6. FEASIBILITY STUDY AND ALTERNATIVES ANALYSIS

This section presents: 1) the remedial technology screening matrix based on contaminated media, risk-based cleanup levels, and rough development grading requirements; 2) the criteria used to develop and evaluate remedial technologies; 3) the development of remedial action alternatives based on the screening and evaluation; and 4) assessment of remedial alternatives developed for UPC OU-SM, and rationale for selection of the preferred remedial approach.

6.1 Remedial Technology Screening

This section outlines the range of general response actions to address contamination at the Site, and corresponding remedial technologies that are potentially applicable for the contaminated soil, soil vapor, and groundwater at the Site.

6.1.1 General Response Actions

A range of general response actions (GRAs), for which corresponding remedial technologies may be applicable to Site conditions, were identified for the Site for initial baseline evaluation and comparison purposes under RAP Guidance in Section 6.1.2. The GRAs considered for the Site include: no action, institutional controls, containment, ex situ treatment, in situ treatment, and excavation/offsite disposal. One or more remedial technologies that correspond to the GRAs were then evaluated and compared based on three criteria: 1) effectiveness for achieving long-term protection; 2) implementability; and 3) relative costs.

To refine the range of remedial technologies that would potentially be developed into remedial alternatives for the Site that must undergo detailed analysis, the NCP at 40 CFR 300.430(e)(7) provides the opportunity to initially screen them against the short- and long-term aspects of the following three criteria:

- Effectiveness: Alternatives are judged on the degree to which an alternative reduces toxicity, mobility, or volume through treatment; minimizes residual risks and affords long-term protection; complies with ARARs; minimizes short-term impacts; and how quickly it achieves protection. Alternatives providing significantly less effectiveness than other, more promising alternatives may be eliminated. Alternatives that do not provide adequate effectiveness in protecting human health and the environment shall be eliminated from further consideration.
- Implementability: This criterion focuses on the technical feasibility and availability of the technologies each alternative would employ, and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible, or require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration.
- Cost: Costs of construction and any long-term costs to operate and maintain the alternatives shall be considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives may be used as a factor to exclude alternatives from further consideration. Alternatives providing effectiveness and implementability comparable to that of another

alternative by employing a similar method of treatment or engineering control, but at greater cost, may also be eliminated.

6.1.2 Remedial Technology Screening

This section describes the screening and selection of the range of remedial technologies that are potentially applicable for the contaminated soil, soil vapor, and Fill zone groundwater at the Site.

The Remedial Technology Screening Matrix presented in **Table 13** was used to guide whether a technology should be retained for further consideration based on the nature and extent of the current levels of contamination at the Site, as summarized in Section 3.

Land Use Restrictions (administrative/institutional mechanisms) would be included as components of the remedial action alternatives developed based on the remedial technology screening. These controls may be applicable both within the short term (e.g., to prevent reuse of groundwater or select vapor intrusion mitigation measures where there is significant risk or other controls until CULs are achieved), and in the long term to: 1) maintain the reuses consistent with the risk exposures assumed in the development of CULs (or Site-specific CULs) for the preferred remedial actions, and 2) prevent unrestricted reuses of areas where residual contamination may remain.

The following technologies retained from the screening were then incorporated in the development of remedial action alternatives described in Section 6.2:

- Institutional Control (administrative/institutional mechanisms) for Soil, Soil Vapor, and Groundwater – Restrictions limiting Site uses, including adopting land use restrictions (e.g., administrative controls and/or engineering controls) to ensure that uses are protective of Site users for CVOCs in soil vapor and groundwater;
- Capping (containment) for Soils – Capping of existing Site soil using hardscape materials or a specified thickness of clean soil to ensure the protection of future Site users by eliminating direct contact exposure pathways to impacted soil; and
- Excavation for Soils – Where development requires excavation or existing soil cannot be capped, excavation of soil exceeding CULs and offsite disposal and/or excavation and relocation beneath a cap to eliminate direct contact exposure pathways and, in the case of offsite disposal, to reduce the amount of contaminant mass at the Site.

6.2 Remedial Alternatives Development and Evaluation

6.2.1 Description of Evaluation Criteria

The above technologies were assembled into five remedial alternatives. The five remedial alternatives were subjected to: 1) a detailed alternative analysis pursuant to the nine criteria of the NCP and the six criteria of Section 2535b.1 of the HSC; and 2) comparative analysis identifying the advantages and disadvantages of each alternative when compared to other alternatives considered for the Site.

The nine NCP criteria include two threshold, five balancing, and two modifying criteria. For a remedial alternative to be considered an appropriate remedial action, it must meet both threshold criteria.

Balancing criteria provide an opportunity to identify and evaluate strengths, weaknesses, and the cost-effectiveness of an alternative. Modifying criteria are evaluated after the public comment period.

This section introduces these criteria. Summaries of the comparative evaluations of alternatives for the remedial action areas included in this Draft FS/RAP are presented in Section 6.4.

The HSC requires that the remedial alternatives be evaluated relative to the following six additional criteria:

1. Health and safety risks posed by the site conditions;
2. The effect of COCs present on probable present and future uses of contaminated or threatened resources;
3. The effect on available groundwater resources for present, future, and probable beneficial uses (treatment alternatives that reduce the volume, toxicity, and mobility of contaminants as opposed to alternatives that use offsite transport and disposal are preferred);
4. Site-specific conditions (potential for offsite migration) and existing contaminant background levels;
5. Cost-effectiveness, considering the short-term and long-term costs of the remedial action and whether deferral of a remedial action could result in a cost increase or hazard increase to human health or the environment; and
6. The potential environmental impacts of the remedial alternative such as land disposal of contaminated material versus treatment to remove or reduce its volume, toxicity, or mobility prior to disposal.

The six HSC criteria are similar to, and covered under, the nine NCP criteria in this Draft FS/RAP, as described below.

6.2.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment - Addresses whether a remedy provides adequate protection and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or land use restrictions.

Compliance with ARARs - Addresses whether a remedy will meet all applicable or relevant and appropriate Federal, State and local environmental laws and regulations.

6.2.1.2 Balancing Criteria

Long-term Effectiveness and Permanence - Considers the ability of a remedy to provide reliable protection of human health and the environment over time once cleanup goals have been achieved.

Reduction of Toxicity, Mobility, and Volume Through Treatment - Evaluates the anticipated performance of the alternative with respect to the reduction of toxicity, mobility, and volume of contaminants. This criterion reflects the preference for treatment of contaminated soil and groundwater as opposed to offsite transport and disposal.

Short-term Effectiveness - Evaluates the period of time needed to complete the remedy, and any adverse impact on human health and the environment that may be posed during the construction and implementation period, until cleanup standards are achieved. Potential impacts during construction include construction worker exposure to Site COCs, offsite dust migration, offsite storm water and sediment migration, air pollution, and noise.

Implementability - Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a remedial option.

Cost - Evaluates the capital and O&M costs for 10 years for each alternative. Cost estimates of this type are considered accurate to a range of minus 30% to plus 50%. The reasons for this range are the variability of construction materials, variability in construction costs over time, the complexity of developing site-specific cost factors, and the sensitivity of construction costs to economic factors such as interest rates and materials costs.

6.2.1.3 Modifying Criteria

These criteria will be addressed during the public review and comment period on this Draft FS/RAP and will be summarized in the Responsiveness Summary to this Draft FS/RAP.

Regulatory Agency Acceptance - Indicates whether, based on their review of the information, the applicable regulatory agencies would agree with the preferred alternative.

Community Acceptance - The Draft FS/RAP is subject to public review and comment prior to selection of the remedial action alternative. This criterion assesses whether community concerns are addressed by the remedy and whether the community prefers a remedy. The final remedies in this Draft FS/RAP will be selected following the public comment period.

6.3 Description of Remedial Action Alternatives

This section describes the remedial action alternatives that were developed based on assembly of the following applicable remedial technologies that passed the initial screening:

Land Use Restrictions -- Land Use Covenant documenting the following prohibitions: • No occupied buildings, including sensitive uses, where CVOC concentrations in soil vapor exceed CULs without DTSC approval based on either (1) a risk assessment demonstrating Site soil vapor conditions pose no significant risk to human health, or (2) engineering controls, such as building design or gas intrusion mitigation systems, that will reduce the risk of vapor intrusion to an acceptable level; • No growing produce or vegetables for human consumption in native soil. Plants for human consumption may be grown if they are planted in raised beds (above the approved cover) containing non-native soil. Trees producing edible fruit (including trees producing edible nuts) may also be planted provided they are grown in containers with a bottom that prevents the roots from penetrating the native soil; • No extraction or use of underlying groundwater is allowed without a Groundwater Management Plan pre-approved by DTSC; • No drilling for any water, oil, or gas, or extraction or removal of groundwater without a DTSC-approved Groundwater Management Plan and prior written approval by DTSC; • No interference with, or modification of, a vapor mitigation system shall be permitted without prior written approval by DTSC, and future tenants must provide reasonable access for O&M of vapor mitigation systems; • All excavation into the cap shall comply with the DTSC-approved Soil Management Plan (SMP); • Contaminated soils brought to the surface by grading, excavation, trenching or backfilling shall be managed in accordance with all applicable provisions of state and federal law and a pre-approved DTSC SMP; and • All uses and development of the Site shall preserve the integrity and effectiveness of the cap.
Engineering Controls -- Vapor intrusion mitigation systems or intrinsically safe building design for mitigating vapor intrusion into indoor air by VOCs in soil vapor; -- Sub-slab venting.
Capping -- Soil cover meeting unrestricted use screening criteria for the COCs identified at the Site with a minimum 5-foot thickness and an underlying demarcation layer. -- Hardscape consisting of concrete, asphalt, masonry, or other durable, impervious surface. -- Building foundations. -- O&M Plan to maintain capped surfaces and operate vapor intrusion mitigation systems, if applicable.
Excavation -- Onsite relocation of excavated soil exceeding CULs and capping with a soil cover, hardscape, or building foundation. -- Offsite disposal of excavated soil at a licensed and approved waste management facility.

The following Site-wide remedial action alternatives were developed based on the screening of remedial technologies presented in Section 6.1.2 and summarized in **Table 13**:

- Alternative 1: No Action;
- Alternative 2: Land Use Restrictions and Engineering Controls for Vapor Intrusion Mitigation;

- Alternative 3: Soil Capping and Localized Excavation with Some Onsite Relocation and Some Offsite Disposal, Land Use Restrictions, and Engineering Controls for Vapor Intrusion Mitigation;
- Alternative 4: Soil Capping and Excavation with Offsite Disposal, Land Use Restrictions, and Engineering Controls for Vapor Intrusion Mitigation; and
- Alternative 5: Soil Excavation with Offsite Disposal and Land Use Restrictions.

For the evaluation of remedial alternatives, it was assumed that regrading will be completed in anticipation of redevelopment under all remedial alternatives. Regrading for redevelopment assumes soil will be imported to the Site to raise the grade according to the development plan but without a remediation objective. So although remedial alternatives describe remedial activities, not development activities, the remedial alternatives were evaluated based on the anticipated final grade of the Site prior to the commencement of vertical construction.

The alternatives are described below and comparatively evaluated in Section 6.4 based on the criteria presented in Section 6.2.

6.3.1 Alternative 1 — No Action

No additional control or protection of human health and the environment would be implemented for the contamination present at the Site. This alternative is required as a baseline alternative for comparison to other alternatives under RAP Guidance. There is negligible cost associated with administrative activities for this alternative.

6.3.2 Alternative 2 — Land Use Restrictions and Engineering Controls for Vapor Intrusion Mitigation

This alternative assumes no active remediation would be implemented and there would be land use and activity restrictions to prevent an unacceptable risk due to environmental conditions.

Land Use Restrictions: A land use covenant would be recorded on the title to the property that would clearly define the land use and activity restrictions that would be necessary to prevent human exposures to contaminants left in place in soil and/or soil vapor above CULs.

Engineering Controls: Engineering controls would be implemented to control dust emissions and stormwater runoff during construction and to mitigate intrusion of VOC vapors from the groundwater and soil into occupied buildings where needed. For costing purposes, monitoring of engineering controls to verify the vapor intrusion risk has been mitigated would be conducted for 30 years following construction.

The total estimated cost of this alternative is approximately 4,430,000, which includes capital costs of 840,000 and O&M costs of 3,590,000 (Appendix C).

6.3.3 Alternative 3 — Soil Capping and Excavation with Partial Onsite Relocation and Partial Offsite Disposal, Land Use Restrictions, and Engineering Controls for Vapor Intrusion Mitigation

This alternative consists of soil capping in most areas of the Site, as dictated by the proposed development grading plan; excavation of some soil and relocation onsite to be placed under streets or building foundations, which would act as a hardscape cap; excavation of some soil and offsite disposal; land use restrictions where capping or excavation are not implemented; and engineering controls.

As noted in the Project Description (Section 1.4), the proposed development grading plan requires that a significant amount of soil be imported to the Site and placed as fill to raise the grade to a new elevation. The ground surface elevation at the Site will remain at the current elevation adjacent to Bayshore Boulevard, but will be raised substantially near the railroad tracks to accommodate the Geneva Avenue extension flyover. The thickness of fill that is specified in the grading plan ranges from a minimum of 5 feet to as much as 30 feet across most of the Site. To meet the remedial action objectives of this Alternative 3 (i.e., ensure the protection of future Site users by breaking the direct exposure pathway to impacted soil), impacted soil shall be capped with either hardscape material or at least 5 feet of clean, imported soil. The quality of this imported soil will satisfy the residential land use cleanup levels specified in Section 4.2.1 and Appendix D, as determined in accordance with the DTSC's Clean Fill Advisory [DTSC, 2001]. A demarcation layer consisting of a bright-colored geotextile fabric would be placed between the clean soil cap and the existing soil. A conceptual cross-section depicting the cover-fill configuration is provided as **Figure 21**.

Soil in the western portion of the Site adjacent to Bayshore Boulevard with COCs that exceed health risk criteria will either be capped by hardscape (i.e., building foundations or roadways) or excavated for onsite relocation or offsite disposal. The excavations would be backfilled so the thickness of clean soil is at least 5 feet over any residual soil or fill from onsite with COC concentrations exceeding CULs. Excavated soil that is relocated onsite and that contains COCs above CULs will be capped beneath 5 feet of imported clean fill or beneath hardscape elsewhere on the Site.

The property boundary along Bayshore Boulevard is approximately 1,400 feet long. Assuming an average 10% incline, the ground surface elevation will rise by 5 feet at a distance of 50 feet east of Bayshore Boulevard. Within this 1,400 feet by 50 feet area, any existing soil with COCs that exceed the CULs and that will not be covered by hardscape will need to be excavated and backfilled. Assuming that half the area will be covered by hardscape, the area subject to excavation is 35,000 square feet. Further assuming a linear incline from 0 feet to 5 feet, the average thickness of clean fill would be 2.5 feet. Thus, to create a 5-foot thick column of clean soil atop existing Site soil, the average excavation depth in this area would be 2.5 feet (i.e., the excavation depth is zero feet where the thickness of clean fill is 5 feet, and the excavation depth is 5 feet where the thickness of clean fill is 0 feet). An excavation with area 35,000 square feet and thickness 2.5 feet has a volume of 87,500 bank cubic feet, which is approximately 3,200 bank cubic yards or 3,840 bulk cubic yards assuming a bulking factor of 1.2. Providing an allowance for deeper excavations, the assumed volume of soil excavation under this alternative is 5,000 bulk cubic yards.

For costing purposes, 2,500 bulk cubic yards of excavated soil was assumed to be relocated onsite and appropriately capped with a clean soil cover, hardscape, or a building foundation. The other 2,500 bulk cubic yards would be transported offsite for disposal; it was assumed 80% (i.e., 2,000 cubic yards) would be disposed as non-hazardous waste at the Class II facility in Altamont, California, and 20% (i.e., 500 bulk cubic yards) would be disposed as non-RCRA hazardous waste at the Class I facility in Buttonwillow, California. Other permitted disposal facilities may be used if appropriate. The offhaul volume of 2,500 bulk cubic yards corresponds to 208 truckloads of 12 bulk cubic yards per load. Offhaul would occur over approximately 10 days. Excavation and relocation/offhaul details will be specified in the RDIP.

Soil vapor sampling will be conducted after regrading and prior to commencing vertical construction. If warranted by the soil vapor sample results and Site-specific risk assessment, vapor intrusion mitigation will be included in future building construction. For costing purposes, monitoring of engineering controls to verify the vapor intrusion risk has been mitigated would be conducted for 30 years following construction.

The total estimated cost of this alternative is approximately 12,600,000, which includes capital costs of 9,000,000 and O&M costs of 3,600,000 (Appendix C).

6.3.4 Alternative 4 — Soil Capping and Excavation with Offsite Disposal, Land Use Restrictions, and Engineering Controls for Vapor Intrusion Mitigation

This alternative is similar to Alternative 3 except that the entirety of an assumed 5,000 bulk cubic yards of soil would be transported offsite for disposal at a permitted waste management facility rather than half of it being relocated onsite. For the cost estimate, it was assumed that 80% of the soil would be transported to the Class II facility in Altamont, California, and 20% of the soil would be transported to the Class I facility in Buttonwillow, California. Other approved disposal facilities may be used if appropriate. The offhaul volume of 5,000 bulk cubic yards corresponds to 416 truckloads of 12 bulk cubic yards per load. Offhaul would occur over approximately 20 days. All other elements are as described in Alternative 3.

Soil vapor sampling will be conducted after regrading and prior to commencing vertical construction. If warranted by the soil vapor sample results and Site-specific risk assessment, vapor intrusion mitigation will be included in future building construction. For costing purposes, monitoring of engineering controls to verify the vapor intrusion risk has been mitigated would be conducted for 30 years following construction.

The total estimated cost associated with implementation of this alternative is approximately 13,000,000, which includes capital costs of 9,400,000, and O&M costs of 3,600,000 (Appendix C).

6.3.5 Alternative 5 — Excavation with Offsite Disposal, Land Use Restrictions, and Engineering Controls for Vapor Intrusion Mitigation

In this alternative, all soil with COC concentrations exceeding CULs would be excavated to the depth of: (1) the top of a sample with all COC concentrations below screening levels; or (2) a maximum of five feet below ground surface. The estimated excavation depths across the Site are shown in **Figure 22**. All excavated soil would be transported offsite for disposal at a permitted waste management facility. For the cost estimate, it was assumed that 80% of the soil would be transported to the Class II facility in Altamont, California, and 20% of the soil would be transported to the Class I facility in Buttonwillow, California. Other approved disposal facilities may be used if appropriate. The offhaul volume of 242,500 bank cubic yards (291,000 bulk cubic yards) corresponds to 24,250 truckloads of 12 bulk cubic yards per load. Assuming the same haul rate as Alternatives 3 and 4, offhaul would occur over approximately 3 years. Following excavation, clean fill would be imported to the Site and placed in the excavations to bring the ground surface back to the existing grade. Imported soil would be placed and compacted to accommodate additional fill loads and building loads.

Soil vapor sampling will be conducted after regrading and prior to commencing vertical construction. If warranted by the soil vapor sample results and Site-specific risk assessment, vapor intrusion mitigation will be included in future building construction. For costing purposes, monitoring of engineering controls to verify the vapor intrusion risk has been mitigated would be conducted for 30 years following construction.

The total estimated cost associated with implementation of this alternative is approximately 61,500,000, which includes capital costs of 57,900,000, and O&M costs of 3,600,000 (Appendix C).

6.4 Summary Evaluation and Comparative Analysis of Remedial Action Alternatives

The five remedial alternatives identified in Section 6.3 were assessed using seven of the nine NCP criteria for CERCLA sites established by USEPA [USEPA, 1989c] and additional California HSC criteria, as introduced in Section 6.2. The remaining two of the nine NCP criteria will be assessed after the Draft FS/RAP has been made available for public comment. A summary of the alternative evaluation and comparison is presented below.

6.4.1 Threshold Criteria

6.4.1.1 Overall Protection of Human Health and the Environment, and Compliance with ARARs

Under Alternatives 1 and 2, portions of the Site would be capped with imported fill and/or covered with hardscape as part of the development grading plan, irrespective of the presence of COCs in soil. However, future Site users may come into contact with COCs in existing soil in uncapped areas. Thus, Alternatives 1 and 2 would not completely prevent exposure to Site COCs above CULs and would therefore not provide overall protection of human health and the environment nor comply with ARARs. Furthermore, Alternatives 1 and 2 would not provide for mitigation against vapor intrusion, if warranted. For this reason, Alternatives 1 and 2 were not selected.

In contrast, Alternatives 3, 4, and 5 would provide for capping, excavation, land use restrictions, and vapor intrusion mitigation (if warranted) such that exposures to COCs above CULs in soil, soil vapor, and groundwater would be prevented. Therefore, these Alternatives would provide overall protection of human health and the environment as well as comply with ARARs including Measure JJ (**Table 12**).

6.4.2 Balancing Criteria

6.4.2.1 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of contaminants in soil through treatment and fail to meet this criterion. Although Site-specific treatment is not proposed under any alternative, development activities including the placement of clean fill in a portion of the Site and construction of building foundations and roadways would reduce the mobility of contaminants in existing soil. Continued treatment of CVOCs in groundwater migrating from the Schlage OU, as required in the Schlage OU RAP, would provide for reduction of toxicity, mobility, and volume of CVOCs in groundwater. For Alternatives 1 and 2; contaminant toxicity or mobility in soil or soil vapor would not be reduced in areas of the Site where neither raising the ground elevation nor construction are part of the redevelopment plan. In these areas, the risk levels identified in the HRA would be unmitigated during and following redevelopment.

In contrast, Alternatives 3, 4, and 5 would reduce the mobility (e.g., potential wind dispersal and stormwater run-off) of COCs in soil across the entire Site. Continued treatment of CVOCs in groundwater migrating from the Schlage OU, as required in the Schlage OU RAP, would provide for reduction of toxicity, mobility, and volume of CVOCs in groundwater. All existing Site soil would either be isolated beneath a cap of clean soil cover or hardscape, or would be excavated and transferred to a permitted landfill. Additionally, Alternatives 3, 4, and 5 would reduce the mobility and volume of contaminants in soil at the Site through excavation and offsite disposal. However, the toxicity of the off-hauled contaminated soil would not be reduced and would merely be transferred to a permitted landfill. The greater requirement for transport of impacted soil under Alternatives 4 and 5 relative to Alternative 3 increases the risk of release due to the potential for highway-related accidents, loading and unloading activities, and potential releases from the landfill facility, should its containment become compromised. The transport of the impacted soil would also contribute to the emission of criteria air pollutants, other toxic air pollutants, and greenhouse gas emissions.

6.4.2.2 Long-Term Effectiveness and Permanence

Alternatives 1 and 2 would not effectively prevent exposures across the entire Site in the long-term, given the reasonably anticipated use of the Site, because no action would be taken to mitigate Site risks in areas where neither raising the ground elevation nor construction are part of the redevelopment plan.

Alternatives 3, 4, and 5 would offer long-term effectiveness and permanence by addressing COCs in soil across the entire Site, implementing and maintaining land use restrictions, and preparing a soil management plan that would describe requirements for any potential contact with impacted soil or groundwater at the Site. Although Alternative 5 would offer long-term effectiveness for the Site, this Alternative would transfer a significant amount of contaminated soil to a landfill, where it would require management in perpetuity to prevent long-term impacts to the environment. It would also contribute to aggregate greenhouse gas loading.

6.4.2.3 Short-Term Effectiveness

Alternatives 1 and 2 would not be effective in the short term, given the reasonably anticipated use of the Site, because no action would be taken to mitigate Site risks in areas where neither raising the ground elevation nor construction are part of the redevelopment plan.

For Alternatives 3 and 4, the period of time needed to complete the remedy would be similar, though offhaul of excavated soil would be expected to take approximately 10 days for Alternative 3 and 20 days for Alternative 4. Assuming the same haul rate, the time required to complete offhaul of excavated soil for Alternative 5 would be approximately 970 days. For Alternatives 3, 4, and 5, short-term protectiveness would be provided by implementing measures to protect remedial construction workers, and through Occupational Safety and Health Administration (OSHA) work standards during excavation, relocation and capping (Alternative 3), and excavation and offsite disposal (Alternatives 4 and 5).

Controls identified in pre-construction plans and implemented during construction would manage offsite dust migration and offsite storm water and sediment migration. Best practices will be implemented to minimize air pollution, and all construction activities involving heavy machinery will be conducted during typical working hours. Air pollution and noise impacts will be far greater for Alternative 5 than for Alternatives 3 and 4 because of the more extensive earthwork in Alternative 5. Air pollution would be associated with heavy equipment excavating and handling soil, trucks to transport material offsite, trucks to transport soil back onsite to fill the excavation, and heavy equipment for placing and compacting fill soil back into the excavation.

The greenhouse gas emissions by excavators and loaders is roughly proportional to the quantity of soil being excavated and stockpiled. Thus, the greenhouse gases emitted during excavation and stockpiling of 242,500 cubic yards of soil would be approximately 48 times greater than excavating and stockpiling 5,000 cubic yards of soil.

The impacts of soil transportation for each alternative were estimated using assumptions for the UPC OU-SM in the Draft Environmental Impact Report for the Brisbane Baylands [ESA, 2013]. The following emissions were calculated for Alternatives 3, 4, and 5:

Alternative	Offhaul of Excavated Soil	Import of Backfill or Cap Soil	TOTAL
3 – Capping, limited excavation with partial onsite relocation and partial offsite disposal	62	104	166
4 – Capping, limited excavation with offsite disposal	124	104	224
5a – Site-wide excavation and offsite disposal, backfilling to current grade	6,038	89	6,127
5b - Site-wide excavation and offsite disposal, backfilling and regrading to 5 feet above current grade (same as Alternatives 3 and 4)	6,038	193	6,231

Notes: Units are metric tons of greenhouse gas emissions as carbon dioxide equivalents based on emission factors provided in Appendix G of the Draft Environmental Impact for the Brisbane Baylands [ESA, 2013]. Transport of excavated soil to Altamont Landfill (58 miles from the Site) and Buttonwillow Landfill (260 miles from the Site) were assumed for non-hazardous and hazardous soil, respectively; imported fill was assumed to be transported from the Baylands Soil Processing facility (1.25 miles from the Site).

Thus, the greenhouse gas emissions that would be generated transporting soil are approximately 37 times higher for Alternative 5 than for Alternative 3. The soil quantities for placement and compaction are slightly greater for Alternative 3 than for Alternative 5 (i.e., 339,600 bulk cubic yards and 291,000 bulk cubic yards, respectively), so greenhouse gas emissions would be roughly similar but slightly higher for Alternative 3 by a factor of approximately 1.2. The higher greenhouse gas emissions associated with excavation, stockpiling, and transportation make Alternative 5 approximately 35 to 50 times more impactful than Alternative 3.

However, the Site grade following implementation of Alternative 3 or 4 would be five feet higher than current grade across most of the Site, whereas the Site grade would be unchanged following implementation of Alternative 5. Currently, the development plan consists of raising the grade over most of the Site by at least 5 feet and up to 30 feet. Comparing emissions for Alternative 3 or 4 against Alternative 5 for the same post-remedial Site grading (i.e., approximately 5 feet higher than current grade across most of the Site), Alternative 5 would require backfilling the excavation and importing soil to raise the Site grade 5 feet, summarized as Alternative 5b above.

6.4.2.4 Implementability

All alternatives are readily implementable from a technical and administrative feasibility perspective. However, Alternative 2 would be easier to implement from a technical perspective than Alternatives 3, 4, and 5 because it only involves administrative action for implementing the land use restrictions, compared to excavation and/or capping of soils under Alternatives 3, 4, and 5. Alternative 5 is implementable but provides the highest overall risk and emissions to the environment due to waste hauling and offsite transfer of all excavated soil, and import and placement of fill soil. Significantly increased truck traffic would increase congestion on surface streets and highways and increase the likelihood of vehicular accidents.

6.4.2.5 Cost

Of the three remedial alternatives that are protective of human health and the environment, Alternative 3 (12,600,000) has a lower estimated cost than Alternative 4 (13,000,000) and Alternative 5 (61,500,000) (Appendix C).

6.4.3 Modifying Criteria

6.4.3.1 Regulatory Agency and Community Acceptance

Formal assessment of regulatory agency and community acceptance will be considered during the public comment period on this Draft FS/RAP, and documented in a Responsiveness Summary that will be included as part of the Final FS/RAP.

6.4.4 Additional HSC Criteria

Alternatives 1 and 2 do not meet several California HSC criteria for the entire Site, including the health and safety risks posed by contamination at the Site and the effect of contamination on future uses of the Site. Alternatives 3, 4, and 5 would likely meet all California HSC criteria. Alternative 5 would result in the greatest offsite environmental impacts due to hauling and transportation of all excavated soil to an offsite landfill facility.

6.5 Alternatives Screening Results

The comparative analysis of remedial alternatives discussed in the previous section is summarized in **Table 14**. Scores were assigned to each remedial alternative for each of the above criteria based on whether the alternative meets the criterion, mostly meets the criterion, partially meets the criterion, or does not meet the criterion.

Alternatives 1 and 2 are not adequately protective and scored low for threshold criteria and several balancing criteria. Alternatives 3, 4, and 5 are all similarly protective in that COCs in existing fill would be isolated beneath a cap and potential exposure pathways would be incomplete. Alternative 3 scored the highest based on comparable protectiveness as compared with Alternatives 4 and 5 and the lowest environmental impact by virtue of offhauling the least amount of soil of the three alternatives. Alternative 4 scored second highest and is nearly identical to Alternative 3 except for the higher environmental impact associated with the larger volume of soil offhaul. Alternative 5 had the third highest score on account of negligible improvement on protectiveness relative to Alternatives 3 and 4 but considerable environmental impact associated with soil offhaul. Based on the comparative analysis of remedial alternatives, Alternative 3 was selected as the preferred alternative.