

5.0 RISK CHARACTERIZATION

In the risk characterization phase, the results of the exposure and effects assessments are used to estimate risk to the ecological resources represented by the selected assessment endpoints. Information obtained during the exposure and effects assessment are combined to evaluate the relationship between environmental concentrations of chemical stressors and observed adverse effects. Observed effects (in the form of measurement endpoint results) are evaluated using environmentally relevant criteria to distinguish between results that indicate the potential for risk, or do not indicate risk.

This section is organized by focusing on NFD Point Molate assessment endpoints. Risk to each of the assessment endpoints is characterized based on associated measurement endpoint results. The results from the measurement endpoint comparison of sediment sum PAH concentrations to ambient threshold criteria will only be discussed once, as the results considered for each assessment endpoint for this endpoint are the same. The discussion of the sediment chemistry measurement endpoint results appear in Section 5.1.3 and will be referred to in subsequent sections.

5.1 PROTECTION OF THE BENTHIC INVERTEBRATE COMMUNITY ASSOCIATED WITH NFD POINT MOLATE OFFSHORE SEDIMENTS

Characterization of risk to the benthic invertebrate community associated with NFD Point Molate offshore sediments will be accomplished through the evaluation of the following measurement endpoint results:

- Bulk sediment amphipod bioassay results.
- Mysid SWI bioassay results.
- Sediment chemistry analytical results.

The fourth proposed measurement endpoint, the correlation between benthic species composition and abundance and constituent concentrations, will not be evaluated since there was no indication of toxicity in the bioassays (as discussed below).

5.1.1 Comparison of Amphipod Bulk Sediment Bioassay Results to the CWRCB-Developed San Francisco Bay Envelope

The “reference envelope” (CWRCB, 1998) was used to compare *E. estuarius* bulk sediment toxicity bioassay results from NFD Point Molate sample locations to ambient toxicity in the Bay. Based on the CWRCB report (1998), ambient toxicity for this organism is defined as the tolerance interval that can be claimed with $(1-\alpha)100$ percent confidence to contain a specified proportion of the measured reference site toxicity values that were generated by the CWRCB (1998). A detailed description of this approach and the rationale use to select the approach is provided in Section 2.8.2.1. To use this approach, point-by-point comparisons are made of sample location mean test site toxicity (i.e., percentage survival of *E. estuarius*) to the lower CWRCB ambient tolerance limit. If survival in a test site assay is observed to be below this lower limit, that site is judged to exhibit greater than ambient (reference) toxicity. Alternatively, if the sample location assay is observed to be equal to or above the lower limit, the sample location is judged nontoxic relative to ambient. Therefore, 68 percent is defined as the criteria to evaluate effects in the bulk sediment bioassays for NFD Point Molate sediments.

In the control sediment, 98 percent survival was observed indicating an acceptable survival response (e.g., test organism health). Based on the results of the 10-day bulk sediment bioassay results, none of the 10 NFD Point Molate sediments tested using *E. estuarius* exhibited percent survival lower than the 68 percent reference envelope (see Table 4-1). Survival of the amphipods in NFD Point Molate sediments ranged from 69 to 94 percent, and was greater than the 68 percent required for the reference envelope. Although not compared to the reference envelope and not identified as a measurement endpoint, reburial of amphipods in the test sediments was also measured in the laboratory. Mean percent reburial in test sediments ranged from 98 to 100 percent indicating that these sediments did not adversely affect these organisms ability to rebury (see Table 4-2).

The utility of this measurement endpoint and the justification of the criteria used to evaluate the endpoint were previously discussed in Section 2.7.2. In the exposure assessment, the co-occurrence of the stressor (petroleum-related compounds) and the receptor (benthic invertebrates) was established. The test species used was also established as an appropriate surrogate to evaluate risk to the benthic invertebrate community. When the sample location mean percent survival was compared to the criteria proposed in this section to evaluate toxicity (i.e. 68 percent survival), adverse effects (relative to ambient) were not observed for sampling locations at NFD Point Molate. The data generated by

this measurement endpoint, therefore indicate that NFD Point Molate sediments do not pose a risk to the benthic invertebrate community.

5.1.2 Statistical Comparison of Mysid SWI Bioassay Results to Reference Location Results and Evaluation of Minimum Significant Differences (MSD)

The evaluation of mysid SWI bioassay results was conducted using a combination of a statistical comparison of sample location and reference location mean survival, and the application of a MSD to evaluate significant adverse effects. A detailed description of the application of these criteria and the rationale used to select these applications is provided in Section 2.8.2.3.

T-tests were run to compare mysid survival in NFD Point Molate sampling station sediments to survival in the reference sediment (Paradise Cove). No significant differences were observed between the NFD Point Molate sample station sediments and the reference sediments (see Table 4-3).

Growth was also evaluated for *M. bahia* (although not a defined measurement endpoint) to provide additional data in evaluating potential effects to the benthic invertebrate community at NFD Point Molate. A one-way ANOVA was used to determine if differences existed between average dry weights of organisms in the laboratory controls and average dry weights of organisms in the NFD Point Molate sediments. Based on this statistical analysis, no differences in growth were noted between the NFD Point Molate sediments as compared to laboratory controls (see Table 4-4). This further indicates no effects from NFD Point Molate sediments to the associated benthic invertebrate community.

The utility of this measurement endpoint and the justification of the criteria used to evaluate the endpoint are described in Section 2.7.2. In the exposure assessment section, the co-occurrence of the stressor (petroleum-related compounds) and the receptor (benthic invertebrates) was established. In the effects assessment, response data in the form of sample location mean percent survival was presented which, when compared to the criteria proposed in this section to evaluate toxicity, indicates that no adverse effects would be expected. The data generated by this measurement endpoint, therefore, do not indicate that NFD Point Molate sediments pose risk to the benthic invertebrate community at NFD Point Molate.

5.1.3 Comparison of Sediment Sum PAH Concentrations to Ambient Threshold Criteria

Sum PAH concentrations in sediments collected from NFD Point Molate sampling locations were compared with ambient threshold criteria to determine if NFD Point Molate sampling locations should be considered contaminated with PAHs relative to ambient reference locations in the San Francisco Bay. PAHs exceeding the ambient threshold criteria of 3.390 mg/kg were detected in sediments at sampling locations T10-1-1 (4.343 mg/kg) and T11-1 (4.753 mg/kg) (Table 5-1). Based on the definition of ambient threshold criteria provided by CWRCB (1998), these locations (i.e., T10-1-1 and T11-1) are considered contaminated with sum PAH at greater than ambient concentrations. However, these levels (4.343 mg/kg and 4.753 mg/kg, respectively) do not exceed the highest ambient concentration observed in the San Francisco Bay (6.000 mg/kg) at CWRCB reference locations (CWRCB, 1998).

Sum PAH exceedances of ambient threshold criteria cannot be used to evaluate risk. The ambient threshold criteria are non-risk based criteria used to evaluate whether San Francisco Bay sediments are considered to be contaminated with respect to selected ambient reference locations. Ambient threshold criteria are not based on effects data from toxicological or field studies. For purposes of this ERA, the sediment chemistry measurement endpoint will be evaluated in conjunction with other measurement endpoint results to evaluate overall risk at a sampling station.

5.1.4 Summary of Risk Characterization for Protection of Benthic Community Associated With NFD Point Molate Offshore Sediments

Risk to the benthic invertebrate community associated with NFD Point Molate offshore sediments is characterized based on measurement endpoint results derived from amphipod bulk sediment bioassays, mysid SWI bioassays, and sediment chemistry results. These results indicate no risk to the benthic invertebrate community associated with NFD Point Molate offshore sediments. At two sample locations, T10-1 and T11-1, the ambient threshold criteria for sum PAHs in sediment was exceeded. As the ambient threshold criteria is not risk-based, these exceedances by themselves do not indicate risk at these sampling locations. Measurement endpoint results associated with the assessment endpoint for protection of the benthic invertebrate community, combined together, indicate that the offshore sediments at NFD Point Molate do not pose a risk to the associated benthic invertebrate community.

5.2 PROTECTION OF THE LARVAL FISH COMMUNITY ASSOCIATED WITH THE EELGRASS BEDS OFF NFD POINT MOLATE

Characterization of risk to the larval fish community associated with NFD Point Molate offshore sediments will be accomplished through the evaluation of the following measurement endpoint results:

- Topsmelt SWI bioassay results.
- Sediment chemistry results.

5.2.1 Statistical Comparison of Topsmelt SWI Bioassay Results to Reference Location Results and Evaluation of MSD

Sufficient data did not exist to calculate a reference envelope for the topsmelt (*Atherinops affinis*), and therefore, the MSD approach was used to compare site toxicity data with reference or control data. The evaluation of mysid SWI bioassay results using a MSD approach is accomplished through a combination of a statistical comparison of sample and reference location mean survival, and the application of a MSD to evaluate significant adverse effects. A detailed description of the application of these criteria and the rationale used to select these applications is provided in Section 2.8.2.3.

T-tests were run to compare egg hatchability for NFD Point Molate sampling station sediments to egg hatchability from reference sediments (Paradise Cove). Only two sites (T10-1 and T11A) had significantly different average percent egg hatchability as compared to the reference sediment (see Table 4-5). However, these two sites had significantly increased egg hatchability (98 to 100 percent) as compared to the reference sediment (76 percent). This is not considered a deleterious effect.

The utility of this measurement endpoint and justification of the criteria used to evaluate the endpoint are described in Section 2.7.2. In the exposure assessment section, the co-occurrence of the stressor (petroleum-related compounds) and the receptor (larval fish) was established. In the effects assessment, response data in the form of sample location mean percent egg hatchability was presented which, when compared to the criteria proposed in this section to evaluate toxicity, indicate that no effects would be expected. The data generated by this measurement endpoint, therefore, indicate that NFD Point Molate sediments do not pose a risk to the larval fish community at NFD Point Molate.

5.2.2 Comparison of Sediment Sum PAH Concentrations to Ambient Threshold Criteria

The description of the comparison of sum PAH concentrations in sediments collected from NFD Point Molate sampling locations to ambient threshold criteria is presented in Section 5.1.3. Since ambient threshold criteria are non-risk based, the results of this comparison cannot be used to characterize risk in the absence of other relevant risk-based findings.

5.2.3 Summary of Risk Characterization for Protection of Larval Fish Community Associated With NFD Point Molate Eelgrass Beds

Risk to the larval fish community associated with NFD Point Molate eelgrass beds is based on measurement endpoint results derived from topsmelt sediment water interface bioassays and sediment chemistry results. Results from topsmelt SWI bioassays indicate that adverse effects to the larval fish community associated with NFD Point Molate eelgrass beds are unlikely to occur. At two sample locations (T10-1 and T11-1), ambient threshold criteria for sum PAHs in sediment were exceeded. As the ambient threshold criteria are not risk-based, these exceedances by themselves do not indicate risk at these sampling locations. Therefore, measurement endpoint results associated with the assessment endpoint for protection of the larval fish community, when combined together, do not indicate that the offshore sediments at NFD Point Molate pose risk to the associated larval fish community.

5.3 PROTECTION OF THE SHOREBIRD COMMUNITY THAT UTILIZES THE INTERTIDAL HABITAT OF NFD POINT MOLATE AS A FORAGING AREA

Characterization of risk to the shorebird community associated with NFD Point Molate offshore sediments will be accomplished through the evaluation of the following measurement endpoint results:

- Evaluation of calculated doses using avian toxicity data for petroleum products.
- Sediment chemistry results.

5.3.1 Evaluation of Calculated Doses Using Avian Toxicity Data for Petroleum Products

Sum PAH doses calculated for the scaup at NFD Point Molate sampling stations (i.e., DL-1-1, T3-1-1, T5, T6, T9-1, and T9-2) ranged from 0.021 to 0.046 mg/kg/day. At these sampling stations, the calculated doses were below the criteria defining negative findings (0.03 mg/kg/day) indicating that adverse effects to avian receptors based on doses modeled to the scaup are unlikely. However, doses calculated for the scaup at the remaining sites (T-2, T11-1, T10-1-1, and T11A) and doses calculated for the western sandpiper at all sites fell between the criteria defining negative and positive findings (e.g., in the undetermined category).

While the finding is considered indeterminate, the highest modeled dose falls well below any observed effect level seen in avian receptors. The highest modeled dose was 0.2116 mg/kg and the lowest LOAEL from the literature (based on the lowest percent sum PAH assumption) was 0.5 mg/kg (see Figure D-1 and Appendix D for detailed explanation of avian TRV development).

Considering the conservative assumptions associated with the inputs to the dose equation and the conservatism built into the finding criteria, risk to avian receptors is not indicated or expected.

5.3.2 Comparison of Sediment Sum PAH Concentrations to Ambient Threshold Criteria

The description of the comparison of sum PAH concentrations in sediments collected from NFD Point Molate sampling locations to ambient threshold criteria is presented in Section 5.1.3. Since the ambient threshold criteria is non-risk based, the results of this comparison cannot be used to characterize risk in the absence of other relevant risk-based findings.

5.3.3 Summary of Risk Characterization for Protection of the Shorebird Community at NFD Point Molate

Risk to the shorebird community at NFD Point Molate is based on measurement endpoint results comparing site-specific sum PAH doses to the scaup and Western sandpiper to avian toxicity data and sediment chemistry results. Results from the scaup indicate that six of the ten intertidal locations sampled show no adverse effects and, therefore, do not indicate risk. At the other four locations

sampled, the potential for risk is undetermined. For the western sandpiper, all locations sampled indicated an undetermined finding for risk. At two sample locations (T10-1 and T11-1), the ambient threshold criteria for sum PAHs in sediments were exceeded, but because the criteria are not risk-based, these exceedances by themselves do not indicate risk at these sampling locations.

TABLE 5-1

SUM PAH CONCENTRATIONS AT NFD POINT MOLATE SAMPLING LOCATIONS

Area	Station	Sample ID	Sum PAH (ppm)
<i>Intertidal</i>			
North cove	T11A	T11A-1	2.614
		T11A-2	2.839
		T11A-3	2.388
	T11	T11-1	4.753 *
	T10	T10-1-1	4.343 *
	T9-1	T9-1-1	1.633
		T9-1-2	1.255
		T9-1-3	1.854
	T9-2	T9-2-1	N/A
	DL-1	DL-1-1	1.951
South cove	T6	T6-1	0.722
	T5	T5-1	0.757
		T5-2	0.428
		T5-3	0.598
	T3-1	T3-1-1	1.396
	T2	T2-1	2.424
		T2-2	2.947
		T2-3	1.804
<i>Subtidal</i>			
North cove	T10-2	T10-2-1	2.420
Pier	P1	P1-1	2.298
	P2	P2-1	1.523
	P3	P3-1	3.802 *
South cove	T3-2	T3-2-1	1.679

* = Sum PAH concentration exceeds ambient threshold criteria of 3.390 ppm.

NA = Not analyzed