

**State of California
California Regional Water Quality Control Board, Los Angeles Region**

Peer Review

**Technical Memorandum #3:
*Pathogens in Wastewaters that are in Hydraulic Connection with Beaches
Represent a Source of Impairment for Water Contact Recreation***

By

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October 7, 2009

California Regional Water Quality Control Board
Attn.: Wendy Phillips
Chief, Groundwater Permitting and Landfills Section
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

Re: Peer Review of Technical Memorandum #3 in support of an amendment to the Water Quality Control Plan for Coastal Watersheds of Los Angeles and Ventura Counties to Prohibit On-Site Subsurface Disposal Systems – Malibu Civic Center Area

Dear Mrs. Phillips,

Please find enclosed my review of the Technical Memorandum #3 "*Pathogens in Wastewaters that are in Hydraulic Connection with Beaches Represent a Source of Impairment for Water Contact Recreation*" prepared by Elizabeth Erickson.

The review is providing responses to questions formulated in Attachment 2.

Please feel free to contact me if you have any further questions.

Thank you very much.

Sincerely,



Professor Jörg Drewes

Scientific Review Report of Technical Memorandum #3
*Pathogens in Wastewaters that are in Hydraulic Connection with Beaches Represent a Source of
Impairment for Water Contact Recreation*
by Elizabeth Erickson

a. The interpretation of key literature identifying factors that increase the levels of pathogen indicators and risks to human health at the beach

General:

The reviewer concurs with the interpretation of key literature considering in this Technical Memorandum identifying factors that increase the levels of pathogen indicators and risk to human health. The reviewer also concurs with the selection of enterococcus bacteria, since it is more persistent in water and sediments as compared to coliforms, as a recreational water quality indicator illustrating the presence of human waste at the sites studied. However, the author neglects to state that there are also non-human sources for enterococcus, which could potentially contribute to the concentrations observed in beach samples, although the likelihood for non-human contributions is small in the given settings.

Specifics:

- Table 1: Please clarify what the numbers reported for each site represent? – Are these replicates or discrete measurements at different days? What is the time period of data collection?

b. In particular, the interpretation of Haile et al. (1996 and 1999) epidemiology study and the 1983 EPA marine health criteria for health risk

Haile et al. (1996 and 1999) are representing the same experimental dataset published as a final research report (1996) and a subsequent peer-reviewed journal article (1999). Both Haile et al. studies (1996 and 1999) are reporting findings of epidemiological studies conducted in areas that are highly representative and directly linked to surface water and beaches targeted in this Technical Memorandum, - the Santa Monica Bay, Will Rogers Beach, and the Surfrider Beach. It is noteworthy that Haile et al. (1999) represents a journal article that was subject to a peer review process. The reviewer agrees with the key findings of this study that exposure to water impacted by storm run-off exhibits a higher risk of a broad range of human health symptoms, including both upper respiratory and gastrointestinal effects. The strength of the Haile et al. (1996, 1999) study is the size of the study population, the diversity of the population studied, and the assessment of adverse health outcomes through exposure to coliforms, enterococci, and viruses.

Staff's interpretation of the 1983 EPA marine health criteria for health risk agrees with the general published literature in this field (see review article by Pruess, 1998).

Pruess, A. (1998). Review of epidemiological studies on health effects from exposure to recreational water.

c. The application of correlation coefficients in Figures 7, 8, and 9

Plotting enterococcus occurrence data as frequency graphs is appropriate to illustrate distribution changes over several years for May-October Summer time periods. These graphs illustrate that exceedance of the ocean standard of enterococcus is occurring consistently across the three study sites (MC-2, MC-1, and MC-3). The data also illustrate the gradient of severity in impact and as a consequence health effect outcomes. The classification scheme of either "safe" or "unsafe" based on meeting or failing ocean water standards does not seem to reflect this dynamic.

Correlation coefficients between annual enterococcus frequency distributions are reported for the Surfrider Beach (MC-2) data set only and they demonstrate that the variability of the distribution is small from year-to-year.

d. The conclusion, on pages T3-7 through T3-9, that water quality persistently fails to meet water quality objectives during dry weather at Surfrider Beach, Malibu Colony Beach, Malibu Pier Beach, Carbon Beach, and Marie Canyon

Data presented in this Technical Memorandum provide support that beach water quality in the vicinity of the Malibu Creek watershed repeatedly fails to meet water quality objectives. The data presented would not support that the water quality "persistently" fails to meet the water quality objectives since only a limited data set is presented. For some tables, information is missing regarding the size of the data set considered. For example regarding Table 2, what is the total number of samples collected? Exceedance reported for the Surfrider Beach (2006 and 2007) in Table 2 seems to be based on data collected during six weeks in 2006 only, whereas the 2007 data set represents data collected over a four-month period. Are results presented in Tables 3-5 all data that is available for these sampling locations? At a minimum, a clarification should be provided in the Memorandum.

e. The conclusion that groundwater, contaminated with indicators of pathogens, is a source of impairment to lagoon and beaches

The reviewer agrees with staff's determination of impairment through pathogenic organisms and the conclusion that groundwater in this area is a source of impairment to lagoon and beaches.

Overarching questions:

(a) In reading Tech Memos #3 and #4, are there any additional scientific issues, not described above, that are part of the scientific basis of the proposed rule? If so, please comment with respect to the statute language given above.

Regarding Tech Memo #3, there are not additional scientific issues that need to be addressed.

(b) Taking each of Tech Memo #3 and #4 as a whole, is the conclusion of each tech memo based on sound scientific knowledge, methods, and practices?

Regarding Tech Memo #3, with the exception of comments provided above, the conclusions presented in this Tech Memo are based on sound scientific knowledge, methods, and practices.

State of California
California Regional Water Quality Control Board, Los Angeles Region

Peer Review

Technical Memorandum #4:
*Nitrogen Loads from Wastewater Flowing to Malibu Lagoon are a Significant
Source of Impairment to Aquatic Life*

By

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September 10, 2009

California Regional Water Quality Control Board
Attn.: Wendy Phillips
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Los Angeles, CA 90013

Re: Peer Review of Technical Memorandum #4 in support of an amendment to the Water Quality Control Plan for Coastal Watersheds of Los Angeles and Ventura Counties to Prohibit On-Site Subsurface Disposal Systems – Malibu Civic Center Area

Dear Mrs. Phillips,

Please find enclosed my review of the Technical Memorandum #4 "Nitrogen Loads in Wastewaters flowing to Malibu Lagoon Are a Significant Source of Impairment to Aquatic Life" prepared by Toni Calloway, Orlando Gonzalez, and Dr. C.P. Lai.

The review is providing responses to questions formulated in Attachment 2.

Please feel free to contact me if you have any further questions.

Thank you very much.

Sincerely,



Professor Jörg Drewes

Scientific Review Report of Technical Memorandum #4
*Nitrogen Loads in Wastewaters flowing to Malibu Lagoon Are a Significant Source of
Impairment to Aquatic Life*

by Toni Calloway, P.G, Orlando Gonzalez, and Dr. C.P Lai, P.E.

a. The approach used to compile an inventory of wastewater discharges from OWDSs in the Malibu Civic Center area, which staff estimates to total 255,000 gallons per day.

Wastewater discharges in the Malibu Civic Center area originate from commercial and residential sources. Flow data for commercial sources were available from monitoring reports for facilities permitted by the Regional Water Quality Control Board. Therefore, the flow estimate for commercial sources can be considered to be fairly accurate.

For residential sources, the number of individual residencies was determined using public records and aerial photographs that were used to confirm the number of residencies. This number can be considered as very accurate. Flow data for residential sources was based on the number of bedrooms and bathrooms at each residence, which served as a surrogate for the number of persons living at a given residence. A per capita water consumption of 100 gal/day was assumed referencing Table 2-9 (Metcalf and Eddy 1991). This table provides a range of "typical" water consumptions for individual residencies ranging from 40 to 90 gal/day and person (Metcalf & Eddy 1991). The latest edition of Metcalf and Eddy (2003) suggests a typical per capita water consumption of 74 gal/capita day without water conservation and 51.9 gal/capita day with water conservation. A study conducted by the Awwa Research Foundation on 1,100 households determined a per capita water consumption of 60.5 gpcd (Mayer et al. 1999). These more recent numbers would suggest that the assumption of 100 gal/capita day is too high and considering the national average should be corrected to 60-70 gal/capita day. Assuming 70 gal/capita day would reduce the total residential flow to 88,410 gpd and the total flow to 216,879 gpd.

Mayer, P.W., W.B. DeOreo, E.M. Optiz, J.C. Kiefer, W.Y. Davis, B. Dziegielewski, and J.O. Nelson (1999). *Residential End Uses of Water*, American Water Works Association Research Foundation, Denver, CO, 310 p.

b. The methodology used to calculate loads of nitrogen from wastewaters discharged from OWDSs in the Malibu Civic Center area; specifically, staff's interpretation of published literature and assumptions used to calculate nitrogen loads released from OWDSs for those discharges where real data were not available.

General:

- Using BOD concentrations to estimate total nitrogen concentrations when total nitrogen data is unavailable is in principal a reasonable approach. Where neither end-of-pipe nor septic tank effluent analyses were available, staff based the estimation of total nitrogen on typical total nitrogen concentrations reported in the published literature on domestic wastewater composition. In section i) (Commercial Wastewater), the authors refer to two key sources

(Crites and Tchobanoglous 1998 and Metcalf and Eddy 1991) that have been considered regarding ranges of concentrations in typical untreated domestic wastewater. The authors proposed a TN/BOD ratio of 0.2.

The reviewer notes that these particular sources did not distinguish between water characteristics of single sources and raw sewage collected in a centralized sewer system. The wastewater discharged in the Malibu Civic Center area originates from single sources, which have a different make-up regarding organic matter and nitrogen than raw sewage collected in a centralized system. Thus, more appropriate references should be considered to provide a more accurate representation of single source waste streams. A very useful reference that the authors might want to consider is a recent research report published by the Water Environment Research Foundation (Lowe, K., et al. 2007, *Influent Constituent Characteristics of the Modern Waste Stream from Single Sources: Literature Review. Water Environment Research Foundation (WERF), Alexandria, VA*). Based on a comprehensive literature review of waste streams from single sources, findings of this report suggest the following median concentration for septic tank effluents:

Source	BOD (mg/L)	TN (mg/L N)	TN/BOD ratio
Single source	156	55.4	0.36
Multiple sources	184	46	0.25
Food	561	86.5	0.15
Non-medical	244	84	0.344

These results would suggest that a TN/BOD ratio of 0.3 might be more appropriate for single domestic as well as commercial sources (non-medical) than the ratio of 0.2 considered by the authors.

In addition, the authors considered "typical untreated domestic wastewater". Since in this case, septic tank effluents contribute to groundwater contamination, a water quality leaving the tank rather entering a tank should be considered. While septic tanks achieve little to none nitrogen removal, the EPA Onsite Wastewater Treatment Manual (2002) reports 30 to 50 percent of BOD is removed whereas Lowe et al. (2007) reported 55 percent removal during septic tank treatment. In both cases, BOD changes occurring during septic tank treatment will result in shifting the TN/BOD ratio to higher numbers.

Since this ratio was used in the nitrogen load spreadsheet, that was not available to the reviewer, in cases where no "end-of-pipe" total nitrogen concentrations were available, which percentage was also not available, the reviewer cannot assess whether changing the TN/BOD ratio from 0.2 to 0.3 would have a significant effect.

- p. T4-5, third paragraph. "For commercial dischargers such as small offices where we have no data, we choose a low BOD of 220 mg/L, and estimated the TN to be 40 mg/L."

What is the basis for this estimation? As mentioned above, the authors might want to consider findings reported in Lowe et al. (2007). Findings reported in this study would suggest that the BOD concentration for "small offices" is matching the median concentration of 244 mg/L for non-medical sources, but the total nitrogen concentration is only 50 percent of what was

determined for non-medical sources (i.e., 84 mg/L N). Thus, the release of nitrogen from these sources is potentially significantly underestimated.

- p. T4-5, fourth paragraph, last sentence. What is the basis (reference?) for reducing estimated total nitrogen concentrations depending on soil profile and groundwater separation? Why is credit given to subsurface treatment where no credit is given to BOD during septic tank treatment?

- The estimation of the total commercial flow seems reasonable and supported by actual flow data.

- In section ii) (Residential Wastewater), the underlying assumption to estimate the residential flow is 100 gal/capita day. Please see discussion under a.), but the water consumption based on more recent studies would suggest 60-70 gal/capita day.

The estimation of nitrogen concentrations in domestic wastewater is referencing Metcalf and Eddy (1991) with three values (20, 40 and 85 mg/L) for weak, medium and strong wastewater. In the most recent edition of Metcalf and Eddy (2003) these values were revised to 20, 40 and 70 mg/L N.

The recent study by Lowe et al. (2007) reported a median total nitrogen concentration for residential single sources of 63 mg/L N for raw sewage and 55.4 mg/L N for septic effluent, respectively. These values provide support for the total nitrogen concentration of 60 mg/L for septic tank influent proposed by the Regional Board staff in this memorandum.

Although the staff acknowledged that septic tank systems are limited in their ability to remove nitrogen, which is supported by multiple studies (EPA 2002, Lowe et al. 2007), credit was given to OWDS treatment and the estimated total nitrogen concentration of septic tank effluents in the Malibu Civic Center area was reduced from 60 to 45 mg/L N. The basis for this reduction is weak at best.

- Summary of Total Nitrogen Loading from Commercial and Residential Sites

The estimation of total nitrogen releases from commercial sources could be affected by the used TN/BOD ratio of 0.2, which was suggested to be closer to 0.3. For the residential sources, considering a 70 gal/capita day water consumption and nitrogen concentration of 45 mg/L N, the nitrogen load would have been reduced to 12,118 lbs/year or 33.2 lbs/day. Considering the lower water consumption (70 gpcd) and 60 mg/L N, would reduce the total nitrogen loading from 17,311 lbs/year as stated in the report to 16,157 lbs/year or 44.3 lbs/day. This number is close to the estimate of 47.4 lbs/day provided by the Regional Board staff.

Specifics:

- p. T4-4, first subheading. BOD is defined as "biochemical oxygen demand", not "biological oxygen demand" as stated. Please revise.

- p. T4-5, first paragraph. "...TN/BOD ratio found in the above popular wastewater textbooks." The term "popular" doesn't buy credibility and I'd suggest "peer-reviewed", which represents a

better term. Regardless, the author might want to consider other references (see discussion above) that might be more suitable.

- p. T4-6, last paragraph, third sentence. "Using reported or estimated using wastewater..." Typo, deleted "using".

U.S. EPA (2002). *Onsite Wastewater Treatment Systems Manual*. Report No. 625/R-00/008. U.S. Environmental Protection Agency, Cincinnati, OH.

c. Staff's characterization of groundwater flow regimes in the Malibu Civic Center area into five hydrogeologic sectors, and staff's application of the nitrogen loads (calculated from #2 above) into a 'spreadsheet' model that estimates attenuation of nitrogen loads released from OWDSs and transported to Malibu Lagoon (i.e. to the point of groundwater recharge into the lagoon) for each hydrogeologic sector.

The proposed characterization of groundwater flow regimes into five hydrogeologic sectors seems reasonable and is well supported. The number of residencies/sources in these sectors is well known. The estimated flow of wastewater in each section could potentially be revised considering a lower per capita water consumption (60-70 gpcd) as discussed above. The same holds true for the considered total nitrogen concentrations for individual sources, which could be adjusted from 45 mg/L to 60 mg/L N.

The assumed total nitrogen load reduction factors by "soil treatment" for commercial sites is reasonable. Given that little is known about site specific conditions of residential sites, the assumption that no soil treatment is occurring is appropriate.

d. Staff's use of the updated nitrogen loads released from OWDSs (calculated from #2 above) to adjust (update) estimates of nitrogen transported to Malibu Lagoon (i.e. to the point of groundwater recharge into the lagoon), using a relationship already established by a groundwater flow and transport model (which is already accepted by stakeholders in the community).

Besides the comments provided above regarding flow estimation and nitrogen loading from both commercial and residential sites, the use of updated nitrogen loads released from OWDSs to adjust estimates of nitrogen transported to Malibu Lagoon seems reasonable. The adjustments made in these calculations are appropriate (concentrations might change and discharge volumes, see comments above). The only aspect that is somewhat inconsistent is the assignment of a "Leach Field Reduction". What constitutes a reduction of 10 percent vs. 20 percent? In Sector 3, sites with a soil type "sand, silt & clay" and depth to groundwater of 10 or >10 were assigned reduction credits between 0 and 20 percent!?

Overarching questions:

(a) In reading Tech Memos #3 and #4, are there any additional scientific issues, not described above, that are part of the scientific basis of the proposed rule? If so, please comment with respect to the statute language given above.

Regarding Tech Memo #4, there are not additional scientific issues that need to be addressed.

(b) Taking each of Tech Memo #3 and #4 as a whole, is the conclusion of each tech memo based on sound scientific knowledge, methods, and practices?

Regarding Tech Memo #4, with the exception of comments provided above regarding flow estimation and nitrogen loads, the conclusions presented in this Tech Memo are based on sound scientific knowledge, methods, and practices.

