Section 14. Comparative Evaluation of Remedial Alternatives

The comparative evaluation of remedial alternatives presented in this section includes the relative performance of each alternative (that has met the first two threshold criteria) with respect to the five balancing criteria, as outlined in the NCP and presented in Section 13. The NCP states: "The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." As discussed in Section 13.1.1, Alternative 1, the no action alternative, does not meet the first threshold criterion, overall protection of human health and the environment. Alternative 1 is retained for comparison as required by the NCP. The remaining alternatives (Alternatives 2 and 3) meet both threshold criteria (overall protection of human health and the environment and compliance with ARARs), and thus, both are included in this comparative evaluation. Alternative 2 involves excavation and disposal of solid waste, soil, and sediment (including monitoring and institutional controls), and Alternative 3 involves containment of solid waste, soil, and sediment (including monitoring and institutional controls).

The following evaluation compares Alternatives 2 and 3, each of which meets the two threshold criteria, against the five balancing criteria: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility, and volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. This evaluation serves to identify and assess the relative performance of each alternative with respect to these five criteria to assist the decision-making process. As discussed in Section 13, the last two criteria, State and community acceptance, will be assessed in the ROD following comment on the RI/FS and the proposed plan. Figure 14-1 and Table 14-1 summarize the comparative analysis and present each remedial alternative with rankings of its relative performance to each of the five balancing criteria.

14.1. LONG-TERM EFFECTIVENESS

The no action alternative (Alternative 1) would not provide long-term effectiveness or permanence because potential exposures to known areas of contamination would not be controlled.

Alternatives 2 and 3 would each be effective in the long-term. Alternative 2 would provide the highest degree of long-term effectiveness for Parcel E-2 because solid waste, soil, and sediment posing unacceptable risk would be permanently removed from the site, whereas Alternative 3 would leave all contaminant sources in place at the site, to be contained via capping. Alternative 3 would provide a moderate to high degree of long-term effectiveness because the final control systems (cap, gas control

system, and stormwater BMPs) would control potential exposure to contaminated solid waste, soil, and sediment; control landfill gas migration; and prevent off-site transport of contaminated soil via stormwater erosion. With proper maintenance and monitoring, closure of the landfill and adjacent areas (the Panhandle Area, East Adjacent Area, and Shoreline Area) would be both effective and permanent in the long-term.

Both Alternatives 2 and 3 are effective, in the long term, at minimizing exposure to contaminated groundwater. Presuming that the groundwater monitoring program will verify that A- or B-aquifer groundwater concentrations at the Parcel E-2 boundary (the point of compliance) do not exceed the potential chemical-specific ARARs, Alternative 3 could be effective in protecting human health in the long term because the cap would reduce infiltration and leachate generation, thus reducing the potential for contaminant migration in groundwater. In addition, institutional controls would increase the effectiveness of Alternative 3 by establishing legal and administrative mechanisms to manage the control systems and to ensure that land uses are compatible with the final cap. In Alternative 2, the excavation and removal of the contaminant sources (contaminated solid waste, soil, and sediment) would reduce residual concentrations of COCs in groundwater within the Landfill Area and, as a result, eventually allow restrictions on B-aquifer groundwater use to be removed once chemical concentrations have attenuated to less than the remediation goals.

In both alternatives, institutional controls would prohibit the use of Parcel E-2 aquifers as a source of drinking water, and require that workers adequately protect themselves from exposure when conducting activities that may lead to groundwater exposure.

Both alternatives would reduce the potential for gas migration in the long term. Alternative 2 would remove the subsurface waste; effectively eliminating subsurface gas generation. With proper O&M, the landfill gas collection system associated with Alternative 3 would effectively control landfill gas migration in the long term until landfill gas generation ceases to be a concern. Landfill gas treatment, if necessary, would effectively prevent unacceptable risks from inhalation.

The results of the comparative evaluation reveal that Alternative 2 has a higher degree of long-term effectiveness than Alternative 3, mainly due to the fact that the bulk of the contaminant source would be removed. Alternative 1 would have the lowest long-term effectiveness.

14.2. REDUCTION IN TOXICITY, MOBILITY, AND VOLUME

The no action alternative (Alternative 1) would not reduce the toxicity, mobility, or volume of solid waste, soil, sediment, landfill gas, or groundwater because none of these media would be treated, contained, or removed.

Neither Alternative 2 nor Alternative 3 would reduce the volume of contaminated solid waste, soil, or sediment. In Alternative 2, the material would be transferred to another location, and would not undergo any significant volume reduction. However, the excavated material would be placed at a licensed

disposal facility with engineered containment systems; thus reducing its mobility. In addition, because some of the excavated material might require treatment prior to disposal, there would be a reduction in the toxicity and mobility of contaminants in the material.

In Alternative 2, the volume of contaminated A-aquifer groundwater in the Landfill Area would be reduced by the extraction and treatment required as part of the excavation process, and the excavation of potential PCB and TPH soil sources (up to 10 feet bgs) would likely reduce the toxicity of groundwater in these areas. However, these removals would not reduce concentrations of hazardous substances in groundwater throughout Parcel E-2, and long-term groundwater monitoring would be required to ensure that A- or B-aquifer groundwater concentrations at the compliance boundary meet the remediation goals.

Because Alternative 3 involves containment and not active treatment, the volume of contaminated media would not be reduced. Operation of the planned control systems would reduce the mobility of several contaminated media by containing solid waste, soil, and sediment, controlling landfill gas migration, limiting infiltration and potential leachate generation, and preventing off-site transport of contaminated soil via stormwater erosion. However, with the exception of potential landfill gas treatment, this alternative involves containment and not active treatment; thus, the toxicity and volume of contaminated media would not be reduced.

Both Alternative 2 and Alternative 3 are expected to perform equally with respect to reduction in toxicity, mobility, and volume of contaminants criterion. Volume reductions of the contaminated media targeted for remediation (solid waste, soil, and sediment) would be negligible, while reductions in mobility and toxicity of contaminants would presumably be moderate for both alternatives. Alternative 1 would perform the poorest with respect to this criterion.

14.3. SHORT-TERM EFFECTIVENESS

Short-term effectiveness is a measure of the benefits seen by implementation of a remedial alternative and the risks associated with its implementation.

Due to the invasive nature of the excavation remedy, Alternative 2 would pose more short-term risks to site workers and the surrounding community than the containment remedy (Alternative 3). These risks could include exposure to dust, noise, and increased construction traffic. Alternative 2 is estimated to span a 4-year period during which excavation and disposal of solid waste, soil, and sediment would take place. This is two times longer than the two-year construction period estimated to implement Alternative 3, which involves construction of a cap and its associated control systems. Alternative 3 would also require less disruption of the in-place solid waste, soil, and sediment than the excavation remedy. Under both alternatives, risks to site workers and the surrounding community would be minimized, but not eliminated, by the use of institutional controls, engineering controls, and site monitoring.

In light of the elevated risks and longer construction duration associated with the excavation remedy, the short-term effectiveness of Alternative 2 is deemed to be substantially lower than Alternative 3 (the

containment remedy), which is expected to have moderate to high short-term effectiveness. Alternative 1 would have the highest relative short-term effectiveness because it would not involve remediation activities that might pose risks to the community, workers, or the environment.

14.4. IMPLEMENTABILITY

Alternative 2 presents numerous technical barriers that must be overcome for successful implementation due to the size and scale of the proposed excavation, and thus the implementability of this remedy is lower than Alternative 3. To mitigate the acute risks to site workers associated with the excavation remedy, various controls would need to be implemented. The massive scale of the excavation effort, coupled with the heterogeneous site conditions, make such controls difficult to implement. Other complications associated with the implementability of this remedy include:

- The proximity to the Bay
- The detrimental effects on the community caused by the increased rail and road traffic required for implementation (e.g., waste transportation for off-site disposal, construction equipment and supply mobilization/demobilization, importation of backfill soils)
- The difficulties that may be encountered during installation of the sheet-pile wall
- The difficulties associated with coping with groundwater and Bay water intrusion in the excavation area
- The lack of waste characterization information needed to facilitate planning and managing the waste disposal process effectively
- The laborious and time-consuming nature of the radiological screening process

The implementability of Alternative 3 is supported by EPA's guidance related to CERCLA municipal landfills. The technologies, construction methods, qualified personnel, materials, services, and equipment required to improve the implementability of this remedy are readily available. No administrative barriers to implementation are expected, because coordination, consultation, and the general support of public agencies, including EPA Region IX, DTSC, RWQCB, CIWMB, BAAQMD, and the City and County of San Francisco, is anticipated.

Based on the factors discussed above, the implementability of Alternative 3 far exceeds that of Alternative 2, which has a low implementability. The no action alternative (Alternative 1) would have the highest relative implementability because no resources are required to implement this alternative, and no known administrative considerations would impact its overall implementability.

14.5. COST

The costs for the alternatives being considered in this comparative analysis are as follows:

Remedial Alternative	Estimated Cost (Present Value)
Alternative 1 – No Action	$0
Alternative 2 – Excavation and disposal of solid waste, soil, and sediment (including monitoring and institutional controls)	$330 million
Alternative 3A – Containment of solid waste, soil, and sediment (including monitoring, institutional controls, and gas treatment by flare)	$72.8 million
Alternative 3B – Containment of solid waste, soil, and sediment (including monitoring, institutional controls, and gas treatment by GAC and potassium permanganate)	$73.9 million

It should be noted that Alternative 2 has the highest degree of uncertainty associated with the estimated costs due to the uncertainty associated with the constitution of the waste material to be excavated. More detailed cost estimates are included in Appendix R and summarized in Table 13-1.

14.6. STATE AND COMMUNITY ACCEPTANCE

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

14.7. SUMMARY OF COMPARATIVE ANALYSIS

Figure 14-1 summarizes the comparative analysis. The no action alternative (Alternative 1) would not be effective in protecting human health and the environment. Alternatives 2 and 3 (A and B) would be effective remedial alternatives for Parcel E-2. Of these, Alternatives 3A and 3B appear to be the most feasible, predictable, cost effective, time effective and implementable remedy, as revealed by this comparative analysis.

Figures

Remedial Alternatives	Threshold Criteria (Yes or No): Overall Protection of Human Health and the Environment	Threshold Criteria (Yes or No): Compliance with ARARs	Balancing Criteria: Long Term Effectiveness and Permanence	Balancing Criteria: Reduction through Treatment	Balancing Criteria: Short Term Effectiveness	Balancing Criteria: Implementability	Balancing Criteria: Cost
Alternative 1 – No Action No remedial action would be taken to remove solid waste, soil and sediment; groundwater and surface water would not be contained or treated Required by the NCP and is used as baseline against which other remedial actions are compared.	**Alternative 1 – No** Would not remove, contain, or treat solid waste, soil, sediment and groundwater contributing to human health and ecological risk Does not include institutional controls Does not provide any mechanisms for monitoring potential contaminant migration in landfill gas, surface water, or groundwater Would not meet all RAOs	**Alternative 1 – No** Because no action is proposed, this alternative does not comply with ARARs	**Alternative 1** Potential exposures to known areas of contamination would not be controlled Risk associated with exposure to solid waste, soil, sediment, landfill gas, and groundwater would not be reduced Existing control systems (landfill cap, gas control system, and stormwater BMPs) would not be maintained ***Performance: Low***	**Alternative 1** Would not reduce the toxicity, mobility, or volume of landfill solid waste, leachate, landfill gas, or soil exceeding evaluation criteria Shut down of operational gas control system may result in increases in toxicity, mobility, and volume ***Performance: Low***	**Alternative 1** Would not have any adverse short-term impacts because it would not involve remediation activities that might pose risks to the community, workers, or the environment ***Performance: High***	**Alternative 1** No resources are required to implement this alternative. No known administrative considerations would impact its overall implementability. ***Performance: High***	**Alternative 1** Total Capital Cost: No Cost Total O&M Cost: No Cost Total Periodic Cost: No Cost Period of Analysis: N/A Total Cost: No Cost Present Value: No Cost
Alternative 2 – Excavation and Disposal of Solid Waste, Soil, and Sediment (Including Monitoring and Institutional Controls) Excavation and offsite disposal of all solid waste, debris and soil in Landfill Area. Excavation and offsite disposal of solid waste and soil from Panhandle and East Adjacent Areas Excavation and offsite disposal of sediment in Shoreline Area Institutional Controls (legal and administrative mechanisms to enforce various land use restrictions) Site monitoring (groundwater and stormwater) Wetlands Restoration	**Alternative 2 – Yes** Would eliminate potential exposure of receptors to contaminated solid waste, soil, or sediment through direct contact or inhalation Would reduce or eliminates landfill gas generation and migration Would remove potential sources that could contaminate groundwater and surface water	**Alternative 2 – Yes** **Can meet all ARARs including:** Chemical-specific ARARs for groundwater and air Location-specific ARARs identified for the protection of coastal, wetlands, and biological resources Action-specific ARARs for excavation and disposal.	**Alternative 2** Solid waste, soil, and sediment posing unacceptable risk would be permanently removed Removal of contaminants would reduce residual concentrations of COCs in groundwater Institutional Controls would prohibit use of Parcel E-2 aquifers as a source of drinking water and require workers to protect themselves from exposure ***Performance: High***	**Alternative 2** Toxicity and mobility of contaminants in solid waste, soil, and sediment would be reduced Volume of contaminated A-aquifer groundwater would be reduced by extraction and treatment Toxicity of groundwater would likely be reduced due to excavation Would not reduce concentrations of hazardous substances in groundwater ***Performance: Moderate***	**Alternative 2** Risk to site workers and surrounding community Removal, storage, and treatment of contaminated solid waste, soil, sediment, and water would increase potential for spills ***Performance: Low***	**Alternative 2** Presence of subsurface debris would increase difficulty and cost of installing the sheet pile wall around the landfill need to minimize groundwater intrusion and improve excavation stability Without sheet pile wall, would be difficult to control intrusion of Bay water into excavation Screening of excavated materials prior to treatment and disposal would be time-consuming and costly ***Performance: Low***	**Alternative 2** Total Capital Cost: $342 million Total O&M Cost: $3.83 million Total Periodic Cost: $139,300 Period of Analysis: 34 years Total Cost: $346 million Present Value: $330 million
Alternative 3 – Containment of Solid Waste, Soil, and Sediment (Including Monitoring and Institutional Controls) Containment of: 1) Solid waste and soil in the Landfill Area with a multi-layer cap 2) Solid waste, soil, and sediment in the adjacent areas with a geosynthetic cap 3) Landfill gas, with an active collection and treatment system Two options for landfill gas treatment: Alternative 3A - Flare Alternative 3B - GAC and potassium permanganate Institutional Controls (legal and administrative mechanisms to enforce various land use restrictions) Site monitoring (groundwater, landfill gas, and stormwater) Wetlands Restoration	**Alternative 3 – Yes** Would prevent human and ecological receptors from direct contact, incidental ingestion, and inhalation of eroded waste particulates Would prevent exposure to groundwater contamination	**Alternative 3 – Yes** **Can meet all ARARs including:** Chemical-specific ARARs for groundwater and air Location-specific ARARs identified for the protection of coastal, wetlands, and biological resources	**Alternative 3** Caps would control potential exposure to contaminated solid waste, soil, and sediment Gas control system would control landfill gas migration Stormwater BMPs would prevent off-site transport of contaminated soil via stormwater erosion ***Performance: Moderate to High***	**Alternative 3** Mobility of contaminated media would be reduced by: Containing solid waste, soil, and sediment Controlling landfill gas migration Limiting infiltration and potential leachate generation Preventing off-site transport of contaminated soil via stormwater erosion Toxicity and volume of contaminated media would not be reduced. ***Performance: Moderate***	**Alternative 3** Risk of exposure to landfill contaminants or landfill gas would be low because disturbance of the landfill contents would be minimized Risk of contaminant release to the Bay during construction would be alleviated through engineering controls to restrict sediment transport ***Performance: Moderate to High***	**Alternative 3** Implementation along shoreline could be difficult due to depth of waste to be excavated Surface water controls would be required Deeper excavations in Panhandle Area may required dewatering and associated water management, disposal, or treatment Considered to be administratively implementable ***Performance: Moderate***	**Alternative 3** Alternative 3A: Total Capital Cost: $60.4 million Total O&M Cost: $21.2 million Total Periodic Cost: $754,700 Period of Analysis: 32 years Total Cost: $82.4 million Present Value: $72.8 million Alternative 3B: Total Capital Cost: $60 million Total O&M Cost: $23.5 million Total Periodic Cost: $754,700 Period of Analysis: 32 years Total Cost: $84.3 million Present Value: $73.9 million

Modifying Criteria
State and Community Acceptance
(Evaluated in the ROD after comment on the RI/FS and proposed plan)

Acronyms:

ARARs	Applicable or relevant and appropriate requirements
BMPs	Best management practices
COCs	Chemicals of concern
GAC	Granulated activated carbon
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
RAOs	Remedial action objectives
RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision

Note:
* Alternative 2 provided for completeness; this alternative does not meet the threshold criteria and is not required (by the NCP) to be compared against other alternatives

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FIGURE 14-1
Comparative Analysis of Remedial Alternatives

Remedial Investigation/Feasibility Study for Parcel E-2

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Tables

Table 14-1. Comparative Analysis of Parcel E-2 Remedial Alternatives

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Criteria	1 No Action	2 Excavate and Dispose Monitor / IC	3 Containment Monitor / IC
Protective Overall?	No	Yes	Yes
Compliant with Applicable or Relevant and Appropriate Requirements?	No	Yes	Yes
Long-term Effectiveness and Permanence	○	●	◕
Reduction of Toxicity, Mobility, or Volume via Treatment	○	◑	◑
Short-term Effectiveness	●	○	◕
Implementability	●	○	◑
Cost ($ Millions)	0	330	74
State Acceptance	To be evaluated after comment on RI/FS		
Community Acceptance	To be evaluated after the Public Comment Period		

Notes:

IC = institutional controls

RI/FS =remedial investigation/feasibility study

○ = low

◑ = moderate

◕ = moderate high

● = high