City of Carson
Report to Mayor and City Council

November 6, 2013
New Business Consent

SUBJECT: CONSIDER STATUS REPORT ON THE REGIONAL WATER QUALITY CONTROL BOARD ENVIRONMENTAL INVESTIGATION AND CARSON DECLARATION OF THE EXISTENCE OF AN EMERGENCY WITHIN THE CAROUSEL TRACT

Submitted by Jacquelyn Acosta
Acting City Manager

Approved by Jacquelyn Acosta
Acting City Manager

I. SUMMARY

This item is on the agenda at the request of Mayor Pro Tem Santarina to provide updates at all regularly scheduled City Council meetings related to the environmental investigation of the Carousel Tract.

II. RECOMMENDATION

RECEIVE and FILE.

III. ALTERNATIVES

TAKE another action as the City Council deems appropriate consistent with the requirements of law.

IV. BACKGROUND

On March 11, 2011, the Los Angeles Regional Water Quality Control Board (Regional Board) issued Cleanup and Abatement Order (CAO) No. R4-2011-0046 directing Shell Oil Company (Shell) to investigate the Carousel Tract (former Kast Tank Farm Property) and provide remedial action to cleanup and abate the waste in the soil, soil vapor and groundwater associated with contamination from the former tank farm. In accordance with the CAO, Shell submitted a Site-Specific Cleanup Goal Report dated February 22, 2013.

During the City Council meeting of October 15, 2013, Chris Aumais from the law firm of Girardi & Keese and Bob Bowcock from Integrated Resource Management, Inc. (IRM) discussed the current status of litigation and strategies for proceeding forward. The City Council directed staff to assist the City Attorney, Girardi & Keese and IRM in distributing letters to various state, county and local offiCals demanding consideration of an evacuation and to seek an opinion from the Attorney General's Office regarding the ability for the Los Angeles Regional Water Quality Control Board to order an evacuation of the Carousel Tract. Attached as Exhibit No. 1 is a listing of the various agencies,

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companies or individuals to receive or be copied on the letters. Due to schedule conflicts, representatives from Girardi & Keese and IRM are still drafting the letters. The letters will be distributed as soon as they are approved by Girardi & Keese and the City Attorney's Office.

Revised Site-Specific Cleanup Goal Report

On October 21, 2013, Shell Oil Products US (Shell) submitted a Revised Site-Specific Cleanup Goal Report to the Regional Board to address certain deficiencies and comments addressed in the Regional Board letter dated August 21, 2013. A copy of the report without technical exhibits is attached as Exhibit No. 2. A full copy of the report and appendices may be viewed at http://geotracker.waterboards.ca.gov. Chapter 9 of the report is an evaluation of technological and economic feasibility of site specific cleanup goals and selection of site-specific cleanup goals. The City Council may wish to review this information since there is discussion of alternatives ranging from the removal of all homes, roads and utilities to selected excavation of portions of the tract at 2 feet below ground surface (bgs), 5 feet bgs and 10 feet bgs, the capping of exposed soils and landscaped areas and the addition of a soil vapor extraction system. Table 9-5 provides a summary of the alternatives and preliminary cost estimates (Exhibit No. 3). In Section 9.6 of Chapter 9, the report concludes that Alternatives 3, 3+7, 4 and 4+7 have been found to be technologically and economically feasible and are recommended for further evaluation in the Remedial Action Plan. Shell proposes to evaluate options that provide excavation in specified areas and does not include the removal of homes. The Regional Board, the Office of Environmental Health Hazard Assessment and the UCLA Expert Panel are currently evaluating the revised report.

Additional Response to City Council Resolution

On October 24, 2013, the Los Angeles County Department of Public Health responded to the City Council Resolution No. 13-081 which declared an emergency within the Carousel Tract. A copy of the letter is attached as Exhibit No. 4.

Carousel Tract Litigation

Girardi & Keese will attend a future City Council meeting to discuss details of the litigation during closed session. While the City Council seeks to have as much information as is available provided during the public session of the meeting, there are some details that can only be discussed in closed session.

V. **FISCAL IMPACT**

None.

VI. **EXHIBITS**

1. Carousel Letter Distribution List dated October 15, 2013. (pg. 4)
2. Revised Site-Specific Cleanup Goal Report. (pgs. 5-133)
3. Table 9-5: Summary of Preliminary Cost Estimates for Screen Feasibility Study, Revised Site-Specific Cleanup Goal Report. (pgs.134-137)
4. Letter from Los Angeles Department of Public Health dated October 24, 2013. (pgs. 138-139)

Prepared by: Sheri Repp-Loadsman, Planning Officer

TO:Rev06-19-2013

Reviewed by:

City Clerk	City Treasurer
Administrative Services	Public Works
Community Development	Community Services

Action taken by City Council

Date__________ Action______________________________

Carousel Letter Distribution List

State/Federal	City/County	Other (to be cc'd on letters)
Congresswoman Hahn	Supervisor Mark Ridley-Thomas	Ed Platt Shell Oil Company
Congressman Waxman 33rd District	Supervisor Don Knabe	Roy Patterson URS
Congresswoman Walters 43rd District	*Chief Osby Los Angeles County Fire Department	Barclay Hollander
Congressman Lowenthal 47th District	*Chief Jones Los Angeles County Fire Department	Dole Foods
Senator Dianne Feinstein	*Angelo Belomo Los Angeles County Health Department	
Senator Barbara Boxer	Los Angeles Mayor Eric Garcetti	
Edmund G. Brown Jr., Governor	Los Angeles Councilman Joe Buscaino	
Attorney General Kamala Harris		
Senator Ted Lieu 28th District		
Senator Roderick D. Wright 35th District		
Assemblymember Isadore Hall, III 64th District		
Los Angeles Regional Water Quality Control Board (7 members)		
Mr. Sam Unger, Executive Director LARWQCB		
State Water Resources Control Board (5 board members)		
	*added by staff	

EXHIBIT NO. 01

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Prepared for:

Shell Oil Products US
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Revised Site-Specific Cleanup Goal Report

Former Kast Property
Carson, California

Prepared by:

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engineers | scientists | innovators

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Project Number: SB0484-04-2

October 21, 2013

EXHIBIT NO. 02

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Geosyntec
consultants

REVISED SITE-SPECIFIC CLEANUP GOAL REPORT

Former Kast Property
Carson, California

Prepared for:

Shell Oil Products US

Prepared by:

Geosyntec Consultants, Inc.

Mark Grivetti, P.G., CHG
Principal Hydrogeologist

Ruth Custance
Principal

Robert Ettinger
Principal

CERTIFICATION

REVISED SITE-SPECIFIC CLEANUP GOAL REPORT

FORMER KAST PROPERTY

CARSON, CALIFORNIA

I am the Project Manager for Equilon Enterprises LLC doing business as Shell Oil Products US for this project. I am informed and believe that the matters stated in the Revised Site-Specific Cleanup Goal Report dated October 21, 2013 are true, and on that ground I declare, under penalty of perjury in accordance with Water Code section 13267, that the statements contained therein are true and correct.

Doug Weimer

Doug Weimer
Project Manager
Shell Oil Products US
October 21, 2013

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EXECUTIVE SUMMARY

This Revised Site-specific Cleanup Goal Report (Revised SSCG Report) was prepared for the Former Kast Property (Site) in Carson, California by Equilon Enterprises LLC, doing business as Shell Oil Products US (SOPUS) for Shell Oil Company, (Shell). In the Cleanup and Abatement Order No. R4-2011-0046, issued March 11, 2011 (CAO), Shell was required to submit Site-specific cleanup goals (SSCGs) following the completion of pilot testing at the Site and in advance of the Remedial Action Plan (RAP) for the Site. This Revised SSCG Report addresses comments provided by the Los Angeles Regional Water Quality Control Board (Regional Board) in their letter dated August 21, 2013.[1] In the letter, the Regional Board requested that the Site-specific Cleanup Goal Report originally submitted February 22, 2013 be revised in accordance with the specific directives and other comments provided in the letter. SOPUS was also directed to address all comments in the attachments to the Regional Board letter, including comments from the Office of Environmental Health Hazard Assessment (OEHHA), the UCLA Expert Panel, and Regional Board Staff.

Once the SSCGs are approved by the Regional Board, a full Human Health Risk Assessment (HHRA) incorporating the SSCGs will be conducted. The HHRA will further evaluate potential human health risks and will be used to guide final response actions for impacted media (soil, soil vapor and indoor air) at each residence on the Site. Evaluation of the final response actions may include a detailed Feasibility Study to select the final Site remedy. Details of the final Site remedy, as well as the Feasibility Study if conducted, will be included in the RAP, which is due to be submitted within 45 days after the Regional Board approves the SSCGs. The HHRA will be submitted prior to or concurrent with the RAP.

The Site is a former petroleum storage facility that operated from the mid-1920s to the mid-1960s, and was sold by Shell to residential developers Lomita Development Company and Barclay Hollander Corporation, now a subsidiary of Dole Food Company, Inc. The developers drained and decommissioned the reservoirs, graded the Site, and redeveloped it into the Carousel Community residential housing tract in the late 1960s. The objectives of the Revised SSCG Report are to propose remedial action objectives (RAOs) and site-specific cleanup goals (SSCGs) for soil, soil vapor, indoor air, and groundwater that will be used in preparation of the RAP. As required by the

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[1] Appendix D contains responses by SOPUS to the agency and Expert Panel comments to the February 22, 2013 Site-specific Cleanup Goals Report.

Regional Board comments, the Revised SSCG Report presents cleanup goals that are based on technological and economic feasibility and that include all constituents of concern (COCs) identified for the Site, whether associated with Shell's historic use of the Site or associated with activities by other parties. Soil SSCGs are based on human health considerations and potential leaching to groundwater assuming that groundwater is a potable water source. For soil vapor, SSCGs have been developed for the vapor intrusion pathway into indoor air and potential human exposure, as well as considering both nuisance and potential methane-related risks. Groundwater SSCGs have been developed considering the Basin Plan, State Board Resolution No. 68-16, and State Board Resolution No. 92-49.

In order to meet the Regional Board's requirement that SSCGs are technologically and economically feasible, a Screening Feasibility Study (Screening FS) was conducted to evaluate a number of factors related to potential remedial alternatives that could be implemented at the Site. These factors included implementability; environmental considerations; reduction of toxicity, mobility, and volume; social considerations; other issues; and estimated cost of each remedial alternative. The remedial alternatives encompassed a range of possible response actions, including options which would result in unrestricted and restricted land use. Based on the outcome of this evaluation, the SSCGs associated with the most technologically and economically feasible alternative remedies were selected for the Site. As stated above, a more detailed Feasibility Study may be conducted in conjunction with the preparation of the RAP to evaluate potential response actions and select a final Site remedy.

Previous Site Evaluations

Analysis to develop SSCGs included data from the extensive environmental investigation of the Site, which has been conducted under the directives of the Regional Board. Environmental characterization of the Site has followed agency-approved work plans and according to accepted scientific protocols. The investigation is ongoing and is nearly completed as to soils, soil vapor and indoor air at the residential properties. As part of the characterization, investigations conducted include Site-wide and off-Site assessment of soil, soil vapor, and groundwater in roadways and an adjacent rail right-of-way. Property-specific investigations at individual residential properties have included assessment of soil, sub-slab soil vapor, indoor air, and methane screening. Over 10,000 soil samples, 2,000 soil vapor samples and 1,000 indoor air samples have been collected so far.

Through August 31, 2013, the following number of residential properties have been sampled:

- 267 properties (94%) have been screened for methane,
- 266 properties (93%) have had soil samples collected,
- 265 properties (93%) have had sub-slab soil vapor collected, and
- 241 properties (85%) have had been sampled for indoor air samples collected (of which 147 properties (52%) have had the required two rounds of indoor air sampling).

These investigations have indicated the presence of petroleum-related and some non-petroleum-related constituents. To date, over 700 Phase II Interim, Follow-up, and Final Interim Reports[2] have been prepared to document the results of these property-specific investigations and submitted to the Regional Board. These reports included property-specific Human Health Screening Risk Evaluations (HHSREs) and evaluation of interim response actions, which have been reviewed by the Regional Board and OEHHA on an ongoing basis.

The HHSREs provide a preliminary evaluation of potential human health risks associated with detected chemicals at individual properties to assist in interim response planning. The screening-level concentrations used in the HHSREs were developed following California Environmental Protection Agency (Cal-EPA), OEHHA and United States Environmental Protection Agency (USEPA) guidance. Screening levels are based on conservative health-protective assumptions and are used to gain a general understanding of potential issues at the Site. The presence of a chemical at a concentration in excess of a screening level does not indicate that adverse impacts to human health are occurring or will occur, but rather suggests that further evaluation of potential human health concerns is warranted.

As indicated in the Phase II Interim, Follow-up, and Final Interim Reports, concentrations of potential COCs exceeding screening levels were detected in various media (soil, soil vapor, indoor air and groundwater) at various properties at the Site. Based on these results, interim response actions to limit exposure to impacted soils and soil vapor were recommended, as appropriate. The investigations conducted at the Site to date have not found potentially hazardous levels of methane due to petroleum degradation in indoor air or in public areas at the Site. Additionally, the investigations to date have concluded that COCs detected in indoor air are reflective of background levels and are not indicative of vapor intrusion into indoor air.

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[2] Multiple reports are submitted for each property.

Constituents of Concern

Potential COCs were initially identified by reviewing the Site investigation results and include constituents associated with the petroleum storage facility activities in the 1924 to 1966 time frame, as well as constituents that are interpreted to have been introduced from non-Site-related sources, such as the adjacent Turco chemical facility and the Fletcher Oil site, and post-development residential land-use activities. COCs potentially related to the previous operation of the Site as a crude/bunker oil storage facility are considered as Site-related COCs. The remaining COCs are considered non-Site-related COCs. Potential Site-related COCs include:

- Total Petroleum Hydrocarbons (TPH);
- TPH-related volatile organic compounds (VOCs);
- TPH-related semi-volatile organic compounds (SVOCs) (including polycyclic aromatic hydrocarbons [PAHs]);
- Metals (lead and arsenic); and
- Methane.

Non-Site-related COCs include:

- Chlorinated VOCs;
- Trihalomethanes (THMs, which are associated with municipal water treatment);
- Oxygenated VOCs (including tert-butyl alcohol [TBA]); and
- Metals present in soil or groundwater at background levels.

SSCGs for all COCs (i.e., both Site-related and non-Site-related COCs) are presented in this report. The final list of COCs that was incorporated into the SSCG derivation was selected using a conservative screening process based on (1) detection of the constituent during Site investigation activities, (2) the screening levels presented in the HHSRE reports, and (3) background levels.

Remedial Action Objectives and Site-specific Cleanup Goals

Medium-specific response action objectives (RAOs) for soil, soil vapor, indoor air and groundwater were developed based on the results of the Site investigation and HHSREs. The proposed objectives of the remedial action at the Site are:

- Prevent human exposures to concentrations of COCs in soil, soil vapor, and indoor air such that total (i.e., cumulative) lifetime incremental carcinogenic risks are within the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) risk range of 1×10^{-6} (one in a million) to 1×10^{-4} (or

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one in ten thousand) and noncancer hazard indices are less than 1, or COC concentrations are below background, whichever is higher. Potential human exposures include onsite residents and construction and utility maintenance workers. The point of departure risk level for onsite residents is the lower end of the NCP risk range (i.e., 1×10^{-6}) and a noncancer hazard index less than 1.

- Prevent fire or explosion risks in homes, garages and other enclosed spaces (such as neighborhood utility vaults) due to the potential accumulation of methane generated from anaerobic biodegradation of petroleum hydrocarbons in soils. Eliminate methane in the subsurface to the extent technologically and economically feasible.
- Remove or treat light non-aqueous phase liquid (LNAPL) to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result.
- Reduce COCs in groundwater to the extent technologically and economically feasible to achieve, at a minimum, the water quality objectives in the Basin Plan to protect designated beneficial uses, including possible use as municipal supply in the future[3].

This Revised SSCG Report proposes medium-specific SSCGs for soil, soil vapor, indoor air, and groundwater designed to achieve these RAOs. The SSCGs were developed using the guidance documents and agency policies identified by the Regional Board, as well as other applicable resources. The SSCGs for each medium are summarized below.

SSCGs for Soil

SSCGs for soil were calculated considering human health exposure pathways (i.e., risk-based SSCGs), and the leaching to groundwater pathway. Risk-based SSCGs were developed using a methodology and approach similar to that used to conduct the property-specific HHRSEs. Risk-based SSCGs for the residential scenario are based on (1) frequent exposure assumptions (350 days per year) for shallow soil (e.g., from 0 to 2 feet below ground surface [bgs]), and (2) infrequent exposure assumptions (4 days per year) for soils at depth that residents are unlikely to contact more than a few times per year (e.g., from 2 to 10 feet bgs). Risk-based SSCGs for the construction and utility maintenance worker scenario are developed assuming exposures can occur to soil at

[3] Shallow impacted groundwater at the Site is not currently used for drinking water nor will be in the foreseeable future.

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depths from 0 to 10 feet below ground surface (bgs). Soil SSCGs for the leaching to groundwater pathway are calculated using Site-specific soil physical properties following methods recommended in Regional Board (1996) and relevant USEPA guidance documents.

The SSCGs for soil are detailed in Section 6:

- The Soil SSCGs for residential exposures are chemical-specific numerical values for COCs assuming a target incremental cancer risk of 1×10^{-6} and a hazard quotient of 1. These numerical SSCGs are calculated for both frequent and infrequent exposure assumptions.
- The Soil SSCGs for construction and utility maintenance worker exposures are chemical-specific numerical values for COCs assuming a target incremental cancer risk of 1×10^{-5} and a hazard quotient of 1. These numerical SSCGs will be applied to soils from 0-10 feet bgs.
- The Soil SSCGs for the leaching to groundwater pathway are chemical-specific numerical values for COCs based on protection of groundwater to California Maximum Contaminant Levels (MCLs), Notification Levels (NLs), or risk-based values for COCs with no published MCL or NL.

The technological and economic feasibility of the various soil SSCGs were evaluated in the Screening FS. Based on the findings of the Screening FS, soil SSCGs to be used in preparation of the RAP are proposed.

SSCGs for Soil Vapor and Indoor Air

Soil vapor cleanup goals for the residential scenario are based on the sub-slab soil vapor analytical results, the indoor and outdoor air sample results, and a multiple-lines-of-evidence vapor intrusion pathway evaluation. In other words, multiple data evaluation approaches were used to assess whether there is a correlation between the sub-slab COC levels and the COC levels found in indoor air. As summarized here and discussed in detail in Section 7, the results of this multiple-lines-of-evidence evaluation indicate that sub-slab soil vapor concentrations do not have a significant effect on indoor air quality, and that COCs found in indoor air are related to COCs from outdoor air, attached garages and household product use. In their review of the residential sampling reports, the Regional Board and OEHHA have generally concurred in these findings.

Similar to the approach used to calculate soil SSCGs for the construction and utility maintenance worker exposure scenario, the soil vapor SSCGs for the construction and utility maintenance worker consider exposure to volatiles during excavation activities. Additionally, fire and explosion risks are considered for methane.

The multiple-lines-of-evidence evaluation considered the sub-slab soil vapor, indoor air, garage air, and outdoor air data for the 241 properties where indoor air and concomitant sub-slab soil vapor sampling has been conducted as of August 31, 2013. The evaluation relied on published studies of background concentrations of indoor and outdoor air quality. The conclusions of the evaluation are as follows.

- Indoor air and outdoor air concentrations of VOCs detected at the properties evaluated are indistinguishable from background and within the typical ranges of background concentrations reported in the literature.

- Multiple regression analysis results indicate that indoor air concentrations are correlated with outdoor or garage air concentrations and/or largely influenced by indoor sources. This statistical analysis indicates that sub-slab soil vapor concentrations do not have a significant effect on indoor air concentrations as compared to these other sources.

- The presence of background sources[4] of VOCs contributes to the variability in indoor air concentrations detected at the Site. Common household sources of VOCs include cigarette and cigar smoke, gasoline- or diesel-powered equipment, paints, glues, solvents, cleaners, and natural gas leaks. In addition, outdoor air COC levels, which impact indoor air, often exceed screening levels for indoor air.

- Although the literature background comparison and the multiple linear regression analysis indicate that the indoor air COC concentrations are due to background sources and not related to sub-slab soil vapor levels, sub-slab soil vapor SSCGs were calculated based on a vapor intrusion attenuation factor as directed by the Regional Board. These sub-slab soil vapor SSCGs may be used for corrective action planning; however, because the indoor air concentrations are due to background sources, mitigation or remediation will not result in a measureable reduction in indoor air risks.

- Using a single regression analysis of sub-slab soil vapor and indoor air results, a conservative upper-bound vapor intrusion attenuation factor of 0.001 was calculated to determine sub-slab soil vapor SSCGs as required by the Regional Board.

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[4] For vapor intrusion evaluations, background is defined as sources that are not due to subsurface impacts (i.e., contributions due to outdoor air or indoor sources).

The technological and economic feasibility of the potential residential soil vapor SSCGs were evaluated in the Screening FS. Based on the findings of the Screening FS, residential soil vapor SSCGs to be used in preparation of the RAP are proposed.

The SSCGs for construction and utility maintenance worker exposures are chemical-specific numerical values for COCs assuming a target incremental cancer risk of 1×10^{-5} and a hazard quotient of 1. These numerical SSCGs will be applied to soil vapor from 0-10 feet bgs. These numerical values are listed in the report.

Methane screening has been conducted in indoor structures on the Site and in utility vaults, storm drains, and sewer manholes at and surrounding the Site. The screening assessments have not found methane concentrations in enclosed spaces that would indicate a potential safety risk. Methane has not been detected in any of the more than 1,000 indoor air samples collected at the residences. Additionally, more than 2,000 sub-slab soil vapor samples have been collected at 265 properties at the Site and analyzed for methane. Methane resulting from anaerobic biodegradation of residual petroleum hydrocarbons above the interim action levels of 0.1% and 0.5% has been found in one sub-slab soil vapor probe located beneath the garage at a single property (out of more than 840 soil vapor probes installed at the Site); however, no methane exceedances were indicated during the indoor air screening at this property and methane was not detected in the analytical results of the indoor air sampling. Engineering controls were installed to mitigate potential risks due to methane detected beneath the garage at this location. Methane has been detected as a result of leaking natural gas utility lines, which were found at four of the residential properties, and a leaking sewer line at one residential property.

Proposed SSCGs for methane are the same as those presented in the Data Evaluation and Decision Matrix previously prepared for the Site. These SSCGs are consistent with California Environmental Protection Agency Department of Toxic Substances Control (Cal-EPA DTSC) guidance for addressing methane detected at school sites.

Methane Level	Response
>10%LEL (> 5,000 ppmv) Soil vapor pressure > 13.9 in H_2O	Evaluate engineering controls
> 2% - 10%LEL (> 1,000 - 5,000 ppmv) Soil vapor pressure > 2.8 in H_2O	Perform follow-up sampling and evaluate engineering controls

SSCGs for Groundwater

Uppermost (or first) groundwater (Shallow Zone) occurs at variable depths of approximately 51-68 feet bgs depending on well location and timing of sampling. The Gage aquifer underlies the Site at a depth of approximately 80-90 feet bgs, and is underlain by low permeability materials which separate the Gage aquifer from the underlying Lynwood aquifer. There is no documented or expected future use of groundwater within the Shallow Zone or Gage aquifer at or near the Site, and these water-bearing zones are not used as sources of drinking water. Furthermore, the local water purveyor has stated that drinking water supplied to the Carousel Community is safe.

Groundwater beneath the Site, including groundwater in the Shallow Zone and Gage aquifer, is impacted with various chemicals including petroleum hydrocarbons, chlorinated hydrocarbons, metals, and general minerals. Of these, potential Site-related COCs in groundwater which exceed a California drinking water MCL or health-based NL include benzene, naphthalene, and arsenic.

- Benzene: The distribution of benzene in groundwater beneath the Site is well defined, both laterally and vertically, and the dissolved benzene plume at the Site appears to be stable or declining. Concentrations of benzene are non-detect or close to non-detect in the three off-Site, downgradient monitoring wells located near the Site boundaries. The stable or declining plume is consistent with an old crude oil source and the well-documented process of natural degradation of petroleum hydrocarbon compounds in the subsurface environment through microbial activity.

- Naphthalene: Concentrations of naphthalene exceed the NL in two monitoring wells on-Site, both of which are also impacted by benzene.

- Arsenic: Concentrations of arsenic are above the MCL in multiple Site monitoring wells, with higher concentrations detected in the west central portion of the Site. The source of arsenic is likely naturally occurring. The concentrations of arsenic may be locally enhanced due to the presence of degrading petroleum hydrocarbon compounds which can cause arsenic to dissolve into groundwater from some naturally occurring minerals found beneath the Site. Arsenic is recognized as a regional contaminant in southern California groundwater.

- TPH: TPH does not have an MCL or NL. Concentrations of TPH exceeding the San Francisco RWQCB Environmental Screening Levels

(ESL)s were detected in four on-Site wells and the off-Site upgradient well (MW-7) in the most recent monitoring event.

Because no current or future use of the Shallow Zone and Gage aquifer at or near the Site is anticipated, the following groundwater SSCGs are proposed for the Site (consistent with the RAOs):

- Remove or treat LNAPL to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result, and
- Reduce concentrations of COCs in groundwater to the extent technologically and economically feasible to achieve, at a minimum, the water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply.

The technological and economic feasibility of the potential groundwater SSCGs, detailed in Section 8, were evaluated in the Screening FS. Based on the findings of the Screening FS, groundwater SSCGs are proposed to be used in preparation of the RAP.

Screening Feasibility Study

A Screening FS was conducted to evaluate the technological and economic feasibility of the SSCGs. The Screening FS consists of a preliminary evaluation of representative remedial alternatives that could achieve various site SSCGs at the residential properties. The technological and economic feasibility for each alternative were compared and evaluated to the extent practical at this level of project development, and the technologically and economically feasible alternatives were selected for further detailed evaluation in the RAP.

Several remedial alternatives were evaluated in the Screening FS. The alternatives consist of different combinations of the following technologies:

- Sub-slab vapor mitigation;
- Capping;
- Institutional controls;
- Excavation;
- Soil vapor extraction (SVE);
- LNAPL/source removal;
- Hot spot remediation of groundwater; and
- Monitored natural attenuation (MNA).

The preliminary remedial alternatives were screened on the basis of the following criteria:

a) Implementability;
b) Environmental considerations;
c) Reduction of toxicity, mobility, and volume;
d) Social considerations; and
e) Estimated cost.

Cleanup goals that are technologically and economically feasible have been identified using the Screening FS. Based on this evaluation, four remedial alternatives and their associated SSCGs are recommended and will be further evaluated in the RAP. The technologically and economically feasible remedial alternatives identified in the Screening FS consist of:

- Surface soil excavation (0-2 feet bgs) in either open areas and/or areas beneath open and hardscape in areas exceeding soil SSCGs;
- Installation of sub-slab depressurization or ventilation system for properties exceeding soil vapor SSCGs;
- LNAPL removal to the extent technologically and economically feasible;
- Hot spot groundwater and deep soil remediation;
- Monitored natural attenuation for groundwater to achieve MCLs and/or background concentrations; and
- Institutional controls to address residual COCs in soils beneath homes and to limit access to unexcavated soils below 2 feet bgs and groundwater.

Under the identified remedial alternatives, the excavated and filled Site areas would achieve all proposed soil SSCGs. The unexcavated soils would meet the residential human health SSCGs assuming infrequent exposure and the utilization of institutional controls, and would meet nuisance goals.

Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the soils that remain in place. However, over time, groundwater concentrations for the petroleum-related COCs (TPH, naphthalene, benzene and to some extent arsenic) are expected to decline to levels protective of a municipal use for the water. This conclusion is based on the stable to declining plume present at the Site, the age of the source materials (leaching of the COCs has already occurred), and the proposed actions which include further source reduction (hot spot groundwater and deeper soil remediation with SVE). It is also noted that there will be no use of the impacted groundwater in the foreseeable future. Meeting municipal levels for other

COCs in Site groundwater including CVOCs and TBA will require remediation of upgradient sources.

Additionally, the identified remedial alternatives for soil vapor will achieve the SSCGs for VOCs and methane.

1.0 INTRODUCTION

This Revised Site-specific Cleanup Goal Report (Revised SSCG Report) was prepared for the Former Kast Property (Site) in Carson, California on behalf of Equilon Enterprises LLC, doing business as Shell Oil Products US (SOPUS), for Shell Oil Company ("Shell"). This Revised SSCG Report responds to comments provided by the Los Angeles Regional Water Quality Control Board (RWQCB or Regional Board) in their letter dated August 21, 2013. In the letter, the RWQCB requested that the Site-specific Cleanup Goal Report originally submitted February 22, 2013 (Geosyntec, 2013a) be revised in accordance with the specific directives and other comments provided in the letter. Shell was also directed to address all comments in the attachments to the letter, including comments from the Office of Environmental Health Hazard Assessment (OEHHA), the UCLA Expert Panel Interim Report, and Regional Board Staff. A summary of responses to comments contained in the RWQCB August 21 letter and attachments is provided in Appendix D. This summary provides a response to the comment and, where appropriate, a description of the location within the Revised SSCG Report where the comment is specifically addressed.

The Former Kast Property is a former petroleum storage facility that operated from the mid-1920s to the mid-1960s that was sold by Shell to residential real estate developers Lomita Development Company and Barclay Hollander Corporation, now a subsidiary of Dole Food Company, Inc., who had knowledge of the Site's former use and developers, who drained and decommissioned the reservoirs, graded the site and redeveloped it into the Carousel Community residential housing tract in the late 1960s. The site is located in the area between Marbella Avenue on the west and Panama Avenue on the east and E. 244th Street on the north to E. 249th Street to the south (Figure 1).

1.1 Background

This report was prepared in response to Cleanup and Abatement Order (CAO) No. R4-2011-0046 issued to Shell on March 11, 2011 by the California Regional Water Quality Control Board – Los Angeles Region (RWQCB or Regional Board). Section 3.c of the CAO orders Shell to "prepare a full-scale impacted soil Remedial Action Plan (RAP) for the Site." As a part of the RAP several requirements have been set forth that address the development of remedial action objectives (RAOs) and cleanup goals for the Site.

The CAO also ordered that a SSCG report be prepared in advance of the RAP and submitted concurrently with the Pilot Test Report. Pilot tests for the following technologies have been evaluated for applicability at the Site: soil vapor extraction

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(SVE), in-situ chemical oxidation (ISCO), bioventing, and excavation. The results of these pilot studies have been submitted to the Regional Board (URS, 2010b; Geosyntec, 2012a; Geosyntec, 2012b; Geosyntec, 2013b; and URS, 2013a, d). Pilot Test Reports summarizing the results of the pilot studies were submitted to RWQCB in May 2013 and August 2013 (URS, 2013e, g) and an evaluation of the feasibility of removing the concrete slabs of the former reservoirs was submitted in June 2013 (URS and Geosyntec, 2013).

The SSCG Report was prepared to address these requirements of the CAO and provide an overview of the Site conditions, as well as the RAOs and cleanup goals to address petroleum hydrocarbon impacts at the Site. As noted above, this Revised SSCG Report addresses comments provided by the RWQCB on the February 22, 2013 SSCG Report.

The Revised SSCG Report presents cleanup goals that are based on technological and economic feasibility and includes all constituents of concern (COCs) identified for the Site. Soil SSCGs are based on exposure to human health and potential leaching to groundwater considering the groundwater as a potable water source. For soil vapor, SSCGs have been developed for the vapor intrusion pathway and considering nuisance and methane. Groundwater SSCGs have been developed considering the Basin Plan, State Board Resolution No. 68-16, and State Board Resolution No. 92-49.

The Revised SSCG Report is organized into the following sections:

- 1.0 Introduction
- 2.0 Site Conceptual Model
- 3.0 Pilot Test Results
- 4.0 Constituents of Concern and Remedial Action Objectives
- 5.0 Guidance Documents Considered
- 6.0 Soil
- 7.0 Soil Vapor, Indoor Air, and Outdoor Air
- 8.0 Groundwater
- 9.0 Evaluation of Technological and Economic Feasibility of SSCGs and Selection of SSCGs
- 10.0 Summary
- 11.0 References

1.2 Objectives

The objectives of this report are to provide the RAOs and site-specific cleanup goals (SSCGs) that will be used in the forthcoming Human Health Risk Assessment (HHRA) and RAP for the Site. Specifically, this report addresses the following requirements of the CAO:

- Evaluate impacts to shallow soils, defined in the CAO as soils from 0-10 feet below ground surface (bgs)[5] (CAO Section 3);
- Consider listed guidelines and Policies in the development of cleanup goals (CAO Section 3.c.II.i);
- Address groundwater cleanup goals considering the Basin Plan, State Board Resolution No. 68-16, and State Board Resolution No. 92-49 (CAO Sections 3.c.II.ii, iii, and iv); and
- Develop site-specific cleanup levels for residential (i.e., unrestricted) land use (CAO Section 3.c.III) and for construction/utility worker exposures.

In addition, this Revised SSCG Report addresses the directives provided in the August 21, 2013 RWQCB Review of the February 22, 2013 SSCG Report (Geosyntec, 2013a) to determine site-specific cleanup levels that are technologically and economically feasible.

1.3 Previous Response Actions

URS Corporation (URS) and Geosyntec Consultants (Geosyntec) are conducting environmental characterization at the Site on behalf of SOPUS and Shell, as requested in the Regional Board's Section 13267 letter dated May 8, 2008. As part of the characterization, investigations conducted at the Site include (1) Site-wide assessment of soil, soil vapor, and groundwater in roadways and an adjacent rail right-of-way, and (2) property-specific investigations at individual residential properties that have included assessment of soil, sub-slab soil vapor, and indoor air and methane screening.

Results of these investigations have detected the presence of a number of petroleum-related and some non-petroleum-related constituents. Total petroleum hydrocarbons (TPH) quantified as gasoline-range organics (TPHg), diesel-range organics (TPHd), and

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[5] Impacts to shallow soils for residential properties and public rights of way are addressed in this report.

motor oil-range organics (TPHmo) have been detected in Site soils and groundwater. A number of volatile organic compounds (VOCs), including compounds associated with petroleum hydrocarbons (e.g., benzene, toluene, ethylbenzene, xylenes [BTEX], trimethylbenzenes, and other substituted aromatic compounds), and non-petroleum-related VOCs, including the chlorinated solvents trichloroethene (TCE) and tetrachloroethene (PCE) and related breakdown products, as well as chloroform and trihalomethanes associated with drinking water purification byproducts, have been detected in Site soils, groundwater, soil vapor, and indoor/outdoor air. In addition, polycyclic aromatic hydrocarbons (PAHs), including naphthalene and benzo(a)pyrene, have been detected in Site soils associated with hydrocarbon impacts. Various metals including arsenic have been detected in site soils and groundwater.

For each of the property-specific evaluations, a Human Health Screening Risk Evaluation (HHSRE) was conducted to provide a preliminary evaluation of potential human health risks associated with chemicals detected at the property. These were based on the analytical results of the soil, sub-slab soil vapor, and indoor air samples collected to date and conservative screening levels. The HHSREs were conducted in accordance with the approved HHSRE Work Plan (Geosyntec, 2009) and addendum (Geosyntec, 2010b). In conjunction with the HHSRE Work Plan, a Data Evaluation and Decision Matrix was developed (Geosyntec, 2010a). The purpose of the matrix was to identify potential follow-up interim response actions that could be performed upon evaluation of Phase II Site characterization of soil, sub-slab soil vapor, and indoor air analytical data and HHSRE screening results. The screening level concentrations that were used in the HHSRE are consistent with the California Environmental Protection Agency (Cal-EPA), Office of Environmental Health Hazard Assessment (OEHHA) and United States Environmental Protection Agency (USEPA) screening levels. Screening levels are based on general assumptions and are useful to gain a general understanding of potential issues at the Site. The presence of a chemical at concentrations in excess of a screening level does not indicate that adverse impacts to human health are occurring or will occur but suggests that further evaluation of potential human health concerns is warranted. A full Human Health Risk Assessment (HHRA) and an update to the Soil Background Evaluation (URS, 2010) will be conducted to further evaluate potential health risks and will be submitted with the RAP.

Based on the findings of the Phase II investigations, potential follow-up interim response actions were identified. The interim response actions that could be used at the Site were documented in the Interim Remediation Action Plan (IRAP, URS, 2009a). Through August 31, 2013, the number of properties that have been evaluated for potential interim response actions based on the matrix criteria and the IRAP are:

- 267 properties (94%) screened for methane,
- 266 properties (93%) for soil,
- 265 properties (93%) for sub-slab soil vapor, and
- 241 properties (85%) for indoor air (of which 147 properties (52%) have had the required two rounds of indoor air sampling).

These investigations have indicated the presence of petroleum-related and some non-petroleum-related constituents. To date, over 700 Phase II Interim, Follow-up, and Final Interim Reports[6] have been prepared to document the results of these property-specific investigations and submitted to the Regional Board. These reports included property-specific Human Health Screening Risk Evaluations (HHSREs) and evaluation of interim response actions.

The HHSREs provide a preliminary evaluation of potential human health risks associated with detected chemicals at individual properties to assist in interim response planning. The screening-level concentrations used in the HHSREs were developed following California Environmental Protection Agency (Cal-EPA), OEHHA and United States Environmental Protection Agency (USEPA) guidance. Screening levels are based on conservative health-protective assumptions and are used to gain a general understanding of potential issues at the Site. The presence of a chemical at a concentration in excess of a screening level does not indicate that adverse impacts to human health are occurring or will occur, but rather suggests that further evaluation of potential human health concerns is warranted.

As indicated in the Phase II Interim, Follow-up, and Final Interim Reports, concentrations of potential COCs exceeding screening levels were detected in various media (soil, soil vapor, indoor air and groundwater) across the Site. Based on these results, interim response actions to limit exposure to impacted soils and soil vapor were recommended, as appropriate. The investigations conducted at the Site did not identify potentially hazardous levels of methane due to petroleum degradation in indoor air or in public areas at the Site. Additionally, COCs detected in indoor air are reflective of background levels and are not indicative of vapor intrusion into indoor air. Interim response actions for COCs exceeding screening levels in soils were further evaluated at 21 properties and reported in the Evaluation of Interim Institutional and/or Engineering Control Letters submitted to the Regional Board.

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[6] Multiple reports are submitted for each property.

As stated previously, a full HHRA will be submitted with the RAP. The HHRA will incorporate the SSCGs developed in this report and will be used to guide final response actions for impacted media at the Site.

2.0 SITE CONCEPTUAL MODEL

This section summarizes and updates the Site Conceptual Model (SCM), which was included as an appendix to the Plume Delineation Report (PDR) (URS, 2010a). The objectives of the SCM were to summarize the Site understanding related to: (1) identification of potential constituents of concern (COCs); (2) sources of COCs and potential release mechanisms; and (3) potential fate and transport of COCs, including identification of exposure pathways and receptors for the COCs. The information in this section has been updated to incorporate new data and understanding of the site obtained through site investigations conducted subsequent to the September 2010 date of the PDR.

2.1 Potential Sources and Potential Constituents of Concern

Historically, petroleum-related operations were associated with the Site. Crude oil was stored in three concrete-lined earthen reservoirs from 1924 to about 1966. Bunker oil, a very viscous residuum from refining of lighter-end hydrocarbons, was apparently also stored at the Site. Some records also refer to the storage of other heavy intermediate refinery streams. Due to the nature of former crude oil storage operations at the Site, and the oil production and former industrial operations in the surrounding area, a number of sources may have contributed to the contaminants that have been detected at and around the Site. Detailed information about potential sources was included in Section 4.0 of the SCM (URS, 2010a), and is summarized below.

The historical onsite petroleum storage reservoirs are considered to have been a source of petroleum releases to Site soils. The reservoirs are believed to have had reinforced concrete-lined earthen floors and sloped sidewalls with wood frame roofs supported by wooden posts and/or concrete pedestals, and they were surrounded by earthen levees averaging 20 feet in height. The site was sold by Shell to residential real estate developers Lomita Development Company and Barclay Hollander, now a subsidiary of Dole Food Company, Inc., who drained and demolished the reservoirs in the mid-late 1960s for the development of the residential housing tract. Where concrete from the reservoirs was not removed, records indicate that following the removal of residual hydrocarbons remaining in the reservoirs by the residential developer, the developer's contractors cut trenches into the reservoir bases so that the reservoirs would not pond water and adversely affect drainage/infiltration for the subsequent residential development on the Site. Concrete from the reservoir sides was then reportedly placed by the developer's contractors into the base of the reservoirs, and soil from the surrounding levees was subsequently graded and compacted in place, spreading existing petroleum impacts around the site.

In addition to the reservoirs, other potential sources include former pipelines, an onsite oil pump house, various offsite operations by others at surrounding facilities (including refining operations, refined hydrocarbon storage, industrial chemicals processing, and chemical milling operations, dry cleaners), offsite oil wells owned and operated by others, atmospheric depositions, and, likely to a smaller extent, various residential activities.

Compounds associated with crude or bunker oil include TPH and TPH-related compounds such as certain VOCs (primarily BTEX: benzene, toluene, ethylbenzene, and xylene), polycyclic aromatic hydrocarbons (PAHs), and possibly metals. Potential COCs were identified by reviewing the historical and current uses associated with the Site and were selected based on their likelihood of being associated with the petroleum storage facility operating in the 1924 to 1966 time frame. The potential introduction of COCs from non-Site-related sources and residential land-use activities was also considered. Section 5.0 of the SCM (URS, 2010a) contains detailed information about sources for each potential COC. Only COCs related to the previous operation of the Site as a crude/bunker oil storage facility are considered as Site-related COCs[7]. The remaining COCs are considered non-Site-related COCs. The remainder of this section discusses key potential COCs as follows:

- TPH;
- VOCs;
- Semi-volatile organic compounds (SVOCs) including PAHs;
- Metals; and
- Methane.

In addition to the above constituents, polychlorinated biphenyls (PCBs), pesticides, and fuel oxygenates were considered. PCBs and pesticides have not been detected in Site soils and are not considered COCs. The oxygenate tert-butyl alcohol (TBA) and other oxygenates have been detected in Site groundwater and/or other media; however as discussed below, TBA and other oxygenates were not used before the 1970's and are considered non-Site-related COCs.

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[7] Note that Site- versus non-Site -related COCs are identified for purposes of the Site Conceptual Model. SSCGs for all compounds are provided later in this document in accordance with RWQCB directives.

2.1.1 Total Petroleum Hydrocarbons

The specific source of the crude oil stored in the reservoirs is not known. Crude oil is a complex mixture of various petroleum hydrocarbon compounds. TPH concentrations are often reported in general hydrocarbon chain ranges corresponding to gasoline, diesel, and motor oil. If the TPH from crude or bunker oil is present at sufficiently high concentration it will occur as a non-aqueous phase liquid (NAPL), which typically has lower density than water and is often referred to as "light NAPL" or LNAPL. LNAPL has been detected at the Site. An LNAPL sample collected and analyzed from Site monitoring well MW-3 was characterized as a relatively unweathered crude oil likely produced from the Monterey Formation, a common oil-producing geologic formation found throughout southern California.

Borings completed during Site characterization found evidence of petroleum releases at the Site. Elevated TPH and other indicators of petroleum releases were found: (1) beneath the footprint of the former reservoirs (below their bases, but primarily along the perimeter, in the area near the presumed joint between the reservoir bases and the reservoir sidewalls); (2) within the fill material above the base level of the former reservoirs (the source of these impacts appears to be from the developer's reuse of petroleum-impacted fill from other portions of the Site, such as berm areas), and (3) in areas outside the footprints of the former reservoirs. The impacts outside the former reservoirs are potentially from a combination of sources, including the developer's grading activities, possible former on-Site/off-Site pipelines or spills during operation of the storage facility, offsite sources, and shallow soil sources associated with residential activities.

2.1.2 Volatile Organic Compounds

Volatile organic compounds (VOCs) are light molecular weight hydrocarbons which have low boiling points and therefore evaporate readily. Some VOCs occur naturally in the environment, others occur only as a result of manmade activities, and some have both origins. Only VOCs associated with crude oil such as aromatic and aliphatic hydrocarbons are considered Site-related COCs. In addition to a crude oil source, these compounds may also have been released to the Site though accidental releases of gasoline or other refined petroleum products following residential development.

Site-related VOCs: The most prevalent VOCs associated with crude oil include aromatic compounds such as BTEX and aliphatic compounds such as the alkanes (e.g., hexane, heptane). They can impact soil or volatilize from the liquid or sorbed phase to impact soil vapor. For example, BTEX could volatilize from LNAPL and migrate through soil as a soil vapor to an enclosed space or enter a building through vapor intrusion.

Benzene has been detected in Site soil, soil vapor, and groundwater. However, as indicated in regional groundwater concentration maps shown in Appendix E (Figure E-3), benzene is widespread in groundwater in the general Site area and additional sources in the area have been identified. For example, concentrations of benzene in excess of 3,000 µg/L have been detected at the Fletcher Oil and Refining Company site (Fletcher Oil site) located 1,300 feet west (generally upgradient) of the Site. Similarly, Leymaster Environmental Consulting (Leymaster, 2013) reports concentrations of benzene as high as 4,600 µg/L detected in shallow groundwater at the adjacent Turco site, likely associated with their former leaking underground storage tank (UST) (see discussion below).

It is apparent that former Site crude oil operations have contributed to the presence of benzene in shallow groundwater beneath the Site, but some off-Site sources (e.g., Turco leaking UST) have likely contributed to hydrocarbons detected in Site groundwater. It is unlikely that a significant mass of benzene from the Fletcher Oil site has migrated onto the Site, based on the distribution of benzene detections shown in Figure E-3 and the fact that the Fletcher Oil site is located approximately 1,000 feet from the Site. However, the Turco site which is located immediately upgradient of the Site and has had elevated benzene concentrations detected in monitoring wells located adjacent to the Site's western boundary, has likely contributed some benzene in the northwest portion of the Site.

Non-Site-related Chlorinated VOCs: Chlorinated VOCs include hydrocarbon compounds that contain chlorine atoms and are typically used as solvents (such as tetrachloroethene [PCE] and trichloroethene [TCE]). Although these compounds have been infrequently detected at the Site, they are not considered Site-related COCs because there is no historical evidence that chlorinated solvents were used at the Site and the observed distributions of TCE and PCE in soil do not indicate that these constituents are related to Site activities. If these constituents were used during former Site operations (there is no historical evidence that they were) and subsequently released to Site soils, it is expected that they would be more widely distributed and present in deeper soils. A general description of TCE and PCE in Site soils follows.

- TCE was detected in approximately 0.5% of the on-Site soil samples with a maximum concentration of 0.72 mg/kg (see Appendix E, Figure E-1). TCE was only detected in vadose-zone samples collected in shallow soil (i.e., 0 - 10 feet bgs) and only 11 of the 10,290 soil samples collected on the Site had concentrations greater than 0.001 mg/kg. There were no detections of TCE in soils between 10 feet bgs and groundwater (a total of 249 samples).

- PCE was detected in approximately 1.6% of the on-Site soil samples with a maximum concentration of 19 mg/kg (see Appendix E, Figure E-2). The maximum PCE concentration was detected in a sample on the western edge of the Site. PCE was only detected in vadose-zone samples collected in shallow soil (i.e., 0 - 10 feet bgs) and only 66 of the 10,290 soil samples collected on the Site had concentrations greater than 0.001 mg/kg. There were no detections of PCE in soils between 10 feet bgs and groundwater (a total of 249 samples).

- TCE and PCE were most frequently detected in shallow soils on the western border of the Site. As shown on the figures included in Appendix E, other than samples collected on the western border of the Site, detected concentrations of TCE and PCE were generally less than 0.001 mg/kg. The detections of these constituents at higher concentrations along the western border of the Site, and only in shallow soils, suggest that their presence is related to other sources. These sources include the adjacent former Turco Products/Purex facility (Turco) where they are an identified COC (see below); the former Oil Transport Company, Inc. (OTC) site, which is now the location of the Monterey Pines community directly west of the Former Kast Property; or possibly residential chemical product use. A general description of the potential off-site sources, Turco and OTC, follows.

  Turco: Turco's former operations, which included the processing of industrial chemicals and chemical milling operations associated with aircraft production, resulted in contamination of soil and groundwater with VOCs. Contamination is greatest in the areas formerly used for chemical and hazardous waste storage, handling, and treatment. A summary of results of Turco's soil and groundwater investigations indicated that volatile compounds, including benzene, toluene, and chlorinated VOCs, were detected in the groundwater (ERM, 2010). These results are further discussed in Section 8.0. Soil, soil vapor, and groundwater samples were also collected in the Carousel Tract residential area east of the former Turco facility as part of Turco's investigation. Hydrocarbons, including benzene, toluene, xylenes, and ethylbenzene, and chlorinated solvents were detected (ERM, 2010; Leymaster, 2010; and Leymaster, 2013). In an April 2008 Fact Sheet for the former Turco facility, California Environmental Protection Agency Department of Toxic Substances Control (Cal-EPA DTSC) associated the detected VOCs within the soil vapor with past Turco operations (Cal-EPA DTSC, 2008).

Former OTC Facility: OTC operated a trucking firm from 1953 to 1996 specializing in the transportation of crude oil and asphalt (Cal-EPA DTSC, 2009a). The OTC site was used for truck parking and maintenance. The OTC site included one active oil well, above ground and underground fuel and water storage tanks, a clarifier, garage and mechanic shops, and truck wash down areas (PIC Environmental Services, 1996). It is documented that activities at the former OTC facility included the use of chlorinated solvents in the clarifier area (Ecology and Environment, Inc., 2013). In 1997, Blue Jay Partners constructed a residential subdivision called Monterey Pines on the OTC site. Prior to construction operations, seven underground storage tanks (USTs) used to store gasoline, diesel, and waste oil, and associated piping and dispensing islands, were excavated and removed from the site. A brick-lined sump and concrete clarifier were also removed. Soil sampling during the UST and clarifier removal indicated TPH, BTEX, TCE, and PCE impacts in soil (PIC Environmental Services, 1995). PCE and TCE concentrations as high as 1,840 μg/kg and 7,850 μg/kg, respectively, were detected in soils collected during soil excavation operations (PIC, 1995a). Cal EPA-DTSC (2009a) reported that during construction of the residential subdivision, contaminated soils were consolidated under the roads of the new subdivision. As part of the environmental investigation and plume delineation for the Former Kast Property, URS documented elevated concentrations of chlorinated VOCs beneath Monterey and Carmel Drives (URS, 2010a). URS reported TCE and PCE soil vapor concentrations as high as 20,000 $\mu g/m^3$ and 82,000 $\mu g/m^3$, respectively. These soil vapor concentrations are approximately one to two orders of magnitude higher than any TCE and PCE soil vapor concentrations reported in the adjacent southwest corner of the Site. More recently, USEPA completed an investigation within the OTC area (Monterey Pines neighborhood) and also documented the presence of chlorinated VOCs in both soil and soil vapor in areas near the Site (Ecology and Environment, 2013). DTSC did not believe the chlorinated VOC plume beneath the current Monterey Pines Development to be associated with the Former Kast Property (USEPA, 2012a).

In summary, although chlorinated solvents have been detected at the Site, it is unlikely that they are related to former Site operations for the following reasons:

- No records indicate that chlorinated solvents were used or stored at the former oil storage facility.

- Generally, TCE and PCE in vadose zone soils have been detected at relatively low concentrations and sporadically at shallow depths. There are no detections of these compounds in vadose zone soils between 10 feet and groundwater. If undocumented use of these solvents during former Site operations resulted in releases to Site soils, it is likely that they would be detected at higher concentrations, be more widely distributed, and be present in deeper soils.

- The number of TCE and PCE detections in soil (especially PCE) is relatively high on the western boundary of the Site, adjacent to the former Turco facility where TCE and PCE are COCs. Consequently, TCE and PCE in the western portion of the Site may be related to this off-Site facility.

The preponderance of the evidence points to the fact that chlorinated VOCs detected in Site soils are not related to Shell's operations at the Site:

- TCE and PCE were not detected in soil samples collected below a depth of 10 feet at the Site,

- TCE and PCE were detected very infrequently in the upper 10 feet at the Site, and

- The limited detections of TCE and PCE in the upper 10 feet at the Site were at low concentrations.

Given the low concentrations of these compounds in shallow Site soils and their lack of detection in deeper Site soils, the potential for any significant migration to groundwater from on-Site shallow soils is extremely low. As discussed in Section 8.0, off-Site sources are the most likely sources of the TCE, PCE, and other chlorinated solvents observed in groundwater beneath the Site.

Trihalomethanes (THMs) are another group of VOCs detected at the Site, and these can be present from residential activities. Common THMs include bromomethane, chloroform, bromodichloromethane, dibromochloromethane, and bromoform. These have all been detected in Site soils and soil vapor. Their presence at the Site is most likely related to irrigation of yards and landscaping or leaking water lines and other household water use, as THMs are found in the domestic water supply from the California Water Service Company which provides water to the area. THMs are used for water treatment/purification (California Water, 2008/2009). Although these compounds are present at the Site, they are not considered Site-related COCs.

Additionally, some chlorinated VOCs that have been detected at the Site are often found in household products that are generally perceived as safe by the average consumer. For example, 1,4-dichlorobenzene is a compound that is commonly detected in homes due to its presence in household products, including air fresheners, mothballs, and toilet deodorizer blocks (ATSDR, 2006). Other household products that contain these VOCs include paint degreasers and removers, adhesives and adhesive removers, and auto products including brake cleaners, carburetor cleaners, degreasers, and lubricants. Although typical releases are expected to be small, some of these compounds may have been released through resident activities. A list of commonly detected chemicals present on some of the residential properties as well as some known household products that contain these chemicals was provided in the SCM (URS, 2010a).

Non-Site-related Oxygenated VOCs: TBA has been detected in groundwater beneath the Site. TBA is a fuel oxygenate additive and is also a breakdown product of methyl-tert butyl ether (MTBE). TBA and MTBE were both used as gasoline additives beginning in 1979. Although this compound has been detected in Site groundwater, it is considered a non-Site-related COC because its use post-dates the Site use as a crude oil storage facility that ended in the 1960s. The presence of TBA at the Site is likely related to other sources, including offsite sources such as the adjacent former Turco site (discussed above) and the Fletcher Oil site located 1,300 feet west of the Site. Leymaster (2009) indicated that the Fletcher Oil site was used to refine and store petroleum products including crude oil, light distillates such as gasoline, naphtha, and intermediate and heavier distillates such as diesel and asphalt. The refinery was in operation from 1939 to 1992. TBA was detected in groundwater at both the Turco and Fletcher Oil sites. Available information indicates that TBA in groundwater was detected as high as 850 µg/L at the Turco site (Leymaster, 2010) and 800 µg/L at the Fletcher Oil site (Leymaster, 2012).

Residential Activities: Various residential activities which are not related to historical Site activities, including lawn care, hobbies and crafts, auto repair, and home maintenance such as painting, may have resulted in release of and subsequent detections of chemicals in soil, soil vapor, or indoor air. Although it is unlikely that a large volume of a contaminant would be released to the ground surface by resident activities, localized impacts could be noticeable in surface soils, soil vapor, or indoor air.

In summary, with respect to VOCs, only TPH-related VOCs are considered to be related to historical Site activities. Chlorinated VOCs, though present at the Site are not considered Site-related because their presence is not consistent with previous operation of the Site as a crude and bunker oil storage facility and for the other reasons detailed above. Chlorinated VOCs are believed to be present at the Site as a result of either offsite sources (e.g., Turco or OTC) and/or residential activities. Oxygenated VOCs are similarly not considered Site-related because their presence is not consistent with previous operation of the Site as a crude and bunker oil storage facility and for the other reasons listed above. In particular, TBA and MTBE did not come into use as gasoline additives until the late 1970s, many years after the use of the Site as a crude oil storage facility had ended and Shell had sold the Site to others, which occurred in the mid-1960s.

2.1.3 Semi-volatile Organic Compounds

Semi-volatile organic compounds (SVOCs) are organic compounds which have a boiling point higher than water, but may volatilize when exposed to temperatures above room temperature. SVOCs vary widely in their chemical structures. Forms include, but are not limited to, PAHs, phthalates, and phenols. Certain SVOCs can be associated with crude oil and petroleum, and/or produced through combustion. Because of their association with crude oil, select SVOCs are considered Site-related COCs.

PAHs are composed of two or more aromatic hydrocarbon rings bound in a lattice formation. They are commonly found in crude oil, tar, coal, and residues from former manufactured gas plant sites. PAHs are also commonly produced as a by-product of burning fossil fuels (in power plants or vehicle emissions) or biomass fuels (like wood), or as residues from brush or forest fires. While PAHs may have been introduced historically from the crude oil storage operations at the Site, there are other natural and anthropogenic sources that may also be sources of PAHs detected at the Site. In addition to their derivation from the burning of organic materials, PAHs are widely distributed throughout modern urban areas in near-surface soils as a result of atmospheric deposition. As a result, PAHs are found in almost all urban and rural surface soils. PAHs are generally found at higher ambient concentrations in urban areas, near heavily traveled roadways, areas that have been occupied/established for an extended period of time, and areas downwind of urbanized areas (Cal-EPA DTSC, 2009b; Environ, 2002). The PAHs that have been most regularly detected at the Site include pyrene, phenanthrene, chrysene, benzo(a)anthracene, fluoranthene, 2-methylnaphthalene, naphthalene, benzo(a)pyrene, benzo(b)fluorathene, and benzo(g,h,i)perylene. Chrysene, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluorathene are in a group of PAHs that are associated with carcinogenic effects and are commonly evaluated together as the carcinogenic PAHs (cPAHs).

2.1.4 Metals

Metals may be found in crude oil in trace amounts, but are also naturally occurring in southern California soils or are present due to anthropogenic sources. Site investigations indicated the limited, localized presence of arsenic and lead in soils at concentrations above their respective California Human Health Screening Level (CHHSL, Cal-EPA OEHHA, 2005) or regional background values. The sources of these metals are not known. Other metals that are consistent with background concentrations or below CHHSLs are not considered COCs for the Site.

Lead is known to be deposited in urban areas through atmospheric deposition, which was most significant historically prior to the widespread phase-out of leaded gasoline in the late 1970s. Other potential sources of lead include lead-based paint, which may have been used during the crude oil storage operation and on residences before the use of lead-based paint was restricted in 1978.

Arsenic has been used in the past as a pesticide/rodenticide agent and as a wood preservative. It is not known to have been specifically used at the Site. However, it is possible it was used during the crude oil storage period, the residential period, or both. Arsenic is also known to occur naturally in soils and groundwater at concentrations exceeding risk-based screening levels.

Several other metals exceed the California Maximum Contaminant Level (MCL) in groundwater beneath the Site. These metals are arsenic, thallium, and antimony. Additional discussion of the distribution of these metals in groundwater is presented in Section 8.0.

2.1.5 Methane

Methane has been detected in soil vapor samples collected at the Site. Based on the characterization work completed, methane is present primarily as the by-product of anaerobic biological degradation of crude oil compounds in the soils beneath the Site (biogenic methane). Methane has also been detected as a result of leaking natural gas utility lines, which were found at several of the residential properties, and a leaking sewer line at one residential property.

Although petroleum hydrocarbons in the subsurface have likely fermented to produce methane at depth, such methane is generally not present in the shallow subsurface and has not been detected in residences or enclosed areas of the Site at levels that pose a hazard. In one instance to date, methane believed to be attributable to fermentation of petroleum hydrocarbons was detected at a concentration above the interim action level in a sub-slab probe beneath a garage; however, methane was not detected above the interim action level in other sub-slab soil vapor probes located at this property and no methane exceedances were found during the indoor air screening and sampling conducted at this property. The detection at this location is anomalous in that it represents the only detection of petroleum hydrocarbon-related methane out of 840 sub-slab soil vapor locations sampled through August 31, 2013. Although methane has been indicated by hand-held instrument readings in a few instances during indoor air screening, in each of those cases the source was determined to be leaking natural gas lines or connections to a stove, clothes dryer, furnace, or fireplace. In none of these instances was the methane linked to subsurface hydrocarbon impacts.

Methane generated at depth typically migrates very slowly through soils because it is not under significant pressure. Transport is primarily through diffusion, and methane moving upward from depth is typically biologically degraded and/or significantly attenuated in the aerobic shallow soils before it reaches the surface. This bio-attenuation in the vadose zone is evident in the soil vapor data collected at the Site that has been reported in the Interim, Follow-up, and Final Interim Reports and the street soil vapor monitoring reports (URS, 2013b). These natural mechanisms explain the lack of elevated methane levels in the sub-slab soil vapor samples and in indoor air within the residences that have been tested.

2.1.6 Summary of Potential COCs

The SCM identifies a range of constituents that are potential COCs. These are divided into Site-related COCs (i.e., COCs considered to be potentially related to the previous operation of a crude/bunker oil storage facility) and non-Site-related COCs (i.e., COCs related to offsite activities, COCs related to site activities following Site redevelopment, and COCs representative of background conditions). Potential Site-related COCs include:

- TPH;
- TPH-related VOCs;
- TPH-related SVOCs (including PAHs);
- Metals (lead and arsenic); and
- Methane.

Non-Site-related COCs include:

- Chlorinated VOCs;

- THMs;
- Oxygenated VOCs including TBA; and
- Metals present in soil or groundwater at background levels.

Further discussion of COCs is provided in Section 4.0. The RAP will propose what corrective actions, if any, are warranted for the different COCs identified in this report.

2.2 Fate and Transport

Based on the presence of petroleum impacted soils, it appears that crude oil was released to the Site from the former crude oil storage operations. It is assumed that one release mechanism was through leakage of the crude oil storage reservoirs (primarily in the area where the side walls and floors were joined). Also, site grading for residential development appears to have redistributed impacted soils, particularly in the areas overlying the former reservoirs and outside the reservoir boundaries. There may also have been releases from former on-Site pipelines, in adjacent streets and rights-of-way, from adjacent oil production and industrial facilities owned and operated by others, and oil field operations (oil wells) owned and operated by others.

COCs released to soils during the crude oil storage operation presumably migrated downward through soils in the liquid phase. If sufficient volume existed (i.e., through significant leakage over a long period of time), crude oil containing the associated COCs would have migrated downward through the soil profile to the groundwater table as LNAPL. LNAPL has been detected at the groundwater table at MW-3 and adjacent MW-12 near the former location of a sidewall and floor joint of the central storage reservoir.

Petroleum VOCs, PAHs, and metals detected at the Site may be related to crude oil; however, some may be from other sources. For example, their origin at the Site may be through mechanisms such as atmospheric deposition or a combination of Site releases and atmospheric deposition as well as natural occurrence. The presence of secondary sources may complicate the pattern of detections in environmental media and therefore interpretation of transport pathways.

Once COCs enter the soil, they may migrate or have been redistributed via one or more of the mechanisms described below.

Construction Activities: The demolition, grading, and home construction activities, particularly Site grading by Lomita Development Company and Barclay Hollander, now a subsidiary of Dole Food Company, Inc., and their contractors, appear to have redistributed some petroleum-containing soils at the Site, especially in surface soils (approximately the upper 10 feet). Such fill may have been derived from the Site itself (e.g., the berms that formed the reservoirs). Redistribution of petroleum-containing soil during grading by the developer is the most likely explanation for detection of petroleum hydrocarbons in the soils at the Site above the elevation of the former reservoir bases.

LNAPL Migration: If sufficient driving force was present, crude oil in the liquid phase could migrate directly through the soil column. For example, the presence of LNAPL in Site monitoring well (MW-3) indicates that crude oil migrated downward from near-surface release(s) to groundwater at this location. However, cessation of crude storage operations and decommissioning of the reservoirs, which occurred by the mid-1960s, have reduced this potential downward driving force for LNAPL migration.

Leaching: COCs may also have partitioned out of residual crude oil released to Site soils and into infiltrating water (via leaching) from rainfall or Site irrigation water that eventually came in contact with the crude oil in the subsurface. COCs most subject to leaching include VOCs, certain SVOCs, and, to a much lesser degree, PAHs and metals. Infiltrating water could potentially have carried these compounds downward through the soil column and eventually into groundwater.

Based on the SCM and the age of potential petroleum releases at the Site, groundwater impacts due to leaching from Site soils are expected to be stable or decrease. This is discussed further in Section 8 and supported by the age of on-Site releases (greater than 45 years) and the plume stability analysis conducted for the most significant Site-related COC - benzene. It is expected that the VOCs and other COCs currently present in the vadose zone will be further reduced over time through degradation processes and/or continued, but reduced leaching, as the sources diminish. As a result, constituents detected in soil, but not identified as groundwater COCs are not considered COCs for the soil leaching to groundwater pathway.

Groundwater Transport: COCs that reach groundwater would be subject to transport via moving groundwater. Shallow groundwater at the Site currently flows northeastward. The vertical gradient at the Site between the shallow water table aquifer and the underlying Gage aquifer is slightly downward or slightly upward depending upon the area of the Site (URS, 2013c). COCs are expected to migrate at rates much lower than the actual flow of groundwater, as concentrations will attenuate through adsorption to soil particles, dilution, biodegradation, and other mechanisms.

Volatilization: Some VOCs associated with crude oil, including BTEX and naphthalene, may have partitioned from crude oil into the vapor phase (soil vapor). These compounds have the potential to migrate through the Site soils and potentially impact residences through the vapor intrusion pathway. BTEX and naphthalene have generally been detected in deeper soil and soil vapor samples collected throughout the Site. Their presence in these deeper zones is generally attributed to their persistence in anaerobic (no or limited oxygen) conditions. Their migration upward into the shallow soils is limited because these soils are generally aerobic (contain oxygen) which then facilitates their degradation through microbial activity.

Degradation: As with most organic materials, crude oil is subject to biological degradation. A significant by-product of anaerobic biodegradation of crude oil is methane, which is present in the subsurface at the Site. As biological degradation proceeds, the volume of crude oil is decreased. Methane has the potential to migrate through the soil profile and impact residences through the vapor intrusion pathway. However, methane rapidly degrades biologically in the presence of sufficient bacteria and oxygen (Ririe and Sweeney, 1995; Eklund, 2010). It is likely that significant degradation of methane occurs in near-surface (top several feet) soils at the Site where oxygen is more plentiful than deeper zones (URS, 2013b). It is important to note that aerobic degradation of other petroleum compounds such as benzene also likely occurs in the near-surface soils at the Site.

Plant Uptake: Plant uptake of chemicals is controlled by the physical/chemical properties of the chemical, the environmental conditions, and the plant species. Lipophilicity (attraction to fatty compounds) and volatility are the two major parameters that dictate a chemical's potential for plant uptake. Hydrophilic (water-loving) and non-volatile organic compounds can enter plants by root uptake and be translocated to the aboveground parts of the plants through the transpiration stream; while lipophilic and volatile organic compounds enter plants mainly through air deposition.

For the COCs related to crude oil, PAHs, and BTEX, results of prior investigations suggests that the soil-root-above ground plant or fruit pathway plays an insignificant role in their uptake. For PAHs, a number of studies suggest that air deposition is the major pathway for plant uptake of PAHs (Edwards, 1983; Nakajima et al., 1995; Kipopoulou et al., 1999; Wilcke, 2000; Li et al., 2010). Li et al. (2010) investigated PAH distribution in water, sediment, soil, and plants, and no correlation was found between PAH concentrations in soils and plants, suggesting that plants accumulate PAHs mainly through air deposition and not through translocation from the soil to the plant. Kaliszova et al. (2010) summarizes that "plant root PAH uptake was observed in some species, but the available data suggest that it does not represent a significant public health risk, even in heavily polluted soils." In addition, green plants may naturally produce benzo(a)pyrene (New Zealand Ministry for the Environment, 2011). For BTEX, either rapid degradation in the root-zone or volatilization to the atmosphere would occur, preventing effective uptake by plant roots. Volatile contaminants have a low potential to accumulate by root uptake because they quickly escape to air (Trapp and Legind, 2011). Consistent with the literature, Cal-EPA OEHHA does not require evaluation of the soil to root uptake pathway for organic compounds (Cal-EPA OEHHA, 2012). In addition, the CHHSLs which are derived by OEHHA based on an unrestricted land use do not include the produce ingestion pathway.

2.3 Potential Exposure Pathways Evaluated

Potential exposure to COCs at the Site is partly dependent on the type of chemicals that are present and the respective exposure media. For VOCs detected in soil, exposure may occur via direct contact to soil (dermal contact or incidental ingestion) as well as indirect exposure from vapors migrating from the subsurface into indoor or outdoor air. For non-volatile chemicals such as metals and most SVOCs and PAHs, direct human contact exposures should be considered as well as inhalation of particulates.

While the water beneath the Site is not currently used for drinking water, COCs in Site soils may migrate to groundwater through leaching and need to be addressed consistent with the Basin Plan, State Board Resolution No. 68-16 (if applicable), and State Board Resolution No. 92-49. As discussed in Section 2.2, chemical uptake from soil into plants for the primary COCs is considered insignificant. Therefore this pathway was not included in the SSCG derivation.

The potential for exposure is also dependent on the locations at which impacts are identified and the likelihood of different receptors to contact an impacted media. For example, reasonable maximum exposure assumptions are considered for soils which are readily available for human contact. Conversely, infrequent exposures may be considered for soils where limited contact is expected (e.g., soils covered by impermeable media such as a building foundation, driveway, or hardscape, or soils at greater depths). Consequently, this report evaluates cleanup goals for surface soils (considering frequent- and infrequent-exposure scenarios) as well as potential leaching to groundwater. Additionally, the residential exposure scenario is assumed to be limited to the residential properties, while construction and utility maintenance worker may be exposed to impact present on residential properties or within the public rights of way (e.g., utility work within streets).

The following receptors and exposure pathways are considered relevant for the Site.

Receptor	Exposure Medium	Potentially Complete Exposure Pathway
Onsite Resident	Shallow Surface Soil (0-2 feet bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
	Shallow Subsurface Soil (>2-10 feet bgs)	• Infrequent Incidental Ingestion • Infrequent Dermal Contact • Outdoor Air Inhalation
	Soil Vapor	• Vapor Inhalation in Indoor Air via Vapor Intrusion
	Indoor Air	• Inhalation in Indoor Air
Construction and Utility Maintenance Worker	Shallow Soil (0-10 feet bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
	Soil Vapor	• Vapor Inhalation in Outdoor Air
Groundwater	Shallow Soil (0-10 feet bgs)	• Leaching to Groundwater

3.0 PILOT TEST RESULTS

Pilot tests have been completed in accordance with RWQCB-approved work plans to evaluate potential remedial actions for the Site. Pilot tests include:

- Soil vapor extraction (SVE) pilot testing at three locations;
- In-situ chemical oxidation (ISCO) bench-scale testing using persulfate and ozone;
- Bioventing pilot testing at six locations; and
- Excavation pilot testing at two locations.

Detailed pilot testing procedures and results were provided in individual pilot test reports prepared by URS and Geosyntec and are summarized in the *Final Pilot Test Summary Report – Part 1* dated May 30, 2013 (URS, 2013e) and *Final Pilot Test Summary Report – Part 2* dated August 30, 2013 (URS, 2013g).

3.1 SVE Pilot Tests

SVE pilot tests were conducted to evaluate the potential effectiveness of using SVE to remove vapor-phase VOCs from subsurface soils. The SVE pilot test activities and results are detailed in the *Soil Vapor Extraction Pilot Test Report* (URS, 2010b).

SVE pilot tests were conducted at three onsite locations in areas with soil conditions ranging from likely favorable to potentially unfavorable for SVE. At each location, tests were done at three different depth intervals to evaluate the radius of vapor influence (ROVI) in shallow (5 to 10 feet bgs), intermediate (15 to 25 feet bgs), and deep (30 to 40 feet bgs) depth intervals.

On average, vapor flow rates observed from the extraction wells were sufficient for SVE operation. The effective ROVI in the shallow zone (5 to 10 feet bgs) ranged from 24 to 78 feet with an average of approximately 50 feet. The effective ROVI in the intermediate zone (15 to 25 feet bgs) was estimated to be 112 to 131 feet with an average of approximately 125 feet, and the estimated ROVI in the deep zone (30 to 40 feet bgs) was 75 to 156 feet with an average of approximately 115 feet.

Based on findings from the SVE pilot tests, URS concluded that SVE is a potentially feasible option for the remediation of TPHg and VOC-impacted soils at the Site in the intermediate and deep zones. For two of the three shallow test locations, soil permeability to air flow estimates indicated marginal suitability for SVE operations in the shallow zone.

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Although SVE technology is potentially feasible for remediation of the lighter gasoline-range petroleum hydrocarbons, VOCs, and methane, this technology would not be effective for diesel and motor oil-range petroleum hydrocarbons and SVOCs. However, increased air flow induced by an operating vapor extraction system might promote microbial degradation of longer-chain hydrocarbons and, over the long term, could potentially reduce concentrations of these non-volatile compounds.

3.2 ISCO Bench-Scale Testing

A preliminary feasibility evaluation for ISCO was conducted at the time the Pilot Test Work Plan was prepared (URS and Geosyntec, 2011). The preliminary feasibility evaluation concluded that sodium persulfate and ozone had greater potential for treatment of COCs than other oxidants considered, and laboratory bench-scale testing was conducted using sodium persulfate and ozone.

Sodium persulfate was found not to be effective for treatment of TPH and PAHs, despite relatively high doses of sodium persulfate application. Based on the bench-scale test results, Geosyntec concluded that hydrocarbon treatment using high doses of sodium persulfate would not be effective for Site soils, and field-scale tests were therefore not conducted.

ISCO pilot testing using ozone was conducted in two phases. The first phase is documented in the Technical Memorandum prepared by Geosyntec dated July 16, 2012 (Geosyntec, 2012a). The second expanded bench-testing phase is documented in the Phase II Bench-Scale Report (Geosyntec, 2013b).

The results from the Phase I studies indicated that ozone treatment could be effective on Site soils (at the bench-scale level); however, the dose required for achieving greater than 90% treatment was very high and an excessive quantity of ozone would be required for field application. Additionally, ozone consumption rates were slow, presenting the potential for fugitive ozone emissions. As a result, field-scale pilot testing was not recommended based on feasibility analysis and modeling that was reported the Technical Memorandum summarizing Phase I results (Geosyntec, 2012a).

Phase II ozone treatment bench-scale soil column tests were designed to evaluate the impact of varying ozone concentrations and flow rates, and thus doses, on the treatment of TPH in Site soils, and to provide additional insight into the feasibility of in-situ chemical oxidation using ozone. The Phase II test results indicated that higher ozone utilization could be achieved using lower flow rates and lower applied ozone dose per mass of soil; however, less than approximately 50% reduction in TPH concentrations was observed in the Phase II tests.

As with the Phase I findings, Geosyntec concluded that effective field applications would require an excessive quantity of ozone to treat a single injection location, and that full-scale treatment would require an excessive quantity of ozone to achieve greater than 50% reduction in hydrocarbon mass. Therefore, field pilot testing of ISCO using ozone was not recommended based on both Phase I and Phase II findings, and will not be considered as a possible remedial alternative in the RAP.

3.3 Bioventing Pilot Testing

Bioventing pilot testing was conducted at six locations at the Site: four locations used vertical bioventing wells and two locations used horizontal wells installed in a trench. At each location a series of monitoring probes was installed to monitor fixed gases with field instruments during the tests. Individual tests ran for one to two weeks, followed by a week of respirometry measurements. Results from the bioventing pilot tests are summarized in the final *Bioventing Pilot Test Summary Report* (Geosyntec, 2012b).

Evidence of degradation of petroleum hydrocarbons was observed during the pilot tests, indicating that bioventing is a potential technology to remediate residual petroleum hydrocarbons. The bioventing pilot test results indicate that relatively low flow rates are necessary to deliver sufficient oxygen to the subsurface meet the bioventing oxygen demand. Because the horizontal wells affect a larger volume of soils, higher flow rates are required when using the horizontal well configuration. Results of the fan technology testing indicated that required flow rates theoretically can be achieved using commercially available fans; however, radon fans were shown to be more effective than the other two fan technologies tested.

The time frame required for bioventing system operation was estimated using biodegradation rates calculated from respirometry tests conducted at the extraction wells and vapor monitoring probes during the bioventing tests. The mean initial biodegradation rate from the six bioventing tests is 6.6 mg/kg/day and the mean average biodegradation rate is 0.31 mg/kg/day.

The bioventing time frame for hydrocarbon reduction is dependent on the biodegradation rates as well as initial TPH concentration and remedial objectives. To calculate bioventing time frame, Geosyntec assumed an initial soil TPH concentration of 10,000 mg/kg, which is representative of the midrange of the concentrations measured during the pilot tests. The calculated time frame for bioventing system operations ranged from approximately 1 to 4 years, assuming the higher initial biodegradation rate, to several decades assuming the average biodegradation rate.

Based on the pilot test results, the following conclusions were reached regarding application of bioventing at the Site:

- Oxygen delivery is generally more effective using horizontal wells than vertical wells.
- No benefit was observed from using the vapor monitoring probes as passive vents to enhance subsurface flow.
- The radon fans evaluated during the pilot testing provide sufficient air flow to meet the bioventing oxygen demands.
- Radius of influence for the bioventing extraction wells ranged from less than 5 feet to 20 feet with an average radius of influence of approximately 10 feet.

3.4 Excavation Pilot Testing

Excavation pilot testing was conducted to evaluate the feasibility of excavating impacted soils to a depth of 10 feet bgs and removing the concrete reservoir bases (slabs) located at approximately 8 to 10 feet bgs beneath portions of the former oil storage reservoirs, and also to evaluate smaller "surgical" excavation. The excavation pilot tests were conducted in accordance with the *Pilot Test Work Plan* (URS and Geosyntec, 2011).

A slot-trench excavation was completed to approximately 10 feet bgs, including removal of the concrete slab, in the front yard of a property, and a surgical excavation was done to approximately 6 feet bgs in the back yard of a property to evaluate the ability to conduct hot spot removal. The scope of pilot test excavations at these two locations was expanded to include excavation of the remaining portions of the front and back yards, respectively, to a depth of 2 feet throughout the entire non-hardscape covered portions of the yards. Details are provided in the individual excavation pilot test reports (URS, 2013a and 2013d).

Engineering controls and mitigation measures were implemented during excavation activities to mitigate impacts to the community, including:

- Establishing an exclusion zone around work areas to limit access to essential personnel;
- Installing sound attenuation panels around noise-generating equipment operating onsite to lessen noise impacts associated with equipment operations;

- Use of ground protection mats and/or plywood sheeting to prevent damage to hardscape flatwork and adjacent structures;
- Implementing traffic control, as approved by the City of Carson, to manage traffic in the vicinity of excavation operations;
- Offsite staging of trucks to minimize idling of trucks within the neighborhood;
- Application of water mist to control fugitive dust;
- Use and pilot testing of different vapor and odor suppressants to mitigate fugitive vapors; and
- Providing for site security during non-working hours.

Monitoring conducted during pilot excavation activities included:

- Monitoring of existing cracks in hardscape near excavation areas for changes potentially associated with excavation activities (none were noted);
- Monitoring of ground stability in the vicinity of the excavations (no indications of instability were noted);
- Vibration monitoring for potential structurally-damaging vibration levels associated with excavation activities (no potentially damaging vibrations were noted);
- Real-time monitoring of the worker's breathing zone for worker health and safety and collection of time-weighted samples to monitor worker VOC exposure (no worker health and safety issues were identified);
- VOC emissions monitoring in compliance with South Coast Air Quality Management District (SCAQMD) Rule 1166 (compliance with the Rule 1166 permit was maintained);
- Meteorological monitoring for wind speed and direction and ambient temperature;
- Monitoring for VOCs upwind and downwind of the work area for laboratory analysis for VOCs (no downwind impacts were observed);
- Dust monitoring surrounding the work area for SCAQMD Rule 403 compliance (dust control measures were implemented periodically in accordance with monitoring results);
- Odor monitoring within the exclusion zone, at the property boundary, and within the adjacent neighborhood (odor control measures were implemented periodically in accordance with monitoring results); and
- Noise monitoring at multiple locations adjacent to and across the street from excavation operations.

Based upon setbacks from existing structures, a slot-trench excavation 12 feet wide by 26 feet long was completed in the front yard of a selected property. A medium-sized

18,000-pound track-mounted excavator with rubber tracks was used to excavate three approximately 4-foot-wide unshored slot trenches to 10+ feet bgs. The exposed portion of the underlying concrete reservoir base was successfully removed from each trench. The excavator was also used to directly load excavated soil and concrete rubble into dump trucks staged at curbside.

In addition to the pilot excavation to 10 feet bgs, the upper 2 feet of soils were excavated from the remaining part of the front yard and side yard north of the driveway. The additional 2-foot excavation extended to the edge of hardscape walkways, the driveway, and a low fence along the southern property boundary. The shallow excavation was done using a combination of mechanized excavation with the excavator and hand excavation using small hand tools.

The slot-trench excavation pilot test yielded the following findings and conclusions:

- Excavation of impacted soils to a depth of 10 feet bgs and the concrete slab at the former reservoir base was accomplished without the need for installation of shoring.
- Excavation to 10 feet bgs using slot trenching is technologically feasible in geotechnically similar site soils, subject to allowable setback distances from structures and hardscape, and absence of underground utilities that cannot be interrupted. The presence of utilities in excavation areas would significantly complicate deep excavations. Utilities are present in the front yards of many of the residential properties at the Site.
- Allowing for setbacks from structures and hardscape, the overall area of the excavation was approximately 12 feet wide by 26 feet long. Soils were excavated to a depth of 10 feet bgs over approximately 40% of the non-hardscaped area of the yard in front of the property.
- Setbacks will limit the area of yards where excavation can be accomplished to 10 feet bgs to a varying degree based on site-specific geotechnical properties and the area of the yards. This property was selected for pilot testing due to its relatively large front yard without complex landscaping or hardscape configuration. Smaller yards or those with complex hardscape configuration will complicate deep excavations.
- It is technologically feasible to remove most of the exposed concrete reservoir base within the excavation using the slot-trenching method; however, some concrete around the margins of the trenches cannot effectively be removed due to logistical constraints. The concrete base was removed over approximately 75 to 80% of the excavated area, which represents approximately 5% of the total area of the lot at this property.

- Soils within the remaining portion of the front yard and the side yard were readily excavated to a depth of 2 feet bgs using a combination of excavating equipment and hand tools.
- Induced vibrations associated with excavation activities and removal of the reservoir base were well below established damage threshold curves.
- Sound attenuation panels reduced noise levels during the majority of excavation activities to less than the maximum allowable noise level of 75 decibels (dBA) per the City of Carson noise ordinance; however, noise levels associated with some excavation and transportation activities exceeded this level for short periods of time. With sound attenuation panels removed, it was not possible to stay below the 75 dBA maximum.
- Testing of different odor control methods indicated that application of long-acting vapor suppression foam provided the best mitigation of vapor and odors, significantly reducing odors at the source immediately after application.

A surgical excavation was conducted in the back yard of a second property to evaluate the ability to conduct "hot spot" excavation of defined areas in back yards of properties using appropriately-sized equipment. Surgical excavation at this location accomplished a secondary purpose of providing an interim remedy to remove impacted soils that resulted in an elevated risk index from a small, well-defined area of the yard.

The surgical excavation was 9 feet x 9 feet in diameter and 6 feet deep and was conducted using an approximately 3,500-pound rubber track-mounted mini-excavator that was sufficiently narrow to access the back of the property via the side yard. A Bobcat skid-steer mini-loader was used to move the excavated material to the front yard and load soil into covered roll-off bins staged in front of the driveway for transport and disposal. The Bobcat was also used to shuttle clean backfill material from the driveway to the backyard for placement as fill.

In addition to the surgical excavation, the remaining non-hardscaped part of the back yard and the northern side yard were excavated to a depth of 2 feet bgs. The additional 2-foot excavation was done using the mini-excavator and manually using hand tools and wheel barrows.

The surgical excavation yielded the following findings and conclusions:

- Surgical excavation to 6 feet bgs is technologically feasible in geotechnically similar site soils, subject to allowable setback distances from structures and hardscape, and absence of underground utilities that cannot be interrupted. At other locations with less favorable soil conditions, shoring or slot-trenching methods may be required. The presence of utilities in excavation areas could significantly complicate excavations.

- Setbacks from structures or fences may limit the area of some yards where surgical excavation can be accomplished to a varying degree based on site-specific geotechnical properties, depth of planned excavations, and proximity of features that must be protected.
- It is technologically feasible to perform surgical excavations and yard-wide excavations to shallow depths in back yards of properties using a mini-excavator and hand tools, given a sufficiently wide unobstructed access route along a side yard.
- Induced vibrations associated with excavation activities were well below established damage threshold curves.
- Use of sound attenuation panels placed along the fence line of the back yard reduced noise levels during the majority of excavation activities to less than the maximum allowable noise level of 75 dBA per the City of Carson noise ordinance; however, noise levels associated with some excavation and transportation activities exceeded this level. Where it was not feasible to erect sound attenuation panels, it was not possible to stay below the 75 dBA maximum.

4.0 CONSTITUENTS OF CONCERN AND REMEDIAL ACTION OBJECTIVES

As a first step in developing cleanup goals for the Site, the COCs and remedial action objectives (RAOs) must be established. As discussed in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300), which is incorporated into the California Hazardous Substances Account Act (HSAA) by reference), RAOs describe in general terms what a remedial action should accomplish in order to be protective of human health and the environment. RAOs are narrative statements that specify the chemicals and environmental media of concern, the potential exposure pathways to be addressed by remedial actions, and the receptors to be protected. According to USEPA (USEPA, 1988), "RAOs for protecting human receptors should express both a contaminant level and an exposure route, rather than contaminant levels alone, because protectiveness may be achieved by reducing exposure (such as capping an area, limiting access, or providing an alternate water supply) as well as by reducing contaminant levels." The RAOs are used to help develop specific response actions for each media in the remedial action process.

This section presents the COCs and RAOs for the Site. In Sections 6 through 8, the RAOs are discussed in the context of each medium to identify Site-specific Cleanup Goals (SSCGs) for the Site.

4.1 Constituents of Concern

Property-specific HHSREs have been conducted for the majority of properties at the Site to evaluate the analytical results of soil and sub-slab soil vapor samples using a screening evaluation. The HHSRE is a preliminary, conservative evaluation of potential human health risks associated with detected organic chemicals (whether or not they are Site-related COCs). The results of the HHSREs have been used throughout the characterization phase to evaluate whether interim action is warranted in advance of the full HHRA that will be performed for submission with the RAP. The results of the full HHRA will be used to focus further evaluations in the RAP on those media and constituents that pose the majority of potential risk.

The Site-specific cleanup goals presented in this Revised SSCG Report will be used in the full HHRA. In response to the Regional Board's directive, Site-specific clean-up goals have been developed for both Site-related and non-Site-related COCs.[8] In addition to potential human exposure pathways, migration to groundwater through the leaching pathway will be considered. Recommendations for corrective actions for COCs will be presented in the RAP for the Site and will consider the SCM, results of the upcoming HHRA, pilot test results, and the economic and technological feasibility evaluation.

COC screening was conducted using risk-based screening levels (RBSLs) that were calculated assuming potential residential exposures to COCs in soil and soil vapor; the RBSLs were calculated as a part of the HHSRE process and are presented in the approved HHSRE Work Plan (Geosyntec, 2009). The RBSLs address the exposure pathways presented in the SCM in Section 2 and represent the chemical concentrations in the relevant environmental media that would be consistent with a target risk level for the current land use under conservative (i.e., protective) exposure conditions. For the carcinogenic PAHs and metals, a background comparison value was used along with the calculated RBSLs for COC selection. For the selection of soil COCs to address the leaching to groundwater pathway, chemicals that were detected in groundwater above the MCL or notification level (NL) were carried forward into the SSCG derivation process. Based on the SCM presented in Section 2 and the age of potential petroleum releases at the Site, groundwater impacts from leaching from Site soils are expected to decrease through time. This is discussed further in Section 8 and supported by the age of the release and the plume stability analysis. As a result, the inclusion of only chemicals that have been detected above MCLs and NLs in groundwater is considered appropriate for soil COC selection for the leaching to groundwater pathway. As an additional screening criterion for soil, if the chemical was detected in five or less samples it was excluded from the SSCG derivation. Given the large number of soil samples collected (over 10,000) this equates to less than or equal to 0.05% of soil samples.

In the first step of COC selection, a list of detected chemicals in each medium was identified. Tables 4-1 through 4-4 present the prevalence and range of concentrations of all chemicals that were detected at least once in soil, soil vapor, indoor air, and groundwater, respectively, across the Site.

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[8] While Site-specific clean-up goals have been developed for non-Site-related COCs, the Regional Board has previously made clear that Shell is not responsible for addressing contamination not related to Shell's former use of the Site. Regional Board's Response to Comments to Tentative CAO, Response Nos. 8.45, 8.51 (January 27, 2011).

To identify COCs for soil and soil vapor, the maximum concentration was compared to one-tenth of its respective RBSL. If the maximum concentration was greater than one-tenth of the RBSL it was selected as a COC for the Site. One-tenth of the RBSL (i.e., 1×10^{-7} for carcinogenic effects and 0.1 for noncancer effects) was used as a conservative adjustment to screen chemicals for further analysis and to address potential cumulative effects. In addition to the RBSL screen, background concentrations for metals and carcinogenic PAHs (cPAHs as benzo(a)pyrene equivalents[9]) were considered. For groundwater, chemicals present above their respective MCLs or notification levels were identified as COCs. These same groundwater COCs were evaluated for the soil leaching to groundwater pathway with the exception of those chemicals that were detected in five or less soil samples.

Tables 4-5 through 4-6 present the COCs that have been identified for soil and soil vapor. Groundwater COCs are presented in Section 8.

4.2 Remedial Action Objectives

Medium-specific RAOs have been developed based on Site investigations completed to date. Numerical SSCGs for the COCs, where applicable, have been developed to achieve the medium-specific RAOs. It is anticipated that the medium-specific RAOs and SSCGs along with the analysis of Applicable or Relevant and Appropriate Requirements (ARARs) will be presented and used in the RAP to identify the final response actions for each medium.

Various demarcations of acceptable risk have been established by regulatory agencies. The NCP (40 CFR 300) indicates that lifetime incremental cancer risks posed by a site should not exceed a range of one in one million (1×10^{-6}) to one hundred in one million (1×10^{-4}) and that noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a Hazard Quotient [HQ] greater than 1). In addition, other relevant guidance (*The Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, USEPA, 1991c) states that sites posing a cumulative cancer risk of less than 1×10^{-4} and hazard indices less than unity (1) for noncancer endpoints are generally not considered to pose a significant risk warranting remediation. The California Hazardous Substances Account Act (HSAA) incorporates the NCP by

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9 Benzo(a)pyrene equivalents are calculated following methods recommended by Cal-EPA (Cal-EPA DTSC 2009c). Additional details regarding calculation of benzo(a)pyrene equivalents are provided in Appendix A.

reference, and thus also incorporates the acceptable risk range set forth in the NCP. In California, the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) regulates chemical exposures to the general population and is based on an acceptable risk level of 1×10^{-5}. The California Department of Toxic Substances Control (DTSC) considers the 1×10^{-6} risk level as the generally accepted point of departure for risk management decisions for unrestricted land use. Cumulative cancer risks in the range of 1×10^{-6} to 1×10^{-4} may therefore be considered to be acceptable, with cancer risks less than 1×10^{-6} considered *de minimis*. The risk range and target hazard index has been considered in developing RAOs based on human health exposures to soil and soil vapor. For groundwater and the soil leaching to groundwater pathway, water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply, have been considered.

The following RAOs are proposed for the Site based on the above and site-specific considerations:

- Prevent human exposures to concentrations of COCs in soil, soil vapor, and indoor air such that total (i.e., cumulative) lifetime incremental carcinogenic risks are within the NCP risk range of 1×10^{-6} to 1×10^{-4} and noncancer hazard indices are less than 1 or concentrations are below background, whichever is higher. Potential human exposures include onsite residents and construction and utility maintenance workers. The point of departure risk level for onsite residents is the lower end of the NCP risk range (i.e., 1×10^{-6}) and a noncancer hazard index less than 1.
- Prevent fire/explosion risks in indoor air and/or enclosed spaces (e.g., utility vaults) due to the accumulation of methane generated from the anaerobic biodegradation of petroleum hydrocarbons in soils. Eliminate methane in the subsurface to the extent technologically and economically feasible.
- Remove or treat LNAPL to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result.
- Reduce COCs in groundwater to the extent technologically and economically feasible to achieve, at a minimum, the water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply.

The RAOs are addressed for each specific medium in Sections 6 through 8.

5.0 GUIDANCE DOCUMENTS AND POLICIES CONSIDERED

Per the CAO, the following guidance documents and Policies were considered in establishing SSCGs for the Site[10]:

- LARWQCB Interim Site Assessment and Cleanup Guidebook (LARWQCB, 1996).
- USEPA Regional Screening Levels (Formerly Preliminary Remediation Goals) (USEPA, 2012b).
- Use of Human Health Screening Levels (CHHSLS) in Evaluation of Contaminated Properties (Cal-EPA DTSC, 2005a).
- TPHCWG Series (TPHCWG, 1997a,b, 1998a,b, 1999).
- Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach (MADEP, 2002).
- Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology (MADEP, 2003).
- Air-Phase Petroleum Hydrocarbons (APH) Final (MADEP, 2009).
- Advisory-Active Soil Gas Investigations (Cal-EPA DTSC, 2012).
- Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Cal-EPA DTSC, 2011).
- Risk Assessment Guidance for Superfund (RAGS) Parts A-F.
- USEPA User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (2004).
- USPEA Supplemental Guidance for Developing Soil Screening Levels (2002b).
- USEPA Supplemental Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites, (2002a).

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[10]Information contained in some documents may be in conflict (e.g., toxicity factors). Nevertheless, the SSCGs presented in this report are consistent with the listed documents.

- Cal-EPA Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Wastes Sites and Permitted Facilities (Cal-EPA DTSC, 1997).

- Cal-EPA use of the Northern and Southern California Polynuclear Aromatic Hydrocarbons (PAH) Studies in the Manufactured Gas Plant Site Cleanup Process (Cal-EPA DTSC, 2009b).

- California's Maximum Contaminant Levels (MCLs), Notification Levels (NLs), or Archived Action Levels (AALs) for drinking water as established by the California Department of Public Health.

- State Water Resources Control Board's "Antidegradation Policy" (State Board Resolution No. 68-16).

- The Regional Board's Basin Plan.

- Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304 (State Board Resolution No. 92-49).

Additional publications and agency guidance documents considered in establishing SSCGs for the Site include:

- Dichlorobenzenes ToxFAQ, Division of Toxicology and Environmental Medicine, (Agency for Toxic Substances and Disease Registry [ATSDR], 2006).

- Heavy Metals in Soils, Glasgow, Blackie and Son, – As cited by Duverge, D., 2011, Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region, Masters Thesis, San Francisco State University. (Alloway, 1990).

- Advisory on Methane Assessment and Common Remedies at School Sites, School Property Evaluation and Cleanup Division, (Cal-EPA DTSC, 2005b).

- Arsenic Strategies: Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals for Proposed and Existing School Sites (March 21, 2007). (Cal-EPA DTSC, 2007).

- Interim Guidance: Evaluating Human Health Risks from Total Petroleum Hydrocarbons. URL: www.dtsc.ca.gov/AssessingRisk/upload/TPH-Guidance-6_16_09.pdf (Cal-EPA DTSC 2009c).

- Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soils, (Cal-EPA, Office of Environmental Health Hazard Assessment [OEHHA]. 2005).

- Air Toxics Hot Spots Program Risk Assessment Guidelines Technical Support Document for Exposure Assessment and Stochastic Analysis. (Cal-EPA, OEHHA. 2012).

- Harbor Community Monitoring Study (HCMS) Saturation Monitoring, Final Report. (Desert Research Institute, 2009).

- Emissions of 1,2-Dichloroethane from Holiday Decorations as a Source of Indoor Air Contamination, (Doucette, W.J., A.J. Hall, and K.A. Gorder, 2010).

- Polycyclic aromatic hydrocarbons (PAH's) in the terrestrial environment—a review. (Edwards, N.T., 1983).

- Proposed Regulatory Framework for Evaluating the Methane Hazard due to Vapor Intrusion, (Eklund, B., 2010).

- A Methodology for using Background PAHs to Support Remediation Decisions, (Environ, 2002).

- Human Health Screening Evaluation Work Plan, Former Kast Property, Carson, California. (Geosyntec, 2009).

- Data Evaluation and Decision Matrix, Former Kast Property, Carson, California. April 6, 2010 (Geosyntec, 2010a).

- Addendum to the HHSE Work Plan, Former Kast Property, Carson, California. (Geosyntec, 2010b).

- Volatile Organic Compounds in Indoor Air: A Review of Concentrations Measured in North America Since 1990. (Hodgson and Levin, 2003).

- A Critical Review of Naphthalene Sources and Exposures Relevant to Indoor and Outdoor Air. (Jia, C. and S. Batterman, 2010).

- Polycyclic aromatic hydrocarbons in the atmosphere-soil-plant system. The root uptake role and consequences. (Kaliszova, R., Javorska, H., Tlustos, P., and Balik, J., 2010).

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- Bioconcentration of polycyclic aromatic hydrocarbons in vegetables grown in an industrial area. (Kipopoulou, A. M., Manoli, E., and Samara, C., 1999).

- Polycyclic aromatic hydrocarbons in water, sediment, soil, and plants of the Aojiang River waterway in Wenzhou, China. (Li, J., Shang, X., Zhao, Z., Tanguay, R. L., Dong, Q., and Huang, C., 2010).

- Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand. (New Zealand Ministry for the Environment, 2011).

- Comparison of Personal, Indoor, and Outdoor Exposures to Hazardous Air Pollutants in Three Urban Communities. (Sexton, K., Adgate, J.L., Ramachandran, G., Pratt, G.C., Mongin, S.J., Stock, T.H., and Morandi, M.T., 2004).

- Multiple Air Toxics Exposure Study in the South Coast Air Basin (MATES-III), Final Report. (South Coast Air Quality Management District, 2008).

- Uptake of organic contaminants from soil into vegetables and fruits. (Trapp, S., and Legind, C. N., 2011).

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, ((USEPA, 1988).

- The Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. (USEPA, 1991c).

- Exposure Factors Handbook. Volumes I-III. An Update to Exposure Factors Handbook (USEPA, 1997).

- Background Indoor Air Concentrations of Volatile Organic Compounds in North American Residences (1990-2005): A Compilation of Statistics for Assessing Vapor Intrusion, (USEPA, 2011).

- EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic Compounds and Residential Buildings, (USEPA, 2012c).

References for these guidance documents and policies are included in Section 11.

6.0 SOIL

The RAOs for soil are to prevent human exposures to concentrations of COCs in soil such that total (i.e., cumulative) lifetime incremental carcinogenic risks are within the NCP risk range of 1×10^{-6} to 1×10^{-4} and noncancer hazard indices are less than 1 or concentrations are below background, whichever is higher. Potential human exposures include onsite residents and construction and utility maintenance workers. For derivation of individual chemical SSCGs, a lifetime incremental cancer risk of 1×10^{-6} was used for residential land use and a lifetime incremental cancer risk of 1×10^{-5} was used for construction and utility worker exposures consistent with the NCP risk management ranges and common practice within the State of California. A target hazard quotient (HQ) of 1 was used for noncarcinogens.

For the soil leaching to groundwater pathway, water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply, have been considered. Therefore, MCLs and NLs were used as the target groundwater concentration. For TPH, risk-based values were used as no MCL or NL is available.

Because background concentrations for some COCs detected in soil exceed risk-based levels, the evaluation of background concentrations is a critical element in identifying cleanup goals. The background concentration evaluations are detailed in Appendix A and background values used in the SSCG selection process are presented in Table 6-1.

As of August 31, 2013, soil sampling has been conducted at 266 residential properties and in the streets within the Site. Soil samples have been collected within the 0-10 foot bgs range to assess potential exposures to shallow soils as defined in the CAO and were typically collected at a minimum of six locations per property in accessible areas at four depths (0.5, 2, 5, and 10 feet bgs). Samples were collected at alternate depths if impacts were observed or if refusal was met due to subsurface obstructions that prevented collection of the deeper samples. The site investigations have detected soil impacts by primarily petroleum-related constituents. Petroleum-related constituents detected in over 50% of the samples include TPHd and TPHmo; the PAHs pyrene, phenanthrene, chrysene, benzo(a)anthracene, fluoranthene, 2-methylnaphthalene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene; and the VOCs naphthalene and benzene. Of these, chrysene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, and benzo(b)fluoranthene are considered cPAHs for purposes of evaluating benzo(a)pyrene equivalents. In addition, metals have been detected in soils, with arsenic and lead detected at concentrations above background.

To evaluate potential human health exposures to these constituents in soil and the need for interim actions, a screening level risk assessment (HHSRE) was conducted for each property where soil sampling was completed and the results were included in the Interim and Follow-up Residential Sampling reports. Potential exposures were initially evaluated for a depth interval of 0-2 feet bgs, the depth interval where there is a higher potential for residential exposure during recreational activities, landscaping, and yard maintenance. In addition, the full depth interval of 0-10 feet bgs was evaluated to address the more unlikely scenario that contact with deep soils would occur during a major renovation project (e.g., pool installation or underground utility work). Because the Site is completely developed, this deep soil exposure scenario is considered unlikely for residents. However, exposures to these deeper soils could occur during construction or utility maintenance work at the Site.

As presented in Section 4, the Site-related COCs (those COCs associated with the historic use of the Site as an oil storage facility) consist of the petroleum hydrocarbon derived constituents, and some metals. In addition, other chemicals have been detected in Site soils that are unrelated to the Site's use as an oil storage facility and are considered non-Site-related COCs. In response to the Regional Board's directive, SSCGs are established for Site-related and non-Site-related COCs identified for the Site.

The Site-related and non-Site-related COCs are presented below based on human health exposures to soil and the COC selection process described in Section 4.1. Those COCs also detected in groundwater above an MCL or NL and evaluated in the soil leaching to groundwater analysis are noted with an asterisk. For TPH constituents, no MCL or NL is available but given their prevalence in Site soils they are included in the evaluation of leaching to groundwater and are also noted with an asterisk. Figures 6-1 through 6-3 summarize the soil results for the primary Site-related COCs for human exposure to Site soils: cPAHs (as defined by benzo(a)pyrene equivalents), TPH-diesel, and TPH-motor oil.

Site-related Soil COCs	
1,2,4-Trimethylbenzene	Chrysene
1,3,5-Trimethylbenzene	Dibenz(a,h)anthracene
1-Methylnaphthalene	Ethylbenzene
2-Methylnaphthalene	Indeno(1,2,3-c,d)pyrene
Arsenic *	Lead
Benzene *	Naphthalene *
Benzo(a)anthracene	Pyrene
Benzo(a)pyrene	TPH as Diesel *

Benzo(b)fluoranthene Benzo(k)fluoranthene	TPH as Gasoline * TPH as Motor Oil *

Non-Site-related Soil COCs	
1,1,2,2-Tetrachloroethane 1,2,3-Trichloropropane * 1,2-Dichloropropane 1,4-Dichlorobenzene * 2,4-Dinitrotoluene Antimony * Bis(2-Ethylhexyl) Phthalate Bromodichloromethane Bromomethane Cadmium	Chromium VI Cobalt Copper Methylene Chloride Tetrachloroethene * Thallium * Trichloroethene * Vanadium Vinyl Chloride * Zinc

* COCs also detected in groundwater above an MCL or NL and evaluated in the soil leaching to groundwater evaluation. TPH also noted due to being primary COC for Site.

Once the COCs and potentially exposed populations are identified, the complete exposure pathways by which individuals may contact chemicals must be determined. A complete exposure pathway requires a source and mechanism of chemical release, a point of potential human contact within the impacted medium, and an exposure route (e.g., ingestion) at the contact point. These source-pathway-receptor relationships provide the basis for the quantitative exposure assessment.

The following table summarizes the exposure pathways that are relevant for potential residential exposures, potential construction and utility maintenance worker exposures, and groundwater at the Site.

Receptor	Sample Medium	Potentially Complete Exposure Pathway
Onsite Resident (Child and Adult)	Surface Soil (0-2 feet bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
	Shallow Subsurface Soil (>2-10 feet bgs)	• Infrequent Incidental Ingestion • Infrequent Dermal Contact • Outdoor Air Inhalation

Receptor	Sample Medium	Potentially Complete Exposure Pathway
Onsite Construction/Utility Maintenance Worker	Surface and Subsurface Soil (0-10 feet bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
Groundwater	Surface and Subsurface Soil (0-10 feet bgs)	• Leaching to Groundwater

6.1 Residential Receptor

The SSCGs for the residential scenario are based on frequent and infrequent exposure assumptions. Surface soils (e.g. 0-2 feet bgs) are considered for more frequent typical residential exposures whereas subsurface soils (e.g. >2-10 feet bgs) are considered for infrequent contact; the likelihood of a resident contacting soils at deeper depths is extremely low given the developed nature of the Site and typical residential activities where exposure to soil could occur (e.g., recreational activities, lawn care, landscaping). In addition, it is unlikely that soils from a deeper excavation (such as during a major renovation or utility repair work) would be placed at the surface due to the lack of area to place excavated soils. It is assumed for the infrequent contact scenario that institutional controls (e.g., a notification trigger added to the existing excavation permitting process, a soil management plan) to prevent redistribution of deep soils at the surface would be required. The potential for nuisance (e.g., odor) due to the presence of TPH-impacted soils that may be infrequently contacted is addressed in the discussion of soil vapor SSCGs in Section 7.

SSCGs were developed considering the exposure pathways identified above using the same methodology and approach presented in the RWQCB and OEHHA-approved HHSRE Work Plan and addenda. Development of SSCGs also considered background conditions (both natural and non-site-related anthropogenic sources) for metals and PAHs. The consideration of background concentrations is important in risk assessment and remedial planning as it is infeasible to clean up to lower concentrations than background.

As discussed in Section 2.2, evidence from the literature suggests that for the chemicals related to crude oil, PAHs, and BTEX, which are primary COCs for the Site, uptake from soil into plants and fruit does not play a significant role. A number of studies suggest that air deposition is the major pathway for plant uptake of PAHs. For BTEX, either rapid degradation or volatilization to the atmosphere would occur, preventing effective uptake by plant roots. Volatile contaminants in general have a low potential to accumulate by root uptake from soil because they quickly escape to air. Consistent with the literature, Cal-EPA OEHHA does not require evaluation of the soil to root uptake pathway for organic compounds (Cal-EPA OEHHA, 2012). Based on this information, this exposure scenario was not considered in the derivation of the SSCGs. Rather, the pathways that have the most exposure potential, incidental soil ingestion and dermal contact, were included in the SSCG calculation along with particulate and VOC exposure in outdoor air.

Metals may be associated with petroleum hydrocarbons, but are also naturally occurring in the environment. According to DTSC (Cal-EPA DTSC 2009c), an evaluation of background concentrations for naturally occurring materials such as metals is important to evaluate whether the metals concentrations at the Site are consistent with naturally occurring or ambient levels in the area, and whether they should be included in the risk assessment. If concentrations of a metal are within background, the metal is not considered a COC and is not evaluated further. For each metal, an Upper Tolerance Limit (UTL) has been developed based on local background (Appendix A). These values are used with upper-bound Site concentration estimates to determine if a metal is above background and should be considered further. For arsenic, the DTSC background concentration of 12 mg/kg for southern California sites (Cal-EPA DTSC, 2007) or a more detailed statistical evaluation will be used for this Site as presented in Appendix A. For lead, a background comparison is not made but rather the California Human Health Screening Level (CHHSL) of 80 mg/kg is used for surface soil for residential land-use.

PAHs can also be naturally occurring or present at ambient levels not associated with former site activities. A background data set and methodology has been developed to evaluate the presence of PAHs in soil (Cal-EPA DTSC, 2009c). Consistent with agency-approved risk assessment practice in California, the DTSC-developed background concentration of 0.9 mg/kg benzo(a)pyrene equivalents (Bap-eq) (see Appendix A) will be used to evaluate cPAHs results. Benzo(a)pyrene equivalents are calculated following methods recommended by Cal-EPA (*Use of the Northern and Southern California Polynuclear Aromatic Hydrocarbon (PAH) Studies in the Manufactured Gas Plant Site Cleanup Process*. Cal-EPA DTSC, 2009b). Additional details regarding calculation of benzo(a)pyrene equivalents are provided in Appendix A.

Table 6-1 presents the SSCGs for Site-related and non-Site-related COCs using the target risk levels of 1×10^{-6} and a target hazard quotient of 1 for residential land use. Appendix A presents the methodology that was used to derive the SSCGs.

Because of the developed nature of the Site and the reduced exposure potential to soil at depth, SSCGs are calculated separately for surface soil (soils from 0-2 feet bgs) and subsurface soil (>2-10 feet bgs). Residential reasonable maximum exposure (RME) assumptions that are equivalent to frequent exposure (350 days per year) are used to calculate SSCGs for surface soils (soils from 0-2 feet bgs) within the residential property areas. This is consistent with the focus on exposure potential stated in USEPA for conducting feasibility studies [USEPA, 1988]. "RAOs for protecting human receptors should express both a contaminant level and an exposure route, rather than contaminant levels alone, because protectiveness may be achieved by reducing exposure (such as capping an area, limiting access, or providing an alternate water supply) as well as by reducing contaminant levels." The application of cleanup levels to surface soils (0-2 feet bgs) based on frequent contact is considered protective and would meet the RAO for the Site.

To address the unlikely infrequent exposure to subsurface soils (>2-10 feet bgs), SSCGs have been developed assuming a lower frequency of exposures (see Appendix A) based on an exposure frequency of 4 days per year assuming a resident may want to dig deeper than 2 feet to plant a tree as part of gardening. The exposure frequency of 4 days per year is based on $1/10^{th}$ of the USEPA recommended event frequency of 40 events per year for an adult resident gardening outdoors on a more routine basis (USEPA, 1997). Since the value of 40 days per year is based on routine gardening, an adjustment to this value was made to account for infrequent contact to account for instances where a resident may contact deeper soil (e.g., planting a tree).

In addition, it is unlikely that residents would contact soils from a deeper excavation (such as during a major renovation or utility repair work) as these soils could not be placed on site due to the developed nature of the neighborhood and lack of area to place the excavated soils. The conceptual model for this assumption is consistent with existing institutional controls (e.g., requirement for a permit for excavation) to prevent redistribution of deep soils at the surface. A soil management plan will be prepared either as a part of, or subsequent to, the RAP to provide the detailed approach to preventing residential exposure to subsurface soils impacted by COCs.

The chemical-specific SSCGs will be used in the HHRA along with the exposure point concentration for each property and depth interval being evaluated to estimate chemical-specific risks and noncancer hazards. The 95% Upper Confidence Limit

(95UCL) of the arithmetic mean concentration is commonly used as the exposure point concentration when sufficient data are available (Cal-EPA, 2005; Cal-EPA, 1996; USEPA, 2002). The adequacy of the data as it relates to the use of the 95UCL will be described in the HHRA. Cumulative estimates of cancer risk and noncancer hazard will be calculated by summing the chemical-specific estimates presented in the HHRA. In addition, for metals and cPAHs, a parcel-specific comparison to background will be conducted as discussed in Appendix A. Note the SSCGs are independent of the site data and are not based on average concentrations or the 95UCL (i.e. the site concentration data is not used in the SSCG calculation).

6.2 Construction Worker and Utility Maintenance Worker

The soil cleanup goals for the construction and utility maintenance worker scenario apply to the soil data results from 0-10 feet bgs. This is considered an interval where exposure is more likely should utility maintenance work be required at the Site.

Soil cleanup goals were developed considering the exposure pathways identified previously using the same methodology and approach presented in the HHSE Work Plan and HHSE Work Plan Addendum (Geosyntec, 2009, 2010b), modified to account for the different exposure assumptions used for construction workers in risk assessment. In addition, because utility workers may need to conduct subsurface utility repair or maintenance, the potential exists for worker exposure within a trench and this exposure scenario was also included.

Soil cleanup goals were developed considering background conditions (both natural and non-site-related anthropogenic sources) for metals and PAHs as discussed for residential cleanup goals. As mentioned earlier, consideration of background concentrations is important in risk assessment and remedial planning as it is infeasible to cleanup to lower concentrations than background.

Table 6-1 presents cleanup goals for the Site-related COCs using the target risk levels of 1×10^{-5} and a target hazard quotient of 1 for construction and utility maintenance worker exposures. Appendix A presents the methodology that was used to derive the cleanup goals.

While it is unlikely that utility repair will be conducted to depths of 10 feet bgs, this depth interval was included to address that potential. A soil management plan will be prepared either as a part of, or subsequent to, the RAP to provide the detailed approach to preventing unacceptable construction and utility worker exposure to COCs.

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The chemical-specific SSCGs will be used in the HHRA with the 95UCL chemical concentrations calculated for each property, as appropriate, for the depth interval being evaluated to estimate chemical-specific risks and noncancer hazards. Data collected from the streets will be evaluated separately in a similar manner. Cumulative estimates of cancer risk and noncancer hazard will be calculated by summing the chemical-specific estimates. In addition, for metals and cPAHs, a comparison to background will be conducted as discussed in Appendix A.

6.3 Soil Leaching to Groundwater

As discussed in Section 2.0, some COCs may have migrated through the vadose zone to groundwater. However, as discussed in more detail in Section 8.0, based on groundwater data collected at and adjacent to the Site, it appears that the extent of the COCs in groundwater related to the Site is stable and decreasing. Furthermore, COC values in the downgradient wells near the Site boundary are below or very close to the MCLs and NLs. Based on these facts and the age of the releases of COCs in the vadose zone (>~45 years), it is unlikely that significant additional groundwater impacts will result from the remaining shallow soil contamination. Constituents of Concern currently present in the vadose zone at the Site which are also present in Site groundwater may theoretically represent a continuing source of potential groundwater contamination.

In general, infiltration of rainwater and irrigation in open areas of the Site has the potential to mobilize COCs present in the vadose zone and continue to transport those COCs to groundwater. This transport is expected to occur at a declining rate through time as the compounds degrade in the vadose zone and they are depleted through leaching. To address this migration pathway cleanup goals for the leaching to groundwater pathway were established for COCs present in both Site soils and groundwater that are protective of groundwater quality, consistent with the Basin Plan and the State's anti-degradation policy.[11]

For groundwater, chemicals present above their respective MCLs or NLs were identified as COCs. These same groundwater COCs were evaluated for the soil

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[11] As noted below in Section 8.4.2, because groundwater conditions at the time the Basin Plan was adopted in 1994 likely did not meet the water quality objectives set forth in the Basin Plan, State Water Board Resolution No. 68-16 may not be applicable. *Asociacion de Gente Unida por el Agua v. Cent. Valley Reg'l Water Quality Control Bd.*, 210 Cal.App.4th 1255, 1270 (2012). Accordingly, the MCLs set forth in the Basin Plan have been used to develop cleanup goals for soil and groundwater.

leaching to groundwater pathway with the exception of chemicals that were detected in five or less soil samples out of the over 10,000 samples collected for the Site. The chemicals not evaluated are the non-Site-related COCs 1,1-dichloroethane, 1,1-dichloroethene, and trans-1,2-dichloroethene.

For the soil leaching to groundwater pathway, water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply, have been considered. MCLs or NLs were used as the target groundwater concentrations for the COCs evaluated. For TPH constituents, no MCL or NL is available but, given their prevalence in Site soils, they are included in the evaluation of leaching to groundwater. The Site-related and non-Site-related COCs are presented below based on potential leaching to groundwater.

Site-related Soil COCs for Leaching to Groundwater Evaluation	
Arsenic Benzene Naphthalene	TPH as Diesel TPH as Gasoline TPH as Motor Oil

Non-Site-related Soil COCs for Leaching to Groundwater Evaluation	
1,2-Dichloroethane cis-1,2-Dichloroethene 1,2,3-Trichloropropane 1,4-Dichlorobenzene Antimony	Thallium Tert-Butyl Alcohol Tetrachloroethene Trichloroethene Vinyl Chloride

6.3.1 Methodology

To estimate cleanup goals for protection of groundwater quality, the migration of COCs to groundwater was simulated as a two-step process: leaching from soil particles to soil moisture, and mixing of the soil leachate with groundwater. The leaching step was modeled by using the 1996 California Regional Water Quality Control Board "Interim Site Assessment & Cleanup Guidebook" approach (the Water Board approach, LARWQCB, 1996) for organic chemicals. For metals, the USEPA Regional Screening Level methodology was used (USEPA, 2012b). The leachate-groundwater mixing step was modeled by the Soil Attenuation Model (SAM) (Connor et al., 1997). To establish soil cleanup goals, a "backward" calculation was needed, i.e., leachate criteria were first calculated based on regulatory groundwater quality standards and dilution attenuation factors (DAF, obtained from the SAM). A soil concentration (the cleanup goal) which would result in the target leachate criterion was then calculated.

When available, the California MCLs were used as the regulatory groundwater quality standards. In the case where an MCL was not available for a given COC, the California Department of Public Health NL was used. For TPH, the San Francisco Bay Regional Water Quality Control Board Environmental Screening Level (ESL) based on noncancer health-effects was used.

A simple box model approach, proposed in the SAM model (Connor et al., 1997), was used to estimate the mixing of dissolved COCs when soil leachate mixes with lateral groundwater flow. Site-specific weather conditions were accounted for by using Site area precipitation data to quantify the infiltration rate. The mixing zone height was calculated based on the thickness of the aquifer and the relative magnitudes of the infiltration rate and lateral groundwater flow rate. Using the regulatory groundwater quality standard and the DAF, SSCGs for soil leaching to groundwater for specific COCs were obtained.

Waste Extraction Tests (WET) were conducted on site soil samples to quantify the site-specific leachability of soil COCs. The WET extraction method uses a citric acid buffered solution and is intended to simulate acid rain conditions; use of this extraction method is considered conservative. When WET data were available, a sample-specific soil/water partitioning coefficient (Kd) value was calculated (NJDEP, 2013). The geometric mean of the sample-specific Kd values was used as the site-specific Kd.

When WET data were not available, Kd values were calculated from the site-specific fraction organic carbon (foc) data and the chemical-specific organic carbon/water partitioning coefficients (K_{oc}). Based on soil physical property data, the vadose zone soil was classified as 100% sand. The average soil bulk density, total porosity, water-filled porosity, and fraction organic content (f_{oc}) from the site soil physical property measurements were used as model input; and organic carbon/water partitioning coefficients (K_{oc}) and Henry's Law Constants (K_H) were obtained from the USEPA Regional Screening Level (USEPA RSL) database.

6.3.2 Cleanup Goals for Soil Leaching to Groundwater

Using the methodology described above, cleanup goals for Site-related and non-Site-related COCs found in the vadose zone were calculated for leaching to groundwater.

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Table 6-2 lists the SSCGs for soil leaching to groundwater. The details of the SAM model calculation, site-specific Kd determinations, and the Water Board and USEPA RSL approach are presented in Appendix A.

7.0 SOIL VAPOR, INDOOR AIR, AND OUTDOOR AIR

The RAOs for soil vapor and indoor and outdoor air are to limit human exposures to COCs: (1) to concentrations that are at or below background levels[12], or (2) to concentrations such that total lifetime incremental carcinogenic risks are within the NCP risk range and target hazard level (i.e., cancer risk of 1×10^{-6} to 1×10^{-4} and noncancer hazard index less than 1). As described in this section, the SSCGs for soil vapor have been calculated to meet the RAOs for indoor air for residents and outdoor air for construction and utility maintenance workers. The lower end of the NCP risk range (i.e., 1×10^{-6}) and a noncancer hazard index less than 1 is used for the residential exposure scenario and a target risk of 1×10^{-5} and a noncancer hazard index less than 1 is used for the construction and utility maintenance worker exposure scenario. Additionally, the soil vapor SSCGs also consider nuisance-based screening levels for TPH that are presented in the San Francisco Bay Regional Water Quality Control Board Environmental Screening Level (ESL) document.

The RAOs for methane in soil vapor are (1) to prevent fire/explosion risks in indoor air and/or enclosed spaces (e.g., utility vaults) due to the accumulation of methane generated from the anaerobic biodegradation of petroleum hydrocarbons in soils, and (2) eliminate methane in the subsurface to the extent technologically and economically feasible.

Soil vapor cleanup goals for residential and construction worker scenarios are presented in the following subsections.

7.1 Residential Receptor

This section addresses soil vapor SSCGs for VOCs and methane for the residential scenario. For VOCs, the vapor intrusion exposure pathway is evaluated. This is the most sensitive pathway for potential residential exposures to soil vapor; and therefore, SSCGs for the vapor intrusion to indoor air pathway are also protective of potential outdoor air exposures. Fire and explosion risks are considered for methane. The soil vapor cleanup goals for the residential scenario are based on the sub-slab soil vapor sample analytical results and a multiple-lines-of-evidence vapor intrusion pathway analysis including indoor air data collected on Site (Appendix B). Site data are used to

[12] For vapor intrusion evaluations, background is defined as sources that are not due to subsurface impacts (i.e., contributions due to outdoor air or indoor sources). More details on characterization of background in indoor air are provided in Appendix B.

develop a conservative upper-bound estimate for a site-specific vapor intrusion attenuation factor which is used to calculate SSCGs for sub-slab soil vapor. These sub-slab soil vapor SSCGs may be used in the RAP.

Data collected at the Site indicate significant natural attenuation of VOCs in the vadose zone that mitigates the potential migration of vapors detected in soil vapor samples collected at depth to reach the atmosphere. Based on the multiple-lines-of-evidence evaluation, soil vapor samples collected at depth are not considered in the residential receptor analysis. This approach is consistent with Cal-EPA DTSC vapor intrusion guidance (Cal-EPA DTSC, 2011) which states "In general, the closer the sampled medium is to the receptor, the more relevant the data are for estimating exposure and greater its weight of evidence."

7.1.1 Vapor Intrusion to Indoor Air

The sub-slab soil vapor and indoor air data were used to evaluate the vapor intrusion pathway for potential exposure to residents at the Site. As of August 31, 2013, sub-slab soil vapor and indoor/outdoor air sampling events have been conducted at 241 residential properties at the Site, and 147 of these properties have had two sub-slab soil vapor and indoor/outdoor air sampling events. In order to address the temporal and spatial variability of the vapor intrusion data, sampling has been conducted across the Site and on multiple dates. As discussed below, spatial variability in the sub-slab soil vapor and indoor air data is evident; however, the vapor intrusion pathway is evaluated for each property (as reported in the Interim, Follow-up, and Final Interim Phase II reports) to address questions concerning spatial variability. Additionally, indoor air samples have been (or will be) collected two times, at least 3 months apart, at each property to assess temporal variability. Furthermore, indoor air samples have been collected at the Site on more than 220 sampling dates over a period of more than 3 years. As discussed in Appendix B, sub-slab soil vapor and indoor air samples have been collected throughout this sampling period and these data provide a basis for assessing temporal variability across the Site, supplementing the temporal variability assessment for each property based on the two sampling events for each residence.

7.1.1.1 Sub-Slab Soil Vapor Data

As of August 31, 2013, sub-slab soil vapor samples have been collected at 265 properties. Sub-slab soil vapor samples were typically collected at three locations, and multiple sampling events have been conducted at most properties. Through August 31, 2013, more than 2,000 sub-slab soil vapor samples have been collected and the results compared to risk-based screening levels in the HHSREs. The sub-slab soil vapor results for the two primary Site-related sub-slab soil vapor COCs, benzene and naphthalene, are summarized on Figures 7-1 and 7-2. Figures 7-3 and 7-4 show the sub-slab soil vapor results for non-Site-related sub-slab soil vapor COCs, TCE and PCE. The sub-slab soil vapor screening results for COCs that exceed the RBSLs are summarized below.

COC	Number of Samples	# of Samples Above RBSL	# Properties Sampled	# Properties With a Single Exceedance	# Properties With Multiple Exceedances
1,2,4-Trichlorobenzene	2074	1	265	1	0
1,2,4-Trimethylbenzene	2074	2	265	2	0
1,2-Dichloroethane	2074	1	265	1	0
1,3,5-Trimethylbenzene	2074	1	265	1	0
1,3-Butadiene	2074	1	265	1	0
1,4-Dichlorobenzene	2074	1	265	1	0
1,4-Dioxane	2074	11	265	11	0
2,2,4-Trimethylpentane	2074	1	265	1	0
Benzene	2074	79	265	45	15
Bromodichloromethane	2074	28	265	19	4
Carbon Tetrachloride	2074	6	265	6	0
Chloroform	2074	81	265	31	18
Dibromochloromethane	2074	6	265	4	1
Ethylbenzene	2074	7	265	5	1
Methylene Chloride	2074	3	265	1	1
Naphthalene	2074	62	265	41	10
Tetrachloroethene	2074	50	265	16	11
Trichloroethene	2074	3	265	1	1

Note that comparison to RBSLs is a preliminary evaluation of potential human health risks associated with COCs detected at the property. These results are used to evaluate if further action is warranted as data are being collected and processed and does not necessarily indicate that remedial actions are needed.

As shown above and on Figures 7-1 through 7-4, exceedances of sub-slab soil vapor screening levels from the HHSREs for benzene, naphthalene, TCE, and PCE are infrequent. When an exceedance at a property is identified, this is often a result of a single soil vapor sample and is not representative of the bulk of the sub-slab data collected at a property. Sub-slab soil vapor sampling has been conducted throughout the Phase II investigation; consequently, potential variability in concentrations due to seasonal or other effects has been evaluated. Because the majority of exceedances of sub-slab soil vapor screening levels at a specific property are not reproducible, corrective action decisions based on the maximum concentration at that property likely will lead to implementation of mitigation or remedial measures that do not result in a quantifiable reduction of risk. Consequently, the complete data set for each property should be reviewed during the corrective action decision-making process.

7.1.1.2 Background Concentrations in Indoor Air

Background indoor air concentrations for some COCs frequently exceed risk-based levels, making an evaluation of background indoor air concentrations a critical element in identifying cleanup goals. Details of the background indoor air evaluation as well as the statistical evaluation of the vapor intrusion pathway at the Site are provided in Appendix B.

A variety of background sources can contribute to concentrations of VOCs in indoor air, including (1) outdoor air, (2) products used indoors, (3) residential building materials (e.g., paint, carpet, vinyl flooring.), (4) materials brought into the home (e.g., dry cleaned clothing), (5) emissions from municipal water, and (6) sources within attached garages (including vehicles, lawnmowers, paints, etc.).

Outdoor vapors can migrate indoors through open doors and/or windows. Concentrations of VOCs in indoor air are often associated with indoor product use, occupant activities (e.g., hobbies, smoking), and building materials (Van Winkle and Scheff, 2001). Trihalomethanes, such as chloroform and bromodichloromethane, are disinfection byproducts in municipal water that may be emitted to indoor air. Vapors from attached garages may be present in living spaces as a result of poor seals between the garage and the house (CARB, 2005). Common sources of background vapors include cigarette and cigar smoke, gasoline- or diesel-powered equipment, paints, glues, solvents, cleaners, and natural gas leaks. Table 7-1 summarizes potential background sources and the associated VOC concentrations detected in indoor air.

Consideration of household activities and indoor sources of VOCs is a critical element in background evaluations because indoor air background levels commonly exceed outdoor air concentrations (Van Winkle and Scheff, 2001; Hodgson and Levin, 2003; Sexton et al., 2004; CARB, 2005). On average, indoor concentrations reported in literature studies were one (Jia and Batterman, 2010) to five (CARB, 2005) orders of magnitude higher than measured outdoor concentrations. This trend likely is due to the various: indoor sources discussed above, and lower indoor ventilation compared to outdoor dispersion (Sexton et al., 2004). Studies have also shown that background levels in indoor air are building-specific due to household use and occupant activities (Van Winkle and Scheff, 2001; CARB, 2005).

7.1.1.3 Indoor Air Results

The residential air sampling conducted at the Site included indoor, outdoor, and garage air samples collected to evaluate indoor air quality and potential background contributions due to outdoor air and materials present in the garages, which are frequently attached to the living area of the residence. Chemical inventories conducted prior to indoor air sampling are also in the assessment of the contributions of background sources due to household product use.

As of August 31, 2013, more than 780 indoor air samples have been collected at the Site and the results compared to risk-based screening levels in the HHSREs and background concentrations. The indoor air results for benzene, naphthalene, and PCE[13] are summarized on Figures 7-5 through 7-7. As shown in these figures, and discussed below, indoor air concentrations detected at the Site are reflective of background levels. These findings were discussed in the Interim, Follow-up, and Final Interim Phase II reports which have been reviewed by the Regional Board and OEHHA. Overall, the regulatory agency reviews of the Interim, Follow-up, and Final Interim Phase II Site Characterization reports have concurred that the VOCs detected in indoor air appear to be due to background sources.

Appendix B includes a comparison of the measured Site indoor air concentrations to the literature values summarized by USEPA (USEPA, 2011). A comparison of the two data sets also is shown on Figure 7-8. Box and whisker plots are provided for the ten compounds detected most frequently in indoor air samples (detection frequencies greater than 95%). The boxes in this figure show the interquartile range (i.e., 25th to 75th percentile) and the bar in the middle of the box is the median value. The whiskers of the plots show the 10th and 90th percentile concentrations, and outlier results are plotted to illustrate the range of detected concentrations. The colored symbols on this plot show the ranges of median, 90th percentile, and maximum indoor air concentrations reported in the USEPA report (USEPA, 2011). Open and closed symbols show the lower and upper end of the ranges for these statistics, respectively.

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[13] A figure summarizing the indoor air results for TCE is not included, because TCE was infrequently detected in indoor air.

With the exception of 1,2-dichloroethane (1,2-DCA), the concentrations of constituents in samples collected from the Site are within the background range reported by USEPA (which included data collected between 1990 and 2005). Although 1,2-DCA was outside of the background range reported in the USEPA study, more current studies (Doucette et al., 2010 and Kurtz et al., 2010) conclude that this compound has been detected in increasing frequency and higher concentrations since 2004.

The comparison of Site data with literature background values demonstrates that VOCs detected in indoor air are reflective of background concentrations. As a result, the Site indoor air data cannot be used to calculate an empirical vapor intrusion attenuation factor[14] that is not biased high due to the effect of background sources on indoor air quality. Exclusion of data where background concentrations have a significant effect on the indoor air concentrations is an approach that has been used by USEPA in evaluation of empirical attenuation factors for sites across the United States (USEPA, 2012c).

7.1.1.4 Statistical Analysis of Vapor Intrusion Data

To further investigate the relationship between indoor air and sub-slab soil vapor concentrations, single and multiple linear regression analysis methods (as described in Appendix B) were applied to the Site data. A multiple linear regression statistical analysis (in which the potential effects of more than one factor is assessed) evaluated the relationships between VOC concentrations measured in indoor air and VOC concentrations from (1) indoor sources, (2) garage air, (3) outdoor air, and (4) sub-slab soil vapor (i.e., vapor intrusion). The single regression analysis evaluated the relationship between (1) the indoor air concentrations above outdoor levels and (2) sub-slab soil vapor concentrations.

The multiple linear regression results showed that that the correlations for garage air to indoor air and outdoor air to indoor air are statistically significant[15]. This indicates that the indoor air concentrations are related to the garage and outdoor air concentrations. The analysis calculated statistically significant relationships between sub-slab soil vapor and indoor air for chloroform and naphthalene. However, an inverse correlation was calculated for naphthalene (i.e., the contribution to indoor air would be lower for cases

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[14] The vapor intrusion attenuation factor is the ratio of indoor and sub-slab soil vapor concentrations for constituents measured in both media assuming that the contributions from background sources are insignificant.

[15] Note that the outdoor air to garage air coefficient estimate for 1,2-dichloroethane is not statistically significant.

with higher sub-slab soil vapor concentrations) which is not consistent with the vapor intrusion conceptual model. Additionally, the variability in indoor air concentrations was due to indoor sources and not concentrations in sub-slab soil vapor, outdoor air, or garage air. Consequently, the multiple linear regression analysis indicated that sub-slab soil vapor concentrations do not have a significant effect on indoor air quality. In other words, homes with higher indoor air concentrations for a given COC are not any more likely to have higher soil vapor concentrations than homes with low indoor air concentrations.

In summary, the results of this vapor intrusion pathway evaluation at the Site indicate:

- Indoor air and outdoor air concentrations of VOCs detected at the properties evaluated are indistinguishable from background and within the typical ranges of background concentrations reported in the literature.

- The multiple regression analysis results indicate that indoor air concentrations are generally correlated with outdoor or garage air concentrations, are largely influenced by indoor sources, and sub-slab soil vapor concentrations do not have a significant effect on indoor air concentrations as compared to these other sources.

Although the literature background comparison and the multiple linear regression analysis indicate that the indoor concentrations are due to background sources, sub-slab soil vapor SSCGs have been calculated for corrective action planning as directed by the Regional Board. Based on the findings presented above, remediation to the SSCGs will not result in a measureable reduction in indoor air risks. These soil vapor SSCGs have not been developed to address indoor air risks, which are equivalent to background risks, but may be used to identify properties where higher concentrations of COCs were detected in sub-slab soil vapor for further evaluation.

To calculate SSCGs for sub-slab soil vapor, a single regression analysis was conducted to evaluate the relationship between (1) indoor air concentrations above outdoor levels, and (2) sub-slab soil vapor concentrations. Based on the single regression analysis, an upper-bound vapor intrusion attenuation factor was identified. This attenuation factor was based on evaluation of the vapor intrusion data set for cases where higher sub-slab soil vapor concentrations (i.e., greater than 100 $\mu g/m^3$) were observed at residential properties. Although the effect of background sources was still apparent in this data set, the data analysis indicates that the vapor intrusion attenuation factor observed at the Site was less than 0.001. This conservative upper-bound vapor intrusion attenuation factor

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is used to calculate sub-slab soil vapor SSCGs to address the Regional Board's directive.

7.1.1.5 Sub-Slab Soil Vapor SSCGs

SSCGs for sub-slab soil vapor at the Site are presented in Table 7-2. These SSCGs are based on levels that will not theoretically result in an incremental indoor air concentration above risk-based levels. As discussed in Appendix B, indoor sources have a significant effect on the measured indoor air concentrations, and the empirical attenuation factor will overestimate the potential for vapor intrusion at the Site. Additionally, as indoor air data continue to be collected as part of each Phase II property investigation, the data will be reviewed to assess whether indoor air concentrations are representative of background conditions.

7.1.2 Vapor Migration to Outdoor Air

Appendix B summarizes the results of the outdoor air concentrations measured at the Site. These data were compared to literature values for studies conducted in the region (SCAQMD, 2008; DRI, 2009). A comparison of the two data sets is shown on Figure 7-9. The box and whisker plot for each chemical shows the outdoor air concentration distributions for eleven compounds reported in the regional studies. The boxes in this figure show the interquartile range (i.e., 25th to 75th percentile) and the bar in the middle of the box is the median value. The whiskers of the plots show the 10th and 90th percentile concentrations, and outlier results are plotted to illustrate the range of detected concentrations. The colored symbols on this plot show the ranges of mean and maximum outdoor air concentrations reported in the regional studies (SCAQMD, 2008; DRI, 2009). Open and closed symbols show the lower and upper end of the ranges for these statistics, respectively.

The concentrations of these constituents detected in samples collected from the Site are within the reported background ranges. The results of the comparison of Site data with literature background values indicates that VOCs detected in outdoor air are reflective of background concentrations.

A community outdoor air sampling program was also conducted to evaluate concentrations of contaminants detected in outdoor air and to assess whether outdoor air contaminant concentrations within the Site boundary are statistically similar to upwind and downwind locations (Geosyntec, 2010b). Results were used to assess whether or not volatile subsurface contamination is contributing to concentrations of contaminants detected in outdoor air at the Site. Four outdoor air sampling events were conducted between July 31 and September 17, 2010. Outdoor air samples were collected at four locations west of the Site boundary, four locations east of the Site boundary, and four locations within the interior of the Site. Based on the data evaluation, all statistical tests (ANOVA, t-test, and Mann-Whitney) show that air concentrations within the Site boundary are not significantly different from concentrations from areas to the east (generally downwind) and west (generally upwind) of the Site. Consequently, soil vapor to outdoor air screening levels have not been developed for the soil vapor to outdoor air pathway.

7.2 Methane

Methane screening has been conducted in indoor structures on the Site and utility vaults, storm drains, and sewer manholes at and surrounding the Site. The screening assessments have not identified methane concentrations in enclosed spaces that indicate a potential safety risk. Additionally, over 2000 sub-slab soil vapor samples have been collected at 265 properties at the Site and analyzed for methane. Through August 31, 2013, methane concentrations above the interim action levels of 0.1% and 0.5% resulting from biodegradation of residual petroleum hydrocarbons have been identified at one location at one property[16]; however, no methane exceedances were found at this property during the indoor air screening and sampling. Engineering controls have been installed to mitigate potential risks due to methane detected at this location.

Proposed SSCGs for methane are the same as those presented in the Data Evaluation and Decision Matrix (Geosyntec, 2010a). These SSCGs are consistent with DTSC guidance for addressing methane detected at school sites (Cal-EPA DTSC, 2005b). These methane SSCGs are applicable to concentrations measured in soil vapor, in vaults, or above ground.

Methane Level	Response
>10%LEL (> 5,000 ppmv) Soil vapor pressure > 13.9 in H_2O	Evaluate engineering controls
> 2% - 10%LEL (> 1,000 – 5,000 ppmv) Soil vapor pressure > 2.8 in H_2O	Perform follow-up sampling and evaluate engineering controls

[16] Sub-slab soil vapor methane concentrations exceeding interim action levels have been identified as a result of leaking natural gas utility lines, which were found at several of the residential properties, and a leaking sewer line at one residential property

7.3 Construction and Utility Maintenance Worker Receptor

The conceptual exposure scenario for the construction and utility maintenance worker receptor is the same as that considered for soils: exposure to volatiles during excavation. The volatilization factor for soil vapor migration to a trench was calculated using the same relationships as those used for soil, with an additional factor to relate soil and soil vapor source concentrations. Worker exposure due to the dermal and ingestion pathways was not considered in the soil vapor source term (Appendix A). For derivation of individual chemical SSCGs, a lifetime incremental cancer risk of 1×10^{-5} was used for construction and utility worker exposures consistent with the NCP risk range and common practice within the State of California. A target hazard quotient (HQ) of 1 was used for noncarcinogens. Table 7-2 presents the SSCGs for VOCs in soil vapor. Potential worker safety concerns associated with methane detected at the site are addressed by occupational safety and health laws.

The chemical-specific soil vapor SSCGs will be used in the HHRA to estimate chemical-specific risks and noncancer hazards. Data collected from the streets will be evaluated separately in a similar manner. Cumulative estimates of cancer risk and noncancer hazard will be calculated by summing the chemical-specific estimates.

8.0 GROUNDWATER

8.1 Introduction

The proposed RAOs listed in Section 3.0 relevant to groundwater are:

- Remove or treat LNAPL to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result, and
- Reduce COCs in groundwater to the extent technologically and economically feasible to achieve, at a minimum, the water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply.

This section contains a summary of:

- Overall occurrence of groundwater at the Site, including information relevant to establishing cleanup goals for the Site.
- Groundwater quality, including identification of COCs exceeding California MCLs or other relevant action levels, COC migration from off-Site sources, plume configuration, and plume stability analysis.
- Issues relevant to establishing Site-specific cleanup goals.

The proposed Site-specific cleanup goals for groundwater, based on technological and economic feasibility and the Basin Plan, are presented in Section 9.0.

8.2 Groundwater Occurrence

Groundwater beneath the Site has been extensively investigated (URS, 2010a and 2011), including quarterly monitoring reports which have been prepared and submitted to the LARWQCB since initial well installation in 2009. The most recent monitoring event, the 3rd quarter 2013 event, was conducted in August 2013 (URS, 2013h). Key findings of the previous investigations related to groundwater are highlighted below.

<u>Shallow Zone Groundwater</u>

- Uppermost (or first) groundwater occurs at variable depths of approximately 51-68 feet bgs, depending on well location and timing of sampling, within sandy deposits of the Bellflower aquitard. This zone is referred to as the "Shallow Zone." A cross section (Figure 8-1) depicting the Bellflower aquitard and underlying units is presented in URS (2011).

- There are currently 17 monitoring wells associated with the Site which are used to monitor Shallow Zone groundwater on a quarterly basis (Figure 8-2).
- Groundwater flow direction in the Shallow Zone is to the northeast (Figure 8-2) with a gradient of approximately 0.002 feet per foot, which has remained generally consistent since monitoring began.
- There is no documented use of groundwater within the Shallow Zone.
- As of September 2013, LNAPL was present in two wells, MW-3 and MW-12. These two wells are located 40 feet apart. Active recovery of LNAPL through pumping currently occurs monthly in MW-3 and LNAPL recovery in MW-12 is scheduled to begin in October 2013.

Gage Aquifer

- The Gage aquifer is interpreted to underlie the Site at a depth of approximately 80-90 feet bgs (Figure 8-1). The base of the unit is estimated to occur at a depth of approximately 163-176 feet. The Gage aquifer is underlain by low permeability materials which separate the Gage aquifer from the underlying Lynwood aquifer.
- Four monitoring wells were installed in the upper portion of the Gage aquifer, and these are paired spatially with four monitoring wells completed in the lower portion of the Gage (Figures 8-3 and 8-4). These well pairs are also co-located near Shallow Zone wells.
- In the shallow Gage wells, the recent groundwater flow direction is reported to be east-northeast with a gradient of approximately 0.0018 feet per foot (3rd Quarter 2013). The groundwater flow direction has varied from east-southeast to northeast over the monitoring period.
- In the deep Gage wells, the recent groundwater flow direction is reported to be east-northeast with an approximate gradient of 0.0019 feet per foot (3rd Quarter 2013). The groundwater flow direction has varied from east-northeast to east over the monitoring period.
- The vertical gradient varies from slightly downward from the Shallow Zone to the Upper Gage to the Lower Gage, to slightly upward in the same zones.
- There is no documented use of groundwater within the Gage aquifer near the Site. The nearest production well to the Site (CWS Well 275 located 435 feet west of the western Site boundary) produces water from the underlying Lynwood and Silverado aquifers. The drinking water supplied to the Carousel

community by the water provider is tested according to state standards and is safe to drink (California Water Service Company, 2013).

8.3 Groundwater Quality[17]

Quarterly monitoring of both Shallow Zone and Gage wells has been conducted since well installation. Wells are sampled quarterly for VOCs and TPH. Additionally, the wells have been sampled for metals, SVOCs, and general mineral parameters, although not on a quarterly basis. Table 4-4 summarizes the on-Site groundwater sampling data[18].

Several compounds have been detected above their respective MCL or NL. Compounds detected in one or more sampling rounds in on-Site monitoring wells which exceed their respective MCL or NL are summarized below.

[17] Note that Site versus Non-Site related COCs are identified herein. SSCGs for all compounds regardless of their source are provided in accordance with RWQCB directives.
[18] Data in Table 4-4 do not include off-Site monitoring well data.

	Chemical	MCL (µg/L)	NL (µg/L)	Maximum detected concentration (µg/L)*
VOCs and Hydro-carbons	1,1-Dichloroethane	5		22
	1,1-Dichloroethene	6		33
	1,2,3-Trichloropropane		0.005	27
	1,2-Dichloroethane	0.5		6.1
	Benzene	1		680
	cis-1,2-Dichloroethene	6		510
	Naphthalene		17	82
	tert-Butyl Alcohol (TBA)		12	250
	Tetrachloroethene	5		260
	trans-1,2-Dichloroethene	10		120
	Trichloroethene	5		400
	Vinyl Chloride	0.5		0.71
	1,4-Dichlorobenzene	5		11
Metals and General Minerals	Antimony	6		19.3
	Arsenic	10		900
	Thallium	2		4.24J
	Iron	300		67,000
	Manganese	50		2550
	Chloride	500 mg/L		1400 mg/L
	Nitrate (as N)	10000		14000
	Total Dissolved Solids	1000 mg/L		3320 mg/L
	Specific Conductance	1600 µS/cm		4200 µS/cm

* Unless noted
J : Estimated
Note: MCLs for iron, manganese, chloride, Total Dissolved Solids, and Specific Conductance are secondary MCLs. MCLs shown for chloride, Total Dissolved Solids, and Specific Conductance are the "upper" secondary MCLs.

Of the compounds listed, only benzene, naphthalene, and arsenic are considered Site-related COCs in groundwater. TPH is also considered a Site-related COC in groundwater. Although MCLs or NLs do not exist for TPH, concentrations in Site groundwater exceed San Francisco Regional Water Quality Control Board Risk Based Environmental Screening Levels (SFRWQCB ESLs). Additional discussion of non-Site and Site-related COCs is presented in Sections 8.3.1 and 8.3.2.

8.3.1 Non Site-Related COCs

8.3.1.1 Tert-Butyl Alcohol (TBA)

TBA has been detected in groundwater beneath the Site. TBA is a fuel oxygenate additive and is also a breakdown product of methyl-tert butyl ether (MTBE). TBA and MTBE were both used as gasoline additives beginning in 1979. Although this compound has been detected in Site groundwater, it is considered a non-Site-related COC because its use post-dates the Site use as a crude oil storage facility that ended in the 1960s. The presence of TBA at the Site is likely related to other sources, including offsite sources such as the adjacent former Turco site (discussed above) and the Fletcher Oil site located 1,300 feet west of the Site. Leymaster (2009) indicated that the Fletcher Oil site was used to refine and store petroleum products including crude oil, light distillates such as gasoline, naphtha, and intermediate and heavier distillates such as diesel and asphalt. The refinery was in operation from 1939 to 1992. TBA was detected in groundwater at both the Turco and Fletcher Oil sites. Available information indicates that TBA in groundwater was detected as high as 850 µg/L at the Turco site (Leymaster, 2010) and 800 µg/L at the Fletcher Oil site (Leymaster, 2012).

TBA is widely detected in groundwater at the Site, both in Shallow Zone and Gage wells. It has been detected in 11 of the 17 Shallow Zone wells including the upgradient well MW-7. It has also been detected in 3 of the 4 shallow Gage wells and one of the deep Gage wells. The highest recorded (i.e., historical) concentration (250 µg/L) is in the shallow Gage well MW-G04S located in the northwestern portion of the Site. Its presence at the Site clearly demonstrates the migration of impacted groundwater onto the Site from off-Site sources. Potential sources are described in Section 2.1.2.

8.3.1.2 Chlorinated Compounds

Chlorinated compounds which exceed their respective MCLs in one or more Site monitoring wells include: 1,1-dichloroethane; 1,1-dichloroethene; cis-1,2-dichloroethene; trans-1,2-dichloroethene; 1,2-dichloroethane; 1,4 dichlorobenzene; tetrachloroethene; trichloroethene; and vinyl chloride. The presence of these chlorinated compounds in Site groundwater is attributed to off-Site sources and further demonstrates the migration of impacted groundwater onto the Site (as with TBA). Off-

Site sources for these compounds are clearly indicated by the observed distribution of TCE and PCE in shallow groundwater. Figures summarizing recent TCE and PCE concentrations in shallow groundwater for the Site and for upgradient off-Site locations, including the Turco Facility, OTC Facility (Monterey Pines), and Fletcher Oil site, are presented in Appendix E (Figures E-4 and E-5). In addition, maximum historical TCE and PCE detections are depicted in Appendix E (Figures E-6 and E-7). The following are salient points regarding the observed TCE and PCE distribution in groundwater.

- There are numerous upgradient monitoring wells located on the adjacent former Turco Facility and OTC facility sites that contain significant concentrations of TCE and PCE. TCE and PCE have recently been detected as high as 660 μg/L and 480 μg/L in the Turco site monitoring wells screened in the Shallow Zone (MW-13S/D nested location). In the past, prior to ongoing remedial efforts at Turco, TCE and PCE were detected as high as 5,500 μg/L and 9,200 μg/L in Turco monitoring wells (Leymaster, 2013). The off-Site Turco monitoring wells containing these elevated TCE and PCE concentrations are located directly adjacent to and upgradient of the Site (Figures E-6 and E-7). Based on the northeasterly groundwater flow direction, groundwater in the vicinity of these impacted off-Site wells has flowed and continues to flow onto the Site.

- The highest concentrations of dissolved TCE and PCE on the Site are present in shallow monitoring wells MW-01 and MW-05; these are both located on the western boundary of the Site immediately downgradient of the former Turco and OTC sites. In August 2013 TCE and PCE were detected at 380 μg/L and 260 μg/L, respectively, in MW-1 and at 310 and 3.5 μg/L, respectively, in MW-05 (URS, 2013h).

  MW-1 is located in the very southwest corner of the Site immediately downgradient of the former clarifier and wash area at the OTC site (Figures E-4 and E-5). As discussed previously in Section 2.0, investigations conducted during the clarifier removal indicated PCE and TCE impacts in underlying soil (PIC Environmental Services, 1995 and 1995a). PCE and TCE concentrations as high as 1,840 μg/kg and 7,850 μg/kg, respectively, were detected in soil samples collected during soil excavation operations in the former OTC wash/clarifier area (PIC, 1995a). Although the PIC report notes the soil concentration data, it is unclear whether groundwater samples were collected. Given the elevated soil impacts at OTC and the lack of deeper vadose zone impacts at the Site (see below), it is likely that groundwater impacts occurred at OTC and migrated downgradient to the Site. MW-05 is located in the northwestern portion of the Site immediately adjacent to the former Turco facility site where high TCE and PCE concentrations have been detected in shallow groundwater (Figures E-4 through E-7).

- Data do not support the Site as a source of the TCE and PCE found in groundwater. No historical evidence for solvent use on-Site was found during extensive research associated with Site investigations over the past several years. Analysis of more than 400 Site soil samples collected in the deeper vadose zone (10 feet to groundwater) contained no detectable TCE or PCE, while these constituents were detected in deeper vadose zone samples collected at the adjacent OTC and Turco sites. TCE and PCE concentrations in Site shallow groundwater are observed to rapidly attenuate across the Site from west (near the off-Site Turco and OTC sources) to east (generally in the downgradient direction of groundwater flow).

- The highest recorded detections of the chlorinated solvents 1,1-dichloroethane, 1,1-dichloroethene, and vinyl chloride in monitoring wells installed during this investigation has occurred in the upgradient and off-Site MW-7 monitoring well. MW-7 is located in the former OTC facility area.

Based on the preponderance of data and information regarding sources of chlorinated solvents, including information presented in Section 2.1.2, the presence of chlorinated compounds in Site groundwater is attributed to off-Site sources.

1,2,3-trichloropropane (1,2,3-TCP) has been previously detected in two Shallow Zone monitoring wells (Shallow Zone well MW-06 located in the northeast portion of the Site and MW-7 located west and hydraulically upgradient of the Site) and shallow Gage well MW-G02S located in the west central portion of the Site. During the most recent 3rd quarter 2013 monitoring event, 1,2,3-TCP was only detected in MW-06 at a concentration of 8.7 μg/L. 1,2,3-TCP is an emerging chemical of concern with no MCL, but a relatively low NL of 5 parts per trillion. 1,2,3-TCP is commonly associated with agricultural soil fumigation activities or industrial solvent use. The chemical is not considered a Site-related COC, but has been detected at the adjacent upgradient Turco site.

8.3.1.3 General Minerals

The general mineral quality of groundwater in nearly all Shallow Zone Site wells exceeds State Secondary MCLs for total dissolved solids (TDS) and electrical conductivity (Table 4-4)[19]. Chloride also exceeds the Secondary MCL in the wells with the highest TDS. Iron and manganese exceed the Secondary MCL in nearly all wells. This is typical of shallow water in the general area.

The most-recently reported TDS concentrations in the Shallow Zone wells ranged from 745 mg/L to 9,700 mg/L (URS, 2013i). The TDS in the underlying Gage aquifer is generally less than 1,000 mg/L and is of better quality than the Shallow Zone groundwater. Elevated concentrations of TDS (and electrical conductivity) are common in groundwater in much of the LA Basin (Water Replenishment District [WRD], 2008), particularly in shallow groundwater and near the coast where aquifers have been affected by seawater intrusion. WRD (2013) indicates that TDS concentrations in the West Coast Basin have been elevated due to seawater intrusion, and the secondary MCL of 1,000 mg/L has been exceeded in areas along the coast and in the Dominguez Gap area. As an illustration of the high background of general mineral concentrations in the area, the highest reported TDS, specific conductance, and chloride in a Site monitoring well have been measured in the upgradient MW-7 well. TDS, specific conductance, and chloride in MW-7 were measured at 9,700 mg/L, 10,000 µmhos/cm, and 4,700 mg/l, respectively, during the 2nd quarter 2013 monitoring event (URS, 2013i). The very high TDS in MW-7 may be also related to historic oil brine disposal on the former OTC site (PIC, 1995b).

Iron and manganese are also elevated in the upgradient well MW-7; these were detected at 15.4 mg/L and 3.3 mg/L, respectively, during the 2nd quarter 2013 event (URS, 2013i). The elevated detection of manganese is higher than any detections in on-Site monitoring wells. The dissolved iron and manganese in groundwater is likely derived primarily from native Site soils (i.e., soils contain a large amount of iron and manganese). WRD (2013) indicates that iron and manganese in groundwater are naturally occurring and that their concentrations in WRD West Coast Basin monitoring wells often exceed their respective secondary MCLs.

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[19] Electrical Conductivity or EC is a generally related and proportional to Total Dissolved Solid concentrations.

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The elevated TDS, specific conductance, chloride, iron, and manganese concentrations at the Site are considered to be regional in nature or from natural or upgradient sources and are not attributed to previous Site activities prior to the late 1960s.

Nitrate exceeds the MCL in one Shallow Zone Site well (MW-01). Detected nitrate (as nitrogen) concentrations have ranged between 12 mg/L and 14 mg/L in the well. The source of the nitrate is not known, but is not expected to be related to previous Site activities prior to the late 1960s. Furthermore, the extremely limited distribution of impact in the Site groundwater indicates that nitrate is unlikely to be related to Site activities.

8.3.1.4 Metals

Antimony and thallium exceed the MCL in several Site wells (Table 4-4). In the most recent monitoring event that sampled and analyzed for these metals (4^{th} quarter 2012), antimony slightly exceeded the MCL in only one shallow monitoring well, and thallium slightly exceeded the MCL in three shallow monitoring wells and three Gage wells (URS, 2013c). Thallium concentrations were reported above the MCL in only the 4^{th} quarter 2012 event and were reported as estimates because of the low levels detected (i.e., 3-4 μg/L).

These metals can be present in trace concentrations in crude oil, but also occur naturally in the environment. Given the very limited distribution of impact in Site groundwater, they are unlikely to be related to crude oil impacts and are not considered Site-related COCs.

8.3.2 Site-Related COCs

Site-related COCs in groundwater exceeding State MCLs or NLs are benzene, naphthalene, and arsenic. TPH also exceeds ESLs. These compounds are discussed below.

8.3.2.1 Benzene

As discussed in Section 2.1.2, benzene is widespread beneath the Site and in upgradient areas. Benzene in Site groundwater is attributed to one or more of the following potential sources:

- Leaching of benzene from hydrocarbon-impacted Site soils,

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- Leaching of benzene from LNAPL locally present at or near the water table beneath the Site, and

- Migration onto the Site from upgradient sources, including Turco.

The distribution of benzene in Site groundwater is depicted on Figures 8-2, 8-3, and 8-4; these figures are based on data in the 3rd quarter 2013 groundwater monitoring report (URS, 2013h). As shown on Figure 8-2, benzene is present beneath much of the Site in the Shallow Zone. The highest concentrations of benzene detected in the Shallow Zone during the 3rd quarter 2013 were in wells MW-13 and MW-06 (440 µg/L and 150 µg/L, respectively). Both monitoring wells are located in the northeast portion of of the Site. Off-Site to the northeast (downgradient), benzene was detected in one downgradient well, MW-10, at a concentration of 3.6 µg/L (URS, 2013h).

Concentrations of benzene attenuate markedly in the underlying Gage aquifer. Figure 8-3 shows recent data for the shallow Gage (URS, 2013h). Benzene concentrations in wells MW-G01S, -G02S, -G03S, and -G04S are ND, 0.19 µg/L, 0.31 µg/L, and 130 µg/L, respectively. The benzene concentration of 130 µg/L in MW-G04S is anomalous because that concentration is significantly higher than the overlying Shallow Zone concentration of 4.9 µg/L in MW-17. Furthermore, the elevated benzene concentration in this shallow Gage well MW-G04S is also associated with the highest TBA concentrations at the Site: 210 µg/L in the 3rd quarter 2013 and up to 250 µg/L historically. As described previously, TBA was introduced as a gasoline additive in 1979 and is associated with relatively recent gasoline impacts. Thus, TBA in MW-G04S is unrelated to Site activities prior to the late 1960s. The association of the anomalous elevated benzene concentration in MW-G04S with the elevated TBA concentration in the same well indicates that benzene impacts in this well are attributable to refined gasoline from an off-Site source and not to former Site operations. Elevated benzene concentrations have been detected in off-site Turco monitoring wells MW-8 and MW13D, which are directly upgradient of MW-G04S (Figure E-3). Benzene concentrations in Turco monitoring wells MW-8 and MW-13D were recently detected at 210 µg/L and 130 µg/L, respectively. Historically, benzene has been detected as high as 4,600 µg/L in Turco MW-8 and 190 µg/L in Turco MW-13D (Leymaster, 2013).

Benzene was not detected in samples collected in the deeper portion of the Gage aquifer during the most recent monitoring event (Figure 8-4).

As shown on Figures 8-2 through 8-4, the lateral and vertical distributions of benzene at the Site are generally well defined. Benzene concentrations in downgradient, off-Site wells (MW-09, MW-10, and MW-11) ranged from ND to 3.6 µg/L in the 3rd quarter 2013 and are significantly lower than in on-Site wells. The Gage aquifer wells define the vertical benzene distribution, with the exception of the anomalously high benzene detection in shallow Gage well MW-G04S which, as discussed above, is attributed to an off-Site source.

To characterize the stability of the benzene groundwater plume at the Site, two public-domain software packages, Monitoring and Remediation Optimization System (MAROS) and Bioscreen, were used to analyze the temporal trends of the plume (AFCEE, 2004 and USEPA, 1996). Details of these analyses are presented in Appendix C.

The results of the MAROS analysis are summarized as follows.

- Based on statistical analysis of the data collected to date from the 23 on-Site and off-Site wells with dissolved phase data (MW-07 was not included because it is an upgradient off-Site well), benzene concentrations in most wells are non-detect or have either No Trend, or Stable or Decreasing trends.
- Overall the MAROS trend analysis indicates that the dissolved benzene plume located beneath the Site is Potentially Decreasing and that benzene concentrations in the "tail area" or downgradient (off-Site) areas are Decreasing.
- The moment analysis shows that the total dissolved mass of the benzene plume displays a Probably Decreasing trend. Four wells display statistically increasing trends. Overall, the MAROS analysis shows the plume is Potentially Decreasing in size.

Given these overall trends provided by the MAROS analysis, it is likely that the benzene in Site groundwater is being attenuated through natural biodegradation processes and is a stable or decreasing plume. This conclusion is supported by the current observed distribution of benzene in the plume, which shows significant attenuation (to non-detect or near non-detect concentrations) at the downgradient plume edge near the property boundary). The conclusion is also supported by the significant age of the plume source (more than ~45years).

Additional modeling was performed using the Bioscreen model (USEPA, 1996) to further evaluate plume stability and to estimate the migration and biodegradation of the benzene groundwater plume. Bioscreen simulates key fate and transport processes of hydrocarbons such as advection, dispersion, sorption, and biodegradation. A description of the model, information on selection of parameters, and simulation results are presented in Appendix C.

Two source-zone scenarios were modeled with the Bioscreen model: (1) a source zone (LNAPL) without reduction, and (2) a source zone assuming 80% reduction (i.e., source removal). Simulation results show that without source zone reduction, the benzene concentration at the source zone will decrease to below the MCL (1 µg/L) in over 300 years, but also that no noticeable down-gradient migration of the benzene plume is predicted. The second simulation (assuming 80% benzene source zone mass removal) predicts that the benzene concentrations in groundwater will be degraded to below the MCL in approximately 70 years, also with no discernible down-gradient migration of the benzene plume.

8.3.2.2 Naphthalene

Naphthalene is detected in groundwater from the majority of Site wells. However, concentrations that exceed the NL of 17 µg/L have been detected in only two wells. Naphthalene has been detected at a maximum concentration of 82 µg/L in well MW-13, located in the northern portion of the Site (detected at 60 µg/L in the 3rd Quarter 2013). MW-13 is the monitoring well with the highest detected concentration of benzene at the Site. Naphthalene is also present above the NL (detected at 30 µg/L during the 3rd Quarter 2013) in well MW-14, located in the southern portion of the Site. Concentrations of naphthalene exceeding the NL are limited to these two areas and the extent is relatively well delineated.

8.3.2.3 TPH

TPH has been detected in Site monitoring wells at concentrations exceeding SFRWQCB groundwater ESLs. TPH-gasoline, TPH-diesel, and TPH-motor oil in Site groundwater have historically been detected as high as 3,200 µg/L, 3,000 µg/L, and 1,700 µg/L, respectively. In the most recent groundwater monitoring event (3rd quarter 2013), TPH-gasoline concentrations above the ESL of 410 µg/L were detected in three Site monitoring wells: MW-02, MW-06 and MW-13 (URS, 2013h). The highest TPH-gasoline concentration, 1,400 µg/L, was detected in MW-13 located in the northern portion of the Site. In the same monitoring event TPH-diesel concentrations above the ESL (200 µg/L) were detected in three wells: MW-06, MW-08, and MW-13 (URS, 2013h). The highest TPH-diesel concentration, 2,400 µg/L, was also detected in MW-13. The TPH-diesel ESL was also exceeded in the off-site upgradient monitoring well MW-07. The TPH-motor oil ESL was not exceeded in samples collected during the 3rd quarter 2013 monitoring event.

8.3.2.4 Arsenic

Arsenic has been detected in most of the Site monitoring wells. During the most recent groundwater monitoring event in which arsenic was sampled (2^{nd} quarter 2013), arsenic concentrations exceeding the MCL of 10 µg/L were detected in several wells MW-4, 5, 6, 7, 8, 10 11, 13, 14, 15, 16, 17, G-04S, and G-03D (URS, 2013i). Dissolved arsenic was relatively elevated (above 100 µg/L) in three Shallow Zone wells located in the west central portion of the Site (MW-05, MW-08, and MW-15) and in one downgradient well (MW-10). The highest historical arsenic concentration, 900 µg/L, was reported in a sample collected from MW-08. Arsenic was not detected in the three off-Site Shallow Zone downgradient wells.

Dissolved arsenic concentrations in the deeper Gage wells are significantly lower and are only slightly above the MCL of 10 µg/L. The highest reported arsenic concentration in the Gage aquifer was 17.1 µg/L in MW-G04S.

Although arsenic is identified as a COC (Section 2.2), it is likely that a portion, if not all, of the arsenic present in groundwater is derived from native Site soils. Arsenic is a natural trace element that occurs in soils. Under reducing conditions, iron oxides that can bind with natural arsenic tend to dissolve. Arsenic can then be freed and will be in a more soluble and, thus, mobile phase. The relatively high dissolved iron and manganese concentrations in many of the Site wells may be indicative of reducing conditions beneath the Site; the relatively low field oxidation reduction potential (ORP) measurements in the field during sampling also indicate reducing conditions. These reducing conditions in the Site subsurface may be natural, but may also be enhanced by the presence of petroleum hydrocarbon compounds that consume oxygen during aerobic biodegradation. Welch et al. (2000) indicates that arsenic in the iron oxides of natural aquifer materials may be an important source of dissolved arsenic at sites contaminated with VOCs.

Because arsenic is naturally soluble, dissolved arsenic is a common contaminant in southern California groundwater. Out of all wells sampled by WRD in the West and Central Groundwater Basins in the Los Angeles area, arsenic exceeds its MCL more than any other constituent (WRD, 2008). WRD (2008) reports that arsenic concentrations as high as 205 µg/L were detected in the wells they monitor. Groundwater immediately upgradient of the Site has elevated arsenic. In the 2^{nd} quarter 2013 event, arsenic was detected above the MCL at a concentration of 38.8 µg/L in the upgradient well MW-7.

In summary, it is known that arsenic is a regional contaminant in southern California. It is likely that at least a portion, if not all, of the dissolved arsenic beneath the Site is derived from natural sediments beneath the Site. Petroleum hydrocarbon impacts at the Site may enhance the solubility of arsenic by lowering oxygen levels in the subsurface, thus increasing the mobility of arsenic in soils beneath the Site. Based on monitoring well data, relatively elevated arsenic concentrations are localized in the central western portion of the Site and are attenuated significantly in the downgradient direction.

8.4 Proposed Cleanup Goals for Groundwater

8.4.1 Site Conditions Relevant to Establishing Cleanup Goals

As described in Section 8.2, groundwater beneath the Site is impacted with various chemicals including petroleum hydrocarbons, chlorinated hydrocarbons, metals, and general minerals. Of these, COCs which exceed an MCL or NL in groundwater are benzene, naphthalene, arsenic, trace metals (antimony and thallium), various chlorinated compounds and 1,2,3-TCP, and general minerals. TPH exceeds ESLs. Key factors in establishing cleanup goals for these compounds are discussed below for these COCs. Selection of the appropriate SSCGs for Site groundwater is addressed in Section 9.

8.4.1.1 Benzene

- Benzene is the most significant of the COCs in groundwater because it is widespread in the Shallow Zone as well as in soil and soil vapor.

- The distribution of benzene in groundwater is generally well defined, both laterally and vertically. The downgradient limit of the benzene plume is at or near the northeastern property boundary. Benzene concentrations are low to non-detect in the Gage aquifer with the exception of one well that is likely being affected by an off-Site source given the co-located elevated concentrations of TBA.

- The benzene groundwater plume at the Site appears to be stable or decreasing in volume and size as shown by statistical analysis and modeling. Statistical analysis indicates that the plume concentrations are decreasing and model simulations predict a reduction of benzene concentrations to MCLs in 70 to over 300 years depending on the level of source removal. The observed current distribution of dissolved benzene in Site monitoring wells demonstrates attenuation of benzene to MCLs or near MCLs at the downgradient end of the plume on the northeastern Site boundary. The presence of relatively low levels of dissolved oxygen in groundwater samples suggests the benzene plume (and other TPH compounds) in groundwater is degrading through microbial activity.

- It is expected that the benzene sources have declined over time and will continue to do so in the future. Based on the SCM and the age of potential petroleum releases at the Site, groundwater impacts from leaching from Site soils are expected to decrease through time. Crude oil present in the vadose zone above the groundwater table and in a limited area at or below the water table has been subject to biological degradation and leaching over a period of more than 45-years. It is expected that benzene concentrations in soils will be further reduced over time by degradation and/or continued, but reduced leaching, as the sources diminish. The diminishing concentrations of benzene in the vadose zone are expected to result in continued declining benzene levels in groundwater in the future.

- The technological and economic feasibility of groundwater remediation of benzene is largely dependent on the ability to remove potential sources in the vadose zone, in LNAPL, in the higher concentration areas of the plume, and in upgradient areas (see above discussion of upgradient sources). This is discussed in detail in Section 9).

8.4.1.2 Naphthalene

- Naphthalene is not expected to be naturally occurring in shallow groundwater beneath the Site and exceeds the NL in two wells on-Site, both of which are already impacted by benzene.

8.4.1.3 TPH

- TPH is not expected to be naturally occurring in shallow groundwater beneath the Site and, based on recent quarterly monitoring results (URS, 2013h), exceeds TPH-gasoline ESLs in three on-site monitoring wells and TPH-diesel ESLs in three on-site monitoring wells. These locations are also impacted by benzene.

- The technological and economic feasibility of groundwater remediation of TPH is largely dependent on the ability to remove potential sources in the vadose zone, LNAPL in groundwater, and in upgradient areas (see Section 9).

8.4.1.4 Arsenic

- The source of arsenic is likely naturally occurring, although the concentrations may be locally enhanced due to the presence of reducing conditions related to the degradation of petroleum hydrocarbon compounds). Once petroleum hydrocarbons are depleted, elevated arsenic would be expected to return to background concentrations.

- Arsenic is recognized as a regional issue in southern California groundwater. Arsenic has been reported by WRD as the constituent that exceeds its MCL more than any other constituent in the West and Central Groundwater Basins (WRD, 2008).

8.4.1.5 Trace Metals

- Dissolved antimony and thallium have been detected at low concentrations above their respective MCLs in groundwater from several Site wells. These metals are present in natural soils and in trace concentrations in crude oil. They are present at very low concentration and have limited distribution in Site groundwater.

8.4.1.6 TCE, PCE and other Chlorinated Compounds

- Based on the lack of detections of TCE and PCE in vadose zone soils below 10 feet and their presence at significant concentrations in groundwater in upgradient areas, the source of these compounds in Site groundwater is considered to be off-Site.

- The technological and economic feasibility of groundwater remediation of all chlorinated compounds will be dependent on the ability to remediate upgradient sources. Cleanup of chlorinated solvents to MCLs at the Site will not be technologically feasible without cleanup of off-Site sources. A groundwater remedy that reduces the concentrations of these compounds in groundwater without source reduction will have limited success (see Section 9).

8.4.1.7 General Minerals

- General minerals or parameters exceeding secondary MCLs include TDS, electrical conductivity, chloride, iron, and manganese. These compounds are observed to be highly elevated in the one upgradient monitoring well (MW-7) and elevated concentrations of these dissolved compounds are common in LA Basin groundwater, particularly near the coast. However, in general, the sources of these general mineral compounds are not thought to be related to previous Site activities prior to the late 1960s.

- Nitrate exceeds the primary MCL in one well. The source of the nitrate is not known, but is not expected to be related to previous Site activities prior to the late 1960s.

8.4.1.8 Other Factors

- Although groundwater beneath the Site is designated for municipal use, groundwater in both the Shallow Zone and the Gage aquifer in the Site vicinity is not currently used for drinking or other purposes. Because groundwater extractions from the area are strictly controlled (the West Coast Basin is adjudicated), there is no foreseeable future use of water from the Shallow Zone and Gage aquifer in the area.

8.4.2 Regulatory Standards Relevant to Establishing Cleanup Goals

CAO # R4-2011-0046 (LARWQCB, 2011) included a discussion of the Basin Plan and State Water Board Resolution Nos 68-16 and 92-49. As stated in the CAO:

> "Groundwater cleanup goals shall at a minimum achieve applicable Basin Plan water quality objectives, including California's MCLs or Action Levels for drinking water as established by the California Department of Public Health, and the State Water Resources Control Board's (SWRCB) 'Antidegradation Policy' (SWRCB Resolution No 68-16), at a point of compliance approved by the LARWQCB, and comply with other applicable implementation programs in the Basin Plan."

> "The SWRCB's 'Antidegradation Policy' requires attainment of background levels of water quality, or the highest level of water quality that is reasonable in the event that background levels cannot be restored. Cleanup levels other than background must be consistent with the maximum benefit to the people of the State, and not unreasonably affect present and anticipated beneficial uses of the water, and not result in exceedance of water quality objectives in the LARWQCB's Basin Plan."

It is not clear that State Water Board Resolution No. 68-16 is triggered here. Resolution No. 68-16 was implemented to regulate "the granting of permits and licenses for unappropriated waters and the disposal of wastes into the waters of the State" where groundwater conditions are better than water quality levels. In such cases, new discharges may only be permitted where certain findings are made. The establishment of SSCGs for the Site does not include a request for approval for disposal of wastes into the groundwater beneath the Site; to the contrary the proposed SSCGs, the future submission of the RAP and the other steps Shell is taking to comply with the CAO are all aimed at addressing the effects of existing Site-related COCs.

Also, Resolution No. 68-16 was implemented to maintain water quality conditions where such conditions are better than water quality levels established in a policy, such as the Basin Plan, at the time of its adoption. Given the historical nature of the Site conditions, it appears unlikely that water quality at the Site (with respect to the COCs in groundwater) was better than the standards set forth in the Basin Plan when it was adopted in 1994. "When undertaking an antidegradation analysis, the Regional Board must compare the baseline water quality … to the water quality objectives. If the baseline water quality is equal to or less than the objectives, the objectives set forth the water quality that must be maintained or achieved. In that case the antidegradation policy is not triggered." *Asociacion de Gente Unida por el Agua v. Cent. Valley Reg'l Water Quality Control Bd.*, 210 Cal.App.4th 1255, 1270 (2012).

In its comments to the original SSCG Report, the Regional Board provided the following discussion concerning State Water Board Resolution No. 92-49:

> "The SWRCB's 'Resolution No. 92-49' requires the Regional Board to assure that waste is cleaned up to background conditions, or if that is not reasonable, to an alternative level that is the most stringent level that is economically and technologically feasible. Resolution 92-49 does not require, however, that the requisite level of water quality be met at the time of site closure. Even if the requisite level of water quality has not yet been attained, a site may be closed if the level will be attained within a reasonable period."

We generally agree with this summary but note that Resolution No. 92-49 does not mandate cleanup of soil, soil vapor, or indoor air to background levels for each of those media. Instead, Resolution No. 92-49 requires that waste is cleaned up and abated:

> "in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored, considering all demands being made and to be made on those

waters and the total values involved, beneficial and detrimental, economic, social, tangible and intangible."

The focus in Resolution No. 92-49 with respect to remedial activity is on water quality and not on all media. Waste in non-water media (such as soil) should be addressed through remediation to promote the attainment of background water quality (not, for example, background levels in soil) or the best water quality that is reasonably feasible given the considerations listed.

8.4.3 Proposed Site-specific Cleanup Goals for Groundwater

To reiterate, the proposed RAOs listed in Section 3.0 relevant to groundwater are:

- Remove or treat LNAPL to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result, and
- Reduce COCs in groundwater to the extent technologically and economically feasible to achieve, at a minimum, the water quality objectives in the Basin Plan to protect the designated beneficial uses, including municipal supply.

There are several possible SSCGs that could be applied to the Site to meet the RAOs for groundwater, as described in general below. Table 8-1 summarizes possible SSCGs for the COCs in groundwater at the Site. Section 9.0 addresses selection of the most appropriate SSCG for the Site, based on the RWQCB directive to "propose SSCGs for groundwater to achieve, at a minimum, applicable Basin Plan water quality objectives within a reasonable time frame and that take into account continuing migration of waste into groundwater" as well as levels that are "economically and technologically feasible."

8.4.3.1 LNAPL

The SSCG for LNAPL is to remove or treat LNAPL to the extent technologically and economically feasible, and where a significant reduction in current and future risk to groundwater will result. The technological and economic feasibility of implementing this SSCG is discussed in Section 9.0.

8.4.3.2 Background Water Quality

One possible SSCG for the Site is background water quality. Background would generally be considered non-detect for most organic compounds (TPH and chlorinated compounds). Background for metals is much more difficult to assess considering that

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Shallow Zone groundwater data for metals from non-impacted sites in the Site vicinity are very limited, metals occur naturally in soils), and naturally elevated concentrations can occur in groundwater due to localized geochemical conditions. For similar reasons, background for general mineral compounds is also difficult to assess. Background levels for several of the metals and general mineral compounds, including arsenic, iron, manganese, TDS, chloride, and specific conductance, are well documented to be elevated in the West Coast Basin.

SSCGs based on background concentrations would be highly protective considering that the groundwater is not used as a water source, nor would be used as a water source in the foreseeable future. As discussed in Section 9.0, cleanup to background levels over a relatively short time period is not technologically or economically feasible given the need to remove all sources both on- and off-Site in order to achieve background water quality.

8.4.3.3 Maximum Contaminant Levels

Given that all groundwater beneath the Site is designated for municipal use in the Basin Plan, MCLs, NLs, and ESLs are possible SSCGs for the Site. MCLs would meet the requirements of the Basin Plan and are protective of hypothetical municipal use, although there is no reasonably anticipated use of the Shallow Zone groundwater in the future given its elevated general mineral content and the adjudicated nature of the basin which effectively restricts future well installation and pumping.

COCs above their MCLs, NLs, or ESLs are presented in Section 8.3 and Table 8-1. The major site-related COC is benzene. As noted in Section 8.3.2.1, based on modeling results for current conditions, the benzene plume will reduce to MCL concentrations in approximately 70 to over 300 depending on While this time frame could be reduced through source removal, it is difficult to quantify the reduction in time to reach MCLs given the potential contribution from off-Site sources.

The Low Threat Closure Policy (SWRCB, 2012e) currently allows closure of sites with up to 1 mg/L or 3 mg/L benzene (based on plume length) where certain criteria are met. Although the Site is not an UST site and does not meet all the criteria for closure under the Low Threat Closure Policy, there are several general criteria which the Site does meet including: (1) the release is located within the service area of a public water system, (2) the unauthorized release consists only of petroleum, (3) the unauthorized release has been stopped, (4) a site conceptual model that assesses the nature, extent, and mobility of the release has been developed, and (5) soil and groundwater has been tested for MTBE and results have been reported. The benzene plume beneath the Site appears be more than 250 feet in length but less than 1,000 feet in length, so the specific criterion of benzene concentrations being less than 1,000 µg/L is met. However, other specific criteria, such as the requirement of the nearest water supply well being located greater than 1,000 feet away is not met, although the one well located within 1,000 feet of the Site is in a hydraulically upgradient area and is completed below the Shallow zone and Gage aquifers.

Cleanup of TPH-related compounds (including benzene) to MCLs will eventually occur due to natural biodegradation; however the length of time needed to meet MCLs will be long and the length of time to meet background levels even longer. The time could be expedited through removal of some source material, such as LNAPL removal, targeting high benzene areas in the vadose zone for SVE, and/or conducting "hot spot" remediation of elevated concentration areas in groundwater. Reduction of TPH-related compounds to the MCL or low-level range is expected to cause arsenic to decrease to background levels as well.

9.0 EVALUATION OF TECHNOLOGICAL AND ECONOMIC FEASIBILITY OF SSCGs AND SELECTION OF SSCGs (SCREENING FEASIBILITY STUDY)

9.1 Introduction

This section provides a preliminary evaluation of remedial alternatives (Screening Feasibility Study [Screening FS]) for the residential properties and the selection of SSCGs[20].

As directed in the CAO and comments from RWQCB and others, SSCGs selected for the Site must be technologically and economically feasible. In order to evaluate the technological and economic feasibility of the SSCGs, possible SSCGs were first defined for soil, soil vapor, and groundwater. These were discussed in Sections 6, 7, and 8 of this report. Next, a series of representative potential remedial alternatives to achieve the various SSCGs were selected and compared against one another using criteria including implementability; environmental considerations; reduction of toxicity, mobility and volume of COCs; social considerations; other issues; and cost. The SSCGs selected for the Site are those SSCGs associated with the recommended remedial alternatives that are identified in this comparative analysis. This process, the Screening FS, is described in this Section and summarized in Table 9-1. The selected SSCGs for the Site are listed in Tables 9-2 through 9-4. It is envisioned that a detailed evaluation of the recommended remedial alternatives will be conducted and presented in the forthcoming RAP.

Remedial alternatives consist of groupings of treatment technologies selected to achieve a specified cleanup goal or set of goals. Remedial alternatives were assembled for evaluation to the extent practical at this level of project development based on the following process:

1. Define possible cleanup goals (Sections 6, 7 and 8).

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[20] The technical and economic feasibility evaluation focuses on remediation of the residential properties located on the Site. This evaluation does not include an assessment of remediation to meet construction and utility maintenance workers goals, because we anticipate that a soil management plan will be put in place to address these exposures. The soil management plan will be prepared either as a part of or subsequent to the RAP.

2. Identify technologies that may be used to meet those goals and screen out technologies that are not effective or are not suitable for the site based on site-specific information and tests conducted on the technologies (Section 9.2).
3. Assemble the technologies into remedial alternatives (Section 9.3).
4. Perform a preliminary evaluation of alternatives based on implementability; environmental considerations; reduction of toxicity, mobility and volume of COCs; social considerations; other issues; and cost. This preliminary evaluation results in a set of alternatives for which a comparative evaluation is performed (Section 9.4).
5. Perform a comparative evaluation (Section 9.5).
6. Recommend an alternative or alternatives and associated SSCGs (Section 9.6).

Steps 2 through 6 are described in the sections that follow.

9.2 Identification and Screening of Remedial Technologies

Technologies implemented in remedial actions mitigate exposure either through elimination of exposure pathways or through removal of COC mass in one or more of the affected media (i.e., soil, soil vapor, or groundwater). In this section, potential technologies are screened on the basis of effectiveness and feasibility.

9.2.1 Remedial Technologies that Interrupt the Human Health Exposure Pathway

The following technologies interrupt the human health exposure pathway:

- Sub-slab vapor mitigation, which may include the installation of vapor barriers, venting, or sub-slab depressurization;
- Capping portions of the Site, which involves the placement of synthetic fibers, clays, and/or concrete; and
- Institutional controls, which restrict access to contaminated media.

Each of these technologies is discussed below with respect to their potential for inclusion in remedial alternatives.

Sub-slab Vapor Mitigation: This technology is proven effective at interrupting the human health exposure pathway to subsurface vapor sources. Although there does not appear to be a measurable contribution of COCs from sub-slab vapor to indoor air, sub-slab vapor mitigation is technologically feasible to implement at the Site and it has been retained for inclusion in remedial alternatives.

Capping Portions of the Site: As a technology, capping is quite effective at interrupting the human health exposure pathway at a site. Various types of site caps may be employed to accommodate future site uses. Types of site caps include soil, asphalt, concrete, marker beds or layers, and chemical or other types of sprays that can solidify a site surface. Capping is technologically feasible to implement at the Site and it has been retained for inclusion in remedial alternatives.

Institutional Controls: Institutional controls consist of administrative steps that may be used, in conjunction with other technologies or as a stand-alone approach, to minimize the potential for exposure and/or protect the integrity of a response action. Institutional controls are commonly utilized at sites to achieve cleanup objectives, and can take many forms (USEPA, 2012d). At this Site, Institutional Controls may include some form of deed notification to ensure current and future residents are aware of any residual contamination. They would also likely involve establishing a process, possibly through existing building and grading permit reviews, general plan overlay or footnote, area plan, or the like, to ensure that if a property owner plans to conduct activities such as building renovation, installation of a pool or deeper landscape alterations, Shell is notified so that the company can arrange for sampling and proper handling of any impacted soils that may be present. As such, it is not expected that Institutional Controls would interfere with the resident's use and enjoyment of his or her property. Institutional controls are technologically feasible to implement at the Site and they have been retained for inclusion in remedial alternatives.

9.2.2 Remedial Technologies that Remove COC Mass and Interrupt the Human Health Exposure Pathway

Technologies that remove COC mass in addition to interrupting the human health exposure pathway can operate through physical removal processes, such as excavation, as well as through chemical or biological processes. The following technologies have been evaluated for their capacity to remove COC mass from the Site in addition to interrupting the human health exposure pathway:

- Excavation;
- Soil vapor extraction (SVE);
- Bioventing;
- In-situ chemical oxidation (ISCO);
- LNAPL/source removal;
- Other removal or remediation of groundwater; and
- Monitored natural attenuation (MNA).

Each of these technologies is discussed below with respect to its relevance for inclusion in remedial alternatives.

Excavation: As discussed in Section 3, selective excavation of the Site around existing structures is feasible. Selective excavation could remove most of the contaminated soils for which a human exposure pathway is complete. Excavation of the entire Site would involve the removal of Site features, such as homes, roads, and utilities. While that may be technologically feasible, it is not considered feasible due to social and other considerations. In addition, excavation of the entire Site is likely not economically feasible especially in light of the limited reduction of risk that would be achieved by razing of the homes and removal of the streets given that the data collected indicate an incomplete pathway from soils beneath the homes and street. Moreover, any marginal improvement to groundwater resulting from Site-wide removal of structures would be greatly outweighed by the tremendous economic and social costs involved. Nevertheless, because excavation in some form is technologically and economically feasible, it is retained for inclusion in remedial alternatives.

Soil Vapor Extraction (SVE): Based on pilot tests conducted onsite, SVE may be able to remove lighter petroleum hydrocarbons, VOCs, and methane (Section 3). However, SVE would not effectively extract diesel, other heavier petroleum hydrocarbons, or SVOCs. SVE was retained for inclusion in remedial alternatives because it is feasible and it appears to be effective at removing some of the COCs.

Bioventing: As discussed in Section 3, bioventing appears to enhance the degradation of petroleum hydrocarbons. However, based on the average rate of biodegradation, the systems would have to be in place for several decades. Additionally, the average radius of influence of bioventing pilot test extraction wells was estimated to be approximately 10 feet. This translates to 15 to 20 extraction points that would have to be installed on each property to use bioventing at this Site, which would is considered to be prohibitive. Therefore, although a bioventing system may be capable of degrading some of the COCs, it would not be technologically and economically feasible to implement and is therefore eliminated from consideration for inclusion in remedial alternatives.

In-situ Chemical Oxidation (ISCO): Oxidants with a relatively high potential for site treatment were tested to assess the technological feasibility of treating Site soils using ISCO, as discussed in Section 3. These tests indicated that sodium persulfate was not effective and that an excessive quantity of ozone would be required for treatment. Based on these results, ISCO is not retained as a treatment technology and is therefore eliminated from consideration for inclusion in remedial alternatives.

LNAPL/Source Removal: Direct LNAPL removal, such as through pumping as is currently done or through direct excavation, is feasible in some areas and can be an effective treatment. Therefore, it is retained for inclusion in remedial alternatives.

Other Remediation or Removal of Groundwater: There are several technologies that may be used to treat the groundwater contaminants. Many of them involve pumping the groundwater to the surface to treat, which increases the probability of exposure. There are also in-situ remedies for some COCs. It is unlikely that widespread active remediation of all compounds in groundwater can be achieved effectively because the sources of the COCs will persist in the vadose zone and/or are located off-Site. Even assuming active remediation could remove all COCs in Site groundwater, the groundwater would become "re-contaminated" in time unless all sources were removed in the vadose zone as well as upgradient sources. Given that natural degradation of the petroleum hydrocarbon COCs is occurring and will continue to occur through time, "hot-spot" remediation of certain COCs in localized areas of groundwater (e.g. where COCs exceed 100x MCLs) may shorten the time over which the concentrations will return to background or MCL levels. Thus, "hot-spot" remediation of certain COCs in localized Site areas is retained for inclusion in the remedial alternatives. It is important to note that there is no complete human health exposure pathway for groundwater currently or in the foreseeable future.

Monitored Natural Attenuation (MNA): MNA relies on naturally occurring processes to decrease concentrations of chemical constituents in soil and groundwater. Natural processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of constituents in media of concern. Monitoring is performed to confirm that the concentrations of COCs are decreasing or to show that they are not. Hot spot remediation of groundwater could reduce the time needed for conditions to reach remedial objectives. MNA, with or without hot spot remediation, was retained for inclusion in remedial alternatives because its implementation is highly feasible and it is anticipated to be effective.

In summary, the following technologies were retained for inclusion in remedial alternatives:

- Sub-slab vapor mitigation,
- Capping,
- Institutional controls,
- Excavation,

- Soil vapor extraction (SVE),
- Hot-spot remediation of groundwater,
- LNAPL/source removal, and
- Monitored natural attenuation (MNA).

9.3 Assembly of Remedial Alternatives for Consideration in Developing SSCGs

In order to assist in the consideration and selection of SSCGs, technologies retained from the screening process were combined into representative preliminary remedial alternatives, as shown in Table 9-1. These remedial alternatives can achieve various SSCGs as discussed in Sections 6 through 8 and shown in Table 9-1. The remedial alternatives consider Site features, such as homes, roads, utilities, residential hardscape, and landscaping. "Residential hardscape" includes driveways, city sidewalks, patios, and walkways on residential properties. Remedial alternatives that involve excavating or capping the entire Site would involve the removal of all Site features, including homes, roads, utilities, residential hardscape, and landscaping.

The representative preliminary remedial alternatives that were assembled for the Screening FS and selection of the cleanup goals are as follows:

1. Excavation of impacted soils over the entire Site, LNAPL removal as feasible, groundwater MNA, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

2. Excavation of the upper 10 feet of the entire Site, LNAPL removal as feasible, groundwater MNA, institutional controls on soil deeper than 10 feet, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

3. Excavation of exposed soils and soils under residential hardscape to 2 feet bgs where human health goals based on 350 days of exposure per year (HH350) or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed the screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on soil deeper than 2 feet beneath homes, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

3A. Excavation of exposed soils and soils under residential hardscape to 5 feet bgs where HH350 goals or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed the screening value, LNAPL removal as feasible, groundwater MNA, and institutional controls on soil deeper than 5 feet beneath homes, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

3B. Excavation of exposed soils and soils under residential hardscape to 10 feet bgs where HH350 goals or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed the screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on COCs in soil deeper than 10 feet beneath homes, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

4. Excavation of exposed soils to 2 feet bgs where HH350 goals or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on residual COCs in soils deeper than 2 feet beneath homes and hardscape, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

4A. Excavation of exposed soils to 5 feet bgs where HH350 goals or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on residual COCs in soils deeper than 5 feet beneath homes and hardscape, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

4B. Excavation of exposed soils to 10 feet where HH350 goals or soil leaching to groundwater goals are exceeded, installation of sub-slab mitigation at homes where sub-slab vapor concentrations exceed screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on residual COCs in soils deeper than 10 feet beneath homes and hardscape, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

5. Capping over the entire Site, removal of LNAPL as feasible, institutional controls onsite soils, and hot spot remediation of groundwater to reduce the time needed to achieve cleanup goals.

6. Capping exposed soils, installation of sub-slab mitigation at homes where sub-slab concentrations exceed screening value, LNAPL removal as feasible, groundwater MNA, institutional controls on residual COCs in soils and hot spot

remediation of groundwater to reduce the time needed to achieve cleanup goals.

7. The addition of limited SVE to Alternatives 2 through 6 for VOC/TPH mass reduction.

9.4 Preliminary Screening of Remedial Alternatives

The preliminary remedial alternatives were screened on the basis of the following criteria:

f) Implementability;
g) Environmental costs;
h) Reduction of toxicity, mobility, and volume;
i) Social costs; and
j) Cost.

The considerations associated with the various criteria for each of the alternatives are summarized in Table 9-1, which also indicates the areas and depths for which each cleanup goal is achieved. Site investigation data collected at the Site (e.g., data reported in the Phase II Interim, Follow-up, and Final Interim Reports, and quarterly groundwater monitoring reports) were used to develop preliminary estimates of the scope of the different remedial technologies for the alternatives considered in the Screening FS. Conceptual costs for each alternative were estimated (approximately +50%/-30%) for the purposes of comparison between the alternatives and are provided in Table 9-5. It is envisioned that proposed remedial actions and costs for the selected alternative will be evaluated in more detail in the forthcoming RAP.

Assumptions used in screening of alternatives are:

- The soil SSCGs were developed assuming that residents would be exposed to surface soils (e.g., <2 feet bgs, <5 feet bgs, or <10 feet bgs) more frequently (350 days/year) than deeper subsurface soils (4 days/year) (see Section 6). These exposure periods are considered typical for residents. Based on the data presented in the Phase II Interim, Follow-up, and Final Interim Reports, the assumed numbers of properties that exceed the HH350 goals that are considered in the Screening FS are: 100 properties for the less than 2 feet bgs interval, 190 properties for the less than 5 feet interval, and 210 properties for the less than 10 feet interval.
- The soil vapor SSCGs were calculated based on the vapor intrusion analysis and assume a vapor intrusion attenuation factor of 0.001. Although the vapor

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intrusion evaluation concluded that the indoor air concentrations are reflective of background concentrations, the sub-slab soil vapor data collected at the Site were used to identify potential properties for vapor intrusion mitigation systems Based on the results presented in the HHSREs, the number of properties that exceed the soil vapor SSCGs that are considered in the Screening FS is 30 properties.

- With respect to groundwater, the possible SSCGs are MCLs/NLs/background for metals; or, background for all compounds. The only appreciable difference in these SSCGs is the length of time needed to achieve the SSCGs which is approximately 70-100 years for the petroleum compounds to meet MCLs/NLs, and longer to meet background.

9.4.1 Alternative 1

Alternative 1 would involve the removal of all Site features, including homes, roads, and utilities in order to remove impacted soils through excavation. This would achieve all soil goals, soil vapor goals, and nuisance goals. Assuming sources of COCs are successfully addressed through LNAPL removal and possibly hot spot groundwater remediation, LNAPL goals would be achieved, groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g., where concentrations exceed 100x MCLs) would reduce the time to achieve the cleanup goals.

a) This alternative would be very difficult to implement. Every resident within the Site would have to agree to relocate and all 285 houses would be razed. If some homeowners declined to move, the presence of some residents would make it untenable to remove all of the surrounding homes, streets and utilities. Permits for this removal action would be difficult to obtain. Approximately 250,000 truckloads of COC-impacted and non-impacted soil, as well as other construction debris from the razed structures (including asbestos), would be hauled to and/or from the Site via Lomita Avenue. It is very unlikely that this alternative would be allowed to proceed due to the need for complete participation from the all homeowners and residents, the anticipated public reactions from residential and commercial areas proximate to the Site, environmental effects, traffic impacts and permitting difficulties. The active remedial action is estimated to take approximately 4-½ years.

b) In the long term, RAOs would be met for the Site. However, in the short term, significant and possibly unmitigateable air quality, noise, and traffic impacts would occur. It is very unlikely that this remedial action would be permitted under California Environmental Quality Act (CEQA).

c) Alternative 1 would remove a high volume of COCs from the Site. Soil and soil vapor COCs would be removed, and source removal would facilitate the faster restoration of groundwater. The time for groundwater restoration is difficult to quantify, but is likely to be shorter than other alternatives that utilize SVE to reduce VOC mass in the Site vadose zone. The limited additional reduction in risk and modest impact to groundwater quality when compared with other alternatives is substantially outweighed by the high additional economic and social (including environmental) costs it would impose on the City, the surrounding residents and business owners and others, as well as the difficulties associated with implementation and the substantial costs required for implementation.

d) The removal of this housing development would have significant long-term impacts to the community. All of the current Site residents would be displaced. Residents in the surrounding neighborhoods would experience the disruption of the community and the City would experience a loss of tax revenue.

e) The cost of this alternative would be in the range of $290MM to $630MM. It is the most costly of the alternatives listed.

Alternative 1 is not considered technologically and economically feasible due to the very difficult degree of implementability; and very high social, environmental, and economic costs. The benefit of more substantial reduction in COC mass throughout the Site compared to other alternatives is outweighed by the high social, environmental, and economic costs of this alternative. Consequently, this remedial alternative is not retained for additional evaluation.

Alternative 2

Alternative 2 would involve the removal of all Site features, including homes, roads, and utilities, in order to excavate the upper 10 feet of Site soils. As a result of this action, all soil goals would be met in the upper 10 feet of Site soils, including leaching to groundwater and HH350. The remaining Site soils would achieve the human health goals for infrequent exposure (4 days per year), and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor SSCGs would also be met. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved, groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the cleanup goals.

a) As with Alternative 1, Alternative 2 would be very difficult to implement. Every resident within the Site would have to agree to relocate and all 285 homes would be razed. If some homeowners declined to move, the presence of some residents would make it untenable to remove all of the surrounding homes, streets and utilities. Permits for this removal action would be difficult to obtain. Approximately 130,000 truckloads of COC-impacted and non-impacted soil, as well as other construction debris from the razed structures (including asbestos), would be hauled to and/or from the Site via Lomita Avenue. It is very unlikely that this alternative would be allowed to proceed due to the need for complete participation from the all homeowners and residents, the anticipated public reactions from residential and commercial areas proximate to the Site, environmental effects, traffic impacts, and permitting difficulties. The active remedial action is estimated to take approximately 2-½ years. Despite the implementation of comprehensive soil removal from the Site, institutional controls would be required to limit access to soils below 10 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, significant air quality, noise, and traffic impacts would occur. It is very unlikely that this remedial action would be permitted under CEQA.

c) Alternative 2 would remove a high volume of COCs from the Site. Soil and soil vapor COCs would be removed, and source removal would facilitate the faster restoration of groundwater through MNA. The time for groundwater restoration is difficult to quantify, but will be similar to other alternatives that utilize SVE to reduce VOC mass in the Site vadose zone. The limited additional reduction in risk when compared with other alternatives is substantially outweighed by the insignificant impact to groundwater quality, high additional economic and social (including environmental) costs it would impose on the City, the surrounding residents and business owners and others, as well as the difficulties associated with implementation and the substantial costs required for implementation.

d) The removal of this housing development would have significant long-term impacts to the community. All of the current Site residents would be displaced. Residents in the surrounding neighborhoods would experience the disruption of the community and the City would experience a loss of tax revenue.

e) Alternative 2 costs are anticipated to be between $190MM and $410MM, which would make it the second most expensive alternative.

Alternative 2 is not considered technologically and economically feasible due to very difficult degree of implementability, and very high social, environmental, and economic costs. The benefit of greater reduction in COC mass in soil throughout the Site compared to alternatives 3 through 6 is outweighed by the high social, environmental, and economic costs of this alternative. Consequently, this remedial alternative is not retained for additional evaluation.

The elimination of Alternatives 1 and 2 indicates that remedial actions to achieve the HH350 goals throughout the upper 10 feet of all Site soils are infeasible.

9.4.2 <u>Alternative 3</u>

Alternative 3 would involve excavation to 2 feet bgs in open areas and areas beneath hardscape where human health goals for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas and residential hardscape would be replaced in kind with clean soils and new hardscape. Under this alternative, the upper 2 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where SSCGs are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the cleanup goals.

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a) Implementation of Alternative 3 would be moderately difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate landscaped and hardscaped areas. Permission from property owners and tenants at approximately 100 residences would have to be obtained to excavate parts of their property. On the order of 4,000 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. The active remedial action is estimated to take approximately 2-½ years. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 2 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be mitigated.

c) Alternative 3 would remove a high volume of COCs from the upper 2 feet of soils. COCs below 2 feet would not be removed through excavation. There would be a moderate to high reduction in the mobility of soil vapor, with vapor intrusion (VI) potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation, there may be limited COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term, as their driveways, sidewalks, and other hardscape would be removed. Because those features would be replaced in kind following excavation and fill placement, those impacts would not be long term. Surrounding neighborhoods would be impacted in the short term to a lesser extent by heavy truck traffic.

e) Alternative 3 costs are anticipated to be between $22MM and $46MM. This is moderate relative to the costs of other alternatives.

Alternative 3 meets the human health goal for exposure to soils for 350 days per year in the upper 2 feet. Groundwater goals (MCLs) are achievable through MNA in the long term. Background groundwater goals are achievable through MNA in the longer term. Use of hot spot remediation of groundwater will hasten the restoration of groundwater through MNA. Alternative 3 is considered potentially technologically and economically feasible due to the moderate degree of implementability, and moderate social, environmental, and economic costs. Consequently, this remedial alternative is retained for additional evaluation.

9.4.3 Alternative 3A

Alternative 3A would involve excavation to 5 feet bgs in open areas and areas beneath hardscape where human health goals for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas and residential hardscape would be replaced in kind with clean soils and new hardscape. Under this alternative, the upper 5 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where SSCGs are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 3A would be moderately difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate landscaped areas and residential hardscape. Permission from property owners and tenants at approximately 190 residences would have to be obtained. Excavation would need to be conducted around public water supply lines. which are located about 3 feet inside the sidewalks in the front yards of approximately one-half of the properties in the Carousel Tract. These water pipes are of asbestos-cement (transite) construction. Implementation of excavation to depths of 5 feet or greater in the vicinity of the transite water main piping will be very difficult to achieve without damaging the pipes, potentially resulting in interruption of water supply to the community. On the order of 18,000 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. This alternative is estimated to take approximately 7-½ years to implement. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 5 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be mitigated.

c) Alternative 3A would remove a moderate to high volume of COCs from the upper 5 feet of soils. Not all soils would be able to be removed to 5 feet due to setback and sloping requirements and the need to avoid and protect in place certain underground utilities (water mains). COCs below 5 feet would not be removed through excavation. There would be a moderate to high reduction in the mobility of soil vapor, with VI potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation, there would be low COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term, as their driveways, sidewalks, and other hardscape would be removed. Surrounding neighborhoods would be impacted to a lesser extent by heavy truck traffic. Impacts to the community would be somewhat higher for this alternative than for Alternative 3 because a larger soil volume would be excavated and the remedy would take longer to implement.

e) Alternative 3A costs are anticipated to be between $60MM and $130MM. This is high relative to the costs of other alternatives.

This alternative meets the human health goal for exposure to soils for 350 days per year in the upper 5 feet. Groundwater goals (MCLs) are achievable through MNA in the long term. Background groundwater goals are achievable through MNA in the longer term. Use of hot spot remediation of groundwater will hasten the restoration of groundwater through MNA. Alternative 3A is considered potentially technologically and economically feasible due to the moderately difficult degree of implementability, moderate to high social and environmental, and high economic costs. Consequently, this remedial alternative is retained for additional evaluation.

9.4.4 Alternative 3B

Alternative 3B would involve excavation to 10 feet bgs in open areas and areas beneath hardscape where human health goals for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas and residential hardscape would be replaced in kind with clean soils and new hardscape. Under this alternative, the upper 10 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where SSCGs are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 3B would be very difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate landscaped areas and hardscape. Permission from property owners and tenants at approximately 210 residences would have to be obtained. Excavation would need to be conducted around public water supply lines, which are located about 3 feet inside the sidewalks in the front yards of approximately one-half of the properties in the Carousel Tract. These water pipes are of asbestos-cement (transite) construction. Implementation of excavation to depths of 5 feet or greater in the vicinity of the transite water main piping will be very difficult to achieve without damaging the pipes, potentially resulting in interruption of water supply to the community. On the order of 38,000 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. It is estimated that this alternative would be implemented over approximately 14 years. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 10 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be partially mitigated.

c) Alternative 3B would remove a moderate volume of COCs from the upper 10 feet of soils. Not all soils under residential hardscape and landscaping would be able to be removed to 10 feet due to setback and sloping requirements and the need to avoid and protect in place certain underground utilities (water mains).

COCs below 10 feet would not be removed through excavation. There would be a moderate to high reduction in the mobility of soil vapor, with VI potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation in groundwater, there would be low COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term, as their driveways, sidewalks, and other hardscape would be removed. Surrounding neighborhoods would be impacted to a lesser extent by heavy truck traffic. Impacts to the community would be higher for this than for Alternatives 3 and 3A because a larger soil volume would be excavated and the remedy would take substantially longer to implement.

e) Alternative 3B costs are anticipated to be between $110MM and $240MM. This is a very high cost relative to the costs of other alternatives.

Alternative 3B is not considered technologically and economically feasible due to very difficult degree of implementability, high social and environmental costs, and very high economic costs. The benefit of greater reduction in COC mass in soil throughout the Site compared to alternatives 3, 3A, 4, 4A, 4B, 5, and 6 is outweighed by the high social, environmental, and economic costs of this alternative. Consequently, this remedial alternative is not retained for additional evaluation.

9.4.5 Alternative 4

Alternative 4 would involve excavation to 2 feet bgs in open and landscaped areas where human health goals for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas would be replaced in kind with clean soils and new landscaping. Under this alternative, the upper 2 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where SSCGs are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 4 would be moderately difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate and backfill landscaped areas. Permission from property owners and tenants at approximately 100 residences would have to be obtained to carry out excavation in their yards. On the order of 1,700 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. It is estimated that this alternative could be implemented over approximately 2 years. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 2 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be mitigated.

c) Alternative 4 would remove a moderate to high volume of COCs from the upper 2 feet of soils. COCs below 2 feet would not be removed through excavation. There would be a moderate to high reduction in the mobility of soil vapor, with VI potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation, there would be low COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term due to excavation activities and truck traffic. Surrounding neighborhoods would be impacted to a lesser extent by heavy truck traffic.

e) Alternative 4 costs are anticipated to be between $15MM and $32MM. This is moderate relative to the costs of other alternatives.

Alternative 4 meets the human health goal for exposure to soils for 350 days per year in the upper 2 feet. Groundwater goals (MCLs) are achievable through MNA in the long term. Background groundwater goals are achievable through MNA in the longer term. Use of hot spot remediation of groundwater will hasten the restoration of groundwater through MNA. Alternative 4 is considered potentially technologically and economically feasible due to the moderate degree of implementability, and moderate social, environmental, and economic costs. Consequently, this remedial alternative is retained for additional evaluation.

9.4.6 Alternative 4A

Alternative 4A would involve excavation to 5 feet bgs in open and landscaped areas where human health goals for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas and residential landscape would be replaced in kind with clean soils and new landscape. Under this alternative, the upper 5 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where screening levels are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g., where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 4A would be moderately difficult to difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate and backfill landscaped areas. Permission from property owners and tenants at approximately 190 residences would have to be obtained to carry out excavation in their yards. Excavation would need to be conducted around public water supply lines, which are located about 3 feet inside the sidewalks in the front yards of approximately one-half of the properties in the Carousel Tract. These water pipes are of asbestos-cement (transite) construction. Implementation of excavation to depths of 5 feet or greater in the vicinity of the transite water main piping will be very difficult to achieve without damaging the pipes, potentially resulting in interruption of water supply to the community. On the order of 8,100 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. This alternative could be implemented

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over 7 years. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 5 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be mitigated.

c) Alternative 4A would remove a moderate to high volume of COCs from the upper 5 feet of soils. COCs below 5 feet would not be removed through excavation. Not all soils would be able to be removed to 5 feet due to setback and sloping requirements and the need to avoid and protect in place certain underground utilities (water mains). There would be a moderate to high reduction in the mobility of soil vapor, with VI potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation, there would be low COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term due to excavation activities and truck traffic. Surrounding neighborhoods would be impacted to a lesser extent by heavy truck traffic. Impacts to the community would be higher than for Alternative 4 because a larger soil volume would be excavated, and the remedy would take longer to implement.

e) Alternative 4A costs are anticipated to be between $42MM and $90MM. This is moderate to high relative to the costs for other alternatives.

This alternative meets the human health goal for exposure to soils for 350 days per year in the upper 5 feet. Groundwater goals (MCLs) are achievable through MNA in the long term. Background groundwater goals are achievable through MNA in the longer term. Use of hot spot remediation of groundwater will hasten the restoration of groundwater through MNA. Alternative 4A is considered potentially technologically and economically feasible due to the moderately difficult degree of implementability, moderate to high social and environmental, and moderately high economic costs. Consequently, this remedial alternative is retained for additional evaluation.

9.4.7 Alternative 4B

Alternative 4B would involve excavation to 10 feet bgs in open and landscaped areas where human health goals[8] for 350 days of exposure per year or soil leaching to groundwater goals are exceeded. However, soil will not be excavated in areas where soil concentrations are below background levels. Excavated areas and residential landscape would be replaced in kind with clean soils and new landscape. Under this alternative, the upper 10 feet of excavated and filled areas would achieve all soil goals. The unexcavated soils would meet the residential human health goal (assuming infrequent exposure) and nuisance goals. Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the unexcavated soils. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where screening levels are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g., where concentrations exceed 100x MCLs) could reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 4B would be very difficult. Although it would not displace the existing community, it would disrupt it in the short term to excavate and backfill landscaped areas. Permission from property owners and tenants at approximately 210 residences would have to be obtained to carry out excavation in their yards. Excavation would need to be conducted around public water supply lines, which are located about 3 feet inside the sidewalks in the front yards of approximately one-half of the properties in the Carousel Tract. These water pipes are of asbestos-cement (transite) construction. Implementation of excavation to depths of 5 feet or greater in the vicinity of the transite water main piping will be very difficult to achieve without damaging the pipes, potentially resulting in interruption of water supply to the community. On the order of 18,000 truckloads of impacted and non-impacted soil would be hauled to and from the Site. Sub-slab mitigation would be installed at approximately 30 homes. It is estimated that this alternative would be implemented over approximately 10 years. Institutional controls would be used to address residual COCs beneath homes, and to limit access to soils below 10 feet.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Based on pilot testing, these impacts are expected to be able to be partially mitigated.

c) Alternative 4B would remove a moderate to high volume of COCs from the upper 10 feet of soils. COCs below 10 feet would not be removed through excavation. Not all soils would be able to be removed to 10 feet due to setback and sloping requirements and the need to protect in place certain underground utilities (water mains). There would be a moderate to high reduction in the mobility of soil vapor, with VI potential reduced through sub-slab mitigation (although the data collected do not indicate a measurable impact to indoor air from sub-slab soil vapor). Depending on the use of hot spot remediation, there would be low COC removal in groundwater.

d) The excavation activities may have a significant impact on the community in the short term due to excavation activities and truck traffic. Surrounding neighborhoods would be impacted to a lesser extent by heavy truck traffic. Impacts to the community would be higher than for Alternatives 4 and 4A because a larger soil volume would be excavated, and the remedy would take longer to implement.

e) Alternative 4B costs are anticipated to be between $87MM and $190MM. This is very high relative to the costs of other alternatives.

Alternative 4B is not considered technologically and economically feasible due to very difficult degree of implementability, high social and environmental costs, and very high economic costs. The benefit of greater reduction in COC mass in soil throughout the Site compared to alternatives 3, 3A, 4, 4A, 5, and 6 is outweighed by the high social, environmental, and economic costs of this alternative. Consequently, this remedial alternative is not retained for additional evaluation.

9.4.8 Alternative 5

Alternative 5 would involve the removal of all Site features, including homes, roads, and utilities, in order to cap the entire Site. This would achieve the human health goal for infrequent exposure to soils and meet nuisance goals by limiting contact with soil, but would not achieve the other soil goals. The soil vapor nuisance goal would be met, but the soil vapor goals for methane and vapor intrusion may not be met in some areas. However, the exposure pathway would be eliminated because there would be no

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receptors. Assuming sources of COCs are successfully addressed through LNAPL removal and groundwater remediation, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g., where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) This alternative would be very difficult to implement. Every resident would have to agree to relocate, all 285 homes would be razed, and approximately 12,500 truckloads of import fill and construction debris from the razed structures (including asbestos) would be hauled to/from the Site via Lomita Avenue. It is very unlikely that this alternative would be allowed to proceed due to anticipated public reactions, reactions from residential and commercial areas proximate to the Site, environmental effects, traffic impacts and permitting difficulties. Moreover, if some homeowners declined to move, the presence of some residents would make it potentially untenable to remove all of the surrounding homes. The active remedial action is estimated to take less than approximately 1 year. Institutional controls would be used to address residual COCs.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would occur. It is very unlikely that this remedial action would be permitted under CEQA.

c) Alternative 5 would result in little removal of COCs from the Site; it would only act to eliminate the exposure pathways. COCs would be less likely to leach into groundwater due to the large reduction in stormwater and irrigation water passing through the soil. The limited additional reduction in risk and minimal impact to groundwater quality when compared with other alternatives is substantially outweighed by the high additional economic and social (including environmental) costs it would impose on the City, the surrounding residents and business owners and others, as well as the difficulties associated with implementation and the substantial costs required for implementation.

d) The removal of this housing development would have significant long-term impacts to the community. All of the current Site residents would be displaced. Residents in the surrounding neighborhoods would experience the disruption of the community and the City would experience a loss of tax revenue.

e) The cost of Alternative 5 would be in the range of \$91MM to \$200MM, a very high cost relative to the other alternatives.

Alternative 5 is not considered technologically and economically feasible due to very difficult degree of implementability, very high social and economic costs, and moderate environmental costs. Consequently, this remedial alternative is not retained for additional evaluation.

9.4.9 Alternative 6

Alternative 6 would involve the capping of exposed soils and landscaped areas of the Site with hardscape or equivalent. This would achieve the human health goal for infrequent exposure to deep soils and for nuisance, but would not achieve the other soil goals. The soil vapor goals would be addressed by installation of a sub-slab depressurization system for homes where SSCGs are exceeded for sub-slab soil vapor. Assuming sources of COCs are successfully addressed through LNAPL removal, LNAPL goals would be achieved. Groundwater goals (MCLs) would be met in the long term, and background levels for groundwater would be achieved in the longer term, both through MNA. Hot-spot remediation of groundwater (e.g. where concentrations exceed 100x MCLs) would reduce the time to achieve the clean-up goals.

a) Implementation of Alternative 6 would be moderately difficult. Permission from property owners and tenants at all 285 residences would have to be obtained. Sub-slab mitigation would be installed at approximately 30 homes. This alternative is estimated to take approximately 1-½ years to implement. Institutional controls would be used to address residual COCs.

b) In the long term, RAOs would be met for the Site. However, in the short term, air quality, noise, and traffic impacts would be anticipated. Potentially significant increases in stormwater runoff could occur. This may require implementation of additional stormwater best management practices.

c) Alternative 6 would result in little removal of COCs from the Site; it would only act to eliminate the exposure pathways. COCs would be less likely to leach into groundwater due to the large reduction in stormwater and irrigation water passing through the soil.

d) The remedial activities may have a significant impact on the community in the short term during landscape removal and hardscape placement. Residents would lose existing landscaping, and future landscaping would have to be done above the cap in planter boxes.

e) Alternative 6 costs are anticipated to be between $13MM and $28MM. This is moderate relative to the costs of other alternatives.

Groundwater goals (MCLs) are achievable through MNA in the long term. Background groundwater goals are achievable through MNA in the longer term. Use of hot spot remediation of groundwater will hasten the restoration of groundwater through MNA. Alternative 6 is considered potentially technologically and economically feasible due to the moderately difficult degree of implementability and moderate social, environmental, and economic costs. Consequently, this remedial alternative is retained for additional evaluation.

9.4.10 Alternative 7 Addition

Alternative 7 consists of the addition of SVE systems to Alternatives 2 through 6. The following summarizes the impact of this additional technology.

a) The implementability of SVE would depend on the number and location of extraction wells and treatment systems. Assuming one to three treatment systems would be installed, each with 5 to 25 associated extraction wells, this would be moderately difficult to difficult to implement. According to the SCAQMD, it will be difficult to obtain the necessary permits from SCAQMD in this residential area.

b) The installation of SVE systems would assist in meeting the RAOs for the Site. There would be some additional short-term impacts to the community during system installation. There may also be long-term impacts from noise.

c) The addition of SVE would decrease the concentrations of VOCs and more volatile fractions of TPH in soil vapor directly, and in soil and groundwater indirectly in the areas where it is applied. However, it is not likely to achieve cleanup goals, particularly for medium- and long-chain hydrocarbons. Methane concentrations would decrease slightly. The mass reduction of VOCs and TPH would reduce the time for groundwater restoration.

d) The addition of SVE would add some short-term disruption to the community during system installation due to well drilling and trenching for pipe installation.

There would also be a need to displace residents from one to two properties for each treatment system installed for this alternative.

e) The addition of SVE would add $7MM to $15MM to the alternative cost.

The addition of SVE to the alternatives would result in the following ratings for implementability; reduction of toxicity, mobility, and volume; and cost. We indicate the addition of Alternative 7 to another alternative by using a "+" sign between the base alternative and Alternative 7.

Alternative	Implementability	Reduction in Toxicity, Mobility, and Volume	Cost	
2+7	Very Difficult	High	Very High	$200MM to $420MM
3+7	Moderate	High for upper 2 ft	Moderate	$29MM to $61MM
3A+7	Moderately Difficult	Moderate for upper 5 ft	High	$67MM to $140MM
3B+7	Very Difficult	Moderate for upper 10 ft	Very High	$120MM to $260MM
4+7	Moderate	High for upper 2 ft	Moderate	$22MM to $47MM
4A+7	Moderately Difficult	Moderate for upper 5 ft	High	$49MM to $110MM
4B+7	Very Difficult	Moderate for upper 10 ft	Very High	$94MM to $210MM
5+7	Very Difficult	Low-Moderate	Very High	$97MM to $210MM
6+7	Moderate	Low	Moderate	$20MM to $43MM

Alternatives 3+7, 3A+7, 4+7, 4A+7, and 6+7 were retained with moderate to moderately-difficult implementability, moderate to high costs, and moderate or low to moderate reduction in toxicity, mobility, and volume.

9.5 Comparative Evaluation of Retained Alternatives

The following alternatives were retained for comparative evaluation to determine technologically and economically feasible SSCGs:

- Alternative 3;
- Alternative 3+7;
- Alternative 4;
- Alternative 4+7;
- Alternative 4A;
- Alternative 4A+7;
- Alternative 6; and
- Alternative 6+7.

The retained alternatives, with the exception of Alternatives 6 and 6+7, meet the soil cleanup goals and soil vapor cleanup goals to some depth. Alternatives 6 and 6+7 have the lowest reduction in toxicity, mobility, and volume. They would also require the most restrictive institutional controls, which would prohibit any future landscaping at the Site. Therefore, although Alternatives 6 and 6+7 have moderate degrees of implementability and moderate costs, they are not recommended.

Alternatives 3, 3+7, 4, and 4+7 have moderate degrees of implementability, while Alternatives 3A, 3A+7, 4A, and 4A+7 have moderately difficult degrees of implementability. However, Alternatives 3+7 and 4+7 are more difficult to implement than Alternatives 3 and 4, because of the addition of SVE (including difficulties associated with AQMD permitting). If the installation of SVE were permitted, it would reduce the COC volume in the soil and soil vapor below the 2 feet of excavated soil. In contrast, Alternatives 3A, 3A+7 4A and 4A+7 would be moderately difficult to implement due to an increase in soil excavated and replaced and increased time required to carry out the remedial action, both of which would negatively affect the community. The improvement in mass reduction for these alternatives is small and provides little additional social or environmental benefit over Alternatives 3, 3+7, 4, and 4+7. Consequently, Alternatives 3A, 3A+7 4A and 4A+7 are not recommended.

9.6 Recommendation of Remedial Alternative that Are Technologically and Economically Feasible Alternatives

The alternatives that remain after preliminary screening are Alternatives 3, 3+7, 4, and 4+7. Each of these four alternatives meets all soil goals (i.e., HH350 and soil leaching to groundwater goals) in the upper 2 feet of soils. The unexcavated soils would meet the residential human health goal assuming infrequent exposure and nuisance goals. These alternatives meet the soil vapor goals, and the groundwater goals in the long term. Each of these alternatives scores well for the other evaluation criteria:

implementability; environmental considerations; reduction of toxicity, mobility and volume; social considerations; and cost.

Soil cleanup levels for groundwater protection (leaching to groundwater) may not be met in all the soils that remain in place. However, over time, groundwater concentrations for the petroleum-related COCs (TPH, naphthalene, benzene and to some extent arsenic) are expected to decline to levels protective of a municipal use for the water, and eventually, to background levels. This conclusion is based on the stable to declining plume already present at the Site, the age of the source materials (considerable leaching of the COCs has already occurred), and the proposed actions which include further source reduction (hot spot groundwater and deeper soil remediation with SVE). Thus, it is proposed that the SSCGs for groundwater be set at MCLs/NLs for petroleum hydrocarbons and background levels for metals. These SSCGs are considered technologically and economically feasible to achieve in the long term (70-100 years) through MNA assuming the measures noted for further source reduction are implemented (hot spot groundwater remediation – e.g. in areas where concentrations exceed 100x MCLs - and SVE in limited areas of the Site) and that off-Site sources are reduced or eliminated. It is also noted that there is no use of the impacted groundwater in the foreseeable future. SSCGs are also proposed at MCLs for other COCs in Site groundwater including CVOCs and TBA, but meeting these SSCGs will require remediation of upgradient sources.

The requirement established in the RWQCB's comment letter to identify cleanup goals that are technologically and economically feasible has been met through this evaluation process. Remedial alternatives have been identified and screened relative to both technological and economic feasibility. Alternatives 3, 3+7, 4, and 4+7 have been found to be technologically and economically feasible and, as such, these four alternatives and their associated SSCGs are recommended and will be further evaluated in the RAP. The SSCGs associated with these alternatives are detailed in Tables 9-2 through 9-4 and are the SSCGs proposed for the Site.

10.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 2006. Dichlorobenzenes ToxFAQ, Division of Toxicology and Environmental Medicine, August.

AFCEE, 2004. Monitoring and Remediation Optimization System Software and User's Guide, Air Force Center for Environmental Excellence. http://www.gsi-net.com/en/software/free-software/maros.html

California Air Resource Board (CARB), 2005. Indoor Air Pollution in California, Report to the California Legislature. July 2005.

Cal/EPA, 1996. Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities: California Department of Environmental Protection, Department of Toxics Substances Control, August, 1996, www.dtsc.ca.gov/ScienceTechnology/ index.html.

California Environmental Protection Agency, Department of Toxic Substances Control (Cal-EPA DTSC), 1997. Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities. February 1997.

Cal-EPA DTSC, 2005a. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties, January 2005.

Cal-EPA DTSC, 2005b. Advisory on Methane Assessment and Common Remedies at School Sites, School Property Evaluation and Cleanup Division, June 16,2005.

Cal-EPA DTSC, 2007. Arsenic Strategies. Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals for Proposed and Existing School Sites (March 21, 2007). Prepared by Human and Ecological Risk Division, Department of Toxic Substances Control. Cal-EPA.

Cal-EPA DTSC, 2008. Environmental Cleanup Plan Available for Review Fact Sheet for the former Turco Products/Purex facility, April 2008. Retrieved 7/11/10 from http://www.dtsc.ca.gov/HazardousWaste/Projects/upload/Turco_FS_Cleanup_Plan.pdf

Cal-EPA DTSC, 2009a. Site Screening Assessment, Oil Transport Company, Carson, Prepared by Majed Al Shami on 2/17/2009.

Table 9-5
Summary of Preliminary Cost Estimates for Screening Feasibility Study
Former Kast Property
Carson, GA

Alternative	Criteria	Property Purchase Cost (285 properties)	Demolition Costs	Excavate, Backfill, & Assoc. Costs	PM, Planning, Field Mgmt, Monitoring, Reporting, Security	Post Excavation Construction and Long-Term O&M	Total Est. Costs	Low-End Costs (-30%)	High-End Costs (+50%)
1	ALTERNATIVE 1 * Remove all site features. * Excavate entire site to remove impacted soils (excavation may locally extend to GW). * Limited removal or remediation of impacted GW. * MNA remedy for remaining GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Remove LNAPL as feasible.	$98,000,000	$18,000,000	$270,000,000	$27,000,000	$4,000,000	$420,000,000	$290,000,000	$630,000,000
2	ALTERNATIVE 2 * Remove all site features. * Excavate upper 10 feet to remove impacted soils. * MNA remedy for remaining GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals.	$98,000,000	$18,000,000	$130,000,000	$19,000,000	$4,800,000	$270,000,000	$190,000,000	$410,000,000
2+7	ALTERNATIVE 2+7 * Remove all site features. * Excavate upper 10 feet to remove any impacted soils. * MNA remedy for remaining GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Remove LNAPL as feasible. * Add SVE to reduce VOC/TPH mass.	$98,000,000	$18,000,000	$140,000,000	$20,000,000	$7,200,000	$280,000,000	$200,000,000	$420,000,000
3	ALTERNATIVE 3 * Excavate exposed soils and soils under residential hardscape to 2 feet where HH350 goals are exceeded. * No excavation beneath streets. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals.	$0	$670,000	$9,400,000	$17,000,000	$4,400,000	$31,000,000	$22,000,000	$46,000,000

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Table 9-5
Summary of Preliminary Cost Estimates for Screening Feasibility Study
Former Kast Property
Carson, CA

Alternative	Criteria	Property Purchase Cost (285 properties)	Demolition Costs	Excavate, Backfill, & Assoc. Costs	PM, Planning, Field Mgmt, Monitoring, Reporting, Security	Post Excavation Construction and Long-Term O&M	Total Est. Costs	Low-End Costs (-30%)	High-End Costs (+50%)
3+7	ALTERNATIVE 3+7 * Excavate exposed soils and soils under residential hardscape to 2 feet where HH350 goals are exceeded. * No excavation beneath streets. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Remove LNAPL as feasible. * Add limited SVE to reduce VOC/TPH	$1,400,000	$890,000	$15,000,000	$17,000,000	$6,800,000	$41,000,000	$29,000,000	$61,000,000
3A	ALTERNATIVE 3A Same as Alt 3 except excavate to 5 feet	$0	$1,300,000	$33,000,000	$47,000,000	$4,400,000	$86,000,000	$60,000,000	$130,000,000
3A+7	ALTERNATIVE 3A+7 Same as Alt 3 except excavate to 5 feet * Add SVE to reduce VOC/TPH mass.	$1,400,000	$1,500,000	$39,000,000	$48,000,000	$6,800,000	$96,000,000	$67,000,000	$140,000,000
3B	ALTERNATIVE 3B Same as Alt 3 except excavate to 10 feet	$0	$1,400,000	$71,000,000	$84,000,000	$4,400,000	$160,000,000	$110,000,000	$240,000,000
3B+7	ALTERNATIVE 3B+7 Same as Alt 3 except excavate to 10 feet * Add SVE to reduce VOC/TPH mass.	$1,400,000	$1,600,000	$76,000,000	$85,000,000	$6,800,000	$170,000,000	$120,000,000	$260,000,000
4	ALTERNATIVE 4 * Excavate exposed site soils from 0 to 2 feet where HH350 goals are exceeded at residential properties. * No excavation beneath residential hardscape, streets and sidewalks. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals.	$0	$0	$4,400,000	$13,000,000	$4,400,000	$21,000,000	$15,000,000	$32,000,000

Table 9-5
Summary of Preliminary Cost Estimates for Screening Feasibility Study
Former Kast Property
Carson, CA

Alternative	Criteria	Property Purchase Cost (285 properties)	Demolition Costs	Excavate, Backfill, & Assoc. Costs	PM, Planning, Field Mgmt, Monitoring, Reporting, Security	Post Excavation Construction and Long-Term O&M	Total Est. Costs	Low-End Costs (-30%)	High-End Costs (+50%)
4+7	ALTERNATIVE 4+7 * Excavate exposed site soils from 0 to 2 feet where HH350 goals are exceeded at residential properties. * No excavation beneath residential hardscape, streets and sidewalks. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Remove LNAPL as feasible.	$1,400,000	$220,000	$9,500,000	$13,000,000	$6,800,000	$31,000,000	$22,000,000	$47,000,000
4A	ALTERNATIVE 4A Same as Alt 4 except excavate exposed soils to 5 feet.	$0	$0	$18,000,000	$38,000,000	$4,400,000	$60,000,000	$42,000,000	$90,000,000
4A+7	ALTERNATIVE 4A+7 Same as Alt 4 except excavate exposed soils to 5 feet. * Add SVE to reduce VOC/TPH mass.	$1,400,000	$220,000	$23,000,000	$39,000,000	$6,800,000	$70,000,000	$49,000,000	$110,000,000
4B	ALTERNATIVE 4B Same as Alt 4 except excavate exposed soils to 10 feet.	$0	$0	$47,000,000	$73,000,000	$4,400,000	$120,000,000	$87,000,000	$190,000,000
4B+7	ALTERNATIVE 4B+7 Same as Alt 4 except excavate exposed soils to 10 feet. * Add SVE to reduce VOC/TPH mass.	$1,400,000	$220,000	$52,000,000	$73,000,000	$6,800,000	$130,000,000	$94,000,000	$200,000,000
5	ALTERNATIVE 5 * Remove all site features and cap site. * Remove LNAPL as feasible. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals.	$98,000,000	$18,000,000	$7,000,000	$2,500,000	$4,400,000	$130,000,000	$91,000,000	$200,000,000
5+7	ALTERNATIVE 5+7 * Remove all site features and cap site. * Remove LNAPL as feasible. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Add SVE to reduce VOC/TPH mass.	$98,000,000	$18,000,000	$12,000,000	$3,200,000	$6,800,000	$140,000,000	$97,000,000	$210,000,000

Table 9-5
Summary of Preliminary Cost Estimates for Screening Feasibility Study
Former Kast Property
Carson, CA

Alternative	Criteria	Property Purchase Cost (285 properties)	Demolition Costs	Excavate, Backfill, & Assoc. Costs	PM, Planning, Field Mgmt, Monitoring, Reporting, Security	Post Excavation Construction and Long-Term O&M	Total Est. Costs	Low-End Costs (-30%)	High-End Costs (+50%)
6	ALTERNATIVE 6 * Cap all areas of exposed soil at the site. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening values. * Remove LNAPL as feasible. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals.	$0	$0	$12,000,000	$2,600,000	$4,400,000	$19,000,000	$13,000,000	$28,000,000
6+7	ALTERNATIVE 6+7 * Cap all areas of exposed soil at the site. * Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening values. * Remove LNAPL as feasible. * MNA remedy for GW. Could add limited hot spot remediation to reduce time to achieve cleanup goals. * Add SVE to reduce TPH/SVE mass.	$1,400,000	$220,000	$17,000,000	$3,300,000	$6,800,000	$28,000,000	$20,000,000	$43,000,000
7	ALTERNATIVE 7 Add limited SVE to reduce VOC/TPH mass for Alternatives 2 through 6	$1,400,000	$220,000	$5,200,000	$700,000	$2,400,000	$9,900,000	$7,000,000	$15,000,000

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COUNTY OF LOS ANGELES
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October 24, 2013

Jackie Acosta
Acting City Manager
701 E. Carson St.
P.O. Box 6234
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ENVIRONMENTAL INVESTIGATION AT THE CAROUSEL TRACT IN THE CITY OF CARSON

This is in response to Resolution 13-081 adopted by your City Council on July 29, 2013. Los Angeles County Department of Public Health (DPH) shares your commitment to take necessary steps to ensure the protection of public health. We are working closely with the Los Angeles Regional Water Quality Control Board (RWQCB), the California Department of Toxic Substances Control (DTSC), and the California Office of Environmental Health Hazard Assessment (OEHHA) to assess conditions at the site and the associated health risks.

Although the levels of benzene, methane, and other petroleum hydrocarbons in site soils are elevated, the levels of these contaminants in indoor air and outdoor air do not differ significantly from levels in the overall Los Angeles air basin. Indoor air levels of petroleum hydrocarbons were also noted to be within published levels for indoor air quality nationwide. Contaminants in site soils do not present a hazard so long as subsurface soils remain undisturbed. Accordingly, none of the data collected to date, including the analysis provided by L. Everett & Associates, indicates an immediate health threat from site conditions at the Carousel Tract.

The State agencies are continuing the site investigation and are preparing a site-wide Human Health Risk Assessment (HHRA) to further evaluate potential health risks. Subsequently, a remedial plan will be adopted to ensure that contaminants in subsurface soils will not present a continuing or future risk to community residents. DPH will review the draft HHRA when it is released, and the subsequent remedial plans.

EXHIBIT NO. 04

DPH will continue to work with the State agencies to provide public health guidance during the remediation process to ensure protection of the Carousel Tract community. If you have any questions or would like additional information, please contact me or Angelo J. Bellomo, Director of Environmental Health, at (626) 430-5374.

Sincerely,

Jonathan E. Fielding MD

Jonathan E. Fielding, M.D., M.P.H.
Director and Health Officer

JEF:cr
PH:1308:009

c: Board of Supervisors
Sachi A. Hamai, Executive Officer
Sharon Reichman
Greg Polk
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