DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
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Ser BPMOW.mgd/0223
December 27, 2006

Ms. Chehreh Komeylyan
Remedial Project Manager
San Diego Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA. 92123-4340

SUBJECT: RESPONSE TO COMMENTS ON THE OCTOBER 2003 FINAL REMEDIAL INVESTIGATION REPORT FOR IR SITE 12, THE BOAT CHANNEL, FORMER NAVAL TRAINING CENTER, SAN DIEGO, CALIFORNIA.

Dear Ms. Komeylyan:

Enclosed are the Navy's Responses to the San Diego Regional Water Quality Control Board (RWQCB) Comments dated April 20, 2004, regarding the Final Remedial Investigation (RI) Report for IR Site 12 (October 2003), the Boat Channel, Former Naval Training Center, San Diego, California. Thank you again for our meeting in July to discuss the boat channel. Since that time and your resubmission of comments regarding the Navy's RI document, we have been working diligently to prepare thorough responses based on our meeting and applicable and available sediment guidance. To that end, we have utilized U.S. EPA Guidance and several peer reviewed technical papers to ensure our responses to your comments are sound.

The accompanying attachments support a two-part evaluation of elevated sediment chemistry when the reference level indicating a potential release, and one of the sediment quality benchmarks are both elevated. This decision is based on the most relevant U.S. EPA Guidance "Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern." This Guidance states "problematic levels of contamination are indicated when sediment-associated contaminants are present at concentrations above one or more of the various sediment quality targets and above background levels." Utilizing this framework and the three criteria of sediment toxicity, potentially degraded benthic community, and potential risk to wildlife, the Navy has identified eight areas of ecological concern in the northern portion of the Boat Channel. These areas include four areas of primary ecological concern (S1S1, S1S4, S1S6 and S1S8) and four areas of moderate concern (S1S2, S1S5, S1S7 and S1S9).

I would like to propose a collaborative technical meeting on January 23rd, 2006 to discuss all relevant technical issues regarding our responses to your comments.

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We are very optimistic that our responses to your comments and a subsequent technical partnering session will yield a path forward for the remediation of the Boat Channel.

Should you have questions or need additional information, please contact Ms. Marie Dreyer, Remedial Project Manager, at (619) 532-0904 or myself at (619) 532-0963.

Sincerely,

DARREN NEWTON
BRAC Environmental Coordinator
By direction of the Director

Enclosure: 1. Response to Comments on the October 2003 Final Remedial Investigation Report for IR Site 12, the Boat Channel, Former Naval Training Center, San Diego, California. Dated December 27, 2006.

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DRAFT RESPONSE TO COMMENTS ON THE OCTOBER 2003
FINAL REMEDIAL INVESTIGATION REPORT FOR IR SITE 12, THE BOAT CHANNEL
FORMER NAVAL TRAINING CENTER, SAN DIEGO, CALIFORNIA

Comments by: Chehreh Sherrie Komeylyan, Water Resource Control Engineer California Regional Water Quality Control Board San Diego Region **Dated:** April 20, 2004 **Responses from:** Darren Newton, BRAC Environmental Coordinator BRAC PMO West Marie Dreyer, Remedial Project Manager BRAC PMO West **Dated:** December 27, 2006	**CLEAN 3 Program** **Contract No. N68-711-95-D-7526** **CTO-0001** **File Code: 0232**
GENERAL COMMENTS	*RESPONSES TO GENERAL COMMENTS*
A. REFERENCE STATIONS None.	
B. SEDIMENT CHEMISTRY	
COMMENT 1. The Navy used the 95% upper predictive limit (UPL) of the five reference stations as the background reference value for sediment chemistry evaluation of the Boat Channel stations. On the other hand, the Navy used the 95% upper confidence limit (UCL) of the reference station pools for toxicity and other assessments. As stated in Comment No. 13 of RWQCB's May 13, 2003 letter, the agencies required Navy to use the 95% UCL for all assessments. This is based on the fact that the number of reference stations is insufficient to provide meaningful statistics, and the use of 95% UPL can exaggerate background conditions resulting in less environmental protection. The 95% UCL (5% significance one-tail test) is a more conservative approach where the number of reference stations is small. The Navy should have used the 95% UCL in all calculations for the Boat Channel sediment investigation. Please note that, staff has applied both 95% UCL and 95% UPL criteria for Boat Channel stations, the results showed that all	**RESPONSE 1:** Per agency request, the 95 percent upper confidence limit (UCL) of the arithmetic mean (95% UCL) will be used in the calculations for the Boat Channel investigation (see Attachment 1 Table 1).

stations have elevated sediment chemistry even using the 95% UPL criterion (see Table 1, Summary of Boat Channel Sediment Chemistry).	
COMMENT 2. The Navy normalized metals to percent fines, and organic chemicals to percent total organic carbon (TOC), and used such normalized data to compare with similarly normalized 95% UPL reference values. This approach is inappropriate because all five reference stations have low percent fines, and TOC, yet most Boat Channel stations contain a high percentage of fines and TOC. To make such a comparison sound, a reference baseline (slope) must be established based on clean reference locations with a wide range of percent fines and TOC, so that the variability of percent fines and TOC of reference stations is accounted for during calculations. Without a calibration between two variables (percent fine and TOC vs. normalized reference values), any comparison would be incorrect and inaccurate. Until such calibration is available, the Navy should have used measured concentrations for all calculations. Staff has re-calculated the mean ratio of sediment chemistry using measured values of heavy metals, organotins, total PCBs, total PAHs, and total chlordane. All Boat Channel sampling stations have elevated sediment chemistry (mean ratio >1) using both 95% UCL and 95% UPL criteria. Total PAHs are normalized to TOC and compared to the consensus-based Threshold Effect Concentration value of 290 ug/g. Table 1, Summary of Boat Channel Sediment Chemistry also listed results of other sediment evaluation criteria as discussed in Comment No. 15 and 17 of RWQCB's May 13, 2003 letter. **NOTE: RWQCB Table 1 is reproduced in this column at the end of this response to comments matrix.**	**RESPONSE 2:** Per agency request, the normalized sediment chemistry data will not be used to make decisions regarding the Former Naval Training Center (NTC) Boat Channel Investigation. In an effort to incorporate comments received and U.S. EPA framework, the Navy has revised the Boat Channel sediment evaluation. A condition of elevated sediment chemical concentrations is identified when one of the chemical concentrations exceeds the reference threshold (95% UCL) as well as one or more of the selected sediment quality guidelines. U.S. EPA's Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern (U.S. EPA 2000a) states "Problematic levels of contamination are indicated when sediment-associated contaminants are present at concentrations above one or more of the various SQTs (sediment quality target) and above background levels." This two-part evaluation identifies chemicals at a station as elevated when the reference level indicating potential releases and sediment quality benchmarks are elevated, thus indicating a potential to elicit adverse biological effects (U.S. EPA 2000a). A summary of the sediment chemistry line of evidence is presented in Attachment 1 Table 1.
COMMENT 3. As indicated in Table 2 – Summary of Station Locations Exceeding Two or More Criteria, based on RWQCB re-calculation results, six stations (S2S2, S2S9, S2S10, S2S12, S2S14, and S2S16) in the southern portion of the boat channel are re-categorized as potential AOEC. **NOTE: RWQCB Table 2 is reproduced in this column at the end of this response to comments matrix.**	**RESPONSE 3:** As noted in the response to comment 2, the Navy has revised the Boat Channel sediment evaluation such that a condition of elevated sediment chemical concentrations is identified when one of the chemical concentrations exceeds the reference threshold (95% UCL of the reference station chemistry) as well as one or more of the selected sediment quality guidelines. U.S. EPA's Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern (U.S. EPA 2000a) states that "Problematic levels of contamination are

	indicated when sediment-associated contaminants are present at concentrations above one or more of the various SQTs (sediment quality target) and above background levels." This two-part evaluation identifies chemicals at a station that are both elevated compared to the reference level indicating potential releases as well as elevated compared to sediment quality benchmarks indicating potential to elicit adverse biological effects (U.S. EPA 2000a). As a result of the incorporation of this consensus-based approach, stations S2S2, S2S9, S2S10, S2S12, S2S14, and S2S16 are not identified as having elevated chemistry and therefore do not meet criteria for a potential AOEC. A summary of the sediment chemistry line of evidence is presented in Attachement 1 Table 1. Identification of AOECs is provided in Attachment 3 Table 2.
C. SEDIMENT TOXICITY	
COMMENT 4. Section 6.1.13, Page A6-10, Paragraph 3 and Appendix H of the RI Report: It is not clear how statistical analyses were performed. ANOVAs for amphipod survival and echinoderm development are missing. Please clarify the statistical methods described for data analysis. If parametric or non-parametric methods are used, please demonstrate how they are appropriate.	**RESPONSE 4:** Statistical methods used to analyze the toxicity data are described on Page 5 of Appendix H of the October 2003 Final RI report as follows: "Statistical comparisons of endpoint data from negative control or "reference" exposures with data from test sediments or porewaters were made using the EPA-derived TOXSTAT software. Data sets were evaluated for normality (Shapiro-Wilks Test) and for homogeniety of variance (Bartlett's Test, Hartley's Test or Cochran's Test). When data were found to be both normal and homogeneous, data were analyzed using the parametric ANOVA followed by Dunnett's Multiple Comparison Test or Bonferroni's t-Test to identify data sets that differed significantly. In the few instances where data were either non-normal and /or non-homogeneous, comparisons were made using the non-parametric Steel's Many-One Rank Test. This approach was followed for evaluation of amphipod survival and reburial data, for comparing echinoderm development data from undiluted porewaters, and for determination of development no observed effects concentration (NOEC) and lowest observed effects concentration (LOEC) values within dilution series' for each porewater sample." The normality and homogeneity tests were performed by the laboratory subcontractor in 1998 and the detailed results, including the ANOVA tables, were not provided to the Navy.
COMMENT 5. Amphipod bioassay results (Section 6.4.1.1) showed that	**RESPONSE 5:** Per agency request, and the small difference between the

station S1S1 had 66% survival rate, which met all three criteria for sediment toxicity because the result is: a) Significantly different from laboratory negative controls ($p<0.05$); b) Less than MSD threshold (77% of laboratory negative control); and c) Less than 95% LCL of 75.9 Yet, this station is categorized non-toxic by the Navy citing grain size confounding effect. Staff believes that this screening step is not appropriate based on the following facts: a) The grain size effect on toxicity test was not discussed or agreed upon between the regulatory agencies and the Navy; b) Even using the protocol developed by DeWitt et al. (1988) as cited by the Navy, the station's predicted survival rate of 73.8% is still significantly higher than the observed 66% survival rate; c) The Navy uses 95% lower predictive limit (LPL) of 65.9% to screen out the station. As discussed in Comment No. 1 above, a 95% LPL is less protective to the environment and underestimates the environmental impact at this station; d) The 65.9% LPL value is practically no different from the observed 66% value in consideration of laboratory and mathematical errors. The Navy should have re-categorized Station S1S1 as having sediment toxicity.	observed survival (66.0 percent) and the threshold suggested by DeWitt et al. (1988) (65.9 percent), and the proximity of Station S1S1 to other locations that reported toxicity to amphipod survival, Station S1S1 will be recategorized as reporting toxicity to amphipod survival.
COMMENT 6. Results of the 12.5% pore water sea urchin larval development bioassay (Section 6.4.1.2) showed that Station S1S8 had a 33.3% developmental rate, which met all three criteria for sediment toxicity because the result is: a) Significantly different from laboratory negative controls ($p<0.05$); b) Less than MSD threshold; and c) Less than 95% LCL of 74.3% Yet, this station is not considered toxic by the Navy citing that this station performed well in the 25% and 50% pore water tests. Staff	**RESPONSE 6:** Per agency request, Station S1S8 will be recategorized to indicate toxicity to sea urchin larval development.

believes that this statement is inconsistent with Navy's contention that confounding interference from ammonia exists at higher percent pore water testing, and the fact that the same station performed poorly at 75% and 100% pore water tests. The Navy suggested 12.5% pore water results for sea urchin larval development test since the reference stations performed well at this concentration level. It is implied that the results from this 12.5% pore water test is most reliable. Although the cause for the discrepancy between the 12.5% and 25%, 50% pore water results is unclear, the Navy should not discard any results from the 12.5% pore water test. The Navy should have re-categorized Station S1S8 as having sediment toxicity.	
COMMENT 7. The pore water at the following stations exceeds the California Toxics Rule (CTR) Water Quality Criteria for chronic copper exposure (3.1 ppb): S1S4, S1S5, S1S9, S2S11, and S2S16. The CTR criteria for chronic lead exposure (8.1 ppb) is exceeded at S1S4, S1S5, and S2S11. The CTR criteria for DDD chronic exposure, 0.001 ppb, and chlordane chronic exposure, 0.004 ppb, is exceeded at S1S4. Exceedance of these concentrations in pore water is important because this is the fraction of water to which organisms that live in the sediments are exposed. Any exceedance of water quality criteria, especially given the questionable results of some of the testing, should trigger further evaluation.	**RESPONSE 7:** The Navy does not agree with the comparison of the CTR criteria to porewater as an indicator of sediment toxicity because of the following: • CTR criteria were developed with and for surface water data (U.S. EPA 2000c), and are not applicable to porewater; and • Toxicity tests using both bulk sediment and porewater were performed for the Boat Channel stations. The results of these laboratory bioassay tests are more appropriate measures of toxicity for this baseline assessment because they are more site-specific measurement endpoints (U.S. EPA 1997). The results of toxicity tests performed for stations S1S9, S2S11, and S2S16 do not indicate toxicity and therefore these stations will not be recategorized.
COMMENT 8. As indicated in Table 2 the Navy should have re-categorized Station S1S1 as an AOEC and Stations S1S8, S1S9, S2S11, and S2S16 as potential AOEC.	**RESPONSE 8:** As described in response to comments 5 and 6, Station S1S1 and S1S8 will be recategorized to indicate sediment toxicity. As a result stations S1S1 and S1S8 are recategorized as AOECs. However, the bioassay results for Stations S1S9, S2S11, and S2S16 do not indicate toxicity and therefore these stations will not be recategorized as AOECs.. Identification of AOECs is provided in Attachment 3 Table 2.
D. BENTHIC COMMUNITY	
COMMENT 9. The Navy should discuss how the Benthic Response Index (BRI) values were derived with supporting calculations.	**RESPONSE 9:** A discussion of the Benthic Response Index (BRI) is presented in Attachment 2 to these responses. A statement indicating that the Margalef diversity values at stations S2S2,

Section 6.1.4, PA6-33, Diversity Indices, Margalef's Diversity. For completeness, it would be helpful to include the information that the Margalef diversity at stations S2S2, S2S10, and S2S11 were lower that the minimum reference value.	S2S10, and S2S11 were lower that the minimum reference value will be provided in any further documentation.
COMMENT 10. Station S2S3 has a Benthic Response Index value of 42, and should be categorized as having degraded benthic community. The Navy shall therefore re-categorize Station S2S3 as a potential AOEC as indicated in Table 2.	**RESPONSE 10:** U.S. EPA's Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance (U.S. EPA 2000b) states "Because of varying sensitivities of the community indexes, several of them should be used concurrently for evaluating impacts. This approach provides greater certainty of the data interpretation than reliance on any single index." Therefore, the Navy has revised the Former NTC Boat Channel sediment evaluation such that a degraded benthic community is indicated by a "hit" from any two of four benthic community assessment indices; the BRI, the Relative Benthic Index (RBI) (Fairey et al. 1996, 1998), cluster analysis, and the Index of Biotic Integrity (IBI). These benthic community assessment indices are selected because they are common indicators used in regional sediment studies. Single hits are not considered indicative of a degraded benthic community. The revised benthic community evaluation is presented in Attachment 2. A summary of stations indicating a degraded benthic community (on the basis of the recommended consensus approach) is presented in Table A2-5 of Attachment 2. The October 2003 Final RI Report identified four stations (S1S1, S1S4, S1S6 and S1S7) as indicating a degraded benthic community. The revised benthic community evaluation presented in Attachment 2 identifies eight stations (S1S1, S1S2, S1S4, S1S6, S1S7, S1S8, S1S9 and S2S6) as indicating a degraded benthic community. S2S3 was not recategorized as indicating a degraded benthic community. Identification of AOECs is provided in Attachment 3 Table 2.
E. BIOACCUMULATION	
COMMENT 11. The Navy used a "refined" biota-sediment accumulation factor (BSAF) to calculate clam tissue concentrations where no direct measurements were obtained. Such refined BSAF values were obtained based on a regression line between logarithm concentrations of clam and sediment data. Using the maximum BSAF values derived from Boat	**RESPONSE 11:** The requested hazard quotients (HQs) based on the maximum biota-sediment accumulation factor (BSAF) are presented in Tables 6-58 through 6-62 of the October 2003 Final RI Report. Both the maximum observed BSAF and the 95 percent UPL of the regression are conservative estimates of the BSAF, which are appropriate for a screening-level ERA. The

Channel sampling stations, 10 stations (Tables 6-61 & 62) had calculated lead hazard quotients (HQ) exceeding 1 for Surf Scoter and Lesser Scaup; while using the refined BSAF, only 2 stations (Table 6-63) exceeded 1 for Surf Scoter and Lesser Scaup, respectively. Although there is merit to the regression approach, staff believes that the regression method is subject to a larger error due to a logarithm regression, and underestimates the environmental hazard to wildlife. The Navy should use either the 95% UPL (n=15) of the regression, or the maximum BSAF value to recalculate HQ values.	regression-based estimate is appropriate for a baseline evaluation and will be retained in the risk calculations.
COMMENT 12. The justification used by the Navy for using alternative toxicological benchmarks for Surf Scoter and Lesser Scaup in ecological risk assessments is not acceptable. Consistent with the review of other military sites, it is recommended that the Navy use toxicity reference values (TRVs) that have been developed for mammalian and avian receptors by the Navy and the U.S. EPA Region 9 Biological Technical Advisory Group (DON/BTAG). These TRVs were developed in a consensus process that involved the Navy, and should be thought of as a standard. New data shall be presented and evaluated in a consensus process in order to change the TRVs. Until this process has been completed the original TRV's shall be used. Therefore, the use of an alternative TRV of 0.25 mg/kg-day for lead at Site 12 is not acceptable. Current DON/BTAG lead TRVs for mammals and birds are 1 mg/kg-day and 0.014 mg/kg-day, respectively. The Avian lead HQs may be refined by including the relative absorption of the different types of lead and estimation of an ingested dose.	**RESPONSE 12:** Per agency request the Navy will not use the alternate toxicity reference value (TRV) presented in the October 2003 Final RI report to evaluate the risk. The NOAEL-based (no-observed-adverse-effect-level) and LOAEL-based (lowest-observed-adverse-effect-level) Navy/BTAG TRVs (TRV_{low} and TRV_{high}, respectively) (EFA-West 1998) and the NOAEL-based U.S. EPA TRV will be used to evaluate the risk. The Navy/BTAG TRV_{low} are presented in Tables 6-50 and 6-51 and were used to calculate HQs shown in Tables 6-58 through 6-62. In addition to the avian Navy/BTAG TRV_{low} for lead (0.014 mg/kg-day), the Navy/BTAG TRV_{high} (8.75 mg/kg-day) and the U.S. EPA TRV (1.63 mg/kg-day) (U.S EPA 2005) will be used to evaluate the risk. HQ_{low} values greater than one will be used to categorize stations as potential AOECs. Although HQ_{low} values were reported for several Boat Channel stations in the range of 1 to 3, HQ_{high} and HQ_{EPA} are less than one and therefore these stations are considered to represent minor potential for ecological risk.
F. WILDLIFE EXPOSURE ESTIMATES	
COMMENT 13. Table 6-24 provides assumptions and parameters used in the risk assessment. The following comments apply to these assumption and parameters used by the Navy:	**RESPONSE 13:**
a) Section 4.5.1, PA4-14, Paragraph 2: Since the first sentence mentions ecosystems at the Boat Channel, it would be helpful to restate that demersal fish are the primary receptors in the conceptual model because sediment is the main exposure medium. More consideration should have been given to a possible pathway from	Potential risk to endangered birds was evaluated in two efforts. The first effort considered endangered birds consuming topsmelt, which was considered representative of surface-dwelling fish (Table 6-57 of the October 2003 Final RI Report). The second effort considered endangered birds consuming clams, which can be considered representative of benthic-dwelling fish (Section

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sediments through surface-dwelling fish to endangered birds.	6.5.2.2 of the October 2003 Final RI Report). The conceptual site model will be clarified in any further documentation.
b) Section 5.3, PA5-114, Paragraphs 3 & 4: Additional exposure information is needed. What are the assumed exposure frequency and exposure duration?	Exposure frequency and exposure duration are two aspects of exposure that are integrated in the site use factor (SUF). The SUFs are presented in Table 5-25 of the October 2003 Final RI Report.
c) Section 8.2.3, PA8-69: The "dose" of the wildlife was not conservative because mean values were used for the BW and IR. Please discuss these in the uncertainty analysis. Also, please discuss the effect of assumptions of exposure duration on the uncertainty.	The exposure estimate (dose) was not designed as the most conservative estimate possible. The exposure dose was intended to include some site-specific information to make it more representative of site conditions than the most conservative estimate. Mean values were selected instead of minimum values for the body weight of a receptor. Use of mean values is likely to have equivalent potential to under-estimate or over-estimate the exposure. The ingestion rates were selected as the mean presented in *Wildlife Exposure Factors Handbook* (U.S. EPA 1993), or the predicted value based on the allometric equations presented in Nagy (1987) or Kushlan (1978). The ingestion rate estimates are likely to have equivalent potential to over-estimate or under-estimate the exposure. The exposure estimate calculation did not include an "exposure duration" factor (Cal-EPA 1996). Additional uncertainty discussion will be added to any further documentation.
d) The Site Use Factors (SUFs) used by the Navy are too low. The USEPA cited 1.8 km to 22 km as a home range is a generic number and does not consider whether a population is resident, or whether an easily available food supply is existent near by. The DON only used the large home range to determine the SUFs. The Navy should perform a screening step using a SUF value of 1.	The SUF was estimated with a mean home range value when multiple estimates were available or a single value if only one home range value was found (Table 6-24 of the October 2003 Final RI Report). The Navy did not preferentially use a large home range. Using a SUF value of 1 assumes that the representative receptor takes all of its food from the site with out foraging anywhere else and is suitable for a screening step. However, SUFs that are more representative of site-specific receptor exposure conditions, as presented in the October 2003 Final RI Report, will be used in the decision making process. Therefore, performance of a screening step is not appropriate for this Baseline ERA.
e) For Lesser Scaup and Surf Scoter, 1 ha is assumed for a single station. At least 13 stations have lead HQ>1 using the maximum BSAF. The Navy should add all stations in the calculations and use SUF value of 1 and the 95% UCL for the ducks.	HQs were prepared for individual stations in response to Regional Board comments of May 13, 2005. The Navy agrees that potential risk to receptors with home ranges larger than the Boat Channel such as the lesser scaup and surf scoter are best assessed with an exposure estimate that integrates exposure for these receptors for the entire Boat Channel. As requested in the comment, the following describes the potential risk based

on the integrated exposure using lead exposure for the surf scoter as an example.

HQs are presented here for the surf scoter based on 1) exposure from the Boat Channel represented by the 95% UCL concentration and 2) exposure from the reference area represented by the reference 95% UCL concentration.

The 95% UCL of the mean lead concentration reported from the clam bioaccumulation tests at the 10 Boat Channel stations is 7.02 mg/kg (wet). The 95% UCL of the mean lead concentration reported from the clam bioaccumulation tests at the 5 reference stations is 3.01 mg/kg (wet). HQs using the Navy/BTAG TRV_{low}, the Navy BTAG TRV_{high}, and the EPA TRV are presented below for the surf scoter, using 0.214 kg/kg-day ingestion rate, 23.23 ha site area, and 95 ha home range.

Location	HQ_{Low}	HQ_{High}	HQ_{EPA}
Boat Channel	61	0.098	0.53
Reference	46	0.074	0.40

Most (75 percent) of the potential hazard noted for the Boat Channel is represented by the reference conditions. Since the HQs based on the other screening-level TRVs (TRV_{High} 8.75 mg/kg-day and EPA TRV 1.6 mg/kg-day) are less than 1 and the HQ_{Low} for the Boat Channel is only a factor of 1.3 greater than the reference, the clam-lead concentrations are not considered to warrant further investigation.

f) The body weight for the following shall be adjusted.

	Body Weight Used	Revised Value
Harbor Seal	80.55 kg	99 kg
Lesser Scaup	1	0.647 kg

The ingestion rates for the following shall be adjusted:

	Ingestion Rate Used In Current Document	Revised Value

The body weight and ingestion rate values shown in the comment may be appropriate for a screening-level ecological risk assessment (ERA), but are not appropriate for a baseline ERA. If further calculations are conducted the equations of Nagy (2001) will be used.

Harbor Seal 0.07 0.10 CA Least Term 0.535 0.79 Pelican 0.149 0.29 Scaup 0.195 0.349 The appropriate ingestion rates for the heron and scoter shall also be calculated using Nagy 2001.	
COMMENT 14. The Navy should provide a revised matrix table for the following parameters: chemistry, toxicity, benthic, and bioaccumulation/wildlife for all stations.	**RESPONSE 14:** A revised matrix table is presented in Attachment 3 Table 1. Sediment Chemistry: As discussed in response to comment 2, the Navy has revised the Boat Channel sediment evaluation such that a condition of elevated sediment chemical concentrations is identified when one of the chemical concentrations exceeds the reference threshold (95% UCL) as well as one or more of the selected sediment quality guidelines. U.S. EPA's Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern (U.S. EPA 2000a) states that "Problematic levels of contamination are indicated when sediment-associated contaminants are present at concentrations above one or more of the various SQTs (sediment quality target) and above background levels." This two-part evaluation identifies chemicals at a station that are both elevated compared to the reference level indicating potential releases as well as elevated compared to sediment quality benchmarks indicating potential to elicit adverse biological effects (U.S. EPA 2000a). Toxicity: As noted in response to comments 5 and 6 stations S1S1 and S1S8 have been rectaegorized as indicating toxicity. However, the bioassay results for Stations S1S9, S2S11, and S2S16 do not indicate toxicity and therefore these stations will not be recategorized as AOECs. Benthic Community Assessment: As discussed in response to comment 10, U.S. EPA 2000b states "Because of varying sensitivities of the community indexes, several of them should be used concurrently for evaluating impacts. This approach provides greater certainty of the data interpretation than reliance on any single index." Therefore, the Navy has revised the Former NTC Boat Channel sediment evaluation such that a degraded benthic community is indicated by a "hit" from any two of four benthic community assessment indices; the BRI, the RBI, cluster analysis, and the IBI. These benthic community assessment indices are selected because they are common indicators

	used in regional sediment studies. Single hits are not considered indicative of a degraded benthic community.
G. HUMAN HEALTH RISK ASSESSMENT	
COMMENT 15. Tables 5-36 and 5-37 Fish Data: Mercury effects concentrations in spotted sand bass exceeds the human health consumption advisory of 0.3 ppb wet weight for all trawls conducted in the channel. The barred sand bass concentration of mercury exceeds the NOAEL (no effects concentrations) of 0.15 ppm wet weight for fish at FT01, FT03, and FT06. The trawls were conducted between sampling locations S2S8 and S2S11. Based on this data the Navy should have re-categorized Stations S2S9, S2S10, and S2S11 as potential AOEC.	**RESPONSE 15:** It is acknowledged that the tissue concentrations of mercury in the spotted sand bass exceed the human health national guideline of 0.3 ppb (fresh weight). However, a site specific evaluation of human health risk was presented in Section 7 of the October 2003 Final RI Report, concluding that human health risk related to ingestion of fish from the Boat Channel was not different than health risk related to ingestion of fish from San Diego Bay. The fish tissue data from the trawls collected in the Boat Channel were intended to be applicable to all of the Boat Channel, not specific stations. These data were evaluated through the ecological risk assessment and the human health risk assessment. Therefore, it is inappropriate to categorize certain stations based on the listed thresholds.
	References: California Environmental Protection Agency. 1996a. Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Part A: Overview. State of California, California Environmental Protection Agency, Department of Toxic Substances Control. 04 July. DeWitt, T.H., G.R. Ditsworth, and R.C. Swartz. 1988. Effects of natural sediment features on survival of the phoxocephalid amphipod *R. abronius*. *Marine Environmental Research. 25*: 99–124. EFA-West. See Engineering Field Activity, West. Engineering Field Activity, West. 1998. Development of Toxicity Reference Values for Conducting Ecological Risk Assessment at Naval Facilities in California, Interim Final. Engineering Field Activity, West, Naval Facilities Engineering Command, United States Navy, San Bruno, California. Kushlan, J.A. 1978. Feeding ecology of wading birds. In: *Wading Birds: Research Report No 7*, ed. A. Sprunt, J. Ogden, S. Winckler, 249–296. New York: National Audubon Society. Nagy, K.A. 1987. Field metabolic rate and food requirement scaling in

mammals and birds. *Ecological Monographs. 57*(2):111–128.

Nagy, K. A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews. 71:21–33.

National Oceanic and Atmospheric Administration. 1999. Sediment Quality Guidelines developed for the National Status and Trends Program. 12 June.

U.S. EPA. 1993. Wildlife Exposure Factors Handbook. Volume 1. EPA/600/R-93/187a. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. December.

U.S. EPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. EPA/540/R-97/006. OSWER 9285.7-25. June.

U.S. EPA. 2000a. Development of a Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern. EPA 905-R-00-008. U.S. Environmental Protection Agency. Great Lakes National Program Office. Chicago, IL.

U.S. EPA. 2000b. Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance. EPA-822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, DC. December.

U.S. EPA. 2000c. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. 65 Federal Register 31682, Thursday, 18 May. (California Toxics Rule.)

U.S. EPA. 2005. Ecological Soil Screening Levels for Lead. Interim Final. OSWER Directive 9285.7-70. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. March.

DRAFT RESPONSE TO COMMENTS ON THE OCTOBER 2003
FINAL REMEDIAL INVESTIGATION REPORT FOR IR SITE 12, THE BOAT CHANNEL
FORMER NAVAL TRAINING CENTER, SAN DIEGO, CALIFORNIA

Table 1 – Summary of Boat Channel Sediment Chemistry

Station	Mean Ratio to Reference (MR) >1	SQGQ1 >0.5	5 Chemicals > Effects-Range Median (ERM)	Chemicals w/ >80% Incidence Rate Exceed ERM
S1S1	Yes	Yes		
S1S2	Yes	Yes		
S1S3	Yes	*Yes (1)*		
S1S4	Yes	Yes	Yes	Copper, Lead, *PCB, Chlordane, DDT, DDE (2)*
S1S5	Yes	Yes		*PCB, Chlordane, DDT (2)*
S1S6	Yes	Yes		*PCB, Chlordane, DDT, DDE (2)*
S1S7	Yes	Yes		*Chlordane, DDT (2)*
S1S8	Yes	Yes		*PCB, Chlordane, DDT (2)*
S1S9	Yes	Yes		*PCB, Chlordane, DDT (2)*
S1S10	Yes	Yes		*PCB, Chlordane, DDT (2)*
S2S1	Yes			
S2S2	Yes			*PCB (2)*
S2S3	Yes			*PCB (2)*
S2S4	Yes	*Yes (1)*		*PCB, Chlordane, DDT (2)*
S2S5	Yes			
S2S6	Yes			*PCB (2)*
S2S7	Yes			*Chlordane (2)*
S2S8	Yes			*PCB (2)*
S2S9	Yes			
S2S10	Yes			*PCB, DDT (2)*
S2S11	Yes			*PCB (2)*
S2S12	Yes			*PCB (2)*
S2S13	Yes			
S2S14	Yes			*PCB (2)*
S2S15	Yes			*PCB (2)*
S2S16	Yes			*PCB (2)*

Acronyms/Abbreviations:
SQGQ1- sediment quality guideline quotient 1

The Navy notes that:

1) the SQGQ1 for S1S3 (0.18) and S2S4 (0.50) do not exceed 0.5.
2) PCBs, DDTs and chlordane do not have an incidence of effects greater than 80% (NOAA 1999, Table 1 and 2) and should be removed from the 5th column of RWQCB Table 1. Tables 1 and 2 from NOAA 1999 are summarized in Tables 3 and 4 at the end of this document.

DRAFT RESPONSE TO COMMENTS ON THE OCTOBER 2003
FINAL REMEDIAL INVESTIGATION REPORT FOR IR SITE 12, THE BOAT CHANNEL
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Table 2 – Summary of Station Locations Exceeding Two or More Criteria

Station	Elevated Chemistry	Degraded Benthic Community	Potential Risk to Wildlife	Toxicity	Potential AOEC	AOEC
S1S1	Yes	Yes		Yes		X
S1S2	Yes					
S1S3	Yes					
S1S4	Yes	Yes		Yes		X
S1S5	Yes			Yes	X	
S1S6	Yes	Yes		Yes		X
S1S7	Yes	Yes			X	
S1S8	Yes			Yes	X	
S1S9	Yes			*Yes (*)*	X	
S1S10	Yes					
S2S1	Yes					
S2S2	Yes			Yes	X	
S2S3	Yes	Yes			X	
S2S4	Yes			Yes	X	
S2S5	Yes			Yes	X	
S2S6	Yes					
S2S7	Yes					
S2S8	Yes					
S2S9	Yes			Yes	X	
S2S10	Yes			Yes	X	
S2S11	Yes			*Yes (*)*	X	
S2S12	Yes			Yes	X	
S2S13	Yes					
S2S14	Yes			Yes	X	
S2S15	Yes					
S2S16	Yes			*Yes (*)*	X	

Acronyms/Abbreviations:
AOEC – area of ecological concern

The Navy notes that:

* stations S1S9, S2S11, and S2S16 are identified by the RWQCB as exceeding toxicity criteria on the basis of a porewater comparison to CTR values. The toxicity line of evidence was designed to address the results of site-specific bioassays the results of which were satisfactory for these stations.

Table 3
Effects-Range Low and Effects-Range Median Values for Trace Metals (parts per million, dry weight) and Percent Incidence of Biological Effects for Concentrations Greater than Effects- Range Median (NOAA 1999)

Chemical	Effects-Range Low	Effects-Range Median	Percent Incidence of Effects for Concentrations Greater than Effects-Range Median
Arsenic	8.2	70	63.0
Cadmium	1.2	9.6	65.7
Chromium	81	370	95.0
Copper	34	270	83.7
Lead	46.7	218	90.2
Mercury	0.15	0.71	42.3
Nickel	20.9	51.6	16.9
Silver	1.0	3.7	92.8
Zinc	150	410	69.8

Table 4
Effects-Range Low and Effects-Range Median Values for Organic Compounds (parts per billion, dry weight) and Percent Incidence of Biological Effects for Concentrations Greater than Effects- Range Median (NOAA 1999)

Chemical	Effects-Range Low	Effects-Range Median	Percent Incidence of Effects for Concentrations Greater than Effects-Range Median
Acenaphthene	16	500	84.2
Acenaphthylene	44	640	100
Anthracene	85.3	1100	85.2
Fluorene	19	540	86.7
2-methyl naphthalene	70	670	100
Naphthalene	160	2100	88.9
Phenanthrene	240	1500	90.3
Sum LPAH	552	3160	100
Benz(a)anthracene	261	1600	92.6
Benzo(a)pyrene	430	1600	80.0
Chrysene	384	2800	88.5
Dibenzo(a,h)anthracene	63.4	260	66.7
Fluoranthene	600	5100	92.3
Pyrene	665	2600	87.5
Sum HPAH	1700	9600	81.2
Sum total PAH	4022	44792	85.0
p,p'-DDE	2.2	27	50.0
Sum total DDTs	1.58	46.1	53.6
Total PCBs	22.7	180	51.0

Acronyms/Abbreviations:
DDE - dichlorodiphenyldichloroethene
DDT - dichlorodiphenyltrichloroethane
HPAH - high-molecular-weight polynuclear aromatic hydrocarbon
LPAH - low-molecular-weight polynuclear aromatic hydrocarbon
PAH - polynuclear aromatic hydrocarbon
PCB - polychlorinated biphenyl

ACRONYMS/ABBREVIATIONS

AOEC	area of ecological concern
ANOVA	analysis of variance
BRI	Benthic Response Index
BSAF	biota-sediment accumulation factor
BTAG	Biological Technical Assistance Group
BW	body weight
CTR	California Toxics Rule
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
EFA-West	Engineering Field Activity, West
ERA	ecological risk assessment
ERM	effects-range median
ha	hectares
HPAH	high-molecular-weight polynuclear aromatic hydrocarbon
HQ	hazard quotient
IBI	Index of Biotic Integrity
IR	ingestion rate
kg	kilogram
kg/kg-day	kilograms per kilogram per day
KLI	Kinnetic Laboratories, Inc.
km	kilometer
LCL	lower confidence limit
LPAH	low-molecular-weight polynuclear aromatic hydrocarbon
LPL	lower predictive limit
LOAEL	lowest observed adverse effects level
LOEC	lowest observed effects concentration
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
MSD	minimum significant difference
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effects level
NOEC	no observed effects concentration
NTC	Naval Training Center

PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
RI	remedial investigation
RBI	Relative Benthic Index
RWQCB	(California) Regional Water Quality Control Board, San Diego Region
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists.
SQGQ1	sediment quality guideline quotient 1
SUF	site use factor
TOC	total organic carbon
TRV	toxicity reference value
UCL	upper confidence limit
UPL	upper predictive limit
U.S. EPA	United States Environmental Protection Agency

ATTACHMENT 1

Table 1. Sediment Chemistry Evaluation

Boat Channel Station	Chemical Concentrations Greater Than Reference*	SQGQ1 > 0.5	Five ERM Exceeded	ERM Exceeded for Chemical with > 80 Percent Incidence of Toxicity	Total PAH > 290 ug/g_{oc}	Total PCB > 400 ug/kg	Elevated Sediment Chemistry Line of Evidence
S1S1	Yes	Yes					Yes
S1S2	Yes	Yes					Yes
S1S3	Yes						
S1S4	Yes	Yes	Yes	Yes			Yes
S1S5	Yes	Yes					Yes
S1S6	Yes	Yes					Yes
S1S7	Yes	Yes					Yes
S1S8	Yes	Yes					Yes
S1S9	Yes	Yes					Yes
S1S10	Yes	Yes					Yes
S2S1	Yes						
S2S2	Yes						
S2S3	Yes						
S2S4	Yes						
S2S5	Yes						
S2S6	Yes						
S2S7	Yes						
S2S8	Yes						
S2S9	Yes						
S2S10	Yes						
S2S11	Yes						
S2S12	Yes						
S2S13	Yes						
S2S14	Yes						
S2S15	Yes						
S2S16	Yes						

Note

* defined as a value greater than one for mean ratio of station chemical concentration to 95% UCL of reference station chemical concentration

Acronyms/Abbreviations:

ERM – effects-range median
SQGQ1 – sediment quality guideline quotient 1
PAH – polynuclear aromatic hydrocarbon

PCB – polychlorinated biphenyl
µg/kg – micrograms per kilogram
$\mu g/g_{oc}$ – micrograms per gram of organic carbon

ATTACHMENT 2

ACRONYMS/ABBREVIATIONS

BRI	Benthic Response Index
ERM	effects-range median
IBI	Index of Biotic Integrity
KLI	Kinnetic Laboratories, Inc.
NTC	Naval Training Center
RBI	Relative Benthic Index
RI	remedial investigation
RWQCB	(California) Regional Water Quality Control Board, San Diego Region
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists.
U.S. EPA	United States Environmental Protection Agency

BENTHIC COMMUNITY ASSESSMENT

This Attachment 2 to responses to comments presents 1) documentation of the Benthic Response Index (BRI) calculation in response to Comment 9, 2) discussion of the BRI error by the Navy in the October 2003 Final Remedial Investigation (RI) Report and corrected BRI values; 3) discussion of the uncertainty associated with the use of the BRI for the Former Naval Training Center (NTC) Boat Channel; and 4) discussion of the recommended consensus approach for assessment of the Former NTC Boat Channel benthic community data.

1.0 BENTHIC RESPONSE INDEX (BRI)

Benthic community data make up a complex three-dimensional data set comprising the taxa or species as identified, enumerated, and distributed among the sampling locations. The use of a benthic community index is an effort to simplify the complex information. Smith et al. (2003) presented the Benthic Response Index (BRI), a benthic community index that represents the condition of the benthic community and its response to disturbance with respect to a reference condition described by Smith et al. (2003) as "sites that had minimal anthropogenic influence".

The BRI, developed as part of the Southern California Bight Regional Monitoring Program, was presented by Smith et al. (1998, 2001) and subsequently revised by Smith et al. (2003) for application to southern California bays.

The BRI, described for northern bays (Point Conception to Newport Bay) and southern bays (Dana Point Harbor to international border) by Smith et al. (2003), is based on benthic data collected during the Southern California Bight 1998 Regional Monitoring Program (Bight 98) (Ranasinghe et al. 2003). The BRI development for northern and southern bays was an extension of similar work for shallow, mid-depth, and deep coastal shelf areas (Smith et al. 1998, 2001), which was based on the benthic data collected during the Bight 94 project (Bergen et al. 1998). The BRI is an abundance-weighted average pollution tolerance value of species occurring at a sampling location.

1.1 BRI CALCULATION

The BRI is the average pollution tolerance value for species occurring at the sample location weighted for species-specific abundance. Smith et al. (2003) developed a pollution tolerance score for certain species by evaluating the relationship of its abundance with the mean effect-range median (ERM) quotient and amphipod toxicity.

$$\text{Benthic Response Index} = \frac{\sum_{i=1}^{n} \sqrt[3]{a_{si}}\, p_i}{\sum_{i=1}^{n} \sqrt[3]{a_{si}}}$$

where

n	=	total number of individual specimens identified in a sample
p_i	=	pollution tolerance of species i
a_{si}	=	abundance of species i at site s

The BRI was calculated for the Former NTC Boat Channel using benthic community data reported by Kinnetic Laboratories, Inc. (KLI) (1999). The benthic community analytical results (KLI 1999) are presented in the October 2003 Final RI Report (BEI 2003, Table 1 of Appendix C "Benthic Invertebrate Data"). Taxonomic identifications from the analytical data (KLI 1999) were matched with taxonomic identifications presented in Ranasinghe et al. (2003, Appendix D, Table 2). Taxonomic synonyms were checked with a standardized list of Southern California marine invertebrates (SCAMIT 2001). Pollution tolerance scores for southern bays were selected from Ranasinghe et al. (2003, Appendix D, Table 2). Table A2-1 of this Attachment lists the taxa from KLI (1999), the matching taxa and pollution tolerance scores from Ranasinghe et al. (2003), and any taxonomic synonyms from SCAMIT (2001).

The taxonomic synonyms identified are:

Amphilochus neapolitanus = *Apolochus barnardi*

Cardium substriatum = *Laevicardium substriatum*

Nassarius tegula = *Nassarius tiarula*

Synchelidium = *Americhelidium*

Smith et al. (2003) categorized BRI values as:

- Reference (less than 31);
- Response Level 1: marginal deviation (31 to 42);
- Response Level 2: biodiversity loss (greater than 42 to 53);
- Response Level 3: community function loss (greater than 53 to 73); and
- Response Level 4: defaunation (greater than 73).

Response Levels 2, 3, and 4 were considered to be clear evidence of disturbed benthic community. Response Level 1 was not considered clear evidence of a disturbed community (Ranasinghe et al. 2003, Bay et al. 2003). Therefore, evidence of disturbed benthic community for the Former NTC Boat Channel was evaluated using a BRI threshold value of 42.

1.2 BRI RESULTS

The BRI was used as the key benthic community assessment index in the October 2003 Final RI Report (BEI 2003) at the request of the Regional Water Quality Control Board, San Diego Region (RWQCB). In the October 2003 Final RI Report stations with a BRI exceeding 42 were identified as indicating degraded benthic community. The BRI calculation results presented in the October 2003 Final RI Report (BEI 2003) used all the species occurring at a Former NTC Boat Channel station. However, the Navy reviewed the BRI source documents (Smith et al. 1998, 2001, 2003) in September 2004, and these documents indicate that only those species with pollution tolerance scores should have been included in the calculation. In addition, the BRI source documents provide BRI pollution tolerance scores for only 49 percent of the Former NTC Boat Channel taxa.

BRI values were recalculated using only those species with BRI pollution tolerance scores. The revised BRI values are higher than those presented in the October 2003 Final RI Report and are presented in this Attachment. However, based on the uncertainties involved in this benthic community assessment index, the BRI is not considered appropriate as a single-tool criterion for the benthic community assessment. Due to the potential error of using a single benthic community assessment index, several benthic indices will be used to evaluate the benthic community data (U.S. EPA 2000).

Table A2-2 presents an example BRI calculation for Station S1S6. Results of the corrected BRI calculations are presented in Table A2-3. BRI values were calculated for each of the 31 stations of the Former NTC Boat Channel and were compared to the threshold values developed by the original authors (Smith et al. 2003). A BRI of less than 42 was considered by Smith et al. (2003) as a station with a benthic community similar to reference conditions. A BRI of greater than 42 was considered by Smith et al. (2003) as a station with a disturbed benthic community. All the stations in Stratum S1 and twelve stations in Stratum S2 have a recalculated BRI of greater than 42 and meet the BRI criteria for a disturbed benthic community.

The BRI index does not indicate the cause of the disturbed benthic community, which could include natural or anthropogenic stressors. It is important to note that benthic communities respond to natural and anthropogenic disturbances in similar manners. Benthic community assessments cannot distinguish between these two types of disturbances. Therefore, risk assessments must require evaluation of additional lines of evidence to identify areas that are adversely affected by contaminants from a particular source.

2.0 UNCERTAINTIES OF THE BRI

The BRI was designed to identify stations where anthropogenic impacts were present. However, the appropriateness of the BRI for evaluation of the Former NTC Boat Channel is limited by: 1) the lack of pollution tolerance scores for dominant taxa of the Former NTC Boat Channel, 2) variation of pollution tolerance scores among habitats, 3) an inability to assess the effects of habitat characteristics such as grain size and total organic carbon, and 4) uncertainty of the index value.

2.1 Taxonomic Limitations

Although the BRI was developed with San Diego Bay data, the Former NTC Boat Channel data set is not well represented; only 49 percent of the Former NTC Boat Channel taxa are included in the BRI calculation. Therefore, the BRI may not be appropriate for the Former NTC Boat Channel evaluation. The inclusion of more of the Former NTC Boat Channel's dominant species may alter the interpretation of the benthic community condition.

Smith et al. (2003) describe the BRI as unaffected by the presence or absence of a particular species. They tested the BRI by removing the ten most abundant species and found the recalculated values to correlate well ($r = 0.85$) with the original BRI values (Smith et al. 2003). Similarly, the BRI for Former NTC Boat Channel stations was tested by eliminating the ten most abundant taxa. The original and recalculated Former NTC Boat Channel BRI values strongly correlated ($r = 0.89$). However, the conclusions were significantly changed as 59 percent of the stations originally classified as "disturbed" were reclassified as "nondisturbed."

To illustrate this effect, four key taxa from the Former NTC Boat Channel that were not included in the BRI due to a lack of a "bay pollution tolerance score" were assigned the species-specific score from the "shallow coastal pollution tolerance score." The recalculated BRI values resulted in 55 percent of the disturbed stations being reclassified as nondisturbed. The four key species, *Acuminodeutopus heteruropis, Eranno lagunae, Lyonsia californica*, and *Synchelidium* sp., occurred at 78 percent of the stations at an average abundance greater than five. This suggests that if pollution tolerance scores were available for these key species, the BRI values and the interpretation of the benthic community condition would be much different from the present case.

2.2 Pollution Tolerance Scores

Smith et al. (2003) presented pollution tolerance scores for certain species applicable to the southern bays. Pollution tolerance scores were also presented for many of these species for other habitat regions such as the northern bays, and shallow, mid-depth, and deep coastal shelf habitats (Smith 2001, 2003). The species-specific pollution tolerance scores for these five different habitats can vary widely. This wide variance in species response depending on the habitat is a potential source of error (Exponent 2003), which is not addressed by Smith et al. (2003).

2.3 Physical Habitat Characteristics

In addition to elevated chemistry, benthic community structure also varies with physical habitat characteristics such as total organic carbon, percent fine-grained sediment, temperature, and salinity. Therefore, the BRI value may exceed the threshold value simply because of variations in these physical habitat characteristics. The BRI has, on occasion, classified stations with mean ERM quotients less than 0.1 and no amphipod toxicity as disturbed (Ranasinghe et al. 2003).

Most benthic community assessment indices, including the BRI, are fairly efficient at sorting the various benthic communities on the basis of their response to stress, but are unable to identify sources of stress or the ecologically significant threshold of the index.

Boat Channel data for percent fine-grained sediment, total organic carbon, and northing (distance into the channel) show a strong correlation between each of these habitat characteristics and the BRI ($r = 0.607$, 0.742, and 0.723, respectively). These values are very similar to the strong correlation ($r = 0.736$) between the BRI and the mean ERM quotient. The strong correlation ($r = 0.755$) between the fines and total organic carbon and similar distribution patterns presented in the October 2003 Final RI Report (BEI 2003) suggests that the increase in total organic carbon is due to organic material naturally adhering to the increased surface area available in fine-grained sediment.

Sediment investigations in San Diego Bay have reported an increase in BRI values at reference stations with increasing distance from the mouth of the bay: shipyards study (Exponent 2003) and Chollas and Paleta Creek study (Chadwick 2004). One of the key characteristics of the Boat Channel is its increasing distance and isolation from the bay. It can, therefore, be expected that the reference BRI value applicable to the Boat Channel would change with increasing distance into the channel. It should also be noted that reference BRI values for a habitat so removed from the mouth of the bay and the bay itself have not been developed.

Additionally, other recent San Diego Bay sediment studies have reported unexpectedly high BRI values for established reference stations. The BRI values for some San Diego Bay reference stations exceed threshold values indicative of a degraded benthic community (Ranasinghe, pers. com. 2004).

2.4 Index Value Uncertainty

The uncertainty associated with BRI values by Smith et al. (2001) is plus or minus 3.4, which means that the calculated BRI values could actually represent BRI values slightly higher or lower. This uncertainty range could extend beyond the threshold values used to identify response levels. Applying this uncertainty range to the Boat Channel data results in more stations potentially being categorized in a lower response level (i.e., less impact) than in a higher response level. Therefore, for the Boat Channel, the uncertainty is more likely to result in an overestimation of the benthic response than an underestimation (see Table A2-3).

3.0 SUMMARY AND CONCLUSIONS OF THE BRI

The corrected BRI classifies 85 percent of Boat Channel as disturbed, but its appropriateness for the Boat Channel is limited by its lack of pollution tolerance scores for dominant Boat Channel taxa, variation of pollution tolerance scores among habitats, an inability to assess the effects of habitat characteristics such as grain size and total organic carbon, and uncertainty of the index value. The BRI cannot identify stations at which the benthic community is disturbed solely due to elevated sediment chemistry.

The BRI was developed with San Diego Bay data but the list of taxa from the Boat Channel is not well represented and, therefore, the BRI may not be appropriate for the Boat Channel evaluation. Only 49 percent of the Boat Channel taxa are included in the BRI calculation. Inclusion of more of the Boat Channel's dominant species into the BRI may alter the interpretation of the benthic community condition.

4.0 RECOMMENDED ASSESSMENT OF BENTHIC COMMUNITY DEGRADATION

Because of the uncertainties of using a single benthic community assessment index for benthic community analysis and in accordance with EPA guidance (U.S. EPA 2000), a consensus approach is recommended using the RBI (Fairey et al. 1996, 1998), BRI, IBI, and cluster analysis. These benthic community assessment indices are selected because they are common indicators used in regional sediment studies. In an effort to incorporate recent indices (e.g. IBI) and to limit the uncertainties associated with the BRI, the Navy has revised the Former NTC Boat Channel sediment evaluation such that a degraded benthic community is indicated by a "hit" from any two of these four benthic community assessment indices (the BRI, the RBI, cluster analysis, and the IBI). Single hits are not considered indicative of a degraded benthic community.

U.S. EPA's Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance (U.S. EPA 2000) states "Because of varying sensitivities of the community indexes, several of them should be used concurrently for evaluating impacts. This approach provides greater certainty of the data interpretation than reliance on any single index." When applied to the Former NTC Boat Channel benthic community data these other techniques present a preponderance of evidence that an altered benthic community is present mostly in the central area of Stratum 1 (BNI 2003). One of these techniques, the IBI, used in northern California and the east coast of the United States, and recently developed for southern California by Ranasinghe et al. (2004), classifies stations S1S1, S1S2, S1S6, S1S8, S1S9, and S2S6 as impacted based on its protocol of using total taxa, molluscan taxa, and total abundance as assessment indicators (Table A2-4). A summary of stations indicating a degraded benthic community (on the basis of the recommended consensus approach) is presented in Table A2-5.

5.0 REFERENCES

Bay, S.M., M.J. Allen, J. Anderson, D.E. Montagne, J.A. Noblet, J.A. Ranasinghe, and S.B. Weisberg. 2003. Integration of the Coastal Ecology Indicators. In: Ranasinghe et al. 2003. Southern California Bight 1998 Regional Monitoring Program: VII. Benthic Macrofauna, Appendix A. Southern California Coastal Water Research Project. Westminster, CA. March.

Bechtel Environmental, Inc. 2003. Final Remedial Investigation Report for IR Site 12, the Boat Channel. Former Naval Training Center. San Diego, California. October.

Bergen, M., S. B. Weisberg, D. Cadien, A. Dalkey, D. Montagne, R. W. Smith, J. K. Stull, and R. G. Velarde. 1998. Southern California Bight 1994 Pilot Project: IV. Benthic Infauna. Southern California Coastal Water Research Project, Westminster, CA. February.

Chadwick, Bart. 2004. Space and Naval Warfare (SPAWAR) Systems Center San Diego, U.S. Navy. Personal communication regarding Benthic Response Index results in San Diego Bay. 25 March.

Exponent. 2003. NASSCO and Southwest Marine Detailed Sediment Investigation. Prepared for NASSCO and Southwest Marine, San Diego, CA 92113. October.

Fairey, R., C. Bretz, S. Lamerdin, J. Hunt, B. Anderson, S. Tudor, C. Wilson, F. La Caro, M. Stephenson, M. Puckett, and E. Long. 1996. Chemistry, toxicity, and benthic community conditions in sediments of the San Diego Bay Region. Final Report. California State Water Resources Control Board. Sacramento, California.

Fairey, R., C. Roberts, M. Jacobi, S. Lamerdin, R. Clark, J. Downing, E. Long, J. Hunt, B. Anderson, J. Newman, R. Tjeerdema, M. Stephenson, and C. Wilson. 1998. Assessment of Sediment Toxicity and Chemical Concentrations in the San Diego Bay Region, California, USA. Environmental Toxicology and Chemistry, *17*(8):1570–1581.

Kinnetic Laboratories, Inc. 1999. Benthic Invertebrate Data and Statistical Analysis at the Boat Channel Former Naval Training Center San Diego, California. Final Report. May

Ranasinghe J.A., D. E. Montagne, R.W. Smith, T.K. Mikel, S.B. Weisberg, D. Cadien, R. Velarde and A.Dalkey. 2003. Southern California Bight 1998 Regional Monitoring Program: VII. Benthic Macrofauna. Southern California Coastal Water Research Project. Westminster, CA. March.

Ranasinghe, J.A., B. Thompson, R.W. Smith, S. Lowe, and K. Schiff. 2004. Evaluation of Benthic Assessment Methodology in Southern California Bays and San Francisco Bay. Technical Report 432, Southern California Coastal Water Research Project, Westminster, California. Contribution 89, San Francisco Estuary Institute, Oakland, California. April.

Ranasinghe, J.A. 2004. Southern California Coastal Water Research Project. Telephone conversation. 04 October.

SCAMIT. See Southern California Association of Marine Invertebrate Taxonomists.

Smith, R.W., J.A. Ranasinghe, S.B. Weisberg, D.E. Montagne, D. Cadien, T. Mikel, R. Velarde, and A.Dalkey. 2003. Extending the Southern California Benthic Response Index to Assess Benthic Conditions in Bays. In: Ranasinghe et al. 2003. Southern California Bight 1998 Regional Monitoring Program: VII. Benthic Macrofauna, Appendix C. Southern California Coastal Water Research Project. Westminster, California. March.

Smith, R.W., M. Bergen, S.B. Weisberg, D.B. Cadien, A. Dalkey, D.E. Montagne, J.K. Stull, and R.G. Velarde. 1998. Benthic Response Index for Assessing Infaunal Communities on the Mainland Shelf of Southern California. In: Bergen et al. 1998. Southern California Bight 1994 Pilot Project: IV. Benthic Infauna, Appendix E. Southern California Coastal Water Research Project. Westminster, California. February.

Smith, R.W., M. Bergen, S.B. Weisberg, D.B. Cadien, A. Dalkey, D.E. Montagne, J.K. Stull, and R.G. Velarde. 2001. Benthic response index for assessing infaunal communities on the southern California mainland shelf. Ecological Applications 11:1073–1087.

Southern California Association of Marine Invertebrate Taxonomists. 2001. A Taxonomic Listing of Soft Bottom Macro and Megainvertebrates. Fourth Edition. The Southern California Association of Marine Invertebrate Taxonomists. San Pedro, CA. October.

U.S. EPA. 2000. Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance. EPA-822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, DC. December.

Table A2-1
Taxonomic Index and Benthic Response Index Pollution Tolerance Scores

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Acteocina inculta	*Acteocina inculta*	*Acteocina inculta*		P008	
Acuminodeutopus heteruropus	*Acuminodeutopus heteruropus*	*Acuminodeutopus heteruropus*		P010	
Alpheus californiensis	*Alpheus californiensis*	*Alpheus californiensis*		P549	53.29
Ampharete labrops	*Ampharete labrops*	*Ampharete labrops*		P041	-61.775
Amphicteis scaphobranchiata	*Amphicteis scaphobranchiata*	*Amphicteis scaphobranchiata*		P044	-5.582
Amphideutopus oculatus	*Amphideutopus oculatus*	*Amphideutopus oculatus*		P045	13.043
Amphilochus neapolitanus	*Apolochus barnardi*	*Apolochus barnardi*	*Apolochus barnardi = Amphilochus neapolitanus*	P534	-54.791
Amphipholis sp(p).	*Amphipholis sp*	*Amphipholis*; all taxa within the genus		P048	-5.094
Amphipholis squamata	*Amphipholis sp*	*Amphipholis*; all taxa within the genus		P048	-5.094
Amphiporus sp(p).					
Amphiuridae, unident.					
Ancula pacifica					
Anoplodactylus erectus	*Pycnogonida*	*Pycnogonida*; all taxa within the class		P558	27.01
Aphelochaeta sp(p).	*Aphelochaeta/Monticellina complex*	*Aphelochaeta, Monticellina*; all taxa within the genera		P059	97.387
Armandia brevis	*Armandia brevis*	*Armandia brevis*		P070	32.335
Asteropella slatteryi	*Asteropella slatteryi*	*Asteropella slatteryi*		P076	-63.807
Asthenothaerus diegensis	*Periploma/Thracia complex*	*Asthenothareus, Thracia*; all taxa within the genera; and *Periploma discus* [exclude P. sp]		P379	-36.193
Barleeia subtenuis	*Barleeia sp*	*Barleeia*; all taxa within the genus		P579	-54.511
Bathyleberis garthi	*Bathyleberis sp*	*Bathyleberis; Xenoleberis*; all taxa within the genera		P080	
Bathyleberis hancocki	*Bathyleberis sp*	*Bathyleberis; Xenoleberis*; all taxa within the genera		P080	
Bemlos macromanus	*Bemlos macromanus*	*Bemlos macromanus*		P535	47.994
Brania brevipharyngea	*Brania sp*	*Brania*; all taxa within the genus		P529	5.67
Bulla gouldiana					
Caecum crebricinctum	*Caecum crebricinctum*	*Caecum crebricinctum*		P094	
Campylaspis rubromaculata	*Campylaspis sp*	*Campylaspis*; all taxa within the genus		P547	-1.169
Capitella capitata (hyperspecies)	*Capitella capitata complex*	*Capitella*; all taxa within the genus		P103	88.339
Cardium substriatum	*Laevicardium substriatum*	*Laevicardium substriatum*	*Cardium substriatum = Laevicardium substriatum*	P567	0.664
Caridea, unident.					
Carinoma mutabilis					
Cerebratulus californiensis					
Cerebratulus sp(p).					

(table continues)

Table A2-1 (continued)

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Ceriantharia, unident.	*Ceriantharia*	*Ceriantharia*; all taxa within the order		P111	25.789
Chione californiensis	*Chione sp*	*Chione*; all taxa within the genus		P117	-28.846
Cirratulidae, unident.					
Cnidarian, unident.					
Copepoda, unident.					
Cossura sp(p).	*Cossura sp*	*Cossura*; all taxa within the genus		P132	
Cossura sp. A	*Cossura sp*	*Cossura*; all taxa within the genus		P132	
Crucibulum spinosum	*Crucibulum spinosum*	*Crucibulum spinosum*		P582	-16.324
Cryptocelis occidentalis					
Cryptomya californica	*Cryptomya californica*	*Cryptomya californica*		P136	19.896
Cuthona albocrusta					
Cyathodonta pedroana					
Cylichnella sp(p).					
Diopatra tridentata	*Diopatra tridentata*	*Diopatra tridentata*		P154	
Diplocirrus sp(p).	*Diplocirrus sp*	*Diplocirrus*; all taxa within genus		P521	28.468
Discosolenia burchami					
Dorvillea annulata	*Dorvillea(Schistomeringos) longicornis*	*Dorvillea(Schistomeringos)*; all taxa within the subgenus		P155	90.093
Dorvillea longicornis	*Dorvillea(Schistomeringos) longicornis*	*Dorvillea(Schistomeringos)*; all taxa within the subgenus		P155	90.093
Edwardsia californica	*Edwardsiidae*	*Edwardsiidae*; all taxa within the family		P160	77.062
Eranno lagunae	*Eranno lagunae*	*Eranno lagunae*		P167	
Erichthonius sp. SD1 (SCAMIT 98)					
Eteone cf. aestuarina	*Eteone sp*	*Eteone*; all taxa within the genus		P171	37.356
Euchone limnicola	*Euchone sp*	*Euchone*; all taxa wihin the genus		P172	45.212
Euclymeninae, unident.					
Eumida longicornuta	*Eumida longicornuta*	*Eumida longicornuta*		P177	18.25
Euphilomedes carcharodonta	*Euphilomedes carcharodonta*	*Euphilomedes carcharodonta*		P180	22.722
Eupolymnia heterobranchia	*Eupolymnia heterobranchia*	*Eupolymnia heterobranchia*		P183	
Exogone lourei	*Exogone lourei*	*Exogone lourei*		P189	48.162
Fabricinuda limnicola					
Foxiphalus xiximeus					
Glycera americana	*Glycera americana*	*Glycera americana*		P206	4.06
Goniada littorea	*Goniada littorea*	*Goniada littorea*		P214	-24.214

(table continues)

Table A2-1 (continued)

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Grandidierella japonica	*Grandidierella japonica*	*Grandidierella japonica*		P536	47.936
Halosydna johnsoni	*Halosydna johnsoni*	*Halosydna johnsoni*		P528	-3.225
Harmothoe hirsuta					
Harmothoe imbricata					
Harmothoinae, unident.					
Harpacticoida, unident.					
Hartmanodes hartmanae	*Monoculodes sp*	*Monoculodes, Hartmanodes, Pacifoculodes, Deflexilodes,* all taxa within the genera		P306	40.62
Hesionidae, unident.					
Heteromysis odontops					
Heteroserolis carinata	*Serolis carinata*	*Heteroserolis carinata*		P462	10.319
Hydroida, unident.					
Leitoscoloplos pugettensis	*Leitoscoloplos pugettensis*	*Leitoscoloplos pugettensis*		P248	94.277
Leptochelia dubia	*Leptochelia dubia*	*Leptochelia dubia*		P251	0.733
Leptostylis calva	*Leptostylis sp A*	*Leptostylis calva*		P254	
Leptosynapta sp(p).	*Synaptidae*	*Synaptidae, Chirodotidae;* all taxa within the families		P495	65.464
Lineus sp(p).					
Listriella eriopisa	*Listriella eriopisa*	*Listriella eriopisa*		P260	
Listriella melanica	*Listriella melanica*	*Listriella melanica*		P262	-29.76
Listriella sp. A (SCAMIT 87)					
Lophopanopeus frontalis					
Lumbrineridae, unident.					
Lyonsia californica	*Lyonsia californica*	*Lyonsia californica*		P271	
Macoma balthica					
Mactrotoma californica	*Mactridae*	*Mactridae;* all taxa within the family		P277	-19.478
Malacoplax californiensis	*Malacoplax californiensis*	*Malacoplax californiensis*		P550	39.757
Mayerella banksia	*Mayerella banksia*	*Mayerella banksia*		P287	150.301
Mediomastus californiensis	*Mediomastus sp*	*Mediomastus;* all taxa within the genus		P288	29.193
Mediomastus sp(p).	*Mediomastus sp*	*Mediomastus;* all taxa within the genus		P288	29.193
Megalomma pigmentum	*Megalomma pigmentum*	*Megalomma pigmentum*		P289	
Metasychis disparidentatus	*Metasychis disparidentatus*	*Metasychis disparidentatus*		P300	6.715
Microspio pigmentata	*Microspio pigmentata*	*Microspio pigmentata*		P303	-4.847
Micrura alaskensis					

(table continues)

Table A2-1 (continued)

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Micrura sp(p).					
Monocorophium acherusicum	*Corophium sp*	*Corophiinae;* all taxa within the subfamily	Subfamily genera listed in Amphipod Newsletter #25 August 2003.	P130	0.356
Monticellina cryptica	*Aphelochaeta/Monticellina complex*	*Aphelochaeta, Monticellina;* all taxa within the genera		P059	97.387
Musculista senhousia	*Musculista senhousia*	*Musculista senhousia*		P563	69.863
Mysidacea, unident.					
Mysidopsis californica					
Mysidopsis sp. A (Phillips)					
Nassarius tegula	*Nassarius tiarula*	*Nassarius tiarula*	*Nassarius tiarula = Nassarius tegula*	P578	52.64
Naushonia macginitei	*Naushonia macginitei*	*Naushonia macginitei*		P551	102.751
Neanthes acuminata	*Neanthes acuminata complex*	*Neanthes acuminata;* all forms referred to under this name		P526	89.682
Nebalia pugettensis	*Nebalia sp*	*Nebalia;* all taxa within the genus		P320	
Nematodes, unident.					
Nemertea, unident.					
Neotrypaea californiensis	*Neotrypaea sp*	*Neotrypaea;* all taxa within the genus		P325	-4.874
Nephtys caecoides	*Nephtys caecoides*	*Nephtys caecoides*		P326	-9.638
Nephtys cornuta	*Nephtys cornuta*	*Nephtys cornuta*		P327	41.732
Notomastus tenuis	*Notomastus sp*	*Notomastus;* all taxa within the genus		P336	-6.496
Notoplana sp(p).					
Odontosyllis phosphorea	*Odontosyllis phosphorea*	*Odontosyllis phosphorea*		P339	52.772
Odostomia amianta	*Odostomia sp*	*Odostomia;* all taxa within the genus		P340	
Oligochaeta, unident.					
Ophiuroidea, unident.					
Paracerceis sculpta	*Paracerceis sculpta*	*Paracerceis sculpta*		P556	57.289
Paradexamine sp(p).	*Paradexamine sp*	*Paradexamine;* all taxa within the genus		P542	47.047
Paranemertes californica					
Paranemertes sp(p).					
Paranthura elegans	*Paranthura elegans*	*Paranthura elegans*		P555	28.772
Paraprionospio pinnata	*Paraprionospio pinnata*	*Paraprionospio pinnata*		P373	33.071
Parasterope barnesi	*Parasterope sp*	*Parasterope, Postasterope;* all taxa within the genera		P374	
Pherusa capulata	*Pherusa capulata*	*Pherusa capulata*		P522	122.293
Phoronida, unident.	*Phoronida*	*Phoronida;* all taxa within the order		P387	32.809
Pinnixa sp(p).					

(table continues)

Table A2-1 (continued)

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Pista alata	*Pista alata*	*Pista agassizi*		P401	65.688
Pista sp(p).					
Podarke pugettensis	*Podarke pugettensis*	*Ophiodromus pugettensis*		P409	-51.972
Podocerus fulanus	*Podocerus fulanus*	*Podocerus fulanus*		P545	12.682
Podocerus sp(p).	*Podocerus sp*	*Podocerus;* all taxa within the genus		P412	
Podocopida, unident.					
Poecilochaetus johnsoni	*Poecilochaetus johnsoni*	*Poecilochaetus johnsoni*		P414	22.48
Poecilostomatoida, unident.					
Polycera atra					
Polydora cornuta	*Polydora sp*	*Polydora, Dipolydora;* all taxa within the genera		P419	34.328
Polyophthalmus pictus	*Polyophthalmus pictus*	*Polyophthalmus pictus*		P524	
Portunus xantusii					
Prionospio (Minuspio) lighti	*Prionospio lighti*	*Prionospio lighti and P. multibranchiata (P. lighti* only in bay habitats)		P426	4.949
Prionospio heterobranchia	*Prionospio(Prionospio) heterobranchia*	*Prionospio heterobranchia*		P531	26.309
Prionospio sp(p).					
Pseudopolydora paucibranchiata	*Pseudopolydora paucibranchiata*	*Pseudopolydora paucibranchiata*		P532	37.542
Pseudotanais makrothrix					
Pyromaia tuberculata	*Pyromaia tuberculata*	*Pyromaia tuberculata*		P433	96.217
Rudilemboides stenopropodus	*Rudilemboides sp*	*Rudilemboides;* all taxa within the genus		P537	25.101
Schmittius politus	*Schmittius politus*	*Schmittius politus*		P557	68.492
Scolelepis sp(p).	*Scolelepis spp*	*Scolelepis;* all taxa within the genus except *S. occidentalis* [exclude S. sp]		P460	
Scoletoma tetraura	*Lubrineris sp*	*Lumbrineris & Scoletoma;* all taxa within the genera		P270	47.842
Scyphoproctus oculatus	*Scyphoproctus sp*	*Scyphoproctus;* all taxa within genus		P179	44.94
Siliqua sp(p).					
Solen rostiformis	*Solen sp*	*Solen;* all taxa within the genus		P472	-12.356
Spiophanes duplex	*Spiophanes missionensis*	*Spiophanes duplex*		P480	14.573
Spirorbidae, unident.					
Stylochus exiguus					
Stylochus franciscanus					
Stylochus sp(p).					
Synchelidium shoemakeri	*Synchelidium sp*	*Americhelidium;* all taxa within the genus	*Synchelidium = Americhelidium*	P496	
Synchelidium sp(p).	*Synchelidium sp*	*Americhelidium;* all taxa within the genus	*Synchelidium = Americhelidium*	P496	

(table continues)

Table A2-1 (continued)

Boat Channel Taxa Name	P-Name	Included Taxa	Synonym - SCAMIT 2001	P-Code	Bay South
Tagelus subteres	*Tagelus subteres*	*Tagelus subteres*		P587	-9.515
Tellina idae	*Tellina idae*	*Tellina idae*		P500	
Tenonia priops	*Tenonia priops*	*Tenonia priops*		P502	
Theora lubrica	*Theora lubrica*	*Theora lubrica*		P590	55.417
Thracia curta	*Periploma/Thracia complex*	*Asthenothareus, Thracia;* all taxa within the genera; and *Periploma discus* [exclude P. sp]		P379	-36.193
Trachycardium quadragenarium	*Trachycardium quadragenarium*	*Trachycardium quadragenarium*		P508	
Tubulanus frenatus					
Tubulanus nothus					
Tubulanus pellucidus					
Zeuxo normani	*Zeuxo normani*	*Zeuxo normani*		P593	35.661
Zeuxo paranormani					

Acronyms/Abbreviations:
SCAMIT Southern California Association of Marine Invertebrate Taxonomists

Table A2-2
Benthic Response Index Calculation for Station S1S6

Former Naval Training Center Boat Channel Taxa	S1S6 Abundance (a_{si})	P-Code	Pollution Tolerance Score (p_i)	($\sqrt[3]{a_{si}}$)	($\sqrt[3]{a_{si}}\,p_i$)
Acuminodeutopus heteruropus	8	P010		0	0
Cuthona albocrusta	1			0	0
Eranno lagunae	11	P167		0	0
Euchone limnicola	35	P172	45.212	3.271066	147.8915
Hartmanodes hartmanae	1	P306	40.62	1	40.62
Leitoscoloplos pugettensis	3	P248	94.277	1.44225	135.971
Mayerella banksia	67	P287	150.301	4.061548	610.4547
Mediomastus sp(p).	6	P288	29.193	1.817121	53.0472
Micrura alaskensis	2			0	0
Monticellina cryptica	16	P059	97.387	2.519842	245.3999
Parasterope barnesi	8	P374		0	0
Pherusa capulata	201	P522	122.293	5.857766	716.3638
Phoronida, unident.	172	P387	32.809	5.561298	182.4606
Pista alata	10	P401	65.688	2.154435	141.5205
Pista sp(p).	4			0	0
Podarke pugettensis	41	P409	-51.972	3.448217	-179.211
Polycera atra	1			0	0
Polydora cornuta	2	P419	34.328	1.259921	43.25057
Rudilemboides stenopropodus	19	P537	25.101	2.668402	66.97955
Schmittius politus	1	P557	68.492	1	68.492
Synchelidium sp(p).	19	P496		0	0
Theora lubrica	75	P590	55.417	4.217163	233.7025
Sum				40.27903	2506.943

$$\text{Benthic Response Index S1S6} = \frac{2506.943}{40.27903} = 62.24$$

Table A2-3
Revised Benthic Response Index Values for Former Naval Training Center Boat Channel

Station	Benthic Response Index	Reference (<31) [a]	Response Level 1 (31 - 42) Marginal Deviation [b]	Response Level 2 (42-53) Biodiversity Loss [c]	Response Level 3 (53-73) Community function loss [d]	Response Level 4 (>73) Defaunation [e]
S1S1	52.32			S1S1		
S1S2	43.06			S1S2		
S1S3	44.12			S1S3		
S1S4	56.25				S1S4	
S1S5	47.54			S1S5		
S1S6	62.24				S1S6	
S1S7	54.29				S1S7	
S1S8	55.26				S1S8	
S1S9	44.37			S1S9		
S1S10	46.91			S1S10		
S2S1	50.16			S2S1		
S2S2	42.43			S2S2		
S2S3	41.45		S2S3			
S2S4	45.10			S2S4		
S2S5	37.92		S2S5			
S2S6	43.09			S2S6		
S2S7	43.50			S2S7		
S2S8	41.79		S2S8			
S2S9	42.94			S2S9		
S2S10	45.27			S2S10		
S2S11	45.77			S2S11		
S2S12	46.09			S2S12		
S2S13	48.04			S2S13		
S2S14	48.07			S2S14		
S2S15	44.42			S2S15		
S2S16	37.42		S2S16			
S3S1	32.46		S3S1			
S3S2	29.29	S3S2				
S3S3	36.82		S3S3			
S3S4	30.17	S3S4				
S3S5	24.15	S3S5				

(table continues)

Table A2-3 (continued)

Notes:

a Reference Condition - Healthy

b Response Level 1 - Healthy, marginal deviation, change in relative abundance of species, more than 5 % of reference species lost (31 - 42)

c Response Level 2 - Biodiversity loss, exclusion of sensitive species from the assemblage, more than 25 % of reference species lost (42 - 53), clear evidence of disturbance

d Response Level 3 - Community function loss, taxonomic groups (arthropods and ophiuroids are mostly excluded, more than 50 % of reference species lost (53 - 73), clear evidence of disturbance

e Response Level 4 - Defaunation, exclusion of 90% of the species typical of reference condition, more than 80 % of reference species lost (53 - 73), clear evidence of disturbance

Table A2-4
Southern California Index of Biological Integrity[a]
for Former Naval Training Center Boat Channel Sediment Stations

Station Name	Molluscan Taxa	Total Taxa	Total Abundance	Index of Biological Integrity Assessment Value[b]	Station Category[c]
S1S1	1	26	248	2	Impacted
S1S2	3	36	236	2	Impacted
S1S3	8	46	644	0	Unimpacted
S1S4	3	29	344	1	Unimpacted
S1S5	3	39	295	1	Unimpacted
S1S6	3	22	586	2	Impacted
S1S7	3	34	387	1	Unimpacted
S1S8	3	25	228	3	Impacted
S1S9	2	32	218	2	Impacted
S1S10	3	41	333	1	Unimpacted
S2S1	7	47	589	1	Unimpacted
S2S2	4	37	335	1	Unimpacted
S2S3	2	37	278	1	Unimpacted
S2S4	3	33	258	1	Unimpacted
S2S5	8	44	416	0	Unimpacted
S2S6	2	30	202	2	Impacted
S2S7	9	53	633	0	Unimpacted
S2S8	6	45	448	1	Unimpacted
S2S9	3	35	353	1	Unimpacted
S2S10	3	33	521	1	Unimpacted
S2S11	8	33	363	0	Unimpacted
S2S12	5	42	364	1	Unimpacted
S2S13	3	35	423	1	Unimpacted
S2S14	5	43	308	1	Unimpacted
S2S15	4	41	527	1	Unimpacted
S2S16	6	50	576	1	Unimpacted
S3S1	3	53	621	1	Unimpacted
S3S2	9	68	891	0	Unimpacted
S3S3	3	45	843	1	Unimpacted
S3S4	9	56	476	0	Unimpacted
S3S5	7	53	458	0	Unimpacted
Reference Range[a]	8–27	29–70	241–1,560		

(table continues)

Table A2-4 (continued)

Notes:

[a] as described by Ranasinghe et al. 2004

[b] assessment value is the number of indicators exceeding the reference range (Ranasinghe et al. 2004); to be conservative in this table, boundary values were considered out of the reference range

[c] category considered unimpacted if assessment value was 0 or 1, impacted if assessment value was 2 or more (Ranasinghe et al. 2004)

Table A2-5
Summary of Stations Indicating a Degraded Benthic Community
(based on recommended consensus of assessment indices)

Station	Relative Benthic Index <0.30 (Fairey et al. 1996, 1998)	Benthic Response Index >=42 (Smith et al. 1998, 2001, 2003)	Cluster Analysis[a]	Index of Biotic Integrity >1 (Ranasinghe 2004)	Degraded Benthic Community? [b]
S1S1	Yes	Yes	Yes	Yes	**Yes**
S1S2		Yes		Yes	**Yes**
S1S3		Yes			No
S1S4		Yes	Yes		**Yes**
S1S5		Yes			No
S1S6		Yes	Yes	Yes	**Yes**
S1S7	Yes	Yes	Yes		**Yes**
S1S8	Yes	Yes	Yes	Yes	**Yes**
S1S9		Yes		Yes	**Yes**
S1S10		Yes			No
S2S1		Yes			No
S2S2		Yes			No
S2S3					No
S2S4		Yes			No
S2S5					No
S2S6		Yes		Yes	**Yes**
S2S7		Yes			No
S2S8					No
S2S9		Yes			No
S2S10		Yes			No
S2S11		Yes			No
S2S12		Yes			No
S2S13		Yes			No
S2S14		Yes			No
S2S15		Yes			No
S2S16					No

Note:
[a] those stations not clustered with reference stations, October 2003 Final RI Report Appendix C Figure 10 and Table 3
[b] a degraded benthic community is indicated when a "hit" is indicated by any two of the four listed indicators

ATTACHMENT 3

Table 2. Sediment Evaluation

Boat Channel Station	Elevated Sediment Chemistry	Sediment Toxicity	Potentially Degraded Benthic Community	Potential Risk to Wildlife	AOEC
S1S1	Yes	Yes (A)	Yes		●
S1S2	Yes		Yes		⊙
S1S3					
S1S4	Yes	Yes (A)	Yes		●
S1S5	Yes	Yes (UD, UF)			⊙
S1S6	Yes	Yes (A)	Yes		●
S1S7	Yes		Yes		⊙
S1S8	Yes	Yes (UD)	Yes		●
S1S9	Yes		Yes		⊙
S1S10	Yes				
S2S1					
S2S2		Yes (UF)			
S2S3					
S2S4		Yes (UF)			
S2S5		Yes (UF)			
S2S6			Yes		
S2S7					
S2S8					
S2S9		Yes (UF)			
S2S10		Yes (UF)			
S2S11					
S2S12		Yes (A)			
S2S13					
S2S14		Yes (UF)			
S2S15					
S2S16					

Notes:
● - AOEC of primary concern due to elevated sediment chemistry, and both sediment toxicity and potentially degraded benthic community
⊙ - AOEC of moderate concern due to elevated sediment chemistry, and either sediment toxicity or potentially degraded benthic community

Acronyms/Abbreviations:
AOEC – area of ecological concern
A – amphipod bioassay
UD – urchin development bioassay
UF- urchin fertilization bioassay