APPENDIX A

PEER REVIEW COMMENTS AND RESPONSES

The technical portions of the proposed Basin Plan amendment to incorporate TMDLs for indicator bacteria were peer reviewed by Professor Patricia Holden of the Donald Bren School of Environmental Science & Management, University of California, Santa Barbara, and by Professor Kara Nelson of the Department of Civil and Environmental Engineering, University of California, Berkeley. 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 San Diego Water Board provided the peer reviewers with the draft Technical Report, the draft Basin Plan amendment, and a list of key issues with discussion for the peer reviewers to address. 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. **Use of land use composition to quantify bacteria sources from all watersheds to affected beaches and creeks in the San Diego Region.**
   Bacteria are ubiquitous in the environment, as there are numerous sources including both controllable and non-controllable. Controllable sources include sewage related sources (spills, leaking sewer lines), trash, farm animal waste, and pet waste. Noncontrollable sources include aquatic and terrestrial wildlife, decaying matter, and soil. To manage this abundance of sources and quantify them in a useful way, land-use types were identified in the San Diego Region and quantified in terms of bacteria generation.

   Various bacteria sources are present across different land-use categories. For example, wildlife can be present in both urbanized and non-urbanized areas. Despite this source variability, loading can be highly correlated with land use practices. For this reason, it was decided to quantify the bacteria load coming from each land use type rather than quantify the sources directly. This approach was applied to both wet weather and dry weather conditions.

2. **Use of wet weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks.**
   A regional watershed-based approach (model study) was developed to simulate the build-up and wash-off of bacteria, and the hydrologic and hydraulic processes that affect delivery of bacteria to the impaired waters. In this approach, bacteria re-growth is assumed to be zero.

   This approach was based on the application of the U.S. Environmental Protection Agency's (USEPA) Loading Simulation Program in C++ (LSPC) to estimate bacteria loading from streams and assimilation within the waterbody to determine existing bacteria loads, as well as total maximum daily loads, to receiving waters. LSPC integrates a geographical information system (GIS), comprehensive data storage and management capabilities, a dynamic watershed model (a re-coded version of EPA's Hydrological Simulation Program—FORTRAN [HSPF]), and a data analysis/post-processing system into a convenient PC-based windows interface that dictates no software requirements. Please comment on the use of this modeling system for the purpose of calculating TMDLs to impaired waters during wet weather.

3. **Selection of a Los Angeles watershed as a "reference" for background loading of bacteria in the San Diego Region during wet weather.**
The interim numeric target for the TMDL calculations is based on the use of a "reference watershed approach," a concept that was introduced by the Los Angeles Regional Water Quality Control Board in the Santa Monica Bay Beaches TMDL (Los Angeles Water Board, 2002). In this approach, a certain amount of exceedances of the single sample maximum water quality objectives are allowed, based on the frequency of exceedances expected in a relatively pristine, or "reference," watershed. Since there are natural sources of bacteria in a reference watershed, a certain amount of exceedances of the water quality objectives are expected. It is assumed that these exceedances are not from anthropogenic origin. This exceedance frequency is incorporated into the waste load allocations that were calculated for all urbanized watersheds. However, if water quality is better than that of the reference watershed in a particular location, no degradation of existing bacteriological water quality is permitted. This approach ensures no further bacteriological degradation of water quality where existing conditions are better than that of the reference watershed.

In the San Diego Region, candidate watersheds for use as a "reference" for TMDL development have been identified. However, to date, these candidate watersheds do not have sufficient data needed for characterization. In lieu of suitable data originating from the San Diego Region, the exceedance frequency of the reference watershed used for TMDL development in Los Angeles, the Arroyo Sequit watershed, were used. Specifically, the allowance frequency of 22 percent was used in the calculation of the interim TMDLs. Final TMDLs for wet weather were calculated using the single sample maximum water quality objectives (no allowable frequency of exceedance).

4. **Use of single-sample maximum objectives for wet weather numeric targets.**
Bacteria water quality objectives have two temporal components: single sample maximum values and 30-day geometric mean values. As a conservative measure for wet weather analyses, the single sample maximum values were chosen as TMDL numeric targets.

Wet weather events, and subsequent high bacterial counts, are sporadic and episodic. Wet weather runoff and flows contain elevated bacteria densities, but have a quick time of travel. Thus, bacteria densities remain elevated for relatively short time periods following storm flows. Storm events do not typically result in an exceedance of the 30-day geometric mean bacteria densities, even though single sample densities are very high. Therefore, the single sample maximum values were used as numeric targets for the wet weather simulations.

5. **Reasonableness of assumptions (described in Appendix L) for wet weather modeling.**
Several assumptions are relevant to the LSPC model developed to simulate the fate and transport of wet weather sources of bacteria in the Region. This model was used to estimate

both existing bacteria loads and total maximum daily loads. Please comment on the validity of these assumptions.

6. **Use of wet weather modeling parameters to simulate build-up/wash-off of bacteria from a similar study in Los Angeles (Los Angeles Water Board, 2002).**
   As explained earlier, sources of bacteria are quantified by correlating land use types to bacteria loading.

   Land use data was classified into 13 distinct categories. Each category had a unique parameter describing the amount of bacteria loading directly to the *critical point* (defined as the culmination point at the bottom of each affected watershed). These unique parameters were obtained by using those that were previously defined in the TMDL for Santa Monica Bay (Los Angeles Water Board, 2002). This includes land-use-specific accumulation rates and build-up limits. Using these values assumes that land use characteristics for all categories in the San Diego Region are sufficiently similar to characteristics of all land use categories in the Los Angeles Region. This assumption was validated through evaluation of model results with local water quality data. Please comment on the application of modeling parameters derived in the Los Angeles Region to the San Diego Region.

7. **Use of dry weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks.**
   During dry weather conditions, bacteria levels are highly variable and not predicted well using standard modeling techniques, such as the LSPC model developed for wet weather. To account for this variability, empirical equations were developed to represent water quantity and quality associated with dry weather runoff from various land uses. Concentrations of fecal coliform were developed using regression analysis as a function of total area and land use composition in each subwatershed. Concentrations of total coliform and enterococci were developed as functions of fecal coliform concentrations.

   The predictive model represents the streams as a series of plug-flow reactors, with each reactor having a constant source of flow and bacteria. Although it is understood that dry weather flows and bacteria densities vary over time for any given stream, for prediction of average conditions in the stream, flows and concentrations are assumed to be in steady state. Bacteria re-growth is assumed to be zero.

8. **Use of data from Aliso, San Juan, Rose, and Tecolote Creeks to characterize dry weather source loading in the entire San Diego Region.**
   Data from Aliso Creek, San Juan Creek (Orange County), Rose Creek, and Tecolote Creek (San Diego County) were used for characterization of dry weather flows and water quality because the data sets associated with these creeks are assumed sufficient in size. Data from these four creeks were used to generate regression equations describing flow and water quality as functions of land use composition and watershed size. Conditions in these four creeks are assumed representative of conditions throughout the Region.

9. **Use of geometric mean objectives for dry weather numeric targets.**
   Bacteria water quality objectives have two temporal components: single sample maximum

values and 30-day geometric mean values. For dry weather analyses, the geometric mean values were chosen as TMDL numeric targets. This is because the dry weather model simulates steady state flow for predictions of average conditions in the creeks. To compare the conditions of these average flows to water quality objectives, the geometric mean is more appropriate since this value likewise represents average conditions over 30 days.

10. **Reasonableness of assumptions (described in Appendix L) for dry weather modeling.**
Several assumptions are relevant to the empirical model developed to simulate the fate and transport of bacteria during dry weather in the Region. Please comment on the validity of these assumptions.

11. **Location of *critical points* for TMDL calculation.**
The *critical point* for loading assessment is defined as the culmination point at the bottom of the watershed, before inter-tidal mixing takes place. Both current loading and total maximum daily loading is calculated at the critical point for each watershed having an impaired waterbody. High bacteria loading is predicted at the critical point, and is therefore considered a conservative location for TMDL calculation. TMDL calculations were determined at the critical point in both wet and dry weather.

12. **Use of conservative assumptions to comprise an implicit Margin of Safety.**
Rather than incorporating an explicit margin of safety (MOS) to TMDL calculation, the conservative assumptions built into both the wet weather and dry weather models are considered sufficient to account for any uncertainties. The implicit MOS was thus generated by incorporating a series of conservative assumptions regarding current source loading of bacteria from the watersheds, as well as assumptions regarding the assimilation of bacteria into the waterbodies and surrounding environment.

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 Technical Report 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. Use of land use composition to quantify bacteria sources from all watersheds to affected beaches and creeks in the San Diego region.

Comment: In concept, this seems fine. However, as per the regression model on page K-6, not all land uses correlated with indicator bacteria discharge during dry weather. There were 13 land use categories overall, and eight are listed on page K-6. Perhaps comments are being requested for only the wet weather calculations (this review point only).

As for the wet weather usage, how current are land use data from 2000 (page J-4)? Has development in the region been so rapid as to make these land use data obsolete in some areas?

Response: For the dry weather analyses, eight of thirteen land uses were determined to have statistical significance for prediction of fecal coliform concentrations. The remaining land uses do not have statistical significance for prediction of fecal coliform concentrations.

Development or changes in stormwater management resulting from land uses may have changed since 2000 when spatial coverages were compiled. However, these were the most recent datasets available at the time of TMDL development. Should these datasets be updated in the future that confirm significant changes in land use, the models can be updated and TMDLs can be revised.

2. Use of wet weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks.

Comment: Few details about the model are provided, but the methods appear to be well-referenced. The model simulations (e.g. Figure N-3) of concentration appear to fit the real data well (where there are data). However, for some of the figures (e.g. N-1, N-2) it is not possible to tell how well the simulations worked because of the density of the simulated data.

Response: To improve visualization of results, Figure N-1 was divided into 3 figures (Figures N-1-A, N-1-B, and N-1-C) representing different periods of record, and Figure N-2 was edited and confined to the period with the most observed data (1997-1999).

3. Selection of a Los Angeles watershed as a "reference" for background loading of bacteria in the San Diego Region during wet weather.

Comment: In the absence of a sufficiently characterized "reference" (i.e. relatively undeveloped) watershed in the San Diego region, designating a nearby, well-characterized, similarly undeveloped watershed in the Los Angeles region as a "reference" watershed seems fine. However, the use of the "reference" watershed as a concept or decision tool is not clear. The document refers to a 22 percent exceedance frequency in the Arroyo Sequit Watershed (in Los Angeles) and this compares similarly to two undeveloped watersheds in San Diego (Tables 4-1 and 4-5, San Mateo Creek and San Onofre State Beach). However, on page 15[1] (section 4.1) of the document it is stated there is no "reference watershed implementation policy" which seems to imply that the use of a "reference watershed" concept is not allowed. This is confusing and it is suggested that it be clarified by either moving this reference watershed discussion to a later point in the document (i.e. implementation) or more clearly stating how it is used at this point in the TMDL process**.**

The "reference" watershed concept inherently assumes that all indicator bacteria are created equal. That is, indicator organisms from an urbanized area are just as problematic as those from an undeveloped watershed. This may not be the case. If false positive results on indicator organism assays frequently occur at the outlets of undeveloped watersheds, this would imply that natural lands discharge bacteria but few pathogens. Transferring an allowable exceedance from an undeveloped watershed to a developed one may inadvertently "allow" the discharge of more pathogens from developed watersheds because it is more likely that microbes discharged from developed watersheds will include pathogens.

Response: The Technical Report has been updated to clarify how the allowable exceedance frequency was used to calculate interim TMDLs, and also why the allowable exceedance frequency was applied to interim, not final, TMDLs. Specifically, the allowable exceedance frequency of 22 percent was used to calculate "interim TMDLs" and accounts for bacteria loads from natural sources. The 22 percent exceedance frequency originates from studies in the Arroyo Sequit watershed in Los Angeles County. The Los Angeles Regional Water Quality Control Board (Los Angeles Water Board) adopted "reference watershed implementation provisions" to incorporate the allowable exceedance frequency as a formal Basin Plan amendment. The Los Angeles Water Board was then able to use the exceedance frequency to calculate TMDLs.

In contrast, the San Diego Water Board has not adopted a Basin Plan amendment to incorporate reference watershed implementation provisions to allow exceedances of the WQOs. Therefore, ultimately, TMDLs must be calculated using existing WQOs in the Basin Plan. As an interim goal, however, interim TMDLs were calculated based on the 22 percent allowable exceedance frequency, as established by the Los Angeles Water Board.

Since the TMDL Report was first made available to peer reviewers on February 7, 2005, a new study has been completed which characterizes a reference watershed in the San Diego Region. The study (Schiff et al., 2005) found that four reference watersheds in Southern California (Ventura, Orange, and San Diego counties) had an average exceedance frequency of 25 percent during wet weather. The San Diego Water Board is currently working on an amendment to the Basin Plan to incorporate reference watershed implementation provisions using this new information. When this occurs, the TMDLs developed in this project can be re-visited to reflect these provisions. Consequently, TMDLs will no longer be distinguished into "interim" and "final" TMDLs; only final TMDLs will be relevant, and will take into account loads due to natural sources.

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[1] The reviewer is referring to page 15 of the draft Technical Report that she received. The "reference watershed implementation policy" is referred to as the "reference system approach" in the draft Technical Report dated December 9, 2005.

In calculating interim TMDLs, the San Diego Water Board did assume that indicator bacteria, whether from an undeveloped watershed or an urbanized watershed, behave similarly. In other words, an exceedance frequency developed in an undeveloped watershed is the same as the exceedance frequency in an urbanized watershed. The San Diego Water Board assumed that bacteria loading from natural sources is present in all watersheds, and that this loading occurs in identical quantities.

4. Use of single-sample maximum objectives for wet weather numeric targets.

Comment: The use of single sample maximum objectives for wet weather seems fine. However, given that rainfall events subject the watersheds to more variability in flow and load, the use of a geometric mean for wet weather seems more practical. This is discussed again for the dry weather assumptions.

Response: The analysis used in this Technical Report was divided into wet weather and dry weather approaches specifically to address the variability between the two scenarios. The dry weather model makes use of the geometric mean and assumes a steady state base flow. The wet weather model analyzes bacteria loads during conditions of high flows and loads, as the commenter suggests. The single sample maximum WQOs are designed to protect human health risk at short intervals, including peak loads. The geometric mean value does not evaluate peak loads at short intervals because values are calculated over several-week's time. Because the model used for wet weather analyzes high flow and loads, which are short-term events, the numeric target must likewise characterize risk from short-term events. Therefore the single sample maximum WQOs were used.

5. Reasonableness of assumptions (described in Appendix L) for wet weather modeling.

Comment: In Section 8.1.1, it is stated that the "92nd percentile" was used as the critical condition for wet weather years. Other than SCCWRP used a 90th percentile previously, what is the scientific justification for this? Was 1993 an El Nino year? Is there an accepted process, similar to flood frequency estimations used in treatment facility designs, for selecting a storm frequency for this process?

Response: Storm frequency analyses can be used for selection of critical wet periods for TMDL calculation. However, a critical wet 'year' was selected for TMDL calculation, which incorporates multiple storms that can occur during the period. Evaluation of a wet year is often reported as a frequency of occurrence (e.g., 1 in 10 years). Based on the data compiled for this study, the 92nd percentile (1 out of 12 years) was determined adequate for identification of the critical wet year. This year corresponded to 1993, which was also identified by SCCWRP as the critical wet year for indicator bacteria loading to Santa Monica Bay beaches. 1993 is considered an El Nino period.

6. Use of wet weather modeling parameters to simulate build-up/wash-off of bacteria from a similar study in Los Angeles (Los Angeles Water Board, 2002).

Comment: There is insufficient information in the report for this to be evaluated. The idea of simulating build up and wash off is logical and sound. But the modeling parameters are not detailed sufficiently for comment. The Santa Monica Bay TMDL used the same approach, but the report provided does not contain detailed information on the modeling.

Response: The modeling parameters referred to in this comment have been incorporated into Appendix J. The item was not meant to solicit opinion about the parameters themselves, but rather the idea of using values identical to parameters that describe the Los Angeles area.

7. Use of dry weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks.

Comment: The model on page K-3 is a simple first order decay model. The derivation of a correct and appropriate model based on mass balance principles, within the context of the assumption of a plug flow reactor, should be provided. Even if each reach is modeled as a complete mix reactor, the resultant equation will not be what is given on page K-3. It should also be stated that bacteria are assumed to be discrete particles that don't settle unless "die off" refers to the combined processes of settling of particle-associated bacteria and death.

The dry weather flow rate of 15 cubic feet per second (cfs) is stated as an assumption (page K-4) but the justification is not provided.

The significances (p values) for regressions (beginning on page K-4) are important. If they are greater than 0.05 (assuming 95 percent confidence intervals for these estimates) then the use of the correlations should be further justified.

Response: The plug flow equation can be derived from the following materials balance equation:

$$QC_{in} - QC_{out} + rV_R = V_R \frac{dC_{out}}{dt}$$

where, $Q = Q_t + Q_r$
V_R = reactor volume
r = rate of change in C
t = time

For simplicity, infiltration losses (I) were not considered. Assuming plug flow with $dC_{out}/dt = 0$ (steady-state), and dividing both sides by V_R,

$$-\frac{dC}{dt} + r = 0$$

With $r = -kC$ (first order loss), and $t = x/u$, the above equation can be determined.

The context of the 15 cfs dry weather flow criterion on page K-4 was specific to screening of regional flows for determination of physical stream dimensions for the model. All flow data for 53 USGS stations in the region were screened so that equations could be developed for prediction of stream cross-sectional area and width as a function of low flows. The purpose for limiting to 15 cfs was to ensure that coefficients of equations 4 and 5 (Appendix K), derived through regression analyses, were not controlled by high wet-weather flows when width verses flow relationships can vary. The 15 cfs assumption was not, of itself, used in development of equations, and therefore does not require justification.

For the multivariable regression analysis performed for dry-weather flows and fecal coliform concentrations (equations 6 and 7), p-values were evaluated for each variable to test statistical significance. Section K.4 was edited to present p-values of each variable. All p-values were below 0.05 cfs, with the exception of the equation 7 variable representing the percentage of subwatershed land use assigned to open recreation, which only slightly exceeded at 0.067.

8. Use of data from Aliso, San Juan, Rose, and Tecolote Creeks to characterize dry weather source loading in the entire San Diego Region.

Comment:Again (as above), the significance (p value) of the derived correlation should be provided. Otherwise, it is hard to know that the equation is valid for predictions (page K-6). It is interesting, and somewhat curious, that the correlation is to so many factors (land uses and watershed size). How this analysis was performed would be important to convey in the document.

If the p value is high for the equation on page K-6, this would suggest that monitoring of the other watersheds should occur. Even if the p value is high, however, the lack of data would suggest that little knowledge exists regarding the need for TMDL extrapolation to the other watersheds, and that data should be collected to refine the process.

Response: P-values and further explanation of the multivariable regression analyses procedure was added to the text.

The San Diego Water Board agrees that as additional data are collected in the region to further characterize dry-weather flows and indicator bacteria concentrations, methods for bacteria load estimation and calculation of TMDLs should be refined in the future.

9. Use of geometric mean objectives for dry weather numeric targets.

Comment: The use of a geometric mean for dry weather numeric targets should be discussed in light of monitoring activities at beaches and how convenient this will be for making posting and closure decisions. A single sample-basis target is potentially more useful (for decision making) regarding beach closures. Also, dry weather conditions are likely to be less variable as compared to wet weather conditions.

Response: The use of geometric means for numeric targets for TMDL calculations is distinct from making posting and closure decisions at public beaches. The decision to post or close a beach is determined by single sample measurements of bacteria, and an immediate response is required if a measurement exceeds the bacteria WQOs for any of the three indicator bacteria for marine waters (total coliform, fecal coliform, or enterococci). This protocol is described and mandated by Health and Safety Code section 115880.

In contrast, TMDL projects are long-term strategies for achieving water quality. Numeric targets are used to calculate the assimilative capacity, and hence the TMDL, of a waterbody. Once the TMDL for a waterbody has been determined for a given pollutant, the required load and waste load reductions are calculated and the method(s) of enforcement determined. The use of a geometric mean for dry weather numeric targets is used for calculating TMDLs, and not proposed for making posting and closure decisions. The San Diego Water Board agrees that dry weather conditions are likely to be less variable than wet weather conditions. For this reason, the geometric mean was used as dry weather numeric targets, since this modeling platform assumes a steady state base flow.

10. Reasonableness of assumptions (described in Appendix L) for dry weather modeling.

Comment: The assumptions appear to be sound. As above, the plug flow modeling probably needs to be shown more completely and double-checked. The multivariate regression analyses should be double checked for significance (p values) and significances reported.

Response: Appendix K has been modified to provide further explanation of the multivariable regression analysis. P values have also been provided.

11. Location of critical points for TMDL calculation.

Comment: The locations of critical points (mouths and bottom of creeks and watersheds) are reasonable for protecting beach water quality. The impact of the watershed at this point is fully integrated from up to downstream. However, where small estuaries or lagoons separate the creek mouth from the coastal ocean, they should also be considered in this process. Lagoons and estuaries can accumulate and discharge fecal coliform-laden sediments during low and high flow conditions, respectively.

Response: The San Diego Water Board recognizes that small estuaries and lagoons provide habitat for wildlife, and therefore can be significant sources of bacteria. For this reason, systems with estuaries or lagoons were not analyzed in this project. Impaired waters having lagoon-like characteristics will be addressed in a subsequent TMDL project, *Bacteria-Impaired Waters TMDLs for Lagoons in the San Diego Region*. The models used in this project are suitable for simulating the unique dynamics of lagoon systems.

12. Use of conservative assumptions to comprise an implicit Margin of Safety.

Comment: In this reviewer's mind, a "margin of safety" is an explicit add-on to a limit. It is really difficult to tell what are the "conservative assumptions". For example, in wet weather modeling, it might not be conservative to make the creek mouth the critical point if there is a lagoon or estuary. On the other hand, most of these discharges do not have lagoons or estuaries downstream of the creek mouth. In any event, the Assumptions in Appendix L don't explicitly describe the "implicit' conservative assumptions, and the only real text devoted to the margin of safety issue appears to be in Section 8.1.7 rather than in the modeling appendices (J and K). It would be worthwhile to add some text to the document that more explicitly outlines where the "implicit" margin of safety is built in to each model.

Response: The location of the critical point at the creek mouth as an assumption is conservative because all watersheds included in this analysis did not include an adjacent lagoon or estuary (see response to comment 11). The discussion regarding the implicit margin of safety and how it was utilized was expanded in section 8.1.7.

<u>Overarching Questions:</u>

(a) Are there any other issues with the scientific basis of the proposed rule?

Comment: The mixed use of REC-1 and SHELL criteria for water quality targets at the same location may introduce some difficulty to water quality managers. The SHELL criteria are more stringent, so the mixed use of these results in a total coliform criteria that is lower than fecal coliform. Practically, this is difficult to achieve since fecal coliform are, in concept and practically, a subset of total coliform. How will total coliform levels ever be lower than fecal coliform levels at the same location? See Table 4-2 for the summary. It appears that this is only a problem at beaches.

Section 10 on Implementation is nonexistent. The impression from the placeholder paragraph is that dischargers may amend the TMDLs and that the timescale for implementation is unknown. If more data are to be collected for more study of the watersheds, and the resulting impact is delayed or uncertain implementation, this would delay protection of the coastal water quality in the San Diego Region. Implementation measures are the translation of the science into effective water quality management. The degree to which the science can be implemented adds to its validity in the TMDL process. Therefore, an additional comment on this document is that the presentation of implementation strategies and monitoring plans should be part of the TMDL document. One aspect of implementation will be flow measurement. As stated in Appendix K, few flow measures are available, yet to comply with the TMDLs these will have to be made.

Response: Table 4-2 has been modified for clarity. The San Diego Water Board recognizes that in all instances, final numeric targets for fecal coliform are greater than the numeric targets for total coliform, even though total coliform includes fecal coliform. This is because the final targets are based on WQOs associated with SHELL, and SHELL only applies to total coliform. Final targets for fecal coliform are associated with REC-1.

Since the Technical Report was made available to the peer reviewers on February 7, 2005, the San Diego Water Board, in consultation with the Stakeholder Advisory Group, has developed an Implementation Plan that outlines the strategy for achieving compliance with WLAs developed in the technical analysis. The TMDLs will be implemented primarily by reissuing or revising the existing NPDES requirements for MS4 discharges to include WQBELs that are consistent with the assumptions and requirements of the bacteria WLAs for MS4 discharges. The process for issuance of NPDES requirements is distinct from the TMDL process, and is described in section 11.5.1. WQBELs for municipal stormwater discharges can be either numeric or non-numeric. Non-numeric WQBELs typically are a program of expanded or better-tailored BMPs and submission of annual water quality monitoring reports. Reporting shall continue until the bacteria WQOs are attained and maintained in impaired beaches and creeks.

(b) Is the scientific portion of the proposed rule based upon sound scientific knowledge, methods and practice?

Comment: In Appendix C-1, a small editorial recommendation is to remove the word “species” from the first line of page C-1. This is because “total coliform” and “fecal coliform” are empirically-defined groups of bacteria and are not “species” per se. While many taxonomic groups make up the total and fecal coliform, these indicator organism classifications are not derived from any accepted taxonomy.

Overall, it is great to see the development of and use of simulation tools for modeling bacterial discharge under two seasonal regimes as the basis for TMDL development. However, as with all TMDLs, there is a need to demonstrate a relationship between indicator bacteria and threat to swimmers and fishers. Increasingly, DNA-based metrics of human-waste associated *Bacteriodes* or *Enterococcus* are used to make a more robust link between the presence of bacteria in coastal waters and the presence of human waste. Better yet, these methods are increasingly becoming quantitative with the availability of real-time or quantitative polymerase chain reaction (QPCR). At the time of this review, there is a reasonable amount of evidence in the peer-reviewed scientific literature that DNA-based markers of human waste can be used to more definitively understand the presence of human waste. At the very least, new TMDL programs, as part of the monitoring portion of implementation, should strive to gather a better understanding of the real presence of human waste using DNA-based evidence from sampling and analysis in conjunction of standard indicator organism assays.

Response: The word “species” has been removed from the first line of page C-1.

The San Diego Water Board agrees that there is a need to demonstrate a relationship between indicator bacteria and threat to swimmers and fishers, and that this is an area of uncertainty. Furthermore the San Diego Water Board recognizes that there is an increasing amount of research being done to establish this link using innovative methods.

The required monitoring portions described in the Implementation Plan consist of monitoring for indicator bacteria. As part of source identification, responsible persons can monitor for DNA markers, or use other innovative methods as appropriate.

Comments from Professor Nelson

Comment: My overall assessment is that the approach used to determine interim TMDLs is technically sound, with the exception of the concerns raised below regarding the dry-weather model. I believe that implementation of the Interim TMDLs will result in a significant improvement in water quality, and is far preferable to postponing action until remaining sources of uncertainty can be addressed. However, there is an opportunity to learn more about the fundamental processes that contribute fecal indicator bacteria to the surface waters in the San Diego region through the monitoring that will be required to document compliance with Interim (and Final) TMDLs. I strongly recommend that the San Diego Water Board, in preparing the Implementation Plan, ensure that the monitoring data are collected in a manner that maximizes the amount of information that can be learned, including gaining more insight into the fundamental source, fate, and transport processes.

Response: Comment noted. The San Diego Water Board agrees that insight into the sources, fate, and transport processes for bacteria is valuable for designing strategies for abatement. The Implementation Plan outlines monitoring efforts that will be required from responsible persons, including receiving water monitoring and identification of bacteria sources.

1. Use of land use composition to quantify bacteria sources from all watersheds to affected beaches and creeks in the San Diego Region.

Comment: This is a reasonable approach.

Response: Comment noted.

2. **Use of wet weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks**.

Comment: In general, the approach used for the wet weather model seems reasonable given the limited existing data. The method for calibrating and validating the model is presented well. Although the model results agreed fairly well with the observed concentration for the high flows (especially above 60 percent unit area flow, as reported in Appendix N Figures 12-25), at low flows the model often underestimated the concentrations. In the text on p. J-11 it is stated that these flows may be better modeled as dry flows. However, since the flow on these days was defined as a wet flow, it is not clear to me that these loadings are being appropriately incorporated into the TMDLs. It may be necessary to redefine the classification of wet flows. In addition, as the science describing the sources of fecal pollution and their transport mechanisms improves, the model will need to be improved and TMDLs reevaluated. For example, the resuspension and erosion of sediments in water channels during storm events may be an important source of indicator bacteria that is not accounted for in the current model.

Specific comments on Appendix J:

a. (p.J-4) Please provide a table of the percent (%) impervious for each land-use category.

b. (p.J-6) I don't believe atmospheric deposition of fecal indicator bacteria is a potential source, unless you mean deposition from birds.

c. (p.J-12) I would not characterize the model and observed data as "extremely" well. I would say "fairly" well.

Additional comments on Appendix M:

d. It is difficult to see the curves for the observed and modeled daily rainfall on the calibration and validation graphs because the peaks are so sharp and the lines so thin. Since this graph is the only one presented for the validation, I suggest changing it to monthly rainfall rather than daily rainfall (as was done for the calibration).

e. The legend for the validation curves is incorrect (states monthly instead of daily rainfall).

Response: Wet and dry periods were identical to San Diego County Department of Environmental Health's General Advisory to avoid contact with ocean and bay water within 300 feet on either side of any storm drain, river, or lagoon outlet, and the timeframes for these advisories are designated as 72 hours after 0.2 inch or more of rain. For each watershed, rainfall data from the nearest rain gage was analyzed for identification of wet and dry days based on these criteria. The general nature of this approach may have resulted in selection of wet days that are not representative of wet conditions. This was shown in calibration results that illustrated under-prediction of bacteria concentrations during lower flow ranges that were categorized, based on the methodology above, as wet conditions. However, the impact of this under-prediction is minimal on overall wet-weather TMDL calculations because the required load reductions were dominated by higher flow conditions (loadings during wet weather were multiple orders of magnitude above dry - see Appendices O and P). If better methods are determined for defining criteria for selection of wet and dry conditions impacting beaches and creeks, the TMDLs can be reevaluated in the future.

The San Diego Water Board agrees that an improved understanding of bacteria sources and transport from the watersheds may require future updates of the wet-weather model and reevaluation of TMDLs. The association of bacteria to sediments in the stream channels and processes of settling and resuspension are important considerations, and the LSPC model includes capabilities for simulation of these processes if data becomes available to define modeling assumptions or facilitate model calibration.

Specific comments addressed in Appendices J and M were as follows:

a. Table J-2 was added to Appendix J that lists percent imperviousness for each of the urban land uses, based on assumptions from the National Resources Conservation Service's (formerly known as the Soil Conservation Service) TR-55 manual.

b. The San Diego Water Board agrees that atmospheric deposition is not a potential source of bacteria. This discussion was removed from the text on page J-6 of Appendix J.

c. The text on page J-12 of Appendix J was changed to state that the model and observed data matched "fairly" instead of "extremely" well.

d & e. All daily hydrology calibration and validation results reported in Appendix M show daily rainfall, although the plots were mislabeled as "Avg Monthly Rainfall." The plots were edited to correctly label rainfall as "Daily Rainfall." Daily results are more appropriate for these plots so that impacts on daily flows can be observed. Monthly rainfall would not show this relationship with the same resolution as daily results.

3. Selection of a Los Angeles watershed as a "reference" for background loading of bacteria in the San Diego Region during wet weather.

Comment: Given that sufficient data do not exist for a reference watershed in the San Diego Region, it is reasonable to use a reference watershed in Los Angeles. However, the Implementation Plan should require that one or more appropriate reference watersheds are identified and characterized for the San Diego region, and that these data are used to determine the final TMDLs.

Response: The San Diego Water Board agrees that an appropriate reference watershed(s) should be identified and characterized in the San Diego Region. The San Diego Water Board is actively participating in a workgroup chaired by the Southern California Coastal Water Research Project (SCCWRP) that has completed a study to characterize reference systems for bacteria in southern California. A reference system was defined in the study as a beach and upstream watershed consisting of at least 95 percent undeveloped land. Because the reference systems consist almost entirely of undeveloped land, the bacteria washed down to the beach come from natural, nonanthropogenic sources. Measurements during the 2004-2005 winter season showed that in four reference systems (two in Los Angeles County, one in Orange County, and one in San Diego County), 27 percent of all samples collected within 24 hours of rainfall exceeded water quality thresholds for at least one indicator (i.e. a single sample WQO was exceeded 27 percent of the time due to nonanthropogenic sources within 24 hours of rainfall) (Schiff et al., 2005). This is higher than the 22 percent found at the Arroyo Sequit watershed in Los Angeles, which was used to calculate interim TMDLs discussed in section 4.1. The Arroyo Sequit watershed is one of the four reference watersheds included in this study.

The reference system approach is designed to account for bacteria loading from natural sources. This approach assumes that the natural processes that generate bacteria loads in a reference system, such as bacteria regrowth on beach wrack,[2] resuspension from disturbed sediment, and direct deposition of bird and mammal feces in water, also occurs in the urbanized watershed and downstream beach. The frequency of exceedance of single sample bacteria WQOs from natural

[2] Wrack consists of seaweed, eel grass, kelp, and other marine vegetation that washes up on shore and accumulates at the high tide line. The "wrack line" is essentially the high tide line.

sources can be measured in reference systems, and applied in urbanized watersheds. As discussed in section 4, dischargers are not required to reduce bacteria loads from these and other natural sources to achieve TMDLs.

As written, this TMDL project requires attainment of both interim TMDLs, which incorporate the reference system approach, and final TMDLs, which adhere to WQOs as currently written in the Basin Plan. A Basin Plan amendment to authorize the reference system approach for implementing single sample bacteria WQOs is required to avoid the need to attain the final TMDLs. The San Diego Water Board will investigate and process the proposed reference system Basin Plan amendment in accordance with local priorities and resources. After this Basin Plan amendment is adopted, TMDLs included in this project can be re-calculated to reflect an appropriate exceedance frequency.

4. Use of single-sample maximum objectives for wet weather numeric targets.
Comment: The use of single-sample maximums for the wet weather targets is a reasonable approach.

Response: Comment noted.

5. Reasonableness of assumptions (described in Appendix L) for wet weather modeling.
Comment: The assumptions are reasonable, except please clarify that the first-order die-off rate is an "apparent" rate, not an actual rate.

Response: The first order die-off assumed in the wet-weather model was an "apparent" rate assumed based on model sensitivity analyses performed in similar studies in Southern California.

6. Use of wet weather modeling parameters to simulate build-up/wash-off of bacteria from a similar study in Los Angeles (Los Angeles Water Board, 2002).
Comment: The use of data from L.A. is reasonable given that no local data exist. However, the starting values taken from the Los Angeles Water Board should be reported in Appendix J, or in a separate Appendix.

Response: Comment noted. The values for the modeling parameters have been incorporated into Appendix J.

7. Use of dry weather model to simulate fate and transport of bacteria, and to calculate TMDLs, to affected beaches and creeks.

Comment: The assumption of plug-flow hydraulics to describe the creek flows, and the empirical approach used to model the bacterial concentrations appears to be an acceptable approach given the limited data that are available. However, I have some significant concerns about how the empirical relationships were developed. Appendix K is poorly written, and it is possible that most of my concerns could be addressed if the methods were explained more clearly and in more detail.

Response: The comment regarding the clarity of Appendix K was noted. Appendix K was revised to more clearly explain the development of the dry weather model.

Comment continued: My specific concerns are the following (many of these items are interrelated):

a. Please number each of the equations.

Response: All equations were numbered.

b. Please explain how the functional form (linear, exponential, etc.) and best fit (quantitative or qualitative?) for each of the equations in Appendix K was determined. In particular, how were the multiplication factors (constants) determined in the equations on p. K-5 and K-6? In the equation on p. K-6, why isn't A (total watershed area) multiplied by the rest of the equation? It seems to me that the fecal coliform concentration should increase or decrease proportionally (although not necessarily linearly) with the watershed area.

Response: Additional explanation of the multivariable regression equations developed to estimate dry weather flows and fecal coliform concentration was provided in Section K.3 and K.4 of Appendix K. These discussions describe the method for regression analyses, the justification for structure of the equations, and tests performed for evaluation of statistical significance of variables.

c. How are infiltration and evaporation incorporated into the flow mass balance (equation at top of p. K-4)?

Response: Infiltration and evaporation are not included in the mass balance (equation 2) since this equation is specific to calculation of the bacterial concentration of the *inflow* to the reach (C_{in}) that includes local watershed drainage as well as upstream reach flows. The infiltration/evaporation assumptions only apply for calculation of the flow at the bottom of the reach (see added explanation in text). This flow at the bottom of the reach is then multiplied by the concentration determined by equation 1 for determination of the loading from the reach.

d. (p.K-3) My understanding is that in the model for bacterial loading, the loading for the drainage area for each segment is added at the bottom of that segment (which is the top of the next segment). If this is the case, it is a conservative approach, because the decay of any bacteria that actually enter the watershed upstream of that point is not considered. This assumption should be discussed, and its contribution to the "Margin of Safety" should also be stated.

Response: The commentor's definition of the watershed loading input to a stream reach is correct. Also correct is the comment that bacterial decay is not considered explicitly upstream of the point where a watershed is assumed to discharge to the reach. However, the "total area of watershed" variable in equation 7 is also implicitly representative of additional die-off that may occur in the watershed prior to discharge to the reach (see added explanation in text). As a result, we consider the two bacterial die-off formulations to be acceptable and not overly conservative, and therefore not necessary to mention in the Margin of Safety.

e. I have some major concerns about how the empirical equations for the bacterial loadings and die-off rates were developed. It seems that first the Equation on p. K-6 was developed by regression analysis. Then, using the same data set, die-off rates were incorporated and their values adjusted until the "best fit" was achieved between the modeled and observed (geometric mean) values at each sampling station. Thus, the die-off rates are just accounting for the inability of the regression equation to describe the observed data. If this is the case, the die-off rates are just fitting parameters but there is no reason to believe that what is being modeled is actually die-off. Furthermore, I do not understand how the die-off rates for total coliform bacteria and enterococci were determined independently from the multiplication ratios (on p.K-7), nor how the regression equations were evaluated for best fit. For example, in Figure K-11 the results are presented for the calibrated enterococci model, but the observed concentrations are significantly lower than the modeled concentrations. Thus, it does not seem that the model was calibrated correctly. In addition, it is not clear to me what parameter would be adjusted to achieve a better fit – increase the die-off rate, or decrease the multiplication factor?

Response: Several stations used in development of the regression analysis for prediction of watershed of bacteria concentration (equation 7) and the calibration and validation of in-stream bacterial die-off were the same. As many stations as possible were used in the regression analysis due to a general lack of watershed data in the region and a need for a robust dataset to provide statistical significance. Effects of bacteria die-off that may be implicitly incorporated in the regression equations (e.g., negative correlation of bacteria concentration to watershed size suggests effects of bacteria die-off in equation 7) were not considered duplicated in the reach assumptions. Model configuration of multiple subwatersheds and reaches differed from single representative watersheds used in regression analyses, and required incorporation of assumptions for reach infiltration and bacterial die-off to account for losses occurring during transport. Each model subwatershed used the regression equations to estimate flow and bacterial concentration that were routed through a network of stream reaches that ultimately met locations corresponding to monitoring stations used for calibration. However, watersheds used for regression analyses represented a single watershed for the same area, with no stream routing. Hence, the die-off rates developed for the reaches were not consistent with errors associated with regression equations applied to the entire watershed without reach routing and losses considered. To further prove the independence of the calibration procedure from the regression analyses, data from five additional in-stream monitoring stations that were not used for regression analyses were also used for calibration. Bacterial die-off rates were also validated for fifteen stations on Tecolote Creek and San Juan Creek, of which eight of these stations were not used in development of the regression equation 7.

The process for calibration of die-off rates for total coliform and enterococci were consistent with the procedure used for fecal coliform. The die-off rates were calibrated to minimize the difference between observed in-stream bacteria levels and model predictions. Upon review of Figure K.11 that showed calibration results for the enterococci die-off rate, an error in the plot was discovered that resulted in depiction of modeled concentrations that were higher than those actually modeled. (All other calibration and validation plots were correct). The plot was fixed and replaced in the text. The modeled enterococci concentrations were well within the ranges of observed concentrations.

f. Other limitations to the empirical approach are evidenced by the fact that equations relating total coliform bacteria and enterococcus concentrations to land use could not be developed. I expect that the use of multipliers to determine the concentrations of these indicators as a function of fecal coliform concentrations is a major source of error in the model, because different sources of fecal waste may have different ratios; furthermore, the rates of removal and inactivation in the environment may differ for the different bacteria. The variation in the fecal coliform: enterococci ratio is expected to be particularly large, since it is known to range from a ratio of less than one in human waste to greater than 40 in some animals wastes. Thus, although there was fairly good agreement for the creek segments used to validate the model, I expect these assumptions to introduce significant amount of error for other creek segments (those that were not used for model calibration.)

Response: The San Diego Water Board agrees that there are limitations to the empirical approach that are evidenced by the inability to derive equations for total coliform and enterococci as a function of land use. Furthermore, the method for prediction of total coliform and enterococci based on fecal coliform introduces additional potential error in the technical approach. However, the San Diego Water Board feels that given the limited data in the region to define dry weather loading, and the proven ability of the model to calibrate and validate fairly well to data in multiple watersheds representative of environments in the north and south of the region, the empirical methods are sufficient for calculation of TMDLs. However, as more data are collected in the watersheds in the region, the empirical methods can be refined, retested, or even substituted with more robust methods developed through further study.

g. Some of my concerns with the empirical approach used to develop the equation on p.K-6 may be addressed if the explanation was better. Section K.4 needs significant improvement:
   i. In addition to the number of sampling stations for each Creek, please also report the number of samples for each station.
   ii. Clearly large data sets are better than small data sets, but was the number of samples at each station taken into account for the regression analysis? Was the data from some stations not used?
   iii. How is it known that 40 data points is enough to adequately represent the range of conditions at one sampling station?
   iv. Please explain exactly how the regression analysis was performed. How did the regression analysis of the data at each station result in the final equation?

Response: Tables K-1 and K-2 were added to the text to list the monitoring stations and number of measurements available for calculation of the average flows and geometric mean of indicator bacteria concentrations used in development of the regression equations.

Large datasets were preferred in the analyses of indicator bacteria data, but were not "required" as the original text had mistakenly reported. Many of the stations in the Aliso Creek study had 40 measurements for analyses. The number of measurements at stations in the other creeks varied. No criteria were developed for selection of stations based on the number of samples for representative geometric mean calculations. Rather, station selection included qualitative evaluation for consideration in the analyses. Specific stations of Rose Creek, Tecolote Creek, and San Juan Creek were selected for analyses even though few samples were available at these locations for geometric mean calculations. These stations were selected for multiple reasons, including the relatively low indicator bacteria concentrations observed (see Figure K-4), strategic locations of watersheds to provide an expanded spatial coverage for analyses, size of the watershed, or representation of key land uses. Since some of these stations were representative of subwatershed runoff that is less urban than other locations in the Aliso Creek watershed, and geometric means of concentrations were less than those for more urban areas, their inclusion in the analyses was determined useful regardless of the smaller datasets. Use of these lower concentrations also expands the applicability of regression equations for prediction of concentrations that fall within the range of values used in their development.

The accuracy of the regression equation 7 appears to be impacted by the amount of data used in the geometric mean calculation. It is evident from results shown in Figure K-4 that the model performs better for those stations that had many data points for geometric mean calculation. Prediction of lower concentrations for San Juan Creek, Rose Creek, and Tecolote Creek were less accurate, although the equation successfully predicted concentrations lower than what was observed in Aliso Creek. So, the general trend was captured for lower concentration ranges (based on geometric means of smaller datasets), but the exactness of the equation could be improved or evaluated better if more data was available at these stations.

Some stations were not used in the analyses because there was no information regarding the subwatershed draining to the station location (particularly in Aliso Creek that had many small, urbanized subwatersheds). Other stations were within the creek mainstem and were reserved for calibration or validation of the model's reach formulations. Other stations had no data.

Section K.4 was expanded to improve explanation of the method for regression analyses and how the final variables and associated coefficients were developed for equation 7.

8. Use of data from Aliso, San Juan, Rose, and Tecolote Creeks to characterize dry weather source loading in the entire San Diego Region.

Comment:It is difficult to assess whether these three creeks are representative of the rest of the watersheds in terms of runoff and bacterial densities. I suggest including a paragraph with a short description of these three watersheds and a discussion of how they compare to others. In the Implementation Plan, a strategy should be outlined for incorporating data from additional watersheds into the development of final TMDLs.

Response: A short description of the watersheds and their relevant characteristics was added to section K.1.

In terms of implementation, see response to comment 3. The Regional Board anticipates development of final TMDLs that are based on exceedances frequencies calculated from additional reference watersheds.

9. Use of geometric mean objectives for dry weather numeric targets.

Comment: The use of the geometric mean seems to be an appropriate water quality objective if the assumption that dry weather concentrations are fairly constant is correct. However, if future monitoring efforts identify high episodic concentrations, this approach may need to be reevaluated because health impacts are likely to result from exposure to the high episodic concentrations, which may not be adequately represented (and therefore regulated) by geometric means.

Response: The San Diego Water Board recognizes that dry weather concentrations are not constant and are likely to vary significantly during a 30-day period. However, accounting for this variability in TMDL calculation has proven to be complex due to difficulty in predicting the variability for watersheds where data are limited. Therefore, the San Diego Water Board believes that the method used in this prediction of bacteria loads for this TMDL analysis is adequate. As more data are collected to provide further study and development of improved methods for estimation of bacteria loading, TMDL calculations can be revisited in the future.

10. Reasonableness of assumptions (described in Appendix L) for dry weather modeling.

Comment: Most of the assumptions are reasonable, except:

a. Please clarify that the first-order die-off rate is an “apparent” rate, not an actual rate. Also, I agree that given the lack of data on the occurrence of bacterial regrowth in the Southern California region, it is not possible include regrowth in the model for dry weather flows. However, regrowth has been demonstrated in tidally-influenced river sediments in Florida (e.g. Desmarais, T. R., Solo-Gabriele, H. M., and Palmer, C. J. 2002. "Influence of soil on fecal indicator organisms in a tidally influenced subtropical environment." Applied and Environmental Microbiology, 68(3), 1165-1172.) Thus, regrowth should be recognized as a potential source of error, and should regrowth be documented in the region in the future, it may need to be incorporated into the modeling framework.

b. There is a typographical error in the "regrowth" assumption – it says "wet" instead of "dry".

Response: The first order die-off assumed in the wet weather model was an "apparent" rate assumed based on model sensitivity analyses performed in similar studies in Southern California. The San Diego Water Board recognizes that other factors such as bacteria regrowth may play a role in impaired streams, but presently there are no data to verify or quantify these factors. Therefore, the apparent rate of bacteria die-off may be representative of multiple factors that ultimately result in a net loss in bacteria over time. Should regrowth be documented and quantified in the future, model assumptions for re-growth and die-off can be redefined and TMDLs can be revised.

The typographical error has been corrected.

11. Location of critical points for TMDL calculation.

Comment: The location of the critical points is appropriate.

Response: Comment noted.

12. Use of conservative assumptions to comprise an implicit Margin of Safety.

Comment: The use of conservative assumptions rather than an explicit Margin of Safety is appropriate. Also see comment 7d above.

Response: Comment noted.

***Editorial Comment*:** Several of the references to Appendices, Tables and Figures were incorrect, as documented below. (The entire document should be checked).

- (p.7) Reference to Appendix G is incorrect (should be Appendix H?)
- (p.K-2) Reference to Sections J.2.2. and J.2.3. incorrect?
- (p.K-13) Should be Figures K-13 through K-15 (not J)
- (p.J-10) Should be Tables J-3 through J-5 (not F-3 through F-5)
- (p.J-11) Should be Tables J-3 through J-5 (not F-3 through F-5)
- (p.L-1) Should be Appendices J, M and N (not J, O and P)

Response: Comment noted. The Technical Report has been modified to correct the text, as noted above, and the entire report checked for consistency.