Castro Cove/Chevron Richmond Refinery

FINAL
Damage Assessment and Restoration Plan/
Environmental Assessment

June 2010
Prepared by:
National Oceanic and Atmospheric Administration
United States Fish and Wildlife Service
California Department of Fish and Game

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EXECUTIVE SUMMARY

Background

Chevron USA, Inc. (Chevron) owns and operates a petroleum refinery in Richmond, California which, prior to 1987, discharged wastewater directly into Castro Cove, a small embayment within San Pablo Bay. Although the wastewater discharge was relocated outside of Castro Cove in 1987, some of the sediments inside the Cove retained elevated levels of contaminants, including mercury and polycyclic aromatic hydrocarbons (PAHs). In 2007 and 2008 Chevron undertook a major, on-site cleanup project, removing the most highly contaminated sediments within Castro Cove, in compliance with an order issued by the California Regional Water Quality Control Board. In addition to the $20 to $30 million in cleanup costs estimated by the Trustees, Chevron is liable for “natural resource damages.”

Natural resource damages, which are used to fund environmental restoration projects, are compensation for the diminished ecological value of injured resources, including contaminated habitats, such as the intertidal mudflat, salt marsh, and other shallow subtidal habitat in Castro Cove. The Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA), the United States Department of the Interior’s Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG) are the federal and State trustee agencies (Trustees) for the natural resources injured by the releases into Castro Cove. As a designated Trustee, each agency is authorized to act on behalf of the public to assess injuries to those natural resources under its trusteeship resulting from the releases of contaminants and to recover damages to make the environment and the public whole.

This summary explains how the Trustees assessed the loss of natural resource services and developed a final restoration plan to compensate for the resource losses by restoring or improving the function of comparable habitats.

Damage Assessment and Restoration Plan (DARP)/Environmental Assessment (EA)

The Trustees have prepared this final DARP/EA to inform the public about the natural resource damage assessment (NRDA) and restoration planning conducted for the Castro Cove releases and to guide the implementation of restoration. Consistent with standard practice, the Trustees invited Chevron to work cooperatively on the NRDA for the Castro Cove case. Chevron accepted the invitation, and representatives of Chevron and the Trustees coordinated technical activities to determine and quantify the injury and to scale and plan restoration actions. The Trustees released the draft DARP/EA on November 25, 2008, for public review and received public comments through January 9, 2009. The Trustees considered and responded to comments (see Appendix B) and amended the draft DARP/EA in issuing this final DARP/EA. The final DARP/EA describes the injuries and identifies the selected restoration alternatives. The document also serves, in part, as the Trustees’ compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

Injury Quantification
The cleanup of Castro Cove sediments undertaken by Chevron addresses restoration of the ecological health of the injured resources. Therefore, the Trustees' NRDA efforts have focused on compensation for lost natural resource services from 1980 (when the Trustees received statutory authority to pursue damages) until the cleanup actions and natural processes will allow the injured habitats to recover to their baseline ecological conditions. The Trustees quantified injuries to natural resources using Habitat Equivalency Analysis (HEA), a commonly used method of scaling injuries and restoration actions. To estimate the loss of natural resource services resulting from the contamination of sediments in Castro Cove, the Trustees relied on amphipod toxicity tests. Amphipods (a type of small crustacean that inhabits bay mud) were placed in sediment from Castro Cove and their survival was studied in a laboratory. The Trustees used the estimates of amphipod mortality as a surrogate measurement of total ecological injury because amphipods and other benthic invertebrates form the base of the food web. In other words, injury to benthic invertebrates results in injury to other organisms that depend on them for food.

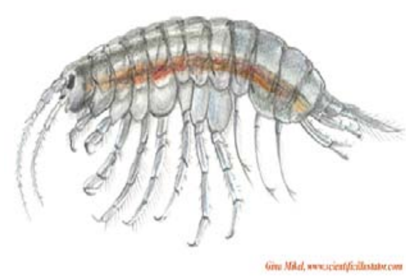

Image of a gammarid amphipod

Restoration Planning
After estimating the total resource injury caused by the contamination in Castro Cove, the Trustees identified and evaluated a range of possible project alternatives that could provide ecological services of the same type as those that were estimated to be lost. The Trustees also calculated how large such a restoration action must be to provide resource service gains equal to service losses estimated to have been caused by the release of contaminants. Based on the Trustees' best estimates, approximately 203 acres of tidal wetland habitat restoration would be needed to offset the loss of services calculated in the injury assessment.

The Trustees' restoration strategy is to identify and implement projects that improve the ecological function of habitats in San Pablo Bay that at present are not fully functional and that are identical or similar to the intertidal mudflat, salt marsh, and shallow subtidal habitat that was injured in Castro Cove. The Trustees consulted with local scientists, several public and private organizations, and State, federal and local governments to identify a reasonable range of restoration projects. The Trustees then evaluated these potential projects against a set of State and federal criteria, including two threshold criteria: (1) relationship of the proposed restoration project to the injured resources and/or lost services and (2) proximity of the proposed project to the affected area. In particular, the Trustees sought out projects located within the North Bay subregion of San Francisco Bay, the same ecological subregion (Goals Project 1999) in which Castro Cove is located. Additional criteria were then applied to emphasize project differences and determine which projects would provide the greatest resource benefits in the most efficient manner. Lastly, the Trustees identified the preferred restoration alternative (other potential restoration alternatives analyzed by the Trustees are discussed in the final DARP/EA). After the draft DARP/EA was released and public comments were received and considered, the Trustees refined the preferred alternative, as discussed below.

Preferred Alternative

The Trustees have selected a combination of two projects from among the seven tidal and three subtidal wetlands restoration projects that they evaluated. They will provide settlement funds for a proportional share of the Cullinan Ranch restoration project (estimated contribution: 158 acres of the 1,500 acre project) and will reserve another portion of the settlement funds to be applied toward the Breuner Marsh project to restore tidal wetlands (at least 30 and up to 45 acres of tidal wetlands).

Cullinan Ranch

Cullinan Ranch is located in the North Bay subregion in Solano County, approximately 12.5 miles north of Castro Cove. This project consists of returning approximately 1,500 acres of diked baylands to their historical wetland state as mature tidal marsh. A proportional share of this project equating to 158 acres will be funded by a settlement with Chevron for Castro Cove natural resource damages. This project ranks high in technical feasibility since planning and design have been completed and an environmental impact analysis is nearing completion. This project will not only provide resource benefits similar to those lost in Castro Cove but the amount of the settlement funds which the Trustees plan to allocate to this project is expected to act as a catalyst for the larger restoration project.

Breuner Marsh

Breuner Marsh is also located in the North Bay subregion, in the City of Richmond, south of Point Pinole Regional Shoreline in western Contra Costa County. It was recently acquired by the East Bay Regional Park District (EBRPD). Approximately 113 acres of the property is upland, seasonal wetlands and degraded tidal marsh, and 105 acres are open water, mudflats and other baylands. The restoration design for this project is still conceptual but calls for restoration of at least 30 and up to 45 acres of tidal wetlands as part of a broader set of habitat improvements and improved public access and recreation areas. The project ranks high because it is close to the injured site (approximately 2 miles) and the tidal wetlands restoration will provide resource benefits similar to the injured habitat in Castro Cove. The Trustees understand that the proposed amount allocated to this project from funds recovered in the settlement with Chevron will not only contribute to the planning, design and construction of a portion of the project but will also assist in raising additional funds for implementation. One million dollars, and potentially up to $2 million in additional funds have already been identified, as discussed below (see letter from EBRPD dated April 20, 2009 in Appendix C).

The combination of restoration at Cullinan Ranch and Breuner Marsh was identified as the Trustees' preferred alternative because these projects ranked the highest. Other projects ranked lower for various reasons. Some projects benefitted different types of resources than those injured in Castro Cove; others were located farther from the injury site; others did not provide enough restoration potential or were already funded; and still others ranked lower because of cost, feasibility, and/or land ownership issues. Ultimately, in the Trustees' judgment, funding portions of the costs of Cullinan Ranch and Breuner Marsh will best satisfy the evaluation criteria and provide appropriate compensation to restore habitats that support the fishery, birds, and other biological resources injured as a result of the Chevron releases in Castro Cove.

Additionally, both the Cullinan Ranch and Breuner Marsh projects rank high in regional restoration prioritizing plans (Goals Project 1999, San Francisco Bay Joint Venture http://www.sfbayjv.org/projects.php). And, as previously mentioned, partial funding from the Castro Cove NRDA settlement for these projects is likely to help secure additional funding from other sources. This, in turn, is likely to accelerate completion of both projects.

After circulating the draft DARP/EA for public review and comment, the Trustees have considered and responded to comments (see Appendix B). While the projects selected in the final DARP/EA did not change, the allocation of restoration acreages between Cullinan Ranch and Breuner Marsh has been adjusted in response to comments. These comments included additional information provided to the Trustees by the Breuner Project implementer indicating that more area is available for tidal wetland restoration. Based on this new information, the Trustees have increased the allocation of funding from the Castro Cove settlement for the Breuner Marsh project to $1 million. With this reallocation, the Trustees secured a commitment from EBRPD to match this funding with $1 million from other District funding sources, including a recently enacted bond measure, and to pursue still more funding through other grant sources (see letter from EBRPD dated April 20, 2009 in Appendix C).

The Trustees have negotiated a tentative legal settlement with Chevron and anticipate that the funds from a completed settlement will be sufficient to implement the preferred alternative selected in this final DARP/EA.

Table of Contents

ACRONYMS

AOC	Area of Concern
BAF	Bioaccumulation Factor
BCDC	Bay Conservation and Development Commission
CAA	Clean Air Act
CAP	Corrective Action Plan
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DARP	Damage Assessment and Restoration Plan
DOI	Department of the Interior
DSAY	Discounted Service Acre-Year
DWR	California Department of Water Resources
EA	Environmental Assessment
EBRPD	East Bay Regional Park District
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
HEA	Habitat Equivalency Analysis
HQ	Hazard Quotient
LGM	Logistic Growth Model
LRM	Logistic Regression Model
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observable Adverse Effect Level
NRDA	Natural Resource Damage Assessment
NWR	National Wildlife Refuge
OSPR	Office of Spill Prevention and Response
PAH	Polycyclic Aromatic Hydrocarbon
RMP	San Francisco Estuary Institute’s Regional Monitoring Program
ROD	Record of Decision
RP	Responsible Party
RWQCB	Regional Water Quality Control Board

SCR	Site Cleanup Requirements
TPAH	Total Polycyclic Aromatic Hydrocarbon
TRV	Toxicity Reference Value
USFWS	United States Fish and Wildlife Service
WCCSL	West Contra Costa Sanitary Landfill

1.0 INTRODUCTION

Chevron USA, Inc. (Chevron) owns and operates a 3,000-acre petroleum refinery in Richmond, California which historically discharged wastewater to the south side of Castro Cove, an embayment of San Pablo Bay in the San Francisco Bay estuary. These discharges resulted in elevated concentrations of mercury and polycyclic aromatic hydrocarbons (PAHs) in Castro Cove sediments. Lead pellets also were deposited in a portion of the Cove sediments from past skeet shooting activities. This final Damage Assessment and Restoration Plan (DARP) and Environmental Assessment (EA) has been prepared by the State and federal natural resource Trustees responsible for restoring natural resources and resource services injured by Chevron's releases of hazardous substances and oil into Castro Cove.

Both federal and State of California laws establish liability for natural resource damages and require responsible parties to compensate for injuries to natural resources and interim-lost services resulting from those injuries. These interim-lost resource services are not addressed by the response or clean up actions which result in primary restoration assisting the site in recovering from injuries. The Trustees use the recovered damages to implement projects that will restore the injured resources and services and/or compensate the public for services lost while the injured resources recover or are restored. Restoration planning undertaken by the Trustees in a natural resource damage assessment (NRDA) provides the link between the natural resource injuries and the restoration actions to compensate for the injuries. The purpose of restoration planning is to identify and evaluate restoration alternatives and to provide the public with an opportunity for review and comment on the proposed restoration alternatives.

This final DARP/EA informs the public about the affected environment, the injuries to natural resources and their quantification, restoration planning, and the restoration actions selected to address the natural resource injuries in Castro Cove. The Trustees received public comments from November 25, 2008, though January 9, 2009, on the restoration alternatives presented in the draft DARP/EA, and have considered and set forth their responses to the comments which they received in this final DARP/EA (see Appendix B). While the selected projects in the final DARP/EA did not change from those proposed in the draft, the allocation of restoration acreages has been adjusted in response to comments. These comments included additional information provided to the Trustees by the Breuner Project implementer indicating that more area is available for tidal wetland restoration. The Trustees have negotiated a tentative settlement with Chevron and anticipate the funds from such a settlement will be sufficient to implement the alternatives selected in the final DARP/EA. Upon recovering damages from Chevron, the Trustees will commence with restoration project implementation.

1.1 Purpose and Need for Restoration

The purpose of restoration is to make the environment and the public whole for injuries resulting from the releases of hazardous substances and discharges of oil. This is accomplished by implementing restoration actions that return injured natural resources[1] and resource services[2] to baseline[3] conditions and compensate for interim losses[4]. The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), the Department of the Interior's (DOI) United States Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG) are the federal and State trustee agencies (Trustees) for the natural resources injured by the releases and/or discharges into Castro Cove. As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources and services injured as a result of the releases and/or discharges.

This action, selection and funding of projects that restore natural resources, is needed to compensate for natural resource injuries resulting from historical releases of hazardous substances into Castro Cove. These pollution releases and their impacts are further explained in Section 1.2 and Section 3. The Trustees are selecting restoration actions at this time because of efforts to address historical contamination in Castro Cove. The California Regional Water Quality Control Board (RWQCB) recently issued site clean up orders to Chevron, and Chevron has conducted activities to clean up the site.

The Trustees have prepared this final DARP/EA to inform the public about the natural resource damage assessment and restoration planning efforts that have been conducted

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[1] Natural resources are defined as "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government. (See section 101 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C. § 9601 *et seq*. and section 11.13 of the Natural Resource Damage Assessment rule (NRDA Rule or DOI Rule) 43 C.F.R. Part 11 established under CERCLA for purposes of assessing natural resource damages resulting from a release of a hazardous substance under CERCLA or a discharge of oil under the Clean Water Act (CWA) 33 U.S.C. 1251-1376.)

[2] Services (or natural resources services) means the functions performed by a natural resource for the benefit of another natural resource and/or the public.

[3] Baseline is the condition that the environment (or a specific resource) would have been in if the releases or discharge in question had not occurred.

[4] Interim losses are those losses that occur from the time of the release/discharge or the date specified in the applicable statute, whichever is later, until the injured resources have either recovered naturally or are restored through an active restoration project.

and to guide restoration implementation. This document also serves, in part, as the trustee agencies' compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). By integrating the Natural Resource Damage Assessment process established by the Department of the Interior (DOI Rule) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund law," Title 42 U.S.C. Section 9601 et seq.) with the NEPA/CEQA process, the Trustees are meeting the public involvement components of the DOI Rule and NEPA/CEQA concurrently. However, a selected project may have already undergone or may require additional environmental compliance prior to actual implementation.

1.2 Overview of the Site / Summary of Releases

Castro Cove is a shallow, protected embayment in San Pablo Bay with extensive mudflats and salt marsh habitat that is influenced by tidal action. It is located entirely within Contra Costa County and is bordered to the north by San Pablo Bay, to the east by the West Contra Costa Sanitary Landfill (WCCSL) and Wildcat Creek Salt Marsh, and to the south and west by the Chevron refinery in Richmond (Figure 1). Castro Cove is defined as the area immediately north of the Chevron Refinery's North Yard Impound Basin enclosed by a line drawn from the Point San Pablo Yacht Harbor to the WCCSL. Rubble mound seawalls form the northeastern boundary adjacent to the landfill. Castro Creek and Wildcat Creek enter the cove from the south and east. The southeastern boundary consists of salt marsh and a levee containing the Refinery's North Yard Impound Basin. Portions of the southern and western shorelines contain salt marsh habitat with levees, containing a lagoon and the Chevron yacht harbor, running along the remainder of the western shoreline. Chevron leases use of Castro Cove from the State Lands Commission.

Historically, numerous industrial, commercial, and municipal operations discharged wastewater and stormwater runoff directly or indirectly into Castro Cove and the creeks running into the Cove (URS 1999). Ongoing nonpoint sources, such as urban runoff, are likely to continue into the future.

In 1902, refinery operations began adjacent to Castro Cove (URS 1999). In the early 1900s, the 250-Foot Channel and a navigation channel were dredged from San Pablo Bay along the approximate existing alignment of the Castro Creek channel to provide shipping access to the refinery. In 1957, a dam and dikes were constructed across the mouth of the 250-Foot Channel. Standard Oil Company, a predecessor of Chevron, discharged wastewater treated by an oil water separator into the south side of Castro Cove. After implementation of the Clean Water Act in 1972, all process water was biologically treated prior to being discharged into the 250-Foot Channel. In 1987, discharge of treated effluent to Castro Cove ended when all discharge water was rerouted to the Deep Water Outfall located offshore of Point San Pablo, outside of Castro Cove.

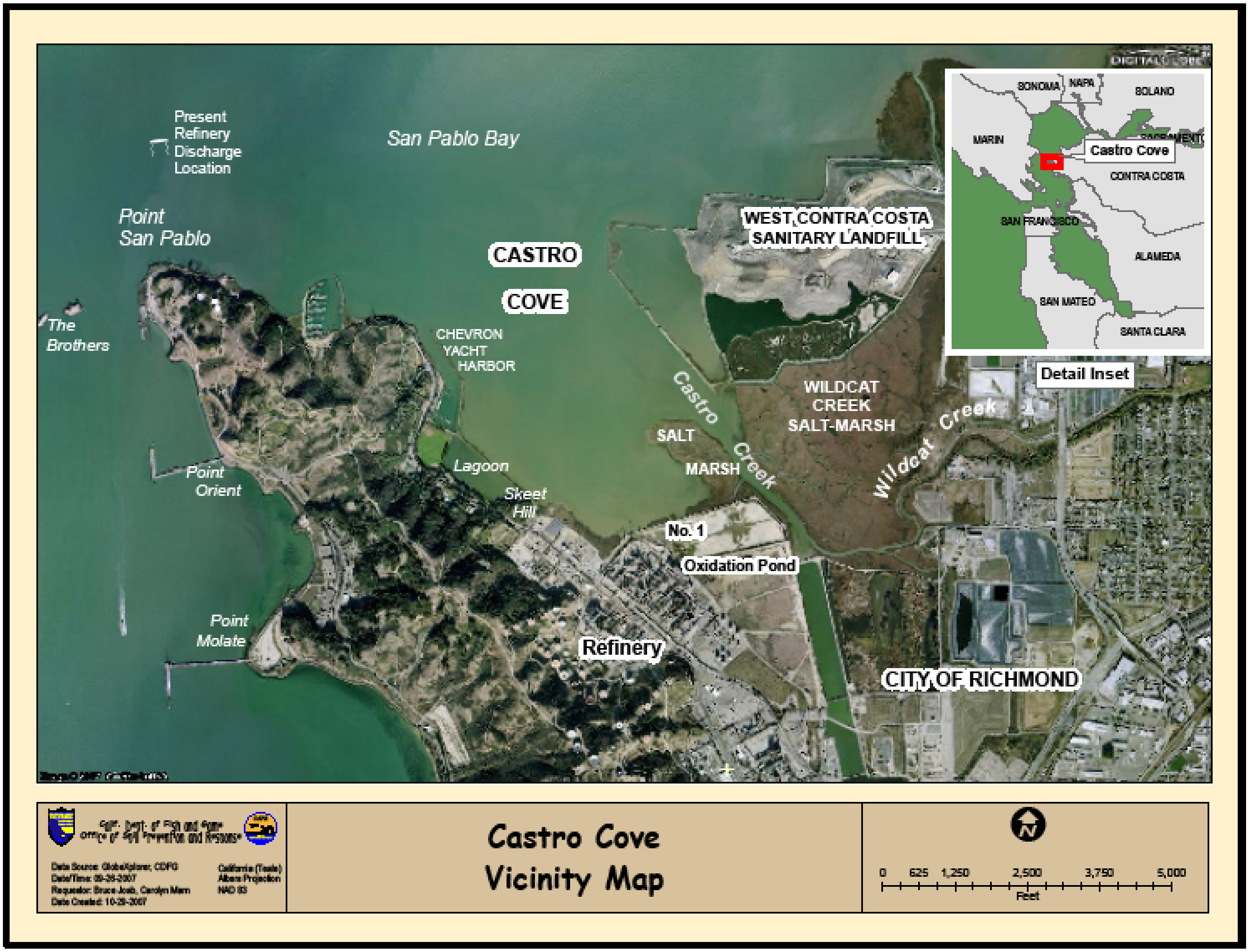

Figure 1: Castro Cove vicinity map.

Until the completion of a municipal treatment plant in 1955, the San Pablo Sanitary District discharged untreated sewage into Castro Creek near the confluence with Wildcat Creek. The district discharged treated effluent directly into the cove through a channel which ran along the southern end of the West Contra Costa Sanitary Landfill from 1955 to 1981. These discharges, not associated with Chevron effluent discharges, ended in 1981 when the district relocated its outfall to a deep-water site offshore of Point Richmond.

From 1960 to 1994, Chevron operated a trap and skeet shooting range at the northwestern end of the Richmond refinery on Skeet Hill (URS 2002a). The shooting sites were located in the middle of a leveled area (82 feet in elevation) approximately 250 and 300 feet from the shoreline of Castro Cove. The area of shot deposition in Castro Cove comprises approximately 9 acres or 9.5 percent of the total mudflat area in Castro Cove at low tide. Lead shot (primarily #9 and #8, also #7 ½) is concentrated in the upper six inches of sediment over a 1 ¾-acre area extending between 200 and 425 feet from the shoreline.

1.3 Natural Resource Trustees and Authorities

CERCLA and the CWA authorize federal, state, or tribal authorities to seek monetary damages for injury, destruction, or loss of natural resources resulting from releases of hazardous substances or discharges of oil. The USFWS, NOAA, and the CDFG are the federal and State of California Trustees respectively for the natural resources injured by the releases into Castro Cove. No Tribal trustees have been identified. As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources injured as a result of releases of hazardous substances and oil. The USFWS and NOAA are designated federal trustee agencies for natural resources pursuant to subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 C.F.R. § 300.600 et seq.) and Executive Order 12580 (3 C.F.R., 1987 Comp. p. 193, 52 Fed. Reg. 2923 (January 23, 1987) as amended by Executive Order 12777 (56 Fed. Reg. 54757 (October 19, 1991)). For purposes of coordination and compliance with CERCLA, the CWA, and NEPA, NOAA is designated as the lead federal Trustee. CDFG has been designated as a State trustee for natural resources pursuant to subpart G of the NCP. Additionally, CDFG has State natural resource trustee authority pursuant to Fish and Game Code §§ 711.7 and 1802.

1.4 Natural Resource Damage Assessment Process

Under CERCLA and the CWA responsible parties (RPs) are liable for the reasonable costs of conducting a natural resource damage assessment, as well as for damages for injury to, destruction of, or loss of natural resources. Chevron accepted the Trustees' invitation to enter into a Cooperative Natural Resource Damage Assessment

Agreement (hereinafter "Agreement") for the Castro Cove releases. The Agreement established a process by which representatives of Chevron and the Trustees coordinated technical activities in the injury determination and quantification stages of the assessment, as well as restoration scaling and planning activities.

Under the Agreement, biologists, toxicologists, resource economists, and other specialists representing the Trustees and Chevron cooperated as a technical working group to analyze data and other information regarding the assessment of injuries to various species and habitats. They also worked together to identify potential actions that would restore or compensate for injuries. This final DARP/EA was developed based upon the cooperative injury assessment and restoration planning efforts between the Trustees and Chevron and their representatives. The determinations and other decisions made by the Trustees, documented in this final DARP/EA, reflect consideration of the efforts and input of the technical representatives of the parties. Appendix A and the Administrative Record contain the results of this cooperative effort, including reports on specific topics.

1.5 Coordination with the California Regional Water Quality Control Board

In addition to the Trustees' NRDA efforts, the primary restoration or clean up of contaminated sediments in Castro Cove is being conducted by Chevron with oversight by the RWQCB. In 1998, the RWQCB requested that Chevron prepare a Sediment Characterization Workplan based on the identification of Castro Cove as a candidate toxic hot spot under the Bay Protection and Toxic Cleanup Program. The site investigations conducted at the request of the RWQCB by Chevron between 1999 and 2001 indicated that historical releases from industrial, commercial and municipal operations had affected near surface sediments in the Cove with the primary contaminants of concern being mercury and PAHs. Based on the presence of PAHs, mercury, dieldrin, and selenium in sediments, Castro Cove was added to the State's Clean Water Act (CWA) section 303(d) list of impaired waters in 2002. A Corrective Action Plan (CAP) for sediment remediation was submitted in 2002, and a revised CAP was submitted in 2006. In 2006, the RWQCB issued site cleanup requirements and a water quality certification under Section 401 of the Federal CWA for remediation of sediment contamination in Castro Cove, based on the finding that there was unacceptable risk to ecological receptors (i.e., sediment-dwelling benthic invertebrates). Chevron was considered to be the sole discharger for purposes of the cleanup order. The RWQCB found that implementing the CAP would appropriately remediate the sediments in Castro Cove, and this served as the basis for the Tentative Site Cleanup Requirements (SCRs).

The portion of Castro Cove that is being remediated under the CAP covers about 20 acres in area and is referred to as the area of concern (AOC)[5]. Delineation of the size and depth of the AOC was based on site investigations and characterization overseen by the RWQCB. Site characterization included collecting sediment samples and analyzing them for chemical constituents and testing them for toxicity to fish and amphipods, a small sediment dwelling organism. The chemical and biological data were used to define the area of contamination and to assess the potential risk that the contaminants presented to wildlife. The chemical results indicated that the sediments in south Castro Cove to a depth of two feet below the mud-line were impacted by historical discharges from refinery operations. The risk assessment conducted for the RWQCB concluded that the contaminant concentrations in the AOC posed a potential risk to the benthic community (that is, organisms living in the upper layers of the sediments).

To ensure that this upper layer of sediment is removed and that the biological viability of Castro Cove is restored, the CAP requires Chevron to hydraulically dredge the uppermost 2.5 feet of sediments from most of the AOC. In an approximately 1.5-acre area in the southwest corner of the AOC where contaminants are found slightly deeper than two feet, the CAP requires Chevron to excavate sediments to a depth of three feet and then backfill to provide an area of suitable elevation for cordgrass (*Spartina*) restoration. The dredged materials are to be placed at the Number 1 Oxidation Pond (Pond) located within the Refinery, and Chevron is required to construct a protective barrier/cap over the disposed material. The RWQCB adopted a mitigated Negative Declaration after determining that the remediation project would not result in any impacts that were not sufficiently addressed by mitigation measures and included as part of the project.

Chevron is expected to complete the dredging of contaminated sediments in the AOC in 2010; implementation of the other requirements of the CAP is still in progress. With the exception of long-term monitoring requirements, the requirements of the CAP are expected to be completed during 2010, or soon thereafter.

[5] The use in this document of the term "Area of Concern" is not intended to imply that areas outside of the AOC are not of concern from the standpoint of natural resource injuries. The term derives from existing documents prepared to investigate and address the need for remediation of sediments exceeding certain cleanup thresholds developed by the San Francisco Bay Regional Water Quality Control Board for this site.

1.6 Coordination with Non-Trustees

Prior to developing the final DARP/EA, the Trustees conducted numerous outreach efforts to solicit ideas and concepts for restoration projects that would compensate the public for injuries to natural resources at Castro Cove. The Trustees contacted over 28 community groups and State, federal and local agencies to seek relevant information on potential restoration projects and restoration ideas (see Section 4.5) and met with City of Richmond representatives to inform them of the NRDA at Castro Cove and to solicit input on potential restoration projects. The Trustees also evaluated specific projects identified by the City of Richmond as part of a re-evaluation of the preferred projects based on new information provided by the City.

1.7 Public Participation

An opportunity for the public to comment on the draft DARP/EA was an integral component of this restoration planning process as set forth in the DOI Rule and CERCLA. The Trustees scheduled a 45-day period for the public to review and comment upon the draft DARP/EA, from November 25, 2008 through January 9, 2009. The Trustees held an open house to discuss the draft DARP/EA with the community and interested members of the public at the Point Richmond Community Center, in Richmond, California on December 17, 2008. Comments received are a part of the official record and are presented, along with the Trustees' responses, in Appendix B.

1.8 Administrative Record

The Trustees opened an Administrative Record (Record). The Record includes documents relied upon or considered thus far by the Trustees during the injury assessment and restoration planning performed in connection with the Castro Cove releases. The official Record is maintained by NOAA (Point of Contact: Trina Heard at (562) 980-4070 or by email at Trina.Heard@noaa.gov). The Record Index may be viewed at the following websites:

www.dfg.ca.gov/ospr/spill/nrda/nrda_castro.html

www.darrp.noaa.gov/southwest/castro/index.html

2.0 AFFECTED ENVIRONMENT

This section presents a brief description of the physical and biological environment affected by the releases and discharges into Castro Cove, and potentially affected by the preferred projects, as required by NEPA (40 U.S.C. Section 4321, et. seq.). The physical environment most directly affected by the releases is the 20 acres of intertidal mudflats in the AOC and an additional 184 acres of intertidal mudflat and salt marsh habitat within Castro Cove that were contaminated to a lesser extent. This acreage within Castro Cove is a part of a larger embayment comprising approximately 90 square miles of San Pablo Bay in the northern reach of San Francisco Bay. The biological environment includes the benthic community that resides in the intertidal mudflats as well as birds, fish, mammals, shellfish, and other organisms that use intertidal mudflat and salt marsh habitats in San Pablo Bay. Several State and federally-recognized threatened or endangered species are found within the region. To the extent that proposed projects are located within this area, this chapter provides information on the affected environment as required by NEPA (42 U.S.C. Section 4321, et. seq.). When seeking restoration projects, the Trustees prefer in-kind restoration (e.g., the creation of a new marsh or enhancement of an existing marsh to compensate for lost marsh services) in geographical proximity to the area affected.

2.1 Physical Environment

The San Francisco Bay and the Delta formed by the Sacramento and San Joaquin rivers, create the West Coast's largest estuary. Four distinct subregions comprise the estuary, designated based upon unique features and habitat restoration constraints and opportunities (Goals Project 1999). San Pablo Bay is in the North Bay subregion of San Francisco Bay, downstream of the Carquinez Bridge which forms the western boundary of the brackish Suisun subregion and upstream of the more saline Central Bay subregion delineated between Point San Pedro and Point San Pablo (see Figure 2).

The patterns of water circulation and salinity in San Pablo Bay are affected directly by the freshwater Delta outflow and runoff from the Napa and Petaluma rivers and diurnal tides from the Pacific Ocean (URS 1999). Two unequal high tides and two unequal low tides occur during each approximate 25 hour period. Winter runoff contains large quantities of sediment which are deposited in the Bay with resuspension of some sediment occurring during the higher spring tides. Tidal and wave action during the remainder of the year provide the energy to separate sediments, retaining heavier material in the higher energy areas of the Bay and depositing finer material in sheltered coves and tidal marshes. Castro Cove, as a shallow embayment in San Pablo Bay, has finer sediments (primarily silts and clays with some fine sand) than control sites in San Pablo Bay, with a higher percentage of sandy material in the Castro Creek channels (URS 1999). Radioisotope dating and bathymetric surveys for Castro Cove indicate that sediment is accreting at a rate of 0.4 to 0.5 inches per year with higher rates of 3 to 4 inches per year in areas that have been dredged.

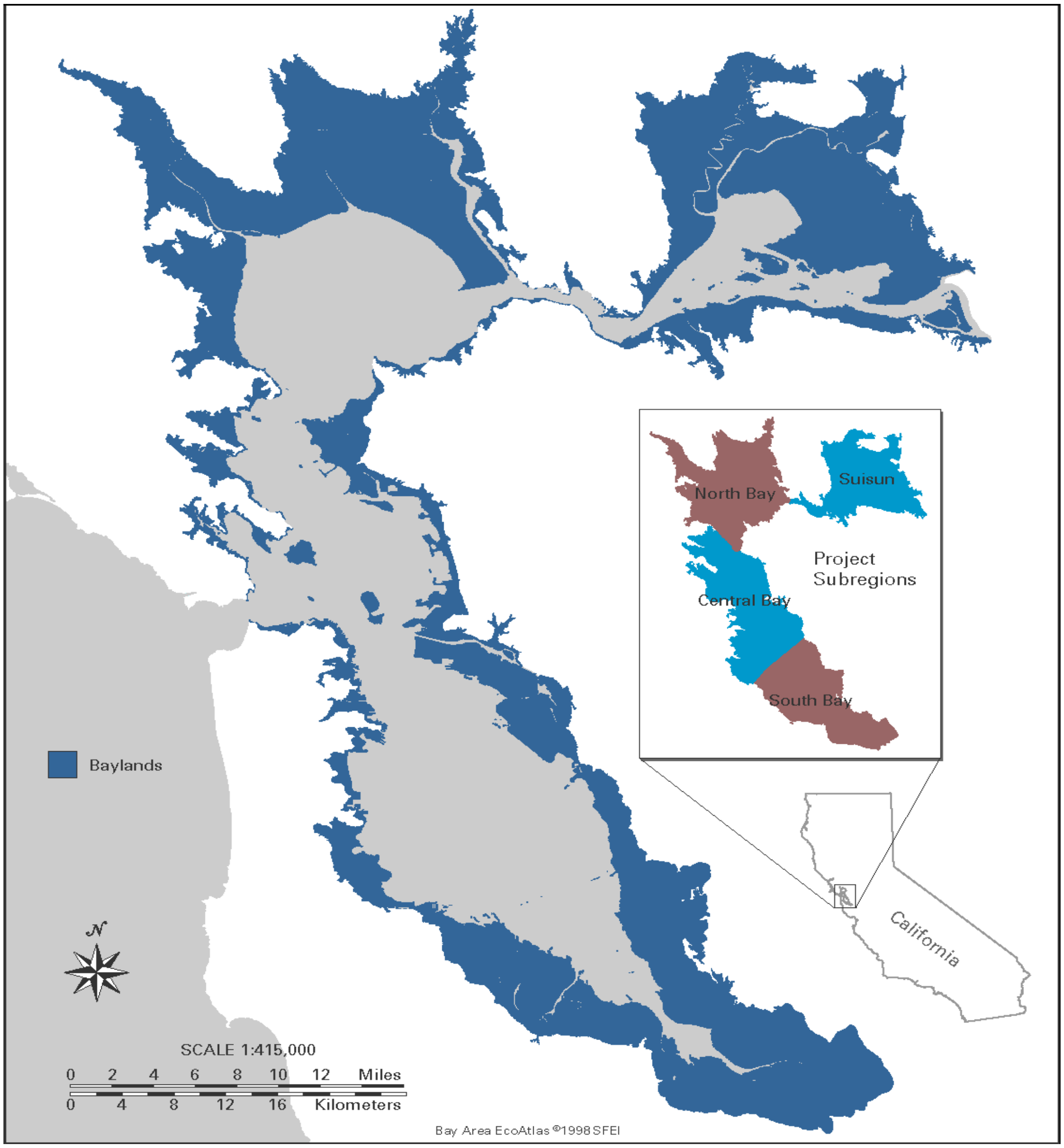

Figure 2. Map of project subregions including Suisun, North Bay, Central Bay, and South Bay (Goals Project 1999).

Habitats in San Pablo Bay vary from deep bay marine to mudflats and marsh/slough complexes; although approximately 60 percent of San Pablo Bay is less than 6 feet deep at mean lower low tide. The 80,000 acres of diked and tidal baylands remaining around the perimeter of the Bay and adjacent to rivers are unique features of San Pablo Bay. Baylands refer to the shallow water habitats between the maximum and minimum elevations of the tides (Goals Project 1999). San Pablo Bay historically contained large tracts of tidal marshes bordered by extensive mudflats. The area surrounding lower Castro Creek (see Figure 1) once contained a large tidal marsh bordered by large areas of moist grasslands. An estimated 75 percent of the original tidal wetlands associated with San Pablo Bay have been converted to other uses.

2.2 Biological Environment

San Pablo Bay contains the largest continuous expanse of open shallow-water habitat in the northern estuary and these productive intertidal mudflats and subtidal shallow-water habitats support the phytoplankton and benthic microalgae that provide the basis for the food web in San Pablo Bay. San Pablo Bay provides important spawning and rearing habitat for many marine, estuarine, and anadromous fish as well as marine and estuarine invertebrates. Shorebirds, diving ducks, and bottom-feeding fish are the primary predators to the benthic invertebrates. The largest, over 1500 acres (Merkel & Associates 2004), and most contiguous eelgrass (*Zostera marina*) bed in San Francisco Bay can be found within shallow-water areas in San Pablo Bay and provides important habitat for benthic invertebrates, fish, and birds.

San Pablo Bay contains about one-third of the estuary's tidal mudflat habitat. During low tide, most of Castro Cove consists of exposed mudflats (URS 1999). The Castro Creek channel, which is 1 to 2 feet deeper than the surrounding mudflats, also is largely mudflat habitat at low tide. Mudflats provide important foraging habitat for shorebirds. Willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), long-billed curlew (*Numenius americanus*), dunlin (*Calidris alpina*), whimbrel (*Numenius phaeopus*), sanderling (*Calidris alba*), and Western sandpiper (*Calidris mauri*) have been observed foraging at the tideline in Castro Cove. When water inundates the mudflats during the twice-daily high tides, migratory waterfowl, gulls (*Larus* sp.), and other water birds may forage or use the cove for roosting or as a staging area, including Western (*Aechmophorus occidentalis*) and Clark's grebe (*A. clarkii*), scaup (*Aythya* spp.), ruddy duck (*Oxyura jamaicensis*), American wigeon (*Anas americana*) and mallard (*Anas platyrhynchos*). The double-crested cormorant (*Phalacrocorax auritus*), nests on the Richmond/San Rafael Bridge and has been observed in Castro Cove (URS 1999). Castro Cove supports macroinvertebrates including dungeness crab (*Cancer magister*), yellow shore crabs (*Hemigrapsus oregonensis*), native oyster (*Ostreola conchaphillia*), bay shrimp (*Crangon franciscorum*), and the oriental shrimp (*Palaemon macrodactylus*), in addition to the benthic invertebrates, such as polychaetes, oligochaetes, bivalves, amphipods, and other crustaceans (URS 2002a). Many midwater and epibenthic fish species such as starry flounder (*Platichthys stellatus*) feed on the invertebrates in Castro Cove. Striped bass (*Morone saxatilis*), northern anchovy (*Engraulis mordax*), longfin smelt (*Spirinchus thaleichthys*), rockfish (*Sebastes* spp.), white sturgeon (*Acipenser transmontanus*), Pacific staghorn sculpin (*Leptocottus armatus*), and shiner perch (*Cymatogaster aggregata*) also may occur in Castro Cove. Fish-eating birds, such as osprey (*Pandion haliaetus*) and California brown pelicans (*Pelecanus occidentalis*), are also known to forage in Castro Cove.

Tidal salt marsh is considered a sensitive natural community. These vegetated wetlands that are subject to tidal action along the Bay are dominated by Pacific cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia virginica*) depending on elevation within the intertidal zone. On the tidal mudflats around the marsh plain and in low marshes cordgrass predominates, while pickleweed begins to dominate in middle tidal salt marshes at elevations near the mean high water (MHW) and above. The tidal salt marsh in the southeastern portion of Castro Cove along the Castro Creek channel and adjacent to Castro Creek is mostly a middle marsh community dominated by pickleweed with scattered patches of saltgrass (*Distichlis spicata*) and communities of cordgrass located along the edge of the bay (URS 1999). Nesting black-necked stilts (*Himantopus mexicanus*), American avocets (*Recurvirostra americana*), dowitchers (*Limnodromus* spp.), snowy egrets (*Egretta thula*), great egrets (*Ardea alba*), and Canada geese (*Branta canadensis*) have been reported along Castro Creek (URS 1999).

2.3 Species of Concern

There are several species that utilize or could potentially utilize Castro Cove that are of special concern due to their population status. Endangered coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*), and threatened green sturgeon (*Acipenser medirostris*) and steelhead (*O. mykiss*) could potentially occur in the open water area. The endangered California least tern (*Sternula antillarum*) preys on small fish and often forages in eelgrass beds in the estuary while the threatened Western snowy plover (*Charadrius alexandrinus*) forages in mudflat habitat. The California clapper rail (*Rallus longirostris*) and the salt marsh harvest mouse (*Reithrodontomys raviventris*), both federal- and State-listed endangered species that occupy salt marsh habitats around the Bay, occur in the Castro Cove area (URS 1999). The State-listed threatened California black rail (*Laterallus jamaicensis*) was reported in the area in 1981 (URS 1999). Two State-listed Species of Concern, the San Pablo vole (*Microtus californicus*) which has been observed at the mouth of Wildcat Creek, and the saltmarsh wandering shrew (*Sorex vagrans*) which is known to occur in the San Pablo Creek Marsh, could occur in the salt marsh adjacent to Castro Cove (URS 1999).

3.0 CASTRO COVE INJURY QUANTIFICATION

This section describes the technical working group efforts to quantify the nature, extent, and severity of injuries to natural resources resulting from Chevron's releases to the water and sediment in Castro Cove. It begins with an overview of the data used in assessing the injury to resources in Castro Cove, followed by a description of the methods used to determine and quantify the injuries and lost resource services. Biologists, toxicologists, resource economists, and other specialists representing the Trustees and Chevron cooperated as a technical working group in gathering and analyzing data and other information regarding injuries to various species and habitats. They also worked together to identify potential actions that would restore or compensate for injuries to species and habitats. The timeframe from January 1981 forward to the remediation and post-remedial recovery is the period addressed by the NRDA process. While discharges occurred prior to January 1981, this date represents the beginning of the statutory authority to recover damages for any injuries to natural resources under CERCLA. Remediation of contaminated sediments in the most heavily impacted areas was initiated in 2007, and is largely complete (see Section 1.5 above). Although this was an extensive sediment removal action, not all of the contamination was removed. This is accounted for in the injury quantification.

State and federal scientists and Chevron's consultants used existing chemical analysis and bioassay test results from Castro Cove and San Pablo Bay, modeling, scientific literature, and scientific judgment to arrive at the best estimate of the injuries caused by the releases of hazardous substances and discharges of oil. This analysis recognized that some uncertainty is inherent in the assessment of injuries from chemically impacted sites such as Castro Cove. While the Trustees understand that collecting more information would likely reduce some of the uncertainties in the estimate of injuries, they have sought to balance the desire for improved injury estimates with the reality that further study would delay the implementation of restoration projects and substantially increase assessment costs, and they recognize that, given the conservative input estimates utilized in the Habitat Equivalency Analysis (HEA), more certainty in those data would be unlikely to produce any significant difference in the nature or scale of the restoration actions.

Natural resources may support recreational activities or other public uses potentially affected by contamination. The Trustees considered potential recreational uses including fishing, swimming, wildlife viewing, and boating, but found no information indicating services of this nature have been lost or diminished due to contaminants released at the site.

No health advisories exist with respect to swimming or any other contact recreational activities in Castro Cove. Public access to the Cove is extremely limited because the surrounding upland is largely comprised of private industrial properties. Boating access to the inner portion of the Cove is inhibited by extremely shallow water and soft sediments. Therefore, there is little likelihood of lost recreational use of surface waters due to the contamination at the site.

Based on this situation, the Trustees concluded that there was no reason to conduct a separate analysis of recreational losses and assumed that restoration actions addressing lost habitat services would also address any un-quantified human use losses that may have occurred as a result of contamination at the site.

3.1 Approach to Injury Assessment

Figure 3 provides an overview of Castro Cove and the sampling sites used to evaluate the injury. Based on an analysis of sediment samples, the technical working group determined that the inner half of the cove was the area most significantly impacted by the releases. Levels of contamination in samples collected in the outer half of the cove were not significantly different from background contamination levels in other parts of San Pablo Bay. The technical working group divided the impacted area in the inner half of the cove into two sections: (1) the AOC delineated by the RWQCB; and (2) the non-AOC. The AOC, approximately 20 acres where sediment removal has occurred, contains tidally-influenced mudflats. The non-AOC includes tidally-influenced mudflats, sections of saltmarsh, as well as lower Castro Creek (Figure 3). Additional details are presented in Section 3.2.

Castro Cove was mapped, and polygons were delineated by use of a tessellation process that divided the cove into bounded areas, each containing a single sediment sample in the center (Figure 3). A tessellation is a collection of polygons fit together such that they fill the plane with no overlaps or gaps. All sediment data were taken from existing reports (URS 1999; 2002b). The data set was quite extensive since Castro Cove has had numerous rounds of investigation, some of them related to the remediation process overseen by the RWQCB. Mercury and total polycyclic aromatic hydrocarbon (TPAH) concentrations in sediment samples were highly correlated; the Trustees used TPAH for the primary injury assessment to benthic invertebrates and evaluated additional risk to vertebrates from mercury and lead shot as described below.

The primary injury analysis utilized paired Castro Cove TPAH sediment concentrations and amphipod bioassay results (i.e., percent mortality). The Trustees compared these two sets of data in a manner similar to one used to predict amphipod toxicity (either the probability of toxicity or the magnitude of toxicity) from sediment chemistry (Field et al. 2002). This comparison then provides a means to characterize toxicity at sampling stations where only sediment chemistry data are available. The TPAH concentrations in the sediment samples from each polygon were used to estimate the severity of the contamination. The magnitude of the TPAH contamination was then used to determine the degree of injury to the natural resource services. An area weighting factor was applied proportionate to the size of the polygons to account for the areal extent of contamination in the injury estimate.

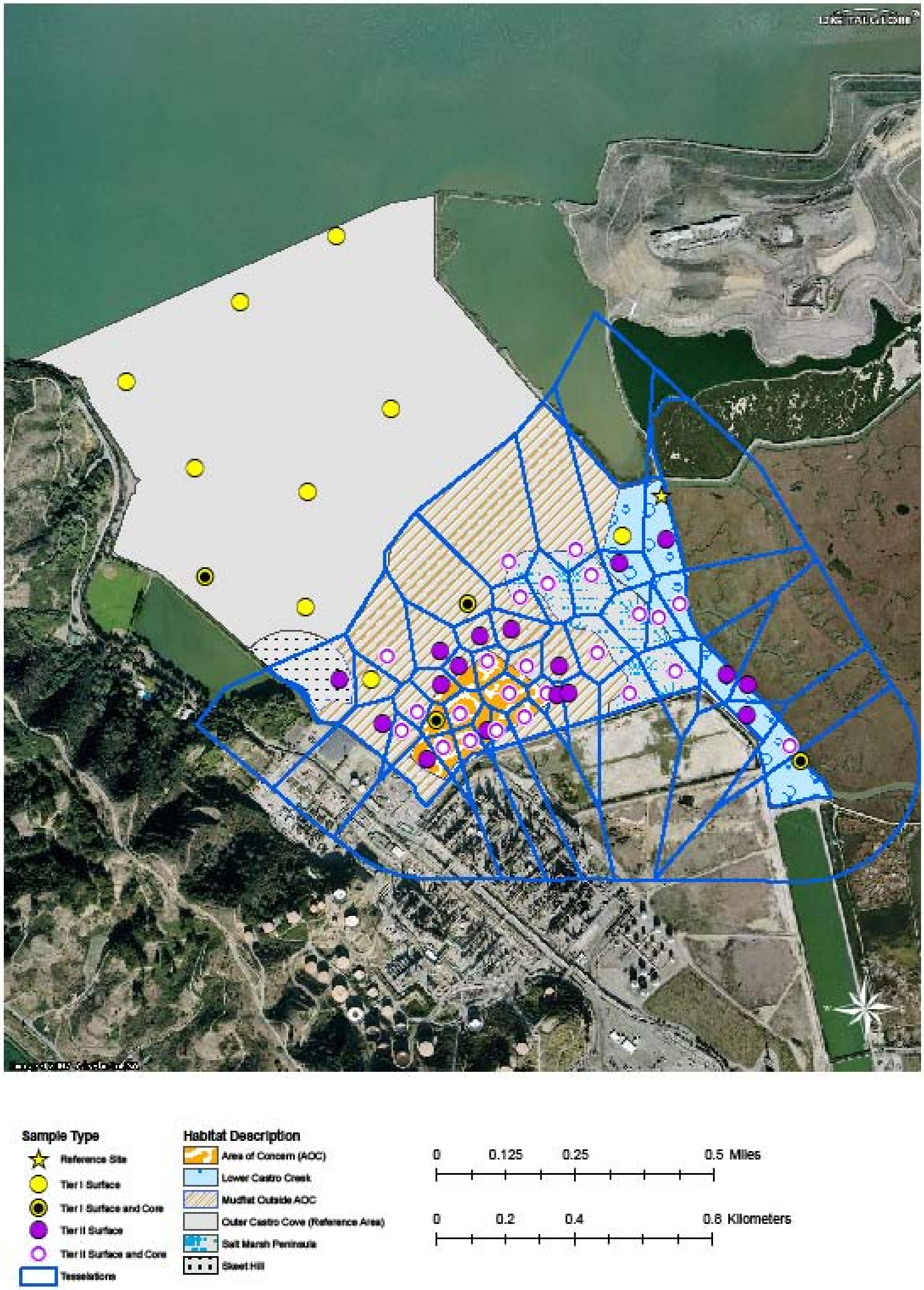

Figure 3. Castro Cove sediment sampling locations and tessellation polygons.

The Trustees used the estimates of amphipod mortality as the measure of total ecological injury and lost services in a direct 1:1 manner. Thus, amphipod injury served as a proxy for injuries throughout the ecological food web. The technical working group considered this appropriate and a conservative measure of service loss to the food web since benthic invertebrates such as amphipods form the base of the food web for other aquatic organisms and wildlife that depend upon them. Additional details are presented in Section 3.3.

In addition to the amphipod mortality evaluation, a food chain model estimated risk to resident birds and small mammals in the salt marsh (i.e., the California clapper rail and salt marsh harvest mouse). Since mercury is a persistent contaminant that bioaccumulates and can increase to harmful levels up the food chain, a food chain model examined whether there was sufficient risk present to justify additional injury quantification for the effects of mercury on birds and mammals in Castro Cove. Additional details are presented in Section 3.4.

As fish utilize the Castro Cove habitat, a separate risk assessment for fish evaluated whether sufficient risk was present to justify a separate injury analysis for these resources. The risk assessment addressed both TPAHs and mercury, and is described in greater detail in Section 3.5.

Lastly, the technical working group conducted an evaluation of the risk to shorebirds and waterfowl from ingestion of lead shot in the sediment. Shot, resulting from historical skeet range activities, is present in the sediments in an arc-like pattern emanating from Skeet Hill and extending into Castro Cove's mudflat habitat (Figure 3). An assessment of the risk of lead shot ingestion to sediment-probing shorebirds and waterfowl determined whether any additional injury quantification was warranted for this receptor group. This assessment is described in greater detail in Section 3.6.

3.2 Chemistry

Sediment data collected from previous investigations indicated that the primary contaminants of concern that Chevron had contributed to the sediments of Castro Cove were mercury and PAHs. These were also identified by RWQCB as the primary chemicals of interest in determining Chevron's cleanup requirements for Castro Cove. The chemistry results from the *Draft Sediment Characterization and Tier I Ecological Risk Assessment for Castro Cove* (URS 1999) and the *Tier II Sediment Characterization and Ecological Risk Assessment Castro Cove* (URS 2002b) were used along with bioassay results to assess the extent of injury to the benthic macroinvertebrate infauna living in the mudflat habitat of Castro Cove. Copies of these documents are available in the Administrative Record, discussed in Section 1.8.

Concentrations of mercury and PAHs were compared to background levels in San Pablo Bay using the San Francisco Estuary Institute's Regional Monitoring Program (RMP) dataset (Appendices A-1a and A-2c). This step corrected for concentrations of these chemicals in Castro Cove sediments due to sources other than Chevron.

Mercury and TPAH concentrations were highly correlated. For scaling purposes, the Trustees selected TPAHs as the indicator for injury assessment. Concentrations of TPAHs above background were used to determine the degree of injury to attribute to Chevron within each polygon. If sample results from the 0 to 1 foot depth did not exist, surface sample data were used. The method for determining the degree of injury for each sample is described in the following section.

3.3 Amphipod Bioassay Results

A standardized laboratory procedure known as a bioassay was conducted to evaluate the toxicity of Castro Cove sediments to aquatic benthic organisms. A bioassay with the amphipod *Eohaustorius estuarius* was performed in some of the sediment samples taken from Castro Cove (URS 2002b). The results of these amphipod bioassays were used along with the chemistry results to create a dose-response curve that predicts the percent mortality at a given concentration of TPAH in the sediment (Figure 4). This curve is referred to as a Logistic Growth Model (LGM) based upon the mathematics of its derivation.

Shallow aquatic habitats such as Castro Cove provide many types of natural resource services, including biological productivity and food web services, breeding and nesting sites, shelter from predators, roosting grounds for migratory birds, and other functions. Nevertheless, for this case, the Trustees assumed the overall degree of natural resource injuries and lost services in Castro Cove to be equal to the degree of amphipod mortality predicted by the LGM curve. Thus, amphipod mortality associated with sediment contamination is used as a proxy for a broad range of natural resource injuries and lost services, including higher-level organisms (i.e., birds and fish) and other non-food web services. This was done because while there was a quantitative estimate of risk to birds and fish in Castro Cove, there was no useful quantitative metric for evaluating these injuries in the HEA, i.e., to convert them to Discounted Service Acre-Years (DSAYs) for the HEA (see Appendix A-6), and the fundamental role of the benthic community in the health and productivity of the entire ecosystem made the use of a conservative estimate of impacts on that community a reasonable surrogate for impacts on the entire system.

The LGM curve served as a tool for predicting amphipod mortality which was then used to determine the level of injury. For each polygon the TPAH chemistry results were used to determine the injury level by applying the mathematical relationship represented by the LGM curve. Figure 4 shows this curve as the dashed line (see also Appendix A-2d).

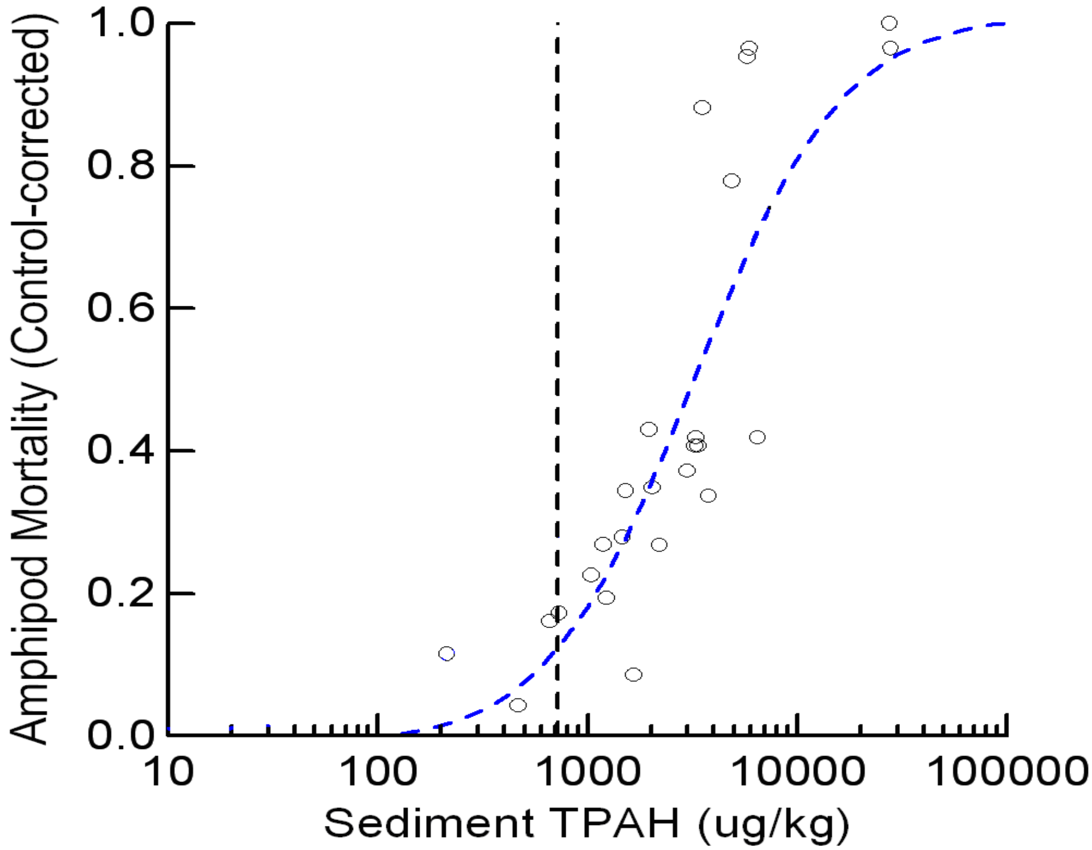

Figure 4. Logistic growth model for amphipod toxicity test responses (mortality) to TPAH concentrations. The vertical dashed line corresponds to the regional background concentration based on mean TPAH concentrations from the RMP for San Pablo Bay.

3.4 Food-chain Modeling Results for Selected Castro Cove Receptors

A food chain model was constructed to estimate risk to the California clapper rail and the salt marsh harvest mouse as these organisms are assumed to inhabit the salt marsh habitat adjacent to Castro Cove year round. Risks to the willet and scaup were assessed using the food chain model for exposures occurring in the mudflat habitat (Appendix A-3b). These analyses were performed based on mercury exposure, as it has the capacity to bioaccumulate in the food chain resulting in harm to higher-level organisms and particularly their offspring. Environmentally protective assumptions (e.g., 100 percent bioavailability of mercury, a range of bioaccumulation factors (BAF), and sediment concentrations based on the upper 95 percent value), were used in estimating exposures as a means of addressing uncertainties and erring on the side of over-estimating injuries in this analysis. The results generated several hazard quotients (HQs) below one and a few HQs above one (Table 1)[6]; HQs > 1 indicate potential risk because the estimated dose to the organism exceeds either a Low toxicity reference value (TRV) considered safe or a High TRV associated with adverse effects. The HQ results for the California clapper rail, salt marsh harvest mouse, willet, and scaup were low enough that the Trustees considered the “reasonable worst case scenario” described by the LGM prediction of injury sufficient to incorporate the estimated injuries based on food chain modeling. Thus, the Trustees assumed there was no additional injury beyond that described by the process in Section 3.3 and applied to the Castro Cove ecosystem.

Table 1. Dose and Hazard Quotient Estimations for Select Castro Cove Receptors, using the Upper 95% Surface Sediment Concentrations and Low and High Toxicity Reference Values (DTSC 2000).

Species/ Location	**Estimated Hg Dose BAF = 1.66* (mg/kg/day)**	**Estimated Hg Dose BAF = 0.187** (mg/kg/day)**	**Hazard Quotient BAF = 1.67**		**Hazard Quotient BAF = 0.187**	
			TRV_{Low}	**TRV_{High}**	**TRV_{Low}**	**TRV_{High}**
California Clapper Rail/Salt Marsh	0.1090	0.0217	2.79	0.61	0.56	0.12
Salt Marsh Harvest Mouse/Salt Marsh***	0.2457	0.0305	0.983	0.061	0.124	0.008
Willet/Mud Flat	0.1903	0.0413	4.91	1.06	1.06	0.23
Scaup/Mud Flat	0.1739	0.0250	4.49	0.97	0.64	0.14

*Bioaccumulation Factor is an average for San Pablo Bay sites in the RMP.
**Mean BAF from clams collected from offshore areas at Mare Island (Tetra Tech EM Inc. 2000).
***A BAF of 1.66 was assumed for the vegetation ingested by the salt marsh harvest mouse, as 100 percent of the diet is vegetable matter.

3.5 Fish Injury Assessment

The technical working group evaluated potential injuries to fish in Castro Cove using the English sole (*Parophrys vetulus*) as the surrogate species. This species is a bottom-dwelling flatfish that has been extensively studied for effects from exposure to PAHs. In the absence of site-specific data on fish injuries for Castro Cove, the technical working group relied on service loss assumptions for English sole that were developed for a natural resource damage assessment for the Hylebos Waterway in Commencement Bay, Washington State (NOAA 2002). Sediment concentrations of

[6] A hazard quotient (HQ) is calculated by dividing the exposure point concentration for an organism by the toxicity reference value (TRV). A more detailed description of this computation can be found in Appendix A-3.

TPAHs in Castro Cove were compared to sediment concentrations of TPAHs for which thresholds of assumed service losses were developed for the Hylebos NRDA case. The results of this analysis suggest some potential for injuries to fish from TPAHs in Castro Cove (Appendix A-4). The degrees of service losses derived using the Hylebos assumptions were generally lower at corresponding sediment concentrations than those derived using the LGM approach, discussed above.

To assess potential injuries to fish from mercury, the technical working group calculated HQs using four different TRVs (Appendix A-4). The TRVs were developed based on literature values for no observed adverse effects levels (NOAELs) for growth, reproduction, and mortality to adults and embryos. A review of the effects attributable to mercury in fish shows that neurological and reproductive systems tend to be affected to the greatest degree relative to other organs or functions. Table 2 shows the results of this analysis, with HQs ranging from 0.53 to 133.5 in the mudflat habitat, 0.31 to 78.5 in the salt marsh habitat, and 0.25 to 63 in the creek channel area. These results suggest some potential for injuries to fish from mercury in Castro Cove.

Since the LGM curve estimates service losses equal to or greater than those predicted by other examinations of potential fish effects, as with the determination made for the food chain modeling results for wildlife, the Trustees considered the degrees of service losses predicted by the LGM approach sufficient to incorporate the estimated injuries to fish from TPAHs and mercury.

Table 2. Hazard Quotient Risk Characterization Based on a Range of Tissue-Specific Toxicity Reference Values (TRV) in Fish

Species: Life Stage/Chronic Effect	**TRV (µg-Hg/g-tissue)**	**Hazard Quotient**		
		Mudflat	**Salt Marsh**	**Creek Channel**
Rainbow trout: Adult/Mortality	NOAEL: 5 (McKim et al. 1976)	0.53	0.31	0.25
Rainbow trout: Eggs & Larvae/Mortality	NOAEL: 0.02 (Birge et al. 1979)	133.5	78.5	63
Juvenile & Adult fish/Growth & Reproduction	NOAEL: 0.20 (Beckvar et al. 2005)	13.35	7.85	6.3
Fathead Minnow: Larvae/Growth & Reproduction	NOAEL 0.32 (Snarski and Olson 1982)	8.34	4.91	3.94

3.6 Lead Pellet Ingestion Risk to Shorebirds and Waterfowl

The portion of Castro Cove contaminated with lead shot from an historical skeet range known as Skeet Hill was investigated for potential risk to shorebirds and diving ducks. Based on previous work done at the Alameda Point Skeet Range, two diving duck species were selected: the scaup and the surf scoter (*Melanitta perspicillata*) (Battelle and ENTRIX 2002). Based upon previous work done for Castro Cove, the willet was selected as the shorebird for this evaluation. The willet is relatively abundant in Castro Cove and has probe-feeding characteristics well suited to represent a relatively high (protective) exposure potential (URS 2002a).

The analysis used sets of less-environmentally protective and more-environmentally protective assumptions to create a risk range for these birds. The probabilistic risk estimates represent the probability of exceeding the no observed adverse effects level (NOAEL), which is three No. 8 lead shot for these birds. The results for risk to the willet ranged from 7.9×10^{-6} to 1.6×10^{-3}. Therefore, with the more environmentally protective or reasonable maximum exposure assumptions, the probability of a willet ingesting greater than the NOAEL number of shot is less than or equal to 1.6×10^{-3} (i.e., between 1 and 2 in 1,000 individuals). For the waterfowl (combining the scoter and scaup) the risk range calculated was 1.9×10^{-9} to 4.1×10^{-5} using the less and more environmentally protective assumptions, respectively (Appendix A-5). For waterfowl, the probability of ingesting greater than the NOAEL number of shot, assuming the maximum exposure parameters, is less than or equal to 4.1×10^{-5}, or 1 in 41,000.

As with the decision based on the food chain modeling results, the Trustees concluded that the “reasonable worst case scenario” described by the LGM prediction of injury is sufficient to incorporate the estimated injuries to shorebirds and waterfowl from ingestion of lead shot in Castro Cove.

3.7 Quantification of Natural Resource Injuries

Quantification of injuries relied on a service-to-service restoration-based approach. The Trustees sought to identify appropriate restoration projects to compensate for the interim losses between 1981 (the commencement date under CERCLA) and projecting forward 100 years, assuming that some of the injury (to a lesser degree) will persist. For this task, the technical working group agreed to use HEA. Used both in California and elsewhere in the United States, HEA is a commonly used method of scaling injuries and restoration across space and time. The HEA method is divided into two main tasks: the debit (or injury) calculation and the credit (or restoration) calculation. The debit calculation involves determining the amount of natural resource services that the affected habitats would provide had they not been injured. The unit of measure in this case is discounted service-acre-years, which incorporates both the time and space of resource services provided by the habitat. The credit calculation seeks to estimate the quantity of those resource services that would be created by a proposed compensatory restoration project. Thus, the size of the restoration project is said to be “scaled” to equal the size of the injury. Restoration scaling is discussed in Section 3.9 and scaling of the selected restoration projects is discussed in Section 4.6.

3.8 Summary of Injury

Using TPAH concentration inputs to the LGM for amphipods, the technical working group estimated that the overall average degree of injury and lost services due to hazardous substances and oil from the Chevron refinery was 60.0 percent in the AOC and 17.5 percent in the areas having contamination above ambient levels outside of the AOC. No injury was attributed in the mudflat areas of the outer cove where TPAH levels were similar to background concentrations in other parts of San Pablo Bay. No additional injury (beyond that encompassed in the LGM-based estimate) was estimated for birds, mammals, or fish based on the food chain model results and other analyses. Similarly, no additional injury was estimated for lead shot ingestion by birds near the Skeet Hill area. The Trustees believe that the injury levels estimated using the LGM method are sufficient to indirectly incorporate the potential injuries to other natural resources that may have been impacted by the contaminated sediments in Castro Cove.

Appendix A-6 contains a summary of the injury inputs to the HEA calculations. For quantification purposes, the service loss was divided into two areas: the AOC (19.7 acres) and the non-AOC. The non-AOC (184.5 acres) is less injured and outside of the cleanup area so the Trustees assigned the same level of service loss from 1981 through 2106. The AOC is significantly injured from 1981 though 2008, with the greatest level of lost services occurring due to the excavation associated with the remediation. However, after the remediation actions, it is assumed that recovery will take 5 years, the AOC will recover to the level of services provided by the non-AOC, and that it will provide services at this level through 2106. A total of 2,958 discounted service-acre-years of intertidal and shallow subtidal habitat was calculated as the resource services debt owed to the public by Chevron for the contaminant-induced reduction in natural resource services using these input parameters (see Figure 5).

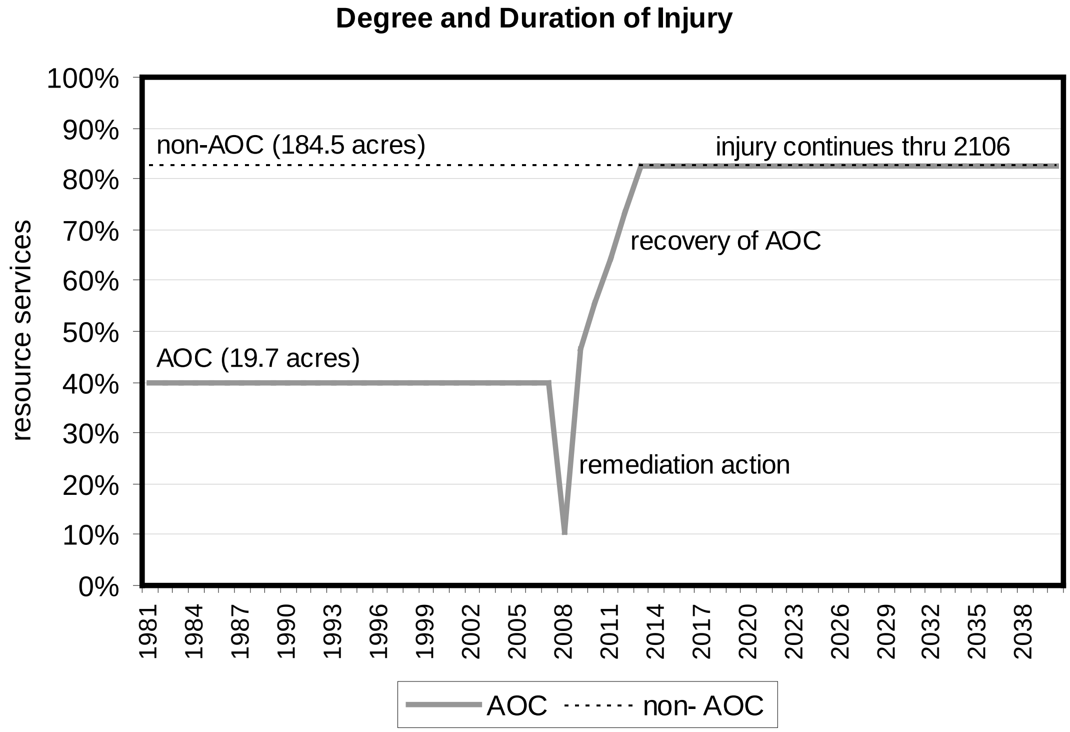

Figure 5. Castro Cove injury quantification trajectory for the degree and duration of lost natural resource services

3.9 Scaling Restoration

The process of "scaling" a compensatory restoration action involves determining the size of the restoration action(s) needed to provide resource and service gains equal to the value of interim losses due to the release of hazardous substances (NOAA 1997; 1999). Because the duration of the injury differs from the lifespan of the restoration action(s), equivalency is calculated in terms of the present discounted value of services lost due to resource injuries and gained due to compensatory restoration. Restoration actions must restore the equivalent of the injured resources by providing resources and services of the same type and quality and of comparable value as those injured.

The details of the HEA used by the Trustees to compare the lost natural resource services resulting from the Castro Cove contamination (debit calculation) to the anticipated natural resource service benefits of potential restoration projects (credit calculation) is presented in Appendix A-6. Based on the Trustees' best estimates of the timeframes for realizing the project benefits of the selected restoration projects and the anticipated degree of improvements in habitat values, the Trustees concluded that approximately 203 acres of tidal wetlands habitat restoration are needed to offset the loss of services calculated in the injury assessment.

4.0 RESTORATION PLANNING AND ALTERNATIVES ANALYSIS

The goal and strategy of this restoration plan is to identify and select appropriate habitat restoration actions to compensate for the loss of natural resource services provided by intertidal, shallow subtidal, and saltmarsh habitats in Castro Cove that have been injured by releases of hazardous substances and discharges of oil. This chapter addresses the restoration strategy, the process for development of restoration alternatives and projects, the evaluation of the No-action Alternative, the criteria used to evaluate the restoration projects, the identification of potential restoration projects, evaluation of restoration projects and project types, and cumulative impacts of the selected alternative projects.

4.1 Restoration Strategy

The Trustees achieve restoration objectives by returning injured natural resources to their baseline condition and by compensating for any interim losses of natural resources and services during the period of recovery to baseline (See Section 1). The DOI Rule and NEPA provide that Trustees consider a range of possible alternatives and actions that restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources and lost services. Restoration activities can range from natural recovery, to actions that prevent interference with natural recovery, to more intensive actions expected to return injured natural resources and services to baseline faster or with greater certainty than natural recovery. Restoration also may restore resources or services beyond baseline conditions as a means of compensating for interim losses.

Restoration actions are either primary or compensatory. Primary restoration actions are taken to return injured natural resources and lost services to their respective baseline conditions. If the release of a contaminant impairs the ability of organisms to reproduce, actions that restore the injured organisms' reproductive function to the level that would exist were it not for the release are considered primary restoration. An example of a primary restoration action is the removal of the contamination from the organisms' environment, which in this case, involves removal (remediation) of bay mud from approximately 20 acres in Castro Cove (see Section 1.5).

Compensatory restoration actions are taken to compensate for interim losses of natural resource services pending complete recovery to baseline conditions. Under the DOI Rule, compensatory restoration claims are recovered as claims for "compensable value." The regulations describe these damages as, "The compensable value of all or a portion of the services lost to the public for the time period from the discharge or release until the attainment of the restoration, rehabilitation, replacement, and/or acquisition of the equivalent of the resources and their services to baseline" (Title 43 C.F.R. Part 11.80).

The remediation of the most highly contaminated sediments in Castro Cove, initiated by Chevron in 2007, constitutes primary restoration of injured resources.

The Trustees have not identified any other primary restoration actions that could be taken to accelerate recovery of natural resources within Castro Cove to their baseline conditions. Thus the Trustees have focused efforts on identifying compensatory restoration actions to offset interim losses of natural resource services that resulted from the contamination in Castro Cove.

The Trustees' restoration strategy in this case is to identify and implement projects that improve the ecological function of habitats in San Pablo Bay (see Figure 2) that are not fully functional at present, and that are identical or similar to habitat injured in Castro Cove (i.e., intertidal mudflat, salt marsh, and shallow subtidal habitat). Therefore, restoration projects that were beneficial to the San Pablo Bay ecosystem were considered. In addition, the Trustees seek to optimize restoration benefits through coordination with other resource management and restoration programs in the region (i.e., to take advantage of regional partnerships to gain efficiency and avoid duplication of effort).

4.2 Development of Restoration Alternatives and Projects

In accordance with the DOI Rule, the Trustees identified a reasonable range of restoration projects, evaluated them against specific criteria, and identified the preferred alternative projects. The Trustees first identified a large number of diverse restoration projects (some only conceptual, others ready for implementation) capable of serving as compensatory restoration for the injured natural resources and/or services. The Trustees then evaluated these projects against a set of State and federal criteria (Section 4.4). As part of the effort to develop restoration alternatives and projects, the Trustees consulted with local scientists, several public and private organizations, and State, federal and local governments to get their perspectives on the benefits and feasibility of various types of projects. These efforts were important in assisting the Trustees in identifying restoration actions or projects that are feasible, have strong net environmental benefits, and meet restoration requirements to compensate for injuries resulting from Chevron's releases and/or discharges into Castro Cove. The Trustees have selected a restoration alternative in this final DARP/EA that is composed of two projects after consideration of public comments received on the draft DARP/EA.

Some of the restoration projects considered by the Trustees for this case would provide natural resources and services equivalent (i.e., of the same type, quality, and value) to those injured; these are referred to as "in-kind" restoration projects. Other projects considered would provide natural resource services that are in some ways similar but not equivalent in type, quality, and value to those injured. The Trustees preferentially seek in-kind restoration (e.g., the creation of a new marsh or enhancement of an existing marsh to compensate for lost marsh services) in geographical proximity to the area affected. Increased benefits and efficiency may be achieved by addressing several injured resources and/or lost services with a single restoration project.

4.3 Evaluation of the No-action Alternative (No project)

NEPA requires the Trustees to consider a No-action Alternative. Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services pending environmental recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources.

Natural recovery of the injured resources would occur over time (and in this case will occur more rapidly because of the remedial action). However, natural recovery cannot compensate the public for interim losses suffered during the time between injury and complete recovery. Accordingly, should the Trustees choose natural recovery as the means to provide compensatory restoration, the public will go wholly uncompensated for interim losses. Given the Trustees' responsibility to seek compensation for interim losses; the availability of technically feasible; cost-effective; and ecologically beneficial restoration options; and the Trustees' determination that compensable interim losses exist in this case, the Trustees do not select the No-action Alternative.

4.4 Criteria Used to Evaluate Restoration Projects

Under NRDA regulations, the Trustees identify preferred and non-preferred restoration projects based on State and federal criteria. Projects must be consistent with the Trustees' goal to restore, rehabilitate, replace, enhance, or acquire the equivalent of the injured resources and resource services. There are several criteria that the Trustees used to make these decisions, described below.

4.4.1 First Tier Screening Criteria

In order to pare down the large list of potential restoration projects, and focus information gathering efforts on the most likely alternative projects, the Trustees screened the potential projects against two threshold criteria: 1) relationship of the proposed restoration project to the injured resources and/or services and 2) proximity of the restoration action to the affected area. These two criteria were used because they reflect important project attributes critical to the Trustees' restoration goal and could be applied to all restoration projects and concepts without the need to gather detailed, extensive information. These two primary screening criteria are defined below.

1. *Relationship to Injured Resources and/or Services***.** Projects that restore, rehabilitate, replace, enhance, or acquire the equivalent of the same or similar resources or services injured by the releases are preferred to projects that benefit other comparable resources or services. This criterion considers the types of resources or services injured and the connection between restoration project benefits and the injured resources. Thus, the Trustees evaluate the habitat type being enhanced or created and the potential relative benefits of that habitat for injured resources or service losses.

2. *Proximity of a Project to the Affected Area*. Implementing restoration actions near the affected area increases the probability that the same resources that were injured benefit from the restoration project(s). The Trustees decided to limit consideration of projects to those in the North Bay subregion of San Francisco Bay, i.e., along the North East Bay (Alameda County) and San Pablo Bay and Suisun shores (Contra Costa and Solano Counties). Projects in these areas would benefit many species of fish and birds that utilize the San Pablo Bay ecosystem, of which Castro Cove is a part.

4.4.2 Second Tier Screening Criteria

After the first tier screening, a second set of screening criteria was applied to the remaining restoration projects and project locations. The criteria used to rank these projects were those that served to emphasize project differences and determine which projects would provide the greatest resource benefits in the most efficient manner.

3. *Technical Feasibility*. This criterion considers site-specific factors that may influence a project's potential success, such as whether a project is technically and procedurally sound, utilizes proven methods, involves sufficient acreage that is suitable and available for project implementation, and whether there are potential institutional or legal constraints.

4. *Cost Effectiveness*. This criterion considers the cost associated with implementation of the restoration project relative to expected resource and service benefits. Projects that provide similar benefits but that are less expensive are preferred.

5. *Time to Provide Benefits*. This criterion considers the time it will take for benefits to be provided to the target ecosystem. A more rapid provision of benefits is preferred.

6. *Duration of Benefits*. This criterion considers the expected duration of project benefits, favoring projects whose benefits can be protected for the long term or in perpetuity.

7. *Compliance with Applicable Federal, State, and Local Laws and Policies*. The project must comply with applicable laws and policies.

8. *Multiple Resource and Service Benefits*. The extent to which the project benefits more than one injured natural resource or resource service is considered favorably.

9. *Avoidance of Adverse Impacts*. The project should avoid or minimize adverse impacts to the environment and the associated natural resources. Adverse impacts may be caused by collateral injuries when implementing, or as a result of implementing, the project.

10. *Public Health and Safety*. The project must not pose a threat to public health and safety.

11. *Likelihood of Success*. The potential for success and the level of expected return of resources and resource services is considered. The ability to evaluate the success of the project, the ability to correct problems that arise during the course of the project, and the capability of individuals or organizations expected to implement the project are also considered.

4.5 Identification of Potential Restoration Projects

In initiating the restoration planning process for injuries sustained in Castro Cove by the Chevron releases, the Trustees limited the geographic scope of the potential restoration projects that they would consider to those in the North Bay subregion of San Francisco Bay, i.e., along the North East Bay (Alameda County) and San Pablo Bay and Suisun shores (Contra Costa and Solano Counties). A list of potential restoration projects was created from those described by the San Francisco Bay Joint Venture (www.sfbayjv.org), the Baylands Ecosystem Habitat Goals Document (Goals Project 1999), and the San Francisco Bay Wetlands Tracker (http://www.wetlandtracker.org/). To supplement this list, the Trustees contacted over 28 community groups, universities, consultants, State, federal and local agencies that might have relevant information concerning these projects or additional restoration ideas including those listed in Table 3. Potential projects were then grouped by habitat type: tidal wetlands, subtidal, and stream/riparian (Table 4).

In a July 18, 2007 letter the City of Richmond suggested that the Trustees consider four additional restoration concepts. These included an expansion of the Breuner project beyond the tidal wetlands restoration portion considered by the Trustees, creosote piling removal from certain locations along the Richmond waterfront, restoration of historical portions of Castro Cove marsh that have been filled and developed for many years, and restoration of wetlands habitat in Hoffman marsh. These are evaluated in Section 4.6.

Table 3. Parties Contacted for Information on Potential Compensatory Restoration Projects for Injuries to Castro Cove

Parties Contacted	
California Coastal Conservancy Spartina Project	Mactec
California Department of Fish and Game	Natural Heritage Institute
City of El Cerrito	Port of Richmond
City of Richmond	Restoration Design Group
Contra Costa County Resource Conservation District	San Francisco Bay Conservation and Development Commission
Cooper Crane	San Francisco Bay Joint Venture
Creek Keepers	San Francisco Bay Trails
Ducks Unlimited	San Francisco State University
East Bay Regional Park District	Save San Francisco Bay Association
East Shore State Park	Sonoma Land Trust
Friends of Five Creeks	The Watershed Project Group
Friends of Pinole Creek	Wetlands and Water Resources
Kleindfelder	U.S. Fish and Wildlife Service
Ma'at Youth Academy for Environmental Leadership	Urban Creeks Council

Table 4. Potential Restoration Projects to Compensate for Injuries to Castro Cove

Project	County
Stream/riparian projects	
Wildcat Creek 1	Contra Costa
Wildcat Creek 2	Contra Costa
San Pablo Creek	Contra Costa
Pinole Creek	Contra Costa
Tidal wetlands projects	
Pacheco Marsh	Contra Costa
McNabney Marsh	Contra Costa
Breuner Marsh	Contra Costa
Baypoint Marsh	Contra Costa
Wildcat Marsh	Contra Costa
Cullinan Ranch	Solano
Hoffman Marsh	Alameda
Historical Castro Cove Marsh	Contra Costa
Spartina eradication • Multiple locations	Contra Costa
Shallow subtidal projects	
Eelgrass seeding • Breuner • Point Orient	Contra Costa
Oyster restoration • Breuner • Point Orient	Contra Costa
Creosote removal • Terminal 4 • Red Rock warehouse • Richmond bridge	Contra Costa

Available information about all of the restoration projects was gathered, including descriptions of the projects, the sizes and types of habitats to be restored, the current land use/ownership, the resources/services to be restored or benefited, the expected time to implementation, the expected time to achieve full benefits, the status of project design and environmental documentation, the status of permitting, the cost per acre benefitted, and public involvement. Sixteen projects, including those suggested by the City of Richmond, were initially examined. Fourteen were located within Contra Costa County, one was located in the North East Bay (Alameda County) and one was located in Solano County (Table 4).

4.6 Evaluation of Restoration Projects

From the original sixteen potential projects, the twelve projects that address tidal and shallow subtidal habitats were found to best meet the first tier screening criteria (Section 4.4.1). These were the eight tidal wetlands restoration projects, the Invasive Spartina Project, and three subtidal projects (eelgrass seeding, native oyster restoration, and creosote piling removal). Since a reasonable number of intertidal and subtidal projects were available for evaluation that provide resources “of the same type and quality, and of comparable value” as the injured habitats in Castro Cove (NOAA 1995) and were within reasonable proximity to the site, the Trustees screened out from further consideration the four stream and riparian restoration projects. The natural resource services that these latter four projects would provide, while ecologically valuable and addressing some of the injured resources and lost services of the case, do not meet the first tier screening criterion 1 as well as the tidal wetland and subtidal projects.

In the process of gathering more detailed information about the Invasive Spartina Project, the California State Coastal Conservancy informed the Trustees that this project was fully funded (Peggy Olofson, pers. com.); therefore, the Invasive Spartina Project was dropped from further consideration. The McNabney Marsh site was also dropped from consideration because funding was no longer needed. Thus ten projects (seven tidal wetlands projects and three subtidal projects) underwent more detailed evaluation.

Table 5 summarizes the Trustees’ evaluation of potential restoration projects based on the evaluation criteria. As a group, the tidal wetlands restoration projects best satisfied the Trustees’ threshold evaluation criteria. A detailed discussion and evaluation of each project is provided later in this Section.

In the event the Trustees later determine that one or more of the projects selected for implementation is/are not feasible due to unforeseen issues, the Trustees may pursue another project or projects from among the other projects evaluated in this Section.

A project may be determined infeasible if, upon further investigation, the Trustees find that a project no longer satisfies the evaluation criteria used to select the preferred projects.

Table 5. Summary evaluation of the potential restoration projects.

PROJECTS	EVALUATION CRITERIA (See key below) H – High M – Medium *L* – Low											Overall Ranking
	Tier One		Tier Two									
	1	2	3	4	5	6	7	8	9	10	11	
Cullinan Ranch*	H	M	H	H	H	H	H	H	H	H	H	High
Breuner Marsh*	H	H	M	M	M	H	H	H	H	H	H	High
Pacheco Marsh	H	L	M	M	M	H	H	H	H	H	H	Medium
Baypoint Marsh	H	L	H	L	H	H	H	H	H	H	H	Medium
Eelgrass	M	M	M	M	M	H	H	H	H	H	H	Medium
Native Oyster	M	M	M	M	M	H	H	H	H	H	H	Medium
Creosote Piling Removal	H	H	M	L	H	M	H	M	M	H	H	Medium
Historical Richmond Marsh	H	H	L	L	L	L	L	H	L	M	L	Low
Wildcat Marsh	H	H	M	L	H	L	L	L	M	H	H	Low
Hoffman Marsh	H	M	L	L	L	H	M	H	M	M	L	Low

* Selected Projects
Evaluation Criteria:
1. Relationship to injured resources and/or lost services
2. Proximity to Castro Cove and within the North Bay subregion
3. Technical feasibility
4. Cost effectiveness
5. Time to provide full benefits
6. Duration of benefits
7. Compliance with applicable federal, State, and local laws and policies
8. Multiple resource and service benefits
9. Avoidance of adverse impacts
10. Public health and safety
11. Likelihood of success

4.6.1 Tidal Wetlands Restoration Projects

Several tidal wetlands restoration projects were identified in close proximity to Castro Cove and within the San Pablo Bay subregion. The Trustees carefully considered these projects because their expected resource benefits are most similar to the resources injured by the releases into Castro Cove. This type of restoration project best satisfies the Tier One threshold evaluation criteria. In addition, tidal wetlands creation and enhancement projects typically have a high likelihood of success and tend to be cost effective. Restoration of wetlands and water quality functions associated with wetlands can assist ongoing efforts to improve the health of the estuary.

Also, tidal wetlands restoration projects generally are consistent with broad regional goals for restoring the ecological health of the San Francisco Bay estuary.

Tidal wetlands provide complex habitat supporting numerous fish and wildlife species. Tidal wetlands restoration will provide services benefiting a wide range of natural resources, including benthic invertebrate species that inhabit marshes and the bird and fish species that feed on them. By providing benthic invertebrates, critical nursery habitat for shrimp, fish and other aquatic species, and nesting and foraging habitat for shorebirds, waterfowl and other wildlife, restored marshes and mudflats will benefit many of the same species that were injured by the releases in Castro Cove.

The Trustees identified two projects from among the seven tidal wetlands restoration projects that best fit the evaluation criteria and that in combination provide sufficient restoration acreage to achieve the needed scale of restoration for this case: the Cullinan Ranch and Breuner Marsh restoration projects. The Trustees select these two restoration projects in this final DARP/EA. The lead implementing agencies for these two projects are the USFWS National Wildlife Refuge Program and East Bay Regional Park District (EBRPD), respectively. The Trustees plan to contribute funds toward restoration of tidal wetlands habitat at each of these two sites to restore sufficient acreage to compensate for the estimated loss of natural resource services from contamination in Castro Cove.

4.6.1.1 Evaluation of Cullinan Ranch Restoration: Selected Project

Project Description

The Cullinan Ranch site, located along the north side of San Pablo Bay approximately 12.5 miles north of Castro Cove, is one of the largest proposed restoration projects in the North Bay (see Figure 6). Cullinan Ranch is located in an area of the Napa River Delta that was historically defined by a network of meandering sloughs and extensive estuarine tidal marshes. The Cullinan Ranch restoration project will restore approximately 1,500 acres of diked baylands to their historical wetland state as mature tidal marsh. The project will convert pasture, grassland and seasonal wetlands into a mosaic of tidally influenced channels, mudflats, and salt marsh habitat. Cullinan Ranch is part of the San Pablo Bay National Wildlife Refuge (NWR). Although some of the project will take place on lands managed by CDFG, USFWS is the sole implementing agency for the restoration project.

Restoration design includes a 10:1 sloped buttress levee, lowered levees along Dutchman Slough, and islands that will provide pickleweed habitat for endangered species within the first 2 years. The buttress levee will be constructed to enhance habitat and protect Highway 37 from tidal fluctuation. Breaching levees (constructed decades ago to dry out the marsh for farming) will restore tidal flow and create vital salt marsh habitat for endangered species, including the salt marsh harvest mouse and the California clapper rail, as well as providing foraging and roosting habitat for fish, migratory waterfowl, and waterbirds.

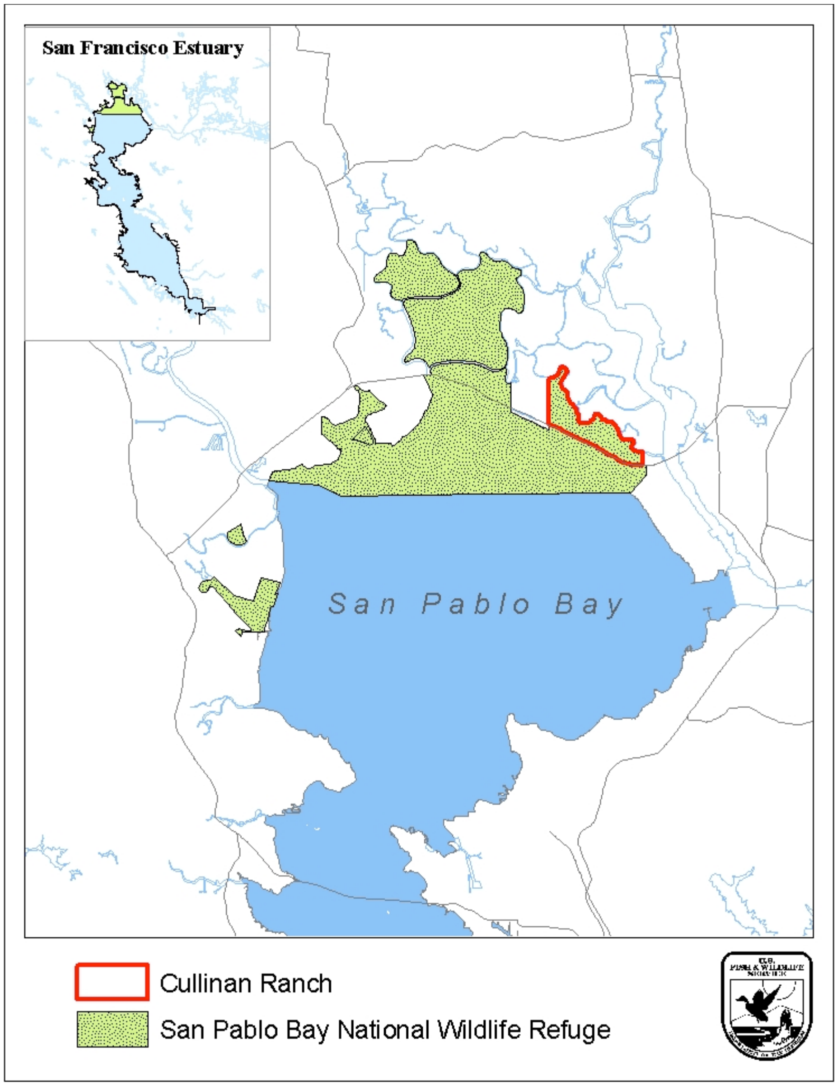

Figure 6. Location of Cullinan Ranch

It will take years of tidal exchange to return the land to mature intertidal marsh habitat found to the north in the Napa Sonoma Ponds. The tide will bring in sediment and gradually raise the bottom elevation of the site which has subsided over the decades as it had been diked and farmed. As the process begins, the site will provide shallow water habitat, functions, and services similar to nearby ponds currently managed for bay fish and waterfowl. Gradually the marsh will evolve, the function will change and it will provide services for fish, clapper rails, salt marsh harvest mice and other tidal marsh species. This project is supported by several regional restoration and conservation groups and is considered a high priority project by the San Francisco Bay Joint Venture (http://www.sfbayjv.org/projects.html).

Restoration Objectives

The project goal is to restore tidal influence to the Cullinan Ranch area to restore and create tidal marsh habitat for salt marsh-dependent species. The objective is to provide suitable habitat to support the endangered species in the larger San Francisco Bay ecosystem.

Scale

The project will restore approximately 1,500 acres to tidal wetlands. Since only 203 acres of restoration are needed to satisfy the Trustees' claim, the Trustees will fund only a portion of the project, in a proportionate amount to account for approximately 158 acres at Cullinan Ranch. The Trustees will achieve the total needed restoration acreage by contributing to both the Breuner project described in section 4.6.1.2 (which is within the City of Richmond) and the Cullinan project. Based on recent information provided by EBRPD (see Appendix C), up to 45 acres of tidal wetlands restoration is available at the Breuner site, leaving a balance of 158 restoration acres needed to achieve the 203 acres required for this case. Therefore, the Trustees plan to allocate a portion of the tentative Chevron/Castro Cove settlement equivalent to the per acre cost of 158 acres of the Cullinan Ranch restoration project.

Likelihood of Success

The probability of success for this wetland restoration project is high. The project site is a former salt marsh that has been diked and converted to pasture. Wetland restoration often can be achieved very rapidly in such situations. For example, wetland restoration following breaching of levees at CDFG's Pond 2A (Napa-Sonoma Marsh Complex) resulted in a salt marsh appearing structurally similar to natural ones within only five to six years. Across the Napa River from Pond 2A, reestablishment of wetlands at the Port of Oakland's American Canyon marsh, a former pasture that had subsided moderately (4 to 5 feet) since diking, also has progressed quickly since partial breaching of the levee only three years ago. While deposition of sediments to restore tidal marsh elevations at Cullinan may not proceed as rapidly as the above referenced projects, it is likely that natural sloughs and channels will evolve as the marsh plain develops because hydrologic sources and networks remain largely intact. By using some of the lessons learned from early restoration efforts within the Bay-Delta and elsewhere, the Trustees expect that the project will result in a wetland complex with functions and values similar to those achieved by other restoration projects and, perhaps more importantly, by other natural wetland systems.

Success Criteria and Monitoring

Success criteria will be developed to enable USFWS refuge managers and the Trustees to determine if the restoration actions at Cullinan Ranch are successful. To assist in developing success criteria, monitoring will be conducted prior to project implementation at the project site and selected "reference" wetlands. Monitoring of reference wetlands will enable the development of a range of values for various parameters of ecological structure and function, such as vegetation cover and species composition, nutrient levels in water and sediment, flood water retention, and wildlife use. In addition, implementing monitoring during the environmental compliance phases of the project will enable a comparison of pre-project and restored conditions. The exact post-construction monitoring schedule will be determined during design of the long-term monitoring program.

Approximate Project Cost

The Trustees estimated total costs for design, construction, contingencies, permitting, and monitoring between $10,000 and $12,000 per acre. This estimate includes all phases of environmental compliance (e.g., development of restoration alternatives, preparation of an Environmental Impact Statement (EIS), public scoping, Section 7 consultation, and preparation of other regulatory permits), construction, re-vegetation, and pre- and post-construction monitoring.

Environmental Consequences

The USFWS San Pablo Bay NWR prepared an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) under NEPA and CEQA to identify environmental consequences associated with restoration of the diked pasture land at Cullinan Ranch to tidal wetlands. The final EIS/EIR was released on May 20, 2009 (Ducks Unlimited 2009). The Record of Decision (ROD) is expected in 2010. Environmental baseline studies to identify existing vegetation communities, wetlands, and special status plant species, and surveys to document use by both common and special status wildlife species have already begun. Anticipated consequences of project implementation include a shift in the current vegetation communities (e.g., from predominantly pastureland with some freshwater marsh to salt, brackish, and freshwater marsh) resulting in changes in the types of common and special status species occurring at the site. While implementation will result in beneficial impacts for species associated with tidal salt marsh (e.g., California clapper rail, black rail, and salt marsh harvest mouse) and subtidal aquatic habitat (e.g., anadromous fish and special status fish species, migratory shorebirds, brown pelicans, and diving ducks), adverse and unavoidable impacts are anticipated as seasonal wetlands, emergent marsh, and uplands are converted to tidal wetlands (Ducks Unlimited 2009). These impacts include habitat loss for upland mammals and some species of wintering waterfowl and foraging habitat loss for special-status bat species. Construction and armoring of the buttress levee to protect Highway 37 will involve placement of permanent fill in jurisdictional wetlands, which is considered an adverse and unavoidable effect. The USFWS has evaluated and adopted all practical measures to avoid and mitigate environmental impacts that could result from implementation. All measures to avoid or minimize impacts have been incorporated into the project as described in the final EIS/EIR and will be incorporated by reference into the ROD for the project.

Council on Environmental Quality (CEQ) regulations on NEPA recommend the avoidance of repetitive discussions when more than one environmental document addresses the same action (such as is the case for this DARP/EA and the Cullinan Ranch Restoration final EIS/EIR). One of the Trustee agencies for the Castro Cove case, USFWS, is also the lead agency for the Cullinan Ranch Restoration EIS/EIR. Therefore, the potential environmental impacts of the Cullinan Ranch project are being considered for this DARP/EA as well. NOAA, the other federal Trustee in this matter, has considered the information contained in the Cullinan Ranch EIR/EIS as well. Both federal Trustee agencies incorporate by reference the analysis of environmental consequences contained in the Cullinan Ranch Restoration final EIS/EIR (Ducks Unlimited 2009). The release of any Trustee funds for Cullinan Ranch is conditioned upon the USFWS issuing a ROD that it will implement the project.

Evaluation
The tidal wetlands at Cullinan Ranch will provide important habitat for many species of fish and wildlife in the North Bay subregion, as well as maintaining the quality and productivity of estuarine and marine ecosystems as a whole. The intertidal and shallow subtidal habitats that were injured by the Chevron releases, serve as vital habitat for the same species of fish and wildlife that will benefit from the Cullinan Ranch project. There is a strong relationship between this restoration project and the injured resources.

This project ranks high in technical feasibility since planning and design have been performed and a final EIS/EIR has been released. This project will provide extensive resource and service benefits yet is also the most cost-effective project evaluated. Benefits to natural resources will occur relatively quickly based on the implementation schedule (2010). As Cullinan Ranch is part of the National Wildlife Refuge System (San Pablo Bay NWR), benefits are expected to accrue in perpetuity. Although temporary and permanent impacts to certain special status species may occur, overall, the project is expected to provide significant benefits to wildlife such as shorebirds, waterfowl, rails, salmon, steelhead, and flatfishes, as well as the ecosystem as a whole. The probability of success for this wetland restoration project is high.

The Trustees evaluated the project against the evaluation criteria developed to select restoration projects and concluded that this project is consistent with them. The Trustees determined that this type and scale of restoration will effectively provide appropriate compensation for intertidal and shallow subtidal injuries that occurred as a result of Chevron's releases to Castro Cove.

The Trustees consider funding a portion of this wetland restoration project, in combination with funding the tidal wetlands portion of the Breuner Marsh project, to best satisfy the evaluation criteria and provide appropriate compensation for fishery resources, wetlands, birds, and other biological resources injured as a result of the Chevron releases in Castro Cove. Therefore the Trustees will contribute $1.65 million in settlement funds to the Cullinan Ranch restoration project.

4.6.1.2 Evaluation of Breuner Marsh Restoration: Selected Project

Project Description
The 218-acre Breuner property, in the City of Richmond, lies just south of Point Pinole Regional Shoreline in western Contra Costa County, California (Figure 7).

Approximately 113 acres of the property are upland, seasonal wetland and tidal marsh, and 105 acres are open water, mudflats and other baylands. The restoration design for this project is still at a conceptual stage, but the conceptual plan calls for restoration and enhancement of up to 45 acres of tidal wetlands, 45 acres of seasonal wetland, 2 acres of riparian habitat along Rheem Creek, and 25 acres of coastal prairie/upland buffer.

The restored tidal wetlands at the Breuner site will provide spawning and nursery habitat for fish; foraging and roosting habitat for shorebirds, wading birds, waterfowl, passerines, and raptors; and another source of primary productivity (organic carbon and nutrients) to the Bay ecosystem. Improvement of the 45 acres is extremely valuable given that this is an important natural resource in a very industrialized portion of the Bay. No plans have been developed for the remaining 105 acres of the property, however, this area could be considered for enhancement of subtidal habitat (e.g., native oyster and eelgrass beds), mudflat, and shorebird roosting areas. Conceptual goals for public access include a public staging area, completion of a key segment of the San Francisco Bay Trail, and improved public access to San Francisco Bay. This project is supported by several regional restoration and conservation groups and is considered a high priority project by the San Francisco Bay Joint Venture (http://www.sfbayjv.org/projects.html). The California Coastal Conservancy has identified the Breuner Marsh restoration project as a high priority for funding (Amy Hutzel, pers. com.).

The property was recently acquired by EBRPD through its eminent domain authority. EBRPD purchased the property on May 6, 2008.

Restoration Objectives
The preliminary goals for the property developed in the conceptual plan focus on wildlife habitat restoration and enhancement and development of public access, including completion of the San Francisco Bay Trail.

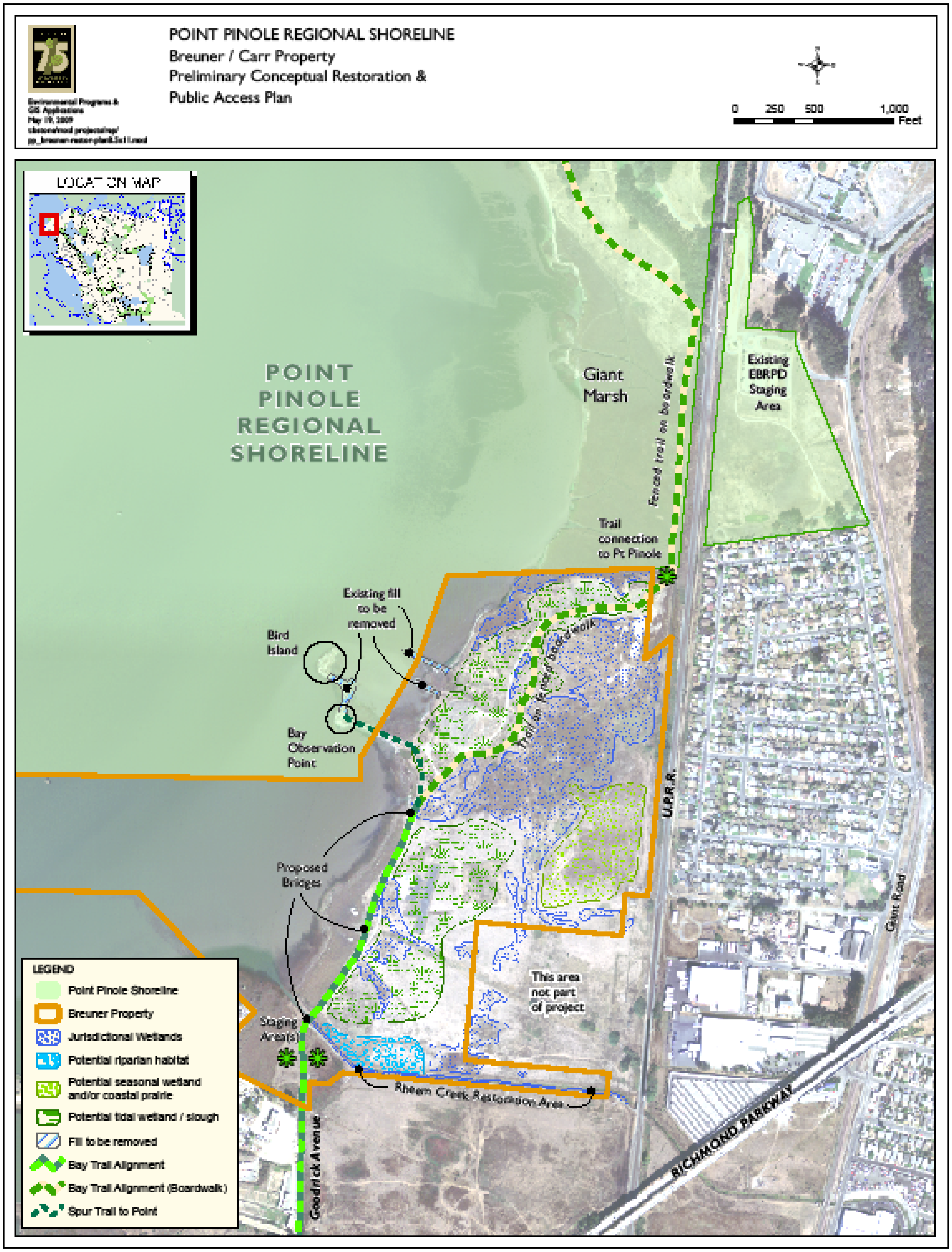

Figure 7. Location of Breuner Property

Scale
Of the 218 acres on the Breuner property, up to 45 acres are considered suitable for tidal wetlands restoration based on information recently provided by EBRPD (see Appendix C). This information was provided after the release of the draft DARP/EA. The restoration of up to 45 acres of tidal marsh at Breuner will provide only a portion of the 203 acres needed to fully compensate for the injuries resulting from the contamination in Castro Cove, leaving 158 additional restoration acres needed to achieve the approximately 203 acres required for this case. The Trustees plan to achieve the total needed restoration acreage by contributing both to the Cullinan project, described in Section 4.6.1.1, and the Breuner project. Therefore, the Trustees will allocate a portion of the tentative Chevron/Castro Cove settlement to pay for the equivalent of 158 acres of the Cullinan Ranch restoration project. Additionally, the Trustees will reserve a portion of the tentative Chevron/Castro Cove settlement for restoration of up to 45 acres of tidal wetlands within the Breuner Marsh restoration project. This represents an increase from $750,000 in funding for the Breuner Marsh project, as proposed in the draft DARP/EA, to an allocation of $1 million in this final DARP/EA, for reasons explained under the evaluation section below.

Likelihood of Success
The likelihood of success for this wetland restoration project is expected to be high. EBRPD has completed numerous resource enhancement projects at other sites in the Bay area. Planning, compliance, construction, and monitoring involve proven conventional processes and methods. EBRPD has indicated it will match the $1 million contribution from the Chevron/Castro Cove settlement with $1 million from other District funding sources, including a recently enacted bond measure. It will pursue still more funding through other grant sources (see letter from EBRPD in Appendix C). With this monetary allocation from the Chevron settlement along with the other funds discussed above, EBRPD expects to be able to raise sufficient additional funding to implement this project.

Success Criteria and Monitoring
During detailed planning and compliance documentation, success criteria will be developed to enable EBRPD managers and the Trustees to determine if the restoration is successful. To assist in developing success criteria, monitoring will be conducted prior to project implementation at the project site and selected “reference” wetlands. Monitoring of reference wetlands will enable EBRPD to develop a range of values for various parameters of ecological structure and function, such as vegetation cover and species composition, nutrient levels in water and sediment, flood water retention, and wildlife use. In addition, implementing monitoring during the environmental compliance phases of the project will enable a comparison of pre-project and restored conditions. The exact post-construction monitoring schedule will be determined during design of the long-term monitoring program.

Approximate Project Cost
EBRPD has preliminarily estimated that the total cost for the 218-acre project, including upland projects, public access improvements, and other actions not within the scope of wetlands restoration is from $5 to $7 million. For marsh restoration projects that do not yet have site-specific cost estimates, such as the Breuner property, the Trustees estimated costs based on an examination of the costs of similar projects previously planned and/or implemented in the San Francisco Bay area, and through contact with agencies or organizations that have conducted similar restoration work. A range of costs for restoring intertidal wetlands and mudflats was developed by compiling the implementation costs of several projects elsewhere in the San Francisco Bay estuary for which detailed costs could be obtained, including Sonoma Wetlands, Bay Point Regional Shoreline, Sears Point Wetlands, Napa Sonoma Marsh, Bair Island, Hamilton Army Airfield, Cullinan Ranch, Cargill/Napa River, and Petaluma Marsh. Cost estimates for projects generally took into account planning and design costs, construction costs and contingencies, and long-term maintenance and monitoring costs.

Environmental Consequences
With the recent acquisition of the property, EBRPD will prepare a detailed plan for the restoration of the site and environmental compliance documentation under CEQA. Thus, this restoration project will not be ripe for detailed analysis of environmental consequences until after project specific implementation details are more fully developed. Additional NEPA analysis, if necessary, will be addressed at the time that CEQA documentation is prepared by EBRPD. The Trustees provide below a level of environmental analysis appropriate for the current stage of planning for the Breuner Marsh project.

The actions to be undertaken to restore tidal wetlands at the Breuner site are likely to involve conventional construction methods and short-term impacts similar to methods and impacts occurring in recent years at other similar wetlands restoration sites around San Pablo Bay and the greater San Francisco Bay estuary. Examples include the projects listed in the *Approximate Project Cost* subsection above and the Cumulative Impacts section (4.7) below.

Biological Effects
The biological consequences of wetlands restoration such as those anticipated at the Breuner site are largely beneficial given the historical losses of such habitats within the affected area, their relative scarcity today, and their valuable ecological functions. Restoration of the Breuner site is expected to increase habitat value for tidal marsh-dependent species in this portion of San Pablo Bay. It will provide habitat for many birds and other wildlife species including special status species such as the California clapper rail and salt marsh harvest mouse, as well as foraging and rearing habitat for many species of fish. Wetlands restoration, while beneficial for biological resources overall, requires careful planning, analysis, and consideration of the trade-offs between different and sometimes competing biological resources and uses. The project may convert habitat favored by some shorebirds and mammals to habitat

favoring tidal marsh-dependent species. Mitigation measures, if needed, should be identified during subsequent environmental analysis once project details are more fully developed.

Depending on their location and design, wetlands may provide benefits to water quality (USEPA 2001). Restoration of tidal exchange may also increase contributions of sediment from terrestrial watersheds into coastal areas. Wetlands restoration could also have several indirect physical effects, including hydrological consequences, the need to identify disposal requirements for excavated material, and potential impacts on roads and utilities. Mitigation measures, if needed, should be identified during subsequent environmental analysis once project details are more fully developed.

Evaluation

Restoring tidal wetlands at the Breuner site will provide important habitat for several species of fish and wildlife in the North Bay subregion, as well as maintain the quality and productivity of estuarine and marine ecosystems as a whole. The project site is in close proximity to Castro Cove which is favorable, as there is a high likelihood that restoration will address resources similar to those that were injured.

During the public comment period for the draft DARP/EA, EBRPD indicated that a greater number of acres of tidal wetlands may be designated for restoration at the Breuner Marsh site than the 30 acres they had previously estimated prior to the release of the draft DARP/EA. Furthermore, in a letter to the Trustees dated April 20, 2009, (see Appendix C) EBRPD committed to providing an additional $1 million in matching funds from their own sources if the Trustees allocated $1 million for the Breuner Marsh project from this Castro Cove settlement. EBRPD is confident that this combined $2 million in funding could be leveraged to obtain still more funding through outside grant sources. The specific timing, implementation, and accrual of resource benefits are unknown at this time. However, the project will be owned and managed by a public agency, and its benefits are expected to accrue in perpetuity. The likelihood of success for this wetland restoration project is expected to be high.

The Trustees evaluated the project against the evaluation criteria developed to select restoration projects and concluded that this project is consistent with them. The Trustees determined that this type and scale of restoration will effectively provide appropriate compensation for mudflat and intertidal impacts that occurred as a result of Chevron's releases into Castro Cove.

The Trustees consider funding the tidal wetlands portion of the Breuner project, in combination with funding a portion of the Cullinan Ranch restoration project, to best satisfy the evaluation criteria and provide appropriate compensation for fishery resources, wetlands, birds and other biological resources injured as a result of the Chevron releases in Castro Cove. The Trustees will reserve $1 million of the tentative settlement funds to apply toward the design and permitting of the Breuner project and restoration of at least 30 and up to 45 acres of tidal marsh at Breuner.

4.6.1.3 Evaluation of Pacheco Marsh Restoration: Non-preferred Project

This project is located adjacent to Martinez in the Suisun subregion, approximately 14 miles East by Northeast from Castro Cove. The Muir Heritage Land Trust, Contra Costa County Flood Control District and the EBRPD acquired the 122-acre Pacheco Marsh in 2002 to restore the property to its historic tidal wetland flow. The goal is to maximize wetland and wildlife habitat for a variety of plant and animal species, including the 12 special status species that would benefit from this restoration. They are looking for partners to fund design, permitting, and the implementation phases of this project. The estimated time to implementation is approximately 2 to 3 years and estimated time to reach full benefits is 5 years.

This project was not preferred for the following reasons: it is outside of the North Bay subregion; it is among the more distant projects from the contaminated site; and costs of restoration are relatively high compared to other available projects.

4.6.1.4 Evaluation of Bay Point Regional Shoreline Restoration: Non-preferred Project

This project is located along the southern shore of Suisun Bay near Pittsburg, approximately 25 miles East by Northeast from Castro Cove. Once part of a natural marsh, some 40 acres have been diked and partially filled. Exotic vegetation covers the site and the original grade has subsided. The project proponent, EBRPD, proposes to reestablish tidal flow and return the site to emergent tidal wetland habitat. The goal is to return approximately 33 acres to tidal action. The project costs are estimated at $1.5 million. This project is ready to implement with full benefits expected 3 to 5 years after implementation.

This project ranked lower than the selected tidal wetlands projects for the following reasons: it is a greater distance from the contaminated site than other available projects; it is located in the Suisun subregion where salinity levels and associated plant and animal communities are not as comparable to the contaminated site as those sites in the North Bay subregion; and it has a relatively high project cost.

4.6.1.5 Evaluation of Wildcat Marsh: Non-preferred Project

Located adjacent to Castro Cove, on property owned by Chevron, this project involves removal and regrading of scattered imported fill material/levees in various portions of the marsh. This project initially ranked high because of its proximity to the injured site and strong relationship to the injured resources. However, the area that could benefit from restoration activities is minimal (approximately 5 to 10 acres), and while some minor localized enhancements to address prior dredging operations (i.e., removing berms to reduce weedy upland patches of habitat) can be implemented, the marsh appears to be functioning at a relatively high level for natural resource services. These localized improvements would probably be expensive, based on initial estimates, relative to the limited benefits that would accrue. Also, Chevron could not provide assurance that the restored natural resources would remain protected in the long-term.

This project was not selected based on the lack of a project proponent, uncertainty over duration of benefits, and limited potential for habitat improvement.

4.6.1.6 Evaluation of Historical Castro Cove Wetlands: Non-preferred Project

The Trustees understand this concept encompasses restoring the large tidal marsh complex that historically spanned much of the area between the San Pablo Peninsula and Point Pinole prior to extensive filling and development over the past century. Most of this area has been filled and developed and is currently zoned for use by heavy industry, including the Chevron refinery and the rail yard. This area includes the oxidation pond where, under the CAP, Chevron has placed and capped the contaminated sediments dredged from Castro Cove.

This restoration concept would be highly constrained by current land use, ownership and on-site contamination. It does not, to the Trustees' knowledge, have a specific project proponent so the likelihood of success is low. It also is expected to be prohibitively expensive to displace the current businesses and structures located in the area, and remove and dispose of millions of tons of fill material. For these reasons, this project is not considered feasible for the restoration purposes of this case.

4.6.1.7 Evaluation of Hoffman Marsh: Non-preferred Project

The Trustees investigated the potential for tidal wetlands restoration at Hoffman Marsh, located in the Central Bay subregion. The Eastshore State Park General Plan includes exploration of small restoration opportunities in Hoffman Marsh, including removal of exotic plant species and re-vegetation with native plant species. There also are possible improvements to be made for shoreline protection along the south bank of the channel entering Hoffman Marsh. According to EBRPD, the northwest area of Hoffman Marsh is owned by several entities, complicating restoration opportunities. Currently, EBRPD and State Parks are not attempting to purchase these lands. While restoration opportunities such as removing contaminants, providing improved tidal circulation and removal of upland fill exist, until these properties are acquired by a public agency, EBRPD believes that there are limited opportunities for restoration projects at Hoffman Marsh.

Based on current information, and lacking a specific restoration project to evaluate, restoration potential at Hoffman Marsh appears limited at this time by a number of constraints affecting feasibility. As there are other tidal restoration projects close to Castro Cove and within the North Bay subregion that better meet the Trustees' evaluation criteria, this project is not preferred.

4.6.2 Subtidal Restoration Projects

Subtidal restoration projects are those that enhance habitats that are found at the mean low water tide line or lower. The following subtidal projects were evaluated by the Trustees and were generally found to meet the evaluation criteria. The evaluated projects include: seeding subtidal areas with eelgrass, providing hard substrate on which native oyster spat may settle, and removing contaminated pilings and pier structures. Eelgrass and native oyster communities in San Francisco Bay provide important habitat for benthic invertebrates, fish and birds. Creosote pilings have been shown to reduce the survival of bay fishes and some piling structures inhibit the growth of eelgrass due to shading. Restoring eelgrass and oysters and removing contaminated pilings within San Pablo Bay would benefit some of the same species that utilize the subtidal and intertidal habitats within Castro Cove. However, the relationship of the expected costs to the expected benefits from the restoration was not found to be as advantageous as for many of the tidal marsh projects.

4.6.2.1 Evaluation of Eelgrass Restoration: Non-preferred Project

Eelgrass is the predominant seagrass found in San Francisco Bay. It occurs in select locations just offshore and underwater and beds can vary in distribution, density, and height from year to year. Eelgrass beds create a valuable shallow-water habitat which provides shelter, feeding, and/or breeding habitat for many species of invertebrates, fishes, and waterfowl. Efforts to restore eelgrass beds in San Francisco Bay, administered by many community-based non-profit and scientific groups with financial support from NOAA and the Coastal Conservancy, have been pilot efforts. New data suggest that these projects are feasible, but to date they have not been attempted at a scale larger than ¼ acre in size. Eelgrass restoration costs have been estimated at approximately $65,000/acre. Eelgrass restoration could occur along the shoreline at Point Pinole, the Breuner property, WCCSL, and locations on the west side of Point San Pablo.

Although eelgrass restoration potentially satisfies the Trustees' primary criteria, technical feasibility and cost effectiveness are of significant concern. As there are tidal restoration projects close to Castro Cove and within the North Bay subregion that better meet the Trustees' evaluation criteria and cost less than eelgrass restoration, this project is not preferred.

4.6.2.2 Evaluation of Native Oyster Restoration: Non-preferred Project

California oysters *(Ostreola conchaphila)* have declined throughout their range and have been reduced to a few scattered remnant populations in San Francisco Bay. The loss of oyster reef habitat impacted benthic and pelagic food webs. Without oyster reefs, eelgrass and other bottom habitats declined, replaced by broad expanses of shifting soft substrates. Feeding, sheltering, spawning, and nursery functions of these habitats were lost, impacting many benthic and pelagic species. Restoration of native oysters will provide biological, societal, and commercial benefits. NOAA and the

Coastal Conservancy have funded projects that introduce hard substrate on which native oyster spat can settle into the Bay, creating mini-reefs. These projects, administered by many community-based non-profit and scientific groups, have been pilot efforts. New data suggest that these projects are feasible at a small scale, but they have not been attempted at a scale larger than ¼ acre in size. Oyster restoration costs have been estimated at approximately $314,000/acre. Offshore sites along the Richmond shoreline in which restoration of these habitats could occur include: the Breuner property, Point Pinole, WCCSL, and locations on the west side of Point San Pablo.

Although oyster projects potentially satisfy the Trustees' primary criteria, their technical feasibility and cost effectiveness are of significant concern. As there are tidal restoration projects close to Castro Cove and within the North Bay subregion that better meet the Trustees' evaluation criteria and cost less than oyster restoration, this project is not preferred.

4.6.2.3 Evaluation of Creosote Pier and Piling Removal: Non-preferred Project

The Trustees have identified three locations (Richmond/San Rafael Bridge pile, Terminal 4, and the Red Rock Warehouse along the Point San Pablo Shoreline), totaling 7.8 acres, where creosote pilings might be removed; however, the Trustees have undertaken no formal survey and do not know the total number of individual pilings. While the removal of creosote pilings and associated structures would theoretically improve water and sediment quality resulting in improved biological conditions beneficial to fish and other aquatic life, the magnitude and spatial extent of expected improvement is unknown. Some information suggests that the pilings and dilapidated docks along the Point San Pablo shoreline also restrict the growth of eelgrass by shading.

The City of Richmond has received funding from the San Francisco Bay Conservation and Development Commission (BCDC) to remove pile supported structures at both the Terminal 4 site and the Red Rock Warehouse site. The Trustees were told by the Port of Richmond that a full survey of the area and bids for piling removal pursuant to the Scope of Work for this project are forthcoming (Norman Chan, pers. com.).

The project is close to the affected area and is of similar habitat type to that injured by the Chevron releases into Castro Cove, thus satisfying the primary evaluation criteria. However, the expected benefits to the types of species that utilize the subtidal and intertidal habitats within Castro Cove are low compared to the high estimated project costs. This project is not preferred because there are tidal wetlands projects that better satisfy the evaluation criteria.

4.6.3 Riparian Restoration Projects

As stated in Section 4.6, the Trustees did not pursue detailed evaluation of the stream and riparian restoration projects because the benefits that they would provide do not restore the equivalent of the resources injured by the Chevron releases (criterion 1) and several potential in-kind tidal wetland and subtidal projects exist to restore the equivalent of the resources injured by the releases into Castro Cove.

4.6.4 Preferred Alternative

The Trustees have selected two projects (see Sections 4.6.1.1 and 4.6.1.2) as the preferred alternative from among the seven tidal and three subtidal wetlands restoration projects which they evaluated in this assessment process. The Cullinan Ranch and Breuner Marsh restoration projects best fit the evaluation criteria and in combination provide sufficient restoration acreage to achieve the needed scale of restoration for this case. This combination of restoration projects represents the Trustees' preferred alternative.

4.7 Cumulative Impacts

Cumulative impacts are impacts that result from an action along with other past, present, and reasonably foreseeable near-term future actions taken together. Significant cumulative impacts can result from a combination of actions that do not have significant impacts individually. Taken collectively, the effects of several actions may be additive, countervailing, or synergistic. Impacts are considered regardless of the agencies or parties involved. Thus, in considering cumulative impacts, this analysis is not limited to the actions of this case but also considers other projects in the region.

Overall, the selected restoration projects toward which the Trustees plan to contribute funding from the settlement of the Castro Cove NRDA will result in long-term net improvement in fish and wildlife habitat, restoration of ecological balance in areas where disturbances have led to adverse impacts on sensitive native species, and improvement in the natural resource services provided by fish and wildlife in the region. Cumulative impact analysis is nonetheless performed to evaluate whether there are specific components of the proposed actions that, when considered in combination with other closely related past, present, and future actions in the affected area, have potentially significant cumulative adverse effects.

The Trustees evaluated the restoration projects selected in this DARP/EA in conjunction with other known past, proposed or foreseeable closely related projects that could potentially add to or interact with the these projects within the affected area to determine whether significant cumulative impacts may occur. Specifically, the selected restoration projects were analyzed within the context of regional habitat restoration efforts, focusing on the North Bay (i.e., San Pablo Bay) subregion of the San Francisco Baylands Ecosystem Goals Project (Goals Project 1999). Castro Cove and the two wetlands restoration projects selected in this final DARP/EA (Cullinan Ranch and Breuner Marsh) are all located within this North Bay subregion. Past, present, and reasonably foreseeable future actions considered in this cumulative impacts analysis are listed in Table 6.

Cumulatively, tidal wetlands creation and improvement projects in the area are expected to result in similar environmental effects (beneficial and adverse) as the selected projects. A description of each of the other tidal restoration projects listed above is not provided in this DARP/EA; however, it can be generally stated that these projects are intended to restore or enhance hydrology, water quality, and ecological functions in a manner similar to the two projects selected for funding in this DARP/EA.

Table 6. Completed and reasonably foreseeable tidal wetlands restoration projects in the San Pablo Bay region.

Bahia Lagoon	Nevada-Shaped Parcel, Richmond Shoreline at Wildcat Creek
Bel Marin Keys Unit V	Petaluma River Marsh
Breuner Marsh	Port Sonoma Marina Perimeter
Central Avenue Marsh	Sears Point
Cullinan Ranch	Skaggs Island
Gallinas Creek	Sonoma Baylands
Green Point/Toy Marsh	Tolay Creek
Hamilton Airfield	Tubbs Island
Mare Island Navy Mitigation Marsh	Vallejo Mitigation Sites
Mare Island Refuge	Wildcat Marsh
Napa River Salt Marsh Restoration Project	

Cumulative impact analysis has been performed previously for the Cullinan Ranch project and for several other past and planned regional tidal wetlands restoration projects listed above. These analyses of cumulative impacts, and associated regional habitat restoration plans and programs were compiled and reviewed by the Trustees during the preparation of this DARP/EA. CEQ regulations on NEPA recommend the avoidance of repetitive discussions when more than one environmental document addresses the same actions; thus in the interest of conciseness, cumulative impact analysis available in other referenced environmental documentation is simply summarized below.

The reintroduction of tidal influence to the selected project sites along with other tidal wetlands restoration projects in the region, would be expected to improve water quality in San Pablo Bay. In the long-term, the overall water quality effects of the selected projects and other wetlands restoration projects is expected to be beneficial, since wetlands are generally acknowledged to provide favorable water quality improvement mechanisms such as filtration, settling, entrapment of sediment, and enhanced biological activity. Project construction could cause temporary water quality impacts; however, these impacts would be limited in scope and duration, would be mitigated by use of best management practices, and are unlikely to contribute to cumulative water quality impacts in San Pablo Bay.

One general concern about wetlands restoration projects being undertaken throughout the greater San Francisco Bay region is that many of the sites are subsided and proponents plan to import substantial amounts of dredged material or other fill material during implementation. Neither of the projects selected in this DARP/EA anticipate use of off-site sediments. Restoration of large tracts to tidal influence also has the potential to alter tidal prisms and potentially affect the balance of sediment accretion and erosion, potentially resulting in a reduction of mudflat and shallow subtidal zones in certain areas. Long-term monitoring of potential hydrological impacts of all tidal wetlands restoration sites has been and will continue to be required by regulatory authorities as a condition of implementation of these projects.
All of the past and proposed tidal wetlands restoration projects for this region are part of a long-term strategy to recreate a complex mosaic of wetlands habitats in the greater San Francisco Bay area. The selected projects, considered along with other wetlands restoration projects in the North Bay subregion, will result in cumulatively beneficial impacts to plants and wildlife, including special-status species, providing additional habitat to support recovery of these sensitive communities and resulting in greater habitat complexity, diversity, and productivity. These projects will cumulatively increase the availability and quality of fringe marsh, mudflat, and shallow water aquatic habitats throughout the region. A potentially significant adverse cumulative impact to which the selected projects may contribute is the conversion of current lands to tidal influence, resulting in a shift in biological communities from those that occupy the current land areas to tidal marsh-dependent bird, fish, mammal, and invertebrate species. Considerations for monitoring and potentially mitigating for potentially significant impacts to existing biological communities is addressed in the individual NEPA and CEQA documents for these projects.

More specifically, the potential conversion of certain open water and seasonal wetlands habitats to tidal marsh and mudflat habitats could potentially have adverse impacts on regional shorebird and waterfowl populations. Proposed tidal wetlands restoration projects in San Pablo Bay are expected to cumulatively alter the amount of open water and seasonal wetlands habitats used by shorebirds and waterfowl over the next several decades. This change could result in either an increase or decrease of open water habitats suitable for such species, depending on which restoration approaches are implemented. Neither the Cullinan Ranch nor the Breuner Marsh projects are anticipated to incrementally contribute to losses of such habitats. Regional habitat restoration plans, and site-specific environmental documentation for other tidal wetlands restoration projects in the region, address this potential impact.

Another potential cumulative impact from multiple tidal wetlands restoration projects is the potential for invasion of aggressive non-native plant species, such as certain cordgrass species (*Spartina alterniflora and Spartina densiflora*). The number of restoration projects planned in the region increases the availability of suitable habitat for colonization by these species, and in the past, several restoration projects along the shores of San Francisco and San Pablo bays have been degraded because of non-native cordgrass out-competing native California cordgrass. The ability to control the cumulative effects and spread of exotic species of cordgrass and other plants requires a regional effort and the willingness of resource agencies to fund estuary-wide control programs. Specific restoration projects require monitoring and control of exotic pest plant species within restored marsh areas, and coordination with the Invasive Spartina Project (a regional program to control non-native *Spartina* in the San Francisco estuary).

For further detailed discussion of cumulative impacts, the reviewer is directed to environmental documentation on the following projects, provided in the references section: Cullinan Ranch Restoration Project Final EIS/EIR (Ducks Unlimited 2009); Hamilton Army Wetland Restoration Feasibility Study Final EIS/EIR (Jones and Stokes Associates 1998); Bahia Marsh Restoration Project EIR (California Department of Fish and Game 2006); South Bay Salt Ponds Final EIS/EIR (EDAW et al. 2007); and San Francisco Baylands Ecosystem Habitat Goals (Goals Project 1999).

4.7.1 Uncertainty: Impacts of Global Sea Level Rise on Coastal Wetland Habitats in San Francisco Bay

In addition to the above analysis of the environmental consequences and cumulative effects of the proposed actions, the Trustees describe here the potential that in the long-term, climate change and sea level rise will have consequences on coastal resources in San Francisco Bay, including the projects analyzed herein. The Intergovernmental Panel on Climate Change estimates that the global average sea level will rise between 0.6 and 2 feet (0.18 to 0.59 meters) by the end of the 21st century (IPCC 2007). More recently, the Pacific Institute has projected a 1.4 meter sea level rise along the California Coast by the end of the century (Heberger et al. 2009).

Increased coastal flooding, loss of wetland habitats, an increase in the salinity of estuaries and freshwater aquifers, and changes in tidal ranges in rivers and bays, transport of sediments and nutrients, and patterns of contamination in coastal areas are amongst the main effects of sea level rise on coastal regions. These in turn will likely result in shifts in species compositions and an overall reduction in coastal wetlands productivity and function (Warren and Niering 1993; Titus 1991).

It is generally understood, however, that increases in temperature, sea-level rise, and changes in precipitation will degrade those benefits and services. It also is important to recognize the degree of uncertainties associated with projections of the consequences for wetland ecosystems resulting from climate change. For example, the ranges of change estimated for North America from pre-industrial levels are +/– 20 percent for precipitation, +/– 10 percent for evaporation and +/– 50 percent for runoff (Frederick 1997). There is further uncertainty regarding the increase in frequency and intensity of extreme events, such as storms, droughts, and floods. The ability of wetland ecosystems to adapt will be highly dependent on the rate and extent of these changes.

Coastal wetland flora and fauna generally respond to small, permanent changes in water levels. However, the degree to which they are able to adapt to these changes will depend to a great extent on the ability for species to 'migrate' to alternative areas. Rising sea levels will likely force wetland systems to migrate inland. However, this migration path could be obstructed by inland land uses or by the ability of these systems and their components to migrate in sufficient time to persist. For example, many coastal and estuarine wetlands will be unable to migrate inland due to the presence of dikes, levees or specific human land uses close to the coastal area (Kusler et al. 1999).

The projected environmental benefits of planned tidal wetlands restoration projects may be affected by sea level rise in the 21st century. For instance, tidal wetlands restoration sites that are more constrained to their inland side by existing human development may be less able to adapt to rising sea level, reducing their intended long-term benefits. As the rate of relative sea level rise experienced at many locations along California's coast is somewhat consistent with the worldwide average rate of rise observed over the past century, it may be reasonable to assume that changes in worldwide average sea level through this century will also be experienced by California's coast (DWR 2006).

Ultimately the specific degree to which the intertidal and subtidal projects considered herein may be affected by sea level rise in the coming decades is uncertain and dependent upon different projections of climate change effects and how society chooses to adapt to and/or mitigate these changes in the future.

5.0 APPLICABLE LAWS AND REGULATIONS

The major laws guiding the development of this final DARP/EA addressing restoration of the injured resources and services at the Castro Cove site are CERCLA and NEPA. These statutes and the regulations implementing them set forth a specific process of impact analysis and public review. In addition, implementation of selected restoration actions may trigger compliance with other applicable laws, regulations, and policies at the federal, state, and local levels. A brief description of the relevant and potentially relevant laws, regulations, and policies are set forth below.

5.1 Key Federal Statutes, Executive Orders, Regulations, and Policies

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. 9601 et seq.)

CERCLA, otherwise known as the Superfund law, provides the basic legal framework for the cleanup and restoration of the nation's hazardous substances sites. Under CERCLA, responsible parties are liable for damages, including reasonable assessment costs, for injuries to, or the loss of, natural resources. The term "natural resources" is broadly defined by CERCLA to mean "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, … any state or local government, any foreign government, or any Indian tribe…." This statute provides that parties responsible for contamination of sites and the current owners or operators of contaminated sites are liable for the cost of cleanup and for damages to natural resources. Compensation is used to restore, replace, rehabilitate, or acquire the equivalent of natural resources and services.

CERCLA also required the promulgation of regulations for assessing natural resource damages resulting from the release of a hazardous substance and/or the discharge of oil for purposes of the CWA (33 U.S.C. 1321 (f)(4) & (5)). The Department of the Interior prepared the implementing regulations for natural resource damage assessment and restoration also referred to herein as the DOI Rule (43 C.F.R. Part 11). Federal and state agencies and Indian tribes may act as Trustees on behalf of the public to assess the injuries, to recover damages for those injuries, and to implement restoration. This final DARP/EA has been prepared jointly by the three trustee agencies with trust resources affected by contamination at the Castro Cove site: NOAA, USFWS, and CDFG. CERCLA and its implementing regulations for natural resource damage assessment and restoration provide that the designated Trustees shall develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources and lost services.

National Environmental Policy Act (42 U.S.C. 4321, et seq.; 40 C.F.R. Parts 1500–1508)

NEPA sets forth a specific process of environmental impact analysis and public review. NEPA is the basic national charter for the protection of the environment. Its purpose is to “encourage productive and enjoyable harmony between man and the environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation.” The law requires the federal government to consider the consequences of major federal actions on human and natural aspects of the environment to minimize, where possible, adverse impacts. Equally important, NEPA establishes a process of environmental review and public notification for federal planning and decision making.

Generally, when it is uncertain whether a proposed federal action will have significant effects, federal agencies will begin the NEPA planning process by preparing an EA. They may seek public review and comment on the EA, and will consider any public comments in making a determination whether a proposed action is likely to have a significant impact on the environment or not. If the effects of a project are considered significant, an EIS will be prepared. If they are determined not to be significant, a finding of no significant impact (FONSI) will be issued. In this case, the Trustees have prepared an EA, and after obtaining public comment, the federal Trustees have each issued a decision document under NEPA (see Appendix D). The NEPA analysis was performed to the level of detail possible given currently available information. The Breuner Restoration Project is at an early stage of planning, while the potential environmental impacts of the Cullinan Ranch Restoration project have been considered in a separate EIS/EIR for that project. As more site-specific information is developed regarding the Breuner Project, it may be necessary to conduct further NEPA and/or CEQA analysis.

The Trustees have integrated CERCLA restoration planning with the NEPA analysis to achieve efficiencies and to meet the public involvement requirements of CERCLA and NEPA concurrently.

The Clean Water Act (33 U.S.C. 1251, et seq.)

The CWA is the principal federal statute governing water quality. The goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation’s waters. The CWA regulates both the direct and indirect discharge of pollutants into the nation’s waters. Section 301 of the CWA prohibits the discharge into navigable waters of any pollutant by any person from a point source unless it is in compliance with a National Pollution Discharge Elimination System permit.

Section 311 of the CWA regulates the discharge of oil and other hazardous substances into navigable waters and waters of the contiguous zone, as well as onto adjoining shorelines, that may be harmful to the public or to natural resources. The CWA allows the federal government to remove the substance and assess the removal costs against the responsible party. Under the CWA, removal costs include those associated with the restoration or replacement of the natural resources damaged or destroyed as a result of a discharge of oil or a hazardous substance. Section 301 (c) of CERCLA required the promulgation of regulations for assessing natural resource damages resulting from the release of hazardous materials as well as the discharge of oil for purposes of the CWA (33 U.S.C. 1321 (f)(4) & (5)). The DOI prepared the implementing regulations for natural resource damage assessment and restoration under CERCLA and the CWA also referred to herein as the DOI Rule (43 C.F.R. Part 11). This final DARP/EA has been prepared jointly by the three trustee agencies with trust resources affected by contamination at the Castro Cove site: NOAA, USFWS, and CDFG. The DOI Rule provides that the designated Trustees shall develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources and lost services.

Section 404 of the act authorizes the U.S. Army Corps of Engineers to issue permits, after notice and opportunity for public hearings, for the disposal of dredged and fill material into navigable waters. Generally, projects that discharge dredged or fill material into waters including wetlands require Section 404 permits. Section 401 of the CWA provides that projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. The Trustees anticipate that the tidal wetlands restoration projects at Cullinan Ranch and the Breuner property will require permits under the CWA; the implementing agency for each project will apply for these permits as appropriate after sufficient site-specific information is developed.

The Clean Air Act (42 U.S.C. 7401, et seq.)

The Clean Air Act (CAA) is the principal federal statute governing air quality. The primary goal of the CAA is to protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population. The CAA regulates both the direct and indirect discharge of airborne pollutants. Section 7471 of the CAA states that applicable implementation plans shall contain emission limitations and such other measures as may be necessary, as determined under regulations promulgated under this part, to prevent significant deterioration of air quality.

The Trustees anticipate that the restoration projects at Cullinan Ranch and the Breuner property may require discussion of general conformity requirements; the implementing agency for each project will address these requirements after sufficient site-specific information is developed.

Coastal Zone Management Act (16 U.S.C. 1451, et seq.)

The goal of the Coastal Zone Management Act (CZMA) is to encourage states to preserve, protect, develop, and, where possible, restore and enhance valuable natural coastal resources. Participation by states is voluntary. The State of California has enacted the federally approved California Coastal Act.

Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the state the opportunity to concur that the project is consistent with the state's coastal policies. The regulations outline the consistency procedures.

The San Francisco Bay Conservation and Development Commission (BCDC) is the federally-designated state coastal management agency for the San Francisco Bay segment of the California coastal zone. This designation empowers the BCDC to use the authority of the federal CZMA to ensure that federal projects and activities are consistent with the policies of the Bay Plan and state law.

The Trustees believe that the selected projects can be implemented in a manner that will either have no effect on coastal resources or uses or will be consistent to the maximum extent practicable with the McAteer-Petris Act (California Government Code Sections 66600 to 66694) and the San Francisco Bay Plan (Bay Plan). The Trustees and/or the project implementers, as appropriate, will seek federal consistency concurrence and/or a permit for these projects; however, for the tidal marsh restoration project at the Breuner property, further site-specific development will be necessary before it is appropriate to seek BCDC's concurrence or a permit.

Endangered Species Act (16 U.S.C. 1531, et seq.)

The purpose of the Endangered Species Act (ESA) is to conserve endangered and threatened species and the ecosystems on which they depend. The ESA directs all federal agencies to use their authorities to further these purposes. Pursuant to Section 7 of the ESA, each federal agency shall, in consultation with the Secretaries of NOAA and/or USFWS, ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

Under the ESA, NOAA's National Marine Fisheries Service (NOAA Fisheries Service) and the USFWS publish lists of endangered and threatened species. Before initiating an action, the federal action agency, or its non-federal permit applicant, must ask the USFWS and/or the NOAA Fisheries Service to provide a list of threatened, endangered, proposed, and candidate species and designated critical habitats that may be present in the project area. If no species or critical habitats are present, the federal action agency has no further ESA obligation under Section 7. If a listed species is present and the federal action agency determines that the project may affect a listed species, consultation is required. The first phase of consultation is informal. For major construction activities, a biological assessment is required to assist in the determination of whether the proposed action is likely to adversely affect listed species and critical habitats. For actions that are not major construction activities, the federal action agency must provide the USFWS and/or the NOAA Fisheries Service with an account of the basis for evaluating the likely effects of the action.

If the federal action agency concludes that the project will not adversely affect listed species or critical habitats, the agency submits a “not likely to adversely affect” determination to the USFWS and/or the NOAA Fisheries Service for its concurrence. If the USFWS and/or the NOAA Fisheries Service concurs with the federal action agency that the project is not likely to adversely affect any listed species, then the consultation (informal to this point) is concluded and the decision is put in writing.

If the federal action agency determines that a project may adversely affect a listed species or a designated critical habitat, formal consultation is required. There is a designated period of time in which to consult (90 days), and beyond that, another set period of time for the USFWS and/or the NOAA Fisheries Service to prepare a biological opinion (45 days). The determination of whether or not the proposed action would be likely to jeopardize the species or adversely modify its critical habitat is contained in the biological opinion. If a jeopardy or adverse modification determination is made, the biological opinion must identify any reasonable and prudent alternatives that could allow the project to move forward.

Several threatened and endangered species occur in the project areas for this final DARP/EA, including steelhead, the salt marsh harvest mouse, and the California clapper rail. For each project that is selected in the final DARP/EA, the Trustees and/or the project implementer, as appropriate, will evaluate the potential effects of the project on listed species and critical habitat. Based on this analysis, the Trustees and/or the project implementer will perform the appropriate level of consultation with the USFWS and/or the NOAA Fisheries Service pursuant to Section 7 of the ESA.

Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801, et seq.)

The federal Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) establishes a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After an EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

The Trustees do not anticipate that either selected project has the potential to affect an EFH. If, upon development of further site-specific information, it is determined that either project could affect an EFH, the Trustees and/or the project implementer, as appropriate, will consult with appropriate NOAA officials.

Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.)

The federal Fish and Wildlife Coordination Act requires that federal agencies consult with the USFWS, the NOAA Fisheries Service, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the CWA, NEPA, or other federal permit, license, or review requirements.

The Trustees and/or the project implementers will consult with the appropriate agencies as they pursue any required permitting for specific actions that may trigger such consultation.

Marine Mammal Protection Act (16 U.S.C. 3371, et seq.)

Under the Marine Mammal Protection Act (MMPA), the Secretary of Commerce is responsible for the conservation and management of pinnipeds (other than walruses) and cetaceans. The Secretary of the Interior is responsible for walruses, sea otters, polar bears, manatees, and dugongs. The Secretary of Commerce delegated MMPA authority to the NOAA Fisheries Service. Title II of the act established an independent Marine Mammal Commission and its Committee of Scientific Advisors to oversee and recommend actions necessary to meet the intents and provisions of the act. The act provides that the Secretary shall allow the incidental, but not intentional, taking, by U.S. citizens engaged in activities other than commercial fishing of small numbers of depleted as well as non-depleted marine mammals if, after notice and opportunity for public comment, the secretary finds that the total of such taking will have a negligible impact on the affected species or stock, and prescribes regulations setting forth permissible methods of taking, and requirements for mitigating, monitoring and reporting such taking.

The Trustees have determined that the Cullinan Ranch project does not have the potential to affect marine mammals. Although further project development is necessary, the Trustees do not anticipate that the tidal marsh restoration project at the Breuner property will have the potential to affect marine mammals. However, if necessary, the Trustees and/or the project implementer, as appropriate, will consult with appropriate NOAA or USFWS officials after sufficient site-specific information is developed.

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703, et seq.)

The Migratory Bird Treaty Act (MBTA) implements four international treaties involving protection of migratory birds, including all marine birds, and is one of the earliest statutes (amended several times) to provide for avian protection by the federal government. Among its other provisions, it broadly prohibits actions to “pursue, hunt, take, capture, kill, attempt to take, kill, possess, offer for sale, sell, offer to purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird...or any part, nest, or egg of such bird." Exceptions to these prohibitions are only allowed under regulations or permits issued by USFWS. Hunting of game birds, including waterfowl and certain shore birds, is annually regulated through a process in which the USFWS sets "framework regulations" based on the best current population data available, and states pass regulations that conform to those federal regulations. All other prohibited actions are only allowed under specific permits issued by the USFWS. Criminal violations of this act are enforced by USFWS, and it is also the primary statute under which USFWS and the DOI have responsibility to manage all migratory birds wherever they occur, including marine birds.

Projects discussed in this final DARP/EA will be conducted in full compliance with the MBTA.

Rivers and Harbors Act (33 U.S.C. 401, et seq.)

The federal Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the act prohibits unauthorized obstruction or alteration of navigable waters and vests the U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters. Restoration actions that require Section 404 CWA permits are likely also to require permits under Section 10 of the Rivers and Harbors Act. However, a single permit usually serves for both. Therefore, the Trustees can ensure compliance with the Rivers and Harbors Act through the same mechanism.

Executive Order 11988: Construction in Flood Plains

This 1977 executive order (EO) directs federal agencies to avoid, to the extent possible, the long-and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of development in floodplains wherever there is a practicable alternative. Each agency is responsible for evaluating the potential effects of any action it may take in a floodplain. Before taking an action, the federal agency should determine whether the proposed action would occur in a floodplain. For any major federal action significantly affecting the quality of the human environment, the evaluation would be included in the agency's NEPA compliance document(s). The agency should consider alternatives to avoid adverse effects and incompatible development in floodplains. If the only practicable alternative requires siting in a floodplain, the agency should: (1) design or modify the action to minimize potential harm and (2) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

The projects selected in this final DARP/EA are either not in a floodplain (i.e., subtidal projects) or are of a type compatible with the functions of a floodplain (i.e. wetlands restoration).

Executive Order 13112: Invasive Species

EO 13112 applies to all federal agencies whose actions may affect the status of invasive species and requires agencies to identify such actions and to the extent practicable and permitted by law (1) take actions specified in the order to address the problem consistent with their authorities and budgetary resources; and (2) not authorize, fund, or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, "pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

The Trustees will require those implementing the selected projects to comply with the requirements of this EO.

Executive Order 13186: Protection of Migratory Birds

EO 13186, titled the Responsibilities of Federal Agencies to Protect Migratory Birds, requires federal agencies to avoid or minimize the effects of their actions on migratory birds, and, in some cases, to evaluate the effects of actions and plans on migratory birds during environmental analyses. The EO further directs federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement, within two years, a Memorandum of Understanding with the USFWS that shall promote the conservation of migratory bird populations.

Neither of the selected projects is expected to have negative effects on migratory bird populations.

Executive Order 12898: Environmental Justice

The 1994 EO 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. In the memorandum to heads of departments and agencies that accompanied EO 12898, the President specifically recognized the importance of procedures under NEPA for identifying and addressing environmental justice concerns. The memorandum states that "each federal agency shall analyze the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by [NEPA]." The memorandum particularly emphasizes the importance of NEPA's public participation process, directing that "each federal agency shall provide opportunities for community input in the NEPA process." Agencies are further directed to "identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices." The CEQ has oversight of the federal government's compliance with EO 12898 and NEPA.

All potential actions implementing the projects selected in this final DARP/EA are expected to have positive environmental impacts and not to impose any adverse impacts on any community.

Information Quality Law, Public Law 106-554, Section 515

Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554. These guidelines are intended to ensure and maximize the quality of the objectivity, utility, and integrity of such information. This final DARP/EA is an information product covered by the information quality guidelines established by NOAA and the DOI for this purpose. The quality of the information contained herein is consistent with these guidelines, as applicable.

5.2 Key State of California Statutes

California Environmental Quality Act (Pub. Res. Code 21000–21178.1)

CEQA was adopted in 1970 and applies to most public agency decisions to carry out, authorize or approve projects that may have environmental impacts. Its basic purposes are to inform California governmental agencies and the public about the potentially significant effects of proposed activities, identify ways that environmental damage can be avoided or significantly reduced, prevent significant avoidable damage to the environment through adoption of feasible alternatives or mitigation measures, and to disclose the reasons for agency approval of a project resulting in significant environmental effects.

The CEQA process begins with a preliminary review as to whether CEQA applies to the project in question. Generally, a project is subject to CEQA if it involves a discretionary action that is carried out, funded or authorized by an agency, and that has the potential to impact the environment. Once the agency determines that the project is subject to CEQA, the lead agency must then determine whether the action is exempt from CEQA compliance under either a statutory or categorical exemption.

If the lead agency determines that the project is not exempt, then an Initial Study is generally prepared to determine whether the project may have a potentially significant effect on the environment. Based on the results of the Initial Study, the lead agency determines whether to prepare a Negative Declaration (i.e., the project will not result in significant adverse effects to the environment) or an EIR. The test for determining whether an EIR or negative declaration must be prepared is whether a fair argument can be made based on substantial evidence that the project may have a significant adverse effect on the environment.

CEQA encourages the use of a federal EIS or FONSI prepared pursuant to NEPA when such documents are available, or the preparation of joint state/federal documents, in lieu of preparing a separate EIR or negative declaration under CEQA. In this case, the Trustees have prepared an EA, and after obtaining public comment, the federal Trustees have issued decision documents finding no significant impact (see Appendix D). Accordingly, this DARP/EA and FONSIs, may be relied upon or adopted by the state trustee agencies or the lead agency for the project(s) towards compliance with CEQA where appropriate.

To this end, the State Trustee, CDFG has coordinated with the federal Trustees to ensure the DARP/EA complies with CEQA guidelines (Title 14 CCR, Chapter 3, § 15220 *et seq*.).

The analysis in this DARP/EA was performed to the level of detail possible given currently available information. The Breuner Restoration Project is at an early stage of planning, while the Cullinan Ranch Restoration project is nearing completion of a separate NEPA analysis. Accordingly, as more site-specific information is developed regarding the Breuner Project, it may be necessary to conduct further CEQA and/or NEPA analysis. The lead agency for the Breuner project will be required to carry out any additional CEQA compliance, as appropriate.

McAteer-Petris (California Government Code Sections 66690, et seq.)

The McAteer-Petris Act established the BCDC as a state agency with authority to regulate development in and around San Francisco Bay. The Act describes the broad policies the BCDC must use to decide whether to issue permits for activities in and along the shoreline of San Francisco Bay. The Act was first adopted in 1965 to establish the BCDC as a temporary State agency. The BCDC was charged with preparing a plan for the long-term use of the Bay and regulating development in and around the Bay. The Bay Plan was completed in January 1969. In August 1969, the McAteer-Petris Act was amended to make BCDC a permanent agency and to incorporate the policies of the Bay Plan into State law.

The Trustees do not anticipate that either of the selected restoration projects in this final DARP/EA will adversely affect coastal resources in the San Francisco Bay segment of the California Coastal Zone. The implementing entity for each project will be required to apply for any necessary permits and approvals, including any required San Francisco Bay permit. However, for the tidal marsh restoration project at the Breuner property, further site-specific development will be necessary before it is appropriate to seek a BCDC permit or approval.

California Endangered Species Act (Fish and Game Code 2050 et seq.)

Pursuant to the California Endangered Species Act (CESA) (California Fish and Game Code Sections 2050 et seq.), it is the policy of the State of California that state agencies should not approve projects as proposed that would jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species if there are reasonable and prudent alternatives available. However, if reasonable alternatives are infeasible, individual projects may be approved if appropriate mitigation and enhancement measures are provided.

Pursuant to the CESA, the Fish and Game Commission has established a list of threatened and endangered species based on criteria recommended by the California Department of Fish and Game. Section 2080 of the California Fish and Game Code prohibits "take" of any species that the Commission determines to be an endangered species or a threatened species. Take is defined in Section 86 of the Fish and Game

Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." The CESA allows for take incidental to otherwise lawful development projects. The CESA emphasizes early consultation to avoid potential impacts to rare, endangered, or threatened species and to develop appropriate mitigation planning to offset project-caused losses of populations of listed species and their essential habitats.

Several threatened and endangered species occur in the project area for this final DARP/EA, including the salt marsh harvest mouse and the California clapper rail. For each project that is selected in the final DARP/EA, the Trustees and/or the project implementer, as appropriate, will evaluate the potential effects of the project on listed species and critical habitats. With regard to the Cullinan Ranch Restoration project, the USFWS is conducting an intra-service consultation in accordance with the ESA. No additional approval or incidental take permit from CDFG is required under CESA. With regard to the Breuner Restoration Project, the implementing entity will be required to obtain approval and a Section 2081(b) incidental take permit from CDFG, if appropriate, pursuant to the requirements of the CESA. However, no Section 2081(b) permit may authorize the take of "fully protected" species such as the salt marsh harvest mouse and the California clapper rail (Fish and Game Code Sections 3511 and 4700). If a project is planned in an area where a fully protected species occurs, an applicant must design the project to avoid all take; the Department cannot provide take authorization for such species under CESA.

Public Resources Code, Division 6, Sections 6001, et seq.

The Public Resources Code, Division 6, gives the California State Lands Commission trustee ownership over State sovereign tide and submerged lands. Permits or leases may be required from the State Lands Commission if a restoration project is located on such lands.

5.3 Other Potentially Applicable Statutes, Regulations, and Authorities

Additional statutes may be applicable to NRDA planning activities. The statutes listed below, or their implementing regulations, may require permits from federal or state permitting authorities.

- Archaeological Resources Protection Act, 16 U.S.C. 460, et seq.
- National Historic Preservation Act of 1966 as amended (16 U.S.C. 470-470t, 110)
- EO 11514 – Protection and Enhancement of Environmental Quality
- EO 11990 – Protection of Wetlands
- EO 11991 – Relating to the Protection and Enhancement of Environmental Quality
- Porter-Cologne Water Quality Control Act (Porter-Cologne), Water Code Section 13000, et seq.

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7.0 REFERENCES

Battelle and ENTRIX, Inc. 2002. Appendix D.1: Draft Skeet Range Probability Model Parameter Proposal *in* Draft Remedial Investigation Report: Skeet Range (Alameda Point, formerly Alameda Naval Air Station).

Beckvar, N, TM Dillon, and LB Read. 2005. Approaches for linking whole body fish tissue residues of mercury or DDT to biological effects thresholds. Environmental Toxicology and Chemistry 24:2094–2105.

Birge, WJ, JA Black, AG Westerman, and JE Hudson. 1979. The effects of mercury on reproduction of fish and amphibians. Pp 629-655. *In* JO Nriagu (ed.) Biogeochemistry of mercury in the environment. Elsevier/North-Holland Biomedical Press, New York.

California Department of Fish and Game, 2006. Bahia Marsh Restoration Project EIR. www.sfbayjv.org/bahiaFEIR.html

DTSC, HERD. 2000. EcoNOTE4: Use of Navy/U.S. Environmental Protection Agency (USEPA) Region 9 Biological Technical Assistance Group (BTAG) Toxicity Reference Values (TRVs) for Ecological Risk Assessment. www.dtsc.ca.gov/AssessingRisk/eco.cfm

Ducks Unlimited. 2009. Final Environmental Impact Statement/Environmental Impact Report, Cullinan Ranch Restoration Project, Solano and Napa Counties, California. Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game.

DWR. 2006. Progress on Incorporating Climate Change into Management of California's Water Resources. Technical Memorandum Report. California Department of Water Resources. http://baydeltaoffice.water.ca.gov/climatechange/reports.cfm

EDAW, Philip Williams and Associates, Ltd., HT Harvey and Associates, Brown and Caldwell, and Geomatrix. 2007. South Bay Salt Ponds Restoration Project Final Environmental Impact Statement/Report. Submitted to U.S.Fish and Wildlife Service and California Department of Fish and Game. www.southbayrestoration.org/EIR/downloads.html

ENTRIX. 2006. Additional models for the estimation of benthic mortality in Castro Cove, Memorandum to Mike Amman of Chevron, March 9.

ENTRIX. 2006. Estimation of historical sediment chemical concentration in Castro Cove, Memorandum to Mike Amman of Chevron, February 23.

ENTRIX. 2006. Models of injury assessment for the estimation of benthic service losses in Castro Cove, Memorandum to Mike Amman of Chevron, February 23.

ENTRIX. 2006. Preliminary estimation of discounted service-acre-year (DSAYs) losses in Castro Cove, Memorandum to Mike Amman of Chevron, April 13.

ENTRIX. 2006. Preliminary hazard quotient risk estimation to wildlife for Castro Cove, Memorandum to Mike Amman of Chevron, March 20.

ENTRIX. 2006. Regional background chemical concentrations for Castro Cove, Memorandum to Mike Amman of Chevron, February 23.

ENTRIX. 2006. Risk and Injury Assessment to Fish in Castro Cove, Memorandum to Mike Amman of Chevron, May 22.

ENTRIX. 2006. Risk assessment approach for HEA, Memorandum to Mike Amman of Chevron, February 22.

ENTRIX. 2006. Risk to shorebirds and waterfowl from lead pellet ingestion at Skeet Hill in Castro Cove, Memorandum to Mike Amman of Chevron, June 21.

ENTRIX. 2006. Sediment concentrations of mercury in regional (SFEI) and Castro Cove (Tier 1) data – A basis of establishing reference or background conditions, Memorandum to Mike Amman of Chevron, January 18.

ENTRIX. 2006. Spatial extent of potential service losses in Castro Cove, Memorandum to Mike Amman of Chevron, February 23.

Field, LJ, DD MacDonald, SB Norton, CG Ingersoll, CG Severn, D Smorong, and R Lindskoog. 2002. Predicting amphipod toxicity from sediment chemistry using logistic regression models. Environmental Toxicology and Chemistry 21:1993–2005.

Frederick, K. 1997. Water resources and climate change. Climate Issues Brief no. 3. Resources for the Future, Washington D.C., 14 p.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, California. www.sfei.org/sfbaygoals/

Heberger, M, H Cooley, P Herrera, PH Gleick, E Moore, 2009. The Impacts of Sea-Level Rise on the California Coast. A Paper from California Climate Change Center, prepared by the Pacific Institute. California Energy Commission CEC-500-2009-024-D.

IPCC. 2007. Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson, Eds., Cambridge University Press, Cambridge, UK, 976 pp.

Jones and Stokes Associates. 1998. Hamilton Army Wetland Restoration Feasibility Study Final EIS/EIR. www.spn.usace.army.mil/hamilton/

Kusler, J, M Brinson, W Niering, J Patterson, V Burkett, and D Willard. 1999. Wetlands and Climate Change: Scientific Knowledge and Management Options. Institute for Wetland Science and Public Policy, Association of Wetland Managers. Berne, NY, USA.

McKim, JM, GF Olson, GW Holcombe, and EP Hunt. 1976. Long-term effects of methylmercuric chloride on three generations of brook trout (*Salvelinus fontinalis*): toxicity, accumulation, distribution, and elimination. Journal Fisheries Research Board Canada 33:2726–2739.

Merkel & Associates, Inc. 2004. San Francisco Bay Eelgrass Inventory, June – October 2003. Prepared for Caltrans and NOAA Fisheries. 83pp.

NOAA. 2002. Hylebos Waterway Natural Resource Damage Settlement Proposal Report. A habitat restoration-based approach for resolving natural resource damage claims relating to the Hylebos Waterway of the Commencement Bay nearshore/tideflats superfund site combined with a proposal for allocating liability for settlement purposes. March 14.

NOAA. 1999. “Discounting and the Treatment of Uncertainty in Natural Resource Damage Assessment.” NOAA Damage Assessment and Restoration Program, Washington, D.C., February, 1999.

NOAA. 1997. “Natural Resource Damage Assessment Guidance Document: Scaling Compensatory Restoration Actions (Oil Pollution Act of 1990).” NOAA Damage Assessment and Restoration Program, Washington, D.C., December, 1997.

NOAA. 1995. “Habitat Equivalency Analysis: An Overview.” Policy and Technical Paper Series, No. 95-1, (Revised 2000).

URS. 2002a. Additional sediment characterization and risk evaluation: Skeet Hill. Prepared for Chevron Products Company, Richmond, California. March 26.

URS. 2002b. Tier II Sediment Characterization and Ecological Risk Assessment Castro Cove. Prepared for Chevron Products Company, Richmond, California. June 7, 2002.

URS. 1999. Draft Sediment Characterization and Tier I Ecological Risk Assessment for Castro Cove Tier I Report. Prepared for Chevron Products Company, Richmond, California. May 17, 1999.

U.S. Environmental Protection Agency (USEPA). 2001. Wetlands functions and values. Web page. Available at http://www.epa.gov/owow/wetlands/functions.html Functions and Values of Wetlands. USEPA Fact Sheet 843-F-01-002c.

Snarski, VM and GF Olson. 1982. Chronic toxicity and bioaccumulation of mercuric chloride in the fathead minnow (*Pimephales promelas*). Aquatic Toxicology 2:143–156.

Tetra Tech EM Inc. 2000. Final Offshore Areas Ecological Risk Assessment, Mare Island, Vallejo, California, Volume 2. Prepared for U.S. Department of the Navy. Contract No. N62474-94-D-7609 Task Order No. 082.

Titus, JG. 1991. Greenhouse effect and coastal wetland policy: How Americans could abandon an area the size of Massachusetts at minimum cost. Environmental Management 15: 39-58.

Warren, RS and NA Niering. 1993. Vegetation change on a Northeast tidal marsh: Interaction of sea level rise and marsh accretion. Ecology 74: 96–103.

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9.0 APPENDICES

Appendix A: Injury Quantification

Appendix B: Public Comments Received and Trustees’ Responses to Comments

Appendix C: East Bay Regional Park District (Robert Doyle) letter on Breuner

Appendix D: NEPA Decision Documents/Finding of No Significant Impact

Appendix A: The memoranda prepared by ENTRIX and presented in this appendix are working review drafts which were not edited or finalized by the Trustees.

Appendix A-1:

- **A-1a**, “Regional background chemical concentrations for Castro Cove”

- **A-1b** “Estimation of historical sediment chemical concentrations in Castro Cove”

Original Author(s): ENTRIX

Distributed to the injury subcommittee in the cooperative NRDA process.

Trustee Comments: These memoranda address mercury data. Total polycyclic aromatic hydrocarbon (TPAH) concentrations used in the injury quantification were estimated from available data after these documents were written and therefore are not contained in these memoranda. The geometric mean of the TPAH concentration that was calculated in March 2006, based on data from the San Francisco Estuary Institute’s samples from San Pablo Bay, was 722 µg/kg (see graph in appendix A-2c). The Castro Cove Injury Quantification is presented in Chapter 3.

ENTRIX

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: February 23, 2006

Re: Regional background chemical concentrations for Castro Cove

Project No. **3054545**

PURPOSE

Calculation of ecological service loss in Castro Cove due to exposure to the chemicals of concern (COCs) requires estimation of the conditions (e.g., biota and ecological services from those biota) that would have been present *but for* the concentrations of those COCs attributable to Chevron's activities. This memorandum describes the method for estimating the background concentrations of those COCs by estimating a regional background level of mercury in sediment. It will be part of the text associated with Section 3.2 of the DARP outline, "Data Sources."

INTRODUCTION

It has been determined that concentrations of mercury in sediment can be used to adequately model potential injury and service loss to the benthic community of Castro Cove[1]. It is, therefore, the only COC considered below.

A data set of regional sediment samples for the COCs in Castro Cove was assembled from the San Francisco Estuary Institute (SFEI) data base. The SFEI is responsible for implementation of the Regional Monitoring Program (RMP) for Trace Substances, established by the San Francisco Regional Water Control Board (Board) in 1992. The

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[1] See memorandum "Estimation of historical sediment chemical concentrations in Castro Cove."

RMP regularly monitors contaminant concentrations in water, sediment, fish and shellfish in San Francisco Bay. This monitoring program allows the Board to evaluate the effectiveness of its water quality programs in meeting its overarching goal of protecting the beneficial uses of the San Francisco Bay[2].

The concentrations of mercury in this samples are considered to to represent the typical, or *but for*, background conditions for this region of the Bay.

RESULTS

Sediment samples were selected from the SFEI reference data set for 18 locations in San Pablo Bay nearest to Castro Cove (Figure 1). The sediment samples were collected from 0-5 cm below surface, with the objective of monitoring current conditions. For 12 of these sampling locations, a single observation was available, while at the remaining six sampling locations, as many as 18 samples had been collected over time. .To eliminate any bias towards some sampling locations presented by this imbalance, the mercury sample values were averaged for each of these six sampling locations.

The 18 stations were not spatially weighted in any way-- *e.g.*, we did not use Voronoi tessellation[3] -- because the sampling locations are:

- generally dispersed throughout a large area of San Pablo Bay, and
- biased neither towards or away from any apparent or known gradients of mercury in San Pablo Bay (*i.e.*, a higher density of sampling preferentially located near a known or suspected source of mercury).

These resulting 18 values were then averaged, producing an estimate of **0.28** mg/kg for the regional mean mercury sediment concentration[4].

CONCLUSION

This estimate of the typical concentration of mercury (0.28 mg/kg) in sediments of the region is taken to represent *regional background*. This mean estimate will be used in estimating potential benthic injuries (and potential the benthic service losses) in Castro Cove from exposure to COC concentrations above regional background. It will also be used to define the spatial extent of Chevron's contribution to sediment mercury concentrations as one moves toward the mouth of Castro Cove.

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[2] See memorandum "Sediment concentrations of mercury in regional (SFEI) and Castro Cove (Tier I) data – A basis for establishing reference or background conditions" for additional information about this database.
[3] These tessellations form what are also known as Thiessen polygons or Dirichlet cells.
[4] The standard deviation equals 0.06 mg/kg.

Slipsheet for figure 1

E N T R I X

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: February 23, 2006

Re: Estimation of historical sediment chemical concentrations in Castro Cove

Project No. **3054545**

PURPOSE

This memorandum addresses the development of representative chemical concentrations in Castro Cove for use in the calculation of estimated service loss for the period of interest, using available data.

APPROACH

We address this question by the comparison of chemical concentrations in samples collected from surface sediment to samples collected from sediment cores. The steps in that comparison are a description of relevant data; an examination of accretion studies in Castro Cove; the selection of representative chemicals; and an analysis of the concentration gradients with sediment depth.

BACKGROUND

An important component of the calculation of discounted service-acre-years (DSAYs) in Castro Cove is the estimation of representative concentrations of certain chemicals in the Cove throughout the period of interest (1981 through 2006). Most of the available data for chemical concentrations – both in Castro Cove and the region – are from surficial sediment samples (upper 5 cm or 2 inches, depending upon the survey) collected within the past ten years. Investigations suggest that sediments from San Pablo Bay at large are being borne into and deposited in Castro Cove. These newer surface sediments are burying older sediments, with deposition at a rate suggesting that surficial sediments from the 1980's are now sequestered.

SEDIMENT DATA INVENTORY

Samples were collected from 13 locations throughout Castro Cove in the Tier I investigation (Dames & Moore 1999) (Figure 1). In the northern portion of the Cove, the chemical concentrations in Tier I samples were low, and indistinguishable from regional background[5] [6]. In the southern portion of the Cove, chemical concentrations were higher. Based on those results, additional samples were collected in the southern portion of the Cove in the Tier II investigation (URS June 2002).

In the Tier II study, samples were collected from 43 locations (including 2 reference locations). In all of these locations, samples were collected from 0 to 2 inches below the sediment's surface. In 24 of those 43 locations, co-located core samples were collected from 0 to 1 foot and 1 to 2 feet below the sediment's surface (Figure 1).

In a separate ecological risk assessment of the area of Castro Cove surrounding Skeet Hill, sediment samples were collected at 15 locations at 0 to 6 inches and 6 to 12 inches depth below surface. These samples were only analyzed for lead concentration and number of lead shot present (URS March 2002).

SEDIMENT ACCUMULATION RATE STUDY

As part of the Tier II investigation, sediment accumulation rates were estimated, to determine the rate at which sediment deposited in various areas of Castro Cove was burying contaminated sediments (URS 2002; Dr. Ian Austin, pers. comm.).

Four cores were collected, one each from the middle of the Area of Concern (AOC), the northern edge of the AOC, the weir at the end of the 250-foot channel, and just offshore of the Rod and Gun Club Lagoon. Based on measurements of isotope decay for Pb-210 and Cs-137, it was estimated that accumulation rates varied from 4.3 inches/year at the weir to 0.2 inches/year at the northern edge of the AOC. Accumulation rates in the middle of the AOC and offshore of the Rod and Gun Club Lagoon were approximately 0.5 inches/year. These estimates do not take into account the effects of bioturbation, chemical diffusion, and the apparent non-steady state sediment deposition at some of the core sites, all of which contribute uncertainty to both the accuracy and precision of the estimated accumulation rates.

RELATIONSHIPS BETWEEN CHEMICALS IN SEDIMENT

In URS's Tier II report, sample concentrations of arsenic, mercury, and PAHs were compared to ERL and ERM criteria. For all samples except one, where any chemical

[5] Also see memorandum "Spatial extent of service losses in Castro Cove attributable to Chevron"
[6] These samples were excluded from the remainder of the analyses in this memorandum.

other than mercury exceeded its ERL, so did mercury. In the one exception, the surface sample at DM-36, arsenic was reported at 8.5 mg/kg, compared to its ERL of 8.2 mg/kg (Figure 1). In the same sample, mercury was 0.11 mg/kg, compared to its ERL of 0.15 mg/kg. Using EPA/NOAA's logistic regression model (LRM) approach (EPA 2005), P values for mercury are almost always higher than P_Max[7] for mercury plus PAHs.

The URS ecological risk assessment at Skeet Hill addressed lead contamination, with the primary concern impacts on feeding birds. The ecological risk assessment concluded that the concentrations of lead (in shot or adsorbed to sediment particles) in the sediments of Castro Cove are unlikely to result in substantial riskto either the benthic community or to higher level organisms via bioaccumulation (URS March 2002).

Lead concentrations (after lead shot were sieved out) collected from 0 to 6 inches in Skeet Hill sediments ranged from 16 to 42 mg/kg, with a mean of 31 mg/kg. Lead concentrations in sediment samples collected from 6 to 12 inches ranged from 8.1 to 51 mg/kg, with a mean of 34 mg/kg. These concentrations never exceeded the ERM (218 mg/kg), and exceeded the ERL (46.7 mg/kg) in only one sample[8] (URS March 2002).

The NOAA/EPA P value from the average mercury concentration in Tier I and II samples[9] collected in surface sediments near Skeet Hill was higher (46%) than for the average lead concentrations from the 0-6 inches Skeet Hill samples (21%) (Table 1). As with arsenic and PAHs, the probability of significant toxicity for observed lead concentrations is less than for mercury. Based on the LRM evaluation, lead is unlikely to contribute any additional risk (which is used here as a conservative surrogate measure of service loss) to the Castro Cove benthic community beyond that present from the baseline or reference values.

These results, taken together, demonstrate that mercury alone is sufficient to represent the area where sediment concentrations of contaminants might result in a loss of benthic services I beyond baseline levels in Castro Cove.

CHANGES IN MERCURY CONCENTRATIONS IN SEDIMENT WITH CHANGING DEPTH

Mercury concentrations in 0-1 foot core samples are, on average, higher than in surface (0-2 inches) sediment samples (URS June 2002). However, this average value obscures the fact that mercury concentrations in 0-1 foot samples and in co-located surface (upper 2 inches) samples are typically comparable throughout most of Castro Cove (Figure 2).

Three sample locations (DM-18, 23, and 43) have mercury concentrations in 0-1 foot samples that are substantially higher than in co-located surface samples. If these three samples are removed from the data set, the Pearson correlation coefficient between log-transformed surface and 0-1 foot sample concentrations increases from 0.51 to 0.73 and their linear regression is not significantly different ($p = 0.05$) from a 1:1 relationship (Figure 3), which indicates these three samples are statistical outliers (Figure 1)[10].

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[7] In four surface sediment and two subsurface samples, P_Max was 4-5% higher than P for mercury. In one subsurface sample (DC/DM-36), the difference was greater (9%), but those P values were low: 9% *vs.* 18%.

[8] SH-2 at 51 mg/kg

[9] DM-8, 13, 28, and 29.

In addition, mercury concentrations in 1-2 feet sediment samples were almost always lower than in co-located surface samples and co-located 0-1 foot samples (24 of 27 of locations sampled).

CONCLUSION

These analyses support the conclusion that for the majority of the Cove, mercury concentrations do not increase substantially at greater depths, and that in a relatively small portion of Castro Cove, accretion may have buried older sediments, which contained higher mercury concentrations. This result supports the use of the larger data set of surface sediment results for the estimation of service loss in Castro Cove. Doing so removes the substantial uncertainties associated with attempting to estimate mercury concentrations in older, deeper sediments, using newer, surface sediment samples where deeper samples were not collected. It also allows a direct comparison of sediment chemical concentrations in samples from Castro Cove to concentrations in reference samples throughout San Pablo Bay.

For those three sampling locations noted above (DM-18, 23, and 43) where sediment mercury concentrations are clearly higher in deeper sediments, an alternative approach could be implemented. The 0-1 foot cores are a physical average of sediments representing the chemical concentrations at 6 inches depth; similarly, the 0-2 inches surface samples represent the 1 inch depth. Using an accretion rate of 0.2 inches/year,[11] we can estimate the year of deposition for a given sediment depth. For example, sediments at 3 inches depth correspond to 1985 (based on samples collected in 2000). Mercury concentrations for each depth (or year) of interest could be estimated by linear interpolation (or extrapolation) of concentrations between the sampled depths of 1 and 6 inches in a given location. This method could be used to estimate the potential additional service loss that might be associated with higher mercury concentrations found in deeper (older) sediments at these four locations.

REFERENCES

Dames & Moore. May 1999. Draft sediment characterization and Tier I ecological risk assessment for Castro Cove.

EPA. 2005. Predicting toxicity to amphipods from sediment chemistry. National Center for Environmental Assessment, Washington, DC; EPA/600/R-04/030

URS. March 2002. Additional sediment characterization and risk evaluation: Skeet Hill

URS. June 2002. Tier II sediment characterization and ecological risk assessment: Castro Cove

		N	Average	Maximum
Skeet Hill[1]	Lead (mg/kg)	14	31	42
	P value from LRM		0.21	0.28
Castro Cove[2]	Mercury (mg/kg)	4	0.41	
	P value from LRM		0.46	

Notes:
[2] Sediment samples from 0-6 inches, collected near Skeet Hill in 2001 as part of ecological risk assessment
[2] Sediment samples from 0-2 inches, collected near Skeet Hill in 1999 and 2000 as part of Tier II study

Table 1. Comparison of P values from LRMs for lead and mercury near Skeet Hill.

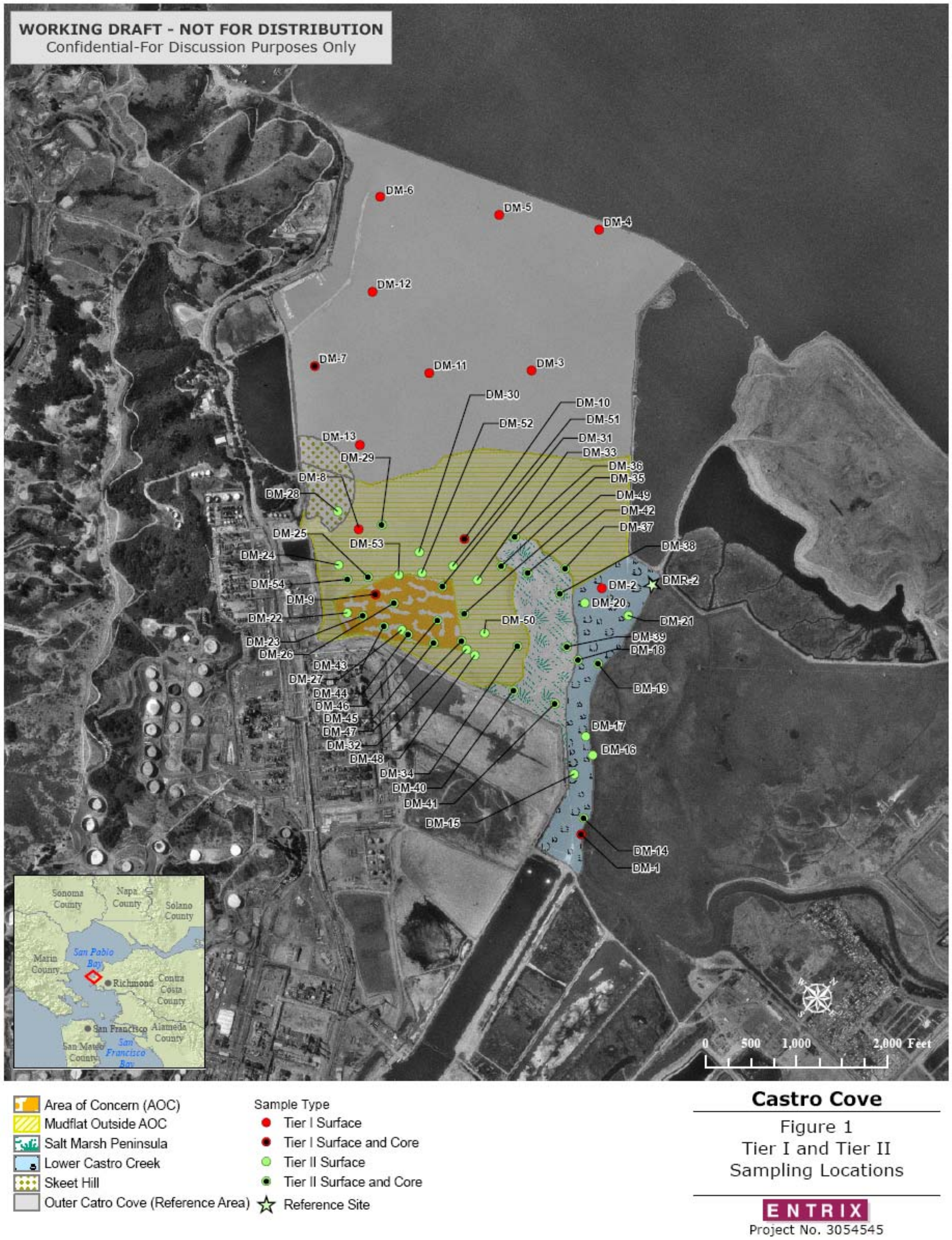

Figure 1. Castro Cove with Area of Concern and Sample Sites.

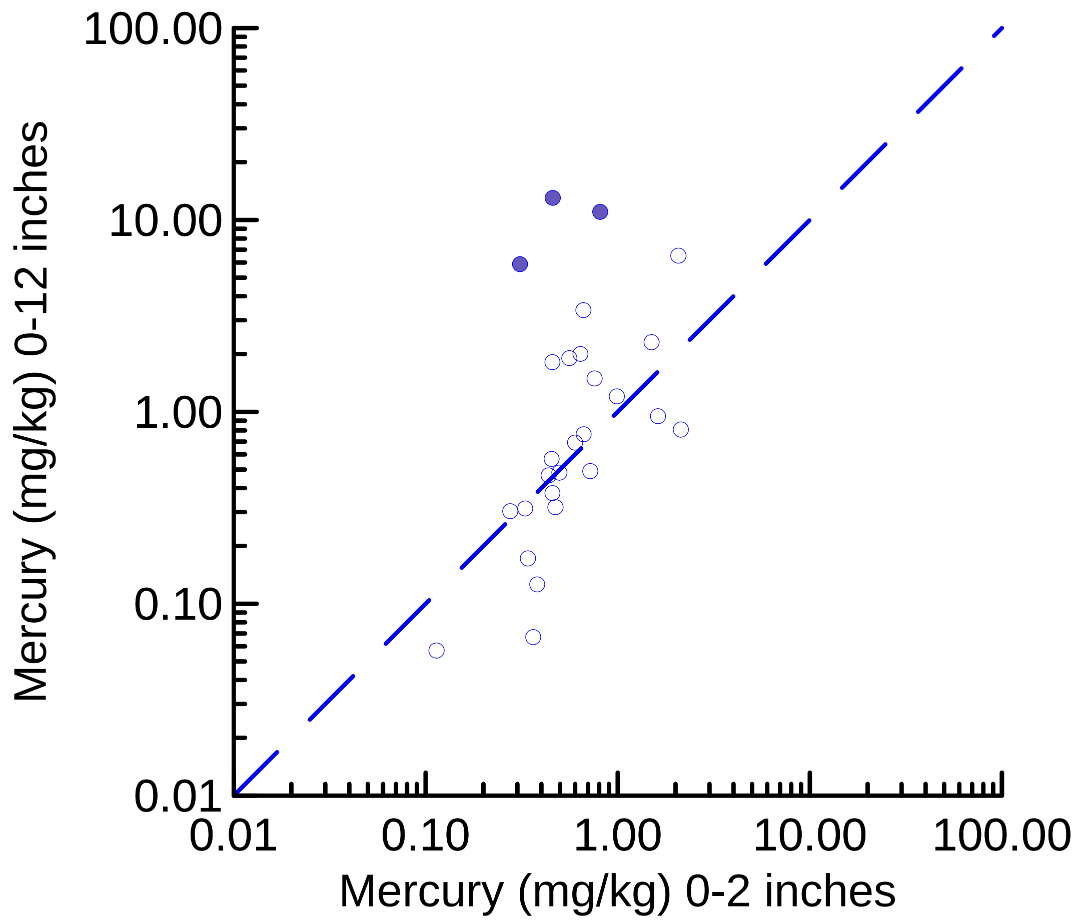

Figure 2. Scatter plot comparing mercury concentrations in samples collected from surface sediments (0 to 2 inches) and co-located sediment cores (0 to 1-foot depth) in Castro Cove. The dashed line represents the 1:1 relationship in concentration. The four symbols filled in black represent sample locations DM-18, 23, and 43, which are noted in the text.

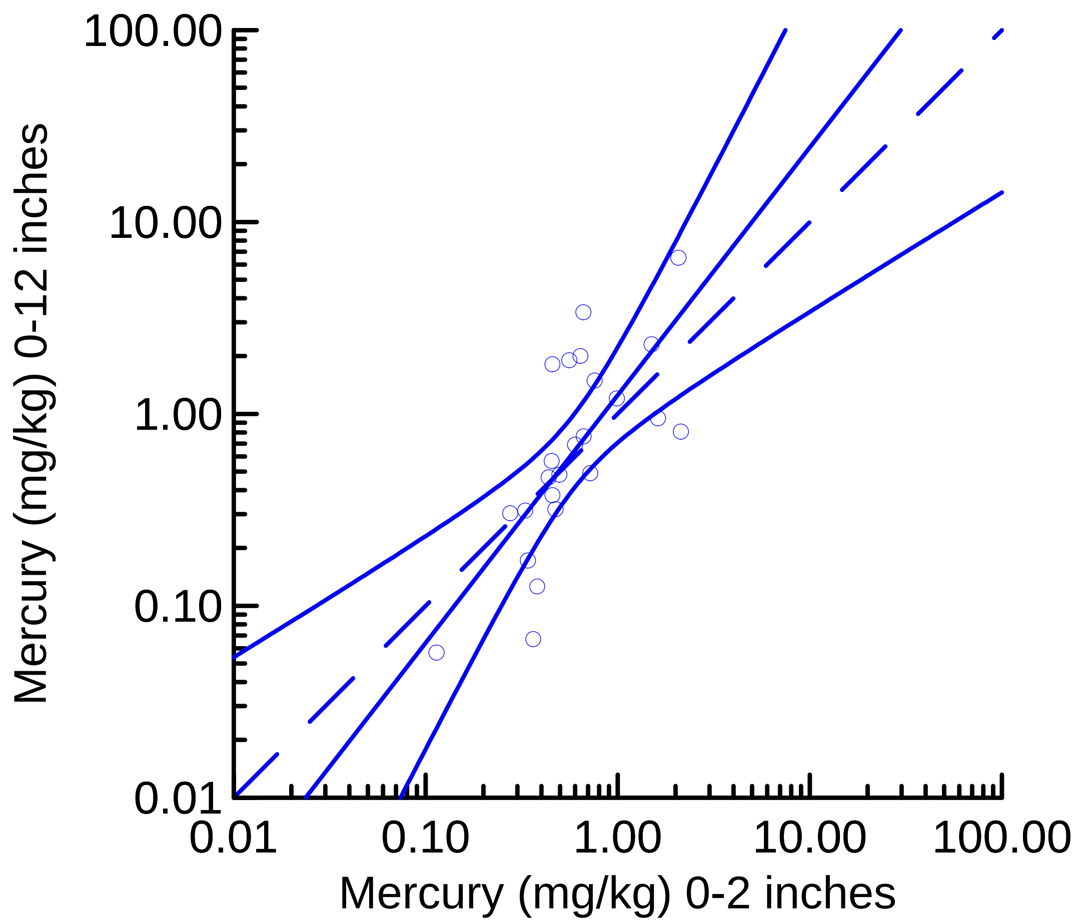

Figure 3. Scatter plot comparing mercury concentrations in selected samples collected from surface sediments (0 to 2 inches) and co-located sediment cores (0 to 1-foot depth) in Castro Cove. The dashed line represents the 1:1 relationship in concentration. The solid straight line represents a linear regression of the log-transformed data; the curved solid lines enclose the 95% confidence limit around the linear regression.

Appendix A: The memoranda prepared by ENTRIX and presented in this appendix are working review drafts which were not edited or finalized by the Trustees.

Appendix A-2:

- **A-2a**, “Models of injury assessment for the estimation of benthic service losses in Castro Cove”
- **A-2b** “Additional models for the estimation of benthic mortality in Castro Cove”
- **A-2c** “Preliminary estimation of discounted service-acre-year (DSAYs) losses in Castro Cove”
- **A-2d** The final curve selected for use in estimating amphipod mortality from TPAH concentration for each polygon in Castro Cove (originally Figure w in “Preliminary estimation of discounted service-acre-year (DSAYs) losses in Castro Cove”)

Original Author(s): ENTRIX

Distributed to the injury subcommittee in the cooperative NRDA process.

Trustee Comments: Total polycyclic aromatic hydrocarbon (TPAH) concentrations were used to estimate amphipod mortality and degree of injury, rather than mercury concentrations as is described in these memoranda. This is shown in the memorandum titled “Preliminary estimation of discounted service-acre-year (DSAYs) losses in Castro Cove”. The information contained in the referenced table in this memorandum on calculated DSAY estimates may be found in Appendix I6. TPAH concentrations from 0–1 foot core samples were used where they were available, and surface sample concentrations were used where the core sample data were not available. Additionally, while the “Appendix D” or “Commencement Bay Hylebos Waterway NRDA” method was not utilized, that method was intended to sum the injury from many chemicals present at that site, not utilizing one chemical as an indicator of injury as was done for this case. As a result the “Models of injury assessment for the estimation of benthic service losses in Castro Cove” memorandum shows that method “substantially underestimates amphipod mortality” when compared to the toxicity test results obtained with Castro Cove sediments. The Castro Cove Injury Quantification is presented in Chapter 3.

E N T R I X

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: February 23, 2006

Re: Models of injury assessment for the estimation of benthic service losses in Castro Cove

Project No. 3054545

PURPOSE

The proposed approach to developing an estimate of potential of injury and service loss to Castro Cove is based on the estimation of benthic mortality. This memorandum evaluates different models of benthic mortality against the observed toxicity tests and sediment chemistry samples from Castro Cove. It will be part of the text associated with Section 3.1 of the DARP outline, "Injury Assessment Strategy and Methods."

INTRODUCTION

Amphipod mortality toxicity results for 26 samples from the Tier II study (Table 1). ranged from 15% to 100% mortality, with an average response of 55% mortality. Mercury concentrations[1] in these samples ranged from 0.11 to 2.1 mg/kg, with an average of 0.69 mg/kg with this range spanning all surface mercury concentrations observed in surface sediments collected from Castro Cove[2].

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[1] Benthic service losses may be estimated using only mercury because its concentrations and effects are representative of other COCs; see memorandum "Chemicals of concern for service loss in Castro Cove."
[2] Estimates of benthic injuries will be based primarily of surface sediment concentrations; see memorandum "Estimation of historical sediment chemical concentrations in Castro Cove."

There is substantial variability in bioassay response at intermediate mercury concentrations. However, these mortality and concentration data are correlated (Pearson's r = 0.65) (Figure 1). Furthermore, at the lowest mercury concentrations, only low mortality values are observed and only high mortality values are observed at the highest mercury concentrations.

The amphipod mortality results were not corrected by subtraction of control mortality, and so the results include mortality that occurs simply because the experiment was conducted with Bay sediment. Accordingly, the Castro Cove toxicity test results are potentially overestimates of the mortality solely due to refinery-related contaminants. However, that potential overestimate is eliminated by subtracting theestimated effects from exposure to the average mercury concentration for regional background[3] from the modeled mortality associated with Castro Cove samples.

This method explicitly allows the unadjusted benthic mortality estimate for a given sample within Castro Cove to take any value from 0% to 100%. For those samples whose mercury concentrations are less than the regional background average, the mortality (injury) will also be less than the injury that based on the regional background average.

MODELS

Four approaches were considered for the estimation of potential benthic injury and service loss as a function of sediment chemistry:

- EPA/NOAA's logistic regression model (LRM) approach using parameters[4] published in "Predicting Toxicity to Amphipods from Sediment Chemistry" (EPA 2005);
- A LRM with parameters estimated using amphipod mortality and sediment chemistry data collected from Castro Cove;
- A linear regression of amphipod mortality and sediment chemistry data collected from Castro Cove; and
- An approach used by the Trustees for the Commencement Bay Hylebos Waterway NRDA in Puget Sound, Washington (NOAA 2002a).

Each model is described below. In Attachment 1, more details are provided about the LRM and linear regression model.

[3] See memorandum "Regional background chemical concentrations for Castro Cove."
[4] The LRM has two parameters that are estimated by statistical solution, based on a given set of data. These parameters are analogous to the slope and intercept of a linear regression. These linear regression parameters describe a line, and their estimates for a given set of data define a particular line that fits (*i.e.,* passes through) that set of data. For the LRM, the estimates of the model's parameters result in an equation that estimates the probability of an event (here, a significant toxicity test) based on a given chemical concentration. However, as discussed above, the LRM discusses only the probability of a significant toxicity test, not the magnitude of the toxicity response.

The LRM estimates the probability of a significant toxicity test (P value) for a given concentration of a chemical (or group of chemicals), and by extension, a toxic effect. As the EPA/NOAA (2005) report notes, the P value is correlated with mortality in toxicity tests; *i.e.*, as the estimated probability of a significant toxic effect increases, so does the bioassay mortality. The use of the LRM for injury assessment here rests on this correlation between P value and mortality.

In NOAA/EPA's (2005) report, parameter estimates of the LRM are provided for certain chemicals. These LRM parameter estimates were calculated using a database of over 3,000 tests assembled by EPA/NOAA from sediment toxicity studies across the United States. The LRM was also solved using the toxicity testing data available for Castro Cove to develop site-specific parameter estimates.

As an alternative regression approach, a simple linear regression of the proportion of amphipod mortality on sediment mercury concentration was applied to the Castro Cove toxicity data.

In the settlement for the Hylebos Waterway, the Trustees developed ranges of benthic injuries corresponding to ranges of concentrations for selected chemicals present in the sediments of Commencement Bay (NOAA 2002). These categories of concentration and natural resources injury were applied to Castro Cove data.

RESULTS

For each of the modeling approaches, the predicted injury may be compared to the amphipod mortalities observed in the toxicity test results (Figure 2). The NOAA/EPA LRM and site-specific LRM regression estimates are similar throughout much of the range of mercury concentration observed in the samples. The estimates based on the site-specific LRM diverges slightly from the NOAA/EPA LRM, beginning at about 0.5 mg/kg mercury, with the site-specific model estimating slightly lower mortality at higher mercury concentrations.

The linear regression model estimates slightly lower mortalities than either LRM model in the range of 0.5 to 1.5 mg/kg mercury. This difference is never more than about 5% mortality. However, at mercury concentrations above 1.5 mg/kg, the estimates from the two regression approaches differ more. For the highest mercury concentrations observed in a toxicity test sample (about 2 mg/kg), the linear regression estimates 100% mortality (which matches the observed mortality for that sample), while the NOAA/EPA LRM predicts substantially less mortality (about 83%).

The Appendix D method underestimates the observed amphipod mortality throughout the entire range of mortality and mercury concentration. It never predicts more than 20% mortality. This may be due, in part, to the difference in the intent between the Appendix D method and any of these other models. The Appendix D method expresses service loss to the benthic community in the environment, while the regression-based approaches estimate mortality of a single sensitive species in response to a given chemical concentration in a laboratory test.

CONCLUSION

The LRM and the linear regression both "fit" the observed amphipod mortality results, although in slightly different ways. The linear regression does have the theoretical limitation that for mercury concentrations higher than about 2 mg/kg, the estimated proportion mortality would exceed 1.0 (or 100%). However, for these data from Castro Cove, the linear regression captures the higher mortalities observed better than the LRM, thereby reflecting the actual, higher, mortality of a relevant test species observed in response to mercury in sediment samples collected from Castro Cove. The observed mortality of 100% was associated with the highest mercury concentration observed in surface sediment samples (2.1 mg/kg), and therefore extrapolation beyond the range of 2.1 mg/kg mercury and 100% amphipod mortality will be unnecessary for the majority of samples and locations within Castro Cove[5].

The Appendix D service loss estimate consistently and substantially underestimates amphipod mortality, although it may be more representative of the overall benthic community service losses.

To summarize the advantages and disadvantages of the approaches to estimation of injury:

LRM
Advantages:
Published approach
Disadvantages:
Intended to estimate the probability of a significant toxicity effect

LINEAR REGRESSION MODEL
Advantages:
Directly estimates relationship between mortality and chemical concentration
Uses site data
Analytically simple and straightforward
Disadvantages:
Theoretical limitations

Appendix D approach of Hylebos DARP
Advantages:
Published injury assessment for another West Coast NRDA site.
Disadvantages:
Substantially underestimates observed mortalities in Castro Cove toxicity test data

[5] For 3 sampling locations (DM-18, 23, and 43), mercury concentrations at depth were substantially greater than at surface. For these locations, an interpolation between surface and 1-foot samples is proposed, and for those interpolated mercury concentrations greater than 2 mg/kg, the estimated mortality will simply be bounded at proportion = 1.0, or 100%.

For the estimation of amphipod mortality in Castro Cove, the linear regression has more advantages, and fewer disadvantages, than the other approaches considered.

REFERENCES

EPA. 2005. Predicting Toxicity to Amphipods From Sediment Chemistry. EPA/600/R-04/030. March 2005.

NOAA. 2002a. Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Viewed at: http://www.darp.noaa.gov/northwest/cbay/hyle-settlement.html on February 15, 2006.

NOAA. 2002b. Appendix D: Defining Injuries to Natural Resources in Hylebos Waterway *in* Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Viewed at: http://www.darp.noaa.gov/northwest/cbay/hyle-settlement.html on February 15, 2006.

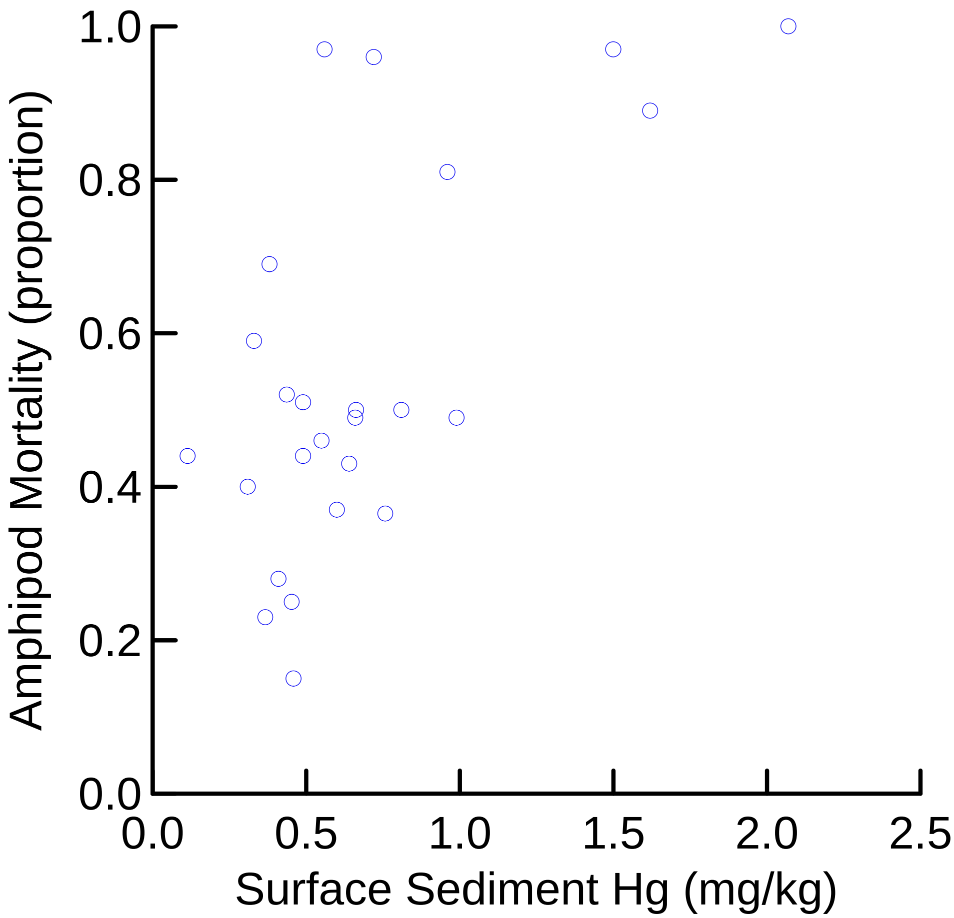

Figure 1. Scatter plot of amphipod mortality against mercury concentration for samples from Castro Cove (Pearson's correlation coefficient r = 0.65).

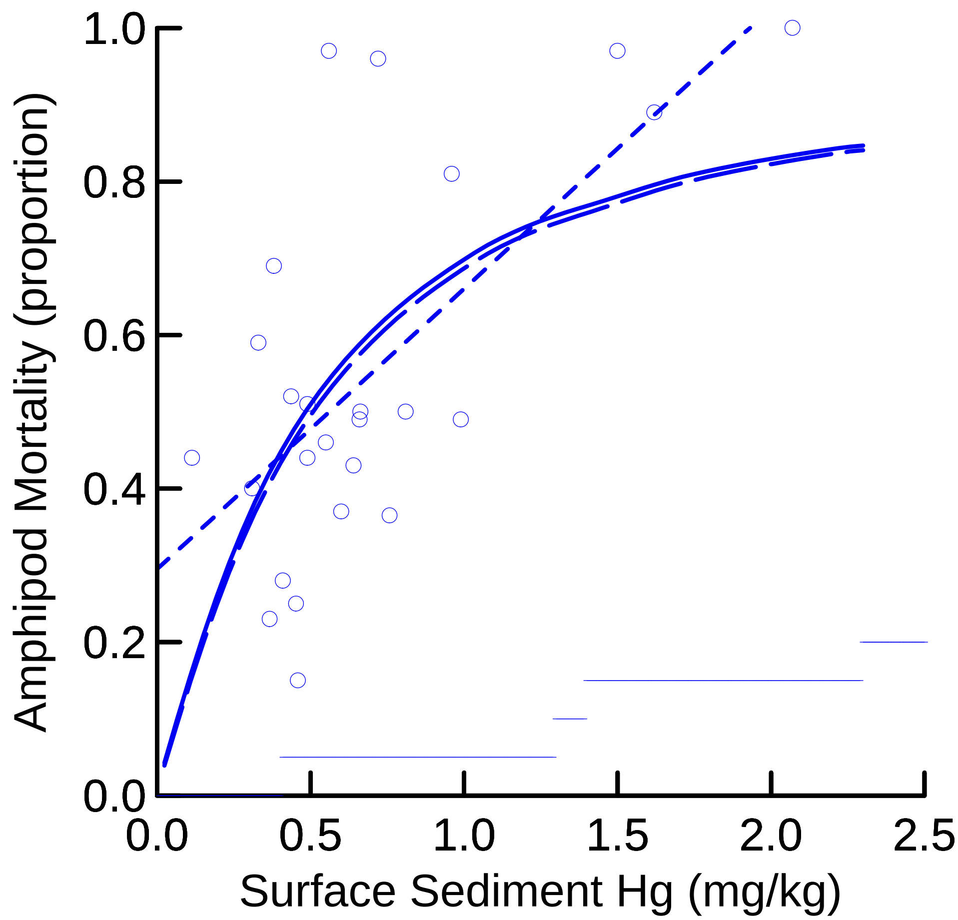

Figure 2. Comparison of injury models. Amphipod mortality and mercury concentrations in samples from Castro Cove (open circles) are compared to EPA/NOAA LRM estimates of P value (solid curved line), site-specific LRM estimates (dashed curved line), linear regression estimates (dashed straight line), and NOAA Hylebos Waterway injury categories (horizontal solid lines).

ATTACHMENT 1: DISCUSSION OF LOGISTIC REGRESSION AND LINEAR REGRESSION MODELS

Logistic Regression Model

The Logistic Regression Model (LRM) is defined as follows:

P(Y=1|X=x) = exp((a + bx)/(1 + exp((a + bx)),

Where **P(Y=1|X=x)** is the probability that Y will take the value of 1 when the explanatory (or independent) variable X takes the value **x**. Here, Y = 0 or 1 corresponds to a non-significant or significant amphipod bioassay result, respectively. The variable **x** is the log-transformed chemical concentration. **P(Y=1|X=x)** corresponds to the P values calculated using the equations in March 2005 NOAA/EPA guidance when using the parameter estimates provided in that document (EPA 2005).

For the site-specific development of the LRM, the parameters **a** and **b** are estimated using nonlinear regression software. Amphipod moralities reported in the toxicity tests and their associated sediment sample mercury concentrations were the data used in the analysis.

There is an important distinction between the two LRMs. In the NOAA/EPA approach, the LRM estimates the probability that a certain chemical's concentration would result in a significant statistical test of toxicity, while in the site-specific approach, the LRM estimates the proportion mortality for each sample. This difference arises for two reasons. First, the NOAA document addresses the question: "if a series of toxicity tests were performed for this site, what is the chance they would result in a finding of significant toxicity?" However, the analogous question relevant to the purpose of estimating injury to Castro Cove benthos is: "what mortality (and injury) results from a given concentration of this chemical associated with the site?" Second, the site-specific data were simply too few to allow for an analysis equivalent to the NOAA/EPA approach.

The site-specific LRM estimates were an evaluation of the LRM approach in light of available site-specific data. The NOAA/EPA guidance recommends exactly this:

> "Before applying the models to a particular site, we recommend first evaluating how well the models fit the local situation by collecting a test set of matching sediment chemistry and toxicity test data…. The LRMs should not be considered a complete substitute for direct-effects assessment (*e.g.,* toxicity tests)[6]."

The site-specific data allowed both a validation of the published LRM parameters and development of an alternative LRM.

[6] Section 7.3, p. 60 of EPA (2005).

Linear Regression Model
The Linear Regression Model is defined here as follows:

Mortality = a + bx,

Where **Mortality** is the proportion of amphipod mortality observed in a particular toxicity test, **x** is the chemical concentration in the associated sediment sample, and **a** and **b** are the intercept and slope parameters, respectively, of the model.

E N T R I X

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: March 9, 2006

Re: Additional models for the estimation of benthic mortality in Castro Cove

Project No. 3054545

PURPOSE

In our meeting with the Trustees on February 27, 2006, we discussed the choice of model for the estimation of benthic mortality. The Trustees have requested that we also consider the logistic growth model and a quadratic regression for that purpose. This memorandum evaluates those models in comparison to the benthic mortality models previously considered.

INTRODUCTION

As we noted in our previous memorandum[7], these models were used to estimate amphipod mortality from sediment mercury concentration in samples from the Tier II study. The amphipod mortality results were not corrected by subtraction of control mortality, *i.e.*, the mortality results using the Tier II sediment included mortality that occurred simply because the experiment was conducted with Bay sediment and the animals were in a laboratory setting. As we noted during the meeting, we would, as a result, expect that observed and predicted mortality at very low mercury concentrations would be greater than zero. This component of the mortality is subtracted when the regional background mercury concentration is used to estimate the "but for" incremental amphipod mortality.

[7] See previous memorandum "Models of injury assessment for the estimation of benthic service losses in Castro Cove" dated February 27, 2005.

MODELS

In the February 27, 2006 memorandum, four approaches were considered for the estimation of potential amphipod mortality as a function of sediment chemistry:

- EPA/NOAA's logistic regression model (LRM) approach using parameters published in "Predicting Toxicity to Amphipods from Sediment Chemistry" (EPA 2005);
- A LRM with parameters estimated using amphipod mortality and sediment chemistry data collected from Castro Cove;
- A linear regression of amphipod mortality and sediment chemistry data collected from Castro Cove; and
- An approach used by the Trustees for the Commencement Bay Hylebos Waterway NRDA in Puget Sound, Washington (NOAA 2002). (This model actually estimates injury and uses mortality as one of the inputs to the injury estimate).

These models are described in detail in the February 27, 2006 memorandum.

Based on discussions in February 27, 2006 meeting, two additional models are considered here: the logistic growth model (LGM) and the quadratic regression model.

Logistic growth model

The LGM has the form:

y = 1/(1 + a*exp(bx)),

Where:

y is the proportion of amphipod mortality in a given bioassay and
x is the concentration of mercury in the same sediment sample used for the bioassay.

The parameters **a** and **b** are estimates for a given data set. With these parameter estimates, the model is fitted to the data. The LRM and LGM are similar in form. Both have an exponential term in the denominator,

exp(bx),

And the absolute value of the parameter estimate **b** determines the maximum rate of increase in response with increase in dose. The form of the LRM is intended for modeling a "yes/no" result. In contrast, the LGM is typically used to describe the change in a proportional variable constrained between zero and one. There are several versions of this model within the family of logistic growth models, and there are several different families of sigmoidal growth models. The LGM is derived from a growth equation and is used to estimate dose-response relationships.

Quadratic regression model

The quadratic regression is simply the linear regression plus an additional squared term allowing the model to be curvilinear:

$$\mathbf{y = a + bx + cx^2,}$$

Where:

y is the proportion of amphipod mortality in a given bioassay,
x is the concentration of mercury in the same sediment sample used for the bioassay, and
a, **b**, and **c** are the parameter estimates of the model.

RESULTS

For each of the modeling approaches, the predicted amphipod mortality may be compared to the mortality observed in the toxicity test results (Figure 1). The Commencement Bay approach was not included in this figure. The NOAA/EPA LRM and site-specific LRM regression estimates of mortalityare similar throughout much of the range of mercury concentration observed in the samples. The estimates based on the site-specific LRM diverge slightly from the NOAA/EPA LRM, beginning at about 0.5 mg/kg mercury, with the site-specific LRM estimating slightly lower mortality at higher mercury concentrations.

The linear regression model estimates slightly lower mortality than either LRM model in the range of 0.5 to 1.5 mg/kg mercury. This difference is never more than about 5% mortality. However, at mercury concentrations above 1.5 mg/kg, the estimates from the two regression approaches differ more. For the highest mercury concentrations observed in a toxicity test sample (2.07 mg/kg), the linear regression estimates 105% mortality, while the NOAA/EPA LRM predicts substantially less mortality (about 83%).

The LGM yields results similar to those from either the linear regression or the LRM models in the mid-range of mercury concentrations (about 0.75 to 1.5 mg/kg). At lower concentrations, the LGM results are similar to those from the linear regression. At higher concentrations, its results are intermediate between those of the linear regression and the LRM models. In the range of about 1.5 to 2 mg/kg mercury, the LGM predicts higher mortality than either LRM, and its predictions are closer to the observed mortality in those samples whose mercury concentrations fall in this range.

In response to comments from the Trustees, the quadratic regression was applied for models both with and without the intercept. The quadratic regression with an intercept has the form:

$$\textbf{Proportion mortality} = \mathbf{a + b*Hg + c*Hg^2,}$$

Where **Hg** is mercury concentration and **b** and **c** are parameter estimates that relate mercury concentration to amphipod mortality in the toxicity test results. The parameter estimate **a** is the intercept of the equation and it represents the proportion mortality that would occur if the mercury concentration was equal to zero. For the quadratic regression *with* an intercept, the resulting model is indistinguishable from the linear regression (Figure 1).

For the quadratic regression *without* an intercept, the parameter estimate **a** is "forced" to zero, and then the remaining two parameter estimates are solved from the data. In effect, this approach forces the model solution to estimate proportional mortality to be exactly zero when the mercury concentration is zero. Like the LRM models, the quadratic regression without an intercept underestimates observed amphipod mortality in samples with low mercury concentrations. From about 0.8 to 1.7[8] mg/kg mercury, the quadratic regression model without an intercept predicts higher mortality than any other model discussed here.

The residuals (observed mortality minus predicted mortality) of the site-specific LRM and the LGM were plotted against their predicted mortality values in scatter plots (Figures 2 and 3). The plots are similar, with neither displaying apparent patterns in the residuals except that the highest residuals are associated with some of the intermediate mortality estimates. These are the toxicity test results that were noted in the February 27, 2006 meeting as potential outliers. To assess the effect of outliers, the four data points with the most extreme absolute values for their residuals in the LGM[9] were removed from the data set[10]. The LGM was then fitted to this reduced data set. The model based on the reduced data set predicted lower mortality at lower mercury concentrations, with this difference decreasing with increasing mercury concentrations. This difference is about 5% at lower mercury concentrations, shrinking to a negligible amount as mercury approaches 2 mg/kg.

To illustrate the differences among the models, their responses are compared at three different ranges of mercury concentrations.

For mercury concentrations near zero mg/kg: the LGM, linear regression, and quadratic regression with an intercept predict non-zero mortality. This reflects the observed data, which include control mortality. The LRMs and the quadratic regression without an intercept force the mortality to zero.

In the intermediate range of observed mercury concentrations (around 1 mg/kg): The quadratic regression model without an intercept generally returns the highest mortality estimate, while the LRM, linear regression, quadratic regression with an intercept, and the LGM all predict similar and lower mortality values.

At the highest observed mercury concentrations (about 1.5 mg/kg to 2 mg/kg): the LGM, linear regression, and quadratic regression either with or without an intercept estimate higher mortality than either LRM, thereby better reflecting the observed mortality of amphipods in sediment samples collected from Castro Cove.

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[8] Only one surface sample mercury concentration exceeds this value.
[9] The LGM was selected as a representative example.
[10] These data were associated with DM-23, 35, 46, and 47. The range of their absolute residuals ranged from 0.47 to 0.27. The choice of four data was based on examination of the quantile plot of absolute residuals.

CONCLUSIONS

The LRMs underestimate observed mortality at both low and high mercury concentrations in the toxicity test. The predicted response mortality using the linear regression model increases proportionally with increasing mercury concentration, continuing to do so even beyond 100% mortality. The quadratic regression model with an intercept is virtually identical to the linear regression. The quadratic regression without an intercept term predicts increasing mortality with increasing mercury concentration up to a point determined by its parameter estimates **b** and **c**; beyond that point, the model predicts decreasing amphipod mortality. At high mercury concentrations, the behavior of any linear or quadratic regression model fails to reflect the assumptions underlying dose-response relationships.

The LGM fits the observed amphipod mortality data across all observed mercury concentrations. The LGM has the further advantage over all other models considered to date for this project in that it is derived from a growth model and is typically used by toxicologists to predict dose-response relationships.

To summarize the advantages and disadvantages of the approaches to estimation of amphipod mortality:

LRM
Advantages:
Published approach
Can be used in a site-specific model
Disadvantages:
Intended to estimate the probability of a significant toxicity effect with increasing concentration, not the magnitude of the effect.

LINEAR REGRESSION MODEL
Advantages:
Uses site data
Analytically simple and straightforward
Disadvantages:
Theoretical limitations – estimated mortality increases proportionally with increasing mercury concentration, even if predicting mortality greater than 100%.

LOGISTIC GROWTH MODEL
Advantages:
Uses site data
Based on dose-response relationship
Can represent numerous biological response functions from toxicity dose-response to population growth
Disadvantages:
No apparent disadvantages

QUADRATIC REGRESSION MODEL
Advantages:
Uses site data
Analytically simple and straightforward
Disadvantages:
Theoretical limitations – estimated mortality increases with increasing mercury concentration up to a limit, and then estimated mortality decreases with increasing mercury concentration. This situation occurs with the site specific data for Castro Cove.

REFERENCES

EPA. 2005. Predicting Toxicity to Amphipods From Sediment Chemistry. EPA/600/R-04/030. March 2005.

NOAA. 2002. Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Viewed at: http://www.darp.noaa.gov/northwest/cbay/hyle-settlement.html on February 15, 2006.

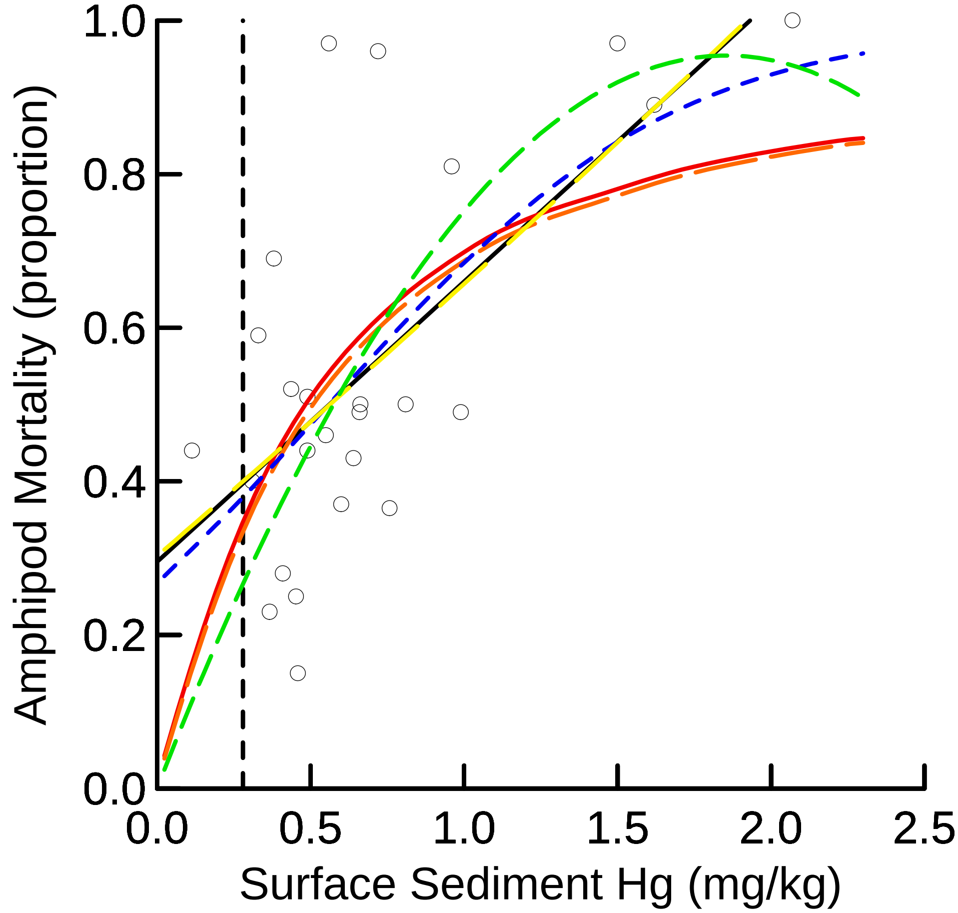


Figure 1. Comparison of mortality estimation models. Amphipod mortality and mercury concentrations in samples from Castro Cove (open circles) are compared to: EPA/NOAA LRM estimates of P value (solid red curved line); site-specific LRM estimates (long-dash orange curved line); logistic growth estimates (short-dash blue line); linear regression (straight black solid line); and quadratic regression with (dashed straight yellow line) and without an intercept term (dashed green curved line).

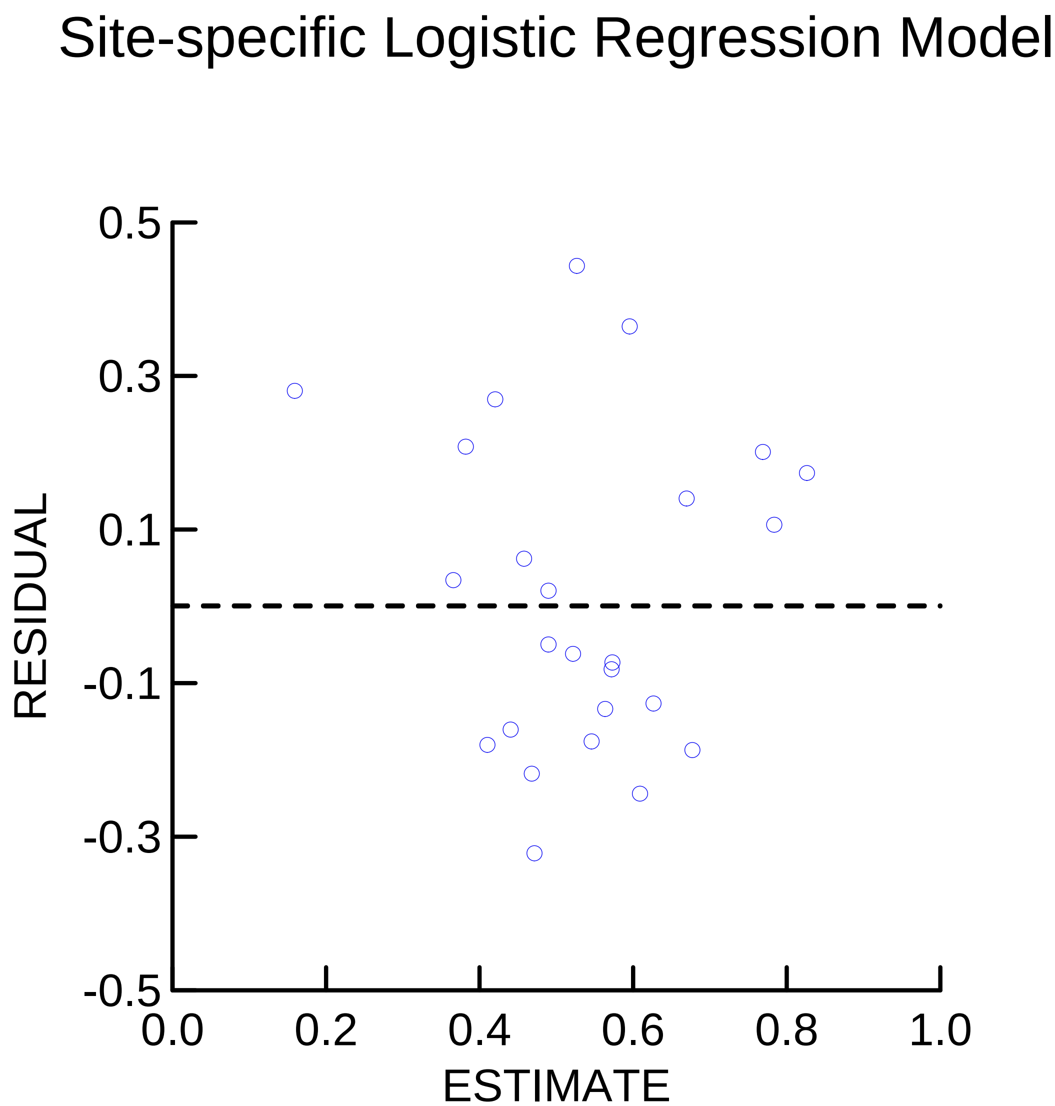


Figure 2. Residuals plot of site-specific LRM mortality estimates.

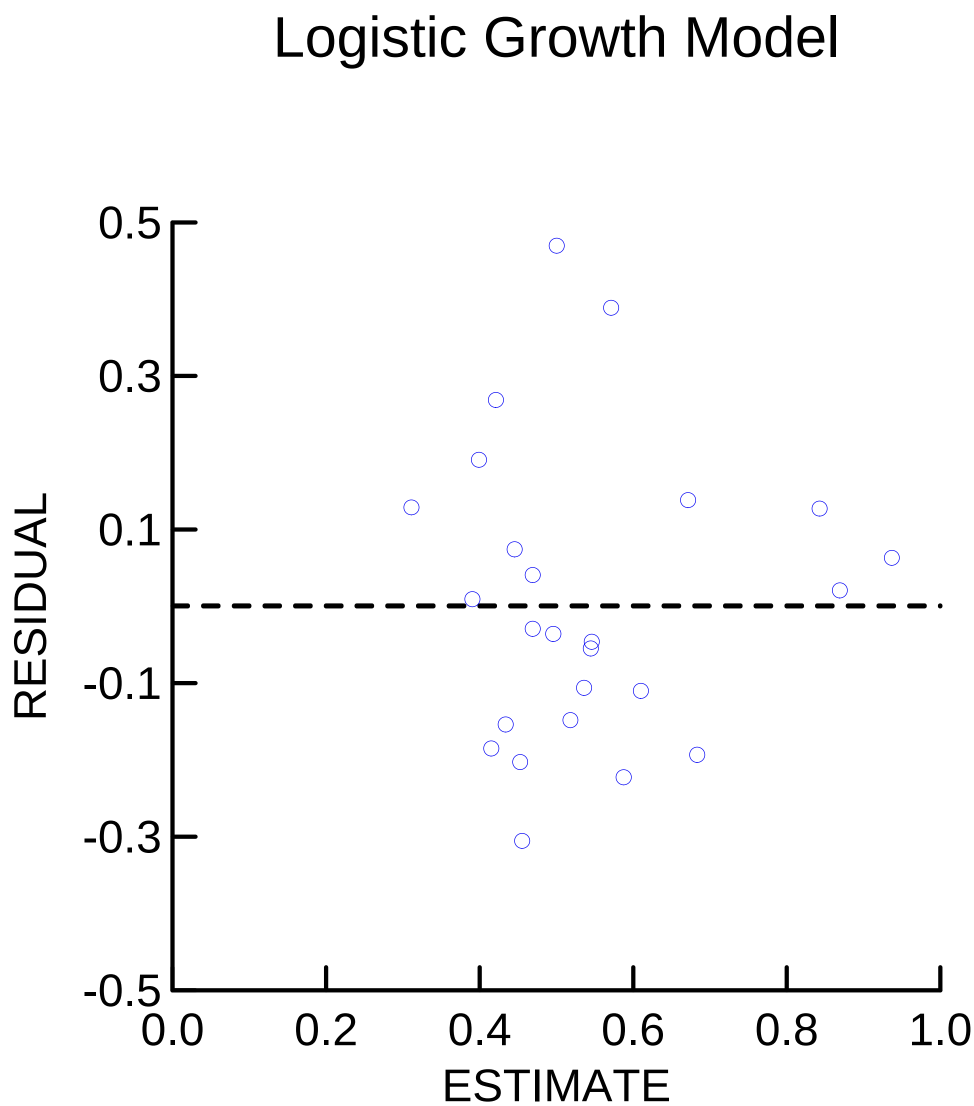


Figure 3. Residuals plot of LGM mortality estimates.

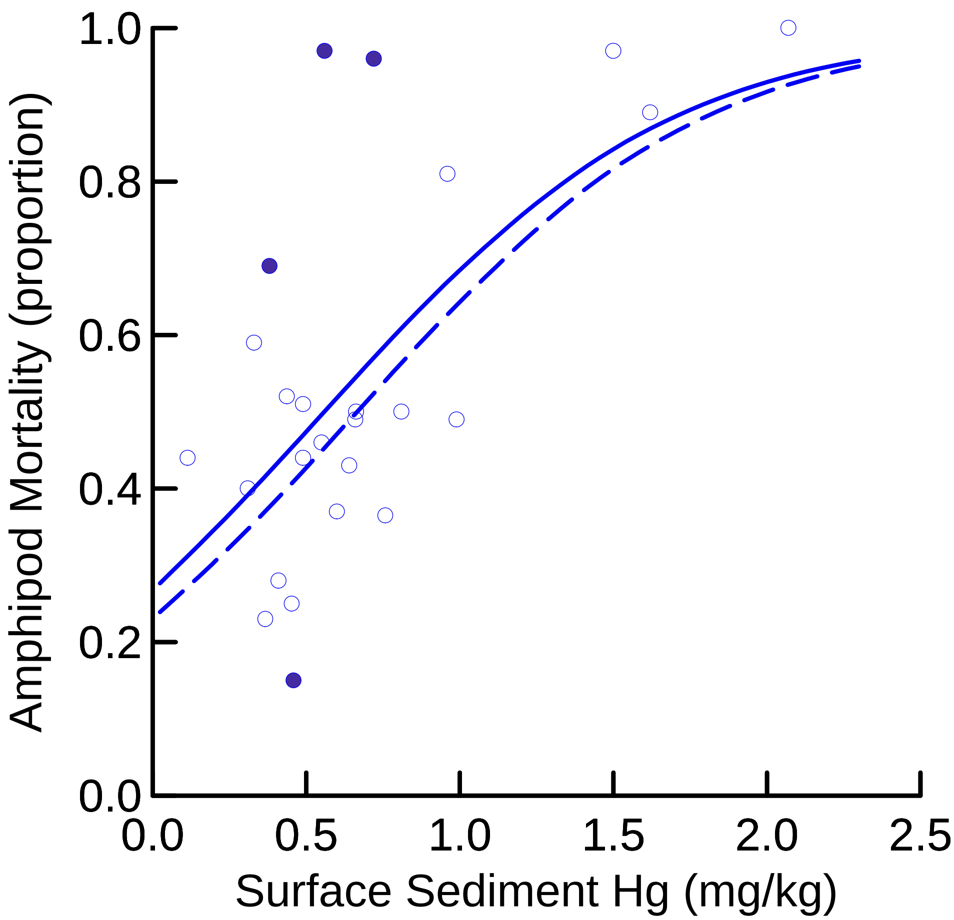


Figure 4. Effect of certain data on LGMs. Amphipod mortality and mercury concentrations in samples from Castro Cove are shown as circles. The LGM based on all toxicity test data (solid curved line) is compared to the LGM based on only selected toxicity test data (dashed curved line), which are shown as open circles. The four data excluded from the second LGM are shown as filled circles; they are discussed in the text.

ENTRIX

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: April 13, 2006

Re: Preliminary estimation of discounted service-acre-year (DSAYs) losses in Castro Cove

Project No. 3054545

PURPOSE

In a conference call with the Trustees on March 30, 2006, we discussed the estimation of the dose-response relationship of amphipod mortality to sediment chemical concentration using a logistic growth model (LGM). At the Trustees' request, that estimation was based on a data set that excluded the Salt Marsh. In that call, the Trustees requested that we run the DSAYs calculations based on revised LGMs for mercury and total polycyclic aromatic hydrocarbons (TPAHs) and provide those results. This memorandum provides those LGMs and preliminary DSAYs estimates.

The LGMs are used to estimate benthic mortality in response to sediment chemical concentrations. These LGMs were developed based on the bioassay data available for Castro Cove. In the March 30, 2006 call, the Trustees requested that – in addition to the Salt Marsh data – the bioassay data associated with Tubbs Island also be eliminated from the estimation of the LGM. Figures 1 and 2 (attached) are graphs showing the full data set and the resulting LGMs for mercury and TPAHs, respectively. Two LGMs are shown in each figure; they allow a comparison of the models that result from omitting the Salt Marsh data and omitting the Salt Marsh and Tubbs Island data.

In addressing the Trustee request, we have calculated estimates of DSAYs using conservative assumptions for inputs in to the calculation. The attached table describes the assumptions and inputs to the preliminary DSAYs calculations. DSAYs were calculated for mercury and TPAHs, using two different assumptions about baseline services. The table summarizes the inputs and results and assumes that the reader is familiar with the DSAY estimation process. We are prepared to provide to the Trustees the Excel workbooks used to make these calculations.

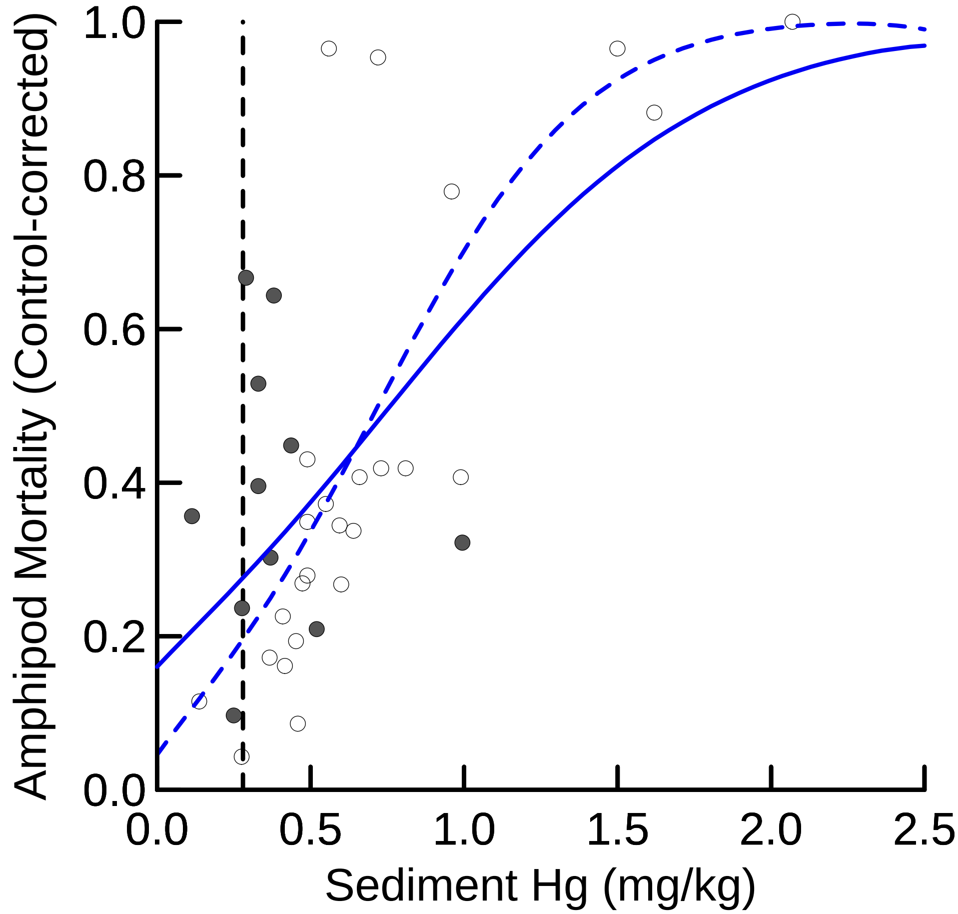


Figure 1. Logistic growth models (LGMs) for toxicity test amphipod mortality responses to mercury concentrations, excluding samples from the Salt Marsh. The solid line represents the LGM derived without samples from the Salt Marsh. The dashed line represents the LGM derived without samples from the Salt Marsh and the Tubbs Island reference station. The filled circles represent samples from salt marsh stations and the Tubbs Island reference station. The vertical dashed line equals the mean mercury concentration in San Francisco Estuarine Institute samples from San Pablo Bay used to represent regional background.

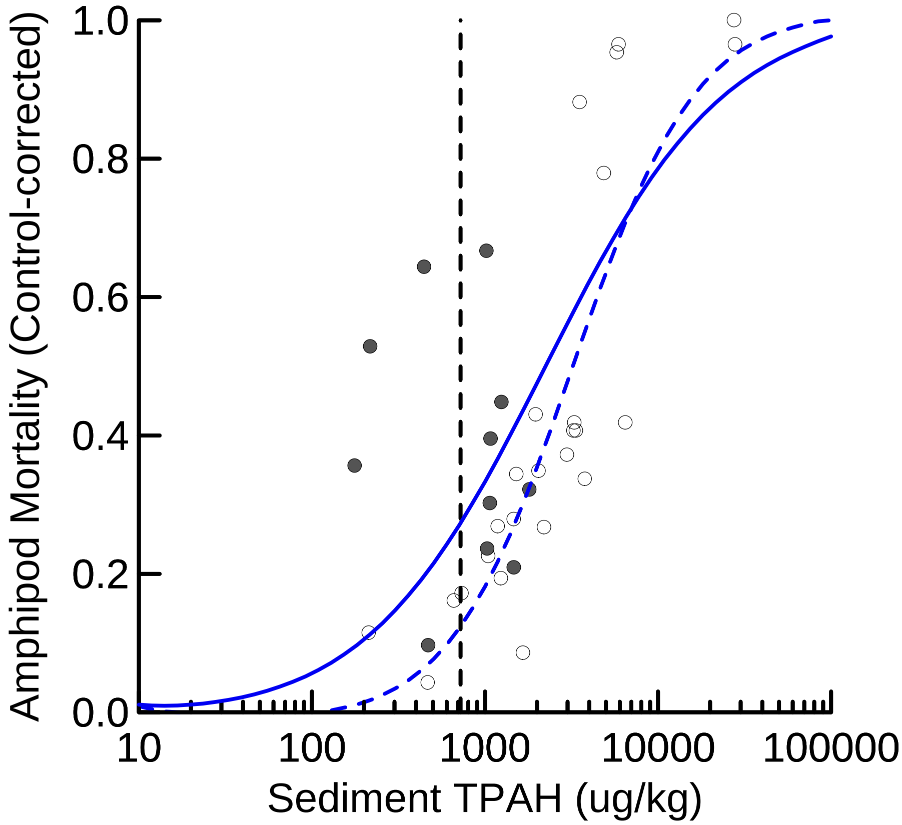
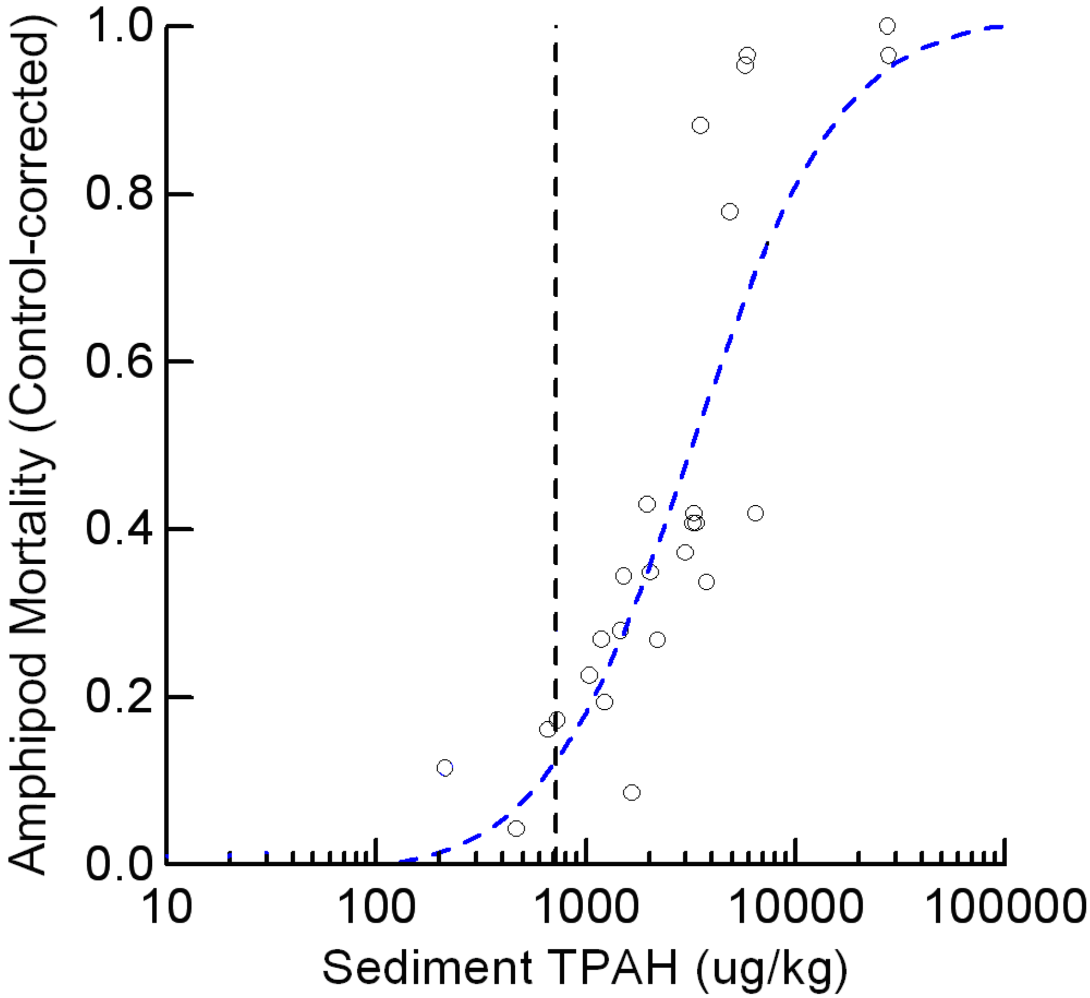


Figure w. Logistic growth models (LGMs) for toxicity test amphipod mortality responses to TPAH concentrations, excluding samples from the Salt Marsh. The solid line represents the LGM derived without samples from the Salt Marsh. The dashed line represents the LGM derived without samples from the Salt Marsh and the Tubbs Island reference station. The filled circles represent samples from salt marsh stations and the Tubbs Island reference station. The vertical dashed line equals the mean TPAH concentration in San Francisco Estuarine Institute samples from San Pablo Bay used to represent regional background.

Appendix I2d- Final curve selected to represent injury level based upon TPAH concentrations in Castro Cove Sediments. Curve is for estimating amphipod mortality where the equation is $1/1+B_0e^{B_1 \log[TPAH]}$, where B_0=121,354 and B_1=-3.3478.



Appendix A: The memoranda prepared by ENTRIX and presented in this appendix are working review drafts which were not edited or finalized by the Trustees.

Appendix A-3:

- **A-3a**, "Risk Assessment Approach for HEA"
- **A-3b** "Preliminary Hazard Quotient Risk Estimations to Wildlife for Castro Cove"

Original Author(s): ENTRIX

Distributed to the injury subcommittee in the cooperative NRDA process.

Trustee Comments: The "Risk Assessment Approach for HEA" memorandum contains the methodology used, while the "Preliminary Hazard Quotient Risk Estimations to Wildlife for Castro Cove" memorandum contains the results from applying the methodology to the data from Castro Cove.

E N T R I X

MEMORANDUM

DRAFT

ENTRIX, Inc.
148 Rogers St.
Olympia, WA 98512
(360) 352-3225

Date: February 22, 2006

Re: Risk Assessment Approach for HEA

Project No. **3054545**

PURPOSE

This memorandum outlines a methodology to estimate exposures and potential risks to selected ecological receptors that may use the Castro Cove area presently or that may have used it at some other time since 1980, thus encompassing the full period under consideration for the Castro Cove NRDA.

The Trustees requested this estimation of risk for use by the Trustees and CVX in the consideration of service losses and other elements of the injury and damage assessment process. In particular, Chevron and the Trustees want to determine if the potential risks and thus the potential for injury to selected species of fish, birds and mammals from bioaccumulation of chemicals of potential concern (COPCs) are substantial enough to warrant developing a more quantitative estimate of service losses than provided through use of the habitat equivalency approach for mudflats.

This memo does not provide exposure doses for relevant receptors, which will first require agreement with the Trustees on input parameters needed to estimate exposure.

BACKGROUND

Chevron discharged processed wastewater into Castro Cove (San Pablo Bay, CA) through two locations over several decades in the middle part of the last century. Several investigations have already been performed to examine the conditions at the site, gauge the level of contamination, and frame the options for remediation. A Tier 1 assessment examined sediment concentrations at

13 locations and identified hot spots requiring further investigation at two locations (Dames and Moore 1999). Further analysis of sediment toxicity was conducted focusing on these sites in a Tier II investigation published in 2002 (URS 2002a). In the Tier II investigations three areas were examined: (1) Castro Creek channel, (2) Castro Cove Mudflat, and (3) Salt Marsh area. Further investigations of lead contamination were also performed in sediments near Skeet Hill, a former shotgun practice range (URS 2002b). To date, there has been no predictive modeling of exposure to COPCs exceeding sediment quality criteria for representative ecological receptors that may use the area for all or some portion of their life history. The requested assessments will evaluate potential exposure pathways relevant to the potential for injury and loss of services from the exposures to COPCs.

APPROACH

The approach proposed for conducting the ecological risk assessment is consistent with the State of California's 'Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities' (Cal EPA 1996). This guidance is relatively consistent with federal guidance for conducting ecological risk assessments (USEPA 1996) at all types of sites potentially contaminated with COPCs, whether or not defined as hazardous waste sites. Specifically, as stated in the guidance, the principles described are generally applicable to "the assessment of risk to biota whenever the Department requires corrective action pursuant to Health and Safety Code 25187 or 25200.10."

Briefly, the approach involves: (1) identification of COPCs, (2) identification of ecological receptors of potential concern, (3) identification of habitats and biological communities of concern, (4) selection of toxicity reference values (TRV), (4) identification of exposure parameters and appropriate uptake equations, (5) prediction of estimated exposure to COPCS, and (6) comparison of estimated exposure to recognized toxicological hazards associated with the COPCs to ascertain risks. Each of these steps are discussed below

[1] Identification of Contaminants of Potential Concern

The following COPCs are those identified in the URS Tier I and II risk assessment reports that exceeded the Effects Range Low (ERL—defined in more detail below) in at least one sediment sample.

- Mercury
- Arsenic
- PAH (select high and low molecular weight congeners)
- Lead (Skeet Hill, lead shot only)
- Chlordane

Based on a preliminary interpretation of the results from past studies, it was determined that of all COPC's, total sediment mercury exhibited the greatest exceedance of sediment criteria in almost all samples collected in the cove and salt marsh areas. Thus, with the exception of the creek channel, the area of concern for contamination and potential uptake can be bounded by the mercury samples in these areas. Although the delineation for clean-up purposes can be bounded by the mercury footprint, the Trustees have also requested estimates of risks to higher trophic levels from the other contaminants that exceeded sediment benchmarks, and those risks will also be considered to the extent practical from the existing data.

[2] Identification of Ecological Receptors of Potential Concern

Table 1 (appended below) lists ecological receptors potentially exposed to contaminants of concern in the Castro Cove area, as identified from past studies done on benthic communities, wildlife, and fisheries in or near the site vicinity (CH2M Hill 1982, URS 2002a,b). Figure 1 (appended below) depicts a draft conceptual site model that charts exposure pathways for a 'short list' of the ecological receptors identified in Table 1. Doses will be estimated only for those biota classes for which complete exposure pathways are possible, and for which site data conservatively suggest that risk from that exposure could be significant. Toxicity information on surrogate species may be used to characterize toxicological risks to ecological receptors of concern, if toxicity or life history data for the proposed receptors are insufficient to characterize exposure and risk. The fundamental assumption of this approach is that if negligible risk from the estimated exposure is determined for the surrogate species, it will be assumed that the entire guild of species in which the site-specific species belongs will be protected.

[3] Identification of Communities and Habitats of Potential Concern

Consistent with the previously summarized data, the areas identified with levels of contamination of potential concern include: (1) the Castro Cove mudflat (incl. the 20-acre area of concern), (2) the salt marsh area, (3) lead shot depositional area from the former Skeet Hill firing range (a 10-acre portion of the mudflat), and (4) the lower Castro Cove Creek Channel. Exposure assessments will provide estimates of the amount of time the identified ecological receptors could or would spend in each of these areas, proportional to the total area of Castro Cove and to the receptor's home range.

[4] Selection of Toxicity Reference Values for Hazard and Risk Assessment

Ingestion-based toxicity reference values (TRVs) that will be considered to gauge risks to ecological receptors in Castro Cove were derived primarily from Navy/U.S. EPA sites around San Francisco Bay (Appended Table 2). These Navy/EPA TRVs were developed on a consensus basis between the U.S. Navy and the EPA's Biological Technical Advisory Group (BTAG) (*see* PRC Environmental Management 1997 for source documentation). No uncertainty factors were applied to account for interspecies or intraspecies sensitivity in developing the BTAG TRVs. Chemicals for which only lowest-adverse-effect-levels (LOAELS) were available had uncertainty factors of up to 10 applied to adjust to a no-observed-adverse-effect-level (NOAEL). Chemicals for which only subchronic exposure studies were conducted had uncertainly factors of 10 applied to adjust to a chronic value. The TRV values appended in Table 1 reflect these BTAG values for the low TRVs. The U.S Fish and Wildlife Service also considers these values protective of ecological receptors that could be chronically exposed to the COPCs.

<u>Sediments</u>

Sediment criteria proposed for use in this risk assessment are based on identified impacts to benthic invertebrates from controlled lab studies and co-located sediment and biota data sets from the field (Long et al. 1995). These values will be the same as those used in the initial screening described in the URS reports (URS 2002a,b). Briefly, these metrics include the low range ecological effects (ERL) and the median range for ecological effects (ERM). The ERL is defined as the sediment concentration above which adverse effects on sensitive species or life stages may occur. The ERL values were obtained from matching numerous co-located chemical and biological data sets from both field and lab studies. The ERL, as originally proposed by Long et al. (1995), is ultimately calculated from the 10^{th} percentile of the effect data set. The ERM corresponds to the 50^{th} percentile of the same effect data set, and is thought to correspond to a value above which adverse effects are always or frequently observed. Table 3 (appended below) provides the sediment benchmarks for the COPCs identified for the Castro Cove site.

<u>Accumulation Factors</u>

No tissue residue data have been collected from marine worms or other biological matrices in the habitats of concern in Castro Cove. Thus, bioaccumulation factors developed for appropriate reference areas in the Bay region will be used to estimate tissue residue concentrations in food sources (prey items) that could be consumed by the ecological receptors of concern. Lipid-normalized tissue data co-located with sediment organic carbon data are not available from the region to calculate a Biota-Sediment Accumulation Factor (BSAF) that could be applied to the Castro Cove area. However, sufficient data are available to calculate a bioaccumulation factor (BAF)—the ratio of tissue residue of a COPC to the concentration of that COPC in the environmental media (e.g., sediment, soil, etc.). The Trustees have provided BAFs from reference stations that can be used in the exposure calculations (appended Table 4).

<u>Receptor-Specific Trophic Transfer Factors</u>

Dry weight Trophic Transfer Factors (TTFs) for the short list of ecological receptors of potential concern will be used to improve the accuracy of exposure dose estimates, where such data are available. For example, TTF data are available for the clapper rail and salt marsh harvest mouse, from sampling of mussels, crabs, and worms, and co-located sediment samples collected from an adjacent coastal salt marsh by the U.S. Army. are to be considered for modeling exposure point concentrations. Tables 5, 6 and 7 (appended below) summarize these parameters for arsenic, mercury, and chlordane, respectively.

[5] Identification of Exposure Parameters and Equations Used for Estimating Exposure Doses to Ecological Receptors of Potential Concern

The exposure parameters and guild species used in this assessment are summarized in Table 1. The values for body weight, dietary preference, ingestion rates, and other parameters of relevance necessary to extrapolate doses of COPC's from the Castro Cove site were primarily from studies of each species in the San Francisco Bay area, the Wildlife Exposure Handbook (US EPA 1993) and the Birds of North America web-site (Birds of North America 2006). However, it should be recognized that additional data sources are being explored to identify values for missing parameters. Table 5 provides exposure parameters that may be used to estimate site exposure and characterize risk for the short list of ecological receptors of concern from the data acquired to date.

Although more detailed equations have been identified, the principal dosage calculation will consider daily intake of COCs by each of the complete pathways with the general equation, [I].

[I] Daily intake = CM * CR * FI * AF * BW

Where,

CM = Concentration of contaminant in exposure media of concern.

CR = Contact Rate—The estimate of the quantity of the medium consumed per day.

FI = Fractional Intake—The fraction of time spent in contact with the contaminated media (e.g., the proportion of the total diet obtained from the site, as extrapolated from information such as home range data on the species, or empirical findings).

AF = Absorption Fraction—The amount of contaminant contacted (e.g., consumed) that is actually assimilated into tissue to assert a potentially toxic effect.

Recognizing that the exposure mediium for some of the receptors is assumed to be sediment, it will be necessary to identify how much sediment is taken into the diet directly [II].

[II] Sediment ingestion rate (g sediment, dw/day = (% sediment in the diet)*(food ingestion rate, g/day)

Further, where a surrogate species is used to extrapolate dose to a receptor of relevance to Castro Cove, equation [III] may be applied.

[III] $\text{Dose}_{\text{receptor}} = \text{Dose}_{\text{test organism}} (\text{BW}_{\text{test organism}}/\text{BW}_{\text{receptor}})^{1/3}$

Where,

BW = receptor body weight (kg).

[6] Predictive Assessment of Risk from COPC Exposure

Potential risks will be characterized from an analysis of the anticipated exposure relative to the toxicity reference value, through the calculation of hazard quotients [IV]. The general form of the hazard quotient (HQ) equation for chronic exposure (Carlisle *et al.*. 1996) is modified below assuming an exposure frequency of 365 days per year and a lifetime exposure duration.

[IV] $$HazardQuotient = (1/TRV) \times Cs \times \frac{[IR \times CF \times EF \times ED]}{[BW \times AT \times 365day/year]}$$

Where-

AT = averaging time, 365 days/year
TRV = toxicity reference value, mg/kg-BW-day
Cs = concentration of chemical in sediment, mg/kg
IR = Ingestion rate (food or sediment) mg/day on a dry weight basis
CF = conversion factor to convert mg sediment to kg sediment, 10^{-6}
EF = exposure frequency, assumed to be 365 days/year
ED = exposure duration, assumed to be lifetime of the animal
BW = body weight of animal (kg)
AT = averaging time of exposure, assumed to be the lifetime of the animal

Where source data for input parameters are not available, the HQ will be calculated from the following equation:

$$HQ_1 = EPC/TRV_{low}$$

$$HQ_2 = EPC/TRV_{high}$$

Where: EPC = Exposure Point Concentration

The TRV, in this case, may be reflective of tissue-specific toxicity metrics, as obtained from literature sources (e.g., Beyer et al. 1996), and the EPC would reflect the tissue-residue expected following the application of bioaccumulation factors.

The relationship between service loss calculations for the NRDA and risks characterized from the above analyses would be subsequently explored in discussions with the Trustees.

REFERENCES

Birds of North America. Website http://bna.birds.cornell.edu/BNA/ , viewed January 23, 2006.

California Environmental Protection Agency. 1996. Guidance for ecological risk assessment at hazardous waste sites and permitted facilities. Department of Toxic Substances Control, Human and Ecological Risk Division.

Dames & Moore. May 1999. Draft sediment characterization and Tier I ecological risk assessment for Castro Cove.

Filice, F.P. 1954. An Ecological Survey of the Castro Creek Area in San Pablo Bay. Wassman Journal of Biology, 12: 1-24.

Filice, F.P. 1958. Invertebrates from the estuaring portion of San Francisco Bay and some factors influencing their distributions. Wassman Journal of Biology, 16:159-211.

Fisler, G. F. 1963. Effects of salt water on food and water consumption and weight of harvest mice. *Ecology* **44**, 604-609.

Long, ER, MacDonald DD, Smith SL, Calder FD. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19:81-97.

Nagy, K. A. 1987. Field metabolic rate and food requirement scaling in mammals and birds. *Ecol. Monogr.* **57**, 111-128.

Scott, M. L., Zimmermann, J. R., Marinsky, S., Mullenhoff, P. A., Rumsey, G. L. and Rice, R. W.. 1975. Effects of PCBs, DDT, and mercury compounds upon egg production, hatchability and shell quality in chickens and Japanese quail. *Poultry Sci.* **54**, 350-368.

URS. June 2002a. Tier II sediment characterization and ecological risk assessment: Castro Cove.

URS. March 2002b. Additional sediment characterization and risk evaluation: Skeet Hill.

U.S. EPA 1993a. Wildlife exposure factors handbook. Office of Research and Development, Washington, D.C.

U.S. EPA 1993b. A review of ecological assessment case studies from a risk assessment perspective.

U.S. EPA. 2005. Predicting toxicity to amphipods from sediment chemistry. National Center for Environmental Assessment, Washington, DC; EPA/600/R-04/030.

U.S. Fish and Wildlife Service. 1980. Selected vertebrate endangered species of the seacoast of the United States, Clapper Rail., Report FWS/OCB-80/01.56. U.S. Fish and Wildlife Service Biological Services Program, Washington, D.C.

Table 1. Ecological Receptors with Possible Use of Castro Cove Areas of Concern

Mammals	**Birds**	**Fish**	**Benthic Invertebrates**
Salt Marsh Mouse	Greater Scaup	Starry flounder	Coelenterata: *Metridium senile*
Norway rat	Mallard Duck	English sole	Polychaeta: *Capitella capitata* *Etione lighti* *Nephtys caecoides* *Neanthes succinea* *Polydora ligna* *Streb. benedicti*
	Avocet	Speckled Sanddab	
	Long Billed Curlew	Staghorn Sculpin	Arthropoda: *A. confervicolus* *Balanus glandula* *B. improvisus* *Hemigrapsus oregonensis* *Pagurus hirsutiusculus* *Traskorchestia traskiana* *Cancer magister*
	Willett	Yellowfin goby	Mollusca: *Clinocoardium nuttalli* *Gemma gemma* *Modiolus demissus* *Macoma nasuta* *Mya arenaria* *Mytilus edulis* *Nassarius obsoletus* *Tapes semidecussata* *Myosotella myosotis* *Mya californica*
	Marbled Godwit	Plain midshipman	
	Dowitcher	Perch	
	Black headed Stilt	Anchovy	
	Ruddy Duck	Striped bass	
	Canvassback Duck	Steelhead trout	
	Osprey		
	Brown Pelican		

Table 2. Toxicity Reference Values Proposed for Castro Cove Ecological Risk Assessment (mg/kg body wt./day)

Ecological Receptor Guild or Species	Hg NOAEL	Hg Low TRV	Lead (Acetate form only)	Arsenic	Chlordane
Lg. Mammal	0.027	0.027	0.0015	0.32	0.0014
Sm. Mammal	0.16	0.25	0.0015	0.32	0.0014
Avian		0.039	0.014	5.5	

Table 3. Dry Weight Sediment Benchmarks for Castro Cove COPCs (ug /kg).

Chemical	**Sediment Benchmark (ug/kg)**	**Reference**
Benz(a)anthracene	261/1,600	Long et al. 1995
Benzo(a)pyrene	430/1,600	Long et al. 1995
Benzo(b)fluoranthene	3,600	US EPA 1993
Benzo(g),h,I)perylene	720	US EPA 1993
Chrysene	384/2,800	Long et al. 1995
Dibenz(a,h)anthracene	63.4/260	Long et al. 1995
Indeno(1,2,3-cd)pyrene	690	US EPA 1993
Pyrene	665/2,600	Long et al. 1995
Chlordane	7	Persaud et al. 1992
Arsenic	8,200/70,000	Long et al. 1995
Mercury	150/710	Long et al. 1995

Table 4. Bioaccumulation values for mercury, arsenic and lead, obtained from co-located sediment/biota reference stations in the San Francisco Bay Area.

Arsenic			***Mercury***			***Lead***		
	Average	Standard Deviation		Average	Standard Deviation		Average	Standard Deviation
All Sites	0.995138	0.560758	All Sites	1.65648	2.093551	All Sites	0.033876	0.032381
Petaluma River	0.89455	0.596417	Petaluma River	1.003958	0.520089	Petaluma River	0.049414	0.046629
San Pablo Bay	0.579885	0.21228	San Pablo Bay	0.770819	0.396981	San Pablo Bay	0.03064	0.015787
Pinole Point	0.823251	0.352256	Pinole Point	1.043019	1.160563	Pinole Point	0.055417	0.0492
Davis Point	1.03771	0.233945	Davis Point	2.054351	1.692403	Davis Point	0.017867	0.013682
T-0	1.281965	0.663606	T-0	2.139226	3.15900	T-0	0.016284	0.008878
			Mare Island	0.187				

Table 5. Arsenic low and high TRV values and trophic transfer factors for clapper rail and harvest mice

Values for Arsenic	*Clapper Rail*	*Harvest Mice*
TRV (mg/kg BW-day)	Low - 5.5; High - 22.01 [a]	Low -0.32; High - 4.7 [a]
TTF – Range (Minimum - Maximum) [sample size] (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 0.13 – 0.45 [3] [b] Crab : 0.19 – 0.45 [3] Worm : 0.41 – 0.95 [3]	Pickleweed : 0.0256 – 0.464 [3] [c]
TTF – Mid (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 0.269 (mean) Crab : 0.272 (mean) Worm : 0.620 (mean)	Pickleweed : 0.189 (mean)
Low TRV Sediment Values (mg/kg sediment, dry wt)	With Max TTF : 66.1 With Mid TTF : 93.0 With Min TTF : 126	With Max TTF : 2.53 With Mid TTF : 5.84 With Min TTF : 25.9
High TRV Sediment Value (mg/kg sediment, dry wt)	With Max TTF : 265 With Mid TTF : 372 With Min TTF : 505	With Max TTF : 37.2 With Mid TTF : 85.8 With Min TTF : 380
Hamilton Army Airfield ROD/RAP Action Goals (mg/kg sediment, dry wt)	Inboard - 16.7 Coastal Salt Marsh - 23	

[a] Value used from (PRC Environmental Management, 1997) and agreed upon by Navy and BTAG.
[b] Based on co-located sediment, mussel, crab, and worm samples collected by US Army at Hamilton in 1995 (Woodward-Clyde, 1995).
[c] Based on co-located sediment and pickleweed samples collected by US Army at Hamilton in 1995 (Woodward-Clyde, 1995).

Table 6. Mercury low and high TRV values and trophic transfer factors for clapper rail and harvest mice

Values for Mercury	*Clapper Rail*	*Harvest Mouse*
TRV (mg/kg BW-day)	Low - 0.0078 - 0.015 [a] High - 0.18 [b]	Low - 0.25; High - 4 [b]
TTF – Range (Minimum - Maximum) [sample size] (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 0.09 – 0.195 [3] [c] Crab : 0.247 – 0.289 [3] Worm : 0.202 – 0.244 [3]	Pickleweed : 0.0005 – 0.0092 [3] [d]
TTF – Mid (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 0.143 (mean) Crab : 0.271 (mean) Worm : 0.218 (mean)	Pickleweed : 0.0043 (mean)
Low TRV Sediment Values (mg/kg sediment, dry wt)	With Max TTF : 0.18 – 0.34 With Mid TTF : 0.19 – 0.37 With Min TTF : 0.21 – 0.40	With Max TTF : 30.9 With Mid TTF : 36.6 With Min TTF : 42.7
High TRV Sediment Value (mg/kg sediment, dry wt)	With Max TTF : 4.08 With Mid TTF : 4.41 With Min TTF : 4.79	With Max TTF : 494 With Mid TTF : 585 With Min TTF : 684
Hamilton Army Airfield ROD/RAP Action Goals (mg/kg sediment, dry wt)	Inboard - 0.43 Coastal Salt Marsh - 0.58	

[a] Value used from (PRC Environmental Management, 1997) and agreed upon by Navy and BTAG.
[b] Revised low TRV for mammals (Anderson, 2002).

[c] Based on co-located sediment, mussel, crab, and worm samples collected by US Army at Hamilton in 1995 (Woodward-Clyde, 1995).
[d] Based on co-located sediment and pickleweed samples collected by US Army at Hamilton in 1995 (Woodward-Clyde, 1995).

Table 7. Trophic Transfer Factors and Toxicity Reference Values for Chlordane

Values for Total Chlordanes	*Clapper Rail*	*Harvest Mouse*
TRV (mg/kg BW-day)	Low - 0.0014 [a] No high TRV available	No TRVs available
TTF - Range (Minimum - Maximum) [sample size] (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 1.47 - 103.6 [11] [b]	
TTF - Mid (mg/kg biota dry wt) ÷ (mg/kg sediment dry wt)	Mussel : 16.37 (geometric mean)	
Low TRV Sediment Values (mg/kg sediment, dry wt)	With Max TTF : 0.0001 With Mid TTF : 0.0008 With Min TTF : 0.0081	
High TRV Sediment Value (mg/kg sediment, dry wt)	NA	
Hamilton Army Airfield ROD/RAP Action Goals (mg/kg sediment, dry wt)	Coastal Salt Marsh and Inboard - 0.0048	

[a] Value used from the Service's chlordane TRV (unpublished) based on (National Research Council of Canada (NRRC), 1975).
[b] Based on co-located sediment and mussel samples collected by the Service in 1998 (unpublished results).

Table 8: Preliminary Biological Parameters for Calculating Exposure to Select Ecological Receptors								
Species	**Adult Body Weight (g)**	**Daily Food Intake (g)**	**Daily Water Intake (ml)**	**Home Range (km^2)**	**Est. Portion of Diet from Site**	**Surface Area (cm^2)**	**Diet Preference**	**Relevant Life History Characteristics Relevant to Exposure**
Avocet	B: 313	54		No data available		F: 43 M: 47	Aquatic insects, marine worms, small fishes, small crustaceans and mollusks; occasionally seeds and grasses. Long, thin upturned bill used to filter zooplankton	Breeds in shallow, brackish waters and marshes in April-June; Have long, thin upturned bill; Feeds in shallow water (< 25cm)
Willet	B: 265	45		B: 0.26		F: 33 M: 41	Aquatic insects, marine worms, small fishes, small crustaceans and mollusks; occasionally seeds and grasses. Thick, long bill used to peck, probe and plow to capture food; this occurs at 7 cm water depth of wave outwash, and prey is found within 5 cm of surface	Breeds in April-June along edge of salt marshes in spartina, in sand-dune areas utilizing beachgrass, in pond margins and raised ground near water . Inhabits eelgrass beds, muddy to sandy bottoms, and the low intertidal zone.
Dungeness Crab	B: 79			F: 3.4 (size dependent)		F: 9 M: 15	Aquatic insects, clams, fish, starfish, worms, squid, snails, and eggs from fish or crabs	Mate from May-June; Hatching between January-March Inhabits eel-grass beds, muddy to sandy bottoms, and the low intertidal zone

Table 8: Preliminary Biological Parameters for Calculating Exposure to Select Ecological Receptors								
Species	**Adult Body Weight (g)**	**Daily Food Intake (g)**	**Daily Water Intake (ml)**	**Home Range (km^2)**	**Est. Portion of Diet from Site**	**Surface Area (cm^2)**	**Diet Preference**	**Relevant Life History Characteristics Relevant to Exposure**
Marsh Wren	B: 11.25	8	3	No data		F: 45 M: 48	Insects, spiders, mollusks, and crustaceans	Breed in April; hatch in May; Migration in fall and spring; likely to be found within coastal marsh habitat where *Spartina* is abundant
Salt Marsh Harvest Mouse	B:21	9 (lactating)	7	F: .025 M: 023		F: 86 M: 91	Mixture of nuts, seeds, and insects	Breed several times during the year
Mallard Duck	F: 1,043 M: 1,225	250	F: 0.042 M: 0.055	F: 0.42 M: 0.48		F: 1,030 M: 1,148	A surface feeding "puddle" duck, feeds on an omnivorous diet. Dietary patterns vary with season. In winter, mallards feed mostly on seed mast, and to a lesser extent invertebrates. In the migratory and breeding seasons, high protein and fat diets are consumed, with more invertebrate biomass .	Affinity to marsh and wetland habitats in fresh and brackish water conditions.
Scaup	F: 770 M: 860	50	F: 0.064 M: 0.062	F: 0.34 M: 0.36		F: 842 M: 906	Juveniles ate entirely animal matter in NW territories study; 61% animal matter in Louisiana study,	Pacific Flyway spring migration from March—April; fall migration from September-mid-October.

Figure 1: Conceptual Exposure Pathways for a Short List of Species For Which Exposure Modeling Will be Attempted

Contaminant Of Concern	Ecological Receptor Exposure Route	Potential Estuarine Receptors in the Affected Envi						
		Flat Fish	Clapper Rail	Willett	Benthic Infauna (Macoma)	Benthic Epifauna (D. Crab)	Avocet	Salt M
Hg	Direct Sediment Ingestion	●	■	■	■	■	■	
	Bioaccumulation from diet or sediment	■	■	■	■	■	■	
	Bioconcentration from water	■	□	□	●	●	□	
	Drinking dissolved COPC	■	●	●	□	■	●	
PAH (select congeners)	Direct Sediment Ingestion	●	■	■	■	■	■	
	Bioaccumulation from diet or s	■	■	■	■	■	■	
	Bioconcentration from water	■	□	□	●	●	□	
	Drinking dissolved COPC	■	●	●	□	■	●	
Arsenic	Direct Sediment Ingestion	■	■	■	■	■	■	
	Exposure via Bioaccumulation	■	■	■	■	■	■	
	Bioconcentration from water	■	□	□	●	●	□	
	Drinking dissolved COPC	●	●	●	□	■	●	
Lead Shot	Direct Sediment Ingestion	●	■	■	□	□	■	
	Exposure via Bioaccumulation	□	□	□	□	□	□	
	Bioconcentration from water	□	□	□	□	□	□	
	Drinking water (dissolved COC)	□	□	□	□	□	□	

■ Complete pathway
□ Incomplete pathway or not applicable
● Potentially complete, but likely insignificant

E N T R I X

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
148 Rogers St.
Olympia, WA 98512
(360) 352-3225

Date: March 20, 2006

Re: **Preliminary Hazard Quotient Risk Estimations to Wildlife for Castro Cove**

Project No. **3054545**

Approach

Dosage estimates for mercury were developed for select ecological receptors known to use the salt marsh and mud flat areas of Castro Cove using equation [1].

[!] Dose = (Suf(IR[food]*C[food]) + (IR[water]*C[water]) + (IR[sed]*C[sed]*AE))/BW

Where:

(1) SUF = Site Use Factor of Habitat Area (percent)

(2) IR = consumption (i.e., intake) rate of [media]

(3) C = consumption of contaminant in [media]

(4) AE = assimilation efficienfy of benthos-derived contaminant from sediments

(5) BW = Body Weight

[2] Concentration of Contaiminant in Food (C) = ((% invertebrates in diet (BAF[inverts]*C[sed] + (% vegetation in diet (BAF [veg]*C[sed]))(percent of food contaminated)

Where:
(1) BAF = bioaccumulation factor (i.e., biota tissue concentration/sediment concentration)

Dosage was calculated considering the mean, maximum and upper 95% confidence values (95 UCL) above the mean for the sediment data derived from these areas. Hazard quotients presented in this memo reflect the 95 UCL only. Input parameters were primarily derived from the wildlife exposures handbook (EPA 1993), or from Sample et al (1997). Allometric conversions of food and water intake were developed from body weight (BW), where these parameters were not already presented in the previously mentioned references.

Conservative assumptions implicit to this modeling included:
- Presumed site use of 100 percent
- Presumed 100 percent assimilation efficiency of mercury with any sediment consumed (i.e., 100% bioavailable)
- Presumed that 100% of food consumed was contaminated

The toxicity reference values used in the calculation of hazard quotient are summarized below in Table 1. These values have been adopted by the BTAG for the bay area.

Table 1. Mercury Toxicity Reference Values Used for Hazard Quotient Estimations

Species Guild	**Model Species/ Habitat**	**Low Dose TRV (mg/kg BW/day)**	**Toxicological Endpoint**	**High Dose TRV (mg/kg BW/day)**	**Toxicological Endpoint**
Sm Mammal	Harvest Mouse/ Salt Marsh	**0.25**	reproductive and developmental effects in rats (EPA 1995)	**4**	reproductive and developmental effects in rats (EPA 1995)
Avian	Clapper Rail/ Salt Marsh	**0.039**	chronic reproductive effects in mallards (EPA 1995)	**0.18**	mortality and neurological impairment in mallards (EPA 1995)
Shorebird	Willet/ Mudflat	**0.039**	chronic reproductive effects in mallards (EPA 1995)	**0.18**	mortality and neurological impairment in mallards (EPA 1995)

Results

Dosage varied substantially based on the use of different bioaccumulation factors for mercury derived from a variety of sediment studies in the bay area in past studies (Table 2). Hazard quotients summarized in Table 3 below reflect the 'worst' and 'best' case scenarios, wherein for the former, we used the average BAF from SFEI data provided by the Trustees (i.e., BAF = 1.66), and in the latter we used the BAF estimate from Mare Island (BAF = 0.187) adopted by BTAG.

Table 2. BAF Values from Co-located Sediment and Biota Samples in the Bay Area

Hunters Point Reference Data Set						
SubLocation	**Min**	**Max**	**Sublocation Average BAF**	**St. Dev**	***n***	**Species**
Alameda Buoy	NA	NA	0.333	NA	1	*Macoma nasuta*
Alcatraz Environs	NA	NA	4.563	NA	1	*Macoma nasuta*
Bay Farm Borrow Pit	NA	NA	0.360	NA	1	*Macoma nasuta*
Eastern Wetland Area	0.365942	2.091584	1.234	0.740	8	*Macoma nasuta*
India Basin Area I	0.341176	0.59761	0.439	0.095	6	*Macoma nasuta*
Oil Reclamation Area	0.184385	0.465347	0.310	0.091	6	*Macoma nasuta*
Paradise Cove			0.381	NA	1	*Macoma nasuta*
Point Avisadero Area	0.106292	2.675497	0.622	0.665	16	*Macoma nasuta*
Red Rock			1.816	NA	1	*Macoma nasuta*
South Basin Area X	0.106122	0.775862	2.385	0.133	23	*Macoma nasuta*
	Average of All Sites for Hunter's Pt Data Source		0.582	0.747		*Macoma nasuta*
SFEI Reference Data						
Petaluma River	0.332865	2.186047	1.004	0.520	10	*Crassostrea gigas, Mytilus edulis*
San Pablo Bay	0.273689	1.413613	0.771	0.397	14	*Crassostrea gigas*
Pinole Point	0.891753	1.2891	1.043	1.161	4	*Crassostrea gigas, Mytilus edulis*
Davis Point	0.599318	5.439189	2.054	1.692	10	*Crassostrea gigas, Mytilus edulis*
T-0	0.40201	13.03085	2.139	3.159	22	*Crassostrea gigas, Mytilus edulis, Corbicula fluminea*
	Average of All Sites for SFEI Data Source		1.656	2.094		*Crassostrea gigas, Mytilus edulis, Corbicula fluminea*
Mare Island *	Mare Island		0.187		?	*Macoma nasuta*

***BAF value presented by BTAG, full data set not reviewed so *n* is unknown.**

Table 3. Dose and Hazard Quotient Estimations in Castro Cove to Select Ecological Receptors, based on the Upper 95% Sediment Concentrations

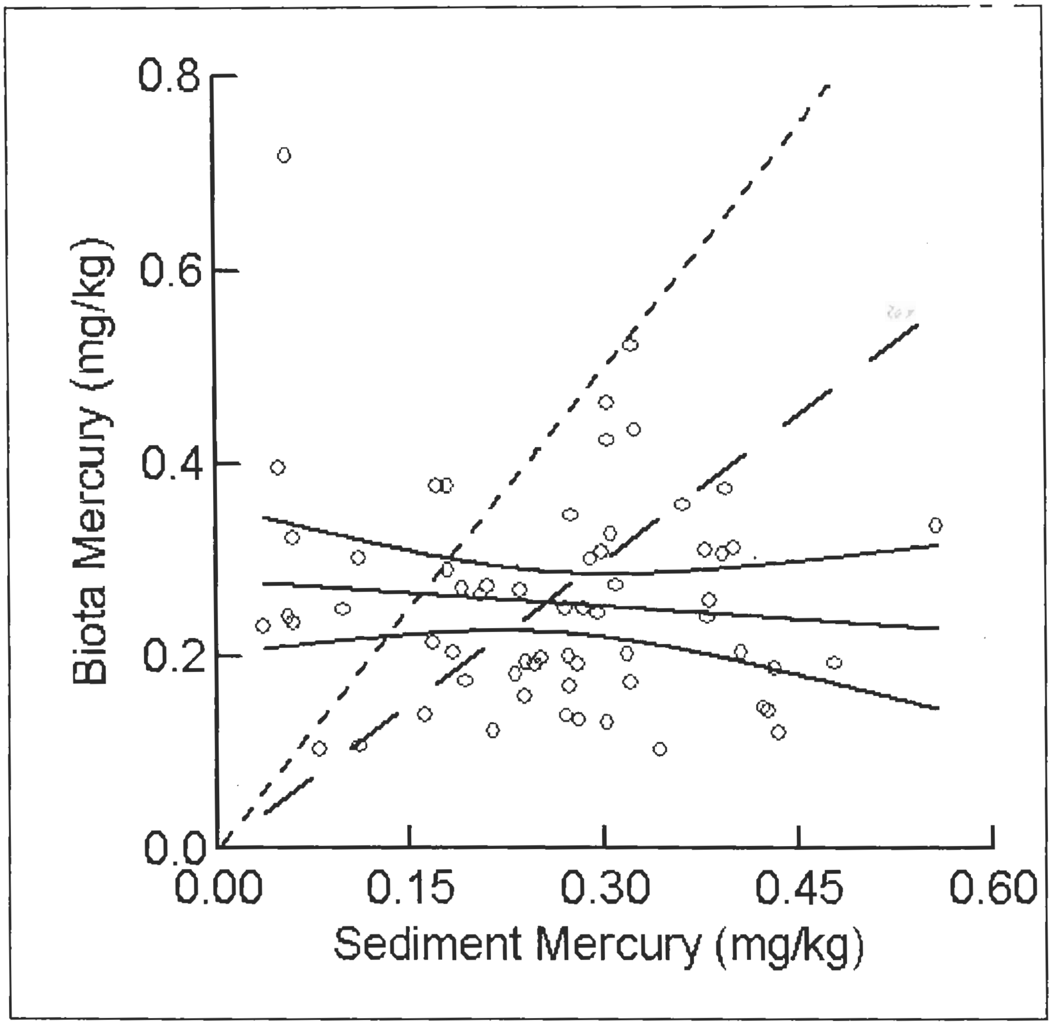
Species/Location/ Sediment	Predicted Hg Dose w/SFEI BAF of 1.66	Predicted Dose with Hg w/ BAF of 0.187 (Mare Island)	HQ* with SFEI BAF of 1.67		HQ with Mare Island BAF of 0.19	
			Low TRV	HighTRV	Low TRV	High TRV
Clapper Rail/Salt Marsh/Surface	0.1090 mg/kg/day	0.0217 mg/kg/day	2.79	0.61	0.56	0.12
Harvest Mouse/Salt Marsh/Surface**	0.2457	0.0305	0.983	0.061	0.124	.008
Willet/Mud Flat/ Surface	0.1903	0.0413	4.91	1.06	1.06	0.23
Scaup/Mud Flat /Surface	0.1739	0.0250	4.49	0.97	0.64	0.14

*HQ: Hazard Quotient = Predicted Dose/Toxicity Reference Value (TRV). TRVs presented in Table 1.
**A highly conservative BAF of 1.66 was also assumed for the harvest mouse vegetation, as 100% of diet is vegetable matter.

Table 3 reflects the spread in the results that have been observed. As observed in Table 3, hazard quotients exceeded '1' for the low TRV for the scaup, willet, and clapper rail, indicating possible risk to higher trophic levels in all modeling scenarios using a BAF of 1.66 (the average of all SFEI reference stations). Only the willet exposure scenario exceeded an HQ of '1' when the BAF from the Mare Island study was used.

Further discussion on the appropriate BAF value to use is required before more modeling should be conducted. To this end, BAF data plotted against the co-located sediment data from the bay area did not reflect any significant correlation between sediment and tissue mercury (Figure 1). The lack of any significant regression between sediment mercury and tissue concentration would support the use of a BAF value substantially below the 1.66 value derived from the average of the SFEI data (and consequently, lower hazards). However, it is unlikely that the Mare Island BAF value 0.187 is also representative.

Figure 1: Scatter Plot of Biota Mercury to Sediment Mercury in San Francisco Bay Samples*



*Short dashed line represents modeled relationship between sediment mercury and tissue mercury if BAF was 1.66. Long dashed line represents the same relationship if BAF = 1. Solid line represents best fit line from the observed data, with 95% confidence limits applied.

Appendix A: The memorandum prepared by ENTRIX and presented in this appendix is a working review draft which was not edited or finalized by the Trustees.

Appendix A-4:

- **A-4**, "Risk and Injury Assessment to Fish in Castro Cove"

Original Author: ENTRIX

Distributed to the injury subcommittee in the cooperative NRDA process.

E N T R I X

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
148 Rogers St.
Olympia, WA 98512
(360) 352-3225

Date: May 22, 2006

Re: **Risk and Injury Assessment to Fish in Castro Cove**

Project No. **3054545**

SUMMARY

This memo provides an assessment of the potential risks and injury to fish from exposure to mercury and polycyclic aromatic hydrocarbons (PAHs) in Castro Cove sediments. Flatfish (English sole) were assumed as the surrogate for all fish species' risk, in keeping with the analyses conducted for the Hylebos Settlement Agreement (the Hylebos Settlement). Since the Hylebos Settlement did not clarify fish injuries due to mercury exposure, the analysis in this memo estimated mercury uptake (dose) from assumed trophic transfer factors (TTFs), and compared the estimated uptake against tissue-specific screening values in the literature. Principal findings of this analysis can be summarized as follows:

- Flatfish risks from PAH exposure, presuming conditions of the Hylebos Settlement, equated to 20 to 40% service loss, depending on the presumed area where exposure might occur, and assuming the 95% upper confidence limit of the mean sediment concentrations as the exposure point concentration for risk assessment.

- Hazard quotient (HQ) estimations for estimated mercury uptake based on a No Observable Adverse Effect Level (NOAEL) in whole body tissues ranged from 0.53 to 133.5 for fish assumed to occupy the mudflat, 0.31 to 78.5 for fish exposed in the salt marsh, and 0.25 to 63 in the creek channel. (HQ values above '1' are considered at the screening level to be indicative of potential risk and injury).

- Variation in the hazard quotient estimations was the result of profound differences in tissue-based NOAELs reported in the literature.
- High HQ values were all associated with a NOAEL of 0.02 mg-Hg/kg body wt in larval salmonids, from a study that is not widely supported in the scientific community. Values below 1 were associated with an adult fish TRV of 5 mg-Hg/kg-body wt. Intermediate HQ values were associated with TRV values of 0.2 and 0.32 mg-Hg/kg-body wt from literature that is likely the most pertinent to Castro Cove.
- The broad range in the hazards outlined in this memo reflects elements of uncertainty in the modeling of fish risks from mercury exposure in Castro Cove due to the lack of tissue residue data from the site and direct evidence of injury. The high degree of uncertainty in the tissue estimations, and the limited toxicological basis for the use of TTFs for estimating metals doses in general, supports basing the fish injury assessment in Castro Cove on PAH contamination.

BACKGROUND

Estimates of potential impacts to the benthic community have been previously developed through Habitat Equivalency Analysis (HEA) conducted by ENTRIX, Inc., using logistic growth modeling and other models to examine potential mortality based on amphipod bioassay data conducted in association with Tier II sediment investigations (Butcher 3/9/06). Estimates of risks to wildlife from mercury consumption in the Castro Cove vicinity were also provided in an earlier ENTRIX, Inc. memo (Fisher 3/20/06). This memo provides a summary of possible risk to fish, based on fish use of the habitats, and toxicity of the principal contaminants of concern (PAHs and mercury).

Fish Use in Castro Cove

Aquatic habitats available for use to fish in the Castro Cove project area include the waters overlying the cove's mudflats, the lowermost portion of the Castro Cove creek channel, and tidal sloughs within the adjacent Salt Marsh. In past studies of the project area, 21 fish species have been captured (Woodward Clyde 1976, CH2MHill 1982). In the CH2MHill 1982 study, 19 species were captured and identified in the cove's habitats, but species richness and abundance was higher in reference mudflat habitats (Gallinas and Corte Madera) than in Castro Cove during spring sampling. Abundance during the rest of the year was similar amongst the three sites, and diversity in Castro Cove increased to match that of the Gallinas reference site, although it remained lower than the Corte Madera site. Table 1 summarizes the species caught over all seasons in this study. No difference in richness or abundance was observed between the Castro Cove salt marsh habitat and the salt marsh habitats sampled at the reference sites, regardless of season.

Table 1. Fish Species Captured within the Castro Cove Study Area*

(Source CH2MHill 1982)

Fish Species Common Name	Scientific Name	Habitat Where Captured
Leopard shark	*Triakus semifasciata*	Creek station only
Walleye surfperch	*Hyperprosopon argenteum*	Main channel in cove
Pacific herring	*Clupea harengus*	Main channel in cove
Northern anchovy	*Engraulius mordax*	All habitats sampled (creek, channel, mudflat, marsh)
Smelt	Osmeridae sp.	
Whitebait smelt	*Allosmerus elongates*	Mudflats only
Topsmelt	*Atherinops affinis*	All habitats except main channel
Threespine stickleback	*Gasterosteus aculeatus*	All habitats except main channel
Bay pipefish	*Syngnatuhus leptorhynchus*	Creek station only
Staghorn sculpin	*Leptocottus armatus*	All habitats sampled
Striped bass	*Morone saxatilis*	All habitats sampled
Yellowfin goby	*Acanthogobius flavimanus*	Main channel and salt marsh
Arrow goby	*Clevelandia ios*	All habitats except salt marsh
Longjaw mudsucker	*Gillichthys mirabilis*	Salt marsh only
Bay goby	*Lepidogobius lepidus*	All habitats except salt marsh
Pacific sanddab	*Citharichthys sordidus*	Mudflat and salt marsh
English sole	*Parophyrs vetulus*	Creek station only
Starry flounder	*Platichthys stellatus*	Main channel and mudflat
White Croaker	*Genyonemus lineatus*	Mudflat only

* Capture methods included otter trawl in all habitats except salt marsh; gill net and minnow traps used in salt marsh only.

All of the species listed in Table 1 have potential for exposure to sediment contamination in Castro Cove. The lack of substantial differences in abundance or diversity among the Castro Cove epibenthic and pelagic (midwater) fish assemblages relative to the two reference sites sampled in 1982 suggests that these species are not affected by that exposure. However, the reports did not provide statistical analyses that would definitively clarify significant differences among fish use in the study sites. The most striking finding from the past study was the relative absence in Castro Cove of benthos-associated flatfish, despite the availability of otherwise suitable mudflat habitat. Abundant populations of juvenile English sole and starry flounder were found each spring in the two reference stations, but similar concentrations were not observed in Castro Cove until later, and never at as high an abundance. The authors suggested this finding may reflect possible impacts to these benthos-associated species. However, the lower use of Castro Cove by flatfish and other species in the early spring may also be a result of high spring run-off related to basin hydrology. The report did not include hydrological or water quality comparisons to help clarify the reason for the difference in abundance.

Two other studies have examined fish use of Castro Cove that provide data of additional relevance to the Castro Cove injury assessment. A Woodward-Clyde study (1976) examined fish populations in Castro Cove, the Castro Cove creek channel, and mudflats using trap lines and gillnets. In that study, only four species of fish were captured (starry flounder, American shad, staghorn sculpin and black perch) and numbers were low (N = 23). Sampling methods and effort were not adequate to fully determine fish use in the cove. In a later study of the outer Castro Cove area, outside the NRDA project area, sampling was much more extensive (Entrix 1989). In this latter study, seven stations were sampled at monthly or bimonthly intervals using an otter trawl, over a year long period. Seven species dominated the 12,785 fish captured, with nearly 45 percent derived from two shallow water transects, and 49% from intermediate depth stations. In contrast to the CH2MHill study, roughly 40% of the total catch was flatfish (English sole and speckled sanddab), and 47.8% of the total catch was composed of a mix of shiner surfperch, yellowfin goby, staghorn sculpin, plainfin midshipman and northern anchovy. Similar to the CH2MHill study, abundant English sole were not abundant until the beginning of March, when abundant young of the year captures increased dramatically in the shallow water transects. Taken collectively, these two studies captured four additional species that were not seen in the CH2MHill studies (speckled sanddab, black perch, American shad and plainfin midshipman).

In addition to the fishes identified in the above studies, it is recognized that Wildcat Creek flows into San Pablo Bay north of Castro Cove and supports a limited steelhead trout population; thus, this species should also be considered as a potential user of the project area habitat and is therefore listed in Table 2, although it was not captured in the previous studies.

Fish Toxicity Reference Values

Mercury

Although mercury bioaccumulation in fish has been extensively examined in San Francisco Bay and elsewhere to support human health screening (Greenfield et al. 2003), relatively little has been reported on the effects of mercury on fish themselves, and most that has been reported is from freshwater environments (Weiner and Spry 1996). Effects data on fish populations within San Francisco Bay burdened with mercury are particularly lacking (Davis et al. 2003). Developing a mercury TRV for the protection of fish in Castro Cove is further complicated by the general lack of sediment-associated effects in estuarine fish studies specific to mercury. As reflected in the brief summary of the effects literature appended to this memo, wet weight residues of 6 to 20 μg/g-muscle will likely lead to adverse effects in adult fish. Weiner and Spry (1996) have suggested a no observable adverse effect level (NOAEL) concentration of 5 μg/g-muscle or brain for salmonids based on the earlier work of McKim et al. (1976), where brook trout were chronically exposed for three generations to waterborne methylmercuric chloride. Birge et al (1979) proposed a NOAEL for early life stages of salmonids more than two orders of magnitude below the adult TRV—0.02 μg/g, based on results from exposing eyed rainbow trout eggs and larvae to mercuric chloride in sediment and water; this TRV is the lowest identified in the literature and is not largely accepted. Snarski and Olson (1982) proposed a NOAEL TRV for fathead minnow reproduction of 0.32 μg/g. This TRV may be more relevant to the aquatic habitats of Castro

Cove, given the chronic exposure of the waterborne exposure test (41 weeks), and the estuarine fish species tested.

In a recent study, four analytical approaches of increasing complexity (simple ranking, empirical percentile, tissue threshold-effect level [t-TEL], and cumulative distribution) were evaluated for deriving protective levels of mercury in fish (Beckvar et al. 2005). In this evaluation, a total of 10 papers containing mercury residue-effect information for eight fish species were identified from which paired no-effect residue (NER) and low-effect residue (LER) values were obtained (i.e., equivalent to NOAEL and LOAEL TRVs). The same datasets were analyzed using all four approaches or methods. The reasonableness of the estimated threshold-effect concentrations for the four methods was assessed by comparing them to both the geometric means of control organisms reported in the papers and to ambient tissue residue concentrations from fish captured in areas unaffected by point sources of contaminants. Of the four approaches evaluated in this study, the t-TEL approach--the same approach as outlined in this memo--best represented the underlying data and resulted in a mercury t-TEL of 0.21 mg/kg for adult fish. A mercury t-TEL was not developed for early life stages (ELS) due to the paucity of data. Indeed, the authors indicated that additional ELS fish studies using lower mercury detection limits are needed to validate the protective concentration of 0.02 mg/kg proposed by Birge et al. (1979) discussed in the preceding paragraph.

PAH

Unlike the situation with mercury studies, risk to flatfish from exposure to PAHs has been identified in an array of studies conducted during the previous two decades, which demonstrated significant cellular, reproductive, or other health-related effects in a dose-dependent manner (Myers et al. 1994, NOAA 1997, Johnson 2000). The following conclusions were drawn relative to these past studies on PAH contamination:

- Nearly 10% of English sole examined had cancerous and precancerous lesions in soft body tissue when PAH concentrations were about 1 mg-HPAH [high molecular weight PAH]/kg-sed (dry wt).
- Nearly 5% of adult female flatfish were infertile at about 1 ppm.
- Lesions increased roughly three-fold when sediment HPAH concentrations increased to about 5 ppm (17% above baseline reference areas).
- Invertebrate populations, as measured through the array of Apparent Effects Threshold (AET)[1] bioassays that the State of Washington has used to establish its Sediment Management Standards (SMS), begin to show impacts at about 7.9 ppm.
- At total sediment HPAH concentrations of 10 ppm, over 40% of English sole studies exhibited lesions, and 25% were infertile.
- Between 10 and 69 ppm, more than half of the invertebrate bioassays revealed adverse effects.

[1] AET tests include: (1) bivalve AET, (2) benthic community AET, (3) Microtox AET, (4) amphipod AET, (5) echinoderm AET, (6) oyster AET, (7) Neanthes AET

- A total sediment HPAH concentration of 100 ppm, over 70% of all English sole studied in Puget Sound exhibit toxicopathic lesions, half of adult females have inhibited gonada growth, 2/3rds do not spawn, and at least 3/4ths are infertile; all invertebrate AETs are exceeded.

METHODS

PAH

Consistent with the Hylebos Waterway Natural Resource Damage Assessment in Puget Sound and recommendations from the Trustees, estimates of potential risk to fish from exposure to PAHs were based on English sole. The English sole is representative of a typical flatfish guild species that would use mudflat habitat, for which contaminant uptake could be expected to be significant given their demersal life style, and for which significant toxicological literature on PAHs is available upon which to base injury assessments (Collier et al. 1997, Johnson 2000, NOAA 2002).

It was assumed that potential routes of exposure to PAH contaminants in the mudflat include:

- ingestion of contaminated prey
- incidental ingestion of contaminated sediment
- transdermal exposure from direct contact with contaminated sediments
- bioconcentration across the gills and skin from PAHs dissolved in water

Estimates of potential impact on fish species from exposure to PAH concentrations in sediment were calculated using methods originally outlined in Appendix D of the Hylebos Natural Resource Damage Settlement Proposal (Wolotira 2002). In that proposal, PAH compounds were separated into groupings of low and high molecular weight, but estimates of potential impacts in the Hylebos study were based on HPAH concentrations because total PAHs were not provided in the AET data set from which effects data were derived.

Tier II sediment source data from the Tier II Castro Cove study used the same PAH groupings, with the exception that fluroanthene was listed as a low molecular weight PAH. To maintain consistency with the Hylebos methodology, all fluroanthene results from Castro Cove were switched to the HPAH grouping. Concentrations of each HPAH and LPAH (low molecular weight PAH) were added for each sample to determine the total HPAH and LPAH numbers, respectively. Only the total HPAH number was used to calculate estimates of potential impact for reasons previously mentioned.

The service loss estimates for total HPAHs identified in the Hylebos Settlement and adopted for this draft memo were as follows:

- 20% service loss (flatfish injuries and invertebrate AET) between sediment concentrations from 1 to 8 ppm total HPAH
- 40% service loss from 8 to 17 ppm HPAH
- 60% service loss from 17 to 70 ppm

- 80% service loss when HPAH concentrations exceed 70 ppm

Mercury

A different method for estimating risk and injury to fish from sediment mercury was required than was applied to the Hylebos Settlement for PAHs, as Hylebos mercury injuries were based solely on invertebrate injuries identified through the AET database. However, there have been no tissue samples collected from fish within Castro Cove to compare against the tissue-specific risk screening levels discussed earlier. To estimate a tissue concentration in flatfish inhabiting Castro Cove, it was therefore necessary to assume trophic transfer from the sediment to the fish. In a review of over 300 papers, trophic transfer factors (TTFs) in the literature for total mercury varied widely, with marine TTFs ranging from 0.2 to 6.8, depending on the food web modeled (Suedel et al. 1994). The only study identified in that review which examined trophic transfer from sediment associated benthos to fish was that of Kiorboe et al. (1983), in which a TTF of 1.0 was identified from polychaetes to flatfish, eel and/or eelpout. In the absence of site-specific data, and for the purposes of this memo, tissue concentrations were modeled based on an assumed TTF from sediment to benthos of 1.67, the TTF previously applied to the wildlife risk assessment memo for Castro Cove (Fisher 3/20/06).

For the sake of comparison with the PAH analysis, the following injuries to benthos were identified from sediment mercury in the Hyleobs Settlement from AET bioassays:

- 5% service loss at mercury sediment of 0.41 ppm dry wt (Microtox AET)
- 10% service loss at 1.3 ppm sediment mercury (neanthes AET)
- 15% service loss at 1.4 ppm (echinoderm AET)
- 20% service loss at 2.3 ppm (amphipod AET)

RESULTS

Table 2 presents the sediment exposure point concentrations for PAH and mercury used for screening fish risks.

Table 2. Upper 95% C.I. of Castro Cove Sediment Data (ppm)

Contaminant of Concern	Mudflat Surface	Salt Marsh Surface	Castro Cove Creek Surface
Mercury mg/kg	0.963	0.564	0.451
Total PAH mg/kg	14.035	1.53	1.158
Total HPAH mg/kg	13.748	1.375	1.052

PAH

Using the Hylebos screening and injury estimation methods, the total HPAH surficial sediment in each habitat area in Castro Cove would be associated with some degree of potential service loss. In the Hylebos, over 40% of English sole examined exhibited lesions, and 25% were infertile at total sediment HPAH concentrations of 10 ppm. If the upper 95% confidence interval (C.I.) concentration of total HPAH contamination in the Castro Cove mudflats (i.e., 13.75 ppm) is assumed to represent the sediment concentration to which all flatfish would be exposed in the Cove, then a significant increase in toxicopathic lesions and reduction in fertility in English sole could be possible. Using the Hylebos Settlement injury breakdown, sediments from the Castro Cove mudflat would equate to service losses of 40%. Based on the lower sediment HPAH concentrations (Table 2) a 20 % service loss would be anticipated in the salt marsh and creek channel, respectively.

Mercury

An assumed TTF of 1.67 from sediment to benthic invertebrates, and subsequently from invertebrates potentially ingested by flatfish (i.e., primary consumer to secondary consumer), yielded estimated (assumed) whole body tissue mercury concentrations of 2.69, 1.57, and 1.26 ppm in flatfish presumed to be foraging exclusively in the mudflat, salt marsh and creek channel, respectively. Hazard quotients based on a range of TRVs reported in the literature are summarized in Table 3. These screening values, based on modeled fish tissue concentrations that might accumulate in resident flatfish consuming diets exclusively from each of the Castro Cove sediment study areas, and assuming 100% assimilation, do not indicate significant concern for mercury risks to adult fish, but suggest potential risks for fish reproduction/early life stages may be possible and injury may be occuring.

As an aside, it is interesting to note that if benthos injuries from mercury in Castro Cove were consistent with the Hylebos Settlement, service losses would range between 5 and 10 percent for each of the sediment contamination areas.

Table 3. Hazard Quotient Risk Characterization Based on a Range of Tissue-Specific TRVs in Fish

Species/Life Stage/Chronic Effect	TRV (µg-Hg/g-tissue)	Mudflat HQ	Salt Marsh HQ	Creek Channel HQ
Rainbow trout/Adult/ Mortality	NOAEL: 5 (McKim et al. 1976)	0.53	0.31	0.25
Rainbow trout/Eggs & Larvae/ Mortality	NOAEL: 0.02 (Birge et al. 1979)	133.5	78.5	63
Juvenile and Adult fish/growth & reproduction	NOAEL: 0.20 (Beckvar et al. 2005)	13.35	7.85	6.3
Fathead Minnow/Larvae/ Growth & Reproduction	NOAEL 0.32 (Snarski and Olson 1982)	8.34	4.91	3.94

Uncertainty

Numerous sources of uncertainty in the assessment of mercury exposure in Castro Cove bring to question the validity of any results based on modeling without site specific data. McGeer et al. (2003) have argued that bioaccumulation factors for metals are inherently flawed in general because conclusions can be reached that have no basis in the toxicological data. Specifically, high BAF values are obtained when exposure concentrations are lowest (suggesting high hazard), and BAF values are lowest when exposure media concentrations are highest (suggesting low hazards). Certainly this relationship is seen when BAF is plotted against sediment mercury from the SFEI reference samples previously provided (*see* Fisher 3/20/06).

Sources of uncertainty specifically include:

- The toxicological foundation for the TTF applied to mercury.
- The mercury uptake model outlined above conservatively assumes 100 percent assimilation from the diet, although that degree of assimilation is far above any reported assimilation rate.
- Tissue doses do not assume any significant uptake from waterborne mercury.
- TRV values were based on freshwater fish studies in controlled laboratory settings.
- Fish use data from Castro Cove suggest significant use in the Cove by juvenile flatfish.
- Lack of tissue data from fish resident to the Cove.
- Lack of information on percent of site use by flatfish relative to total life history.

APPENDIX

Overview of Mercury Effects in Fish

Existing lab and field study reports on mercury toxicity in fish indicate toxicologic effects occur in the same tissues as seen in higher vertebrates, with neurological and reproductive systems affected to the greatest degree (Weiner and Spry 1996). Ninety to ninety-nine percent of the mercury measured in fish tissues has been shown to be in the methylated form (i.e., methylmercury), despite the fact that almost all mercury found in sediments and water is present in other forms (Bloom 1992). There are two principal reasons for this difference: (1) the principal route of exposure to mercury in fish is considered dietary (and zooplankton and other fish food sources also bioconcentrate the methylated form), and (2) solubilized methylmercury also has much greater assimilation efficiency across the gills than inorganic mercury. However, the route of uptake has no bearing on the toxicological significance of methylmercury, as the mode of action will be on internal organs (e.g., brain), not on the tissues exposed directly to waterborne forms assimilated by the fish.

Fish captured in field studies from Minimata Bay, Japan, where mercury was discharged with waste sludge from an acetaldehyde plant, presented a range of toxicological and neurological effects, including diminished locomotor activity, toxicopathic brain lesions, and emaciation (Takeuchi, 1968). Toxicologically-affected fish of six species captured from the Minimata Bay contained an average of 15 ug mercury/g-wet weight in axial muscle (range 8.4 to 24 µg/g -muscle) (Kitamura 1968).

McKim et al. (1976) examined effects of mercury in three sequential generations of brook trout. Lethal aqueous concentrations of methylmercuric chloride caused loss of appetite, muscle spasms, and deformities prior to death, and yielded tissue concentrations of 24, 32, 42, 48, 147, 58 and 155 ug-Hg/g-tissue in axial muscle, gonad, brain, gill, kidney, liver and spleen, respectively.

Three- to eight-year old northern pike from mercury-polluted Clay Lake in Ontario contained from 6 to 16 µg/g -muscle, were emaciated, and exhibited a complex of bioenergetic indices of stress including low fat stores, total protein, glucose, and serum alkaline phosphatase. When fish from Clay Lake were transferred to a reference lake and measured a year later, these indices had recovered to approximately half the base line of the reference population, but only 30% of their mercury body burden had been eliminated (Lockhart 1972).

Studies conducted on rock bass in a Virginia stream examined physiological condition in a population residing in a relatively contaminated reach, where the muscle and liver concentrations measured were 1.4 and 2.9 µg/g-tissue, respectively, versus 0.17 µg/g and 0.10 µg/g in fish from the reference reach (Bidweel and Heath 1993). At these tissue concentrations, no significant physiological or biochemical differences were noted between the two populations.

Similar to birds, early life stages of fishes are very sensitive to mercury. Past studies reviewed by Wiener and Spry (1996) have examined mercury-induced teratogenesis in mummichog, rainbow trout, brook trout and fathead minnow. Teratogenesis was observed from laboratory exposures to waterborne mercury at concentrations ranging from 0.2 µg/L to

100 μg/L. Craniofacial, cardiovascular and skeletal flexure abnormalities have all been observed (Birge et al. 1979; Weis and Weis, 1991). Exposure of the embryo to waterborne mercury is likely limited by the egg chorion membrane, so the principal route for exposure in the wild is thought to be via translocation during oogensis (Weis and Weis 1991), as the exposure history of the parental female has been reflected in egg burdens in both field (Weis and Weis 1984) and lab studies (McKim et al. 1976). Niimi (1983) found that translocation into eggs from contaminated females in the wild yields relatively lower concentrations of mercury than is found in the tissues of the parent, amounting to roughly 0.3 to 2.3 percent of the whole-body burden. Burdens of 0.04 to .010 ug/g-egg, less than 1% of the body burden associated with overt toxicity in adult rainbow trout, have been identified as the LOEL for eyed eggs or larval mortality after 10 days of exposure (Birge et al. 1979).

References

Beckvar, N. T.M. Dillon, L. B. Read. 2005. Approaches for linking whole body fish tissue residues of mercury or DDT to biological effects thresholds. Environmental Toxicology and Chemistry 24: 2094-2105.

Bidwell, J.R. and A.G. Heath. 1993. An *in situ* study of rock bass (*Ambloplites rupestris*) physiology: effect of season and mercury contamination. Hydrobiologia 264:137-1.

Birge, W.J., J.A. Black, A.G. Westerman, and J.E. Hudson. 1979. Ehte effects of mercury on reproduction of fish and amphibians. P. 629-655 *In*: J.O. Nriagu (Ed.). Biogeochemistry of mercury in the environment. Elsevier/North-Holland Biomedical Press, New York.

Bloom, N.S. 1992. ON the chemical form of mercury in edible fish and marine invertebrate tissue. Can. J. Fish. Aquat. Sci. 49:1010-1017.

CH2 Mhill. 1982. Chevron equivalent protection study—intensive investigation. Final report.

Collier, T.K., L. L. Johnson, M. S. Myers, C.M. Stehr, M. M. Krahn, and J.E. Stein. 1997. Fish injury in the Hylebos Waterway of Commencement Bay, Washington. NOAA/NMFS.

Davis, J., D. Yee, J. Collins, S. Schwarzbach, and S. Luoma. 2003. Potential for increased mercury accumulation in the estuary food web. San Francisco Estuary and Watershed Science 1:1

Greenfield, B., J. Davis, R. Fairey, C. Roberts, D. Crane, G. Ichikawa, and M. Petreas. 2003. Contaminant concentrations in fish from San Francisco Bay, 2000. RMP Technical Report: SFEI Contribution 77. San Francisco Estuary Institute, Oakland, CA.

Kitamura, S. 1968. Determination on mercury content in bodies of inhabitants, cats, fishes and shells in Minamata District and in the mud of Minamata Bay. P. 257-266. *In* Minamata disease. Study Group of Minamata Disease, Kumamoto University, Japan.

Lockhart, W. L. J. F. Uthe, A. R. Kenney and P.M. Mehrle. 1972. Methylmercury in northern pike (*Esox lucius*): distribution, elimination, and some biochemical characteristics of contaminated fish. J. Fish. Res. Board Can. 29:1519-1523.

Johnson, L. 2000. An analysis in support of sediment thresholds for polycyclic aromatic hydrocarbons (PAHs) to protect estuarine fish. USDOC, NOAA, NMFS, Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 32 pp.

Kiorboe, T. Mohlenberg, HU Riisgard. 1983. Mercury levels in fish, invertebrates, and sediment in a recently recorded pollted area (Nissum Broad, Western Limfjord, Denmark). Mar. Pollut. Bull. 14:21-24.

McKim, J.M. G.F. Olson, G.W. Holcombe and E.P. Hunt. 1976. Long term effects of methylmerdcuric chloride on three generations of brook trout (*Salvelinus fontinalis*): toxicity, accumulation, distribution, and elimination. J. Fish. Res. Board Can. 33:2726-2739.

McGeer, J.C., K.V. Brix, J. M. Skeaff, D.K. DeForest, S. Brigham, W. Adams, and A. Green. 2003. Inverse relationship between bioconcentration factor and exposure concentration for metals: implications for hazard assessment of metals in the aquatic environment. Env. Tox. Chem. 22;1017-1037.

Myers, M.S., C.M. Stehr, O. P. Olson, L.L. Johnson, B.B. McCain, S-L Chan, and U. Varanasi. 1994. Relationshiops between toxicopathic hepatic lesions and exposure to chemical contaminants in English sole (Pleuronectes vetulus), starry flounder (Platichthys stellatus) and white croaker (Genyonemus lineatus) from selected marine sites on the Pacific Coast, U.S.A. Environ. Health Perspect. 102:200-215.

Nimi, A.J. 1983. Biological and toxicological effects of environmental contaminants in fish and their eggs. Can. J. Fish. Aquat. Sci. 40:306-312.

NOAA. 2002. Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Public Review Draft, March 14, 2002.

Suedel, B.C., J.A. Boraczek, R.K. Peddicord, P.A. Clifford, and T.M. Dillon. 1994. Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. Rev. Environ. Contam. Toxicol. 136: 21-89.

Takeuchi, T. 1968. Pathology of Minamata disease. P. 141-228. *In* Minamata disease. Study group of Minamata Disease, Kumamoto University, Japan.

Weiner, J.G. and D. J. Spry. 1996. Toxicological significance of mercury in freshwater fish. In: Environmental Contaminants in Wildlife—Interpreting Tissue Concentrations. Beyer, WN., G.H. Heinz and A. W. Redmon-Norwood (eds.). Lewis Publishers, Boca Raton.

Weis, J.S. and P. Weis. 1984. A rapid change in methylmercury tolerance in a population of killifish, *Fundulus heteroclitus,* from a golf course pond. Mar. Environ. Res. 13:231:245.

Weis, P. and J.S. Weis. 1991. The developmental toxicity of metals and metalloids in fish. P. 145-169. *In* M.C. Newman and A.W. McIntosh (Eds.). Metal ecotoxicology—concepts and applications. Lewis Publishers, Boca Raton, Fla.

Wolotira, R.J. 2002. Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Public Review Draft, March 14, 2002. Appendix D: Defining injuries to natural resources in Hylebos Waterway. Prepared for: The Commencement Bay Natural Resource Co-Trustees

Appendix A: The memorandum prepared by ENTRIX and presented in this appendix is a working review draft which was not edited or finalized by the Trustees.

Appendix A-5:

- **A-5**, "Risk to shorebirds and waterfowl from lead pellet ingestion at Skeet Hill in Castro Cove"

Original Author(s): ENTRIX

Distributed to the injury subcommittee in the cooperative NRDA process.

ENTRIX

MEMORANDUM

WORKING REVIEW DRAFT

ENTRIX, Inc.
2701 1st Avenue
Seattle, WA 98121
206/269-0104

Date: June 21, 2006

Re: Risk to shorebirds and waterfowl from lead pellet ingestion at Skeet Hill in Castro Cove

Project No. 3054545

PURPOSE

This memorandum estimates the potential risk to shorebirds and waterfowl from the ingestion of lead pellets within Castro Cove sediments from the former Skeet Hill shooting range.

APPROACH

A binomial model was applied to characterize lead shot risk to scaup and scoter, two representative diving duck species known to occur in moderate abundance within San Franscico Bay and/or Castro Cove (*see* URS 2002—Table 3-13). The model applied was consistent with that used to address lead shot risks to water fowl in the Alameda Point Skeet Range (Battelle and ENTRIX 2002). Upon further examination, the Alameda model calculations were found consistent with those used previously to examine lead shot risks to shorebirds within Castro Cove (URS 2002). In the URS study the willet was modeled as the shorebird species for which maximum lead shot risk was assumed, based on biological and abundance characteristics. For the present analysis, the "average" or "most likely" (i.e., central tendancy,) and "reasonable maximum" (i.e., worst case) exposure scenarios were considered to estimate probabilistic risk for each bird guild.

The binomial approach assumes there is only one of two possible outcomes from an 'event'. In the present case, that 'event' is whether a bird encountering a pellet, consumes it as grit, or rejects the pellet as grit. The rate of acceptance/rejection is species specific, and dependent on a variety of biological and behavioral factors (e.g., probe depth, # probes/unit time). The probability of an initial encounter with a lead pellet (as a grit surrogate) is in turn dependent on a number of additional factors such as pellet density and depth, and the proportion of time a bird would use the site (i.e., the 'site use factor').

The previous ecological risk assessment (ERA) conducted for Skeet Hill evaluated the vertical and horizontal distribution of lead shot pellets to assess the probability of lead shot ingestion by shorebirds as opposed to waterfowl because the Skeet Hill mudflats of Castro Cove are dominated by shorebirds (URS 2002). The biological criterion derived for that assessment looked at impacts to the individual and extrapolated these probabilities outward to estimate a population level effect from estimates of the avian populations using Skeet Hill (*see* Table 3-14, URS 2002). Of the shorebird species present, the willet, long-billed curlew, and marbled godwit preferentially select grit the size of lead shot at Skeet Hill (i.e., Nos. 7 ½, 8, and 9). By intersection of species abundance and grit size preference, the willet was selected as the indicator species for the URS ERA as the species with the greatest exposure potential. (Compared to other shorebird species, their morphology--longer bill and larger body--was considered to further increase their probability of lead pellet ingestion at the site).

The previous URS ERA report did not address risks to waterfowl. In the present analysis, the risk assessment for waterfowl was considered with the approach used in the Alameda Point Skeet Range remedial investigation (Battelle and ENTRIX 2002). As indicated above, this binomial pellet ingestion model was the same as that used in the URS study (i.e., the differences that appear between the two formula simply relate to how they are written, not how they are calculated). Two waterfowl species – surf scoter and lesser scaup – were selected to represent the waterfowl present at Alameda Point, and the same species and biological input parameters used for these diving ducks were applied for Skeet Hill (e.g., home range, probes/day). These species have been used in other studies to examine metal contamination derived from estuarine dietary sources (Cohen et al. 2000). These waterfowl species (in particular the scaup) have also been documented in the bay area in high abundance, particularly in the winter months.

Based on the above description, the probability of a bird ingesting a given number of lead pellets in the risk assessment is predicted by:

$$P_r = {}_nC_r\, p^r(1\text{-}p)^{n\text{-}r}$$

Where:

$P(r)$ = probability of a bird ingesting r lead pellets in n probes for grit

r = number of lead shot pellets based on a No Observable Adverse Effect Level (NOAEL)

n = number of probes for grit a bird makes in a specified time period

${}_nC_r$ = number of possible combinations of n and r

p = probability that an individual bird will encounter a lead pellet in the range of 7 1/2 to 9 in a single probe

The risk that a given individual might pick up and retain a sufficient number of lead pellets to meet or exceed the relevant NOAEL is the probability of a bird ingesting a number of pellets ≥ NOAEL, or:

$$\text{Risk} = 1\text{-} \sum(P_r;\ \text{r} < \text{NOAEL})$$

Where:

$$\Sigma(P_r;\ r < \text{NOAEL}) = (P_r;\ r = 0) + (P_r;\ r = 1) + \ldots + (P_r;\ r = \text{NOAEL-1})$$

A variety of lead shot No Observable Adverse Effects Level (NOAEL) values have been reported for waterfowl (mainly mallards). These values have ranged from one (Rattner et al. (1989) to six No. 4 shot (Sanderson 2002,; Korande et al. 1979). Meaning, in the studies cited, with the endpoints examined (e.g., growth), the range of the lowest 'dose(s)' of shot consumed that yielded *no* measurable effect was 1 to 6 shot, of the size N~~n~~o. 4 shot class. This shot size is typically used for hunting waterfowl, but is far larger than the shot size normally discharged at trap and skeet clubs. Shooters firing on clay targets at such clubs generally shoot shot sizes in the 7.5 to 9 range. At Skeet Hill, indeed all the shot recovered was in this smaller shot size range, and roughly 80% of the shot identified was of the No. 8 size. To compare the NOAEL values reported in the literature for No. 4 shot~~,~~ requires a conversion to the size class of shot found at Skeet Hill in order for the results to have relevance. For this technical memo (and the Alameda study) this conversion was based on surface area equivalence; the range of the No. 4 lead shot NOAELs (i.e., 1 to 6) would equate to a range of 3 to 16 No. 8 shot.

Although the Alameda study used a NOAEL of 9 No. 8 shot, we have used a NOAEL of 3 No. 8 shot, and a LOAEL of 4 No. 8 shot, to be consistent with the previous modeling done on the willet from Castro Cove (URS 2002). Thus, the NOAEL applied can be considered to be significantly more conservative than that applied to Alameda.

To estimate the 'average' or 'central tendancy' waterfowl risk, the input parameters entered into the binomial model assumptions were based on the average estimates provided in the Alameda study or the literature cited therein. For the 'reasonable' maximum risk scenario, the appropriate maximum assumption provided in either the Skeet Hill (URS 2002) -or Almeda Point reports were used (URS 2002; Battelle and ENTRIX, Inc. 2002, respectively). These input assumptions are provided in the results Table 1

RESULTS

Risks based on the binomial probability calculations are shown in Table 1. For wading shorebirds (i.e., using the willet as the surrogate for all shorebirds) the probability that an individual bird exceeds the NOAEL based on typical exposure assumptions is **7.9E-06**; that is, less than 1 in 100,000 and more than 1 in 1,000,000 individuals. With reasonable maximum assumptions for all available input paramaters assumed, the probability increases to **1.6E-03**; that is, between 1 and 2 in 1,000 individuals. This increase of risk by roughly 200 times over the average exposure reflects compounded conservatism: the calculation is based on the assumption that the individual shorebird experiences the reasonable maximum for two parameters *simultaneously*.

For waterfowl, the probability that an individual exceeds the NOAEL based on typical exposure is **1.9 E-09**; that is, less than 1 in 100 million and more than 1 in a billion (i.e., essentially zero). With reasonable maximum assumptions for all available input parameters the probability increases to **4.1 E-5**; that is, less than 1 in 10,000 but more than 1 in 100,000 (or, specifically, 1 in 41,000). In other words, it would take roughly 41,000 scaup to visit the Skeet Hill site before a single individual would ingest enough lead to exceed the highly conservative NOAEL of 3 No. 8 shot.

CONCLUSION

Individual wading shorebirds *may* experience risks in excess of 1 in 1,000, but the typical shorebird incurs a risk of less than 1 in 100,000. The roughly 200-fold increase in risk with reasonable maximum assumptions indicates that a substantial amount of uncertainty exists around the upper bound estimate. However, the *average* shorebird risk (a measure much more applicable to non T&E populations with large number of individuals) is not significant.

Based on the input parameters detailed in Table 1, neither individual nor population level risks appear significant for waterfowl that may use the Skeet Hill area of Castro Cove. There appears to be no significant probability of exceeding the most conservative NOAEL for lead pellet consumption in Castro Cove. Additional dietary factors available in estuarine environments that are known to modulate lead and other metal toxicity in estuarine environments would appear to add a further element of certainty in this risk characterization (*see* Koranda et al. 1979; Cohen et al. 2000). That is, the risk may be substantially lower than that estimated from the above analysis because of factors inherent to estuarine diets of diving ducks.

Table 1. Risk calculations for lead pellet consumption by wading shorebirds and waterfowl at Skeet Hill in Castro Cove

		Central Tendency Assumptions		Conservative Assumptions	
Input Variable	**Units**	**Wading Bird[a]**	**Waterfowl[b]**	**Wading Bird**	**Waterfowl**
Shot count	#/ ft^2	688	688	688	688
Shot coverage	fraction	3.03E-02	3.03E-02 [c]	3.03E-02	3.03E-02
Preference	fraction	0.26	0.18 [d]	0.26	0.18
Pellet contact	fraction	0.5	0.5 [e]	1	1
p	fraction	3.94E-03	2.73E-03 [f]	7.88E-03	5.46E-03
Grit probe rate	#/day	1.5	152	3	290
Area Use Factor (AUF)	fraction	1	0.004 [g]	1	0.006
Grit retention period	days	21	11	21	20
N	count	32	7 [h]	63	35
NOAEL (= *r*)	count	3	3	3	3
Risk		**7.9E-06**	**1.9E-09** [i]	**1.6E-03**	**4.1E-05**

Notes:

[a] Assumptions for shorebirds from URS (2002a)

[b] Assumptions for waterfowl from Battelle and ENTRIX (2002)

[c] Coverage based on pellet density and area, by pellet size (#7 1/2, #8, and #9)

[d] Preference for grit size > 2 mm, equivalent to #9 shot or larger

[e] Probability that a pellet, having been contacted, is ingested

[f] P = Shot coverage * Shot preference * Shot contact

[g] Skeet Hill = 10 ac = 0.04 km^2

AUF = Area(Skeet Hill) / Area(home range)

AUF (Scoter) = 10ac / 7km^2 = 0.006

AUF (Scaup) = 10ac / 20km^2 = 0.002

[h] N = Grit probe rate * AUF * Grit retention period

[i] Probability that a bird will equal or exceed the NOAEL for lead pellet consumption

REFERENCES

Battelle and ENTRIX, Inc. 2002. Appendix D.1: Draft Skeet Range Probability Model Parameter Proposal *in* Draft Remedial Investigation Report: Skeet Range.

Cohen, J.B., J.S. Barclay, A.R. Major, and J.P. Fisher. 2000. Greater scaup as bioindicators of metal contamination at national wildlife refuges in the Long Island Sound region. Archives of Environmental Contamination and Toxicology 38:83-92.

Koranda, J., K. Moore, M. Stuart, and C. Conrado. 1979. Dietary effects on lead uptake and trace element distribution in mallard ducks dosed with lead shot. Lawrence Livermore Laboratory Report. 39 pp.

Rattner, B.A., W.J. Fleming, and C.M. Bunck. 1989. Comparative toxicity of lead shot in black ducks (anas rubripes) and mallards (anas platyrhynchos). J. Wildlife Disease, 25:175-183

Sanderson, G. 2002. Effects of diet and soil on the toxicity of lead in mallards. Ecotoxicology 11:11-17.

URS. March 2002. Additional sediment characterization and risk evaluation: Skeet Hill.

APPENDIX A-6: Castro Cove Habitat Equivalency Analysis Summary

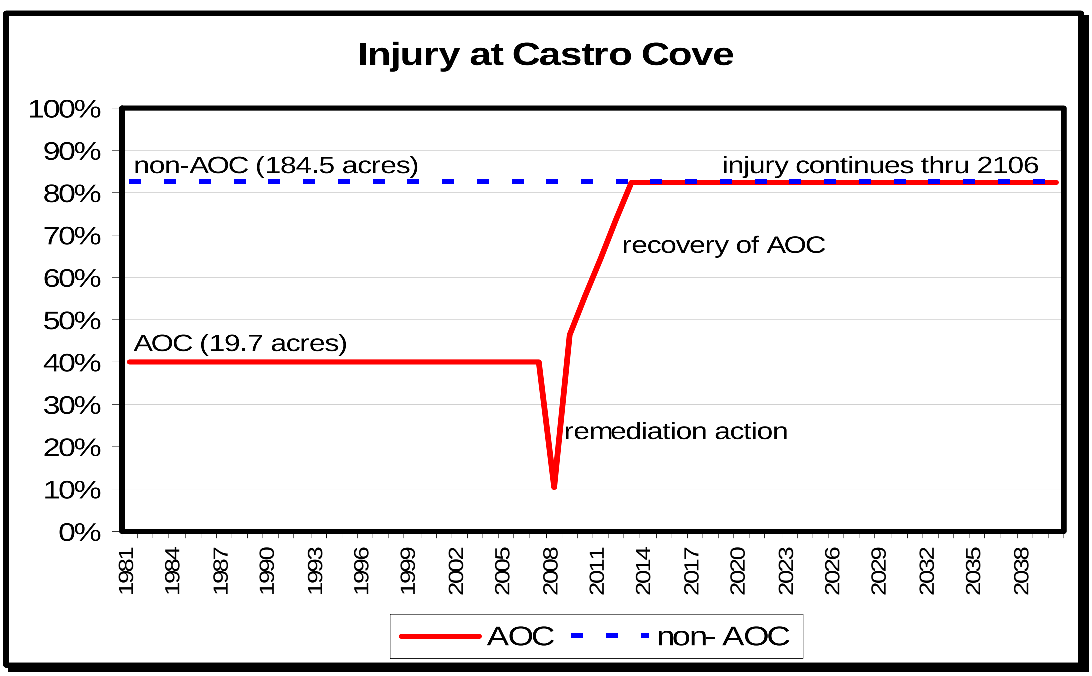
INJURY CALCULATION

For quantification purposes, the impacted area was divided into two areas:

1. AOC (Area of Concern, excavated by remediation actions)
2. Non-AOC (areas outside of the AOC)

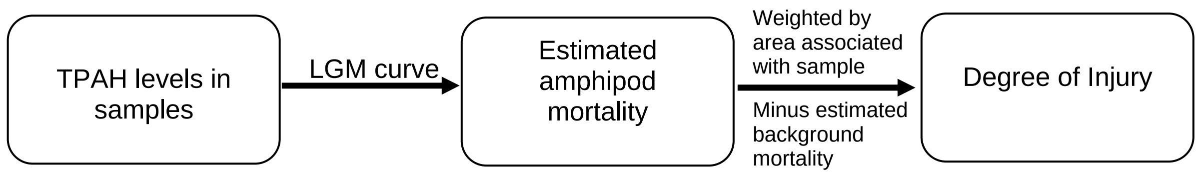
	AOC	Non-AOC
Size of area	19.7 acres	184.5 acres
Injury start date	1981 (per CERCLA law)	1981
Injury end date	2106	2106
Initial degree of injury*	60.0%	17.5%
Injury trajectory	Assumes maximum injury (minus background levels) in 2008, due to excavation associated with remediation. Assumes a rapid recovery to the level of the non-AOC in the following five years. 1981-2007: 60.0% 2008: 89.3% 2009: 53.5% 2010: 44.5% 2011: 35.5% 2012: 26.5% 2013 - 2106: 17.5%	Assumes no change between 1981 and 2106. 1981-2106: 17.5%
Lost discounted acre-years of services	620	2,338
Total lost discounted acre-years	2,958	

* See below for derivation of initial degree of injury.



Initial Degree of Injury

The degree of injury was assumed to be equal to the estimated amphipod mortality within each area, minus the expected baseline mortality expected from background pollution in the bay.



Expected mortality was estimated from TPAH sample results from 54 sites spread across the AOC and non-AOC, according to the following steps:

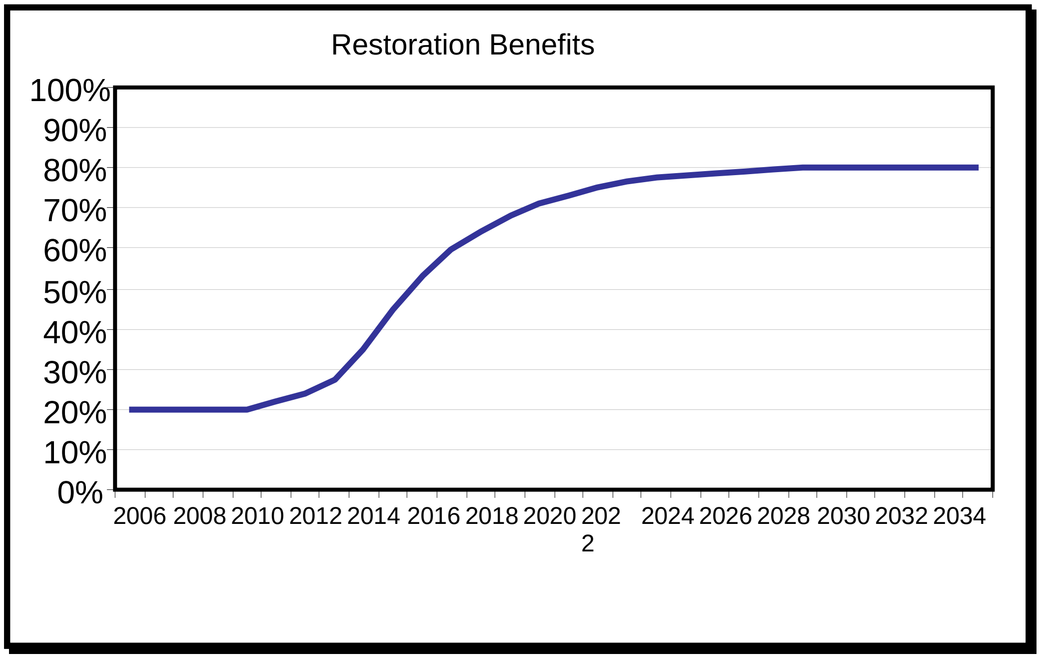
1. TPAH levels from the 0-1 foot depth samples were used. At the 26 sample sites where those were not available, surface samples were used.
2. Amphipod mortality at each sample site was estimated using the Logistic Growth Model described in Appendix I2d (% of Amphipod Mortality = $1/1+B_0e^{B_1 \log[TPAH]}$, where B_0=121,354 and B_1=-3.3478).
3. Each sample site was associated with an area (tessellation polygons). These areas were weighted according to size.
4. Total amphipod mortality, and thus service loss, within the AOC and the non-AOC was based on the weighted average of the estimated amphipod mortality of each area (tessellation polygon) associated with a sample site. This was estimated to be 70.7% in the AOC and 28.2% in the non-AOC.
5. Background mortality, which was derived similarly using data from around the San Rafael Bay, was subtracted from the injury estimate. This was estimated to be 10.7%. Thus, the initial degrees of injury were 60.0% in the AOC and 17.5% in the non-AOC.

CREDIT CALCULATION (projected restoration benefits *per acre*)

Benefits over time from a compensatory restoration project were based upon studies from other restoration projects in saltmarsh habitats. The key assumptions were:

- Time period: project benefits begin in 2011 and continue thru 2106.
- Net gain in resource services: 60% (going from a base of 20% to a maximum of 80%).
- Trajectory: a logistic-type curve which assumes a relatively quick restoration of some services, but approximately 20 years until the maximum level is achieved.

The graph below illustrates the assumed restoration benefits trajectory. Note that benefits are assumed to continue thru 2106.



Here are the actual net benefit values of the restoration trajectory:

Year	Net benefits	Year	Net benefits
2010	0%	2021	53.3%
2011	2.0%	2022	55.1%
2012	4.0%	2023	56.4%
2013	7.5%	2024	57.4%
2014	15.0%	2025	58.2%
2015	24.8%	2026	58.8%
2016	33.1%	2027	59.3%
2017	39.5%	2028	59.7%
2018	44.4%	2029	59.9%
2019	48.2%	2030	60.0%
2020	51.1%	thru 2106	60.0%

A project with this restoration benefits trajectory would need to be 203 acres in size to provide for the 2,958 discounted acre-years of services lost due to the injury.

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Appendix B: Public Comments Received and Trustees' Responses to Comments

Comment Letter #1

Subject: Chevron settlement money being stolen from Richmond
From: Tedrick384BC@aol.com
Date: Sun, 30 Nov 2008 14:29:22 -0500 (EST)
To: castrocove@noaa.gov
CC: tom.butt@intres.com

It makes no sense at all to take money due Richmond from a settlement with Chevron, and use that money elsewhere. Richmond has horrendous environmental problems due to more that a century of environmental destruction caused by Chevron's activities, and Richmond has severe financial problems due to Chevron's abuse of the political and legal system, which has enabled Chevron to avoid paying its fair share of local taxes, while making $billions in profits from Chevron refinery operations in Richmond.

Tom Tedrick
Richmond

Comment Letter #2

Subject: Please reconsider redirecting funds where they truly belong.
From: David K <David@mvbamboo.com>
Date: Sun, 30 Nov 2008 12:56:44 -0800
To: castrocove@noaa.gov

It has come to my attention that your department is taking money received from the Chevron Corporation's settlement with your department for environmental damage done in around Richmond and investing it in Sonoma. While I am a long-term resident and political activist in Marin County, I wish to express my deep disappointment in your decision to apply these funds for remediation in Sonoma County and not where they were not only generated .... where the damage was done and the help is most needed.

While we are but one Bay, and unhappily there never seems to be enough money to do all the work you so ably attempt to do, the folks that live in Richmond need all the help they can get for everyone's well being. Sonoma is a Paradise compared to Richmond's urban atmosphere.

I would hope you will reconsider your perceptively unfair decision, and apply these funds from where they were generated; and will, more importantly, enhance and affect the most number of people.
--
Warmest Regards,

David

General Manager,
Mill Valley Bamboo

101 Roblar Drive

Novato, California 94949

T: 415.883-6888 FAX: 415.925-6088

Cell: 415.250-2200

Comment Letter #3

Subject: Richmoond shoreline funds
From: Owen Martin <owenlmartin@earthlink.net>
Date: Sun, 30 Nov 2008 18:01:31 -0800
To: castrocove@noaa.gov, Tom Butt <tom.butt@intres.com>

Hello,

Funds from any source should be spent on the area they were intended for.
If the projects in Richmond are only in the planning stage then continue with
the planning and save the money for the date the plans are ready to empliment.

If anyone has plans for Sonoma County projects and no funds too bad. Find the
funds for Sonoma County else where. Stop stealing from Peter to pay for Paul.

Whether Federal, State, or County Employees, Richmond has to be funded.
To Clean up Richmond lands and waterways, or to train and educate Richmond
residents to do other wise is to rip off this community.

Thank you for your time,
Owen Martin
owenlmartin@earthlink.net

Comment Letter #4

RECEIVED

DEC 02 2008

SACRAMENTO FISH
& WILDLIFE OFFICE

November 30, 2008

To: Ms. Carolyn Marn
US Fish & Wildlife Service

From: Tony Sustak
Margaret Browne
Richmond, CA

Re: Diversion of abatement funds meant for the City of Richmond to non-Richmond projects. Castro Cove – Tentative Settlement with Chevron/Restoration Planning

Ms. Marn:

We are writing in protest of the planned diversion of Chevron abatement penalties from their proper application in the City of Richmond. Your agency continues to plan, in conjunction with the California Dept. of Fish and Game, to divert monies intended for Richmond to other areas. We feel that this diversion in yet one more example of environmental racism directed at a community that has a very high percentage of minority residents. Further more, this racist rip-off is apparently going forward in spite of the protestations of the City of Richmond, the East Bay Regional Parks Department and other agencies within the Federal Government.

We make no judgment on the value of restoration in the Sonoma project. No doubt, it is worthy and should be done. Claiming that the funds coming from Chevron as punishment for its behavior should be diverted to the Sonoma project "because the Sonoma project is further along" is an after-the-fact rationalization for racist behavior. The monies can be held, earning interest, until they are ready to be fully expended in Richmond. Moreover, as many have already argued, the monies can be expended in stages, on the Richmond marshes, doing the most needed remediation work now.

Again: We feel that the planned diversion of funds intended for Richmond is a slap in the face to the heavily impacted communities of Richmond. The most heavily impacted communities of Richmond are largely people of color. Bruener Marsh abuts a community of color. Diverting monies from the restoration of Bruener Marsh and its related areas, denies those who live alongside the Marsh and those who live in the city as a whole, a cleaner, safer habitat for both humans and wildlife, in an area that desperately needs both.

See attached letter from July 21, '07, courtesy of Richmond Councilman Tom Butt.

Yours Truly
Tony Sustak
Margaret Browne

Tony Sustak
Margaret Browne

CC: Rep. Geo. Miller, State Sen. Loni Hancock, Assembly Person Nancy Skinner, East Bay Regional Parks Director Whitney Dotson

Comment Letter #5

Subject: Resource Restoration in Richmond
From: Michele McGeoy <michelemcgeoy@earthlink.net>
Date: Fri, 05 Dec 2008 23:55:54 -0800
To: castrocove@noaa.gov

I am very concerned to find that funds from a Chevron settlement will be funneled into Sonoma County. The residents of Richmond
are strongly impacted by pollution with one of the highest asthma rates in the state. Please consider using all of these funds to enhance Richmond!!!

Michele McGeoy

From: Butt, Tom [mailto:tom.butt@intres.com]
Sent: Sunday, November 30, 2008 10:18 AM
Subject: TOM BUTT E-FORUM: Government Agencies Conspire to Steal Pollution Compensation from Richmond

Despite repeated objections from the City of Richmond, Congressman George Miller and state legislators representing Richmond, the U.S. Fish & Wildlife Service, the California Department of Fish and Game and the National Oceanic and Atmospheric Administration is barreling ahead with plans to use most of the money from a settlement with Chevron over Richmond pollution to restore wetlands in Sonoma County.

For history, see:

- Triad of Agencies Conspire to Deprive Richmond of Funds for Resource Restoration, July 21, 2007
- Agencies Mine Richmond for Environmental Damage Money to Spend Elsewhere, October 26, 2007

Although it appears to be only part of a cover-up for stealing funding for Richmond's own shoreline needs, the U.S. Fish & Wildlife Service, the California Department of Fish and Game and the National Oceanic and Atmospheric Administration will hold an "open house" to provide information and seek comments about the plan on
Wednesday, December 17, 2008, from 4:00 PM to 7:00 PM at the Point Richmond Community Center, 139 Washington Avenue, Richmond, CA.

The total amount of funding, which has not been disclosed, is proposed to be used to restore 1,500 acres of marsh at Cullinan Ranch in Sonoma County and only a token "up to 30 acres" in Richmond's Breuner Marsh. The three agencies responsible for the project claim that the Cullinan Ranch project is "nearly ready for implementation" while the Breuner Marsh project is "still in the conceptual stage."

In fact, the Castro Cove settlement was sought by the three agencies as a funding source for their own Cullinan Ranch project, and they have been loath to consider other projects in Richmond, although at least a half-dozen appropriate and deserving Richmond projects have been suggested.
We also believe that the Trustee agencies have an apparent conflict of interest in diverting the Castro Cove settlement funds from restoration of Richmond's shoreline to lands the USFWS owns and jointly administers with DFG as part of the San Pablo Bay National Wildlife Refuge. Cullinan Ranch was purchased by the USFWS in 1992. See http://www.fws.gov/sfbayrefuges/San%20Pablo/San%20Pablo%20Gen.pdf for a map and info about the Refuge.
The learn more about the project, visit http://www.dfg.ca.gov/ospr/spill/nrda/nrda_castro.html.

Written comments and requests for copies may be sent to: Carolyn Marn, U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento, CA 95825, or by fax: 916/414-6713, or via email to castrocove@noaa.gov.

East Bay Regional Park District
2950 PERALTA OAKS COURT P.O. BOX 5381 OAKLAND CALIFORNIA 94605-0381 T. 510 635 0135 F. 510 569 4319 TDD. 510 633 0460 WWW.EBPARKS.ORG

Comment Letter #6

December 11, 2008

Carolyn Marn
US Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

Subject: Comments on Castro Cove Draft DARP

Dear Ms. Marn,

The following are the East Bay Regional Park District's (District) comments on the Damage Assessment and Restoration Plan (DARP) for the Natural Resource Damage Assessment (NRDA) for Castro Cove in Richmond, California.

We believe that the DARP provides inadequate funding for restoration of ecological habitats within close proximity of Castro Cove. The DARP provides $2,650,000 for restoration projects. The majority of these funds, $1,900,000, are proposed for funding tidal marsh restoration at Cullinan Ranch in Solano County and just $750,000 is provided for the Breuner Property in Richmond. We believe that a significantly larger portion of the funds should be provided for the Breuner Property restoration.

Restoration of the 218-acre Breuner Property will include a variety of ecological habitats for the benefit of plants and animals, including several special-status species. These habitats include coastal prairie, seasonal wetlands, riparian scrub, tidal salt marsh and mudflat. It could also include subtidal habitat for eel grass, oysters and salmonids.

The restoration opportunity identified in the DARP process for the Breuner Property appears to solely focus on the creation of tidal salt marsh. The DARP proposal is for 30-acres; however the area could support more acreage of salt marsh than is proposed. An earlier mitigation bank proposed to create up to 70-acres of wetland. This would greatly increase the potential wetland creation opportunities on the Breuner Property.

Many of the species that use salt marsh also use adjacent upland and/or aquatic habitats at some point in their life cycle, including coastal prairie, seasonal wetlands, riparian scrub, tidal channels and mudflat. For example, the endangered California clapper rail uses these habitats during their life cycle for foraging, nesting, cover and high tide refuge.

We believe close proximity of the restoration site to the impact site is key to the success of the DARP in realizing benefits for the habitats impacted at Castro Cove. The Breuner Property is within two miles of Castro Cove, whereas Cullinan Ranch is about thirteen miles distant. Most of the resident wildlife species and plants impacted in Castro Cove would not benefit from a restoration project at Cullinan Ranch. For example, clapper rail and the endangered salt marsh harvest mouse generally do not migrate over significant distances. Clapper rails may move up and down the shoreline in areas where there is sufficient habitat and cover. They are reluctant and poor flyers, preferring to walk. Harvest mice have an even smaller range and their habitat is tied to contiguous cover from predators. It is very unlikely that individual rails and mice would find their way across San Pablo Bay from Cullinan Ranch to Castro Cove.

As stated before, we believe that DARP funds should be devoted to restoring a broad range of ecological habitats on the Breuner Property and not just salt marsh. It must account for the full range of habitats that were impacted at Castro Cove, the close proximity and connectivity of Castro Cove to the Breuner Property and the significant opportunities for creation of these habitats on the 218-acre Breuner Property.

The District has invested more than $7,200,000 in public funds to acquire the Breuner Property. Up to an additional $7,000,000 will be required to plan and construct all of the proposed habitat and public access improvements. The DARP proposes $750,000 in funding for the construction of 30-acres of salt marsh on the Breuner Property. We could not construct just the 30-acres of salt marsh without also making other improvements, such as tidal channels, tide gates, culverts, bridges, buffers, relocating utilities and site remediation that are necessary to support a 30-acre marsh.

It is unlikely that other significant State or Federal funding sources will be available in the short-term due to the current fiscal crises in Sacramento and Washington. Therefore the Castro Cove funds have become critical for the Breuner Property restoration. The District respectfully requests that at least $2,000,000 in Castro Cove DARP funds be provided to plan and construct a first-phase of restoration on the Breuner Property.

Please call me at (510) 544-2622 should you have any questions regarding our letter.

Sincerely yours,

Brad Olson
Environmental Programs Manager

cc. EBRPD Board of Directors
Pat O'Brien, General Manager
~~Robert E. Doyle, Asst. General Manager~~
Mike Anderson, Asst. General Manager

Richmond City Council
Bill Lindsay, City Manager
~~Natalie Cosentino-Manning, NOAA~~
Charles McKinley, USDOI
Bruce Joab, DFG OSPR

Comment Letter #7

Restoration
Design
Group, LLC

2612b Eighth Street
Berkeley, CA 94710

T 510.644.2798
F 510.644.2799

7 January 2009

US Fish and Wildlife Service
Attn: Carolyn Marn
2800 Cottage Way, Rm W-2605
Sacramento, CA 95825

Dear Trustees:

This letter serves as my public comment on *Castro Cove/Chevron Richmond Refinery Draft Damage Assessment and Restoration Plan/Environmental Assessment*. Restoration Design Group is listed in the document as one of the organizations contacted. In addition, I am also listed as a contact at the Natural Heritage Institute, my previous employer. I have assisted in the identification of restoration alternatives.

With over 30 miles of shoreline, Richmond has an abundance of tidal and subtidal resources and thus many restoration opportunities. If I had my preference, all of the money available for restoration would be spent within the City of Richmond. Regrettably, outside of what the report has already identified, much of the work necessary to plan, design, and implement tidal marsh restoration projects in Richmond has not yet been completed. If other public comments identify additional projects in Richmond that meet the criteria, I urge the Trustees to consider them. This may include additional restoration at Breuner Marsh or Stege Marsh. Absent additional information from potential project proponents, I believe the Trustees have correctly identified those tidal marsh restoration alternatives that best meet the established criteria.

The State Coastal Conservancy is currently designing a conservation action planning process for the North Richmond Shoreline. When complete, this effort will advance restoration planning for current and former baylands and subtidal areas between Point San Pablo and Point Pinole, including Castro Cove. Conservation planning on the North Richmond Shoreline has suffered in large part due to the legacy of industrial pollution on the shoreline, such as wastewater discharges into Castro Cove. This creates the perception that few restoration opportunities exist and subtly discourages restoration planning in the area. Given the nexus between the injury and the lack of conservation planning on the North Richmond Shoreline to date, **I request that the Trustees consider funding all or part of the Coastal Conservancy's conservation action plan.** This will identify necessary actions toward restoration of 900 acres of mudflat, 550 acres of tidal marsh, and the extensive subtidal zone between Pt. San Pablo and Pt. Pinole. Please see the forthcoming comment letter from the Coastal Conservancy for additional detail.

I have reviewed the draft DARP/EA. My review included all sections except Section 3.0 Castro Cove Injury Quantification. The material in Section 3.0 section is beyond my capacity to review. Allow me to highlight a few very minor points that will enhance the Draft DARP/EA:

- Page 4 – The vicinity map has been compressed horizontally and has not maintained the correct aspect ratio. As a result, the scale bar in the lower right hand corner of the figure is only valid when measuring horizontal distances.

- Page 31 – Hoffman Marsh, which is 5.5 miles away from Castro Cove, is given a Low score for proximity. Cullinan Ranch, which is 10 miles away, is given a Medium score for proximity. For consistency, Hoffman Marsh should receive a Medium score. I don't believe that will impact the overall ranking.

- Page 37 – The map of Breuner property shows the full extent of lands formerly owned by Don Carr. The EBRPD acquired all but 20 acres in the southeast corner. Please check with the District for a more current map. Additionally, the shown map has been compressed vertically and, as a result, its aspect ratio is off.

Thank you for your diligence in identifying the injury and compensatory restoration actions. It is my hope that in a few years, if there are other NRDAs completed in the North Bay, we will have identified and advanced planning for restoration actions in Richmond far enough to receive additional settlement funds.

Sincerely,

Rich Walkling
Restoration Planner

Cc: Tom Butt, City of Richmond
Natalie Cosentino-Manning, NOAA
Whitney Dotson, EBRPD
Michelle Jesperson, State Coastal Conservancy
Brad Olsen, EBRPD

Comment Letter #8

Dedicated to promoting the conservation of the natural resources and fostering public understanding and appreciation of the San Pablo Bay National Wildlife Refuge complex

FRIENDS
OF THE SAN PABLO BAY
NATIONAL WILDLIFE REFUGE

January 8, 2009

U.S. Fish and Wildlife Service
Attn: Carolyn Marn
2800 Cottage Way, Rm. W-2605
Sacramento, CA, 95825

Dear Ms. Marn:

The Friends of the San Pablo Bay National Wildlife Refuge is an independent, non-profit, organization dedicated to promoting the conservation of the natural resources of the refuge and engaging in activities that will assist the U.S. Fish and Wildlife Service to meet its mandates. Our members are actively involved in the restoration of and environmental education about tidal marshes in San Pablo Bay including cultivating and planting native species, leading walks and tours to Cullinan Ranch and surrounding wetlands, and fostering public understanding of refuge management.

The Friends of San Pablo Bay National Wildlife Refuge are writing in strong support to apply Castro Cove settlement funds to the restoration of Cullinan Ranch. Nestled in the northern reaches of San Pablo Bay, Cullinan Ranch is surrounded by a mosaic of public wildlife areas, open space, conservation easements, and other lands in the process of being preserved and restored. The lack of development enables larger scale issues to be addressed in ways many urbanized areas cannot, providing a unique opportunity for landscape level wildlife and community benefits. Cullinan Ranch is the cornerstone piece for tidal marsh restoration along Highway 37 (also known as the Flyway Highway) from the Napa River to Sonoma Creek. With the multi-agency restoration efforts in the Napa-Sonoma Marshes and the adjacent Guadalcanal restoration, the Cullinan Ranch Restoration Project represents a landscape-level opportunity to link tidal marshes in a continuous corridor increasing the ecosystem function and resource value for wildlife in the North Bay.

Sincerely yours,

Francesca C. Demgen

Francesca Demgen
President of Friends of SPBNWR

7715 Lakeville Highway Petaluma, CA 94954 www.pickleweed.org

Comment Letter #9

Subject: comments
From: Edgar Polaño <sminches@gmail.com>
Date: Fri, 09 Jan 2009 02:58:35 -0500
To: castrocove@noaa.gov

Trustee Council,

I have a few comments on your draft plan.

You must be kidding to pick Cullinan Ranch, which is pretty far from Richmond after the City has suggested good projects much closer to the Chevron facility and the affected public! "The Trustees preferentially seek in-kind restoration (e.g., the creation of a new marsh or enhancement of an existing marsh to compensate for lost marsh services) in geographical proximity to the area affected." That statement is crap if you go north across San Pablo Bay. To pick Cullinan over the projects proposed by the City of Richmond seems contrived. It looks like two public agencies, San Pablo Bay National Wildlife Refuge and CDFG, get to advance their own interests instead of Richmond residents. How can the Trustee Council say it has complied with Executive Order 12898 on Environmental Justice by saying they preferentially seek restoration in geographic proximity to the area affected and then identify projects to compensate the public on the north side of San Pablo Bay! I recommend that you eliminate the north side of San Pablo Bay from restoration project consideration and keep the restoration projects as close to Richmond as possible like the Breuner Marsh project.

The Trustee Council's evaluation of projects using the likelihood of success criterion is capricious. I can't tell how the Trustee Council can determine if a project will be rated likely to succeed (or not) simply by having a proponent. I like two or the non-preferred projects, the Historical Castro Cove Wetlands and Wildcat Marsh, and so does the City of Richmond. Now you have two proponents so you can now rate likelihood of success as high. Better yet, I propose that the Trustee Council do the work itself on these two projects. Now you have a technically competent third proponent to undertake the project and you can bill Chevron for the cost. Along these same lines, why does Chevron need to provide assurance that the Wildcat Marsh project would remain protected in the long run in order for it to be successful? If the Trustee Council chooses a project it can require a conservation easement that can be enforced or it can make Chevron buy a huge performance bond. Having a proponent (or not) is a stupid reason to evaluate a restoration project's likelihood of success.

The cost effectiveness analysis the trustees give for most of the non-preferred projects is arbitrary. Two projects were dropped because they had funding (Invasive Spartina Project and McNabney Marsh) and others are given low ratings for the cost effectiveness criterion yet estimates of how much they will cost aren't even made e.g. Pacheo Marsh. Cullinan Ranch will cost 10,000 – 12,000 per acre including all phases but you also say a lot of the work has already been done. Sounds like Chevron is getting a sweetheart deal and worse, a subsidized project. The San Francisco Baylands Ecosystem Goals Project says that some wetland projects may cost up to $50,000 per acre. Hoffman Marsh should be critically evaluated and if costs are considered, they should include the price to acquire the land. The point is you don't provide equal objective information on all these non-preferred projects. I like the Historical Castro Cove Wetlands project but all the information I have about cost is it is expected to be prohibitively expensive. Do not go north, across the Bay, to give Chevron the best deal which will leave the public holding the bag to restore the non-preferred projects requiring contamination clean up.

Let's get one thing straight about costs, Chevron isn't going to go bankrupt by doing more than one restoration project in the proximity of Richmond! Just look at these two news articles:

"Soaring oil prices lifted Chevron Corp.'s annual profit to $18.7 billion in 2007, the fourth consecutive year that the San Ramon company made record amounts of money.

Chevron, America's second-largest oil company, reported Friday that its annual profit jumped 9 percent from 2006, as crude oil prices reached their highest levels in 26 years. Sales topped $220.9 billion, up 5 percent from the year before."

http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/02/02/BU6AUQMT9.DTL

"HOUSTON — The Chevron Corporation, the oil company, said Friday that its third-quarter profit more than doubled on the back of record crude prices this summer.

Chevron, based in San Ramon, Calif., said it earned $7.89 billion, or $3.85 a share, in the three months ended Sept. 30, compared with $3.72 billion, or $1.75 a share, at the period a year ago." http://www.nytimes.com/2008/11/01/business/01chevron.html?partner=rssnyt

I recommend the Trustee Council use its discretion and eliminate the Cost Effectiveness and Compliance with Applicable Federal, State, and Local Laws and Policies tier two evaluation criteria (seriously, you have to do this anyway) and replace these criteria with an Environmental Justice criterion weighted more heavily than all other Tier Two criteria.

Finally, I support the two non-preferred restoration projects that would require clean-up of contamination, i.e., Creosote Pier and Piling Removal, Hoffman Marsh, Historical Castro Cove Wetlands. It just seems to me that this is the kind of restoration Chevron ought to be doing in the first place. I also support the Breuner Marsh project. Chevron had to clean up its own mess, but it could do good by the City of Richmond by cleaning up and restoring some of the other habitats nearby.

-Edgar Polaña

Comment Letter #10

Isa Woo
351 Los Cerritos Drive
Vallejo, CA 94589

U. S. Fish and Wildlife Service
2800 Cottage Way Room W-2605
Sacramento, CA 95825

January 8, 2009

Dear Carolyn Marn,

As a citizen of Vallejo, I am writing in strong support for the preferred alternative to use settlement funds towards the Cullinan Ranch Restoration project in the Castro Cove/Chevron Richmond Refinery Draft Damage Assessment and Restoration Plan/Environmental Assessment.

Owned by the San Pablo Bay National Wildlife Refuge, Cullinan Ranch is surrounded by a mosaic of public wildlife areas, open space, conservation easements, and other lands in the process of being preserved and restored. The lack of development in San Pablo Bay provides a unique opportunity for landscape level restoration to benefit wildlife and the community. This area is well known for its amazing birding opportunities for the public, especially during the annual Flyway Festival held on Mare Island. Thousands of visitors around the greater San Francisco Bay area participate in the festival and the birding, wetlands, and wildlife tours offered to children, adults, and families. Because of its location along Hwy 37, Cullinan Ranch is ideally situated to provide an area where thousands of people can enjoy the vast scenic beauty in this urbanized estuary.

With the restoration efforts in the Napa Sonoma Marshes and the adjacent Guadalcanal restoration, the Cullinan Ranch Restoration Project represents a landscape-level opportunity to increase tidal marsh linkages from the Napa River to Sonoma Creek. The funding support for the Cullinan Ranch Restoration would greatly improve the ecosystem function and resource value for tidal marsh inhabitants (such as the endangered salt marsh harvest mouse) as well as the community in the San Francisco Bay. These biological and social benefits can easily be quantified by the numeration of species and visitation rates; however, there are also intangible benefits to the Cullinan Ranch Restoration project that include enjoying a multitude of wildlife in an expanse of contiguous tidal marsh wetlands and instilling a sense of place and wonder.

Sincerely yours,

Isa Woo

Comment Letter #11

Subject: Request-Extension for Comments on Castro Cove Draft EA
From: Michelle Levenson <michellel@bcdc.ca.gov>
Date: Fri, 09 Jan 2009 14:30:07 -0800
To: castrocove@noaa.gov

Dear Ms. Marn-
BCDC staff requests an extension of the comment deadline, to January 16, 2009, to review and comment on the draft EA for the Castro Cove Restoration Project. The notice of the document was received early this month and due to holiday schedules staff has not had an opportunity to review and comment on the document at this time. Please let me know if our request has been granted. Thank you in advance for your consideration.

Michelle Levenson
Permit Analyst
BCDC

Comment Letter #12

Napa Solano Audubon Society
Post Office Box 10006
Napa, California 94581-2006

Our goal is to be the best birding and conservation organization that focuses on Napa and Solano Counties.

January 9, 2009

U.S. Fish and Wildlife Service
ATTN: Carolyn Marn
2800 Cottage Way, RM W-2605
Sacramento, CA. 95825

Re: Support to apply Castro Cove settlement funds to the restoration of Cullinan Ranch.

Dear Ms. Marn:

The Napa Solano Audubon Society is an independent, not for profit, organization dedicated to public education and wildlife and habitat conservation. Many of our 844 members have long-time involvement with the San Pablo Bay National Wildlife Refuge and particularly Cullinan Ranch. Our organization was instrumental in the battle to stop the commercial, residential development of this property and led the campaign to obtain Cullinan ranch for the USFWS.

The membership of the Napa Solano Audubon Society is writing in strong support to apply Castro Cove settlement funds to the restoration of Cullinan Ranch. This component of the San Pablo Bay National Wildlife Refuge is the premier property for tidal marsh restoration along Highway 37, “The Flyway Highway”, from the Napa River to Sonoma Creek.

Along with the multi-agency restoration efforts currently underway in the Napa-Sonoma Marshes and the adjacent Guadalcanal restoration, the Cullinan Ranch Restoration Project offers a terrific opportunity to link tidal marshes in a continuous corridor that will increase the ecosystem function and resource value for wildlife in the North Bay. The proximity of this project to the City of Vallejo will greatly enhance the educational and wildlife viewing opportunities for the local communities.

Sincerely yours,

Gerald D. Karr

Gerald D. Karr
Conservation Chair

Comment Letter #13

Coastal Conservancy

January 9, 2009

Carolyn Marn
US Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

RE: Comments on the Draft Restoration Plan/Environmental Assessment, Restoration of San Pablo Bay Tidal Wetlands

Dear Ms. Marn,

Thank you for the opportunity to provide comments on the proposed Draft Restoration Plan and Environmental Assessment (EA) prepared in response to the natural resource damages that have occurred at Castro Cove. The State Coastal Conservancy ("Conservancy") has a strong interest in and plays a key role in wetland restoration projects through the San Francisco Bay and along the coast of California. We appreciate your work to evaluate and compensate for the detrimental impacts to these valuable natural resources.

The Conservancy is currently designing a conservation action planning process for the North Richmond Shoreline. When complete, this effort will advance restoration planning for current and former wetlands, baylands and subtidal areas between Point San Pablo and Point Pinole, including Castro Cove. There has been a lack of conservation planning on the North Richmond Shoreline to date, in part because of the legacy of industrial pollution on the shoreline, such as wastewater discharges into Castro Cove. This creates the perception that few restoration opportunities exist and subtly discourages restoration planning in the area. Despite this, the Conservancy believes that there is a need and the potential for land conservation, natural resource protection and enhancement in this area, and this is why we are working to develop a North Richmond Shoreline Conservation Plan.

We are now under contract with the consulting firms of Restoration Design Group and URS Corporation to develop a scope of work for the conservation planning process. Restoration Design Group is in the process of completing the scope for the overall plan development and URS Corporation is providing technical expertise on existing natural resources, land use and zoning, and infrastructure constraints

1330 Broadway, 13th Floor
Oakland, California 94612-2512
510•286•1015 *Fax*: 510•286•0470

through research, data collection, and GIS mapping. Once this work is complete we will have a scope of work, schedule, and budget for development of a North Richmond Conservation Plan.

While we are still working out the details of plan development, we anticipate that the planning process will likely involve a series of meetings aimed at soliciting input from community members (public meetings), a series of meetings aimed at coordinating actions between resource agencies, scientists, and land owners (conservation action planning meetings – also open to the public), and research, data compilation, and document preparation. The project will likely take at least one year from start to finish. We estimate that full development of the plan will cost approximately $100,000.

We are very supportive of the Draft Restoration Plan/EA allocation of funding in support of restoration efforts at Cullinan Ranch and Breuner Marsh. We respectfully submit to the Trustees that some funds from the contamination of Castro Cove funds now or in the future for other natural resource damage assessments could be allocated to the North Richmond Shoreline Conservation Plan effort. Given the nexus between the injury and the lack of conservation planning on the North Richmond Shoreline to date, we hope that the Trustees will consider this request.

Please feel free to contact me with questions or additional information.

Sincerely,

Michelle J

Michelle Jesperson
Project Manager, State Coastal Conservancy

Comment Letter #14

CNPS California Native Plant Society

January 9, 2009

Carolyn Marn
USFWS
2800 Cottage Way, Rm W-2065
Sacramento, CA 95825

castrocove@noaa.gov
al_donner@fws.gov

SUBJECT: Castro Cove, Richmond, CA

Dear Trustees:

The Willis Jepson Chapter of the California Native Plant Society representing Solano County agrees with the Trustee's recommendation for the preferred restoration alternatives for the Castro Cove discharge compensation.

The tidal areas of San Francisco Bay function as the nursery for the entire bay. As the source of much of the lower food web and detritus that fuels the aquatic animals that inhabit the entire bay, restoration of these areas is a high priority. Restoration in tidal salt marsh and mud flat benefits extend to the larger bay as well.

The sediment spill by Chevron in Castro Cove is of particular concern, for while the sediment has now been cleaned up in the cove, much of the chemicals in the sediment may have been released into the bay ecosystem already and are beyond cleanup. The substantial tidal restoration proposal for Cullinan Ranch appears to be a great restoration project to compensate for some of these damages. While we understand the need for projects as close to the original spill site as possible, we believe that the Cullinan Ranch tidal area is adequately connected to the San Pablo Bay ecosystem to have a positive effect for that entire area, including Richmond. The Cullinan Ranch project has many benefits including the fact that the project is ready to go and interconnected with present and future tidal wetlands.

We also support funding a part of the Bruener Marsh project. While smaller and not in a ready stage for on the ground work, funding will assist with restoration in an important area of San Pablo Bay.

Sincerely,

Gene Doherty

Gene Doherty
President, Willis Linn Jepson Chapter
California Native Plant Society

Comment Letter #15

DUCKS UNLIMITED

WESTERN REGIONAL OFFICE
3074 Gold Canal Drive
Rancho Cordova, CA 95670-6166
916-852-2000 916-852-2200 (fax)
www.Ducks.org

January 15, 2009

Carolyn Marn
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

Dear Ms. Marn:

I am writing to urge you to allocate a portion of the Castro Cove Natural Resource Damage Assessment (NRDA) funding to the Cullinan Ranch restoration project. Cullinan Ranch is one of the largest tidal wetland restoration projects in the San Francisco Bay region, and meets essential criteria for NRDA.

Restoration of the San Pablo Bay (SPB) watershed, and of the Cullinan Ranch project site in particular, is the subject of several planning documents and will help achieve significant improvements in water quality as well as species protection goals. San Pablo Bay is designated as impaired under Section 303(d) of the Clean Water Act and is ranked as a top priority for federal restoration funding under the Federal Clean Water Action Plan. This project will implement restoration priorities set in the landmark Baylands Ecosystem Habitat Goals Report.

The Cullinan Ranch project will restore a continuous band of emergent tidal marsh between Sonoma Creek and the Napa River. This is expected to improve water circulation, re-establish hydrological gradients between Sonoma Creek and the Napa River, provide tidal flats for shorebirds foraging, and re-establish connectivity to adjacent restored tidal marsh habitat for endangered species. This will benefit numerous waterfowl, shorebird, and waterbird species during breeding, migrating, and wintering periods. The restored habitat is also expected to benefit state and federal special status species, including California clapper rail, California black rail, salt marsh harvest mouse, California brown pelican, and western snowy plover. This project will improve smolting habitat for federally endangered Chinook salmon, as well as federally threatened steelhead, green sturgeon, white sturgeon, and Sacramento splittail. Other fisheries benefited will be Pacific herring and Dungeness crab.

In addition to benefits to fish and wildlife, people will also benefit from upgraded access to the area. Improvements include a parking lot, visitors kiosk, fishing pier, kayak launch point, and levee top trail that will facilitate fishing, hiking, kayaking, and bird watching.

The Cullinan Ranch restoration project is poised for implementation when funding becomes available. The Final Environmental Impact Statement is nearly complete and the permitting process is underway. The NRDA funding would support restoration of 173 acres of tidal marsh habitat and provide leverage for additional funding to complete the total 1500-acre project.

Please allocate a portion of the Castro Cove NRDA funding to Cullinan Ranch restoration. I appreciate your attention in this matter. Please contact me with any questions.

Sincerely,

Rudolph Rosen, Ph.D.
Director

Comment Letter #16

The Bay Institute

Over a Quarter Century of Protecting and Restoring San Francisco Bay from the Sierra to the Sea.

January 15, 2009

Carolyn Marn
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

Dear Ms. Marn:

I am writing to recommend that you allocate a portion of the Castro Cove Natural Resource Damage Assessment (NRDA) funding to the Cullinan Ranch restoration project. Cullinan Ranch is one of the largest tidal wetland restoration projects in the San Francisco Bay region, and meets essential criteria for NRDA.

Restoration of Cullinan Ranch will advance the goals of multiple estuary planning documents, including the Baylands Habitat Goals Report and the San Pablo Bay Framework Plan prepared by the USACE, among others. San Pablo Bay is designated as impaired under Section 303(d) of the Clean Water Act and is ranked as a top priority for federal restoration funding under the Federal Clean Water Action Plan.

The Cullinan Ranch restoration project is poised for implementation. Restoration activities outside of the jurisdiction of permitting agencies can begin immediately. The Final Environmental Impact Statement is nearly complete and the permitting process is underway. The NRDA funding would support restoration of 173 acres of tidal marsh habitat and provide leverage for additional funding to complete the total 1500-acre project.

I personally worked on the acquisition of Cullinan Ranch in 1989. It was expected that full restoration of the site would be achieved by 1995. For almost fifteen years this valuable restoration opportunity has been delayed due to lack of funding. Please allocate a portion of the Castro Cove NRDA funding to restoring Cullinan Ranch.

Thank you.

Very truly yours,

Marc Holmes

Marc Holmes, Director
Bay Restoration Program

695 De Long Avenue, Suite 100 • Novato, CA 94945
(415) 878-2929 • bayinfo@bay.org • www.bay.org • (415) 878-2930 fax

Comment Letter #17

CITIZENS COMMITTEE TO COMPLETE THE REFUGE

453 Tennessee Lane, Palo Alto CA 94306 Tel 650 493-5540 Fax 650 494-7640 email: florence@refuge.org

January 16, 2009

Ms. Carolyn Marn
U.S. Fish & Wildlife Service
2800 Cottage Way, Rm. W 2605
Sacramento, CA 95825
Fax: (916) 414-6713

Re: Draft Damage Assessment and Restoration Plan – Castro Cove

Dear Ms. Marn:

Thank you for allowing us to comment on the Natural Resource Damage Assessment and mitigation for the Castro Cove damage.

The draft document seems to indicate that the responsible agencies have studied the contamination present as a result of Chevron's activities.

Our group was one of those that campaigned years ago for the acquisition of the Cullinan Ranch, and we have been gratified by the recent efforts to restore it to productive tidal marsh. Therefore, we wish to express our strong support for the current plans by the agencies to use some of the funds available for further restoration at Cullinan.

The entire north bay region will profit from restoration along this part of San Pablo Bay.

Thank you for considering our comments.

Florence LaRiviere

Florence M. LaRiviere
Chair

Comment Letter #18

RECEIVED

FEB 02 2009

SACRAMENTO FISH & WILDLIFE OFFICE

bcdc

Making San Francisco Bay Better

January 27, 2009

Ms. Carolyn Marn
United States Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, California 95825

SUBJECT: Castro Cove Draft Restoration Plan/Environmental Assessment

Dear Ms. Marn:

On December 1, 2008, San Francisco Bay Conservation and Development Commission staff received notification that the Draft Restoration Plan/Environmental Assessment for the Castro Cove Remediation Project, located at Castro Cove, near the City of Richmond, Contra Costa County, was available for public review. The Draft Restoration Plan/Environmental Assessment evaluates and quantifies the natural resource damages associated with historical contamination of Castro Cove and proposes compensation (i.e., restoration) for these damages. The analysis presented in the document proposes that 200 acres of tidal wetland habitat restoration would be needed to offset the historical ecological losses at Castro Cove. In addition, the preferred restoration alternative presented in the document proposes that settlement funds be provided that would contribute to the restoration of 173 acres of tidal marsh at Cullinan Ranch, a proposed restoration project in Sonoma County, and 30 acres of tidal marsh at Breuner Marsh, a recently acquired East Bay Regional Park District property in the City of Richmond, Contra Costa County.

Although the Commission itself has not reviewed the environmental document, the staff comments are based on the McAteer-Petris Act and the San Francisco Bay Plan.

Jurisdiction

The Commission's area of jurisdiction includes all tidal areas of the Bay up to the line of mean high tide, all areas formerly subject to tidal action that have been filled since September 17, 1965, marshlands lying between mean high tide and five feet above mean sea level, and the "shoreline band," which extends 100 feet inland from and parallel to the Bay jurisdiction. The Commission also has jurisdiction over the Suisun Marsh and other managed wetlands adjacent to the Bay, salt ponds, and certain waterways.

State of California • **SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION** • *Gray Davis, Governor*
50 California Street, Suite 2600 • San Francisco, California 94111 • (415) 352-3600 • Fax: (415) 352-3606 • info@bcdc.ca.gov • www.bcdc.ca.gov

Commission permits are required for certain activities, including construction, changes of use, dredging, and dredged material disposal, within its area of jurisdiction. P ermits are issued if the Commission finds the activities to be consistent with the McAteer-Petris Act and the policies and findings of the Bay Plan.

On March 22, 2007, the Commission issued BCDC Permit No. M06-33 to Chevron Products Company to remediate the contamination in Castro Cove. While the permit did require restoration and post-construction monitoring of salt marsh vegetation in the area that was remediated, no other mitigation was required in the permit. The selection of a preferred restoration alternative to compensate for historical damages is subject to the Commission's consistency review and authorization, authority which we have decided to waive in this instance. However, the construction of the restoration projects proposed at Cullinan Ranch and the Breuner site will be subject to either the Commission's permitting process or federal consistency review, depending on the entity that undertakes the project(s).

Tidal Habitat Restoration

The Bay Plan policies on Tidal Marshes and Tidal Flats state that "where and whenever possible, former tidal marshes and tidal flats...should be restored...." The proposed restoration projects at Cullinan Ranch and the Breuner site would, therefore, be consistent with this overreaching policy.

Mitigation

The Bay Plan policies on Mitigation state that, "The amount and type of compensatory mitigation should be determined for each mitigation project based on a clearly identified rationale that includes an analysis of: the probability of success of the mitigation project; the expected time delay between the impact and the functioning of the mitigation site; and the type and quality of the ecological functions of the proposed mitigation site as compared to the impacted site...."

The Commission's staff is concerns that restoration of the Breuner site to adequately and expeditiously mitigate the impacts of Castro Cove may be several tears away. As indicated in the document, the Breuner site was recently purchased and the restoration project is still in the conceptual stages. It is uncertain how long it will take to obtain approval, additional funding, and to begin construction of the restoration project at this site, and thus provide functioning habitat similar to that which was lost at Castro Cove. The staff urges the trustee agencies to consider increasing the amount of mitigation proposed for the Breuner site in light of the lengthy time frame anticipated for its construction and resultant habitat benefits, either by restoring or enhancing more acres and/or by allocating additional funds to be used for construction of the restoration project..

Thank you for providing staff with the opportunity to review and comment on the Draft Restoration Plan/Environmental Assessment. If you have any questions regarding this letter or the Commission's laws and policies, please feel free to call me at (415) 352-3618, or by email at michellel@bcdc.ca.gov.

Sincerely,

MICHELLE BURT LEVENSON
Permit Analyst

ML/mm

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Trustees' Response to Comment #1, Tom Tedrick

The Trustees acknowledge the sentiment of this commenter and others who feel that Richmond is entitled to the settlement funds from Chevron in this case. However, this natural resource damages claim is not for "money due Richmond" and is not related to legal matters between the City of Richmond and Chevron. Rather, the Trustees' claim was brought under federal and State laws that authorize the recovery of damages for natural resources on behalf of all citizens of California and the United States. The historical sediment contamination being cleaned up in Castro Cove did not just impact the area in and around the Cove. The contaminants, which passed through the food web to fish, birds, and other mobile wildlife, had effects that ranged beyond the immediate vicinity of the Cove and of the City of Richmond.

Nevertheless, the Trustees strongly considered relative proximity to Castro Cove (among other evaluation criteria) when rating potential projects. In fact, as discussed in Section 4.4.1, proximity was one of two "threshold criteria" that the Trustees considered. The other threshold criterion was whether a proposed project would provide or enhance the type of habitat that was injured by the Chevron releases, i.e., intertidal mudflat, shallow subtidal habitat and/or tidal saltmarsh. The Trustees initially focused on potential restoration sites within the immediate vicinity of Castro Cove (e.g., Wildcat Marsh and other portions of Castro Cove), along with areas somewhat farther away but in the same ecological subregion of San Francisco Bay. However, some of these projects (including some outside of Richmond) were not feasible due either to ownership issues or other logistical impediments. Other projects did not restore the appropriate resources or did not meet other criteria for restoration projects in this case. Given these challenges, and to ensure they were not overlooking potential projects, the Trustees met with local leadership and environmental groups to see if there were projects near Castro Cove of which they were unaware. In 2007, before preparing the draft Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA), the Trustees received and researched four project ideas from the City of Richmond. The tidal marsh portion of the Breuner Marsh project, one of the four suggested by the City (and which the Trustees had already identified) satisfies the evaluation criteria and is one of the two selected restoration projects.

After the release of the draft DARP/EA, the Trustees met with East Bay Regional Park District (EBRPD), the project proponent for Breuner Marsh. The Trustees were informed that a greater proportion of that site may be suitable for tidal marsh restoration than was originally expected (up to 45 acres). Accordingly the Trustees have increased the allocation of settlement funds for the Breuner Marsh project from $750,000 to $1,000,000, based on a commitment of matching funds from EBRPD. The Trustees and EBRPD foresee that the combination of $1 million from the Chevron settlement, $1 million from EBRPD sources, and additional funds which EBRPD expects to obtain by leveraging these commitments, will be sufficient to plan, design, and implement several stages of restoration at Breuner Marsh (please see the letter from Robert Doyle, EBRPD, Appendix C).

It is also noteworthy that the cleanup of contaminated sediments, which the Trustees estimate cost Chevron $20 to $30 million, is taking place in Castro Cove. In other words, the vast majority (roughly 95%) of the environmental cleanup/restoration funds in this case are being spent within the City of Richmond in the immediate vicinity of Castro Cove.

Trustees Response to Comment #2, David K

This commenter and other comments received expressed concern that settlement funds were being proposed for projects in Sonoma or Sonoma County. In fact, the Trustees did not propose any restoration projects in Sonoma or Sonoma County. This is likely a misunderstanding because one of the selected projects, Cullinan Ranch, is in Solano County. It is noteworthy that Cullinan Ranch is located only about 12.5 miles from Castro Cove in San Pablo Bay and is part of the same North Bay ecological subregion as Castro Cove. Thus, Cullinan Ranch is much closer to Castro Cove than any project in Sonoma County.

This commenter also acknowledges the concept of “one Bay,” a point that is exceptionally important and implicit in the decisions made by the Trustees. The effects of restoration activities are not constrained to their immediate vicinity, but affect areas of the Bay with the movement and migration of fish, birds, other wildlife, and resources that they benefit. In other words, a project outside of Castro Cove can benefit the natural resources within Castro Cove. This is particularly true in this case, given that Cullinan Ranch is only about 12.5 from Castro Cove, across San Pablo Bay in adjacent Solano County.

Also, as noted in the EBRPD letter dated 20 April 2009 (Appendix C), the Breuner Marsh site, which represents the Trustees best restoration option within Richmond, does not contain enough potential marsh acreage to fully compensate for the injuries at Castro Cove. Cullinan Ranch contains enough acreage of in-kind habitat, when added to the tidal marsh that will be created in the Breuner project, to fully compensate the public for the resource injuries in this ecological subregion.

As to other issues raised in this comment, please see the Trustees’ response to Comment #1.

Trustees’ Response to Comment #3, Owen Martin

This commenter also expressed concern that settlement funds were being proposed for projects in Sonoma County. As noted in Response to Comment #2, the Trustees did not propose any restoration projects in Sonoma or Sonoma County.

This comment suggests saving the settlement funds until a time when there are restoration projects in Richmond for which the planning stage has been completed. This is what the Trustees have done with the Breuner Marsh project. Even though Breuner Marsh had not yet reached the planning stage, the Trustees proposed to reserve funds for that project to assist EBRPD in leveraging other funding and to contribute to planning and design of the project. Presently, the Trustees are not aware of other appropriate potential projects for which “saved” settlement funds could be applied in a reasonably short time frame. The Trustees are also reluctant to hold funds for longer periods because, in the short term, the public is denied the benefits of restoration.

Trustees' Response to Comment Letter #4, Tony Sustak and Margaret Browne

This comment, as well as the previous ones, reflects a misunderstanding of the location of the Cullinan Ranch project and the nature of the Trustees' claim for injuries to the resources of the North Bay ecological subregion (San Pablo Bay). Please see response to comment #2.

This comment also characterizes the settlement funds as "abatement penalties" and as "punishment" for Chevron's "behavior." However, the Trustee agencies have no legal claim for fines or penalties, and the amounts they may recover for resource injuries are not punishment for the behavior of a responsible party. Claims for natural resource injuries seek only compensation for services which the injured resources would have provided in their uninjured condition. A responsible party is strictly liable for these damages whether or not it engaged in culpable behavior.

The comment further asserts that the expenditure of funds anywhere other than Richmond is insensitive to the low income and minority residents of Richmond. The Trustees are mindful of the challenges facing Richmond and its citizens. However, the Trustees believe that both of the selected projects will benefit Richmond and its residents by enhancing the ecosystem that adjoins Richmond. Both projects are expected to have positive environmental impacts and not to impose any adverse impacts on any community.

Trustees' Response to Comment #5, Michele McGeoy

This comment is similar to those addressed above. Please see responses to prior comments. This comment attached a copy of an email from the "Tom Butt E-FORUM." It appears that this attachment was a source of much of the misinformation contained in some of the earlier comments, including the location of the Cullinan Ranch project.

There are several misleading statements in this attachment. The City of Richmond is not a natural resource trustee for the Castro Cove case and thus has no legal claim to the settlement funds. The applicable laws do not mandate that restoration projects occur within a specific municipal, state, or even national boundary, so long as the projects appropriately address the injured resources. It is common in natural resource cases that selected restoration includes projects outside the local jurisdictional boundaries, since the goal is to restore ecological services of the appropriate type and size, and those ecological services may not always be found within a specific city or even county boundary. Also, ecological improvements as proposed at both selected restoration sites benefit the entire San Pablo Bay area, including Richmond. Thus, the selection of these two projects does not represent a "diversion" of funding away from the City of Richmond.

Trustees' Response to Comment Letter #6, Brad Olson, East Bay Regional Park District

As noted above, the Trustees have had discussions with EBRPD subsequent to receiving this comment letter and have addressed many of the issues raised in it. Subsequent to the Trustees' publication of the draft DARP/EA, EBRPD revised its earlier estimate of potential tidal salt marsh creation in the proposed Breuner Marsh project from 30 acres to as much as 45 acres. Based on this change, and given EBRPD's commitment to provide additional funds and seek funding from other sources, the Trustees will reallocate the settlement funds to reserve up to $1 million for planning, design and implementation of tidal salt marsh restoration at Breuner Marsh (see the letter from Robert Doyle, EBRPD, Appendix C).

Trustees' Response to Comment Letters #7, Rich Walkling, RDG and #13, Michelle Jesperson, California Coastal Conservancy

The Trustees agree that an effort such as the Conservation Action Plan (CAP) described in these letters would be a valuable undertaking for the North Richmond Shoreline. The Trustees researched restoration opportunities and contacted over 30 individuals and organizations to have an understanding of what restoration actions could take place along the Richmond shoreline and its intertidal and subtidal areas. Unfortunately, many of the potential restoration actions identified were either conceptual in nature or did not have even preliminary cost estimates. As in this case, the lack of even rudimentary planning can serve as a significant impediment to resource management and conservation organizations looking for restoration, conservation and acquisition opportunities. A CAP for the North Richmond shoreline would be a very useful tool for such organizations in the future.

However, while the CAP may be a worthwhile endeavor, the Trustees are precluded from using Castro Cove settlement funds to pay for it. Under the law, the Trustees pursue restoration projects that may be implemented in a reasonable time frame and that can be demonstrated to make the environment and the public whole for injuries resulting from the releases of hazardous substances and discharges of oil. This is accomplished by implementing restoration actions that return injured natural resources and resource services to baseline conditions and compensate for interim losses as quickly as possible. The CAP, though a valuable process that is likely to ultimately result in benefits to the environment, does not itself achieve demonstrable restoration.

Regarding suggested edits to the draft DARP/EA, we have addressed them in the final document.

Trustees' Response to Comment Letters #8, Friends of the San Pablo Bay National Wildlife Refuge; #10, Isa Woo; #12, Gerald Karr, Audubon Society; #15, Rudolph Rosen, Ducks Unlimited; #16 Marc Holmes, Bay Institute; and #17, Florence LaRiviere, Citizens Committee to Complete the Refuge

The Trustees agree that the tidal wetlands at Cullinan Ranch will provide important habitat for many species of fish and wildlife in the North Bay subregion, as well as maintain the quality and productivity of estuarine and marine ecosystems as a whole. The intertidal and shallow subtidal habitats that were injured by the Chevron releases serve as vital habitat for the same species of fish and wildlife that will benefit from the Cullinan Ranch project. There is a strong relationship between this restoration project and the injured resources.

The Trustees consider funding a portion of this wetland restoration project, in combination with funding the tidal wetlands portion of the Breuner Marsh project, to best satisfy the evaluation criteria and provide appropriate compensation for fishery resources, wetlands, birds, and other biological resources injured as a result of the Chevron releases in Castro Cove. Therefore the Trustees will contribute $1.65 million in settlement funds to the Cullinan Ranch restoration project.

The Trustees recognize that many agencies and organizations have contributed to Cullinan Ranch's acquisition, restoration planning and permitting review. We expect that the funds from the Castro Cove settlement will help provide leverage for additional funding to complete the 1,500-acre project for the benefit of the public throughout the San Pablo Bay.

Trustees' Response to Comment #9, Edgar Polaño

Several of the issues raised by this comment have been addressed in earlier responses. Those that have not been addressed previously are discussed below.

The comment suggests that selection of a restoration project on the north side of San Pablo Bay is not consistent with Executive Order 12989. Executive Order 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. All potential actions described in the draft DARP/EA are expected to have positive environmental impacts and not to impose any adverse impacts on any community (with the possible temporary and minimal disturbance associated with construction activities in Breuner Marsh).

The comment questions the "likelihood of success" criterion, and whether having a project proponent is a legitimate consideration. This comment appears to confuse a "project proponent" (one who favors a project) with a "project implementer" (one who carries out the project). The Trustees do justifiably give greater weight to a project where there exists a capable "project implementer" (as distinguished from a "project proponent") because it is important that restoration funds be used to compensate the public in a reasonable time frame. In the absence of a willing and capable project implementer, the Trustees run the risk that a project will not be carried out and that the public will not be appropriately compensated. This comment goes on to suggest that the Trustee Council serve as the project implementer. The Trustee Council is not a legal contracting entity that can implement projects. However, on occasion Trustee agency staff can and do implement restoration projects, particularly in situations where the project is located on lands owned or managed by a particular Trustee agency.

The comment also suggests that Chevron be required to pay more or be compelled to undertake certain actions. Absent a settlement with Chevron in which it agrees to either of these suggestions, it would be necessary for the Trustees to convince a federal court judge to require Chevron to pay more or be compelled to undertake certain actions. Litigation to seek a better result than the Trustees have achieved through settlement would require a substantial expenditure of time and money, would yield uncertain results, and would undoubtedly delay the implementation of any restoration.

The comment disputes the legitimacy and application of the “cost effectiveness” criterion. Cost effectiveness is only one of several criteria, and the Trustees are not restricted to selecting the lowest cost project. In fact, the Trustees did not simply choose the most inexpensive project in this case. Breuner Marsh, which was selected largely due to its proximity to Castro Cove, has projected costs that are roughly two to three times greater per acre than Cullinan Ranch. Ultimately, all other factors being equal, preference is given to cost effective projects. The Trustees considered the potential costs of the projects evaluated. Total costs, including those already expended (such as planning and design work for Cullinan Ranch) were factored into all cost evaluations equally.

The comment suggests favoring certain projects that involve cleanup of existing contamination. It is common for wetland restoration projects around the San Francisco Bay area to include some degree of cleanup during implementation. The Trustees do not exclude sites from serious consideration solely because they involve cleanup of historical contamination. However, the Trustees are less likely to select a project if there are other financially viable liable parties for such sites. In those situations, it is not appropriate to use natural resource damages recovered from one party to meet the cleanup obligations of another.

In addition to the previously mentioned cleanup issues, the specific sites mentioned in this comment (e.g., Hoffman Marsh, Historical Castro Cove Wetlands, and Creosote Piling Removal), were not selected for other reasons described more fully in Section 4 of the final DARP/EA. For Hoffman Marsh, the Trustees considered several feasibility issues raised by one of several Hoffman Marsh property owners, East Bay Regional Park District. Specifically, EBRPD cited multiple owners (some of whom are not willing sellers), contamination issues, and limited restoration opportunities. For creosote piling removal at Terminal 4, the City of Richmond already received partial funding from the Bay Conservation and Development Commission several years ago. However, despite the Trustees’ repeated efforts to ascertain the City’s plans for implementing this project and what additional funding was needed, the information was not provided to the Trustees in time for further consideration. For the Historical Castro Cove Wetlands, the Trustees were provided insufficient information to fully evaluate the concept; however, given the Trustees’ understanding of the proposal, it would involve buying and converting to wetlands large tracts of property currently occupied by various industrial operations, displacing those businesses, and removing significant amounts of contaminated fill that were just placed there under an order from the Regional Water Quality Control Board. Adding to these challenges, there is no known project implementer to carry out these activities.

Trustees' Response to Comment Letter #11, Bay Conservation and Development Commission request for extension of the comment period

The Trustees granted the Bay Conservation and Development Commission's (BCDC) request for extension of the comment period until January 16, 2009. We received the BCDC's comment letter on February 2, 2009 (dated January 27, 2009). Please see the response to letter #18 below.

Trustees' Response to Comment Letter #14, Gene Doherty, California Native Plant Society

The Trustees agree that the tidal wetlands at Cullinan Ranch and Breuner Marsh will provide important habitat for many species of fish and wildlife in the North Bay subregion, as well as maintaining the quality and productivity of estuarine and marine ecosystems as a whole. The intertidal and shallow subtidal habitats that were injured by the Chevron releases, serve as vital habitat for the same species of fish and wildlife that will benefit from both projects. There is a strong relationship between these restoration projects and the injured resources.

This letter also expressed concerns that despite the recent sediment cleanup performed by Chevron in Castro Cove, some of the contamination may have been released historically into the broader San Pablo Bay ecosystem. In 2007 and 2008 Chevron undertook a major, on-site cleanup project, removing the most highly contaminated sediments within Castro Cove, in compliance with an order issued by the RWQCB. The RWQCB found that implementing this remedial action would appropriately remediate the sediments in Castro Cove. This served as the basis for the Tentative Site Cleanup Requirements (SCRs) issued by the Board. Concerns over any remaining contamination should be directed to the RWQCB, www.swrcb.ca.gov/rwqcb2.

Trustees' Response to Comment Letter #18, Michelle Levenson, Bay Conservation and Development Commission

The Trustees thank the staff of the San Francisco Bay Conservation and Development Commission for their comments on the draft DARP/EA and for the observation that the preferred restoration alternatives are in compliance to the McAteer-Petris Act and the San Francisco Bay Plan. We understand that the construction of the restoration projects will be subject to the Commission's permitting process or federal consistency process.

The BCDC staff recommends that the funding or acreage be increased for the Breuner Marsh. As discussed above in response to prior comments, the Trustees have increased the share of settlement funds allocated to the Breuner Marsh project.

Appendix C: East Bay Regional Park District (Robert Doyle) letter on Breuner

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EAST BAY REGIONAL PARK DISTRICT

East Bay Regional Park District

2950 PERALTA OAKS COURT P.O. BOX 5381 OAKLAND CALIFORNIA 94605-0381
T. 1 888 EBPARKS F. 510 569 4319 TDD. 510 633 0460 WWW.EBPARKS.ORG

April 20, 2009

SENT VIA U.S. MAIL

Carolyn Marn
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

Re: Supplemental Comments on Castro Cove Damage Assessment and Restoration Plan

Dear Ms. Marn:

This is a follow-up to the East Bay Regional Park District's ("District") December 11, 2008 comments on the draft Damage Assessment and Restoration Plan ("DARP") for Castro Cove, and reflects our further discussions with the Natural Resource Trustee representatives ("Trustees").

The restoration of Breuner Marsh and the completion of the Bay Trail in North Richmond is a priority project for the District and the City of Richmond ("City"). The District believes that a larger commitment of the Trustees' Castro Cove settlement funds to Breuner Marsh will achieve not only the ecological benefits identified in the District's prior comment letter, but serve the important goal of restoring natural resources similar to those injured at Castro Cove in the community most affected by the releases. However, we also recognize that a limited amount of settlement funds are available, and that full restoration of the injured resources requires the development of significantly more acres of tidal marsh than the Breuner Marsh property alone can provide.

In light of the above, we believe the following presents a reasonable allocation of the settlement funds. If the Trustees will allocate $1 million from the Castro Cove settlement to Breuner Marsh for planning, design, and implementation of a project that will provide at least 30 and up to 45 acres of tidal wetland, the District can match these funds with monies from other sources, including the District's recently enacted bond measure WW, which included funding for the North Richmond shoreline. In addition, the District is confident that, with the assistance of the Trustees, grant funding of $1 million or more will be available for both the restoration project and the completion of the Bay Trail segment. In total, the Trustees' funding commitment of $1 million should yield a minimum of **$3 million** towards this worthy project.

Please feel free to contact me directly if you would like to discuss this matter. We look forward to working with the Trustees and the City in achieving a successful restoration project and providing additional natural resources and recreational opportunities to the North Richmond community.

Yours truly,

Robert E. Doyle
Assistant General Manager
Land Acquisition & Interagency Planning Division

Appendix D: NEPA Decision Documents/Finding of No Significant Impact

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U.S. Fish and Wildlife Service for the Department of the Interior

NEPA Decision Document/Finding of No Significant Impact (FONSI)

For the Castro Cove/Chevron Richmond Refinery Final Damage Assessment and Restoration Plan/Environmental Assessment

November 2009

Background:

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Natural Resource Trustee Agencies (Trustees), including the U.S. Fish and Wildlife Service (Service), the National Oceanic and Atmospheric Administration (NOAA), and the California Department of Fish and Game prepared the Castro Cove/Chevron Richmond Refinery Final Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA). The DARP/EA assesses damages and evaluates restoration alternatives for natural resource injuries incurred from historical releases of contaminants from the Chevron USA Inc. (Chevron) refinery in Richmond, California.

Prior to 1987, the Chevron refinery discharged wastewater containing oil and hazardous substances ("releases") directly into Castro Cove, a small embayment within San Pablo Bay. Although the wastewater discharge was relocated outside of Castro Cove in 1987, some of the sediments inside the Cove retained elevated levels of contaminants, including mercury and polycyclic aromatic hydrocarbons. In 2007 and 2008 Chevron undertook a major, on-site cleanup project, removing the most highly contaminated sediments within Castro Cove, in compliance with an order issued by the California Regional Water Quality Control Board. In addition to cleanup costs, Chevron is liable for "natural resource damages," which are used to fund environmental restoration projects intended to compensate the public for the diminished ecological value of injured resources, including contaminated habitats, such as the intertidal mudflat, salt marsh, and other shallow subtidal habitat in Castro Cove.

Selected Restoration Alternative:

The Trustees cooperatively developed the DARP/EA. It examines and evaluates potential projects to restore natural resources in compensation for injuries resulting from the releases into Castro Cove.

The DARP/EA considered, in a public process, a "no action" alternative and many individual projects to address the injured resources. The Trustees developed criteria to evaluate and prioritize the entire suite of projects that were under consideration. These criteria included the project's ability to restore those resources directly impacted by the release of oil and hazardous substances and relevant federal and state law provisions governing use of recoveries for natural resources. The Trustees rejected the "no action" alternative because it does not provide compensation to the public for interim losses suffered by the resources.

CERCLA clearly establishes trustee authority to seek compensation for interim losses pending recovery of natural resources. Furthermore, technically feasible alternatives for restoration are available.

The alternative selected by the Trustees consists of the following two restoration projects:

- Cullinan Ranch Restoration
- Breuner Marsh Restoration

Both of these projects are, or will be, the subject of further environmental analysis in another document or documents. The environmental impacts of Cullinan Ranch were evaluated fully in the Cullinan Ranch Restoration Environmental Impact Statement/Environmental Impact Report (EIS/EIR), which was prepared by the Service (Ducks Unlimited 2009). The project implementer for Breuner Marsh, East Bay Regional Park District (EBRPD), will be required to prepare a detailed plan for the restoration of the site and to produce environmental compliance documentation under the California Environmental Quality Act (CEQA). Thus, this restoration project will not be ripe for detailed analysis of environmental consequences until after specific project implementation details are more fully developed in that planning process. Supplemental environmental analysis under NEPA may be addressed by the federal Trustees and/or by a federal permitting agency at the time that CEQA documentation is prepared by EBRPD.

Public Involvement:

The Trustees released a draft DARP/EA on November 25, 2008, for public review and received public comments through January 9, 2009. In addition, the Trustees held a public meeting in Richmond on December 17, 2008. Public comments were split nearly evenly between those that were supportive of the Trustees' proposal in the draft DARP/EA and those that were critical. Those that were critical generally preferred a larger expenditure on projects within Richmond (Cullinan Ranch is approximately 12.5 miles from Castro Cove). The Trustees carefully considered the public comments, amended the draft DARP/EA, and responded to the comments (see Appendix B in the final DARP/EA). Significantly, the Trustees re-allocated a portion of the restoration funds from Cullinan Ranch to Breuner Marsh, which still provides an appropriate amount of compensatory restoration.

Alternatives Considered:

The DARP/EA evaluates specific potential project alternatives for restoration of tidal and subtidal habitats against certain criteria. The initial screening criteria were that a project must provide resources "of the same type and quality, and of comparable value" as the injured habitats in Castro Cove (NOAA 1995) and that a project must be within reasonable proximity to Castro Cove. Additional criteria included: Technical Feasibility, Cost-Effectiveness, Time to Provide Benefits, Duration of Benefits, Avoidance of Adverse Impacts, Likelihood of Success, Multiple Resource and Service Benefits, Public Health and Safety, and Compliance with Applicable Federal, State, and Local Laws and Policies. The Trustees selected the two most meritorious projects based on this evaluation.

Ten projects (seven tidal wetlands projects and three subtidal projects) underwent detailed evaluation. Two projects (Invasive Spartina and McNabney Marsh) were dropped from further consideration because funding was no longer needed. The specific projects which the Trustees considered are listed below with the selected projects shown in italics.

Tidal Wetlands:
- *Cullinan Ranch*
- *Breuner Marsh*
- Pacheco Marsh
- Baypoint Marsh
- Historical Richmond Marsh
- Wildcat Marsh
- Hoffman Marsh

Subtidal Habitat:
- Eelgrass
- Native Oyster Restoration
- Creosote Piling Removal

Environmental Consequences:

The National Environmental Policy Act (NEPA) and the CEQA require an analysis of the potential effects of proposed government actions on the quality of the human environment. In addition, Council on Environmental Quality regulations implementing NEPA recommend the avoidance of repetitive discussions when more than one environmental document addresses, or will address, the same action(s), as is the case for the two projects selected in this final DARP/EA. The Breuner Marsh Restoration Project is still at an early stage of planning that will include an environmental analysis, while the Cullinan Ranch Restoration project is nearing completion of a separate NEPA analysis. The Trustees have considered the full impacts analysis conducted in the Cullinan Ranch EIS/EIR but only the preliminary conceptual plan for Breuner Marsh. Accordingly, as more site-specific information is developed regarding the Breuner Marsh Project, it may be necessary to conduct further NEPA and/or CEQA analysis. Trustee funding of either project is conditioned upon the implementer complying with all legal requirements for analysis of environmental impacts.

As documented in the DARP/EA, the Trustees expect the proposed actions to substantially benefit the habitats targeted by the DARP/EA. The proposed actions are designed to make the environment and the public whole for injuries to, or lost use of, natural resources and services from historical releases of contaminants into Castro Cove. There are some adverse and unavoidable effects identified in the Cullinan Ranch EIS/EIR as seasonal wetlands, upland, and emergent marsh habitats are returned to tidal marsh habitat. In addition, in order to protect Highway 37 from project-induced flooding, a buttress levee will be constructed and armored with riprap which will involve placement of permanent fill in jurisdictional wetlands, an adverse and unavoidable effect. However, the Service has evaluated and adopted all practical measures to avoid and mitigate environmental impacts that could result from restoring Cullinan Ranch by incorporating all measures to avoid or minimize impacts of the project as described in the final

EIS/EIR. Restoring tidal circulation to approximately 1,549 acres of the Cullinan Ranch Site will provide vital habitat for the endangered salt marsh harvest mouse and California clapper rail, as well as other salt marsh dependent, federally listed threatened and endangered species in San Pablo Bay; anadromous fish and special status fish species; and migratory shorebirds, brown pelicans, double-crested cormorants, and diving duck species. The open water and tidal wetlands that will be restored will recreate a portion of the historical Napa River estuary and provide a continuum of wetland habitat that will further enhance species numbers and diversity.
The Service is preparing, pursuant to its role under the Endangered Species Act, a biological opinion for the Cullinan Ranch restoration project. Because the project is restoring approximately 1,549 acres of tidal marsh habitat, it will substantially increase available habitat for the California clapper rail, salt marsh harvest mouse, and other salt marsh-dependent wildlife and plant species. Increases in these habitats through restoration activities are anticipated to provide beneficial effects to these special status species.

As the Breuner Marsh project is more fully developed, the project implementer will consult with the Service to determine whether the proposed actions at Breuner Marsh will adversely affect any species listed under the federal Endangered Species Act.

Cumulative Impacts:

The DARP/EA summarizes potential overall cumulative impacts of implementing the selected alternative. To the degree that the selected restoration projects may contribute to potentially significant cumulative impacts, these impacts are, or will be, discussed in detail in the individual NEPA and CEQA documents for these projects. Overall, the Trustees believe that the selected projects, considered along with other wetlands restoration projects in the North Bay subregion, will result in cumulatively beneficial impacts to plants and wildlife, including special-status and listed species, providing additional habitat to support recovery of these sensitive communities and resulting in greater habitat complexity, diversity, and productivity. Since the restoration projects are designed to restore injured natural resources, any cumulative environmental consequences will be largely beneficial.

The Trustees believe that, overall, the alternative selected in this restoration plan, when considered along with past and reasonably foreseeable future actions, will have long term, local and regional beneficial impacts to natural resources.

Environmentally Preferred Alternative:

The environmentally preferred alternative is the alternative that will promote NEPA, as expressed in Section 101 of NEPA. The environmentally preferred alternative is the one that best meets the following:

- Fulfill the responsibility of each generation as trustee of the environment for succeeding generations;
- Ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing surrounding;

- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Based upon analyses of the proposed action when compared to the alternative projects (non-preferred) and the no action alternative, the proposed action meets the criteria above and is therefore also the Service's environmentally preferred alternative.

Basis for Decision:

Implementation of the two selected projects is expected to have long term, local and regional beneficial impacts to natural resources. The Cullinan Ranch Final EIS/EIR contains a full analysis of the restoration action, environmental consequences and mitigation proposed. No highly uncertain or controversial impacts, unique or unknown risks, significant cumulative negative effects, or elements of precedence have been identified, and implementing the preferred alternative will not violate Federal, State, or local environmental protection laws.

Conclusion:

Based upon an environmental review and evaluation of the DARP/EA for the Castro Cove/Chevron Richmond Refinery as summarized above, and upon the Cullinan Ranch EIS/EIR, the Service has determined (with the potential reconsideration as to Breuner Marsh noted below) that implementation of the restoration plan does not constitute a major Federal action significantly affecting the quality of the human environment under the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969 (as amended). Accordingly, an environmental impact statement is not presently required for this action. However, the Breuner Marsh Restoration Project will be subject to further environmental review and the Service may reconsider this issue in the future. The DARP/EA is available upon request from the Service's Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, California 95825.

Regional Director, Pacific Southwest Region
Authorized Official, Department of the Interior

Dec 21 2009
Date

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

DATE: January 22, 2010

MEMORANDUM FOR: Patricia A. Montanio
Director, Office of Habitat Conservation

THROUGH: for Christopher D. Doley PERRY GAYARDO
Director, NOAA Restoration Center

FROM: Greg Baker
Case Team Manager

SUBJECT: Castro Cove/Chevron Richmond Refinery DARP/EA and Finding of No Significant Impact

The National Oceanic and Atmospheric Administration (NOAA) is the lead federal agency for National Environmental Policy Act (NEPA) compliance for the Castro Cove/Chevron Richmond Refinery Restoration Projects in Contra Costa and Solano Counties, CA. These projects are sponsored by the Castro Cove/Chevron Richmond Refinery Natural Resource Trustees and designed to help restore natural resources injured by releases of hazardous substances into Castro Cove in Richmond, CA.

NOAA prepared this Environmental Assessment (EA) to set forth: (1) the decision-making process that takes into account all of the environmental impacts of an action and how the public was involved in that decision making, (2) its determination that the selected alternative (funding for Breuner Marsh Restoration and Cullinan Ranch Restoration) other than the no-action alternative or the other alternatives considered would be the most ecologically sound alternative, and (3) its determination that an environmental impact statement (EIS) will not need to be prepared for this project.

Cullinan Ranch is located in the North Bay subregion in Solano County, approximately 10 miles north of Castro Cove. This project consists of returning approximately 1,500 acres of diked baylands to their historical wetland state as mature tidal marsh. The settlement with Chevron for Castro Cove natural resource damages will fund a proportional share of this project ($1.65 million) that will restore 158 acres. This project will not only provide resource benefits similar to those lost in Castro Cove but the amount of the settlement funds which the Trustees plan to allocate to this project is expected to act as a catalyst for the larger restoration project. Additional funds are being sought from a variety of sources including a National Coastal Wetlands Conservation Grant.

Breuner Marsh is also located in the North Bay subregion, in the City of

Richmond, south of Point Pinole Regional Shoreline in western Contra Costa County. The restoration design for this project is still conceptual but calls for restoration of at least 30 and up to 45 acres of tidal wetlands as part of a broader set of habitat improvements and improved public access and recreation areas. The Trustees understand that the proposed amount allocated to this project from funds recovered in the settlement with Chevron ($1 million) will not only contribute to the planning, design and construction of a portion of the project but will also assist in raising additional funds for implementation. One million dollars, and potentially up to $2 million in additional funds have already been committed to the project from other sources, including the East Bay Regional Park District.

The Trustees determined that contributing funding for these two wetland restoration projects will compensate for interim losses of natural resource services caused by historical releases of hazardous substances into Castro Cove, which resulted in long term contamination of sediments within Castro Cove and impairment of the ecological services they provide. In 2007 the Chevron Company undertook a sediment remediation action in Castro Cove in compliance with a cleanup order issued by the California Regional Water Quality Control Board. The selected restoration projects, when implemented, will restore habitat services of a nature and scale equivalent to the interim lost services caused by the presence of contaminated sediments in Castro Cove.

The environmental review process has led NOAA to conclude that this restoration action will not have a significant effect on the quality of the human environment. Therefore, an environmental impact statement will not be prepared. A determination of a Finding of No Significant Impact (FONSI) is recommended. In accordance with NOAA Administrative Order 216-6, the EA and FONSI are attached for your environmental review and transmittal for concurrence by NOAA's Office of Policy and Strategic Planning.

Three (3) Attachments:

1. DARP/EA for Castro Cove/Chevron Richmond Refinery
2. Proposed Finding of No Significant Impact (FONSI)
3. Concurrence Memo for Office of Policy and Strategic Planning

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

DECISION DOCUMENT/FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Castro Cove/Chevron Richmond Refinery Final Damage Assessment and Restoration Plan and Environmental Assessment

National Oceanic and Atmospheric Administration (NOAA) Administrative Order 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality regulations at 40 C.F.R. 1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Following is an explanation of the required criteria relevant to making a finding of no significant impact for the restoration activities proposed in the Castro Cove/Chevron Richmond Refinery Final Damage Assessment and Restoration Plan and Environmental Assessment (DARP/EA). In drawing these conclusions, NOAA relied upon guidance in the NEPA regulations at 40 C.F.R. § 1508.27, which describe the criteria that federal agencies should consider in evaluating the potential significance of proposed actions. In making the findings discussed below, NOAA also relied upon the impacts analysis conducted in the Cullinan Ranch EIS/EIR prepared by the U.S. Fish and Wildlife Service (USFWS) and the preliminary conceptual plan for Breuner Marsh.

Background:

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Natural Resource Trustee Agencies (Trustees), including NOAA, the USFWS on behalf of the Department of the Interior, and the California Department of Fish and Game, prepared the Castro Cove/Chevron Richmond Refinery Final DARP/EA. The DARP/EA assesses damages and evaluates restoration alternatives for natural resource injuries incurred from historical releases of contaminants from the Chevron Product Company (Chevron) refinery in Richmond, California.

Prior to 1987, the Chevron refinery discharged wastewater containing oil and hazardous substances directly into Castro Cove, a small embayment within San Pablo Bay. Although the wastewater discharge was relocated outside of Castro Cove in 1987, some of the sediments inside the Cove retained elevated levels of contaminants, including mercury and polycyclic aromatic hydrocarbons (PAHs). In 2007 and 2008 Chevron undertook a major, on-site cleanup project, removing the most highly contaminated sediments within Castro Cove, in compliance with an order issued by the California Regional Water Quality Control Board. In addition to cleanup costs, Chevron is liable for natural resource damages, which are used to fund environmental restoration projects to compensate the public for the diminished ecological value of injured resources, including contaminated habitats, such as the intertidal mudflat, salt marsh, and other shallow subtidal habitat in Castro Cove.

Restoration Alternatives:

The Trustees cooperatively developed the Final DARP/EA. It examines and evaluates potential projects to restore natural resources in compensation for injuries resulting from the releases into Castro Cove.

The DARP/EA considered, in a public process, a "no action" alternative and many individual projects to address the injured resources. The Trustees rejected the "no action" alternative because it does not compensate the public for interim losses suffered by the resources. CERCLA clearly establishes trustee authority to seek compensation for interim losses pending recovery of natural resources. Furthermore, technically feasible alternatives for restoration are available. For the remaining active restoration alternatives, the Trustees developed criteria to evaluate and prioritize the entire suite of projects that were under consideration. These criteria included each project's ability to restore resources of the type impacted by the release of oil and hazardous substances in Castro Cove, and relevant federal and state law provisions governing use of damages for natural resources. Based on an evaluation under these criteria, the Trustees selected an alternative that provides funding for the following two restoration projects:

- Cullinan Ranch Restoration
- Breuner Marsh Restoration

Before being brought to the attention of the Trustees, both of these projects were already slated for planning/implementation by their implementing agencies. Therefore, they are, or will be, the subject of further environmental analysis in another document or documents. The environmental impacts of the Cullinan Ranch project were evaluated fully in the Cullinan Ranch Restoration Environmental Impact Statement/Environmental Impact Report (EIS/EIR), which was prepared by the USFWS San Pablo Bay National Wildlife Refuge (the USFWS is also one of the Trustee agencies for Castro Cove). USFWS issued the Cullinan draft EIS/EIR in April 2008 and the final EIS/EIR in May 2009; USFWS has not yet issued the Record of Decision. For Breuner Marsh, the project implementer (East Bay Regional Park District, or "EBRPD"), will be required to prepare a detailed plan for the restoration of the site and to produce environmental compliance documentation under the California Environmental Quality Act. Thus, this restoration project will not be ripe for detailed analysis of environmental consequences until after specific project implementation details are more fully developed in that planning process. The proposed action under this DARP/EA, which provides partial funding for these projects, is not expected alter them in any way that will incrementally increase impacts beyond those that have been or will be identified and planned for by the project implementers.

Public Involvement:

The Trustees released a draft DARP/EA on November 25, 2008, for public review and received public comments through January 9, 2009. In addition, the Trustees held a public meeting in Richmond on December 17, 2008. Public comments were split nearly evenly between those that were supportive of the Trustees' proposal in the Draft DARP/EA and those that were critical. Those that were critical generally preferred a larger expenditure on projects within Richmond (Cullinan Ranch is approximately 12.5 miles from Castro Cove). The Trustees carefully considered public comments, amended the draft DARP/EA, and responded to those comments (see Appendix B in the Final DARP/EA). Significantly, the Trustees reallocated a portion of the restoration funds from Cullinan Ranch to Breuner Marsh, which still provides an appropriate amount of compensatory restoration.

Alternatives Considered:

The DARP/EA evaluates an array of project alternatives for restoration of tidal and subtidal habitats against certain criteria. The initial screening criteria were that a project must provide resources "of the same type and quality and of comparable value" to the injured habitats in Castro Cove (NOAA 1995) and that a project must be within reasonable proximity to Castro Cove. Additional criteria included the following: technical feasibility, cost-effectiveness, time to provide benefits, duration of benefits, avoidance of adverse impacts, likelihood of success, multiple resource and service benefits, public health and safety, and compliance with applicable federal, State, and local laws and policies. The Trustees selected the two most meritorious projects based on this evaluation.

Ten projects (seven tidal wetlands projects and three subtidal projects) underwent detailed evaluation. Two projects (Invasive Spartina and McNabney Marsh) were dropped from further consideration because funding was no longer needed. The specific projects which the Trustees considered are listed below with the selected projects shown in italics.

Tidal Wetlands:
- *Cullinan Ranch*
- *Breuner Marsh*
- Pacheco Marsh
- Baypoint Marsh
- Historical Richmond Marsh
- Wildcat Marsh
- Hoffman Marsh

Subtidal Habitat:
- Eelgrass
- Native Oyster
- Creosote Piling Removal

Environmental Consequences:

The National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) require an analysis of the effects of government actions on the quality of the human environment. In addition, Council on Environmental Quality (CEQ) regulations implementing NEPA recommend the avoidance of repetitive discussions when more than one environmental document addresses (or will address) the same action(s) (as is the case for the two projects selected to receive partial funding in this Final DARP/EA).

The Cullinan Ranch Restoration Project is the subject of a separate and nearly-completed NEPA analysis in the form of an EIS/EIR, which contains a full impacts analysis. The Trustees carefully considered this analysis when evaluating and subsequently selecting this project. The Breuner Marsh Restoration Project is still at an early stage of planning that will include the appropriate environmental analysis. However, at this time, only the preliminary conceptual plan for Breuner Marsh was available for Trustee review. Accordingly, as more site-specific information is developed regarding the Breuner Marsh Project, it may be necessary to conduct further impacts analysis. Trustee funding of either project will be conditioned upon the implementer complying with all legal requirements for analysis of environmental impacts.

As noted above, the selected projects were already set for planning/implementation prior to Trustee involvement. Also, funding from the Trustees is not expected alter the projects in any way that will incrementally increase impacts beyond those that have been or will be identified and planned for by the project implementers. Thus, the addition of Trustee funding is expected to be without significant adverse effects to soil, air quality, water resources, floodplains, wetlands, vegetation, fisheries, wildlife, visual quality, aesthetics/recreation, wilderness, subsistence, cultural resources, park management, or the local economy.

(1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in Federal Management Plans (FMPs)?

> <u>Response</u>: No. As documented in the DARP/EA, the Trustees do not expect the selected projects to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act. Any short-term and temporary localized impacts (such as increased turbidity) will be minimized by the use of best management practices (BMP's).
>
> A full analysis of the effects of the Cullinan Ranch project is presented in the EIS/EIR for that project. The proposed actions in this DARP are not expected to alter the project in such a way as to change the level of impact from that which was already expected and planned for. Funding of a portion of the Cullinan Ranch project may lead to minimal adverse effects to designated essential fish habitat (EFH). This is explained in the July 31, 2008, comment letter from the National Marine Fisheries to the USFWS confirming that the project may have minor adverse impacts to certain EFH identified under the Magnuson-Stevens Fishery Conservation and Management Act, but that such effects were minimal and short-term in nature and so did not warrant any conservation measures to minimize, mitigate, or otherwise offset those effects.
>
> Based on preliminary plans, the Bruener Marsh restoration action is not expected to cause substantial damage to the ocean and coastal habitats or designated essential fish habitat (EFH).

(2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: No. The selected projects are not expected to have a substantial impact on ecosystem function and species biodiversity. Both of the projects are designed to improve habitat function through the conversion of what at present are principally terrestrial areas into diverse wetland ecotones. Because these projects are intended to restore natural resources, they are expected to cause a net increase to habitat productivity and improve ecosystem function. While there will be certain changes resulting from the conversion of one habitat type to another as discussed in question (1) above, the proposed actions are not expected to alter the project in such a way as to increase the level of impact beyond that which was already expected and planned for.

(3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health and safety?

Response: No. The selected restoration projects are not expected to have any substantial adverse impacts on public health and safety.

(4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: The proposed action is not expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species. For the Cullinan Ranch project, the USFWS conducted consultations under Section 7 of the Endangered Species Act both internally and with NOAA. The NOAA consultation concluded that any adverse impacts would be insignificant and short term, and the USFWS consultation resulted in a "no jeopardy" opinion.

According to the USFWS in the Cullinan Ranch Draft EIS/EIR, implementation of the Cullinan restoration will result in an increase of approximately 1,525 acres of tidal marsh habitat, including tidal marsh vegetation, meandering tidal sloughs, and upland refugia. Anticipated increases in these habitats through restoration activities would result in an increase in subtidal habitat available for anadromous fish that currently inhabit adjacent subtidal aquatic habitat. Anticipated increases in subtidal habitats through restoration activities would also result in a beneficial effect for special status fish species in the Napa River and San Pablo Bay. There would also be a beneficial effect to other special status species including the black rail, San Pablo song sparrow, Suisun shrew, and plants such as soft bird's beak and Mason's lilaeopsis.

Based on preliminary plans, the Bruener Marsh restoration action is not expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species.

(5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: No. The Trustees do not expect there to be significant adverse social or economic impacts interrelated with natural or physical environmental effects of the selected projects.

(6) Are the effects on the quality of the human environment likely to be highly controversial?

Response: No. The environmental effects of the selected projects are not expected to cause controversy. During the public comment period for the Draft DARP/EA, some members of the public expressed concern about the allocation of funding between the two selected projects. However, the concerns that were expressed were not related to adverse impacts; rather, they were related to the geographic distribution of beneficial impacts. Specifically, some commenters requested that a greater portion of the restoration funds be spent within the City of Richmond. In the Final DARP/EA the Trustees allocated a larger portion of the restoration funds to Breuner Marsh, which in turn will leverage an additional \$1 - \$2 million for that project.

(7) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Response: No. The Trustees do not expect the selected projects to result in substantial adverse impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas. The impacts from the proposed action will not adversely affect districts, highways, structures or objects listed on the National Register of Historic Places, or cause loss or destruction of significant scientific, cultural, or historical resources. Overall, wetlands will be created by this project, and no functioning farmlands will be affected. Historically, the area of the project was predominantly tidal marsh in the floodplain of the Napa River. Around the turn of the century the proposed project area was leveed for agricultural purposes. The Cullinan Restoration project as well as the Bruener marsh restoration project would restore a mosaic of wetland and associated habitats to benefit estuarine biota including waterfowl, shorebirds, fishes, and small mammals.

(8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: No. The Trustees do not believe that the proposed restoration projects pose any uncertain effects or unknown risks to the human environment. The areas in which the projects will be implemented are well known to the project implementers, and none of the project methods that are expected to be used are unique, controversial, or untried. The Trustees expect the project implementers to use standard methods for marsh creation that have been used frequently and with great success throughout the San Francisco Bay area.

(9) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Response: No. The DARP/EA summarizes potential overall cumulative impacts of implementing the selected projects in conjunction with other known past, proposed or foreseeable closely related projects that could potentially add to or interact with the these projects within the affected area. As described in the DARP/EA, the actions to be funded are not expected to result in additional incremental effects that are significant when evaluated cumulatively with other projects within the affected area.

(10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

Response: No. The selected projects are not expected to impact any cultural, scientific, or historic resources. The Trustees are aware of no previously recorded archeological sites located in the area of the proposed projects. The projects are also not expected to adversely impact any roadways.

(11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Response: No. The selected projects remove non-native species from areas that currently support them, and do not promote the introduction or spread of invasive species. Existing San Francisco Bay invasive species monitoring and control programs will continue to be required to prevent the spread of invasive species that already occur in the Bay into the newly restored areas.

(12) Is the proposed action likely to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

Response: No. The selected projects are not expected to set precedents for future actions that would significantly affect the human environment or represent a decision in principle about a future consideration. In fact, all of the project concepts (e.g., marsh creation) are extensions of well established and frequently used restoration methods.

(13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response: No. Implementation of the selected projects would not require any violation of federal, state or local laws designed to protect the environment. The Trustees will condition the use of Castro Cove settlement funds on the proposed restoration actions being implemented in compliance with all applicable laws.

(14) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response: No, the selected projects will not result in a substantial cumulative adverse effect on target species or non-target species. The restoration projects' primary goal is to compensate for injured natural resources or services lost due to the releases into Castro Cove.

DETERMINATION

Based upon an environmental review and evaluation of the DARP/EA for the Castro Cove/Chevron Richmond Refinery as summarized above, and upon the Cullinan Ranch EIS/EIR, NOAA has determined that implementation of the restoration plan does not constitute a major Federal action significantly affecting the quality of the human environment under the meaning of Section 102(2) (c) of the National Environmental Policy Act of 1969 (as amended). Accordingly, an environmental impact statement is not presently required for this action. However, the Breuner Marsh Restoration Project will be subject to further environmental review and NOAA may reconsider this issue in the future. The DARP/EA is available upon request from Greg Baker, NOAA Regional Restoration Coordinator, at (650) 329-5048.

Dean L Smehil 6-21-2010

for Patricia A. Montanio Date
Director, Office of Habitat Conservation, NOAA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

JUN 23 2010

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Castro Cove/Chevron Richmond Refinery Damage Assessment and Restoration Plan/ Environmental Assessment

LOCATION: Contra Costa and Solano Counties, California

SUMMARY: The National Oceanic and Atmospheric Administration (NOAA) is the lead federal agency for National Environmental Policy Act (NEPA) compliance for the Breuner Marsh Restoration and Cullinan Ranch Restoration Projects, Contra Costa and Solano Counties, California. These projects are sponsored by the Castro Cove/Chevron Richmond Refinery Natural Resource Trustees and designed to help restore natural resources injured by the releases of hazardous substances in Castro Cove, City of Richmond, Contra Costa County, California.

As documented in the DARP/EA, the selected projects are expected to compensate for injuries to natural resources caused by releases from the Castro Cove/Richmond Refinery. The projects selected will improve ecosystem function and species biodiversity through the conversion of what at present are principally terrestrial areas into diverse wetland ecotones. The DARP/EA was circulated for public review and comment, and responses were made to all comments. As a result of these comments, while the projects selected remained the same, the allocation of restoration acreage between the two projects was adjusted. Both projects are expected to be constructed in compliance with all permits required by the State and Federal regulatory agencies. The proposed activity was evaluated under the criteria specified by the National Environmental Policy Act (40 CFR 1508.27). Based on a review of all of these factors, NOAA and the Ttustees concur that the proposed activity would not have a significant effect on the quality of the human environment.

RESPONSIBLE
OFFICIAL: Pat Montanio
Director, Office of Habitat Conservation
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1315 East-West Highway, Rm. 14828
Silver Spring, Maryland 20910
Phone: 301-713-2325
Fax: 301-713-1043

The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact including the supporting environmental assessment (DARP/EA) is enclosed for your information.

Although NOAA is not soliciting comments on this completed EA/FONSI, we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the responsible official named above. Also, please send one copy of your comments to my staff at NOAA Program Planning and Integration (PPI), SSMC3, Room 15603, 1315 East-West Highway, Silver Spring, MD 20910.

Sincerely,

for Paul Doremus, Ph.D.
NOAA NEPA Coordinator

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

MEMORANDUM FOR: Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

FROM: Patricia A. Montanio
Director, Office of Habitat Conservation

SUBJECT: Finding of No Significant Impact for the Final Damage Assessment/Environmental Assessment on Castro Cove/Chevron Richmond Refinery – DECISION MEMORANDUM

Based on the subject DARP/EA for the Castro Cove/Chevron Richmond Refinery, I have determined that no significant impacts to the quality of the human environment will result from the proposed action. I request your concurrence in the determination of a Finding of No Significant Impact. Please return this signed memorandum for our project files and for the Administrative Record.

I concur: ______________________ 6/23/10
Date

I do not concur: ______________________
Date

Attachments