San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission



525 Golden Gate Avenue, 13th Floor
San Francisco, CA 94102
T 415.554.3155
F 415.554.3161
TTY 415.554.3488



June 30, 2016

Ms. Felicia Marcus, Chair
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100
*Via electronic mail*: commentletters@waterboards.ca.gov

RE: Total Maximum Daily Load for Bacteria at San Francisco Bay Beaches

Dear Ms. Marcus,

The San Francisco Public Utilities Commission (SFPUC) appreciates the opportunity to comment on the San Francisco Bay Basin Plan Amendment (BPA) adopted by Region 2 on April 13, 2016 that establishes a Total Maximum Daily Load (TMDL) and implementation plan for bacteria at impaired San Francisco Bay beaches. Three of the beaches addressed by this TMDL are in San Francisco (City). Consequently, the TMDL has the potential to significantly affect the City. The SFPUC is concerned that the TMDL numeric target and the wasteload allocation (WLA) for urban runoff are likely unattainable due to non-controllable sources. The SFPUC has expressed these concerns in comments to the San Francisco Bay Regional Water Board which are attached herein for your reference.

Below we provide further detailed comments on why establishing a recreational water TMDL based on cultured *Enterococcus* monitoring data is premature given that the underlying indicator is fraught with uncertainties. Despite the long use of enterococci as a human fecal contamination indicator, the efficacy of using the bacteria for this purpose has come under scrutiny in recent years. It is now known that *Enterococcus* concentrations exhibit extreme variability in recreational waters, they occur naturally and grow in the environment, and their presence does not correlate with the presence of human pathogens at beaches with non-point sources of fecal contamination. These revelations introduce uncertainty into the evaluation of *Enterococcus* monitoring data. For example, as demonstrated below, beach managers posting a beach due to elevated enterococci do not know if the bacteria are still present, if they indicate the presence of fecal contamination or are naturally occurring, or if there are any associated human pathogens. In addition, technological advances in microbial source tracking have outpaced regulations. The advent of molecular techniques provides the opportunity to greatly improve monitoring programs by identifying sources (1). Recognizing the inadequacy of current indicators, Boehm and others (1) have stated that "In some situations, [beach] managers find themselves spending valuable resources issuing swimming advisories, establishing TMDLs, and developing implementation strategies to address perceived pollution problems at a beach where no real threat to public health exists to recreational swimmers." And in a study looking at the contributions of

various *Enterococcus* sources, Jiang (2) stated "The results imply that complying with current FIB [fecal indicator bacteria] water criteria places unnecessary burdens on the recreational water manager without necessarily managing the recreational water illness (RWI) rate." Approval of this TMDL is premature without first investigating how much of the offending bacteria are naturally occurring versus anthropogenic and whether or not BMPs are available that could successfully address the problem. The SFPUC requests that the Water Board delay approval of this TMDL until these and related questions can be answered.

**Sources of uncertainty in monitoring of recreational waters for *Enterococcus* bacteria**

*Enterococcus* bacteria are the current indicator of choice for detecting human fecal contamination in marine recreational waters. Epidemiological studies have found, at beaches impacted by point source fecal contamination, that a 30-day average (geometric mean) of *Enterococcus* concentrations correlates with increased risk of gastrointestinal and other illness for persons engaged in water contact recreation (3,4). However, other studies have shown that the correlation of enterococci with gastrointestinal illness breaks down at beaches impacted by non-point sources of fecal contamination in California (5,6) and elsewhere (7,8). It is important to note that enterococci are (usually) not themselves pathogenic and the causative pathogens were not identified in the epidemiological studies[1]. Indeed, as discussed below, the nature of monitoring enterococci in recreational waters for human health risk necessarily involves high levels of uncertainty at multiple levels.

UNCERTAINTY OF INDICATOR CONCENTRATIONS: Concentrations of enterococci bacteria at California beaches are extremely variable. Two samples taken within minutes of each other can have significantly different results, meaning one exceeds the water quality standard and one does not (9). Enterococci concentrations are known to vary by time of day and tidal cycle (10,11). By necessity monitoring programs must rely on a single sample, usually taken in the morning, to represent the condition of the beach for that day even though it is known that condition will change. In fact Boehm (9) has stated that "Policy makers… are cautioned that a single sample of water reveals little about the true water quality at a beach." For example, an analysis of *Enterococcus* monitoring data at Huntington Beach found that even if posting decisions were revised every 10 minutes the error rate could still be as high as 30% (10). Given the extreme variability in concentrations of enterococci and the impracticality of frequent sampling, there is huge uncertainty that the results from a single sample represent the enterococci concentrations encountered by swimmers on that day.

UNCERTAINTY OF SOURCE: Enterococci bacteria have been considered indicators of human fecal contamination because they occur in human guts and are present in human feces. However they also occur in other vertebrate guts and therefore may represent contamination by livestock, pets, and wildlife. The risk of illness from recreating in waters contaminated by non-human feces is largely unknown. One study has shown that the risk of illness from exposure to

[1] A retrospective application of quantitative microbial risk assessment (QMRA) to an epidemiology study performed in sewage-effluent impacted freshwaters of the Great Lakes found norovirus to be the most likely culprit (22).

waters impacted by cattle feces may be similar to the risk from waters impacted by human sources, but the risk to humans from waters impacted by gull, chicken, or pig feces is substantially less (12). Similar studies have not been done for most wildlife or pet species. Standard methods for enumerating enterococci do not identify sources so it is therefore impossible to know the true risk to human health from a single sample with enterococci above a selected threshold.

UNCERTAINTY OF FECAL CONTAMINATION: Some species of enterococci are not enteric at all, but occur naturally and are ubiquitous in the environment associated with plants, soils, and maybe food (13,14). Enterococci can survive and grow in sediment, eel grass, beach wrack, and other environments long after a contamination event (15-20). A study of beach sands at 55 beaches along the California coast found that enterococci were nearly ubiquitous (21). Enterococci in beach sands and eel grass have been shown to contribute to water quality exceedances (15,16,19,20). It is hard to imagine that California beaches were not already inoculated with enterococci by marine mammals and birds prior to the arrival of humans some 10,000 or more years ago. The association of pathogens with these environmental and naturalized enterococci is largely unknown. Furthermore, human associated enterococci are not all fecal, but are also found externally and in bodily fluids urine, abscesses and wounds, the mouth, and the vagina (14). Thus, bather shedding directly at the beach can contribute to water quality exceedances of enterococci (23). There is huge uncertainty that detection of enterococci in recreational waters represents recent fecal contamination.

UNCERTAINTY OF ASSOCIATION WITH HUMAN PATHOGENS: Enterococci are generally not pathogenic themselves, but because they occur in human guts and feces they are associated with human fecal contamination and thus their presence is assumed to indicate the presence of human pathogens. However, enterococci also occur in other animal feces, plus they are not fecal specific because they are also naturally ubiquitous in the environment. Non-fecal, plant and soil associated species of *Enterococcus* can form a substantial percentage of the total enterococci in California beach and urban runoff samples (13). Routine measures of enterococci concentrations do not identify the species or the source, thus there is huge uncertainty that swimmers are exposed to pathogens even when enterococci sample results exceed water quality standards. In fact, in an epidemiology study at a southern California beach impacted by non-point sources of fecal contamination, Colford and others (5) found “No correlation was observed between traditional water quality indicator levels for enterococcus, fecal coliform, or total coliform and the risk of illness. Using diarrhea as an example, there was no notable elevations in risk with enterococcus…“. In addition, Boehm and Sassoubre (24) have stated “There is a striking lack of data to support an association between enterococcal and virus concentrations, or the concentration of pathogens in general, in recreational waters”. Furthermore, in a study in Santa Monica Bay, Noble and Fuhrman (25) found “There was no significant correlation between the presence of enteroviruses and individual standard microbiological indicators of fecal contamination, specifically total coliforms, fecal coliforms, or enterococci”. There is huge uncertainty that detection of enterococci in recreational waters is associated with the presence of human pathogens.

PUBLIC NOTIFICATION IMPERFECT: Because culture methods of identifying and enumerating bacteria take 18 to 24 hours and even polymerase chain reaction (PCR) takes hours, notification to the public is necessarily after the fact and frequently not indicative of current conditions. It is common to take a sample one day, receive the results the next day which indicate elevated bacteria, post the beach and re-sample only to find on the third day that the re-sample results from the second day are low. Thus, the beach was not posted when water quality standards were exceeded (first day) and was posted when water quality standards were not exceeded (second day). Nearly 70% of water quality exceedances in southern California are single-day events even at the most frequently contaminated sites (26). An evaluation of 25 beaches in California found that current beach monitoring practices result in the correct posting of beaches when water quality standards are exceeded only about 30% of the time (27). Because of the necessary delay in public notification due to analysis times there is huge uncertainty that we are providing the public correct information because we are wrong about two-thirds of the time. It is worth pointing out that even widespread adoption of quantitative or digital PCR to shorten analysis time would represent an incremental improvement, not a solution, to this problem[2]. Every beach manager knows that beach users frequently ignore the warnings at posted beaches and go into the water anyway. In fact, at beaches with non-point sources of fecal contamination there is no correlation between traditional water quality indicator levels for *Enterococcus*, fecal coliform, or total coliform and the risk of illness(5). Exposure to indicator measures above the two different California state water quality thresholds, geometric mean and single sample maximum, does not show increased risk of illness (5).

ANALYTICAL UNCERTAINTY: There are also analytical uncertainties associated with measuring *Enterococcus* concentrations. Thoe and others (27) point out that "…although analytically a measurement of 106 MPN/100 mL may not be statistically different from 103 MPN/100 mL at the 95% confidence level, the former will result in a beach posting for ENT [enterococci] and the latter will not". When investigating the relationship between most probable number (MPN) and colony forming unit (CFU) estimates of fecal coliform concentrations, Gronewold & Wolpert (28) found that "…MPN and CFU intra-sample variability does not stem from human error or laboratory procedure variability, but is instead a simple consequence of the probabilistic basis for calculating the MPN". Thus, in addition to multiple levels of uncertainty inherent in the indicator itself, the analytical methods most commonly used to estimate indicator concentrations also add uncertainty.

**New Molecular Approaches**

The uncertainties discussed above result from the use of an imperfect indicator. Development of better indicators may eliminate or reduce some of those uncertainties, but they are unlikely to be fully eliminated until we are monitoring pathogens directly. Rapidly developing molecular technologies have put this possibility within our reach, although there is more work to be done before it can be fully realized. However, some of those technologies (e.g.,

[2]It is also worth mentioning that Nowcast models, which can predict same-day water quality impairment, are currently being tested at some California beaches where they allow public notifications based upon parameters sometimes associated with *Enterococcus* concentrations such as rainfall, tidal condition (ebb/flood, spring/neap), wind direction and/or speed, etc. In many cases the models outperform current practices.

quantitative and digital polymerase chain reaction and molecular microarrays such as the PhyloChip and ViroChip) and methods (e.g., microbial source tracking and quantitative microbial risk assessment) are available now to answer the questions left open by reliance on *Enterococcus* alone. Molecular markers now allow detection and quantification of human and non-human sources of fecal contamination. Species identification methods can determine fecal vs. environmental *Enterococcus* and quantitative microbial risk assessment source-apportionment can determine the contributions of *Enterococcus* from various sources and allow a health-risk based approach to managing beach water quality (2).

**Conclusions**

We are aware that this discussion of uncertainties could be interpreted as an indictment of the current beach monitoring paradigm in general and even some aspects of the epidemiology studies upon which the paradigm is based, but that is not our intent. Rather, our intent is to impress the limitations of bacteria monitoring upon those passionate about water recreation and protecting human health. Understanding the multiple levels of uncertainty inherent in bacteria monitoring can help to develop realistic expectations and prevent over interpretation of data.

Given the limitations of *Enterococcus* as an indicator, the SFPUC requests that the TMDL for Bacteria at San Francisco Bay Beaches not be approved before more investigative work is done. Continued reliance on *Enterococcus* as the basis for implementing a bacteria TMDL at beaches with non-point sources of fecal pollution does not make sense without first bringing the new molecular tools to bear. Source apportionment coupled with microbial source tracking should be a necessary preliminary step to TMDL approval.

Thank you for consideration of these comments. If you have any questions concerning them please contact Amy Chastain, SSIP Regulatory Program Manager, at 415-554-1683.

Sincerely,

Tommy T. Moala
Assistant General Manager
Wastewater Enterprise
San Francisco Public Utilities Commission

NOTES

---


1. Boehm, A.B., N.J. Ashbolt, J.M. Colford, Jr., L.E. Dunbar, L.E. Fleming, M.A. Gold, J.A. Hansel, P.R. Hunter, A.M. Ichida, C.D. McGee, J.A. Soller, and S.B. Weisberg 2009. A sea change ahead for recreational water quality criteria. Journal of Water and Health 7:9-20. (link)
2. Jiang, S. 2016. Evaluation of the dry and wet weather recreational health risks in a semi-enclosed marine embayment in southern California. Presentation to the USEPA Recreational Waetrs Conference, New Orleans, Louisiana, April 14, 2016. (abstract and slides)

3. U. S. Environmental Protection Agency 1986. Ambient water quality criteria for bacteria – 1986. United States Environmental Protection Agency, Office of Water, EPA 440/5-84-002. (link)
4. U.S. Environmental Protection Agency 2012. Recreational water quality criteria. United States Environmental Protection Agency, Office of Water, EPA 820-F-12-058. (link)
5. Colford, J.M., Jr., T.J. Wade, K.C. Schiff, C.C. Wright, J.F. Griffith, S.K. Sandhu, S. Burns, M. Sobsey, G. Lovelace, and S.B. Weisberg 2007. Water quality indicators and the risk of illness at beaches with nonpoint sources of fecal contamination. Epidemiology 18(1):27-35. (link)
6. Arnold, B.F., K.C. Schiff, J.F. Griffith, J.S. Gruber, V. Yau, C.C. Wright, T.J. Wade, S. Burns, J.M. Hayes, C. McGee, M. Gold, Y. Cao, S. B. Weisberg, J. M. Colford, Jr. 2013. Swimmer illness associated with marine water exposure and water quality indicators: impact of widely used assumptions. Epidemiology 24:845-853. (abstract)
7. Calderon, R.L., E.W. Mood, A.P. Dufour 1991. Health effects of swimmers and nonpoint sources of contaminated water. International Journal of Environmental Health Research 1(1):21-31. (abstract)
8. Fleisher, J.M., L.E. Fleming, H.M. Solo-Gabriele, J.K. Kish, C.D. Sinigalliano, L. Plano, S.M. Elmir, J.D. Wang, K. Withum, T. Shibata, M.L. Gidley, A. Abdelzaher, G. He, C. Ortega, X. Zhu, M. Wright, J. Hollenbeck, and L.C. Backer 2010. The BEACHES study: health effects and exposures from non-point source microbial contaminants in subtropical recreational marine waters. International Journal of Epidemiology 39:1291-1298. (link)
9. Boehm, A.B. 2007. Enterococci concentrations in diverse coastal environments exhibit extreme variability. Environmental Science & Technology 41(24):8227-8232. (link)
10. Kim, J.-H. and S.B. Grant 2004. Public mis-notification of coastal water quality: a probabilistic evaluation of posting errors at Huntington Beach, California. Environmental Science & Technology 38(9):2497-2504. (link)
11. Boehm, A.B. and S.B. Weisberg 2005. Tidal forcing of enterococci at marine beaches at fortnightly and semidiurnal frequencies. Environmental Science & Technology 39(15):5575-5583. (abstract)
12. Soller, J.A., M.E. Schoen, T. Bartrand, J.E. Ravenscroft, and N.J. Ashbolt 2010b. Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of faecal contamination. Water Research 44:4674-4691. (link)
13. Ferguson, D.M., J.F. Griffith, C.D. McGee, S.B. Weisberg, and C. Hagedorn 2013. Comparison of *Enterococcus* species diversity in marine water and wastewater using Enterolert and EPA method 1600. Journal of Environmental and Public Health 2013:6 pp. (link)
14. Ferguson, D.M. 2016. Are all enterococci found in the environment, humans, animals, and hospital settings the same bug? Presentation to the SWRCB Central/Northern California Ocean and Bay Water Quality Monitoring Group, Oakland, California, May 12, 2016.
15. Grant, S.B., B.F. Sanders, A.B. Boehm, J.A. Redman, J.H. Kim, R.D. Mrse, A.K. Chu, M. Gouldin, C.D. McGee, N.A. Gardiner, B.H. Jones, J. Svejkovsky, G.V. Leipzig, and A. Brown 2001. Generation of bacteria in a coastal saltwater marsh and its impact on surf zone water quality. Environmental Science & Technology 35(12):2407-2416. (link)
16. Halliday, E., J.F. Griffith, and R.J. Gast 2010. Use of an exogenous plasmid standard and quatitative PCR to monitor spatial and temporal disposition of *Enterococcus* spp. in beach sands. Limnology and Oceanography: Methods 8:146-154. (link)
17. Imamura, G.J., R.S Thompson, A.B. Boehm, and J.A. Jay 2011. Wrack promotes the persistence of fecal indicator bacteria in marine sands and water. FEMS Microbiology Ecology 77(2011):40-49. (link)
18. Russell, T.L., K.M. Yamahara, and A.B. Boehm 2012. Mobilization and transport of naturally occurring enterococci in beach sands subject to transient infiltration of seawater. Environmental Science & Technology 46(11):5988-5996. (abstract)
19. Yamahara, K.M., S.P. Walters, and A.B. Boehm 2009. Growth of enterococci in unaltered, unseeded beach sands subjected to tidal wetting. Applied and Environmental Microbiology 75(6):1517-1524. (link)
20. Ferguson, D.M., S.B. Weisberg, C. Hagedorn, K. De Leon, V. Mofidi, J. Wolfe, M. Zimmerman, and J.A. Jay 2016. *Enterococcus* growth on eelgrass (*Zostera marina*): implications for water quality. FEMS Microbiology Ecology 92(2016):1-7. (abstract)
21. Yamahara, K.M., B.A. Layton, A.E. Santoro, and A.B. Boehm 2007. Beach sands along the California coast are diffuse sources of fecal bacteria to coastal waters. Environmental Science & Technology 41(13):4515-4521. (abstract)
22. Soller, J.A., T. Bartrand, N.J. Ashbolt, J. Ravenscroft, and T.J. Wade 2010a. Estimating the primary etiologic agents in recreational freshwaters impacted by human sources of faecal contamination. Water Research 44:4736-4747. (link)

23. Elmer, S.M., M.E. Wright, A. Abdelzaher, H.M. Solo-Gabriele, L.E. Fleming, G. Miller, M. Rybolowik, M.-T. P. Shih, S.P. Pillai, J.A. Cooper, and E.A. Quaye 2007. Quantitative evaluation of bacteria released by bathers in a marine water. Water Research 41(1):3-10. (link)
24. Boehm, A.B. and L.M. Sassoubre 2014. Enterococci as indicators of environmental fecal contamination, Pp. 71-86 in M.S. Gilmore (Ed.) Enterococci: from commensals to leading causes of drug resistant infections. Massachusetts Eye and Ear Infirmary, Boston. Last updated 2014 Feb 24. (link)
25. Noble, R.T. and J.A. Fuhrman 2001. Enteroviruses detected by reverse transcriptase polymerase chain reaction from the coastal waters of Santa Monica Bay, California: low correlation to bacterial indicator levels. Hydrobiologia 460(1):175-184. (abstract)
26. Leecaster, M.K. and S.B. Weisberg 2001. Effect of sampling frequency on shoreline microbiology assessments. Marine Pollution Bulletin 42(11):1150-1154. (abstract)
27. Thoe, W., M. Gold, A. Griesbach, M. Grimmer, M.L. Taggart, and A.B. Boehm 2014. Sunny with a chance of gastroenteritis: predicting swimmer risk at California beaches. Environmental Science & Technology 49(1):423-431. (abstract)
28. Gronewold, A.D. and R.L. Wolpert 2008. Modeling the relationship between most probable number (MPN) and colony forming unit (CFU) estimates of fecal coliform concentration. Water Research 42(13):3327-3334. (abstract)

ATTACHMENT

Comments submitted to the San Francisco Bay Regional Water Quality Control Board

February 29, 2016

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

525 Golden Gate Avenue, 13th Floor
San Francisco, CA 94102
T 415.554.3155
F 415.554.3161
TTY 415.554.3488

February 29, 2016

Dr. Terry Young, Chair
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612
*Via electronic mail*: johara@waterboards.ca.gov

RE: Total Maximum Daily Load for Bacteria at San Francisco Bay Beaches, Draft Staff Report for Proposed Basin Plan Amendment

Dear Dr. Young,

The San Francisco Public Utilities Commission (SFPUC) appreciates the opportunity to comment on the draft Basin Plan Amendment (BPA) Establishing a Total Maximum Daily Load (TMDL) and Implementation Plan for Bacteria at Impaired San Francisco Bay Beaches. We also thank staff for keeping us regularly informed of the TMDL status, and for their efforts to engage and solicit input from many stakeholders.

Three of the six beaches addressed by this TMDL are in San Francisco. Consequently, it has the potential to have significant implications for the City. The SFPUC is very much concerned that the TMDL numeric target and the wasteload allocation (WLA) for urban runoff are likely unattainable due to non-controllable sources. Without a defined path to identifying the contribution from non-human sources, or clearly outlining the limits of stormwater BMPs, this TMDL could result in the expenditure of significant resources without producing measureable water quality benefits.

The SFPUC requests that the Regional Board postpone adoption of this TMDL until an approach for identifying and addressing natural or background sources in the Bay is developed. In the interim, we support moving forward with implementation of cost-effective measures to identify anthropogenic sources, continued beach monitoring, and development and implementation of a regional source identification plan to better characterize sources of fecal indicator bacteria (FIB) and target future implementation measures. Proceeding with implementation of these measures without a TMDL will ensure that progress is made in addressing fecal indicator bacteria exceedances, but will prevent the need for future Basin Plan amendments if non-controllable sources are identified as significant contributors to impairment.

This approach may also help harmonize this effort with the State Water Board's anticipated adoption of statewide water quality objectives for bacteria. Our understanding is that the State Water Board expects to adopt objectives in 2016 and may include implementation guidance on addressing natural sources, mixing zones, and even seasonal modifications to the recreational beneficial use. These and other

potential measures should be assessed for use in this TMDL and incorporated where appropriate. Our specific concerns and requests are described in more detail below.

**1. The BPA should more specifically address environmental sources of enterococcus.**

Although the United States Environmental Protection Agency (USEPA) recommends the use of enterococcus as an indicator of marine water quality, it is an imperfect indicator. Not all enterococcus are indicators of fecal contamination because not all enterococcus are specific to vertebrate intestinal tracts. For example, multiple studies have identified that plant-associated species of enterococcus can be the most prevalent enterococcus in beach samples.[1] One 2006/2007 enterococcus speciation study conducted by Orange County at six ocean sites found that 42 percent of enterococcus species identified were plant-associated. Other studies have found enterococcus in storm drains or seawrack.[2] Even if enterococcus in receiving waters are of fecal origin, the current EPA approved culture-based method does not distinguish between human and other animal sources and the risk to humans from exposure to pathogens associated with animal feces is not well understood or characterized.

Recent monitoring conducted by the SFPUC indicates that non-human sources of enterococcus may be significantly contributing to the observed frequency of water quality objective exceedances at some locations. In 2014 the SFPUC analyzed shoreline samples collected as part of the SFPUC's routine beach monitoring program for enterococcus using the culture-based EPA Method 1609.1, and for the presence of the human-associated HF183 Taqman marker[3] using quantitative polymerase chain reaction (qPCR). The results of this study for the beaches subject to this TMDL are summarized in an attachment to these comments.

The results show that, at the Candlestick beaches, cultured enterococcus concentrations were often elevated even when HF183 results were below the method level of quantification. For example, 38 out of 88 samples (43 percent) collected at Sunnydale Cove exceeded 104 MPN/100 mL. 68 of those 88 samples were also analyzed for the presence of HF183. Of those 68 samples, only 7 (10 percent) had levels of HF183 above the method level of quantification. In other words, the majority of elevated levels at these beaches may not be from humans or vertebrate animals. As currently

---

[1] *See., e.g.*, Ferguson, D., *Comparison of Enterococcus Species Diversity in Marine Water and Wastewater Using Enterolert and EPA Method 1600*, J. Environ. & Public Health; 2013(10):848049 (June 2013). Byappanahallia, M., *Enterococci in the Environment*, Microbiol Mol Biol Rev.; 76(4): 685–706 (December 2012). Moore, D., *Does Enterococcus Indicate Fecal Contamination? Presence of Plant Presence of Plant-Associated Enterococcus in Southern California Recreational Waters*, Orange County Presentation (October 24, 2007).

[2] *See, e.g.*, Derry, C., *Regrowth of enterococci indicator in an open recycled-water impoundment*; Sci Total Environ.; 468-469:63-7 (Jan 2014); Ferguson, D., *Natural Sources and Regrowth of Enterococcus in Coastal Environments*, Southern California Coastal Research Project presentation.

[3] The HF183 Taqman marker is the recommended starting point for detecting human fecal material because it provides the best combination of sensitivity and specificity. However, it has been shown to occasionally detect with chicken or dog feces. The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches, Southern California Coastal Research Project, Technical Report 804 (December 2013). The SFPUC is investigating conducting similar studies with HumM2, less sensitive but more specific marker.

structured, the process for using this type of information to inform management decisions is unclear.

In the past decade, technological advances in detecting microorganisms have outpaced regulations. The ability to identify sources of enterococcus – environmental, non-human fecal, and plant-associated species – has further highlighted the limitations of relying on FIB for human health protection. Considering that high enterococcus concentrations may be caused by non-human sources, we are especially concerned that the TMDL target may be unattainable even if all human sources are controlled. Adoption of this TMDL is premature without further investigating and identifying the sources and relative contributions of enterococcus at the impaired beaches.

The draft BPA notes that environmental sources may be contributing to water quality objective exceedances,[4] but places the onus on stakeholders undertake "adaptive implementation at beaches where numeric targets are not met after fully addressing anthropogenic and controllable sources."[5] This implies that the City will be required to address the non-anthropogenic sources using some "adaptive implementation" approaches. It is unclear, however, how stakeholders could demonstrate that all anthropogenic sources are being controlled or what quantity and type of data would be needed to demonstrate that non-controllable sources of enterococcus (e.g., plant or wildlife) are causing or contributing to impairment, even assuming the City could be deemed responsible for those sources. As currently structured, the TMDL will require stakeholders to meet performance targets that very well may be unachievable due to natural sources. This problem is compounded by the likelihood that the TMDL targets cannot be adjusted at a later date because of concerns over "backsliding" or perceived health risk.

The SFPUC requests that the Regional Board delay adopting this BPA until more data can be collected to better ascertain the relative contribution of non-human sources of enterococcus and to develop a natural source exclusion approach, if a TMDL is still warranted. Adopting the BPA without recognizing the likely contribution of uncontrollable sources of enterococcus is likely to result in the need for yet another BPA amendment in the future and creates uncertainty about the level of effort stakeholders must invest in both monitoring and in management actions.

The San Francisco Bay Regional Monitoring Program for Water Quality (RMP) has a long history of providing a forum for the Regional Board, scientists and dischargers to collaboratively identify, prioritize and fund studies to improve management of San Francisco Bay. Development and implementation of a source identification plan to inform this BPA should take place as part of the RMP. This will help ensure that all stakeholders actively support the generation of data and that source identification efforts will be consistent across all San Francisco Bay beaches. We recognize that RMP's budget for pilot and special studies is currently over-subscribed, and would commit to identifying additional funding from stakeholders and other sources to ensure that studies to support this TMDL proceed on an appropriate schedule.

[4] Draft Staff Report for Proposed Basin Plan Amendment at 40.

[5] Draft Staff Report for Proposed Basin Plan Amendment at 65.

**2. Wasteload allocations for urban stormwater are unnecessarily stringent and unattainable.**

The draft BPA's wasteload allocation (WLA) for urban stormwater is the same as the targets for the TMDL: no more than 10 percent of samples may exceed 104 MPN/100 mL and the geometric mean cannot exceed 35 MPN/100 mL. Fecal indicator bacteria are not conservative pollutants – their concentrations decline with time due to transport, mixing and dilution, predation, and die-off. It is inappropriate to essentially require that urban stormwater discharges comply with numeric water quality objectives without taking into account these factors.

Even though the BPA states that numeric effluent limitations will not be incorporated into municipal separate storm sewer (MS4) permits, it is unclear whether this BPA can constrain future permitting actions. Notably, end-of-pipe monitoring (outfall) for stormwater is now being required in some municipal separate stormwater (MS4) permits, and even this region's Phase I MS4 permit has been appealed to the State Water Board on the grounds, inter alia, that it fails to require wet weather or end-of-pipe monitoring sufficient to determine compliance. Additionally, while the BPA does not currently require end-of-pipe monitoring, such monitoring may be helpful to better characterize sources of loading to a particular beach. If exceedances of the numeric water quality objective are detected as part of a source identification effort, these data could be used in future compliance determinations, regardless of this Regional Board's intent and whether the exceedance is attributable to anthropogenic sources.

As recognized in the draft BPA, a number of studies have confirmed that fecal indicator bacteria are typically found in elevated concentrations in urban stormwater runoff.[6] The non-structural best management practices available to reduce bacteria in urban runoff are relatively limited, and consist mainly of source control measures such as street cleaning and pet waste control programs, which are already implemented to some degree at San Francisco beaches. We are currently unaware of any instance in which enterococcus in stormwater has been reduced to concentrations below the draft BPA's WLA through implementation of non-structural BMPs. Structural BMPs are also proving unable to consistently reduce enterococcus levels to water contact standards[7]. While this is likely partly a function of the limitations of enterococcus as an indicator of fecal contamination, it is also likely due to the challenges in controlling diffuse and ubiquitous sources of pollution. Structural BMPs, such as chemical or ultraviolet disinfection, have the potential to reduce concentrations to below the WLA. Such measures, however, would likely have substantial environmental and financial costs, and would be exceedingly challenging to deploy across many stormwater outfalls and operate on a standby basis. The SFPUC is concerned that the stringent WLA for urban stormwater may result in requirements to implement structural BMPs which are not feasible and without a cost/benefit analysis.

[6] Draft Staff Report for Proposed Basin Plan Amendment at 43.

[7] *See* Clary, J., *Fecal Indicator Bacteria Reduction in Urban Runoff*, Forester Daily News (Feb 2016).

Finally, the SFPUC requests modifications to the Source Assessment section related to Candlestick Point Beaches.[8] The Candlestick area is part of the larger Hunters Point Shipyard and Candlestick redevelopment area that comprises over 700 acres of waterfront land along San Francisco's southeastern shores. These projects are being designed to provide over 10,500 residential units and over 300 acres of new waterfront parks.[9] For various reasons, including the goal of not increasing the volume of combined sewer discharges, these areas will consist of separate storm and sanitary sewers.

The draft BPA states that "stormwater controls…must be incorporated into the new design(s) and construction as the property is redeveloped, with the goal of eliminating or minimizing urban runoff flows to the Candlestick Recreation Area shoreline," and that "[a]ny new development of these parcels should be designed to eliminate or minimize runoff to the Candlestick Recreation Area shoreline."[10] These sentences should be deleted from the draft BPA. All redevelopments in the separate storm sewered area of San Francisco are required to capture and treat the rainfall from a 0.75 inch storm, with a preference towards approaches, like rainwater harvesting, that retain stormwater. Accordingly, all private parcels and the future public right of way will be developed to comply with San Francisco's Stormwater Management Ordinance. Additionally, in the absence of a source assessment, it is premature to speculate about the causes of exceedances at the Candlestick beaches or the appropriate control measures.

### 3. Economic analysis pursuant to §13241 is required.

As articulated in the previous comment, implementation of the available non-structural best management practices do not generally reduce the elevated bacteria levels typically found in urban stormwater. Accordingly, the SFPUC is concerned that the stringent WLA may result in requirements to implement costly structural BMPs which would be exceedingly challenging to deploy and maintain, with limited water quality benefit.

Water Code §13241 requires a Water Board to take economic considerations into account when establishing objectives. This TMDL takes a general receiving water objective and redefines it as an objective that applies to end-of-pipe, without any dilution or consideration of attenuation. This redefinition of the objective requires the §13241 cost/benefit analysis. An economic analysis for this TMDL is particularly critical because of the likelihood that significant public expenditures will be needed and the required measures may have only very limited impact on water quality due to the natural sources of bacterial at the beaches. Benefits would likely need to be assessed in terms of beach user-days.

---

[8] Draft Staff Report for Proposed Basin Plan Amendment at 48.

[9] http://sfocii.org/overview

[10] Draft Staff Report for Proposed Basin Plan Amendment at 49.

**4. The TMDL is not self-implementing.**

All of the implementation plan tables include a footnote to the column titled "Completion Timeframe." This footnote states that the timeframe for completing the implementation actions begins on the effective date of the BPA.[11] TMDLs are not self-implementing, but must be incorporated into permits or other regulatory mechanisms. This footnote should be deleted and the Regional Board should continue to engage stakeholders in developing a logical and practical strategy for implementation. For example, the implementation plan for Sanitary Sewer Collection Systems requires submittal of an "enhanced Sewer System Management Plan that prioritizes sewer system inspections and repairs in areas within ¼ mile of [the impaired] beach."[12] Most of the SFPUC's pipes that are within this area are part of the SFPUC's combined sewer system and not subject to the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems' requirement to develop these plans.

The following comments are made in the event that the TMDL proceeds forward, despite previous comments.

**5. The sewer system inspection requirement should be limited to sewer mains.**

The TMDL should require inspection and repairs of sewer mains only. The City's large transport/storage (T/S) structures and force mains should be excluded. T/S structures should be excluded from the inspection requirement because inspection requires confined space entry and the technologies – such as closed circuit television and Electroscan – available for inspecting sewer mains have limited utility for inspecting T/S structures. Additionally, because they are designed to store very large volumes of stormwater, T/S structures typically contain very low volumes of dry weather sanitary flows, making exfiltration from these structures unlikely. Force mains similarly present inspection challenges in that they must be taken out of service to inspect, which may not be feasible if a particular force main does not have redundancy.

**6. The timeframe for sewer system repairs should be flexible.**

The SFPU's Collection System Division has estimated the length of sewer mains affected by the TMDL inspection provisions. We anticipate being able to complete these inspections within the three years specified by the draft TMDL without significantly disrupting our current condition-based asset preventative maintenance program. It is possible, however, that any needed repairs or replacements cannot be completed within three years. The schedule for repairs and replacements would need to be driven by the results of the inspections, other condition-based priorities in the collection system, and factors outside of the SFPUC's control such as the City's moratorium on disturbing newly paved roads for five years. The BPA should be revised to allow the collection system owner to propose a schedule for identified repairs based on feasibility and other priorities.

---

[11] Draft Staff Report for Proposed Basin Plan Amendment at 80.

[12] *See* Draft Staff Report for Proposed Basin Plan Amendment at 81.

7. **The BPA should clarify requirement to inspect and repair pipes within a quarter mile of a beach.**

   The requirement to inspect all sanitary sewer pipes within a quarter mile of the affected beaches needs to be better delineated. It is unclear whether the requirement applies to all pipes within a quarter mile of the property line of the beach, to all pipes within a quarter mile of the listed sampling location, or to some other measurement. For smaller beaches, such as Aquatic Park, it may be appropriate to require inspections within a quarter mile of the property line. For larger beaches where only one sampling station is driving impairment, such as Crissy Field, some other demarcation may be more appropriate.

8. **The requirement to implement a private lateral replacement program should be deleted.**

   Implementing a city-wide private sewer lateral program in San Francisco would require Board of Supervisors approval and a substantial investment of resources to develop and manage certification, inspection and enforcement programs. The benefit to water quality of a city-wide private sewer lateral program would be small or none. The majority of San Francisco's estimated 195,000 private sewer laterals are located in the combined sewer system and a quite a distance from the shoreline, and therefore, are not likely to affect water quality. Moreover, the SFPUC has existing authority to compel repair or replacement of a private sewer lateral so, if laterals were identified as contributing to impairment, the SFPUC would take targeted actions against the owners of the properties associated with those laterals.

Sincerely,

Tommy T. Moala
Assistant General Manager
Wastewater Enterprise
San Francisco Public Utilities Commission