FUNCTIONAL EQUIVALENT DOCUMENT

AMENDMENT OF THE WATER QUALITY CONTROL PLAN FOR OCEAN WATERS OF CALIFORNIA

CALIFORNIA OCEAN PLAN

SUBJECT TO REVISION

MARCH 1990

STATE WATER RESOURCES CONTROL BOARD

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FINAL

MARCH, 1990

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LIST OF ABBREVIATIONS

ADI	allowable daily intake (or reference dose)
AET	apparent effects threshold
ASTM	American Society for Testing and Materials
BAF	bioaccumulation factor
BCF	bioconcentration factor
C	water concentration
CCR	California Code of Regulations
CDC	Center for Disease Control
CDD	chlorinated dibenzo-p-dioxin
CDF	chlorinated dibenzofuran
Ce	effluent concentration
CEAT	Conservative Estimate of Acute Toxicity
CEQA	California Environmental Quality Act
CECT	Conservative Estimate of Chronic Toxicity
CFR	Code of Federal Regulations
Cs	seawater concentration
CWA	Clean Water Act
CWC	California Water Code
DDT	dichlorodiphenyltrichloroethane or 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-benzene]
DHS	Department of Health Services
Dm	minimum initial dilution
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FED	Functional Equivalent Document
FY	fiscal year
GC/MS	gas chromatography/mass spectrometry
HCH	hexachlorocyclohexane
ICS	individual control strategy
IRIS	Integrated Risk Information System
LC 50	lethal concentration that kills 50 % of test organisms
LMS	linear multistage model
MDL	method detection limit
MGD	million gallons per day
mg/l	milligrams per liter
ml	milliliter
NATO	North Atlantic Treaty Organization
ng/l	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NOEL	no observed effect level
NPDES	National Pollutant Discharge Elimination System
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PQL	practical quantitation level
pg/l	picograms per liter
POTW	Publicly Owned Treatment Works
ppb	parts per billion (ug/l)
ppq	parts per quadrillion (pg/l)
ppt	parts per trillion (ng/l)
q*	cancer potency factor
QSAR	quantitative structure activity relationship
RfD	reference dose
RWQCB	Regional Water Quality Control Board

SCBRC	Southern California Bight Review Committee
SCCWRP	Southern California Coastal Water Research Project
SERRA	South East Regional Reclamation Authority
SWRCB	State Water Resources Control Board
TBT	tributyltin
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TEF	toxicity equivalency factor
TLm%	percent median tolerance level
TRE	toxicity reduction evaluation
tu	toxicity unit
TUa	toxicity unit acute
TUc	toxicity unit chronic
ug/l	micrograms per liter
U.S.	United States
USDA	United States Department of Agriculture
WDH	Wisconsin Department of Health

SUMMARY

The State Water Resources Control Board (State Board) staff has prepared this final Functional Equivalent Document for consideration of several amendments to the California Ocean Plan. A hearing was held on the proposed amendments on August 29, 1989. We have summarized and developed responses for each comment received before the hearing record was closed. Some of the alternatives and Ocean Plan amendments have been modified to reflect the comments received. The report contains the staff review of some of the high priority issues raised in the Ocean Plan Triennial Review and Workplan (completed in 1987). A summary of the review follows:

1. Monitoring Guidance: We propose to reorganize the Ocean Plan slightly so guidance on plan implementation can be included in the plan as amendments are added. A new appendix is proposed for Ocean Plan monitoring guidance.

2. Bacterial Standards: We recommend a new bacterial assessment and remediation section in Chapter II of the Ocean Plan.

3. Initial Dilution: We do not recommend any change in the use of minimum initial dilution for implementing water quality objectives.

4. Amendment to Table B Objectives: We recommend several new water quality objectives be included in Table B so the State Board can comply with Section 303(c)(2)(B) of the Clean Water Act (CWA). We recommend the use of method detection limits and practical quantitation levels to implement water quality objectives. For clarity of presentation we addressed the five sub-issues below:

   a. Update of Existing Table B Objectives: We recommend modifying the water quality objective for cyanide and total residual chlorine.

   b. Add New Water Quality Objectives to Table B: We recommend adding two new aquatic life water quality objectives (endosulfan and selenium) to Table B. The substances selected for incorporation in Table B are toxic pollutants identified under Section 307(a) of the CWA ("priority pollutants") not already contained in the Ocean Plan.

   c. Add New Water Quality Objectives to Protect Human Health from Consumption of Fish: We recommend several new objectives to protect human consumption of fish. We have used the Environmental Protection Agency (EPA) methods for calculating the water quality objectives and have updated the fish consumption estimate and some of the potency factors.

   d. Add a Water Quality Objective for Chlorinated Dibenzodioxins and Dibenzofurans: We recommend a new human health objective for chlorinated dibenzodioxins and related dibenzofurans.

   e. Add a New Water Quality Objective for Tributyltin (TBT): We recommend adding a new human health water quality objective for TBT.

5. Bioassay Protocols and Their Implementation: We recommend the State Board adopt a new toxicity water quality objective and a list of protocols for implementing the objective.

6. Sludge Disposal: We recommend no change in the sludge disposal requirements in the Ocean Plan.

FUNCTIONAL EQUIVALENT DOCUMENT:
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CALIFORNIA OCEAN PLAN

INTRODUCTION

In March 1987 (Resolution No. 87-21), the State Water Resources Control Board (State Board) declared its intent to amend the Water Quality Control Plan for Ocean Waters of California (Ocean Plan) annually or as major issue analysis is completed (SWRCB, 1987). The first set of amendments was adopted by the State Board on September 22, 1988 (SWRCB, 1988b; 1988c). The purpose of this report is to present the staff recommendations for modification of some other portions of the Ocean Plan.

Recommendations are made for six major issues raised in the 1987 Triennial Review of the Ocean Plan: monitoring guidance, bacteriological standards, initial dilution, additions and update of Table B, bioassay protocols and related objectives, and sludge disposal. A public hearing was held by the State Board (Danny Walsh, Hearing Officer) on August 29, 1989 to receive public comment on the proposed amendments (SWRCB, 1989). The comments received are summarized under each issue. The comments not pertinent to the issues under consideration by the Board are listed in a separate section.

We are continuing to complete the staff analysis for the remainder of the issues identified in the triennial review (SWRCB, 1987). A progress report of the staff analysis on these issues is presented.

The State Board must comply with the requirements of the California Environmental Quality Act (CEQA) when adopting a regulatory program, such as the Ocean Plan or Regional Water Quality Control Plan amendments. CEQA provides that a State agency regulatory program is exempt from the requirements for preparing Environmental Impact Reports (EIRs), Negative Declarations, and Initial Studies if certified as functionally equivalent by the Secretary for Resources. The process the State Board will use to amend the Ocean Plan has received certification from the Resources Agency to be "functionally equivalent" to the CEQA process [14 California Code of Regulations Section 15251(g)]. The environmental impacts occurring as a result of these amendments are summarized in an Environmental Checklist (Appendix B).

Background

The Ocean Plan establishes the water quality objectives for California's ocean waters and establishes the basis for regulation of wastes discharged into the State's coastal waters. It applies to point and nonpoint discharges. The State Board adopts the Ocean Plan, and both the State Board and the six coastal Regional Water Quality Control Boards (Regional Boards) implement and interpret the Ocean Plan.

The Ocean Plan contains sections on beneficial use designations, water quality objectives, requirements for management of wastes, effluent and receiving water requirements, discharge prohibitions, and general provisions for exceptions and monitoring programs. Chapter I of the Ocean Plan identifies several uses of marine waters that should be protected. These uses include protection and enhancement of marine life and Areas of Special Biological Significance (ASBS) (SWRCB, 1974), fish migration, fish spawning, shellfish harvesting, rare and endangered species, recreation, industrial water supply, commercial and sport fishing, mariculture, aesthetics, and navigation. To protect beneficial uses, the State Board has established in Chapter II a set of narrative and numerical water quality objectives. The objectives include bacterial standards for the protection of water-contact recreation as well as objectives for the preservation of marine biological communities and their habitat.

The third Chapter of the Ocean Plan gives guidance for the development of new discharges into marine waters. The Ocean Plan provides a listing of the considerations a discharger must address before a new discharge will be permitted. The fourth Chapter of the Ocean Plan contains effluent and receiving water quality objectives for the protection of marine waters. The effluent limits (Table A of the Ocean Plan) apply to all publicly owned treatment works (POTW) and to industries that do not have effluent limitation guidelines established by the U.S. Environmental Protection Agency (EPA) regulations.

The water quality objectives contained in Table B are derived from data from scientific literature that measure the toxicity of various substances to marine organisms (Klapow and Lewis, 1979). These scientific data are combined with information on attainability and site-specific considerations to form the water quality objectives. The water quality objectives for receiving water are converted into effluent limitations that apply to discharges into State ocean waters. These effluent limitations are established on a discharge-specific basis depending on the initial dilution calculated for each outfall. The Table B limits must be met after initial dilution is complete. Table B currently contains 21

numerical limits for specific substances or groups of related substances and limitations for toxicity and radioactivity.

The last two sections of the Ocean Plan contain sections on discharge prohibitions (e.g., municipal or industrial sludge, bypassing, discharge into ASBS, and others) and general provisions. These provisions mandate Regional Boards to require dischargers to monitor their discharges and provide a mechanism for allowing exceptions to the Ocean Plan under special circumstances, provided beneficial uses are protected and the public interest is served.

Major Issues Identified in the 1987 Triennial Review

The Ocean Plan was first formulated by the State Board as part of the State Policy for Water Quality Control (SWRCB, 1972a). Changes in the California Water Code (CWC) in 1972 required the State Board to redraft its proposed Policy as a Water Quality Control Plan. At that time, it was the intent of the State Board to "...determine...the need for revising the Plan to assure that it reflects current knowledge..." (SWRCB, 1972b). The Ocean Plan was reviewed and amended in 1978 to fulfill the intent of the State Board and the requirements of State and federal law for periodic review. In 1983, a second review and revision was completed (SWRCB, 1983b). The major changes to the Ocean Plan were the addition of several chemicals to the receiving water limitations, modification of the bacterial standards, and the incorporation of parts of the 1972 and 1978 guideline documents into the Ocean Plan.

In 1986, the CWC was amended to require the State Board to review the Ocean Plan at least once every three years. The most recent review of the Ocean Plan was completed in 1987 with the adoption of the Ocean Plan Triennial Review and Workplan (SWRCB, 1987).

For the 1987 review, the State Board held two public hearings, one each in northern and southern California, to solicit input on which parts of the Ocean Plan needed improvement. The testimony and comments were summarized, and the State Board adopted the workplan that identified the issues to be addressed over the following three years [by Fiscal Year (FY) 1989-90].

Forty-two issues were raised by the public in the hearing process. Twenty-one of the issues were identified by the State Board as high priority and to be addressed before the next Ocean Plan triennial review. The high priority issues fell into seven general categories: suspended solids regulation, bioassay protocol adoption and implementation, nonpoint

sources, bacterial standards, water quality standards, administrative cleanup, and monitoring methods. In 1988, the State Board acted on seven of the issues identified in the 1987 triennial review (SWRCB, 1988b) by revising the Ocean Plan (SWRCB, 1988c).

The Impacts of the Proposed Amendments

We make recommendations on six issues identified in the 1987 triennial review. There are no significant adverse environmental impacts from the proposed Ocean Plan as amended (for the purposes of the CEQA, the amendments are considered a "project"). A discussion of the specifics of each proposed change in the Ocean Plan is presented in separate sections below, and the potential environmental effects of the amended Ocean Plan are addressed in the Environmental Checklist (Appendix B of this report).

If the State Board adopts the recommended amendments to the Ocean Plan, there will be no unavoidable environmental impacts. The purpose of the Ocean Plan is to protect the quality of California's coastal waters for the use of the people of the State. Consequently, the changes will serve to better protect ocean waters for the identified beneficial uses. Since no significant adverse effects are expected, mitigation measures are not proposed.

In accordance with CWC Section 13170.1, we have considered the following management agency agreements: (a) NPDES memorandum of Agreement (SWRCB and EPA, 1989), (b) Section 301(h) Memorandum of Understanding (SWRCB and EPA, 1984), (c) the Interagency Memorandum of Agreement Regarding the Tijuana/San Diego Land Outfall (City of San Diego et al., 1990), and (d) the two forest practices management agency agreements.

LIST OF COMMENTERS

Individuals or organizations who submitted written comments on the draft Functional Equivalent Document (SWRCB, 1989) before the close of the hearing record (September 30, 1989) or who gave testimony at the August 29, 1989 hearing are listed below. Each of the commenters are referred to by number when referenced in the various issues. When an agency or person submitted written comments, we relied on that source to characterize their comments. All comments presented at the hearing were addressed.

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PROPOSED OCEAN PLAN AMENDMENTS

In the staff analysis of each of the proposed Ocean Plan amendments, we present a summary of the issue under consideration, present Ocean Plan policy, a description of the issue including historical development (if appropriate), a summary of the comments received, responses to comments, alternatives for State Board action, staff recommendations, and the proposed Ocean Plan amendment.

Each issue analysis contains the following sections:

Issue:	A brief description of the issue.
Present Ocean Plan Policy:	A summary of the current provisions related to the issue.
Issue Description:	A detailed description of the issue, plus the historical development of the current Ocean Plan approach, and, if appropriate, a description of what led the State Board to establish the current provisions.
Comments Received:	This section was completed after the State Board hearing on August 29, 1989 on the issues under consideration. All substantial comments raised during the evaluation process were addressed. Those comments not pertinent to the list of issues being considered were listed in a separate section. Copies of the written comments and the hearing transcript are available for any person to review. The Environmental Checklist Form was not revised as a result of the review of comments received.
Alternatives For Board Action:	For each issue, staff has provided at least two alternatives for State Board action.
Staff Recommendation:	In this section, a suggestion is made for which alternative should be adopted by the State Board.

Proposed Ocean Plan Amendment:	An amendment is proposed, if appropriate. A draft Ocean Plan with all the proposed amendments is included in the report (Appendix A).

Issue 1: Appendix for standard monitoring procedures to implement the Ocean Plan.

Present Ocean Plan Policy: Some of the methods necessary to implement the Ocean Plan are contained in several State Board and EPA documents that are not included explicitly in the Ocean Plan. Also, some statements in the Ocean Plan give some guidance on how to implement the Ocean Plan.

Issue Description: Two documents have been published by the State Board regarding the implementation of the Ocean Plan: "Water Quality Control Board Table B Guidelines Ocean Waters of California" (SWRCB, 1978) and "Guidelines for the Preparation of Technical Reports on Waste Discharges to the Ocean and for Monitoring the Effects of Waste Discharge on the Ocean" (SWRCB, 1972c). These documents have not been updated and are now of limited use in the design of monitoring programs to implement the Ocean Plan. The EPA has prepared several technical support documents for the design of monitoring programs (e.g., EPA, 1982; Tetra Tech, 1986a; Tetra Tech, 1986b) to be implemented under Section 301(h) of the CWA. These documents may be useful for the design of non-301(h) monitoring programs as well. Although not explicitly stated in the Ocean Plan, the analytical procedures listed in 40 Code of Federal Regulations (CFR) Part 136 are required for measurements made to comply with the Ocean Plan.

Monitoring guidance should be modified as provisions of the Ocean Plan change or as better techniques develop. Consistent reporting of monitoring information is important to efforts to evaluate impacts on beneficial uses. A section in the Ocean Plan for the incorporation of monitoring guidance and reporting requirements would ensure that the most up-to-date methods are used.

Comments Received: Comment: Several commenters expressed support for the monitoring guidance section (7, 15, 23, 29, 32).

Response: No response is necessary.

Comment: Existing test methods should be supplemented with new methods capable of achieving lower detection limits, provided they have been properly validated and are cost effective (17, 32). An example was a suggestion to adopt the congener-specific method for PCB analysis in

Appendix II (17). Similarly, the absence of an analytical method for tributyltin (TBT) was noted (17). New test methods should include quality assurance/quality control procedures and minimum detection limits that testing laboratories are required to achieve with proficiency (16, 32). Emphasis on lowest detection limits requires that GC/MS validation of analyses would often be sacrificed (17).

Response: We agree that existing methods should be supplemented with validated new methods that have lower detection limits and quality assurance/quality control procedures. The choice of new methods, however, should be shared by both the Regional Board and EPA. To facilitate this joint responsibility, the Regional Boards should specify all analytical methods appropriate for use in the monitoring requirements section of waste discharge requirements by referencing 40 CFR Part 136 or other appropriate protocols approved by EPA. We propose that Appendix II be modified to require that all approved methods be specified in the monitoring requirements section of waste discharge requirements and when alternate protocols are necessary, EPA approval is required.

Comment: The Regional Board should be allowed to deviate from the standard monitoring procedures in Appendix II without approval by the State Board (3, 34).

Response: The Regional Boards will continue to have flexibility in the establishment of monitoring programs. In order to establish some consistency between dischargers in different regions it is necessary provide a list of monitoring protocols to be used on a statewide basis. If site-specific conditions require alternate protocols, the Regional Boards will be allowed to use them. For some protocols (e.g., toxicity tests [see Issue 5]), the CWC requires the State Board to approve the protocols. With respect to 40 CFR Part 136, alternate protocols must be approved by EPA. The introductory language to Appendix II has been modified to not always require State Board approval of alternate monitoring protocols.

Comment: The monitoring guidance appendix should be expanded (20, 33, 25, 29). The appendix should contain details on sampling design, statistical methods, the need for additional target species, natural rates of change, and related concerns (20).

Response: Guidance for monitoring is a significant issue that involves a considerable amount of work to develop. Since the National Research Council Marine Board's nationwide study on monitoring practice is nearing completion (Bookman, pers. comm.), we will address changes in monitoring guidance in subsequent amendments.

Comment: Change all reference to "guidance" in Appendix II to "direction" (26).

Response: The necessary corrections have been made.

Alternatives for Board Action:

1. Do not consolidate the monitoring guidance into an appendix of the Ocean Plan. This alternative would keep the Ocean Plan as it currently exists and would perpetuate the lack of up-to-date guidance necessary for Regional Board and discharger implementation of the Ocean Plan.

2. Reorganize the Ocean Plan to move existing monitoring guidance into a new appendix. Consolidating reference to monitoring programs, chemical analyses, testing organisms, reporting requirements, etc., including references to specific required techniques (such as 40 CFR Part 136) into a single section of the Ocean Plan would simplify use and interpretation of the Ocean Plan. Another advantage of this alternative is that as the Ocean Plan is modified, the guidance necessary to implement changes could be more easily incorporated into the Ocean Plan. A third advantage is that consistency in reporting of monitoring information would be encouraged.

3. Incorporate by reference the two State Board guidance documents and the several EPA Technical Support Documents into the Ocean Plan. The advantage of this alternative is that the coastal Regional Boards will be provided with some guidance on the design of monitoring programs. The overriding disadvantage is that the State Board monitoring guidance documents are dated and not very useful for the types of monitoring that are currently required. EPA documents provide the techniques necessary for monitoring but give little help to the Regional Boards on evaluating whether beneficial uses are impaired. Before these or any documents are

incorporated in the Ocean Plan, the State Board should develop more specific objectives (ecological hypotheses) to be tested and then select the analytical and statistical procedures necessary to evaluate the discharger monitoring reports.

Staff Recommendation: Adopt Alternative 2.

Proposed Ocean Plan Amendment:

1. Create a new appendix and rename existing appendix.

Amend the title of existing appendix to read:

"APPENDIX I: DEFINITION OF TERMS"

Create a new appendix with the following introductory paragraph:

"APPENDIX II: STANDARD MONITORING PROCEDURES"

"The purpose of this appendix is to provide direction to the Regional Boards on the implementation of the California Ocean Plan and to ensure the reporting of useful information. It is not feasible to cover all circumstances and conditions that could be encountered by all dischargers. Therefore, this appendix should be considered as the basic components of any discharger monitoring program. Regional Boards can deviate from the procedures required in the appendix only with the approval of the State Water Resources Control Board unless the Ocean Plan allows for the selection of alternate protocols by the Regional Boards. If no direction is given in this appendix for a specific provision of the Ocean Plan, it is within the discretion of the Regional Board to establish the monitoring requirements for the provision.

"The appendix is organized in the same manner as the Ocean Plan."

2. Move the appropriate section listed below from Chapter IV to Appendix II. Add language regarding standard analytical procedures (i.e., 40 CFR 136) to Appendix II:

"Chapter IV. Table B. Compliance with Table B objectives:

"Procedures, calibration techniques, and instrument/reagent specifications used to determine compliance with Table B shall conform to the requirements of federal regulations (40 CFR 136). All methods shall be specified in the monitoring requirement section of waste discharge requirements.

"The State or Regional Board may, subject to EPA approval, specify test methods which are more sensitive than those specified in 40 CFR 136. Total chlorine residual is likely to be a method detection limit effluent requirement in many cases. The limit of detection of total chlorine residual in standard test methods is less than or equal to 20 ug/l."

3. Include proposed language on bacterial monitoring, Table B objectives, and water quality-based toxicity (see issues 2, 4 and 5).

4. Chapter VI.D. Add a new last sentence to first paragraph as follows:

"Monitoring provisions contained in discharger waste discharge requirements shall be in accordance with the Monitoring Procedures provided in Appendix II."

Issue 2: Bacterial Standards for Water-Contact Recreation

Present Ocean Plan Policy: Chapter II.A.1.: "Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline, and in areas outside this zone used for body contact sports, as determined by the Regional Board, but including all kelp* beds, the following bacteriological objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a concentration of total coliform organisms less than 1,000 per 100 ml (10 per ml); provided that not more than 20 percent of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 per ml), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml (100 per ml).

b. The fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per 100 ml.

The "Initial* Dilution Zone" of wastewater outfalls shall be excluded from designation of "kelp* beds" for purposes of bacteriological standards, and Regional Boards should recommend extension of such exclusion zone where warranted to the State Board (for consideration under Chapter V.I.F.).

Adventitious assemblages of kelp plants on waste discharge structures (e.g., outfall pipes and diffusers) do not constitute kelp* beds for purposes of bacteriological standards."

Issue Description: The bacterial standards in the Ocean Plan form the basis for the regulation of discharges that could affect bathing beaches and kelp beds along the California coastline. The appropriateness of the bacterial standards contained in the Ocean Plan was raised as an important issue in the Triennial Review completed in 1987. The staff analysis for this issue addresses (1) which indicator(s) of pathogen-caused illness are appropriate to

*This term is defined in the Ocean Plan definition appendix.

use in regulating discharges to the ocean and (2) how new indicators can best be utilized to protect beneficial uses.

Background

In the context of bathing beach standards, an indicator organism is a microorganism whose density in the water can be related quantitatively to the potential health risks of exposure to pathogens in the water or to the occurrence of sewage. Enteric viruses derived from fecal material and transported through water contaminated with fecal wastes can pose a health hazard to humans. Human fecal waste is considered the most hazardous, although feces of other animals also can contain pathogenic agents. The principal source of human fecal waste in California's ocean waters is the discharge of wastewater from POTWs.

Early efforts to identify problem situations were limited by an inability to detect pathogens directly. Even as detection techniques improved, the number of potential pathogens and their temporal and quantitative variability in wastewater presented an unmanageable monitoring problem. To a large extent, these problems with the direct measurement of sewage-derived pathogens exist today.

An alternative to the measurement of pathogens is the use of indicator organisms. Ideally an indicator organism should have the following traits (Goyal, 1984; Cabelli, 1983):

a. Consistent and exclusive association with the source of the pathogens, i.e., fecal waste, particularly human waste.

b. Presence in sufficient numbers to provide accurate estimates of the concentration of indicator organisms whenever the concentration of pathogens reaches a level associated with an unacceptable risk of illness.

c. Persistence and survivability in the treatment process and the ocean similar to the most persistent pathogen of concern.

d. Ready, consistent, and accurate quantification using relatively inexpensive methods.

The first organisms to be used as indicators of pathogens in water were a group of bacteria known collectively as total coliform (Cabelli, 1976, 1983; Dutka, 1973). Coliform are usually not pathogenic organisms but are abundant in effluent, are easily detectable and were believed to be correlated with the presence of pathogenic organisms. Subsequent work demonstrated that coliform bacteria are not human-specific or even fecal-specific and are not consistently correlated with the presence of pathogens (Cabelli, 1978; Melnick, 1984; Salas, 1986). Coliform bacteria can exist on soil particles and plant surfaces, and are associated with the animal wastes that pose little or no risk to human health.

Despite these problems, success in detecting the presence of sewage has been accomplished utilizing standards based on total coliform density. Title 17, California Code of Regulations (CCR), Section 7958 requires the monitoring of total coliform.

In response to concern in the public health community that total coliform is not an adequate indicator of sewage contamination of water, a National Technical Advisory Committee in 1968 recommended to the Federal Water Pollution Control Administration that a fecal coliform standard be adopted. Fecal coliform were recommended as an indicator because initially it was believed that fecal coliform were more human-specific than total coliform. However, subsequent work has not supported this notion (Cabelli, 1978; Henderson, 1968).

The search for appropriate indicator organisms continues today. Moreover, the basis for the selection of an indicator has moved from the mere detection of the presence of sewage to the detection of a quantifiable risk to human health. Wastewater can contain a number of pathogenic bacteria and viruses, including Salmonella, Shigella, Cholera, infectious hepatitis, and poliovirus. However, given the low survival of these pathogens in the marine environment and in treatment processes now practiced in California, these pathogens are well controlled. The illness of most concern with respect to ocean waters is gastroenteritis caused by Norwalk-like viruses, human rotavirus, and other agents.

EPA Health Effects Study

In order to determine the health risk associated with various potential indicator organisms in marine waters, the EPA conducted extensive epidemiological studies between 1972 and 1978. The purposes of the studies were to determine which indicator organisms best correlated with human health effects and to develop a mathematical relationship between the indicator and health effects.

The first phase of the study took place over a three-year period. Ocean waters in New York State at Rockaway and Coney Island Beaches were sampled for an array of organisms, including enterococci, Escherichia coli, Klebsiella, Enterobacter-Citrobacter, fecal coliform, Clostridium perfringens, Pseudomonas aeruginosa, Aeromonas hydrophila, Vibrio parahemolyticus and staphylococci.

In the second phase, indicators with the two highest correlations with health effects, enterococci and E. coli (Cabelli, 1982), were measured in epidemiological studies in Boston Harbor, Lake Pontchartrain and Alexandria, Egypt. Indicator densities were correlated with health effects in a mathematical relationship. Data from Alexandria were not used for this calculation.

The studies found the following: (a) a statistically significant increase in swimming-associated gastroenteritis (as compared to incidence of illness in non-swimming population) occurred at polluted beaches; (b) enterococcus was the best indicator of incidence of illness (Table 1); (c) fecal coliform were a poor indicator of illness; (d) highly credible gastrointestinal symptoms occurred at beaches which met coliform standards; (e) very low enterococcus and E. coli densities (10/100 ml) were associated with appreciable illness rates (10/1000 persons) (Figure 1); and (f) a direct relationship exists between swimming-associated gastrointestinal illness and indicator density.

EPA has recommended that states adopt an enterococcus standard of no higher than 35/100 ml (EPA, 1986) for marine waters. This recommendation corresponds to an estimated risk level of 19 illnesses/1000 persons. EPA also recommended that different confidence intervals be used for beaches with different levels of use; the greater the use at a beach, the smaller the

confidence interval. States are free to adopt more stringent enterococcus standards.

EPA criteria are based on the relationship between illness rate and indicator concentration developed by Cabelli (EPA, 1986a). This relationship may not hold if the population contributing the fecal wastes is small or there is an epidemic in the discharging community. There is also concern that the correlations developed in EPA studies may differ in the relatively cooler California ocean waters from those exhibited at the warm-water sites studied by Cabelli.

EPA studies provide the first and only correlation of the incidence of illness with concentrations of indicator organisms in marine waters.

Two reports have criticized the EPA study in detail (Association of Metropolitan Sewerage Agencies, 1984; Durand et al., 1986). We analyzed the criticisms of the EPA study and concluded that many of the problems identified are inherent in this type of epidemiological study. Specifically, we believe (1) problems in the epidemiological design are minor or probably unavoidable, and (2) statistical reworking of the data does not invalidate the conclusions. The EPA study represents the best available information and indicates that enterococcus is the best indicator of health risk in marine waters.

Table 1: Correlation coefficients for swimming-associated highly credible gastroenteritis rates against mean indicator densities at marine bathing beaches (Cabelli, 1983).

Indicator	Data Grouped by Summer	Data Grouped by Trial
enterococci	0.75	0.96
E. coli	0.52	0.56
Klebsiella	0.32	0.61
Enterobacter-Citrobacter	0.26	0.64
C. perfringens	0.19	0.01
P. aeruginosa	0.19	0.59
Fecal coliform	-.01	0.51
A. hydrophila	-.09	0.60
V. parahemolyticus	-.20	0.42
total coliform	0.19	0.65

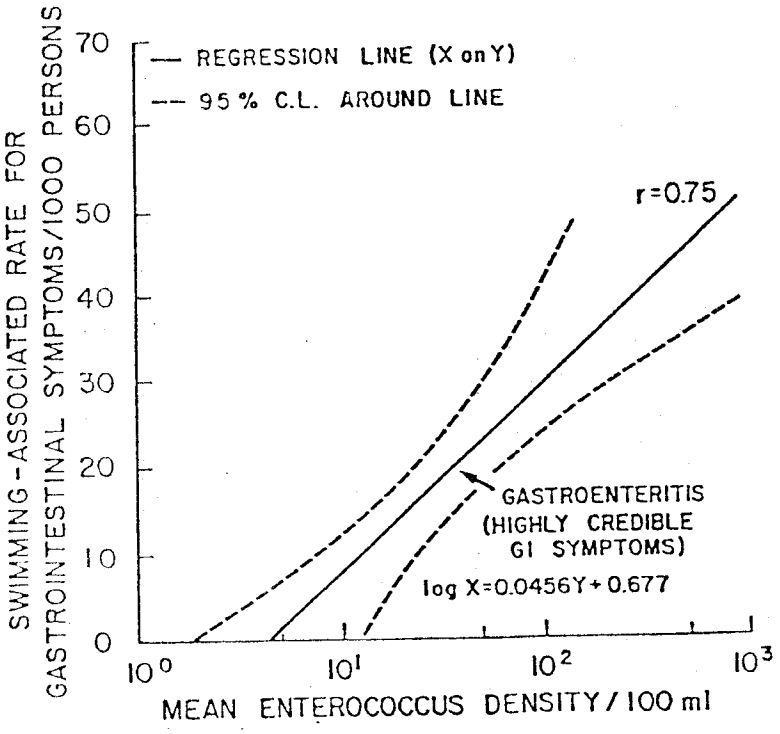

Figure 1: EPA recommended health effects criterion relationship for marine recreation waters (Cabelli, 1983).

California Parallel Monitoring Study

To facilitate our analysis of bacterial standards issues we assembled an advisory group, the Bacteriological Standards Subcommittee of the Southern California Bight Review Committee (SCBRC). The subcommittee has members from the public; Department of Health Services; San Diego, Los Angeles, and Orange County Health Departments; City of San Diego; Los Angeles County Sanitation Districts; the Los Angeles Regional Water Quality Control Board, and the State Board.

The subcommittee devised a study to measure enterococcus and coliform (total and fecal) in parallel. The study, in part, intended to: (1) determine the correlation, if any, between coliform and enterococci; (2) determine which indicators are more influenced by runoff; and (3) determine dischargers ability to attain different enterococcus densities under existing conditions. The study did not address correlations between levels of indicator organisms and incidence of illness. The study was performed cooperatively by Orange County Health Department; Los Angeles County Public Health Laboratory; Los Angeles County Sanitation Districts, Orange County Sanitation Districts; the Cities of San Diego, Los Angeles, and San Francisco; and the Santa Ana Regional Water Quality Control Board.

Some results of the California Parallel Monitoring Study (July 1 to December 31, 1988) are presented in Tables 2 and 3. It is clear that for stations not affected by runoff, all dischargers attained the existing total coliform standards nearly 100 percent of the time. Similarly, stations not affected by runoff attained enterococcus densities of less than 12 enterococci per 100 ml of water 100 percent of the time (Table 2).

Table 2: Percentage of the station-months attaining the specified number of enterococci per 100 milliliters (ml) and the current Ocean Plan total coliform standard. These data do not reflect runoff or rain effects.

	Number of Enterococci per 100 ml					Total Coliform
	<35	<24	<12	<6	<3	<1000
City of Los Angeles	100	100	100	89	22	85
Los Angeles County	100	100	100	100	100	100
Orange County	100	100	100	0	0	100
San Diego	100	100	100	100	100	100

At stations that were identified as influenced by runoff, the attainment of total coliform standards and enterococcus levels are variable (Table 3). For most of the stations included in the calculations for Table 3, there is an identified surface runoff input that is probably responsible for the higher density of indicator organisms.

The parallel monitoring study was conducted over a six-month period which, due to a lack of rain during the study period, did not allow us to assess the effects of rainfall and the ensuing runoff on attainment of shore station standards. Rain typically has a great influence on the density of the indicators at the shore stations. Other studies have shown that during storms, total coliform and enterococcus density at surf zone stations typically are much higher than can be attributed to the effect of the POTW discharge. Most increases are attributed to increased surface runoff.

Table 3: Percentage of the station-months affected by runoff attaining the specified number of enterococci per 100 milliliters (ml) and the current Ocean Plan total coliform standard. These data do not reflect rain effects.

	Number of Enterococci per 100 ml					Total Coliform
	<35	<24	<12	<6	<3	<1000
City of Los Angeles	100	100	62	25	13	63
Los Angeles County	100	100	100	50	0	100
Orange County	50	25	0	0	0	96

An important aspect of the Parallel Monitoring Study results is that there does not appear to be a consistent correlation between enterococcus and either coliform group. In some instances changes in coliform and enterococcus densities followed similar patterns, while in other instances the patterns were quite different. This behavior, in light of the fecal-specific nature of enterococcus, suggests that enterococcus may be used to detect contamination not detected by coliform monitoring alone.

As part of our analysis, we also assessed the possibility of conducting an epidemiological study to establish California-based health risk correlations for various indicators. Assuming the relationships established by Cabelli (1983) are appropriate for California, a sample size of approximately 70,000 individuals would be required to obtain definitive results. The cost of such a study is estimated at $2-3 million. A number of problems with experimental design and study management make it impossible to guarantee definitive results from such a study.

Information Relevant to Evaluating Alternatives

In our review, we addressed several questions that are pertinent to assessing alternative State Board actions, as follows:

1. What is the problem with the current objectives?

   An evaluation of the performance of total and fecal coliform based on the traits of indicator organisms listed previously reveals that these groups of organisms are not well suited to the role of indicators of the risk to human health. Total and fecal coliform do not demonstrate exclusive association with the source of the pathogens or survival characteristics similar to the pathogens (Henderson, 1968; Melnick, 1984). In addition, levels of health risk are not highly correlated with coliform concentrations. The values of the standards for both total and fecal coliform are based on empirical observations of the occurrence of illness coincident with a measured concentration of total coliform (Henderson, 1968; Salas, 1986). (The fecal coliform standard is based on the total coliform standard and derived from an estimate of the relative abundance of fecal and total coliform in human waste.)

2. What is the best indicator of the risk to human health?

   EPA studies (Cabelli, 1983) are the only available assessment of correlations of indicator organism concentrations and incidence of illness. According to EPA studies, enterococcus provides the best indication of the potential to contract gastroenteritis (the principal illness of concern).

3. What is the best indicator of the presence of pathogens in seawater?

   Of the bacterial indicators, enterococcus has been shown to be superior to the coliform groups (Elliot and Colwell, 1985; Fattal et al., 1983) as an indicator of pathogen presence. Enterococcus (a) demonstrates survival during waste water treatment and in ambient seawater which is more indicative of pathogen survival than the coliform groups, (b) does not reproduce in seawater, and (c) has sources more like those of pathogens than the coliform groups. Other indicators, such as bacteriophages, which may serve as well or better than enterococcus in indicating the presence of pathogens, are being investigated. However, the methods of detection and performance of these other indicators have not been sufficiently tested to incorporate them into standards at this time.

4. What are the sources of the various indicators?

A number of non-sewage and, in some cases, non fecal sources of the various indicators exist (Cabelli, 1978; Henderson, 1968). The California parallel monitoring study identified a number of sampling stations which were affected by surface runoff, stream channels, and nearby developed areas which had elevated densities of all indicator organisms sampled. Stations isolated from such influences but affected by discharge plumes generally did not demonstrate elevated indicator densities. The relative contributions of indicator organisms from sewage outfalls and other sources at the runoff stations have not been identified. Specific non-outfall sources at some of these stations also have not been identified. The elevated level of indicators at shore stations, therefore, may indicate health hazards from sewage contamination (leaking sewers, non-sewered discharges) or may indicate non-sewage, and presumably nonhazardous, sources. It is not possible to assess a health risk unless the sources of the indicator organisms are determined.

5. What concentration of the best indicator organism is a reasonable standard for the protection of human health?

The technical aspects of this question cannot be addressed adequately given the existing information. The performance of enterococcus as an indicator in California may be compromised somewhat by the cool ocean temperatures. Cool temperatures allow pathogens to survive longer than in the warm-water conditions used in the EPA studies. If enterococcus retains its character as a high quality indicator and the relationships developed by Cabelli hold for California, then the answer to this question becomes a policy decision based on acceptable incidence of illness. The Bacteriological Standards Subcommittee will continue to assist staff in addressing technical questions leading to health-based standards.

6. Can an enterococcus standard be generally applied to water contact areas in California ocean waters?

The use of enterococcus in a water quality standard has many advantages over the use of total and fecal coliform, principally:

a. Enterococcus has been correlated with the incidence of illness in populations exposed to ocean water contaminated with sewage;

b. Enterococcus exhibits survival more similar to that of identified pathogens causing gastroenteritis than other bacterial indicators;

c. Enterococcus is more fecal-specific than the coliform groups.

However, a number of uncertainties make it difficult to develop a specific numeric standard to be applied to ambient waters of all water contact areas. At the same time, the advantages of enterococcus can be put to good use in managing problem areas along the shoreline. Specifically, enterococcus may serve well in sorting out various sources of indicators at shore stations which repeatedly exceed coliform standards. Enterococcus may also be used to detect low-level contamination obscured in coliform analysis by non-sewage sources of indicators.

Comments Received:

Comment: A number of commenters support the staff proposal to add provisions relating to enterococcus to the Ocean Plan (5, 16, 19, 23, 24, 25, 29, 47). Suggested modifications to the staff proposal ranged from revising the provisions to apply to all water contact areas, kelp beds, and shellfish harvesting areas (5, 9, 24, 29) to deleting all references to numerical values (17). One commenter suggested that any enterococcus standard should be at least as protective as the total coliform and fecal coliform standards (47). One commenter noted that a "mosaic of indicators" may be needed to assess contamination in the various environmental settings (13).

Response: When using indicator organisms to assess water quality conditions it is difficult to state an absolute density of indicator organisms correlated with a level of pathogen contamination which results in the impairment of water contact recreation. This is because only some of the multiple sources of indicator organisms also discharge pathogens. Therefore, it is necessary to confirm that an impairment is occurring before taking corrective actions. The proposal establishes a point at which confirmation of impairment or non-impairment is required. The selection of the proposed numeric values for enterococcus is based on historic data for major dischargers in southern California. These values are not intended to correlate with a specific level

of risk to public health, but rather to trigger efforts to confirm potential exposures to pathogens.

We agree with the suggestion that a "mosaic" of indicators may be appropriate for adequate assessment of fecal contamination. Enterococcus is proposed as an additional indicator because the available information indicates that its survival in treatment processes and ambient sea water is more indicative of pathogen survival than the coliform groups. It is not necessary to determine whether the proposed requirement is more or less protective than the existing coliform standards since enterococcus is proposed to be utilized in addition to the coliform standards.

The proposed requirement is focussed on shore stations because of our concern for protection of the most exposed populations (bathers at beaches) and the limitations of the available information. Statutory requirements to protect the beneficial uses of water (Water Code Sections 13000, 13142.5, CWA Sections 101, 301, 303, 402) obligate us to pursue protective measures when sufficient information exists to support such an action. Such information exists for shore stations, and therefore we disagree with the suggestion that no numerical values should be implemented. The informational basis needed to justify establishing an enterococcus standard in all water contact areas and shellfish beds does not currently exist. We were not able to develop a consensus of professional judgement for the selection of an appropriate numeric value for enterococcus densities which would trigger surveys or corrective actions at nearshore or offshore stations. The National Marine Fisheries Service is beginning a 5-year program to evaluate hazards and standards for shellfish beds (Robert Kaifer, pers. comm.). Information from these efforts will be reviewed and incorporated into the Ocean Plan when it becomes available.

Comment: A number of commenters suggested that information concerning epidemiological studies, viable but nondetectable pathogens, and impacts on marine mammals be considered in establishing a standard (13, 17, 19, 24).

Response: Suggestions to consider information relating to the epidemiology of illness associated with water contact, viable but nondetectable pathogens, and impacts on marine mammals are well founded. However, insufficient information exists about these issues to modify the staff proposal.

Comment: It is appropriate to monitor for enterococcus (13, 17, 18, 19). Monitoring requirements for enterococcus should be applied to all stations required to monitor for coliform bacteria (5, 9, 10, 23, 24, 29, 33, 47). New provisions of the Ocean Plan relating to enterococcus should be restricted to monitoring provisions (17).

Response: Monitoring for enterococcus at sites other than shore stations could provide valuable information about the level of contamination at these sites. We believe that monitoring these additional sites would be beneficial and would ultimately provide information to support ambient enterococcus standards. Therefore, we propose to include a provision for enterococcus monitoring at all sites required to monitor for bacterial indicators. The principal benefit from this additional monitoring will be to determine correlations (or lack of correlations) of indicator densities at various stations with sources of sewage discharge. Over time this should provide better characterization of the impacts of outfall plumes on receiving waters. The principal costs of this additional requirement are the costs of added sampling and analysis. We estimate that these costs will range from $7 to $35 per sample. For some dischargers, such as the Hyperion Treatment Plant (City of Los Angeles), no additional monitoring will be required because the NPDES permit for the facility already requires enterococcus monitoring at all stations.

Enterococcus will serve as an important tool in water quality assessment. Limiting our actions to the collection of monitoring data will not fully utilize the advantages that enterococcus can provide to a regulatory program. Where information is sufficient to develop numeric requirements such as the one proposed, a requirement should be implemented. This will ensure the most accurate assessment of water quality and protection of beneficial uses.

Comment: Clarification is needed regarding the State and Regional Boards' authority to require other governmental agencies to conduct sanitary surveys and which agencies will be considered appropriate to conduct sanitary surveys (16). A mechanism should be established to compensate an entity for survey work completed if the survey demonstrates that the agency conducting the survey is not responsible for the elevated indicator densities

(16, 17). It is unreasonable for a sewage discharger to bear the costs of a survey triggered by their own data or another agency's data (13).

Response: As with any water quality problem, a Regional Board can direct the discharger most likely to be responsible for the problem to conduct an investigation to more clearly identify the problem. In most cases this entity will be the agency responsible for monitoring the station in question, e.g., the major POTW dischargers. However, in some cases existing information may clearly reveal that certain sources can be considered as not contributing to the problem. In these cases, other agencies, such as flood control districts or cities, responsible for discharges potentially affecting the station in question, may be required to conduct surveys.

Any agency operating under a NPDES permit or Waste Discharge Requirements is subject to Regional Board authority (CWC Section 13260 et seq.) In addition, Water Code Section 13267 provides that a discharger must furnish technical or monitoring reports that a Regional Board may specify. Similarly, Section 13225 provides that a Regional Board shall require, as necessary, any state or local agency to investigate and report on any technical factors involved in water quality control. Both Section 13267 and Section 13225 contain limitations that require that the burden of such reports, including costs, bear a reasonable relationship to the benefits to be obtained from the information. We consider that investigation of a public health threat associated with sewage contamination is a benefit which will justify the costs of the survey. Implicit in these Water Code sections is the assumption that the reporting agency shoulder the burden of costs. We therefore, do not agree that a method of compensation is needed when an agency determines that its discharge is not causing the elevated densities at a particular station.

To eliminate confusion about the responsibilities of agencies conducting sanitary surveys, we have clarified the proposed language to indicate that the agency performing the survey is responsible for determining whether its discharge is causing the observed density of indicators.

We disagree that it is unreasonable for an agency to bear the costs of survey work required as a result of their own agency's monitoring data. One purpose of monitoring requirements is to be able to determine if the

discharge is adversely impacting beneficial uses. The sanitary survey is merely a site-specific refinement of this basic assessment. In addition, to ignore monitoring data collected by dischargers would severely restrict a Regional Board's ability to assess which entity is the most appropriate to conduct a sanitary survey.

Comment: Beach closures, health warnings, and related regulatory actions should be triggered by the same mechanism that forces a sanitary survey (5).

Response: Such activities are not under the control of the State or Regional Boards. Authority for these actions lies with the Department of Health Services (Title 17 CCR Section 7960).

Comment: The Ocean Plan should recognize adequate treatment and disinfection as the best means to ensure protection of public health (19).

Response: The provision in the last paragraph of Chapter III, General Requirements for Management of Waste Discharge to the Ocean addresses this concern.

Comment: Move the proposed text to a different section of the plan in order to eliminate confusion that might arise about what constitutes a violation (13).

Response: We agree that the proposed amendment is a somewhat different approach to regulation than the current coliform standards and that confusion might arise relating to what constitutes a violation under the two approaches. This confusion could be minimized by creating a new heading in Chapter II that would clearly distinguish the amendment from the total and fecal coliform standards. Therefore, we propose creating a new heading entitled "Bacterial Assessment and Remedial Action Requirements". The proposed enterococcus requirement would be placed in this section together with the following introductory statement:

> "The requirements listed below shall be used to 1) determine the occurrence and extent of beneficial uses impairment due to bacterial contamination; 2) generate information which can be used in the development of an enterococcus standard; and 3) provide the basis for

remedial actions necessary to minimize or eliminate any impairment of a beneficial use."

Comment: Permits should contain provisions requiring dischargers to control any controllable discharge identified in a sanitary survey (26). Permits should also require the permittee to conduct sanitary surveys when so directed by a Regional Board (26).

Response: We agree with these suggestions and have modified the proposal accordingly.

Alternatives for Board Action:

1. Retain total and fecal coliform standards. Maintaining the Ocean Plan as it exists would perpetuate a long-term data base. This alternative would also maintain consistency between the Ocean Plan and requirements of Title 17 CCR Section 7958 that local agencies monitor total coliform concentrations. The disadvantage of this option is that it perpetuates the problems associated with the current standards and ignores the apparent advantages of the use of enterococcus.

2. Replace total and fecal coliform standards with an enterococcus standard. The advantage of this alternative is that it utilizes the best indicator organism to provide a health risk-based standard. However, there is no good basis for selecting a specific numerical value for enterococcus densities. Uncertainty about the applicability in California waters of the relationships developed by Cabelli preclude selection of a value solely based on acceptable rates of illness. Although the Parallel Monitoring Study provides some information on attainability of various enterococcus densities, the data are not complete enough to develop a standard. This option would also abandon a substantial amount of historical monitoring data and be inconsistent with Title 17 CCR Section 7958.

3. Add enterococcus and drop total coliform standards. This alternative would have all the advantages and disadvantages of using enterococcus, while retaining an organism to continue a historical data base and with which dischargers and regulators are familiar. The major disadvantage, as stated above, is the inability to support a specific numeric value for enterococcus in ambient waters. In addition, this alternative does not

provide consistency with Title 17 CCR Section 7958 (bacterial water quality standards promulgated by the Department of Health Services).

4. Add enterococcus and drop fecal coliform standards. This alternative would have all the advantages and disadvantages of using enterococcus, while retaining consistency with the Title 17 CCR Section 7958. An added advantage is continuing the most complete, long-term monitoring data base. The disadvantage of this alternative is the inability to support a specific numeric value for enterococcus in ambient waters.

5. Perform a California epidemiological study. This alternative may provide information on specific health risks under California conditions, thereby removing the need to rely on the EPA studies. However, given a high degree of variability and the relatively low densities of enterococcus in California waters, it is likely that a epidemiological study could not clearly distinguish between various sources of pathogens. In this event an epidemiological study appears not to be cost-effective and probably would not provide better information than currently exists.

6. Combine the use of enterococcus with total and fecal coliform to identify sources of contamination at shore stations and require monitoring of enterococcus at all bacteria monitoring stations. Advantages of this approach are:

   a. allows the State and Regional Boards to take advantage of enterococcus as an indicator without the problems encountered in establishing an ambient water standard,

   b. focuses efforts on areas which pose the greatest potential of exposing the public to water-borne pathogens (shore stations),

   c. provides direction for specific actions needed to identify sources of indicators and determine the presence of contamination.

   The disadvantage of this alternative is that it requires the dischargers to become familiar with detection methods for another indicator and increases monitoring costs. However, most dischargers have already conducted limited monitoring of enterococcus using standard techniques,

and so will have little difficulty with the new requirement. The costs are justified by the added protection provided to the public.

Staff Recommendation: Adopt alternative 6. We recommend addition of an enterococcus assessment and remedial action requirement for shore stations when densities of enterococcus or total or fecal coliforms indicate a potential of contamination. Specifically, when mean enterococcus density exceeds 24 enterococci/100 ml for a 30-day period or 12 enterococci/100 ml for a six-month period the Regional Board would require a sanitary survey to locate the source of contamination.

The specific numeric levels for enterococcus recommended are based on data obtained in the Parallel Monitoring Study and on discussions with representatives of various dischargers and public health agencies. It is believed that these levels are sensitive enough to identify chronic problem areas without triggering an undue number of investigations. In addition, this recommendation relies on the Regional Boards to exercise their judgement in directing specific surveys.

We also recommend the addition of language pertaining to monitoring and analytical methodology to assure standard procedures are employed and that data will be useable for future refinements of bacterial standards.

Proposed Ocean Plan Amendment: The bacterial standards section of the Ocean Plan should be amended as follows:

1. Retitle section: "Bacterial Characteristics."

2. Replace the phrase "body contact" with the phrase "water contact;" replace the term "concentration" with term "density;" replace the term "log mean" with the term "geometric mean."

3. Insert a new section in Chapter II, Water Quality Objectives, as follows:

"B. <u>Bacterial Assessment and Remedial Action Requirements</u>"

The requirements listed below shall be used to 1) determine the occurrence and extent of any impairment of a beneficial use due to

bacterial contamination; 2) generate information which can be used in the development of an enterococcus standard; and 3) provide the basis for remedial actions necessary to minimize or eliminate any impairment of a beneficial use.

Measurement of enterococcus density shall be conducted at all stations where measurement of total and fecal coliforms are required. In addition to the requirements of Section II.A.1., if a shore station consistently exceeds a coliform objective or exceeds a geometric mean enterococcus density of 24 organisms per 100 ml for a 30-day period or 12 organisms per 100 ml for a six-month period, the Regional Board shall require the appropriate agency to conduct a survey to determine if that agency's discharge is the source of the contamination. The geometric mean shall be a moving average based on no less than five samples per month, spaced evenly over the time interval. When a sanitary survey identifies a controllable source of indicator organisms associated with a discharge of sewage, the Regional Board shall take action to control the source."

"Waste discharge requirements shall require the permittee to conduct sanitary surveys when so directed by the Regional Board. Waste discharge requirements shall contain provisions requiring the permittee to control any controllable discharges identified in a sanitary survey."

4. Reletter the other sections in Chapter II in order to accommodate the new section II.B. proposed above.

5. Include the following text in Appendix II:

"Chapter II. A. Bacterial Standards

"For all bacterial analyses, sample dilutions should be performed so the range of values extends from 2 to 16,000. The detection methods used for each analysis shall be reported with the results of the analysis.

"Detection methods used for coliform (total and fecal) shall be those presented in the most recent edition of Standard Methods for the

Examination of Water and Wastewater or any improved method determined by the Regional Board (and approved by EPA) to be appropriate."

"Detection methods used for enterococcus shall be those presented in EPA publication EPA 600/4-85/076, Test Methods for Escherichia coli and Enterococci in Water By Membrane Filter Procedure, or any improved method determined by the Regional Board to be appropriate."

Issue 3: Initial Dilution

Present Ocean Plan Policy: Initial dilution is used in the Ocean Plan to implement the water quality objectives in Chapter II and Table B. Water quality objectives must be met after initial dilution is complete (i.e., at the edge of the zone of initial dilution).

Initial dilution is the process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around a point discharge. For the purposes of the Ocean Plan, minimum initial dilution is the lowest average initial dilution within a single month of the year. It is the policy of the State Board that dilution estimates shall be based on observed waste flow characteristics, observed receiving water density structure, and the assumption that no currents flow across the discharge structure.

The numerical model that is typically used to calculate initial dilution is the PLUME model (EPA, 1985b). However, the Regional Boards have flexibility in selecting which model to use after they have considered the model's accuracy and applicability.

Issue Description: Several ocean dischargers would like to receive greater dilution allowances as a means to comply more easily with Table B effluent limits. They have argued that the State Board initial dilution policy is unrealistic because currents are not considered in the calculation of dilution. This is true. However, other aspects of the mixing zone policy which are unrealistic provide additional dilution such as the use of calculated background concentrations based on open ocean conditions instead of ambient concentrations. Furthermore, the granting of a mixing zone is an implementation mechanism to provide dilution credit in order to facilitate the attainment of objectives and need not necessarily fully reflect the physical reality of every plumes' behavior.

Initial dilution around any outfall varies with several factors, including thermal stratification, water density, and current velocity. Consequently, it is not surprising that the dilution measured at various times of the year is greater than the minimum calculated dilution.

In the development of the initial dilution policy (SWRCB, 1978), the State Board had to address the variability of dilution measurements in order to use dilution in calculating effluent limitations. Instead of allowing effluent limitations to vary seasonally or more frequently, the State Board chose to use the minimum initial dilution for the purpose of calculating effluent limits. It was considered more appropriate to have a single value if an enforcement action is necessary.

Existing treatment technology does not generally provide attainment of water quality objectives at the end of discharge pipes. Mixing zones are provided where additional treatment would not provide sufficient improvement in protection of beneficial uses to justify the expense associated with requiring additional treatment. The policy goal is to allow the minimum impact necessary while generally maintaining water quality as defined by the objectives. Mixing zones allow ambient water quality objectives to be exceeded in small volumes of ocean water, provided that the beneficial uses of the entire water body are not unreasonably affected.

The State Board has used the existing initial dilution policy for over 11 years with only a few minor instances of noncompliance at ocean discharge sites (SWRCB, 1988b; please refer to the additions to Table B sections of this report).

The State Board has delegated to its Executive Director the responsibility of selecting the most useful numerical dilution model for calculating initial dilution. Some studies have examined which of the EPA models best emulate actual dilution (T. Hendricks, Southern California Coastal Water Research Project, pers. comm.; D. Jones, San Francisco Clean Water Program, pers. comm.).

Comments Received:

Comment: A range of comments were received on the requirements for modelling initial dilution that are specified in the Ocean Plan, especially on the requirement of assuming "that no currents of sufficient strength to influence the initial dilution process flow across the discharge structure." The comments follow.

Existing policy should be changed to allow for ambient currents in calculating initial dilution (Alternative 2) (11, 28). Ambient currents and

ambient background concentrations be used in Equation 1 for calculating effluent limits (Alternative 3) (4, 12, 15). Some commenters supported the staff recommendation to retain the existing policy (Alternative 1) (24, 29, 34). Other commenters suggested that effluent limits should not be based on calculated initial dilution, but should limit mass emissions, similar to what was proposed in Alternative 4, or that objectives should be applied to undiluted effluent unless the discharger demonstrates that there will be no significant degradation of marine resources within an initial dilution zone (7, 20).

Another argument is that short term worst case hydrologic conditions should not be used, since the new objectives are based on chronic effects or human health effects based on life-long exposure. Use of 30-day or 6-month average flow and currents in calculating initial dilution was recommended, especially for calculating 6-month median effluent limits. Another commenter recommended the use of the tenth percentile currents in calculating effluent limits. Several commenters suggested that dischargers be given the option of using ambient currents in calculating effluent limits if they choose to submit the information, such as dye studies, to document ambient conditions.

Response: Factors to be considered in developing a method for calculating effluent limitations include characteristics of the effluent plume, physical and chemical characteristics of the receiving waters, impacts to receiving waters, and ease of application.

The primary argument given to support the inclusion of ambient currents in calculating initial dilution is that the calculations or models should be as accurate as possible, so that the impacts of the discharge can be realistically appraised. The statement that there have been few problems in complying with Table B objectives was countered with the prospect that the current amendments propose many new objectives, some of which are below detection limits, which may present compliance problems.

We do not support the concept of dynamic permit limits, which change with seasonal conditions, for discharging to the marine environment for two reasons. From our perspective, the goal of water quality regulation is not to be at the level of the objective most of the time, but to be below the objective most of the time, with the objective as an upper limit. Secondly,

ocean dischargers do not face the restrictions in terms of availability of dilution water faced by inland water dischargers. We object to the use of ambient currents in calculating effluent limits because of the difficulty involved in documenting and verifying ambient conditions year-round. Under the circumstances, we do not feel that the extra work involved in developing and administering dynamic permit limits is worthwhile or necessary. Although the proposal of allowing dischargers to use currents as an option addresses the concern of the burden to dischargers, it does not answer the regulatory concerns. Therefore, we support the assumptions of no ambient currents in calculating effluent limits.

If the goal is to realistically assess the impacts of the discharge, we agree that measured background concentrations are essential. However, this would further complicate the process of developing effluent limitations. It is appropriate to ask whether or not the presence of strong currents in the vicinity of the discharge is an adequate justification for allowing the discharge of a greater mass of pollutants. The logical extension of this question is to ask whether or not any characteristics of the discharge or its location justify an increased rate of discharge of pollutants. In contrast to the modelling approach, the mass emissions approach (recommended by one commenter (5)) limits the amount of pollutants emitted by each discharge, regardless of flow rate. This approach is rooted in concern for the water body's long-term ability to assimilate pollutants, rather than for the size and shape of the mixing zone. The same concern was voiced in the comment that mixing zones only be granted where the discharger has demonstrated that no significant degradation of marine resources will result.

The Ocean Plan approach for using initial dilution is not a true modelling approach, but combines consideration of some features of the discharge and its location with some conservative assumptions that serve to limit the amount of dilution credit granted to dischargers. Mixing zones are allowed by the Ocean Plan because it seems reasonable to allow a limited zone of degradation where objectives are not met, compared with the costs of meeting objectives at the end of the pipe. However, this must be balanced by a concern for the mass of pollutants discharged. We do not feel that more accurate models of plume behavior necessarily provide a superior regulatory approach.

In summary, comments were received recommending both more and less stringent approaches to calculating effluent limits, as well as endorsements of the existing policy. The existing approach is simple to implement and has not created attainability problems. To our knowledge, it has not resulted in significant degradation of marine resources. The attainability analysis for the new objectives shows that most dischargers will be able to meet most of the objectives. It would be inappropriate to change the implementation of objectives on the basis of speculative problems with compliance. Also, changing the method of calculating effluent limits at the same time that new objectives are introduced would cause unnecessary confusion. Although the use of currents in calculating initial dilution is defended as a more realistic assessment of the impacts of the discharge, we find that there has been no assessment of the long term impacts to receiving waters that would result from the increase in pollutant discharge caused by greater dilution credits. In conclusion, we do not recommend changing the existing Ocean Plan method for calculating minimum initial dilution.

Alternatives for Board Action:

1. Do not modify the existing initial dilution policy. The methods for calculating the site-specific initial dilution of ocean dischargers would remain unchanged. Even though a few dischargers may experience some difficulty in achieving objectives, the State Board would continue to take a conservative approach for regulating marine discharges. For the most part, dischargers can achieve the existing Table B objectives under the current Ocean Plan mixing zone policy. The continuity of the Ocean Plan would be maintained. In order to clarify State Board policy we propose to move the requirements for assumptions for calculating initial dilution from Appendix I to the Ocean Plan (below Equation 1).

2. Allow the use of ambient currents in the calculation of initial dilution. The advantage of this alternative is that the models would more closely mimic the discharge characteristics. The existing initial dilutions would increase substantially. This would raise effluent limits to allow a greater concentration and therefore a greater amount of pollutants to be potentially emitted from each outfall, and to increase the size of the mixing zone, where water quality objectives are exceeded. Since, under existing policy, ambient water concentrations are not used to establish either background concentrations or compliance with water quality objectives, the increase in discharge of pollutants would be accompanied

by a decrease in confidence that water quality objectives are being met and beneficial uses protected after initial dilution.

3. Allow the use of currents in the initial dilution calculations and require that ambient water quality concentrations be used as background concentrations (Cs) in calculating effluent limitations. If currents are to be taken into account in calculating initial dilution in order to provide more accurate modeling, actual background concentrations of pollutants should also be considered in calculating effluent limitations. As in Alternative 2, this alternative would more closely model discharge characteristics and would substantially increase calculated initial dilution. However, in areas where receiving water concentrations are greater than Table C values, which are based on open ocean conditions, the allowable increase in pollutant concentration (Co - Cs) would be reduced. Effluent limitations resulting from Equation 1 would be higher in pristine waters than in heavily impacted waters.

   An advantage of this alternative is that the cumulative impacts of point and nonpoint sources at a given site are taken into account. Disadvantages are that permitted dischargers into heavily impacted waters might not meet the lower effluent limitations and that a relatively greater amount of pollutant discharge would be permitted into cleaner waters. Derivation of effluent limitations would be more complex and sampling costs to determine background concentrations would be significant.

4. Establish a maximum allowable dilution credit for ocean discharges. Reject the use of initial dilution modeling. With the existing policy of calculating site-specific initial dilutions for discharges, effluent limitations and the total permissible mass of pollutants discharged are a function of water depth and outfall design, especially with regard to diffusion. The limiting factors in this approach are the ambient water quality objectives to be met after initial dilution. However, water quality objectives do not take into account bioaccumulation or accumulation of toxic substances in sediments which are more strongly related to the mass of pollutants discharged than to ambient water concentrations.

This alternative would establish a maximum allowable dilution credit (e.g., the 10:1 dilution credit in the San Francisco Bay Regional Basin Plan (RWQCB, 1986)) such as 20:1 for ocean outfalls. The advantages of this approach are to decrease the permissible mass discharge of pollutants for a given flow rate and to limit the concentrations of pollutants in the mixing zone. The disadvantages are the removal of the incentive to dischargers to design outfalls to achieve greater initial dilution and that many dischargers may have difficulty meeting the lower resulting effluent limitations.

Staff Recommendation: Adopt Alternative 1.

Proposed Ocean Plan Amendment: Move the last paragraph of the definition of initial dilution from Appendix I to Chapter IV below Equation 1.

Issue 4: Amendments to Table B Objectives and Modification of Implementation Procedures for Water Quality Objectives

Present Ocean Plan Policy: Table B of the Ocean Plan contains objectives for toxic materials and provides the basis for calculation of effluent limitations for ocean discharges. If a calculated effluent limit is equal to or less than the detection limit, then the detection limit is considered to be the effluent limit.

Issue Description: Section 303(c)(2)(B) of the Clean Water Act requires that states adopt numerical objectives for the priority pollutants which EPA has published criteria under CWA Section 304(a) and that are reasonably expected to impair beneficial uses. To comply with this section of the Clean Water Act and to complete staff review of substances identified in the Ocean Plan triennial review (SWRCB, 1987), we have evaluated a number of substances for inclusion in Table B. These reviews fall into six general categories: (a) revision of procedures for implementing Table B water quality objectives, (b) revision of existing objectives for protection of marine life, (c) addition of objectives for priority pollutants for protection of marine life, (d) addition of objectives for priority pollutants for protection of human health from the effects of consumption of contaminated fish and shellfish, (e) review of aquatic life and human health objectives for chlorinated dibenzodioxins and dibenzofurans, and (f) addition of objectives for tributyltin. These categories will be discussed separately below.

The staff analysis of these issues included an assessment of the risks to aquatic life and human consumption of fish. We also analyzed POTW and industrial discharger monitoring data to assess potential compliance with proposed objectives. We were not able to make an assessment of the impact the proposed objectives would have on stormwater or other nonpoint source pollutant inputs to the marine environment.

As a result of our evaluation of the hearing record, we have expanded Issue 4 to include an evaluation of improved methods for implementing water quality objectives at or below method detection limits (MDLs).

Issue 4F provides a summary of the staff analysis contained in Issues 4 and 4A through 4E.

Comments Received:

Comment: The attainability analysis for the proposed Table B objectives did not include stormwater discharges. It is premature to adopt a new set of objectives that will apply to stormdrains before concentrations of these substances are known, or impacts from these pollutants in stormwater are documented. The application of these objectives to stormdrain discharges needs to be defined. Does Table A apply to discharges from stormdrains? (4, 16)

Response: The attainability analysis did not include stormwater discharges because there are few data available on pollutant concentrations in stormdrains. EPA's proposed regulations for stormwater discharges do not use water quality-based effluent limits for stormdrains. Instead, an approach based on Best Management Practices is proposed, following an initial period of characterization.

We do not propose to apply water quality-based effluent limits such as Table B to stormdrains at this time. Technology-based standards will not be based on Table A, but on Best Management Practices. Since the Table B objectives represent levels of pollutants that are protective of beneficial uses they may be applied to stormdrains at some future date. We do not anticipate that this would occur until adequate characterization data are available so that attainability can be assessed and implementation measures established.

At present, the Introduction of the Ocean Plan contains statements regarding how to apply Table B objectives to nonpoint sources of pollutants. The Ocean Plan says that compliance shall be determined by direct measurement in receiving waters. We do not propose that these statements be changed.

Comment: There must be standards in the Ocean Plan to protect human health and marine resources from pollutants discharged from storm drains (6).

Response: Public concern over pollutants discharged from stormdrains is twofold: potential pathogens in stormwater may increase the risk of infection to swimmers, and toxic chemicals in stormwater may concentrate to dangerous levels in seafood and threaten marine biota. The bacterial assessments and standards for shore stations proposed in Issue 2 will improve our ability to detect and eliminate sources of pathogens, whether stormdrains

or other sources. The proposed objectives in Table B define protective levels of toxic chemicals for ambient waters, regardless of the source. Standards specific to stormdrains are not needed. The upcoming stormwater permitting program will allow us to determine the extent to which stormwater is impacting ocean waters. Once that is known, we can work to eliminate any instance where an objective is exceeded due to stormdrain runoff.

Comment: The State Board should work with stormwater management agencies relative to permit controls for land drainage facilities (36).

Response: No response is necessary.

Comment: Several comments were received pertaining to the existing Ocean Plan provision which requires that the limit of detection be used as an effluent limit whenever a calculated effluent limit falls below the limit of detection specified in 40 CFR 136 (1, 17, 28, 31). It was pointed out that the term detection limit is a generic term while 40 CFR 136 contains Method Detection Limits (MDLs) which are defined specifically (28). It was further noted that regulatory precedence exists for utilizing the practical quantitation levels (PQL) as minimum effluent limits and that the PQL is a more appropriate regulatory tool than an MDL (28). It was stated that there is no supportable justification for adopting effluent limitations below PQLs because compliance cannot be determined (28).

Response: We agree with many of the comments pertaining to detection limits and their use in developing effluent limitations. We agree that (a) the term "limit of detection" should be replaced by the term Method Detection Limit, (b) in some cases PQLs are more appropriately used for determining compliance than MDLs, and (c) methods for implementing objectives and determining compliance should be clarified. We disagree with the assertion that the minimum effluent limit must be equal to a PQL and that compliance with limitations below the PQL cannot be determined.

Both MDLs and PQLs characterize certainty about analytical data based on single sample quantitation. The MDL is defined as the minimum concentration of a substance, in a single sample, that can be distinguished from zero with 99 percent confidence (cf. 40 CFR Part 136). The PQL is the lowest level of a substance that can be reliably measured, in single samples,

within specified limits of precision and accuracy under routine laboratory operating conditions (Federal Register, Vol. 52, No. 130, July 8, 1987). EPA developed the PQL and defined specific PQLs based either on laboratory performance evaluations or, where performance data were not available, as a multiple of the MDL. EPA generally sets the PQL at 10 times the MDL except where considerations of carcinogenicity or other factors suggest that a value of 5 times the MDL is more appropriate (40 CFR Part 136; Federal Register, Vol. 54, No. 97, May 22, 1989).

In general, the PQL provides a high degree of assurance that the value reported is actually the amount present in the sample. At levels above the PQL more precise assurance of the true concentration is provided while below the PQL greater uncertainty of the actual concentration exists. Below the MDL little assurance is provided that the reported amount is different from zero, although an amount other than zero can be characterized with less than 99 percent confidence (ASTM, 1988).

We have developed new alternatives under this issue and revised the staff recommendation to reflect these considerations and we have proposed that the existing Ocean Plan language be modified to make use of PQLs and MDLs.

Comment: Concerns about the appropriate use and interpretation of MDLs and PQLs were the focus of a number of comments. An appropriate definition of a PQL is required (28). The problem of matrix effects altering the numeric value of the MDL was raised (17, 28, 31). Since no 40 CFR 136 method exists for TCDD and TCDF, a method should be stipulated (28). It was recommended that analytical values below the method detection limit be interpreted as indicating a discharge has met effluent requirements (16). Also, it was suggested that when determining compliance for a group of chemicals which are subject to a single objective (TCDDs, PCBs, etc.) that analytical values below the MDL for individual members of the group be considered to be zero (28). A question was also raised regarding the meaning of and appropriate response to a single reported value when the objective is substantially below the MDL (5). A suggestion was made that Appendix II contain a list of minimum detection limits and accompanying protocols. Laboratories would have to achieve these limits in order to have acceptable data (16).

Response: We agree with many of the comments pertaining to the appropriate use and interpretation of MDLs and PQLs. We agree that (a) definition of PQL and MDL should be included in the Ocean Plan, (b) published values for MDLs and PQLs should be used in the absence of recent laboratory performance evaluations, (c) the matrix of the sample can have significant effects on the MDL and that dischargers should be allowed to develop a MDL appropriate for their matrix, (d) interpretation of effluent limitations below MDLs should be clarified for individual chemicals and groups of chemicals, (e) methods not specified in 40 CFR 136 should be established, and (f) acceptance of data should be predicated on demonstrated laboratory performance.

These issues are addressed under the new Alternative 2 (below) and the staff recommendation has been revised to reflect these considerations.

Alternatives for Board Action:

1. Do not change the existing methods for implementing Table B water quality objectives when the calculated effluent limit is near the method detection limit. The procedure for establishing an effluent limitations near the method detection limit would remain unchanged. The advantage of this alternative is that continuity of the Ocean Plan would be maintained. However, the Ocean Plan would be inconsistent with federal regulation (40 CFR Part 136) and the Regional Boards would be unable to make clear judgements of whether the Table B water quality objectives are exceeded.

2. Modify existing methods for implementing Table B water quality objectives when the calculated effluent limit is near the method detection limit. The procedure for establishing an effluent limit near the method detection limit would be changed to make use of both MDLs and Practical Quantitation Levels (PQLs). One advantage of this alternative is that the Ocean Plan would be more consistent with federal regulation (40 CFR Part 136). Another advantage is that the Regional Boards would be better able to make clearer judgements of whether the Table B water quality objectives are exceeded. Under this alternative, the Regional Boards would be provided with a process for determining compliance with objectives for single-sample measurements and for multiple-sample measurements.

In general, the PQL provides a high degree of assurance that the value reported is actually the amount present in the sample. At levels above the PQL more precise assurance of the true concentration is provided while below the PQL greater uncertainty as to the actual concentration exists. Below the MDL little assurance is provided that the reported amount is different from zero, although an amount other than zero can be characterized with less than 99 percent confidence (ASTM, 1988).

In many regulatory activities it is desirable to be able to determine compliance from a single sample. Where the calculated effluent limit is greater than or equal to the PQL, compliance should be based on the calculated effluent limit. When a calculated effluent limit is less than the PQL, the discharge should be considered to be out of compliance (based on a single sample), only if the constituent concentration is equal to or greater than the PQL. Although this may create a situation where compliance based on a single sample analysis is not quantified (the analytical response is between the effluent limit and the PQL), the degree of assurance that a single reported value accurately characterizes the sample warrants such an approach.

In addition to the consideration of compliance based on single sample analysis, compliance with any calculated effluent limit can be determined through the analysis of multiple samples using parametric or nonparametric statistical methods, as appropriate (Hirsch et al., 1982; Gilliom and Helsel, 1986; Schaffer and Kerster, 1988). To facilitate these types of analysis it is important to provide all the information available from sample analysis. All data should be reported uncensored with detection limits and quantitation limits identified (Gilliom et al., 1984; ASTM, 1988; Porter et al., 1988). No analytical response should be reported as not detected.

In cases where the calculated effluent limit falls below the PQL and recurrent detection below the PQL occurs, the Regional Board should require additional sampling and analysis to determine compliance.

A definition of PQL is required in order to establish the appropriate use and interpretation of PQLs. We propose to define a PQL as the lowest

concentration of a constituent which can be consistently determined within +/- 20 percent by 75 percent of the labs tested in a performance evaluation study. Alternately, if performance data are not available, the PQL should be defined as the MDL x 5 for carcinogens and the MDL x 10 for noncarcinogens. This definition is consistent with the EPA definition of PQL (Federal Register, Vol. 54, No. 97, May 22, 1989), except that EPA assigned a 10X value for some carcinogens. We believe that the behavior of many carcinogens at low environmental exposures (nonthreshold dose-response curve in the low-dose region) and uncertainty about interactions of various chemicals requires accepting less certainty about the concentration of carcinogens.

Since a PQL can be defined as a multiple of an MDL, a definition of an MDL is also required. We propose to define an MDL by reference to 40 CFR 136.

Published values for MDLs and PQLs should be used for determining compliance, except where recent laboratory performance evaluations have developed revised limits. Where published values are not available the Regional Boards should determine appropriate values based on available information.

The matrix of the sample can have significant effects on the MDL. If a discharger believes the sample matrix under consideration in the waste discharge requirements is sufficiently different from that used for an established MDL value, the discharger may demonstrate to the satisfaction of the Regional Board what the appropriate MDL should be in the discharger's matrix. In this case, the PQL should be established at a level equal to 10 standard deviations above the average measured blank (limit of quantitation) used for development of the MDL in the discharger's matrix. This is consistent with the American Chemical Society's recommendations for analytical quantitation (ACS, 1980; ACS, 1983).

The question of how to handle analytical results below the method detection limit can be approached in various ways. Any analysis reported below the MDL could be considered to be zero when averaging values for compliance purposes. To assume zero is usually incorrect and would

result in allowing excess pollution. An alternative is to consider values below the MDL to be equal to the MDL. We disagree with this option as well, since this conclusion is usually incorrect and the result would be to artificially increase the frequency of noncompliance. Rather than attempt broad generalizations about the data, a more appropriate approach is to utilize the data available by requiring that all data from laboratory analyses be reported uncensored (ASTM, 1988; Gilliom et al., 1984). This is consistent with current ASTM recommendations. The Regional Boards should then apply appropriate statistical methods to determine compliance. A number of statistical approaches using multiple sample analysis can provide adequate characterization of a discharge relative to calculated effluent limits.

In determining compliance for a group of chemicals subject to a single effluent limit we believe the same approach as described above is appropriate, i.e., reporting uncensored data and using appropriate statistical analysis. However, some simplification may be appropriate for single-sample compliance determinations. We, therefore, accept that analytical values below the method detection limit for individual members of a group of chemicals may be considered to be zero for purposes of determining compliance based on a single sample.

The interpretation of a single value is always subject to best professional judgement, particularly when the value falls near the method detection limit used for the analysis. In responding to a particular reported value, the Regional Boards will have to determine the potential for impairment associated with a specific incident. In some cases, a single value may trigger additional investigation while in others such efforts may only be undertaken if effluent limits are recurrently exceeded.

We believe the proposed Appendix II language referring to 40 CFR 136 adequately describes the methods and associated detection limits to be utilized. However, as was pointed out in the comments, 40 CFR 136 does not contain methods for all constituents of concern. To address this problem we propose to clarify Appendix II language by adding the following:

"Where methods are not available in 40 CFR 136, the Regional Boards shall specify suitable analytical methods in waste discharge requirements."

We agree that acceptance of data should be predicated on demonstrated laboratory performance and have included a statement to this effect in the staff recommendation.

Staff Recommendation: Adopt Alternative 2. Specifically we recommend:

1. Delete paragraph following Table B that describes the procedure for establishing effluent limits below limits of detection.

2. Add the following direction to Regional Boards for determining compliance with single sample and multiple sample measurements above and below the PQL:

"All analytical data shall be reported uncensored with detection limits and quantitation limits identified. For any effluent limitation, compliance shall be determined using appropriate statistical methods to evaluate multiple samples. Compliance based on a single sample analysis should be determined where appropriate as described below.

"When a calculated effluent limitation is greater than or equal to the PQL, compliance shall be determined based on the calculated effluent limitation and either single or multiple sample analyses.

"When the calculated effluent limitation is below the PQL, compliance determinations based on analysis of a single sample shall only be undertaken if the concentration of the constituent of concern in the sample is greater than or equal to the PQL.

"When the calculated effluent limitation is below the PQL and recurrent analytical responses between the PQL and the calculated limit occur, compliance shall be determined by statistical analysis of multiple samples. Sufficient sampling and analysis shall be required to determine compliance.

"Published values for MDLs and PQLs should be used, except where revised MDLs and PQLs are available from recent laboratory performance evaluations, in which case the revised MDLs and PQLs should be used. Where published values are not available the Regional Boards should determine appropriate values based on available information.

"If a discharger believes the sample matrix under consideration in the waste discharge requirements is sufficiently different from that used for an established MDL value, the discharger may demonstrate to the satisfaction of the Regional Board what the appropriate MDL should be for the discharger's matrix. In this case the PQL shall be established at the limit of quantitation (equal to 10 standard deviations above the average measured blank used for development of the MDL in the discharger's matrix).

When determining compliance based on a single sample, with a single effluent limitation which applies to a group of chemicals (e.g., PCBs) concentrations of individual members of the group may be considered to be zero if the analytical response for individual chemicals falls below the MDL for that parameter."

3. Add the following definitions to Appendix I:

"MDL (Method Detection Limit) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR 136 Appendix B.

PQL (Practical Quantitation Level) is the lowest concentration of a substance which can be consistently determined within +/- 20% of the true concentration by 75% of the labs tested in a performance evaluation study. Alternatively, if performance data are not available, the PQL for carcinogens is the MDL x 5, and for noncarcinogens is the MDL x 10.

4. Clarify Appendix II language by adding the following:

"Where methods are not available in 40 CFR 136, the Regional Boards shall specify suitable analytical methods in waste discharge requirements. Acceptance of data should be predicated on demonstrated laboratory performance."

Issue 4A: Update of existing Table B objectives.

Present Ocean Plan Policy: Table B regulates the concentration of 23 substances or classes of substances in receiving waters. It provides three limits, namely, a six-month median, a daily maximum, and an instantaneous maximum. For most substances, including heavy metals, the three limits are set in the ratio 1:4:10. For chlorinated hydrocarbons the ratio is 1:2:3. The six-month median concentration allowed for each chemical is determined by a formula that uses the results of chronic (long-term) toxicity tests and acute (usually four-day) lethality tests (SWRCB, 1988b). The objective must fall between background seawater concentration and an estimate of the lowest concentration that induces chronic toxicity. The latter concentrations are given in a separate table (Table D). Regional Boards, with the concurrence of the State Board and EPA, can allow higher limits than those in Table B, but not greater than Table D.

Issue Description: Toxic substances are regulated by application of numerical water quality objectives contained in Chapter IV, Table B of the Ocean Plan. The numerical objectives are derived from toxicity studies, published in the peer-reviewed literature, which aim to identify safe levels of exposure for marine organisms.

Table B in the original 1972 Ocean Plan (SWRCB, 1972b) contained fixed effluent concentration limits for toxic substances. During the 1978 review, receiving water limitations were devised to protect marine life from potential harm.

The 1988 amendments to the Ocean Plan included a review of Table B objectives for nine heavy metals (SWRCB, 1988b). In this issue objectives for chlorine, cyanide, pesticides, and polychlorinated biphenyls (PCBs) are reviewed. Ammonia and radioactivity are not addressed in this amendment.

Comments Received: Comment: Since the State Board uses data which EPA found unacceptable for the development of water quality criteria, the State Board should publish criteria for determining the acceptability of toxicity data (12).

Response: We have not used data which EPA considers unacceptable in the development of Table B objectives or the current proposal. The basic EPA

requirements for acceptable data (Stephan et al., 1985) are: Typed, dated, and signed hard copy such as manuscripts, publications, letters, or memoranda, "with enough supporting information to indicate that acceptable test procedures were used and that the results are probably reliable". Additional written information from the investigators may be required on occasion.

Data should be rejected if they are questionable. Examples of questionable data (Stephan et al., 1985) are when:

- o the test did not contain a control treatment,
- o too many organisms in the control treatment displayed stress symptom or mortality,
- o unusual dilution water was used,
- o tests evaluated formulated materials,
- o concentrations in the test solutions were not adequately verified,
- o tests were conducted on species not resident to North America, and
- o tested individual organisms were previously exposed to the tested substance.

Beyond these requirements, additional requirements and professional judgement are needed at a number of steps in EPA's water quality criteria development process. Although we use a method other than EPA's for developing proposed objectives, the basic requirements (listed above) apply equally to the Ocean Plan method (SWRCB, 1988b). The impression that the State Board has used unacceptable data may stem from our use of data listed as "other data ..." in EPA criteria documents. Our use of this data is consistent with EPA criterion development guidance which states that the use of data classed as "Other Data" should be the basis for a criterion when such data indicate that the calculated criterion is inappropriate. In addition, when using the Ocean Plan method, data on aquatic plant response is weighted equally with data on animal response. These factors require that certain data classed as "Other Data" by EPA assume a larger role in our objectives development procedures.

Comment: Commenters support the proposed total residual chlorine objective because it is more consistent with the current knowledge of chlorine toxicity and with the proposed toxic objectives (24, 25).

Response: Comment acknowledged and no response is necessary.

Comment: The proposed revised chlorine objectives do not take into account the nonconservative nature of chlorine or the chlorine demand of ocean water (32). The proposed objectives are based on chlorine exposure to organisms entrained through a facility. The assessment of toxicity due to chlorine should be based on exposure at the edge of the ZID, as was done for the current objectives (32).

Response: The FED does refer to "entrainment", but we mean entrainment in the discharge plume, not entrainment in the facility. The proposed objectives are to be applied after accounting for initial dilution, as are the existing objectives. It is true that the proposed objectives do not take into account volatilization or chlorine demand that takes place during mixing within the ZID. However, the proposed objectives also do not accurately reflect the short toxic exposure time shown by the research results cited in the FED. 8 ug/l is proposed as daily maximum when, in fact, chronic effects to sand dollars were shown after a five minute exposure. We feel that the current proposal takes a balanced approach, weighing new information on short-term, low-dose toxicity of chlorine against the benefits of maintaining the existing regulatory framework of setting daily maxima and allowing for initial dilution.

Comment: The total chlorine residual objective does not regulate the discharge of chlorination by-products which are potentially toxic. More research is needed on the formation of chlorinated organics during chlorination of sewage and standards for chlorination/dechlorination would be reconsidered in light of such research. (4, 5)

Response: We agree. At this point, we do not know of a practical way to regulate the discharge of chlorination by-products. We also do not have enough information to fully evaluate the tradeoffs involved in requiring alternate methods of disinfection. Suggestions such as this for new research should be brought up at the next Ocean Plan Triennial Review.

Comment: The cyanide water quality objective and other aquatic life objectives, should not be based on a single study. Chronic toxicity data for cyanide is inadequate for setting an objective. (2, 11)

Response: The Ocean Plan water quality objectives for the protection of aquatic life are not based on a single study. The objective is calculated based on the lowest three measurements of chronic toxicity among the acceptable data. This procedure for establishing aquatic life water quality objectives (SWRCB, 1988b) has been used by the State Board to establish water quality objectives since the late 1970's. We believe the method allows the State Board to establish reasonable objectives for the protection of aquatic life. Based on the EPA criteria document and our analysis of the aquatic toxicological literature for cyanide, we believe there are adequate data to develop an objective.

Comment: The comments submitted to the State Board concerning the derivation of Estimated Protective Levels (EPLs) in the Pollutant Policy Document (PPD) for the San Francisco Bay-Delta are also applicable to the revised objectives for CN^- (11).

The comments on the EPLs in the PPD that relate to the Ocean Plan pertain to the Ocean Plan objectives that were adopted in 1988. We are not re-evaluating that information in these amendments, we are proposing to modify some of the objectives based on new data: The comments on the PPD submitted by Bay Area Dischargers Association did not address the new data considered in this proposal. Comments on the Ocean Plan method, such as determination of acceptable data were addressed in response to other comments in this section. We believe that the Ocean Plan method has been adequately reviewed in the past since it has been in use since the late 1970s.

We would like to point out that the water quality objectives in the Ocean Plan are very different from the EPLs derived in the first draft of the PPD. For example, 6-month median Ocean Plan objectives were proposed as instantaneous maxima in the PPD.

Comment: Both the analytical method and the water quality objective for cyanide should be based on free rather than total cyanide (2, 15).

Response: We agree that free cyanide (HCN and CN^-) is the form of cyanide that is toxic to aquatic life; and that the regulation of total cyanide represents a conservative approach. However, free cyanide in ambient waters may result from the dissolution of some cyanide complexes present in effluent as well as from the discharge of free cyanide itself. Forms of cyanide capable of releasing free cyanide to the aquatic environment include the simple alkali metal cyanides, such as NaCN and KCN, and the weakly complexed organometallic cyanide complexes (EPA, 1989c).

Simple alkali metal cyanides are freely soluble in water, and readily ionize releasing the CN^- ion. This ion is then able to form the highly toxic hydrogen cyanide at the pH of marine waters.

Organometallic cyanide complexes vary in stability and dissociation increases with decreasing complex concentration and decreasing pH. Cadmium and zinc complexes are the least stable and would be expected to readily dissociate and release free cyanide at the dilute concentrations expected in a waste discharge, particularly after initial dilution. Complexes which contain nickel, copper and silver dissociate to a lesser extent and are considered to be moderately stable (APHA et al., 1985).

Strongly complexed cyanides are not expected to dissociate rapidly under ambient marine conditions. Iron-containing and cobalt-containing complexes are among the most stable cyanides (Kunz et al., 1978). Such strongly complexed cyanides may dissociate due to ultra violet light or sunlight (APHA et al., 1985) or due to bacterial degradation (Cherryholmes, 1985).

The difficulty in restricting the objective to the forms of cyanide that readily dissociate and release free cyanide is that limitations of the available analytical methods make it difficult to distinguish the weaker complexes from the strongly complexed cyanides. Available analytical methods are capable of determining free cyanide in a waste discharge resulting from the presence of: (1) CN^- or HCN; (2) the ionization of simple alkali metal cyanides, and; (3) the dissociation of weakly complexed organometallic cyanides, (APHA et al., 1985). There have been problems in using these methods to analyze complex discharges, particularly pulp and paper and refinery effluents (APHA et al., 1985). There are efforts currently underway

to provide better analytical resolution of strongly and weakly complexed cyanides (T. Mumley, RWQCB, San Francisco Bay Region, pers. comm.).

We have modified Alternative 2 and added a footnote to Table B stating if a discharger can demonstrate to the Regional Board that reliable analytical methods are available, the cyanide objective may be met by the combined measurements of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanides.

Alternatives for Board Action:

1. Do not change the existing Table B water quality objectives. The compounds and concentration limits in Table B would remain unchanged. The advantage of this alternative is that continuity of the Ocean Plan would be maintained. However, the estimates of cyanide and chlorine effects, from which the present objectives were derived (before 1978), are not based on the most current scientific information. Present Table B water quality objectives may not protect beneficial uses.

2. Revise Table B to reflect current knowledge of chronic toxicity for cyanide and total residual chlorine. Do not modify the objectives for the pesticides and PCBs. New information is available on the toxicity of chlorine and cyanide that allows a better estimate of chronic toxicity. The results of recent studies of toxicity and calculations of the six-month median, daily maximum and instantaneous maximum for the subject compounds are presented below.

Chlorinated Organic Compounds: Pesticides and PCBs

Chlorinated organic compounds in Table B include chlorinated phenolics, aldrin and dieldrin, chlordane and related compounds, DDT, endrin, hexachlorocyclohexane (HCH), polychlorinated biphenyls (PCBs) and toxaphene. The current six-month median limiting concentrations range from 1 ng/l (part per trillion) to 7 ng/l except that the limit for chlorinated phenolics is 1 ug/l (part per billion).

These objectives were added to Table B as part of the Ocean Plan amendments in 1983. Our review of toxicity data revealed only a handful of new studies and no findings that would suggest changes in any of the objectives. For example, for chlordane and related

compounds, there have been no new acceptable toxicity data published on a marine organism since 1978 (Phillips, 1988c).

The water quality objectives for chlorinated organic compounds should not be modified. The rationale for the current limits, to prevent discharge of chlorinated hydrocarbons by manufacturers or major commercial or industrial users (SWRCB, 1983) still applies. The six-month median objective allows for the small residues found in treated domestic wastewater.

Cyanide

The present six-month median limitation is 5 ug/l and the daily and instantaneous maximum limits are 20 ug/l and 50 ug/l, respectively. The objective is based on acute toxicity because of a scarcity of information on chronic toxicity. A recent EPA review (EPA, 1985b) provides enough new data (Table 4) to allow determination of a Conservative Estimate of Chronic Toxicity (CECT), namely, 10 ug/l. The CECT for cyanide should be added to Table D, since there is now no Table D value for cyanide.

The revised water quality objective, based on the new information, should be 1 ug/l as a six-month median, 4 ug/l as a daily maximum, and 10 ug/l as an instantaneous maximum. A survey of discharge data from several southern California sanitation districts indicates no difficulty in meeting this more stringent objective. The survey included the major industrialized districts where cyanide concentrations in wastewater should be greatest.

Table 4. Lowest Three Measurements of Chronic Toxicity of Cyanide in Salt Water.

Species	Cyanide (ug/l)	Effect	Duration (days)	Reference
Cancer irroratus (rock crab)	5	Death; abnormal shell development	4	EPA, 1985b
Champia parvula (red alga)	11	Discontinued sexual reproduction	14	Steele and Thursby, 1983
C. parvula (red alga)	16	Reduced reproduction	11	Steele and Thursby, 1983

The regulation of free cyanide alone would not provide adequate protection to aquatic life. To avoid unreasonable limitations for discharges containing significant amounts of strongly complexed cyanides, we believe if a discharger can demonstrate to the Regional Board that reliable analytical methods are available, the cyanide objective may be met by the combined measurements of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanides.

Chlorine (Total Chlorine Residual)

Chlorine is unique among Table B toxicants in that it is deliberately added to wastewater as a biocide. Chlorination and subsequent dechlorination of wastewater at POTWs is continuous and may produce a continuous discharge of residual chlorine. In contrast, chlorination of cooling water at electricity generating stations (power plants) is periodic, typically lasting 10 to 40 minutes and occurring at 8 to 12 hour intervals. Discharge of residual chlorine from power plants follows the same pattern.

Limiting concentrations in Table B include a six-month median of 2 ug/l, a daily maximum of 11 ug/l, and an instantaneous maximum of 126 ug/l. Both the daily and instantaneous maxima are derived from an

equation contained in footnote "b" to Table B. The same equation is used to compute objectives for intermittent discharges not exceeding two hours. That equation allows greater amounts of chlorine for shorter discharge periods. For example, the equation provides that the chlorine concentration during a two-hour discharge cannot exceed 26 ug/l, while the concentration during a five-minute discharge cannot exceed 74 ug/l.

The equation for total chlorine residual applied to intermittent discharges is based on Mattice and Zittel (1976). That study emphasized short-term lethality tests with fish species. More recent examination of the toxicity of chlorine to marine organisms has focused on nonlethal effects on early life stages of invertebrates. The results suggest that a revision of the chlorine objective is in order.

A 30-minute exposure to residual chlorine (including chloramine) adversely affected oyster (Crassostrea virginica) and lobster (Homarus americanus) larvae at 10 ug/l and rotifers (Brachionus sp.) at 20 ug/l (Capuzzo et al., 1977; Goldman et al., 1978). A five-minute exposure prevented fertilization of sand dollar (Dendraster excentricus) eggs at about 8 ug/l (Dinnel et al., 1981). Brief exposure (less than one minute) ceased to interfere with giant kelp (Macrocystis pyrifera) germination only when chlorine concentration fell to about 58 ug/l (Hose, 1987; SWRCB Resolution 88-80).

These results imply that remarkably short exposure to chlorine residual harms planktonic organisms. Full protection would require the instantaneous maximum not to exceed about 58 ug/l, while exposures of five minutes or more should be less than 8 ug/l.

The chlorine concentrations that planktonic organisms experience is hard to determine, but we assume that when an organism is entrained in a chlorinated discharge plume, it is the initial, high concentration that largely establishes the degree of toxicity. After entrainment, the chlorine concentration in the water mass falls; it falls quickly if the discharge is short, but more slowly if the discharge is prolonged. In practice, chlorination events are either short (up to 40 minutes at power plants) or continuous (at POTWs). The equation used to calculate objectives for intermittent discharges must be modified to incorporate the short-term

toxicity data presented above. A new equation can be derived based on the following:

1. a log-log relationship between chlorine dose and time of exposure for a given level of toxicity, as established in Mattice and Zittel (1976);

2. an allowable concentration for one minute of 60 ug/l, based on the proposed instantaneous maximum;

3. an allowable concentration for two hours of 8 ug/l, based on the harmful effects shown at that level by Dinnel et al. (1981).

The resulting equation is:

$$\log y = -0.43(\log x) + 1.8$$

where y = the water quality objective (in ug/l) to apply when chlorine is being discharged, and

x = the duration of uninterrupted chlorine discharge in minutes.

This new equation differs from the current approach in requiring that two hour discharges meet the same standard as 24 hour discharges, because the new short term toxicity data demonstrate that short term exposure at relatively low levels is harmful to marine organisms.

Staff Recommendation: Adopt Alternative 2. Specifically we recommend:

1. Revise water quality objectives to Table B as follows:

	Units	6-mo. Median	Daily Maximum	Instantaneous Maximum
Total Chlorine Residual	ug/l	2	8	60
Cyanide	ug/l	1	4	10

2. Change the equation in footnote b) of Table B to read:

   $\log y = -0.43(\log x) + 1.8$

3. Add a CECT for cyanide to Table D as follows:

Constituent	Estimate of Chronic Toxicity (ug/l)
Cyanide	10

4. Add a new footnote b) to Table B as follows:

   "b) If a discharger can demonstrate to the satisfaction of the Regional Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by Standard Methods 412F, G, and H (Standard Methods for the Examination of Water and Wastewater. Joint Editorial Board, American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Most recent edition.)."

5. Reletter existing Table B footnote b) to c).

Issue 4B: Add new aquatic life objectives to Table B: selenium, endosulfan, and volatile organics.

Present Ocean Plan Policy: Water quality objectives for the protection of marine life from the effects of toxic pollutants are contained in Table B. The Ocean Plan does not contain objectives for the above named substances.

Issue Description: The CWA requires the State to adopt numerical water quality objectives for the priority pollutants that are expected to impair beneficial uses for which EPA has developed criteria for the protection of human health and marine life. The Ocean Plan already contains objectives for all such priority pollutants to protect marine life except selenium and endosulfan. The following discussion is limited to our findings on the aquatic toxicity of these two chemicals, plus several volatile organochlorine compounds which are priority pollutants without EPA criteria. A later section treats objectives for the protection of human health.

The procedure for computing water quality objectives is described in the Functional Equivalent Document for Amendment of the California Ocean Plan (SWRCB, 1988b). The procedure relies principally on calculation of a CECT, defined as the geometric mean of the three lowest concentrations known to cause chronic toxicity (Klapow and Lewis, 1979). The computation for a water quality objective is the geometric mean of the CECT and the natural background concentration of the substance in seawater. For substances whose natural background concentration is zero, the CECT is divided by ten.

When data on chronic toxicity are insufficient to provide a calculation of a CECT, we calculate a "Conservative Estimate of Acute Toxicity" (CEAT), defined as the tenth percentile, from the low end, of the ranked acute toxicity (96-hr LC 50) values. To calculate the water quality objective, the CEAT is multiplied by a factor intended to represent the ratio between the safe concentration and the acutely toxic concentration. The factor has ranged from 0.1 to 0.01, depending on the potential for bioaccumulation of the substance.

Comments Received:

Comment: A comment was received in support of the proposed selenium and endosulfan objectives (24).

Response: No response is necessary.

Alternatives for Board Action:

1. Do not add new water quality objectives to Table B. The compounds and concentration limits in Table B would remain unchanged. The advantage of this alternative is that continuity of the Ocean Plan would be maintained. However, the objectives would not reflect up-to-date information. The requirements of the CWA (Section 303(c)(2)(b)) would not be met.

2. Revise Table B to reflect new water quality objectives for selenium and endosulfan. Do not adopt objectives for volatile organic compounds. EPA has developed Section 304(a) criteria for selenium and endosulfan to protect aquatic life; therefore, the State Board is required to adopt water quality objectives for these substances for water bodies where they could impair beneficial uses. The following discussion presents the results of recent studies of toxicity for these substances and calculates the six-month median, daily maximum, and instantaneous maximum for the subject compounds.

Selenium

The natural background level of selenium in the ocean ranges from about 0.02 to 0.2 ug/l (Phillips, 1988a). A review of data on chronic toxicity provided a CECT of 147 ug/l (Table 5). Calculation of an objective using the reported background levels and the CECT yields a value with an unreasonable large safety factor (a factor of 27). We, therefore, propose an objective of 15 ug/l which utilizes a safety factor of 10 (147 ug/l divided by 10 and rounded to the nearest whole number). The daily and instantaneous maximum limits would be 60 ug/l and 150 ug/l, respectively. The proposed objective is far higher than selenium concentrations known from ocean discharges. Of measurements at six facilities, the highest six-month median receiving water concentration noted was 0.33 ug/l.

Table 5. Lowest Three Measurements of Chronic Toxicity of Selenium in Salt Water.

Species	Selenium (ug/l)	Effect	Duration (days)	Reference
Platymonas subcordiformis (green alga)	100	Reduced population growth rate	14	Wheeler et al., 1982
Porphyridium cruentum (red alga)	100	Reduced population growth rate	14	Wheeler et al., 1982
Mysidopsis bahia (mysid shrimp)	320	death; reduced number of offspring	17	Ward et al., 1981

Endosulfan

Data on chronic toxicity of endosulfan in marine organisms are too scant to permit computation of a CECT (Phillips, 1988b). The CEAT, based on 23 tests from marine and estuarine waters, is 0.09 ug/l. This value is the 96-hr LC 50 for a fish, Leiostomus xanthurus (Schimmel et al., 1977). The next higher value, 0.10 ug/l, is for juvenile striped bass, Morone saxatilis (Korn and Earnest, 1974). The lowest value, 0.04 ug/l, is for pink shrimp, Penaeus duodarum (Schimmel et al., 1977).

Endosulfan appears to have lower bioaccumulation potential than other chlorinated pesticides (Phillips, 1988b), so that an application factor of 0.1 is appropriate. This yields a proposed water quality objective of 0.009 ug/l as a six-month median. If the daily and instantaneous maximum limits are computed as they are for other chlorinated hydrocarbons in Table B, the limits are 0.018 ug/l and 0.027 ug/l, respectively.

We examined Reports of Waste Discharge from 21 facilities that measure endosulfan concentrations. All but two reported it as not detected. However, a broad range of detection limits were reported. Since attainability is a function of effluent limitations and dilution, it is not

possible to determine whether dischargers reporting nondetectable levels (utilizing the methods with less sensitive limits of detection) will have difficulty meeting the proposed objective. The two dischargers that detected endosulfan met the proposed objective.

Volatile Organochlorine Compounds

We reviewed published data on the acute and chronic toxicity of six classes of volatile organochlorine compounds identified by the EPA as priority pollutants. They included dichloroethanes, trichloroethanes, trichloroethylene, perchloroethylene, dichlorobenzenes, and hexachlorobutadiene. Toxicity data for all six were too scant for development of estimates of either acute or chronic toxicity. Salt-water toxicity measurements which meet EPA guidelines for properly conducted studies (Stephan et al., 1985) include only two measurements each for dichloroethane, trichlorethane, and trichloroethylene and none for any other compound (Leson et al., 1988). Consequently, we do not have enough information to propose water quality objectives for the protection of marine life for any of the six volatile organochlorines.

Records of concentrations of volatile organochlorine compounds in wastewater are few. Eight ocean dischargers reported measurements. Only the two largest and most industrialized sanitation districts (Los Angeles County and Hyperion) detected any volatile organochlorines (Baird and Neisess, 1988). Whole effluent levels at those two facilities ranged from one to three orders of magnitude lower than known toxic concentrations for freshwater organisms.

Staff Recommendation: Adopt Alternative 2. Specifically we recommend:

1. Add new water quality objectives for selenium and endosulfan to Table B as follows:

	Units	6-mo. Median	Daily Maximum	Instantaneous Maximum
Selenium	ug/l	15	60	150
Endosulfan	ng/l	9	18	27

2. Since endosulfan is a chlorinated pesticide, Chapter VI.B. should be amended as follows:

"Limitations on chlorinated pesticides ... in Table B (6-month median = 31 ng/l, daily maximum = 62 ng/l, and instantaneous maximum = 93 ng/l)."

Issue 4C: Add new objectives for priority pollutants for protection of human health against effects due to consumption of contaminated fish and shellfish.

Present Ocean Plan Policy: Presently, the Ocean Plan contains objectives to protect aquatic life. The Ocean Plan does not contain numerical objectives to protect against human health effects arising from the consumption of contaminated seafood.

A narrative water quality objective in Chapter II of the Ocean Plan specifies that the concentration of organic materials in fish, shellfish, or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.

Issue Description: Section 303(c)(2)(B) of the CWA requires that states adopt numerical objectives for the priority pollutants that are expected to impair beneficial uses and for which EPA has published criteria under Section 304(a). In its guidance for implementation of this section (EPA, 1989a), EPA lists 95 priority pollutants as having published 304(a) criteria to protect human health from contaminated fish and shellfish consumption. These criteria represent concentrations in water that protect against the accumulation of the chemicals in fish and shellfish to levels predicted to result in significant human health problems. The EPA method for calculating these criteria dates to 1980 when separate equations were presented for carcinogens and noncarcinogens (Federal Register Vol. 45, No. 231, pages 79347-79356, November 28, 1980).

For carcinogens, the water concentration (C) (i.e., proposed water quality objective) in mg/l corresponding to a lifetime cancer risk of 10^{-6} for a 70 kg person is calculated by the formula:

$$C = \frac{70 \times 10^{-6}}{q^*(0.0065BCF)}$$

where q* (cancer potency) is measured in $(mg/kg/day)^{-1}$, 0.0065 is an estimate of average daily seafood consumption in kg/day, and BCF (bioconcentration factor) is in l/kg. For noncarcinogens, the water concentration (C) is calculated by the formula:

$$C = \frac{ADI}{(0.0065BCF)}$$

where ADI (allowable daily intake, now called reference dose) is measured in mg and the remaining units are as above.

Assumptions Related to the Risk Estimation Equations

Development of human health objectives relies on several assumptions to adequately characterize risk. The most common of these are presented below (from Houk, 1986):

1. When human data are not adequate, adverse effects in experimental animals are regarded as indicative of adverse effects in humans.

2. Results obtained with dose-response models can be extrapolated outside the range of experimental observations to yield estimates or estimated upper bounds on low-dose risk.

3. When an appropriate standardized dosage range is used, observed experimental results can be extrapolated across species.

4. There is no threshold for the production of cancer, but threshold effects may apply for other toxicologic outcomes.

5. When dose rates are not constant, average doses give a reasonable measure of exposure.

6. In the absence of pharmacokinetics data, the effective or target dose is assumed to be proportional to the administered dose.

7. Risks from any exposures and from many sources of exposure, to the same chemical, are usually assumed to be additive.

8. In the absence of evidence to the contrary and regardless of the route of exposure, 100 percent absorption across species is assumed.

9. Results associated with a specific route of exposure are potentially relevant for other routes of exposure.

Analysis of Uncertainties Associated with the Risk Estimation Equations

The purpose of an uncertainty analysis is to provide the public and the risk managers with some insight into the degree to which the quantitative estimates are likely to reflect the magnitude of the human health or ecological risks (EPA, 1989e). The following lists the principal sources and magnitudes of uncertainty associated with the process for establishing objectives to protect human health:

1. BCF based on the log of the Partitioning Coefficient (log P): The 95 percent prediction limits for the regression are approximately one order of magnitude (Veith and Kosian, 1982 in EPA, 1989e). Thus, for a BCF of 100, the 95 percent prediction limits would range from approximately 10 to 1,000. For BCFs of super-hydrophobic chemicals, i.e., chemicals with log Ps greater than 6.5, overestimation of the BCF value by log P regression equations will be greater as the log P increases. Thus, errors to 2 or 3 orders of magnitude may not be uncommon.

2. Bioaccumulation factor (BAF) compared to BCF: Chemical residues may in some species increase above the BCF as the result of consuming residue-containing food. For chemicals with log P between 4.5 and 7.0, bioaccumulation above bioconcentration increases from 3 times to 100 times for higher trophic level fishes.

3. Fish percentage lipid: Non-polar chemicals, being lipophilic, accumulate proportionately to the lipid content of the organism. The BCF data base was generated using fish with a lipid content of 7.6 percent. Fillets often are in the range of 3.0% or less. Some fish may be as high as 30% fat.

4. Fish average exposure compared to exposure at point of application of the criterion: Depending on the spatial variability in the area, the behavior of the target fish species, and the point of application of the criterion, the average exposure of landed fish may be as little as a small fraction of, or as great as 100 percent of the exposure at the point of application of the criterion. For example, where the criterion is applied

at the end of the pipe, the average exposure would be a small fraction. Where the criterion is applied as an average over a substantial area, the average exposure would be equal to exposure at the point of application of the criterion.

5. Fish consumption by humans: 0 - 67 g/day (5th - 95th percentile range for individual's consumption over a single month, separated by ethnic group).

6. Percentage of human's fish intake obtained from study area (or point of criteria application): 0 to 100 percent depending on size and character of area, and the value of its fishery.

7. Design dilution: Residue formation in tissues often requires up to 30 days or longer to achieve a steady state concentration. Carcinogens are currently classed as nonthreshold chemicals, thus the exposure to such chemicals should be based on a long-term average concentration. The use of design flow to accommodate these considerations could be 1.4 times higher for threshold chemicals and 4 times higher for non-threshold chemicals.

8. Cancer potency: Cancer potency estimates are subject to great uncertainty due to extrapolation from animals to humans, and from high doses to low doses. EPA believes that its procedures produce a plausible upper 95 percent confidence limit for risk. Such an estimate, however, does not necessarily give a realistic prediction of risk. The true risk may be as low as zero.

9. Allowable individual risk: Once its value is agreed upon, the allowable risk has no uncertainty. However, the allowable risk may vary from situation to situation. In its past actions, the EPA has usually targeted allowable individual risks in the range of 10^{-4} to 10^{-7} depending on costs and aggregate risks.

10. Reference Dose (RfD): The RfD is a threshold below which effects are unlikely to occur. While exposures above the RfD increase the probability of adverse effects, they do not produce a certainty of adverse effects. Similarly, while exposure at or below the RfD reduces the

probability, it does not guarantee the absence of effects in all persons. As RfDs often employ safety factors in the range of 100 to 1000, they are imprecise estimates.

Application of the formulas to toxicologic and other information available approximately a decade ago resulted in the Section 304(a) criteria. These two formulas and the resultant criteria form the basis for the range of alternatives presented.

Comments Received:

Comment: Comments were received regarding modifications to the equations used for the calculation of proposed objectives. New research is necessary to check the accuracy of the relationship between the proposed objectives and the concentration of the respective chemical in fish that will produce a 10^{-6} risk of cancer (5). There is a need for estimates of the number of California residents exposed to contaminated fish and shellfish (17). The BCFs used should be derived from the species actually consumed (15).

Response: Although it may be possible to improve the predictive capability (through research) of the equations used to compute the proposed objectives, it would have been an extremely time-consuming process to develop modifications, test their accuracy, and develop consensus for their adoption. The equations used were subjected to thorough scientific review and public comment when they were developed and approved by EPA.

A check of the accuracy of the relationship between the proposed objectives and the concentration in fish implies replacing the BCF in the equations with terms reflective of bioavailability and bioaccumulation. Although progress is being made in this area (e.g., EPA, 1989e), such modifications are not yet ready for application. Similarly, surveys have only recently been initiated to provide preliminary estimates of the frequency of contamination of fish and shellfish and, therefore, the number of Californians exposed (DHS, 1985). Until sufficient information is generated to accurately judge the proportion of the population's seafood diet that is contaminated, no such term can be incorporated in the equations.

We believe, however, that modifying the equation to address the number of people exposed is inappropriate. Water quality objectives are developed to

protect beneficial uses; they are not made more lenient because ambient water concentrations approach the objective in a few water bodies. Finally, although restricting BCF data to those organisms actually consumed is logical, these BCFs are generally not available. We used the BCF values recommended by EPA in each criteria document.

Comment: Comments were received regarding the data used in the equations for calculating proposed objectives. The choice of the estimate of daily fish and shellfish consumption was criticized (17, 20, 30). It was suggested that we use a consumption rate greater than the daily average (23 g/day) to protect those persons who consume large amounts of fish (20). It was also suggested to use a minimum consumption rate of 23 g/day for the daily average based on a review of the literature published between 1971 and 1989 (30). Basing the fish consumption estimate on a personal communication is inappropriate (17). The BCFs should be provided (5) and EPA's IRIS values should be used for cancer potency and reference dose unless the Department of Health Services (DHS) has developed its own estimate (30).

Response: Significant effort was devoted to locating the best available data for all variables contained in the equations: measures of toxicity (cancer potency and reference dose), fish and shellfish consumption estimates, and bioconcentration factors. Since much of this information is available in data bases and criteria documents and because much space was devoted in these sources to examination of the data's quality, we chose not to include such a discussion. However, such a review was not available for the fish consumption estimate; consequently, we have included the DHS analysis of fish consumption rate in Alternative 3.

The BCF data and review of its quality also appear in the EPA criteria documents. DHS has classified carcinogens and estimated their potency. We have used DHS cancer potency and reference dose values when available. In summary, we have used the best and most up-to-date information available in Alternative 3 to calculate the proposed water quality objectives.

Comment: Comments were received to raise, lower, or justify our choice of 10^{-6} as a cancer risk level. Basing the choice of risk level on attainability analyses is not advisable (1, 14, 20). Ease of attainment does not provide sufficient justification for choosing 10^{-6} rather than a more stringent level

(20). The risk level choice should be a policy decision for the State Board to make, rather than being driven by attainability. A risk level of 10^{-5} should be selected to be consistent with Proposition 65 implementation (1, 14). Include 10^{-5} as another option for our attainability analyses. The 10^{-6} risk level is too stringent given that 18 of the 32 dischargers evaluated would not have met at least one of the proposed objectives (17).

Response: One of our fundamental concerns in choosing a cancer risk level was that the choice reflect an effort to balance costs and benefits and that these costs and benefits be supported with data. In the past, judgments were based on assessments of attainability without examining actual monitoring data. Rather than pursuing a purely economic approach for estimating the costs of various risk levels, we chose to assess the frequency with which dischargers have not recently attained the various proposed objectives. The goal was to find a risk level that was both generally attainable and yet satisfied a consensus view of being adequately protective.

In this effort, we anticipated given the number of dischargers (thirty two) and the number of proposed objectives for carcinogens (thirty seven in all, which was all the data available to us), there would be a few instances where these objectives would not be attained (Tables 10 through 13). The new attainability analysis demonstrates an impact on a small number of dischargers. Of the almost two thousand comparisons we made (between monitoring data and proposed objectives), the proposed objectives were exceeded in only 18-26 instances (depending on the alternative and risk level selected). These exceeded objectives were caused by 12 or fewer dischargers in contrast to the 18 dischargers identified in the original attainability analysis (SWRCB, 1989). We have expanded the analysis to contrast the various alternatives.

From an attainment perspective, the difference between the 10^{-5} and 10^{-6} alternatives is that two fewer dischargers would exceed the proposed objectives using the 10^{-5} option.

Comment: Comments were received to enlarge, reduce, or justify the list of chemicals to be regulated. An objective for polychlorinated terphenyls should be added to Table B (7). Human health objectives for chlorobenzene, hexachlorocyclopentadiene, and nitrobenzene have been published by EPA

and, therefore, should be added to Table B (29). Protection of human health constitutes the most sensitive beneficial use for six other substances (arsenic, aldrin-dieldrin, chlordane, DDT, PCBs, and toxaphene) and, therefore, the State Board should adopt these objectives rather than aquatic life water quality objectives (29). A description should be included that depicts whether each proposed Table B constituent has been detected in discharges and whether they accumulate in seafood subsequently consumed by humans (4).

Response: Given the deadline for adopting these new objectives, we have limited ourselves in this amendment to the priority pollutants with published human health criteria because of the time and the information available to us. Tributyltin was added because the information necessary for developing water quality objectives was recently reviewed (SWRCB, 1988d). Development of additional objectives, including one for polychlorinated terphenyls if the data are available, can be considered at a future date.

We agree that several other chemicals with published EPA human health criteria should be added to Table B. We have revised our recommendation to propose the lower human health objective unless there is a good reason not to adopt the lower number (40 CFR 131.11(a)). In this set of proposed objectives, arsenic is the only exception (see the attainability section below).

We can not determine if some of the constituents for which we propose objectives can be reasonably expected to interfere with beneficial uses because we do not have all the information necessary to assess if constituents are present in effluents or marine organisms. Table 6 illustrates that almost all of the chemicals for which objectives are proposed have been detected in either mussels or effluent. DHS is expected to supplement this information in the near future with results for edible fish collected from Santa Monica Bay (G. Pollock, DHS, pers. comm.). Given the results shown in Table 6, all the Table B human health constituents were detected, except the following: acrolein, bis (2-chloroethyl) methane; acrylonitrile; bis (2-chloroethyl) ether; bis(2-chloroisopropyl) ether; 3,3'-dichlorobenzidine; 1,3-dichloropropene; 2,4-dinitrotoluene; fluoranthene; hexachlorobutadiene; hexachlorocyclopentadiene; hexachloroethane; isophorone; nitrobenzene; and 1,1,2-trichloroethane (monitoring data were not available for tributyltin). Two of these substances [bis(2-chloroethyl) ether and 3,3'-dichlorobenzidene] are of

concern because effluent limits calculated from the proposed objectives are below the method detection limit, making it impossible to determine if beneficial uses are impaired.

Table 6: Detection of priority pollutants in discharger effluent and mussels. Data were obtained from the California State Mussel Watch 10-year data base (T. Stevens, pers. comm.) and the ocean discharger monitoring reports used in attainment analysis.

Chemical	Substance detected in Mussels	Substance detected in ocean discharges
NONCARCINOGENS		
acrolein	NA	ND
antimony	NA	D
bis(2-chloroethoxy) methane	NA	ND
bis(2-chloroisopropyl) ether	NA	ND
bis(2-ethylhexyl)phthalate	NA	D
chlorobenzene	NA	D
chromium (III)	D	D
di-n-butyl phthalate	NA	D
dichlorobenzenes	NA	D
1,3-dichloropropene	NA	ND
diethyl phthalate	NA	D
dimethyl phthalate	NA	D
4,6-dinitro-2-methylphenol	NA	D
2,4-dinitrophenol	NA	D
endosulfan	D	D
ethylbenzene	NA	D
fluoranthene	NA	ND
isophorone	NA	ND
mercury	D	D
nickel	D	D
thallium	NA	D
toluene	NA	D
1,1,1-trichloroethane	NA	D
hexachlorocyclopentadiene	NA	ND
nitrobenzene	NA	ND
CARCINOGENS		
acrylonitrile	NA	ND
aldrin	D	ND
arsenic	D	D
benzene	NA	D
benzidine	NA	D
beryllium	NA	D
a-HCH	D	D

b-HCH	D	D
g-HCH	D	D
bis(2-chloroethyl) ether	NA	ND*
carbon tetrachloride	NA	D
chlordane	D	D
DDT	D	D
3,3'-dichlorobenzidine	NA	ND*
1,2-dichloroethane	NA	D
1,1-dichloroethylene	NA	D
dichloromethane	NA	D
dieldrin	D	D
2,4-dinitrotoluene	NA	ND
1,2-diphenylhydrazine	NA	D
halomethanes	NA	D
heptachlor	D	D
hexachlorobenzene	D	ND
hexachlorobutadiene	NA	ND
hexachloroethane	NA	ND
N-nitrosodimethylamine	NA	D
N-nitrosodiphenylamine	NA	D
PAHs	NA	D
PCBs	D	D
2,3,7,8-tetrachloro dibenzo-p-dioxin	NA	D
1,1,2,2-tetrachloro-ethane	NA	D
tetrachloroethylene	NA	D
toxaphene	D	ND
1,1,2-trichloroethane	NA	ND
trichloroethylene	NA	D
2,4,6-trichlorophenol	NA	D
vinyl chloride	NA	D

D = detected; ND = not detected; NA = not analyzed
* = proposed objective is significantly below method detection limit for these chemicals, which were not detected in either mussels or effluents.

Comment: Control of recognized laboratory contaminants (e.g., methylene chloride, chloroform, and phthalates) requires special facilities too costly for most laboratories (16).

Response: We realize the difficulty of preventing laboratory contamination by these substances but these substances may pose a threat to human health and, therefore, it is appropriate to regulate them. This problem can be resolved by using labs that have acceptable quality assurance performance

for these substances rather than to conduct extensive modification of many labs.

Comment: The water quality objective selection process should include development of several alternative proposed objectives based on different assumptions and/or calculation procedures and assessment of the attainability and impacts of achieving each alternative (11).

Response: We agree and have included proposed objectives calculated using various cancer potency values, reference doses, and cancer risk levels. An attainment analysis has been performed on each of these alternatives and assessments made regarding their impacts.

Comment: Use "daily maximum" instead of "30-day average" in Table B (23).

Response: If marine organisms are exposed to carcinogenic substances, the resulting concentrations in tissues will be the result of the average exposure. We understand that using a 30-day average for compliance purposes could be interpreted to require more than one sample per month to obtain an average. To clarify these statements, we have added language after Table B that states if only one sample is collected during a sampling interval (whether it be an average or a median), then the single sample measurement shall be considered the average or median, whichever is appropriate.

Comment: Modifications to Table B resulting from updates in the Integrated Risk Information System (IRIS) data base should not be so frequent as to disrupt treatment facility planning (4).

Response: We strongly agree with this comment. Regardless of the pace at which the IRIS data base is modified, Table B objectives should only be changed by formal action of the State Board. Amendments are only expected to occur in the future as directed by the State Board in the triennial review of the Ocean Plan. It is unlikely that the State Board would choose to revise these objectives every three years.

Comment: A description of the assumptions and uncertainties in the methods for calculating the water quality objectives to protect human health is missing (17, 28).

Response: The various assumptions and uncertainties associated with the calculation of the EPA criteria has been added to the issue description.

Comment: Comments were received regarding which chemicals should be monitored, the frequency of monitoring, and where samples should be collected. Suggestions for the group of chemicals to be monitored ranged from a supplementation of Table B with other chlorinated organics (5), to only those Table B compounds likely to be present in effluent (18, 32), to only those actually found in effluent (31). The frequency of certification should be determined by net rather than gross discharge flow rates (3, 31, 32), and testing should be limited to establish certification of nondetection to once a year (16).

Response: We have attempted to strike a balance in the proposed monitoring provisions between reliable documentation of effluent composition and reasonable cost for monitoring. A primary method to reduce costs to dischargers is the certification process where the Regional Boards are allowed to not require monitoring for substances certified by the discharger as neither added to nor present in the waste stream (SWRCB, 1988c; Chapter VI). In the draft FED (SWRCB, 1989), we proposed a section outlining the frequency of certification. Using the Chapter VI certification process to determine how often a discharger shall sample to determine compliance was inappropriate. After reconsidering this point, we feel that all certification decisions should be made by the Regional Boards. We have revised the Appendix II language to reflect this change and to focus exclusively on monitoring frequency. The new language gives direction to the Regional Boards on the minimum frequency for determining compliance with all Table B parameters. Smaller dischargers could be allowed to monitoring less frequently.

Comment: Change "substances" to "parameters" in the language related to calculation of effluent limits and Table C (22).

Response: We have incorporated these changes.

Comment: Change Table B subheadings from "aquatic life", "noncarcinogen", and "carcinogen" to "objectives for protection of marine aquatic life",

"objectives for protection of human health--noncarcinogens", and "objectives for protection of human health--carcinogens" (23).

Response: We have incorporated these changes.

Comment: Discrepancies exist between the proposed objectives recommended in the FED and those appearing in Table B of the Draft Ocean Plan (4).

Response: The discrepancies have been corrected.

Comment: A comment was received criticizing various characteristics of the attainability analyses (4). The degree to which an objective was exceeded was not indicated, some potentially impacted dischargers were not included, and more cases where objectives were exceeded may appear as method detection limits are improved.

Response: We have not included an indication of the degree to which a water quality objective is exceeded; our analysis can be considered to be a worst case. However, the information can be provided if necessary. A few small dischargers are not a part of these analyses because no data were available. High method detection limits among some dischargers may have masked some exceeded effluent limits but it is impossible to know the frequency with which this has occurred. It is important to note that the attainability analyses were performed to judge the impact of applying various cancer potencies and risk levels rather than to apply a strict rule of adoption/rejection. The attainability analysis was accurate enough to distinguish between alternative sets of proposed objectives (i.e., EPA criteria documents and DHS/EPA recent potency factor and reference dose updates and the two cancer risk levels (10^{-5} and 10^{-6})).

Comment: The validity of proposing objectives for classes of chemicals may be inappropriate as compared to objectives for individual chemicals composing each class (1). All noncarcinogenic PAHs should be removed from the definition of PAH (12).

Response: The rationale for proposing objectives for classes of chemicals is the correlation between chemical structure and toxicity. When EPA's halomethane criteria document was published, only chloroform was a known

carcinogen. However, a criterion based on its potency factor was applied to the entire group because of concern over structural similarities between it and the other halomethanes. This has proven to be a reasonable policy with the determination of one of these other halomethanes, dichloromethane, as a carcinogen. The same approach was applied to PAH and should not be modified as all PAHs have not been thoroughly evaluated for carcinogenicity.

Comment: Expand the technical content and references to answer the questions and challenges to the proposal to establish health-based/seafood-route objectives (34).

Response: We feel the foregoing has provided answers to these questions and challenges.

Alternatives for Board Action:

1. Do not develop objectives to protect human health. The CWA (Section 303(c)(2)(B)) requires the adoption of numeric objectives for the substances for which EPA has developed criteria (Section 304(a)) that are expected to impair beneficial uses. These objectives are to be included whenever water quality standards are revised or reviewed. If EPA determines the revised standards do not meet the requirements of the CWA, EPA is required to promulgate appropriate standards. Therefore, no action by the State Board will merely defer to EPA the task of setting appropriate objectives.

2. Convert EPA's 304(a) criteria to objectives. This option gives the State Board some latitude in setting objectives. Such critical decisions as the choice of risk level for carcinogens (10^{-5} or 10^{-6}) and the importance of current discharge levels are resolved by the State Board rather than EPA. It does not, however, allow the State Board to question the acceptability of Section 304(a) criteria themselves. Scientific investigations over the last decade have produced new data regarding cancer potency, reference dose, and average daily fish and shellfish consumption in the United States (U.S.) and California. A disadvantage of this alternative is that the criteria are dated in several respects and could be revised to reflect these new developments (see Alternative 3). The proposed water quality objectives under this alternative are presented in Table 7.

Table 7: Alternative 2: Proposed marine water quality objectives for the protection of human health from the consumption of contaminated aquatic organisms (unmodified Section 304(a) criteria).

Chemical	Units	Proposed Objective (30-day Average)
NONCARCINOGENS		
acrolein	ug/l	780
antimony	mg/l	45
bis(2-chloroethoxy) methane	ug/l	15.7
bis(2-chloroisopropyl) ether	mg/l	4.36
bis(2-ethylhexyl)phthalate	mg/l	50
chlorobenzene	ug/l	488
chromium (III)	g/l	3.43
di-n-butyl phthalate	mg/l	154
dichlorobenzenes*	mg/l	2.6
1,3-dichloropropene	mg/l	14.1
diethyl phthalate	g/l	1.8
dimethyl phthalate	g/l	2.9
4,6-dinitro-2-methylphenol	ug/l	765
2,4-dinitrophenol	mg/l	14.3
endosulfan	ug/l	159
ethylbenzene	mg/l	3.28
fluoranthene	ug/l	54
hexachlorocyclopentadiene	ug/l	206
isophorone	mg/l	520
mercury	ug/l	0.15
nickel	ug/l	100
nitrobenzene	mg/l	19.8
thallium	ug/l	48
toluene	mg/l	424
1,1,1-trichloroethane	g/l	1.03

CARCINOGENS		Cancer Risk Level		
Chemical	Units	10^{-7}	10^{-6}	10^{-5}
acrylonitrile	ug/l	0.065	0.65	6.5
aldrin	ng/l	0.0079	0.079	0.79
arsenic	ng/l	1.75	17.5	175
benzene	ug/l	4	40	400
benzidine	ng/l	0.053	0.53	5.3
beryllium	ng/l	11.7	117	1170
a-HCH	ng/l	3.1	31	310
b-HCH	ng/l	5.47	54.7	547
g-HCH	ng/l	6.25	62.5	625
bis(2-chloroethyl) ether	ug/l	0.036	0.36	3.6
carbon tetrachloride	ug/l	0.69	6.9	69
chlordane	ng/l	0.048	0.48	4.8

chloroform	ug/l	1.57	15.7	157
DDT	ng/l	0.024	0.024	0.24
3,3'-dichlorobenzidine	ug/l	0.002	0.02	0.2
1,2-dichloroethane	ug/l	24.3	243	2430
1,1-dichloroethylene	ug/l	0.185	1.85	18.5
dieldrin	ng/l	0.0076	0.076	0.76
2,4-dinitrotoluene	ug/l	0.91	9.1	91
1,2-diphenylhydrazine	ug/l	0.056	0.56	5.6
halomethanes**	ug/l	157	15.7	157
heptachlor	ng/l	0.03	0.3	3
hexachlorobenzene	ng/l	0.074	0.74	7.4
hexachlorobutadiene	ug/l	5	50	500
hexachloroethane	ug/l	0.87	8.7	87
N-nitrosodimethylamine	ug/l	1.6	16	160
N-nitrosodiphenylamine	ug/l	1.6	16	160
PAHs	ng/l	3.1	31	310
PCBs	ng/l	0.0079	0.079	0.79
1,1,2,2-tetrachloro-ethane	ug/l	1.07	10.7	107
tetrachloroethylene	ug/l	0.88	8.8	88
toxaphene	ng/l	0.073	0.73	7.3
1,1,2-trichloroethane	ug/l	4.18	41.8	418
trichloroethylene	ug/l	8.07	80.7	870
2,4,6-trichlorophenol	ug/l	0.36	3.6	36
vinyl chloride	ug/l	52.5	525	5250

* = dichlorobenzenes include 1,2-; 1,3-; and 1,4-dichlorobenzene.
** = halomethanes include bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, dichlorobromomethane, and dichloromethane (methylene chloride).

3. Adopt updated (i.e., modified) 304(a) criteria as objectives. Two modifications of the Section 304(a) criteria can be accomplished easily and result in better estimates of risk. A new average daily fish and shellfish consumption rate of 0.023 kg/day can be substituted for the old estimate of 0.0065 kg/day to reflect the increased preference for seafood over the last decade (National Marine Fisheries Service, 1988). We propose to use a value of 0.023 kg/day in the calculations (see justification below). Additionally, more up-to-date estimates of cancer potency and reference dose can be incorporated to reflect the results of toxicologic research completed during this same period (Table 8). The resulting criteria were neither consistently higher nor lower than CWA Section 304(a) criteria (Table 9). Objectives for classes of chemicals (e.g., halomethanes, PCBs, PAHs) refer to the sum of concentrations of chemicals in the class.

California Fish Consumption Estimate

The Department of Health Services prepared and submitted the rationale for the estimated average fish and shellfish consumption rate (Kizer, 1989). The DHS rationale is presented below.

It is important to estimate fish and shellfish consumption rates because exposure assessment is an integral part of the risk assessment process for chemically contaminated seafood. Exposure assessment is the process of characterizing the human populations exposed to the chemicals of concern, the environmental transport fate pathways of those chemicals, and the frequency, magnitude, and duration of the exposure (EPA, 1986c). The dose to humans of a specified contaminant in seafood is directly related to the amount of seafood consumed and the chemical levels in the seafood.

DHS has reviewed over 24 reports covering 14 scientific studies of fish and shellfish consumption rates in the U.S. In general, DHS finds a great variability in the scope, goals, and methods of these studies, which make it difficult to draw meaningful comparisons. Of particular concern, many states in DHS' review do not distinguish between consumption rates of commercially and recreationally caught seafood, marine and freshwater fish, or finfish and shellfish.

Additionally, different population bases have been used in the various surveys. For example, the National Marine Fisheries Service of the U.S. Department of Commerce averages consumption rates over both consumers and nonconsumers of fish in its annual report, "Fisheries of the United States". This method underestimates the average per capita consumption for individuals who consume fish. Puffer (1982), on the other hand, used only pier fisherpersons as a population base in the study of the consumption rates of potentially hazardous fish caught in the metropolitan Los Angeles area. While this approach may lead to a more accurate estimate of consumption by recreational fisherpersons, it may overestimate average consumption rates for the general population. There are only a few studies available for specific, localized groups of seafood consumers (Puffer, 1982; Fiore et al., 1989; WDH, 1987).

Review of the literature on seafood consumption indicates that average per capita seafood (including fish and shellfish) consumption rates appear to fall into two ranges. The first range is 20-30 g/day (Yang and Nelson, 1986; NOAA, 1987; Pastorok, 1988; NOAA, 1971; USDA, 1977-78; USDA, pers. comm. with DHS). NOAA (1987) reported an estimated average fish consumption rate of 24 g/day based on USDA statistics of commercially purchased fish, averaged over the entire civilian population. Pastorok (1988) suggested a value of 20 g/day for marine, estuarine, and fresh water fish and shellfish in cases where comprehensive data are lacking.

Earlier studies tend to report slightly lower consumption rates. Average consumption in the U.S. of shell, fin, and canned fish was estimated at 16.7 g/day (17.3 g/day for the Pacific region) by NOAA (1971) based on data from a 1969 consumer panel survey. Results of the USDA (1977-78) National Food Consumption Survey indicated average consumption rates of fish to be 16 g/day and 12 g/day for males and females, respectively.

However, two factors suggest the values in this range may underestimate current consumption rates for seafood consumers. First, the values reported by NOAA (1971), USDA (1977-78), and NOAA (1987) were derived from consumption surveys or USDA records of total marketplace seafood sales, averaged over both consumers and nonconsumers. Averaging total consumption over the entire U.S. civilian population or survey group, including nonconsumers, may significantly underestimate consumption rates of seafood consumers. For example, Yang and Nelson (1986) estimated average fish consumption rates of 22 g/day for males and 18.5 g/day for females, using data from the USDA 1977-78 survey averaged over fish consumers. Secondly, fish consumption rates are reported to have increased by approximately 5 percent per year in recent years (NOAA, 1987; NOAA, pers. comm. with DHS). Therefore, by adjusting the values from earlier studies (NOAA, 1971; USDA, 1977-78; Yang and Nelson, 1986) to estimate current consumption levels by calculating a 5 percent annual increase, seafood consumption estimates fall within the 20-30 g/day range.

The second range of seafood consumption rate estimates, based upon surveys of consumers, is 35-40 g/day (Humphrey, 1988; Puffer, 1982; USDA, 1977). A three-day survey of seafood consumption by the USDA (1982) yielded an average consumption rate of 48 g/day among seafood consumers. These consumption rates are estimated for the average consumer and do not account for subsistence fisherpersons or subpopulations in areas such as Santa Monica Bay or the Great Lakes who consume larger quantities of locally caught sport fish.

Consumption studies which consider demographic characteristics of the population (e.g., region, race, age, and sex) suggested that average consumption rates of seafood may vary between 6 and 113 g/day (Suta, 1978; Puffer, 1982; SRI, 1980; Fiore et al., 1989; Humphrey, 1988; WDH, 1987; USDA, 1982; 1985; 1986; 1987). Regional estimates of total seafood consumption ranged from 16.8 g/day (WDH, 1987) and 26.1 g/day (Fiore et al., 1989) in Wisconsin to 40 g/day for consumers of Lake Michigan fish (Humphrey, 1988). Puffer (1982) estimated the median consumption rates for Oriental and Samoan fisherpersons in the Los Angeles area to be 70.6 g/day and 113 g/day for fisherpersons age 65 or older. The USDA (1986, 1987) reported different average fish consumption rates for men and women and different rates for two age groups of men and women.

Published maximum consumption rates include 77 g/day for one percent of the general U.S. population (Finch, 1983), and 63.4 g/day and 339 g/day for 5 percent of the recreational fisherpersons in Wisconsin (Fiore et al., 1989) and Los Angeles (Puffer, 1982), respectively. The USDA (1982) estimated consumption rates of fish and shellfish for the highest 5 percent of U.S. seafood consumers at 128 g/day and 94 g/day for the highest 10 percent. Regional maximum consumption rates may actually be higher still (Humphrey, 1988; Kleinman, 1985).

DHS uses 23 g/day as an estimate of the average total seafood consumption rate. Most of the recent studies of seafood consumption report average consumption rates within the range of 23-40 g/day. Since values estimated for fish and shellfish consumers and local populations or subgroups tend to be higher, the 23 g/day value is probably an underestimate of the current real average for actual seafood consumers.

Updated Reference Doses and Potency Factors

We modified approximately two-thirds of the published EPA criteria using EPA's computerized Integrated Risk Information System (IRIS) (EPA, 1989f) and DHS values (Kizer, 1989) (Table 8). The bioaccumulation factors used in our calculations are the same as published in the EPA criteria documents.

Table 8: Updated Reference Dose and Potency Factors for Selected Section 304(a) Criteria. Data Were Obtained Through IRIS (EPA, 1989f) and from the Department of Health Services (Kizer, 1989).

Chemical	Measure of Toxicity
NONCARCINOGENS	Reference Dose (mg/kg/day)
antimony	4×10^{-4}
chlorobenzene	6×10^{-2}
chromium (III)	1×10^{0}
di-n-butyl phthalate	1×10^{-1}
dichlorobenzenes	9×10^{-2}
1,1-dichloroethylene	1.3×10^{-2}
diethyl phthalate	8×10^{-1}
2,4-dinitrophenol	2×10^{-3}
endosulfan	5×10^{-5}
ethylbenzene	1×10^{-1}
nickel	2×10^{-2}
nitrobenzene	5×10^{-4}
toluene	3×10^{-1}
1,1,2,2-tetrachloroethane	2×10^{-3}
1,1,1-trichloroethane	4×10^{-1}
1,1,2-trichloroethane	6.4×10^{-2}
CARCINOGENS	potency factor $(mg/kg/day)^{-1}$
acrylonitrile	1×10^{0}
aldrin	1.7×10^{1}
arsenic	3.4×10^{0}
benzene	1×10^{-1}
benzidine	5×10^{2}
bis(2-chloroethyl) ether	2.5×10^{0}

bis(2-ethylhexyl) phthalate	6.7×10^{-3}
carbon tetrachloride	1.8×10^{-1}
chlordane	9.4×10^{0}
chloroform	6.1×10^{-3}
DDT	3.4×10^{-1}
1,4-dichlorobenzene	3×10^{-3}
3,3'-dichlorobenzidine	1.2×10^{0}
1,2-dichloroethane	2×10^{-2}
dichloromethane	7.5×10^{-3}
1,3-dichloropropene	1.8×10^{-1}
dieldrin	1.6×10^{1}
halomethanes	6.1×10^{-3}
a-HCH	6.3×10^{0}
b-HCH	1.8×10^{0}
heptachlor	4×10^{-1}
N-nitrosodimethylamine	1.6×10^{1}
N-nitrosodiphenylamine	9×10^{-3}
PCBs	5×10^{0}
tetrachloroethylene	1×10^{-3}
trichloroethylene	1.1×10^{-2}
2,4,6-trichlorophenol	7×10^{-2}
vinyl chloride	7×10^{-2}

Table 9: Alternative 3: Proposed marine water quality objectives for the protection of human health from the consumption of contaminated aquatic organisms (DHS and IRIS updates).

Chemical	Units	Proposed Objective (30-day Average)
NONCARCINOGENS		
acrolein	ug/l	220
antimony	mg/l	1.2
bis(2-chloroethoxy) methane	ug/l	4.4
bis(2-chloroisopropyl) ether	mg/l	1.2
chlorobenzene	ug/l	570
chromium (III)	mg/l	190
di-n-butyl phthalate	mg/l	3.5
dichlorobenzenes*	mg/l	5.1
1,1-dichloroethylene	mg/l	7.1
diethyl phthalate	mg/l	33
dimethyl phthalate	mg/l	820
4,6-dinitro-2-methylphenol	ug/l	220
2,4-dinitrophenol	ug/l	4.0
endosulfan	ug/l	0.56
ethylbenzene	mg/l	4.1
fluoranthene	ug/l	15
hexachlorocyclopentadiene	ug/l	58

isophorone	mg/l	150
mercury	ng/l	110
nickel	mg/l	1.3
nitrobenzene	ug/l	4.9
thallium	ug/l	14
toluene	mg/l	85
1,1,2,2-tetrachloroethane	mg/l	1.2
1,1,1-trichloroethane	mg/l	540
1,1,2-trichloroethane	mg/l	43

CARCINOGENS

Chemical	Units	Cancer Risk Level 10^{-7}	10^{-6}	10^{-5}
acrylonitrile	ug/l	0.010	0.10	1.0
aldrin	ng/l	0.0022	0.022	0.22
arsenic	ng/l	2.0	20	200
benzene	ug/l	0.59	5.9	59
benzidine	ng/l	0.0069	0.069	0.69
beryllium	ng/l	3.3	33	330
a-HCH	ng/l	0.38	3.8	38
b-HCH	ng/l	1.3	13	130
g-HCH	ng/l	1.8	18	180
bis(2-chloroethyl) ether	ug/l	0.0045	0.045	0.45
bis(2-ethylhexyl) phthalate	ug/l	0.35	3.5	35
carbon tetrachloride	ug/l	0.090	0.90	9.0
chlordane	ng/l	0.0023	0.023	0.23
chloroform	mg/l	0.013	0.13	1.3
DDT	ng/l	0.017	0.17	1.7
1,4-dichlorobenzene	ug/l	1.8	18	180
3,3'-dichlorobenzidine	ng/l	0.81	8.1	81
1,2-dichloroethane	mg/l	0.013	0.13	1.3
dichloromethane	mg/l	0.045	0.45	4.5
1,3-dichloropropene	ug/l	0.89	8.9	89
dieldrin	ng/l	0.0040	0.040	0.40
2,4-dinitrotoluene	ug/l	0.26	2.6	26
1,2-diphenylhydrazine	ug/l	0.016	0.16	1.6
halomethanes**	mg/l	0.013	0.13	1.3
heptachlor	ng/l	0.072	0.72	7.2
hexachlorobenzene	ng/l	0.021	0.21	2.1
hexachlorobutadiene	ug/l	1.4	14	140
hexachloroethane	ug/l	0.25	2.5	25
N-nitrosodimethylamine	ug/l	0.73	7.3	73
N-nitrosodiphenylamine	ug/l	0.25	2.5	25
PAHs	ng/l	0.88	8.8	88
PCBs	ng/l	0.0019	0.019	0.19
tetrachloroethylene	ug/l	9.9	99	990
toxaphene	ng/l	0.021	0.21	2.1
trichloroethylene	ug/l	2.7	27	270
2,4,6-trichlorophenol	ug/l	0.029	0.29	2.9
vinyl chloride	ug/l	3.6	36	360

* = Dichlorobenzenes include 1,2- and 1,3-dichlorobenzene.
** = Halomethanes include bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, and dichlorobromomethane.

Other modifications, though desirable, are considerably more time consuming and are, therefore, achievable only in subsequent amendments after careful review. For example, estimates of bioconcentration factors should be updated and made more specific. Unfortunately, these data are not available at this time but are being developed at the EPA Office of Research and Development.

A possible disadvantage of selecting a large number of new objectives is that an unreasonable amount of new monitoring for substances that are not detected in effluents may be required of dischargers. To avoid problems with excess monitoring, the State Board could adopt provisions in the Ocean Plan that would specify the general frequency of monitoring. The monitoring frequency could be based on the size of the discharge.

4. Develop an alternative method for calculating criteria and convert these to objectives. Although development of alternative methods is allowed by EPA (EPA, 1989) the effort would require considerable time and agreement among dischargers and regulatory agencies. EPA's formulas received extensive scientific review prior to their final publication. Efforts to derive new formulas would reopen debate about such issues as the most appropriate low-dose extrapolation techniques and variables to be included in the formulas. Indications of what would be acceptable to EPA or State health agencies are not clear.

Attainability of Alternate Proposed Objectives

To evaluate the present attainability of the objectives in Alternatives 2 and 3, effluent data from 32 California ocean dischargers were examined. This group represented ocean dischargers known to have conducted priority pollutant scans as required through either the CWA Section 301(h) waiver application process, waste discharge requirements, or NPDES permits. In all,

four attainability analyses were performed (Alternatives 2 and 3 were evaluated at the 10^{-5} and 10^{-6} cancer risk levels). Of the noncarcinogens, only mercury was included in the analysis because the effluent limits of the other substances are generally so high that they could be easily attained. Arsenic was excluded from the carcinogen group because all the proposed objectives are far below background concentrations in the ocean (refer to Table C in the Ocean Plan). At this time, an arsenic human health objective will not be considered for inclusion in the Ocean Plan.

Comparisons of the combinations of risk level and alternatives to the calculated receiving water concentrations are summarized in Tables 10 through 13. Each table illustrates the number of dischargers above and below the proposed objective for chemicals that were exceeded. Objectives for chemicals that were never exceeded are not included. Table 14 compares the four options by indicating the total number of dischargers exceeding their calculated effluent limits.

For 28 of the 63 proposed objectives, the chemical was either assumed to be very low in concentration when compared to the proposed objective (predominantly the noncarcinogens) or was never detected in effluents. Moreover in 24 instances where the chemical was detected, the calculated receiving water concentration (i.e., effluent concentration divided by one plus the initial dilution) was less than the objective proposed at the 10^{-6} cancer risk level. Therefore, 52 of the 63 proposed objectives are currently attainable at the 10^{-6} cancer risk level because they are not detected or because the levels detected are diluted to sufficiently low concentrations.

Based on attainment, there is virtually no distinction between the original and modified criteria (Alternatives 2 and 3). It is apparent, however, that the updated proposed objectives (Alternative 3) are less stringent even though they reflect more accurate and up-to-date information. Furthermore, selecting the 10^{-5} cancer risk level and thereby incurring an estimated ten-fold excess cancer deaths does not seem justified in that the number of affected dischargers would only be reduced by two.

Table 10: Number of Dischargers with Calculated Receiving Water Concentrations Above and Below Proposed Objectives, Based on EPA Criteria (Alternative 2) and 10^{-6} Cancer Risk Level, by Chemical.

Chemical	Number exceeding proposed objective	Number meeting proposed objective or not detected
Noncarcinogens		
mercury	3	27
Carcinogens		
benzidine	1	13
beryllium	1	12
chloroform	1	17
DDT	8	18
dieldrin	1	25
heptachlor	2	23
PCBs	2	17
PAHs	2	12

Table 11: Number of Dischargers with Calculated Receiving Water Concentrations Above and Below Proposed Objectives, Based on EPA Criteria (Alternative 2) and 10^{-5} Cancer Risk Level, by Chemical.

Chemical	Number exceeding proposed objective	Number meeting proposed objective or not detected
Noncarcinogens		
mercury	3	27
Carcinogens		
benzidine	1	13
beryllium	1	12
DDT	7	19
dieldrin	1	25
PCBs	2	17
PAHs	1	13

Table 12: Number of Dischargers with Calculated Receiving Water Concentrations Above and Below Proposed Objectives, Based on DHS and IRIS Updates (Alternative 3) and 10^{-6} Cancer Risk Level, by Chemical.

Chemical	Number exceeding proposed objective	Number meeting proposed objective or not detected
Noncarcinogens		
mercury	3	27
Carcinogens		
benzidine	1	13
beryllium	2	11
bis(2-ethylhexyl)	2	17
phthalate	1	24
DDT	7	19
dieldrin	1	25
heptachlor	2	23
PCBs	2	17
PAHs	2	12
2,4,6-trichloro-phenol	1	19

Table 13: Number of Dischargers with Calculated Receiving Water Concentrations Above and Below Proposed Objectives, Based on DHS and IRIS Updates (Alternative 3) and 10^{-5} Cancer Risk Level, by Chemical.

Chemical	Number exceeding proposed objective	Number meeting proposed objective or not detected
Noncarcinogens		
mercury	3	27
Carcinogens		
benzidine	1	13
beryllium	1	12
chlordane	1	24
DDT	2	24
dieldrin	2	24
heptachlor	2	23
PCBs	2	17
PAHs	2	12

Table 14: Frequency of nonattainment among dischargers.

Number of proposed objectives exceeded by an individual discharger	Number of dischargers in each category			
	Original EPA Criteria		Modified EPA Criteria	
	10^{-6}	10^{-5}	10^{-6}	10^{-5}
1	6	7	3	5
2	5	3	6	3
3	0	0	0	0
4	0	0	1	0
5	0	1	0	0
6	0	0	0	1
7	1	0	0	0
8	0	0	1	0
Total	12	11	11	9

Staff Recommendation: Adopt Alternative 3. Use a cancer risk level of 10^{-6}.

Summary of Staff Recommendation

1. Change Table B subheadings from "aquatic life", "noncarcinogen", and "carcinogen" to "objectives for protection of marine aquatic life", "objectives for protection of human health--noncarcinogens", and "objectives for protection of human health--carcinogens."

2. Amend Table B to include appropriate objectives for noncarcinogens listed in Table 9 and objectives for carcinogens at the 10^{-6} risk level listed in Table 9.

3. Adding dozens of parameters to Table B requires the same number of additions to Table C (Background Seawater Concentrations). Nearly all the new Table B compounds have natural background levels of zero. We

propose to alter Table C to include only substances with non-zero background levels. Table C would appear as follows:

Waste Constituent	Cs (ug/l)
Arsenic	3
Copper	2
Mercury	0.0005
Silver	0.16
Zinc	8

For all other Table B parameters, Cs = 0.

4. New Definitions:

"DICHLOROBENZENES shall mean the sum of 1,2- and 1,3-dichlorobenzene.

ENDOSULFAN shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

HALOMETHANES shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, and dichlorobromomethane.

HEPTACHLOR shall mean the sum of heptachlor and heptachlor epoxide.

PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene and pyrene.

PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-1260."

5. Replace the existing definitions for chlordane and DDT with the following definitions:

"CHLORDANE shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane.

DDT shall mean the sum of 4,4'DDT, 2,4'DDT, 4,4'DDE, 2,4'DDE, 4,4'DDD, and 2,4'DDD."

6. Add to Appendix II:

"Monitoring for the substances in Table B shall be required periodically. For discharges less than 1 MGD (million gallons per day), the monitoring of all the Table B parameters should consist of at least one complete scan of the Table B constituents one time in the life of the waste discharge requirements. For discharges between 1 and 10 MGD, the monitoring frequency shall be at least one complete scan of the Table B substances annually. Discharges greater than 10 MGD shall be required to monitor at least semiannually."

7. Change "substances" to "parameters" in the Ocean Plan related to calculation of effluent limits and Table C.

8. Add a section heading and subheadings after Table B footnotes to describe different implementation procedures and the following statement after Table C as follows:

"If only one sample is collected during the time period associated with the water quality objective (e.g., 30-day average or 6-month median), the single measurement shall be used to determine compliance with the effluent limitation for the entire time period."

Issue 4D: Add new objectives to Table B for chlorinated dibenzodioxins (CDDs) and dibenzofurans (CDFs).

Present Ocean Plan Policy: None.

Issue Description: CDDs and CDFs have never been intentionally manufactured (except for research), but rather are formed as unwanted contaminants in various chemical and industrial processes. Once released into the environment through either waste discharges or through the use of products containing them as contaminants, they are very persistent because they are chemically very stable.

This group of chemicals includes one of the most toxic substances known, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), commonly called dioxin. In addition to extreme acute toxicity, 2,3,7,8-TCDD is the most potent animal carcinogen ever evaluated by the EPA Carcinogen Assessment Group. The next most potent carcinogen(s) is a 2,3,7,8-chlorinated hexaCDD mixture (EPA, 1985d). Both 2,3,7,8-TCDD and this hexaCDD mixture are classified as definite animal carcinogens (and as a probable human carcinogens) by EPA and the DHS (SWRCB, 1988a). Other CDD and CDF congeners are of concern; 17 CDDs and CDFs chlorinated in the 2,3,7, and 8 positions have the greatest toxicity. The CDD and CDF congeners exhibit toxicity similar to one another but are variable in terms of their potency. This variation has been formalized as toxic equivalency factors which relate the toxicity of all the congeners to 2,3,7,8 TCDD, the most potent of any CDD or CDF (SWRCB, 1988a).

Studies with aquatic species have demonstrated toxicity at extremely low levels of exposure in the parts per quadrillion (ppq) range. As suggested by their high octanol:water partition coefficients, CDDs and CDFs accumulate in tissues high in lipid content. They are not only readily absorbed, bioconcentrated, and retained by aquatic species, but are also biomagnified resulting in CDD and CDF tissue levels in species at the top of the food web. These physical, chemical, and biological characteristics of CDDs and CDFs are reflected in the high potential for bioconcentration and bioaccumulation, and the long biological half-lives measured in aquatic species.

The only facilities confirmed to discharge CDDs and CDFs to California ocean waters are two pulp mills in Humboldt County. Effluents from the Louisiana-Pacific and Simpson mills discharge about 100 to 360 pg/l 2,3,7,8-TCDD and 660 to 1,800 pg/l 2,3,7,8-TCDF, or up to 540 pg/l of TCDD equivalents (W. Rodriguez, North Coast Regional Board, pers. comm.). Other facilities may discharge CDDs and CDFs to California marine waters, but have been neither identified nor confirmed at this time.

The Canadian government recently closed the fisheries for prawn, shrimp, and crab located near three pulp mills on the British Columbia coast, citing contamination by CDDs and CDFs discharged by the mills as the basis for the closure (Fisheries and Oceans Canada, 1988). In California, DHS has issued health advisories for the Sacramento River near Anderson due to elevated TCDD levels in rainbow trout. CDDs and CDFs have also been detected in turbot from Santa Monica Bay (D. Eberhardt, EPA Region 9, pers. comm., 1989) and in wastewater from two Canadian oil refineries (M. Narvaez, EPA Region 9, pers. comm., 1989).

Information on tissue residues of marine aquatic organisms in California ocean waters is limited. An EPA survey (National Bioaccumulation Study) investigated fish at sites near suspected CDDs and CDFs discharges. Other studies (Kor, 1989) have demonstrated that CDDs and CDFs occur in tissues of organisms all along the North Coast. Tomcod and dungeness crab (only a few samples) taken from waters adjacent to the Samoa Peninsula, in the vicinity of pulp mill discharges were found to be contaminated with CDDs and CDFs (Radian Corporation, 1988). Analysis of tomcod livers indicated levels of 2,3,7,8-TCDD and 2,3,7,8-TCDF ranging up to 16.53 and 59.30 parts per trillion (ppt), respectively. The crab hepatopancreas was found to contain 2,3,7,8-TCDD and 2,3,7,8-TCDF at levels up to 4.39 ppt and 91.57 ppt, respectively.

EPA is developing a national strategy to control TCDD at pulp mills. The goal is to eliminate TCDD from pulp mill discharges to the waters of the United States (Hanmer, 1988). The State Board has commented on the strategy (letter from D. Ruiz to R. Hanmer, October 27, 1988) by noting that regulation of dioxin discharges should include CDFs.

The most direct and certain means currently known to eliminate discharge of CDDs and CDFs from pulp mills is to eliminate or greatly reduce the use of molecular chlorine in the production of finished pulp. A process called oxygen delignification could reduce chlorine use by 50% at the Humboldt County mills. Elimination of the remainder may require use of bleaching chemicals other than chlorine, e.g., peroxide, ozone, nitrogen dioxide, or sulfur dioxide. None of these zero-chlorine bleaching methods are established technologies, but their development has been constrained largely by their high cost relative to chlorine bleaching (Jain, 1988). Using chlorine dioxide instead of molecular chlorine has proven effective in reducing CDD and CDF formation.

These findings demonstrate the need for consideration of an objective which can be applied to ocean waters. CDDs and CDFs are separated from the other substances in Issue 4C because we consider an additional alternative (a prohibition) in Issue 4D.

Comments Received:

The comments and responses presented below were based on the issue as presented in the draft FED (SWRCB, 1989). The issue description and alternatives have been revised in response to comments.

Comment: There is no evidence that exposure to either CDDs or CDFs causes cancer in humans. Furthermore, 2,3,7,8-TCDD has been found to be inactive in most mutagenicity studies. (28)

Response: There is adequate evidence from animal studies for the EPA, DHS, and the Proposition 65 Science Advisory Panel (Proposition 65, 1989) to classify 2,3,7,8-TCDD as a probable human carcinogen (Group B2); a mixture of 2,3,7,8-chlorinated hexaCDDs is also considered to be a probable human carcinogen by EPA and DHS (SWRCB, 1988a). For a more thorough discussion of CDD and CDF carcinogenicity and mutagenicity, refer to Alternative 4.

Comment: There is evidence that 2,3,7,8-TCDD may act as a tumor promotor, and that a threshold could exist for carcinogenicity. (28)

Response: Where available data suggest 2,3,7,8-TCDD to be a potent tumor promoting agent, they are not sufficient to eliminate the possibility that

tumors may be produced by other mechanisms, particularly since there are studies which have provided indications of co-carcinogenicity, tumor initiation, and even tumor inhibition (SWRCB, 1988a). Many receptor-mediated, structure-activity-related biochemical effects are well documented for CDDs and CDFs and may ultimately be involved in their carcinogenicity. However, available data are not adequate to characterize the series of events necessary to elicit a biological response (such as tumor development through a promotional mechanism), subsequent to the initial CDD or CDF molecule binding to the receptor. Also, a validated receptor-mediated model currently does not exist that is capable of defining a threshold for 2,3,7,8-TCDD induced carcinogenesis through such a promotor mechanism (EPA, 1989a).

It is possible the LMS may eventually be replaced by a receptor-mediated model able to define a threshold for CDD and CDF induced carcinogenesis. However, currently available data do not support the use of a threshold-based, receptor-mediated approach to CDD and CDF risk assessment (EPA, 1989a; Bayard, 1989; DHS, 1986).

Comment: Neither the EPA water quality criterion for 2,3,7,8-TCDD nor CWA Section 307 list any other CDD or CDF isomers. Neither the EPA nor the State Board have provided adequate discussion to support the inclusion of CDDs and CDFs in this objective through the use of Toxic Equivalency Factors (TEFs) (28).

Response: We believe it is appropriate and scientifically justifiable to use TEFs. There are adequate data from numerous studies indicating that many biochemical effects produced by 2,3,7,8-TCDD are also produced by CDDs and CDFs chlorinated in the 2,3,7 and 8 positions. These effects are related to the molecular structure these compounds have in common. We have included a discussion of our rationale for using TEFs in Alternative 4.

Comment: TCDD TEFs should be eliminated from Table B objectives, with the RWQCBs allowed to include them in NPDES permit effluent limits on a case-by-case basis. (32)

Response: We disagree that TCDD TEFs should be used on a case-by-case basis. We believe the use of TEFs are warranted in all cases because of our concern about the toxic effects of other CDDs and CDFs. The use of toxic

equivalent factors for the assessment and regulation of CDDs and CDFs is an established approach (it has been adopted by EPA) which reflects recent toxicological information (EPA, 1989d).

The TEF approach allows the concentration of any combination of CDD and/or CDF congeners to be expressed as an equivalent concentration of 2,3,7,8-TCDD for the purposes of risk assessment. The use of TEFs is also important because the ratios of the various CDDs and CDFs in a sample can be very useful for identifying the sources of these pollutants.

Comment: The State Board should select a consistent acceptable risk level associated with exposure to carcinogens to be applied to all toxicants regardless of their potency. (28)

Response: We disagree with the assertion that a single risk level is required for all toxicants. Acceptable risk of exposure to toxicants is best managed by balancing the benefits and costs of allowing discharge at a specified level. In some instances the activity which leads to the exposure is of extreme importance to the vitality or safety of individuals or the general public. In these situations a relatively high degree of risk may be reasonable. In other instances, the activity producing the exposure provides only marginal benefits at best. In these instances, strict regulation to minimize the exposures is warranted.

However, when adopting objectives to ensure protection of public health, it is prudent to prescribe a uniform low level of risk for any given constituent. This risk level should be evaluated and alternative risk levels should be allowed when the resulting costs appear to be high. CWC Sections 13000 and 13241 require the balancing of various concerns in the protection of water quality and the development of objectives. Adoption of different risk levels for specific toxicants based on positive and negative consequences from allowing certain levels of exposure is consistent with these provisions of law.

Comment: Selection of a cancer potency value for dioxin was described alternately as a policy question which the Board must consider and a scientific determination. In making a determination about the appropriate

potency value the Board should use a model depicting a threshold response to TCDD. (28)

Response: We believe that the selection of a potency factor is a scientific determination based on an analysis of the various underlying assumptions. We have presented a brief analysis in Alternative 4 of the various scientifically valid potency factors that have been developed by EPA, the Food and Drug Administration, and the Center for Disease Control. We disagree with the assertion that a threshold model should be used in establishing a potency factor for TCDD (please refer to alternative 4 for our justification).

Comment: The Clean Water Act requires that a determination of the amount of a substance that is toxic be completed before a standard can be developed. EPA criteria do not predict levels that result in significant human health problems and are not regulatory standards or thresholds for safety. The State Board cannot rely on EPA criteria to define a toxic amount of dioxin and must make an independent determination of what constitutes a toxic amount. (28)

Response: The national policy stated in CWA Section 101(a)(3) is that the discharge of toxicants in toxic amounts be prohibited. Accordingly, EPA has developed Section 304(a) criteria which are designed to prevent impairments to beneficial uses, including exposure to toxic amounts of pollutants.

Acceptable discharge levels of carcinogens are based on the incremental lifetime cancer risk associated with the substance. EPA provides states with several risk levels to choose from so each state may determine a reasonable level of protection. There is no obligation to regulate at the threshold of toxicity (at the point where a beneficial use is impaired). When the State Board adopts an objective to protect human health, it is determining the protective level.

We believe that EPA criteria are an appropriate basis for a water quality objective for CDDs and CDFs. The human health criterion proposed in Alternative 4 is our estimate of the ambient level which is protective of human health via consumption of fish and shellfish.

Comment: The Ocean Plan's narrative objective requiring organic materials in marine resources to be maintained at levels below those which are harmful to human health (through consumption of contaminated tissue) requires that the State Board make a large number of determinations before adopting an objective based on human health concerns. (28)

Response: The existing narrative objective is an independent requirement that neither directs the development of numerical objectives nor is superseded by a numerical objective. Although it is the intent that any numerical objective developed to protect human health will satisfy the requirements of the existing narrative objective, it can not be guaranteed that this will in fact be the case.

The numerical objectives are based on toxicity data depicting the toxic responses to individual chemicals. However, in the environment many mixtures of constituents co-occur and, in combination, may have additive or synergistic effects. In these cases a numerical objective is not sufficient to protect the beneficial use and the narrative objective is required. The detection of such synergistic responses is accomplished through observation and experimentation. Restrictions based on the narrative objective can be included in waste discharge requirements until sufficient information is developed to allow characterization of these effects or when numerical objectives do not exist.

Comment: Since fish sampled from both fresh and ocean waters (some near pulp mills) have been found to be contaminated with dioxin, geographically extensive fish consumption bans could be appropriate. Such bans would have significant adverse effects on local commercial and recreational economies. (28)

Response: Geographic-based fish consumption bans, or health advisories in the case of California, constitute a reactive approach, at which point a substantial degradation of beneficial uses and probable human exposure has not only occurred, but is continuing to occur. In California, these are advisory only, and are intended to provide only guidance to consumers of contaminated seafood; they do not carry the force of law or regulation (Pollock, 1989). They do not protect, in any way, the fish and shellfish resources from current or future contamination from the same or different

pollutant source(s), or adequately protect humans from the adverse health effects expected to occur when such contaminated seafood is consumed. Such a warning, which confirms the existence of a health hazard, is based on factors other than those considered for the development of an objective and may be issued for residue levels substantially above those calculated from water quality objectives. These differences in numeric values of water quality objectives and public health warnings reflect the different purposes of these numbers.

Impacts on local commercial and recreational economies are not problems arising from public notice of health hazards or development of new water quality objectives, but rather problems arising from the contamination of resources due to the discharge of wastes. The solution to these problems is not to withhold notification of the public when hazards exist, but to correct the pollution problem to prevent the hazard.

The State Board does not usurp the responsibilities of DHS by establishing a water quality objective. By adopting a water quality objective, the State Board will take a positive step to avoid the loss of the fish consumption beneficial use.

Comment: The goal of the State Board should not be to eliminate all discharges of dioxin, but rather only those in toxic amounts consistent with State and federal law. (28)

Response: Although the proposed objective is not a ban on CDD and CDF discharges, the State and Regional Boards may elect to utilize a prohibition if, in the Boards' opinion, circumstances warrant such an approach. While CWA Section 101(a)(3) declares a national goal of prohibiting the discharge of pollutants in toxic amounts, CWC Section 13243 specifically provides for designation of areas where the discharge of any waste or specific types of waste is prohibited. Prohibitions are currently used in California in a number of locations for a variety of constituents. In general, prohibitions may be considered when the local ecology and hydrology present a particularly sensitive situation.

With respect to TCDD TEFs, two important points should be noted. First, since the estimate of the level which is protective is below measurement

capabilities, preventing the discharge of CDDs and CDFs is the only certain way to guarantee that discharges are below the protective level. Second, if the dose-response of TCDD is linear in the low-dose range (nonthreshold model assumed), then any amount of TCDD would be toxic. In this case, the national goal and CWC Section 13243 are complementary.

Comment: It is unprecedented for the State Board to propose the elimination of a particular process (use of chlorine) in order to reach the goal of eliminating CDDs/CDFs in pulp mill discharges, which may adversely effect the ability of California pulp mills to compete worldwide. (28)

Response: We have not proposed the elimination of chlorine bleaching of wood pulp in order to eliminate the discharge of CDDs and CDFs in pulp mill discharges. However, as a point of information, we have made the observation that CDDs and CDFs result from the use of molecular chlorine bleaching in pulp production processes and, that the use of other bleaching agents can significantly reduce the concentration of CDDs and CDFs in both pulp and pulp mill discharges, and even finished paper products. Of course, the method of complying with water quality objectives is ultimately up to the discharger.

Comment: The level of TCDD TEFs in tissue samples of aquatic species from sites near pulp mill effluent discharges is comparable to other control sites along the coast, with the highest levels found in areas not impacted by such discharges. This is contrary to the FED statement that the only facilities confirmed to discharge dioxins to California water are two pulp mills in Humboldt County, and it should not be presumed that these mills are primarily responsible for dioxins in ocean waters off the coast, since there may be other significant discharges. (28)

Response: The objective is not intended to regulate only those CDDs and CDFs contained specifically in discharges from pulp mills. Rather, it applies to all sources of CDDs and CDFs discharged to ocean waters. If the State Board adopts a TCDD equivalents objective, the monitoring requirements for Table B compounds will provide data on CDDs and CDFs discharged to coastal waters from other point sources which have not yet been identified. We have revised the issue description to reflect this.

Comment: All available aquatic studies should be reviewed by the State Board staff. While parts per billion (ppb) levels of TCDD have severe adverse effects which are probably observable in natural systems, parts per trillion (ppt) levels of TCDD do not produce adverse effects in laboratory settings. The study by Mehrle et al. (1988) did not distinguish between uptake of TCDD through contaminated water relative to adsorption to ingested food. (28)

Response: All relevant aquatic studies have been reviewed by the State Board (SWRCB, 1988a), and critically considered in the process of developing the proposed aquatic life water quality objective.

CDD and CDF toxicity to aquatic species is seen at extremely low levels of exposure, with significant adverse effects on growth and survival observed in rainbow trout exposed to a 2,3,7,8-TCDD concentration of 38 pg/l (parts per quadrillion) (Mehrle et al., 1988). The statement that parts per trillion levels of 2,3,7,8-TCDD do not produce adverse effects in laboratory settings is not correct.

Even after acute exposures, i.e., 96-hour LC 50 studies, death is delayed and may not occur during the actual exposure period, instead it is observed during the post-exposure depuration or observation period. This is particularly true at lower exposure concentrations. Effects characteristic of CDD and CDF toxicity commonly seen in various aquatic species include (SWRCB, 1988a): (a) fin necrosis, (b) edema, (c) liver necrosis, (d) hemorrhage, (e) weight loss (wasting syndrome), (f) growth retardation, and (g) behavior (SWRCB, 1988a).

Many of the early studies with 2,3,7,8-TCDD used relatively short exposure and depuration periods, which did not allow for the expression of the delayed toxicity characteristic of CDDs and CDFs. Such delayed toxicity has been well documented for mammalian species. These protocols also did not measure the CDD or CDF exposure concentration in the water, neglecting sorption to surfaces and particulates in the test system. The dose-response relationships based on data obtained from such studies is questionable (SWRCB, 1988a).

As the exposure and depuration/observation periods have been lengthened in later studies, the delayed toxicity seen in mammalian studies has become apparent for aquatic species. Even 96-hour LC 50 exposures are now followed by observation periods ranging up to 24 weeks, although standardized exposure and depuration periods have not been established for CDDs and CDFs. Determination of the actual CDD or CDF concentration in the exposure system by analysis at regular intervals during the course of the study has allowed dose-response relationships for CDDs and CDFs to be better defined. Earlier studies that used a nominal exposure concentration based on dilution overestimated the actual exposure concentration and underestimated toxicity (SWRCB, 1988a).

The Mehrle et al. (1988) study did differentiate between the uptake of 2,3,7,8-TCDD from water relative to food (the food consisted of Tetramin floating flakes fed ad libitum during the study). A review of the study (Shenker and Cherr, 1989) concluded that this study "...appears to be a well conducted piece of research, with proper experimental design and methodology, appropriate data analysis and conclusions." The review further states that "...it is unlikely that significant adherence of TCDD to the dry flakes occurred before consumption by the trout." As part of the study design, both fecal matter and excess food were removed on a daily basis, and were not allowed to accumulate in the exposure system. However, it is unlikely that all particles were completely removed.

A previously unreviewed (by SWRCB, 1988a) study by Muir and Yarechewski (1988) evaluated the accumulation of ^{14}C-labeled 1,2,3,7-TCDD, 1,2,3,4,7-pentaCDD, 1,2,3,4,7,8-hexaCDD, and 1,2,3,4,6,7,8-heptaCDD fed in the diet to rainbow trout and fathead minnows for 30 days followed by a 30 to 75 day depuration period. The 2,3,7,8-chlorinated hexa- and heptaCDDs were found to have higher assimilation efficiencies and lower elimination rates compared to the tetra- and pentaCDDs, which appeared to be more extensively metabolized and eliminated by both species. A previous study (Muir et al., 1985) with this hexaCDD congener at an exposure level of 47 ng/l resulted in delayed mortality (26 percent after 12 days of depuration). The delayed mortality was not observed in the Muir and Yarechewski (1988) study. Both delayed mortality and decreased weight gain have been seen in various aquatic species after exposure to 2,3,7,8-TCDD in either water or in the diet.

We have included a discussion of bioconcentration in Alternative 4.

Comment: CWA Section 304(l) requires a number of activities be undertaken for point source discharges to water bodies which have been listed as not meeting water quality standards for toxics due to point source discharges. Adoption of a stringent objective will most likely result in the unreasonable consequence of being placed on the 304(l) list and a requirement for compliance by 1992.

Response: In 1989, the State Board adopted the required CWA Section 304(l) short list (water bodies not attaining water quality standards for toxic substances due to point source discharges). North Coast waters (where the pulp mills discharge) were not included on that list. However, the North Coast is included on the State proposed final short list and EPA's proposed additions to the State's 1989 list. Listing of a water body is required if the water body exceeds an applicable standard, i.e., either a "numeric criterion" which is part of a standard or a narrative standard. A narrative standard is considered to be exceeded if the water body is exceeding (a) a proposed State standard, (b) an explicit State policy, or (c) an EPA national water quality criterion. While the proposed TCDD objectives are sufficient to require a listing for the 304(l) short list, North Coast waters are required to be listed irrespective of amendments to the Ocean Plan since the EPA criterion for 2,3,7,8-TCDD is exceeded. Therefore, the current Ocean Plan amendment will not affect the State Board's 304(l) listing process.

We have no indication that EPA intends to revise the draft short list to delete the North Coast. Therefore, we must assume that the mills will be subject to the requirements of CWA Section 304(l) whether an objective for TCDD is or is not adopted.

Comment: Ocean dischargers should not be required to monitor for CDDs and CDFs unless there is good reason to suspect their presence in discharge (28). POTWs and refineries should be investigated as sources of CDDs and CDFs (5).

Response: The certification provisions of the Ocean Plan currently accommodate both comments. Regional Boards can elect to not require

effluent limits for substances certified by the discharger (except for POTWs) as neither added to nor present in the waste stream. The frequency of certification should be determined by the Regional Board.

Comment: It should be explained how this objective applies to POTWs and oil refineries. (5)

Response: These industries will be required to be in compliance with the adopted water quality objectives. All Table B objectives apply to all dischargers within the jurisdiction of the Ocean Plan.

Comment: Since there is no 40 CFR 136 method for CDDs/CDFs the State Board must specify what analytical method is to be used to determine compliance with the objective. Until EPA publishes a validated analytical method for CDDs/CDFs in 40 CFR 136, the National Council for Air and Stream Improvement (NCASI) 2,3,7,8-TCDD method should be used for compliance purposes (28).

Response: We agree that the EPA method (Method 1613) should be required when published in 40 CFR 136. Until that time, presently anticipated to be 1990, either the current 40 CFR 136 method should be used (Method 613) or one judged by the Regional Board and EPA to be more sensitive.

Comment: The analytical methods for some of the isomers included in the TCDD TEF table are not specific for 2,3,7,8 chlorinated isomers, an example being the coelution of 1,2,3,4,5,6- and 1,2,3,4,7,8-hexaCDFs during analysis; guidance was requested on how to assign TEFs in this situation. It was suggested that for 2,3,7,8-substituted isomers that cannot be analytically resolved without interference from non-2,3,7,8-substituted isomers, the TEF shall be reduced by half. (28)

Response: There are analytical methods capable of resolving the 2,3,7,8-chlorinated CDD and CDF congeners. Congeners that coelute on one gas chromatograph analytical column may be separated on another, for examples, refer to SWRCB (1988a). The EPA Method 1613, which is presently undergoing validation studies, specifies the use of two different analytical columns to resolve 2,3,7,8-chlorinated CDD and CDF congeners. For compliance purposes, the discharger may either to assume that the total area

under the peak is the 2,3,7,8-chlorinated congener, or may use more than one column to resolve the coeluted congeners.

Alternatives for Board Action:

1. Adopt no objective for chlorinated dibenzodioxins and dibenzofurans. The shortage of data on chronic toxicity might warrant this approach. Any computed water quality objective may prove to be underprotective. The safe level for marine life will probably not be identified for many years to come.

2. Adopt an objective of 0.4 pg/l for 2,3,7,8-TCDD equivalents to protect aquatic life. CDDs and CDFs are extremely toxic to aquatic species at very low levels of exposure. In acute studies, the 96-hr LC 50's for a variety of aquatic animals range from about 10 ng/l to 10 ug/l (SWRCB, 1988a). The delayed expression of toxicity seen in mammalian studies has also been demonstrated in aquatic species, and adverse effects often do not appear until weeks or months after exposure (SWRCB, 1988a).

   Tests involving chronic exposure are very few. About 3 ng/l killed all exposed mosquitofish and channel catfish within 20 days (Yockim et al., 1978). A recent study by Mehrle et al. (1988) exposed rainbow trout to 38 pg/l (picograms per liter, or parts per quadrillion) for 28 days and found that nearly half the fish died after an additional 28 days. Since lethality occurred at the lowest concentration tested, it was not possible to determine a no effect level. In the same study 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) was toxic at concentrations as low as 900 pg/l.

   The available data are insufficient to generate a CECT for any CDDs or CDFs. Only one species, rainbow trout, has been tested at low concentrations; in that test the lowest concentration tested was toxic. In the face of unknown differences in sensitivity to toxicants among species, EPA (1985a) recommends an uncertainty factor of 10 be applied to estimate the concentration that would affect the most sensitive species. If 38 pg/l is used as a starting point to estimate chronic toxicity, use of the uncertainty factor yields a CECT of 4 pg/l. Then, if the background concentration is assumed to be zero, the six-month median water quality objective for TCDD is 0.4 pg/l.

However, chlorinated dibenzodioxins and dibenzofurans do not occur alone but in mixtures. EPA (1989d) recommends evaluation of the toxicity of mixtures based on toxic equivalence to 2,3,7,8-TCDD. The regulatory implication of this is the recommended 0.4 pg/l would apply to the sum of all 2,3,7,8-chlorine substituted CDDs and CDFs, based on the TEF approach. The table below shows the relative toxicity of chlorinated dibenzodioxins (CDDs) and chlorinated dibenzofurans (CDFs) using the EPA method. This method is being used by a number of nations, including Sweden, Norway, Finland, Denmark, the Netherlands, and Canada as well as New York State (EPA, 1989d; North American Treaty Organization, 1988).

Table 15: Relative Toxicity of Chlorinated Dibenzodioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) (EPA, 1989d).

Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

For example, a wastewater sample containing 2 pg/l 2,3,7,8-TCDD and 30 pg/l 2,3,7,8-TCDF exhibits a toxic equivalence concentration of 5 pg/l 2,3,7,8-TCDD. Water quality objectives for CDDs and CDFs should be based on the sum of TCDD equivalents shown in Table 15.

Our estimate of the toxicity of dioxin to marine life is based on its toxicity to freshwater animals because there are no studies on organisms in ocean water. Freshwater data are relevant in this instance for two reasons. First, there is no evidence, and no reason to believe, that dioxin

will prove less toxic to marine life than to freshwater life. While many inorganic compounds, such as heavy metals, are inactivated by certain chemicals present in seawater, this is not true for organic compounds generally or for chlorinated organic compounds specifically.

The second reason is that other organochlorines with similar properties (i.e., great toxicity, solubility in fatty tissue) are at least as toxic in salt water as in freshwater. Of 16 organochlorine compounds examined (Table 16), only 2 are more toxic to freshwater life than to marine organisms. Twelve are more toxic in salt water. It is prudent to assume that CDDs and CDFs conform to this general pattern.

Table 16: Acute Toxicity of Certain Organochlorine Compounds to Marine and Freshwater Animals. EPA National Water Quality Criteria (EPA, 1986b) are Given.

Substance	Marine Criterion (ug/l)	Freshwater Criterion (ug/l)	Ratio
aldrin	1.3	3.0	0.43
HCH	0.34	100	0.0034
chlordane	0.09	2.4	0.4
chlorpyrifos	0.011	0.083	0.13
DDT	0.13	1.1	0.11
TDE	3.6	0.06	60.00
dieldrin	0.71	2.5	0.28
endosulfan	0.034	2.2	0.01
endrin	0.037	0.18	0.21
heptachlor	0.053	0.52	0.10
lindane	0.16	2.0	0.08
methoxychlor	0.03	0.03	1.00
mirex	0.001	0.001	1.00
PCB	10	2	5.00
pentachloro-phenol	13	20	0.65
toxaphene	0.21	0.73	0.29

The two known dischargers of CDDs and CDFs, the Louisiana-Pacific and Simpson pulp mills, would have to achieve large reductions in CDD and CDF discharge to meet this objective. Both companies have committed to process changes that may reduce dioxin discharge by 50%,

and perhaps as high as 75 percent. This assumes that dioxin is reduced in the same proportion as other organochlorine compounds, which in turn are reduced in proportion to the use of chlorine as a bleaching agent.

3. Prohibit measurable discharge of dioxin (2,3,7,8-TCDD). The extraordinary toxicity, persistence and potential for biomagnification of dioxin all suggest that adverse effects can occur at the lowest concentration measurable in the water column. The reliably achieved method detection limit in pulp mill waste water is currently about 10 pg/l. Louisiana-Pacific and Simpson pulp mill wastewaters contained about 100 pg/l to 360 pg/l of dioxin as of mid-1988. Thus, a discharge prohibition in Chapter V of the Ocean Plan would require a reduction of as much as 95 percent. It is unlikely that the mills will meet an effluent objective of 10 pg/l with the improvements already announced. However, immediate compliance with such an objective is not essential. A prohibition would provide the companies with a strong incentive to adopt a chemical process which prevents dioxin production entirely.

4. Adopt an Objective of 0.0039 pg/l to Protect Human Health from Consumption of Contaminated Fish and Shellfish. Under this alternative we provide the rationale and justification for the development of a water quality objective to protect human health from the consumption of seafood contaminated with CDDs and CDFs. The following description reflects the numerous comments received on this alternative.

Carcinogenicity

Both 2,3,7,8-TCDD and a mixture of 2,3,7,8-chlorinated hexaCDDs are considered to be animal carcinogens by EPA and DHS (SWRCB, 1988a). The EPA (1985d) Carcinogen Assessment Group has classified both 2,3,7,8-TCDD (the most potent carcinogen ever evaluated by EPA), and the 2,3,7,8-hexaCDD mixture (the second-most potent carcinogen(s) ever evaluated by EPA), as B2 carcinogens. B2 Carcinogens are substances where evidence of carcinogenicity in humans is inadequate to confirm carcinogenicity but sufficient evidence in animals exists to consider them probable human carcinogens. The International Agency for Research on Cancer (IARC) has classified 2,3,7,8-TCDD similarly (SWRCB, 1988a). The classification of 2,3,7,8-TCDD as an animal carcinogen by each of

the above agencies is based on the results of a study by Kociba et al. in 1978 (refer to SWRCB, 1988a). Sprague-Dawley rats were fed at levels ranging from 0.001 to 0.1 ug/kg/day 2,3,7,8-TCDD. Both sexes were evaluated for cancer in various organs.

Data from existing in vivo and in vitro mutagenicity studies have been reviewed and evaluated by EPA (1989a, 1985d), DHS (1986), and IARC (1982); both positive and negative indications of mutagenicity have been reported. Such data are considered inadequate to determine the mutagenicity of CDDs and CDFs to humans (SWRCB, 1988a).

Human epidemiological studies currently available have numerous deficiencies which limit their ability to determine the carcinogenicity of CDDs and CDFs to humans (EPA, 1985d, 1989a; DHS, 1986; SWRCB, 1988a):

- o Quantitative exposure to CDDs and CDFs can only be crudely estimated.

- o CDD and CDF exposures have only occurred concurrently with exposure to other chemical agents.

- o Exposures have been of very short duration relative to a human life time.

- o Sample sizes of exposed persons have been insufficient to detect small increases in tumor occurrence.

Results from such studies have been both positive and non-positive, with the statistical power of any study not sufficient to determine what is considered "no effect", i.e., that CDDs and CDFs do not cause cancer in humans. However, there are studies which have produced some suggestive evidence that CDDs and CDFs may be carcinogenic to humans (EPA, 1985d, 1989a; DHS, 1986).

In summary, California regulatory agencies consider firm evidence of animal carcinogenicity sufficient to classify a substance as a carcinogen (Proposition 65, 1989; Kizer, 1989). Sufficient information exists to

justify regulation of 2,3,7,8-TCDD and its congeners as probable human carcinogens.

CDD and CDF Structure-Activity Relationships

Much of the biochemical activity produced by CDDs and CDFs chlorinated in the 2, 3, 7, and 8 positions, and to a lesser extent non-2,3,7,8-chlorinated congeners, is related to the molecular structure these compounds have in common. Structure-activity relationships have been clearly demonstrated (EPA, 1985d, 1988b, 1989d; DHS, 1986; NATO, 1988a, 1988b; SWRCB, 1988a) for effects which include:

- o Progressive weight loss (wasting syndrome)
- o Chloracne and other skin disorders
- o Thymic atrophy
- o Porphyria
- o Enzyme induction
- o Liver disorders
- o Teratogenic/reproductive effects
- o Immunotoxicity

2,3,7,8-TCDD is the most potent of the CDDs or CDFs, and 2,3,7,8-TCDF the most potent among the CDFs producing such effects. While the effects produced by the various CDD and CDF congeners are similar qualitatively, there are wide variations in potency among them, as described by quantitative structure-activity relationships (QSARs). Such QSARs are well established for many classes of drugs and chemicals, with the principles involved being fundamental to many sciences, including both toxicology and pharmacology. They form the basis of the TEFs (Toxicity Equivalency Factors) being considered in Alternative 4 (Table 15).

The TEF approach allows the concentration of any CDD or CDF congener to be expressed as an equivalent concentration of 2,3,7,8-TCDD for the purposes of risk assessment (EPA, 1989d). The TEFs considered here were developed by an EPA led, six-nation international group assembled under the North Atlantic Treaty Organization (NATO). The NATO effort presents a standardized set of CDD and CDF TEFs developed to ensure the internationally consistent communication of human risk, both carcinogenic and noncarcinogenic, associated with human exposure to CDDs and CDFs. This TEF standard has recently been formally adopted by EPA (1989d), and represents the current state-of-the-art with regard to assessing risk resulting from human exposure to complex mixtures of CDDs and CDFs. It is an evolution of the EPA-TEF approach previously recommended for use by both State and Regional Boards (SWRCB, 1988a).

TCDD Potency

Due to experimental limitations, the potency of TCDD at low doses is estimated using models. In general, these models either assume a linear response in the low-dose range, typical of carcinogens, or a threshold response typical of non-carcinogens and promoters. Several parameters associated with the models must be determined based on best professional judgement. The selection of a model is a determination of how compelling the information is with respect to competing models and our understanding of the modes of action for TCDD. The linearized multistage model (LMS) is one of several models which have been created to depict dose-response and is currently used by EPA, DHS, and Proposition 65 for depicting TCDD carcinogenicity.

In recent reviews of the appropriateness of the LMS model used by EPA to develop water quality criteria for TCDD, two independent expert committees concluded that it would not be prudent to adopt a threshold approach to estimating human cancer risk for 2,3,7,8-TCDD (EPA, 1988a; EPA Science Advisory Board, 1989). The principal justification for a threshold model is based on TCDD's promoter activity. However, TCDD should not be considered a classic promoter because of its long residence time in tissue and its toxicity at extremely low doses. Reliance on a

threshold model, which has not been developed, to describe TCDD's promoter character is not justified based on currently available data; therefore, the LMS model is appropriate for extrapolation to low dose in the development of Alternative 4.

While selection of an appropriate type of model is a fundamental decision in determining potency estimates, a number of other factors also affect the final numeric value for potency. These include:

- o Choice of animal bioassay
- o Adjustments made for differential non-tumor mortality among treatment groups
- o Selection of types of tumors for modeling
- o Animal-to-human dose equivalence
- o Dose measurement used for curve fit.

Choices for these factors are the source of differences in the final potency factors derived by various regulatory agencies which use the LMS model. Potency factors developed by EPA, Food and Drug Administration (FDA) and the Center for Disease Control (CDC) vary by a factor of nine; EPA developed the most stringent factor. Of the factors listed above, the animal-to-human dose equivalence has the greatest impact on the final potency value derived from the linearized multistage model. FDA's potency value is nine times less than the value derived by EPA. Two-thirds of this difference is accounted for by the animal-to-human dose equivalence. FDA uses a dose-to-body weight equivalence while EPA uses a dose-to-surface area equivalence. Similarly, CDC's potency value is four times lower than the EPA value and the major factor involved is the animal-to-human dose equivalence. CDC's use of liver concentration for the equivalence accounts for half of the difference between EPA and CDC potency values. Justifications for each method are well documented.

The potency factor, as defined by EPA (1989c), is a measure of the cancer-causing potential of a substance. It is estimated by the upper 95 percent confidence limit of the slope of the straight line low dose-response curve generated by the linearized multistage model. The potency factor derived by EPA and used in this alternative is 1.56×10^5 $(mg/kg/day)^{-1}$ (EPA, 1985d).

The EPA Science Advisory Board (1989) has recently reviewed the existing information on the toxicity of 2,3,7,8-TCDD and determined that there are no new studies, either long term animal studies or human epidemiological studies, which would support changing the current potency factor. The EPA method and potency value are used in this alternative for two reasons. First, DHS, which uses essentially the same method, has endorsed the use of the EPA potency value for the Ocean Plan amendments (Kizer, 1989). Secondly, while a range of potency values have been derived using the LMS model, the EPA value represents an upper bound estimate which is most likely to be protective given the various assumptions and estimates integral to the method (EPA, 1988a).

Bioconcentration Factor

Each CDD and CDF congener exhibits unique absorption and retention rates. Such variation can be attributed to differences in transport across the gills or other biological membranes, biotransformation processes, elimination rates, the relative amount of lipids present between species, and the number and location of chlorine atoms, along with the overall molecular weight of the CDD or CDF molecule (SWRCB, 1988a). Since these processes operate at all levels in the food web, the overall effect is to selectively retain and magnify the 2,3,7,8-chlorinated congeners of toxic concern in species at the top of the food web. The greatest degree of bioaccumulation of any CDD or CDF is exhibited by 2,3,7,8-TCDD (Cook, 1987).

Various studies have been conducted to determine the bioconcentration of CDDs and CDFs in various aquatic species, with most studies using the 2,3,7,8-TCDD congener. Most older studies (before 1980-1985) were flawed by neglecting factors which either over- or under-estimated the actual accumulation. More recent studies, better designed to consider the

physical, chemical, and biological characteristics of CDDs and CDFs, have consistently produced Bioconcentration Factors (BCFs) much higher than these earlier studies. Bioconcentration factors for 2,3,7,8-TCDD as high as 39,000, 66,000, and 159,000 have been determined in rainbow trout, carp, and fathead minnows, respectively (SWRCB, 1988a; Cook 1987). The BCF for 2,3,7,8-TCDF in rainbow trout was 6049 in a recent study conducted by Mehrle et al. (1988).

Some confusion surrounds the BCF term used in the EPA equations used to develop criteria for the protection of human health through consumption of contaminated aquatic resources. BCF is included in the equation, together with the average daily consumption of aquatic resources, to provide an estimate of the exposure to a toxicant. For regulatory purposes, the value of concern is the accumulation in tissue through any mechanism or route, i.e., the total bioaccumulation of a substance (EPA, 1985a; EPA, 1989b). A variety of definitions of bioconcentration have been offered to emphasize the author's major points of concern. The central theme of these definitions is that bioaccumulation includes the consumption of food whereas bioconcentration includes uptake from water (e.g., gill and epithelial tissue) but is not characterized by trophic level transfers.

The distinction between bioaccumulation and bioconcentration is not particularly useful in a regulatory sense for several reasons. First, it is the total burden which is of concern, not just the percentage that may be attributable to bioconcentration. Secondly, bioconcentration must be considered in terms of steady-state conditions. Since many organisms of concern often require extended periods of exposure to reach a steady-state condition, bioconcentration cannot be measured. If food is withheld in order to comply with the rigors of the definitions of bioconcentration, starvation may radically alter an organisms uptake. If food is provided, a substrate is created which can bind the substance of concern. This bound substance is then either ingested or removed. In either case the resultant measurement cannot be considered a bioconcentration factor. Third, in reviewing the studies which has been used to derive the BCF values used in the EPA criteria development it is clear that attempts have been made to minimize the food route for accumulation of toxics, but the calculated factors can rarely be considered BCFs because there is other

substrate (e.g., non-food particles, organics, colloids, etc.) which are not removed. Fourth, many discharges contain organic material with associated toxicants which can act as food sources for some organisms but not for others.

Although total bioaccumulation is a more appropriate value than bioconcentration for assessing exposure, BAFs are not readily available. Therefore, for the purpose of this alternative, we have used the BCF estimate utilized by EPA in the development of the CWA Section 304(a) dioxin criterion.

Therefore, because the "BCF" term in the risk estimation equation likely addresses introduction of the chemical to the organism from all sources. The resulting water quality criterion and, hence, the proposed objective under this Alternative should be applied to the total number of CDD and CDF molecules present in both effluent and receiving waters (refer to Table B and the definition of "waste" in the Ocean Plan (SWRCB, 1988c)). Nevertheless, the value of 5,000 is used in this alternative since it represents an estimate of the bioconcentration or bioaccumulation potential of CDDs in aquatic organisms. It is a reasonable estimate for 2,3,7,8-TCDF.

Seafood Consumption

For this alternative, exposure is limited to consideration of dietary exposure from contaminated fish and shellfish. DHS has prepared and submitted a rationale for an estimated average fish and shellfish consumption rate (Kizer, 1989). This rationale, presented in Issue 4C, uses 23 g/day as an estimate of the average total seafood consumption rate. Most of the recent studies of seafood consumption report average consumption rates within the range of 23-40 g/day. Since values estimated for fish and shellfish consumers and local populations or subgroups tend to be higher, the 23 g/day value may be an underestimate of the current real average for seafood consumers. The estimate of 23 g/day is used in this alternative.

Calculation of the Proposed Water Quality Objective and Attainment

Substituting the values described above into EPA's carcinogen equation (cf. Issue 4C) results in:

$$C = \frac{70 \text{ kg} \times 10^{-6}(1000 \text{ ug/mg})(1000 \text{ ng/ug})(1000 \text{ pg/ng})}{(1.56 \times 10^{5}(\text{mg/kg/day})^{-1})(0.023 \text{ kg/day})(5000 \text{ l/kg})} = 0.0039 \text{ pg/l}$$

where:

C is the proposed water quality objective,
70 kg is the average weight of an adult,
1.56×10^{5} $(mg/kg/day)^{-1}$ is the potency factor,
0.023 kg/day is the average seafood consumption rate,
10^{-6} is the one in one million lifetime cancer risk level, and
5000 l/kg is the bioconcentration factor.

The proposed objective at the 10^{-6}, 10^{-5} and 10^{-4} risk level is 0.0039 pg/l, 0.039 pg/l and 0.39 pg/l, respectively.

The proposed water quality objectives are not currently attained by the two pulp mills at any of the cancer risk levels presented (10^{-6}, 10^{-5}, or 10^{-4}). However, there has been an indication from preliminary assessment that the oxygen delignification process is very effective at lowering the level of TCDD (W. Rodriguez, North Coast Regional Board, pers. comm.). Monitoring data from three other discharges are available too, but the method detection limits at these three facilities were too high to determine whether those discharges exceeded the proposed objectives.

Staff Recommendation: Adopt alternative 4. Use a risk level of 10^{-6}.

1. Add a new water quality objective for chlorinated dibenzodioxins and dibenzofurans to Table B as follows:

	Units	30-day Average
TCDD equivalents*	pg/l	0.0039

2. Add a new definition to Appendix I as follows:

TCDD EQUIVALENTS shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective potency factors, as shown in the table below.

Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

*This term is defined in the Ocean Plan Definition Appendix.

Issue 4E: Add objectives to Table B for tributyltin (TBT).

Present Ocean Plan Policy: None.

Issue: Description: TBT is used as an antifouling agent in paints used on hulls of boats and ships. In 1985, the State Board included TBT in its priority chemical studies because: (1) TBT was proving to be extremely toxic to aquatic life (2) information was lacking on current levels of TBT in California marine waters and sediments, and (3) there was concern over the effect of the Navy's proposed fleet-wide use of TBT antifouling paint on water quality in San Diego Bay. In the 1986 Ocean Plan triennial review hearings, TBT was suggested for inclusion in Table B.

The report of the State Board study (SWRCB, 1988d) contains information on the use, environmental fate, toxicology, and environmental occurrence of TBT and makes conclusions and recommendations for its regulation.

Comments Received: Comment: Comments were received in support of and against the adoption of a tributyltin (TBT) objective (5, 17, 24). There is no need for an objective given the virtual absence of TBT in point source discharge (17).

Response: We developed a TBT objective in response to a recent State Board report that reviewed available information on TBT. Even if TBT is not a point source problem (difficult to judge since we could not find nor did any discharger submit monitoring data), an objective will still be useful eventually for controlling nonpoint sources.

Comment: A comment was received in support of adopting the more stringent human health objective (7).

Response: No response is necessary.

Comment: Move TBT from the noncarcinogen to the aquatic life category (23).

Response: The human health-derived water quality objective is more stringent and designed to protect the more sensitive use in this case (consumption of fish).

Alternatives for Board Action:

1. Do not adopt an objective for TBT. The chemicals and concentration limits in Table B would remain unchanged. The disadvantage of this alternative is that TBT would not be controlled via the Ocean Plan, and any potential discharges into marine waters would go unregulated.

2. Adopt a water quality objective to protect aquatic life. The State Board report on TBT (SWRCB, 1988d) provides the chronic toxicity data necessary to calculate a CECT of 63 ng/l (Table 17). Since the natural background level in ocean waters is zero, the proposed water quality objective to protect aquatic life is 6 ng/l. Correspondingly, the daily and instantaneous maxima are 12 and 18 ng/l, respectively.

Table 17: Lowest Three Measurements of Chronic Toxicity of Tributyltin in Salt Water. TBT Concentrations are Reported as the Cation in ng/l.

Species	TBT (ng/l)	Effect	Duration (days)	Reference
Nucella lapillus (snail)	47	blockage of oviduct	427	Gibbs et al., 1987
Ostrea edulis (oyster)	57	growth inhibition	10	Thain and Waldock, 1985
Mytilus edulis (mussel)	95	death	15	Beaumont and Budd, 1984

Since the predominant use of TBT is in antifouling paints applied to boat hulls, it has not been routinely monitored in POTW discharge. We could not locate any POTW discharge monitoring records for TBT. However, organotin concentrations in sediments at some of the major outfalls in Southern California are high relative to reference locations (Anderson, Bay, and Thompson, 1988). The amount of TBT in these sediments is

unknown; the relative percentage of TBT versus the less toxic degradation products, monobutyltin and dibutyltin, is also unknown.

3. Adopt a water quality objective to protect human health from the consumption of contaminated fish and shellfish. To calculate this water quality objective, we used the equation for noncarcinogens as described in the section on water quality objectives to protect human health. The necessary values were taken from the State Board TBT report (SWRCB 1988d).

$$C = \frac{ADI}{0.023R}$$

where ADI (allowable daily intake [now called reference dose]) is measured in mg/day, R (bioconcentration factor) is measured in l/kg, C is measured in mg/l, and 0.023 is an estimate of average daily seafood consumption in kg/day.

For TBT, ADI = 200 X 10^{-5} mg/day.

If 0.0023 kg/day is used as the seafood consumption estimate (see previous section), and R is 6×10^4 l/kg [derived by correcting the measured value of 6000 l/kg in Crassostrea gigas to reflect the ten-fold lower (0.3% versus 3.0%) than ordinary lipid content of this organism (M. Stephenson, Department of Fish and Game, pers. comm.)], then

$$C = \frac{200 \times 10^{-5} \text{mg/day}}{(0.023 \text{ kg/day})(6000 \text{ l/kg})(3.0\%/0.3\%)} = 1.4 \text{ ng/l}$$

Staff Recommendation: Adopt Alternative 3. Specifically we recommend:

1. Add water quality objective to Table B in the noncarcinogen section as follows:

	Units	30-day Average
Tributyltin	ng/l	1.4

Issue 4F: Staff recommendations in Issues 4 and 4A through 4E.

Present Ocean Plan Policy: The existing Table B values do not reflect the amendments discussed in Issues 4A through 4E of this report.

Issue Description: Federal regulations (40 CFR 130.11) require protection of the most sensitive beneficial use. Therefore, in cases where there are proposed objectives for more than one beneficial use, Table B should contain the objectives which provide protection for the most sensitive use. In some cases, the appropriate objective will be the objective developed for protection of human health while in other cases protection of marine life is the more sensitive beneficial use.

Staff Recommendation: Adopt new objectives, definitions, and implementation provisions as described below.

Proposed Ocean Plan Amendments:

1. Add a new subheading ("OBJECTIVES FOR PROTECTION OF MARINE AQUATIC LIFE") to Table B for objectives related to the protection of marine aquatic life.

2. Revise the existing Table B for aquatic life objectives as follows:

	Units	6-mo. Median	Daily Maximum	Instantaneous Maximum
Total Chlorine Residual	ug/l	2	8	60
Cyanide	ug/l	1	4	10

Modify the equation in footnote b) of Table B to read:

$$\log y = -0.43(\log x) + 1.8$$

Add a CECT for cyanide to Table D as follows:

Constituent	CECT(ug/l)
Cyanide	10

3. Add new aquatic life water quality objectives for selenium and endosulfan to Table B as follows:

	Units	6-mo. Median	Daily Maximum	Instantaneous Maximum
Selenium	ug/l	15	60	150
Endosulfan	ng/l	9	18	27

Since endosulfan is a chlorinated pesticide, Chapter VI.B, should be amended as follows:

"Limitations on chlorinated pesticides ... in Table B (6-month median = 31 ng/l, daily maximum = 62 ng/l, and instantaneous maximum = 93 ng/l)."

4. Select new water quality objectives to protect human health from the consumption of fish and shellfish. Replace existing Table B aquatic life water quality objectives with human health water quality objectives for aldrin, chlordane and related compounds, DDT, dieldrin, PCBs, and toxaphene. Add the remainder of the human health objectives and an objective for TBT to Table B.

Add two new sections to Table B containing the noncarcinogens and carcinogens. The values in these two sections are 30-day averages. If the sampling is one time per month or less then the values become maxima. The new values to include are:

Chemical	Units of Measurement	30-day Average
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH -- NONCARCINOGENS		
acrolein	ug/l	220
antimony	mg/l	1.2
bis(2-chloroethoxy) methane	ug/l	4.4

bis(2-chloroisopropyl) ether	mg/l	1.2
chlorobenzene	ug/l	570
chromium (III)	mg/l	190
di-n-butyl phthalate	mg/l	3.5
dichlorobenzenes*	mg/l	5.1
1,1-dichloroethene	mg/l	7.1
diethyl phthalate	mg/l	33
dimethyl phthalate	mg/l	820
4,6-dinitro-2-methylphenol	ug/l	220
2,4-dinitrophenol	ug/l	4.0
ethylbenzene	mg/l	4.1
fluoranthene	ug/l	15
hexachlorocyclopentadiene	ug/l	58
isophorone	mg/l	150
nitrobenzene	ug/l	4.9
thallium	ug/l	14
toluene	mg/l	85
1,1,2,2-tetrachloroethane	mg/l	1.2
tributyltin	ng/l	1.4
1,1,1-trichloroethane	mg/l	540
1,1,2-trichloroethane	mg/l	43

OBJECTIVES FOR PROTECTION OF HUMAN HEALTH -- CARCINOGENS

acrylonitrile	ug/l	0.10
aldrin	ng/l	0.022
benzene	ug/l	5.9
benzidine	ng/l	0.069
beryllium	ng/l	33
bis(2-chloroethyl) ether	ug/l	0.045
bis(2-ethylhexyl) phthalate	ug/l	3.5
carbon tetrachloride	ug/l	0.90
chlordane*	ng/l	0.023
chloroform	mg/l	0.13
DDT*	ng/l	0.17
1,4-dichlorobenzene	ug/l	18
3,3'-dichlorobenzidine	ng/l	8.1
1,2-dichloroethane	mg/l	0.13
dichloromethane	mg/l	0.45
1,3-dichloropropene	ug/l	8.9
dieldrin	ng/l	0.040
2,4-dinitrotoluene	ug/l	2.6
1,2-diphenylhydrazine	ug/l	0.16
halomethanes*	mg/l	0.13
heptachlor*	ng/l	0.72
hexachlorobenzene	ng/l	0.21
hexachlorobutadiene	ug/l	14
hexachloroethane	ug/l	2.5
N-nitrosodimethylamine	ug/l	7.3
N-nitrosodiphenylamine	ug/l	2.5
PAHs*	ng/l	8.8
PCBs*	ng/l	0.019
tetrachloroethylene	ug/l	99
toxaphene	ng/l	0.21
trichloroethylene	ug/l	27

2,4,6-trichlorophenol	ug/l	0.29
vinyl chloride	ug/l	36

5. Add a new water quality objective for CDD and CDF equivalents for the protection of human health to Table B as follows:

	Units	30-day Average
TCDD equivalents*	pg/l	0.0039

6. Adding dozens of parameters to Table B requires the same number of additions to Table C (Background Seawater Concentrations). Nearly all the new Table B compounds have natural background levels of zero; we propose to alter Table C to include only substances with non-zero background levels. Table C would appear as follows:

"

Waste Constituent	Cs (ug/l)
Arsenic	3
Copper	2
Mercury	0.0005
Silver	0.16
Zinc	8

For all other Table B parameters, Cs = 0."

7. New Definitions:

Add a new definition to the Appendix as follows:

"TCDD EQUIVALENTS shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective potency factors, as shown in the table below.

Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

"

"DICHLOROBENZENES shall mean the sum of 1,2- and 1,3-dichlorobenzene.

ENDOSULFAN shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

HALOMETHANES shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, and dichlorobromomethane.

HEPTACHLOR shall mean the sum of heptachlor and heptachlor epoxide.

PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene and pyrene.

PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-1260.

8. Modified Definitions:

"CHLORDANE shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane."

"DDT shall mean the sum of 4,4'DDT, 2,4'DDT, 4,4'DDE, 2,4'DDE, 4,4'DDD, and 2,4'DDD."

9. Add to Appendix II:

"Monitoring for the substances in Table B shall be required periodically. For discharges less than 1 MGD (million gallons per day), the monitoring of all the Table B parameters should consist of at least one complete scan of the Table B constituents one time in the life of the waste discharge requirements. For discharges between 1 and 10 MGD, the monitoring frequency shall be at least one scan of the Table B substances annually. Discharges greater than 10 MGD shall be required to monitor at least semiannually."

10. Modify Table B implementation procedures to clarify State Board direction on establishing at or below method detection limits:

A. Delete paragraph following Table B that describes the procedure for establishing effluent limits below limits of detection.

B. Add the following direction to Regional Boards for determining compliance with single sample and multiple sample measurements above and below the PQL:

"All analytical data shall be reported uncensored with detection limits and quantitation limits identified. For any effluent limitation, compliance shall be determined using appropriate statistical methods to evaluate multiple samples. Compliance based on a single sample analysis should be determined where appropriate as described below.

"When a calculated effluent limitation is greater than or equal to the PQL, compliance shall be determined based on the calculated effluent limitation and either single or multiple sample analyses.

"When the calculated effluent limitation is below the PQL, compliance determinations based on analysis of a single sample shall only be undertaken if the concentration of the constituent of concern in the sample is greater than or equal to the PQL.

"When the calculated effluent limitation is below the PQL and recurrent analytical responses between the PQL and the calculated limit occur, compliance shall be determined by statistical analysis of multiple samples. Sufficient sampling and analysis shall be required to determine compliance.

"Published values for MDLs and PQLs should be used, except where revised MDLs and PQLs are available from recent laboratory performance evaluations, in which case the revised limits should be used. Where published values are not available the Regional Boards should determine appropriate values based on available information.

"If a discharger believes the sample matrix under consideration in the waste discharge requirements is sufficiently different from that used for an established MDL value, the discharger may demonstrate to the satisfaction of the Regional Board what the appropriate MDL should be for the discharger's matrix. In this case the PQL shall be established at a level equal to 10 standard deviations above the

measured average blank (limit of quantitation) used for development of the MDL in the discharger's matrix.

"When determining compliance based on a single sample, with a single effluent limitation which applies to a group of chemicals (e.g., PCBs) concentrations of individual members of the group may be considered to be zero if the analytical response for individual chemicals falls below the MDL for that parameter."

C. Add the following definitions to Appendix I:

"MDL (Method Detection Limit) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR 136 Appendix B.

PQL (Practical Quantitation Level) is the lowest concentration of a substance which can be consistently determined within +/- 20% of the true concentration by 75% of the labs tested in a performance evaluation study. Alternatively, if performance data are not available, the PQL for carcinogens is the MDL x 5, and for noncarcinogens is the MDL x 10.

D. Clarify Appendix II language by adding the following:

"Where methods are not available in 40 CFR 136, the Regional Boards shall specify suitable analytical methods in waste discharge requirements. Acceptance of data should be predicated on demonstrated laboratory performance."

11. Add a new footnote b) to Table B as follows:

"b) If a discharger can demonstrate to the satisfaction of the Regional Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide

complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by Standard Methods 412F, G, and H (Standard Methods for the Examination of Water and Wastewater. Joint Editorial Board, American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Most recent edition.)."

12. Reletter existing Table B footnote b) to c).

13. Add a section heading and subheadings after Table B footnotes (to distinguish between implementation procedures). Add the following statement after Table C as follows:

"If only one sample is collected during the time period associated with the water quality objective (e.g., 30-day average or 6-month median), the single measurement shall be used to determine compliance with the effluent limitation for the entire time period."

Issue 5: Adoption of a chronic toxicity objective and incorporation of the requirements of Water Code Section 13170.2(d) into the Ocean Plan.

Present Ocean Plan Policy: Toxicity objectives are measured in Toxicity Units (tu). Toxicity Units are computed as 100/96-hr LC 50, where the LC 50 is the percent effluent which kills 50 percent of the test organisms after 96 hours of exposure. The test organisms typically are minnows or sticklebacks. The objective intends to protect against long-term, sublethal effects on marine life by measuring a short-term lethal effect on freshwater fishes.

Toxicity objectives appear in four parts of the Ocean Plan.

1. Chapter IV, Table A. Toxicity Concentration in undiluted wastewater must not exceed 1.5 tu as a 30-day average, 2.0 tu as a seven-day average, and 2.5 tu as a maximum at any time.

2. Chapter IV, Table B. Toxicity Concentration in receiving waters, that is, after initial dilution of wastewater, must not exceed 0.05 tu as a six-month median.

3. Chapter VI, Waste Discharge Requirements. Alternative provisions less restrictive than those in Table B must not exceed a receiving water toxicity objective of 0.05 tu.

4. Appendix, definition of Toxicity Concentration. Toxicity Concentration is expressed in Toxicity Units as described above.

Issue Description: The regulation of effluent toxicity as a parameter provides one numerical interpretation of existing narrative objectives in the Ocean Plan that prohibit the discharge of toxic substances in amounts that degrade marine biota. These narrative objectives are consistent with CWA Section 101(A)(3) which states "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." Whole effluent toxicity bioassay testing may be used by Regional Boards to measure compliance with existing narrative objectives. When a numerical toxicity objective is in place (e.g., in Table B), effluent limits for toxicity based on bioassay testing must be included in waste discharge requirements where there is reason to believe that an effluent may be toxic. The existing toxicity objective is based on the use of

acute toxicity bioassay tests. New bioassay techniques are now available that measure chronic or critical life stage toxicity to marine organisms. This approach more accurately represents of the level of protection required by the Ocean Plan narrative objectives than do the standard acute bioassay techniques.

EPA advocated the use of biological testing of effluents in their National Policy on the Development of Water Quality Based Permit Limitations for Toxic Pollutants (Federal Register, Vol.49, No.48, March 9, 1984). The National Policy summarized the advantages of biological testing over chemical testing of effluents. Biological testing measures the effects of combinations of substances found in complex effluents, the bioavailability of toxicants in individual effluents, and the toxicity of substances for which there are inadequate chemical analyses or insufficient data for criteria development.

In response to EPA's National Policy, the State Board developed a draft Water Quality Control Policy for Water Quality-Based Toxicity Control which was the subject of public hearings on April 6 and October 20, 1988. The State Board subsequently decided that the subject matter of this Policy should be incorporated into the Ocean Plan and the proposed Inland Waters and Bays and Estuaries Plans. Five elements of the draft Policy that affect the development of a chronic toxicity objective for the Ocean Plan are summarized below:

1. There shall be no acute toxicity in any discharge to surface waters or any measurable chronic toxicity outside the zone of initial dilution.

2. Dischargers must use at least three species (fish, invertebrate, and plant) of marine organisms in toxicity tests.

3. Toxicity tests shall measure nonlethal effects on critical life stages.

4. Dilution and control water shall be obtained from an unaffected area of the receiving waters.

5. If a discharge consistently shows unacceptable levels of toxicity, the discharger must conduct an investigation (a toxicity reduction evaluation) to identify the sources of toxicity and methods to reduce it.

In addition to the incorporation of a chronic toxicity objective for marine waters, the proposed amendment addresses the provisions of Water Code Section 13170.2, which require the State Board to adopt a list of bioassay tests for ocean dischargers by January 1, 1990. Further, the Board must require inclusion of the bioassay tests in the monitoring requirements for discharges greater than 100 million gallons per day (MGD) by January 1, 1991, and adopt a schedule for use of the bioassay tests in monitoring for smaller discharges by January 1, 1992.

Comments Received:

Comment: Some commenters support staff recommendation to adopt a chronic toxicity objective of 1.0 TUc as a 30-day average, and the use of the proposed protocols to implement the objective (5, 24, 25, 29).

Response: No response is necessary.

Comment: Chronic toxicity testing is a valuable tool for monitoring the biological impacts of waste discharge. However, a chronic toxicity objective should not be adopted because the toxicity testing protocols are not reliable, adequately reviewed, or ready to be used in a regulatory program (14, 32, 34).

Response: We disagree that the protocols are not "ready" to form the basis of a regulatory program.

All the protocols have been reviewed, either by the Marine Bioassay Project Scientific Review Committee, ASTM, EPA, or in the peer-reviewed publication process. The EPA protocols include single laboratory precision data. The draft Technical Support Document (EPA, 1989e) includes a comparison of the precision of nine chronic bioassay tests to the precision of chemical analytical methods near detection limits, which shows that they are comparable. Four of the tests were marine, specifically Champia parvula, Mysidopsis bahia and Menidia beryllina, which are included in the list recommended for adoption, and Arbacia punctulata, an east coast species of sea urchin. The A. punctulata protocol is a modification of the Dinnel et al.

(1987) protocol for the west coast sea urchins, which is recommended for adoption.

Single-laboratory precision tests have been conducted for the five EPA marine chronic protocols by Schimmel et al. (1989) and Morrison et al. (1989). Schimmel et al. (1989) reported coefficients of variation ranging from 0 to 55.9 percent, with a mean of 34.7 percent, and Morrison et al. (1989) reported coefficients of variation ranging from 1.8 percent to 46.4 percent, with an average of 24.5 percent. These coefficients of variation compared favorably with the precision of acute fresh- and saltwater tests, which are currently used to determine compliance with an objective, and freshwater chronic tests.

The Marine Bioassay Project has assessed variability using reference toxicants and conducted interlaboratory tests and tests of treatment plant effluent toxicity for the abalone and kelp protocols (Anderson et al., 1988; Hunt et al., 1989). The Louisiana Pacific and Simpson paper companies (28) have submitted data on single-laboratory precision for the west coast sea urchin species showing coefficients of variation of 37 and 39 percents, which are within the range found for the EPA tests.

In addition to the peer review involved in development and publication, test protocols were evaluated on the basis of the seven criteria listed in Alternative 2. Protocols that were not deemed "ready" were not recommended. Such a determination is always somewhat subjective, and there is always room for the refinement of protocols. However, refinement will continue to occur and will probably be expedited after adoption of a chronic toxicity objective.

We agree that the regulated community may not be prepared to consistently implement toxicity testing. However, we want to emphasize that the problem is not with the protocols but with the experience and equipment limitations of the regulated community in running these new tests.

We agree that chronic toxicity testing is a valuable tool for monitoring the biological impacts of waste discharge, and we strongly support the development of objectives that assess actual impacts to marine life. We would like to avoid imposing additional monitoring requirements that will produce data that will not be adequately evaluated by regulators. We believe

that the best use of valuable monitoring tools such as chronic toxicity testing is to use them to determine compliance with objectives that are accompanied by reasonable implementation measures. This approach will expedite the development of routine toxicity testing practices without unduly penalizing dischargers.

Comment: The proposed chronic toxicity objective should not be adopted because it cannot be met in effluent using existing facilities (14).

Response: As a parameter in Table B, the chronic toxicity objective is to be met at the edge of the zone of initial dilution, not at the end of the pipe. Thus, the effluent limit in TUc units will be developed for each discharge, and will not equal the objective unless there is no initial dilution.

In general, we are reluctant to give much weight to a claim of inability to comply with the proposed objective until we are assured that it is based on the appropriate effluent limits and that toxicity testing has been correctly conducted, including appropriate dilution water, controls, etc. If the conclusion persists after these factors have been considered, we feel it indicates a water quality problem in the discharge or receiving water rather than a problem with the proposed objective. We acknowledge that the regulation of chronic toxicity is a program requiring new expertise, and that initial results deserve scrutiny and repeated evaluation. Note that the proposed enforcement mechanism is an investigation into the sources of toxicity.

Comment: Define what a Toxicity Reduction Evaluation (TRE) is in more detail and explain how it will be determined that "a discharge consistently exceeds the toxicity objective in Table B", triggering the requirement for a TRE. EPA guidance on TREs is based on acute toxicity testing, and it is not clear that the same procedures can be used to isolate chronic toxicity (5, 11, 31).

Response: As the name implies, a TRE is simply a stepwise process for identifying the agent(s) and/or source(s) of toxicity in a given effluent. We do not propose to define the term more specifically in the Ocean Plan, because each TRE will be unique. In each case the discharger will develop a plan for conducting a TRE in coordination with the Regional Board. We are

aware that EPA has defined specific procedures for identifying the source(s) of acute toxicity in effluent, and if acute toxicity is present, these may be the most appropriate methods to use. If only chronic toxicity is present, it will be up to the discharger and Regional Board staff to devise a program to identify the source of the toxicity. Similarly, the determination of if a discharge consistently exceeds its effluent limitation for chronic toxicity is left to the Regional Board.

Comment: The sentence related to TRE implementation should be changed to read: "If a discharge consistently exceeds an effluent limitation based on a toxicity objective in Table B,...." (23).

Response: We have incorporated this change.

Comment: Clarify that the chronic toxicity objective is to be met at the edge of the zone of initial dilution (ZID) (13).

Response: The text for the Ocean Plan does specify that effluent limitations for substances identified in Table B, which includes chronic toxicity, shall be calculated using equation 1 which allows for initial dilution. Table B objectives are to be met using calculated initial dilution rather than actual sampling at the edge of the ZID. We agree that the text following Table B could be better presented so that the reader understands that it deals with the implementation of the Table B objectives and have formatted the text to address this concern (refer to Issue 4F).

Comment: Clarify what is meant by "an unaffected area of the receiving waters" as a source for dilution and control waters. What quality of waters is required for dilution? (13).

Response: "An unaffected area of the receiving waters" means an area where the discharge in question is fully mixed with the receiving waters. In order to determine the NOEL of the effluent, a dilution and control water that show no chronic toxicity must be used. The NOEL of the effluent will be affected by the dilution water used, since the presence of toxicants in sublethal amounts may lower the concentration of effluent that will show toxicity. In other cases, ambient water quality may mediate the toxic effects of the effluent.

In order to gather enough information to determine the NOEL of the effluent and to determine the resulting toxicity of the effluent diluted with ambient water, toxicity tests using several control/dilution waters may be required. Therefore, the appropriate source location(s) for dilution and control waters shall be determined on a case-by-case basis by the Regional Board as needed to develop a water quality based effluent limit for chronic toxicity.

Comment: Dischargers should only be held responsible for the net toxicity from their discharge.

Response: Chapter IV of the Ocean Plan states:

> "Table A limitations, and effluent concentrations calculated from Table B limitations, shall apply to a discharger's total effluent, of whatever origin (i.e., gross, not net, discharge) except where otherwise specified in the Plan".

We see no reason why toxicity should be regulated differently than individual toxicants in this regard. Regulation of the gross toxicity of each effluent is the only way to assure that the toxicity objective is met in the receiving waters.

Comment: Dischargers should be required to use the most sensitive species when testing for chronic toxicity (7).

Response: We agree that it is appropriate to use the most sensitive species in testing effluents for chronic toxicity. Relative sensitivity of species depends on the nature of the discharge. We believe that it is appropriate to let the Regional Boards specify test species, in order to take into account factors such as seasonal and geographic availability of test organisms. The proposed Plan language does require that, if monitoring requirements are decreased from three species to one species, the most sensitive species be used.

Comment: Provisions should be included for the seasonal availability of test species. (14)

Response: It is up to the Regional Board to determine which protocols and species shall be used by each discharger. Factors such as seasonal availability of species will certainly be taken into account in the Regional Board's determination.

Comment: Only use chronic toxicity tests that have a proven track record. A greater number of reliable tests is needed (7, 12, 13).

Response: We agree that only proven chronic toxicity tests should be used. The protocols recommended for adoption do have "proven track records" since they have been reviewed either by the ASTM process, the Marine Bioassay Project, or EPA. As other reliable tests are developed, they may be submitted to the State Board for adoption. With seven tests that are ready to be adopted, we feel that the Regional Boards will have enough flexibility to develop appropriate toxicity testing requirements for each discharge. Our intent is to require the use of the most sensitive test for each discharge. The adoption of the toxicity objective will serve as an impetus for the development of sensitive, repeatable, easy to run tests.

Comment: What is the timeline for enforcing the proposed toxicity objective? A one to two year trial period should be established to allow dischargers to get more experience, space, and personnel for running the critical life stage bioassays. The guidance in the Ocean Plan is inadequate for starting a regulatory program. (4, 14, 15)

Response: The schedule for incorporating effluent limitations into waste discharge requirements is determined by the Regional Boards. At a minimum, new objectives must be incorporated when waste discharge requirements are renewed. Regional Boards may choose to modify waste discharge requirements before the renewal date in order to incorporate new objectives. This type of permit modification requires a public hearing.

In the case of the chronic toxicity objective, there would be advantages to modifying a group of waste discharge requirements at one time to incorporate toxicity limits. This approach would allow the dischargers to work together in gaining expertise to run the tests consistently, and share the burden of resolving the practical details of how to run the tests on a regular

basis. However, in some Regions the added work involved in modifying the permits before their scheduled renewal may not be justifiable.

Monitoring requirements may be added to waste discharge requirements by the Executive Officer of the Regional Boards, without holding a public hearing. We recommend that dischargers be required to begin using the critical life stage bioassays as a monitoring requirement one year before their waste discharge requirements renewal date so that they can gain the necessary experience to produce repeatable test results. This will not be possible, of course, for dischargers with permit renewal dates that are less than one year after the date of adoption of this Ocean Plan amendment. These dischargers should take advantage of whatever time is available to prepare for running the tests. Experience will be gained as the objective is implemented. Toxicity Reduction Evaluations are only required when the toxicity objective is consistently exceeded, and such a finding can only be made after repeated toxicity measurements are made.

Water Code Section 13170.2 requires that all discharges greater than 100 MGD start using the new bioassay tests by January 1, 1991. We have added language to Appendix II that requires these dischargers to start monitoring by that date and requires smaller dischargers to monitor using critical life stage bioassays one year before the waste discharge requirements renewal date, or upon renewal of the permit if that occurs less than one year after the adoption of the Ocean Plan.

Comment: Silversides (Menidia beryllina) are not a suitable test organism because they are not an estuarine species and are not endemic to California. (16)

Response: Although Menidia beryllina is not native to California, it is established in California. It is an estuarine species that occurs in a wide range of saline conditions, including the salinity of ocean waters. Therefore, it was found to meet criterion (g): "Use of marine organisms native to or established in California". State Board staff feel that it is important to include a fish among the proposed protocols, and EPA's protocol for Menidia seems to be suitable.

Comment: The commenter strongly objects to the adoption of the Dinnel 1987 sea urchin fertilization test at this time, because of the inherent variability in the test, and because it does not meet the first four criteria for adoption proposed in the FED. (28)

Response: Based on data submitted by the commenter, the coefficient of variation for the Dinnel test in single laboratory measurements of the EC 50% from lyophilized pulp mill effluent was 37 percent for one laboratory and 39 percent for another. This is in the same range as the coefficients of variation for the EPA chronic tests for marine and fresh waters.

The Dinnel et al. (1987) protocol was evaluated on the basis of the criteria listed in the FED as were the other recommended protocols. The first four criteria were met as follows. The detailed written description of the test method is included in the Dinnel et al. (1987) paper, as are reports of testing with a reference toxicant. The commenter has submitted results from interlaboratory comparisons of the method. The protocol has been tested on wastewater discharged to the ocean since the commenter has been required to conduct the test to determine compliance with effluent limits for toxicity since August, 1987. A variety of discharges have been tested by EPA using the Arbacia punctulata protocol. In summary, we find that the Dinnel et al. (1987) protocol is as well suited for adoption as are the other recommended protocols.

Comment: The acute toxicity limits in Table A do not seem consistent with EPA policy as summarized in the document. Are they adequately protective? EPA policy is misinterpreted. Limited initial dilution should be allowed in meeting the acute toxicity objective. (12, 21, 23, 24, 34)

Response: We agree that, to a certain extent, EPA policy was misstated. The six policy points listed in the FED were mistakenly attributed to EPA's Technical Support Document. In fact, five of these six points were part of the December, 1988 draft of the Water Quality Control Policy for Water Quality Based Toxicity Control for the State Board. That Policy was never adopted because it was decided to address the issue of regulating whole effluent toxicity through the Ocean Plan and the proposed Inland Waters and

Bays and Estuaries Plans. The Issue Description has been rewritten to clarify the rationale for the proposed amendment.

Some aspects of EPA policy with respect to acute toxicity are not entirely clear. In general, EPA's position is that within mixing zones chronic toxicity is permissible as long as acutely toxic conditions do not occur. However, in the Technical Support Document (EPA 1985a), EPA recommends that a criterion maximum concentration of 0.3 TUa be met after some initial mixing on a smaller scale than the full mixing zone. We feel that the two points of application already in the Ocean Plan; at the end of the pipe (Table A) and at the edge of the ZID (Table B); are difficult enough to understand without trying to define a third intermediate level of dilution. The Ocean Plan Table A objectives for TUa (1.5 monthly average, 2.0 weekly average, 2.5 instantaneous maximum) at the end of the pipe are not inconsistent with the EPA recommendation of 0.3 TUa after some initial mixing.

Lastly, it was not our intent to review the numerical value of the acute toxicity objective at this time. We have not solicited comment on the subject, so it would be inappropriate to propose a change in the objective, at this time.

Comment: The equation used to calculate TUa (Kopperdahl, 1976) in cases with less than 50% mortality in effluent samples produces illogical results. If ten fish are tested and 3 or fewer die in 100% effluent, the resulting TUa is less than one. This should correspond to a NOEC of greater than 100%, which is meaningless. Also, control mortality and "tank effects" are not taken into account. Since tests are normally run with one control and five effluent concentrations, there is no true replication. Using an effluent limit of 1 TUa and change acute toxicity testing procedures so that three controls and three 100% effluent treatments are run. The results of the 100% effluent treatment should be compared to the controls using a t-test to determine if mortality is significantly different between the two. Reference toxicant tests should be run for quality control purposes. (8)

Response: We appreciate the critical review of current acute toxicity testing practices and suggestions for improvements. We agree that current test procedures do not produce statistically sound results. However, specifics of acute toxicity testing procedures are not in the Ocean Plan, and as stated

above, the acute toxicity objective is not under review. The suggested modifications of test procedures depend on the use of a more stringent standard than currently exists (1 TUa rather than 1.5 and basing the TUa unit on the NOEC rather than the LC 50) and they cannot be easily modified for use with the existing standard. We have included a requirement for running reference toxicant tests in conjunction with chronic bioassay tests in Appendix II of the Ocean Plan.

Comment: Clarify and justify the differences between the requirements for chronic toxicity testing in the Water Code and the proposed Ocean Plan amendments. (21)

Response: Water Code Section 13170.2 requires that:

> "the state board shall develop bioassay protocols to evaluate the effect of municipal and industrial waste discharges on the marine environment."

It mandates that the Board adopt the protocols by January 1990 and require their use in monitoring discharges greater than 100 million gallons per day (MGD) by January 1991. For discharges less than 100 MGD, use of the protocols is to be required under a schedule to be adopted by the State Board by January, 1992.

The proposed Ocean Plan amendment complies with the requirement that the State Board adopt bioassay protocols. The amendment goes beyond the requirements of the CWC Section 13170.2 by proposing that a chronic toxicity objective of 1 TUc be adopted, with compliance to be measured through use of the bioassay protocols. The new chronic and existing acute toxicity objectives will serve as numeric interpretations of the existing narrative objectives that prohibit the discharge of substances in toxic amounts. The Ocean Plan amendment does not distinguish between discharges greater than and less than 100 MGD. Once the chronic toxicity objective is adopted all discharges should begin the process of implementing it as directed by the Regional Board.

While the Board must, at a minimum, meet the requirements of the CWC Section 13170.2, however, it may establish more stringent requirements as

necessary to protect water quality. The proposal for a chronic toxicity objective is, in part, in response to the EPA Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants which calls for the use of both biological and chemical testing techniques in assessing effluent toxicity. It is based further on the authority of the State and Regional Boards to establish water quality objectives. We believe that the implementation of a toxicity objective through permit limits and toxicity testing is the best way to ensure that the valuable information collected through bioassay testing is evaluated and used, and the best way to protect the beneficial uses related to marine habitat in marine waters. The Issue Description has been modified to clarify the relationship between the requirements of the Water Code and the proposed Ocean Plan amendments.

Comment: The impact of the chronic toxicity objective to industrial and stormwater dischargers was not adequately addressed in the FED. (4)

Response: The attainability of the chronic toxicity objective was not extensively addressed because we have very limited chronic toxicity data for marine discharges. The chronic toxicity objectives are numerical definitions of the narrative objectives prohibiting the discharge of toxic substances in toxic amounts, and are based on the protection of beneficial uses rather than attainability. Where compliance proves to be a problem, the recommended course of corrective action is to require a Toxicity Reduction Evaluation to define the reasonable steps that can be taken to reduce toxicity.

Comment: Since the proposed Policy for Water Quality-Based Toxicity Control is no longer scheduled for adoption independently, but instead chronic toxicity objectives are to be adopted in the statewide plans, all comments on that Policy should be considered and responded to in the response to comments for the Ocean Plan.

Response: Comments on the proposed Policy for Water Quality-Based Toxicity Control were reviewed and considered in developing this amendment to the Ocean Plan. We have reviewed the comments that were made on the draft policy and a Staff Report by the Division of Water Quality (January, 1990) responded to the comments received.

Alternatives for Board Action:

1. Make no change in Ocean Plan provisions dealing with toxicity.

This alternative would be inconsistent with Water Code Section 13170.2(d) and with the draft statewide policy for water quality-based toxicity control.

2. Adopt a chronic toxicity objective and address the requirements of Water Code Section 13170.2 into the Ocean Plan. The toxicity issue prompts several changes or additions to the Ocean Plan: (1) modification of the receiving water objectives in Table B and Chapter VI; (2) a State Board-approved list of critical life stage toxicity tests; (3) provisions concerning implementation of the proposed objective; and (4) a schedule for requiring critical life stage toxicity testing in monitoring programs. These proposed changes are discussed below.

Modification of the Receiving Water Quality Objective

The unit of chronic toxicity is referred to as TUc, which is defined as 100/NOEL, where NOEL (No Observed Effect Level) is the percent effluent that causes no observable adverse effect on the test organism. Adopt an objective of 1 TUc which, based on the definition of a TUc, corresponds to no measurable chronic toxicity. This chronic toxicity objective would apply at the edge of the zone of initial dilution, and would replace the acute toxicity objective in Table B. The effluent limitation for acute toxicity would remain in Table A, with renamed units of TUa.

State Board-approved list of toxicity texts

We have assembled a list of bioassay tests to use in measuring chronic toxicity of ocean discharges. The tests were developed chiefly by the State Board's Marine Bioassay Project (Hunt et al., 1989), EPA (Weber et al., 1988), and the American Society for Testing and Materials (ASTM). The tests on the list had to meet seven requirements for suitability:

a. the existence of a detailed written description of the test method;

b. a history of testing with a reference toxicant;

c. interlaboratory comparisons of the method;

d. adequate testing with wastewater;

e. measurement of an effect that is clearly adverse;

f. measurement of at least one nonlethal effect; and

g. use of marine organisms native to or established in California.

The tests in Table 18, meet the seven criteria mentioned above with the following exception. The test with mysid shrimp does not meet requirement (g); we include it because it is the best crustacean test available, and we believe it is essential to have crustaceans available as test organisms. Importation of Mysidopsis into California requires a permit from the Department of Fish and Game.

Adoption of this list would meet one of the requirements of CWC 13170.2. Other tests could be added to the list at such time as they meet all seven requirements. Several bioassays are close to that goal. They are briefly described in Table 19, along with the work still needed.

Table 18: Bioassays Recommended for Use in Determining Compliance with the Table B Toxicity Objective.

Organism	Effect	Test Duration	Reference
red alga	number of cystocarps	7-9 days	Weber et al., 1988
giant kelp	percent germination; germ tube length	48 hours	Hunt et al., 1989
abalone	abnormal shell development	48 hours	Hunt et al., 1989
oyster, mussel	abnormal shell development; percent survival	48 hours	ASTM, 1987
urchins, sand dollar	percent fertilization	1 hour	Dinnel et al., 1987
mysid shrimp	growth; fecundity; percent survival	7 days	Weber et al., 1988
silversides	larval growth rate; percent survival	7 days	Weber et al., 1988

Table 19: Bioassays that do not Meet the Criteria for an Acceptable Test Protocol.

Organism	Effect	Reference	Work Needed
kelp (Laminaria sp.)	number of sporophytes	Steele and Thursby, 1987	Interlaboratory comparison; whole effluent tests
Urchin	echinochrome level	Bay et al., 1983	Interlaboratory comparison
Urchin	abnormal development	Oshida et al., 1981	Interlaboratory comparison; reference toxicant
Polychaete (Dinophilus)	reproduction	Carr et al., 1986	Interlaboratory comparison
Kelp bass; Anchovy; Croaker; Halibut	reproduction; development	Hose and Parker, In Preparation	Interlaboratory comparison

Attainability

The capacity of dischargers to comply immediately with chronic or critical life stage toxicity limits is uncertain. In April and May of 1987, Bay and Greenstein (1988) conducted a survey of effluent toxicity from seven southern California sewage treatment plants having ocean outfalls. They used critical life stage bioassays to determine the degree of dilution of wastewater needed to produce no statistically significant toxic response, that is, a NOEL.

Treatment plants in highly industrial areas, such as the Los Angeles County Joint Water Pollution Control Plant, the County Sanitation District of Orange County facility, and the City of Los Angeles' Hyperion Plant, had much more toxic wastewater than smaller plants, such as Encina, Oxnard and South East Regional Reclamation Authority (SERRA).

Among treatment plants of similar size, effluent samples with the lowest suspended solids content generally elicited the least toxicity. The four largest dischargers, including Point Loma, exceeded the proposed limit for TUc. Bay et al. (1989) repeated the tests in December 1988 and found substantially less toxicity in effluent samples from all seven plants. They attributed the difference to a reduction in the level of contaminants during the sample period.

Implementation of the Toxicity Objective

Compliance with the chronic toxicity objective is to be measured using critical life stage bioassays approved by the State Board. If a toxicity effluent limit is consistently exceeded, we recommend that the discharger be required to perform a toxicity reduction evaluation (TRE) to determine the source(s) of toxicity. A TRE is a stepwise process for identifying the agent(s) and/or source(s) of toxicity in a given effluent. We do not propose to define the term more specifically in the Ocean Plan, because each TRE will be unique. In each case the discharger will develop a plan for conducting a TRE in coordination with the Regional Board. EPA procedures for identifying the source(s) of acute toxicity in effluent may be the most appropriate methods to use if acute toxicity is present. If only chronic toxicity is present, it will be up to the discharger and Regional Board staff to devise a program to identify the source of the toxicity.

If a discharger identifies the source of toxicity they should take all reasonable steps to reduce the source of the toxicity in order to meet their effluent limitation.

The requirement to conduct a TRE should be based on an evaluation of monitoring results by the Regional Boards. The Regional Boards should make a determination that the effluent limitation has been consistently exceeded.

Schedule for Requiring Bioassay Monitoring Requirements

To ensure that the requirements of Water Code Section 13170.2(d) are met, this alternative includes a requirement to use the approved critical life

stage bioassay tests in monitoring complex effluents of greater than 100 MGD by January 1, 1991. All other dischargers would be required to begin using the critical life stage tests to monitor their effluents at least one year before their waste discharge requirements renewal date.

Under this Alternative the Ocean Plan would be modified as follows: (a) change the Table B toxicity objective to 1 Chronic Toxicity Unit (TUc) measured as a Daily Maximum; (b) adopt the proposed list of test protocols; (c) require use of critical life stage toxicity tests to determine compliance with the objectives; (d) require use of receiving waters as dilution water in toxicity tests; (e) require toxicity reduction evaluations for dischargers who consistently exceed one TUc; and (f) require that all reasonable measures be taken to reduce the identified toxicity.

Staff Recommendation: Adopt Alternative 2.

Proposed Ocean Plan Amendment:

1. Chapter IV, Table A. In order to distinguish between acute toxicity units (tu) and chronic toxicity units (TUc), change toxicity units in Table A to TUa.

2. Chapter IV, Table B.

   Change objective for Toxicity Concentration to Chronic Toxicity, with a value of 1 TUc (daily maximum). Delete 0.05 tu (six-month median).

   Add the following paragraph after Table B:

   "If a discharge consistently exceeds an effluent limitation based on a toxicity objective in Table B, a toxicity reduction evaluation (TRE) is required. The TRE shall include all reasonable steps to identify the source of toxicity. Once the source(s) of toxicity is identified, the discharger shall take all reasonable steps necessary to reduce toxicity to the required level.

"The following shall be incorporated into waste discharge requirements: (1) a requirement to conduct a TRE if the discharge consistently exceeds its toxicity effluent limitation, and (2) a provision requiring a discharger to take all reasonable steps to reduce toxicity once the source of toxicity is identified."

3. Chapter VI, B, paragraph 5.

   Change b) to the following: "A receiving water toxicity* objective of 1 TUc is not exceeded;"

4. Change the definition of Toxicity Concentration to define Acute Toxicity as follows:

   "ACUTE TOXICITY
   a. Acute Toxicity (TUa)

      Expressed in Toxic Units Acute (TUa)

      TUa = 100/96-hr LC 50%

   "b. Lethal Concentration 50% (LC 50)"

      Substitute LC 50 for TLM in the existing definition of Median Tolerance Limit, and substitute TUa for Tc(tu).

5. Add a definition of Chronic Toxicity as follows:

   "CHRONIC TOXICITY: This parameter shall be used to measure the acceptability of waters for supporting a healthy marine biota until improved methods are developed to evaluate biological response."

   "a. Chronic Toxicity (TUc)

      Expressed as Toxic Units Chronic (TUc)

      TUc = 100/NOEL"

"b. No Observed Effect Level (NOEL)

The NOEL is expressed as the maximum percent effluent or receiving water that causes no observable effect on a test organism, as determined by the result of a critical life stage toxicity test listed in Appendix II."

6. Add a section in Appendix II.

"Compliance with the acute toxicity objective (TUa) in Table A shall be determined using an established protocol, e.g., American Society for Testing Materials (ASTM), EPA, American Public Health Association, or State Board.

"The Regional Board shall require the use of critical life stage toxicity tests specified in this Appendix to measure TUc. Other species or protocols will be added to the list after State Board review and approval. A minimum of three test species with approved test protocols shall be used to measure compliance with the toxicity objective. If possible, the test species shall include a fish, an invertebrate, and an aquatic plant. After a screening period, monitoring can be reduced to the most sensitive species. Dilution and control water should be obtained from an unaffected area of the receiving waters. The sensitivity of the test organisms to a reference toxicant shall be determined concurrently with each bioassay test and reported with the test results.

"Use of critical life stage bioassay testing shall be included in waste discharge requirements as a monitoring requirement for all discharges greater than 100 MGD by January 1, 1991 at the latest. For other major dischargers, critical life stage bioassay testing shall be included as a monitoring requirement one year before the waste discharge requirements is scheduled for renewal. For major dischargers scheduled for waste discharge requirements renewal less than one year after the adoption of the toxicity objective, critical life stage bioassay testing shall be included as a monitoring requirement at the same time as the chronic toxicity effluent limits is established in the waste discharge requirements.

"The following tests shall be used to measure TUc. Other tests may be added to the list when approved by the State Board.

Species	Effect	Test Duration	Reference
red alga, Champia parvula	number of cystocarps	7-9 days	1
giant kelp, Macrocystis pyrifera	percent germination; germ tube length	48 hours	2
abalone, Haliotis rufescens	abnormal shell development	48 hours	2
oyster, Crassostrea gigas; mussel, Mytilus edulis	abnormal shell development; percent survival	48 hours	3
urchins, Strongylocentrotus purpuratus, S. franciscanus; sand dollar, Dendraster excentricus	percent fertilization	1 hour	4
shrimp, Mysidopsis bahia	percent survival; growth; fecundity	7 days	1
silversides, Menidia beryllina	larval growth rate; percent survival	7 days	1

Bioassay References

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2. Hunt, J.W., B.S. Anderson, S.L. Turpin, A.R. Conlon, M. Martin, F.H. Palmer, and J.J. Janik. 1989. Experimental Evaluation of Effluent Toxicity Testing Protocols with Giant Kelp, Mysids, Red Abalone, and Topsmelt. Marine Bioassay Project. Fourth Report. California State Water Resources Control Board, Sacramento.

3. American Society for Testing Materials (ASTM). 1987. Standard Practice for conducting static acute toxicity tests with larvae of four species of bivalve molluscs. Procedure E 724-80. ASTM, Philadelphia, PA.

4. Dinnel, P.J., J. Link, and Q. Stober. 1987. Improved methodology for sea urchin sperm cell bioassay for marine waters. Archives of Environmental Contamination and Toxicology 16: 23-32."

Issue 6: Sludge disposal

Present Ocean Plan Policy: The Ocean Plan currently prohibits the discharge of municipal and industrial waste sludge directly into the ocean or into a waste stream that discharges to the ocean without further treatment. This prohibition, however, is contingent on federal law. The Ocean Plan states that if federal law is amended to permit sludge discharges, the State Board may consider requests for exceptions provided that an Environmental Impact Report (EIR) indicated that any available alternative disposal method would have a greater environmental impact.

Issue Description: Comments were received during the Ocean Plan triennial review hearings that sludge disposal should be prohibited regardless of federal law. Even though there is a federal ban on the ocean disposal of sludge, amendments to the CWA in 1987 included a provision that may allow Orange County Sanitation Districts (Districts) to discharge sludge as an experiment. A research permit could be issued if the Districts are pursuing long-term land-based options for the handling of sludge with special emphasis on remote disposal alternatives, if there is "no likelihood of an unacceptable adverse effect on the environment as a result" and if the permit would meet the requirements in paragraph 2 of CWA Section 301(h) which state that the discharge "will not interfere, alone or in combination with pollutants from other sources, with the attainment or maintenance of that water quality which assures protection of public water supplies and protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, and allows recreational activities, in and on the water".

In the new technical regulations proposed by EPA, ocean disposal is not considered an option. Congress is also considering bills requiring a ban on ocean sludge disposal. In the last area where sludge disposal is still allowed, the Northeast, a prohibition will be in force by 1991.

Comments Received:

Comment: One comment each was received in support of the adoption of Alternative 2 (23) and Alternative 1 (5). Land application of sludge, rather than disposal in landfills or the ocean, should occur as long as it is relatively innocuous to the environment and humans.

Response: Given, first, that the federal government is unlikely to further loosen its regulations regarding the ocean disposal of sludge and, second, that the State Board may consider requests for exceptions regardless of federal law, Alternative 2 remains our recommendation.

Alternatives for Board Action:

1. Amend the current Ocean Plan prohibition on sludge disposal to be effective regardless of federal law. There is no indication that the federal government is loosening its regulations regarding the ocean disposal of sludge. On the contrary, a total ban seems imminent.

2. Do not change present Ocean Plan policy. Since it is highly unlikely that the federal government will allow a sludge discharge in California, there seems to be no need to change present policy. If there is a change in EPA policy, the existing Ocean Plan prohibition on sludge disposal would require evidence that beneficial uses would not be impaired by the discharge.

Staff Recommendation: Adopt Alternative 2

Proposed Ocean Plan Amendment: None

GENERAL COMMENTS

Comment: The State Board has complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to CEQA (27).

Response: No response is necessary.

Comment: What are the environmental impacts of the technology needed to meet the human health-based water quality objectives (17)? The finding that the proposed amendment could not have a significant effect on the environment is questionable. The FED should include an assessment of the effects on other environmental media (4).

Response: If the State Board adopts the staff recommendations, we do not expect the Ocean Plan to have any significant or potentially significant adverse impacts on the environment. Therefore, no mitigation measures are proposed to avoid or reduce any significant effects in the environment.

An argument has been made that in order to come into compliance with objectives in the Ocean Plan, extensive additional treatment of wastewater will be required. It is alleged that this will result in increased use of energy with possible redirection of effluent to other disposal points such as reinjection or discharge to inland waters. These potential impacts are too speculative to allow for an accurate environmental analysis at this time. A stringent source control program, for example, may avoid the need for much of the additional treatment which is being proposed as an inevitable by product of the adoption of the recommended water quality objectives. Moreover, changes in treatment facilities or other specific projects which are undertaken to meet the requirements of the Ocean Plan will no doubt be subject to CEQA and will thus result in a full environmental analysis of each project's effects including consideration of appropriate mitigation measures.

Comment: Explain the implementation of permit revisions since permits will no longer meet the requirements of the Ocean Plan (20). How will human health objectives will be enforced? (5).

Response: Waste discharge requirement revisions will be implemented as required (i.e., at least every 5 years). Human health objectives will be enforced in a manner identical to previous enforcement of existing Table B constituents, except as described elsewhere in

comment responses relating to objectives lower than method detection limits and to practical quantitation limits.

OTHER PUBLIC COMMENT RECEIVED

Comments were received regarding Ocean Plan revisions, which were not pertinent to amendments offered in this document. Some of these issues will be addressed in the future. Comments addressing these issues will be considered at that time. The additional comments received were:

Table C should be amended to include naturally occurring background levels of radioactivity in seawater (32).

Future amendments should address nonpoint sources, sediment toxicity criteria, objectives based on mass emissions, and standardization of monitoring programs (5).

In the next phase of this triennial review, the State Board should develop specific ecological hypotheses to be tested for ambient monitoring of ocean waters (29).

Large users of ocean water should be allowed to report the net discharge of listed substances for the assessment of compliance (31).

Regional Boards should identify all shellfish harvesting areas (10, 35).

The definition of shellfish expanded to include scallops (5).

PROGRESS REPORT FOR OTHER ISSUES IDENTIFIED IN THE TRIENNIAL REVIEW

Many of the issues raised in the 1987 Ocean Plan Triennial Review require considerable staff review and, in some cases, applied research projects in order to prepare a meaningful and reasonable staff analysis. In what follows, we present the status of our assessment of the high priority issues identified in the triennial review.

The State Board has sponsored the SCBRC to assist it in assessing marine pollution problems in southern California waters and to assist us in making recommendations for possible and potential regulatory remedies. Many of the issues discussed below have been brought before the SCBRC. Even though the focus of the SCBRC is southern California, many of the issues have statewide implications.

Suspended Solids

Several of the comments raised in the 1987 Ocean Plan triennial review were related to suspended solids regulation. Staff analysis of these issues will involve several steps: (1) determination of safe levels of pollutants in tissues of marine organisms and in sediments; (2) assessment of the relationship between pollutant levels and total load of materials discharged; (3) allocation of waste discharge into stressed areas; and (4) level of treatment required to meet objectives.

Regulation of Pollutant Levels in Sediments

The regulation of pollutant levels in sediments is a high priority issue in the Ocean Plan Triennial Review. Many of the toxic materials in wastewater are attached to particles that settle and become part of the sediment. Many organisms ingest sediment, accumulate toxicants, and often transfer them to other animals higher in the food web. Sediment can also release toxicants back into the water by physical processes. Thus, sediment contamination is important in controlling many bioaccumulation problems. In order to regulate the direct impact of discharges on sediments, sediment quality objectives should be established.

Many techniques have been developed to evaluate sediment toxicity for the establishment of sediment quality objectives, each with its own advantages and disadvantages. These

techniques have been reviewed and evaluated by staff. The Apparent Effects Threshold (AET) approach, a technique developed by EPA, was identified as a promising method for developing sediment quality objectives for the ocean waters of California. The AET relates sediment chemistry with statistically significant toxic effects in the laboratory and depressions of infaunal abundance in the field. Chemical data are classified according to the absence or presence of associated biological effects to determine concentrations of contaminants above which biological effects would always be expected to occur.

There are several advantages to the AET approach: (1) biological effects of individual contaminants can be distinguished from overall contaminant effects of complex sediment; (2) there are no constraints on the type of contaminant for which the AET can be established; (3) a diverse set of biological indicators can be used to determine the AET for a given chemical; and (4) observed biological effects always occur above the AET by definition, hence the approach provides a sediment quality value that is based on noncontradictory evidence of environmental effects.

The major disadvantage is that AET values have been established with a relatively small database from Puget Sound in the State of Washington. Contaminants contained in California's sediments are quantitatively different from those in Puget Sound. The narrow range of certain chemicals in a small, geographically isolated area may skew AET values. Sediment chemistry, sediment bioassay and infaunal data from California waters are needed to make this approach usable in the Ocean Plan. Some of these data have already been collected in San Francisco Bay by the National Oceanographic and Atmospheric Administration (NOAA).

During FY 1986-87, we contracted with the Southern California Coastal Water Research Project (SCCWRP) to collect sediment chemistry, sediment bioassay, and infaunal data concurrently in the Southern California Bight. SCCWRP used short-term and long-term bioassays with Southern California species. These data: (1) provide information for development of AET values specific to California; (2) identify sites with significant levels of sediment toxicity; (3) help determine which chemicals are most responsible for sediment toxicity in the Southern California Bight; and (4) provide an independent analysis to determine levels at which certain chemicals are toxic in the sediment. Work has been completed on this contract and SCCWRP has submitted a final report entitled: "Characteristics and Effects of Contaminated Sediments from Southern California" (Anderson, Bay & Thompson, 1988).

During FY 1987-88, a project was begun by PTI Environmental Services, Inc. for the development of sediment quality objectives. The contract will assist us in combining the San Francisco Bay AET data with the southern California data to establish AET values specifically for California. These values will then be compared to AETs derived from Puget Sound data and to a set of combined Puget Sound and California data, if appropriate. We have assembled usable information from nearly 200 samples collected in several California coastal locations. The results of these analyses were completed by late-1989.

Establishing Ocean Plan Objectives Based on Mass Emissions

Table A and Table B limitations on discharge of materials are based on concentrations of substances in effluents. Although these limitations protect against toxicity in the water column, they do not protect against sediment loading which may cause direct toxicity or bioaccumulation. There is general agreement that some type of mass emission limitation is the best way to protect against sediment loading.

Once sediment quality objectives are established, a regulatory method must be developed to ensure that these objectives are met. Two models have been developed which relate mass emissions to sediment loading. Tetra Tech has developed the DECAL model for EPA. This model is a fairly simple, empirical model based on site-specific measurements. The SCCWRP model, SEDF2D, which is complex and theoretical, has been developed for NOAA and EPA. We have contracted with SCCWRP to verify the SEDF2D model so it can be used to implement sediment quality objectives in California waters.

Nonpoint Sources

The State Board is developing a nonpoint source program. As the program develops, applicable portions of it will be incorporated into the Ocean Plan.

Standard Methods for Marine Monitoring Programs

Standardization of discharger monitoring methods and programs would simplify comparisons between discharge sites and allow use of a uniform reporting system. To address this issue, the State Board is participating in the National Research Council study, "A Systems Assessment of Marine Environmental Monitoring."

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APPENDIX A: DRAFT OCEAN PLAN

State of California

STATE WATER RESOURCES CONTROL BOARD

~~1989~~90

CALIFORNIA OCEAN PLAN

WATER QUALITY CONTROL PLAN

OCEAN WATERS OF CALIFORNIA

Adopted and Effective

~~September 22, 1988~~

Table of Contents

CALIFORNIA OCEAN PLAN

WATER QUALITY CONTROL PLAN FOR OCEAN WATERS OF CALIFORNIA

INTRODUCTION

In furtherance of legislative policy set forth in Section 13000 of Division 7 of the California Water Code (Stats. 1969, Chap. 482) pursuant to the authority contained in Section 13170 and 13170.2 (Stats. 1971, Chap. 1288) the State Water Resources Control Board hereby finds and declares that protection of the quality of the ocean* waters for use and enjoyment by the people of the State requires control of the discharge of waste* to ocean* waters in accordance with the provisions contained herein. The Board finds further that this plan shall be reviewed at least every three years to guarantee that the current standards are adequate and are not allowing degradation* to marine species or posing a threat to public health.

This plan is applicable, it its entirety, to point source discharges to the ocean*. Nonpoint sources of waste* discharges to the ocean* are subject to Chapter I Beneficial Uses, Chapter II - Water Quality Objectives, Chapter III -General Requirements, Chapter IV - Table B (wherein compliance with water quality objectives shall, in all cases, be determined by direct measurements in the receiving waters) and Chapter V - Discharge Prohibitions.

This plan is not applicable to discharges to enclosed* bays and estuaries* or inland waters nor is it applicable to vessel wastes, or the control of dredging spoil.

Provisions regulating the thermal aspects of waste* discharged to the ocean* are set forth in the Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed* Bays and Estuaries* of California.

Chapter I
BENEFICIAL USES

The beneficial uses of the ocean* waters of the State that shall be protected include industrial water supply, water contact and non-contact recreation, including aesthetic enjoyment, navigation, commercial and sport fishing, mariculture*, preservation and enhancement of Areas of Special Biological Significance, rare and endangered species, marine habitat, fish migration, fish spawning and shellfish* harvesting.

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* See Appendix I for definition of terms.

Chapter II
WATER QUALITY OBJECTIVES

This chapter sets forth limits or levels of water quality characteristics for ocean* waters to ensure the reasonable protection of beneficial uses and the prevention of nuisance. The discharge of waste* shall not cause violation of these objectives.

The Water Quality Objectives and Effluent Quality Requirements are defined by a statistical distribution when appropriate. This method recognizes the normally occurring variations in treatment efficiency and sampling and analytical techniques and does not condone poor operating practices.

Compliance with the water quality objectives of this chapter shall be determined from samples collected at stations representative of the area within the waste field where initial* dilution is completed.

A. ~~Bacteriological~~ Bacterial Characteristics

1. ~~Body~~ Water-Contact Standards

Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline, and in areas outside this zone used for ~~body~~ water contact sports, as determined by the Regional Board, but including all kelp* beds, the following bacteri~~ologic~~al objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a ~~concentration~~ density of total coliform organisms less than 1,000 per 100 ml (10 per ml); provided that not more than 20 percent of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 per ml), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml (100 per ml).

b. The fecal coliform ~~concentration~~ density based on a minimum of not less than five samples for any 30-day period, shall not exceed a ~~log~~ geometric mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per 100 ml.

The "Initial* Dilution Zone" of wastewater outfalls shall be excluded from designation as "kelp* beds" for purposes of bacteri~~ologic~~al standards, and Regional Boards should recommend extension of such exclusion zone where warranted to the State Board (for consideration under Chapter VI.F.). Adventitious assemblages of kelp plants on waste discharge structures (e.g., outfall pipes and diffusers) do not constitute kelp* beds for purposes of bacteri~~ologic~~al standards.

2. Shellfish* Harvesting Standards

At all areas where shellfish* may be harvested for human consumption, as determined by the Regional Board, the following bacteri~~ologic~~al objectives shall be

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* See Appendix I for definition of terms.

maintained throughout the water column:

The median total coliform ~~concentration~~ density shall not exceed 70 per 100 ml, and not more than 10 percent of the samples shall exceed 230 per 100 ml.

B. Bacterial Assessment and Remedial Action Requirements

The requirements listed below shall be used to 1) determine the occurrence and extent of any impairment of a beneficial use due to bacterial contamination; 2) generate information which can be used in the development of an enterococcus standard; and 3) provide the basis for remedial actions necessary to minimize or eliminate any impairment of a beneficial use.

Measurement of enterococcus density shall be conducted at all stations where measurement of total and fecal coliforms are required. In addition to the requirements of Section II.A.1., if a shore station consistently exceeds a coliform objective or exceeds a geometric mean enterococcus density of 24 organisms per 100 ml for a 30-day period or 12 organisms per 100 ml for a six-month period, the Regional Board shall require the appropriate agency to conduct a survey to determine if that agency's discharge is the source of the contamination. The geometric mean shall be a moving average based on no less than five samples per month, spaced evenly over the time interval. When a sanitary survey identifies a controllable source of indicator organisms associated with a discharge of sewage, the Regional Board shall take action to control the source.

Waste discharge requirements shall require the permittee to conduct sanitary surveys when so directed by the Regional Board. Waste discharge requirements shall contain provisions requiring the permittee to control any controllable discharges identified in a sanitary survey.

~~C.~~B. Physical Characteristics

1. Floating particulates and grease and oil shall not be visible.

2. The discharge of waste* shall not cause aesthetically undesirable discoloration of the ocean* surface.

3. Natural* light shall not be significantly* reduced at any point outside the initial* dilution zone as the result of the discharge of waste*.

4. The rate of deposition of inert solids and the characteristics of inert solids in ocean* sediments shall not be changed such that benthic communities are degraded*.

~~D.~~C. Chemical Characteristics

1. The dissolved oxygen concentration shall not at any time be depressed more than 10 percent from that which occurs naturally, as the result of the discharge of oxygen demanding waste* materials.

2. The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.

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* See Appendix I for definition of terms.

3. The dissolved sulfide concentration of waters in and near sediments shall not be significantly* increased above that present under natural conditions.

4. The concentration of substances set forth in Chapter IV, Table B, in marine sediments shall not be increased to levels which would degrade* indigenous biota.

5. The concentration of organic materials in marine sediments shall not be increased to levels which would degrade* marine life.

6. Nutrient materials shall not cause objectionable aquatic growths or degrade* indigenous biota.

~~D.~~ Biological Characteristics

1. Marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded*.

2. The natural taste, odor, and color of fish, shellfish*, or other marine resources used for human consumption shall not be altered.

3. The concentration of organic materials in fish, shellfish* or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.

~~E.~~ Radioactivity

1. Discharge of radioactive waste* shall not degrade* marine life.

Chapter III
GENERAL REQUIREMENTS FOR MANAGEMENT OF WASTE* DISCHARGE TO THE OCEAN*

A. Waste* management systems that discharge to the ocean* must be designed and operated in a manner that will maintain the indigenous marine life and a healthy and diverse marine community.

B. Waste discharged* to the ocean* must be essentially free of:

1. Material that is floatable or will become floatable upon discharge.

2. Settleable material or substances that may form sediments which will degrade* benthic communities or other aquatic life.

3. Substances which will accumulate to toxic levels in marine waters, sediments or biota.

4. Substances that significantly* decrease the natural* light to benthic communities and other marine life.

5. Materials that result in aesthetically undesirable discoloration of the ocean* surface.

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* See Appendix I for definition of terms.

C. Waste* effluents shall be discharged in a manner which provides sufficient initial* dilution to minimize the concentrations of substances not removed in the treatment.

D. Location of waste* discharges must be determined after a detailed assessment of the oceanographic characteristics and current patterns to assure that:

1. Pathogenic organisms and viruses are not present in areas where shellfish* are harvested for human consumption or in areas used for swimming or other body-contact sports.

2. Natural water quality conditions are not altered in areas designated as being of special biological significance or areas that existing marine laboratories use as a source of seawater.

3. Maximum protection is provided to the marine environment.

Waste* that contains pathogenic organisms or viruses should be discharged a sufficient distance from shellfishing* and ~~body~~ water-contact sports areas to maintain applicable bacteri~~ological~~al standards without disinfection. Where conditions are such that an adequate distance cannot be attained, reliable disinfection in conjunction with a reasonable separation of the discharge point from the area of use must be provided. Disinfection procedures that do not increase effluent toxicity and that constitute the least environmental and human hazard should be used.

Chapter IV
QUALITY REQUIREMENTS FOR WASTE* DISCHARGES (EFFLUENT QUALITY REQUIREMENTS)

This chapter sets forth the quality requirements for waste* discharge to the ocean*.

Table A limitations apply only to publicly owned treatment works and industrial discharges for which Effluent Limitations Guidelines have not been established pursuant to Sections 301, 302, 304, or 306 of the Federal Clean Water Act.

Table B limitations apply to all discharges within the jurisdiction of this plan.

Table A limitations, and effluent concentrations calculated from Table B limitations, shall apply to a discharger's total effluent, of whatever origin (i.e. gross, not net, discharge), except where otherwise specified in this Plan.

The State Board is authorized to administer and enforce effluent requirements established pursuant to the Federal Clean Water Act. Effluent limitations established under Sections 301, 302, 306, 307, 316, 403, and 405 of the aforementioned Federal Act and administrative procedures pertaining thereto, are included in this plan by reference. Compliance with Table A limitations, or Environmental Protection Agency Effluent Limitations Guidelines for industrial discharges, based on Best Practicable Control Technology, shall be the minimum level of treatment acceptable under this plan, and shall define reasonable treatment and waste control technology.

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* See Appendix I for definition of terms.

TABLE A
MAJOR WASTEWATER CONSTITUENTS AND PROPERTIES

	Unit of measurement	Limiting Concentrations: Monthly (30 day Average)	Weekly (7 day Average)	Maximum at any time
Grease and Oil	mg/l	25	40	75
Suspended Solids			see below+	
Settleable Solids	ml/l	1.0	1.5	3.0
Turbidity	NTU	75	100	225
pH	units		within limits of 6.0 to 9.0 at all times	
Acute* Toxicity ~~Concentration~~	~~tu~~ TUa	1.5	2.0	2.5

+Suspended Solids: Dischargers shall, as a 30-day average, remove 75% of suspended solids from the influent stream before discharging wastewaters to the ocean*, except that the effluent limitation to be met shall not be lower than 60 mg/l. Regional Boards may recommend that the State Board (Chapter VI.F.), with the concurrence of the Environmental Protection Agency, adjust the lower effluent concentration limit (the 60 mg/l above) to suit the environmental and effluent characteristics of the discharge. As a further consideration in making such recommendation for adjustment, Regional Boards should evaluate effects on existing and potential water* reclamation projects.

If the lower effluent concentration limit is adjusted, the discharger shall remove 75% of suspended solids from the influent stream at any time the influent concentration exceeds four times such adjusted effluent limit.

Effluent limitations shall be imposed in a manner prescribed by the State Board such that the concentrations set forth below as water quality objectives shall not be exceeded in the receiving water upon completion of initial* dilution, except that limitations indicated for radioactivity shall apply directly to the undiluted waste* effluent.

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* See Appendix I for definition of terms.

TABLE B
TOXIC MATERIALS LIMITATIONS

	Units of Measurement	Limiting Concentrations: 6-Month Median	Daily Maximum	Instantaneous Maximum
OBJECTIVES FOR PROTECTION OF MARINE AQUATIC LIFE				
Arsenic	ug/l	8	32	80
Cadmium	ug/l	1	4	10
Chromium (Hexavalent) (see below, a)	ug/l	2	8	20
Copper	ug/l	3	12	30
Lead	ug/l	2	8	20
Mercury	ug/l	0.04	0.16	0.4
Nickel	ug/l	5	20	50
Selenium	ug/l	15	60	150
Silver	ug/l	0.7	2.8	7
Zinc	ug/l	20	80	200
Cyanide (see below, b)	ug/l	~~5~~ 1	~~20~~ 4	~~50~~ 10
Total Chlorine Residual (For intermittent chlorine sources, see below, ~~b~~ c)	ug/l	2	~~11~~ 8	~~126~~ 60
Ammonia (expressed as nitrogen)	ug/l	600	2400	6000
Chronic* Toxicity ~~Concentration~~	~~tu~~ TUc	~~0.05~~	1	
Phenolic Compounds (non-chlorinated)	ug/l	30	120	300
Chlorinated Phenolics	ug/l	1	4	10
~~Aldrin and Dieldrin~~	~~ug/l~~	~~0.002~~	~~0.004~~	~~0.006~~
~~Chlordane* and Related Compounds~~	~~ug/l~~	~~0.003~~	~~0.006~~	~~0.009~~
~~DDT* and Derivatives~~	~~ug/l~~	~~0.001~~	~~0.002~~	~~0.003~~
Endosulfan	ng/l	9	18	27
Endrin	~~u~~ ng/l	~~0.00~~2	~~0.00~~4	~~0.006~~
HCH*	~~u~~ ng/l	~~0.00~~4	~~0.00~~8	~~0.0~~12
~~PCBs*~~	~~u ng/l~~	~~0.003~~	~~0.006~~	~~0.009~~
~~Toxaphene~~	~~u ng/l~~	~~0.007~~	~~0.014~~	~~0.021~~
Radioactivity	Not to exceed limits specified in Title ~~17~~ 22, Chapter 15, ~~Subchapter 4, Group 3,~~ Article 3 4, Section ~~30269~~ 64443 of the ~~California Administrative Code~~ California Code of Regulations.			

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* See Appendix 1 for definition of terms.

Table B Continued

Chemical	Units of Measurement	30-day Average
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH -- NONCARCINOGENS		
acrolein	ug/l	220
antimony	mg/l	1.2
bis(2-chloroethoxy) methane	ug/l	4.4
bis(2-chloroisopropyl) ether	mg/l	1.2
chlorobenzene	ug/l	570
chromium (III)	mg/l	190
di-n-butyl phthalate	mg/l	3.5
dichlorobenzenes*	mg/l	5.1
1,1-dichloroethylene	mg/l	7.1
diethyl phthalate	mg/l	33
dimethyl phthalate	mg/l	820
4,6-dinitro-2-methylphenol	ug/l	220
2,4-dinitrophenol	ug/l	4.0
ethylbenzene	mg/l	4.1
fluoranthene	ug/l	15
hexachlorocyclopentadiene	ug/l	58
isophorone	mg/l	150
nitrobenzene	ug/l	4.9
thallium	ug/l	14
toluene	mg/l	85
1,1,2,2-tetrachloroethane	mg/l	1.2
tributyltin	ng/l	1.4
1,1,1-trichloroethane	mg/l	540
1,1,2-trichloroethane	mg/l	43
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH -- CARCINOGENS		
acrylonitrile	ug/l	0.10
aldrin	ng/l	0.022
benzene	ug/l	5.9
benzidine	ng/l	0.069
beryllium	ng/l	33
bis(2-chloroethyl) ether	ug/l	0.045
bis(2-ethylhexyl) phthalate	ug/l	3.5
carbon tetrachloride	ug/l	0.90
chlordane*	ng/l	0.023
chloroform	mg/l	0.13
DDT*	ng/l	0.17
1,4-dichlorobenzene	ug/l	18
3,3'-dichlorobenzidine	ng/l	8.1

* See Appendix I for definition of terms.

Chemical	Units of Measurement	30-day Average
1,2-dichloroethane	mg/l	0.13
dichloromethane	mg/l	0.45
1,3-dichloropropene	ug/l	8.9
dieldrin	ng/l	0.040
2,4-dinitrotoluene	ug/l	2.6
1,2-diphenylhydrazine	ug/l	0.16
halomethanes*	mg/l	0.13
heptachlor*	ng/l	0.72
hexachlorobenzene	ng/l	0.21
hexachlorobutadiene	ug/l	7.3
hexachloroethane	ug/l	2.5
N-nitrosodimethylamine	ug/l	14
N-nitrosodiphenylamine	ug/l	2.5
PAHs*	ng/l	8.8
PCBs*	ng/l	0.019
TCDD equivalents*	pg/l	0.0039
tetrachloroethylene	ug/l	99
toxaphene	ng/l	0.21
trichloroethylene	ug/l	27
2,4,6-trichlorophenol	ug/l	0.29
vinyl chloride	ug/l	36

a) Dischargers may at their option meet this limitation as a total chromium limitation.

b) If a discharger can demonstrate to the satisfaction of the Regional Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by Standard Methods 412F, G, and H (Standard Methods for the Examination of Water and Wastewater, Joint Editorial Board, American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Most recent edition.).

~~b~~ c) Water quality objectives for total chlorine residual applying to intermittent discharges not exceeding two hours, shall be determined through the use of the following equation:

$$\log y = -0.~~3343~~ (\log x) + ~~2.1~~1.8$$

where: y = the water quality objective (in ug/l) to apply when chlorine is being discharged;
x = the duration of uninterrupted chlorine discharge in minutes.

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* See Appendix I for definition of terms.

Implementation Provisions for Table B

A. Calculation of Effluent Limitations

Effluent limitations for parameters ~~substances~~ identified in Table B with the exception of Radioactivity, shall be determined through the use of the following equation:

$$Ce = Co + Dm (Co - Cs) \quad (1)$$

where:

Ce = the effluent concentration limit,
Co = the concentration to be met at the completion of initial* dilution,
Cs = background seawater concentration (see Table C below),
Dm = minimum probable initial* dilution expressed as parts seawater per part wastewater.

For the purpose of this Plan, minimum initial dilution is the lowest average initial dilution within any single month of the year. Dilution estimates shall be based on observed waste flow characteristics, observed receiving water density structure, and the assumption that no currents, of sufficient strength to influence the initial dilution process, flow across the discharge structure.

The Executive Director of the State Board shall identify standard dilution models for use in determining Dm, and shall assist the Regional Board in evaluating Dm for specific waste discharger. Dischargers may propose alternative methods of calculating Dm, and the Regional Board may accept such method upon verification of its accuracy and applicability.

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* See Appendix I for definition of terms.

TABLE C
BACKGROUND SEAWATER CONCENTRATIONS (Cs)

Waste Constituent	Cs (ug/l)
Arsenic	3
~~Cadmium~~	~~0~~
~~Chromium (Hexavalent)~~	~~0~~
Copper	2
~~Lead~~	~~0~~
Mercury	0.0005
~~Nickel~~	~~0~~
Silver	0.16
Zinc	8
~~Cyanide~~	~~0~~
~~Phenolic Compounds~~	~~0~~
~~Total Chlorine Residual~~	~~0~~
~~Ammonia (Expressed as nitrogen)~~	~~0~~
~~Toxicity* Concentration (in toxicity units)~~	~~0~~
~~Chlorinated Pesticides and PCB's~~	~~0~~

For all other Table B parameters, Cs = 0.

The six-month median effluent concentration limit shall apply as a moving median of daily values for any 180 day period in which daily values represent flow weighted average concentrations within a 24-hour period. For intermittent discharges, the daily value shall be considered to equal zero for days on which no discharge occurred.

The daily maximum effluent concentration limit shall apply to flow weighted 24 hour composite samples.

The instantaneous maximum shall apply to grab sample determinations.

If only one sample is collected during the time period associated with the water quality objective (e.g., 30-day average or 6-month median), the single measurement shall be used to determine compliance with the effluent limitation for the entire time period.

Discharge requirements shall also specify effluent requirements in terms of mass emission rate limits utilizing the general formula:

$$\text{lbs/day} = 8.34 \times Ce \times Q \quad (2)$$

The six-month median limit on daily mass emissions shall be determined using the six-month median effluent concentration as Ce and the observed flow rate Q in millions of gallons per day. The daily maximum mass emission shall be determined using the daily maximum effluent concentration limit as Ce and the observed flow rate Q in millions of

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* See Appendix I for definition of terms.

gallons per day.

Any significant change in waste* flow shall be cause for reevaluating effluent quality requirements.

~~If a calculated Ce value falls below the limit of detection of the test method specified in the Code of Federal Regulations, 40 CFR 136, the limit of detection shall serve as the limiting effluent concentration.~~

B. Compliance Determination

All analytical data shall be reported uncensored with detection limits and quantitation limits identified. For any effluent limitation, compliance shall be determined using appropriate statistical methods to evaluate multiple samples. Compliance based on a single sample analysis should be determined where appropriate as described below.

When a calculated effluent limitation is greater than or equal to the PQL*, compliance shall be determined based on the calculated effluent limitation and either single or multiple sample analyses.

When the calculated effluent limitation is below the PQL*, compliance determinations based on analysis of a single sample shall only be undertaken if the concentration of the constituent of concern in the sample is greater than or equal to the PQL*.

When the calculated effluent limitation is below the PQL* and recurrent analytical responses between the PQL* and the calculated limit occur, compliance shall be determined by statistical analysis of multiple samples. Sufficient sampling and analysis shall be required to determine compliance.

Published values for MDL*s and PQL*s should be used except where revised MDL*s and PQL*s are available from recent laboratory performance evaluations, in which case the revised MDL*s and PQL*s should be used. Where published values are not available the Regional Boards should determine appropriate values based on available information.

If a discharger believes the sample matrix under consideration in the waste discharge requirements is sufficiently different from that used for an established MDL* value, the discharger may demonstrate to the satisfaction of the Regional Board what the appropriate MDL* should be for the discharger's matrix. In this case the PQL* shall be established at the limit of quantitation (equal to 10 standard deviations above the average measured blank used for development of the MDL* in the discharger's matrix).

When determining compliance based on a single sample, with a single effluent limitation which applies to a group of chemicals (e.g., PCBs) concentrations of individual members of the group may be considered to be zero if the analytical response for individual chemicals falls below the MDL* for that parameter.

~~The State or Regional Board may, at their discretion, specify test methods which are more sensitive than those specified in 40 CFR 136. Total chlorine residual is likely to be a "limit of detection" effluent requirement in many cases. The limit of detection of total chlorine residual in standard test methods is less than, or equal to, 20 ug/l.~~

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* See Appendix I for definition of terms.

Due to the large total volume of powerplant and other heat exchange discharges, special procedures must be applied for determining compliance with Table B limitations on a routine basis. Effluent concentration values (Ce) shall be determined through the use of equation 1 considering the minimal probable initial* dilution of the combined effluent (in-plant waste streams plus cooling water flow). These concentration values shall then be converted to mass emission limitations as indicated in equation 2. The mass emission limits will then serve as requirements applied to all inplant waste* streams taken together which discharge into the cooling water flow, except that limitations on total chlorine residual, chronic* toxicity ~~concentration~~ and instantaneous maximum limitations on Table B toxic materials shall apply to, and be measured in, the combined final effluent, as adjusted for dilution with ocean water. The Table B limitation on radioactivity shall apply to the undiluted combined final effluent.

C. Toxicity Reduction Requirements

If a discharge consistently exceeds an effluent limitation based on a toxicity objective in Table B, a toxicity reduction evaluation (TRE) is required. The TRE shall include all reasonable steps to identify the source of toxicity. Once the source(s) of toxicity is identified, the discharger shall take all reasonable steps necessary to reduce toxicity to the required level.

The following shall be incorporated into waste discharge requirements: (1) a requirement to conduct a TRE if the discharge consistently exceeds its toxicity effluent limitation, and (2) a provision requiring a discharger to take all reasonable steps to reduce toxicity once the source of toxicity is identified.

Chapter V
DISCHARGE PROHIBITIONS

A. Hazardous Substances

The discharge of any radiological, chemical, or biological warfare agent or high-level radioactive waste* into the ocean* is prohibited.

B. Areas of Special Biological Significance

Waste* shall not be discharged to areas designated as being of special biological significance. Discharges shall be located a sufficient distance from such designated areas to assure maintenance of natural water quality conditions in these areas.

C. Sludge

Pipeline discharge of sludge to the ocean* is prohibited by federal law; the discharge of municipal and industrial waste* sludge directly to the ocean*, or into a waste* stream that discharges to the ocean*, is prohibited by this Plan. The discharge of sludge digester supernatant directly to the ocean*, or to a waste* stream that discharges to the

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* See Appendix I for definition of terms.

ocean* without further treatment, is prohibited.

It is the policy of the State Board that the treatment, use and disposal of sewage sludge shall be carried out in the manner found to have the least adverse impact on the total natural and human environment. Therefore, if federal law is amended to permit such discharge, which could affect California waters, the State Board may consider requests for exceptions to this section under Chapter VI, F. of this Plan, provided further that an Environmental Impact Report on the proposed project shows clearly that any available alternative disposal method will have a greater adverse environmental impact than the proposed project.

D. By-Passing

The by-passing of untreated wastes* containing concentrations of pollutants in excess of those of Table A or Table B to the ocean* is prohibited.

Chapter VI
GENERAL PROVISIONS

A. Effective Date

This Plan is in effect as of the date of adoption by the State Water Resources Control Board.

B. Waste Discharge Requirements

The Regional Boards may establish more restrictive water quality objectives and effluent quality requirements than those set forth in this Plan as necessary for the protection of beneficial uses of ocean* waters.

Regional Boards may impose alternative less restrictive provisions than those contained within Table B of the Plan, provided an applicant can demonstrate that:

Reasonable control technologies (including source control, material substitution. treatment and dispersion) will not provide for complete compliance; or

Any less stringent provisions would encourage water* reclamation;

Provided further that:

a) Any alternative water quality objectives shall be below the conservative estimate of chronic toxicity, as given in Table D below, and such alternative will provide for adequate protection of the marine environment;

b) A receiving water toxicity* objective of ~~0.05 tu~~ 1 TUc is not exceeded; and

c) The State Board grants an exception (Chapter VI.F.) to the Table B limits as

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* See Appendix I for definition of terms.

established in the Regional Board findings and alternative limits.

TABLE D
CONSERVATIVE ESTIMATES OF CHRONIC TOXICITY

Constituent	Estimate of Chronic Toxicity (ug/l)
Arsenic	19
Cadmium	8
Hexavalent Chromium	18
Copper	5
Lead	22
Mercury	0.4
Nickel	48
Silver	3
Zinc	51
Cyanide	10 ~~a)(see below)~~
Total Chlorine Residual	10.0
Ammonia	4,000.0
Phenolic Compounds (non-chlorinated)	a)(see below)
Chlorinated Phenolics	a)
Chlorinated Pesticides and PCB's	b)

a. There is insufficient data for ~~cyanide and~~ phenolics to estimate chronic toxicity levels. Requests for modification of water quality objectives for ~~any of these three~~ these waste* constituents must be supported by chronic toxicity data for representative sensitive species. In such cases, applicants seeking modification of water quality objectives should consult the Regional Water Quality Control Board to determine the species and test conditions necessary to evaluate chronic effects.

b. Limitations on chlorinated pesticides and PCB's shall not be modified so that the total of these compounds is increased above the limitations in Table B (6-Month Median = ~~0.022 ug/l~~ 31 ng/l, Daily Maximum = ~~0.044 ug/l~~ 62 ng/l, and Instantaneous Maximum = ~~0.066 ug/l~~ 93 ng/l).

C. Revision of Waste* Discharge Requirements

The Regional Board shall revise the waste* discharge requirements for existing discharges as necessary to achieve compliance with this Plan and shall also establish a time schedule for such compliance.

D. Monitoring Program

The Regional Boards shall require dischargers to conduct self-monitoring programs and

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* See Appendix I for definition of terms.

submit reports necessary to determine compliance with the waste* discharge requirements, and may require dischargers to contract with agencies or persons acceptable to the Regional Board to provide monitoring reports. Monitoring provisions contained in waste discharge requirements shall be in accordance with the Monitoring Procedures provided in Appendix II.

Where the Regional Board is satisfied that any substance(s) of Table B will not significantly occur in a discharger's effluent, the Regional Board may elect not to require monitoring for such substance(s), provided the discharger submits periodic certification that such substance(s) are not added to the waste* stream, and that no change has occurred in activities that could cause such substance(s) to be present in the waste* stream. Such election does not relieve the discharger from the requirement to meet the limitations of Table B.

The Regional Board may require monitoring of bioaccumulation of toxicants in the discharge zone. Organisms and techniques for such monitoring shall be chosen by the Regional Board on the basis of demonstrated value in waste* discharge monitoring.

E. Areas of Special Biological Significance

Areas of special biological significance shall be designated by the State Board after a public hearing by the Regional Board and review of its recommendations.

F. State Board Exceptions to Plan Requirements

The State Board may, in compliance with the California Environmental Quality Act, subsequent to a public hearing, and with the concurrence of the Environmental Protection Agency, grant exceptions where the Board determines:

1. The exception will not compromise protection of ocean* waters for beneficial uses, and

2. The public interest will be served.

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* See Appendix I for definition of terms.

APPENDIX I

DEFINITION OF TERMS

ACUTE TOXICITY

a. Acute Toxicity (TUa)

Expressed in Toxic Units Acute (TUa)

TUa = 100/96-hr LC 50%

b. Lethal Concentration 50% (LC 50)*

LC 50 (percent waste giving 50% survival of test organisms) shall be determined by static or continuous flow bioassay techniques using standard test species. If specific identifiable substances in wastewater can be demonstrated by the discharger as being rapidly rendered harmless upon discharge to the marine environment, but not as a result of dilution, the LC 50 may be determined after the test samples are adjusted to remove the influence of those substances.

When it is not possible to measure the 96-hour LC 50 due to greater than 50 percent survival of the test species in 100 percent waste, the toxicity concentration shall be calculated by the expression:

$$TUa = \frac{\log (100 - S)}{1.7}$$

S = percentage survival in 100% waste. If S > 99, TUa shall be reported as zero.

~~CHLORDANE AND RELATED COMPOUNDS shall mean the sum of chlordane (cis + trans), trans-nonachlor, oxychlordane, heptachlor and heptachlor epoxide.~~

CHLORDANE shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane.

CHRONIC TOXICITY: This parameter shall be used to measure the acceptability of waters for supporting a healthy marine biota until improved methods are developed to evaluate biological response.

a. Chronic Toxicity (TUc)

Expressed as Toxic Units Chronic (TUc)

TUc = 100/NOEL

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* See Appendix I for definition of terms.

b. No Observed Effect Level (NOEL)

The NOEL is expressed as the maximum percent effluent or receiving water that causes no observable effect on a test organism, as determined by the result of a critical life stage toxicity test listed in Appendix II.

~~DDT AND DERIVATIVES shall mean the sum of the p,p' and o,p' isomers of DDT, DDD (TDE) and DDE.~~

DDT shall mean the sum of 4,4'DDT, 2,4'DDT, 4,4'DDE, 2,4'DDE, 4,4'DDD, and 2,4'DDD.

DEGRADE: Degradation shall be determined by comparison of the waste field and reference site(s) for characteristics species diversity, population density, contamination, growth anomalies, debility, or supplanting of normal species by undesirable plant and animal species. Degradation occurs if there are significant differences in any of three major biotic groups, namely, demersal fish, benthic invertebrates, or attached algae. Other groups may be evaluated where benthic species are not affected, or are not the only ones affected.

DICHLOROBENZENES shall mean the sum of 1,2- and 1,3-dichlorobenzene.

ENCLOSED BAYS are indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

ENDOSULFAN shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

ESTUARIES AND COASTAL LAGOONS are waters at the mouths of streams which serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams which are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include but are not limited to the Sacramento-San Joaquin Delta as defined by Section 12220 of the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

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* See Appendix I for definition of terms.

HALOMETHANES shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, and dichlorobromomethane.

HEPTACHLOR shall mean the sum of heptachlor and heptachlor epoxide.

HCH shall mean the sum of the alpha, beta, gamma (lindane) and delta isomers of hexachlorocyclohexane.

INITIAL DILUTION is the process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge.

For a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from the submarine outfalls, the momentum of the discharge and its initial buoyancy act together to produce turbulent mixing. Initial dilution in this case is completed when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

For shallow water submerged discharges, surface discharges, and nonbuoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.

~~For the purpose of this Plan, minimum initial dilution is the lowest average initial dilution within any single month of the year. Dilution estimates shall be based on observed waste flow characteristics, observed receiving water density structure, and the assumption that no currents, of sufficient strength to influence the initial dilution process, flow across the discharge structure.~~

KELP BEDS, for purposes of the bacteriological standards of this plan, are significant aggregations of marine algae of the genera Macrocystis and Nereocystis. Kelp beds include the total foliage canopy of Macrocystis and Nereocystis plants throughout the water column.

MARICULTURE is the culture of plants and animals in marine waters independent of any pollution source.

MDL (Method Detection Limit) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR 136 Appendix B.

NATURAL LIGHT: Reduction of natural light may be determined by the Regional Board by measurement of light transmissivity or total irradiance, or both, according to the monitoring needs of the Regional Board.

OCEAN WATERS are the territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal

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* See Appendix I for definition of terms.

lagoons. If a discharge outside the territorial waters of the State could affect the quality of the waters of the State, the discharge may be regulated to assure no violation of the Ocean Plan will occur in ocean waters.

PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene and pyrene.

PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-1260.

PQL (Practical Quantitation Level) is the lowest concentration of a substance which can be consistently determined within +/- 20% of the true concentration by 75% of the labs tested in a performance evaluation study. Alternatively, if performance data are not available, the PQL* for carcinogens is the MDL* x 5, and for noncarcinogens is the MDL* x 10.

SHELLFISH are organisms identified by the California Department of Health Services as shellfish for public health purposes (i.e., mussels, clams and oysters).

SIGNIFICANT difference is defined as a statistically significant difference in the means of two distributions of sampling results at the 95 percent confidence level.

TCDD EQUIVALENTS shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown in the table below.

Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

* See Appendix I for definition of terms.

~~TOXICITY CONCENTRATION: This parameter shall be used to measure the acceptability of waters for supporting a healthy marine biota until improved methods are developed to evaluate biological response.~~

~~a. Toxicity Concentration~~

~~Expressed in Toxicity Units (tu)~~

~~$Tc\ (tu) = \frac{100}{96\text{-hr. TLm\%}}$~~

~~b. Median Tolerance Limit (TLm%)~~

~~TLm (percent waste giving 50% survival of test organisms) shall be determined by static or continuous flow bioassay techniques using standard test species. If specific identifiable substances in wastewater can be demonstrated by the discharger as being rapidly rendered harmless upon discharge to the marine environment, but not as a result of dilution, the TLm may be determined after the test samples are adjusted to remove the influence of those substances.~~

~~When it is not possible to measure the 96-hour TLm due to greater than 50 percent survival of the test species in 100 percent waste, the toxicity concentration shall be calculated by the expression:~~

~~$Tc\ (tu) = \frac{\log (100 - S)}{1.7}$~~

~~S = percentage survival in 100% waste. If S > 99, Tc shall be reported as zero.~~

WASTE: As used in this Plan, waste includes a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge.

WATER RECLAMATION: The treatment of wastewater to render it suitable for reuse, the transportation of treated wastewater to the place of use, and the actual use of treated wastewater for a direct beneficial use or controlled use that would not otherwise occur.

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* See Appendix I for definition of terms.

APPENDIX II

STANDARD MONITORING PROCEDURES

The purpose of this appendix is to provide direction to the Regional Boards on the implementation of the California Ocean Plan and to ensure the reporting of useful information. It is not feasible to cover all circumstances and conditions that could be encountered by all dischargers. Therefore, this appendix should be considered as the basic components of any discharger monitoring program. Regional Boards can deviate from the procedures required in the appendix only with the approval of the State Water Resources Control Board unless the Ocean Plan allows for the selection of alternate protocols by the Regional Boards. If no direction is given in this appendix for a specific provision of the Ocean Plan, it is within the discretion of the Regional Board to establish the monitoring requirements for the provision.

The appendix is organized in the same manner as the Ocean Plan.

Chapter II. A. Bacterial Standards:

For all bacterial analyses, sample dilutions should be performed so the range of values extends from 2 to 16,000. The detection methods used for each analysis shall be reported with the results of the analysis.

Detection methods used for coliforms (total and fecal) shall be those presented in the most recent edition of Standard Methods for the Examination of Water and Wastewater or any improved method determined by the Regional Board (and approved by EPA) to be appropriate.

Detection methods used for enterococcus shall be those presented in EPA publication EPA 600/4-85/076, Test Methods for Escherichia coli and Enterococci in Water By Membrane Filter Procedure or any improved method determined by the Regional Board to be appropriate.

Chapter IV. Table B. Compliance with Table B objectives:

Procedures, calibration techniques, and instrument/reagent specifications used to determine compliance with Table B shall conform to the requirements of federal regulations (40 CFR 136). All methods shall be specified in the monitoring requirement section of waste discharge requirements.

Where methods are not available in 40 CFR 136, the Regional Boards shall specify suitable analytical methods in waste discharge requirements. Acceptance of data should be predicated on demonstrated laboratory performance.

The State or Regional Board may, subject to EPA approval, specify test methods which are more sensitive than those specified in 40 CFR 136. Total chlorine residual is likely to be a method detection limit effluent requirement in many cases. The limit of detection of total chlorine residual in standard test methods is less than or equal to 20 ug/l.

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* See Appendix I for definition of terms.

Monitoring for the substances in Table B shall be required periodically. For discharges less than 1 MGD (million gallons per day), the monitoring of all the Table B parameters should consist of at least one complete scan of the Table B constituents one time in the life of the waste discharge requirements. For discharges between 1 and 10 MGD, the monitoring frequency shall be at least one complete scan of the Table B substances annually. Discharges greater than 10 MGD shall be required to monitor at least semiannually.

Chapter IV. Compliance with Toxicity Objectives:

Compliance with the acute toxicity objective (TUa) in Table A shall be determined using an established protocol, e.g., American Society for Testing Materials (ASTM), EPA, American Public Health Association, or State Board.

The Regional Board shall require the use of critical life stage toxicity tests specified in this Appendix to measure TUc. Other species or protocols will be added to the list after State Board review and approval. A minimum of three test species with approved test protocols shall be used to measure compliance with the toxicity objective. If possible, the test species shall include a fish, an invertebrate, and an aquatic plant. After a screening period, monitoring can be reduced to the most sensitive species. Dilution and control water should be obtained from an unaffected area of the receiving waters. The sensitivity of the test organisms to a reference toxicant shall be determined concurrently with each bioassay test and reported with the test results.

Use of critical life stage bioassay testing shall be included in waste discharge requirements as a monitoring requirement for all discharges greater than 100 MGD by January 1, 1991 at the latest. For other major dischargers, critical life stage bioassay testing shall be included as a monitoring requirement one year before the waste discharge requirement is scheduled for renewal date. For major dischargers scheduled for waste discharge requirements renewal less than one year after the adoption of the toxicity objective, critical life stage bioassay testing shall be included as a monitoring requirement at the same time as the chronic toxicity effluent limits is established in the waste discharge requirements.

The following tests shall be used to measure TUc. Other tests may be added to the list when approved by the State Board.

Species	Effect	Test Duration	Reference
red alga, Champia parvula	number of cystocarps	7-9 days	1
giant kelp, Macrocystis pyrifera	percent germination; germ tube length	48 hours	2
abalone, Haliotis rufescens	abnormal shell development	48 hours	2
oyster, Crassostrea gigas;	abnormal shell	48 hours	3

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* See Appendix I for definition of terms.

mussel, Mytilus edulis	development; percent survival		
urchins, Strongylocentrotus purpuratus, S. franciscanus; sand dollar, Dendraster excentricus	percent fertilization	1 hour	4
shrimp, Mysidopsis bahia	percent survival; growth; fecundity	7 days	1
silversides, Menidia beryllina	larval growth rate; percent survival	7 days	1

Bioassay References

1. Weber, C.I., W.B. Horning, II, D.J. Klemm, T.W. Neiheisel, P.A. Lewis, E.L. Robinson, J. Menkedick, and F. Kessler (eds.). 1988. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. EPA-600/4-87/028. National Technical Information Service, Springfield, VA.

2. Hunt, J.W., B.S. Anderson, S.L. Turpin, A.R. Conlon, M. Martin, F.H. Palmer, and J.J. Janik. 1989. Experimental Evaluation of Effluent Toxicity Testing Protocols with Giant Kelp, Mysids, Red Abalone, and Topsmelt. Marine Bioassay Project. Fourth Report. California State Water Resources Control Board, Sacramento.

3. American Society for Testing Materials (ASTM). 1987. Standard Practice for conducting static acute toxicity tests with larvae of four species of bivalve molluscs. Procedure E 724-80. ASTM, Philadelphia, PA.

4. Dinnel, P.J., J. Link, and Q. Stober. 1987. Improved methodology for sea urchin sperm cell bioassay for marine waters. Archives of Environmental Contamination and Toxicology 16: 23-32.

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* See Appendix I for definition of terms.

APPENDIX B

ENVIRONMENTAL CHECKLIST FORM

I. Background

1. Name of Proponent State Water Resources Control Board

2. Address and Phone Number of Proponent Division of Water Quality,
P.O. Box 944213, Sacramento, CA 94244-2130
(916) 322-4506 Craig J. Wilson, (Marine Water Standards Unit)

3. Date of Checklist Submitted July 14, 1989

4. Agency Requiring Checklist Resources Agency

5. Name of Proposal, if applicable: Amendment of the California Ocean Plan. Amendments are proposed for revisions of Table B, Addition of Substances to Table B, Addition of Objectives to protect fish consumption, new bacterial requirements, a new toxicity objective and bioassay protocols and implementation.

II. Environmental Impacts

(Explanations of all "yes" and "maybe" answers are required on attached sheets.)

	Yes	Maybe	No
1. Earth. Will the proposal result in:			
a. Unstable earth conditions or in changes in geologic substructures?	__	___	X
b. Disruptions, displacements, compaction or overcovering of the soil?	__	___	X
c. Change in topography or ground surface relief features?	__	___	X
d. The destruction, covering or modification of any unique geologic or physical features?	__	___	X
e. Any increase in wind or water erosion of soils, either on or off the site?	__	___	X

	Yes	Maybe	No
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?	__	___	X
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?	__	___	X
2. Air. Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?	__	___	X
b. The creation of objectionable odors?	__	___	X
c. Alteration of air movement, moisture, or temperature, or any change in climate, either local or regionally?	__	___	X
3. Water. Will the proposal result in:			
a. Changes in currents, or the course of direction of water movements, in either marine or fresh waters?	__	___	X
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?	__	___	X
c. Alterations to the course or flow of flood waters?	__	___	X
d. Change in the amount of surface water in any water body?	__	___	X
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?	__	___	X
f. Alteration of the direction or rate of flow of ground waters?	__	___	X

	Yes	Maybe	No
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?	__	___	X
h. Substantial reduction in the amount of water otherwise available for public water supplies?	__	___	X
i. Exposure of people or property to water related hazards such as flooding or tidal waves?	__	___	X
4. Plant Life. Will the proposal result in:			
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?	__	___	X
b. Reduction of the numbers of any unique, rare or endangered species of plants?	__	___	X
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?	__	___	X
d. Reduction in acreage of any agricultural crop?	__	___	X
5. Animal Life. Will the proposal result in:			
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)?	__	___	X
b. Reduction of the numbers of any unique, rare or endangered species of animals?	__	___	X
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?	__	___	X
d. Deterioration to existing fish or wildlife habitat?	__	___	X

	Yes	Maybe	No
6. Noise. Will the proposal result in:			
a. Increases in existing noise levels?	—	—	X
b. Exposure of people to severe noise levels?	—	—	X
7. Light and Glare. Will the proposal produce new light or glare?	—	—	X
8. Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?	—	—	X
9. Natural Resources. Will the proposal result in:			
a. Increase in the rate of use of any natural resources?	—	—	X
b. Substantial depletion of any nonrenewable natural resource?	—	—	X
10. Risk of Upset. Will the proposal involve:			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	—	—	X
b. Possible interference with an emergency response plan or an emergency evacuation plan?	—	—	X
11. Population. Will the proposal alter the location distribution, density, or growth rate of the human population of an area?	—	—	X
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?	—	—	X
13. Transportation/Circulation. Will the proposal result in:			
a. Generation of substantial additional vehicular movement?	—	—	X

	Yes	Maybe	No
b. Effects on existing parking facilities, or demand for new parking?	__	___	X
c. Substantial impact upon existing transportation systems?	__	___	X
d. Alterations to present patterns of circulation or movement of people and/or goods?	__	___	X
e. Alterations to waterborne, rail or air traffic?	__	___	X
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	__	___	X
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following area:			
a. Fire protection?	__	___	X
b. Police protection?	__	___	X
c. Schools?	__	___	X
d. Parks or other recreational facilities?	__	___	X
e. Maintenance of public facilities, including roads?	__	___	X
f. Other governmental services?	__	___	X
15. Energy. Will the proposal result in:			
a. Use of substantial amounts of fuel or energy?	__	___	X
b. Substantial increase in demand upon existing sources or energy, or require the development of new sources of energy?	__	___	X
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:			
a. Power of natural gas?	__	___	X

	Yes	Maybe	No
b. Communications systems?	__	__	X
c. Water?	__	__	X
d. Sewer or septic tanks?	__	__	X
e. Storm water drainage?	__	X	-
f. Solid waste and disposal?	__	__	X
17. Human Health. Will the proposal result in:			
a. Creation of any health hazard or potential health hazard (excluding mental health)?	__	__	X
b. Exposure of people to potential health hazards?	__	__	X
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?	__	__	X
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	__	__	X
20. Cultural Resources.			
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site?	__	__	X
b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?	__	__	X
c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?	__	__	X
d. Will the proposal restrict existing religious or sacred uses within the potential impact area?	__	__	X

	Yes	Maybe	No
21. Mandatory Findings of Significance.			
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	—	—	X
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	—	—	X
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	—	—	X
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	—	—	X

III. Discussion of Environmental Evaluation
(See main body of report.)

IV. Determination

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment, and a FUNCTIONAL EQUIVALENT DOCUMENT equivalent to a NEGATIVE DECLARATION will be prepared. X

I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A NEGATIVE DECLARATION WILL BE PREPARED. ___

I find the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required. ___

Date

Signature

For the State Water Resources Control Board

16e: We were not able to make an assessment of the impact the proposed objectives would have on stormwater or other nonpoint source pollutant inputs to the marine environment. The information to make this assessment specifically is not available.

STATE WATER RESOURCES CONTROL BOARD
P. O. Box 100, Sacramento, CA 95801

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

REGION 5 - Redding Branch Office
415 Knollcrest Drive
Redding, CA 96002
(916) 224-4845

LAHONTAN REGION (6)
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South Lake Tahoe, CA 95731-2428
(916) 544-3481

NORTH COAST REGION (1)
1440 Guerneville Road
Santa Rosa, CA 95403
(707) 576-2220

CENTRAL VALLEY REGION (5)
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
(916) 361-5600

SAN FRANCISCO BAY REGION (2)
1800 Harrison Street,
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Oakland, CA 94612
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REGION 5 - Fresno Branch Office
3614 East Ashlan Ave.
Fresno, CA 93726
(209) 445-5116

REGION 6 - Victorville Branch Office
Civic Plaza
15428 Civic Drive, Suite 100
Victorville, CA 92392-2359
(619) 241-6583

CENTRAL COAST REGION (3)
1102-A Laurel Lane
San Luis Obispo, CA 93401
(805) 549-3147

LOS ANGELES REGION (4)
101 Centre Plaza Drive
Monterey Park, CA 91754-2156
(213) 266-7500

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