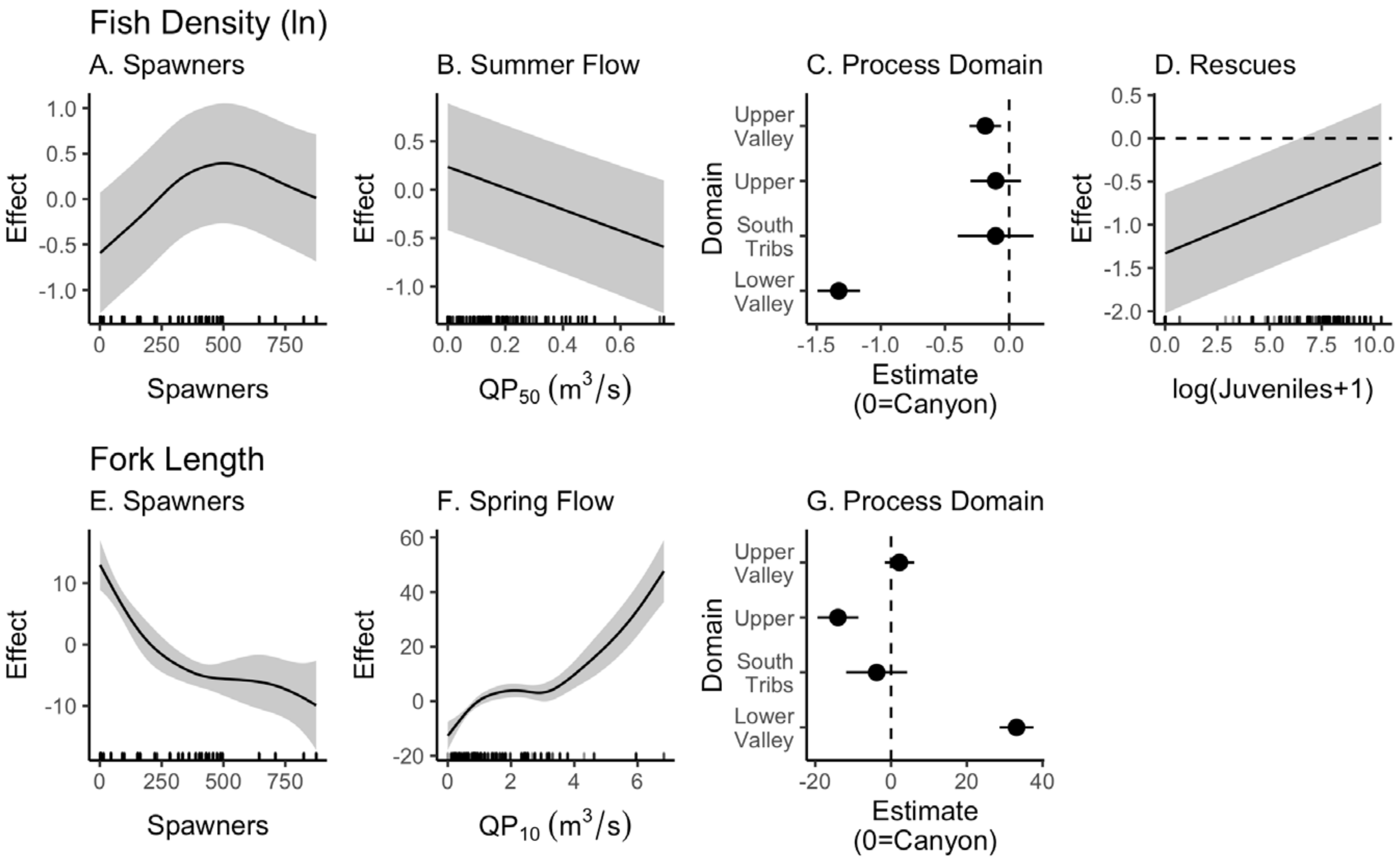
Wetted Length = Process Domain + s(Flow)

s(X) = smoothed regression curve for X

Flow metrics considered:

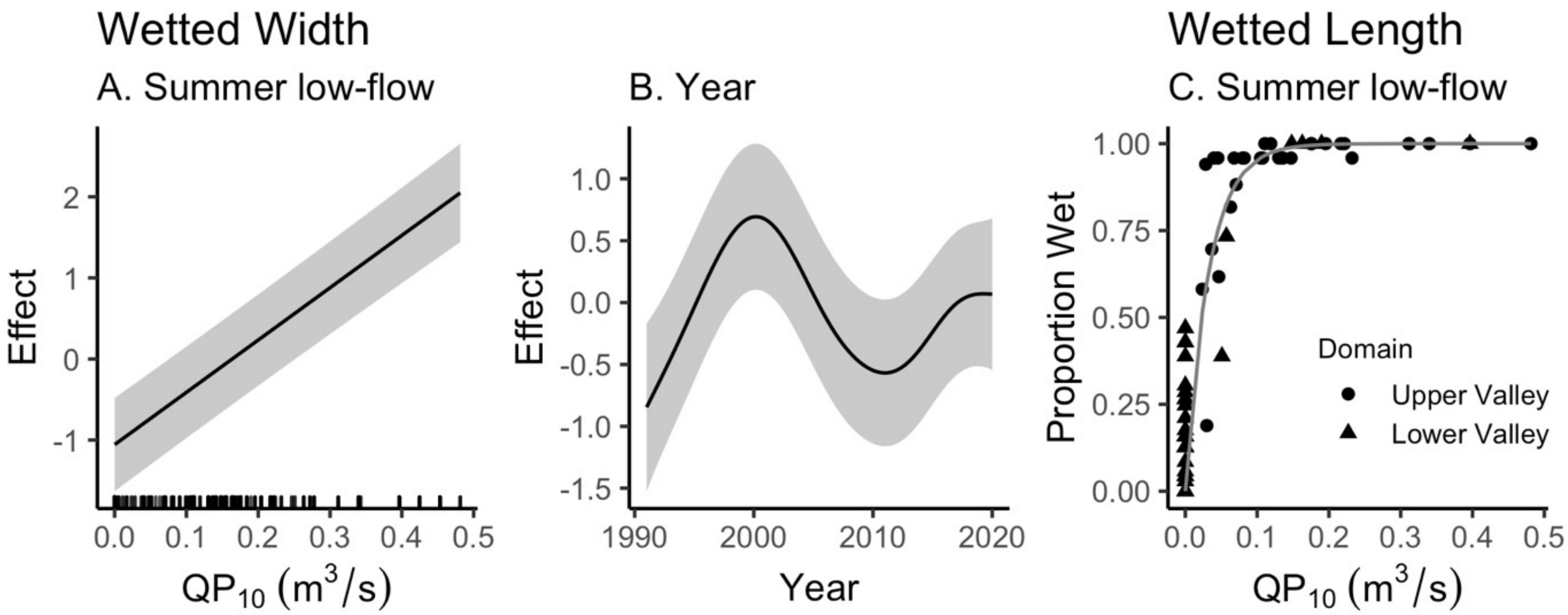
Season	
Spring	March to May
Summer	July to September
Statistic	
QP_{10}	Seasonal low flow (10^{th} percentile of daily flow)
QP_{50}	Seasonal median flow (50^{th} percentile)
QP_{90}	Seasonal high flow (90^{th} percentile)
Qmean	Seasonal mean flow
Domain	Gauges local to each domain

The parr model



NOAA FISHERIES

Wetted area



Wetted Width
A. Summer low-flow
Effect
2
1
0
-1
0.0 0.1 0.2 0.3 0.4 0.5
QP10 (m3/s)
B. Year
Effect
1.0
0.5
0.0
-0.5
-1.0
-1.5
1990 2000 2010 2020
Year
Wetted Length
C. Summer low-flow
Proportion Wet
1.00
0.75
0.50
0.25
0.00
Domain
Upper Valley
Lower Valley
0.0 0.1 0.2 0.3 0.4 0.5
QP10 (m3/s)

Carmel Steelhead and Carmel River Flow

- Conceptual framework
- Parr model
- Spawner model
- Hydrologic scenarios
- Population response to hydrologic scenarios

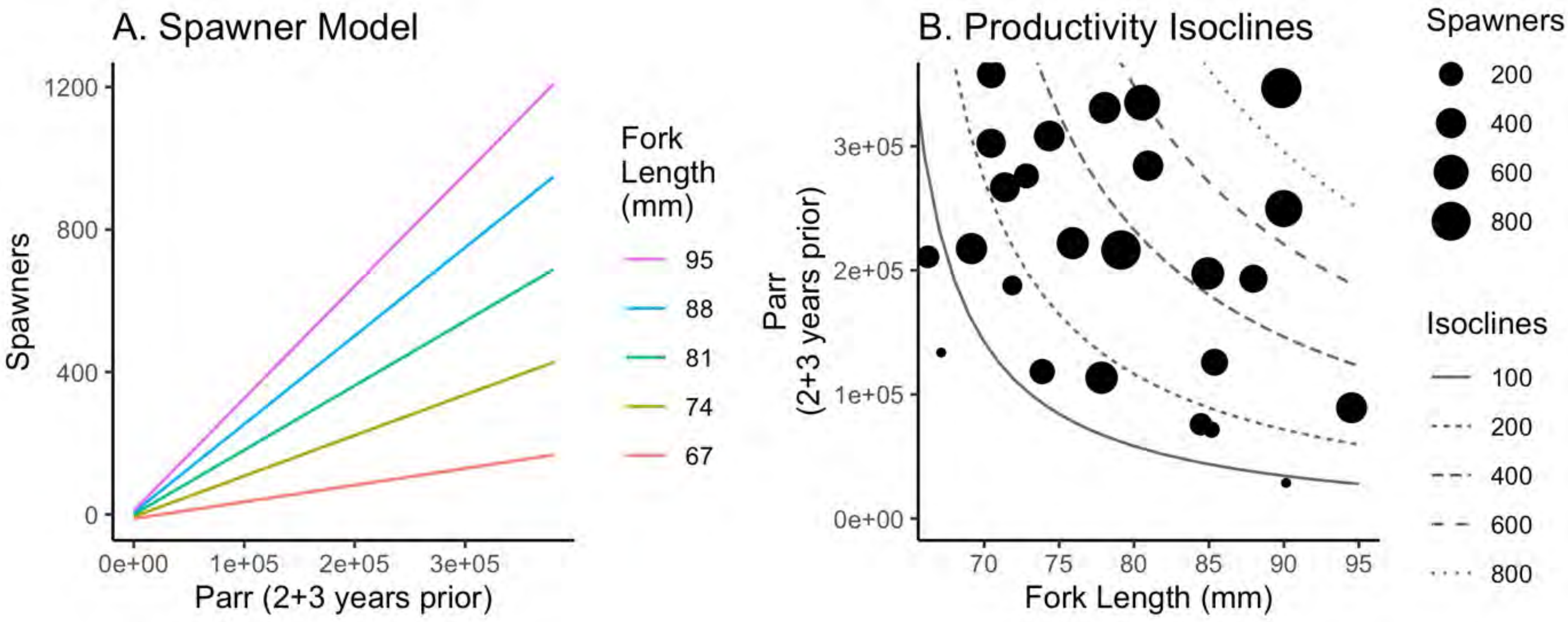
Spawner model:

Number of Adults	=	Number of Parr 2 & 3 years earlier	+	Mean Size of Parr 2 & 3 years earlier

Linear regression where:

- Parr 2 & 3 years earlier are lumped
- Includes captively-reared parr
- Constrained to have y-intercept = zero
- Number of Adults = Estimated counts at San Clemente Dam site (Estimated to be 57% of total)

The spawner model



Carmel Steelhead and Carmel River Flow

- Conceptual framework
- Parr model
- Spawner model
- Hydrologic scenarios
- Population response to hydrologic scenarios

Two methods for hydrologic scenarios:

Empirical	Regressions (GAMs) fit to gauge data
BHM	Output from Basin Hydrologic Model (statistically bias-corrected using gauge data)

Basin Hydrologic Model (BHM) scenarios

Baseline	In Real Life (IRL) flow conditions
LP Dam-removal	Dam removal, continued water usage (3376 acre-ft)
Unimpaired	No dam, no water usage
CDO/3376	If baseline had conformed to the CDO
LP Dredge/3906	Reservoir dredged to provide 3906 acre-ft
LP Dredge/4492	Reservoir dredged to provide 4492 acre-ft

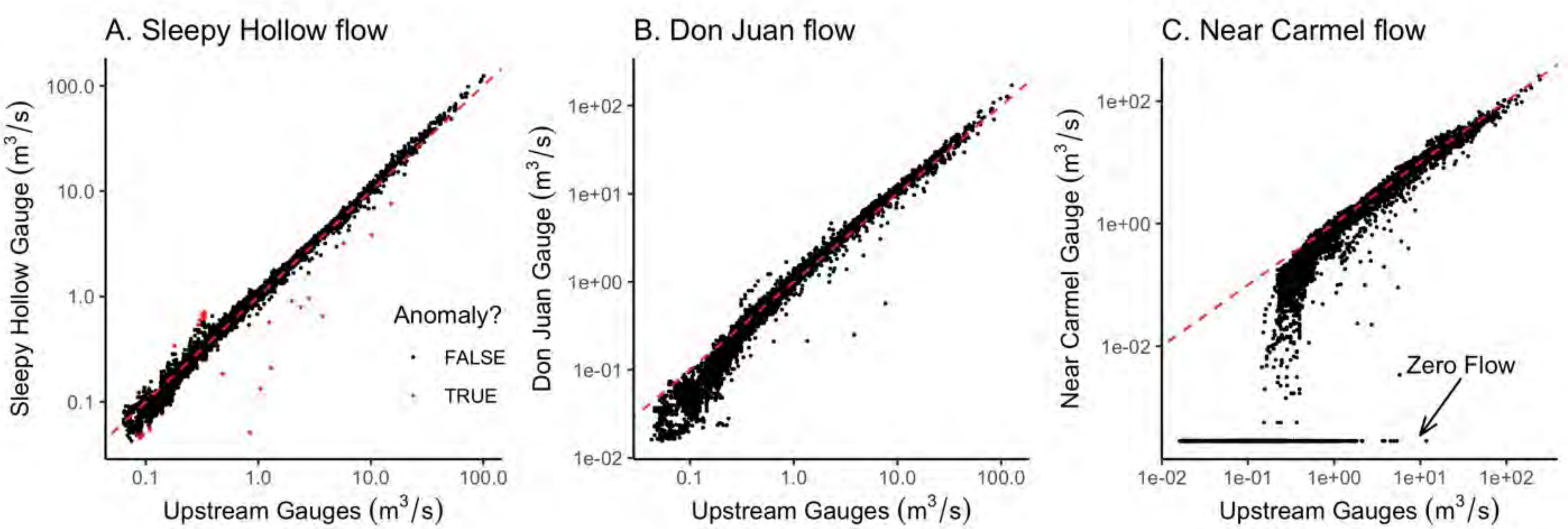
Bias-correction of BHM scenarios

Bias-corrected Scenario X	=	Modeled Scenario X	-	Modeled Baseline Scenario	+	Empirical Baseline Scenario

Two potential methods:

1. Bias-correct daily gauge data, then aggregate to seasonal indicators.
2. Aggregate daily gauge data to seasonal indicators, then bias-correct.

Empirical scenarios

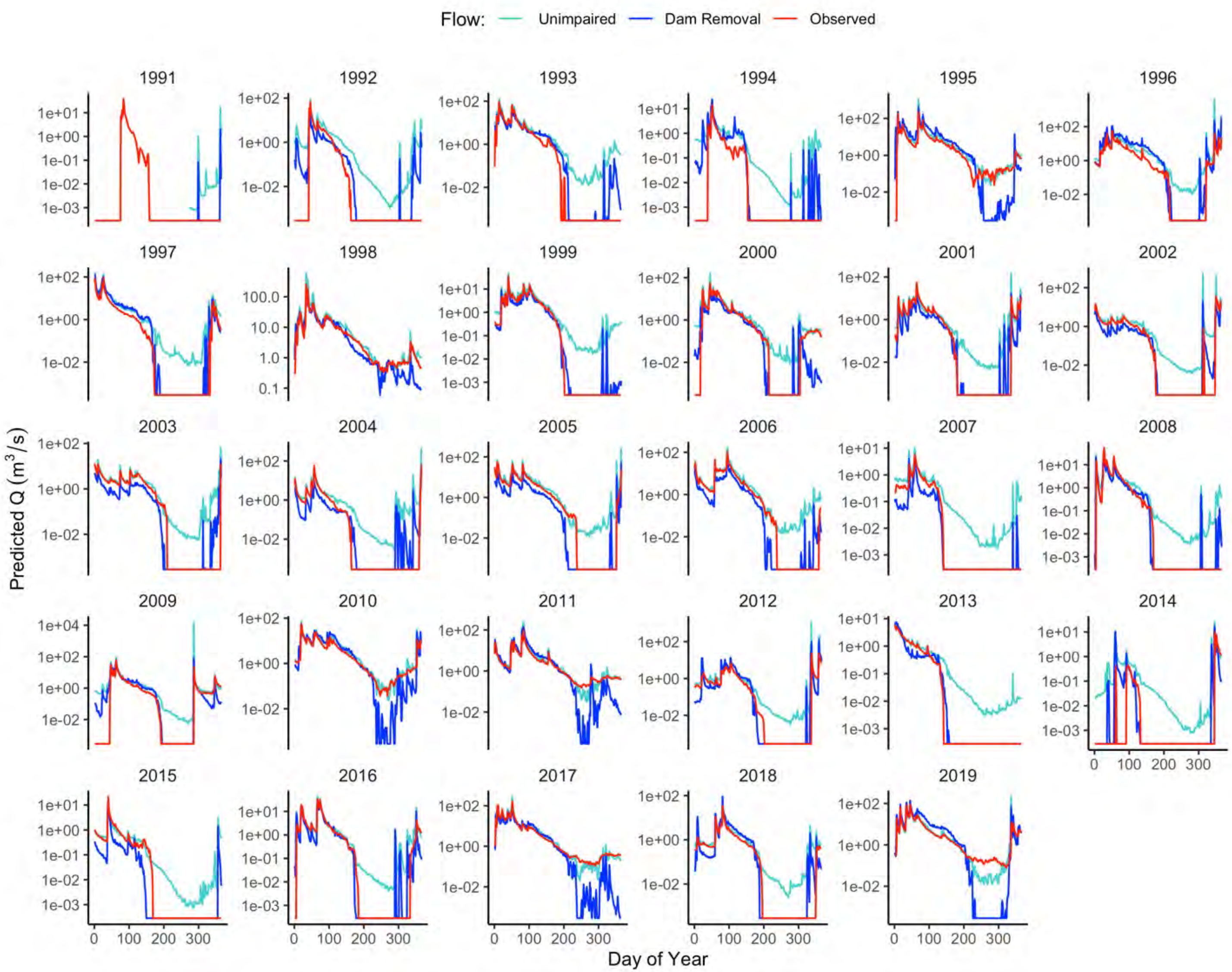


Empirical flow scenarios

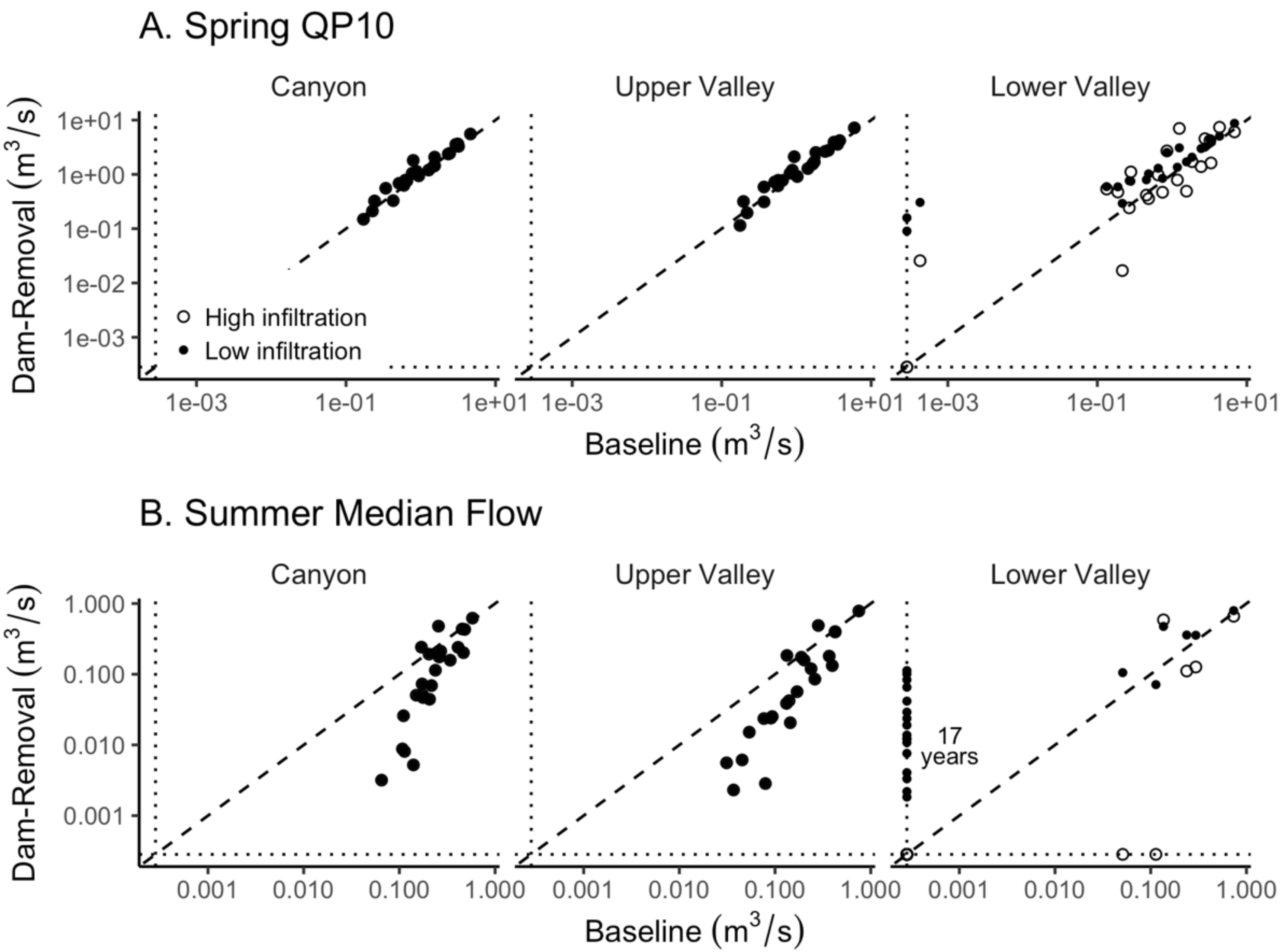
Similar approach as BHM scenarios, except:

Dam-removal	Substitute LP gauge for BL gauge (above Los Padres for Below Los Padres), then use regression models to predict downstream gauges
Unimpaired	Like dam-removal, but assume infiltration in Lower Valley is same as infiltration in Upper Valley (use DJ regression model to predict NC gauge)
Others	Bias-correction of BHM output done at BL gauge, and then the daily flow is propagated downstream using at-a-station regression

Example: Lower Valley



Empirical Scenarios (summary)



Carmel Steelhead and Carmel River Flow

- Conceptual framework
- Parr model
- Spawner model
- Hydrologic scenarios
- Population response to hydrologic scenarios

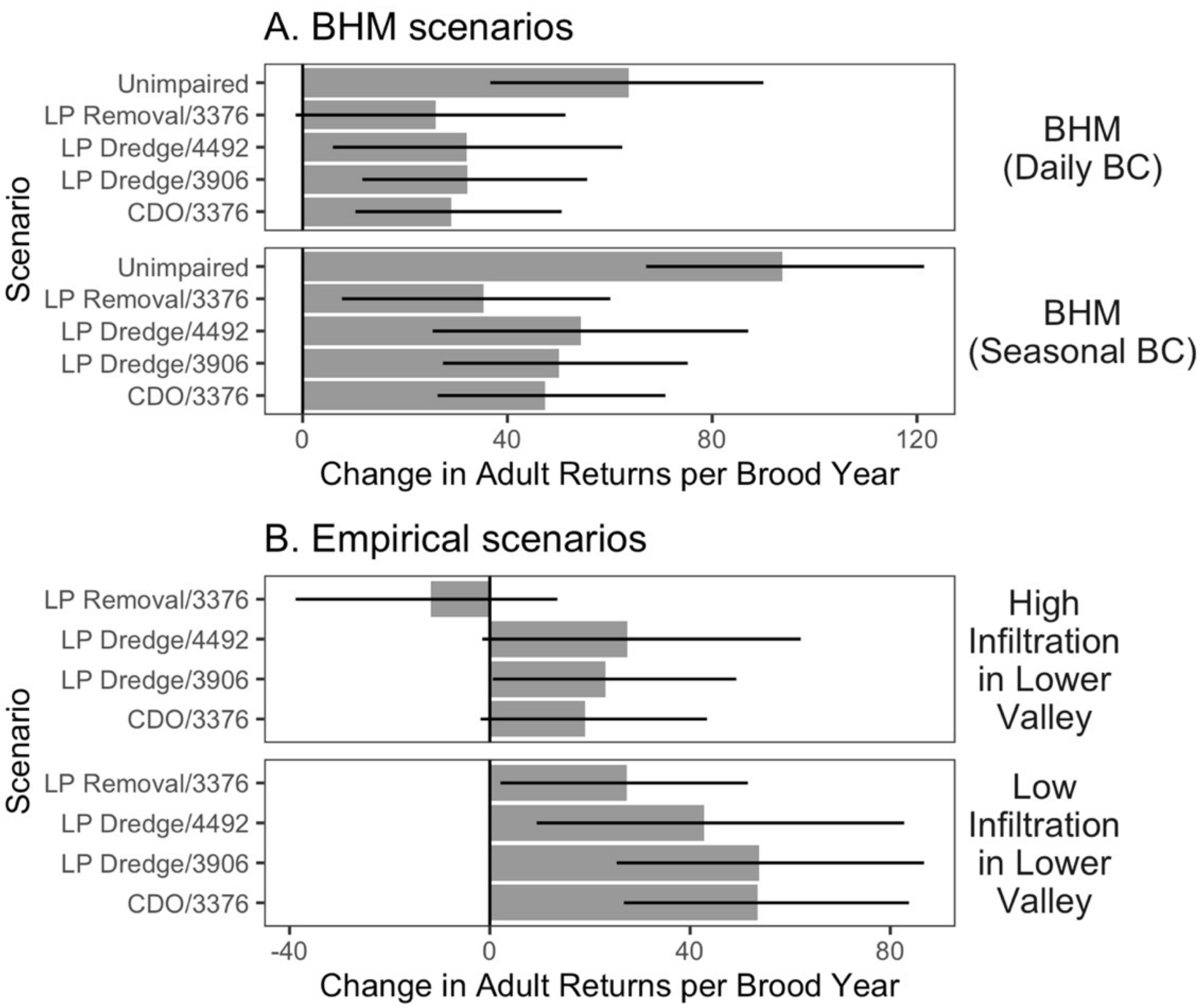
Population response:

- **Predict parr abundance and size from flow scenarios, holding all else constant.**
- **Predict spawner abundance from parr abundance and size.**
- **Propagate parameter uncertainty while holding random effects constant across scenarios.**

Conceptually:

Each of the 23 brood years is a statistically "independent" experiment; everything is held constant except the spring and summer flow regime experienced by that particular brood year.

Steelhead population response



Main points

- Spring flow drives parr size, which affects density via self-thinning
- Summer flow drives bottleneck in capacity, via wetted area
- Self-thinning an important underlying process
- Different scenario methods give similar results on average (empirical vs BHM, bias-correction methods)
- Summer flow in Lower Valley has big effect due to large parr
- Dam removal improves headwater production but is offset by poorer production downstream due to lower summer flows
- Reservoir dredging and perfect CDO improve production relative to current situation, but so does unimpaired flow, mostly because these scenarios all have greater production in the Lower Valley
- Begs some questions about distribution of large parr, role of Estuary and Lower Valley habitat
- We focused on flow; scenarios have many other effects on fish

Review of alternatives comparison with updates

ALTERNATIVES COMPARISON

Alternatives Construction Cost Comparison

Alt. No.	Alternative Name	Alternative OPCC: Non-sediment OPCC	Alternative OPCC: Sediment Removal OPCC	Fish Passage OPCC	Total	Annual O&M Cost
1	Passage Improvements, No Sediment Action	$21,900,000	—	$82,100,000	$104,000,000	$1,115,000
2	Dam and Sediment Removal	$41,910,000	$52,760,000	—	$94,700,000	-
3	Storage Expansion and Dredging	$30,430,000	$70,830,000	$82,100,000	$183,360,000	$1,165,000
5	Recover Storage Capacity with Sluice Tunnel	$20,700,000	$60,920,000	$82,100,000	$163,720,000	$1,165,000

- Dam removal now lowest OPCC
- Lower cost fish passage may also be appropriate in some cases
- Largest component of O&M is fish passage operations

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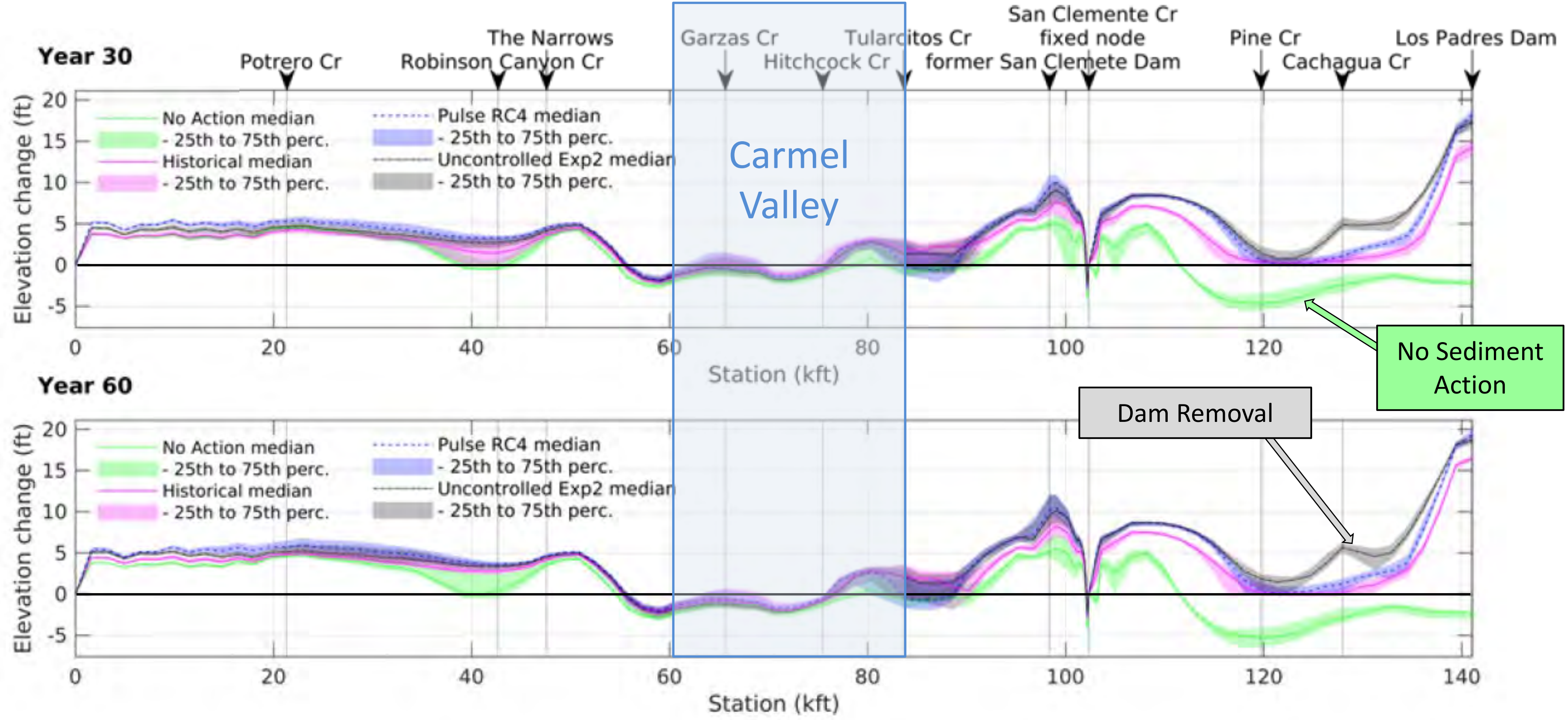
Alternatives Sustainability Comparison

- Multiple lenses
  - Duration of sediment benefits
  - Capital cost (labor, material, fuels as surrogate for greenhouse gas emissions)
- Manual processes and/or shorter duration of benefit < natural processes and/or longer duration of benefit

Alternative No.	Alternative Name	Sustainability Rank	Sediment Removal OPCC[1]	Duration of Sediment Benefit
2	Dam and Sediment Removal	1	$52,760,000	Forever
5	Recover Storage Capacity with Sluice Tunnel	2	$60,920,000	≥ 50 Years
3	Storage Expansion and Dredging	3	$70,830,000	≈100 Years
1	Fish Passage, No Sediment Management	4	No Sediment Removal	No Benefit

Alternatives Geomorphic & Flood Risk Comparison

Bed elevation change for wet hydrographs



Alternatives Storage & Summer Release Comparison

No.	Alternative Name	Change in Storage	Change in Dry-Season (6 months) Release
1	Fish Passage, No Sediment Action	- 1,601 AF gradually over ~100 years	- 4.2 cfs (-8.4 AF/day) gradually over ~100 years[1]
2	Dam and Sediment Removal	- 1,601 AF	- 4.2 cfs (-8.4 AF/day)[1]
3	Storage Expansion and Dredging	+ 625 AF with gates + 1,113 AF with dredging + 55 AF with both[2] + 1,793 AF total	+ 1.7 cfs (+3.4 AF/day) with gates + 3.1 cfs (+6.1 AF/day) with dredging + 0.2 cfs (+0.3 AF/day) with both[2] + 5.0 cfs (+9.8 AF/day) total
5	Recover Storage with Sluice Tunnel	+ 1,000 AF (potentially) gradually as sluiced	+ 2.8 cfs (+5.5 AF/day) (potentially) gradually as sluiced

Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage	Habitat Quantity
Alternative 1 Fish Passage, No Sediment Action	- / - None until sediment overtops dam	- / + Gradual reduction of summer releases as LPR capacity decreases	- / + Suboptimal temperature regime until sediment overtops dam and continued blockage of thermal refugia	- / + Managed passage, limited design coordination needed; no upstream juvenile passage; migration through reservoir	- / + Summer refugia inaccessible
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration	+ / + Restoration of 10,000 feet of river, access to summer refugia
Alternative 3 Storage Expansion and Dredging	- / + Potential for one-time introduction of coarse sediment	+ / + More wetted summer rearing habitat	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir	- / - Summer refugia inaccessible; impacts to 3,500 feet of upstream habitat with dredging and gate operation
Alternative 5 Recover Storage Capacity with Sluice Tunnel	+ / - Potential for periodic bedload transport from upstream of LPD, uncertain impacts from fine sediment	+ / - More wetted summer rearing habitat but quantity uncertain	- / - Suboptimal temperature regime, continued blockage of thermal refugia	- / - Managed passage design coordination needed; no upstream juvenile passage; migration through reservoir	- / - Summer refugia inaccessible; possible reversion of up to 3,500 feet of upstream habitat to reservoir pool

Legend
+ / + Best
+ / - Better
- / + Worse
- / - Worst

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Discuss potential changes to draft final report

REPORT CHANGES

Report Changes

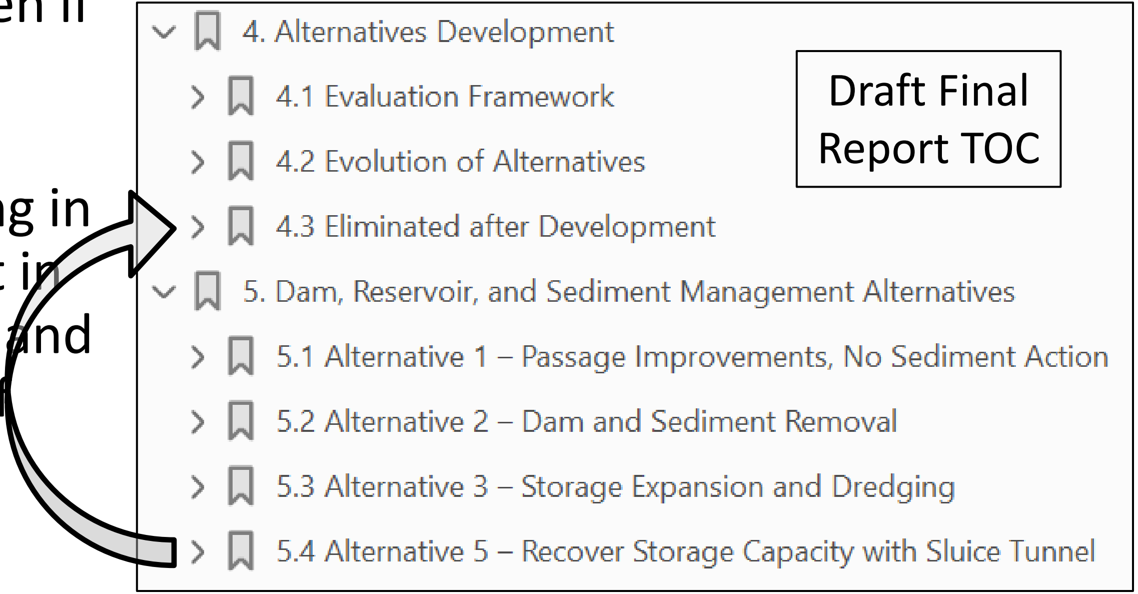
Eliminate (move to Section 4) Alt. 5 - Recover Storage Capacity with Sluice Tunnel?

- Little support for Sluice Tunnel
  - Cal-Am, Alts. Development TM: "…Alternative 5 would be the lowest priority…"
  - MPWMD, Alts. Development TM: " …could be further investigated if it is determined that the dam should stay in place..."
  - NMFS, Draft Final Report: "NMFS does not consider… as feasible... severe adverse affects to steelhead… avoidance, minimization, and mitigation measures would likely fall short of compensating the effects..."
  - CDFW, Draft Final Report: "CDFW doesn't consider… feasible."

Report Changes

Eliminate (move) Alt. 5 - Recover Storage Capacity with Sluice Tunnel?

- Little support & key regulatory agencies consider it infeasible
- Cost increased $20.7M since Draft Final Report
- Concept captured even if moved to Section 4
- If not favored by any stakeholders, retaining in Section 5 could result in unnecessary analysis and delay identification of preferred alternative



Report Changes

Eliminate (move to Section 4) Alt. 1 – Fish Passage, No Sediment Action?

- No support for implementing Alternative 1
  - Cal-Am, Alts. Development TM: "…does not address the long-term impacts of sediment accumulation and loss of reservoir capacity…should not be considered further."
  - MPWMD, Alts. Development TM: "…effects of leaving the dam in place with no sediment management (Alternative 1) need to be described in the final report, …likely…default going forward…until…issues are addressed."
  - NMFS, Alts. Development TM: "…would not be beneficial in the long-term for either Cal-Am (declining water supply) or steelhead (declining water supply for releases, and quality)..."
  - NMFS, Draft Final Report: "…does not consider…as feasible... implemented fish passage facilities and infrastructure would lose their efficacy and result in poor water quality conditions..."
  - CDFW, Draft Final Report: "…doesn't consider…feasible."

Report Changes

Eliminate (move) Alt. 1 – Fish Passage, No Sediment Action?

- Two key regulatory agencies consider it infeasible
- Cost increased $21.9M since Draft Final Report
- Moving to Section 4 would:
  - Clarify stakeholder sentiment
  - Not preclude Alt. 1 from being point of comparison in the future

Draft Final Report TOC

Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage	Habitat Quantity
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Legend
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+ / - Better
- / + Worse
- / - Worst

Alternatives Effects to Steelhead Comparison

	Sediment Transport	Water Availability	Water Temperature	Fish Passage	Habitat Quantity
Alternative 2 Dam and Sediment Removal	+ / + Natural sediment transport, increased habitat complexity and increased spawning habitat	- / - Less wetted summer rearing habitat	+ / + Restores natural thermal regime, provides access to thermal refugia	+ / + Volitional upstream & downstream passage for all life stages; no reservoir migration	+ / + Restoration of 10,000 feet of river, access to summer refugia
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MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

CALIFORNIA AMERICAN WATER

Decisions and next steps

CONCLUSION

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Confirm Meeting Outcomes

- Shifts in stakeholder sentiment considering new information?
- Alternatives to eliminate/move to Section 4?
- Other decisions?

Future Milestones

- Feb. 2, 2023: Revised Draft Final Report
  - Limited changes to incorporate new information
  - Comments on previous draft addressed as feasible (e.g., clarifications, corrections)
  - TRC review due March 3
- April 7, 2023: Alternatives Study Final Report
  - Limited changes to Revised Draft to address comments (e.g., clarifications, corrections)

Study Schedule

Study Preparation	**Thu 2/23/17**	**Mon 10/30/17**
Restart	**Tue 5/11/21**	**Thu 7/1/21**
Sediment Management	**Thu 2/23/17**	**Thu 3/21/19**
Effects on Steelhead	**Tue 11/28/17**	**Fri 1/7/22**
Identify Feasible Alternatives	**Thu 10/28/21**	**Wed 5/18/22**
Draft Final Report	**Thu 5/19/22**	**Mon 9/26/22**
Revised Draft Final Report	**Fri 11/11/22**	**Fri 3/3/23**
TRC Meeting No. 4	Wed 12/14/22	Wed 12/14/22
Meeting Report	Thu 1/5/23	Thu 1/5/23
Prepare Revised Draft Final Report	Fri 11/11/22	Thu 2/2/23
TRC Review Report	Fri 2/3/23	Fri 3/3/23
Final Report	**Mon 3/6/23**	**Fri 4/7/23**
Prepare Final Report	Mon 3/6/23	Fri 4/7/23
Final Report	Fri 4/7/23	Fri 4/7/23