California Regional Water Quality Control Board

Central Coast Region

Attachment 5
Scientific Peer Review and Staff Responses to Comments

for

Amendment to the Water Quality Control Plan for the Central Coastal Basin to Adopt Total Maximum Daily Loads for Turbidity in the Gabilan Creek Watershed, Monterey County, California (Resolution No. R3-2022-0002)

Prepared by Peter Meertens, Environmental Scientist

Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101,
San Luis Obispo, California 93401
(805) 549-3147
http://www.waterboards.ca.gov/centralcoast/

1. INTRODUCTION

In this report, Central Coast Regional Water Board Quality Control Board (Central Coast Water Board) staff provides responses to external scientific peer reviews on the proposed Total Maximum Daily Loads (TMDL) for turbidity in the Gabilan Creek watershed technical report (TMDL technical report) and a report on the *Proposed Methodology to Derive Natural Conditions for Turbidity and Derivation of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Region* (natural turbidity report). These reports to provide the scientific basis for future proposed amendments to the Water Quality Control Plan for the Central Coastal Region and meet the requirement of the California Health and Safety Code section 57004 for California Environmental Protection Agency organizations to submit for external scientific peer review the scientific basis and scientific portion of all proposed policies, plans, and regulations.

On December 4, 2020, staff requested that the Cal/EPA Scientific Peer Review Program (Cal/EPA) initiate the process with the University of California, Berkeley (University) to identify and select external scientific peer reviewers for these reports. The peer reviewer's responsibility is to determine whether the scientific findings, conclusions, and assumptions are based upon sound scientific knowledge, methods, and practices. The University confidentially identified three qualified reviewers and initiated reviews. The detailed step-by-step guidance for setting up and obtaining reviews appears in an Interagency Agreement between the California Environmental Protection Agency and the University of California (see Exhibit F of the guidance document). A January 7, 2009 Supplement to the Guidelines, in part, provides guidance to ensure confidentiality of the process. No person may serve as an external scientific peer reviewer if that person participated in the development of the scientific basis or scientific portion of the proposed rule, regulation, or policy. CAL/EPA provided the final reviews to the Central Coast Water Board on May 11, 2021.

Approved reviewers:

George M. Hornberger, Ph.D.
University Distinguished Professor of Civil and Environmental Engineering and Earth and Environmental Sciences
Vanderbilt University
155 Buttrick Hall
Nashville, TN 37235-1831

John S. Schwartz, Ph.D., P.E.
Professor and Director of the Tennessee Water Resources Research Center
Department of Civil and Environmental Engineering
413 John D. Tickle Engineering Building
University of Tennessee
Knoxville, Tennessee 37996

Alberto Bellin, Ph.D., Professor

Department of Civil, Environmental and Mechanical Engineering
University of Trento
Via Mesiano, 77
I-38123 Trento, Italy

Staff requested the reviewers to comment on whether the scientific portions of the TMDL technical report and natural turbidity report are based upon sound scientific knowledge, methods, and practices. Specifically, the reviewers were asked to comment on five specific areas related to the documents:

1) Numeric Targets - *Primary Scientific Issue*: The scientific basis for the assignment of numeric targets for turbidity TMDLs and for use more broadly as water quality objectives.

2) Source Analysis - *Primary Scientific Issue*: The methodologies, data and assumptions used, and conclusions made in identifying probable source categories contributing turbidity pollution in surface waters.

3) TMDLs and Allocations - *Primary Scientific Issue*: The scientific and technical basis of the proposed TMDLs and allocations.

4) Implementation - *Primary Scientific Issue*: The technical basis of the proposed implementation and monitoring plans.

5) Monitoring Plan - *Primary Scientific Issue*: The scientific and technical basis of the proposed monitoring plan.

Staff reproduced the peer review comments herein based on the dates provided in the three comment letters received; the comment letter with the earliest date is reproduced herein first, the comment letter with the latest date is reproduced herein third.

The California Health and Safety Code states that if the external scientific peer reviewers find that a State agency failed to demonstrate that the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices, the reviewer's report shall state that finding, and the reasons explaining the finding. After receiving the reports from the reviewers and considering their comments, staff concludes that the reviewers found the two reports to be based on sound scientific principles. The reviewers have extensive knowledge and experience in the areas addressed in the reports and their reviews provide valuable feedback that staff addressed in this response document and incorporated into the reports.

The Central Coast Regional Water Quality Control Board appreciates the thorough reviews provided by these scientists. Their comments and insight have prompted us to clarify and improve technical information in the TMDL technical report and the natural turbidity report in several areas, as described in this document.

Format used for staff response to comments:
In the following sections of this document, staff reproduce direct and unmodified transcriptions of the comments from each reviewer and insert staff responses using **bold, blue text**.

2. PEER REVIEW COMMENTS OF GEORGE M. HORNBERGER, Ph.D.

Review Date: April 2, 2021

2.1. Overall Comment

The report and the supporting material are thorough, thoughtful, and clear. The basis for the decisions about setting targets for turbidity remediation is well documented. In my opinion, the report provides a sound basis to proceed. My comments below on the specific questions to which I was asked to respond highlight a few things that might be considered in the future as the plans are finalized and the program is moved to an implementation stage but in no way should they be taken to imply that there are critical inadequacies.

Staff Response (SR-1):
Thank you for taking the time and effort to review the TMDL technical report. Staff appreciates these comments that validate the appropriateness of the approach taken to develop the TMDLs and acknowledgement that the TMDL technical report provides a sound basis for proceeding with the project.

2.2. Numeric Targets - *Primary Scientific Issue:* The scientific basis for the assignment of numeric targets for turbidity TMDLs and for use more broadly as water quality objectives.

The Gabilan Creek Watershed has been highly modified hydrologically, including drainage of wetlands and widespread application of irrigation in agriculture. It is essentially impossible that every part of the watershed could be returned to "pristine" conditions with respect to turbidity.

The plan lays out a rationale for selection of TMDL values using available monitoring data. The EPA recommended approach of considering the 75th percentile of the frequency distribution of least impacted streams and the 25th percentile of the frequency distribution of the general population of streams was used to inform the final choices.

Estimates based on routine monitoring are subject to considerable error (e.g., Edwards et al., 2004) and uncertainty is carried through to TMDL estimates using the data. Furthermore, turbidity levels will be affected by numerous physical processes that vary across a watershed.

Difficulties notwithstanding, the final recommended numeric targets are consistent with targets that have been identified elsewhere and therefore seem sensible. For example, consider the year-round targets of 2.5 NTU and 8 NTU for upper Gabilan Creek and the more highly impacted lower Gabilan Creek, respectively. The Oregon DEQ (2014) recognizes values of from 4 to 10 NTU as those that may impact different aspects of the ecosystem; Klein et al. (2008) use a turbidity threshold of 10 NTU (equaled or exceeded 55% of the timein the wet season) to define a background cumulative watershed effect; and Tetra Tech (2019) consider that a geometric mean NTU of 5 in the wet season and 2 in the dry season are protective of class 1 and 2 waters on Oahu. Many other cases also have targets that are consistent with those developed for Gabilan Creek.

Staff Response (SR-2):
Staff acknowledges the reviewer's finding that "*the final recommended numeric targets are consistent with targets that have been identified elsewhere and therefore seem sensible*" and staff appreciates reference to additional scientific literature and they will be noted in the staff report.

2.3. Source Analysis - *Primary Scientific Issue:* The methodologies, data and assumptions used, and conclusions made in identifying probable source categories contributing turbidity in surface waters.

Results from a 2003 study, the Central Coast Watershed Studies (CCoWS), formed the basis for identifying probable sources. The results, as summarized in the report, indicate that agriculture is a primary source but also notes that remobilization of sediments deposited previously in stream channels is a source of turbidity not analyzed in the 2003 CCoWS study.The report also cites a thesis by Cassagrande that includes analyses from storms in 2001 to conclude that "Data from winter storm event monitoring suggests that agriculture and urban land use practices contribute significant proportions of the total suspended sediment in Gabilan Creek." These studies qualitatively identify the probable sources.

It should be noted, however, that mobilization and transport of suspended sediments are highly variable in both space and time, and probably especially so in streams in a Mediterranean climate. Although the likelihood is that agricultural land contributes the highest suspended sediment loads in Gabilan Creek, detailed delineation of sources areas is problematic. As the 2003 CCoWS report notes, "Decisions based on these data should be cognizant of the inherent uncertainty in the results."

Staff Response (SR-3):
Staff acknowledges the findings from the CCoWS 2003 study indicating that agriculture is a primary source of turbidity and that the remobilization of sediments previously deposited in stream channels is a source of turbidity not analyzed in the CCoWS study. Staff updated the TMDL technical report to include the remobilization of stream channel sediments to the source analysis section of the TMDL technical report.

Additionally, staff acknowledges the comment that the mobilization and transport of suspended sediments are highly variable in streams in Mediterranean regions such as is found in the Central Coast Region. This is evident in the extensive turbidity monitoring data set summarized in the TMDL technical report. The data

are summarized seasonally, and the data illustrates much higher levels during the wet season. Another example is the turbidity and flow monitoring data in TMDL from the City of Salinas stormwater program, which show the episodic nature that storms can achieve in the watershed (Tables 32 and 33).

Staff notes the comment that it is difficult to delineate specific sources of turbidity in a watershed, which is why the TMDL Project takes a watershed scale approach to analyze sources and relies on multiple types of source analysis. Although the CCoWS study noted inherent uncertainty in their results, their study did clearly identify sediments leaving farms and subsequent field observations and photos in the TMDL technical report illustrate the threat of sediment erosion from farm fields.

2.4. TMDLs and Allocations - *Primary Scientific Issue*: The scientific and technical basis of the proposed TMDLs and allocations.

Suspended sediment production and transport is affected by many factors and is highly variable in space and time (e.g., Bywater-Reyes et al., 2018). Thus, allocation ofloads with the intent of meeting instream TMDLs is fraught with difficulty. The load allocations in the report follow the defined numeric targets for turbidity in NTUs.

Turbidity sources are listed in Table 38 along with the type of load allocation. Compliance is to be assessed through monitoring at selected locations in creeks, canals,sloughs, etc. (page 119).

A question that arises relates to the extent to which sediment remobilization from the streambed itself contributes to observed turbidity. Although “channel maintenance” is recognized in the report as a type of allocation, the possibility that legacy sediments in the highly modified channel network may be a major contributor is not considered. Unstable stream channels can be a major source of turbidity (e.g., Mukandan et al., 2011)and there can be no expectation that management of the surrounding landscape will mitigate suspended sediment impacts in such cases.

One other issue relates to the nature of turbidity in the dry season. Data and photographs in Appendix C of California Regional Water Quality Control Board Central Coast Region (2013) suggest that algae may be significant in terms of turbidity in some locations. If so, setting allocations can be complicated. Reducing suspended mineral sediment may reduce phosphate and thus limit algal growth if the control is nutrient limitation but at the same time improving water clarity by reducing suspended silt and clay may have the opposite effect if the algae are light limited.

Staff Response (SR-4):
Staff acknowledges the reviewers comment that unstable stream channels and legacy sediments may be a major contributor to turbidity and need to be addressed in the TMDL technical report. A discussion of these sources has been included in the TMDL technical report.

As noted by the reviewer, in portions of the lower Gabilan Creek watershed, algae growth may currently be limited by reduced light and therefore reducing suspended sediments in these waters and improving clarity could stimulate algae growth. Staff has made note of this potential unintended consequence in the Turbidity TMDL technical report. The nutrient TMDL project noted by the reviewer, sets targets for improving nutrients levels, which should mitigate the effects of improved water clarity and light penetration on stimulating algae growth. Additionally, the turbidity TMDL Project establishes targets for stream biological conditions including emergent macrophytes, increased plant growth, and shading that would reduce biostimulation.

2.5. Monitoring Plan – *Primary Scientific Issue*: The scientific and technical basis of the proposed monitoring plan.

The recommendations for monitoring are sound. The plan to monitor not only in the channels but also at outfalls, drainage waters from agricultural fields in particular, is imperative to identify potential favorable outcomes and also potential problems.

Attaining desired results in managing to restore water quality in receiving waters is difficult. As GAO (2013) reported in a survey of TMDL results, "pollutants had been reduced in many waters, but few impaired water bodies have fully attained water quality standards." Uncertainties about the sources (especially nonpoint sources) and delivery mechanisms of pollutants to water bodies abound. This has led to the recognition that TMDL plans should employ adaptive implementation (NRC 2001; Shabman et al., 2007).The report for the Gabilan Creek watershed does have interim targets in recognition that progress will occur over time but no indication is given about use of adaptive management. Adequate monitoring is essential to characterize the effectiveness of actionstaken and to revise plans as necessary in the spirit of adaptive implementation. One aspect of monitoring that could prove very useful to inform mid-course corrections to turbidity TMDL allocations is identifying sources using sediment fingerprinting (e.g., Collins et al., 2017; Lamba et al., 2015).

The recommendation that stakeholders responsible for implementation should develop a coordinated plan is critical. Cooperation of those in the agricultural sector is essential given that stakeholder engagement to curb discharges from privately held land determines success (Benham et al., 2012). "The policy challenge is to induce the implementation of the right practices in the right places (within fields and watersheds) to achieve water quality goals at least cost" (Shortle, 2017). Given that shared trust is needed to achieve TMDL goals (Drevno, 2018), working with stakeholders to develop a coordinated plan is indeed a required element.

Staff Response (SR-5):
Staff acknowledges the reviewers comment that the TMDL monitoring recommendations are sound and support for cooperative monitoring. Staff also acknowledges the reviewer's comment regarding the difficulties TMDL projects

face in restoring water quality and the value of incorporating adaptive management strategies along with sediment finger printing to inform adjustments to plans during implementation. Based on the reviewer's comments, staff incorporated recommendations for adaptive management and recommends that future monitoring and analysis include sediment finger printing.

3. PEER REVIEW COMMENTS OF JOHN S. SCHWARTZ, PH.D.

Review Date: April 30, 2021

3.1. Numeric Targets.

Water quality standard attainment, stated in the Basin Plan for turbidity WQO are based on a narrative WQO and a numeric WQO. They are as follows: 1) waters shall be free of changes in turbidity that causes nuisance or adversely affect beneficial uses, and 2) increase in turbidity attributable to controllable water quality factors shall not exceed the following: i.) where natural turbidity is between 0 and 50 nephelometric turbidity unit (NTU), increases shall not exceed 20%, ii.) where natural turbidity is between 50 and 100 NTU, increases shall not exceed 10 NTU, and iii.) where natural turbidity is greater than 100 NTU, increases shall not exceed 10%. In general, beneficial uses associated with aquatic life are the limiting use to govern setting numerical targets, in which Table 2 lists several such as cold and warm freshwater habitat, spawning, preservation of biological habitats of significant importance, others.

The study reference by Sigler et al. (1987) is appropriate for COLD freshwater habitat because it utilized juvenile steelhead trout (*Oncorhynchus mykiss*) for investigating impacts to feeding (foraging). The reference by Lloyd et. al. (1987) focused on primary production in Alaska though they did examine avoidance to turbid water and found comparable results of an impairment turbidity threshold of 25 NTU. Sweka and Hartman (2011b) utilized brook trout (*Salvelinus fontinalis*) a non-anadromous salmonid to study the impacts of elevated turbidity of forging efficiency and found a wide range of NTU affecting growth rates. The range was within what was observed by Sigler et.al. (1987). The numeric NTU target for the COLD beneficial use is scientifically sound.

Staff Response (SR-6):

Comment noted that the numeric turbidity target for the COLD beneficial use based on reference by Sigler et. al. (1987) is scientifically sound. The reviewer uses the acronym "WQO" and it stands for Water Quality Objectives.

Fish foraging efficiency as a measure for ecosystem harm is a logical choice without further studies to better understand the complex stressor relationships to multiple aquatic organism groups (i.e., periphyton/diatoms, macroinvertebrates, amphibians, and fish) and different life history strategies for the higher order organisms. Staff did reference Davies-Collet et al. (1992) that examined the impacts of increased turbidity to benthic algae biomass, identifying a 15 NTU threshed reduce biomass production. Complex stressor relationships from elevated fine sediment transport on fish includes spawning success (recruitment) and rearing habitat quality (Waters 1995; Wood and Armitage 1997; Schwartz et al. 2011). Excessive fine sediment can smother fish redds reducing oxygen to eggs, thus reducing survival (Jensen et al. 2009). Potentially, excessive fine sediment may impact pool and riffle habitat for rearing, and fish production indirectly by affecting the benthic macroinvertebrate community. Making direct impairment relationships with ambient turbidity levels to these other stressors is difficult because they generally reflect the fine sediment transport and deposition during high-flow events, which is episodic in nature (Newcombe 2003; Schwartz et al. 2008). Episodic transport of fine sediment (turbidity) must be characterized in terms of concentration (or NTU), duration, and frequency (CDF). At this time turbidity CDF data are not available in the Gabilan Creek watershed, therefore NTU numeric targets based on fish foraging are scientifically sound. In the review of the Monitoring Plan section, suggestions are made to better link impacts to biotic integrity to the episodic nature of fine sediment transport (turbidity).

Staff Response (SR-7):
Comment acknowledged that a fish foraging efficiency is an appropriate measure of ecosystem health. Staff appreciates the overview of the impacts of turbidity and sediments of freshwater ecosystems. Staff also acknowledges the value of characterizing and possibly setting targets that consider the turbidity duration and frequency, but this data is not currently available and would difficult to obtain and use for regulations.

The primary reference supporting the WARM beneficial use is by Shoup and Wahl (2009) based on impacts to predation (foraging) by largemouth bass (*Micropterus salmoides*). As noted above for COLD beneficial uses, fish foraging is an appropriate biological function to determine a numeric NTU target in lieu of having CDF turbidity and fish response data. In general, warmwater fisheries will be more diverse. To support the use of largemouth bass as the “model” for forging impacts it would be informative to acknowledge that largemouth bass currently occupy, or should occupy the lower reaches of the Gabilan Creek watershed. A species list of the current fish community would also be beneficial. Additional references investigating the impacts of turbidity on WARM species would strengthen the 40 NTU target from Shoup and Wahl (2009). In lieu of additional studies, this 40 NTU appears appropriate to support an interim TMDL milestones. It is noted that in literature, specific relationships between for turbidity or total suspended solids (TSS) and species impairment is limited; therefore, as general guidance the effect levels listed in Table 18 appear reasonable for a TMDL numerical target.

Staff Response (SR-8):
Staff acknowledges that the effect levels listed in Table 18 of appear reasonable for a TMDL numeric target. Staff notes the reviewer’s recommendation that additional references on warm water fish could be helpful and documentation that bass are present in the lower watershed would support the 40 NTU target. Unfortunately, no data are available showing largemouth bass in the watershed, although they are a proxy for other native and introduced warm freshwater fish species. Staff used the 40 NTU turbidity evaluation guideline to determine 303(d) List status for inland surface waters designated WARM in the Central Coast

Region since 2008. For this TMDL Project, 40 NTU target is an interim target and natural reference site conditions support lower targets.

The applied factor of safety (FOS) of 2x versus 10x in Table 18 for potential NTU targets are based on policy, referencing an USEPA Office of Pesticide Planning document (Bower 2000). These potential targets in Table 18 are proposed for the narrative component of the turbidity WQO, and FOS selection is based on policy. In Table 22, Summary of Potential Numeric Targets for both narrative and numeric methods, a FOS of 2x was selected. Only through an effective monitoring program, the FOSs can be assessed to whether they sufficiently provide recovery to biotic integrity in the Gabilan Creek watershed (as noted in Section 6.0, Biological Condition Numeric Targets).

<u>Staff Response (SR-9):</u>
Staff acknowledges that the selection of a FOS is a policy decision and future monitoring would be needed to assess whether the FOS is adequate for recovery of biological integrity.

Development of the potential numerical targets for turbidity based on the numeric component of the turbidity WQO consisted of three analysis approaches. They were the: 1) Hydrogeomorphic Approach, 2) USEPA Ecoregion Approach, and 3) Analysis of Regional Agricultural Monitoring Data Approach by the Cooperative Monitoring Program for Irrigated Agriculture (CMP Approach). It is recognized that an ecoregion “reference” stream constitutes a less-impaired streams and not necessarily pristine. All these approaches rely on analysis of existing monitoring data. A minor comment, the report should specifically state the samples were collected by grab (or other protocols), sample frequency and criteria for collecting (i.e., so many hours after a rain event of a specified magnitude, or other), and analytical equipment (field or lab instrument). Because different datasets used different protocols, and table summarizing the dataset used and their protocols would be beneficial.

<u>Staff Response (SR-11):</u>
Comment noted that the TMDL technical report should specifically state the turbidity monitoring protocols and methods. The data analysis section of the TMDL technical report has been updated with this information.

The Hydrogeomorphic Approach was developed by the US Army Corps of Engineers (ACOE, 1995) classifying stream reaches based on geomorphic setting, water source, and hydrodynamics. The approach is summarized in the report and additional detail in Appendix 1. Two classes of reference streams were identified; they were perennial riverine and sloughs. Through the reference streams with NTU data are in Appendix 1, how were these streams sites selected from a larger data site of sites, and how were geomorphic setting, water source, and hydrodynamics applied in that analysis. The Natural Turbidity Technical Report defines that selection procedure, but in the TMDL Report it is less clear to their determinization. The data are valuable and averages appear reasonable, but a better description of how the references sites were selected is needed.

Staff Response (SR-12):
Staff notes that the request for addition information on how of how reference sites were selected. The appendix to the TMDL technical report describing the Hydrogeomorphic Approach was updated with additional details.

The USEPA Ecoregion Approach relies on deriving natural turbidity conditions, and assessing reference (less-disturbed) streams within a common ecoregion, and classifying streams based on slope, drainage area size, and bed substrate. As Appendix 2, the Technical Project Report "*Proposed Methodology to Derive Natural Conditions for Turbidity and Development of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Range*" was reviewed separately and commented on below beginning on page 13. Defining "natural" conditions in the Natural Turbidity Technical Report utilized similar stream classification protocols as described in the Hydrogeomorphic Approach, in addition to identifying references streams based on Ode et al. (2016) and the USEPA Ecoregion Approach. In summary, the resulting "natural" levels of NTUs were determined through stream classification and season, identifying least impacted streams, and utilizing percentile data analysis approach as defined by USEPA (2015) were scientifically sound based on the existing monitoring data available. The TMDL Implementation and Monitoring Plans will improve water quality in the Gabilan Creek watershed, and provide future data for adaptive watershed management practices to further target BMP locations in the watershed.

Staff Response (SR-13):
Comment noted that the reviewer supports the percentile data analysis approach for deriving natural conditions and that the TMDL implementation and monitoring plans will improve water quality.

The CMP Approach relies on regional monitoring data for irrigated agriculture sampled on a monthly frequency. The dataset includes 50 monitoring sites with 10 sites located within the Gabilan Creek watershed. All data were summarized in Appendix 3. Based on best professional judgment (BPJ), the 25^{th} percentile of the data collected was chosen to represent less disturbed condition. This percentile appears reasonable but ultimately the Monitoring Plan provides the scientific evidence that NTU numeric targets are improving biotic integrity to ecoregion biomonitoring standards by CA state.

Staff Response (SR-14):
Staff acknowledges that the lower 25^{th} percentile of CMP data outside of the Gabilan Creek watershed appears to be a reasonable interim target for some waterbodies in the Gabilan Creek watershed. Staff agree that future monitoring will provide the best evidence that ecological health is improving.

Selection of interim and final numeric targets were based on a summary table (Table 22) of both narrative and numeric methods, and separated by year-round, wet season, and dry season NTU targets. Targets were also separated by upper and lower portions of the Gabilan Creek watershed. The separate seasonal and watershed NTU numeric targets are fully supported scientifically by data and literature. The justification for the upper Gabilan Creek watershed is strongly supported by using the USEPA Ecoregion Approach, and it is consistent with narrative targets based on ecological functions for steelhead trout growth and feeding reactive time, and benthic algae growth. Using the 75th percentile for low-head vegetated streams is justified by BPJ and the Natural Turbidity Technical Report on deriving natural conditions for turbidity. Justification for the lower Gabilan Creek watershed is supported by the Hydrogeomorphic Approach, however, see the comment above about the need for greater clarity in the TMDL technical report on how reference streams were selected. Sample frequency (number of samples per year) for both geographical portions of the watershed should be determined through a statistical power analysis setting a 95% significance level for a designated period of time (e.g., five years per the first interim target period). A statistical power analysis can be easily accomplished with the existing data, though the data are to be normally distributed.

Staff Response (SR-15):
Comment noted that the approach of separating targets by location in the watershed and seasonally are fully supported by scientific data and literature. Staff also notes the recommendation for a sampling frequency statistical power analysis and staff conducted a power analysis to determine the sampling frequency necessary to reach the TMDL targets within the TMDL attainment schedule. Staff updated the monitoring recommendations accordingly.

Editorial note: Page 76, Section 5.1, second paragraph: Paragraphs as worded is not correct. Number 1 is the lowest, not number 4. Potential target number 2 relates to the benthic algae indicator.

Staff Response (SR-16):
The paragraph referenced by the reviewer in the editorial note was an error and was deleted from the report.

Steelhead protection in the upper Gabilan Creek watershed may not only be a function of the ambient water column turbidity, as relationship to the feeding/growth ecological function for fish, but also the embeddedness of channel bed substrate. Elevated levels of fine sediment transport occur during high flow events and sediment can become deposited in habitats and in the substrate interstitial pore space. Embeddedness relates to the ecological function for fish spawning success, and it is suggested to be added as a parameter in the Monitoring Plan.

Staff Response (SR-17):
Staff acknowledges the importance of embeddedness as it relates to stream health and the recommendation that it be added as a monitoring parameter in the upper Gabilan Creek watershed. The TMDL technical report includes a recommendation for biological assessment monitoring, which includes collection

of physical habitat data such as embeddedness and pebble size (for calculations of median diameter).

Chapter 6 describes biological condition numbered targets, and relates to the narrative WQO. The Surface Water Ambient Monitoring Program (SWAMP) developed SOP for conducing biological surveys including benthic macroinvertebrates (Ode et al. 2016). It was noted that these biological surveys with benthic macroinvertebrates for biotic integrity index (IBI) scores are only valid in the streams of the upper Gabilan Creek watershed. Because riffle habitat is necessary for the sampling it is understandable that streams/canals in the lower Gabilan Creek watershed, the SOP would not be applicable. However, a diatom/algae IBI per Fetscher et al. (2014) may be applicable. Data from SWAMP and the California Rapid Assessment Method (CRAM) were not used directly with the development of the turbidity TMDL. It is recommended that the monitoring program and future data analysis conduct a "linkage analysis" correlating NTU data with relevant IBI data. These relationships per the upper and lower sections of the Gabilan Creek watershed would provide greater scientific justification for the NTU numeric targets. Suggestions and a few references are provided below in the section for review of the Monitoring Plan.

Staff Response (SR-18):
Staff acknowledges the comments on the value of biological indices. California currently utilizes the California Stream Condition Index (CSCI) and the Algae Stream Condition Index (ASCI) (SWAMP, 2021). These are not limited to riffle habitat and instead rely on identification of reference streams with similar characteristics. There are limited benthic invertebrate and algae data available for the Gabilan Creek watershed and therefore we chose not to use them for targets. During development of the TMDLs staff researched developing biological targets based on diatom/algae data but found that other biological targets had more support by stakeholders. For example, groups have extensively monitored and studied the conditions of riparian habitats in the lower Gabilan Creek watershed using the CRAM and regional monitoring programs have conducted very limited biological assessments.

Staff notes the recommendation that future monitoring and data analysis to conduct a linkage analysis correlating biological index scores to turbidity. Staff references this type of study in the TMDL technical report. The Central Coast Water Board funded a similar study in the Pajaro and San Lorenzo River watersheds by Herbst that links physical stream habitat conditions (percent sands and fines) to benthic macroinvertebrate taxa diversity (Herbst et al., 2014). More specifically, the physical stream habitat conditions (percent fines and sands) are linked EPT taxa diversity, which includes Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

Note that the reviewer uses the acronym "SOP" that stands for Standard Operating Procedures.

References Cited by the Reviewer

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3.2. Source Analysis

Identification of instream sources of turbidity (fine sediment) were based on land/use/cover types, land use conditions and management activities using several means including a GIS analysis supported by monitoring data, watershed reconnaissance, assessing monitoring data from the City of Salinas Municipal Stormwater Program (MS4 NPDES permit), and review of existing studies/reports. The source analysis was largely founded on a 2003 study by Californian State University at Monterey Bay (CSUMB) for the Salinas Valley TMDL Project, in which the Gabilan Creek watershed was a sub-basin within the entire Valley. In the CSUMB study researchers monitored 3 storm events from 11 publicly accessible sites in Gabilan Creek watershed and the Salinas Reclamation Canal.

Per Section 7.1, a table identifying the 11 monitoring sites and what land use they represented In the CSUMB study is needed (grazing/natural, crops, and urban), and where they are located. This additional information could be added to Table 29. To assess the strength of the monitoring data representing each land use type, this information is important. The study divided the Gabilan Creek watershed into upper and lower, above and below the City of Salinas, which was supported by results of water quality monitoring data where Carr Lake reaches appear to be a depositional zone changing the sediment transport dynamics and/or dilution from urban runoff. Table 29 does not break the modeled loads per the upper and lower watershed areas, though this information is presented from another study described in Section 7.7.

Note that the reviewer uses the acronym "GIS" that stands for Geographic Information System

Staff Response (SR-19):

Staff notes the request for additional information from the CSUMB study and that this information could be valuable in the TMDL technical report. When developing the TMDL technical report, staff did not include this information because of limitations noted by the CSUMB researchers on the conclusions that may be drawn from this section of their study. Their conclusions for this section are as follows:

> *The conclusions that may be drawn from the Gabilan monitoring and analysis in relation to the determination of Salinas Valley sediment sources are as follows:*
>
> - *Determination of watershed sediment budgets in non-perennial systems is confounded by the dominant influence of episodicity, percolation, and in-channel sediment storage, even when detailed storm-based monitoring is conducted at multiple sites simultaneously for a whole storm season. Conclusions based on monitoring data are thus limited. Decisions based on these data should be cognizant of the inherent uncertainty in the results.*
> - *There is good evidence that row-crop agricultural lands contributed the highest suspended sediment loads per unit area under the conditions experienced in 2000-1.*
> - *There is good evidence that urban lands contributed the greatest volume of runoff per unit area.*
> - *There is some evidence for significant input of coarse material (transported as bedload) from strawberry lands.*
> - *There is some evidence that sediment load from grazing lands can be high if not mitigated by stream-bank vegetation.*
> - *More conclusive results based on in-stream monitoring could be gained through long term (5-10 years) storm-based monitoring programs capable of sampling from large flood flows. The high cost of such programs could be partly offset by carefully thought out improvements in site selection.*

Although the CSUMB study has limitations on conclusions for source analysis, the CSUMB study provides valuable information, noted by the reviewer, that staff added to the introductory sections of the TMDL technical report to describe watershed and sediment processes. To supplement the CSUMB study staff conducted additional watershed and subwatershed GIS analysis to analyze watershed land use in relation to monitoring data. This information is section 7.7 of the TMDL technical report. The reviewer acknowledges the value of this source analysis for identifying major sources of turbidity and for prioritizing implementation in the paragraph below.

Applying monitoring data by land use with GIS is a static modeling approach to estimate sediment loads. This approach is simplest and commonly used. Sediment load outputs per defined catchment are best to be viewed as relative mass loads and not absolute. This modeling approach is valuable in a source analysis to identify major sources of fine sediment (turbidity) leading to impairment, and to set priorities for the TMDL implementation plan. In general, conclusions from the 2003 CSUMB study summarize the fine sediment sources within the associated waterbodies of Gabilan Creek watershed. To note, the contribution from bank erosion was not added in the list (page 93) of sediment sources though bank erosion is likely a major source of sediment. Section 7.5 and Figure 28 through reconnaissance and a study prepared for MCWRA indicate that this source may be substantial.

Staff Response (SR-20):
Staff acknowledges the comment that bank erosion is a substantial source of turbidity and it is included in the list of sources in the TMDL technical report, see Table 35. Staff also notes that the CSUMB study summarizes fine sediment sources within waterbodies of the Gabilan Creek watershed.

Note the reviewer uses the acronym "MCWRA" that stands for Monterey County Water Resources Agency.

Because bank erosion can be significant sources of sediment to the stream channel, it is suggested a geomorphic study be conducted assessing the "risk" or the vulnerability of excessive erosion from bank fluvial erosion, bank mass failure, and upland concentrated flow drainage forming rills on banks. This effort may have been completed by the Balance Hydrologics study for MCWRA, but it is not clear if their study was only reconnaissance or it included it included an analysis. A geomorphic study should include stream reach information consisting of hydraulic shear stress (or stream power), measurements of bank soil properties for erodibility, and bank protection/resistance properties. The reason this is important is that several studies have reported 60-80% of instream fine sediment is from bank erosion (e.g., Simon and Rinaldi 2000; Simon et al. 2009; others). Schwartz (2004) found in an urbanizing watershed in East Tennessee that 80% of the annual TSS load was from bank erosion, based on AnnAGNPS model results. When fine sediment enters the stream from bank erosion, it becomes embedded in the channel bottom and can be easily remobilized during high flow events.

As noted in the list of sediment sources (on page 93) remobilization of deposited fine sediment is a potential source of turbidity but was not analyzed in the CSUMB 2003 study. It is recommended that remobilization be investigated as part of the Monitoring Plan to estimate the potential lag period after implementation of BMPs to observe water quality improvements in the stream. A suggestion for recognizing remobilization is in the review of the Monitoring Plan. Having a general idea of this lag period provides key information for assessing overall performance of the TMDL Implementation Plan.

Staff Response (SR-21):
The study by Balance Hydrologics (2015) in the Carr Lake area did not include a sediment risk model but the authors of the study noted that the steep banks and bare channels are obvious sources of erosion. This is also evident in their photos. Staff notes that the modeling approaches recommended by the reviewer and the high levels TSS loading from bank erosion found in these studies. The studies noted by the reviewer also provide evidence that remobilization of deposited fine sediment is a potential source of TSS and turbidity. The reviewer's recommendation to investigate remobilization of fine sediment in future TMDL monitoring has been noted. The value of modeling such as based on the Annualized Agricultural Non-Point Source Pollutant Model (AnnAGNPS) for identifying sources of fine sediment will be considered for future projects in this watershed and other watersheds in the region.

The 2003 CSUMB study for the Salinas Valley TDML Project, in addition to the watershed sediment source analysis, included a sediment model, and described on page 92, in the second paragraph. This paragraph is confusing where placed in the introduction to Section 7 on Source Analysis; it could be its own sub-section with additional information/discussion of its results. It appears the sediment model applied the revised universal soil loss equation (RUSLE) to obtain estimates of sediment yields per catchment. The use of RUSLE is a static approach for sediment modeling. It was noted that RUSLE models for catchments predicted greater sediment yields than field measurements. It appears that models were not properly calibrated and/or incorrect C-factors were applied. Not suggested at this time, but for future adaptive management of the TMDL Implementation Plan, use of a dynamic watershed model such as the USDA Soli and Water Assessment Tool (SWAT) model, AnnAGNPS model, or other models (i.e., USEPA BASINS software and models) would improve the source analysis and estimates of sediment yields per watershed conditions. The future use of a dynamic model could be calibrated based on more recent turbidity (TSS) data – it is noted that the 2003 CSUMB Study is now 18 years old.

Staff Response (SR-22):
Staff reviewed the second paragraph of the introduction and revised it. Comments regarding the CSUMB model are addressed in SR-18 and the use of dynamic models is addressed in SR-20.

Other reports, studies, and staff reviews included: the Salinas Reclamation Canal Watershed Assessment, field reconnaissance of pump lift stations, runoff from highway and paved rural roads, the 2015 streambank erosion study by Balance Hydrologics as noted above, cannabis operations, and review of the City of Salinas Stormwater Program (Phase I MS4 NPDES permit No. CA0049981, Order R3-2019-0073). Section 7.7 describes a TMDL turbidity source analysis based on watershed land cover. Similar to the 2003 CSUMB study, this source analysis used monitoring data and applied that date per dominant land cover types (developed, forest/scrub, grassland, and cropland). This analysis focused on assessing the effect of the Salinas urban and Carr Lake areas. It was observed that turbidity levels dropped on the Salinas Reclamation Canal from flows leaving the city limits. Though the turbidity levels dropped, fine sediment sources in urban runoff still do contribute to turbidity as stated in Section 7.8 and Table 32. Per the TMDL turbidity source analysis (Section 7.7), Table 31 summarizes the percentage of land cover and total watershed acreage above the monitoring sites, and the median dry/wet period turbidities. This table does not provide the justification, or linkage between the land cover types to the turbidity measurements. Just the percentage of land cover does not necessarily mean it is related to the measured NTU. For example, hypothetically, one small location contributing sediment to a channel in a classified large area could potentially be the dominant cause for observed downstream turbidity. Overall, this analysis is valuable to better understand the sediment dynamics within the City of Salinas and the Carr Lake area. As noted above, application of a dynamic sediment model would provide more insight to waterbody turbidity within and below the City. Relationships between flow stage and turbidity (Tables 33 and 34) would also be improved with a dynamic sediment model.

Staff Response (SR-23):

Comments regarding the use of a dynamic model are addressed in SR-20. Staff acknowledges the comment that the watershed land cover summary in Table 31 does not on its own provide linkage to turbidity measurements. It is a static model that illustrates the type of land uses in the watershed that are potential sources of turbidity. The TMDL source analysis includes other evidence such as field reconnaissance, edge of agricultural field monitoring, and urban outfall monitoring that link land use to turbidity. A dynamic model could provide beneficial insight but does appear necessary given the magnitude of the turbidity impairments, field level study by CSUMB, and the appearance of degraded channels and bare ground in the Gabilan Creek watershed.

Minor notes: 1) page 102 Table 36 should be Table 31; 2) Figure 29 lacks a legend, and 3) page 105, it should be an automated sampler or a passive sampler but not an automatic passive sampler – state what equipment/device is used.

Staff Response (SR-24):

Comments noted and the report was updated.

Overall, with the level of water quality impairment for turbidity in the Gabilan Creek watershed, the use of all available monitoring data, studies/reports, and reconnaissance, the source analysis is scientifically sound and provides the necessary information to development the TMDL Implementation Plan. Because the TMDL

Implementation Plan extends 20 years with incremental targets, further studies and modeling as suggested above will aid assessing the targets, and BMP performance.

Staff Response (SR-25):
Comments noted that the source analysis is scientifically sound and provides the information necessary for implementation. Recommendations for additional studies and modeling are also noted and will be considered during TMDL implementation.

References Cited by the Reviewer

Simon, A., and M. Rinaldi. 2000. Channel instability in the loess area of the Midwestern United States. *Journal of the America Water Resources Association* 36(1): 133-150.

Simon, A., N. Pollen-Bankhead, V. Mahacek, and E.J. Langendoen. 2009. Quantifying reduction in mass-failure frequency and sediment loads from streambanks using toe protection and other means: Lake Tahoe, United States. *Journal of the America Water Resources Association* 45(1): 170-186.

3.3. TMDLs and Allocations

Turbidity TMDLs meet the WQO for the Central Coast Region and based on the 75th percentile and medians in the watershed because of the episodic nature of fine sediment transport driven by mostly by storm events which skew the statistical analysis. The proposed turbidity TMDLs in NTU metrics for Gabilan Creek waterbodies and year-round and wet/dry seasons are scientifically supported by the comprehensive analyses described in Sections 5 and 7 (Numeric Targets and Source Analysis, respectively), and the Natural Turbidity Technical Report. Allocations per waste loads and load (point source and non-point source loads), and per watershed location (upper and lower) follow standard protocols, and accurately match turbidity sources as listed in Table 38 (page 113). Interim allocations as defined in Section 8.4 for the lower Gabilan Creek watershed based on percentiles from monitoring data, and BPJ for percentile selection are rationale to progress with the implementation plan and reach attainable milestone NTU targets. The margin of safety (MOS) of 2 selected is justified by literature cited in Section 5, and follow USEPA protocols.

Staff Response (SR-26):
Staff acknowledges that the reviewer finds that turbidity TMDLs and allocations meet the turbidity water quality objectives of the Water Quality Control Plan for the Central Coastal Region (Basin Plan) and they are scientifically supported in the TMDL technical report. Additionally, it is noted that the interim allocations along with the implementation plan provide sound rationale for attaining the TMDL milestones.

The sample frequency in generally was suggested as weekly but not less than monthly. Noted above and relative to development of the Monitoring Plan, a statistical power analysis would provide the number of samples (frequency) over a designated period of time in order to detect a change in turbidity, per a defined level of confidence (e.g., 5-

year period, turbidity change to meet TMDL, 95% confidence). The power analysis can be accomplished on a seasonal basis, or year-round. The current monitoring data is sufficient to obtain turbidity sample variance, necessary to conduct the statistical power analysis, though normality must be checked.

Staff Response (SR-27):
As recommended, staff conducted a statistical power analysis to determine the sampling frequency necessary to measure the improvement need reach the TMDL targets within the TMDL attainment schedule and updated the monitoring recommendations accordingly.

3.4. Implementation Strategy

The TMDL Implementation Plan identifies the regulatory and non-regulatory mechanisms that responsible parties will use to meet their TMDL allocations. The Water Quality Control Plan for the Central Coastal Basin (Basin Plan) and statewide policies form the basis for regulatory actions to protect waters of the state in compliance with portions of the state Porter-Cologne Act and the federal Clean Water Act. Nonpoint source dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan Prohibitions of Discharge by participating in the nonpoint source (NPS) pollution control Implementation Programs development and implementation. All NPS pollution control Implementation Programs must meet requirements following five key elements including a description of management practices, implementation and schedule, monitoring, and enforcement (page 122). Table 38 lists the turbidity sources and whether the sources will be regulated per TMDL waste load allocations (WLA, point sources) and load allocations (LA, NPS).

The TMDL Implementation Plan components were cross-referenced with turbidity sources and TMDL allocation type in Table 38. Please see the table below. The review identifies implementation strategies to meet TMDL allocations for most turbidity sources, particularly those associated with existing stormwater programs and regulated by NPDES permittees. Greater clarity in the TMDL technical report is needed for two sources to how they are addressed in the Implementation Plan; they are: 1) low threat discharges, and 2) nurseries and greenhouses.

Staff Response (SR-28):
Staff clarified in the TMDL technical report that nurseries and greenhouses will implement the TMDLs through the either the Irrigated Lands Program or the Cannabis Program depending on crop types. Low threat discharges will be implemented through their permits.

Turbidity Source	Type of Allocation	Implementation Plan
Urban stormwater runoff	WLA	Stormwater NPDES permits, Section 9.3
Construction and industrial stormwater runoff	WLA	Stormwater NPDES permits, Section 9.4

Turbidity Source	Type of Allocation	Implementation Plan
Highway stormwater runoff	WLA	Section 9.8
Low threat discharges	WLA	Not clear, unless it is under Section 9.9 Cannabis Order
Irrigated agriculture/ cropland	LA	Section 9.2
Undeveloped areas and woodlands	LA	Section 9.7
Grazing land	LA	Section 9.7
Wetlands (Streams, lake channel, sloughs, marshes)	LA	Section 9.5 Stormwater Management Plan
Rural roads stormwater runoff	LA	WDR; Prohibition of Discharge. Section 9.1
Channel maintenance	LA	WDR; Prohibition of Discharge. Section 9.1
Pumping (lift stations and sump pumps)	LA	Section 9.6
Nurseries and greenhouses	LA	Not clear, unless it is under Section 9.9 Cannabis Order, or Section 9.1

Land disturbance by various human activities are major contributors to elevated levels of waterbody turbidity from NPS pollution. The TMDL Implementation Plan identifies WDR and NPDES permits. Land disturbances prohibitions are in the Basin Plan, and the Report identities road grading, channel maintenance, and channel dredging as unpermitted activities (page 123). The Basin Plan prohibits these discharges therefore the BMPs identified to minimalize the impacts of sediment entering the waterbodies should be better clarified. The Irrigated Lands Program will be key to meeting the WQO based on the existing source analysis (Section 7), and a permitting process has been established along with required sediment and erosion management plan development and monitoring/recordkeeping. As evidence from the source analysis, BMP for the operation of lift stations and agricultural drainage pumps are also key to meeting the WQO, however this activity remains unpermitted. The LA for this activity is stated it is in Section 8, but should be clarified in Section 9.6 to whether it is the waterbody NTU target or is there an end of pipe NTU limit.

Staff Response (SR-29):

As noted by the reviewer, unpermitted/unregulated/unapproved land disturbance activities associated with grading, channel maintenance, and dredging are subject to the Basin Plan Land disturbance prohibition. Growers are not subject to the prohibition because they are regulated under the Agricultural Order. Additionally, as noted, BMPs for unpermitted activities such as operation of lift stations and agricultural drainage pumps are key to meeting water quality objectives and these activities although unpermitted are subject to enforcement.

The reviewer asks if LA for lift stations are end of pipe NTU limits or a waterbody NTU target. The TMDL LA and WLA are applied to receiving waterbodies and are not end of pipe limits. The LA and WLA are identified for specific waterbodies in Table 40 of the TMDL technical report.

Stormwater discharges are regulated through MS4, Construction/Industrial NPDES permits, and the Caltrans NPDES permit (Sections 9.3, 9.4, and 9.8). The MS4 NPDES permits, City of Salinas Phase I permit, Monterey County Phase II permit, and Caltrans NPDES highway runoff permit will be revised for WLA one year after approval of the turbidity TMDL for the Gabilan Creek watershed, and revisions based to meet the TMDL allocations. For these permittees, a list of WLA attainment programs include 14 tasks, which is comprehensive. One question, does the WLA attainment program include updating city/county ordinances for their stormwater programs? In the WLA attainment program completing a quantifiable numeric analysis is stated in Item #7 (page 126). In the review of the Source Analysis section (Section 7) it was suggested a dynamic watershed model be used to better quantify the fine sediment contributions to waterbodies, and also to assess and prioritize implementation of BMPs in the watershed. Various models were suggested (above), though common for stormwater programs is the use of USEPA Storm Water Management Model (SWMM). A model is valuable to improving planning and management to meet TMDL targets. The Monterey County Regional Stormwater Resources Management Plan may have included a modeling effort but it was not stated in Section 9.5.

Staff Response (SR-30):
The TMDL implementation does not include updating city and county ordinances. Staff notes the value that models recommended by the reviewer have in improving stormwater planning and management and as noted the Monterey County Regional Stormwater Resources Management Plan (Regional Plan) does include modeling. Staff added this information to Section 9.5 and added a recommendation for the regional planning group to consider the developing dynamic models.

The Monterey County Regional Stormwater Resources Management Plan is a comprehensive effort to integrate multiple goals for achieving the WQO, and flood control, environmental, and community benefits. The ten projects support the Plan goals. The use of a watershed model as noted above could be used to track the improvements from the projects, coupled with the proposed Monitoring Plan.

Staff Response (SR-31):
Staff acknowledges that the ten projects proposed in the Regional Plan support the goals of the TMDL Project. Staff acknowledges that a watershed model combined with monitoring could be used to track watershed improvements and a recommendation for modeling was added to the Regional Plan implementation section of the TMDL technical report.

The components of the TMDL Implementation Plan related to rangeland and natural areas (Section 9.7) and Cannabis Order (Section 9.9) are adequate and address sources of turbidity. Rural paved roads in Section 9.8 will meet LA through rules per Prohibition of Discharge (Section 9.1); however effective enforcement will be required for successful reductions in fine sediment sources from this activity.

Staff Response (SR-32):
Comment acknowledged that the implementation sections addressing rangeland areas and cannabis are adequate and address sources of turbidity. Concerns regarding the effective enforcement of the prohibition of discharge are also noted and although these discharges are not regulated under a permit, they can be controlled through enforcement actions.

In summary, the Implementation Plan addresses the major sources of turbidity as noted in the table above. During the review of the monitoring data and the interim targets, if interim targets are not met, adjustments to the Implementation Plan should be conducted as adaptive management. Funding and timelines/milestones for implementation as proposed are achievable.

Staff Response (SR-33):
Comments acknowledged that the implementation plan addresses major sources of turbidity and that adjustments can be made with adaptive management if interim targets are not met. It is also noted that the proposed funding and timelines/milestones are achievable.

3.5. Monitoring Plan

The TMDL monitoring and reporting recommendations are designed to provide feedback and to verify that WQO are achieved in the Gabilan Creek watershed. Additional TMDL monitoring is recommended for verifying compliance with turbidity numeric targets and meeting the Basin Plan WQO. The Monitoring Plan aligns with the Implementation Plan. Some suggestions are summarized below related to the determination of adequate sampling frequency, field methods and instrumentation, data analysis, and watershed modeling support.

Determining the adequate sampling frequency could be justified by completing a statistical power analysis. The outcome of this analysis is the number of samples requested to achieve a level of certainty to detect a change (e.g. 95%) based on a computed variance from existing monitoring data. It was noted in the Natural Turbidity Technical Report, the data collected by the CCAMP may overrepresent sites impacted by irrigated agriculture, thus a power analysis would provide evidence that non-agricultural sites were of sufficient number above a stated level of certainty (e.g., 95%). In Ode et al. (2016), a peer-reviewed published work in *Freshwater Science*, they used classification and a principal components analysis to identify reference or least impaired streams, and included benthic macroinvertebrate data.

Staff Response (SR-34):

The value of a statistical power analysis is acknowledged and has been incorporated in the monitoring design.

Note the reviewer uses the acronym "CCAMP" that stands for Central Coast Ambient Monitoring Program.

In the headwaters, in additional to instream turbidity measurements, monitoring should include bed sediment embeddedness in areas where steelhead spawn. It could also include a measure of redd quality if there are sufficient number of redd sites. This activity may already be conducted by the California Department of Fish and Wildlife.

Staff Response (SR-35):
The recommended biological assessment monitoring in the TMDL Project includes physical habitat data collection including measures of embeddedness, substrate pebble size (for calculations of median pebble size or D50) as well as other measures of reach substrate composition health. Thank you for the additional monitoring recommendations and they will be shared with groups conducting habitat monitoring in the water such as CCAMP and the Central Coast Wetland Group.

To support a watershed modeling effort with data for model calibration and verification, flow data should be collected with turbidity data (at least at selected trend sites). In addition, most water quality models use TSS as a parameter in transport. Therefore, within sub-basins turbidity-TSS relationships need to be developed so that modeled TSS values can be converted to NTU values for TMDL target and load allocations. A watershed model has been mentioned various times in this review because such a model can support improving watershed plans and management, and aid in the selection of additional waterbody monitoring sites. It appears some additional sites have been selected as mentioned on Page 145.

Staff Response (SR-36):
The TMDL monitoring will be built from established watershed monitoring programs that routinely monitor for flow and TSS along with turbidity. The City of Salinas' stormwater monitoring program has already developed correlations between TSS and turbidity. Staff acknowledges that modeling can assist in the identification of monitoring sites but finds it unnecessary for the Gabilan Creek watershed because the existing monitoring network as good coverage in the watershed. Stakeholders may also develop additional monitoring sites based on field experience and monitoring data in lieu of modeling.

In the description of existing monitoring programs, it was noted that CCAMP extensively monitors the watershed on a five-year cycle. This spatial data is valuable and should align with the TMDL Implementation Plan with interim NTU targets and allocations. Several key sites that are monitored on the five-year cycle should be sampled at a greater frequency serving as trends stations. Those sites may have already been identified but needed to mention it because trend stations provide data for temporal analysis, whereas five-year, extensive watershed sampling efforts provide data for spatial analysis. These data should be correlated with biological data collections in order to develop relationships between turbidity and biotic integrity. The three to five frequency for bioassessments as noted should be increased and co-located with trend monitoring stations (or continuous data collection sites as suggested below).

Staff Response (SR-37):
Staff have considered increasing the bioassessment monitoring frequency. However, benthic invertebrate and algal communities are severely impacted by pesticides, ammonia, toxicity, and other stressors and until those factors are abated, increased bioassessment monitoring is not warranted. Once these stressors are abated, staff agree the free the frequency should be increased.

The use of water quality sondes for trend stations would be a valuable addition to the overall monitoring program relying on grab samples at ambient flows and stormflows. Analysis of sonde data has several benefits over grab sampling in that elevated levels of turbidity are generally episodic in nature, and sondes record these episodic events either occurring during stormflows or from human activities (e.g., irrigation pumps, other). Other benefits are ecological and physical associated with quantifying resuspension of fine sediment from the channel bed.

Staff Response (SR-38):
Staff acknowledges the suggestion to deploy continuous monitoring sondes to capture high frequency and continuous measurements of turbidity in ambient flows, as it changes during stormflows and episodic events. A recommendation for continuous logging equipment to be deployed watershed has been included in the TMDL technical report.

An NTU target based on a measure of a suspended sediment "concentration" does not reflect the episodic nature of fine sediment transport, and the impact on different aquatic organisms. Aquatic organisms each differ to their response to elevated levels of suspended sediment based on their functional species traits and biological needs (i.e., trophic structure, spawning, and rearing habitat). A better scientific basis for establishing NTU or TSS target can include NTU or "concentration", duration, and frequency (CDF) of event. Newcombe (2003) generated an impact assessment model for clear water fishes exposed to cloudy water based on dose responses (concentration and duration). Schwartz et al. (2011) related suspended sediment concentrations, duration, and frequencies to fish functional traits, and to geomorphic channel stability with suggestions on designating TMDLs per CDF curves. Woockman (2012) using a methodology developed by Schwartz et al. (2008) developed suspended solids concentration (SSC), duration, and frequency relationships and correlated with Tennessee Macroinvertebrate Indices (TMIs) to assess turbidity ecological impacts. In his study, he used sonde turbidity and stage sensors recorded at 15-minute intervals. Interestingly, Woockman (2012) found that poor TMI scores correlated best with concentration and frequency, in which more frequent events above a concentration threshold appeared to be due to resuspension of fine sediments on the channel bed, and streams located in anthropogenically disturbed watersheds.

Staff Response (SR-39):
During the development of the TMDLs, staff reviewed the work by Newsome and when developing the TMDL technical report, staff considered setting targets based on it. However, due to the extent and magnitude of the turbidity problems in the watershed, staff choose the approach outlined in the TMDL technical report. If the watershed was less impaired, targets based on concentration, duration, and frequency would be appropriate. Additionally, the monitoring data necessary for analysis proposed by Newsome is not available.

References cited by the reviewer in this section are at the end of the review for numeric targets

3.6. Report on Derivation of Natural Turbidity Conditions for Central Coast Streams

The 2020 Technical Project Report "Proposed Methodology to Derive Natural Conditions for Turbidity and Development of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Region" (Natural Turbidity Technical Report) provides a scientific quantification for what constitutes natural conditions for turbidity in waterbodies. Current language in the Water Quality Control Plan for the Central Coast (the Basin Plan) defines NTU exceedances as a percent or value over natural turbidity however "natural turbidity" has not been defined. The Basin Plan allows increases in turbidity from 10 to 20 percent over natural conditions.

In the 2020 Technical Report, three methods were used to scientifically define natural turbidity conditions for waterbodies in the Central Coast Region based on USEPA guidance documents (USEPA, 2000a, 2000b, and 2015). In the USEPA (2000a) document three methods outlined included: 1) identification of least impacted streams for each stream class using best professional judgement (BPJ) or percentile selections of data plotted as frequency distributions; 2) use of predictive relationships (e.g., trophic state classification, models, and biocriteria); and 3) application and/or modification of established nutrient/algae thresholds (e.g., nutrient concentration thresholds or algal limits from published literature). Method 1 was selected utilizing percentile selections and existing turbidity data. Percentile selection was based on the USEPA (2015) document namely the 25th percentile for the general population of streams, and the 75th percentile for reference streams. The USEPA (2015) is not explicit on the determination of these thresholds, however Method 1 is supported by existing data where as Methods 2 and 3 would require additional study and data. Thus Method 1 is the most scientifically sound method to define natural conditions at present. As noted above in the review of the Turbidity TMDL Technical Report, additional monitoring of biotic integrity data co-located with turbidity and flow measurements would provide the data to accomplish Method 2 and/or 3 in the future.

Staff Response (SR-40):
Comment acknowledged that of the three methods recommended by USEPA, the most scientifically sound method for the study was selected. Comment noted that with future biological integrity data along with turbidity and flow measurements there would be enough data for the other analyses. Recommendations for additional data have been incorporated into the TMDL technical report.

The analysis framework applied to determine turbidity natural conditions utilized the USEPA (2015) document. The USEPA (2000b) document provided general support. The framework included stream classification based on geomorphic parameters of slope, drainage area size, and channel substrate, in addition to land cover/use. This classification procedure is similar to the Hydrogeomorphic Approach defined in the TMDL Technical Report for estimating numeric targets. Stream classification functions as a means to determine the spatial and temporal boundaries of natural background criterion, and provides a scientifically sound approach to statistically analysis the data to compute percentiles. Various stream classification systems were reviewed. A classification was used based on three variables: 1) size per the Strahler stream order system; 2) substrate per the Cowardin system codes; and 3) slope also per the Cowardin system codes. From these three variables six classes were determined to be adequate to group turbidity data based on controlling watershed parameters. The number of turbidity sites within each stream class are as follows: 1) head-high-unconsolidated, n= 64; 2) head-low-unconsolidated, n = 112; 3) head-low-vegetated, n = 54; 4) medium-high-unconsolidated, n = 33; 5) medium-low-unconsolidated, n = 78; and 6) medium-low-vegetated, n = 19. Thus, the range of data sites per classes was between 19 and 112, which should be sufficient to generate applicable confidence intervals. Identifying least impacted streams were based on the land cover/use from reclassification of 11 NLCD land cover classes into two: 1) impacts and 2) natural.

Staff Response (SR-41):
Thank you for providing a summary of the framework used to derive natural turbidity conditions for central coast streams. Staff acknowledges that the number of turbidity sites sampled per stream classification should be enough to generate applicable confidence intervals.

Data validation followed Ode et al. (2016), a peer-reviewed published work in *Freshwater Science*, where they used stream classification based on land cover/use and a principal components analysis to identify reference or least impaired streams and included benthic macroinvertebrate data. Thirty-two sites were identified as high-quality, “least impacted” sites. Data validation procedures compared the upper endpoint of proposed NTU criteria to percentiles of 1) impacted streams and 2) least impaired streams; and the lower endpoint of the proposed NTU criteria to percentiles of least impacted streams. This comparison was a logical process for data analysis to assess appropriate numeric NTU targets based on streams classification and season. Data gaps were identified to were monitoring data were absent (Figure 4). Through the overall analyses, a range of NTUs were identified using the USEPA (2015) protocols and stream classifications, though narrowed through their analyses between 0.0 and

5.8, based on policy a single NTU for wet/dry seasons were recommended. NTU values were based on the 75th percentile NTU values of reference streams, and this is what is used for TMDL allocations in the Technical Report for Gabilan Creek watershed. The data analysis supports this policy decision and with the TMDL Implementation Plan and Monitoring Plan water quality in the Gabilan Creek watershed will be improved. These Plans will provide future data to support adaptive watershed management practices.

Staff Response (SR-42):
Comment acknowledged that the data analysis supports the policy decision in the TMDL technical report to select NTU values based on the based on 75th percentile NTU from reference streams.

Abstract - Editorial Comments: 1) Guidance element #1 should also indicate land use in stream classification determination; 2) Table 1 needs a legend for the six stream class types defining head/medium, high/low, and unconsolidated/vegetated.

Staff Response (SR-43):
Thank you for the editorial comments and they were addressed in the TMDL technical report.

4. PEER REVIEW COMMENTS OF ALBERTO BELLIN, PH.D.

Review Date: May 9, 2021

4.1. General Comments

Overall the submitted study is accurate, technically sound, comprehensive and scientifically defensible. My general comments to the three conclusions listed above are the following:

Staff Response (SR-44):
Thank you for your review and your overall comment that the study is accurate, technically sound, comprehensive, and scientifically defensible.

Conclusion 1: Numeric targets have been identified by considering the nuisances to the freshwater ecosystem caused by turbidity from several viewpoints and angles. A first aspect concerns the nuisance to the fish population caused by water turbidity. This analysis was performed by means of a literature review; turbidity levels causing nuisance to fish species (different species are considered for the headwaters and the low streams) were identified and divided by a safety factor fixed at 2. This value may be considered somewhat low, given the uncertainty of ecological and biological response to external stressors. To have a comparative term this safety factor is not dissimilar to those commonly adopted in civil engineering, thereby in a situation where the response of the system to external loads is less uncertain than in biological systems. The second, alternative, methodology to identify proper numeric targets is the statistical analysis of regional data performed either including or excluding the measurement stations within the Gabilan Creek watershed. This analysis is well performed and produces results consistent with the previous analysis, though leading to more restrictive numeric targets.

Furthermore, this analysis responds to the request of stakeholders and has been adopted to set the numeric targets for headwaters. A third approach considered the biological conditions of the sampling sites by assigning a score according to the California Rapid Assessment Method (CRAM), a standardized field level framework for holistically mapping and assessing wetland conditions and stressors. The values produced by this analysis are larger than those obtained with the statistical analysis, but they are of the same order of magnitude and still represent a remarkable reduction of the actual turbidity levels in the lower Gabilan watershed. The decisions taken by the authors of the report in setting the target turbidity values are balanced and reasonable. In particular, they set the most restrictive values (the 75-th percentile of reference headwaters) to the upper Gabilan Creek watershed and larger (i.e. less restrictive) values to the lower watershed. These numeric targets are consistent with values obtained from the literature concerning the nuisances caused by turbidity to the fish population (reduced by a factor of two to take into account that these values are actually causing nuisance to the fish population), and in line with the median of the turbidity in the perennial riverine reference sites. With the objective of facilitating the reader I suggest to anticipate in chapter 3 the information concerning crucial morphological characteristics discussed in chapter 7. For example, the settling occurring at the Carr Lake and its wetland area seems the key mechanism causing the remarkable reduction of turbidity both during dry and wet seasons downstream to the sampling sites 309GAB and 309NAD. I immediately noticed this reduction while reading chapter 3 of the report, but I could find a convincing explanation only later in chapter 7. Similarly, the fact that the investigated rivers are ephemeral with streamflow sustained by irrigation runoff during the dry season is a type of information that will facilitate the reader to construct a reliable conceptual model and in my view it should be presented earlier. In the current structure the first report should be read twice in order to have the entire picture clear in mind.

Staff Response (SR-45):
Staff appreciates the reviewer's summary of target development and acknowledges the comment that the decision's taken in setting the target turbidity values are balanced and reasonable. For example, the reviewer notes that it is appropriate to have more protective targets for headwaters than in the lower watershed and to have seasonal targets.

Staff acknowledges the recommendations to present information on stream flows earlier in the report to provide the reader with a better conceptual understanding of watershed hydrology. Staff updated the TMDL technical report accordingly.

Conclusion 2: This conclusion concerns the identification of the sources. It is based on a study conducted by the California State University Monterey Bay (CSUMB) with the support of the Water Board staff and specific grants as well as analyses conducted by the authors of the reports. The CSUMB study addressed specifically the sources of turbidity in the Salinas area and includes runoff and sediment transport to the Gabilan river from agricultural fields both during stormflow and irrigation (dry) seasons. Concerning the CSUMB study from the description provided in the report I got the impression of a well organized and careful study. However, I cannot comment on the conclusion summarized by the authors at page 93 of the report, not having access to the CSUMB study. However, the independent analysis conducted by the authors of the report under review, namely the comparative analysis of turbidity and land use, as well as a number of direct inspections, provided clear evidence of the type of turbidity sources in the catchments. Therefore, I conclude that the analyses performed and the review of previous studies are in agreement in identifying the major sources of turbidity in the Gabilan Creek watershed.

Staff Response (SR-46):
Comment acknowledged that the TMDL source analysis identifies the major sources of turbidity in the Gabilan Creek watershed.

Conclusion 3: From my understanding the scientific bases of the study are defensible and a good balance is kept between general scientific knowledge about the impact of turbidity on the freshwater ecosystem and local conditions, considering that most of the analyzed rivers are morphologically altered, and some highly altered, due to the intensive agricultural activities conducted in the area. Safety factors are adequately considered in the decisions the authors of the report took for allocating the TMDL.

Staff Response (SR-47):
Comment acknowledge that the reviewer finds the scientific and technical basis of the proposed TMDLs and allocations scientifically defensible and balanced.

4.2. Specific Comments on the Turbidity TMDL

Chapter 1: Introduction
After describing the objectives of the study the report specifies that the impaired water bodies are identified according to the federal Clean Water Act "*as not meeting water quality standards (impaired) for turbidity on the 2014-2016 federal Clean Water Act section 303(d) List of impaired waters (303(d) List*".

Furthermore, in this chapter the beneficial water uses defined by the Basin Plan are introduced. I do not have particular comments on this chapter, which “sets the scene” also in relation to federal regulations

Staff Response (SR-48):
Staff notes that the reviewer has no comments on this section.

Chapter 2:
In this chapter hydrology, geology and impacting factors are introduced. More details on key factors justifying the conceptual model of turbidity in the watershed is needed in my view. For instance, it would be beneficial for the reader to know that the Gabilan watershed is dominated by ephemeral rivers, that stormwater infiltrates at the entrance of Salinas and that in dry season the lower watershed is fed by irrigation water, I assume extracted from groundwater. All these relevant pieces of information become

clear later in the report, hampering the construction of a clear conceptual model since the beginning. I recommend that a section presenting the conceptual model of the watershed is added early in the report.

The role of groundwater is not discussed in the report and I suggest adding a specific section concerning groundwater in the revised report. For instance, I realized late in the report (chapter 7) that the upper watershed streams are losing, nothing is said for the lower watershed, except that in dry season streamflow is sustained by irrigation runoff. Are there any portions of the river in gaining conditions with respect to groundwater? Is groundwater overexploited by irrigation?

These elements are not directly related to the objective of the report, but would help in setting the scene and are part of the conceptual model of the watershed.

Staff Response (SR-50):
Based in part on these comments, staff updated section 1 of the TMDL technical report to include a conceptual model/description of the watershed. In this section, staff describes that streams in the lower Gabilan Creek watershed are gaining and supported by groundwater and that stream flows from the headwaters are ephemeral and they recharge groundwater when entering the alluvial valley.

Chapter 3: Turbidity and Monitoring Data Analysis
This section summarizes the statistical analysis of available turbidity data described more in detail in the second report titled "*Proposed Methodology to Derive Natural Conditions for Turbidity and Development of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Region*". The narrative is clear and seasonality effects on turbidity are well identified and described together with their changes in space and time. As I described in the general comments, without a clear conceptual model of the watershed in mind I had difficulties in interpreting the remarkable reduction of turbidity occurring downstream the monitoring sites 309NAD and 309GAB. Furthermore, it would be useful to add graphs showing the time evolution of turbidity at the following three representative sites: 309GAB, 309NAD and 309ALD. The latter showing a median turbidity much lower than the other two sites both located at the entrance of the city of Salinas. Data referring to the dry period (Table 14) show that the 25-th percentile of the two upstream sites (309GAB and 309NAD) are about twice that of 309ALD, but that the 75-th percentile of 309GAB and 309NAD are about one order of magnitude higher than the latter. This suggests a significant variability of turbidity sources upstream the sites 309GAB and 309NAD also in the dry season when natural sources of turbidity are likely absent, and a remarkable settling within the urban area. The fact that this settling actually occurs in the area of the Carr lake is specified later in chapter 7 when discussing the sources. As I said in the general comment I suggest to anticipate the discussion of this important mechanism in this chapter, or even before in chapter 2 by adding a specific subsection on the conceptual model.

Staff Response (SR-51):

The comment regarding a conceptual model previously addressed in Staff Response (SR-44). Staff acknowledges the reviewer's analysis of the monitoring data from sites 309GAB, 309NAD, and 309ALD and the request for incorporating this more in-depth source analysis in the TMDL technical report. This type of analysis was considered during TMDL development but is at higher level of detail than required for the goals of the section, which include identification of water quality problems and support of TMDL source analysis.

Chapter 4: Development of Turbidity numeric targets
I do not have particular comments in this section, which is well organized and clearly written. The approach followed to identify the numeric targets are well described and lead to consistent results. Table 15 referred in the text is missing.

Staff Response (SR-52):
Staff notes that the reviewer has no specific comments on this section but in general found the target development to be well described, which lead to consistent results.

Chapter 5: Selection of Turbidity Numeric Targets
This section describes how the achievement of the final numerical targets should be monitored in the watershed. The suggested assessment involves weekly sampling at the same monitoring sites used to set the numeric targets, followed by the computation of the 75-th percentile of the measured turbidity in wet and dry seasons and in the entire year (i.e., with reference to all the collected data) to be compared with the selected targets. I did not find in the report (I may have missed it) the extension of the monitoring period, or the minimum number of data to be used for a meaningful comparison.

Staff Response (SR-53):
Staff recommend weekly monitoring but no less than monthly and that based on comments received from others, staff conducted a power analysis to determine the monitoring frequently to detect the desired change/improvement within the TMDL attainment schedule.

Chapter 6: Biologic condition numeric targets
This analysis appears complete and consistent with the available turbidity measurements reported in the previous chapters. All the creeks are highly fragmented and ephemeral.

Staff Response (SR-54):
Comments noted that the analysis for development of biological condition numeric targets appears completed and consistent with available turbidity monitoring data.

Chapter 7: Source analysis
It appears clear here that the lower Gabilan is ephemeral with streamflow generated in the headwaters infiltrating before reaching the turbidity monitoring station 309ALD. This

means that for what concerns turbidity the upper part of the Gabilan Creek should be separated by the lower part, which may be fed by groundwater, in addition to runoff of irrigation water. In this respect data on water discharge in the stream, whether available would help in having a clear picture of the situation.

Staff Response (SR-55):
Staff acknowledges the need for a better description of sources of streamflow and section 2 of the TMDL technical report has been updated with additional information on hydrology. However, existing table 6 and figure 9 in the TMDL technical report provides information on the classification of stream channels including type of streamflow (perennial and non-perennial).

The conclusions of this chapter are relevant and based on a specific study conducted by the California State University Monterey Bay (CSUMB), in which "they monitored both rainfall and irrigation events and measured water applied and the total amount of water and sediment running off the individual fields from individual events". Because specifically conducted at the impacted sites this monitoring activity provides important insights on the origin of the high turbidity observed in the Gabilan Creek and provides directions for achieving the quality targets set in the previous chapters. For a better understanding of the conditions it would help knowing whether the investigated sites are upstream or downstream the monitoring station 309ALD.

Staff Response (SR-56):
Comment noted that that the conclusions in the source analysis section are relevant. As noted by the reviewer, the study by CSUMB provides valuable information on the sources in the watershed. Information on the specific locations of farms monitored by CSUMB was not disclosed in their report. However, the farming methods, management practices, and runoff found in the study are considered representative of areas both upstream of site 309ALD and downstream of it and the City of Salinas.

4.3. Specific Comments on the Report: Proposed Methodology to Derive Natural Conditions for Turbidity andDevelopment of Site-Specific Water Quality Criteria for Turbidity in the CentralCoast Region, technical Project Report

This report is well crafted and organized. It contains technical details on the statistical analysis performed to estimate the natural levels of turbidity, later used in setting the target values. The only suggestion I have here is to add graphs showing the time evolution of turbidity at the most relevant sites within the Gabilan Creek watershed and for comparison similar graphs showing "typical" conditions of headwaters and low waters in a watershed considered similar from a morphological point of view to the Gabilan Creek watershed. Box plots providing a better perspective of the datasets more than the percentiles (25-th, 50-th and 75-th) is a type of information I missed in my reading of the report. In particular, box plots of the observations at the monitoring stations of the Gabilan Creek watershed would be beneficial.

Staff Response (SR-57):
Staff appreciates the review of the second report and acknowledges the finding that it is well crafted and organized. The suggestion for additional time series graphs and box plot graphs will be considered when the report is revised as will graphs comparing sites in the Gabilan Creek watershed to ones with “typical” conditions in the region.

5. REFERENCES USED BY STAFF IN RESPONSES TO REVIEWS

Herbst D.B., R.B. Medhurst, and I.D. Bell. 2014. Benthic Invertebrate and Deposited Sediment TMDL Guidance for the Pajaro River Watershed. Sierra Nevada Aquatic Research Laboratory, University of California, Santa Barbara.

Surface Water Ambient Monitoring Program (SWAMP). 2021. Data and Interpretive Tools, Consolidated Standard Operating Procedures (SOP for Calculating Bioassessment Indices and other Tools for Evaluating Wadeable Stream in California <https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/data_tools.html>