STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

STAFF SUMMARY REPORT (Setenay Bozkurt Frucht)
MEETING DATE: June 13, 2018

ITEM: **6**

SUBJECT: **Proposed Amendment to the Water Quality Control Plan (Basin Plan) for the San Francisco Bay Region to Establish a Total Maximum Daily Load (TMDL) for Sediment in the Pescadero-Butano Watershed and an Implementation Plan to Achieve the TMDL and Habitat Enhancement Goals –**
Hearing to Consider Adoption of Proposed Basin Plan Amendment

CHRONOLOGY: There has been no previous action by the Board on this matter.

DISCUSSION: The attached Tentative Resolution (Appendix A) and proposed Basin Plan Amendment (Appendix B) would amend the Basin Plan to incorporate a TMDL and implementation plan to control delivery of fine sediment and enhance habitat in the Pescadero-Butano Creek watershed.

Pescadero and Butano creeks drain a large watershed along coastal San Mateo County. The creeks in the watershed provide important habitat for steelhead trout and Coho salmon. Impairment due to excess fine sediment in channels, channel simplification, and elimination of floodplain sediment storage has resulted in steelhead and salmon population declines. Besides sediment impairment, the most significant cause contributing to declining salmonid populations is channel incision. Channel incision reduces the frequency of gravel bars and pools, side channels, and alcoves and results in disconnection of the channel from its floodplain.

The proposed Basin Plan amendment would establish the following:

- A sediment TMDL equal to 125 percent of natural background sediment load;
- Numeric targets for sediment, expressed as residual pool volume and substrate composition;
- Numeric targets for habitat condition, expressed as the amount of large woody debris in channels;
- Allocations for all significant sediment source categories;
- An implementation plan to achieve the TMDL and related habitat enhancement goals; and
- A plan and schedule for monitoring and evaluating progress toward meeting the targets.

The Basin Plan amendment would require implementing parties to take actions to address sources of sediment in the watershed, including parks and open space, county roads, and agricultural, grazing, and timberlands. The most important source of sediment in the watershed is road-related erosion. As with other sediment TMDLs the

Board has approved, the implementation plan includes recommended, not required, habitat enhancement actions to improve aquatic habitat for endangered species.

The TMDL aims to increase channel complexity, increase channel connections to floodplains, and increase fine sediment storage. Achievement of these goals would help improve resiliency in the watershed to climate change.

Pescadero marsh at the bottom of the watershed is a separate water body in the Basin Plan. Implementation actions identified in the TMDL will contribute to water quality improvement in the marsh; however, a separate project to evaluate and address water quality in the marsh-lagoon complex is underway and will be continued, working collaboratively with stakeholders.

Additional documentation in this package includes the Staff Report (Appendix C), Responses to Comments (Appendix D), and copies of the scientific peer reviews and all written comments (Appendix E).

Comments from Stakeholders and Staff Responses

During the public comment period, we received twelve comment letters. The California Department of Fish and Wildlife (CDFW), National Marine Fisheries Service (NMFS), Trout Unlimited, and CalTrout were supportive of the goals of the TMDL. They asked clarifying questions about the scientific basis of the impairment and disagreed with some statements made in the Draft Staff Report about the condition of the marsh and lagoon and their hydrodynamics. We address their comments, explaining the relationship between sedimentation and water quality and providing additional details about our understanding about the marsh/lagoon hydrodynamics and tidal prism. All comment letters underscored the need to coordinate and consult with NMFS and CDFW as we address water quality in the marsh and lagoon.

Several Commenters identified the need to establish acreage thresholds or raised concerns about small operations bearing the cost and responsibilities of TMDL implementation. These Commenters include the San Mateo County Farm Bureau, the Resource Conservation District, Big Creek Lumber Company, and Redwood Empire (the last two are both timberland owners). In response, we reevaluated parcel size and attainment of the TMDL and propose thresholds for agriculture (5 acres), grazing (50 acres) and timberlands (100 acres). In addition, the Commenters asked about the process for implementing the TMDL and its timeframe. To clarify the process, we identify a three-year planning and prioritizing phase that allows these implementing parties to evaluate property-specific sources of sediment and propose erosion control actions and an implementation schedule, subject to Executive Officer approval. The TMDL requires coverage under general or individual waste discharge requirements (WDRs) or waivers of WDRs for dischargers, if necessary.

San Mateo County (County) raised a number of issues about the elements of the TMDL, and the Midpeninsula Open Space District provided comments about the proposed numeric targets; we addressed all these comments in detail. The County and other Commenters, e.g., Peninsula Open Space Trust, highlighted issues related to mitigation requirements and the complexity of permitting (costs and limited work

windows) given the various endangered species in the watershed, especially the marbled murrelet. We understand the difficulties in completing projects in the watershed given the limited work windows and will work to coordinate agencies with overlapping jurisdictions. We have models for coordinating efforts in other watersheds, e.g., the Lagunitas watershed, that may apply here. The TMDL provides for a twenty-year implementation time frame to complete necessary road-related actions; we anticipate that there will be adequate time to prioritize and budget for necessary implementation actions

We made a number of revisions, clarifying changes, and minor corrections to the Staff Report and the proposed Basin Plan amendment in response to the comments received. In addition, we made some staff initiated changes to provide clarity.

RECOMMEN-DATION Adoption of the Tentative Resolution.

APPENDICES:

A. Tentative Resolution with Exhibit A, Proposed Basin Plan Amendment
B. Revised Proposed Basin Plan Amendment showing changes made since initial circulation
C. Staff Report – showing changes made in response to comments received
   Available electronically at:
   https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/pescaderobutanocrkstmdl.html
D. Responses to Comments
E. Comment Letters
   Available electronically at:
   https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/pescaderobutanocrkstmdl.html

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Appendix A

Tentative Resolution

with proposed Basin Plan amendment (Exhibit A)

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

TENTATIVE RESOLUTION No. R2-2018-00XX

Amending the Water Quality Control Plan (Basin Plan) for the San Francisco Bay Region to Establish a Total Maximum Daily Load (TMDL) for Fine Sediment in the Pescadero-Butano Watershed and an Implementation Plan to Achieve the TMDL and Related Habitat Enhancement Goals

WHEREAS, the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board), finds that:

1. The Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) is the Water Board's master water quality control planning document. It designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater. It also includes programs of implementation to achieve water quality objectives. The Basin Plan was duly adopted by the Water Board and approved by the State Water Resources Control Board (State Water Board), State Office of Administrative Law (OAL), and the United States Environmental Protection Agency (U.S. EPA), where required.

2. The Basin Plan may be amended in accordance with California Water Code section 13240. This Basin Plan amendment complies with this section.

3. Pescadero and Butano creeks have been identified under federal Clean Water Act section 303(d) as impaired due to fine sediment.

4. Pescadero and Butano creeks are not meeting narrative water quality objectives for sediment, settleable material, and population and community ecology due to elevated rates of erosion and sedimentation in the Pescadero-Butano watershed.

5. Under Clean Water Act section 303(d), the Water Board is required and authorized to establish a TMDL for those pollutants identified as causing impairment of waters on the section 303(d) list. Additionally, under Water Code section 13242, the Water Board is authorized to develop an implementation program for achieving water quality objectives.

6. The Basin Plan amendment, including specifications on its physical placement in the Basin Plan, is set forth in Exhibit A. The Basin Plan amendment establishes 1) a sediment TMDL for Pescadero and Butano creeks at 125 percent of natural background (150,000 tons/year); 2) numeric targets for residual pool volume and substrate composition; 3) allocations for all significant sediment sources; and 4) an implementation plan to achieve the TMDL and related habitat enhancement goals.

7. The scientific basis for the regulatory elements of this Basin Plan amendment was subjected to an independent, external peer review by professors Noah Finnegan and Darren Ward, pursuant to the requirements of California Health and Safety Code section 57004. Water Board staff revised the proposed Basin Plan amendment in response to the comments provided by the reviewers or provided a written response that explained the basis for not incorporating their comments. The peer reviewers' responses confirmed that the rulemaking portions of the proposed TMDL and implementation plan are based on sound scientific knowledge, methods, and practices.

8. On January 10, 2018, Water Board staff publicly noticed and distributed for public review and comment the proposed Basin Plan amendment, supporting draft Staff Report, and draft Substitute Environmental Documentation, in accordance with applicable State and federal laws and regulations.

9. The process of basin planning has been certified in accordance with section 21080.5 of the California Environmental Quality Act (CEQA) as exempt from the requirement to prepare an Environmental Impact Report or Negative Declaration.

10. The Basin Plan amendment package includes a Staff Report, Environmental Checklist, an assessment of the potential environmental impacts of the Basin Plan amendment, and a discussion of alternatives and cumulative impacts. The Basin Plan amendment, Environmental Checklist, Staff Report, and supporting documentation serve as a Substitute Environmental Documentation under the Water Board's certified regulatory program.

11. The Water Board has duly considered the Staff Report and Substitute Environmental Documentation with respect to environmental impacts and finds that the proposed Basin Plan amendment will not have a significant impact on the environment. The Water Board further finds, based on consideration of the record as a whole, that there is no potential for adverse effect, either individually or cumulatively, on wildlife as a result of the proposed Basin Plan amendment.

12. The Water Board has also considered the environmental analysis in the Staff Report and the Substitute Environmental Documentation of the reasonably foreseeable methods of compliance with the Basin Plan amendment, including economic impacts.

13. The Water Board has carefully considered all comments and testimony received, including responses thereto, on the proposed Basin Plan amendment, as well as all the evidence in the administrative record.

14. The Basin Plan amendment must be submitted for review and approval by the State Water Board, OAL, and U.S. EPA. Once approved by the State Water Board, the amendment is submitted to OAL and U.S. EPA. The Basin Plan amendment will become effective upon approval by OAL and U.S. EPA.

NOW, THEREFORE BE IT RESOLVED THAT:

1. The Water Board adopts the Basin Plan amendment as set forth in Exhibit A hereto.
2. The Executive Officer is directed to forward copies of the Basin Plan amendment to the State Water Board in accordance with the requirements of Water Code section 13245.
3. The Water Board requests that the State Water Board approve the Basin Plan amendment in accordance with the requirements of Water Code sections 13245 and 13246 and forward it to OAL and U.S. EPA for approval.
4. If, during the approval process, Water Board staff, the State Water Board, or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes and shall inform the Water Board of any such changes.
5. Since the Basin Plan amendment will involve no potential for adverse effect, either individually or cumulatively, on wildlife, the Executive Officer is directed to sign a CEQA Filing Fee No Effect Determination Form and to submit the exemption in lieu of payment of the Department of Fish and Wildlife CEQA filing fee.

I, Bruce H. Wolfe, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on June 13, 2018.

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BRUCE H. WOLFE
Executive Officer

Attachment:

Exhibit A – Basin Plan Amendment to Establish a Total Maximum Daily Load for Fine Sediment in the Pescadero-Butano Watershed and an Implementation Plan to Achieve the TMDL and Related Habitat Enhancement Goals

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Exhibit A

PROPOSED BASIN PLAN AMENDMENT

The following text is to be inserted into Chapter 7: Water Quality Attainment Strategies Including Total Maximum Daily Loads.

7.4.2 Pescadero-Butano Watershed Sediment TMDL and Habitat Enhancement Plan

This sediment TMDL and habitat enhancement plan address the impairments to beneficial uses in Pescadero and Butano creeks. The following sections establish:

- The sediment TMDL, which identifies the allowable annual sediment load that can be discharged into the Pescadero-Butano watershed, expressed as a percentage of the natural background sediment delivery rate to channels; and
- An implementation plan to achieve the TMDL and habitat enhancement goals.

The goals of the Pescadero-Butano Watershed Sediment TMDL and Habitat Enhancement Plan are as follows:

- To restore water quality and attain beneficial uses.
- To conserve the steelhead trout population.
- To restore a self-sustaining coho salmon population.
- To improve water quality and habitat for native fish and aquatic wildlife species communities.

The TMDL and the implementation plan address the significant increases in sediment supply to channels, as well as simplification, loss, and/or reduction in the quality and quantity of instream habitat for listed populations of salmonids in the Pescadero-Butano watershed. To attain water quality objectives and restore properly functioning channels and habitat, the TMDL calls for actions throughout the watershed to substantially reduce sediment supply to channels and, where safe and feasible, reconnect the channels to their floodplains and enhance channel complexity by adding and retaining large woody debris in channels.

This TMDL focuses on the implementation actions within the channel network upstream of the Pescadero lagoon and marsh complex, located at the watershed-ocean interface, and does not address other water quality issues specific to the Pescadero lagoon and marsh complex. However, achievement of this TMDL is a necessary step to help restore water quality and beneficial uses throughout the watershed, including the lagoon and marsh.

7.4.2.1 Problem Statement

Populations of steelhead and salmon in the Pescadero-Butano watershed have declined substantially over the last century due to progressive changes in land use resulting in excess sediment in the channels and degradation of channel habitat. Land clearing, timber harvesting, legacy grazing and agricultural practices, channel modifications, and roads have: i) increased hillslope erosion; ii) doubled annual sediment supply to channels; iii) resulted in deep incision of Pescadero and Butano creeks and their tributaries; and iv) eliminated sediment storage along the channel and on the floodplains.

Pescadero and Butano creeks are impaired by excess erosion and sedimentation such that the narrative water quality objectives for sediment and settleable material are not being met, and cold freshwater

habitat, wildlife habitat, fish spawning and migration, contact and non-contact recreation, and preservation of rare and endangered species beneficial uses are impaired. In addition, the narrative water quality objective for population and community ecology is not being met due to channel incision**,** which is a significant sediment source and results in habitat simplification and floodplain disconnection. Channel incision and associated simplification of habitat are primary causes of the decline of coho salmon and steelhead trout populations and are controllable water quality factors.

Habitat conditions are degraded by elevated concentrations of fine sediment in the streambed (primarily sand) – caused by pervasive alteration of sediment supply, transport, and storage, which further reduces juvenile salmonid growth and survival in all freshwater life stages. Excess amounts of fine sediment have been deposited on the streambed at potential steelhead spawning and rearing sites. Excess fine sediment in the streambed can cause poor incubation for fish eggs, resulting in high mortality prior to emergence. Fine sediment has also compromised the quality of pools as rearing habitat and reduced winter rearing habitat by filling the spaces between cobbles and boulders.

Channel incision has severely impacted the basic physical habitat structure of the channel and has caused habitat simplification expressed by a substantial reduction in the frequency and area of gravel bars, riffles, and side channels. Channel incision has isolated channels from their floodplains: floodplains no longer function as sediment storage sites and are lost as excellent rearing and refuge habitats for juvenile salmon and steelhead. In addition, a substantial reduction in the amount of large woody debris in channels has greatly diminished the capacity for the creeks to store, sort, and meter sediment, as well as the quality and diversity of freshwater channel habitats. Lastly, significant and persistent increases in sediment supply and loss of floodplains have contributed to an order-of-magnitude increase in the sedimentation rate in the Pescadero lagoon and marsh, adversely impacting water quality.

7.4.2.2 Numeric Targets

The numeric targets for the TMDL to achieve the Basin Plan's water quality objectives for sediment, settleable material, and population and community ecology are listed in Table 7.4.2-1.

Table 7.4.2-1 Sediment TMDL and Habitat Targets for Pescadero and Butano Creeks and Their Tributaries

Sediment Condition Target	
Residual Pool Volume (V*) A unitless measure of the fraction of a pool's volume that is filled by fine sediment	Mean value ≤ 0.21 Maximum value ≤0.45
Substrate Composition	≤ 14% fines < 0.85 millimeter (mm), i.e., percent fines less than 0.85 mm in diameter is less than or equal to 14% of the total bulk core sample ≤ 30% fines < 6.40 mm
Habitat Condition Target	
Large Woody Debris (LWD) loading in Redwood Channels	≥ 300 cubic meters per hectare of bankfull channel area (m^3/ha)
LWD loading in Hardwood Channels	≥ 100 m^3/ha
Redwood channels are defined as those where the adjacent valley floor and/or hillslopes are vegetated primarily by coast redwood forest. Hardwood channels are defined as those where the adjacent valley flat is vegetated by a hardwood forest (typically some combination of willow species, white alder, California bay laurel, bigleaf maple, tan oak, and/or Oregon ash). The large woody debris loading targets apply to channel reaches that provide actual or potential spawning habitat for anadromous salmonids as defined above.	

7.4.2.3 Sediment Sources

Field inventories and sediment modeling conducted throughout the Pescadero-Butano watershed provide credible estimates of the average rate of sediment delivery to channels between 1970 and 2010. Based on this work (Table 7.4.2-2), the Water Board concludes:

1. Sediment delivery to fish-bearing channels has doubled in the last 150 years as compared to the natural background rate. More than half of the fine sediment delivered to Pescadero and Butano creeks and their tributaries is associated with land use activities, including roads, human-caused channel incision, and legacy effects of intensive historical livestock grazing and timber harvesting.
2. The average annual rate of sediment supply to channels in the watershed is 1,200 tons per km^2 per year.
3. More than 40,000 tons of sediment that historically deposited annually on floodplains and alluvial valley (one third of the total sediment delivered from the watershed) is now transported downstream to the Pescadero lagoon and marsh complex due to channel incision. Therefore, not only has this significant storage function along the floodplains and alluvial valley been lost, but the valley itself is now a significant sediment source.

4. Contributions of sediment from municipal and construction stormwater runoff are small in comparison to other sources and are estimated to be about 500 tons per year.

Table 7.4.2-2 Mean Annual Sediment Delivery to the Pescadero-Butano Watershed (tons/year)

Sediment Source Category	Natural Background Annual Delivery Rate (tons/year)	Current Mean Annual Delivery Rate (tons/year)
Sediment Sources		
▪ Natural Processes:	**120,000**	**120,000**
▪ Human Actions:		
• Roads		51,000
• Channel incision		30,000
• Gullying on grasslands		24,000
• Landslides and debris flows		23,000
• Surface erosion on grasslands		4,500
Total from Human Actions		**132,500**
TOTAL		**252,500**

7.4.2.4 Total Maximum Daily Load and Allocations

The Pescadero-Butano watershed sediment TMDL is 150,000 tons per year, or 125 percent of the estimated natural background load and applies to Pescadero and Butano creeks and their tributaries. In order to achieve the TMDL, controllable sediment delivery resulting from human actions needs to be reduced by approximately 78 percent (Table 7.4.2-3).

Attainment of the TMDL will be evaluated immediately downstream of the confluence of Pescadero and Butano creeks at the upstream boundary of the Pescadero marsh and lagoon complex. Attainment of the TMDL will be evaluated using a 10-year averaging period.

Table 7.4.2-3 Load Allocations

Source Category	Current Load	Estimated Percentage Reductions Needed	Load Allocations	
	tons/year	Percent	tons/year	Percent of Natural Background
▪ Natural processes	120,000	0	120,000	100
▪ Human actions:				
- Roads*	51,000	78	11,500	9.5
- Channel incision	30,000	78	6,600	5.5
- Gullies	24,000	78	5,300	4.4
- Landslides	23,000	78	5,100	4.2
- Surface erosion grasslands	4,500	78	1,000	0.8
TOTAL	**252,500**		**149,500**	**124.4**

*Approximately 15% of the allowable load for roads is allocated to San Mateo County

Table 7.4.2-4 Wasteload Allocations for Stormwater Runoff

Source Category	Current Load	Percent Reductions Needed	Wasteload Allocations	
	tons/year		tons/year	Percent of Natural Background
▪ San Mateo County Municipal Stormwater NPDES Permit No. CAS612008	300	0	300	0.3
▪ Construction Stormwater NPDES Permit No. CAS000002	150	0	150	0.3
▪ CalTrans Stormwater NPDES Permit No. CAS000003	<50	0	50	0
TOTAL	**500**	**0**	**500**	**0.6**

7.4.2.5 Implementation Plan

The actions described below are necessary to achieve TMDL targets, allocations, performance standards, and habitat enhancement goals within twenty years of the effective date of the Basin Plan amendment.

Stormwater Runoff

Stormwater runoff from State highways and municipal and construction stormwater runoff are the only known point sources of sediment to the Pescadero-Butano watershed and have small wasteload allocations (Table 7.4.2-4) relative to nonpoint sources of sediment. These sources are regulated under existing NPDES permits that include requirements to control erosion, sedimentation, and hydromodification from new development and requirements to maintain rural roads. Table 7.4.2-5 shows implementation measures required for these sources. Implementation to address reductions in loading for sediment discharges associated with roads under the jurisdiction of San Mateo County and the San Mateo County Flood Control District are included here.

Table 7.4.2-5 TMDL Implementation Measures for Sediment Discharges Associated with Stormwater Runoff and Roads

Source Category	Actions	Implementing Parties
Stormwater Runoff CalTrans, Construction	Comply with applicable NPDES permits	CalTrans Owners or operators of construction projects > 1 acre
Stormwater Runoff and Roads Municipal	Comply with applicable NPDES permits	San Mateo County

Nonpoint Sources

The State's 2004 Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program provides for regulation of nonpoint source discharges using the Water Board's administrative permitting authorities, including WDRs, waiver of WDRs, Basin Plan Discharge Prohibitions, or some combination of these. Consistent with this policy, Tables 7.4.2-6 through 7.4.2-11 specify actions and performance standards by nonpoint source category, as needed to achieve TMDL targets and allocations in the Pescadero-Butano watershed. The Water Board will consider adopting permits that apply to the nonpoint sources from roads, grazing lands, non-grazing agricultural lands, and/or timberlands listed in Tables 7.4.2-6 through 7.4.2-10. Individual landowners or coalitions may work with "third parties," such as the San Mateo Resource Conservation District, to develop and implement sediment pollutant control programs.

Habitat Enhancement

Channel incision, loss of sediment storage function, and loss of essential habitat features are the result of multiple historical and ongoing disturbances. This implementation plan calls for habitat enhancement actions. A channel and habitat restoration program that increases woody debris and re-establishes width-to-depth ratios and a modest flood plain will be the most effective means of controlling channel incision and reducing related sediment delivery to the creeks. Floodplains and large woody debris jams

would provide essential high-quality rearing habitats and enhance food production for coho salmon and steelhead. These features also help create pools, reduce scouring, store sediment, and diversify habitat types within the stream. The habitat enhancement program, presented in Table 7.4.2-11, will therefore focus on actions to: (1) to the extent safe and feasible, substantially increase the amount of large woody debris in channels that run through public lands and timber harvest lands; and (2) study safe and feasible opportunities for floodplain restoration in channel reaches on private lands. The effectiveness of implementation of actions specified in Table 7.4.2-11 to enhance habitat will be evaluated as part of the adaptive implementation program.

7.4.2.6 Agricultural Water Quality Program Costs

The implementation measures in Tables 7.4.2-6 and 7.4.2-7 for grazing and agricultural land constitute an agricultural water quality control program and therefore, consistent with Water Code section 13141, the cost of this program is estimated herein. This cost estimate includes the cost of implementing all road-related and surface erosion-related sediment control measures specified in the implementation plan and is based on costs associated with technical assistance, project design, and implementation of actions needed to achieve the TMDL.

There are no other costs to farmers or ranchers associated with actions to enhance channel habitat complexity and floodplain connection, because participation by private landowners is voluntary, and almost all of the costs of these projects are expected to be paid for from grants by public agencies and/or non-profits. In estimating costs, the Water Board estimated that owners of grazing and non-grazing agricultural businesses own up to 20 percent of the total land area. The Water Board estimates that the total cost to agricultural businesses associated with efforts to reduce sediment supply to Pescadero and Butano creeks watershed is $200,000 to $300,000 per year.

7.4.2.7 Evaluation and Monitoring

Water Board staff, working in partnership with other entities, e.g., San Mateo County and the San Mateo County Resource Conservation District, will conduct baseline monitoring to document existing residual pool volumes (V*), substrate composition, and woody debris loadings along representative reaches. In addition to baseline conditions monitoring, the following monitoring is necessary:

1) Implementation monitoring to document actions taken on individual properties to reduce fine sediment discharge and enhance habitat complexity and connectivity;

2) Upslope effectiveness monitoring to evaluate effectiveness of sediment control actions in reducing rates of sediment delivery to channels on a subwatershed basis; and

3) In-channel effectiveness monitoring (e.g., pool filling and substrate composition) to evaluate channel response to management actions and natural processes.

Implementation monitoring will be conducted by landowners or designated agents to document that sediment control actions, i.e., best management practices as specified herein, occur.

The Water Board anticipates working in partnership with the implementing parties to conduct upslope effectiveness monitoring to reevaluate rates of sediment delivered to channels from land use activities and natural processes.

In-channel effectiveness monitoring should be conducted by the Water Board and local partners with scientific expertise and demonstrated capability in working effectively with private property owners (to gain permissions for access), as needed to develop a representative sample of stream habitat conditions, in relation to sediment supply and transport within the watershed. In-channel effectiveness monitoring is needed to evaluate: a) progress toward achieving water quality targets, and b) channel response to management measures and natural processes. The main parameters that will be monitored to assess progress toward achieving water quality targets are residual pool volume and substrate composition.

The Water Board, working in partnership with other entities, such as the San Mateo County Resource Conservation District and other organizations with scientific expertise, will assess large woody debris loading in channels to evaluate attainment of the numeric targets for large woody debris loading and to guide development of reach-specific prescriptions for installation of engineered log jams and riparian management actions to attain the target values in future years through natural recruitment.

Desired measurement frequency for pool filling, substrate composition, and large woody debris is once every five years.

7.4.2.8 Adaptive Implementation

Adaptive implementation entails taking actions commensurate with existing, available information, reviewing new information as it becomes available, and modifying actions as necessary based on the new information. Water Board staff will evaluate and report to the Water Board on the progress of implementation of the TMDL and habitat enhancement actions periodically and will evaluate the need for amending the TMDL within 10 years of the effective date of the TMDL.

Key questions to be considered in the course of adaptive implementation:

- What is the population status of steelhead and coho salmon in the watershed? Do numbers of steelhead and coho salmon increase as sediment reduction and habitat enhancement measures are implemented? An improved understanding of the status of steelhead and salmon populations in the Pescadero-Butano watershed is essential for guiding adaptive updates to the management actions recognized in this plan.
- Are Pescadero and Butano creeks and their tributaries progressing toward TMDL targets and performance standards as expected? If there is a lack of adequate progress, how might the implementation actions, targets, performance standards, or allocations be modified?
- Are the specified sediment reduction measures and recommended habitat enhancement measures resulting in an improving trend in channel habitat quantity and quality?
- Are there new data or information available that warrant revision of water quality targets, allocations, or implementation measures?

Table 7.4.2-6 Required TMDL Implementation Measures for Sediment Discharges Associated with Non-Grazing Agricultural Lands of 5 Acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
NON-GRAZING AGRICULTURAL LANDS	**Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Stream corridors:** Protect streambanks, wetlands, and riparian areas from degradation through vegetated buffers; **and** **Gullies and/or shallow landslides:** Manage non-grazing agricultural practices to allow for natural recovery of gullies and/or landslides, prevent human-caused increases in sediment delivery from unstable areas, and decrease connectivity of gullies to stream channels; **and** **Effectively attenuate significant increases in storm runoff**, so that the runoff from non-grazing agricultural lands shall not cause or contribute to downstream increases in rates of bank or bed erosion.	**PLANNING AND PRIORITIZING** Inventory and assess natural resources, agricultural lands, and management practices that may deliver sediment to streams. Evaluate stream and riparian corridors for opportunities for improving habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions. **EITHER** Submit a Report of Waste Discharge (ROWD) to the Water Board that provides, at a minimum, the following: a description of the land; identification of site-specific erosion control measures needed to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs. Develop and begin implementing an erosion control plan that would be approved as part of WDRs or waiver of WDRs.	Non-grazing agricultural land owner and/or operator of properties ≥5 acres	3 years from effective date of this Basin Plan amendment 5 years from effective date of this Basin Plan amendment As specified in applicable WDRs or waiver of WDRs

Table 7.4.2-7 Required TMDL Implementation Measures for Sediment Discharges Associated with Grazing Lands of 50 Acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
GRAZING LANDS	**Surface erosion associated with livestock grazing**: Attain or exceed minimal residual dry matter (RDM) values consistent with University of California Division of Agriculture and Natural Resources Guidelines[1]; **and** **Stream corridors:** Protect streambanks, wetlands, and riparian areas from degradation through grazing management, livestock access controls, and vegetated buffers; **and** **Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Gullies and/or shallow landslides:** Manage grazing practices to allow for natural recovery of gullies and/or landslides, prevent human-caused increases in sediment delivery from unstable areas, and decrease connectivity of gullies to stream channels.	**PLANNING AND PRIORITIZING** Inventory and assess natural resources, agricultural practices, and management practices that may deliver sediment to streams. Evaluate stream and riparian corridors and water bodies for opportunities for improving habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions for farm owner(s). **EITHER** Submit a ROWD to the Water Board that provides, at a minimum, the following: description of the property/ranch and road network; identification of site-specific erosion control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs. Develop and begin implementing Grazing Management plan that would be approved as part of WDRs or waiver of WDRs.	Landowner and/or ranch operator of properties ≥50 acres	3 years from effective date of this Basin Plan amendment 5 years from effective date of this Basin Plan amendment As specified in applicable WDRs or waiver of WDRs

[1] University of California 2002, California guidelines for residual dry matter (RDM) management on coastal and foothill annual rangelands. Rangeland Monitoring Series Publication 8092.

Table 7.4.2-8 Required TMDL Implementation Measures for Sediment Discharges associated with San Mateo County

Landowner Type	Performance Standards	Actions	Implementing Parties	Completion Dates
SAN MATEO COUNTY	**Roads:** Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Gullies and/or shallow landslides:** Promote natural recovery and minimize human-caused increases in sediment delivery from unstable areas. Manage existing roads and other infrastructure to prevent additional erosion of legacy sediment delivery sites and/or delivery from potentially unstable areas.	**PLANNING AND PRIORITIZING** Comply with NPDES Permit No. CAS612008 (also referred to as the Municipal Regional Stormwater Permit). **AND** Create an inventory of roads that may contribute to sediment delivery to streams and develop a prioritized list and schedule of actions. Where performance standards are not achieved or where road-related sediment sources are not covered by NPDES Permit No. CAS612008, do one of the following: **EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the road network and/or segments; identification of erosion and sediment control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified control measures. For paved roads, erosion and sediment control actions could primarily focus on road crossings to meet the performance standard. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.	San Mateo County	3 years from effective date of this Basin Plan amendment 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-9 Required TMDL Implementation Measures for Sediment Discharges associated with Parks and Open Space Lands

Landowner Type	Performance Standards	Actions	Implementing Parties	Completion Dates
PARKS/OPEN SPACE LANDS	**Roads:** Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Gullies and/or shallow landslides:** Promote natural recovery and minimize human-caused increases in sediment delivery from unstable areas. Manage existing roads and other infrastructure to prevent additional erosion of legacy sediment delivery sites and/or delivery from potentially unstable areas.	**PLANNING AND PRIORITIZING** Adopt and implement best management practices for maintenance of unpaved (dirt/gravel) roads, conduct a survey of stream-crossings associated with unpaved public roadways, and develop a prioritized implementation plan and schedule for repair and/or replacement of high priority crossings/culverts to reduce road-related erosion and protect stream-riparian habitat conditions. **EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the road network and/or segments; identification of erosion and sediment control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified control measures. For paved roads, erosion and sediment control actions could primarily focus on road crossings to meet the performance standard. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.	State of California, Department of Parks and Recreation MidPeninsula Open Space District Peninsula Open Space Trust	3 years from effective date of this Basin Plan amendment 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-10 Required TMDL Implementation Measures for Sediment Discharges Associated with Timber Lands of 100 acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
TIMBER LANDS	**Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Gullies, shallow landslides, and/or unstable areas:** Manage operations (e.g., tree removal (felling), hauling of trees, road construction, heavy equipment use) to prevent additional erosion of legacy sediment delivery sites, and/or delivery from other potentially unstable areas, and to decrease connectivity of gullies to stream channels.	Comply with California Forest Practice Rules, Anadromous Salmonid Protection Rules, and Road Rules or other requirements to control sediment sources from timber harvest operations that are provided by the Water Board. **PLANNING AND PRIORITIZING** Inventory and assess natural resources and management practices that may contribute to sediment delivery to streams. Evaluate stream and riparian corridors and water bodies for opportunities to improve habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions for timberland owner(s). **EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the property road network; identification of site-specific erosion control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with other applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.	Landowner and/or timber lands operator of properties ≥100 acres	Ongoing 3 years from effective date of this Basin Plan amendment 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-11 Recommended Actions to Reduce Sediment Load and Enhance Habitat Complexity in Pescadero and Butano Creeks and Their Tributaries

Stressor	Management Objective(s)	Actions	Implementing Parties	Completion Dates
Habitat degradation as a result of incision along Pescadero and Butano creeks and their tributaries.	Reduce rates of sediment delivery (associated with incision) to channels, by 78 percent. Increase sediment storage in the channels and on the floodplains. Enhance channel habitat complexity and connectivity as needed to support self-sustaining run of steelhead and coho salmon and enhance the overall health of the native fish community.	Develop detailed technical studies to characterize reach-specific opportunities and priorities for floodplain restoration. Develop and implement plans to enhance stream-riparian habitat conditions and channel complexity. Comply with conditions of Clean Water Act section 401 certifications in the implementation of projects to increase channel-floodplain connectivity	State and local government agencies, landowners and/or designated agents, and reach-based stewardships	Technical studies to characterize reach specific opportunities and priorities for floodplain restoration will be completed within 5 years of Basin Plan amendment.
Habitat degradation as a result of reduction in large woody debris in stream channels.	Enhance quality of rearing habitat for juvenile salmonids.	Develop and implement plans to enhance large woody debris loading and restore natural rates of recruitment to channels, as needed to achieve numeric targets for large woody debris loading. This plan will include a survey to quantify baseline values for large woody debris loading. Comply with conditions of Clean Water Act section 401 certifications in the implementation of projects for large woody debris loading and recruitment.	State and local government agencies, landowners and/or designated agents, and reach-based stewardships	Targets for large woody debris loading will be achieved within 10 years of Basin Plan amendment adoption.

Appendix B

Proposed Basin Plan Amendment

showing changes since January 12, 2018

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Changes to the January 12, 2018, version circulated for public comment are shown with underline representing new text and strike-through representing deleted text.

PROPOSED BASIN PLAN AMENDMENT

The following text is to be inserted into Chapter 7: Water Quality Attainment Strategies Including Total Maximum Daily Loads.

7.4.2 Pescadero-Butano Watershed Sediment TMDL and Habitat Enhancement Plan

This sediment ~~Total Maximum Daily Load (~~TMDL~~)~~ and habitat enhancement plan address the impairments to beneficial uses in Pescadero and Butano creeks. The following sections establish:

- The sediment TMDL, which identifies the allowable annual sediment load that can be discharged into the Pescadero-Butano watershed, expressed as a percentage of the natural background sediment delivery rate to channels; and
- An implementation plan to achieve the TMDL and habitat enhancement goals.

The goals of the Pescadero-Butano Watershed Sediment TMDL and Habitat Enhancement Plan are as follows:

- To restore water quality and attain beneficial uses.
- To conserve the steelhead trout population.
- To restore a self-sustaining coho salmon population.
- To improve water quality and habitat for native fish and aquatic wildlife species communities.

The TMDL and the implementation plan address the significant increases in sediment supply to channels, as well as simplification, loss, and/or reduction in the quality and quantity of instream habitat for listed populations of salmonids in the Pescadero-Butano watershed. To attain water quality objectives and restore properly functioning channels and habitat, the TMDL calls for actions throughout the watershed to substantially reduce sediment supply to channels and, where safe and feasible, reconnect the channels to their floodplains and enhance channel complexity by adding and retaining large woody debris in channels.

This TMDL focuses on the ~~sediment impairment~~implementation actions within the channel network upstream of the Pescadero lagoon and marsh complex, located at the watershed-ocean interface, and does not address other water quality issues~~include implementation actions~~ specific to the Pescadero lagoon and marsh complex. However, achievement of this TMDL is a necessary step to help restore water quality and beneficial uses throughout the watershed, including the lagoon and marsh.

7.4.2.1 Problem Statement

Populations of steelhead and salmon in the Pescadero-Butano watershed have declined substantially over the last century due to progressive changes in land use resulting in excess sediment in the channels and degradation of channel habitat. Land clearing, timber harvesting, legacy grazing and agricultural practices, channel modifications, and roads have: i) increased hillslope erosion; ii) doubled annual sediment supply to channels; iii) resulted in deep incision of Pescadero and Butano creeks and their tributaries; and iv) eliminated sediment storage along the channel and on the floodplains.

Pescadero and Butano creeks are impaired by excess erosion and sedimentation such that the narrative water quality objectives for sediment and settleable material are not being met, and cold freshwater habitat, ~~warm freshwater habitat,~~ wildlife habitat, fish spawning and migration, contact and non-contact recreation, and preservation of rare and endangered species beneficial uses are impaired. In addition, the narrative water quality objective for population and community ecology is not being met due to channel incision**,** which is a significant sediment source and ~~causes~~ results in habitat simplification and floodplain disconnection. Channel incision ~~is a~~ and associated simplification of habitat are primary causes of the decline of coho salmon and steelhead trout populations and ~~is a~~ are controllable water quality factors.

Habitat conditions are degraded by elevated concentrations of fine sediment in the streambed (primarily sand) – caused by pervasive alteration of sediment supply, transport, and storage, which further reduces juvenile salmonid growth and survival in all freshwater life stages. Excess amounts of fine sediment have been deposited on the streambed at potential steelhead spawning and rearing sites. Excess fine sediment in the streambed can cause poor incubation for fish eggs, resulting in high mortality prior to emergence. Fine sediment has also compromised the quality of pools as rearing habitat and reduced winter rearing habitat by filling the spaces between cobbles and boulders.

Channel incision has severely impacted the basic physical habitat structure of the channel and has caused habitat simplification expressed by a substantial reduction in the frequency and area of gravel bars, riffles, and side channels. Channel incision has isolated channels from their floodplains: floodplains no longer function as sediment storage sites and are lost as excellent rearing and refuge habitats for juvenile salmon and steelhead. In addition, a substantial reduction in the amount of large woody debris in channels has greatly diminished the capacity for the creeks to store, sort, and meter sediment, as well as the quality and diversity of freshwater channel habitats. Lastly, significant and persistent increases in sediment supply and loss of floodplains have contributed to an order-of-magnitude increase in the sedimentation rate in the Pescadero lagoon and marsh, adversely impacting water quality.

7.4.2.2 Numeric Targets

The numeric targets for the TMDL to achieve the Basin Plan's water quality objectives for sediment, settleable material, and population and community ecology are listed in Table 7.4.2-1.

Table 7.4.2-1 Sediment TMDL and Habitat Targets for ~~the~~ Pescadero and Butano Creeks and Their Tributaries

Sediment Condition Target	
Residual Pool Volume (V*) A unitless measure of the fraction of a pool's volume that is filled by fine sediment	Mean value ≤ 0.21 Maximum value ≤0.45
Substrate Composition	≤ 14% fines < 0.85 millimeter (mm), i.e., percent fines less than 0.85 mm in diameter is less than or equal to 14% of the total bulk core sample ≤ 30% fines < 6.40 mm
Habitat Condition Target	
Large Woody Debris (LWD) loading in Redwood Channels	≥ 300 cubic meters per hectare of bankfull channel area (m^3/ha)
LWD loading in Hardwood Channels	≥ 100 m^3/ha
Redwood channels are defined as those where the adjacent valley floor and/or hillslopes are vegetated primarily by coast redwood forest. Hardwood channels are defined as those where the adjacent valley flat is vegetated by a hardwood forest (typically some combination of willow species, white alder, California bay laurel, bigleaf maple, tan oak, and/or Oregon ash). The large woody debris loading targets apply to channel reaches that provide actual or potential spawning habitat for anadromous salmonids as defined above.	

7.4.2.3 Sediment Sources

Field inventories and sediment modeling conducted throughout the Pescadero-Butano watershed provide credible estimates of the average rate of sediment delivery to channels between 1970 and 2010. Based on this work (Table 7.4.2-2), the Water Board concludes:

1. Sediment delivery to fish-bearing channels has doubled in the last 150 years as compared to the natural background ~~the~~ rate. More than half of the fine sediment delivered to ~~the~~ Pescadero and Butano creeks and their tributaries is associated with land use activities, including roads, human-caused channel incision, and legacy effects of intensive historical livestock grazing and timber harvesting.
2. The average annual rate of sediment supply to channels in the watershed is 1,200 tons per km^2 per year.
3. More than 40,000 tons of sediment that historically deposited annually on floodplains and alluvial valley (one third of the total sediment delivered from the watershed) is now transported downstream to the Pescadero lagoon and marsh complex due to channel incision. Therefore, not only has this significant storage function along the floodplains and alluvial valley ~~has~~ been lost, but the valley itself is now a significant sediment source.

4. Contributions of sediment from municipal and construction stormwater runoff are small in comparison to other sources and are estimated to be about 500 tons per year.

Table 7.4.2-2 Mean Annual Sediment Delivery to the Pescadero-Butano Watershed (tons/year)

Sediment Source Category	Natural Background Annual Delivery Rate (tons/year)	Current Mean Annual Delivery Rate (tons/year)
Sediment Sources		
▪ Natural Processes:	**120,000**	**120,000**
▪ Human Actions:		
• Roads		51,000
• Channel incision		30,000
• Gullying on grasslands		24,000
• Landslides and debris flows		23,000
• Surface erosion on grasslands		~~5,000~~ 4,500
Total from Human Actions		**~~133,000~~ 132,500**
TOTAL		**~~253,000~~ 252,500**

7.4.2.4 Total Maximum Daily Load and Allocations

The Pescadero-Butano watershed sediment TMDL is 150,000 tons per year, or 125 percent of the estimated natural background load and applies to Pescadero and Butano creeks and their tributaries. In order to achieve the TMDL, controllable sediment delivery resulting from human actions needs to be reduced by approximately 78 percent (Table~~s 3A~~ 7.4.2-3).

Attainment of the TMDL will be evaluated immediately downstream of the confluence of Pescadero and Butano creeks at the upstream boundary of the Pescadero marsh and lagoon complex. Attainment of the TMDL will be evaluated using a 10-year averaging period.

Table 7.4.2-3 Load Allocations

Source Category	Current Load	Estimated Percentage Reductions Needed	Load Allocations	
	tons/year	Percent	tons/year	Percent of Natural Background
▪ Natural processes	120,000	0	120,000	100
▪ Human actions:				
- Roads*	51,000	78	11,500	9.5
- Channel incision	30,000	78	6,600	5.5
- Gullies	24,000	78	5,300	4.4
- Landslides	23,000	78	~~5,000~~ 5,100	~~4.1~~ 4.2
- Surface erosion grasslands	~~5,000~~ 4,500	78	~~1,100~~ 1,000	~~0.9~~ 0.8
TOTAL	**~~253,000~~ 252,500**		**149,500**	**124.4**

*Approximately 15% of the allowable load for roads is allocated to San Mateo County~~ Parks and San Mateo County Public Works.~~

Table 7.4.2-4 Wasteload Allocations for Stormwater Runoff

Source Category	Current Load	Percent Reductions Needed	Wasteload Allocations	
	tons/year		tons/year	Percent of Natural Background
▪ San Mateo County ~~per~~ Municipal Stormwater NPDES Permit No. CAS612008	300	0	300	0.3
▪ Construction Stormwater NPDES Permit No. CAS000002	150	0	150	0.3
▪ CalTrans Stormwater NPDES Permit No. CAS000003	<50	0	50	0
TOTAL	**~~450~~500**	**0**	**500**	**0.6**

7.4.2.5 Implementation Plan

The actions described below are necessary to achieve TMDL targets, allocations, performance standards, and habitat enhancement goals within twenty years of the effective date of the Basin Plan amendment.

Stormwater Runoff

Stormwater runoff from State highways and municipal and construction stormwater runoff are the only known point sources of sediment to the Pescadero-Butano watershed and have small wasteload allocations (Table 7.4.2-4) relative to nonpoint sources of sediment. These sources are regulated under existing NPDES permits that include requirements to control erosion, sedimentation, and hydromodification from new development and requirements to maintain rural roads. Table ~~4~~ 7.4.2-5 shows implementation measures required for these sources. Implementation to address reductions in loading for sediment discharges associated with roads under the jurisdiction of San Mateo County and the San Mateo County Flood Control District are included here.

Table 7.4.2-5 TMDL Implementation Measures for Sediment Discharges Associated with Stormwater Runoff and Roads

Source Category	Actions	Implementing Parties
Stormwater Runoff CalTrans, Construction	Comply with applicable NPDES permits	CalTrans Owners or operators of construction projects > 1 acre
Stormwater Runoff and Roads Municipal	Comply with applicable NPDES permits	San Mateo County ~~San Mateo County Flood Control District~~

Nonpoint Sources

The State's 2004 Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program provides for regulation of nonpoint source discharges using the Water Board's administrative permitting authorities, including WDRs, waiver of WDRs, Basin Plan Discharge Prohibitions, or some combination of these. Consistent with this policy, Tables ~~5~~7.4.2-6 through ~~10~~7.4.2-11 specify actions and performance standards by nonpoint source category, as needed to achieve TMDL targets and allocations in the Pescadero-Butano watershed. The Water Board will consider adopting permits that apply to the nonpoint sources from roads, grazing lands, non-grazing agricultural lands, and/or timberlands listed in Tables ~~5~~7.4.2-6 through ~~9~~7.4.2-10. Individual landowners or coalitions may work with "third parties," such as the San Mateo Resource Conservation District~~s~~, to develop and implement sediment pollutant control programs.

Habitat Enhancement

Channel incision, loss of sediment storage function, and loss of essential habitat features are the result of multiple historical and ongoing disturbances. This implementation plan calls for habitat enhancement actions. A channel and habitat restoration program that increases woody debris and re-establishes width-to-depth ratios and a modest flood plain will be the most effective means of controlling channel

incision and reducing related sediment delivery to the creeks. Floodplains and large woody debris jams would provide essential high-quality rearing habitats and enhance food production for coho salmon and steelhead. These features also help create pools, reduce scouring, store sediment, and diversify habitat types within the stream. The habitat enhancement program, presented in Table ~~10~~7.4.2-11, will therefore focus on actions to: (1) to the extent safe and feasible, substantially increase the amount of large woody debris in channels that run through public lands and timber harvest lands; and (2) study safe and feasible opportunities for floodplain restoration in channel reaches on private lands. The effectiveness of implementation of actions specified in Table ~~10~~7.4.2-11 to enhance habitat will be evaluated as part of the adaptive implementation program.

7.4.2.6 Agricultural Water Quality Program Costs

The ~~I~~implementation measures in Tables ~~5~~7.4.2-6 and ~~6~~7.4.2-7 for ~~located on~~ grazing and agricultural land constitute an agricultural water quality control program, and, therefore, consistent with Water Code ~~requirements (S~~section 13141~~)~~, the cost of this program is estimated herein. This cost estimate includes the cost of implementing all road-related and surface erosion-related sediment control measures specified in the implementation plan and is based on costs associated with technical assistance, project design, and implementation of actions needed to achieve the TMDL.

There are no other costs to farmers or ranchers associated with actions to enhance channel habitat complexity and floodplain connection, because participation by private landowners is voluntary, and almost all of the costs of these projects are expected to be paid for from grants by public agencies and/or non-profits. In estimating costs, the Water Board estimated ~~assumed~~ that owners of grazing and non-grazing agricultural businesses own up to 20 ~~40~~ percent of the total land area ~~on hillside parcels~~. The Water Board estimates that the total cost to agricultural businesses associated with efforts to reduce sediment supply to Pescadero and Butano creeks watershed is $200,000 to $300,000 per year.

7.4.2.7 Evaluation and Monitoring

Water Board staff, working in partnership with other entities, e.g., San Mateo County and the San Mateo County Resource Conservation District, will conduct baseline monitoring to document existing residual pool volumes (V*), substrate composition, and woody debris loadings along representative reaches. In addition to baseline conditions monitoring, the following monitoring is necessary:

1) Implementation monitoring to document actions taken on individual properties to reduce fine sediment discharge and enhance habitat complexity and connectivity;

2) Upslope effectiveness monitoring to evaluate effectiveness of sediment control actions in reducing rates of sediment delivery to channels on a subwatershed basis; and

3) In-channel effectiveness monitoring (e.g., pool filling and substrate composition) to evaluate channel response to management actions and natural processes.

Implementation monitoring will be conducted by landowners or designated agents to document that sediment control actions, i.e., best management practices ~~are implemented,~~ as specified herein, occur. ~~in applicable waivers of WDRs, WDRs and NPDES permits.~~

The Water Board anticipates working in partnership with the implementing parties to conduct upslope effectiveness monitoring to reevaluate rates of sediment delivered to channels from land use activities and natural processes.

In-channel effectiveness monitoring should be conducted by the Water Board and local partners with scientific expertise and demonstrated capability in working effectively with private property owners (to gain permissions for access), as needed to develop a representative sample of stream habitat conditions, in relation to sediment supply and transport within the watershed. In-channel effectiveness monitoring is needed to evaluate: a) progress toward achieving water quality targets, and b) channel response to management measures and natural processes. The main parameters that will be monitored to assess progress toward achieving water quality targets are residual pool volume and substrate composition.

The Water Board, working in partnership with other entities, such as the San Mateo County Resource Conservation District and other ~~or~~ organizations with scientific expertise, will assess large woody debris loading in channels to evaluate attainment of the numeric targets for large woody debris loading and to guide development of reach-specific prescriptions for installation of engineered log jams and riparian management actions to ~~maintain or exceed~~attain the target values in future years through natural recruitment.

Desired measurement frequency for pool filling, substrate composition, and large woody debris is once every five years.

7.4.2.8 Adaptive Implementation

Adaptive implementation entails taking actions commensurate with existing, available information, reviewing new information as it becomes available, and modifying actions as necessary based on the new information. ~~The~~ Water Board staff will evaluate and report to the Water Board on the progress of implementation of the TMDL and habitat enhancement actions periodically ~~annually~~ and will evaluate the need for amending the TMDL within 10 years of the effective date of the TMDL.

Key questions to be considered in the course of adaptive implementation:

- What is the population status of steelhead and coho salmon in the watershed? Do numbers of steelhead and coho salmon increase as sediment reduction and habitat enhancement measures are implemented? An improved understanding of the status of steelhead and salmon populations in the Pescadero-Butano watershed is essential for guiding adaptive updates to the management actions recognized in this plan.
- Are Pescadero and Butano creeks and their tributaries progressing toward TMDL targets and performance standards as expected? If there is a lack of adequate progress, how might the implementation actions, targets, performance standards, or allocations be modified?
- Are the specified sediment reduction measures and recommended habitat enhancement measures resulting in an improving trend in channel habitat quantity and quality?

- Are there new data or information available that warrant revision of water quality targets, allocations, or implementation measures?

Table 7.4.2-6 Required TMDL Implementation Measures for Sediment Discharges Associated with Non-Grazing Agricultural Lands of 5 Acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
NON-GRAZING AGRICULTURAL LANDS	~~**Surface Erosion**: Control excessive rates of sediment delivery to channels resulting from surface erosion from non-grazing agricultural lands; **and**~~ **Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips at culverted crossings that have a diversion potential; **and** **Stream corridors:** Protect streambanks, wetlands, and riparian areas from degradation through vegetated buffers; **and** **Gullies and/or shallow landslides:** Manage non-grazing agricultural practices to allow for natural recovery of gullies and/or landslides, prevent human-caused increases in sediment delivery from unstable areas, and decrease connectivity of gullies to stream channels; **and** **Effectively attenuate significant increases in storm runoff**, so that the runoff from non-grazing agricultural lands shall not cause or contribute to downstream increases in rates of bank or bed erosion.	~~Complete a comprehensive inventory and assessment of natural resources, agricultural lands, and management practices documenting all sediment sources and evaluating stream and riparian corridors and water bodies through a farm planning process.~~ **PLANNING AND PRIORITIZING** Inventory and assess natural resources, agricultural lands, and management practices that may deliver sediment to streams. Evaluate stream and riparian corridors for opportunities for improving habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions. **~~AND~~ EITHER** Submit a Report of Waste Discharge (ROWD) to the Water Board that provides, at a minimum, the following: a description of the land; identification of site-specific erosion control measures needed to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs. Develop and begin implementing an erosion control plan that would be approved as part of WDRs or waiver of WDRs.	Non-grazing agricultural land owner and/or operator of properties ≥5 acres	~~January 2021~~ 3 years from effective date of this Basin Plan amendment ~~January 2023~~ 5 years from effective date of this Basin Plan amendment As specified in applicable WDRs or waiver of WDRs

Table 7.4.2-7 Required TMDL Implementation Measures for Sediment Discharges Associated with Grazing Lands of 50 Acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
GRAZING LANDS	**Surface erosion associated with livestock grazing**: Attain or exceed minimal residual dry matter (RDM) values consistent with University of California Division of Agriculture and Natural Resources Guidelines[1]; **and** **Stream corridors:** Protect streambanks, wetlands, and riparian areas from degradation through grazing management, livestock access controls, and vegetated buffers; **and** **Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips ~~installed~~ at culverted crossings that have a diversion potential; **and** ~~**Gullies and/or shallow landslides:** Manage existing grazing operations, stock ponds, and roads to prevent additional erosion of legacy sediment delivery sites, and/or delivery from other potentially unstable areas, and decrease connectivity of gullies to stream channels.~~ **Gullies and/or shallow landslides:** Manage grazing practices to allow for natural recovery of gullies and/or landslides, prevent human-caused increases in sediment delivery from unstable areas, and decrease connectivity of gullies to stream channels.	~~Complete a comprehensive inventory and assessment of natural resources, agricultural practices, and management practices documenting all sediment sources and evaluating stream and riparian corridors and water bodies through a farm planning process.~~ **PLANNING AND PRIORITIZING** Inventory and assess natural resources, agricultural practices, and management practices that may deliver sediment to streams. Evaluate stream and riparian corridors and water bodies for opportunities for improving habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions for farm owner(s). **~~AND~~ EITHER** Submit a ROWD to the Water Board that provides, at a minimum, the following: description of the property/ranch and road network; identification of site-specific erosion control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs. Develop and begin implementing Grazing Management plan that would be approved as part of WDRs or waiver of WDRs.	Landowner and/or ranch operator of properties ≥50 acres	~~January 2021~~ 3 years from effective date of this Basin Plan amendment ~~January 2023~~ 5 years from effective date of this Basin Plan amendment As specified in applicable WDRs or waiver of WDRs

[1] University of California 2002, California guidelines for residual dry matter (RDM) management on coastal and foothill annual rangelands. Rangeland Monitoring Series Publication 8092.

Table 7.4.2-8 Required TMDL Implementation Measures for Sediment Discharges associated with ~~the~~ San Mateo County

Landowner Type	Performance Standards	Actions	Implementing Parties	Completion Dates
SAN MATEO COUNTY/~~PARKS/PUBLIC WORKS~~	**Roads:** Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips ~~installed~~ at culverted crossings that have a diversion potential; **and** **Gullies and/or shallow landslides:** Promote natural recovery and minimize human-caused increases in sediment delivery from unstable areas. Manage existing roads and other infrastructure to prevent additional erosion of legacy sediment delivery sites and/or delivery from potentially unstable areas.	**PLANNING AND PRIORITIZING** Comply with ~~the~~ NPDES Permit No. CAS612008 (also referred to as the Municipal Regional Stormwater Permit). **AND** Create an inventory of roads that may contribute to sediment delivery to streams and develop a prioritized list and schedule of actions. Where performance standards are not achieved or where road-related sediment sources are not covered by NPDES~~the~~ Permit No. CAS612008, do one of the following: **~~AND~~ EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the road network and/or segments; identification of erosion and sediment control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified control measures. For paved roads, erosion and sediment control actions could primarily focus on road crossings to meet the performance standard. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.	San Mateo County ~~San Mateo County Parks Department~~ ~~San Mateo County Public Works~~	~~January 2021 through January 2038~~ 3 years from effective date of this Basin Plan amendment ~~January 2023~~ 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-9 Required TMDL Implementation Measures for Sediment Discharges associated with Parks and Open Space Lands

Landowner Type	Performance Standards	Actions	Implementing Parties	Completion Dates
PARKS/OPEN SPACE LANDS~~/PUBLIC WORKS~~	**Roads:** Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips ~~installed~~ at culverted crossings that have a diversion potential; **and** **Gullies and/or shallow landslides:** Promote natural recovery and minimize human-caused increases in sediment delivery from unstable areas. Manage existing roads and other infrastructure to prevent additional erosion of legacy sediment delivery sites and/or delivery from potentially unstable areas.	**PLANNING AND PRIORITIZING** Adopt and implement best management practices for maintenance of unpaved (dirt/gravel) roads, ~~and~~ conduct a survey of stream-crossings associated with unpaved public roadways, and develop a prioritized implementation plan and schedule for repair and/or replacement of high priority crossings/culverts to reduce road-related erosion and protect stream-riparian habitat conditions. **~~AND~~ EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the road network and/or segments; identification of erosion and sediment control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified control measures. For paved roads, erosion and sediment control actions could primarily focus on road crossings to meet the performance standard. **OR** Comply with applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.	State of California, Department of Parks and Recreation MidPeninsula Open Space District Peninsula Open Space Trust	~~January 2021~~ 3 years from effective date of this Basin Plan amendment ~~January 2023~~ 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-10 Required TMDL Implementation Measures for Sediment Discharges Associated with Timber Lands of 100 acres or Greater

Land Use	Performance Standards	Actions	Implementing Parties	Completion Dates
TIMBER LANDS	**Roads**: Design, construct, and maintain roads to i) reduce road-related sediment delivery to channels to ≤ 500 cubic yards per mile per 20-year period; **and** ii) limit the length of roads that are hydrologically connected to 25 percent of total road length; **and** iii) ensure culvert inlets have low plug potential; **and** iv) install critical dips ~~installed~~ at culverted crossings that have a diversion potential; **and**	Comply with California Forest Practice Rules, Anadromous Salmonid Protection Rules, and Road Rules or other requirements to control sediment sources from timber harvest operations that are provided by the Water Board. **PLANNING AND PRIORITIZING** Inventory and assess natural resources and management practices that may contribute to sediment delivery to streams. Evaluate stream and riparian corridors and water bodies for opportunities to improve habitat. Develop and submit a report acceptable to the Executive Officer that includes a prioritized list and schedule of actions for timberland owner(s).	Landowner and/or timber lands operator of properties ≥100 acres	Ongoing 3 years from effective date of this Basin Plan amendment
	Gullies, shallow landslides, and/or unstable areas: Manage operations (e.g., tree removal (felling), hauling of trees, road construction, heavy equipment use~~, etc.~~) to prevent additional erosion of legacy sediment delivery sites, and/or delivery from other potentially unstable areas, and to decrease connectivity of gullies to stream channels.	~~**AND**~~ **EITHER** Submit a Report of Waste Discharge to the Water Board that provides, at a minimum, the following: description of the property road network; identification of site-specific erosion control measures to achieve performance standard(s) specified in this table; and a schedule for implementation of identified erosion control measures. **OR** Comply with other applicable Waste Discharge Requirements (WDRs) or waiver of WDRs.		~~January 2023~~ 5 years from effective date of this Basin Plan amendment As specified in in applicable WDRs or waiver of WDRs

Table 7.4.2-11 Recommended Actions to Reduce Sediment Load and Enhance Habitat Complexity in Pescadero and Butano Creeks and Their Tributaries

Stressor	Management Objective(s)	Actions	Implementing Parties	Completion Dates
Habitat degradation as a result of incision along Pescadero and Butano creeks and their tributaries.	Reduce rates of sediment delivery (associated with incision) to channels, by 78 percent. Increase sediment storage in the channels and on the floodplains. Enhance channel habitat complexity and connectivity as needed to support self-sustaining run of steelhead and coho salmon and enhance the overall health of the native fish community.	Develop detailed technical studies to characterize reach-specific opportunities and priorities for floodplain restoration. Develop and implement plans to enhance stream-riparian habitat conditions and channel complexity. Comply with conditions of Clean Water Act section 401 certifications in the implementation of projects to increase channel-floodplain connectivity	State and local government agencies, landowners and/or designated agents, and reach-based stewardships	Technical studies to characterize reach specific opportunities and priorities for floodplain restoration will be completed within 5 years of Basin Plan amendment.
Habitat degradation as a result of reduction in large woody debris in stream channels.	Enhance quality of rearing habitat for juvenile salmonids.	Develop and implement plans to enhance large woody debris loading and restore natural rates of recruitment to channels, as needed to achieve numeric targets for large woody debris loading. This plan will include a survey to quantify baseline values for large woody debris loading. Comply with conditions of Clean Water Act section 401 certifications in the implementation of projects for large woody debris loading and recruitment.	State and local government agencies, landowners and/or designated agents, and reach-based stewardships	Targets for large woody debris loading will be achieved within 10 years of Basin Plan amendment adoption.

Appendix C

Staff Report

June 13, 2018

available electronically at:

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/pescaderobutanocrkstmdl.html

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Appendix D

Responses to Comments

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PART I

Staff Response to Written Comments on the January 10, 2018 Draft Staff Report and Proposed Basin Plan Amendment

We received twelve comment letters during the public comment period, which began on January 10 and, after granting an extension request, closed on March 14, 2018. The comments are numbered, summarized, and presented with our responses. Appendix E contains the comment letters with the entire comment delineated and numbered to correspond to the summarized comment herein.

Comment letters received:

1. Big Creek Lumber Company (BC, Janet McCrary Webb)
2. California Department of Fish and Wildlife (CDFW, Greg Erickson)
3. California Trout (CT, Patrick Samuel)
4. Farm Bureau (FB, BJ Burns)
5. Midpeninsula Regional Open Space District (Midpen, Aaron Hébert)
6. National Marine Fisheries Service (NMFS, Alecia Van Atta)
7. Peninsula Open Space Trust (POST, Daniel Olstein)
8. San Mateo County Resource Conservation District (RCD, Kellyx Nelson)
9. Redwood Empire (RE, Michael J. Duffy)
10. County of San Mateo (SMC, Jim Eggemeyer)
11. Tom Gandesbery, State Coastal Conservancy (TG, Tom Gandesbery)
12. Trout Unlimited (TU, Tim Frahm)

Comment Letter No. 1: Big Creek Lumber Company (BC)

Comment BC-1: The Commenter states that a state-approved Timber Harvest Plan (THP) is the functional equivalent of an Environmental Impact Report and that the objectives the Regional Board seeks to accomplish with the TMDL process are procedurally addressed in the THP permitting process.

Response: While THPs can include actions that will minimize sediment transport, they only cover a small percentage of timberlands. The TMDL implementation plan contains performance standards for all the roads in timberlands to address road-related sediment sources that are actively delivering significant amounts of sediment to channels. Because THPs address only a small portion of all timberlands in the Watershed, we cannot rely on implementation of THPs alone to meet the performance standards.

Comment BC.2: Since acquiring the property, Big Creek has systematically addressed legacy land issues. Addressing these legacy issues has proven costly. Infrastructure improvements on the Butano property are solely possible because of the forest management activities that occur there.

Response: Comment noted. We appreciate the actions Big Creek has taken to improve water quality and enhance aquatic habitat.

Comment BC-3: The Commenter states that their current practices are specifically designed to meet the objectives of the TMDL but that documenting how Big Creek's actions comply with the standards of the TMDL will involve considerable expense. Resources are best spent on making improvements in the forest rather than on additional documentation. This is particularly true for owners of small timber properties, who don't typically have sufficient resources to devote to such an effort. They caution against a regulatory approach that imposes a burden for small landowners, as such a burden would only serve as a disincentive to continue forest management.

Response: In response to this comment on the potential burden on small landowners, we have revised the Basin Plan amendment and Draft Staff Report to include a threshold of 100 acres timberland for TMDL implementation. We evaluated the 100-acre threshold and the data indicate that parcels below this threshold do not significantly contribute to excess fine sediment delivery. See also our response to Redwood Empire comment RE-4.

Comment BC-4: Modify language in the implementation tables for timberlands (Basin Plan Table 9). Consider changing "identification of site-specific erosion control measures to achieve performance standard(s) specified in this table" to "identification of site-specific erosion control measures to achieve the *objectives* of the performance standards specified in this table..."

Response: While we do not agree that the language in the Basin Plan amendment warrants changing, we remain interested in collaborating with implementing parties so that the objectives of the TMDL can be met in a timely and cost-effective manner.

Comment BC.5: The Commenter states that while timberland owners are already implementing good stewardship practices under existing law, they understand the Water Board's obligation to adopt the TMDL and urge the TMDL be crafted to not inadvertently discourage the kind of forest management that will yield further improvements.

Response: Comment noted.

Comment Letter No. 2: California Department of Fish and Game (CDFW)

Some of CDFW's specific comments, addressed below, focus on the Pescadero marsh and lagoon, including comments asking for clarification on the lagoon habitat condition, the linkage between sedimentation and water quality, and tidal prism. This TMDL includes implementation actions to address sediment sources in the watershed to decrease sediment loads, reduce channel incision, and improve habitat complexity in Pescadero and Butano creeks, which will also be beneficial to the marsh and lagoon. The TMDL is not intended to address other water quality issues within the marsh and lagoon, which is a separate project that we are currently working on collaboratively with State Parks, CDFW and other resource agencies and stakeholders.

Comment CDFW-1: Warm water fish habitat should not be considered a beneficial use in the Pescadero-Butano Watershed. The Commenter is concerned that warm water fish habitat supports non-native and invasive species that are detrimental to salmonids.

Response: The Basin Plan designates Pescadero and Butano Creeks as having the WARM beneficial use, which refers to uses of water that support warm water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates. This is a presumptive use under the Clean Water Act, meaning that it is presumed to exist in all waterbodies. The intent of the use is not to support non-native or invasive fish species. However, this use isn't impaired by excess sediment, therefore we have eliminated it from Table 1 in the Staff Report.

Comment CDFW-2: Please clarify in the Staff Report that, despite sediment impairment of the creeks, growth conditions continue to be exceptional in the Pescadero Lagoon.

Response: Based on the information provided by CDFW, we revised the Staff Report, Section 1.1, page 10 to state: "Elevated sediment loads from the watershed have contributed to increased sedimentation in the Pescadero lagoon and marsh (estuary), however the estuary still provides exceptional conditions for growth."

CDFW-3: The Draft Staff Report, page 12, indicates that "[t]here has been a substantial reduction in the depth and continuity of channels in the lagoon, which are likely adversely impacting steelhead smolt production and fitness." There is not sufficient evidence to support a direct link between channel depth and smolt production and fitness.

Response: In response to the comment on the link between channel depth and smolt fitness, we have revised this sentence in Chapter 2, Key Points, to remove the reference to fitness; however, we maintain that smolt production is linked to channel depth.

Our conceptual model indicates that the carrying capacity of the lagoon is density-dependent, meaning that steelhead production is limited because the fish are vertically and horizontally compressed into a small amount of habitat that remains suitable. This model is supported by the most recent study on the management of steelhead in the Pescadero lagoon (Huber, 2018). The link between channel depth and production is discussed in more detail in our response to Comment CDFW-4, below.

Comment CDFW-4: Water quality rather than sedimentation should be considered the primary causal agent of fish kill events. For example, during the recent drought, low dissolved oxygen and high temperature eliminated entire rearing populations in 2014 and 2015. Please clarify language on page 20 and footnote on page 14. Please provide the full citation in the References for Jankovitz, 2016.

Response: We agree that fish kills are linked to poor water quality (anoxic/hypoxic events) following the breaching of the lagoon mouth after an extended closure in late summer or fall and that fish do not appear to be dying due to the direct impacts of excess sediment (e.g., due to lethal levels of turbidity harming fish gills or chronic suspended solids reducing or eliminating photosynthetic plant growth). However, our conceptual model hypothesizes that excess sediment degrades habitat and water quality, and contributes to fish mortality, in the following ways:

a) Sedimentation in the tidal channels and the lagoon reduces water depth and volume, and therefore reduces available physical habitat and carrying capacity. We infer that the habitat lost or adversely impacted is rearing habitat in the lagoon. The most recent study on the management of steelhead in the Pescadero lagoon (Huber, 2018) supports our conceptual model that sedimentation results in direct negative impacts to available habitat, hydrodynamics, and circulation and in indirect impacts to dissolved oxygen and temperature. Therefore, sedimentation appears to limit the carrying capacity of the lagoon by compressing the steelhead population into a small amount of remaining suitable habitat. Huber (2018) on p.3 states that:

> *"I observe that vertical and lateral habitat compression is correlated to degraded water quality both at depth and upstream in the estuary. The fish exhibited strict preferences for shallow (<1.5 m) and protected microhabitats where the sandy substrate/food production zone occurred within the lighted and oxygenated freshwater epilimnion. Fish use of the upper estuary declined linearly when mean daily water temperatures surpassed 18.0ºC and dissolved oxygen concentrations declined below 7.0 ppm. The concentration of individuals in restricted zones of suitable water quality likely contributes to the density-dependent growth effects observed."*

b) Coastal lagoons comprise a mosaic landscape and are dynamic ecosystems, supporting diverse habitats, landscapes, and species. Excessive sedimentation in the Pescadero lagoon system and loss of tidal channels and sloughs have adversely impacted the habitat complexity and diversity that allows Pescadero lagoon to support its threatened steelhead population;

c) Sedimentation along Butano Creek and shoaling of the channel as it enters the lagoon severely limit the upstream movement of fish in Butano Creek, by creating large barriers to their movement (Largier et al, 2015). With no escape routes from Butano Creek and Butano channel, juvenile steelhead on the Butano side of the system have significantly diminished chances of escaping hypoxia in the lagoon;

d) Excess sediment along Butano Creek through the marsh has accreted such that the creek channel is above the marsh plain. The freshwater of Butano Creek is redirected to and routed through the marsh (see also the response to comment CDFW-6 below). This adversely affects water quality in two ways: (a) reducing freshwater flow to the lagoon because the evaporation rate of the dispersed flow through the marsh is higher than the evaporation rate along a channel; and (b) degrading water quality water in the lagoon: soils in the marsh have a high dissolved oxygen (DO) level due to very high concentrations of

reduced substances (Richards et al., 2018). When these reduced compounds come in contact with water, re-oxidation of the reduced substances leads to very low DO (Richards and Pallud, 2016) and anoxic marsh waters draining into the lagoon (Largier et al., 2015). Accretion of sediment in the main Butano Creek channel is thought to exacerbate this anoxic drainage from the marsh to the lagoon.

e) Sedimentation in the tidal channels and the lagoon results in shallower depths and therefore higher water temperatures. Furthermore, oxygen depletion is more severe in shallow locations, where the effect of chemical oxygen demand from sediment resuspension during the breach will be less diluted (Largier et al., 2015, p. 30).

We have included the full citation from Jankovitz in Chapter 10, References. No additional clarifying language is necessary on page 20 or the footnote on page 14 in the Staff Report.

Comment CDFW-5: CDFW would like to clarify that Pescadero is currently the most significant recreational steelhead fishery in San Mateo County.

Response: Comment noted.

Comment CDFW-6: CDFW states that the footnote on p. 16 may be interpreted to indicate that spawning reaches are inaccessible in Butano Creek. Please note that the Pacific States Marine Fisheries Commission documented successfully spawning adults in this creek during 2016/2017 surveys.

Response: Under most hydrologic conditions, access to the spawning reaches of Butano Creek is limited due to sedimentation along the Butano Creek through the marsh. There may have been successful spawning adults documented in this creek during 2016/2017 surveys; however, please note that Water Year 2017 was a wet year, the third largest runoff volume since 1961, with 150% average annual runoff. During the 2016-2017 spawning season, the watershed received over 100% average rainfall for several months, resulting in high flow events in the creeks. One study states that spawning activity was observed in Butano Creek for the first time since 2011 (with one adult salmonid and 4 redds observed in the most upstream reach) and that it is likely due to the extreme flow events (PSMFC, 2017). The report further states that "Ongoing sedimentation issues in the lower watershed near Pescadero Marsh ha[ve] caused the watershed to become inaccessible to anadromous fish during nearly all flows .... Frequent and severe flooding of Pescadero Creek Road during the 2016-2017 season likely provided enough water for anadromous fish to travel upstream through the marsh and over the road."

We revised the Footnote 4 on page 16 of the Staff Report for clarification to read:

" Please note on average, about 20% of the total length of potential spawning habitat was surveyed. Therefore, using weighted average values for redd density, and an inferred ratio between the number of redds and adult steelhead, still results in fairly high uncertainty in estimating the number of returning adults. An additional complicating factor exists related to determining whether potential spawning habitat in the Butano Creek sub-watershed remains accessible (except for very high water levels) to spawning adults under current conditions, which include complete filling of its channel within the Pescadero Lagoon."

Comment CDFW-7: Rather than citing the Science Panel Report (Largier et al., 2015), which summarizes a review of available scientific information, the Commenter recommends including references to the original studies.

Response: The Largier et al. Report (2015) did not merely summarize the available scientific information; the study also synthesized and interpreted the best available science and applied it to Pescadero lagoon and marsh. We revised the Staff Report to include specific references to page numbers from the Largier Report that cite the original research.

Comment CDFW-8: Stream-reared life history stages may have produced more fish than today under historical conditions, resulting in higher net production in the watershed. Also, physical and ecological conditions in Scott Lagoon and Pescadero Lagoon are different, and comparisons may have limited availability.

Response: We agree that historically stream-reared life history stages may have produced more fish than today.

The Staff Report compares Scott and Pescadero lagoons to highlight the ability of lagoon-reared juvenile steelhead to achieve much larger size compared to the juvenile steelhead that rear exclusively in freshwater channel reaches. Excellent growth of lagoon-reared steelhead has been observed in well-mixed lagoon conditions in several systems along the Central Coast including San Gregorio, Scott, Waddell, and Pescadero Creeks (Shapovalov and Taft, 1954; Smith, 1987; Smith, 1994; Bond et al., 2008; Hayes et al., 2008; Atkinson, 2010; Hayes et al., 2011).

Comment CDFW-9: Fish kills were not documented prior to the 1992 restoration project, which opened the north pond/marsh, breached several levees, and widened several channels, effectively increasing the tidal prism. The Staff Report on page 32 states that sedimentation increased by an order of magnitude and decreased the tidal prism to a quarter of its historic volume and triggered significant water quality problems that result in near-annual fish kills.

Response: We agree that fish kills were not documented prior to the restoration project in 1992. The tidal prism increased by an estimated 5 acre-feet by ESA PWA (2011) following the restoration project, whereas sedimentation, marsh reclamation, levee building, and channelization since the 19th century have decreased the tidal prism by an estimated several hundred acre-feet (see also our response to Comment NMFS-1). Given the complexity of the extent and timing of disturbances to the marsh and lagoon system, we have removed the reference to fish kills being linked to the tidal prism and revised the sentence in the Staff Report, Chapter 4, Key Points, page 31 to read "[a]n order of magnitude increase in sedimentation in the estuary reduced the tidal prism to a quarter of its historic volume, decreased the available key nursery habitat for steelhead, and contributed to poor water quality conditions that result in near-annual fish kills."

Comment CDFW-10: The statement on historic and current tidal prism estimates needs clarification on whether both analyses include the north pond/marsh area in the estimates.

Response: Both analyses exclude the North Pond/North Marsh. Our references confirm that they are not included in the historic estimate (PWA, 1990; Dane Behrens, pers. comm., 3/29/18); likewise, the

current tidal prism estimate of 60 acre-feet excludes the North Pond/North Marsh area (ESAPWA , 2011). These estimates are therefore comparable, and no change is needed to the Staff Report. We add that 49 acre-feet is a more current estimate of tidal prism, based on the most recent bathymetry collected by CBEC and excluding North Pond/North Marsh (Dane Behrens, pers. comm., 3/29/18).

Comment CDFW-11: The Commenter notes the transport of beach sand via summertime afternoon onshore tradewinds as a significant sediment source that produces the reverse Delta under Highway 1 Bridge.

Response: Comment noted.

Comment CDFW-12: The Commenter recommends against using the preliminary hydrodynamic model for establishment of a TMDL.

Response: The hydrodynamic model the Commenter refers to does not form the basis for the TMDL. It was referenced in relation to the contribution of littoral sand being limited to the lower lagoon. We used the adjective “preliminary” to indicate that other models currently being developed may better describe the hydrodynamics of the lagoon.

We have revised the sentence in the Staff Report in Section 4.2, to remove the word, preliminary, and it now reads "Based on a hydrodynamic model of the lagoon, the littoral influence appears to be largely limited to the lower lagoon (Stacey, 2017)".

Comment CDFW-13: The CDFW recommends including a lower limit for the estimate of the amount of sediment deposits upstream of the Old Haul Road.

Response: There are approximately a dozen tributaries that drain the Butano Ridge and cross the 8-mile long Old Haul Road. Massive log and fill structures (Humboldt crossings) constructed at tributary road crossings still exist. The sediment deposit estimate was based on field assessments of the length, width, and depth of sediment deposits behind road crossings, as well as on the volume of the fill at crossings along the Old Haul Road. Existing road assessments (including Best, 2015 and PWA, 2003) document the significant amounts of fill at several of these crossings and state that potential future erosion due to fill failure at the crossings range from 70,000 to 85,000 tons. If the volume of sediment deposited along the tributary channels behind these 40-50 feet high crossings is considered, it is likely that the total volume of sediment "dammed" by Old Haul Road would not be that different from the 2 million tons estimate.

Providing a lower limit estimate is not necessary at this time but could be developed as needed as assessments are conducted along the Old Haul Road. The implementation plan identifies the Old Haul Road as an area where stream crossing improvements and storm-proofing along the road are a high priority and should be assessed by the responsible parties.

Comment CDFW-14: The Commenter states that the photos on p. 102 compare open water habitat availability in 1915 and 2010. Please clarify whether the photos were taken under similar conditions (e.g., open vs. closed, fully inundated).

Response: We replaced both photos in the Staff Report for clarity. The new 2010 photo is taken from the same perspective as the 1915 photo. We also replaced the 1915 photo with a better image, taken

from the original black and white version. However, we do not know the conditions under which the 1915 photo was taken. These photographs are shown to illustrate another line of evidence for the loss of open water due to sedimentation. Many studies have established that the lagoon and marsh complex had a significantly higher tidal prism (see comment NMFS-1), a much deeper lagoon, and a deeper and more extensive tidal channel and slough network (excluding North Pond/North Marsh) (Viollis, 1979; Curry, 1985; PWA, 1990). Historic maps and aerial photographs provide further evidence of this. Please also see our response to NMFS-7.

Comment CDFW-15: The Draft Staff Report states that "[a]ggradation of sediment in Pescadero Marsh has been and continues to be responsible for the loss of important estuary rearing habitat." Rearing habitat in the lagoon is intact and is actively used. Please revise or remove.

Response: Although we agree that the lagoon continues to support rearing habitat, sedimentation in the lagoon and in the tidal channels in the marsh have diminished the available rearing space for salmonids by reducing water depths, channel length, area, volume, and water flow, and therefore carrying capacity. We also infer that excessive sedimentation in the system and loss of tidal channels and sloughs have adversely impacted the habitat complexity and diversity that support Pescadero watershed's threatened steelhead population. We did not make the requested changes.

Comment CDFW-16: The Commenter states that the Draft Staff Report identifies pool margins as potential spawning sites. They state that the features most utilized for spawning include transitions between pools and riffles, glides, and runs, and 65 percent of redds were found in pool tails during spawner surveys in 2016 and 2017 in coastal San Mateo and Santa Cruz.

Response: Comment noted.

Comment CDFW-17: Draft Staff Report states that "achievement of this TMDL is a necessary condition to restore water quality and beneficial uses of the lagoon." Please provide further explanation of the relationship between water quality and sedimentation and how implementation of the sediment TMDL would be expected to benefit water quality.

Response: Please see our response to Comment CDFW-4.

Comment CDFW-18: Commenter noted that the incorrect scientific names are given for steelhead trout and coho salmon on p. 161.

Response: In response to this comment, we have corrected the scientific names on p. 161 of the Staff Report.

Comment Letter No. 3: California Trout (CT)

Comment CT-1: California Trout fully supports the added regulatory attention on the watershed. If successfully implemented, the implementation plan would result in restoration of some key ecological function in the highly productive estuary downstream, increased availability of suitable habitat for both salmonid species, greater survival rates, and eventual increases in population abundance over time.

Response: We appreciate your support.

Comment CT-2: The problem statement focuses on incision as a primary cause of the decline of coho salmon and steelhead, when there are many factors that contribute. Rather than blame incision, the focus should be on the land use factors that cause incision, otherwise the TMDL ignores the kinds of activities, e.g., grazing and agricultural practices, that need to be regulated or amended to restore ecological function.

Response: We agree that many factors contribute to declining salmonids, but disagree that the TMDL lacks a focus on the land use factors that cause incision. In the TMDL, we identify those land uses that contribute to surface erosion, gullying and channel incision. The TMDL's implementation plan identifies actions needed from land use activities, including grazing and agricultural practices, and proposes regulating these activities as appropriate.

The TMDL provides a pathway for conserving and augmenting steelhead trout populations, restoring an annual spawning run of coho salmon, and protecting and enhancing habitat for native aquatic species. To achieve these goals, specific actions are needed to reduce sediment loads to the creeks, re-establish sediment storage, and enhance riparian habitat complexity and connectivity by restoring floodplains and large woody debris jams.

Comment CT-3: Both sedimentation and siltation and channel incision (which alter physical processes and can lead to habitat simplification) are of primary concern in the watershed and require attention to address.

Response: We agree. Please refer to the Problem Statement and Implementation Plan sections of the Staff Report (specifically, pages 10, 13, 16-18, 126-128, 140, and 141) where these concerns are addressed.

To provide further clarity, we have revised Section 7.4.2.1. Problem Statement of the Basin Plan amendment to state:

"In addition, the narrative water quality objective for population and community ecology is not being met due to channel incision, which is a significant sediment source and ~~causes~~ results in habitat simplification and floodplain disconnection. Channel incision ~~is a~~ and associated simplification of habitat are primary causes of the decline of coho salmon and steelhead trout populations and ~~is a~~ are controllable water quality factors."

Comment CT-4: This comment refers to the "reach-specific prescriptions for installation of engineered log jams" in the Evaluation and Monitoring Section of the Basin Plan amendment and states that a parcel-by-parcel approach to plan restoration work will not be sufficient to restore ecological function. The comment also notes that a watershed-wide assessment of large woody debris (LWD) needs to be undertaken. California Trout looks forward to partnering with local landowners and restoration practitioners to develop a comprehensive plan to address LWD loading and natural recruitment in a coherent way to meet stated objectives and targets, and to help restore ecological function.

Response: We agree that a comprehensive plan is needed, and that approach is supported in the TMDL implementation plan. What we mean by reach-specific prescription is not a parcel-by-parcel assessment

but a geomorphic reach-based assessment of LWD loadings and a plan to reach the targets. We concur with the need for a watershed-wide assessment to determine the types of large wood needed for various functions; to this end, we look forward to supporting stakeholders in obtaining funding for this type (and other types) of project in the watershed.

Comment CT-5: California Trout supports the TMDL goal of restoring water quality for sediment and habitat conditions and facilitating the recovery of listed populations of coho salmon and steelhead in the Pescadero-Butano watershed. This goal should be reflected on through each step of the TMDL planning, permitting, and implementation. Future permitting and mitigation requirements should not inhibit or hinder the ultimate goal of facilitating the recovery of listed salmonids.

Response: Comment noted. We are committed to facilitating restoration projects in the watershed and will work closely with other permitting entities to help facilitate the permitting process where possible.

Comment CT-6: Rather than relying exclusively on local agency staff to do in-channel effectiveness monitoring, federal and state agency staff, as well as local non-profit organizations, should have some input and oversight of the process.

Response: Comment noted. We look forward to working collaboratively with California Trout and other stakeholders on effectiveness monitoring work.

Comment CT-7: This Comment refers to adaptive implementation, Section 8.6: When considering the results of studies that enhance our understanding of the populations of steelhead and coho salmon, the Water Board should consult with the respective federal and State wildlife agencies and should include input from local agency and non-agency partners with fisheries expertise.

Response: We agree and support multi-agency coordination, consultation with fisheries agencies, and collaboration with non-agency partners as we adaptively implement the TMDL.

Comment CT-8: This comment notes that the nature and large scale of the work required to mitigate and address sediment input into the Pescadero-Butano Watershed is significant, and individual projects should not be discounted or disapproved simply because they are likely to have short-term sediment impacts during construction that will ultimately benefit the watershed and help meet the TMDL goals. Water Board and its staff are requested to adopt and maintain a thoughtful, measured approach during project review. Similarly, the comment requests that permitting of work can be streamlined under programmatic consultation to facilitate rapid project development and implementation.

Response: Comment noted. As stated above, we are committed to facilitating restoration projects in the watershed and will work closely with other permitting entities to help coordinate the permitting process where possible. We expect that, as with other restoration projects in the region, permit conditions and mitigation or avoidance measures will help to balance projects' short-term impacts against their long-term benefits.

Comment Letter No. 4: Farm Bureau (FB)

Comment FB-1: The Commenter expresses disappointment that, while it has facilitated site access to support technical studies and water quality assessments, Water Board staff did not reach out to them during development of the TMDL, in particular, in respect to gaining property access.

Response: Water Board staff has appreciated the assistance Farm Bureau staff provided to secure site access in support of technical studies and water quality monitoring; this comment appears to relate to the general statement in the Draft Staff Report about our inability to gain access at *every* location we visited (emphasis added). The Farm Bureau's knowledge of the watershed has been invaluable, and we expect it will continue to be so. We are strongly committed to building on this history of collaboration and to working with the Farm Bureau and other stakeholders towards effective implementation of the TMDL.

Comment FB-2: The Farm Bureau has developed a program for water quality education and outreach in San Mateo County. Water Board staff missed an opportunity to better understand how these early efforts influence current land management practices in the watershed.

Response: We disagree that we have ignored early implementation: the water quality education and outreach the Farm Bureau references will, if continued, help ranchers and farmers achieve the performance standards for sediment control specified in the Draft Staff Report and Basin Plan amendment. In response, we have revised the implementation plan to clarify the focus of the three-year "planning and prioritizing" period. During this time, we envision that ranchers and farmers will seek Farm Bureau and Resource Conservation District assistance to evaluate whether their properties are meeting the specified performance standards, and if not, to help them prioritize needed erosion control improvements and a schedule for implementation.

Comment FB-3: The numbers of acres under cultivation and relative numbers of acres cultivated on valley floor and hillside cited in the draft Staff Report are not correct. The Farm Bureau estimates that 750 acres of valley floor cultivation and 150 acres of hillside cultivation.

Response: We revised the Staff Report (p. 92) to cite agricultural acreages presented in the Department of Conservation Farmland Mapping and Monitoring Program (FMMP) for San Mateo County for 2016. That report estimates 1,006 acres in active agriculture, similar to the Farm Bureau's estimate of 900 acres. Our estimate of hillside cultivation, 440 acres, likely varies from the Commenter's because we define hillslope ranch or farmland as that land which occurs on slopes of 5 percent grade or greater. Please note that the TMDL's implementation plan does not include separate performance standards applicable to hillslope lands versus valley floor lands.

We also have revised the Staff Report (pp. 129 and 131) and the Implementation Tables in the Basin Plan amendment to reflect a farm land threshold of 5 acres, which focuses on the largest potential sources of sediment. Based on our analysis, farm lands with an area of 5 acres or greater comprise approximately 974 acres and include about 42 property owners. Our analysis indicates that the 5-acre threshold captures 95 percent of the total farm land area while excluding a large number of small farmers. We updated the agricultural water quality programs cost discussion in the Basin Plan amendment, and Table 28 of the Staff Report to reflect cost changes associated with these new acreage

thresholds. In addition, we deleted the reference to hillside parcels in the cost discussion in the Basin Plan amendment, because this analysis did not differentiate between hillslope and flat land acreage.

Comment FB-4: Farmers and ranchers are actively improving their soil conservation and resource protection practices, individually and through work with the Natural Resources Conservation Service and Farm Bureau.

Response: We appreciate these efforts and acknowledge that land use practices have improved.

Comment FB-5: There is no clear demonstration that a sediment issue exists from agricultural activities (cultivated lands). Because of the proactive work of farmers and the reduced acreage of hillside cultivation, agriculture has already achieved the implementation goal.

Response: Based on this comment we re-estimated surface erosion from farmlands using newly acquired FMMP 2016 farmland map acreage (see also response to Comment FB-3). This analysis showed that surface erosion from farmlands was less than 500 tons/year and therefore negligible in the context of the total sediment delivery. Therefore, we have revised the Staff Report (pages 90-92, 94 and Tables 12 and 13) and the Basin Plan amendment implementation tables for agricultural lands to remove the performance standard for surface erosion for non-grazing agricultural lands.

Comment FB-6: We appreciate that San Mateo County roads are included and emphasize that unmaintained and maintained road ditches and culverts often dramatically impact the erosion of soils off of agricultural winter fallow fields in Pescadero and Butano watershed.

Response: Comment noted. We agree that poorly maintained and improperly constructed roads, crossings, and stormwater conveyances, particularly if they drain towards an unstable area, can deliver excessive amounts of sediment to receiving waters.

Comment FB-7: The Commenter was disappointed to read that access to private lands for the 2004 Assessment's field surveys was constrained, impeding access to randomly selected sites. The Commenter is unsure of the importance of random V* non-random sites, but that if access was needed, the Farm Bureau could have been consulted.

Response: The analysis the Commenter refers to was completed 14 years ago and did rely on data from an adequate number of randomly selected sites to develop the sediment budget at the time. The Water Board appreciates the Farm Bureau's willingness to negotiate access in the future. Please also see our response to Comment FB-1 above.

Comment FB-8: Irrigated agriculture has generally decreased in the watershed. While flatland farm acreage has remained relatively unchanged over time, cultivation on hillsides has decreased. Current landowners' practices have reduced sediment input but will be regulated due to legacy sediment sources that are not of their making.

Response: We appreciate that hillside cultivation has decreased. We disagree that landowners' practices that have reduced sediment input will be regulated due to legacy sediment sources. The TMDL does ask landowners to manage their current operations to avoid worsening erosion from legacy sources and ongoing unstable areas. An example would be directing a culverted stormwater discharge away from an

unstable area to minimize erosion. Separately, the TMDL calls for recommended habitat enhancement actions that reverse or mitigate legacy sedimentation or channel incision, however these actions are not required but are anticipated to be implemented on a voluntary, collaborative basis.

Comment FB-9: Because of slow germination and slow growth, cover crops do not generally provide erosion benefits but rather soil health and nitrogen fixing benefits.

Response: Comment noted. Cover crops are mentioned in the Draft Staff Report as one possible management practice and are successfully used for some crops, e.g., vineyards.

Comment FB-10: In 2004/2005, the Farm Bureau petitioned the State Water Board to consider de-listing Pescadero Creek. At that time, the Farm Bureau specified only Pescadero Creek and did not suggest de-listing Butano Creek. State Board staff considered the request and was agreeable to treat the two watersheds separately. After consideration, the State Board took actions which added language to the listing of Pescadero Creek specifically. In a public outreach meeting in Pescadero two years ago, Farm Bureau asked staff if they would consider separating these two very different watersheds so that one report and one program would not make recommendations to be applied equally between these two different watersheds. At that public meeting, staff told the audience that they would consider that. Please state how the determination was made to not make that separation.

Response: We cannot respond to the potential confusion over State Board listing actions, as we have found no documentation on this particular issue. Our response to addressing the two watersheds together is as follows. Butano and Pescadero Creeks are both impaired by excess sediment and the sources of sediment and land uses in the watersheds are very similar. When we group two or more water bodies with the same impairment into a single TMDL, it is because the sources of impairment and the implementation actions are very similar (or the same) in both water bodies. This allows staff to develop TMDLs for our impaired waters in a logical and efficient progression.

Comment FB-11: Current grazing practices result in little to no sediment delivery/input. Coordinate a meeting of grazing practitioners so that Water Board staff can understand the current management standards within the grazing community.

Response: In response to this comment, we have revised the Implementation Plan in the Basin Plan amendment and Staff Report page 132 to include a ranch land threshold of 50 acres, to focus on the largest potential sources of sediment. Based on our analysis, grazing land with an area of 50 acres or greater comprise approximately 7,024 acres and include about 30 property owners. We find that the 50-acre threshold captures 85 percent of the total grazing land area while excluding small ranchers. In addition, we have revised the Implementation Plan to include a three-year "planning and prioritizing" period. During this time, we envision that ranchers (of properties of 50+ acres) will evaluate their properties, identify and prioritize any sediment issues, and develop an implementation schedule as appropriate.

Comment FB-12: Timberland owners are already implementing good stewardship practices under existing law. We caution against designing a program that imposes a burden for timberland owners that is unnecessary given the scale and intensity of their infrastructure and operations, and the exhaustive regulatory framework that already exists. Such a burden would only serve as a disincentive

to continue forest management and thus would result in less road improvement, maintenance, monitoring, etc. on small timber properties.

Response: Comment noted. Please see our response to Big Creek comment BC-3 and Redwood Empire comment RE-4, in which we propose a 100-acre threshold for timberlands to avoid disproportionately burdening small properties not expected to contribute significantly to the sediment impairments in the watershed.

Comment Letter No. 5: Midpeninsula Regional Open Space District (Midpen)

Comment Midpen-1: The TMDL's estimate for total sediment delivery from road and stream crossings may be too high and could set up a conflict around achieving the 78 percent reduction goal. If the TMDL guidance to address "high" and "medium-high" sites were fully implemented, Midpen's road assessment study suggests that about 66 percent of all potential sediment would be reduced. Therefore, Midpen would have achieved the implementation action standards but failed to reach the sediment reduction goal of 78 percent.

Response: Midpen will not be required to assess and quantify its sediment load reduction. Sediment TMDLs, including this one, specify numeric targets and performance standards within the affected water body or water bodies to attain water quality objectives. The load allocation in the TMDL provides an indicator of the estimated level of effort that may be needed to achieve the water quality objective in the water bodies. The performance standard for roads contained in the TMDL must be achieved to evaluate compliance with the TMDL.

Comment Midpen-2: PWA evaluated 25.6 miles of Midpen's roads in the watershed. Midpen's upper watershed crossings have a maximum potential sediment delivery of about four times less than the average estimated road crossing sediment delivery in the TMDL. This suggests that the instream baseline monitoring may show different data than the report suggests and the sediment budget may need recalibration sooner than the "ten years" subsequent to Basin Plan amendment adoption.

Response: We appreciate the assessment and implementation work Midpen has conducted for its lands in the watershed. The completed projects that are consistent with implementation plan actions will help achieve the TMDL.

To the extent the PWA study estimated less delivery than the sediment budget developed for the TMDL, Midpen has less work to do to meet the TMDL's road performance standards. Sediment delivery estimates (both actual and potential) vary in different parts of the watershed under different types and intensity of land uses.

Attainment of the TMDL and the water quality objectives will be evaluated by instream channel conditions and performance standards identified on the implementation tables; there will not be a need to update the sediment budget before the 10-year mid-implementation period.

Comment Midpen-3: The rates of chronic surface erosion delivery (which will vary over elevations, slopes, soils, and geologies) will have a significant effect on landowner's ability to meet the performance standards and may setup conflict around the 78 percent reduction goal.

Response: Please see our response to comments Midpen-1 and Midpen-2.

Comment Midpen-4: The proposed method of assessing sediment reduction efforts instream, V*, could cause future disputes about the effectiveness of the TMDL and landowner actions. Midpen recommends using multiple lines of evidence to support the TMDL reassessments. The Commenter also summarized the residual pool volume (V*) assessment work conducted in the El Corte de Madera Open Space Preserve in the San Gregorio watershed.

Response: We disagree that the in-stream monitoring proposed in the TMDL, which includes V*, will lead to problems in evaluating the effectiveness of TMDL implementation actions. TMDL implementation by Landowners will be evaluated by the degree to which they meet performance standards (e.g., for road design and maintenance), not by V* data. We find, and our scientific peer reviewers agree, that the TMDL is adequately supported without adding further information.

Comment Midpen-5: The Commenter noted that it can take upwards of 40 years before V* reflects mitigation of current disturbance. Therefore, V*, alone, may be a poor choice to consider instream changes before the end of the implementation period. Midpen recommended identification of smaller subwatersheds and sediment sampling concurrently with V* measurements. Midpen recommended the use of large woody habitat or material instead of large woody debris (LWD). Midpen offered to arrange a visit to the V* sites in San Gregorio watershed for the Water Board staff.

Response: While we agree that, generally speaking, V* takes a long time to reflect water quality improvements, we disagree that that the V* target is an inadequate choice within the implementation timeframe given we are proposing to monitor LWD and associated habitats as additional metrics of channel quality. The TMDL does not rely on V* alone to measure progress toward attainment of sediment-related water quality objectives. The numeric targets for substrate size and V* (residual pool volume) help assess attainment of Sediment/Settleable Material Water Quality Objectives, while the targets for large woody debris track attainment of the Population and Community Ecology Water Quality Objectives.

We appreciate Midpen's recommendation to identify smaller subwatersheds and monitor other sediment parameters concurrently with the proposed numeric targets. We will work with the entities conducting these assessments to address the details of sampling reaches and additional parameters once specific projects are identified and funded.

Regarding terminology, LWD is the term that is used very commonly both in literature and restoration practice, so we use it here for consistency. Our use does not intend to put a value judgment on the term "debris."

We appreciate the offer to visit the San Gregorio watershed and have arranged a June field trip with Midpen staff and their consultants to visit their V* sites and learn about their project there.

Comment Midpen-6: Midpen recommends concurrently inventorying the stream for large wood loading and V* as the hydraulics of wood jams can be a significant issue for V* sites. It is worth deferring to site-specific assessments of where large wood is appropriate. The distribution of wood loading in the watershed may be different than historically and given the upcoming inventory and survey efforts, reassessing target thresholds for the hardwood reaches may be appropriate in the future through the Basin Plan update process.

Response: Again, we appreciate Midpen's thoughtful comments and recommendations. We agree that site-specific assessments are necessary. The TMDL includes adaptive implementation and we will continue to evaluate new data and data collection methods as the TMDL is implemented.

Comment Letter No. 6: National Marine Fisheries Service (NMFS)

Comment NMFS-1: Historic and current tidal prism estimates presented in the Staff Report are not well supported.

Response: The discussion in the Staff Report about the marsh and lagoon tidal prism is included as part of the overall problem statement due to its linkage to Butano and Pescadero creeks and the upper watershed (see also the general response to CDFW's comment letter about inclusion of information about the marsh and lagoon in the TMDL). The TMDL applies to the sediment impairment identified in Butano and Pescadero creeks watershed and does not address other water quality concerns in the marsh and lagoon complex.

To address the comment on tidal prism estimates, we provide the following supporting information. PWA (1990) and ESA PWA (2011) estimated the historical tidal prism based on the 1854 map in the Coast and Geodetic Survey series, which reflected surveys conducted immediately following statehood. Multiple scientific interpretations of this topographic map series concluded that the maps were based upon a geodetic network done by careful surveyors and that they are remarkably accurate documents for their era.

The 1854 map allows an approximate lower bound estimate of the tidal prism at that time. In the map, tidal flats are shown on either side of the deeper channel, distinguished by a series of very closely spaced dots indicating mean lower low water (-2.99 feet). The lagoon was assumed to drain to mean sea level only (approximately 0 feet NGVD). The mean high water was estimated at 1.59 feet. The tidal marsh was indicated by straight lines with tufts of grass and the line between the tidal marsh and uplands were indicated with a dotted line separating the two (at around +6 feet). It was assumed that the lagoon filled to +3 feet in a moderately high tide. The tidal prism estimate was developed using a stage vs. storage relationship that primarily assumed that **area increased linearly with elevation** between -2.99 feet, mean high water of +1.51 feet, and +3 feet. **Depth of channels are not estimated to compute tidal prism**. Rather, known elevations are plotted against areas inundated at these elevations. The area was assumed to increase linearly with elevation and thus a stage-storage relationship is developed. *"The tidal prism between +3.0 and -3.0 feet was estimated as almost 500 acre-feet. If the lagoon is assumed to drain only to mean sea level (0 feet NGVD) as the mouth location has not changed significantly, the effective tidal prism would have been about 225 acre-feet."* (PWA, 1990, p.13). This

estimate does not include North Pond/North Marsh area. Dane Behrens of ESA PWA, who developed a Quantitative Conceptual Model of the lagoon and marsh, re-estimated the historical tidal prism and stated that the above approach is reasonable (Behrens, pers. comm., 3/29/18). He also stated that the mouth may not have always been pushed up against the rocks and there may have been times when it could have cut deeper and would have had a larger tidal prism. Based on this, we infer that 225 acre-feet is a minimum estimate for the historical tidal prism.

Using the most recent bathymetry collected by CBEC in 2017, excluding the North Pond/North Marsh, area and following the same estimation methods as ESA PWA (2011) (i.e., subtracting the volume at the estimated mouth sill elevation, 0 foot NGVD29, from the volume at mean higher high water), Behrens also assessed the current effective tidal prism and estimated it as 49 acre-feet (Behrens et al, 2017; Dane Behrens, pers. comm., 3/29/18).

The tidal prism estimate reported in 2011 was 60 acre-feet.

We believe that these studies adequately estimate the historical tidal prism and accurately model the current tidal prism. Despite some uncertainties related to the assumed elevations of lagoon drainage or mean higher high water, we estimate that the historical tidal prism estimate would not have been lower than 225. Therefore, existing scientific investigations establish that the current tidal prism in this system is at most one quarter of what it was historically.

Comment NMFS-2: Artificial connection to North Marsh/North Pond that maintains a larger tidal prism is having adverse impacts to a range of species and their habitats.

Response: Comment noted. We look forward to working with NMFS, CDFW, State Parks, and other stakeholders collaboratively to develop a more specific problem statement for the lagoon and marsh complex in a separate project to address the water quality concerns in this water body, including dissolved oxygen. The connection to North Pond/North Marsh will then be addressed along with ecological function of the system.

Comment NMFS-3: NMFS support the goals of the restoration actions to address sediment sources and to promote floodplain connectivity and sediment sorting/storage throughout the watershed.

Response: We appreciate your support.

Comment NMFS-4: The Commenter notes the lack of hydrologic connectivity historically between the lagoon and the North Pond/North Marsh and suggests that historic estimates of the tidal prism do not include the North Pond/North Marsh. As part of the 1990 restoration efforts, North Pond/North Marsh was connected to the lagoon via culverts and it is currently subject to tidal fluctuations when the mouth is open. The Commenter suggests that the current tidal prism estimate should consider the North Pond/North Marsh.

Response: To address the specific comments on the North Pond/North Marsh connectivity and tidal prism estimates, we provide the following information.

We concur that the North Pond/North Marsh was opened to daily tidal fluctuations via culverts as part of the restoration project in 1990s and clarify that the historical tidal prism estimate does not include North Pond/North Marsh.

There has not been definitive reporting on how much tidal volume is currently exchanged between the lagoon and North Pond/North Marsh. The ESA PWA (2011) study estimated the tidal prism of the North Pond and North Marsh as 13 and 12 acre-feet, respectively. We do not find adequate cause to revise the tidal prism estimate at this time. See also response to Comment NMFS-1.

Comment NMFS-5: The Commenter notes that the tidal prism increase in the early 1990s resulted in the sandbar forming later in the summer and that the delayed closure of the sandbar impacts the ability of the lagoon's water column to convert to freshwater.

Response: Comment noted. See also response to Comment NMFS-1.

Comment NMFS-6: Restoration actions to increase tidal prism implemented in the 1990s have not achieved their intended goal of increasing scour. Instead, a reverse delta now forms each year inside the mouth of the creek, presumably due to the prolonged period of tidal fluctuation and overall lack of scour.

Response: We agree that the restoration actions of the 1990s have not succeeded in inducing scour and that a flood shoal delta has been growing under the Highway 1 Bridge over the last three decades. However, our understanding is that (1) other factors besides the restoration actions have contributed to formation of the flood shoal delta; and (2) based on the existing analyses and models (both the QCM and a hydrodynamic model by UCB researchers) of the Pescadero system, as well as on research on other lagoonal systems, the response of the lagoon and marsh to the increase in tidal prism is expected to be higher shear stresses and more scour. However, the location of an increase in tidal prism, rather than the increase itself, more significantly affects the ability to scour. We agree with the Commenter that the connection to the North Pond/North Marsh may be reducing the ability to scour more efficiently.

Modeling currently underway for the Butano Creek reconnection project will likely shed light on lagoon hydrodynamics. We look forward to working with NMFS and other stakeholders on that project and any future habitat restoration projects in the watershed. See also response to Comment NMFS-1.

Comment NMFS-7: There has been no measurable loss of lagoon depth in the main embayment due to sedimentation since the 1980s (Jerry Smith, personal communication, March 2018). The effects of sedimentation in certain areas of the lagoon (and the loss of depth) on salmonid rearing habitat are likely negligible. A reduction to the tidal prism due to sedimentation has been at least partially offset by the artificial excavation of "Butano Channel" (borrow ditch in Butano Marsh parallel to Butano Creek), as well as the connection with North Marsh/North Pond. Also, it is hard to discern the previous (i.e., during the 1850s) water depths from a historic map that lacks contours and therefore accurate estimates of the historic tidal prism are hard to develop.

Response: We disagree that there has been no measurable loss of lagoon depth due to sedimentation. Our estimate of sedimentation in the lagoon and changes in depth is based on an analysis of two sets of

cross section surveys by PWA in 1987 and 2011. A comparison of three cross sections in the lagoon revealed that the average deposition between 1987 and 2010 along the thalweg ranged between 0.5 feet and 3.5 feet. We analyzed cross sectional change and estimated that approximately 32,000 CY (40,000 tons) of sediment accumulated in the lagoon proper between 1987 and 2011. This corresponds to an annual sediment deposition of approximately 1,300 CY (1,630 tons). We cross checked this estimate by considering the loss of effective tidal prism of 165 acre-feet since 1854. This volume would equal an average annual sedimentation volume of 1,700 CY. The consistency of these two estimates convinces us of their accuracy.

Comment noted on the highly productive nature of the lagoon as a rearing habitat. We look forward to developing a better understanding of how the system is functioning for salmonids, as we work on water quality concerns in the marsh and lagoon complex as a separate project.

Regarding the Butano Channel's tidal prism, our understanding is that Butano Channel and the deep section created during the 1990s restoration is a low-energy slough and does not flush effectively. The deep section traps seawater, organic particles, and flocs and provides little chance of mixing, thus creating an environment in which anoxia develops readily (Largier, et al., 2015). Therefore, the tidal volume going in and out of the Butano Channel is unclear.

The historic tidal prism was not computed by estimating water depths. The estimate is based on an area vs. elevation relationship that was assumed to increase linearly. Please also see our response to NMFS-1.

Comment NMFS-8: The photographs of the lagoon from 1915 and 2010 are not taken from the same location. The photographs are misinterpreted as they are likely taken during dissimilar hydrologic conditions: 1915 photo during a high-water event and 2010 photo taken during a more normal high tide or closed lagoon condition.

Response: See response to Comment CDFW-14.

Comment NMFS-9: Further discussion and collaboration is needed on the topic of tidal prism and lagoon function.

Response: We agree that further discussion and coordination is needed to develop a more detailed conceptual model of the changes and trends in tidal prism, as well as lagoon function and different habitat units. We look forward to working with the NMFS, CDFW, State Parks, USFW, as well as other stakeholders, to develop a better understanding of how the lagoon processes and ecosystem function as we work on water quality concerns in the marsh and lagoon complex.

Comment Letter No. 7: Peninsula Open Space Trust (POST)

Comment POST-1: Their greatest concern is the fiscal impact on farming and ranching operations which they are working to preserve as farmland. The assessments, permitting, and implementation actions described in the TMDL are costly. Assessments required for agricultural and grazing lands can vary in price by one to two orders of magnitude, and road assessments cost thousands of dollars. Permitting is complex because of the fully protected species and can cost around $50,000 for fees and

consultants. Road work treatments can cost tens of thousands of dollars/mile ($35,000 per mile typically) and often require full-time biological monitoring.

Response: Please see our responses to the Commenter's specific comments below. We understand that permitting can be complex, given the number of special status species in the watershed and the limited work windows. We plan on working to coordinate agencies with overlapping jurisdictions to facilitate permitting. We also revised the cost estimates in the Staff Report, section 9.4 for unpaved roads to incorporate the Commenter's cost estimate of $35,000 per mile for a typical road segment versus our estimate of $20,000 in the draft Staff Report. Also, we updated the agricultural water quality program costs in the Staff Report using the $35,000 per mile cost for unpaved roads.

Comment POST-2: Third-party certification programs proposed in the TMDL that could assist agricultural producers in meeting requirements have not been developed. We recommend extending the timeline for voluntary compliance and providing resources so that these programs could be developed.

Response: The TMDL does not propose a third-party certification program; however, we do encourage working with third parties. It is our understanding that there have been existing efforts, including third-party programs, to address some of the implementation actions identified in the TMDL over the last decade or longer. While we do not feel the timeline needs to be extended, we have revised the Implementation Plan in the Staff Report and Basin Plan amendment to include a three-year "planning and prioritizing" period. During this time, we envision that ranchers and farmers will seek assistance from third-parties, e.g., the Farm Bureau, the RCD, or POST, to evaluate whether their properties are meeting the specified performance standards, and if not, to help them identify priority erosion control improvements and a schedule for implementation.

By identifying recommended habitat enhancement actions in the Basin Plan amendment, the Water Board formally establishes these actions as priorities for funding, permit review, and technical support. We will work with landowners and third-parties to accomplish this type of work.

Comment POST-3: With respect to farming and ranching operations, we recommend less emphasis on extensive assessments and focus on implementation of proven Best Management Practices as the best use of funds to achieve sediment reduction.

Response: We have eliminated the formal requirement for farm plans, opting for a planning and prioritizing period as discussed in response to POST-2 above, which requires an assessment of priority erosion control actions, and the goal is to focus efforts on implementation.

Comment Letter No. 8: San Mateo County Resource Conservation District (RCD)

Comment RCD-1: The Commenter supports the large woody debris (LWD), stream complexity, flood plain reconnectivity and habitat enhancement goals of the TMDL, and looks forward to working with California Department of Fish and Wildlife (CDFW) and National Oceanic and Atmospheric Administration (NOAA) Fisheries (i.e., resource agencies) on these types of projects.

Response: Comment noted. Achievement of the TMDL, in part, relies on enhancing habitat complexity, and we look forward to working with the RCD, NOAA, and CDFW on future habitat restoration projects.

Comment RCD-2: The RCD is concerned over what is described as a lack of consultation with and review by CDFW and NOAA fisheries during development of TMDL.

Response: We disagree that we failed to consult with CDFW and NOAA during development of the TMDL. Although the two agencies submitted technical comments on the Draft Staff Report, those comments stem largely from questions related to the marsh and lagoon which we plan on continuing to work on as part of a separate project. Consultation with the resource agencies will be critical as we implement the TMDL.

Comment RCD-3: The Draft TMDL Implementation Plan, particularly Tables 17-22, does not sufficiently differentiate based on the impacts of different sediment types for fish habitat. Tables 17-22 require a one-size-fits-all, no-transport objective for projects. The Commenter is concerned that this will limit both fine and coarse sediment delivery to the channels; coarse material is needed for proper habitat conditions.

Response: We disagree that coarse sediment would be limited by the actions called for in the TMDL or that the implementation tables needs to differentiate between fine and coarse sediment. The implementation tables are intended to outline the broad actions that are necessary to reduce excess sediment that is delivered from human sources and that is above the natural background conditions. Natural background sediment input delivers ample amounts of coarse and fine sediment and in a complex channel habitat where LWD, floodplains, and channel processes and functions are not degraded, the sediment is sorted, metered, and delivered in such a way that a mosaic of habitats with different sizes are created and maintained. Our approach to TMDLs emphasizes the continuity of sediment throughout the channel network, as opposed to eliminating most sediment input of a given size. The sediment budget, numeric targets, and implementation actions incorporate our understanding of watershed processes (hydrologic, sediment, and wood) connected throughout the upstream reaches (the canyon reach), the alluvial fan reach, the wet meadow reach, and the lagoon and marsh, creating a functional resilient dynamic river corridor and a replenishing lagoon marsh system.

In addition, these tables do not require any single action; rather, they describe performance standards. The Regional Board is not specifying manner and means of compliance. Rather than one-size-fits-all, the tables allow implementing parties to take actions that are appropriate for problems in their jurisdictions.

Comment RCD-4: The RCD is concerned that the TMDL will place costly, time-consuming requirements on all agricultural lands for negligible sediment savings.

Response: Comment noted. We have proposed property size thresholds for farms, grazing lands, and timberlands to reduce the burden of TMDL compliance on small landowners. Please see our response to Comments FB-3, FB-11, FB-12, BC-3 and RE-4, that outline changes made in response to similar comments from other commenters.

Comment RCD-5: The RCD expresses concern that site inventories and assessments that are technically demanding and data-driven will place a burden on landowners and provide no benefit towards informing or improving implementation of sediment control actions.

Response: We disagree. The implementation provides a planning and prioritization period for conducting site inventories and assessments, in lieu of a formal farm plan, thus allowing farmers to evaluate problem areas without a heavy administrative burden. Please also see our response to Comment POST-3.

Comment RCD-6: The Commenter requests that consideration level of detail for implementation actions consider farm size, crop, erosion potential and site complexity be extended to all land uses identified in the TMDL.

Response: We have revised the implementation plan to scale implementation actions to property size. Please see our responses to Comment FB-5 and RCD-4. We believe that, by eliminating the surface erosion performance standard for agricultural lands, establishing a property size threshold for farms, grazing lands, and timberlands, and eliminating the formal farm plan requirement, we have addressed the concern stated here.

Comment RCD-7: The RCD requests that the descriptions of implementation monitoring and effectiveness monitoring be made consistent to avoid scope creep.

Response: We agree and have revised the Staff Report section 8.6 (p. 147) and the Basin Plan amendment section 7.4.2.7 as follows: "Implementation monitoring will be conducted by landowners or designated agents to document that the implementation actions specified herein or in applicable waivers of WDRs and WDRs have occurred."

Comment RCD-8: Ultimately, we think that the existing USDA Natural Resource Conservation Service (NRCS) model of conservation planning for agricultural and grazing land uses which includes identification of proven sediment reduction practices, will be the most cost-effective approach, and would leave more money available for implementation.

Response: Comment noted. We look forward to considering this approach during the planning and prioritizing phase of TMDL implementation.

Comment RCD-9: Establishment of a threshold for agricultural lands to address the issue of scale of implementation versus environmental benefits would help maximize planning efficiencies for the RWQCB, partners and landowners, and prevent inordinate efforts to implement sediment control regulations or permit requirements on small- or medium-sized properties where sediment delivery potential is low.

Response: We agree. Please see our response to Comment RCD-4.

Comment RCD-10: The RCD is concerned that the draft TMDL provides insufficient discussion of the regulatory actions proposed to address gully and surface erosion, that performance standards for gully and surface erosion are not consistent across all land uses, and that the proposed actions be

modified to emphasize practices to prevent surface erosion, such as improvement of soil health) and to stabilize gullies.

Response: The Commenter correctly points out the inconsistency in wording for the performance standards that apply to gully/shallow landslides. In response to this comment we have revised the implementation tables in both the Staff Report and Basin Plan amendment to read consistently across the land categories that have performance standards for gullies and shallow landslides. These tables include the regulatory framework for addressing erosion.

Comment RCD-11: The RCD provides information from a recent RCD/NRCS study that is specific to two subwatersheds in the TMDL project area. The RCD/NRCS study found that the rate of gully erosion in the lower watershed is decreasing, that hydro-connectivity of active gullies is highly variable across the watershed, and active gullies may therefore contribute less sediment than is estimated in the draft TMDL.

Response: The study the Commenter refers to analyzed gully activity primarily in the Bradley Creek watershed and stated that active gullying has decreased by 15 to 20 percent since 2005 and that comparatively few new gully segments were observed in 2016, with the majority of new gully length resulting from headwall expansion or the formation of flutes (vertical grooves) in gully sidewalls. However, the study cautioned that relatively low storm activity during the drought from 2012 to 2016 may have allowed for this gully stabilization process and that an increase in storm activity in an average year could reactivate stabilized gullies and/or create new ones. In fact, the study also noted that informal observations after the heavy precipitation winter of 2016/2017 suggest expansion of gullies and formation of new ones in areas where gullying previously occurred. We will review the amended study, which will incorporate a more detailed analysis of gullies in the 2017 aerial photos.

The Basin Plan amendment does not require actions specifically to prevent sediment delivery from gully erosion; rather, it calls for management of grazing lands to prevent additional erosion of gullies. If the inventories prepared for ranches during the planning phase of TMDL implementation indicate a deceleration in gully expansion, then those ranchers would be closer to achieving performance standards.

Comment RCD-12: The RCD requests that guidance be included in the Implementation Plan (Chapter 8) to address discrepancies between the TMDL and estimated sediment delivery rates in the development of required management plans and best management practices.

Response: We disagree that guidance is necessary. As described in our response to Midpen-1, implementing parties are required to meet performance standards, not to achieve the estimated percent reduction.

Comment RCD-13: The Commenter requests that additional information be provided on how the TMDL will be implemented (e.g., though third-party programs and permits), the process the Water Board will use to determine if a permit is needed, and requests examples of permit requirements developed to implement similar TMDLs. The RCD also identified a broken link on our webpage to the Non-Point Source Policy.

Response: We have revised the Implementation Plan to establish a planning and prioritization period during which implementing parties can work with third-parties. Based on reports to be submitted during this period, the Water Board will assess the level of and commitment to implementation, and would likely develop waste discharge requirements or other regulatory mechanism, as necessary, to ensure the TMDL is implemented.

The performance standards proposed for grazing lands in this TMDL are consistent with the regulatory approach used to implement similar TMDLs. For example, the Regional Board has adopted two waivers of waste discharge requirements for grazing operations, implementing the mercury, sediment, and bacteria TMDLs for the Tomales Bay watershed (R2-2013-0039), and the sediment and bacteria TMDLs adopted for the Napa River and Sonoma Creek watersheds (R2-2017-0043). Similarly, the Regional Board recently adopted General Waste Discharge Requirements Order No. 2017-0033 for Vineyard Properties in the Napa River and Sonoma Creek watersheds. A key component of these permits is addressing road-related erosion.

All three of these existing permits account for ongoing local efforts, establish acreage enrollment thresholds, contain performance standards for the control surface erosion, require assessments and control of road-related erosion, require management actions so as to not exacerbate erosion of legacy gullies and shallow landslides, and allow for the development of third-party programs to assist landowners with water quality monitoring, reporting, and vineyard/ranch and road assessments and repair. Lastly, vineyard and grazing land erosion assessment templates have been developed to implement the grazing and vineyard programs. These templates could serve as a basis for a similar approach in the Pesadero-Butano Creek watershed. While the TMDL does not require a third-party certification effort in this watershed due to the small number of properties involved, we encourage the use of third-parties such as the RCD to support and assist TMDL implementing parties. We understand from further discussions with the RCD that they are engaged in other farm assessment efforts, e.g., to address healthy soils and carbon sequestration. The RCD might consider building on these efforts to include priority implementation actions required by the TMDL and propose implementation schedules for individual properties. See also response to Comment POST-2.

We have corrected the link to the Nonpoint Source Enforcement Policy; thank you for notifying us.

Comment RCD-14: Almost the entire watershed is designated critical habitat for multiple federal and State listed species. This significantly increases costs and time to permit and complete projects and is a hurdle to landowners. The TMDL does not account for time and costs inherent to permitting and monitoring projects in coastal San Mateo County. The RCD requests that the Water Board take the lead in securing the funding and programmatic permits to implement the TMDL.

Response: Water Board staff understands the issues related to restoration projects in critical habitat locations. We are committed to facilitating restoration projects in the watershed and will work with other permitting entities to help facilitate the permitting process where possible. See also responses to Comments CT-5 and POST-1.

Comment RCD-15: The RCD recognizes the importance of cooperative and coordinated efforts to implement sediment reduction practices and the urgency for implementation, and has the right experience to facilitate this work. However, the RCD believes that completion deadlines for the

voluntary approaches are unrealistic due to significant time being required to develop the stewardship and/or third-party certification programs and the lengthy environmental reviews and permitting processes.

Response: We greatly appreciate the RCD's level of experience and willingness to facilitate habitat enhancement projects in the watershed. As stated in our response to Comment RCD-14 above, we do not believe a third-party certification program will be required in this watershed. Similarly, we are committed to working collaboratively with other agencies to facilitate permitting and do not agree that the timeline in the TMDL must be lengthened. See also response to Comment POST-2.

Comment RCD-16: The RCD will continue to collaborate with public and private partners to improve watershed health.

Response: We appreciate your commitment to support farmers and ranchers, to coordinate with all the stakeholders, and to improve the watershed health.

Comment Letter No. 9: Redwood Empire (RE)

Comment RE-1: "We applaud the Water Board for addressing sedimentation at the watershed level. Assembling a sediment TMDL for a watershed as large and complex as Pescadero Creek has no doubt taken an enormous effort. The report includes a thoughtful and thorough analysis of the plethora of management activities and their associated impacts."

Response: We appreciate your support and your comments on the Draft Staff Report.

Comment RE-2: Separate the landowners who engage in timber harvesting from those that reside in timberland but do not actively manage their forests. Explain documentation requirements.

Response: We disagree that actively managed timberlands must be distinguished from inactively managed lands for implementation purposes, as both types of lands have sediment impacts. Based on our analysis, properties designated as timberlands with an area of 100 acres or greater comprise approximately 13,000 acres and include about 16 property owners. The 100-acre threshold captures almost 90 percent of the timberlands while excluding small timberland owners. All timberlands of 100 acres or more must address road-related sediment delivery, regardless of whether timber harvesting or active forest management is done on the property.

Regarding documentation, an initial inventory of road network, sediment sources, site-specific erosion control measures, and a schedule for road improvements is needed to demonstrate that the TMDL performance standards will be met.

Comment RE-3: The information for the Report of Waste Discharge is already required to be included in Timber Harvest Plans by the Forest Practice Rules. It may be appropriate to first assess the information already being submitted with Timber Harvest Plans prior to requesting additional road inventory data from the entire watershed.

Response: We agree and, during the planning and prioritizing period of TMDL implementation, we recommend assessing pertinent information on how the THP process can assist with implementation.

However, THPs typically cover a small percentage of the total timberland. Therefore, limiting road assessments to THP areas would not adequately capture road-related sediment issues.

Comment RE-4: Setting a minimum acreage threshold of 100 acres or more will likely capture the majority of sediment impacts, will allow for a more efficient and less intrusive process, and will prevent creating a financial burden for smaller landowners.

Response: We agree with this recommendation. In response to this comment, we have revised the Staff Report to incorporate a minimum total acreage threshold of 100 acres (per landowner/property, not per parcel size) requiring implementation actions for timberlands. Based on our analysis, properties designated as timberlands with an area of 100 acres or greater comprise approximately 13,000 acres and include about 16 property owners. The 100-acre threshold captures almost 90 percent of the timberlands while excluding small timberland owners.

This will not alter the requirements or applicability of the Forest Practice Rules, Anadromous Salmonid Protection Rules, and Road Rules.

Comment Letter No. 10: San Mateo County (SMC)

Comment SMC-1: San Mateo County acknowledges the effort and supports the TMDL's goals; County conducts road maintenance and stream bank repairs in support of these goals; County Parks has conducted sediment assessments; will work collaboratively with the Water Board.

Response: Comment noted. We appreciate that the County is taking steps to control sediment during maintenance of their roads.

Comment SMC-2: Include an overarching conceptual description of land-use and erosion history, including (1) Patterns and trends of erosion and sedimentation over time throughout the watershed; and (2) Sequencing of the land use and erosional impacts associated with settlement and development in the watershed. Without a sequential description, or organization, that explains what happened in the watershed, where, and when, the evaluation relies on overly general statements.

Response: Although we agree that a conceptual flow chart of sediment delivery to channels, and channel sediment storage has value, the details of what happened where and when in the Pescadero Creek watershed are presented in the Staff Report - in the main body, and other figures and tables.

For example, Table 5 summarizes the timing of land-use disturbances that significantly altered watershed erosion and sedimentation. Figure 32 shows location of gullies within the watershed. Table 10 summarizes trends through time in gully erosion rates, and Figure 33 depicts gully expansion through time at an example location. Similarly, the timing and location of conversion of scrubland and forest to rangelands and farms, and the logging of old-growth forests is shown in Figures 15 and 16. The locations and time periods for mill dams are shown in Figure 17.

Also, the Staff Report and the responses to Comments SMC-23, SMC-26, and SMC-27, describe the locations and timing of the onset of channel incision throughout the watershed. Although a more detailed presentation of the variation in timing and magnitude of incision might be useful, it is not

essential to guide policy decisions to address the impacts of incision on sediment loads and habitat complexity and connectivity.

We know where incision has been significant – along most of the lengths of lower Pescadero and Butano creeks. Where technically feasible and compatible with adjacent land-use and public safety, we recommend projects to enhance large woody debris loading and reconnect channels to their floodplains as needed to restore habitat complexity and connectivity, natural floodplain sediment storage, and where incision is active to control future channel widening and lowering. Reach-specific geomorphic and habitat surveys will help identify locations for projects and guide design of specific large-wood and floodplain restoration actions. A good example of this approach is the Oakville to Oak Knoll Napa River Restoration Project (California Land Stewardship Institute and Philip Williams & Associates, 2011; Horizon Environmental, 2013).

Comment SMC-3: An improved geomorphic conceptual description would document the processes of channel incision, sedimentation within channels, sedimentation at the marsh/lagoon, and how these processes are occurring over time and space within the watershed (refer to p. 18).

Response: In response to this comment, we offer the following clarification on the distribution of incision and sedimentation over time and space. During the period when incision is active and significant, all other influences being equal, we would not expect the streambed to become finer. However, in most locations along lower Pescadero Creek, the onset of channel incision was in the nineteenth century, and along lower Butano Creek, during the first half of the twentieth century. Although incision appears to be active at present in some reaches of Butano Creek (Balance Geo, 2015, pp. 104-105), rates likely are much lower in recent decades than they were several decades ago. Since the onset of incision, there has been a substantial and persistent increase in rates of sediment delivery to channels and an overall fining of the supply[1], a substantial reduction in floodplain sediment storage, and significant decrease in large woody debris loading (which degrades in-channel sediment sorting, and metering through the channel network of large episodic sediment inputs). These changes have interacted to cause the streambed to become finer and more poorly sorted than would occur under more natural sediment transport and storage dynamics (i.e., restored wood loading, floodplain connection, and natural background rates of sediment delivery).

Comment SMC-4: In the Natural Background section, the description of past sediment processes would be strengthened with physical information, or references, that would provide a basis for the interpretation of how the system previously worked (refer to p. 61). For example, the description of the role of Large Woody Debris (LWD) in the channel as one of the primary agents for storing sediment is not cited, referenced, documented, or otherwise given a physical basis for this claim.

[1] In addition to an approximate doubling of the sediment delivery rate to channels caused by land-uses, sediment supply has likely become richer in sand. Both changes (higher supply rate and the higher percentage of sand) would contribute to a fining of the streambed. Prior to Euro-American settlement, natural sediment supply was largely from deep-seated landslides and soil creep; in channels, bank erosion was balanced by floodplain deposition, so these processes had a neutral effect on sediment supply. We infer at present, sediment supply is richer in sand because gullies (which we infer are largely anthropogenic) erode colluvial soil and soft sandstones and shales, road-related erosion delivers mostly sand and finer sediment, and bank erosion along incised channel reaches that are now widening is typically rich in sand and finer sediment.

Response: Although the specific page (61) this comment refers to does not contain physical information or references, subsequent pages of the Natural Background section (sediment source analysis) are well supported with physical information and references. We have added a citation to the description of LWD as a primary agent for sediment storage on page 61 of the Staff Report. We also provide the following discussion.

Research conducted in Redwood National Park demonstrates that sediment storage associated with large woody debris jams in first- through fourth-order stream channels draining old-growth coast redwood forests can be substantial. Streams draining old-growth redwood forests store and meter (slowly release sediment delivered by large episodic inputs) a substantial volume of sediment as compared to total sediment delivery to channels from landslides, and when considered as a percentage of average annual bedload sediment supply.

Tributary sediment stored behind large woody debris jams in streams draining old-growth coast redwood forests averaged approximately 49 percent of the total sediment delivery from landslides delivered during the preceding three decades[2] in high-relief watersheds, and 168 percent in low-relief watersheds (Pitlick. 1995, p. K8, Table 7). The amount of sediment stored in large woody debris jams in one stream that was intensively studied, expressed as a percentage of bedload supply, represented about 100-to-150 years of bedload supply; available future storage volume in these debris jams represented an additional 50-to-100 years of bedload supply (Keller et al., 1995, pp. 23-26).

Comment SMC-5: This section presents a summary of channel incision and erosion processes, in short - that due to lack of floodplain storage and disconnected channels from their floodplains, eroded material is all sent downstream. The description should further describe the role of various other sediment storage opportunities (not on floodplains) that occurs in the watershed (refer to p. 140).

Response: The Draft Staff Report does describe the role of other sediment storage opportunities (not on floodplains) in the watershed, for example see the discussion in the Sediment Storage section starting on page 99.

In addition, we are providing the following discussion. As discussed in the Staff Report, a primary opportunity for long-term sediment storage is through restoration of alluvial fans. Efforts to reconnect incised channel reaches to floodplains, in addition to restoring floodplain storage, also restore channel sediment storage. Also, undisturbed alluvial fans - where fans have not been ditched - in some locations may present significant sediment storage opportunities. Therefore, where ditch removal would be compatible with adjacent land-uses and public safety, alluvial fan restoration may be a cost-effective approach for reducing sediment delivery to channels from gully erosion.

Comment SMC-6: The sediment budget is incomplete. The draft Staff Report does not adequately portray the net sediment budget of inputs, outputs, or changes of storage within or from the watershed. This is problematic because the TMDL and implementation actions are therefore based on an incomplete understanding of sediment processes.

[2] The preceding three decades were characterized by extensive clear-cut logging, tractor yarding, and road-building in unstable areas, and two very large storms.

Response: We disagree. Please see our responses to comments SMC-7, SMC-8, and SMC-9 below for more information on our sediment budget calculations and assumptions.

Comment SMC-7: Clarify whether the 203,000 tons/yr. of sediment is exiting the watershed entirely or if some of it is being stored in other watershed locations. Clarify if the dash in the row for wet meadow/alluvial valley storage for the period 1970-2010 on Table 14, means there is no measurable sediment storage in that category.

Response: Based on our understanding of the watershed processes, we infer that: a) most suspended sediment - predominantly the clay and silt sized material that is delivered to channels, and some of the sand that is transported in suspension during high flows - is discharged from the watershed to the Pacific Ocean; and b) most bedload - all gravel delivered to channels and most of the sand - is deposited in the sites listed in Table 14 of the Draft Staff Report.

The Pescadero-Butano watershed can be compared to similar nearby watersheds where the percentage of the total sediment load transported as suspended and bed-load have been estimated (Willis and Griggs, 2003; Inman and Jenkins, 1999; Downs et al., 2017). We conclude that suspended-load probably represents about 80-to-90 percent of the total sediment load in the Pescadero-Butano watershed or 202,000-to-228,000 tons per year, which is similar to the difference between estimated sediment delivery to channels and watershed sediment storage.

Potentially significant long-term channel sediment storage changes not quantified in the Pescadero-Butano sediment budget include debris flows and landslides deposited in tributary reaches upstream of Humboldt Crossings along the Old Haul Road, which may be as high as 2,000,000 tons[3] (see Balance Geo, 2015). Also, we did not quantify aggradation along Bradley Creek, although it is likely that Bradley Creek includes an aggrading reach along its lower course near its confluence with Pescadero. Anecdotal evidence of aggradation along lower Bradley Creek includes direct observation of extensive/fresh backhoe spoils along Bradley Creek that define informal levees along the creek. However, please note that that regular dredging along this reach may be effective in maintaining a high sediment yield to Pescadero Creek.

Also, it is plausible that some fraction of gully sediment delivery to the channels - that we estimate averages about 24,000 tons per year - is going into long-term storage in alluvial fans in locations where fans have not been ditched.

The dash in Table 14 does not mean that there is no measurable storage; it represents an unknown quantity. We will replace the dash in the Staff Report with the word “unknown” to be clear.

Comment SMC-8: The lack of a complete sediment budget is problematic because the numeric targets and implementation actions are therefore based on an incomplete understanding of how sediment is being eroded, transported, or stored across the watershed. The Staff Report provides a detailed sediment source evaluation, but without a more complete understanding of what proportion of

[3] Most of this sediment likely was deposited prior to the timeframe of the sediment budget, which is 1970 to 2010. For example, if about one-fourth of the total deposition upstream of the Old Haul Road occurred during the 1970 to 2010 period, then an additional 10,000-to-15,000 tons per year of channel sediment storage is not accounted for.

sediment leaves or remains in the watershed, and where it is found, it is difficult to determine how the management prescriptions and requirements of the TMDL should be applied. The County requests a more complete sediment budget before requiring a target sediment reduction of 78 percent.

Response: We disagree that the sediment budget presented in the Draft Staff Report is incomplete. Scientific peer reviewers found the sediment budget to be based on sound scientific knowledge, methods, and practices (see Finnegan, 2017, p. 1). As noted in *Rapid Evaluation of Sediment Budgets* (Reid an Dunne, 1996) "most studies only require part of a sediment budget to satisfy their primary objectives, and the part that is needed depends on the objectives." To be responsive to this comment, we offer the following discussion.

We focused the Pescadero-Butano sediment budget primarily on quantification of sediment delivery rates to channels and interpretation of these features to infer natural or anthropogenic causation, because this approach is essential to developing the sediment TMDL. Furthermore, channel incision is extensive and the sediment budget also quantifies these changes in channel sediment storage.

The estimate of 78 percent reduction in sediment loading needed to attain the TMDL is evaluated using numeric targets in the receiving water bodies. See also response to Comment Midpen-1. The numeric targets are independent of the sediment budget. To develop the numeric targets, we selected parameters that are biologically meaningful, are responsive to sediment supply changes; and can be accurately measured. We chose target values that are protective of beneficial uses, in this case properly functioning substrate conditions for anadromous salmonids. While suggesting some clarifications and additional specification, the peer reviewers found V* and percent fines, and selected target values, to be reasonable and scientifically sound. Other scientific reviewers also have approved these same parameters and target values, which are included in several other adopted sediment TMDLs (See North Coast Water Board, 2004 and 2006).

Comment SMC-9: In Table 12 the distinction between natural and anthropogenic sources is not always clear. Please verify if there is any double counting between anthropogenic and natural sources. These topics are described earlier in Chapter 5, but it is unclear how rates for gullying, landslides, or surface erosion due to anthropogenic causes were distinguished, or kept separate, from the natural sediment source rates, and no overlap in accounting occurred. Furthermore, please clarify what constitutes 'road-related landslides.'

Response: We confirm that we did not double count sediment sources. To provide clarification in response to this comment, we offer the following discussion. We identified six significant anthropogenic sources of sediment delivery to channels: 1) surface erosion processes acting on the road prism; 2) road-crossing related gullies and landslides; 3) channel incision; 4) gullies in rangelands; 5) landslides/debris flows in timber harvest areas; and 6) surface erosion processes acting in rangelands.

All road related sediment delivery to channels, which includes surface erosion processes acting on the road prism and landslides and gullies related to road crossings, are anthropogenic. Estimated erosion rates are based primarily on field inventories of roads.

As explained in our response to Comment SMC-23, 19th century on-the-ground photographs, oral histories, and geomorphic evidence document that channels were not incised prior to land use-related

disturbances. Therefore, we infer that incision during the historical period is entirely anthropogenic[4]. Also, as described in our response to Comment SMC-26, the channel incision rate only considers the change in bed elevation that occurred over the historical period as inferred by a variety of datums.

Gullies in grazing lands are associated directly in time and space with vegetation conversion and hillslope farming and/or intensive grazing in locations underlain by an extremely sensitive soil/bedrock unit (Tahana Member of the Purisima Formation). Also, changes in rainfall intensity did not occur during the period of gully initiation (Swanson et al., 1989), leading us to conclude that historical land-use activities are the cause or a significant contributing factor to gully erosion.

As stated in the Staff Report, we rely on ESA (2004) to estimate the fraction of landslide/debris flow sediment delivery to channels that is anthropogenic. Their approach, like the one we used for gullies, attributes an anthropogenic causation (or land-use as a contributing factor), when there was a direct association in time and space between the land-use activity and the erosion site. In evaluating this source, please note that ESA (2004) estimates that less than 10 percent of all erosion during the 1937-2002 period was not associated in space/time with land use activities, and acknowledges that the percent of landslide/debris flow sediment delivery to channels that is anthropogenic may be overestimated (ESA, 2004, p. 6-44).

Surface erosion in rangelands, a modest sediment source, is inferred as entirely anthropogenic as we only estimate this process in rangelands where grazing has diminished ground cover. Surface erosion related to natural processes (wildfire, grazing by wildlife) and intentional burning by Native Americans, prior to Euro-American settlement is included with soil creep and natural landslide erosion in our overall estimate of natural background rates of sediment delivery to channels.

Comment SMC-10: Curry et al. (1985) indicates a high rate of tectonic uplift; please clarify how large a role it plays and what the degree of natural incision due to faulting and uplift is across the watershed.

Response: Lower Pescadero and Butano creeks appear to traverse tectonically down-dropped blocks, which would promote tectonically induced sediment deposition not incision. Also, as noted in Curry (1985), the slope of lower Butano Creek decreases rapidly along this reach (as compared to lower Pescadero Creek), which would further promote alluvial deposition.

Comment SMC-11: Page 69: The Staff Report says that extensive field work was conducted, but it is not clear what the product or result of that work was – please include. The Staff Report says that the field work was constrained due to access, schedule, and budget issues. The County requests that the information that was unable to be collected be included in the Staff Report. Also, please include whether the conclusions were adequately verified by the field work, or if constraints limited the ability for the field work to provide the necessary information to the Staff Report. Alternately, if the field work was more qualitative and descriptive please describe in the Staff Report.

[4] Furthermore, considering the cosmogenic nuclide-derived denudation rate for the Pescadero Creek watershed, which is 0.25 mm/year. Apply that average annual denudation rate from the time of valley deposition (about 6,500 years ago) to Euro-American settlement results in a total lowering of about 1.3 meters (4.3 feet) over the past 6,500 years along lower Pescadero and Butano creeks. Assuming no alluvial deposition in these reaches (which are down-dropped tectonic blocks) in response to uplift elsewhere in the watershed seems highly unlikely.

Response: While the Draft Staff Report does discuss the results of field work (measurements, observations, etc.), we provide the following discussion in response to this comment. We relied on the approach developed by Reid and Dunne (1996) – "Rapid Evaluation of Sediment Budgets" – to review background information (including published reports, aerial photographs, historic maps, etc.) and conducted watershed reconnaissance to identify significant active processes delivering sediment to channels and to evaluate their relationship to watershed geology, topography, and land-cover/land-uses.

Based on review of previous studies, we identified primary gaps in the quantification of sediment delivery rates for channel incision and gully erosion, which were a focus of the field work conducted by BalanceGeo (2015). Several weeks of field work were conducted in the Pescadero Creek watershed to identify significant active processes delivering sediment to channels, to estimate process rates, and to infer natural or anthropogenic causation.

Please see our responses to Comments SMC-23 and SMC-26, where we describe the data collection methods and extensive field surveys that were conducted to estimate the locations, magnitude, and timing of channel incision throughout the watershed. The field work conducted to estimate rates of sediment delivery to channels from gully erosion is described in pp. 63-64 of the Staff Report. Also, as described above, road-related sediment delivery to channels is based in part on field inventories conducted on roads located in San Mateo County Parks (ESA, 2004, 6-41 and 6-42). Sediment delivery from landslides/debris flows, as described in ESA (2004, 6-19 to 6-21) is based on field survey of 40 field plots and interpretation of features on time sequential aerial photographs. Field reconnaissance along public roads and private property where access was granted together with interpretation of aerial photographs was used to select parameter values for vegetation cover and length-slope values that were input into the USLE Model to estimate surface erosion processes.

Comment SMC-12: Page 70: please provide a numeric or quantitative measure or range of measurements to define the term "massive amounts" of sediment delivered to Bradley Creek.

Response: Bradley Creek watershed is approximately 5 mi^2 (12 km^2) and constitutes one-half of the total area where gully erosion is active. Therefore, just considering gully erosion, we estimate that approximately 12,000 tons/year of sediment is delivered to Bradley Creek, which is approximately 1,000 t/km^2/year. Road-related erosion and surface erosion in rangelands likely add an additional several hundred tons/km^2/year to the total rate of sediment delivery to channels in the Bradley Creek watershed.

Comment SMC-13: Page 89: shallow landslides due to timber harvest are described as providing 23,000 tons/yr. This value is included in Table 12 and built-into the 133,000 tons/yr. total anthropogenic sediment source amount in Table 14. But this amount, and others that are included in the sediment source analysis, are not further described in terms of the sediment budget. Please clarify whether all of these values are simply sediment inputs or if they contribute to sediment storage as well. Clarifying this point would help to explain the 203,000 tons/yr. gap show in Table 14 (described above).

Response: Please see our responses to Comments SMC-7 and SMC-9 above. Specifically, please note that some of the sediment delivery to channels from landslides/debris flows is being deposited upstream of the Old Haul Road.

Comment SMC-14: Historical paintings, photos, and reference studies are qualitatively valuable, but may not be reliable for making geomorphic determinations. Reliance on reference studies from other areas may have limited application to the Pescadero-Butano Watershed.

Response: Please see our response to Comment SMC-23. We acknowledge that there are limitations to using historical paintings and photos, but believe that they provide valuable insight into early conditions of the watershed for which no other data exists.

Comment SMC-15: Clarify how the depth and capacity of pre-European settlement lagoon was determined: a) on p. 44, the historic lagoon is described as much larger and deeper and as a deep-water estuary. Please provide documentation or references; b) on p. 67 the physical basis to quantify background conditions is not specific enough to justify the precision of 78 percent reduction target; c) on p. 102, 1915 and 2010 photos of Pescadero Lagoon are captioned as "clearly illustrating" the loss of open water; d) on p. 103, Curry et al (1985) describe the lagoon's tidal prism as annually variable based on beach height and width, littoral deposition, and amount of runoff/sediment delivery. Thus, it makes little sense to average the rates between the three estimates considered; and e) on p. 126, 3rd bullet: the lagoon's tidal prism decreased by three quarters. Please include more information on the basis of the lagoon depth and volume estimates from 1800s/early 1900s.

Response: Our responses to these comments on the lagoon are given below. Please note also that addressing water quality concerns in the Pescadero lagoon and marsh, beyond the scope of this TMDL, is part of a separate ongoing project.

a) Please see our response to Comment NMFS-1 and Viollis (1979), Williams (1990), ESAPWA (2011), and the 1854 T-Sheet for detailed information.
b) Background sediment delivery was estimated using a cosmogenic analysis conducted by a Stanford researcher (please refer to p. 62 and Gudmundsdottir et al., 2013). The TMDL is set at 125 percent of natural background conditions, which is based on the assimilative capacity of the system that would be protective of beneficial uses, as established in other watersheds. The 78 percent reduction target needed to attain the TMDL is an estimate and will not be quantitively evaluated (please also see our response to Comment SMC-8). The actual extent of sediment control and attainment of the TMDL will be based on the attainment of the numeric targets for sediment.
c) Please see our response to Comment NMFS-8.
d) Please see our response to Comment NMFS-1.
e) Please see our response to Comment NMFS-1.

Comment SMC-16: Include a projection of how watershed conditions may evolve or adjust in the future, as we suspect that current trends are likely to continue. The Staff Report importantly acknowledges in a few locations that in recent years, erosion and sediment loading have been declining. In much of the literature, a watershed adjustment (or recovery) period is often described once impacting land uses (such as logging) are curtailed or reduced, whereby the watershed begins to recover toward a more balanced erosion and sedimentation condition. If the Pescadero-Butano

Watershed is on such a trajectory of recovery (or partial recovery), the County requests this be acknowledged.

Response: Absent implementation of the Basin Plan amendment, we predict that sediment supply will remain substantially elevated and enriched in sand and finer sediment throughout the foreseeable future (several decades-or-more). Our rationale (in summary) is as follows:

a) Gully erosion rates appear to be increasing in recent decades (Staff Report, pp. 84-87, and Table 10). The poorly lithified sandstones and shales that underlie the gullies are more easily eroded than the overlying colluvial soil (see Finnegan, 2017, Section 5.3.3, Gully Erosion Section, p. 3-4).
b) Streambanks along Butano Creek in its lower reaches and its canyon are typically very steep, poorly vegetated, and often comprised of non-cohesive alluvial deposits, which are expected to rapidly widen in future decades.
c) Although sediment delivery from channel incision along Pescadero Creek appears to be decreasing, incision along Pescadero Creek represent only about one-third of the total sediment delivery from incision. Future channel widening along Butano Creek would be expected to more than match the potential future reduction along Pescadero Creek.
d) Sediment delivery from road-related erosion is significant and ongoing. Considering all but the Old Haul Road, drainage design often concentrates road runoff, crossings often are susceptible to plugging and diversion, and many road segments are located mid-slope and underlain by highly erodible bedrock units or mapped landslides. Also, the Old Haul Road presents a very high potential for significant future sediment discharge in response to partial failure of one or more its decaying Humboldt Crossings.

Comment SMC-17: Sea level rise is not addressed in the Staff Report.

Response: Although the Staff Report does not include a discussion of management recommendations within the context of climate change, such consideration is fundamental to our policy recommendations, which emphasize re-establishment of properly functioning conditions with regard to large woody debris and floodplains, as needed to substantially increase the complexity and connectivity of channel and floodplain habitats, and to greatly increase fine sediment storage, sorting, and metering. Where compatible with adjacent land-use and public safety, collaborative projects to restore floodplain connection along sub-reaches of lower Butano, Lower Pescadero, and Bradley creeks also will provide connected habitats that can evolve dynamically to sea-level rise.

Similarly, actions to correct road drainage problems will reduce future sediment delivery rates form roads, attenuate storm runoff increases, and reduce long-term costs associated with maintenance or repair following failures.

Comment SMC-18: Please clarify if the majority of sediment from past logging (minus what's stored behind haul roads) has been transported through the system. State whether on-land sediment sources have decreased. Clarify whether we have already experienced the majority of the channel response to straightening of channels and manipulation of the system. Similarly, discuss if we have approached a dynamic equilibrium in terms of on-going channel incision.

Response: Please see our responses to Comments SMC-16 and SMC-21. We do not believe that the system has yet reached equilibrium.

Comment SMC-19: Figure 5 (p.36) points out "lagunas" indicating freshwater wetlands and a waterlogged valley. Clarify if these features were due to the presence of a waterlogged floodplain, or if these could be influenced by the presence of local faults and tectonic processes.

Response: We interpret the lagunas to be indicative of water-logged conditions related to channel/valley aggradation throughout the mid-Holocene up through the time of Euro-American settlement. In both locations, we also interpret that these valley segments may be down-dropped fault blocks, consistent with the interpretation of Webber and Lajoie (1980).

Comment SMC-20: In Table 12, provide how much erosion conditions have stabilized or improved in the timeframe 1970-2010. Please clarify if there is a positive trajectory suggesting recovering conditions in the watershed.

Response: Please see our response to Comments SMC-16 and SMC-18. As stated above, we do not believe that sedimentation in the watershed has reached equilibrium. Without implementation of restoration projects, we do not believe that the watershed will recover or improve.

Comment SMC-21: Please clarify if incision and gully erosion is expected to continue at the same rate into the future. The Staff Report describes channel incision as a "self-perpetuating process of positive feedback, with ever-deepening channels…". This may be true to a point, but bedrock or other structural control will eventually create a stable base for the channel thalweg. In light of the range of geomorphic processes that may occur across the watershed (Comment 2), and our belief that the watershed may be experiencing recovery/reduction in erosion and sedimentation – the County believes that the description that channel incision is a permanently growing situation (p.108) may not be accurate.

Response: Please see our responses to Comments SMC-18, SMC-20, SMC-23, and SMC-28. We think that the peak rate of incision along lower Pescadero Creek in most locations was in the nineteenth century and in most locations along lower Butano Creek during the first half of the twentieth century. However, Incision remains active along some reaches of Butano Creek, and other reaches of the creek (where incision has waned) appear to be susceptible to substantial widening in future decades (as described in our response to Comment SMC-17).

Comment SMC-22: The County strongly disagrees with the statement "bank erosion should not automatically be considered a threat to buildings or other critical infrastructure in most locations and should be allowed to evolve without intervention, where possible, to widen the channels toward more complex processes and habitat." Flood risk... should be evaluated case by case, based on physical conditions, etc. Stating that, at most locations, bank erosion should not be considered a threat is overly general and misleading.

Response: We concur. We did not mean to imply that bank erosion should be allowed to evolve without regard to flood risk and have revised the cited passage in the first paragraph on page 142 of the Staff Report as follows:

"bank erosion should not automatically be considered a threat to buildings or other critical infrastructure in most locations (where buildings and roads are located far enough away, such that future predicted widening would not be a threat) and should be allowed to evolve without intervention, where possible, to widen the channels toward more complex processes and habitat."

Comment SMC-23: The County agrees with the Staff Report that channel erosion and incision processes have dramatically increased due to more intensive land uses in the watershed in the last two centuries, however, portraying the watershed as having no channel incision prior to this period may be overly simplistic.

Response: We disagree that we have assumed there was no channel incision prior to the last two centuries. We use the term "channel incision" to refer to net lowering of the channel bed elevation over a period of years or decades, in response to disturbance that causes sediment transport capacity to be much greater than supply (Simon and Darby, 1999). We concluded that: a) prior to Euro-American settlement, the broad valleys adjacent to Pescadero and Butano creeks downstream of their canyons were active floodplains that were frequently flooded during the wet season (these channels were not incised); b) in most locations along these reaches, there has been a net lowering of the channel bed of ten feet-or-more during the historical period; and c) the primary causes are anthropogenic, direct channel disturbances (e.g., channel straightening, large woody debris jam removal, construction of mill dams on channels, connection of naturally disconnected tributaries, etc.) and watershed disturbances (logging old-growth redwoods, intensive historical grazing, etc.).[5] Examples of supporting evidence include the following:

a) The photograph along Pescadero Creek near Pescadero in 1867 (Figure 6b) shows an unvegetated bar (highlighted in the pink circle) that is only a few feet lower than the adjacent riparian woodlands. In the foreground the outer/upper edge of the riparian woodlands define the top of bank, which is coincident with the valley floor. Therefore, in this location in 1867 we conclude the valley floor was an active floodplain.
b) Although the bed of Pescadero Creek appears somewhat lower in photographs taken near this same location in 1915 and 1920 (Figure 7), these photos show gravel bars only a few feet below the adjacent riparian woodlands, the upper edges of which are coincident with the valley flat. At present, the channel is more than 15 feet deep in this location.
c) Figure 8 clearly shows a former meander bend in the bare-earth shade-relief image and cross-section. Also, this reach of Pescadero Creek appears to have been straightened, which would increase the streambed slope and facilitate incision. The former meander bend is distinct suggesting it was recently the main channel, most likely during the historical period.

[5] We also concluded that most gravel-bedded channels in the canyon reaches of Pescadero and Butano creeks, and/or their tributaries, experienced net lowering of a few meters-or-more in most locations primarily via removal of large woody debris jams from the channels. For example, through personal communication with Al Solars (a longtime Pescadero resident who was 94 at the time of the interview), Martin Trso documented that in the late 1940's when summer cabins along Butano Creek in its canyon reach began to be used year-round, residents removed the large woody debris jams from the channel to address chronic flooding, which led to significant local incision.

d) Farms around Pescadero cultivate dark organic rich soils indicating extended periods of soil saturation.

Please also note that Professor Noah Finnegan, who performed independent peer review commented:

> *"I found the analysis of historical changes … very compelling. To me, this section effectively demonstrated the degradation in habitat that has occurred in Pescadero Creek as well as the physical changes that occurred due to land-use practices in the watershed. I have no issues with this section [Chapter 4]."*

Comment SMC-24: Please consider potential negative effects of increased floodplain inundation, including that inundation of agricultural areas may increase nutrient other pollutant loading to downstream waters.

Response: We expect that floodplain restoration projects will undergo review under the California Environmental Quality Act, and will seek permits, as appropriate, from local, state, and federal agencies, including the Water Board. We expect that a floodplain reconnection project would be a collaborative, publicly-funded project; would be protective of public safety and infrastructure; and would be compatible with adjacent land-uses. In addition, we expect that effective agricultural water quality control measures are in-place or will be implemented at most agricultural properties in the watershed; such measures include, for example, vegetated filter strips, agricultural chemical discharge control practices, and targeted application of nutrients.

Comment SMC-25: "Prior to incision, about one-third of the total sediment yield…was deposited within floodplains and/or…on alluvial fans…" Please provide more information on the basis of that estimate (p. 16).

Response: We calculated the area of valley and alluvial fan deposits based on review of geologic maps and delineation of the valleys and fans on a bare-earth shaded relief map, generated using one-meter resolution laser altimetry (LIDAR) data, and filtering to remove most vegetation cover. Channel surveys provided the primary basis for estimation of alluvial valley thickness. Example reach maps are available upon request (see for example, Trso, 2015, p. 101). Review of Atwater et al. (1977), as summarized in Viollis (1979) provided the basis for inferred mid-Holocene onset of alluvial valley deposition 6,500 years ago (ya), which is a conservative estimate for the timing of the onset of valley deposition. In other nearby coastal streams where the onset of modern valley deposition has been estimated based on radiocarbon dating of charcoal in basal gravels, the timing was between 3,500 ya in Redwood Creek watershed, Marin County (Stillwater Sciences, 2004), and 5,000 ya in Walker Creek, as reported in Haible (1980).

We then compared the cosmogenic-nuclide derived watershed denudation rate over the past 6,500 years to the volume of alluvium in the valley fills and alluvial fans. Applying a conservative estimate of the onset of valley deposition (6,500 ya), we estimate that approximately one-third (32 percent) of total sediment delivery to channels was deposited in the valley fills and fans from about 6,500 ya to the time of Euro-American settlement. Using a more recent date to define the onset of valley deposition, would increase the percent of sediment delivery that went into long-term storage in the floodplains and fans.

Comment SMC-26: Sediment eroded due to channel incision (p.78) is estimated based on estimated changes in channel dimensions. Clarify what data were used to calculate original channel dimensions and whether actual physical or inferred information was used.

Response: Estimating historical channel dimensions was not part of our approach. Instead, within a given channel reach, we conducted extensive channel surveys to estimate the volume of incision during the historical period by identifying natural-or-anthropogenic datums that could be used to infer the historical bed elevation prior to the onset of incision. We then estimated vertical distance to current streambed elevation, and multiplied incision depth by average channel width within the incised portion of the bank. We used a stadia rod or measuring tape to estimate incision depth and width. Almost the entire length of Pescadero and Butano creeks, and most major tributaries were surveyed to estimate historical incision including Bradley Creek, McCormick Creek, Tarwater Creek, Peters Creek, Oil Creek, Slate Creek, Waterman Creek, and Little Butano Creek.

Example datums included: a) a former mainstem channel reach along Pescadero Creek identified on 1943 aerial photographs and located in the field that is now perched on an alluvial terrace (see for example, Balance Geo, 2015, pp. 102-103); b) along Butano Creek in its canyon reach, where timing of incision was inferred from oral history interviews with Al Solars, the incision depth was estimated by identifying old-growth redwood stumps or living trees in growth position along the channels, and inferring that the elevation of their spreading roots now exhumed following erosion to provide a basis for estimating the minimum depth of incision (see field sketch, Balance Geo, 2015, p. 101).

In some cases, we inferred that incision was modest during the historical period, for example along McCormick Creek, where the skids of a former corduroy road constructed in the channel during nineteenth century logging are still intact and the channel has subsequently incised typically a foot or two below the historical bed elevation (see Balance Geo, 2015, p. 91, upper photo). In the canyon reaches, we often used the exhumed top edge of the spreading roots of old-growth redwood stumps or live trees to approximate the elevation of the streambed (as we infer that the elevation of these roots corresponded approximately to the elevation of the piezometric surface prior to incision – of baseflow or subsurface along the channel).

Comment SMC-27: Describe where and how much sediment is being stored in various channel locations downstream.

Response: Most channel reaches in the Pescadero-Butano watershed are deeply incised, and not connected to active floodplains, including almost all the canyon reaches of Pescadero Creek and its tributaries. Although some LWD jams store locally significant volumes of sediment, the typical timeframe for storage at these sites is a few decades-or-less, and hence at present LWD jams do not provide significant long-term sediment storage. In general, this same pattern holds along Butano Creek and its canyon tributaries. Exceptions are the "Willow/Alder Thicket" along Butano Creek, the volume of which is estimated in the Staff Report. Significant long-term channel sediment storage sites not quantified in the Staff Report include: a) the recently restored floodplain reach along lower Butano Creek; b) debris flow deposits in tributary reaches upstream of Humboldt Crossings along the Old Haul Road, which may be as high as 2,000,000 cubic meters, which in addition to estimated fill volumes that

could be discharged (see Best, 2015), lends further support to the importance of implementing effective road erosion control retrofits in the near-term along the Old Haul Road.

Although we did not attempt to quantify aggradation along Bradley Creek, it likely that it includes an aggrading reach along its lower course near its confluence with Pescadero. Anecdotal evidence for this includes direct observation of extensive recent/fresh backhoe spoils along Bradley Creek that define informal levees along the creek. However, we also note that regular dredging along this reach appears to be maintaining a high sediment transport capacity and yield to Pescadero Creek. It also is plausible that some fraction of gully sediment delivery to the channel network is going into long-term storage in alluvial fans (where fans have not been ditched to promote drainage of adjacent fields). In fact, restoration of natural depositional processes along alluvial fans may be a worthwhile sediment discharge control action where this action is compatible with public safety and adjacent land-uses.

Comment SMC-28: Show the field work and analyses supporting the conclusion that channel incision was occurring in the late 1800s (p.99). Incision in the lower Butano could have been largely in response to channel straightening.

Response: See our responses to SMC-23 and SMC-26, which describe our methods and summarize example points of supporting evidence. As for lower Butano Creek, we agree that it is likely that straightening along part of its lower course is a primary cause or contributing factor to historical incision in this reach.

Comment SMC-29: The Commenter commends Water Board staff for acknowledging that there is insufficient understanding of floodplain processes to provide a basis for a numeric target for this element. The Commenter recommends Water Board reevaluate numeric targets and estimated 78 percent reductions, based on incomplete sediment budget.

Response: We do not agree with the recommendation to reevaluate the numeric targets or sediment budget. Academic expert peer reviewers found the sediment budget to be based on sound scientific knowledge, methods, and practices (see Finnegan, 2017, p. 1). Also, please also note as described in *Rapid Evaluation of Sediment Budgets* (Reid and Dunne, 1996):

> "Most studies only require part of a sediment budget to satisfy their primary objectives, and the part that is needed depends on the objectives"

In our case, we focused primarily on quantification of sediment delivery rates to channels and interpretation of these features to infer natural or anthropogenic causation because quantifying sediment delivery rates to channels and determining causation are essential to development of a total maximum daily load. Furthermore, channel incision is extensive and the sediment budget also quantifies these changes in channel sediment storage. See also responses to Comments SMC-8, SMC-15 and SMC-30.

Comment SMC-30: Stating that floodplain inundation will be a method to achieve the numeric targets is inconsistent with the statement (p.117) that there is currently no basis for a numeric target for floodplain areas.

Response: The Commenter may be confusing recommended implementation actions - our call to restore floodplains as part of the implementation plan - with establishment of numeric targets to define water quality restoration.

Floodplain restoration as described in the Staff Report has multiple sediment budget and habitat enhancement benefits, and because some floodplain restoration project reaches would likely be positioned upstream of Pescadero Road Bridge, these projects also would contribute to a reduction in the chronic flooding that occurs there now. Floodplain restoration also is an essential component of any management program to maintain channel conveyance and fish passage in lower Butano Creek, and to control sedimentation in Pescadero Marsh. As stated in the Staff Report, although we conclude that floodplain restoration has significant geomorphic and ecological benefits, we did not establish a target for floodplain area at this time because: a) there are data gaps that make it difficult to accurately estimate current floodplain area; b) technical and sociopolitical issues must be evaluated as part of a stakeholder engagement and environmental review process that will ultimately influence feasible locations and areal extent of floodplain restoration; c) site-specific studies are needed at potential restoration sites to optimize ecological, flood control, and water quality benefits, while protecting public safety and infrastructure, and maintaining compatibility with adjacent land-uses. The Staff Report calls for site-specific technical studies and stakeholder engagement to identify reaches where floodplain restoration is feasible and would result in significant environmental enhancement, and in those locations to inform project design/construction.

Comment SMC-31: Road surface erosion is estimated by two different methods. Balance Geo (2015) applies their analysis over a 293-mile road network, 182 miles of which is [inferred to be] unpaved. ESA (2004) applies their analysis over a 395-mile road network, 325 miles of which is [inferred to be] unpaved). "This difference of 100+ miles of unpaved roadway and needs to be accounted for as it dramatically increases the sediment delivery estimation given for the road category … In addition, the areas of erosion and slope instability as a result of roadways are not clearly identified and should be more accurately quantified to support actual sediment loading estimations."

Response: Please note that the two analyses referenced in this comment were performed to estimate sediment delivery from surface erosion processes acting on the road prism, that is the cut bank, ditches, road surface, shoulders, and fill slope. Because ESA (2004) infers 143 miles more miles of unpaved roads than Balance Geo (2015) does, it isn't surprising that ESA's estimate of surface erosion is much higher. In either case, the effect of the differences in the two estimates is small in the overall sediment budget. Also, as related to development of policy to control road-related surface erosion, in both cases, we would recommend actions to reduce hydrologic connectivity to 25 percent-or-less along unpaved roads[6], and property-specific road-erosion inventories to identify and design retrofits, which addresses the Commenter's concern about road location in relation to areas of instability.

Comment SMC-32: The County regularly inspects and maintains roads and culverts per County Maintenance Standards and MRP requirements. The Staff Report (p.50) should acknowledge the County's road-related work, documented in PWA (2003), Best (2015), Ross Taylor and Associates

[6] Both to control sediment delivery to channels from surface erosion processes acting on the road prism, and to attenuate increases in storm runoff peak and volume that result from concentration of runoff from roads.

(2004), and past Parks sediment reduction projects. County practice is that when culverts are replaced, they are upsized accordingly for conveyance of peak flows and debris. Moreover, the County recognizes the RCD's work and expertise in assessing roads and other sources of sediment and providing technical assistance to landowners.

Response: We agree that the work the Commenter describes, done by both the County and the RCD, is valuable and will help in achieving the TMDL. We envision that identifying where such work has minimized erosion, and where more work is needed, will be part of the initial planning and prioritizing phase of implementation.

We revised Section 8.4 (p. 136) of the Staff Report to add the following passage to the beginning of the San Mateo County Roads section:

We acknowledge San Mateo County's inspections and maintenance of roads within its jurisdiction. In addition, San Mateo County has directed road erosion inventories (PWA, 2003; Best, 2015), and fish passage assessments of its road crossings (Ross Taylor & Associates, 2004).

Comment SMC-33: The Staff Report should contain more detail on methods used to estimate road surface erosion. Please clarify if the analysis distinguished between paved and unpaved roads and if the surface lowering estimate included paved roads. The concept of "surface lowering" should be better explained.

Response: The Commenter is referring to the following passage on page 73 of the Staff Report:

"To estimate persistent surface erosion, PWA assumed: 1) for unpaved roads: a 25 feet road prism and cutbank contributing area and 0.4 foot of surface lowering over two decades; and 2) for paved roads: 10 feet cutbank and ditch contributing area and 0.4 foot of surface lowering over two decades."

As stated in this section of the Draft Staff Report, f**or unpaved roads**, 0.4 foot surface lowering rate over a two decade period was assumed to occur over a 25-foot wide area of the road prism (the road prism includes all parts of the road – the cut bank, ditches, road surfaces, shoulders, and fill). In contrast, **for paved roads**, the 0.4 foot lowering rate per two decades was only applied over a narrower 10-foot wide strip that corresponds to the cutbank and inboard ditch (i.e., they did not infer any lowering on the running surface of the paved roads).

In response to this comment, the Road Surface Erosion Estimate section of the Staff Report on page 73 has been revised as follows:

"To estimate persistent surface erosion, PWA assumed: 1) for unpaved roads: a 25 feet road prism ~~and cutbank~~ contributing area and 0.4 foot of surface lowering over two decades (surface lowering or denudation rate is the average depth of erosion over the feature referenced); and 2) for paved roads: 10 feet cutbank and inboard ditch contributing area and 0.4 foot of surface lowering over two decades."

Comment SMC-34: The sediment delivery rate for road crossings is not clearly explained, particularly how it was derived.

Response: In response to this comment, we revised page 73 of the Staff Report by adding the following sentence:

This rate is derived by applying the estimate of sediment delivery to channels from road crossing-related erosion by the watershed area that the roads drain into.

Comment SMC-35: The impact of Highway 1 should be a larger focus of the TMDL.

Response: We disagree because the TMDL focuses on actions to reduce delivery of fine sediment to, reduce incision in, and increase habitat complexity in Pescadero and Butano creeks. Highway 1 is located at the bottom of the watershed adjacent to Pescadero marsh and lagoon. While it does not include specific implementation actions for the marsh and lagoon, achievement of this TMDL will help restore water quality and beneficial uses throughout the watershed, including the lagoon and marsh. We agree that the impact of Highway 1 should be addressed appropriately in habitat and water quality improvement projects undertaken in the marsh and lagoon.

Comment SMC-36: Clarify whether roads in 'forested lands' are the same as the 'unpaved' road category and confirm that these roads are not being double-counted.

Response: The source category "unpaved roads" includes all unpaved roads, whether they are located on forested, park/open space, or other lands. Forested lands refer approximately to three quarter of the total watershed area where redwood forests are located and span from the mouth of the canyons along both Pescadero and Butano creeks. Unpaved roads in forested areas (or forest roads) were counted only once.

To add this clarity, we revised Footnote 39 on page 107 of the Staff Report and corrected the sediment delivery estimate from roads in the forested lands: the correct estimate is 38,250 tons/year. We also added the following sentence to bullet 9 on page 107:
In the forested lands, roads and shallow landslides contribute approximately 61,000 tons/year.

Comment SMC-37: The classification 'rural road' needs to be more clearly defined.

Response: The term "rural road" is used within the Staff Report because this is the term used in the Municipal Regional Stormwater Permit, which contains requirements that are applicable to unpaved roads under the jurisdiction of San Mateo County. The source category "unpaved roads" includes San Mateo County's unpaved, or "rural," roads. The performance standards for road sediment discharge are as listed in the proposed Basin Plan amendment in Tables 5 through 8, which are the same for all identified categories of roads.

Comment SMC-38: Make a clearer distinction between ranching land, rangeland, and grazing land (p.130-131). The County Planning and Building Department, Current Planning Section and the County Assessor's Division have data on grazing from Williamson Act contracts; this data is imperfect but may help to provide more details. Also, an estimation of active grazing area, relative intensity, and proximity to waterways, riparian areas, and existing gullies would be beneficial in evaluating gullying formation.

Response: Other Commenters have touched on this topic as well. See also response to Comment FB-3. we analyzed updated land use information obtained from the CA Department of Conservation, Farmland Mapping and Monitoring Program. The FMMP produces maps of agricultural and grazing lands, which are updated every two years. We revised the Staff Report to cite grazing land acreages from two time periods presented in the FMMP data: 2016 grazing land acreage of 7,960 acres (which was used to develop a threshold of 50 acres, above which grazing lands would be subject to the performance standards and implementation actions) and 1984 grazing land acreage of 7,610 that represented the sediment budget period and was used to estimate sediment delivery from surface erosion in grazing lands). In response to these comments, we have revised the grazing acreage in the Staff Report on page 131 to 7,960 acres for implementation plan actions to reflect current conditions.

Grazing lands, as mapped by the FMMP, refer to lands on which the existing vegetation, whether grown naturally or through management, is suitable for grazing or browsing of livestock. We use ranchlands and rangelands, which also refer to grasslands/pasturelands typically located in rural areas, interchangeably with grazing lands.

The detailed information the Commenter suggests will be developed during TMDL implementation, either working individually with owners or operators of grazing lands, or during the development of general a grazing permit.

Comment SMC-39: In addition to grazing, analysis of potential impacts from agricultural roads and their contributions to gully formation should also be considered.

Response: All roads in the watershed, including unpaved roads on farmlands, have been considered in our road-related sediment delivery analysis.

Comment SMC-40: The estimation of gully development over time may be inflated because the sedimentation rates are assumed to be continually increasing despite an overall shift to more sustainable range management techniques that have reduced this trend in recent years. The County recommends that the analysis include data that influence present day gullying rates, such as active grazing areas; relative grazing intensity; proximity to waterways, riparian areas, and existing gullies; and impacts from agricultural roads and their contributions to gully formation.

Response: Although we recognize that range management techniques have improved in some areas, we disagree that our estimation of gully development over time is inflated. Our estimate comes from two journal articles and a review of historic ground photographs and aerial photography. Swanson (1983) and Swanson et al., (1989) reported that in the period from 1930 to 1980 hillside gully erosion increased by 300 percent (without any changes in rainfall intensity during the same period). Our analysis also found that gullies in rangelands are associated directly in time and space with vegetation conversion and hillslope farming and/or intensive grazing, especially in locations underlain by an extremely sensitive soil/bedrock unit, Tahana Member of the Purisima Formation. Tahana member, which underlies almost a quarter of the watershed and all the rangelands, has dispersive soils and piping. Because the Tahana rocks offer less resistance to erosion than the overlying soil (see also response to Dr. Finnegan's Comment F-11 below), once a process initiates a gully in soil, that gully incision will accelerate once it encounters bedrock.

A more recent study on gullies in the watershed was brought to our attention by the RCD (see RCD-11). Although that study stated that although active gullying decreased by 15-to-20 percent in the Bradley Creek watershed from 2005 to 2016, that decrease could be attributed to the drought and low storm activity between 2012 to 2016. In fact, informal observations following the heavy precipitation winter of 2017 suggested that existing gullies expanded and new gullies were formed.

During the planning phase of TMDL implementation, landowners or ranch operators will take inventory of grazing and management practices, as well as natural resources, and assess sediment sources and stream conditions. The detailed information the Commenter recommends will be collected at that stage.

Comment SMC-41: The Commenter acknowledges that improving habitat complexity, increasing LWD, and reducing channel incision provides an overall benefit to the watershed and ecological health, including of salmonid populations. However, the Commenter questions the ability to distinguish between other limiting factors for salmonids with regards to success related to sediment reduction. The Staff Report does not describe other limiting factors. It is important to acknowledge other factors beyond the scope of the TMDL and habitat enhancement plan that may constrain ability to achieve TMDL goals related to salmonid populations.

Response: While we disagree that the Draft Staff Report does not adequately describe the limiting factors for salmonids, we offer the following discussion. The Pescadero Creek watershed population of coho salmon is listed as endangered under the state and federal Endangered Species Acts. Based on review of recent and historical coho salmon population monitoring data, NOAA Fisheries concludes that the Pescadero coho salmon population has been extirpated (Williams et al., 2016, Table 1.1, p. 7).[7] The Pescadero Creek watershed steelhead population is listed as threatened under the state and federal Endangered Species Acts. Review of steelhead population monitoring between 2012-2015 suggests that the adult spawning run averaged a few-to-several hundred in this period, which corresponds to approximately 30 percent of the population viability target. If recent numbers for adult steelhead spawners remained stable or increase substantially, by a factor of three-or-more over the next several years, considering the population viability criteria established by NOAA Fisheries, the steelhead population would be considered to have a moderate risk of extinction (Williams et al, 2016, Table 4.10, p. 78).

Considering the status of the Pescadero Creek watershed anadromous salmonid populations, we conclude all potentially significant stressors/limiting factors must be addressed to facilitate conservation and recovery.

We concur that other stressors – changes to Pescadero lagoon, diminished baseflow, fish migration barriers (e.g., sedimentation along lower Butano Creek in the Willow/Alder Thicket and where the channel disappears in the marsh), and possibly elevated stream temperatures along some reaches of Pescadero and Butano creeks where riparian forests have been converted to farms and pastures – likely interact with high sediment loads and habitat simplification to depress salmonid smolt production.

[7] Although coho salmon have been occasionally observed in the Pescadero Creek watershed within the last ten years, all occurrences appear to be associated with hatchery strays. There is no evidence of persistent occurrence.

The Staff Report identifies two sediment-related impacts on freshwater habitat for steelhead and salmon in the Pescadero-Butano watershed: a) significantly elevated concentrations of fine sediment in streambeds; and b) pervasive channel incision, which is both a significant fine sediment source, and the primary agent for habitat simplification. We conclude that elevated concentrations of fine sediment in streambeds likely act directly (Harvey et al., 2009; Suttle et al., 2004), and/or in a synergistic fashion with other stressors (Harvey and Railsback, 2007) to depress potential production of steelhead and/or coho salmon smolts in a large portion of the potential habitat that occurs within the Pescadero-Butano watershed.

Success per sediment reduction and habitat enhancement will be gauged through progress toward achievement of the numeric targets for sediment substrate conditions and for large woody debris loading. Achieving these targets is expected to increase carrying capacity for steelhead and coho salmon in all freshwater life stages.

We conclude that fine sediment reduction and habitat enhancement are necessary elements of a broader program of actions to conserve and recover salmonid populations, which is consistent with the policy presented in the steelhead and coho salmon recovery plans developed by CDFW and NOAA.

Comment SMC-42: The value of floodplain habitat, and the interactions and usage of floodplains by salmonids in the Pescadero-Butano Watershed may be overstated, because it is based on studies done in Oregon and Vancouver, Canada. These studies provide context, but they may not be suitable for direct comparison to the Pescadero-Butano watershed where flooding frequency, depth, and inundation periods are highly variable.

Response: We disagree that these factors are overstated or that our conclusions regarding the importance of floodplains are not supported. We summarize our supporting information as follows.

The following floodplain habitats - side channels, alcoves, and ponds - are expected under reference conditions because they are formed and maintained under natural loading rates of large woody debris.

Wohl (2013 and 2014) performed literature reviews to make a strong case that almost all streams worldwide have experienced substantial reductions in large woody debris loading and corresponding formation of complex interconnected channel-floodplain fish habitats.

Opperman (2005) provides a detailed examination of large woody debris loading channels draining hardwood forests in the Central California Coast Range to conclude that large woody debris loading is substantially depressed on private lands as compared to public lands, implying land-use management has diminished loading and functions of large woody debris on streams with hardwood forests as compared to reference conditions including a much lower occurrence of channel spanning debris jams. The substantial land-use related reduction debris jams on private lands, has in turn reduced the occurrence of multi-threaded channels. Debris jams cause main channels to fill, and a new side-channels to form[8].

8. In the Tocaloma Reach of nearby Lagunitas Creek (which drains a hardwood forest), in sub-reaches where debris jams block most of width of the main channel, debris jams cause channel avulsions and formation of side channels that are well connected to the adjacent valley flat, which functions as an active floodplain. Many of the side

Floodplain habitats - side channels, sloughs, alcoves, and ponds - together with complex channel habitat provide excellent winter rearing habitats. In nearby Lagunitas Creek, applied research has demonstrated the benefits of these habitats to salmonid populations: where channel habitat is complex and connected to the floodplain, there is a substantial increase in winter rearing capacity (Stillwater Sciences, 2008, pp. 17-18, 44, 57-58, and 62; Ettlinger et al., 2017, pp. 10-11). In Lagunitas Creek, side channels are engaged and flow during common winter flows (< 500 cfs) that are far below the magnitude of the annual flood. These side channels provide excellent foraging and refuge habitats.

The classic single-threaded bankfull channel paradigm is probably an overly simplistic reference condition, which reflects the fact that wood removal has been ubiquitous for a hundred years or more in streams surveyed by Wolman and Leopold, where the single-threaded meandering stream paradigm was established (Wohl, 2013 and 2014). Instead, it is likely that extensive reaches of the lower course of Pescadero and Butano creeks were multi-threaded channels that were actively aggrading and overtopped in common storm runoff events that occurred several times in most years.

Comment SMC-43: The reliance on the Pacific Northwest studies and the general notion of the importance of the channel/floodplain interaction in regard to available salmonid habitat, lead the Water Board staff to conclude that channel incision is a primary cause of the decline of coho salmon and steelhead in the Pescadero-Butano watershed. However, historical and existing reaches that provide suitable spawning and rearing habitat were not reported on, nor were major reaches where major incision has occurred. This information is necessary to help determine if channel incision has reduced potential spawning, rearing, and overwintering habitat.

Response: Please see our response above to Comments SMC-23, SMC-26, and SMC-42 where we describe in detail our basis for determining the significance and extent of channel incision within the watershed. Based on research across a wide array of bioregions, we would expect complex low gradient channel habitats to be highly productive, while requiring low energy expenditure, as has been documented in the Tocaloma Reach of Lagunitas Creek (see response to Comment SMC-42).

Incision has been most dramatic and extensive in channel reaches where Pescadero and Butano creeks, and/or their tributaries that support salmonid spawning and rearing traverse unconfined alluvial valleys (see our response to Comment SMC-23). Pescadero and Butano are incised downstream of their canyon reaches to the marsh. Bradley Creek is incised along most of its length. We infer that the incision replaced extensive swampy meadow floodplains that would have provided exceptional winter rearing habitat for coho salmon and other native fishes (see Figure 4, Staff Report).

We remain confident that channel incision and wood loss have had a significant negative impact on the quality and quantity of rearing habitat for coho salmon, steelhead, and other native fishes. These changes have substantially degraded habitat complexity and connectivity, which in turn significantly depress potential salmonid smolt production.

channels are inundated during winter baseflow and/or during small/frequent runoff events with peak flows < 500 cfs, which less than one-third of magnitude of the annual flood. Harwood and Brown (1993), Collins and Montgomery (2002), and Sear et al. (2010) document this functional role in streams draining hardwood and conifer forests.

Wood loss in the canyon reaches that drain redwood forests also has led to substantial degradation of rearing habitat quality for coho salmon and steelhead in the canyon reaches of Pescadero and Butano creeks and their tributaries, as described in our response to Comment SMC-45.

Comment SMC-44: The County recommends that the Water Board work closely with NMFS and CDFW to set appropriate habitat improvement and species enhancement goals.

Response: The actions called for in the Draft Staff Report are consistent with recovery plans prepared by both agencies. Both agencies submitted comments expressing support for the TMDL. We look forward to the opportunity to work closely together with CDFW and NMFS to implement an effective program to protect and restore freshwater channel and floodplain habitats, and to collaborate on future efforts to protect and enhance the Pescadero marsh and lagoon.

Comment SMC-45: The historic abundance and role of LWD in watershed processes is likely overstated because the TMDL relies on studies conducted in other watersheds with very different hydrologic and streamflow conditions, and LWD biomass.

Response: We disagree. Most of the Pescadero-Butano watershed drains a coast redwood-Douglas fir forest. As summarized in Bilby and Bisson (1998), LWD biomass in stream channels draining coast redwood-Douglas fir forests are greater-than-or-equal to values for the Douglas fir or Sitka spruce/western hemlock forests, which characterize the coastal rainforests of the Pacific Northwest (Bilby and Bisson, 1998, Table 13.1). Also, for the reasons stated in Spence et al. (2011, p. 19-27), we expect reference conditions for LWD biomass and loading to be similar to other northern California coastal redwood streams.

As described by Benda and Bigelow (2014), the most important recruitment processes for LWD in old-growth coast redwood-Douglas fir forest (by percent volume LWD recruited) are tree mortality (about 40 percent), landslides (about 33 percent), and bank erosion (27 percent). The percentage recruited via landsliding is higher in smaller channels and/or confined stream channels. Considering the extent of mapped landslides in the Pescadero-Butano watershed, this recruitment process may be even more important locally.

Although bank erosion is an important recruitment process, especially in larger stream channels (see Beechie et al., 2006, Figure 6), higher peak flows also are much more effective in transporting wood through the channel network. Therefore, with higher flows, although bank erosion-related recruitment rate increases, so does high flow related transport of the LWD onto floodplains or into the marine environment (Kramer and Wohl, 2017, Tables 1 and 2).

Comment SMC-46: The Commenter contends that interpretations of historic vegetative conditions differ within the ESA 2004 report (see Staff Report p. 35, 142) and that "early Spanish explorers described the lower Pescadero valley as a grass-covered landscape extensively burned by the Ohlone, with only a few trees growing in the deeper arroyos."

Response: We disagree that the valley was not forested historically or would not have significantly contributed LWD to the channels. The statements in the ESA report (2004, p. 3-3), including the

statement from Friar Juan Crespi in 1769, discuss the grasses on the hills and not the valley bottoms or riparian areas. Crespi, in two different occasions, writes the following in his diary:

> *"We went on, and just before twelve entered the valleys of San Pedro Regolado [Pescadero], in which we found two very large arroyos containing a good volume of water and* ***well grown with cottonwoods, alders, willows, live oaks****, and some thick groves of redwoods in the side canyons of the valley." and*
>
> *"We crossed three rivulets [San Gregorio, Pescadero, Butano] the second of which might do for a settlement, with plentiful grass, wood, and good timber."*

Comment SMC-47: In light of differing portraits of the historic role of LWD in the watershed (contrasting interpretations of historic vegetative conditions on p. 142 and the lack of analysis of legacy LWD from logging practices, more information is needed on historic abundance, spatial location, and loading rates of LWD in order to specify reaches where LWD is below historic averages and would benefit from LWD projects.

Response: Please see Response to Comment SMC-45, where we summarize our basis for inferring reference conditions in canyon reaches of Pescadero and Butano creeks and/or their tributaries which drain coast redwood forests.

In lower Pescadero and Butano creeks, downstream of the canyons, where hardwood species dominate the riparian forest, almost all local recruitment of LWD - related to tree mortality or bank erosion along these reaches - would be expected to come from a narrow riparian zone, the width of which would be approximately equal to the height of the site potential tree (Benda and Bigelow, 2014, Figure 6).

Opperman (2005, p. 270) found that 90 percent of the large woody debris recruited to channels draining hardwood forests was derived from trees located within 30 feet of the channel. Additionally, we expect LWD transport from upstream reaches draining coast redwood forests to be a significant contributor to the overall volume of LWD deposited in channels and on floodplains because live alders and other hardwood species growing within the bankfull channel along lower Pescadero and Butano creeks would be effective in trapping LWD transported from upstream reaches (Opperman, 2005, p. 274). We rely on Opperman (2005, Table 2, p. 272) to infer that median natural loading of LWD in unmanaged streams draining hardwood forests should be 100 m^3/ha or greater. Please also note that two of the nine channel parkland reaches surveyed by Opperman (2005, Figure 1), were along incised unconfined valley reaches of Olema Creek, where it traverses a down-dropped valley along the San Andreas Fault, an environmental setting that is quite similar to lower Butano Creek.

As explained in SMC-46, we considered all written descriptions of the valleys made by the early Spanish explorers including the earlier more general account by Father Crespi in 1769 that the Commenter cites - "Only in watercourses are any trees to be seen" - and his later more detailed description of the valley in 1774 in which he noted "we found two large arroyos well grown with cottonwoods, alders, willows, and live oaks, and some thick groves of redwood in side canyons of the valley."

The early written accounts, together with early maps prepared in 1861 showing a "willow thicket" along a portion of lower Butano Creek (Staff Report, Figure 11) and a wide riparian corridor along lower

Butano Creek (Staff Report, Figure 5), and an early ground photograph of Pescadero Creek in 1867 (Staff Report, Figure 6), lead us to conclude it is likely that hardwood riparian corridors along lower Pescadero and Butano creeks provided similar or greater rates of LWD recruitment as documented by Opperman (2005) in channel reaches draining hardwood forests in public parklands. Also, it is reasonable to conclude that the loading values Opperman (2005) documented in public parklands are lower than natural reference values considering that it was typical practice until quite recently to aggressively remove LWD from channels.

Comment SMC-48: It is unclear whether the TMDL considers the potential impacts and elevated sedimentation load following LWD placement and lateral adjustment of the channel. Toppling large trees would increase local bank/bed scouring significantly as flows are deflected around the blockages prior to and during pool formation.

Response: We agree that toppling large trees could potentially increase local bed/bank scouring. Because limited data exist, we suggest channel surveys be conducted to quantify baseline values for wood loading. Reach-specific surveys would characterize baseline loading and functions and form the basis for recommendations to enhance wood loading and functions, as needed to achieve target values. These surveys also would identify opportunities and constraints influencing potential projects, including sediment supply rates. We expect LWD enhancement projects will be collaborative efforts. The design and construction of these projects would be based on channel hydraulic and geomorphic analysis and monitoring, as will maintenance and/or adaptive management of jams.

Comment SMC-49: Please clarify if the practical implementation logistics to increase LWD (e.g., studying potential LWD locations, developing designs, CEQA/permitting, access, cost, etc.) were considered in regard to meeting the 10-year timeframe for LWD numeric goals.

Response: The practical implementation logistics to increase LWD were considered. Please see p. 198 and Table 25 of the Staff Report.

Comment SMC-50: Could direct toppling or the placement of trees be considered self-mitigating?

Response: All LWD projects would be guided by site-specific evaluations, and in some cases broader land management plans; these projects also must comply with CEQA, and the terms and conditions of other applicable county, state, and federal permits. Please also see Carah et al. (2014) who describe in detail the approach of intentionally putting LWD into channels via toppling of selected live trees, which has been implemented in recent years in several Mendocino County streams to cost effectively and rapidly enhance wood loading and functions. While we do not anticipate that LWD projects would require compensatory mitigation, mitigation for temporal impacts may be required.

Comment SMC-51: Clarify if LWD would be considered jurisdictional fill by U.S. Army Corps.

Response: Our understanding is that LWD would be considered jurisdictional fill by the Army Corps and would trigger a section 404 permit. This would trigger the Water Board's process for issuing a section 401 water quality certification for the project.

Comment SMC-52: Page 125, 3rd bullet list, 4th bullet: Define "enhancing natural wood loading."

Response: Enhancing natural wood loading includes "soft engineering techniques," such as toppling trees, wood placement by use of heavy equipment, or directional falling of riparian trees. Please also see response to Comment SMC-50. Such "soft engineering techniques" may jumpstart LWD loading in key areas, and lead to further LWD retention without further intervention, as described in our response to Comment SMC-54 below.

Comment SMC-53: For LWD loading in areas where flooding may impact structures, please suggest safeguards.

Response: The TMDL implementation plan specifies that LWD projects be designed such that additional inundation would not threaten structures or human safety. Along much of the length of Pescadero and Butano creeks and/or along their tributaries, there are few structures or roads located near the top of banks (see for example the Roads Map, Figure 37 in the Staff Report). Therefore, as a general matter, we think that attaining target values for wood loading are compatible with public safety, property protection, and/or adjacent land-uses.

As stated in previous responses, LWD projects would be guided by site-specific evaluations and project designs that must comply with CEQA and other applicable county, state, and federal permits. In addition, the TMDL implementation plan includes the requirement to prepare hydrologic and geomorphic analyses to avoid significant increases in flooding; these studies are required to be prepared by a Registered Civil Engineer with expertise in fluvial geomorphology, hydrology, and river restoration. We conclude that adherence to this regulatory process is an adequate safeguard against flooding from LWD loading.

Comment SMC-54: Clarify how the LWD loading rate is distributed between responsible entities.

Response: The targets for LWD are not allocated among TMDL implementing parties. Achievement of the LWD loading rate will occur through habitat and water quality restoration projects undertaken by public or private landowners, likely in collaboration with the RCD and the resource agencies. Funding for projects can be considered under resources allocated for Clean Water Act section 319(h) Non-Point Source Program grants. In addition to enhancing habitat complexity and connectivity, LWD projects are expected to enhance sorting, storage, and metering of fine bed material, therefore, LWD enhancement projects have the potential to reduce the overall cost and timeframe for the achievement of numeric targets for sediment.

In some cases, LWD projects will increase retention of LWD within the project reaches because key pieces of wood will catch debris transported to the reach where the jams are constructed. In such cases, LWD projects themselves may facilitate progress toward achievement of the LWD loading rate.

As was the case for the Butano Floodplain Restoration Project, it will be essential to engage the community and other interested stakeholders, and for designs of LWD structure to be premised on hydraulic, geomorphic, and ecological analyses.

Comment SMC-55: The Staff Report should describe existing stream pool locations, conditions, current volumes, ecological and geomorphic functions, etc. These are not clearly stated, thus the numeric

target discussion for pool volume does not provide a strong linkage to explain how existing conditions will be improved or benefit from the TMDL management prescriptions.

Response: We disagree that linkages between sediment supply and numeric targets are not provided. Please refer to Chapters 6 and 7 of the Draft Staff Report for a detailed discussion. However, as a response, we provide below a clear summary of linkages between sediment input, pool volume, and LWD:

a) As sediment supply increases in gravel-bedded channels, the streambed becomes finer (more sand and fine gravel is deposited in the bed), and the pools fill in with fine deposits, which reduce pool depth and volume.[9] The relationship between pool filling and sediment supply is well established for watersheds underlain by poorly cemented/mechanically weak sedimentary bedrock types (Lisle and Hilton, 1999, Table 1 and Figure 6a), as is underlying most of the Pescadero-Butano watershed.
b) The results of field studies conducted on gravel-bedded streams located in the California Coast Range, Klamath Mountains, Oregon Coast Range, and the Sierra Nevada Range, demonstrate for streams that drain watersheds where the bedrock geology is rich in sand and fine gravel (those underlain by poorly cemented sandstones and shales, granitic rocks, etc.), there is a strong correlation between sediment supply rate and fine sediment deposition in pools, that is V* (Lisle and Hilton, 1999, see Figure 6a and Table 1).
c) In gravel-bedded channels draining forested areas, pool volume and frequency are strongly influenced by large woody debris loading and sediment supply (Buffington et al, 2002).
d) ESA (2004) concluded that primary limiting factors for coho salmon are a lack of good cover and deep pools, the latter is related in part to an abundant total and fine sediment supply (ESA, 2004, pp. 2-13 through 2-15, and pp. 8-14 through 8-16).
e) Sediment supply and LWD loading interact with other fixed variables (e.g., streambed slope, the frequency of bedrock outcrops, whether the channel is boulder-bedded, cobble-bedded, gravel-bedded, etc.) to control pool volume and frequency in stream channels draining forested areas as described in Buffington et al. (2002).

Comment SMC-56: The TMDL goals for percent fines in substrate are based on optimal conditions for spawning beds. This is an important goal, but the percent fines targets should correlate with local watershed conditions to ensure numeric targets are achievable. The Staff Report notes that (p.33)

[9] Relationship between pool volume and Sediment Supply: In a gravel-bedded channels, as sediment supply increases or becomes finer, the streambed may respond by becoming finer and more mobile (Dietrich et al., 1989; Buffington and Montgomery, 1999b). The streambed becomes finer because sand and fine gravel are deposited within and fill the open spaces between the coarser framework gravels that comprise the bed. When the storage capacity in the streambed for fine sediment deposits (sand and fine gravel) is exceeded, well sorted fine (sand and fine gravel) sediment patches will be deposited on the surface of the streambed. As the bed-material sediment supply increases or becomes finer, the extent of fine sediment patches will increase.

The fine sediment patches are mobilized earlier in storm runoff events than the surrounding streambed (as a whole), and remain in transport later in the storm to accumulate as fine patches in pools or other streambed areas, where shear stress is low (Lisle and Hilton, 1999). V-star - the proportion of the residual pool volume filled with fine sediment patches – was developed to quantify fine sediment deposition in relation to sediment supply (Lisle and Hilton, 1992).

geologic conditions are highly erodible and salmonids may have historically utilized sub-optimal substrate composition for spawning but possibly used a larger area of the watershed and/or had a higher density of redds.

Response: We believe that the numeric target for V* is achievable in the watershed, notwithstanding naturally erodible geologic conditions. As stated in our response to Comment SMC-55, Lisle and Hilton (1999) establish a strong correlation between pool filling and sediment supply in watersheds underlain by bedrock types that are rich in sand and fine gravel including mechanically weak poorly-cemented sedimentary rocks (Figure 6a and Table 1); such channels are widespread in the Pescadero-Butano watershed. Please see our response to Comment SMC-58 regarding requirements for numeric targets and the target values proposed for the Pescadero-Butano watershed.

Comment SMC-57: The Staff Report should identify the potential spawning reaches, historic and existing, and describe sediment conditions at those locations to provide a better sense of the actual loss of suitable habitat that the TMDL is seeking to address, and identify areas of potential restoration.

Response: While the Commenter describes important steps in the process of restoring beneficial uses, these steps are more appropriately taken during the TMDL implementation phases. It is not necessary to develop a thorough inventory of current and historic spawning reaches in order to identify impairment of spawning beneficial uses, nor would it be advisable for Water Board to identify areas of potential restoration at this stage in the process. Better results are expected if implementing parties work collaboratively to identify potential restoration projects and seek funding for well-designed projects. Water Board staff commit to assisting with this process.

Comment SMC-58: A baseline understanding of pool numbers, depth, and substrate is needed prior to establishing TMDL numeric targets for V*. Local conditions differ significantly from the North Coast watersheds where the Knopp (1993) study was conducted.

Response: We disagree that baseline pool and substrate conditions are needed to establish numeric targets for V*. See also response to Comment SMC-8.

Regarding applicability of the numeric target for V* to the Pescadero-Butano watershed, please see our response to Comment SMC-56.

Comment SMC-59: The TMDL numeric target of 0.21 to 0.45 as the maximum V* value (applicable in channel reaches with slopes of ≤5% or less) was representative of the control group for the study and not suitable for the Pescadero-Butano TMDL. If using the Knopp (1993) study data, the Water Board should consider using the 'Moderately Disturbed watershed' V* values of 0.37 to 0.91 for the TMDL numeric target. 'Moderately Disturbed watersheds' are defined as drainages with recent management but with good protection of stream courses, predominantly undisturbed buffers.

Response: We disagree that we should consider much higher V* values, because the numeric target of 0.21 to 0.45 is protective of beneficial uses, and the higher values suggested by the Commenter would not be protective of fish habitat.

Regarding feasibility of achieving the target value for V*, please note that several of the streams surveyed by Lisle and Hilton (1999, Table 1) were intensively logged or experienced other large-scale land-use disturbances within a few decades prior to V* measurements including many of the streams draining "fines-rich parent materials" that are listed in Table 1: Three Creeks Creek, Grouse Creek, Grass Valley Creek, North Fork Caspar Creek, South Fork Caspar Creek, Redwood Creek, and Jacoby Creek. Except for Grass Valley Creek, which has by far the highest estimated sediment yield of any stream surveyed, all the other streams listed above that experienced significant recent land-use disturbances, had V* values between 0.14 and 0.30, demonstrating that a target value of 0.21 is attainable.

Comment SMC-60: The Staff Report acknowledges the potential limitations of establishing TMDL numeric targets for V* based on data from other watersheds and states that the Water Board "may modify these values as watershed-specific V* data become available" (p.112). Please elaborate on the criteria or decision process the Water Board would employ to modify the numeric targets for V*.

Response: Many TMDLs are evaluated after a period time, in this TMDL the time period is ten years to consider any new information, advances in science, or other factor affects the basis or implementation of the TMDL. We anticipate that we would use the ten-year evaluation process to consider the appropriateness of the V* target.

Comment SMC-61: The feasibility and extent of floodplain reconnection connectivity needs to be better defined. Although no specific goal is stated for floodplain restoration, the Staff Report suggests 12H:1V bank slopes for optimal gravel-bar formation. However, the Staff Report also states that the channel has incised by several meters-or-more (p.16). This would require a top-of-bank width of 160-315 feet, plus a 50-100 feet. riparian buffer (Jones & Stokes 2002, cited in SFBRWQCB 2004). This may not be feasible in much of the lower valley.

Response: The Commenter may be misinterpreting the goals for floodplain reconnection. The 12:1 ratio refers to bankfull channel width to bankfull channel depth ratio (for instance, a bankfull channel width of 24 feet or more for a bankfull channel depth of 2 feet) (see p. 180) and does not suggest a bank slope ratio of 12H:1V. Even so, we acknowledge that floodplain reconnection is not feasible in much of the lower valley. Indeed, that is one reason the Staff Report gives no specific goal for floodplain restoration; as the Commenter notes: floodplain restoration can be achieved reasonably only where channel banks, land uses, and other physical factors allow. Please see our response to Comment SMC-30 for considerations regarding floodplain restoration projects.

Comment SMC-62: The sediment reduction target of 78 percent is based on targets U.S. EPA established for Noyo Watershed, but the proposed target is a much greater reduction than for Noyo, and geologic conditions are different. In particular, Pescadero-Butano Watershed geology is "mechanically weak and highly susceptible to landsliding, debris flows, and gullying" (p.23).

Response: The proposed 78 percent reduction target is based on the natural background sediment load in the watershed and an estimated assimilative capacity of 25 percent based on hydrologically and geologically similar watersheds. The reference state (TMDL of 125 percent of natural background conditions) would represent conditions where salmonid populations were robust and water quality

objectives for sediment-related parameters were attained. In addition, we note that the Noyo watershed shares attributes with the Pescadero-Butano watershed including high uplift rates and average annual rainfall, occurrence of weak sedimentary rocks that are susceptible to substantial increases in sediment supply in response to land disturbances, and predominance of road-related erosion and channel incision as significant human-caused sediment sources.

Comment SMC-63: A 20-year timeframe for TMDL sediment reduction targets does not accurately reflect the time necessary for changes in practices to translate into changes in floodplain storage, residual pool volume and substrate composition; especially considering increased hydrologic variability (including more droughts) that may occur due to climate change.

Response: We disagree that a 20-year timeframe for implementation actions is inadequate. We recognize that watershed and channel response to such actions may take longer than 20 years if regulatory actions are not supported by habitat enhancement actions, but believe that full implementation is possible within two decades if restoration projects are pursued.

Comment SMC-64: Page 127, bullet 2, states: "We will evaluate the performance of existing regulatory programs to control sediment discharges from the watershed road network and develop permits (WDRs or conditional waivers), as necessary, to require sediment control actions specified in the TMDL that are not already being implemented through the enforcement of an existing local/county program." The Staff Report would benefit from explaining further when a WDR, or other additional permitting condition, will be required -- what are the triggers?

Response: We propose revising the TMDL implementation plan to include a 3-year "planning and prioritizing" period. During that time, we intend for implementing parties to assess their sediment sources and identify priority actions and a schedule for implementation to reduce those sources. The parties may collaborate on developing templates for this assessment, applying for funding, reporting, and/or other common issues. Water Board staff intend on working with the implementing parties during this process. Based on reports to be submitted during this period, the Water Board will assess the level of and commitment to implementation, and would likely develop waste discharge requirements or other regulatory mechanism, as necessary, to ensure the TMDL is implemented. See also response to Comment RCD-13.

Comment SMC-65: Please clarify if the "Recommended Actions" shown in Table 22 of the Staff Report are binding. The Staff Report identifies them as "recommended," but also uses mandatory language for completion dates. Please clarify how these are viewed by the Water Board in terms of agency compliance with the TMDL.

Response: The actions on Table 22 (habitat enhancement) are not required. Text associated with this table states that the Water Board is committed to working with all interested parties to develop and implement the recommended restoration actions. Dates are included in Table 22 to indicate the pace of progress that is expected to help reach attainment of beneficial uses in the 20-year timeframe suggested in the TMDL.

Comment SMC-66: Clarify how the Water Board will ensure that the load allocations, requirements, and compliance actions are fair and proportionate considering multiple implementing parties. Specifically, clarify how compliance activities will be allocated, coordinated, and accounted for between implementing parties.

Response: It is our experience that TMDLs commonly have multiple implementing parties. For this TMDL, we have established a three-year planning and prioritizing period, during which we will work with all parties as they assess their sediment-related practices, prioritize management or corrective actions to take, apply for funding, develop reporting formats, and similar actions. Water Board staff will work to ensure that all entities take the appropriate regulatory actions.

Comment SMC-67: Conducting watershed-wide pool filling (V*, or residual pool volume) and substrate composition monitoring and LWD surveys may be cost prohibitive in combination with other required sediment reduction and habitat enhancement measures.

Response: The Water Board will work collaboratively with the implementing parties to conduct V* monitoring and LWD surveys and likely conduct or partner in the monitoring effort. Our experience in the Napa River and Lagunitas Creek watersheds, where sediment TMDL implementation is ongoing, is that through a collaborative process with the Water Board, Napa River Flood Control District, and the resource agencies, the Napa County RCD has been conducting monitoring and implementing habitat enhancement projects. We will help promote a collaborative approach in the Pescadero-Butano watershed as well.

Comment SMC-68: The County Department of Public Works is not an appropriate lead for sediment control cooperative arrangements with private landowners and other entities.

Response: We agree and did not intend to suggest that the County will be the lead agency for sediment control cooperative arrangements with private landowners. Often a local agency, such as the RCD or Farm Bureau takes a lead role.

Comment SMC-69: Please specify what specific contributions the Water Board would provide to parties interested in restoration projects.

Response: The Pescadero-Butano watershed is eligible for grant funding under the Clean Water Act Section 319(h) Non-Point Source Program. Restoration projects on water bodies for which a TMDL is being implemented may be eligible for other sources of funding as well. Further, Water Board staff with expertise in hydrology, geomorphology, and fisheries can and do provide input and feedback during the development of restoration projects.

Comment SMC-70: Baseline monitoring is recommended to characterize existing conditions. This should be included as the basis of the TMDL and used in developing a credible sediment budget and inventory of LWD prior to establishment of TMDL numeric targets.

Response: We disagree. Please see our responses to Comments SMC-55, SMC-56, SMC-57, and SMC-58.

Comment SMC-71: Specify which "local government agencies" would be responsible for in-channel effectiveness monitoring, and if this responsibility would encompass the entire TMDL watershed area or only areas with/in their jurisdiction.

Response: See response to Comment SMC-67. Any local entity with scientific expertise (in-house or under contract with fisheries experts) and working relationships with private property owners is a good candidate for spearheading this monitoring. To fund this work, the local entity may seek funding from the Clean Water Act Section 319(h) grant program in conjunction with funding intended for TMDL implementation projects. In addition, Water Board staff supports monitoring work as appropriate by contributing staff time and expertise.

Comment SMC-72: Specify what entity would be responsible for salmonid population monitoring.

Response: Typically, fisheries resource agencies (e.g., the CDFW or NMFS), or public or private entities with the support of fisheries biologists, would conduct salmonid population monitoring. In the Pescadero-Butano watershed, staff from CDFW conducted such studies between 2012 and 2016 (see Jankovitz 2012 and 2013, and Goin, 2014 and 2015). Please note that salmonid population monitoring is not required in the Basin Plan amendment. However, these studies are valuable and we offer our expertise in support of any such studies conducted in the watershed.

Comment SMC-73: The TMDL places a heavy burden on individual landowners, particularly small farms and ranches. The County requests that the Water Board make adjustments and specify that the level of detail for implementation actions for all land uses be commensurate with the property size and potential for sediment delivery.

Response: Please see our responses to Comments FB-3, FB-4 and POST-3 that outline changes we propose in response to this and similar comments. We believe that, by eliminating the surface erosion performance standard for agricultural lands, establishing a property size threshold, and eliminating the formal farm plan requirement, we have addressed the concern stated here.

Comment SMC-74: Acknowledge regulatory challenges associated with endangered species. A key example is the very short work window for protection of marbled murrelets, typically Sept. 16-Oct. 15. The County had difficulty installing a single fish passage project within this work window. The County specifically requests that the Water Board help to facilitate permitting with other agencies for TMDL priorities.

Response: We are committed to facilitating restoration projects in the watershed and will work with other permitting entities to help facilitate the permitting process where possible. We realize that there are short work windows due to special status species issues that affect project timeframes. Our proposed TMDL implementation timeframe (e.g., meet the road performance standard in 20 years) takes into account the time necessary to address issues associated with special status species.

Comment SMC-75: Projects may face difficulty/delays in obtaining regulatory approvals. CDFW, NFMS, and U.S. Fish & Wildlife Service (USFWS) permit work in/around endangered species habitats and often have no flexibility in what they can approve. These regulatory constraints may be beyond

the realm of the TMDL, but it would be beneficial for the Staff Report to acknowledge such constraints. A key example of an important environmental and regulatory constraint is the very short annual work window (September 16 to October 15) for protection of marbled murrelets.

Response: We agree to accommodate this request by adding the following sentences to the Staff Report, Section 8.2 Key Considerations Regarding Implementation (p. 128): We note that restoration/habitat enhancement project proponents must seek permits from resource agencies in order to work in areas of special status species habitat, which can be a lengthy process. Water Board staff is committed to facilitating restoration projects in the watershed and will work with other permitting entities to help coordinate the permitting process where possible.

In response to the work window for marbled murrelet, we would like to point out that the mitigation measures developed for the Fisheries Restoration Grant Program are not inflexible. Specific protection measures for marbled murrelet include protocol surveys. If surveys determine that nesting birds will not be impacted, the work window at individual work sites can be advanced.

Comment SMC-76: Other agencies may require mitigation of potential impacts, such as short-term impacts, caused by TMDL-supporting projects, causing projects to be cost prohibitive. Extensive, on-going coordination with other regulatory agencies is needed, with the understanding that projects may have short-term impacts (to endangered species) while achieving the longer-term goals of reducing sediment and improving habitats and overall watershed health.

Response: Please see our responses to Comments SMC-75, SMC-79, and SMC-80.

Comment SMC-77: Add a section in the Staff Report on how this document was vetted with NFMS, CDFW, and USFWS, and what the Water Board's involvement and communication with these agencies involved. Consider entering into a Memorandum of Understanding (MOU) with other regulatory and resource agencies to develop some shared understanding of how projects that support the TMDL process could be implemented, in such a way to address endangered species requirements, such as work windows, etc.

Response: While adding a discussion of our interactions with the resource agencies is beyond the scope of a TMDL Staff Report, we can report that Water Board met with them and other stakeholders numerous times to discuss the scope, technical findings, and implementation aspects of this TMDL. The Commenter's suggestion of developing a MOU is very good in concept; however, development of a multi-agency agreement typically takes several years. We intend to achieve the same result by working closely with other permitting entities to help coordinate the permitting process where possible.

Comment SMC-78: Clarify the regulatory action(s) the Water Board may take to control sediment from county roads. Clarify the criteria for taking such action. Clarify whether the existing municipal stormwater NPDES permit requirements are adequate to address excessive sediment delivery from unpaved roads.

Response: Provision C.2.e. of the Municipal Regional Stormwater Permit (MRP) provides the regulatory framework for addressing excessive sedimentation from unpaved roads in the Pescadero Butano

watershed, and it is our intention to rely on the MRP to spur sediment load reduction from that source. In other words, the MRP could provide an adequate regulatory tool for addressing County-owned roads in the watershed. However, the MRP has been in effect, in one form or another, for nearly three decades, yet unpaved County roads continue to be a source of excess sediment in the watershed. Thus, we acknowledge in the Staff Report that other regulatory mechanisms may be needed to address this source. Such mechanisms could include a Waste Discharge Requirement (WDR) or a Waiver of Waste Discharge Requirements (Waiver). A WDR or Waiver could improve upon the MRP by requiring maintenance on prioritized problem roads -- MRP only gives standards for how maintenance is done, but does not require maintenance per se. Despite the MRP's less-detailed requirements, the County could opt to demonstrate it will take actions, during the planning and prioritization phase, by developing an inventory and prioritized list of maintenance, and a schedule of implementation and commence implementation.

Comment SMC-79: Many stewardship and management approaches described in the TMDL are aligned with the goals of the County's Maintenance Program; County maintenance projects that support the objectives of the TMDL should be considered self-mitigating by the Water Board, under the programmatic permit for maintenance that is currently in development. TMDL-related project work in the Pescadero-Butano Watershed may result in temporal habitat impacts that would require mitigation. These should be considered self-mitigating.

Response: We agree that our two agencies' goals regarding best practices for protecting habitat are aligned and we look forward to a cooperative relationship as we implement the TMDL and the County's Maintenance Standards.

Restoration projects, when they comply with the Basin Plan fill policy, including the "no net loss" policy (or California Wetlands Conservation Policy, Executive Order W-59-93) and antidegradation policy (Resolution No. 68-16), do not require compensatory mitigation. Our experience is that most restoration projects result in a net gain of acreage and function, and therefore, do not typically require compensatory mitigation. However, temporal impacts would still require mitigation.

Comment SMC-80: Provide a pathway to exempt mitigation requirements for TMDL-related projects with minor short-term impacts.

Response: We cannot exempt mitigation requirements for projects with minor short-term impacts without specifying what constitutes a "minor" or "short-term" impact, because these depend on site-specific information. The Water Board incorporates mitigation requirements in 401 certifications to ensure that all projects implemented, including restoration projects, comply with the Basin Plan's fill policy, including "no net loss" and antidegradation policies. The amount of mitigation is commensurate with the size of the projects, and with its potential impacts. As stated previously, we intend to work closely with other permitting entities to help coordinate the permitting process where possible.

Comment SMC-81: Costs given in Chapter 9, Regulatory Analysis, do not include administrative or personnel costs to public agencies that work with project proponents (such as private land owners).

These costs include education and outreach to landowners, organization and communication with stewardship participants, grant writing, and obtaining access and maintenance easements.

Response: The Regulatory Analysis is not expected to include the costs (personnel hours) of obtaining project funding, although we do recognize that is a task for some of the TMDL implementing parties. The Commenter is referring to a cost estimate that is based on data from, among others, the San Mateo RCD's costs for a floodplain restoration project completed in 2016. The RCD may incur at least some of the expenses the Commenter mentions, such as organization and communication with stewardship partners, outreach to landowners.

Comment SMC-82: Identification of project locations, evaluation of existing conditions, and project design requires a much larger effort than is reflected in the cost analysis. Costs associated with BMP and operational actions need to be more thoroughly evaluated and included in the total cost estimate. Also, please clarify if the Water Board would act as the Lead Agency under CEQA for TMDL projects.

Response: We disagree that we need to identify project locations or more thoroughly evaluate project costs at this stage. In conducting a Regulatory Analysis, generally the mid-range costs of potential implementation actions are estimated. We do not attempt to develop detailed estimates based on actual proposed projects. Rather, we rely on available cost data from similar local projects and the literature. We recognize that actual specific-project costs will vary. If the County-prepared road inventory shows that the road-related performance standards are already/close to being met, its predicted costs would be dramatically reduced. The County has until 2038 to achieve the performance standards and load allocations for roads, which should allow time to prioritize and budget for actions.

The Water Board does not have the role of Lead Agency under CEQA; please see our response to RCD-14 regarding facilitating the permitting process.

Comment SMC-83: Similarly, project monitoring costs are underestimated. Restoration projects involving federal and/or state jurisdictional waters typically include annual monitoring and summary reports for 5-10 years. Monitoring must be done by qualified personnel with applicable scientific training and background in geomorphic processes. Post-project activities also require maintenance and adaptive management actions.

Response: We agree that the cost of monitoring restoration projects can be expensive. However, the amount of required monitoring is commensurate with the size of the project and with its potential impacts. In addition, as stated in the Staff Report (Chapter 8 Implementation), we emphasize that we prioritize restoration studies and implementation projects for funding where possible. Please see also our response to SMC-82 above.

Comment SMC-84: The County acknowledges the difficulties in estimating costs when project locations, sizes, designs, feasibility, etc. are largely uncertain at the present time. To improve the costs analysis, the County recommends that Water Board staff compare the cost estimates in the Staff Report to available data from other TMDLs that have been implemented and see how actual costs for project implementation compared to estimated TMDL costs.

Response: The Economic Considerations section of the draft Staff Report based the estimates of costs to address road-related erosion on unpaved roads on road projects in the Napa River watershed that implement the sediment TMDL there. We also provide estimates by Timothy Best Engineering for addressing road crossing erosion along the Old Haul Road. Please see response to Comment POST-1. We revised the costs of addressing unpaved roads in the Economic Considerations section of the Regulatory Analysis of the Staff Report, section 9.4 using a cost estimate from POST.

Comment SMC-85: Erosion-control costs for unpaved roads are not well-supported. It does not appear the private roads cost estimate used the prevailing wage rate, which the County must use. Costs of design, CEQA/permitting, construction, inspection, mitigation, and post-project monitoring should be included.

Response: Although we recognize that there may be some costs unique to road maintenance in San Mateo County, we believe our estimate provides an appropriate level of cost break-down. Please see also our response to Comments SMC-82 and SMC-84.

If the County-prepared road inventory shows that the road-related performance standards are already/close to being met, its predicted costs would be dramatically reduced. We also note that if the County paved roads are found to be discharging high rates of sediment to channels, the drainage infrastructure would also be quite vulnerable to damage or failure during large storms. Planned, pro-active retrofits or replacements of poorly functioning drainage structures along the roads are generally much less expensive than emergency repairs.

Comment SMC-86: On p.133, the Staff Report suggests the County could "contribute professional staff expertise in contract administration, road construction and maintenance, and ability to obtain and manage large grants…" Further on p.134, sediment control cooperative partnerships are described. It is not appropriate for the County Department of Public Works or any County department to assume responsibility or leadership in the forming of partnerships and cooperatives with private landowners or other organizations.

Response: We did not intend to overstate the County's role in the watershed, and have revised the wording on pp. 133-134 of the Staff Report as requested. However, we commend County for its commitment to working collaboratively with the RCD and other agencies and are hopeful that such collaboration will continue throughout implementation of the TMDL.

Comment SMC-87: It is not clear which categories of road related erosion (Tables 7 and 8 and text in pp. 71-74) apply to roads for which the County has ownership and/or maintenance responsibility. The sediment sources identified in Table 7 include a topic for Surface Erosion which in-turn includes management-related roads, grazing, and agriculture and also includes a separate topic called Road Surface Erosion, which includes management-related roads. The text which follows on pages 71-74 under the headings of Road-Related Erosion, Road-Stream Crossing Failures, and Road Surface Erosion Estimate is unclear because the distinction between these categories is not clear.

Response: The Commenter's confusion may stem from the terms "surface erosion," which refers to erosion from land surfaces other than roads, and "road surface erosion," which refers to erosion of a

road surface. To clarify, Table 7 provides a summary of all sediment sources in the watershed and includes surface erosion, which is not road-related. Table 8 is specific to road surface erosion. Pages 71-74 describe the ways in which any road can contribute excess sediment in the watershed, regardless of ownership. The County is responsible for addressing 1) erosion at road crossings on both paved and unpaved roads (including erosion of the fill, as well as landslides and gullies, triggered due to poor drainage); and 2) road surface erosion (due to road surface runoff and vehicle traffic) on unpaved roads.

Comment SMC-88: Clarify Table 19 by identifying San Mateo County and not Public Works and Parks Departments separately.

Response: Revision made to the Staff Report and the Basin Plan amendment Implementation Plan Table 19, as requested.

Comment SMC-89: Consider a varying the standard for percent hydrologically connected (set at 25 percent total road length) based on slope of the road. Steeper roads are more vulnerable to runoff.

Response: While it may be appropriate to prioritize steeper roads for maintenance, we disagree that the performance standard for the implementation plan should be based on road slope. Road hydrologic connectivity of 25% is a recommended average based on the total road-related sediment delivery. Appropriate road maintenance actions are determined based on site conditions and feasibility As the roads get steeper, the length of road between water breaks and/or rolling dips would get shorter. Spacing of rolling dips and ditch relief culverts is a function of proximity to a stream channel, with closer spacing near the channel.

Typically, using simple road drainage techniques, hydrologic connectivity can usually be reduced to 10 to 15 percent (Weaver et al., 2014). Site-specific conditions will determine the type, design, and frequency of road surface drainage facilities and structures, and therefore the hydrologic connectivity.

Comment SMC-90: Please explain the documentation method, or accounting process, envisioned to track compliance with the road performance standards.

Response: During the planning phase of TMDL implementation, we will collaborate with the County as appropriate to develop a documentation method to track compliance with the road performance standards.

Comment Letter No. 11: Tom Gandesbery (TG)

Comment TG-1: Federal, state, and local resource agency staff are often too busy to provide written feedback.

Response: Comment noted.

Comment TG-2: The Commenter expresses concerns about the style and delivery of the information provided in the Balance Geo Technical Memorandum – Summary of Results Assessment of Historical Channel, Floodplain and Estuarine Changes, Sediment Delivery and Sediment Yield. The Commenter is also disappointed that the salmonid population dynamics modeling study was not completed.

Response: We are confident of the data collected and technical analysis conducted by the consultant which was overseen by Professor Bill Dietrich of UC Berkeley and was confirmed and supplemented by ESA (2004) and our own analysis. This analysis constitutes one of the multiple lines of evidence we relied on to develop the TMDL as summarized in the Staff Report.

There have been several studies on fish and aquatic habitat both in the fluvial channels and the marsh and lagoon complex (CDFG, 1996 and 1997; Jankovitz, 2012 and 2013; Goin, 2014 and 2015; Huber, 2018). These studies are adequate to describe the adverse impacts of erosion and sedimentation on the aquatic habitat and provide the basis to develop the TMDL and the implementation actions.

The independent peer review confirmed that the TMDL and the linkages between sediment and habitat, as well as the implementation plan, are based on sound scientific knowledge, methods, and practices.

Comment TG-3: The Commenter expresses concerns about treating sediment as a waste rather than viewing sediment as a resource. The Commenter states the perceived inconsistency between excess sedimentation in the downstream portion of the creeks and incision along the middle and upper reaches and suggests that the "excess" sediment is needed to restore the incised creeks.

Response: We agree that sediment can be a valuable resource. However, in this watershed, impairment is a result of fundamental alteration of natural sediment generation, transport, and deposition processes. Sediment delivery and storage along the channels are out of balance and excess fine sediment deposited in the streambed has severely degraded potential spawning and rearing sites.

We disagree that there is inconsistency between excess sedimentation in the downstream portion of the creeks and incision along the upper and middle portions. In the Pescadero-Butano watershed, incision is a result of i) channelization actions that involved straightening, resectioning (widening and/or deepening of the channel to increase its conveyance capacity), bank protection, and levee construction; ii) pulling of wood in channels and snagging; and iii) increases in runoff due to deforestation and draining of the lower valley for agriculture. Greater sediment loads delivered from canyon reaches and sediment evacuated from the channel bed and banks along the alluvial fan reaches are efficiently transported downstream to the lower valley and marsh where they deposit due to flatter slopes. The channelized and incised streams attempt to establish a new equilibrium gradient through a combination of upstream progressing degradation and downstream aggradation.

Floodplain restoration projects outlined in the Staff Report to address sediment impairment would not involve transporting sediment to incised reaches. Depending on the geomorphic context of the reach, restoration would either involve reaggrading the incised reach (by incorporating large woody debris structures and facilitating sediment deposition) or decreasing the elevation of the adjacent floodplain and reconnecting the channel to its floodplain to induce sediment deposition on the floodplain.

Comment TG-4: The Commenter states that the TMDL conclusions rely on models, historic paintings, and photos and not on measurements of sediment. The Commenter also questions why the TMDL study period ended in 2010.

Response: The TMDL relies on historic aerial and ground photographs, historic maps, accounts of early settlers, and field work to establish watershed and channel changes due to land use changes and human activities. Use of historical evidence to establish changes in watershed and channel morphology is a

common rapid sediment budget tool (Reid and Dunne, 1996). Please see our response to Comment SMC-14.

In his independent peer review, Dr. Noah Finnegan of UCSC stated:

> *"I found the analysis of the historical changes that have occurred in Pescadero Creek watershed very compelling. To accomplish this requires an impressive mix of history and geomorphology. To me, this section effectively demonstrated the degradation in habitat that has occurred in Pescadero Creek as well as the physical changes that have occurred due to land-use practices in the watershed."*

We also relied on surface erosion and road surface erosion models developed for the TMDL, as well as existing models and coring studies to estimate the magnitude of sediment delivery due to human activities. The analysis period (1970-2010) spans four decades and incorporates 10 wet years, 11 dry years, and 20 normal years. It also incorporates extreme drought years (e.g., the 1977 water year) and the wettest water year on record (i.e., 1983). We believe the analysis period adequately captures the hydrologic variability for the TMDL analysis. The contract with Balance Geo ended in 2010, which was the last year incorporated into the sediment modeling efforts.

Comment TG-5: Though not as simple as measuring other water quality parameters, it is feasible to set up sampling stations and gather actual data on sediment yield and type. Bedload and suspended load fractions can be measured. Core samples could be dated to estimate sediment deposition rates.

Response: We agree with the Commenter that it is feasible to collect actual data on channel transport and storage. However, the rapid sediment budget approach we undertook for this TMDL provides this information more quickly and at a lower cost than a sediment budget that directly measures sediment transport through the channel network.

Collecting suspended sediment and bedload sediment data is difficult and costly. Methods for doing so involve either: 1) a network of continuous flow and sediment/turbidity gauging stations to represent different geomorphic domains within the watershed over an adequate time frame (40 years to see all climatic variability for a given gauge per McKee, 2009); or 2) non-continuous grab measurements supplemented by sediment transport equations. Additional data are needed for either approach.

Further, the cost and logistics of collecting the type of data the Commenter suggests present very large hurdles. These include having staff on call to capture samples at peak flow when the majority of sediment is discharged and when there is the most danger to field staff. Even if this is achieved, in order to calculate hourly, daily, or annual sediment loads, the water samples have to be interpolated in time.

By contrast, suspended sediment is comparatively easy to measure accurately by using rating curves and turbidity as a surrogate (which can be automated).

Bay Area watersheds exhibit a runoff variability that is amongst the highest in the world (McKee et al., 2003). Variability increases significantly when we consider the sediment component. For instance, based on 60 years of suspended sediment data collected by the USGS Pescadero station from water year 1952 and 2012, suspended sediment loads have varied from 18 to 330,000 tons. Bedload data are more limited and even more variable. In addition to temporal variability, characterizing as much of the

landscape diversity as is practical in the specific management question context would require a network of gauges at numerous critical locations.

Therefore, we conclude that sediment transport data collection is not warranted for the issue at hand, that we had the sediment data needed to address the sediment TMDL questions, confirmed our approach by a scientific peer review, and developed an implementation plan to adequately address the sediment impairment.

Regarding the use of core samples, sediment cores have been taken as part of several studies including Bergolar (1998) and Clarke (2014). We incorporated the results of two studies that collected cores in Pescadero marsh into our lagoon and marsh sedimentation estimate.

Comment TG-6: The Commenter states that the process to develop the TMDL consists of averaging model-derived estimates and questions whether the statement in the report "sediment delivery to fish bearing channels has increased by more than a factor of two in the last 150 years" mean that loads may be twice as much as the estimated rates. The Commenter states concerns about lack of sediment data and questions who will do the monitoring and how often.

Response: A TMDL must identify pollutant source categories and estimated loads associated with each source. We used a rapid sediment budget approach to identify significant processes that deliver sediment to Pescadero and Butano creeks and their tributaries, and to estimate rates of sediment input to the channel network between 1970 and 2010. Please refer to our response to Comment TG-4 for more details on the multiple lines of evidence developed to establish the TMDL. For a rapid sediment budget approach, estimated rates are expected to be within a factor of two of actual values. (Reid and Dunne 1996, pp. 136-137). That does mean that sediment loads may be twice as high as estimated.

The progress toward restoration of habitat and beneficial uses and the attainment of the TMDL will be evaluated by monitoring progress toward performance standards and by achieving the numeric targets. Please note that we do not plan to measure sediment load directly to evaluate attainment of the TMDL.

We intend to perform baseline surveys of the numeric targets for sediment and of large woody debris loading during water years 2018 and/or 2019. Subsequent numeric target monitoring likely would occur following all large natural disturbance events (e.g., large floods, fires, or earthquakes) and in response to significant milestones in inferred reduction in anthropogenic sediment supply (e.g., following 25 and 50 percent reductions). Please refer to Staff Report Section 8 on p. 146 for further details on monitoring.

Comment Letter No. 12: Trout Unlimited (TU)

Comment TU-1: TU supports comment letters by the RCD, CDFW, and NMFS.

Response: Comment noted.

Comment TU-2: TU supports designating Pescadero Creek (alone) for CDFW Wild Trout and Heritage Trout Waters.

Response: Comment noted.

Comment TU-3: Pescadero Creek and Butano Creek should not be treated as a single problem area. Problem statement of impairment by excess erosion and sedimentation does not correctly characterize Pescadero.

Response: Regarding the comment that Pescadero and Butano creeks should not be treated as a single problem area, please see our response to Comment FB-10.

Comment TU-4: Pescadero lagoon is mischaracterized. The lagoon has in the past and continues to be extraordinary rearing habitat.

Response: We concur that Pescadero lagoon provides exceptional conditions for growth; however, lagoon habitat has been adversely impacted due to sedimentation in the following ways: 1) the habitat extent and the physical living space for fish is diminished due to sedimentation; 2) sedimentation of Butano Creek as it enters the lagoon severely limited upstream movement of fish and largely eliminated fish escape routes on the Butano Creek side of the lagoon; and 3) there is anoxia and severe hypoxia prior to and following sand bar breaches where dissolved oxygen remains zero even at near-surface (Largier et. al., 2015; Largier et al., 2018-when the final report comes). NMFS Coastal Multispecies Recovery Plan (2016) states the impaired condition of the lagoon (particularly for the summer rearing life stage) is one of the most significant limiting factors to the steelhead population in the watershed (p.925).

Please see our responses to Comment CDFW-4 for a discussion on the linkages between sedimentation and water quality.

Comment TU-5: Fish kills are a function of low DO, high water temperature, and other water quality issues rather than sediment or sedimentation.

Response: We agree that fish kills are a result of degraded water quality, including low DO and high water temperature. However, excess sediment delivery to the lagoon and sedimentation within the lagoon and marsh contributes to fish kills by making the lagoon and marsh shallower and reducing circulation. Please see our response to Comment CDFW-4 for more details.

Comment TU-6: The Commenter suggests that the staff consult with CDFW and NMFS for a correct characterization of this robust lagoon.

Response: We fully support a multi-agency coordination and consultation with fisheries agencies as we work on addressing other water quality concerns in the lagoon and marsh system. We will look forward to working with the NMFS, CDFW, State Parks, USFWS, as well as other stakeholders, to develop a better understanding of how the lagoon processes and ecosystem function.

Comment TU-7: The Draft TMDL is consistent with the 2004 Watershed Assessment regarding LWD recommendations. Refer to the 2004 Watershed Assessment for prioritization of project areas and reaches for LWD enhancements.

Response: Comment noted.

Comment TU-8: Trout Unlimited is committed to working with you and residents in this watershed.

Response: We appreciate your commitment and support. We look forward to working with you, resource agencies, and the residents to implement the TMDL and habitat enhancement actions.

PART II

Staff Responses to Peer Review of the June 8, 2017 Draft Staff Report and Basin Plan Amendment

Prof. Noah Finnegan
Department of Earth and Planetary Sciences, University of California, Santa Cruz

In addition to the comments addressed in detail below Dr. Finnegan also provided two editorial comments, which were accepted.

Comment F-1: "Although I offer some detailed comments on how this document can be improved in places, as outlined below, taken as a whole I found the scientific portion of the proposed rule to be based on sound scientific knowledge, methods, and practices. Apart from the issues that I discuss below, there are no scientific issues that I could identify that are part of the scientific basis for the proposed rule."

Response: Comment acknowledged.

Comment F-2: "Chapter 3. Johnson and Finnegan (2015), *GSA Bulletin*, published a paper that compared the erosive behavior of the Tahana Member of the Purisima Formation and the Butano Formation and linked this behavior to the difference in fluvial geomorphology in upper Butano Creek and within the Canyon Reach of Pescadero Creek, particularly with regard to differences in lateral erosion in these two streams. An important finding is that although when wet the Tahana Member and the Butano Formation have identical tensile strengths, upon drying and rewetting the Tahana Member fractures and disaggregates ("slakes"), whereas the Butano formation retains its strength. Thus, in portions of the channel that have exposed Tahana Member rocks and where gullies cut this formation (see comments later) the rocks have essentially no strength and can be eroded simply from rewetting dried rock, as shown by Johnson and Finnegan (2015). This should probably be touched on in this section as it bears on the both processes and mitigation strategies addressed later in the document."

Response: We revised the draft Staff Report to incorporate the characteristics of the Tahana member of the Purisima Formation as highlighted in Johnson and Finnegan (2015) in Section 3.1. Geologic Setting and Table 2 as follows:

> "Overlying the basement assemblage is a thick sequence of marine sedimentary rocks, including sandstone, shale, mudstone, and conglomerate, and some volcanic rocks; all of them ranging in age from Paleocene to Pliocene of Tertiary period (65 – 1.8 Ma) (Figure 2). Table 2 summarizes

the stratigraphy and characteristics of the rock types that comprise the Pescadero-Butano watershed. Many of these sedimentary rock units are mechanically weak and highly susceptible to landsliding, debris flows, and gullying. Most notably, the Tahana Member of the Purisima Formation, which underlies almost a quarter of the Pescadero Creek watershed, has a very low slake durability, and disaggregates (slakes) upon drying and rewetting. This renders channels or gullies underlain by this formation highly susceptible to fluvial erosion after wet-dry cycles."

By contrast, the Butano sandstone, which underlies Butano Creek, maintains its original tensile strength. The difference between the erosive behavior of these rocks contributes to the difference in fluvial geomorphology in upper Butano Creek and within the canyon reach of Pescadero Creek. Specifically, the study showed that lateral erosion is more pronounced in areas underlain by Butano Sandstone, while vertical erosion is more severe in areas underlain by Tahana member. The study also showed most of the bed load in Pescadero Creek is made up of lithologies from upstream that do not slake (Johnson and Finnegan, 2015)."

We also revised the discussion of the Tahana member in Table 2:

Table 2. Stratigraphic Properties of Geologic Units within the Pescadero-Butano Watershed

Geologic Unit	Percentage of Watershed	Properties	Erodibility	Comments
Purisima Formation – Tahana Member (Tpt)	22%	Medium—to very fine-grained lithic sandstone and siltstone, with some silty mudstone. Very low slake durability. Disintegrates easily after wet-dry cycles	High	No signs of active erosion where there is forest canopy; however, significant sheetwash erosion on grazed or deforested slopes. Competent enough to become rounded during transport, but if above base-flow levels, slakes to small shards. Drying of the rock and slaking allow for clear-water erosion of the formation; therefore, Pescadero Creek has a sinuous platform and is incising through the Purisima Formation.

Comment F-3: "I found the analysis of the historical changes that have occurred in Pescadero Creek watershed very compelling. To accomplish this requires an impressive mix of history and geomorphology. To me, this section effectively demonstrated the degradation in habitat that has occurred in Pescadero Creek as well as the physical changes that have occurred due to land-use practices in the watershed. I have no issues with this section."

Response: Comment acknowledged.

Comment F-4: "Section 5.2. The conversion of the cosmogenically derived basin-averaged erosion rate to a sediment yield makes an explicit assumption that the river channels are not eroding over the time period that is integrated by the cosmogenic isotope derived measurements, which corresponds to 2-4 thousand years for the Butano Creek and Peters Creek measurements reported in the Data Repository for Gudmundsdottir et al. (2013). [This] assumption that only hillslopes contribute sediment to the

watershed is pretty unorthodox (and, in fact, violates the steady-state assumption that is made in order to calculate the CRN-derived erosion rate to begin with). I think there should be an explicit justification for making the assumption that no river channel erosion into bedrock has occurred over the last 2-4 thousand years. Alternatively, I would simply use the entire watershed area in calculating the background sediment yield."

Response: We agree that the assumption that only hillslopes contribute sediment to the watershed during Holocene violates the steady-state assumption and that it does not accurately represent natural denudation rates. We revised our natural background sediment inputs to channels to reflect the incoming sediment not only from the hillslopes, but from the entire watershed and revised Table 12 of Section 5.3.6 and the Basin Plan amendment accordingly. As a result of taking into account the whole watershed area of 81 mi^2 (or 210 km^2) our new estimate of the natural background sediment delivery to the channels is 120,000 tons/year (versus the 110,000 tons/year that was estimated for sediment input from hillslopes only). We also revised the staff report to include the language below:

> "Using these erosion rates and areas they represent, an average erosion rate of **0.25 mm/yr** for the whole watershed was estimated. This erosion rate was applied to the whole watershed with an area of 81 mi^2 (or 210 km^2)."

Comment F-5: "I also note that Anderson (1990), *Science*, *Evolution of the northern Santa Cruz Mountains by advection of crust past a San Andreas fault bend*, reports an estimated erosion rate for Pescadero Creek that is 0.22 mm/year, which is right in line with the estimate used here. You could cite this as further support for the 0.25 mm/yr estimate used."

Response: We agree that this study should have been included in our list of reference studies. We added the following sentence to Section 5.2 on natural background erosion:

> "The background erosion rate of 0.25 mm/year inferred from cosmogenic analysis is in line with the estimated erosion rate for Pescadero Creek of 0.22 mm/year, developed by Anderson (1990)."

Comment F-6: "Section 5.3.1. Two very, very different estimates are reported for the possible contribution of roads to the overall sediment budget in Pescadero Creek. Both can't be right, so an average value is used. Why not just report an average value with an uncertainty that is then propagated through to the final sediment budget estimate? This is a highly uncertain exercise, but that doesn't detract from its value. However, a more straightforward reckoning of the uncertainties that are inherent to this exercise would make this document, to me, more valuable. In the scheme of things, doing a formal error propagation would represent a relatively minor undertaking and would at least put some bounds on the confidence that we should place on the sediment budget given the available constraints (that is to say, ignoring the fact that there are also "unknown unknowns")."

Response: Although we do not believe a formal error propagation is warranted, we revised the road surface erosion section in Chapter 5.3.1 to discuss the uncertainty of our road surface erosion estimate as outlined below.

Our analysis estimates erosion rates for two different kinds of road erosion mechanisms: 1) road-stream crossing failures, which account for 70 percent of the total road-related sediment delivery; and 2)

chronic road surface erosion, which accounts for 30 percent of the total road-sediment delivery. This comment referred to the chronic road surface erosion rate, which was estimated by averaging two different estimates, one from the ESA (2004) study and the other from the Balance Geo (2015) study.

PWA estimated sediment delivery volumes from chronic surface erosion of roads, ditches, and cutbanks by inventorying sediment delivery from roads in three San Mateo County Parks and extrapolating its findings to the entire road network in the watershed. PWA based its average rate of surface lowering on cutbanks and along road beds of 0.2 feet/decade on observed retreat or erosion rates in the Pescadero Creek watershed and unpublished data from sediment budget studies on similar geologies in the Redwood Creek watershed in Redwood National Park, Humboldt County. This rate was applied to an average road width of 20 feet and the length of road network.

Balance Geo estimated road surface erosion rates using SEDMODl2. The model runs with GIS layers of elevation, road and stream network, geology, and soils. Three categories of roads were used for the model: 1) road segments that deliver sediment directly to watercourses (at or near road-watercourse crossings); 2) road segments that deliver sediment indirectly (roads which closely parallel watercourses); and 3) road segments that do not deliver sediment (the runoff is directed onto vegetated ground far from a watercourse). Sediment production from each type of road segment was based on the empirical relationships among parent material, soil thickness, surfacing, traffic, road width and slope, construction year, precipitation, and road cutslope height and cover. Default parameters may be used with the model; however, Balance Geo adjusted model parameters with site-specific data gathered in the field and with analysis of soil maps, and road network and land use maps over the last century.

Neither the PWA study, nor the ESA report provide a quantitative uncertainty analysis or an estimate for margin of error; however, the ESA report stated that the source analysis provides gross estimates of sediment production at order-of-magnitude accuracy. There are a wide range of existing road surface erosion estimates and no primary source details for the Pescadero-Butano watershed analyses. Without a way to determine which estimate best fit this watershed, we averaged the two values (22,500 CY/year and 4,300 CY/year rounded to the nearest thousandth), coming up with an average annual road surface erosion rate of **16,000 tons/yr (13,000 CY/yr)** from 1970 to 2010. Because rate is within a factor of three of both of the lower and upper estimates. and the road surface erosion only constitutes 30 percent of the total road-sediment delivery estimate, a formal error propagation would have limited utility.

Comment F-7: "Section 5.3.2. This is an important analysis. I was able to go to Balance Geo's website and download their initial report, which described in more detail both the process used to constrain incision and the locations where this was done. That said, to me, given the importance of this analysis to this report, a map showing where constraints on recent incision were estimated within the watershed would be extremely valuable."

Response: Comment noted. In response, we have included the Balance Geo (2015) report as an appendix to the Staff Report. The map showing the constraints on recent incision appears on page 50.

Comment F-8: "Section 5.3.2. In addition, a more comprehensive appendix with photographs documenting the evidence for recent channel incision would be really helpful here. As written, the

reader is simply asked to believe the Balance Geo report, little of which is reproduced. In fact, the Balance Geo effort is impressive and very valuable and should be highlighted more."

Response: As noted above in Response to Comment F-7, we have included the Balance Geo report as an appendix to the Staff Report to make it available to readers who are interested in the additional photographs and explanations of the background sediment budget work. We also incorporated into Section 5.3.2, entitled Channel Incision, several more annotated photographs in Figure 31 to better illustrate our findings evidence for channel incision along the creeks.

Comment F-9: "Section 5.3.2. I would also note that Johnson and Finnegan (2015) showed that lateral erosion by Pescadero Creek into the Tahana member occurs much more easily and hence rapidly than vertical incision. Topographic profiles along the insides of meander bends in the Canyon section clearly show this (Figure 1, Johnson and Finnegan). I have no doubt that the careful analysis by BalanceGeo is correct in its interpretation that there has been extensive recent vertical incision. That said, it would be good to show that evidence for recent incision is clearly seen on both sides of the channel (which would support true vertical incision) as opposed to only on one side of the channel, which could also be consistent with lateral erosion on the outside of a bedrock meander bend. Clearly the two scenarios carry very different interpretations and hence it would be good to add some language that describes the difference between lateral and vertical bedrock erosion in the channel and how they can be differentiated in the field."

Response: We do not have any photographs showing recent incision on both sides of the channel. However, we would like to clarify that the incision along the canyon reach of the Pescadero Creek primarily refers to the evacuation of the 2-to-4 meter thick Holocene alluvial fill that had accumulated within the channel. It does not refer to incision of the bed into bedrock. The field evidence for the Balance Geo interpretation is the existence of hanging alluvial terraces (and not strath terraces) that are 2 to 4 meters above the channel in the canyon. Balance Geo (2015) noted that "the loss of the 2-4 meter thick and 15 meter wide alluvial bottom in the canyon reach of Pescadero Creek likely began during the first round of logging as a result of the LWD removal and simplification to enable floating of logs". Please also note that the estimate of incision volume in the canyon reach constitutes a very small fraction (13 percent) of the total incision volume estimate.

Comment F-10: "Section 5.3.3. Some recent papers that relate to the gullying in the Purisima formation should probably be considered here as they provide valuable context for understanding and mitigating the gullying erosion here. First, as mentioned above, Johnson and Finnegan (2015) show that once sub-aerially exposed (for example, when soil cover has been removed) the Tahana member offers little resistance to erosion after it has been dried and re-wetted. Indeed, Johnson and Finnegan (2015) document millimeters of erosion following rewetting of the Tahana member (with no applied current) after it was dried out in the summer. This is important because it establishes that the Tahana is extremely susceptible to erosion once it has lost its soil cover, as is the case in the gullies."

Response: See Response to Comment F-2. We added the following language to Section 5.3.3 describing how Tahana member is extremely susceptible to erosion once it has lost its soil cover contributes to gully incision:

> "Similar to Swason et. al. (1989), Johnson and Finnegan (2015) based on their analysis of the erodibility of Tahana member, suggested that soils derived from the Tahana member –especially when vegetation is present, are more resistant to erosion than the underlying rocks. This again implies that once initiated, gully erosion likely accelerates once it encounters Tahana member bedrock, which is the opposite of the way gullying is conceptualized. Tahana member of the Purisima formation occupies approximately a quarter of the watershed underlying the western rangelands, as well as the north of Pescadero Creek along the County park complex.

Comment F-11: "Section 5.3.3. Johnstone et al., GSA Bulletin, in press, *Soil development over mud-rich rocks produces landscape-scale erosional instabilities in the northern Gabilan Mesa, California,* documents the processes that are responsible for the deep gullies in the Gabilan Mesa area of the Salinas Valley, in rocks (Pancho Rico Formation) that are quite similar to the Tehana member in that they have the same slaking behavior and same basic composition. This study shows that soils derived from the Pancho Rico formation are more resistant to erosion than the underlying rocks, much in the same way that Johnson and Finnegan (2015) speculated for the Tehana member. Thus once a process, such as is beautifully described by Swanson's work, initiates a gully in soil, that gully incision will likely accelerate once it encounters bedrock, because the bedrock offers less resistance to erosion than the overlying soil. This is backwards of the way we typically think about gullying, as it is common that the bedrock underlying the soil is more resistant to erosion not less. The instability described by Johnstone et al may explain why the gullies in the Tehana, although initiated in soils, now extend well into bedrock and why the rates of gully erosion have not slowed. In addition, this work suggests that the land-use conditions that led to the initial gullying in soil to begin with may have less relevance to the gullying process once it gets into the weaker rock underneath the soil."

Response: We incorporated the suggested finding into Section 5.3.3 that once a gully is initiated on the Tehana member of the Purisima Formation and encounters bedrock, gully incision will likely accelerate as the soils derived from Tehana member offer more resistance to erosion than the bedrock itself:

> "Similar to Swanson et. al. (1989), Johnson and Finnegan (2015), based on their analysis of the erodibility of Tehana member, suggested that soils derived from the Tehana member – especially when vegetation is present, are more resistant to erosion than the underlying rocks. This again implies that once initiated, gully erosion likely accelerates once it encounters Tehana member bedrock, which is the opposite of the way gullying is conceptualized."

Please also see Response to Comment F-12 where we indicate how this understanding influences our approach towards proposed management actions to control gully erosion.

Comment F-12: "Section 5.3.3. This perspective on the gully erosion process in the Tahana member becomes important in the implementation of the TMDL in section 8.4 in the section called Livestock Grazing. Here it is suggested that excluding livestock from the gullies may help to decelerate erosion in the gullies. I suspect, at this point, based on reasons articulated above, that the cows have little influence on the process of incision in these deep gullies. I suspect that getting a protective layer of sediment on top of the gully bottoms would help to suppress incision. Here, planting of native woody vegetation as suggested (and exclusion of cows to the extent that establishing native vegetation requires) would seem useful because it might encourage sedimentation in the gully bottoms, which

should help protect them from further weathering and hence incision. Otherwise, without getting some soil and sediment back in these gullies, it's not clear that they will decelerate in their incision."

Response: We agree that livestock exclusion alone would not decelerate gully erosion and propose a suite of actions, addressing different causes and mechanisms, to reduce gully and sheetwash erosion. The measures identified in the implementation plan include maintaining adequate vegetative cover, or, residual dry matter on pasture lands; temporary or permanent exclusion fencing to keep livestock out of creeks and away from creek banks and gully heads and banks; planting of native woody vegetation; diversion or dispersion of concentrated runoff originating from roads; modification of grazing strategies, densities, and locations; and the construction of alternative water supplies for livestock.

Comment F-13: "Section 5.3.3. In forested parts of the watershed, where gullies are controlled more by road drainage, the mitigation strategies suggested in the TMDL seem appropriate to me."

Response: Comment noted.

Comment F-14: "Section 5.3.4. Given the acknowledged challenges with getting an accurate estimate of timber harvest related mass-wasting, I again would recommend presenting a range of values for the possible sediment production due to these activities and then propagate that uncertainty through the final budget."

Response: Our estimate of sediment input from timber harvest-related landslides is based on the sediment source investigation conducted by Pacific Watershed Associates in 2003 and presented in the ESA (2004) study. ESA estimated the volume of sediment delivered to channels from timber harvest-related landslides based on an analysis of sequential aerial photographs and subsequent field check of a subset of randomly selected plots. ESA report did not provide a quantitative uncertainty analysis or an estimate for margin of error; however, it stated that the source analysis provides gross estimates of sediment production at order-of-magnitude accuracy. In addition, the report stated the following potential qualitative sources of error:

a) The age of the erosional features – "Assigning ages to field-identified erosional features tends to have an increasing margin of error the older the feature is" (ESA, 2004, pp. 6-45).
b) The quality of the aerial photographs – "It is likely that an under-estimation of sediment delivery in the 1957-1982 time period resulted from limitations in the quality of the 1982 aerial photo set. This photo set was taken in January, resulting in deep shadows in the forested and high relief areas of the Pescadero-Butano watershed. We believe this caused an under-counting of erosional features in forested areas on these photos, and hence an under-estimation of sediment delivery volumes." (ESA, 2004, pp. 6-45).
   PWA analysis applied an adjustment factor to account for the inherent error-prone nature of aerial photography analysis. This was done by visiting a sample of 12 air-photo identified features, recording erosion dimensions and sediment delivery information, and assessing the ratio of field-measured volume of sediment to photo-estimated volume. They then applied this ratio to correct the sediment volumes estimated from aerial photography analysis (ESA, 2004, pp. 6-22).

c) Access to sites – "Because of difficulties in obtaining access to some small private landholdings, sample plots were concentrated in parks and other public lands, and on commercial timberlands. [...] Consequently, the sample plots may not capture the range of land uses or conditions with regard to erosion and sediment delivery." (ESA, 2004, pp. 6-48)
d) Difficulty in finding evidence for road-related erosion – "Likewise evidence of erosion associated with roads can be hidden by road maintenance or re-construction activities, or can be reactivated by changes in road drainage patterns. In unmanaged or formerly managed lands, natural recovery processes can also mask evidence of older erosion, although we consider this effect to be much less significant in causing under-estimation of erosion and sediment delivery volumes." (ESA, 2004, pp. 6-45)

We did not have access to the primary source files that the analysis was based on, therefore, we were not able to provide a range of values that would accurately reflect the margin of error involved in the PWA analysis as report in the ESA (2004) study. However, we note that for watersheds in northern California and the Pacific Northwest where rapid sediment budget techniques have been used, and where monitored sediment yields are available for comparison, estimates from the two approaches are within a factor of two or closer in all cases (Reid and Dunne, 1996). Based on this information, we added the following footnote to Section 5.1 on page 60 of the Draft Staff Report:

> "A rapid sediment budget is a measurement technique that can be performed over a short period of time to provide approximate estimates of rates and sizes of sediment input to channels. Estimated rates are expected to be within a factor of two of actual values (Reid and Dunne, 1996, pp.136-137)."

Comment F-15: "Section 5.3.7. On the one hand, pulling of wood in channels and increases in runoff due to deforestation, it is argued, will tend to result in simplification of channels and stripping of sediment, thereby resulting in negligible sediment storage in channels. I agree. On the other hand, vertical incision triggered by the above processes, it is argued, has disconnected the channels from floodplains and hence resulted in much more sediment being transported along Pescadero and Butano Creek. The implicit assumption here is that despite higher sediment loads in Pescadero Creek now, the recent increases in sediment conveyance (due to incision) and the decreases in channel complexity (due to wood removal) are strong enough to suppress deposition of sediment in the channel, despite the large increases in sediment loads. This seems fine, but this tension may be confusing to some readers, so I would suggest trying the spell this out a little more clearly for readers. In other words, different changes to the watershed may have opposing effects, and unless more clearly acknowledged, may present some confusion to readers."

Response: We address Dr. Finnegan's concern by explaining below our conceptual model for higher sediment loads and channel incision coupled with downstream aggradation below for readers needing additional clarification.

In the Pescadero-Butano watershed, channelization actions to straighten, re-section, widen and/or deepen of the creek channel; bank protection; levee construction; and removal of wood from channels; and increases in runoff due to deforestation and ditching/draining of the lower valley for agriculture all contribute to incision and to more efficient sediment transport. In other words, due to land use changes

and direct disturbances of the channel, the canyon reaches deliver greater sediment loads and faster flows scour out alluvial fan reaches more easily, efficiently transporting more sediment downstream to the lower valley and marsh where they deposit due to flatter slopes. We infer that the increased sediment transport capacity largely prevents the increased sediment load from being deposited until the sediment is at the lagoon and marsh. The result is an increase in sediment supply to downstream reaches (e.g., Pescadero Creek Road along lower Butano Creek), where we see substantial aggradation. The channelized and incised streams attempt to establish a new equilibrium gradient through a combination of upstream progressing degradation and downstream aggradation.

Comment F-16: "Section 5.4. ESA PWA re-surveyed cross-sections in the marsh to constrain recent aggradation rates. Is some of that apparent sedimentation related to the accumulation of organic material rather than sediment transported by the stream? From the perspective of infilling of the lagoon, this distinction is not that important, but it is important in terms of constraining upstream sediment loads. I wonder if some of the sediment coring studies cited in this section constrain the percentage of organic material in the lagoon sediments."

Response: ESA PWA (2011) did not attribute any part of the marsh accretion to the accumulation of organic material, nor did the Berlogar (1988) study.

Comment F-17 (Numeric Targets): "Except where noted above in the Source Analysis section, I have no problems with the numeric targets that are derived from the source analysis and the studies in the Noyo River and Redwood Creek."

Response: Comment acknowledged.

Prof. Darren Ward
Department of Fisheries Biology, Humboldt State University

Comment W-1: "The 'TMDL for Sediment and Habitat Enhancement Plan for Pescadero-Butano Watershed' describes the history and current state of the watershed's sediment dynamics as they relate to land use change, in-stream conditions, and beneficial use as fish habitat. This information is used to estimate loading rates for sediment and to develop a habitat enhancement plan that should allow the system to meet beneficial use objectives. As is to be expected for most watersheds, site-specific historical data is not available for all metrics, bringing some uncertainty into the analysis. However, reference to analogous sites within the region and non-quantitative historical accounts provide sufficient background to reasonably approximate extent of habitat alteration and effects of land use change and compare current anthropogenic and background sedimentation rates."

Response: Comment noted that the analysis provides sufficient background to reasonably approximate the extent of habitat alteration and the effects of land use change.

Comment W-2: "No indication of how to deal with annual variation in assessment of numeric targets or sediment input relative to the TMDL. It is unlikely that assessing any of the numeric targets or sediment inputs in any single year will meaningfully reflect progress toward habitat restoration and meeting beneficial uses (e.g. a wet year will likely have sediment input well over 125% of the long-term average natural baseline regardless of any control efforts). It seems reasonable to specify a time scale for these assessments (e.g. a 10-year rolling average)."

Response: Sediment inputs, expressed as a percentage of the baseline, do not guide attainment of the sediment water quality objectives. Instead, progress toward restoration of habitat and beneficial uses and attainment of water quality objectives will be measured by progress toward achievement of performance numeric targets.

We agree that evaluating the numeric targets in any single year is not meaningful. Because of the inherent variability associated with stream channel conditions and because no single target applies in all situations, attainment of the targets will be evaluated using a weight-of-evidence approach, as described in the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (listing policy) (SWRCB, 2015). The listing policy has requirements for both spatial and temporal representativeness.

We intend to perform baseline surveys of the numeric targets for sediment and of large woody debris loading during water years 2018 and/or 2019. Subsequent numeric target monitoring likely would occur at a minimum, following all large natural disturbance events (e.g., floods with recurrence intervals > 10 years, large fires, large earthquakes).

Timeframes for achieving TMDL allocations and targets are 10 to 20 years following submittal of erosion control and management plans. We typically recommend using median values in space and time in

evaluating numeric targets over a 10-year period (for instance choosing the median value of three measurements in a 10-year period).

Numeric target monitoring will occur in tandem with monitoring of:

a) Flow conditions (e.g., how wet the water years are in the periods between streambed surveys);
b) LWD loading targets and observations of the influence of wood on sediment transport capacity and streambed substrate size distributions; and
c) Inferred reductions in anthropogenic sediment supply tracked through required monitoring and reporting of best management practice (BMP) effectiveness and sediment discharge at properties subject to permitting.

Comment W-3: "Dislink between the demonstrated habitat alterations that interfere with beneficial uses and the proposed actions and numeric targets. The introductory and background material clearly make that case that the estuary and lagoon are severely degraded and not contributing to beneficial use as salmon and trout habitat. As noted in the text, the proposed restoration actions are necessary to restoration of the estuary and lagoon, but they are not sufficient (restoration will probably require some direct action in the estuary to increase the tidal prism and increase sediment export). I understand if estuary restoration is beyond the scope of this document, but without at least some further context it seems that the proposed TDML and habitat enhancement cannot succeed alone in meeting the goals outlined on pg 121. In terms of TMDL requirements, does provision of suitable freshwater habitat meet the beneficial use requirements even if estuarine conditions prevent the target populations from increasing?"

Response: The proposed TMDL addresses sediment impairment within the channel network upstream of the lagoon which is a necessary step towards restoring water quality and beneficial uses in the lagoon. We agree with Dr. Ward that the proposed TMDL alone will not restore the estuary and lagoon. For this reason, we will develop a complementary implementation plan as part of a separate project to restore water quality and beneficial uses in the marsh-lagoon complex. Currently, fisheries and water quality studies in the estuary are under way. The implementation plan for the marsh lagoon complex will incorporate the findings of these studies to achieve the goals outlined for the whole system.

Comment W-4: "Temporal and spatial considerations absent from numeric target assessment. The proposed numeric targets are reasonable parameters that are meaningful to fish populations, but they are factors that a) may take years to respond to reduced sediment inputs and b) are likely to respond in different ways in different parts of the watershed. It would be more meaningful to divide the targets into specific time ranges (e.g. <5 years, 5-10 years, etc.) and spatial locations (headwaters, main stem, marsh reach, etc.) in order to reasonably track the system's response to the implementation of the TMDL and other habitat enhancement efforts."

Response: We agree that it may take years to see a response to reduced sediment inputs. Please see our Response to Comment W-2 above, which addresses temporal and spatial considerations.

We intend to perform baseline surveys of the numeric targets for sediment and of large woody debris loading during water years 2018 and/or 2019. This will help us evaluate which parts of the watershed need the most improvement, and will allow us to track the system's response to TMDL implementation.

Subsequent numeric target monitoring will take place following all large natural disturbance events (e.g., floods with recurrence intervals > 10 years, large fires, large earthquakes), and in response to significant milestones in inferred reduction in anthropogenic sediment supply (e.g., following 25 and 50 percent reductions from roads and other sources).

Comment W-5: "Limited focus of numeric targets. The numeric targets focus on characteristics of pools and sediments. Assessment of these targets alone will not yield information about the overall availability of key habitats in locations where fish can access them (e.g. how much pool area is there in accessible rearing areas? How much suitable spawning gravel exists in accessible tributaries?). As accessibility of habitats seems to be constrained by sedimentation issues in some tributaries (e.g. Butano Creek, tributaries upstream of Old Haul Road), accounting for accessibility in the numeric targets seems essential. Further, there is no assessment of upland factors that need to be addressed to ensure recovery (e.g. land cover, number of failing road crossings). Finally, even if it is not feasible to produce specific targets for some factors, it might be reasonable to specify directional targets (e.g. positive trend in connected floodplain areas, negative trend in channel incision)."

Response: We have not revised numeric targets to incorporate fish passage considerations specifically or to include directional targets. In the Pescadero-Butano watershed, research shows that salmonid populations are more limited by lack of rearing habitat than by lack of spawning habitat (Jankovitz, 2012 and 2013; Goin, 2014 and 2015). In other words, salmonid populations in the watershed are depressed not because access to spawning habitat upstream is impeded, but because there is not adequate rearing habitat in the estuary for juvenile fish that have migrated downstream.

That said, there are multiple projects currently in the works to improve accessibility to upstream spawning habitat. For instance, the San Mateo County RCD recently was awarded a grant to restore habitat access to Butano Creek (http://www.sanmateorcd.org/wp-content/uploads/2017/03/ButanoChannel_ProjectSummaryNarrativeDataManagement.pdf). Plans to reconnect Butano Creek through the marsh are currently being developed. We expect this fish passage/channel restoration project will be completed in water year 2018 or 2019.

The numeric targets in the Pescadero-Butano Watershed Sediment TMDL do address upland factors contributing to erosion, e.g., by incorporating performance standards for roads and grazing lands (see Tables 17 through 22 of the Draft Staff Report). Achievement of these performance standards, by, e.g., planting riparian buffers and repairing stream crossings, are expected to enhance habitat and improve access by salmonids as well as to reduce erosion.

Comment W-6: "In the Linkage Analysis load allocations, the reduction associated with each anthropogenic sediment source is held at the same percentage reduction. This approach seems to ignore two important factors: 1) the different sediment sources are not all equally predictable and avoidable, and 2) the different sources produce sediment (and other habitat effects i.e. channel incision) in different areas of the watershed that have distinct effects on the beneficial uses. Although 78% reduction in all sources is a laudable goal, it may not be realistic. It seems worth a more refined look at which control targets are feasible to address and likely to produce the largest benefits."

Response: We agree that different sediment sources are not all equally controllable, and that different sources produce sediment in different areas with different effects on the beneficial uses. However, we set the TMDL at 125% of natural background sediment input to Pescadero and Butano creeks and their tributaries because this reduction in sediment input, together with restoration of desired habitat conditions, will support healthy salmonid populations and result in attainment of water quality objectives for sediment and settleable material. Achieving the TMDL target of 125% of background loads will require reducing the current loads by 78%. This percentage reflects the overall reduction in sediment to achieve the TMDL. However, we will rely on the numeric targets to gauge attainment of the water quality objectives.

We believe the reductions are feasible within the time period set forth in the TMDL, particularly since the TMDL allows implementation actions to be adapted or modified in response to the results of sediment and fisheries monitoring data. We will be assessing progress on the TMDL on a continuing basis to determine if information is warranted to adapt the TMDL.

Comment W-7: "The implementation plans for Channel Incision and Bank Erosion, Floodplain Restoration, and Wood in Channels are vague and do not include specific actions (or even specific topics and sites for recommended research). For Channel Incision and Bank Erosion, a justification is included for the absence of a plan (incision is a result of historical and current practices and cannot be addressed effectively by individual landowners), but this justification applies to most issues related to sedimentation."

Response: We disagree that the implementation plans for channel incision, bank erosion, floodplain restoration, and wood in channels are vague. These implementation plans are not self-implementing, but provide a road map for the activities and regulatory mechanisms that will lead to reduced sedimentation. Initially, proposed implementation actions for channel incision, loss of storage function, and loss of habitat features are recommended actions and expected to be voluntary, collaborative, and coordinated among stakeholders. We do not intend to propose a regulatory permitting program to require channel restoration to resolve adverse ecological and water quality impacts of channel incision for the following reasons:

a) Channel incision along Pescadero and Butano creeks and their lower tributary reaches is the result of centuries of direct and indirect disturbances. The fragmented ownership of riparian land means that it is not possible for an individual to effectively control the channel incision that may be taking place on his or her property.
b) An effective program to control channel incision in a way that enhances habitat for fish and aquatic species (as outlined above) will require actions by multiple landowners over significant distances along the river.

The science of river restoration and ecological modeling, and the physical and biological information available to guide restoration design and modeling, are still uncertain; before requiring specific actions of responsible parties, we need additional data showing that these actions will effectively reduce or mitigate incision.

Comment W-8: "Inconsistency between sections of text. The major instance of inconsistency that I noted was the content of the numeric targets. Most importantly, the key points summary notes that there is a numeric target defined for floodplain area, but the text on p. 113 states, "[W]e are not currently proposing a floodplain area target." Similarly, substrate composition- percent fines is described as a numeric target but is not listed in the summary or key points noted earlier in the document (e.g. pg 106)."

Response: We revised the text to address the inconsistencies in the numeric targets section.

Comment W-9: "Evaluating the use of literature sources was challenging because many sources cited in the text are missing from the literature cited. I noticed this particularly in Chapter 6 (Alley 1998, Lisle and Hilton 1992, Knopp 1993, Lisle 1993 are all missing). "

Response: All the missing citations were added.

Dr. Ward offered multiple editorial comments and suggestions. We accepted most of these and have clarified remaining issues below:

Issue #2: "Explain how bed mobility relates to sediment deposition and habitat simplification."

We added the following paragraph on page 19:

> "Scour of spawning gravel can be a significant source of mortality to the incubating eggs and larvae of salmon and trout species (Montgomery el al., 1996; Shellberg et al., 2010). The beds of natural gravel channels cut and fill during high flow events. How mobile the bed is, and how deeply it is scoured, are functions of the force per unit area exerted by flowing water on the streambed, channel features that either concentrate or disperse flow energy (e.g., debris, vegetation, bedrock, gravel bars, meanders etc.), and the abundance and sizes of sand and coarser sediment grains supplied to the channel (bedload). Human actions that increase the bedload supply rate, and/or cause it to become finer, will also cause the streambed to become finer, increasing the rate of bedload transport through a channel reach (Dietrich et al., 1989). As the bedload transport rate increases, so does the mean depth and/or spatial extent of streambed scour."

Issue #3*: *"Lagoons can be important, but not as universally as implied here. There are many systems with viable steelhead populations that do not have lagoons or any other extensive estuarine rearing habitat."

Lagoons are essential to sustainable steelhead runs in the Central California coast. As summarized in Hayes et al. (2011), 60-to-90 percent of all returning adult steelhead in several San Mateo and Santa Cruz coastal watersheds, including San Gregorio Creek (Atkinson, 2010), Pescadero Creek (Smith, 1990), and Scott and Waddell creeks (Shapovalov and Taft, 1954, Bond et al., 2008), were lagoon-reared. The lagoons provide tremendously productive habitats that allow the juvenile steelhead to grow quickly and (Hayes et al., 2008) attain a much larger size before migrating to the ocean. Thus, lagoon-reared steelhead have lower rates of marine mortality compared to steelhead that migrate directly to the ocean from their home streams.

California Department of Fish and Wildlife Fisheries biologist Jon Jankovitz has been sampling the Pescadero lagoon to estimates populations, growth rates, and age structures. His results show that the densities and size classes of the lagoon cohorts are exponential compared to stream-reared cohorts and demonstrate the importance of the Pescadero lagoon as a rearing habitat to the survival of steelhead. Jankovitz found that in freshwater reaches, juveniles take 2-3 seasons to reach a length of150 mm or more (smolt size), the minimum needed to survive the ocean and successfully return as adults. By contrast, in the lagoon, juveniles can reach smolt size in the same year (J. Jankovitz, pers. comm., 12/18/2017). "Steelhead in Pescadero Lagoon grow better than anywhere I have seen personally, furthering the importance of the lagoon habitat to the species recovery" (J. Jankovitz, pers. comm., 12/18/2017).

Issue #19: "Do the sediment storage numbers on p. 65 reference the valleys alone (paragraph 1) or the valleys and the marsh (paragraph 2) are these equivalent? Also, was there no storage in the estuary or lagoon historically?"

The sediment storage figures are not equivalent. The sediment storage estimates presented in paragraphs 1 and 2 refer to the terrestrial/alluvial sediment stored in the Pescadero and Butano valleys in the last 6,500 years (approximately when the sea level reached the mouths of the valleys) (Viollis, 1979; and Berlogar, 1988). The annual sediment storage rate of 40,000 tons/year, reported on page 67, is the estimated deposition rate in the valley and not in the marsh; it was erroneously included in the sentence. Therefore, the last sentence of the 2nd paragraph on page 67 should read: "Of this, **40,000 tons/year** historically deposited in the valley and 80,000 tons/year washed out to the ocean."

Analysis of deposits found in Pescadero marsh and lagoon suggest that the present site of the marsh has received sediments from both littoral and fluvial sources for at least the past couple thousand years (Viollis, 1979; Berlogar, 1988; Clarke, 2011) and there was some sediment storage in the lagoon historically. There are no known estimates of sediment storage rate in the lagoon per se; however, the average rate of deposition at Pescadero marsh and lagoon complex for the past 6,500 years appears to be around 1.2 to 2 mm/year (Viollis, 1979; Berlogar). In the last two hundred years, land use changes in the upper watershed, land use changes within the marsh, and the construction/modification of Highway One, resulted in an order-of-magnitude increase in the sedimentation rate in the lagoon and marsh.

The lagoon and the marsh were first mapped accurately by the U.S. Coast Survey in 1854. The map shows that both the Pescadero and Butano channels were much wider, approximately 30 meters wide, and much deeper than present. With logging and agricultural activities intensifying in the late 1800s and the beginning of the 20th century, the Pescadero lagoon and marsh started experiencing drastic changes in sediment dynamics. Between 1900 and 1960, the size of the open water area of the marsh decreased by half (Viollis, 1979). Whereas prior to the Highway One bridge construction in early 1940s, the lagoon was 5 to 6 meters deep in some places (Communication with local residents as reported in Viollis, 1979); today the water in the lagoon is no more than 2 to 3 meters deep. There has been an additional shallowing of the lagoon by approximately 40 cm since 1990.

Issue #21: "The loading estimate of 25 tons per crossing seems to be based on two different datasets and is therefore questionable."

We disagree. The sediment delivery estimate per crossing is reported primarily for reference and comparison purposes to other studies. In addition, PWA's road-related sediment delivery assessment suggests a ratio of stream-crossings per road mile to be approximately 3:1. Extrapolating this ratio to the overall road network of 395 miles yields a total number of crossings within 20 percent of the number of road crossings Balance Geo mapped. Therefore, the two estimates are not incompatible, and the estimate of sediment loading per crossing is not questionable.

Issue #22: "many of the drivers of incision on p. 74 are not addressed in the remediation plan (land use change, channel straightening)".

The Water Board is not a land use planning agency and does not have authority to modify or prohibit any land use. Accordingly, the implementation plan does not call for or require land use changes in the watershed. Instead, the implementation plan addresses activities that result in discharges of sediment to the channels.

Please also see our Response to Comment W-7.

Issue #25: "Is stability of the Old Haul Road crossings, listed on p. 96, addressed in the broader watershed plan? This seems like a major long-term concern."

We agree that the Old Haul Road is a significant concern for road-related sediment delivery. San Mateo County is well aware of the potential issues related to the crossings along this road, has hired qualified professionals to assess the magnitude and extent of the issues (page 134), and has taken the initial steps to develop plans to address these crossings. Similarly, the crossings along Old Haul Road that are located in timberlands are also being evaluated and designs are being developed to repair or replace them as part of timber harvest plans. The implementation plan laid out in the Draft Staff Report highlights the Old Haul Road to identify stream crossing improvements and storm-proofing along the road as a high priority for the responsible parties to address.

Issue #27: "the 'alder thicket' referenced in Table 14 on p. 100 is not called the 'alder thicket' in the text."

We concur and revised the text to refer to the densely vegetated floodplain area upstream of the Pescadero Creek Road as the "willow/alder thicket" consistently. We also included details on the estimate of sediment storage in the willow/alder thicket as follows:

> "Curry (1985) estimated a deposition rate for the period between 1955 and 1985 for: i) the upstream part of the marsh lagoon complex; and ii) the willow/alder thicket upstream of the Pescadero Creek Road. His analysis included core sampling in the marsh, the lagoon, and the channels (to roughly estimate the thickness of deposited sediments following major flood events) and field observations to project lines of equal thickness of sediment units in less-disturbed areas.
>
> a) Curry observed 2 m (6 ft) of sediment in the alder thicket area that had accumulated during and since the 1955 flood. He estimated the area of the thicket as 20 ha (50 ac). This would amount to a total deposition of 600,000 tons. He assumed that most of this sediment was associated with the 1955 flood and the period after that. Therefore, an annual deposition rate of approximately **20,000 tons/yr** in the willow/alder thicket area was inferred."

Issue #30: "Is there a standard depth for bulk core samples?"

There is no standard depth for bulk core samples. Bulk or volumetric sampling involves the removal of a predetermined volume of material large enough to be independent of the maximum particle size. In general, the minimum depth of a volumetric sample should be at least twice the diameter of the maximum particle size.

Issue #35: "Pg 115 paragraph 2 – although a reasonable starting point, the reference time-period approach fails if there is a substantial lag between initiation of high sediment loads and the decline of the salmon and trout population."

We agree that there may be a lag between initiation of high sediment loads and the decline of the salmon and trout population and acknowledge that linking channel conditions to sediment supply is challenging as channel form and sediment deposits reflect the temporal and spatial integration of sediment inputs to and transport through stream channels. Therefore, reference sites may represent the completely unaffected state, a relatively unaffected state, or an increasing degree of existing impact. However, we believe that if the selection of appropriate reference sites reflects a clear understanding of the overall system and the key watershed characteristics and processes, then this approach is adequate. This approach is also adequate because:

a) Pescadero-Butano watershed has a Mediterranean climate and active tectonic setting, therefore, natural sediment loads are highly variable and native stream biota are adapted to large infrequent sediment pulses associated with natural disturbances (e.g., large storm events, wildfires, and tectonic activity);
b) Native stream biota are not adapted to chronic increases in fine sediment load caused by land use activities that disturb vegetation cover and/or infiltration capacity of soil (e.g., road-related erosion, agriculture, construction, timber harvest, livestock grazing). Under the natural sediment input regime, fine sediment input would be very low in most years, and the amount of fine sediment stored in the channel would be rapidly reduced (following a large disturbance) back to levels favorable for spawning and rearing; and
c) By expressing the TMDL and allocations by source as a percentage of natural background, the focus of sediment monitoring shifts to measurement of sediment input rates to channels and determining which sources are natural or human-caused. With this focus, it is possible to rapidly evaluate progress toward attainment of the TMDL, and the effectiveness of management practices toward this end.

Issue #36: "Note that factors outside of the sediment TMDL and habitat enhancement plan could prevent success (e.g. estuary restoration). Similarly, producing suitable habitat for coho may not lead to restoration of a spawning run without introduction of a founding population."

We concur. Restoration of properly functioning freshwater channel and floodplain habitats is necessary but not sufficient to facilitate recovery of watershed populations of coho salmon and steelhead. Substantial enhancement of the estuarine habitats also will be required for steelhead. In the case of coho salmon, local extirpation of at least two of the three brood years (and lack of a large local source population to provide strays), means that restoration efforts also would include introduction of a

founding population. This is consistent with the coho salmon recovery plans developed by the California Department of Fish and Wildlife and National Marine Fisheries Service.

PART III

STAFF-INITIATED CHANGES TO DRAFT STAFF REPORT

Water Board staff made insignificant editorial changes to the draft Staff Report. These include correcting typographic errors and other minor changes to add clarity.

Other staff-initiated changes to the Staff Report are described below:

1. Chapter 1 Introduction, page 9: added the following statement as the third bullet point in the Key Points summary to clarify the project area.

The impairment applies to Pescadero and Butano Creeks, as well as their tributaries.

2. Chapter 2, Problem Statement, page 20: revised a statement at the end of the section and moved it to the beginning.

Although the TMDL and implementation actions focus on the sediment impairment within the channel network upstream of the lagoon and does not include implementation actions specific to the lagoon and marsh, achievement of this TMDL is a necessary step to restore water quality and beneficial uses in the lagoon and marsh. This section describes the lagoon and marsh in order to provide for an understanding of the entire system.

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Appendix E

Comment Letters Received

by March 14, 2018

available electronically at:

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/pescaderobutanocrkstmdl.html