DRAFT

REMEDIAL ALTERNATIVES FEASIBILITY ANALYSIS

1 DOCK STREET

The following feasibility analysis is focused on developing an efficient and cost-effective remediation technology for the impacted soil at the site.

Review of Possible Remedial Alternative

Items to be considered in the selections of an appropriate remedial action for VOC, PAH and ETPH-impacted soils at the site include:

- **Media impacted and degree of impacts**: The affected medium addressed by this RAP is soil. VOC concentrations range up to 1,900,000 parts per billion (ppb) (naphthalene), PAH concentrations range up to 4,800,000 ppb (naphthalene), arsenic concentrations range up to 36 parts per million (ppm) and ETPH concentrations range up to 52,000 ppm.

- **Regulatory requirements**: Remediation of the soil will take place considering the end use of the site as part of a road right-of-way.

- **Volume of contaminated material (soil) requiring action**: The volume of impacted soils is estimated at 270 cubic yards.

- **Site accessibility to equipment (soil) depth and surface features**: The impacted areas are accessible by heavy equipment, as the area is currently a parking lot and the impacted soils are shallow.

- **Physical and biological properties of the contaminants of concern**: VOCs are extracted by sodium bisulfate or methanol via EPA Method 5035 and 8260. This method recovers a broad range of VOCs, including chlorinated solvents. These compounds are very light and easily biodegraded. PAHs, which are a subset of semivolatile organic compounds (SVOCs), are extracted via Method 8270. Given their heavier weights, these compounds are less easily degradable than VOCs and are expected to be more recalcitrant with increasing weight. ETPH, by the CTDEP-approved method, recovers hydrocarbons in the approximate carbon range of C9 to C36. The method would also recover a broad range of PAHs. The compounds at the lighter end of the range may be biodegradable, but are expected to be more recalcitrant with increasing weight.

- **Properties of the contaminated material**: The impacted material consists of fine to medium-grained sands mixed with varying amounts of silt and gravel.

- **Other impacts, such as the presence of hazardous vapors or ground water contamination, which may dictate immediate actions**: The impacts to soils identified to date are likely associated with the presence of USTs on the adjacent site to the east (2 Dock Street) and/or the nature of the fill materials present in the shallow subsurface. Although the reported concentrations of select VOCs, PAHs, arsenic and ETPH exceed the RDEC, direct access to the impacted soils is prevented by asphalt cover.

- **Site use, ability to accommodate disruption during action**: The portion of the 1 Dock Street site that the City has acquired is utilized as a parking lot and it can accommodate disruption associated with remedial activities.

- **Cost of the applicable alternatives**: Costs are a consideration in comparing technologies which could be effective in achieving the applicable standards. Cost is a secondary consideration to schedule or other factors, such as the degree of hazard.

The remedial approaches considered to address the VOC, PAH, ETPH and arsenic impacts to soil at the site are presented below.

No Action/Natural Biodegradation

The no-action alternative would result in the impacted soil remaining in place, and would rely on biodegradation of the residual hydrocarbons by naturally occurring soil bacteria and volatilization to gradually reduce concentrations.

<u>Applicability/Limitations</u>: Natural biodegradation will not result in rapid reduction of PAH and ETPH concentrations, therefore, the concentrations would continue to exceed the RDEC and the GB PMC for a long period of time. This method is not applicable to metals-impacted soils.

<u>Effectiveness</u>: The effectiveness and rate of natural biodegradation would depend on the presence and populations of hydrocarbon-consuming bacteria and the availability of nutrients (oxygen, nitrates, phosphorous, moisture, etc.), which are not known at this time. It is anticipated that natural biodegradation would not decrease concentrations to below the applicable criteria in an acceptable time frame.

<u>Other Considerations</u>: The no-action alternative would not require additional permits and would not cause disruption to the current site operations. However, as the soils will be exposed and disturbed as part of the SUT project, these soils would then need to be properly handled, sampled, disposed of.

<u>Costs</u>: The no-action alternatives would not result in any immediate or short-term costs.

The no-action/natural biodegradation alternative is not considered appropriate, as it would not result in timely/complete remediation of the site.

Soil Vapor Extraction/Bioventing

Soil vapor extraction (SVE) is a process that removes volatile compounds from unsaturated soils by creating a negative pressure in the soil vapor, thereby encouraging volatilization of the residual hydrocarbons into the soil vapor. Bioventing is a similar technology that encourages in-situ biodegradation of residual hydrocarbons by increasing oxygen concentrations in the soil gas.

> Effectiveness/Limitations: SVE/bioventing can be applied to in-situ or stockpiled soils and can be useful for remediating soils inaccessible to excavation, such as deep soils or soils under buildings, roads, or utilities. SVE is well suited to remove high vapor pressure, low boiling point compounds, such as those present in gasoline or degreasing solvents. SVE may not entirely remove volatile hydrocarbons from soils, but should be capable of significantly reducing residual concentrations with the exception of soils in the areas of two soil borings at the site which exhibit relatively low VOC concentrations.
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> The concentrations of heavier hydrocarbons may be reduced by in-situ biodegration facilitated by bioventing. This effectiveness of bioventing may vary significantly depending on the characteristics of the target hydrocarbon compounds.
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> This method is not applicable to metals-impacted soils.
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> Other Considerations: Vapor extraction pilot testing would be required to assess the potential effectiveness of this technology at this site. The system installation would require drilling and trenching. Monitoring would be required during operations, and post-remediation soil sampling would be required to verify completion. Permits would be required for construction. The operational parameters of the system could be regulated to limit air discharges and limit off-gas treatment.
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> Relative Costs: Cost for installation and operation of an SVE/bioventing system would include pre-design testing, design, construction/site restoration, construction management, operational monitoring/reporting, and closure/verification.

Based on the presence of heavier hydrocarbons and the reduced effectiveness of the technology for ETPH and PAHs, SVE/bioventing is not considered appropriate for a timely and/or complete remediation of the site.

Bioremedation Applications

Bioremediation utilizes hydrocarbon-consuming bacteria to degrade hydrocarbons to relatively innocuous byproducts (carbon dioxide and water). Indigenous bacteria are utilized, when present in sufficient numbers, or preselected bacteria can be added to the system, if needed. An engineered bioremediation system can take many forms (e.g., biopile, landfarm), but the objective is to create optimal conditions to enhance biological breakdown of the hydrocarbons. This consists of the addition of nutrients, moisture, and/or oxygen, as necessary, to encourage bioremediation.

> <u>Effectiveness/Limitations</u>: In-situ bioremediation can be applied to soils which can be accessed for the application of the necessary nutrients, including some soils which may not be accessible to excavation and removal. Stratified soils and low-permeability zones may result in uneven distribution of nutrients and may result in untreated zones. Factors such as high or low pH, toxic concentrations of metals, high concentrations of petroleum, or the absence of hydrocarbon-consuming bacteria could influence or complicate the application of this technology to a site. Leaching of hydrocarbons could occur with the application of nutrient solutions.
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> Bioremediation has been proven to be effective in significantly reducing containment concentrations, including some semi-volatile compounds, but bioremediation may not completely remove contaminants. The rate of bioremediation is typically slow, slower than SVE for volatile compounds.
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> This method is not applicable to metals-impacted soils.
> <u>Other Considerations</u>: If nutrient addition is contemplated, additional testing would be required to determine the feasibility of the technology and design consideration, such as nutrient needs and the appropriate rates of application. Permits would be required for the system construction, and CTDEP may require additional permitting or monitoring if the addition of nutrients is contemplated. There would be some disruption to the site, but the extent of disruption would be dependent on the system design. The system would require space for the various possible components (pumps, nutrient tanks, etc.) as well as area to manage the soils. Verification sampling would be required to document completion.
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> <u>Costs</u>: The costs for a bioremediation system utilizing the addition of nutrients cannot be determined with the available data, but are expected to be significant based on contamination concentrations.

This technology is not considered appropriate to meet the desired time frame of the remediation. In addition, high concentrations of ETPH would require the addition of significant quantities of organisms making this alternative cost prohibitive.

Soil Removal

Soil removal consists of the excavation of impacted soils, stockpiling of soils, collection of verification samples, disposal or treatment of impacted soils, and site restoration. Soils would be removed from the site by a licensed contractor and could be thermally treated, disposed of, or put to beneficial use (e.g., asphalt batching). On-site treatment, where treatment equipment is brought to the site to process the excavated soils, is usually applied only to sites with large volumes of soil and where there is adequate room to stockpile and handle soils.

<u>Effectiveness/Limitations</u>: Soil removal is a practical and effective alternative for soils which are not amendable to in-situ treatment and/or where impacted soils are accessible to excavation equipment. Soil removal may also be more cost-efficient or preferred to in-situ treatment were the volumes of impacted soils are small or where time constraints would not allow in-situ treatment. Soil removal may be impossible or cost-prohibitive where soils are inaccessible (e.g., under buildings) and where access is difficult (e.g., deep soils, soils under roads, utility interferences, etc.). The most significant impacts at this site appear to be at shallow depths and would be easily accessible to excavation equipment. Soil removal could be completed in a period of a few days, depending on the extent. Excavation contractors and soil treatment/disposal facilities are readily available.

<u>Other Considerations</u>: Soil excavation may require permits and site restoration. Soil removal activities would obstruct a portion of the site for the duration of the soil removal and site restoration.

<u>Costs</u>: The range of costs will be based on a soil volume of approximately 270 cubic yards and the assumptions that the excavation would need to extend to a depth of 4 ftbg across the area. Applicable costs include: soil removal and treatment/disposal; verification sampling and analysis; site restoration (based on the final SUT construction specifications); and documentation.

This technology is appropriate to meet the time schedule and applicable criteria for remediation of the site.

<u>Selected Remedial Approach</u>

Soil removal is the preferred remedial approach for the following reasons:

- Excavation is the only remedial alternative that mitigates the impacts related to all of the classes of contaminants found at the site.

- Excavation, with proper handling and disposal of the impacted soils, most effectively protects human health and the environment by achieving all stated remedial goals in the shortest timeframe.

  - Because the impacted soils are present at shallow depths and are readily accessible, soil removal can be accomplished in considerably less time than the other alternatives, allowing for the completion of the remediation in the necessary timeframe to accommodate the SUT project schedule.

- Other remedial alternatives will require completion of pilot testing prior to design of the remedial systems. Pilot testing, which is time-consuming and costly, may show that a remedial alternative is not effective.