APPENDIX 3

PEER REVIEW COMMENTS AND RESPONSES

The technical portions of the proposed *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan) amendment to add implementation provisions for indicator bacteria water quality objectives to account for loading from natural uncontrollable sources were peer reviewed by Professor Patricia Holden of the Donald Bren School of Environmental Science & Management, University of California, Santa Barbara, and by Professor Peter Strom of the School of Environmental and Biological Sciences, Rutgers University. External scientific peer review of the technical portion of a proposed rule (in this case, the proposed Basin Plan amendment) is mandated by Health and Safety Code section 57004. This statute states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. The Regional Water Quality Control Board, San Diego Region (San Diego Water Board) provided the peer reviewers with the draft Technical Report, the draft Basin Plan amendment, and a list of key issues for their consideration. The list of key issues with discussion provided to the peer reviewers is given below in the first section of this appendix. The peer reviewers' comments and the San Diego Water Board's responses follow in subsequent sections.

Issues for Peer Review

1. **Does the technical report adequately demonstrate that natural uncontrollable sources of indicator bacteria are causing exceedances of indicator bacteria water quality objectives?**

   The Basin Plan amendment is being proposed because it is believed that natural uncontrollable sources of bacteria are causing exceedances of indicator bacteria water quality objectives. The San Diego Water Board does not intend to hold municipal storm water and nonpoint source dischargers responsible for indicator bacteria from such sources. However, for the San Diego Water Board to take this position, it should adequately demonstrate that natural uncontrollable sources of indicator bacteria are actually causing exceedances of indicator bacteria water quality objectives. In the Technical Report, the San Diego Water Board assesses data from multiple beaches in southern California to support its position.

2. **Does the technical report adequately support the limitations placed on the use of the Reference System and Antidegradation Approach (RSAA) and Natural Sources Exclusion Approach (NSEA)?**

   Use of the RSAA and NSEA is subject to certain limitations. These limitations are based on the applicability of the RSAA or NSEA to the various types of indicator bacteria water quality objectives, and how those water quality objectives are used within the context of Total Maximum Daily Loads (TMDLs). The limitations placed

on the use of the RSAA, as well as the rationale for the limitations, should be clearly stated in the Technical Report.

3. **Does the Technical Report clearly describe the actions that must be completed to justify the use of the RSAA or NSEA in developing and implementing a bacteria TMDL?**

   Prior to the implementation of the RSAA or NSEA, multiple steps must be completed, by both the dischargers and the San Diego Water Board. These steps are principally associated with recalculation of TMDLs incorporating the RSAA or NSEA. The Technical Report should clearly describe the actions that must be completed.

Overarching Questions

Reviewers were not limited to addressing only the specific issues presented above, and were asked to contemplate the following "big picture" questions.

(a) In reading the staff technical reports and proposed implementation language, are there any additional scientific issues that are part of the scientific basis of the proposed rule (the Basin Plan amendment) not described above? If so, please comment with respect to the statute language given above.

(b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers were asked to note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

Comments from Professor Holden

1. **Does the technical report adequately demonstrate that natural uncontrollable sources of indicator bacteria are causing exceedances of indicator bacteria water quality objectives?**

Comment 1: In the opinion of this reviewer, the technical report does not adequately demonstrate that natural uncontrollable sources of indicator bacteria are causing exceedances of indicator bacteria water quality objectives. Table 1 (page 7, Attachment 4) provides single sample exceedances during wet weather at 4 beaches that are at the termini of reportedly "undeveloped" watersheds. However, high values for fecal indicator bacteria (FIB) are nearly always reported in surface water—including in coastal marine waters---after a major rain event has discharged rainfall runoff into coastal creeks. While FIB in surface waters during wet weather may include organisms that are

soil-borne or even non-target, the data in Table 1 only support that there are exceedances of state standards for those times when those samples were acquired.

Response: The Technical Report relies upon the same method to identify exceedances of water quality standards at reference beaches as is used at non-references beaches. Since the method in which the state determines a beach's impairment status for a week or day is based on one sample, the same method is used to determine the conditions of a reference beach. The four beaches identified in Table 1 were chosen for study based on the low levels of development in the watersheds discharging to the beaches. Less than three percent of each of the watersheds studied was developed. The low level of human development in the watersheds greatly decreases the likelihood of significant contributions of indicator bacteria from human sources. To further ensure that human sources were not contributing significant levels of indicator bacteria to the beaches during the studies, samples collected at the beaches were also concurrently analyzed for human enterovirus, a reliable marker for human input of fecal contamination. The virus was only detected for a very small number of sampling events. All data from these sampling events were excluded from the subsequent data analysis from which reference system exceedance frequencies were derived (Griffith, J.F., et al., 2006). As such, the data used in the technical report likely did not include indicator bacteria from human sources.

Comment 2: The sources are not identified and thus whether they are controllable or not is unknown. One would have to first identify the sources then determine if they are "controllable".

Response: As discussed in response to Comment 1, the indicator bacteria at the beaches studied are expected to be from natural sources, as opposed to human sources. Control of indicator bacteria from natural sources is costly and undesirable. As the Technical Report points out, control of indicator bacteria from natural sources is likely to be prohibitively costly due to the size of the loads and the diffuse nature of the sources. Likewise, control of indicator bacteria from natural sources could cause environmental harm by altering aquatic life functions and impacting habitat during construction of treatment works. For these reasons, natural sources of indicator bacteria are identified as being "uncontrollable" in the technical report.

Comment 3: Similarly, in developed watersheds it is also often found that high FIB levels occur after storms. Yet even if the levels have increased by some introduction of soil-borne or sedimentary FIB, the sources overall will be different from the undeveloped watersheds. Analysis of FIB obscures those differing origins, but origins are important to consider when trying to extrapolate FIB data to the consideration of human health protection. In other words, it is very likely that the high values in developed watersheds following rain events are also, similarly to undeveloped watersheds, partly from soil and sediments (i.e. not waste associated). However, the sources are also likely to differ

between developed and undeveloped watersheds and therefore FIB should not be assumed to be equivalent and exchangeable.

Response: Both the RSAA and NSEA require control of anthropogenic sources. Following the control of anthropogenic sources, the remaining sources of indicator bacteria are expected to be natural sources. The Technical Report has been modified to better ensure that this is the case. Provisions for demonstration of control of anthropogenic sources under the RSAA have been added to the Technical Report. These provisions include microbial source tracking to identify the host origin of collected indicator bacteria and sanitary surveys to demonstrate that anthropogenic sources have been controlled.

The goal of indicator bacteria monitoring is to determine if high indicator bacteria levels are due to anthropogenic activities, which can pose a human health threat. Conducting indicator bacteria monitoring to determine equivalency or threat regarding natural sources of indicator bacteria is not standard practice at this time. While the natural sources within a reference watershed and a target watershed may differ to some extent, this difference is expected to be less significant to human health than differences between anthropogenic and natural sources. For example, a recent epidemiological study conducted in Mission Bay in the San Diego area found the lack of a relationship between nonhuman sources of indicator bacteria and health risk (Colford, J.M., et al., 2007). Moreover, since natural sources of indicator bacteria, regardless of type, should not be controlled for reasons discussed in the response to Comment 2, treating the natural sources from reference and target watersheds as equivalent is appropriate. It is also worth noting that the Southern California Coastal Water Research Project (SCCWRP) is currently conducting studies to better characterize reference watersheds. These studies will be useful in matching reference watersheds with similar target watersheds, so that natural sources in the watersheds will be as similar as possible.

Comment 4: Table 2 provides exceedances for the beach but also for the lagoon and upstream in the creek at San Onofre. During dry weather, one would expect that FIB would decrease dramatically between the lagoon and coastal zone simply (more than likely) due to osmotic shock and death upon entering the coastal waters. Decreases as such are observed routinely in other similar locations and there could be an in-common explanation. However, there is no way to know if pathogens also rapidly attenuate upon discharge into the coastal ocean. One might imagine that some pathogens would be relatively halotolerant, thus surviving when FIB are not. The absence of FIB in the water would not signal that the water is devoid of risk to human health.

Response: The San Diego Water Board agrees that indicator bacteria are not the perfect indicator of risk to human health. However, direct testing for human pathogens is not practical at this time, due to the number of potential human pathogens, as well as the cost and time necessary for analysis. For these reasons,

the United States Environmental Protection Agency (USEPA) and State of California use indicator bacteria levels to monitor risk to human health.

Comment 5: The representativeness of Table 3 data for a range of other beaches that are considered to be similarly undeveloped would be important to convey. This should be of interest to the SWRCB, possibly across many RWQCBs.

Response: SCCWRP continues to conduct studies to better characterize reference beaches and watersheds. How representative the Table 3 data is for other beaches will be better known when the Table 3 data can be compared with the results from SCCWRP's ongoing studies.

Comment 6: The overarching problem is that "sources" are actually not determined or defined. Rather, it is assumed that since San Onofre is "undeveloped" that FIB are from "natural sources". Without any other investigation, it seems impossible to assume that the amount of development is correlated with types of FIB sources. This is the critical missing piece of the argument.

Response: Please see response to Comment 1.

Comment 7: Further, stating that (page 11, 4) there are "natural uncontrollable sources" directly requires that a) the sources are known and b) are the sources are known to be uncontrollable. Otherwise, they are really unidentified potential sources (that may be difficult to control).

Response: Please see response to Comment 2.

Comment 8: Additionally, if MS4 and nonpoint dischargers are not required to control FIB from "natural" sources, then it would appear that such dischargers would have to be able to define the fraction of their FIB that are from anthropogenic versus "natural" sources.

Response: As discussed in response to Comment 3, dischargers are required to control anthropogenic sources so that remaining indicator bacteria are expected to be from natural sources. The Technical Report was modified to require that dischargers conduct activities that demonstrate that control of anthropogenic sources has occurred as part of their TMDL implementation plans. A weight of evidence approach is expected to be used to demonstrate anthropogenic source control. This approach may include microbial source tracking, which can be useful in identifying the origin of indicator bacteria.

2. Does the technical report adequately support the limitations placed on the use of the RSAA and NSEA?

Comment 9: On page 12, Attachment 4 (section 4.1), it is stated that the DHS does not qualify FIB when regulating for SHELL standards. This is clearly presented as a limitation on the use of RSAA and clarifies that SHELL standards are based on FIB without concern for their origin. But this fact actually undermines using the data in Table 3 as part of the argument that background levels coming from "natural, uncontrollable" sources are acceptable. If they are not acceptable for SHELL water use, then why should they be acceptable for REC-1 or REC-2? Assuming that FIB are all considered "bad" by SHELL standards, then how can some be considered "good" or "neutral" by REC-1 or REC-2 standards?

Response: Application of the RSAA for the contact water recreation (REC-1), non-contact water recreation (REC-2) and shellfish harvesting (SHELL) beneficial uses is treated differently because of the differences between the water quality objectives for these beneficial uses. The water quality objectives for REC-1/REC-2 are based on an acceptable level of risk, while the water quality objectives for SHELL are not. Therefore, for the REC-1/REC-2 water quality objectives, some level of risk of illness associated with natural sources is acceptable. On the other hand, for the SHELL water quality objectives, risk of illness associated with natural sources is not allowed. For this reason, the RSAA is applicable to the REC-1/REC-2 beneficial uses, while at the same time it is inapplicable to the SHELL beneficial use. However, please note that application of the NSEA to the SHELL beneficial use has been removed from the Technical Report due to recent efforts by the State Water Resources Control Board to review the application of the beneficial use and the appropriateness of its associated water quality objectives.

Comment 10: On page 13, Attachment 4 (section 4.2), the main limitation for NSEA is conveyed as being "formidable" because it requires "demonstration of control of all anthropogenic sources". Implicitly, it also requires determining the sources and thus discovering which are anthropogenic and which are not This is actually crucial and a need that this reviewer does not see as a limitation but rather necessary if it is to be understood what FIB may mean in the environments of concern. Further, the example of 10 years for correcting implemented TMDLs by remedying anthropogenic sources seems arbitrary. There should be some plan and schedule for implementing a source-tracking program then remedying sources that threaten human health.

Response: Identification of sources is a necessary step for the NSEA to be implemented. Section 5.3.1 of the Technical Report requires control of anthropogenic sources, with the assumption that control of anthropogenic sources requires their identification as well. This section of the Technical Report has been modified to clarify the role of source identification as part of the NSEA, including the need for planning of source tracking efforts.

The ten year time frame was included in the Technical Report as an example of the expected time frame to control all anthropogenic sources within a watershed. It has been removed from the Technical Report.

Comment 11: On page 13, it is also implied that RSAA will be the method of choice, with NSEA only used when a reference system cannot be identified. But how to identify a reference system is not fully described.

Response: Identification of a reference system is discussed in section 5.1.1 of the Technical Report. Reference systems should consist of at least 95 percent open space and be represented by data that does not indicate human fecal contamination in the watershed. In addition, reference and target watersheds should be as closely matched as possible, based on consideration of factors that can affect indicator bacteria densities, such as geography, biology, and climate. To help identify an appropriate reference system for a target water body, indicator bacteria conditions of the reference system can be compared to the indicator bacteria conditions of the open space areas of the target water body's watershed. Similar indicator bacteria conditions in these cases would indicate that the reference system may be appropriate for the target water body, since such results would indicate similar natural sources in the reference system and target water body watershed. However, determination of the appropriateness of a reference system for a target watershed must ultimately be made on a case by case basis. Various factors such as suitability of a particular reference system, availability of other potential reference systems, availability of data, and cost of reference system characterization must all be considered. Case by case identification of reference systems will occur prior to calculation of each applicable TMDL.

Comment 12: Also, as above, it seems impossible to relate an undeveloped watershed to a developed one in the ways implied here, i.e. through an algebraic type process when the sources and their relative FIB abundances are unknown and unlikely to be similar. What would be preferred, if there is a reference system, would be to use a watershed where source tracking has reasonably-well delineated where human waste is entering the system and thus allows for a more educated guess of how unhealthy FIB-containing water really might be.

Response: Please see response to Comment 1.

Comment 13: It is also stated on page 14, section 5, that RSAA will be used for wet weather TMDL calculations since reference sites during dry weather are unlikely to have exceedances. But, since land use and development patterns are so different between reference sites and TMDL sites, it just doesn't seem possible that the FIB ---even if at comparable levels---are from similar types of "background " sources and thus have similar meaning to human health concerns.

Response: Please see response to Comment 3.

3. Does the Technical Report clearly describe the actions that must be completed to justify the use of the RSAA or NSEA in developing and implementing a bacteria TMDL?

Comment 14: According to page 14 (end of section 5), actions needed to choose between RSAA and NSEA include knowing where SHELL criteria apply, knowing that it is a dry weather TMDL, and making the determination that a reference watershed is not identifiable. The first two actions are simple to execute. However, as above, it is really unclear how one would identify a reference watershed. In section 5.1.1, there is more definition provided, but it is still unclear. How can a reference watershed in fact be a "reference" if there is a relationship between land use and FIB efflux (implied for this RSAA approach) but the land uses between developed and reference watersheds are, in fact, different? More detail for how the approach is applied needs to be provided.

Response: Identification of an appropriate reference system is discussed in response to Comment 11. The Technical Report has been revised to provide additional information on identification of a reference system. The term "reference" as used in the Technical Report refers to an undeveloped watershed. Such a watershed is considered a reference system because it exhibits indicator bacteria levels that occur under natural conditions, and achievement of these indicator bacteria levels is the goal of the RSAA. The term "reference" is not meant to imply that a reference system and a target water body's watershed have the same land use conditions. The mention of land use in section 5.1.1 has been removed from the Technical Report.

Comment 15: Also, as above, the origins of FIB from reference watersheds during storms are inherently different than for developed watersheds during storms. While there may be overlap, it is not possible to assume accurately that some similar fraction of FIB from the two types of watershed are from the same, relatively harmless, sources. In the RSAA approach, the number of exceedance days is first calculated. Similarly to the above concerns, the calculation obfuscates the origin of the FIB or at least does not consider origins. Thus, the basis for exceedances are regarded to be similar for the two (reference and target) watersheds while they are not likely to be similar. Exceedances mean something different when comparing the two systems.

Response: Please see the response to Comment 3.

Comment 16: Next, the exceedances (from supposedly uncontrollable sources) are added to the TMDL. The effect is to allow exceedances to occur by FIB that are of unknown origin and thus of unknown relationship to pathogens. This seems to add even more uncertainty to the process of protecting public health.

Response: As discussed in response to Comment 3, the RSAA requires control of anthropogenic sources. As such, exceedances will be caused by natural sources.

Therefore, the relationship of the indicator bacteria causing exceedances to pathogens is not completely unknown. Indicator bacteria from natural sources are expected to be less indicative of the presence of pathogens than indicator bacteria from human sources. For example, a recent epidemiological study conducted in Mission Bay in the San Diego area found the lack of a relationship between nonhuman sources of indicator bacteria and health risk (Colford, J.M., et al., 2007). Moreover, as better methods for assessing the presence of pathogens are developed, requirements for use of those methods can be incorporated into TMDL Implementation Plans. Such methods can be required to demonstrate that anthropogenic sources have been controlled, thereby providing better assurances that public health is protected.

Comment 17: In section 5.2.4, while the mathematical operations sound reasonably clear, it is unclear that one can add the reference load to the target load to set a TMDL. Again, as in wet weather, the FIB are from different sources—possibly even more so in dry weather than in wet weather.

Response: In a TMDL utilizing the RSAA, the required water quality of the target water body is to be at least as good as that of a reference system. This precludes the addition of reference system indicator bacteria concentrations to allowable concentrations from anthropogenic sources in order to calculate a TMDL, since the resulting concentrations would exceed those of the reference system. For this reason, the techniques for calculating dry weather TMDLs using the RSAA have been modified in the Technical Report (section 5.2.4).

The approach expected to be used to calculate dry weather TMDLs has been modified to be similar to the approach used for wet weather TMDLs. With this approach, the frequency that geomean water quality objectives are exceeded in the reference system for 30-day dry weather periods is identified. In turn, the frequency that water quality objectives can be exceeded in the target water body is based on this reference system exceedance frequency. The TMDL is calculated by multiplying the target water body's daily dry weather flows by the geomean water quality objectives. However, for the allowable exceedance periods associated with the reference system to be accounted for in the TMDL, the target water body's average water quality is used in TMDL calculations for those allowable exceedance periods, rather than the geomean water quality objectives. In this way, the TMDL incorporates additional loads based on the reference system exceedance frequency. This approach is discussed in greater detail in section 5.2.4 of the Technical Report.

By incorporating this approach into the Technical Report, exceedances of water quality objectives are only allowed in the target water body with the same frequency that exceedances occur in the reference system. This approach helps ensure that the water quality of the target water body is at least as good as that of a reference system.

Comment 18: What is unclear about 5.3.1 is that, prior to controlling anthropogenic sources one must first know that they exist. This may require sampling and analyzing, for example, dry weather flow in storm drains and its creeks for its content of human waste. Section 5.3.2 does make this point, however.

Response: Section 5.3.1 of the Technical Report has been revised to discuss the need for source tracking studies to be implemented.

Comment 19: In Attachment 5, section 1, it says that water quality for shellfish harvesting can be implemented by using the approach of excluding natural sources. Perhaps this reviewer misunderstood the earlier language in Attachment 4, but the implication there was that DHS does not regard differently FIB from either natural or anthropogenic sources.

Response: Application of the NSEA to water quality objectives protecting the SHELL beneficial use has been removed from the Technical Report. Therefore, this comment is no longer applicable to the Technical Report.

Overarching Questions:

(a) In reading the staff technical reports and proposed implementation language, are there any additional scientific issues that are part of the scientific basis of the proposed rule not described above? If so, please comment with respect to the statute language given above.

Comment 20: There are several fundamental issues. First, fecal indicator bacteria (FIB) are known to arise from many sources. This is implicit in the need for the proposed amendment: it is unreasonable for humans to control "natural" bacterial populations in cases where they are not doing harm to us or the environment. (The corollary is that we are also recognizing the essentiality of most bacteria to biogeochemical cycling and thus biosphere function overall.) However, in any setting, the possible origins of FIB are similar: recent human or animal waste, or indigenous soil or sediment bacteria that may have been associated with waste or simply grow in the assays. Just because a setting appears to be less developed does not mean that it is devoid of human-related FIB. One would have to fully describe the activities in the area, assay for markers of human waste, etc. to know for sure. Such studies would have to be done over time to arrive at a reliable characterization that can then be used for some planning basis in the future.

Response: The reference systems referred to in the Technical Report were investigated for human sources of indicator bacteria. As discussed in response to Comment 1, samples collected at the reference beaches were analyzed for human enterovirus, a reliable marker for human input of fecal contamination. Likewise, the Technical Report requires demonstration of control of anthropogenic sources when the NSEA is used (section 5.3.2). The Technical Report has also been revised at

sections 5.1.6 and 5.2.5 to require demonstration that anthropogenic sources have been controlled under the RSAA.

Comment 21: Even more importantly, however, is that the real health concern is not FIB, but "pathogens". Since FIB can arrive from many sources, and any source can harbor many different human pathogens (including viruses that are not accounted for in FIB enumeration), it is not protective of human health to simply assume that "natural" FIB are "ok". By trying to fit FIB into categories, we are not focusing on the most important issues, i.e. that: 1) we should not be exposing ourselves to our own fecal material through water contact because such situations are well-understood to cause disease transmission, 2) we should be trying to determine whether waters in which we swim or harvest seafood are likely to cause infection. The American Academy for Microbiology, in its November 2007 report on Microbial Risk Assessment for drinking water, clearly does not endorse the uninformed use of FIB (i.e. using FIB levels in decision making when it is unknown if they are associated with sources of pathogens and real risk of contracting disease). This seems to reflect an emerging scientific consensus: place less emphasis on parsing FIB and more on determining at least if human waste sources are entering waters wherein human exposure can occur, and better yet determining if pathogens are present such that there is a risk for disease that can then be managed.

Response: While natural sources of indicator bacteria can harbor human pathogens, it is expected that the human health risk associated with natural sources is less than the risk associated with anthropogenic sources. For example, a recent epidemiological study conducted in Mission Bay in the San Diego area found the lack of a relationship between nonhuman sources of indicator bacteria and health risk (Colford, J.M., et al., 2007). Further, the control of natural sources of indicator bacteria is costly and possibly environmentally detrimental. For these reasons, the San Diego Water Board is seeking use of the RSAA/NSEA as a reasonable means for protecting the REC-1/REC-2 beneficial uses.

As discussed in response to Comment 4, indicator bacteria are not the perfect indicator of risk to human health. However, direct testing for human pathogens is not practical at this time, due to the number of potential human pathogens, as well as the cost and time necessary for analysis. For these reasons, the USEPA and State of California use indicator bacteria levels to monitor risk to human health.

Comment 22: In section 5.3.3, it is recommended that FIB levels in shellfish be analyzed. However, it would be much more prudent to, in that case, look for evidence of actual pathogens.

Response: Application of the NSEA to water quality objectives protecting the SHELL beneficial use has been removed from the Technical Report. Therefore, this comment is no longer applicable to the Technical Report.

Comment 23: In Section 7, a very important question should be added: How can we tell if sewage and sewage-associated pathogens are present and where they originate in surface water systems?

Response: The question has been added to the Technical Report.

Comment 24: Thus, on the basis of this reviewer's concerns expressed herein, it is not possible to endorse the draft language on page 5 of attachment 5 in the section 5) "Total Maximum Daily Load (TMDL) Implementation Provisions" regarding allowing either a RSAA or a NSEA approach. Again, the concerns are that it is hard to identify reference systems—reference systems inherently have different sources of FIB and these cannot simply be added or subtracted from the concentrations at other systems because they don't mean the same thing.

Response: Please see response to Comment 1.

Comment 25: Knowledge (or lack thereof) regarding the actual pathogen content or risk associated with FIB is neither sought nor applied.

Response: Please see response to Comment 16.

Comment 26: Anthropogenic sources of FIB need to be identified if they are to be controlled.

Response: Please see response to Comment 10.

Comment 27: Ultimately the first order concern has to be finding human waste sources and controlling them no matter what FIB content they seem to exhibit in the environment.

Response: The San Diego Water Board agrees with this comment. The principal component of both the RSAA and NSEA is control of anthropogenic sources.

(b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Comment 28: The foundation for the two approaches stems from the knowledge that FIB are unreliable for indicating the presence of human waste in the environment. Their unreliability is implicit when stating that there are "natural sources" of FIB. Since FIB, therefore, do not reliably indicate the presence of human waste, continuing to use these as the sole basis for judging water quality or for planning water quality management does not constitute sound scientific practice.

Response: Please see response to Comment 4.

Comment 29: In order to know if FIB are associated with human waste or not, field sampling and appropriate measurements would need to be made. Relationships cannot be assumed on the basis of "development" alone. There is not a sound scientific basis for this type of assumption, at least not based on empirical evidence, and the arguments were not made.

Response: Please see response to Comment 20.

Comment 30: In summary, two systems for arriving at TMDL implementation strategies are described: 1) the RSAA approach whereby a reference "pristine" water body (devoid of anthropogenic fecal contamination) is identified and contamination to the regulated water body is to be reduced to that of (or below) the reference system. This approach seems to make the assumption that all fecal indicator bacteria in the reference system are "good" or at least not indicating the presence of human pathogens. Thus, it would seem that a "source tracking" type of study would need to be performed on the reference watershed if one is to make this assumption. 2) The NSEA approach requires that fecal bacteria from anthropogenic sources be controlled and that the remaining levels be evaluated against water quality criteria. If the levels don't exceed health standards, then they would be deemed acceptable. In both cases, the assumption is that there are "non-anthropogenic" fecal indicator bacteria that are allowed to cause exceedances. The assumption is that these cannot be controlled. With either method, sources of anthropogenic contamination need to be identified. Also, how variability in "natural" background levels is accounted for (what is known about this?) and how relationships to zoonotic disease (e.g. from waterfowl at coastal landfills that may congregate on beaches upon feeding at the "dump") need to be considered. In either approach, the sources need to be considered, if not determined.

Response: The indicator bacteria conditions of reference systems and their relationship to human pathogens are discussed in response to Comments 1-3. Identification of anthropogenic sources is discussed in response to Comments 3 and 10.

Comment 31: Coastal CA is nearly all developed and one could argue affected by human activity. Thus, it is important to define how the determination of "minimally impacted by anthropogenic activities" is made.

Response: Identification of reference systems is discussed in response to Comment 11.

Comment 32: In the Executive Summary of Attachment 4 (page 1), it is stated that "The RSAA or NSEA only apply to municipal separate storm sewer system (MS4) and nonpoint source discharges during development and implementation of indicator bacteria total maximum daily loads (TMDLs)." The footnote reading: "Indicator bacteria contamination from uncontrollable or non-anthropogenic sources that are captured by and/or transported via a storm drain system or directly discharged into receiving waters

are excluded from this definition", implies that for both storm drains and for surface waters, the "natural" and "anthropogenic" fecal indicator bacteria will be differentiated. This is important as one simply cannot assume that separated storm drains harbor only "natural" fecal indicator bacteria.

Response: Sources of indicator bacteria will be differentiated based upon control of anthropogenic sources. Since for both the RSAA and NSEA anthropogenic sources must be controlled, the remaining indicator bacteria in the system are expected to be from natural sources. This differentiation between anthropogenic and natural sources will be confirmed by implementation of a weight of evidence approach that will include implementation of techniques such as microbial source tracking and sanitary surveys.

Comment 33: Further, on page 2 of Attachment 4, it is stated that "wasteload and load allocations calculated for municipal and nonpoint source dischargers will include allowances for natural uncontrollable sources of indicator bacteria". The only way this can be done is to evaluate the stormwater for its content of human waste and try to make some assumptions about fecal indicator bacterial concentrations in human waste and thus how much of the storm drainage is human waste with human-originating fecal indicator bacteria.

Response: As previously stated, both the RSAA and NSEA require control of anthropogenic sources. Therefore, it is expected that remaining indicator bacteria in the system will be from natural sources. Dischargers will be required to demonstrate that remaining indicator bacteria is not of anthropogenic origin by implementing a weight of evidence approach that will include efforts such as microbial source tracking and sanitary surveys.

Comment 34: Further, stating that the amendment "does not obviate the need for MS4 and nonpoint source dischargers to control indicator bacteria from anthropogenic sources" is confusing because: a) in order to determine the natural fraction of fecal indicator bacteria in storm drainage one will also, by default, b) determine the anthropogenic fraction. Further, c) if the charge is to control anthropogenic sources, then d) it would appear to be inconsistent (at best) to know the anthropogenic contribution yet to not require its remediation. Particularly under the NSEA approach, where all "anthropogenic sources of indicator bacteria ….must be controlled" (page 3, Executive summary), it is obvious that one must first differentiate (identify, then specify) natural from anthropogenic sources of fecal indicator bacteria. Thus, one can argue that (page 3, ES, 1.3) the first step in NSEA is to identify all sources of anthropogenic fecal indicator bacteria.

Response: Please see response to Comment 10.

Comments from Professor Strom

1. Does the technical report adequately demonstrate that natural uncontrollable sources of indicator bacteria are causing exceedances of indicator bacteria water quality objectives?

Comment 35: The evidence presented in the technical report strongly suggests that "natural uncontrollable sources" of indicator bacteria are causing *exceedances* of indicator bacteria water quality objectives, and such a conclusion represents application of reasonable professional judgment. However, there appears to be some ambiguity in the definition and use of the phrase "natural uncontrollable sources."

Footnotes 2 and 6 define anthropogenic indicator bacteria sources as "controllable sources of bacteria contamination which [note - I believe this "which" should be changed to "that"; this has a subtle but important effect on the meaning] have been identified as being from humans, domesticated animals, or directly resulting from human activities." Further, these footnotes state, "Indicator bacteria contamination from uncontrollable or non-anthropogenic sources that are captured by and/or transported via a storm drain system or directly discharged into receiving waters are excluded from this definition."

Two examples that illustrate questions about these definitions are:

1. What about wildlife (such as geese) that may congregate in an area because of the human influence on the landscape? Under the definitions, they appear to be natural uncontrollable sources. Yet the situation is not truly natural, may be controllable, and may represent an elevated health risk.

2. Fecal material from wild animals, such as rodents and raccoons, normally might not be carried to waterbodies through runoff, at least to the same extent, in the absence of stormwater systems. These systems reduce the distance and time that the contaminated water must flow over and through soil and vegetation, for example, and may also attract a higher density of some animals.

It is possible that some of these concerns might largely be addressed by small changes in the report. For example, on page 1, line 35, "Since control of such sources is infeasible, possibly detrimental ..." might better be worded "Where control of such ..."

> ***Response:*** As the reviewer points out, it can be difficult to draw a fine line between anthropogenic and non-anthropogenic sources of indicator bacteria. Non-anthropogenic sources are often influenced by anthropogenic activities (as in the geese example provided in the comment above). In the technical report, for an indicator bacteria source to be considered anthropogenic it must be controllable. Sources related to humans but that are not controllable, such as shedding during swimming, are not considered anthropogenic for the purposes of the RSAA and NSEA. The definition of anthropogenic source has been expanded in the technical

report to clarify what is considered controllable. It is expected that this additional discussion will address the issue raised in the above comment. For example, determination of whether a source related to human activity is controllable or uncontrollable will be based on best management practice (BMP) implementation. If a source is not human, but is related to human activity, it will only be considered uncontrollable (and hence non-anthropogenic) after all appropriate BMPs have been implemented to control the source. This approach will apply to all non-human sources for which it can be clearly demonstrated that they are influenced by human activity.

In response to the second issue raised in the comment, the effect of urbanization and municipal separate storm sewer systems (MS4s) on indicator bacteria loading to receiving waters in all instances is not fully known. While in some cases MS4s may enable indicator bacteria to reach receiving waters, in other cases, urbanization and MS4s may reduce indicator bacteria loading to receiving waters. For example, direct deposition of indicator bacteria to receiving waters may be reduced in areas where MS4s are present, since there are fewer receiving waters in such areas. Likewise, urbanization and MS4s can reduce the presence of many animal species, thereby reducing indicator bacteria loads to receiving waters in these cases. In light of this uncertainty regarding the effect of MS4s on indicator bacteria loading in all cases, the San Diego Water Board chooses not to rely on the status of a discharge (MS4 or non-MS4) to determine whether or not indicator bacteria is from a natural or anthropogenic source. Such a determination is better made by considering the actual source of the indicator bacteria.

Comment 36: On page 11, line 17, resuspension from disturbed sediment is given as another example of a natural uncontrollable source. Resuspension is potentially an important factor to be included in developing the TMDL, and may to some extent be uncontrollable. However, it is quite possible that some of the bacteria in the sediment (that later become resuspended) are from controllable anthropogenic sources. How will this be addressed? On the other hand, making allowance for regrowth on the beach wrack seems entirely appropriate, as regrowth of pathogens under these conditions is unlikely.

Response: Both the RSAA and NSEA require control of indicator bacteria from anthropogenic sources. Therefore, indicator bacteria in sediment that may be resuspended is not anticipated to be from controllable anthropogenic sources. As such, indicator bacteria in resuspended sediment is considered to be from uncontrollable natural sources.

Comment 37: On page 6, line 3-4, the statement that "... the NSEA requires evidence that remaining indicator bacteria densities do not indicate an elevated health risk beyond that allowable by applicable bacteriological standards" appears accurate and compelling. However, later in the same paragraph it is indicated that the "NSEA will basically allow an exceedance rate of indicator bacteria water quality objectives that

equates with the exceedance rate caused by uncontrollable natural loading of indicator bacteria." This is not equivalent to the previous statement, and in fact appears to provide a lower level of protection, based on an assumption that the "uncontrollable natural loading" does not contribute to an elevated health risk. Such an assumption does not appear to be supported by the evidence provided in the report, and is in fact probably not true.

Response: The first statement discussed in the comment is the more accurate statement. For this reason, the second statement has been deleted from the technical report.

2. Does the technical report adequately support the limitations placed on the use of the RSAA and NSEA?

Comment 38: The short answer to this question is yes! For example, the second paragraph under subsection 5.2.3 (p. 18) provides a good explanation of why the RSAA could not be used when the average daily indicator bacteria densities of the target water body are lower than those of the reference system. This is an important limitation to maintain the antidegradation requirements, as noted. Another example of a limitation placed on use of the RSAA that is explicitly justified in the report is provided in subsection 5.2.4 (p. 18). Here it is noted that reference systems that are dry for many days likely cannot be used to increase allowable loads for those days. For the section (5.3) on implementation of the NSEA, the limitations are clearly explained and adequately justified.

Response: Comment noted.

3. Does the Technical Report clearly describe the actions that must be completed to justify the use of the RSAA or NSEA in developing and implementing a bacteria TMDL?

Comment 39: The approach described for the RSAA in subsection 5.2.4, Calculation of TMDLs (p. 18) indicates that the reference system concentrations, which may already exceed water quality standards, will be added to the allowable levels from anthropogenic sources. This appears to be in conflict with the proposed Amendment itself (Attachment 5), page 6, added paragraph 3 under "Revisions to Chapter 4 (Implementation)". This paragraph states that the RSAA "requires control of indicator bacteria from anthropogenic sources so that bacteriological water quality in the targeted waterbody is at least as good as that of a reference system." If water quality is measured by the indicator bacteria, this would mean that the TMDL would be based on the reference system, not the reference system plus the controlled anthropogenic concentrations.

The report otherwise does a good job of explaining the steps to be used in implementing a TMDL using the RSAA approach. It also does a good job with respect to the NSEA.

Response: In a TMDL utilizing the RSAA, the required water quality of the target water body is to be at least as good as that of a reference system. As noted by the reviewer, this precludes the addition of reference system indicator bacteria concentrations to allowable concentrations from anthropogenic sources in order to calculate a TMDL, since the resulting concentrations would exceed those of the reference system. For this reason, the techniques for calculating dry weather TMDLs using the RSAA have been modified in the Technical Report (section 5.2.4).

The approach expected to be used to calculate dry weather TMDLs has been modified to be similar to the approach used for wet weather TMDLs. With this approach, the frequency that geomean water quality objectives are exceeded in the reference system for 30-day dry weather periods is identified. In turn, the frequency that water quality objectives can be exceeded in the target water body is based on this reference system exceedance frequency. The TMDL is calculated by multiplying the target water body's daily dry weather flows by the geomean water quality objectives. However, for the allowable exceedance periods associated with the reference system to be accounted for in the TMDL, the target water body's average water quality is used in TMDL calculations for those allowable exceedance periods, rather than the geomean water quality objectives. In this way, the TMDL incorporates additional loads based on the reference system exceedance frequency. This approach is discussed in greater detail in section 5.2.4 of the Technical Report.

By incorporating this approach into the Technical Report, exceedances of water quality objectives are only allowed in the target water body with the same frequency that exceedances occur in the reference system. This approach helps ensure that the water quality of the target water body is at least as good as that of a reference system.

<u>Overarching Questions:</u>

(a) In reading the staff technical reports and proposed implementation language, are there any additional scientific issues that are part of the scientific basis of the proposed rule not described above? If so, please comment with respect to the statute language given above.

Comment 40: In Section 7 of the report, Special Studies (p. 24), three important scientific questions are explicitly raised. It is anticipated that these questions may be addressed during, and/or to support, development of TMDLs under the RSAA or NSEA. This may strengthen the scientific basis for all TMDL development.

An important consideration is whether waters that are influenced only by "natural uncontrollable sources" represent an unacceptable risk (impairment of beneficial use) when they exceed water quality standards for indicator bacteria. This question is specifically raised in the report as the second bullet under Section 7.

Response: Comment noted.

Comment 41: An additional scientific question is the source of indicator bacteria in sediments, and the sanitary significance of their resuspension.

Response: Both the RSAA and NSEA require control of indicator bacteria from anthropogenic sources. Therefore, indicator bacteria in sediment that may be resuspended is not anticipated to be from controllable anthropogenic sources. As such, indicator bacteria in resuspended sediment is considered to be from uncontrollable natural sources.

(b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Comment 42: As might be expected for such a complex issue, not all scientific questions can be completely resolved at this time. Taken as a whole, the report and proposed rule, subject to some questions raised above with regard to the RSAA, is based upon sound science and professional judgment.

Response: Comment noted.

Other Specific Comments:

Comment 43: p. 2, line 19. Change "likelihood of pathogens in surface waters" to "likelihood of pathogens of fecal origin in surface waters."

Response: The suggested change has been made to the Basin Plan amendment.

Comment 44: p. 2, line 21. Change "flora" to "biota". [Sorry - a pet peeve; we no longer consider bacteria to be plants!]

Response: The suggested change has been made to the Basin Plan amendment.

Comment 45: p. 4, line 15. Change "than" (in "provided further than no single") to "that".

Response: The suggested change has been made to the Basin Plan amendment.

References

Colford, J.M., et al. 2007. *Water Quality Indicators and the Risk of Illness at Beaches With Nonpoint Sources of Fecal Contamination*. Epidemiology. Volume 18, Number 1, January 2007.

Griffith, J.F., et al. 2006. *Microbiological Water Quality at Non-Human Impacted Reference Beaches in Southern California During Wet Weather*. Southern California Coastal Water Research Project. Technical Report 495.