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San Leandro Bay Contamination Cleanup and Abatement Project Plan

The purpose of the project is to accomplish cleanup and abatement of contamination in San Leandro Bay, an industrialized subembayment on the east side of Lower San Francisco Bay. The project provides a nexus for several regulatory programs, including the region's cleanup program, municipal and industrial stormwater programs, implementation of TMDLs, potential resolution of 303(d) listings, and implementation of sediment quality objectives.

This project presents a unique blend of challenges and opportunities. The project is challenging because there is no known "smoking gun" of contamination. Instead, because of historical and ongoing industrial landuse on the Bay's shoreline and local watershed, contamination is distributed throughout San Leandro Bay sediments. A second challenge will be to accomplish cleanup while simultaneously promoting the resiliency of both San Leandro Bay's ecosystem and lower watershed against impacts of rising sea levels already being detected in California. A third challenge simultaneously represents a valuable opportunity – despite the presence of legacy contamination, San Leandro Bay has a productive, yet vulnerable aquatic ecosystem that supports birds and wildlife and provides recreational fishing opportunities for local residents. The cleanup and abatement must be accomplished with care such that this ecosystem is supported and enhanced but not threatened as a result of cleanup activities executed.

The guiding principles of the project are threefold – 1) to take actions as rapidly as possible commensurate with our evolving understanding of the site; 2) to adapt the remediation strategy as our understanding improves; and 3) to remedy the water quality and sediment threats caused by past actions while simultaneously making the system more resilient against harm in the future. In this respect, the cleanup and abatement of San Leandro Bay can serve as a model for the remediation and enhancement of other contaminated portions of enclosed bays and estuaries throughout California.

Problem Statement and Regulatory Background

San Leandro Bay is a focal point of the type of sediment contamination problems managed by our agency in that the sediments of this embayment have been contaminated as a result of historical and current industrial activities including electric transformer manufacturing, metal plating, automotive industries, and lead manufacturing industries in addition to urban commercial and residential runoff and atmospheric deposition. Contaminants continue to be conveyed to the embayment via creeks, storm drain channels, and tidal action from the Oakland Inner Harbor.

Because San Leandro Bay is a productive aquatic ecosystem, it represents an area of active transfer of contamination from the sediments into the food web. The sediments have sufficiently high levels of contamination to be directly toxic to aquatic life, and many of the contaminants can cause indirect effects through bioaccumulation in birds and other wildlife higher in the food web. Despite posted fish advisories to limit fish consumption, recreational fishing is popular both from boats and shore locations in San Leandro Bay. Fish caught from this embayment are likely contaminated with a number of toxic constituents. The impairment of recreational-fishing uses represents an environmental justice issue to the extent that some anglers depend on fishing in San Leandro Bay for some of their protein needs.

San Leandro Bay was designated as a toxic hot spot[1] by the State Water Board in 1999[2] for mercury, lead, selenium, zinc, PCBs, PAHs, DDT, and pesticides. The water body is currently on the 303(d) list for all of these contaminants as well as dioxins, furans, and invasive species. The adopted San Francisco Bay PCBs and mercury TMDLs also apply to San Leandro Bay.

The success of the San Francisco Bay PCBs and mercury TMDLs will depend on resolving legacy contamination in San Leandro Bay and other designated hot spots in the Bay. These Bay margin contaminated sites are areas that pose not only a local risk to aquatic life and humans but also risk to the Bay as a whole. One of the few available remedies to accelerate recovery of portions of San Francisco Bay is the cleanup of in-Bay contaminated sites. Areas like San Leandro Bay present the best opportunity for cleanup because contaminants are still somewhat concentrated and there are viable opportunities for remediation. Both TMDLs call for technical studies to better understand contaminated sites along the San Francisco Bay margins like the San Leandro Bay toxic hot spot.

This project also presents an important opportunity to implement the already adopted direct effects triad component of sediment quality objectives (SQOs) as well as provide an excellent "case study" opportunity for the indirect effects component now under development.

Physical Background

San Leandro Bay is a shallow embayment of San Francisco Bay formed by the confluence of several freshwater creeks and channels draining a heavily industrialized 420,000 acre watershed. The open water portion of the embayment extends 690 acres at mean higher high-tide and about 100 acres at mean lower low tide. San Leandro Bay is representative of many contaminated sites on the margin of San Francisco Bay and other urban estuaries that typically have:

- multiple pollutants above thresholds, multiple listings, multiple impairments of beneficial uses, and multiple applicable TMDLs;
- many historic and continuing sources of contamination; and
- a long history of contamination and degradation.

In spite of this legacy of alteration and degradation, San Leandro Bay today still supports many beneficial uses, including providing valuable habitat for endangered species (including least terns and more than 5% of the entire population of the California Clapper Rail) and many other animal and plant species; fishing; recreation; and navigation.

An investigation conducted by the San Francisco Estuary Institute and published in 2000[3] provided a preliminary characterization of the lateral and vertical contamination gradients in San Leandro Bay based on surface sediment measurements and data from sediment cores. The study

[1] Section 13391.5 of the Water Code defines toxic hot spots as: …[L]ocations in enclosed bays, estuaries, or adjacent waters in the 'contiguous zone' or the 'ocean' as defined in Section 502 of the Clean Water Act, the pollution or contamination of which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in the water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives."

[2] State Water Resources Control Board (1999). "Consolidated Toxic Hot Spots Cleanup Plan Volume I: Policy, Toxic Hot Spot Lists And Findings."

[3] San Francisco Estuary Institute 2000). "Sediment Contamination in San Leandro Bay, CA: A Watershed Based Investigation"

revealed horizontal concentration gradients for most of the measured contaminants originating at one or more of the creek channel inputs to the embayment. One exception to this pattern was mercury, which seems to be diffusely distributed in the embayment with no obvious gradients emanating from creek mouths. The evidence of scouring of the input creek channels during high flow periods and vertical gradients for a number of contaminants suggest the possibility of localized ongoing inputs of contaminants. There were discernible vertical gradients for most contaminants, with higher concentrations at depth as expected.

The Proposed Project

Our working hypothesis based on preliminary characterization studies is that there is no obvious known "smoking gun" in terms of a single source or region of San Leandro Bay that contains all the contaminants threatening humans and wildlife. Instead there are many possible historical and ongoing contributions of contaminants to the embayment as well as physical processes (creek flow, winds, tides, currents) at play that tend to redistribute the contamination in the Bay over short and long time scales. Some contaminants are distributed with obvious gradients originating in creek mouths, and others are diffusely distributed around the embayment.

We have no conclusive presumptions regarding the list of responsible parties, but we have identified a number of key stakeholders that we will engage throughout the adaptive implementation of the project. Some of the following stakeholders will likely emerge as responsible parties: Alameda County, local municipalities including the City of Alameda, San Leandro and Oakland, Pacific Gas and Electric, General Electric, East Bay Municipal Utility District, and the Port of Oakland. Once responsible parties have been identified, we will pursue appropriate cost recovery to offset or augment state resources used for the cleanup and abatement efforts.

Addressing the complex combination of problems in San Leandro Bay will be technically challenging so project products will be reviewed by a science peer review panel whose members will be nationally or internationally recognized authorities in their fields, and will represent all areas of expertise needed to guide this multi-disciplinary effort.

An important guiding principle of the project is to initiate cleanup and abatement and other regulatory actions as quickly as possible, commensurate with our understanding of the site. As we gain knowledge of the site through focused studies, we proceed in an adaptive manner where targeted investigations lay the scientific foundation for refined remedial actions.

The project will proceed in a step-wise fashion as outlined in the following paragraphs. The first product will be a detailed project work plan based on a compilation of existing information and current understanding of the sources pathways and loadings of contaminants and their transport and fate within San Leandro Bay. This proposal covers work on steps 1 through 5. Separate proposals for the remaining steps may be prepared in the future depending on whether responsible parties are identified and the nature of the cleanup and abatement actions.

We are requesting $3 million to be spent over 5 years and allocated as follows: project management, including stakeholder participation and scientific peer review ($200,000), project scoping, including compilation of existing data and preparing preliminary impairment

assessment, and detailed work plan ($200,000), spatial and temporal trends ($900,000), sources and loads ($800,000), ecological and human health risk assessment ($300,000), and feasibility assessment of remedial alternatives ($600,000).The Aquatic Science Center (a Joint Powers Authority created by the State Water Board) will be the technical lead on the project, but we envision tapping technical expertise of multiple partners and stakeholders like the United States Geological Survey. A detailed project outline for work is provided as Attachment 1.

1. Characterizing the current spatial extent of contamination

The project team will review available data regarding the contamination patterns as well as collect additional data from shoreline and wetland areas as well as biosentinels (juvenile resident fish and possibly benthic organisms) and sediment quality triad data. These data will provide for a detailed picture of the spatial extent of contamination to aid development in a site conceptual model and to set priorities for cleanup and abatement actions. All data will also be considered in the context of possible 303(d) list revision and refinement.

2. Determining temporal trends in sediment contamination

Temporal trends can be examined on both short and long time scales. Short term trends can be analyzed by comparing current surface sediment contaminant data with those collected a decade or more ago through the Bay Protection and Toxic Cleanup Program and San Francisco Estuary Institute monitoring efforts. Longer timescale trends can be determined through analysis of contaminant data from vertical sediment cores from several locations in the Bay as well as fringing wetlands. Sediment cores record the history of contamination, and measuring the decay of metal isotopes allows scientists to assign dates to vertical strata. These sediment core data provide a timeline for when various contaminants entered the Bay and settled in the sediments. These data can also provide insights as to the location of buried contaminants that may be exposed by erosion of overlying sediments or, conversely, where historical contamination is sequestered under a deep layer of cleaner overlying sediments. The sediment core data from wetlands are especially useful because these are generally areas where sediments only deposit and thus reveal an unambiguous historical record. In contrast, the vertical contaminant profiles from open water sites may be distorted due to vertical mixing from a variety of physical and biological mechanisms. Both types of cores are needed to establish the historical sediment contamination trends.

3. Identifying and characterizing past and current sources and loads

In addition to suspected historical and ongoing industrial sources, San Leandro Bay is likely impacted by stormdrain discharge, sewage discharge, and flux from the greater San Francisco Bay. Information about past and current sources and loads of contaminants comes largely from four types of information: tributary loading data; analysis of sediment cores; review of historical landuse information; and industrial production data. The preliminary sediment contamination characterization work from the late 1990s revealed horizontal concentration gradients for most of the measured contaminants originating at one or more of the creek channel inputs to the embayment. This step in the project will include detailed measurements of the contaminant loads entering the embayment from these creeks, especially during high flow events. Review of sediment cores, historical and current land use, and industrial production data can reveal important information about past and current sources and loads as well. For example, the

sediment cores provide a timeline for when contaminants entered the Bay. This can be cross-checked against available information on historical landuse and industrial production data. This approach often yields valuable insights regarding where to look for ongoing sources and how to approach cleanup and abatement. If we identify ongoing sources through this step, we are well-positioned to take immediate action through existing permitting and regulatory mechanisms, including the municipal regional stormwater permit, the industrial stormwater general permit and the site cleanup program.

4. Performing an ecological and human health risk assessment

Ecological and human health risk assessment identifies vulnerable and valued resources, prioritizes data collection activity, and links human activities with their potential effects. A useful first step in this endeavor is the development of a site conceptual model that describes the key physical, chemical and biological features of the San Leandro Bay site as well as the linkages of these features to relevant risk endpoints. The data described previously from surface and sub-surface sediments, wetlands, and biota will inform this conceptual model, and the direct and indirect effects metrics of California's sediment quality objectives as well as relevant water quality objectives will serve as useful risk-related endpoints as well. The risk assessment process is a powerful way to organize the many types of information needed to develop and evaluate remedial alternatives that can reduce human health and ecological risk and protect the environment in a cost-effective manner.

5. Conducting a feasibility study assessing remedial alternatives

The human and ecological risk assessment will be the basis of identifying a suite of candidate remediation strategies to evaluate. The feasibility evaluation will consider a range of factors including degree of risk reduction resulting from each candidate strategy, technical feasibility, degree of scientific uncertainty, and cost. It is possible that additional monitoring or technical studies will be needed during this step to fill data gaps prior to establishing the remediation action plan. The optimum cleanup strategy may be a hybrid of measures in which where actions having a high probability of success can be initiated immediately, and additional cleanup measures are phased in subject to focused information gathering.

6. Performing appropriate cleanup and abatement activities

All of the preparatory investigations and assessments culminate in the actual design and execution of the remedial action. Of course it is not possible to pre-judge the outcome of the remedial action selection, but foreseeable measures include removal of contaminated in-bay sediments, removal of shoreline sediments, remediation of on-land source areas, in-situ capping, interception of ongoing contaminant loads from the watershed, and monitored natural recovery.

7. Evaluate post-cleanup and residual risks to humans and wildlife

Once cleanup and abatement measures are underway and eventually completed the importance of ongoing evaluation, including monitoring, cannot be understated. Conceptual and quantitative models will be developed and tested against field observations to forecast recovery of the physical environment and food web. Field observations will likely continue for several years after cleanup measures have been completed.

Attachment 1

Outline of San Leandro Bay Contamination Cleanup and Abatement Project Plan Tasks

I. Program Management - **(All Steps 1-7 from narrative)**
   a. Stakeholder Coordination
   b. Peer Review Panel Coordination
   c. Identification of Goals and Objectives
   d. Workplan Development
   e. Budget and Funding Plan
   f. Internal Coordination
   g. Financial Administration
   h. Outreach Communication
   i. Reporting

II. Preliminary Impairment Assessment, Conceptual Model Development, and Sampling Plan Development Based on Existing Information - **(Supports Steps 1-4)**
   a. Evaluation of status of beneficial uses in San Leandro Bay
   b. Development of conceptual models of pollutant impacts
   c. Products
      i. Preliminary Impairment Assessment and Conceptual Model Report
      ii. Sampling Plan to Address Critical Information Needs
      iii. Quality Assurance Plan

III. Remedial Investigation Studies
   a. Ecological and Human Health Risk Assessment - **(Step 4)**
      i. Sediment quality assessment – direct effects
      ii. Sediment quality assessment – indirect effects
      iii. Wildlife risk assessment
      iv. Human exposure assessment
   b. Loading: Trends and Current Status - **(Step 3)**
      i. Tributary loading
      ii. Wetland coring
   c. Spatial Extent and Temporal Trends in Contamination - **(Steps 1-2)**
      i. Vertical extent in Bay cores
      ii. Shoreline inventory
      iii. Wetland inventory
      iv. Watershed inventory
      v. Sentinel monitoring for linkage analysis
   d. Recovery Forecasting - **(Steps 2,3, and 5)**
      i. Model development (including wetlands)
      ii. Field observations
      iii. Food web modeling (including field observations)
   e. Feasibility Assessment **(Step 5)**
      i. Identification of candidate remediation measures
      ii. Feasibility evaluation for candidates including pilot tests
      iii. Identification of data gaps and plan to address them
      iv. Remedial action selection and preparation of remedial action plan
   f. Products
      i. Peer-reviewed technical reports on each of these elements