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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
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SCIENTIFIC PEER REVIEW COMMENTS AND STAFF RESPONSE

The following comments address the scientific review of the San Luis Obispo Creek TMDL for Pathogens.

The first reviewer is Patricia Holden of the University of California at Santa Barbara. The scientific review was completed in July of 2004. The reviewer's comments were arranged in groups of general comments, specific comments, and comments to questions posed to avoid duplication. Staff has aggregated and summarized the comments and responses. The resulting reviewer's comments and staff response are provided below.

Comment 1: The reviewer suggested several, minor, non-substantive editorial changes, such as replace the word "pathogens" with the words "fecal coliform."

Staff response: *These changes were made except where the word "pathogens" was retained for consistency with the 303(d) listing of San Luis Obispo Creek for pathogens, i.e., as in the title of the project report.*

Comment 2: There is a general comment that the identified sources, e.g. sewage, livestock, and urban, were treated alike. The concern stems from the fact that human fecal coliform are more closely related to the incidence of human disease, relative to fecal coliform from other animals. Therefore, the reviewer suggests that the general philosophy of the TMDL should be the eradication of the human fecal coliform source.

Staff response: *The appearance that all sources are treated alike stems from the reductions needed to achieve the TMDL. The reductions (shown in Table 8.5 of the TMDL) describe an equal amount of reduction from the various source categories. The reductions, however, are in units of percent of current loading. The current mass loading from the sewage source in San Luis Obispo Creek (Creek) is over twice that of any other source. Therefore, requiring loading from the sewage source to be reduced by 97% implies a far greater mass reduction than the other source categories. In addition, equal reductions of the other source categories are necessary to achieve the numeric target, which is based on an existing Basin Plan objective. Mandating 100% reduction from the sewage source alone will not result in achieving the numeric target. Conversely, mandating 100% reduction of the non-sewage categories alone will not achieve the numeric target. Hence, the allocations reflect the load reductions necessary in all source categories to achieve the TMDL.*

Comment 3: The categories of "urban" and "sewage", as suggested later in the TMDL document, need careful distinction. Page 29 seems to pose another definition of the categories, relative to the staff report. Is the combined sewer overflow (CSO) source not an urban source?

Staff response: *Language was added in Section 4.2 to clarify the distinction between urban and sewage. Sewage refers to human sources only; urban refers to multiple sources of fecal coliform,*

some of which may be from human sources. In the classic sense of the definition of ‘urban’ sources, where the CSO and/or sewer sources are considered an urban source, this statement may be true. However, the human source has been identified in the DNA analysis and placed in the “sewage” category, and since the CSO source is considered a human source in this case, the CSO was also placed in the sewage category.

Comment 4: Ten years for implementation seems like a long time. Is this a potential “moving target” if development and populations, and thus sources, increase over this time frame?

Staff response: *Staff do not use the ten-year target date to account for development, and therefore increases in loading. The majority of the loading is stemming from areas already fully developed. Therefore, increase loading due to further development is not a significant possibility. The ten-year target to achieve the TMDL is based on cost and the difficulty inherent in tracking down the sewage sources. Although the sewage source has been identified in the tunnelized area of the Creek, inflows to the tunnel drain areas beyond the downtown area. If the sewage source is confined to the tunnel area, the first few years implementation may prove successful at reaching the target. If sewage sources originate from areas beyond the downtown area, detection will not be timely, and therefore will require the full ten years.*

Comment 5: The cost (to achieve the TMDL) is attributed to implementation of NPDES stormwater strategies, but in Figure 4.6, sewage and urban sources are shown to be equally high contributors. The majority of spending (see Page 59) is towards public education. Is this because the sewage is primarily from unmaintained laterals?

Staff response: *The cost is an estimate based on estimated costs of implementing Phase II stormwater permits. The cost stated is both staffs’ and implementing parties’ best estimate of the cost to achieve the TMDL. The strategies outlined in the cost estimate will be incurred whether regulated through the NPDES stormwater (regulating stormwater) or the NPDES permit for the wastewater plant (regulating sewage).*

The public education cost is not the leading cost. Consider the cost calculated on a per-capita basis, as described on page 58. The total annual cost for the City of San Luis Obispo is over \$192,000, whereas the public education cost shown in Table 10.2 is \$16,000. The per-capita costs, e.g. program costs, are the leading implementation cost. Table 10.2 is not intended to be a stand-alone illustration showing the cost break down. Rather, the table describes the categories of expenses that are used to estimate the largest costs to implementing parties, as described on page 58. The cost-estimate is an attempt to estimate implementation cost. Actual costs will depend on the success of source reduction efforts early during implementation.

Comment 6: Attachment-C was not included.

Staff response: *Attachment C (CEQA “Functional Equivalent” Report for Basin Plan Amendments) is not required to be scientifically peer reviewed.*

Comment 7: Regarding pages 5 and 6 of the staff report: It might be useful to add a clause referring to the section in Attachment B where the 81 MPN/100 mL was determined; Table-1 allocations should refer back to Attachment B so the reader can readily see how these were calculated.

Staff response: *Although this clause “might be useful,” as the reviewer suggests, the Resolution is meant to be a stand-alone document, articulating the key points of the TMDL to be voted on by the Regional Board. Support for the key points articulated in the Resolution is not to be provided in the Resolution itself.*

NOTE: Some of the following comments refer to specific page numbers of the TMDL document (Attachment B).

Comment 8: Regarding page 3: a map should precede these bar charts so the reader knows the significance of the x-axis values related to sampling stations.

Staff response: Completed by adding language, referring reader to the map.

Comment 9: Regarding page 7: hard to read Figure 2.2. Can this be made lighter? The version reviewed is in black and white and is hard to read text over shading.

Staff response: The public review document will be available in color. Additionally, color copies can be mailed upon request.

Comment 10: Page 8: missing footnote 1.

Staff response: Edited by removing unnecessary footnote.

Comment 11: Page 10: Figure 2.3: can't read this figure. Shading is too similar.

Staff response: Public review document will be in color. Additionally, color copies can be mailed upon request.

Comment 12: Pages 15-16: The section on DNA analyses implies that the tunnel was the sole location for sampling and analysis. But later in the document it is implied that DNA analysis was used to allocate sources from all sites. This needs to be very clear here, otherwise the basis for source allocation is not clear. Add "fecal" to precede "coliform" on page 16.

Staff response: Yes, the tunnel is the sole location used for DNA analysis. Results from the DNA analysis were used to determine sources from the tunnel only, which in turn were used to allocate to the tunnel sources only. The method of allocation section does not imply that DNA results were used for other locations; discussion of the allocation method [Section 8.1] refers to the source analysis section, where it is clear that the DNA analysis is used for the tunnel area, and water quality data used in Stenner Creek. Language was added on pages 16 and 31 to clarify that the DNA analysis was used to determine sources in the tunnel area only. The word "fecal" has been added to coliform on page 16.

Comment 13: Page 18: The second paragraph is confusing. Basically, it seems that the procedure for each sampling site was to 1) use ribotyping fecal coliform DNA to attribute fecal coliform to specific sources, 2) assume constant flow from upstream to downstream (this assumption is necessary if concentrations are additive), 3) subtract upstream from downstream fecal coliform concentration to calculate the change between two sampling points, 4) allocate this change in fecal coliform to fractions coming from specific sources (e.g. human, dog, bird, etc.) which are assigned based on DNA data. Importantly, flow weighting using the "mixing equation" is not performed here because constant flow is assumed. However, it does not appear that this assumption applies to all sampling stations.

Staff response: Language and calculations were added to clarify. The DNA analysis was used to determine fractional contributions by source from the tunnel area only. Upstream/downstream data were used in locations other than the tunnel area. The "mixing equation" is used in some cases, e.g. where downstream flow is not equal to the upstream flow where data was gathered to determine the fractional contribution for a source. Language was added to clarify this point.

Comment 14: Page 20: The worksheets were not included. Do the undisturbed lands have septic systems? Are these sources? The distinction between “urban source” and “sewage entering stormwater conduits” is very murky.

Staff response: The “Worksheet” refers to a worksheet within an MS Excel file that was provided to the reviewer and is part of the administrative record. The “Analysis” worksheet can be seen by scrolling to the right in the Excel file. Language was added in Section 4.2 to clarify; sewage refers to human sources only, urban refers to multiple sources of fecal coliform, some of which may be from human sources. Regarding septic systems in undisturbed areas, the area draining to monitoring sites used for source analysis contain a minimal number of septic systems, relative to the sewer system. In addition, data from undisturbed areas did not provide evidence that septic systems are a significant source.

Comment 15: Chapter 4 is confusing. This is the most important chapter in the document and needs to be more systematic in its approach and presentation. The main confusion originates in the explanation and formula on page 18, and then applying this throughout. Where tributaries are joining or where new flows are entering a system, the fecal coliform mass should be the object in accounting, not concentration. Recommend that this chapter be revised to more clearly explain, on a station-by-station basis, how source assignments were made. Ultimately, the last section for station 10 should clearly show how these sources mix. Again, however, there is also the recommendation that the priority for source reduction be placed on human sources. This would change the allocation of responsibility of the other sources.

Staff response: Language and equations have been added to Chapter 4 to clarify. However, Chapter 4 is not meant to be an exhaustive explanation of the methods used in the source analysis. Staff must weigh the need for detail and brevity. The lay reader must not be entrenched in detail, yet the reader desiring more detail must be accommodated. Chapter 4 therefore outlines the basic approach used for the source analysis, then refers the reader desiring more detail to the spreadsheet model used, with specific reference to calculations at cell locations within the model. Staff have received internal peer review, as well as non-affiliated scientific peer review; no other reviews have requested more detail in Chapter 4. However, staff have added language and calculations to Chapter 4 to clarify the method, and have added references to calculations within the spreadsheet model.

Regarding using mass rather than concentration, calculations are performed to determine mass loading from the various sources as suggested by the reviewer (see spreadsheet model “SOURCE” worksheet). The mass loads are ultimately converted to concentration to help implementing parties gauge success. However, as suggested by the reviewer, the source analysis IS completed in terms of mass loading of the sources. The Basin Plan objective is expressed in concentration, which served as the basis for the TMDL numeric target. As such, monitoring and gauging TMDL success is in units of concentration, which is based on mass.

Comment 16: Chapter 10: It appears that the City has been performing extensive work towards understanding and potentially reducing human sources. This could possibly be mentioned earlier in the text, particularly if the emphasis on source reduction is changed to “human” as recommended here.

Staff response: Staff notes the suggestion that this early implementation “could possibly” be mentioned earlier in the document. Staff, however, have decided to keep discussion of early implementation in the “Existing Efforts” section, as this is where early implementation by other parties are also discussed, and is referred to in the Table of Contents for the reader.

Comment 17: Page 58:an implication of cow source reduction is that human sources will be incurred. Is this an outcome of development?

Staff response: It is possible that the source could switch from livestock to human. The implication results from the assumption that urbanized areas are human sources of fecal coliform. Although this assumption is sometimes true, staff do not have defensible evidence to state that all urbanized areas in the watershed are sources of human fecal coliform. However, the monitoring plan of the TMDL requires sampling downstream of this proposed landuse conversion. Changes in fecal coliform concentration will be noted in the monitoring reports that will follow.

Comment 18: Page 61, Table 11.1: will sampling be flow-synchronized? Wouldn't this be ideal so that the various points can be related to one another? So the period is 3 months and one 30 day interval has to be selected in that 3 months? Are the samples from the water column only? Are they clear only or can they be turbid?

Staff response: Yes. When monitoring and reporting consistent with the TMDL commences, the monitoring days will be synchronized to get a "snapshot" of the fecal coliform concentration in the upper watershed. What staff cannot do is predict when waters will be turbid or clear. However, every effort will be made to have the monitoring days be synchronized.

Comment 19: Appendix B: These calculations help explain the tables in Chapter 4. Can these example calculations be brought into Chapter 4—i.e. either repeated or referred to more extensively?

Staff response: Appendix B contains six pages of example calculations. Staff have considered incorporating these calculations into Chapter 4, but have concluded that the Chapter is more easily read by referring the reader to the Appendix.

NOTE: The following are reviewer's (P. Holden) responses to specific questions posed by Regional Board Staff.

1. A key summary point is articulated in Section 3.4, stating that monitoring site 10.0 is a critical point of compliance. The conclusion made is that if the TMDL is achieved at monitoring point 10.0, that it is reasonable to conclude that the TMDL will be achieved at points upstream and downstream of this point. As such, the TMDL is calculated for this monitoring point. **Is this a reasonable conclusion, given the available data?**

Reviewers response: It seems reasonable, given the degree of dilution that occurs downstream of monitoring point 10.0, that the TMDL efforts be focused at and upstream of station 10.

Staff response: Comment noted.

2. The method used for the source analysis is presented in Section 4.1. One of the objectives of this approach is to derive a relative contribution of coliform for the identified sources. **Is this a reasonable method for deriving a relative contribution by source?**

Reviewer's response: As mentioned in the review comments above, section 4.1 does not convey the inclusion of flow. If flows are entering a stream reach between up and downstream stations, then concentrations are not additive. It is clear that the authors of this document know this, because they carefully accounted for flow and concentration elsewhere. This section, however, was confusing and therefore not convincing.

Staff response: Flow was accounted for where applicable. Although the spreadsheet model shows where flow calculations were incorporated, the text portion of the TMDL in Section 4.1 did not articulate this. Language has been added on page 19 of Section 4.1 to inform the reader that flow has been accounted for.

3. Section 4.3, and its subsections (particularly subsection “Sources from the Tunnel) leads to the conclusion in Section 4.4 that fecal coliform from human sources contribute a significant portion of the observed coliform density. **Is the conclusion, fecal coliform from human sources are a significant portion of the observed coliform density, scientifically justified?**

Reviewer’s response: Given the data and the DNA study at hand, it does not appear that a different conclusion could have been reached in section 4.3. However, the ribotyping method clearly has its flaws. First, culturability of fecal coliform is different from different sources. Therefore, a bias in fecal coliform source due to the initial step of culturing would have been incurred. Second, as pointed out in the peer review request, only a small percentage of isolates are ribotyped. This introduces bias that could be extraordinary. It is strongly recommended that another DNA source tracking method be employed in a few years to determine, using the best technology at that time, if human waste is the majority influence. Certainly, in a few years the human signal may be eliminated. But at the same time technologies for discerning sources will improve and they should be employed to determine if human waste is present.

Staff response: Staff understands that culturability of various fecal coliform organisms exists, resulting in a bias towards organisms that are easily cultured. This fact however, as the reviewer suggests, does not negate the finding that the human source is present and prevalent within the tunnel. The available data, in conjunction with the fact that leaking private sewer laterals have been identified in the tunnel, suggest that the human source is real and significant. Regarding follow-up source monitoring in the proceeding years: the implementing parties will have the opportunity to re-evaluate and report the sources of fecal coliform, as they will engage in monitoring and reporting during the implementation phase. Staff will encourage the implementing parties to utilize improved technologies (as they become available) aimed at discerning sources of fecal coliform.

4. The allocatable portion of the TMDL is a mathematical function of background levels of fecal coliform (Section 8.1, see “Fixed Load”). As such, the background concentration used in allocation calculations is an important factor for the regulated community; the higher the background level, the less allocatable portion of the TMDL. The method used to estimate background levels of fecal coliform is presented in Section 4.2. **Does the method for estimating background concentration of fecal coliform result in a reasonable estimation?**

Reviewer’s response: This question is not clear. Again, culturability by host species is a bias that can influence these results. Also, the simple fact that only 12 percent were typed introduces bias. This background might make sense, but one should be clear that no septic tanks were influencing this number. If they are, then septic systems represent another source that should be addressed.

Staff response: Staff collected samples from areas upstream of the city sewer system. Some private septic systems are present in the upper portions of the watershed. The results of the sampling indicated that no significant source, other than natural occurring fecal coliform, were present; no data spikes were present and increases in concentration occurred during wetter months indicating runoff from natural sources. These data were used to estimate background concentration.

5. The allocations are presented in Chapter Eight. Section 8.1 describes the method used to calculate allocations. The resulting allocations are articulated in Tables 8.1 through 8.3 in section 8.2. **Does the method described for calculating allocations represent a logical approach? If the allocations are met, is the logical conclusion the achievement of the numeric target, and therefore the TMDL?**

Reviewer’s response: As stated in the overall and specific comments, if all fecal coliform were alike this would be a perfectly logical path. The mathematical approach seems logical and correct (using

flow and concentration to calculate load, then flow again to arrive at concentration). But treating all fecal coliform alike, i.e. those from livestock and other non-human sources as equal threats to human health, does not wholly make sense.

Staff response: Staff understands fully the reviewer's concern regarding the potential health risk from the human source. This comment is largely addressed above in the comment pertaining the Chapter-8. Again, the reduction from the human source is nearly 100% during the critical summer season. Similar reductions (in percent of current loading) are necessary from other sources in order to meet the numeric target, which is based on the current Basin Plan objective. Although the reductions, in percent of current loading, are similar for the source categories, the reduction in mass loading from the human source is significantly greater than other sources. Therefore, the fecal coliform sources are not treated alike.

The following are comments by the scientific peer reviewer George Tchobanoglous, Professor Emeritus of Civil and Environmental Engineering at UC Davis. July 2004.

RESPONSES TO SPECIFIC QUESTIONS POSED BY REGIONAL BOARD STAFF

1. Is it reasonable to conclude that if the TMDL is achieved at monitoring point 10.0 that the TMDL will be achieved at points upstream and downstream of this monitoring point.

Reviewer's response: Based on the fecal coliform data presented in Section 3-1, it is reasonable to assume that if the TMDL is met at point 10.0 it would be met downstream of point 10.0. It is not clear that the same statement can be made for the upstream stations, particularly point 10.3. Referring to Figure 3.3 for Jul/Sept' 02, if the results were scaled it would appear that the TMDL could be met at point 10.0, but not at point 10.3 (see also answer to Question 4).

Staff response: The question was misunderstood. Figure 3.3 represents fecal coliform concentration as observed over the sampling period, and not after implementation. The TMDL allocations, and therefore achieving the TMDL, call for meeting the TMDL allocations at 10.0 by meeting numeric targets at sites upstream of site 10.0, including site 10.3. The question could have better been posed to inquire whether it is a reasonable conclusion to state that meeting the TMDL at site 10.0, which implies achieving the targets upstream of site 10.0, would cause downstream waters to also achieve the TMDL. The answer to the question, as stated by the reviewer in the first sentence, is that this is a reasonable conclusion.

2. Is the method used to derive the relative contribution of coliform organisms from identified sources as presented in Section 4.1 reasonable?

Reviewer's response: The method used to derive the relative contributions of coliform organisms from the identified sources is reasonable, as long as the contributions (fecal and total microorganism concentrations and flow rate) of the individual sources can be quantified with acceptable accuracy.

Staff response: Staff utilized a State approved laboratory for analysis of water samples. The State approved laboratory used EPA approved methods to determine fecal coliform concentration.

3. Is the conclusion presented in Section 4.4 that fecal coliform concentrations from human sources are a significant portion of the observed coliform density justified scientifically?

Reviewer's response: Based on the data presented and the methods of analysis employed, the conclusion is justified.

4. Does the method described in Section 8.1 for calculating allocations represent a logical approach? If the allocations are met, is it logical to conclude that the TMDL can be achieved?

Reviewer's response: The method used to calculate the allocations is reasonable based on the assumptions made. However, without additional analyses, it cannot be concluded that the TMDL will be met consistently, as the variability of each source (fecal and total coliform and flow rate measurements) must be considered. A more rigorous analysis, taking into account the variability of the coliform and flow rate data in a probabilistic sense, would be needed to support the conclusion that the TMDL would be met at the specified frequency (see Comments 1 and 2 presented below). However, as more data are gathered, as outlined in the monitoring plan presented in Section 11, it will be possible to perform a statistical analysis and to adjust the TMDL allocations accordingly

Staff response: Staff agree that a more rigorous approach can be taken, e.g. taking into account the variability of fecal coliform and flow, then factoring this into the TMDL and allocations. There are several reasons why this approach does not make sense at this time. The data required to make predictions based on probability is not available. The inherent variability of flow on a seasonal, and even event basis, prohibit such analysis. In addition, even if more data were available, only mass loading and estimations and reductions necessary to achieve the TMDL would potentially change. However, the allocations (as stated in the methodology on page 42, item 6) are converted to concentration, and are not in units of mass. Therefore, the numeric target must be met regardless of mass loading. Finally, as the reviewer states, adjustments can be made to the proposed implementation as results of monitoring and reporting activities are reviewed. Uncertainties in the calculations are also accounted for in the margin of safety.

THE FOLLOWING ARE GENERAL COMMENTS BY THE REVIEWER

The regional board staff has done an excellent job of developing a sampling program that has led to the identification of the critical reach of the San Luis Obispo Creek with respect to achieving the water quality objectives in the Basin Plan, and a methodology for the pathogen TMDL allocations. In this light, the following comments are presented for your consideration to strengthen the report further.

1. Because of the variability in the fecal and total coliform measurements, greater emphasis should be placed on the probabilistic nature of the data. A brief section should be added to the report to document the inherent variability in the MPN measurement technique used to obtain the data, as well as the variability in the observed fecal and total coliform measurements. Seasonal variations could also be discussed. With respect to the measurement of fecal and total coliform organism concentrations, variations in analytical measurements of plus or minus 0.5 to 1.0 log are not uncommon.

Staff response: Similar to the reviewers comment in Q-4 above, staff agree that a more rigorous approach could be taken, i.e., by incorporating a probabilistic approach. In the end, however, the allocations in terms of concentration would be unchanged. However, to alert the reader of the inherent uncertainties of the approach, a brief section has been added to the beginning of the Margin of Safety section.

2. In the analysis of point sources (Section 4.5) it is not clear that leakage from wastewater collection systems should be considered a point source. If multiple leaks were present in different lines, the leakage may manifest itself as a non point source. Correcting a diffuse

source such as a wastewater collection system with multiple points of leakage may be significantly more complex than correcting a point source.

Staff response: It is true that if multiple leaks are present and are diffused throughout the system, that in the generic sense of the term of a non-point source, this source would be considered a non-point source. Staff consider the sewage leakage(s) from the collection system a point source because such leaks are regulated through existing NPDES permits, which are regulating point sources.

3. The total costs for meeting the TMDL, as presented in Section 10.6, do not reflect the time value of money.

Staff response: The cost for achieving the TMDL is an estimate based on estimates provided by implementing parties for conducting management measures. The implementing parties are just now beginning such measures, and can only estimating the projected cost. Adding in the time value of money would be an estimate based on an estimate, the result of which is not necessary at this time to begin the work toward achieving the TMDL.