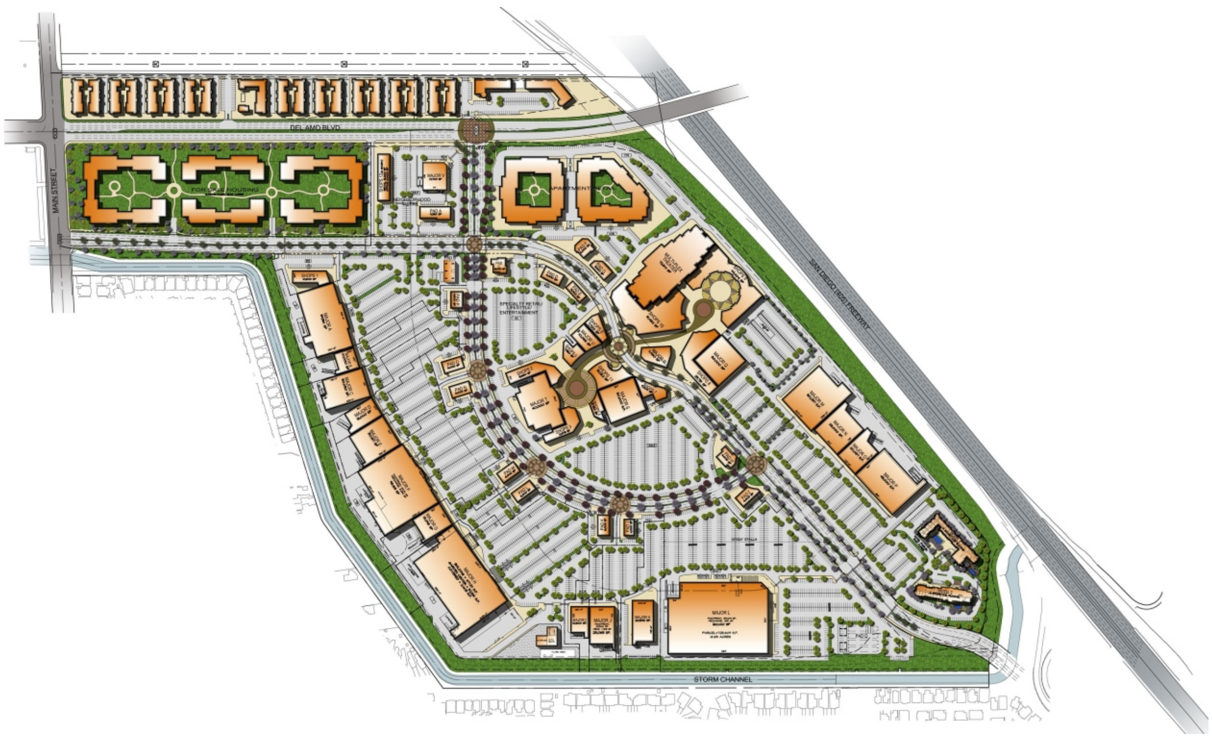
AVALON AT SOUTH BAY PROJECT

Soil Management Goals for Cap Construction



For

Avalon at South Bay
(Formerly Carson Marketplace)
Carson, California

AVALON
AT SOUTH BAY

April 14, 2008

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SOIL MANAGEMENT GOALS

FOR CAP CONSTRUCTION

FOR

AVALON AT SOUTH BAY
(FORMERLY CARSON MARKETPLACE)
20300 MAIN STREET
CARSON, CA

Prepared for:

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1.0 INTRODUCTION

This report describes the development of Soil Management Goals (SMGs) for the Avalon at South Bay development project (Site), which was previously named Carson Marketplace. This proposed brownsfield restoration Site involves the development of the former Cal Compact landfill into multiple land uses, including commercial, recreation, entertainment, big-box retail stores, restaurants, hotels, and residential. The SMGs developed in this report would be used in evaluating soil quality as described in a Soil Management Plan (SMP). The SMGs would be used to determine how soil would be managed and placed during construction, including evaluations of soil sampling and analysis data collected before, during, and immediately after landfill cap construction.

Carson Marketplace, LLC (Developer) has proposed to develop the Site. The proposed Site comprises approximately 157 acres of land located at 20300 Main Street in Carson, California. The property is bounded on the east/northeast by the San Diego Freeway (I-405), on the north by Del Amo Boulevard, on the west by Main Street and single family residences and mobile home development, and on the south by single family residences and mobile home development (Figure 1-1). A strip of vacant land to the north across Del Amo Boulevard, which comprises 11 acres, is also within the overall scope of the Project (168 total acres). This portion of the property was not part of the landfill and therefore the SMGs described herein would not apply to the development activities planned for it.

The Site consists of five separate landfill cells numbered A1 through A5 separated by the Site boundaries on the outer perimeter and by two interior roadways on the interior perimeter (Lenardo Drive and Stamps Drive). A Los Angeles County Flood Control channel (Torrance Lateral) is located adjacent to the south and west sides of the Site and serves to separate the Site from the adjacent residential neighborhood (Figure 1-2).

In 1995, the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) approved a Remedial Action Plan (RAP) for the Site. The RAP was based on, in part, the Final Baseline Risk Assessment (BRA) (completed in 1995). The BRA generally concluded that the potential risks associated with the remediation of the landfill and development of a commercial project on the Site could be reduced to acceptable levels if the landfill were capped to prevent direct exposure to landfill contents, and if landfill gas were removed by extraction and treatment to prevent gas from migrating to land surface or indoor air. In addition, the RAP required that an impermeable membrane be installed under each building to further protect building occupants from the possible migration of landfill-gas into buildings in the unlikely event that landfill gas were not captured by the extraction system. When the RAP was approved, it was envisioned that an earthen cap, primarily consisting of clay, would be imported from off-site locations and presumably not contain any contaminants. During the late 1990s, soil was imported to the Site in anticipation of developing the property and constructing the cap; however, the previously proposed development (LA MetroMall) and the cap were not constructed.

Instead of a strictly commercial project, as was the LA MetroMall plan at the time that the RAP was adopted, the Developer has proposed a mixed-use Site that would include neighborhood commercial, regional commercial, commercial recreation/entertainment, big-box retail stores, restaurants, hotels, and “elevated” residential development (Figure 1-3). To accommodate the residential use and take advantage of technical advances that have occurred since 1995, the Developer and its environmental contractor Tetra Tech, Inc. have completed conceptual and preliminary plans to implement the RAP with certain refinements.

The construction phases of this Site will begin with mass grading and removal of some of the soil covering the landfill cells. This will be done to establish a uniform grade and minimize the thickness of soil cover overlying the refuse material so that compaction of the landfill cells may commence. Soil removed in the grading process will be temporarily stockpiled onsite until it is reused. Compaction of refuse will be done using deep dynamic compaction (DDC) to consolidate the refuse and soil below future parking and open areas to minimize future settling. The refuse under future building locations will not be compacted. Once all compaction is complete, a landfill gas collection system with horizontal collection wells throughout the Site and vertical gas collection wells below future building locations will be installed. This gas collection system will be connected to a gas flare treatment system with a landfill operations center which will have controls and integral monitoring to detect any leakage or system failure. The landfill cells and gas collection system will then have a multi-component landfill cap installed. The first layer of this cap will be the installation of a continuous layer of linear low density polyethylene (LLDPE) geomembrane which will serve as the primary impermeable layer of the cap system. This LLDPE geomembrane will then have drainage strips installed on top of it that will direct water off of the landfill cap so that it does not accumulate. These drainage strips will be covered by a geotextile fabric layer to prevent the accumulation of silt and clogging of the drainage system. This layer will then be covered with soil.

All future buildings will be supported on driven piles. Piles will be driven through the refuse until competent native soil is reached. Pile caps will be installed and the concrete building slabs will be poured on top. The LLDPE geomembrane will be sealed to the pile caps where they penetrate it using an expansion boot to allow expansion and movement while remaining sealed.

A building protection system will be installed below all building locations to serve as a backup in case of landfill cap or primary gas collection system failure. This system will include the installation of a secondary geomembrane attached to the underside of the concrete slab. The space between this secondary geomembrane and the LLDPE geomembrane will have a passive gas venting system installed and will also include methane detection sensors to provide notification of system failure. All buildings will be built aboveground.

The Site will also include the installation of a groundwater extraction and treatment (GET) system along the southern boundary of the Site to contain and treat impacted groundwater underlying the Site. Some refuse materials in the landfill cells may need to be excavated and moved to facilitate the installation of Site utilities and the landfill gas collection system. Tetra Tech is the environmental engineer and general contractor responsible for the design and installation of these remedial systems. Tetra Tech is not, however, responsible for the design and installation of the driven piles, pile caps, and building slabs that make up the building foundations.

The potential for risks to future workers associated with the replacement of the existing cover soil following redevelopment were not evaluated in the BRA and RAP. Therefore, this report describes the development of health-based SMGs for the existing cover soil. SMGs will be used during the design and construction phases of the Site to ensure that soil placed above the LLDPE geomembrane is protective of human health and the environment. The remedial systems that would eliminate potential vapor intrusion and groundwater exposure pathways are also described, although risks to future residents and property occupants following placement of soil over the LLDPE landfill cap will be examined in additional evaluations.

This document is divided into the following sections.

Section 1 – Describes the purpose and the content of the SMG report

Section 2 – Briefly describes the history of the Site including current environmental conditions

Section 3 – Describes the anticipated post-construction conditions once remediation systems described in the RAP, with additional improvements have been constructed

Section 4 – Summarizes and analyzes current Site data and identifies Constituents of Potential Concern (COPC)

Section 5 – Presents the process used to evaluate exposures, or lack thereof, following implementation of the planned remediation systems and construction of the Site. Develops SMGs that would be used during the planning, investigative, design, and construction phase of the Site to ensure that soil placed above the LLDPE geomembrane are protective of human health and the environment for the planned future uses of the Site.

Section 6 – Summarizes future activities that would be completed throughout the Site to collect, monitor, and analyze data, including additional soil sampling and use of SMGs, to ensure that once complete, the Site would be safe for long-term occupancy and beneficial use.

Section 7 – Provides references cited in this report.

The SMGs developed in this report would be used in evaluating soil quality as described in a SMP. The SMGs would be used to determine how soil would be managed and placed during construction, including evaluations of soil sampling and analysis data collected, as necessary, before, during, and immediately after landfill cap construction. All these activities, including the development of SMGs, would be completed under the oversight of the DTSC, who is the lead regulatory agency, and is additionally responsible for ensuring that human health and the environment are protected.

2.0 SITE HISTORY

Land use of the 157-acre property prior to landfill operations was primarily agricultural, including grazing, dairy, feedlot, and cropland (Brown & Root 1995a). Prior to the 1930s, the land immediately surrounding the Site was also used primarily for agriculture, with some limited residential development. During the 1940s, industry was introduced to the area and residential areas became more extensive. The current light industry, commercial, and residential mix of land uses was fully developed by the 1970s (Brown & Root 1995a).

Between 1959 and 1964, the Site was used as a Class II landfill and is currently covered by a layer of soil that varies from 4 to 32 feet in thickness. According to Los Angeles County records, Cal Compact, Inc. (Cal Compact), a California corporation, was issued an industrial waste disposal permit on July 17, 1959, which authorized Cal Compact to operate a Class II landfill on the property (Brown & Root 1995b). Landfill operations began on this property in April 1959 and continued until December 1964 (McLaren/Hart 1992). The landfill operations consisted of the placement and cover of wastes in excavated trenches. All wastes were placed in trenches that were excavated adjacent to the haul roads. The haul road locations have remained unchanged throughout the time the landfill was in operation and are underlain by native soil materials (Brown & Root 1995b).

The landfill was permitted to accept both municipal solid waste and specified industrial liquid wastes. Approximately 6 million cubic yards of solid municipal waste and 6.3 million gallons of industrial liquid waste were received at the landfill (Brown & Root 1995c). Available records indicate that over 90 percent of the liquid wastes were drilling fluids which consisted primarily of water and clay mixtures, with minor heavy metal additives and oily residue. Other wastes received included solvents, oils, sludges, heavy metals, paint sludges, and inorganic salts.

2.1 Regulatory History and Previous Investigations

On March 18, 1988, Remediation Action Order Number HSA87/88-040 was issued, requiring investigation of contamination at the landfill and preparation of a Remedial Action Plan (RAP). A RAP was prepared and approved by the DTSC in 1995. The objective is to develop the Site for mixed uses that benefit the surrounding community. At the same time, the RAP would be implemented to protect human health and the environment during construction and after the Site development is complete and operating.

Prior to the issuance of the RAO, five investigations had been conducted at the Site. Starting in 1975, these investigations consisted of (1) a geotechnical investigation of landfill subsidence, (2) subsurface permeability and air testing, (3) landfill gas investigation, (4) evaluation of the competency of the fill for pavement design and utility support, and (5) an investigation of the waste, groundwater, and soil vapor (Brown & Root 1995b). These studies were primarily focused on the management of landfill gases and the suitability of the Site for development. One study suggested that landfill gas emissions may require mitigation measures, depending on the anticipated future land use (BCL 1981).

Due to the size and complexity of the landfill property, DTSC divided it into two operable units. The Upper Operable Unit (Upper OU) consists of the soil, the waste zone above and within the

Bellflower Aquitard, and the Bellflower Aquitard down to but not including the Gage Aquifer. The Lower Operable Unit (Lower OU) is composed of the Gage, Lynwood, and Silverado Aquifers, and all other areas impacted by the geographic extent of any hazardous substances which may have migrated or may migrate from the aforementioned areas or from the Upper OU. The operable units are also established to prioritize the remedial response to the areas of known impacts (Upper OU) versus potential impacts (Lower OU).

Starting in 1990, a remedial investigation/feasibility study (RI/FS) was initiated in response to the RAO issued for the landfill. Field activities included the drilling of soil borings; the installation of groundwater monitoring wells; collection of soil, waste, and groundwater samples; surface geophysical surveys; installation of vapor monitoring wells and collection of soil vapor samples; and an ambient air monitoring program (McLaren/Hart 1992). In 1995, the RI/FS was completed by consolidating information from the McLaren/Hart (1992) RI with a subsequent groundwater investigation (Brown & Root 1995c). The RI characterized the nature and approximate extent of chemicals of concern in the landfill cover soil and waste zone, groundwater, and air at the Site. The RI identified the presence of landfill gases (methane and carbon dioxide) as well as volatile organic chemicals (VOCs) and metals in soil and groundwater at the Site.

To reduce risks associated with chemicals detected in soil and groundwater as part the RI/FS (Brown & Root 1995b), remedial action was recommended in the RAP. The RAP was developed based on the findings of the Final BRA (Brown & Root 1995a), which generally concluded that the majority (if not all) of the potential risks associated with the Site could be reduced to acceptable levels if the Site was capped to prevent direct exposure to landfill contents, and if landfill gas was removed by extraction and treatment to prevent gas from migrating to land surface. Thus, the RAP approved by DTSC for this Site consists of containment of the buried wastes by a cap, collection and treatment of landfill gas, extraction and treatment of the contaminated groundwater, and long-term monitoring of landfill gas and groundwater.

2.2 Environmental Setting

This section describes the demography, surface features, climatology, surface water hydrology, geology, and hydrogeology of the Site.

2.2.1 Demography and Land Use

Demographics of the area surrounding the Site are variable and include residential, commercial, light industrial, and several former Class II landfills. Residences are adjacent to the southern and western boundaries of the Site. Two former landfills are located to the west of the Site, while the Dominguez Golf Course, which is built over a former Class II landfill, is north of the Site. The San Diego Freeway (I-405) runs along the eastern edge of the Site. The South Bay Pavilion (retail) is located east of the San Diego Freeway approximately 0.5 mile east of the Site.

2.2.2 Surface Features

The topography of the Site is irregular and the surface drainage is poorly developed. The landfill operations modified the historical surface elevations and changed the surface water drainage patterns. Prior to landfill operations, the Site was gently rolling terrain with surface elevations ranging from 7 to 21 feet above mean sea level (msl). The present surface elevation averages between 30 and 35 feet above msl, ranging from 11 to 58 feet above msl.

The top of the refuse and overlying cover soil lies topographically higher than the former haul roads in many areas of the Site. The former haul roads for the landfill are paved and are underlain by water lines, electric lines, storm water drains, and sewer systems. The water, electric, and sewer systems are currently inactive.

Weeds that grow on top of the Site are managed and are abated by periodically disking each cell. The purpose of weed abatement is to prevent root intrusion through the cover soil and minimize the potential for brush fire during dry periods. The Site is currently fenced with 24-hour security to prevent unauthorized access onto the Site.

2.2.3 Climate

The Site is in southern California, with a climate that is determined principally by its location within the large-scale, semi-permanent high-pressure zone of the eastern Pacific. As is typical of coastal areas along the western shores of continents at lower latitudes, the region is characterized by sparse rainfall, with most of it occurring during the winter months (Brown & Root 1995c).

During the spring and summer months, the predominant wind flow in the southern California coastal area is from the northwest. At the Site, the prevailing wind flow pattern is from onshore sea breezes. In the morning, winds usually come from a southerly direction and shift to be from the west and finally north-northwest by the early evening hours. Wind speeds typically range from 7 to 10 miles per hour. Offshore flow occurs at night and early morning with wind directions ranging from the north-northwest through northeast and east. Wind speeds average between 1 and 5 miles per hour.

2.2.4 Surface Water Hydrology

The only surface water features in the vicinity of the Site are the Torrance Lateral Channel and the Dominguez Channel. The concrete lined Torrance Lateral Channel runs along the western and southern boundaries of the Site. Dominguez Channel is a concrete-lined canal that runs along the eastern boundary of the San Diego Freeway, north and east of the Site. Rain water runoff on the Site either flows towards topographic lows or towards storm water drain inlets located along the haul roads. The storm water drains discharge into the Torrance Lateral Channel and ultimately into the Dominguez Channel. These channels are used only for flood control and diversion of storm water and not for drinking, recreation, or irrigation (Brown & Root 1995c). Currently, the storm water drains are located in native soil beneath the former haul roads. As part of the proposed development, new storm water drains would likely be constructed and the existing drains abandoned in place and filled with grouting so that they would not act as conduits.

2.2.5 Geology

The Site is located on the Torrance Plain, a broad gently sloping alluvial surface situated in the Los Angeles Coastal Plain. The Site is also within the Peninsular Range geomorphic province, which is typified by trending geologic structures, including the Newport-Inglewood fault, the Palos Verdes fault, and the Gardena Syncline. The soil encountered in previous investigations of the Site includes cover soil, refuse, and alluvial deposits of the underlying Lakewood formation. The cover soil ranges in thickness from 4 to 32 feet and consists of sandy silt, clayey silt, and silty clay. The refuse underlying the cover soil is up to 53 feet thick (ABBL, 2008).

The closet active fault to the Site is the Avalon-Compton fault of the Newport-Inglewood fault located 2.2 miles northeast of the Site. No active or potentially active faults are known to pass directly beneath the Site.

2.2.6 Hydrogeology

The natural, undisturbed subsurface sediments underlying the Site and comprising the Upper OU include recent alluvium and the upper Pleistocene Lakewood Formation. In the portion of the Torrance Plain that includes the Site, the upper Pleistocene Lakewood Formation consists of the Bellflower Aquitard and Gage Aquifer. Below the Gage Aquifer lie the Lynwood and Silverado Aquifers, which are used as domestic drinking water sources. The Bellflower Aquitard beneath the Site was hydrostratigraphically separated into three units: the Upper Bellflower (UBF), the Middle Bellflower B and C units (MBFB/C), and the Lower Bellflower (LBF) (URS 2000).

The UBF represents the uppermost hydrostratigraphic unit encountered within the Site area. The UBF is an overall fine-grained unit that is regionally recognized. The UBF is typically characterized by a heterogeneous sequence of laminated to massive fine grained materials with less frequent intervals of sand. The UBF dips to the east and is approximately 95 to 116 feet thick beneath the Site. The elevation of the base of the UBF beneath the Site ranges from -78 to -92 feet msl.

The MBFB/C underlies the predominantly fine grained UBF and is also regionally recognized. The MBFB/C constitutes the first laterally continuous, predominantly sandy unit encountered beneath the Site. To the west the unit is divided by a lens of finer grained material that may or may not be present beneath the Site. The MBFB/C is approximately 57 to 68 feet thick beneath the Site. The elevation of the base of the MBFB/C beneath the Site ranges from -135 to -157 feet msl.

The LBF is the lowest of the three Bellflower Aquitard subunits and its base contacts the top of the Gage Aquifer. It is also regionally recognized and is similar in nature to the UBF. The LBF is approximately 40 to 50 feet thick beneath the Site. The elevation of the base of the LBF beneath the Site ranges from -175 to -207 feet msl.

Based on recent monitoring, (SCS Engineers, 2007), groundwater flows toward the south with a hydraulic gradient of 0.002 ft/ft in the Middle Upper Bellflower Aquitard and 0.001 ft/ft in the Middle Bellflower Aquitard.

2.3 Health Risk Basis for Implementing the RAP

Capping of the Site was proposed in order to reduce the main source of risks identified in the BRA (Brown & Root 1995a). The BRA was prepared following applicable U.S.EPA (1988, 1989a, 1989b, 1991a, 1991b, 1992a, 1992b, 1992c, 1994, 1995) and DTSC (1990, 1992a) risk assessment guidance. It comprised the evaluation of unrestricted residential use of the Site, off-site residents, and on-site commercial/industrial workers. In addition, a two-year construction scenario was evaluated to assess the health risks that might be associated with construction of the landfill cap. This section of the report describes the results of the risk assessments conducted for unrestricted residential use and for the construction scenario.

The BRA was conducted using highly health protective analyses in order to "err on the side of safety." As a baseline risk assessment, the BRA was focused on current conditions and did not evaluate post-remediation exposures and risks. In the case of the unrestricted residential land use scenario, it was assumed that single-family housing units could be built directly on the landfill. This assessment included evaluations of residential exposure to soil containing landfill wastes, contaminated groundwater, and inhalation of airborne dusts and vapors emitted from the landfill. These exposures included not only direct contact with the waste layer of soil (e.g., incidental soil ingestion and dermal contact), but also consumption of homegrown vegetables and ingestion of groundwater. The following conclusions were reached regarding unrestricted residential use.

In the BRA, inhalation of vapors was determined to be the predominant exposure pathway leading to unacceptable risk estimates (Tables 1 and 2). In the absence of vapor control systems, future on-site residents and commercial/industrial workers were assumed to experience continuous exposure to indoor air impacted by landfill gases. Inhalation of indoor air represented over 96 percent of the risks estimated for future on-site residents (i.e., a cancer risk estimate of 2 in 1,000), assuming no use of groundwater beneath the property. Risk estimates for use of groundwater beneath the landfill were also unacceptable (i.e., a cancer risk estimate of 2 in 100), although use of groundwater found beneath the Site (in the Bellflower Aquitard) for drinking water purposes is highly unlikely due to low quality and productivity. The Bellflower Aquitard is not used as a potable source of drinking water.

Vapor inhalation by long-term commercial/industrial workers (as evaluated in the BRA) also resulted in elevated risks (6 in 100,000), representing over 90 percent of the total risks estimated for future on-site commercial/industrial workers. Indoor vapor predictions for both future on-site worker and residential exposures were also based on the assumption that only 3 feet of soil cover separated landfill materials from the base of an on-site building. As discussed further below, future development plans include the use of landfill gas collection systems and other controls to eliminate potential exposure to landfill gas. Thus, using a soil cover of only 3 feet in the exposure analysis was highly conservative and differs considerably from proposed future conditions.

In addition to the risks estimated for exposures to landfill contaminants, the BRA determined that there could be fire/explosive hazards due to the accumulation of methane gas beneath houses or businesses. Methane gas is generated in municipal landfills as a by-product of biological degradation of wastes. As a result, accumulation of methane in enclosed structures, such as crawl spaces beneath homes, could result in explosions or fires. Modeling conducted in the BRA estimated that methane concentrations could reach explosive levels in an enclosed crawl space beneath a residence in 45 days to 2 years, depending on whether the highest or average measured methane concentrations were used in the evaluation. Current plans to install a cap, landfill gas collection system, and building protection systems (BPS) beneath each building would also serve to mitigate these potential hazards.

In the BRA, direct contact with soil containing landfill wastes (e.g., soil ingestion, dermal contact, airborne dust inhalation) was estimated to result in health risks within the generally acceptable range of 1 in 1 million to 1 in 10,000 (10^{-6} to 10^{-4}). Risks estimated for potential future residential exposures to soil were approximately 6 in 100,000, with exposures to two metals (arsenic and chromium) contributing the greatest to these risk estimates. Similarly, risk estimates for industrial/commercial worker contact with soil were estimated to be approximately 7 in 1 million, primarily due to potential exposures to arsenic and chromium. These determinations were considered to be health protective, however, because both arsenic and chromium were detected at concentrations typical for soil throughout the United States (Brown & Root 1995a). Also, risks for chromium were estimated based on the assumption that this metal was present in the carcinogenic form (hexavalent chromium). This form of chromium is likely to represent only a very small proportion of the total detected chromium. Based on these considerations, risks for soil contact may have been overestimated in the BRA.

2.3.1 Considerations Under Current Guidance – Unrestricted Use

Guidance on conducting human health risks assessments has been updated since the BRA was developed in 1995. Exposure parameter values currently used to describe residential and worker exposures and also chemical toxicity data differ from those used in the BRA. On balance, it is likely that the risk estimates provided in the BRA are higher than estimates that would be calculated following current risk assessment methodology. One exposure factor for residential receptors in particular (soil adherence to skin) may have resulted in higher risk estimates in the BRA than might be determined now. In the BRA (Brown & Root 1995a), soil adherence was estimated to be 1 milligram per square centimeter (mg/cm^2) for all individuals exposed to soil, while current guidance recommends differing adherence rates (DTSC 2000, U.S.EPA 2004b), varying from 0.07 to 0.3 mg/cm^2 depending on the type of individual exposed to soil. However, this difference in risk estimates is not likely to substantially affect the ultimate outcome of the risk analyses, since risks associated with dermal contact were less than one percent of those estimated for future on-site residents or commercial/industrial worker direct exposures to soil and none exceeded one in one million.

More changes have occurred in chemical toxicity data than in exposure parameter values since the BRA was conducted (Brown & Root, 1995a), although the inhalation toxicity values for those chemicals contributing most significantly to the risk estimates (i.e., benzene, vinyl chloride) have not changed. Notable changes have occurred in several toxicity values used in estimating cancer risks, including those for arsenic, beryllium, and chromium. Current Cal EPA (2008) toxicity data for arsenic suggests that risk estimates for the oral exposure pathway may be about five times higher than those estimated in the BRA. In contrast, toxicity values for estimating cancer risks for beryllium and chromium (in the hexavalent form) have been withdrawn for the oral exposure pathways as there is no evidence that either of these metals are carcinogenic by the oral route of exposure (Cal EPA 2008). This, in turn, suggests that risks for these two metals were overestimated in the BRA.

The DTSC-approved RAP was developed based on the expectation that landfill gases would be controlled and that there would be no future exposure to wastes or soil from the existing cover. The cap would also reduce infiltration of rain water into the buried wastes, thereby reducing the production of landfill gases and the migration of chemicals from wastes into the underlying groundwater. Groundwater treatment was also planned. As discussed below in Section 3, the same control measures are planned for the current Site with additional refinements and benefits. One substantial difference is the re-use of landfill cover soil for portions of the above-cap landscaping. The SMGs described in Section 5 have been developed to address re-use of cover soil.

2.3.2 Construction Scenario

As part of the BRA (Brown & Root 1995a), a two-year construction scenario was also evaluated to assess potential health risks for construction workers and nearby residents during implementation of the RAP. This set of evaluations was also health protective, for example, assuming that all cover soil would be removed for the entire two-year construction period. The construction scenario evaluated potential exposure and risks associated with the inhalation of airborne dusts and vapors emitted from the uncovered landfill. The following conclusions were reached regarding possible exposures evaluated for the two-year construction period.

The inhalation pathways (i.e., particulates and vapors) were determined to be the predominant source of unacceptable risk estimates (see Tables 2-1 and 2-2). In the absence of mitigation or monitoring procedures, it was assumed that future construction workers and nearby residents would inhale airborne vapors and dusts/particulates potentially released during construction activities. Inhalation of indoor air represented over 96 percent of the risks estimated for future off-site residents during the construction activities (i.e., cancer risk estimates of 9 in 100,000 and 4 in 10,000, respectively). Inhalation of predicted airborne dusts/particulates represented about 2 to 4 percent of the risks estimated for future construction workers or off-site residents during construction activities.

On balance, it is likely that the risk estimates calculated in the Brown & Root (1995a) BRA for future construction workers or off-site residents during construction activities are higher than estimates that would be calculated following current risk assessment methodology. This may be due primarily to the use of relatively higher inhalation rates for workers and residential children (38 and 20 cubic meters per day, respectively) than would be considered reasonable given current guidance (20 and 10 cubic meters per day, respectively) (DTSC 1999; U.S.EPA 1997a). Although a construction worker would be evaluated using a slightly higher soil ingestion rate using currently available information (Stanek et al. 1997; U.S.EPA 2002a) (330 milligrams per day [mg/day] compared to 100 mg/day in the BRA), this difference is not likely to substantially affect the outcome of the risk analysis since the soil ingestion exposure pathway would still result in an estimated risk of less than 1 in a million. Since inhalation toxicity values for chemicals that contributed most significantly to the risk estimates (i.e., benzene, vinyl chloride) have not changed, any risk estimates updated to comply with current guidance using only the soil gas data available for the BRA could potentially exceed 1 in a million for construction workers or nearby residents during the construction activities. It should be noted, however, that recent soil gas sampling (BAS, 2007) indicates that benzene and vinyl chloride concentrations in soil gas have decreased by at least an order of magnitude relative to the concentrations used in estimating health risks in the BRA.

Based on the risk estimates for construction workers and off-site residents during construction of the cap, the RAP requires that all potential impacts during the implementation process be mitigated (Brown & Root 1995b). The specified actions to be taken to reduce or eliminate environmental impacts during implementation include dust and particulate monitoring and control, traffic control, construction equipment emission monitoring, noise and odor control, and a worker health and safety plan. The Site would also comply with these mitigation measures. These measures include a site-specific health and safety plan to control exposure of workers involved with construction of the landfill remedial systems. In addition, a SMP that includes ambient air monitoring at on-site and off-site locations would be developed (for DTSC review and approval). The SMP would be implemented during any construction activity that disturbs or moves cover soil and account for recent soil gas data (BAS, 2007) and cover soil sampling data (ABBL 2007a).

3.0 CONCEPTUALIZED POST-CONSTRUCTION CONDITIONS

The development plan for this Site presently includes retail, entertainment, hospitality, and lifestyle elements, in addition to the "elevated residential" component in the northern portion of the Site (Figure 1-3). The Site would include up to 25 acres of "elevated residential" development and 132 acres of retail/commercial development. The proposed development on the Site would include approximately 1,250 "elevated residential" units, a 200-300 room hotel, and approximately 2.4 million square feet (sq. ft.) of commercial and residential floorprint area. Within these combined areas, approximately 60 to 65 acres would be paved parking lots, 10 to 15 acres of paved roads and walkways, and 5 to 10 acres of landscaped areas. Currently there is a Site Plan SP-33 (Figure 1-3) that establishes the preliminary shapes and locations of buildings and features. Future improvements are not expected to significantly change the Site Plan. The development would occur as set forth in the Developer's Specific Plan which identifies permitted uses and design specifications. The conceptual plan for proposed development is shown on Figure 1-3 and includes the following approximate mix of land uses.

Two types of land uses are proposed to occur within the Site: (1) Regional Commercial (RC) and (2) Mixed-Use Marketplace (MU-M). Land uses within the RC zone are intended to contribute to the City's regional shopping areas, as well as the other major retail areas in the City. The uses that would be located within the RC zone are intended to serve a broad population base and offer a wide range of services to both the community and the region. Businesses in this designation include major department stores, promotional retail type stores, lifestyle and entertainment specialty shops, hotel, and restaurants, as well as highway-oriented and smaller neighborhood retail and service uses. The MU-M zone provides opportunities for combining housing with smaller commercial services either within a single building or in separate buildings that would be located in close proximity to one another. The densities and intensities of uses would vary within the MU-M zone and would ultimately be based on the actual uses proposed. All of the uses allowed in the RC zone as described above, are also permitted within the MU-M zone except for stand-alone retail stores with greater than 50,000 sq. ft. of floorprint area. The MU-M zone does not allow business park/limited industrial uses, except for selected types of commercial uses.

Buildings and some outdoor areas would reside on top of structural foundations and cover over 40 percent of the landfill cells (Figure 3-1). The foundations would be supported by over 6,600 piles. The piles would be constructed through the refuse and terminated in competent sediment approximately 20 feet into the Bellflower Aquitard. Concrete caps would be poured in place around piles and pile bundles. An approximate 12-inch, reinforced concrete slab would reside on top of the pile caps, and the concrete surface will likely be topped with a finished floor.

Utility mains currently exist beneath the haul roads residing within native soil. These utilities would likely be replaced or retrofitted to be air and/or water tight, such that they do not act as conduits and can safely be maintained in the future. Utility lines that are not used would be properly abandoned or removed, such that they do not act as air and/or water conduits. Utility laterals would be bundled to minimize the number of laterals servicing the buildings. The laterals would have flexible connections to allow for settlement and would reside above the landfill cap LLDPE geomembrane. Utility lines servicing each building would be supported by the foundation system within utility vaults such that future maintenance and repairs can be completed safely.

Site landscaping would be compatible with and not adversely affect the remediation systems. Due to the subsurface constraints posed by the Site, trees would not be planted directly in the cover soil on top of the landfill cap. The taller species of trees that have a typical dendritic root structure would be containerized either above or below grade. For containerized trees below grade, a subsurface drainage conveyance system would be included to collect or convey drainage off-site. For plantings that would be directly in the cover soil, the landscape palette would consist primarily of small to medium shrubs, members of the grass family, and other plants with fibrous root systems, such as bulbs, culms or rhizomes. Taller species with fibrous and/or surficial root systems include, among others, members of palm and bamboo families. The plant palette for the Site would include, but is not limited to, Bob Perry's *Landscape Plants for Western Regions* as these plants are either native or adapted to the local climate and can survive with limited amounts of water. Drip irrigation and a native plant palette would be used to the maximum the extent feasible to minimize irrigation requirements.

3.1 Summary of Proposed Remedial Systems

This section summarizes the proposed systems that would be incorporated into the Site. Remedial systems, including engineering controls, are proposed for the development to mitigate potential risks associated with direct exposure to groundwater, landfill refuse, landfill gas, and cover soil as well as protection of groundwater resources. These include (1) a landfill cap comprised of an impermeable LLDPE geomembrane with overlying cover soil, (2) a landfill gas collection and treatment system, (3) BPS under each building to block and mitigate potential intrusion of landfill gases into buildings, and (4) groundwater remedial systems. The proposed remedial systems would meet all the requirements of the DTSC-approved RAP for the Upper OU and include additional refinements and benefits that would fully support development as currently proposed.

3.1.1 Landfill Cap System

The Site development plan encompasses the entire landfill surface. A landfill cap would be placed over the entire landfill area, not including the existing roads (built on native soil) that separate the Site into distinct cells (Figure 1-2). To accommodate the Site development plan, the landfill cap design would be tailored for four types of surface features identified below:

- Open outside areas that would typically be paved parking lot areas;
- Areas of outdoor space located above the pile-supported structural concrete slab that extends beyond the building footprints;
- Areas where building footprints are located above the pile-supported structural concrete slabs; and
- Landscaped areas outside building footprints or slab foundations.

The Site cap would be continuous across each cell of the landfill. Throughout the Site, the landfill cap works in conjunction with the landfill gas system. The system would be designed to meet landfill closure requirements and to protect future users of the property from exposure to landfill gas and contact with landfill waste. The proposed landfill cap refinement would be the use of an impermeable 60-mil thick, LLDPE geomembrane instead of the clay layer specified in the DTSC-approved RAP.

As described above, most if not all buildings would be constructed on pile-supported structural foundations. Pile bundles would be constructed through the refuse and into competent sediments. Each pile bundle would be capped and the LLDPE geomembrane would be connected and installed around each pile cap. Attachment would be completed to allow for settlement and to prevent landfill gas from escaping.

On top of the LLDPE geomembrane would be a layer of soil. The soil thickness covering the LLDPE geomembrane is estimated to range from 3.5 to 6 feet in outside areas and from 1 to 2 feet under building slabs. In addition, the surface of the LLDPE geomembrane would be sloped to aid water drainage, and a geonet drainage composite would be placed above the LLDPE geomembrane to further assist water draining.

Prior to placing the LLDPE geomembrane, the Site would be prepared and graded to provide adequate drainage should water infiltrate down to the LLDPE geomembrane. During the LLDPE geomembrane grade construction, a DDC program will also be implemented. The DDC will consist of compacting approximately 61acres in open areas of the development plan to assist in minimizing long term differential settlement (Figure 1-3). Existing voids under the LLDPE geomembrane grades and those caused by the DDC operations shall be filled with soil from the Site prior to placing the LLDPE geomembrane. The soil that has been identified as not meeting the SMGs, as developed and presented in this report, shall be used as the fill soil underneath the LLDPE geomembrane. Additional details of this soil movement will be included in a SMP for the Site.

3.1.2 Landfill Gas Collection and Treatment System

The landfill gas (LFG) collection and treatment system would provide an additional layer of protection in conjunction with the landfill cap system described in Section 3.1.1. The LFG collection system would be a combination of both horizontal and vertical wells screened below the LLDPE geomembrane cap and would be located throughout the landfill (horizontal wells) and under all buildings (horizontal and vertical wells). The purpose of the LFG system would be to physically remove and treat landfill gasses and to establish a slightly negative pressure differential beneath the LLDPE geomembrane. Landfill gas would be conveyed to and treated by a central treatment unit that would be operated in accordance with South Coast Air Quality Management District (SCAQMD) requirements. Therefore, landfill gasses would be removed before they could migrate to land surface.

A LFG Pilot Test (BAS, 2007) was performed at the Site in June 2007 to acquire necessary data for future design of the LFG extraction and treatment system. This was accomplished by collecting field data from push probes, to establish a baseline understanding of the LFG composition and static VOCs to be encountered. This was followed by the installation of a Pilot Test extraction and treatment system comprised of 13 vertical extraction wells, extraction system piping, condensate tanks, a granular activated carbon treatment system (GAC), and a potassium permanganate adsorber. The Pilot Test was initiated and continued over a seven week period in an attempt to reach a LFG generation/extraction equilibrium (steady state condition). The data collected would be used to: 1) establish a steady state extraction rate of LFG; 2) determine the size of extraction system equipment; 3) determine the type of treatment equipment; and 4) assist permitting the final system.

3.1.3 Building Protection System

The proposed BPS would serve to additionally block and thus eliminate potential exposure pathways associated with landfill gas for future building occupants. A BPS would be integrated into each building and reside below each building slab. In conjunction with the landfill cap system described in Section 3.1.1 and the LFG collection and treatment system described in Section 3.1.2 these systems would provide multiple layers of redundant protection, thus ensuring that landfill gases do not migrate into buildings.

The proposed BPS would consist of:

- A primary geomembrane system that is part of the property-wide cap (described above) that would extend under the buildings and be sealed to the pile foundation system of the buildings.

- A sub-slab passive venting system consisting of a network of perforated pipes embedded in a gravel layer under the entirety of each building slab.

- A full time methane detection system that would sense the presence of gas in the sub-slab venting system, automatically notify an operator such that corrective action can be implemented, and could trigger active gas removal from the sub-slab system.

- A secondary geomembrane system that would be mechanically bonded to and seals the bottom of each building slab.

- The residential structures would have open-air naturally ventilated space between the at-grade structural parking slab and the first occupied enclosed area to provide additional assurances that vapors could not migrate into occupied residential building spaces. The parking slab would also have a secondary geomembrane attached to the underside, similar to a typical building slab.

3.1.4 Groundwater Remedial System

As described in Section 2.2.6, groundwater currently resides at approximately 15 to 40 feet bgs within the Upper Bellflower Aquitard. Groundwater sampling results from May 2007 (SCS Engineers, 2007) have confirmed that the Middle and Lower Bellflower Aquitard zones (MBFB/C and LBF units) are not impacted, with the exception of low levels of chlorinated VOCs in one Middle Bellflower well in the extreme northwest corner of the site, most likely from off-site upgradient sources.

After development is completed, groundwater would reside at approximately the same depth below the Site as currently measured (i.e., 15 to 40 feet bgs) and would not be contacted during landfill cap construction or future maintenance. In addition, future restrictions would preclude constructing water wells and using groundwater beneath the Site. Therefore, exposure to potentially impacted groundwater by future Site occupants would be blocked.

The DTSC-approved RAP requires that groundwater remediation be completed in the Upper OU to minimize or prevent further off-site migration of impacts, and to protect groundwater in the Lower OU. Based on numerous years of monitoring, it appears that impacts have not migrated significantly offsite. However, as additional assurance, groundwater remediation refinements have been developed.

A GET would be employed to hydraulically contain impacted groundwater along the property boundary where contaminated groundwater is located and could migrate. The extraction well network would be installed along the boundary in these areas and would concentrate on the southwestern portion of the Site where the highest levels of impacts have been observed. Extracted groundwater would be treated by an aboveground treatment system and discharged offsite, either to the sanitary sewer for transport to the local publicly-owned treatment works (POTW) or into the Torrance Lateral for transport to the Dominguez Channel.

In addition, the existing groundwater monitoring well network would be enhanced with additional groundwater monitoring wells to confirm that impacts in groundwater do not significantly migrate further.

3.1.5 Soil Management and Placement

Additional cover soil characterization was conducted in 2005, 2006, and 2007. These data are evaluated herein to confirm or improve an SMP that would be used to ensure that soil residing above the LLDPE geomembrane is of suitable quality. Additionally, these data would be used to refine plans to protect construction workers and the surrounding community during construction activities.

During and after final soil placement and construction, confirmation soil samples would be collected and analyzed, as necessary. The results of these analyses would be evaluated to confirm that soil placed above the LLDPE geomembrane would not pose an unacceptable risk to human health or the environment.

3.1.6 Multiple Layers of Protection

As described in Section 2.3, the greatest risk to future Site occupants would be exposure to LFG. Therefore, protection of human health and the environment following construction and during occupancy would be ensured through multiple layers of protection that include the landfill cap, LFG extraction and treatment system, BPS, engineered controls, and long-term monitoring. Together, the proposed systems would provide multiple layers of protection and redundancies to ensure the protection of future occupants, should there be an upset of one of the systems. For commercial buildings, six layers of protection would be provided, and for the "elevated residential" buildings, seven layers of protection would be provided, of the following types (from the bottom up):

- A continuously operating site-wide LFG collection and treatment system
- An impermeable primary LLDPE geomembrane as part of the landfill cap
- A building sub floor passive venting system
- A full time continuously operating methane detection system beneath the buildings
- A secondary impermeable geomembrane system that seals the bottom of the building slab
- For the "elevated" residential structures, an open-air and naturally ventilated space between the structural slab and the first occupied enclosed area
- Heating, ventilation, and air conditioning (HVAC) building systems to provide frequent air changes, ventilation, and building pressurization.

All of these systems would be inspected, operated, monitored, and repaired, as necessary, throughout the lifetime of the Site. Additionally, reviews would be completed every five years evaluating the effectiveness of each system. All long-term monitoring and reviews would be completed under the oversight of the DTSC. In addition to the redundant and multiple layers of protection described above to protect occupants from LFG, exposure to potentially impacted groundwater would not occur because groundwater use would be restricted, resides 15 to 40 feet bgs, and a GET system would be employed to hydraulically contain impacted groundwater. Additionally, soil management before, during, and after construction would ensure that the quality of soil that resides above the LLDPE geomembrane is acceptable.

4.0 DATA EVALUATION AND SELECTION OF CONSTITUENTS OF POTENTIAL CONCERN

The current development plans for implementing the RAP include the re-use of existing soil on the property for construction of the final landfill cap. As described in Section 3.0, all exposure pathways associated with landfill refuse, landfill gas, and groundwater would be incomplete following the construction of and operational implementation of the Landfill Cap System, the Landfill Gas Treatment and Collection System, the BPS, and the Groundwater Remedial System. Hence, in the absence of any complete exposure pathways for any of these media, the development would be protective of future users and occupants of the Site. Therefore, potential exposure to cover soil placed on top of the LLDPE geomembrane would remain the only potentially complete exposure pathway associated with the landfill following construction and occupancy of the Site.

Currently, there is an estimated average of 9 to 15 feet of existing cover soil residing above the landfill contents throughout the property (ABBL, 2008). Some of this soil would ultimately reside below the proposed LLDPE geomembrane and some of this soil would reside above as protection for the LLDPE geomembrane at the completion of the Site. While the majority of soil placed above the LLDPE geomembrane would be covered by building slabs and paved parking areas, soil above the LLDPE geomembrane would also be used for limited areas of landscaping. While landscaping of the property would be designed to discourage access to these areas, it is not unreasonable to assume that users, workers, and occupants at the Site could occasionally contact cover soil in these limited areas.

As discussed below in Section 4.1, several investigations have been conducted to characterize existing cover soil. These investigations have shown that several groups of chemical constituents are present in cover soil. The objective of the data evaluation presented in this section is to summarize the findings of recent cover soil investigations and identify constituents of potential concern (COPCs) for further evaluation and development of SMGs. SMGs would be used during the planning, investigative, and construction phases of the Site to ensure that soil placed above the LLDPE geomembrane is protective of human health and the environment for the planned future uses, including the residential area, of the development.

4.1 Cover Soil Analytical Data

Data available to characterize cover soil were collected during seven separate investigations. These investigations include historical datasets for on-site soil (McLaren/Hart 1992; Brown & Root 1995c) and data for soil stockpiles in off-site locations and imported to the property in 1997 and 1998 (Allwest Geoscience, Inc., 1998). More recent sampling was conducted in 2005, 2006, and 2007 (Tetra Tech 2005; ABBL 2007a) to collect chemical analytical data for the existing cover soil. For the development of SMGs, data collected during 2005 to 2007 were evaluated because they are comprehensive, of demonstrably high quality, and most representative of cover soil conditions. The data collection, analytes of interest and detected constituents are summarized below.

In March 2005, 51 soil samples were collected from 51 locations from a depth of 0 to 2 feet bgs (Tetra Tech 2005) (Figure 4-1). These soil samples were combined into 34 samples for analysis (10 discrete samples, 21 composites, and 3 duplicates). The 34 samples were analyzed for organochlorine pesticides, metals, polychlorinated biphenyls (PCBs), petroleum hydrocarbons, and semi-volatile organic compounds (SVOCs). Of these constituents, nine metals, 13 pesticides, one PCB mixture (Aroclor 1262), and one SVOC were detected, as shown in Tables 3 through 8. In April and May 2005, soil samples were collected from 15 soil borings (0 to 2 feet bgs) to confirm the analytical results from the March 2005 soil sampling event and to better define the horizontal extent of PCBs in near-surface soil (Figure 4-2).

During the week of March 20, 2006, Tetra Tech collected soil samples from the existing cover soil in Landfill Cell A1, and small areas in Landfill Cells A2 and A3. Tetra Tech's work on the Site was halted on March 23, 2006. The cover soil investigation was resumed by ABBL March 5, 2007 and completed on April 27, 2007 (ABBL 2007a). The field work for the cover soil sampling was implemented based on the "Final Landfill Cover Soil Sampling Work Plan", prepared by Tetra Tech, dated March 10, 2006 (Tetra Tech 2006a) and approved by the DTSC on March 15, 2006. As indicated in the cover soil report (ABBL 2007a), samples collected by Tetra Tech were reported by the laboratory on a wet weight basis, rather than a dry weight basis as planned (Tetra Tech 2006a). Accordingly, to ensure that these data were consistent with those collected by ABBL (reported on a dry weight basis), the sample results were adjusted upward (by a factor of 1.429) using an upperbound moisture content of 30 percent, based on soil moisture contents reported for the ABBL samples. Tetra Tech also conducted a supplemental validation of the data presented in the draft cover soil report (ABBL, 2007a). The results of this supplemental validation were used in identifying COPCs in the cover soil.

A total of 239 borings were installed in the cover soil (Figure 4-3). A total of 676 discrete samples (plus 92 duplicates) and 154 composite samples (plus nine duplicate composites) were analyzed. The soil samples were analyzed for organochlorine pesticides, chlorinated herbicides, PCBs, VOCs, SVOCs, and polycyclic aromatic hydrocarbons (PAHs). Of these constituents, 21 metals, 14 pesticides, 5 PCB mixtures (Aroclors 1016, 1248, 1254, 1260, and 1262), 37 VOCs, 16 PAHs, and 19 SVOCs were detected, as shown in Tables 3 through 8.

4.2 Local Background Data

In May 2005 and December 2006, soil samples were collected immediately north and across Del Amo Boulevard from an undeveloped property located north of the proposed development (see Figure 4-4) (ABBL 2007b). The objective of this investigation was to collect metals data for the purpose of characterizing background undisturbed soil conditions. The sampled area is currently open space and apparently has not been developed since cessation of agricultural activities in the 1930s or 1940s. Since Del Amo Boulevard forms the northern boundary of the Site (Brown & Root 1995a), the area immediately north of Del Amo Boulevard is unlikely to have been impacted by materials disposed of at the landfill. Notably, the boring logs for soil north of Del Amo Boulevard indicate that there was no observable odor or staining of the soil. Thus, the soil is considered representative of undisturbed background conditions for the Site.

Boring logs produced as part of the investigation of the soil north of Del Amo Boulevard indicate that the soil consists primarily of dark and light brown sandy silt, dark brown silt, and dark brown clayey silt in the top two feet. These soil profiles generally correspond with those of cover soil which were described as dark brown to brown silty sand and silt (McLaren/Hart 1992).

In 2005 and 2006, five and six soil samples, respectively, were collected north of Del Amo Boulevard and analyzed for metals. As shown in Table 9, the sampling results for this background dataset are consistent with two sets of naturally occurring metal concentrations in California soil: (1) background soil analyzed for metals by Lawrence Berkeley National Laboratory (1995) and (2) California background soil analyzed by Bradford *et al.* (1996). These studies further support the use of the metal analyses for soil from the undeveloped property north of Del Amo Boulevard as a reasonable representation of local background metal concentrations. These background metals data are considered adequate for the planning phases of the Site including the development of SMGs.

4.3 Identification of Chemicals of Potential Concern

To be protective, all chemicals detected in cover soil from the 2005, 2006, and 2007 investigations were initially considered to be COPCs. In accordance with U.S.EPA (1989b) and DTSC (1999) risk assessment guidance, chemicals identified as COPCs should be site-related and detected frequently in Site media. Consistent with this guidance, metals detected at concentrations that fall within the range of local or regional background concentrations are not likely site-related and thus would not require further evaluation. Essential nutrients such as calcium, iron, magnesium, potassium, and sodium generally do not require quantitative risk evaluation and therefore were not selected as COPCs. To be protective, all organic chemicals detected in soil were identified as COPCs, although certain constituents, such as acetone detected at low concentrations, may be laboratory contaminants.

Thus, the list of cover soil COPCs was identified using two screening procedures: (1) comparison with background concentrations for metals and (2) identification as an essential nutrient. Each of these procedures is described below.

4.3.1 Background Comparison

U.S.EPA (1989b) and DTSC (1997) guidance recommend the screening of Site metal concentrations against background metal concentrations during the COPC selection process. Soil metal concentrations in cover soil that fall within the range of background concentrations would not be selected as COPCs, and therefore, would not require further evaluation (DTSC 1997). In accordance with DTSC (1997) guidance, the comparison of cover soil metal concentrations to background metals concentrations is an iterative process whereby the first step is a simple comparison of maximum cover soil metal concentrations to upper bound background metals concentrations. When the maximum detected cover soil metal concentration falls below the upper bound background metal concentration for a given metal, it may be concluded that cover soil metal concentrations are within the range of background metal concentrations.

Table 9 shows the comparison of maximum detected cover soil metal concentrations and maximum background concentrations in samples collected from the 11-acres of undeveloped property located north of the Site (i.e., Del Amo Gardens). The results of this comparison indicate that one metal (barium) is likely within the range of the background concentrations. One metal (manganese) was not analyzed in local background soil, but manganese concentrations in cover soil are fully within regional background concentrations (Bradford et al., 1996). On this basis, it would appear that manganese would not be a COPC, although this could not be confirmed using local background data. To be health protective, manganese was identified as a COPC. Otherwise, none of the remaining metals could be considered within local background levels.

Accordingly, a statistical evaluation was conducted of the remaining metals using the local background dataset. This was done by comparing measured metal concentrations to the 95th percentile of the data for each metal analyzed for in the local background soil (i.e., Del Amo Gardens), As shown in Table 9, eleven of the metals detected in existing cover soil (antimony, arsenic, beryllium, cadmium, chromium, cobalt, mercury, nickel, selenium, silver, and vanadium) should not necessarily be identified as COPCs because they are within the ranges of regional background concentrations (Bradford *et al.* 1996; LBNL, 1995). Nevertheless, since the maximum concentrations of these metals are higher than the 95th percentile concentrations of the local background data, to be health protective, all eleven metals either not detected in local background or lower than regional background were identified as COPCs. Thus, to be health protective, SMGs were developed for all of the detected metals.

4.3.2 Essential Nutrients

U.S.EPA (1989b) guidance indicates that constituents considered to be essential human nutrients that are toxic only at high doses do not need to be evaluated in a quantitative risk assessment. Three constituents considered essential nutrients (magnesium, potassium, and sodium) were detected in cover soil and were not retained as COPCs.

4.3.3 Results of the COPC Identification Process

Tables 3 to 8 provide the lists of COPCs identified for cover soil. As shown, 18 metals, 13 pesticides, 37 VOCs, 19 SVOCs, 5 PAHs (in addition to those detected as SVOCs), and, 5 PCB mixtures (Aroclors 1016, 1248, 1254, 1260, and 1262), for a total of 97 constituents were identified as COPCs. SMGs were developed for each of these COPCs for which there were adequate toxicity information.

5.0 DEVELOPMENT OF SOIL MANAGEMENT GOALS

An array of remedial systems, including engineering controls, are proposed for the Site to mitigate potential risks associated with direct exposure to groundwater, landfill refuse, landfill gas, and cover soil as well as protection of groundwater resources. These are described in Section 3 and include (1) a landfill cap comprising an impermeable LLDPE geomembrane with overlying cover soil, (2) a landfill gas collection and treatment system, (3) a BPS under each building to block and mitigate potential intrusion of landfill gases into buildings, and (4) groundwater remedial systems (i.e., GET). The proposed remedial systems meet all the requirements of the DTSC-approved RAP for the Upper OU and include additional refinements and benefits.

The purpose of these remedial systems is to eliminate all exposure pathways associated with landfill refuse, landfill gases, and soil placed beneath the LLDPE geomembrane and to ensure groundwater protection. Therefore, the only complete exposure pathways associated with the landfill following construction and occupancy are those related to cover soil placed on top of the LLDPE geomembrane. Thus, the focus of this section is on the development of SMGs that will be used in the planning, design, and construction phases of the Site to ensure that any soil used as cover soil on top of the LLDPE geomembrane is protective of human health and the environment for the proposed uses of the Site.

The SMGs were developed following U.S.EPA and DTSC risk assessment guidance to be protective of individuals who could in the future contact cover soil at the Site following construction and occupancy. The specific algorithms used to derive SMGs follow U.S.EPA (1991b) guidance for calculating risk-specific soil concentrations. This process consists of the rearrangement of the “forward” risk assessment equations recommended by the U.S.EPA (1989b) for estimating exposures and risks and then solving for the risk-based soil concentration. The derivation of SMGs comprises four main components: (1) exposure assessment, (2) toxicity assessment, (3) target risk levels, and (4) calculation of SMGs. These components are described in Sections 5.1 through 5.4, respectively. An initial comparison of SMGs to existing cover soil data is presented in Section 5.5.

5.1 Exposure Assessment

Exposure assessment is the process of estimating the type, timing, and magnitude of exposures that human receptors may experience. The primary elements of the exposure assessment include (1) the development of a conceptual Site model (CSM), including a description of likely human receptors, exposure scenarios, and complete exposure pathways, and (2) a quantitative exposure analysis focused on the types of exposures described in the CSM. Each of these elements is described below.

5.1.1 Conceptual Site Model

The Site would include a variety of beneficial uses including residential, retail, commercial, entertainment, and hospitality. Four groups of human receptors may use the Site on a regular or semi-regular basis, including: (1) future on-site residents, (2) future commercial/retail workers (including workers at the entertainment and hotel facilities and maintenance/landscape workers), (3) hotel occupants, and (4) individuals who shop at or make use of the commercial/retail services. In addition, off-site residents could be exposed to cover soil from fugitive dust emissions associated with wind erosion of soil and also from the emission and airborne transport of volatile constituents from soil. As discussed previously in Sections 1 and 3, exposure pathways associated with landfill refuse, landfill gasses, soil placed beneath the LLDPE geomembrane, and groundwater would be eliminated by the engineering controls (with monitoring systems to ensure control effectiveness) and remedial measures that would be implemented prior to construction. Therefore, the only media for which there may be a complete exposure pathway is cover soil that would be placed on top of the LLDPE geomembrane.

The majority of cover soil would be placed below building sub-slabs and paved roadways and parking areas, but may also be used for selected areas of landscaping in parking areas, at entrances to the Site, and possibly along the west, south and east perimeter slopes of the Site (e.g., next to roads or pathways). As discussed in Section 3.1.1, the final cover soil thickness would range from 3.5 to 6 feet in areas outside of building footprints, and from 1 to 2 feet thick under building slabs. Conceptually, the specific placement of soil beneath buildings, paved areas, and in landscaped areas would likely follow a risk-based approach; for example, cover soil with the lowest (or not detected) residual COPC concentrations would be used in those areas with the greatest potential exposure (e.g., landscaped areas) and to be protective of specific receptors (e.g., future on-site residents). As currently planned, the landscaped areas would comprise approximately 5 to 10 percent of the total area of the Site.

Future on-site receptors, including visitors, residents and retail, hospitality, hotel, maintenance, and landscape workers could be exposed to COPCs in cover soil through the incidental ingestion, incidental dermal contact, and ambient air inhalation (particulates and vapors) exposure pathways. However, much of the cover soil will be covered by pavement or building slabs following completion of the Site. Thus, the spatial extent of landscaped areas would comprise only a small fraction of the total area of the Site. Furthermore, the extent of exposed soil within landscaped areas would be limited by landscaped vegetation of these areas with a variety of plants and trees including continuous shrubs and/or ground covers. The sloped areas would also be developed as irrigated landscaped areas with limited access (i.e., surrounded by walls and fences). Therefore exposure of all future on-site receptors (including on-site residents) to landscaped soil would be expected to be infrequent and minimal. In addition, maintenance and utility workers could also be exposed to cover soil beneath paved areas and adjacent to utility vaults should it be necessary to service these utilities. Similarly, these activities would likely be infrequent.

Based on the above considerations, landscape workers would have the greater potential for exposure to cover soil following the completion of the Site. SMGs developed for future on-site workers (assumed to contact soil on a frequent, regular basis) would be protective of other on-site receptors including residents, and retail, hotel, entertainment, and hospitality workers because they would have minimal opportunity to contact cover soil in landscaped areas. Therefore, SMGs were developed for long-term on-site workers using standard U.S.EPA (1989b) and DTSC (1992b) risk assessment guidance for assessing risk to commercial/industrial workers presumed to contact cover soil on a daily basis. The exposure pathways included for deriving SMGs for on-site workers include incidental soil ingestion, dermal contact, and inhalation of airborne dusts and VOCs.

Off-site receptors include nearby residents located south and west of the property. Future residential development is also planned on the northern portion of the property (i.e., north of the landfill). Off-site residents could be exposed to COPCs in cover soil through the inhalation of airborne dusts and VOCs potentially transported offsite. Based on the preliminary HRE (Tetra Tech 2006c), exposures following the construction of the proposed remedial systems are likely insignificant as compared to on-site exposures (see Table 5-14 in Tetra Tech 2006c). Thus, SMGs were not developed for these receptors. Nevertheless, to ensure that off-site receptors are protected during Site development, a construction mitigation plan would be developed to ensure dust and vapor releases are within acceptable limits for off-site receptors.

5.1.2 Quantitative Exposure Analysis

Quantitative exposure analysis is the process of estimating the intake or dose of a chemical following contact with environmental media through one or more exposure routes (e.g., ingestion, dermal contact, inhalation). Dose is generally expressed in units of milligrams per kilogram body weight per day (mg/kg-day), and is dependent upon the concentration of the chemical in environmental media, the rate of contact (e.g., soil ingestion rate), exposure frequency, exposure duration, and body weight. Risk-based media concentrations (e.g., SMGs) are derived following the same process, but instead of solving for dose, the same dose equation is rearranged and solved for media concentration at a specific target risk level using chemical specific toxicity information. The toxicity values and target risk levels used to derive SMGs are described in Sections 5.2 and 5.3, respectively.

In order to calculate SMGs protective of future on-site workers, exposure parameter values were compiled for these workers on the basis of reasonable maximum exposures as described in DTSC (1992b, 1999, 2000, 2005) and U.S.EPA (1989b, 1991a, 1997a, 2004b) guidance. Preference was given to DTSC exposure parameter values except in cases where U.S.EPA has established more recent guidance that DTSC has generally found acceptable.

Exposure parameter values were determined for future on-site workers potentially exposed to COPCs in soil as a result of incidental soil ingestion, dermal contact with soil, and the inhalation of airborne dusts and vapors. The exposure parameters and formulas used to calculate SMGs for cover soil are shown in Table 10.

On-site workers were assumed to be 70-kg adults who could potentially be exposed to cover soil. Although soil contact is not anticipated to occur on a frequent basis, it was estimated that contact with cover soil may occur on each of every working day (250 days per year), with each day consisting of an 8-hour work period. Although it is unlikely that the same individuals would be exposed to cover soil every year, to be health protective, on-site workers were evaluated using an exposure duration of 25 years; i.e., the 95th percentile of employment at one location in the U.S. (U.S.EPA 1991a). Soil contact was estimated to result in the incidental ingestion of soil at a rate of 100 mg per day (U.S.EPA 2002; DTSC 2005), and dermal contact to the head, hands, and forearms (dermal surface area of approximately 5,700 cm^2) (DTSC 2005). Soil-to-skin adherence factors were based on values derived by the U.S.EPA (2004b) for commercial/industrial workers (0.2 mg/cm^2). The on-site worker was also assumed to inhale airborne COPCs with an inhalation rate comparable to the mean inhalation rate for heavy activity by outdoor workers (2.5 m^3 per hour) (U.S.EPA 1991a, 1997a).

Dermal absorption fractions used in evaluating dermal contact with soil are provided in Table 11.

5.1.3 Fate and Transport Analyses

Fate and transport models were used to evaluate inter-media transfer and transport of COPCs in the development of SMGs. Inter-media transfer is the movement of constituents between environmental media such as soil and air. Constituent transport occurs through the movement of an environmental medium by natural advective and dispersive processes such as air dispersion. For the purpose of developing SMGs, fate and transport analyses were used to estimate the emission of dusts and vapors from cover soil and the subsequent transport of these airborne constituents to a location where the identified receptors could inhale them.

Dust Emissions and Transport

Respirable dust particles are comprised of particulate matter 10 microns (µm) or less in diameter (PM_{10}). Non-volatile constituents can adsorb to soil and become airborne dusts through wind erosion. Fifty-five COPCs were evaluated for dust emissions. The COPC fraction in airborne dust was assumed to be the same as the COPC fraction in the soil.

Particulate emission factors (PEFs) were estimated according to U.S.EPA (2002a) guidance for future onsite workers and off-site residents. The equation, parameter definitions, values, and assumptions used in evaluating on-site workers and off-site residents are presented in Table 5-3. For these groups of receptors, a dust emission area of 12 acres was used, assuming this is the approximate area of the Site where cover soil would be used for landscaping and not covered by buildings or pavement. The fraction of vegetative cover (V) over this area for the completed development is planned to be 1 (i.e., all cover soil will be vegetated with ground cover, shrubs, etc.). However, since it is not known to what extent cover soil will be covered by shrubs, ground cover, or trees, a conservative estimate of relatively limited vegetated cover (i.e., 20 percent of soil vegetated) was assumed. In other words, it was assumed that 80 percent of landscaped cover soil would be comprised of bare soil (see Table 12).

A summary of the calculated PEF value developed for calculating SMGs for the worker exposure scenarios is presented in Table 12.

Outdoor Air Volatile Emissions and Transport

Several volatile constituents were identified as COPCs in cover soil. These constituents were defined by the following criteria (U.S.EPA 1996; DTSC 1999):

- Molecular weight < 200 g/mol
- Henry's law constant $\geq 1 \times 10^{-5}$ atm-m^3/mol

Table 13 presents the volatile constituents identified as COPCs and their respective chemical properties.

Volatile emissions of these COPCs from cover soil were calculated using the Volatilization Factor (VF) approach as presented by Equation 8 in the *Supplemental Soil Screening Guidance* (U.S.EPA 2002b). The VF was calculated for on-site workers using scenario-specific Q/C values as specified by U.S.EPA (2002b). Table 14 presents the equations from this guidance along with parameter definitions, parameter values, and assumptions for the on-site worker scenario. Two key parameters in this evaluation are soil type and fraction of organic carbon (f_{oc}). Based on the recent cover soil sampling (ABBL, 2007a), the predominant soil types identified for this property are silty sand, sandy silt, clay, and silt (Unified Soil Classification System [USCS] SM, ML, CL, and ML classes, respectively). Therefore, soil properties used in the modeling were based on a soil type characterized by the Soil Conservation Service (SCS) that best fits these types of soil present at this Site. In this case, soil moisture was used in determining the best fit to the soil types, with a weighted average of 10.5 percent moisture for the four soil types nearly comparable to that for sandy loam (i.e., 10.3 percent). Thus, the average soil properties for sandy loam (Schaap and Leij 1998, summarized in U.S.EPA 2003a) were used for modeling VF. For f_{oc}, the U.S.EPA (2002b) Soil Screening Guidance default value of 0.006 was used, which is slightly less than the default value used in the BRA (McLaren/Hart 1992; Brown & Root 1995a). All of the soil properties used for modeling the volatilization factors are shown in Table 14.

The calculated constituent-specific volatilization factors for developing SMGs for the future on-site workers are presented in Table 15.

5.2 Toxicity Analysis

Toxicity analysis is the process of identifying the relevant and appropriate toxicity values required for deriving SMGs. This process considers the characteristics of the likely exposure (e.g., acute, subchronic, or chronic), the route of exposure (e.g., oral, inhalation, dermal), and the chemical-specific toxic response (e.g., carcinogenic and/or non-carcinogenic). All potential exposures associated with on-site workers were conservatively assumed to be long-term chronic exposures. Where appropriate, route-specific toxicity values were used. As applicable, both carcinogenic and non-carcinogenic effects were considered in deriving SMGs.

All toxicity values used in the derivation of SMGs were obtained from toxicity assessments published by the California Environmental Protection Agency (Cal EPA) and the U.S.EPA. The Cal EPA and U.S.EPA classify carcinogens according to their potential carcinogenicity (e.g., possible or probable carcinogens). Toxicity values used to assess carcinogenic effects are known as slope factors (SFs) that quantitatively define the relationship between exposure and the likelihood of carcinogenic effects. SFs are used for estimating the incremental upper bound excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. In practice, SFs (expressed in units of $[mg/kg/day]^{-1}$) are derived from the results of human epidemiology studies or chronic animal bioassays. For this report, Cal EPA (2007) slope factors were used preferentially, unless a Cal EPA slope factor was not available, in which case a U.S.EPA (2007) slope factor was used. Tabulations of the oral and inhalation SFs are provided in Tables 16 and 17, respectively.

The U.S.EPA has determined which constituents potentially cause adverse effects other than cancer. Typically, these adverse effects may not occur until a specific level of exposure is exceeded. As such, toxicity values for non-carcinogenic effects are based on a threshold level of exposure, typically demonstrated in laboratory animals, with the incorporation of several uncertainty factors to ensure the protection of sensitive human individuals. The resulting chronic reference doses (RfDs), expressed in units of mg/kg-day, are defined as an estimate of the maximum daily exposure that will not produce an appreciable risk of adverse health effects during a lifetime (U.S.EPA 1989b). The chronic oral and inhalation RfDs used to derive SMGs were determined in accordance with the hierarchy established by U.S.EPA (2003b) guidance and are presented in Tables 18 and 19, respectively.

For chemicals without toxicity values, toxicity values for surrogate chemicals were used where possible. Surrogate chemicals are chemicals that are assumed to exhibit toxicity similar to that of the chemical lacking a toxicity value based on structural similarities. Chemicals for which surrogate toxicity data were used are indicated on Tables 16 through 19. No toxicity values or reasonable surrogates were found for 4-nitrophenol and benzo(g,h,i)perylene; therefore, SMGs were not calculated for these COPCs.

The U.S.EPA has determined that lead exposure can result in various health effects, depending on the level of exposure. Also, potential health effects differ, depending on whether exposure occurs to an adult, a pregnant woman, or a child. Also, lead exposure is typically evaluated in terms of blood-lead levels. For these reasons and to be protective of pregnant workers, the U.S.EPA Region 9 (2004a) preliminary remediation goal (PRG) for an industrial worker was used as a surrogate SMG. This PRG was calculated using the U.S.EPA Adult Lead Model [ALM]) to achieve a blood-lead action level of 10 micrograms per deciliter (ug/dL).

5.3 Target Risk Levels

Target risk levels were determined according to U.S.EPA and DTSC guidance. U.S.EPA (1990) guidance indicates that a carcinogenic risk probability between 1 in 10,000 and 1 in 1,000,000 (1×10^{-4} to 1×10^{-6}) is generally acceptable. The lower end of this risk management range is typically applied to residential situations, whereas the higher range may be considered appropriate for commercial situations. Therefore, to be protective of future on-site workers, SMGs were calculated using a target risk level of 1×10^{-5} for all of the COPCs except for the potentially volatile constituents. Because of their mobility in the environment, the SMGs for the volatile COPCs were calculated using a target risk of 1×10^{-6}.

Potential non-carcinogenic effects are estimated by calculating the ratio between exposure (e.g., dose) and the chemical-specific RfD. This ratio is defined as the hazard quotient (HQ) and is evaluated separately for each exposure pathway. The sum of all chemical-specific and pathway-specific HQs is defined as a hazard index (HI). The U.S.EPA (1989b, 1990) considers an HI less than 1 protective of adverse health effects. To be protective of future on-site workers, SMGs were developed using a target HQ of 1 for all of the COPCs except for the potentially volatile constituents. Because of their mobility in the environment, the SMGs for the volatile COPCs were calculated using a target HQ of 0.1.

For lead exposures, the blood-lead level of concern to DTSC and the U.S.EPA is 10 ug/dL and the worker-protective SMG was based on the ALM-modeled soil concentration of 800 milligrams per kilogram (mg/kg).

5.4 Soil Management Goals

For each COPC, SMGs were developed for both cancer and non-cancer endpoints, as appropriate. The relevant exposure pathways for each receptor were integrated within the SMG equations in order to derive SMGs that correspond to the total exposure associated with all exposure pathways for the future on-site worker. To be consistent with the approach used by U.S.EPA Region IX (2004a), estimated SMGs greater than 100,000 mg/kg were expressed as an upper limit (i.e., >100,000 mg/kg). The SMGs for carcinogenic and non-carcinogenic effects developed for future on-site workers are shown in Table 20. The lower of the SMGs based on carcinogenic and non-carcinogenic effects for each of the organic COPC would be used in the planning, investigative, and construction phases of the Site. For metals, the SMGs were compared to the background estimates (i.e., the 95th percentile concentration of metals analyzed in background soil) and the higher of the two values was selected as the final SMG. As a result of this comparison, the final SMGs for all metals except arsenic were based on the risk-based SMGs (see Table 20).

5.5 Comparisons to SMGs

An evaluation of soil sampling results at the Site was conducted by comparing each COPC concentration measured in cover soil samples to SMGs. As discussed previously, SMGs derived for the commercial/industrial worker scenario would also be protective of other on-site receptors including maintenance workers, landscape workers, visitors, and residents. To be health protective and determine which COPCs exceed SMGs, the maximum concentration of each COPC was compared to its SMG (see Table 21). Additionally, for PCBs the sum of the Aroclors detected in each sample was compared to the SMG for total PCBs. A similar comparison process was also conducted for the sum of the DDT/DDE/DDD congeners and for the potentially carcinogenic PAHs (based on estimates of benzo(a)pyrene-equivalent concentrations in each sample).

The COPCs detected above their respective SMGs are shown in Table 21. As shown in Tables 21 to 23 the detected concentrations of only six COPCs exceed their respective carcinogenic SMGs and two exceed their non-carcinogenic-based SMG. Six of these are organic constituents -- benzo(a)pyrene, ethylbenzene, methylene chloride, naphthalene, PCBs (Aroclors 1016, 1248, 1260, and 1262) and 1,2,4-trimethylbenzene. Further, these COPCs exceed their respective SMGs in only one or two soil samples. The one metal (arsenic) exceeding its carcinogenic-based SMG exceeds its background 95th percentile (7.6 mg/kg) in 87 locations.

All of the organic COPCs exceeding SMGs were detected in only a few areas of the property (as shown in Table 22 and Figure 5-1). Those COPCs with detected concentrations exceeding SMGs are constituents that would be considered in further detail during the planning, investigative, and construction phases of the proposed development. As a health protective measure, the soil impacted by organic constituents would be placed beneath the LLDPE geomembrane during the initial rough grading and DDC phase of the Site development.

Soil with arsenic concentrations exceeding the background 95th percentile would be addressed depending on its location, as follows. The soil samples in cells A-2, A-3, and A5 have average arsenic concentrations (expressed as the 95 percent upper confidence limit on the mean [UCL_{95}] of 5.4, 5.0, and 6.3 mg/kg) that are lower than the background average (UCL_{95} of 6.5 mg/kg). None of the soil samples in cell A1 have arsenic concentrations exceeding the background 95th percentile (7.6 mg/kg). Based on these determinations, only the soil impacted by organic compounds in cells A1, A2, and A-3 would be placed under the LLDPE geomembrane. One location in cell A-5 with the highest concentration of arsenic in this cell (SBP12-10.0 at 10.6 mg/kg) would also be placed under the LLDPE geomembrane to further reduce the average concentration of arsenic in cover soil.

The soil in cell A4 with arsenic exceeding background levels would be addressed using three approaches; each approach is described as follows. First, 28 of the 39 locations exceeding background, including the location with the maximum arsenic concentration (18 mg/kg), are situated in places that would be beneath the LLDPE geomembrane and would not need to be moved to be excluded from cover soil that would be placed above the LLDPE geomembrane (see Table 23). Second, one (1) of the locations with arsenic above background (SBI03-4.0) would be re-located beneath the LLDPE geomembrane. Thirdly, the remaining soil would have an average arsenic concentration comparable to that observed in background soil (i.e., UCL_{95} concentrations of 6.5 mg/kg). Consequently, future exposure to arsenic in soil remaining in cell A-4 would not likely differ from background.

Altogether, these considerations indicate that the majority of cover soil currently overlying the Site is acceptable for uses that are consistent with the planned Site development and re-location of selected areas of soil to beneath the LLDPE geomembrane would further ensure that these uses could be supported.

6.0 CONFIRMATION OF REMEDIATION CONDITIONS

The worker protective SMGs were developed to describe anticipated conditions at the Site once construction is complete. In addition, this evaluation determined that implementation of the RAP would eliminate the predominant exposure pathway (inhalation of vapors) leading to unacceptable health risks estimated for unrestricted use of the Site. By capping the landfill and removing and treating landfill gas, risks would be reduced to acceptable levels for future use of the Site for a mixture of commercial, entertainment, hospitality, and elevated residential uses.

The evaluation also determined that the majority of COPCs in cover soil across most of the Site is below acceptable limits. Based on existing data, all COPC concentrations are substantially below health protective SMGs with the exception of six constituents—arsenic, benzo(a)pyrene, methylene chloride, naphthalene, PCBs (Aroclor 1016, 1248, 1254, 1260, and 1262), and 1,2,4-trimethylbenzene. Impacted soil exceeding SMG concentrations also appears to be limited. Soil impacted by organic constituents and arsenic already occurs at locations that would be below the LLDPE geomembrane or would be placed below the LLDPE geomembrane during construction of the landfill cap and the implementation of DDC. Other soil with detected levels of arsenic is likely to be within background.

This approach to evaluating Site conditions shall also be used during future design, investigations, construction, and monitoring plans and would be updated as the Site progresses. As such and to fill existing data gaps, additional investigations are planned during Site implementation as described below.

- Pre-design – A *Construction Dust and Landfill Gas Mitigation and Monitoring Plan* would be developed, reviewed, and approved by the DTSC before construction activities begin. At a minimum, the plan would describe engineering controls and monitoring activities that would be completed during construction to mitigate both on- and off-site airborne risks associated with construction to acceptable levels. At a minimum, perimeter air monitoring would be completed for dust, particulates, and constituents determined to be COPCs.
- During and/or after Rough Grading – Soil conditions would be observed during all grading activities and soil sampling and analyses would be completed as described in a SMP to ensure acceptable placement. As necessary, soil management and grading plans would be developed and implemented to ensure that soil placed on top of the LLDPE geomembrane meets SMGs and is protective of future commercial/industrial workers, residents, visitors, and the surrounding community. To the extent possible, unimpacted soil would be placed in landscaped areas to eliminate any future exposure, particularly future on-site residents, to COPCs in soil. Also, confirmation soil sampling would be conducted in the residential area to ensure that soil meets residential health protective criteria (i.e., a cumulative cancer risk of 1×10^{-6} and a non-cancer HI of 1).
- During Construction – Confirmation sampling would be completed to fill remaining data gaps, if any, after grading and during the completion of the construction of remediation systems. Soil samples would be collected from locations above the LLDPE geomembrane and analyzed for COPCs. The analytical results would be used to confirm that SMGs were achieved, and if necessary, complete corrective action.

Site development is anticipated to occur on a cell-by-cell basis in order to cost effectively integrate remediation systems with vertical construction elements. Consequently, as the remediation systems (landfill cap and landfill gas extraction and treatment system) for each cell are installed, Tetra Tech would document that human-health risks are acceptable and systems are in place and functional. This documentation would include that the systems are operating properly and successfully and that human-health risks are confirmed to be within acceptable risk-tolerance ranges by completing a Human-Health Risk Evaluation (HRE) for each cell. Proper construction would be documented and reported in a Remedial Action Completion Report (RACR) submitted as a part of each cell-specific HRE. Additionally, confirmation soil or air monitoring results would be documented in a cell-specific HRE. Thus, the cell-specific HREs would be produced and delivered to DTSC for conditional approval on an on-going basis to document that (1) soil quality is acceptable at all locations within the subject cell or within designated areas within a cell, (2) potentially complete exposure pathways have been blocked, (3) the landfill gas treatment system is adequately collecting and treating landfill gas before discharge, and (4) exposure to groundwater constituents is not occurring.

Once each HRE and associated RACR is conditionally approved by DTSC, vertical construction would begin in each cell, and Tetra Tech and DTSC would work with Los Angeles County (County) to approve sub-surface BPSs.

Operations, monitoring, and confirmation data from each cell would then be compiled into a *Site-Wide Post-Remediation Human-Health Risk Assessment* (HRA). The HRA would describe and document post-construction conditions including soil quality, remediation systems, BPS, and initial operating and monitoring data. Risk estimates would be revised, as necessary, to confirm that anticipated conditions described in the cell-by-cell HREs were achieved. The risk assessment would be reviewed and approved by the DTSC.

Once the BPS vertical components (vent risers, automatic monitoring sensors, alarm systems, etc.) are in place within each building, proper operation would be verified and documented. This documentation would also be delivered to the City, DTSC, and County for final approval. Further, operations, maintenance, and monitoring of all systems throughout the life time of the Site would continue. Routine reports would be reviewed by the DTSC. In addition to routine monitoring, five-year reviews would be completed to ensure that all systems continue to be protective of human health and the environment throughout the life time of the Site.

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TABLES

Table 1
Summary of Cancer Risk Estimates -- Baseline Risk Assessment[1]
Reasonable Maximum Exposure Scenarios
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

	Cancer Risk Estimates[2] for Various Exposure Pathways					
Location and Receptor	**Vapor Inhalation**	**Groundwater Ingestion**	**Soil Ingestion**	**Dust Particulates Inhalation**	**Soil Dermal Contact**	**Total**
On-Site						
Resident	1E-03	2E-02	4E-05	2E-05	7E-07	3E-02
Commercial/Industrial Worker	6E-05	-	9E-07	6E-06	1E-08	7E-05
Trespasser						
Juvenile	7E-05	-	1E-07	1E-07	2E-09	7E-05
Adult	6E-05	-	2E-07	2E-07	4E-09	6E-05
2-Year Construction Worker	9E-05	-	2E-07	3E-06	4E-09	9E-05
Off-Site						
Neighboring Resident	1E-04	-	-	2E-05		2E-04
2-Year Construction Neighbor	3E-04	-	-	7E-06		4E-04

Notes:

1 - *Baseline Risk Assessment* (Brown & Root 1995b)

2 - Risk estimates are presented as probabilities using scientific notation; for example, 1E-6 is one chance in a million.

Table 2
Summary of Non-cancer Hazard Index Estimates -- Baseline Risk Assessment[1]
Reasonable Maximum Exposure Scenarios
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

	Hazard Index Estimates[2] for Various Exposure Pathways					
Location and Receptor	**Vapor Inhalation**	**Groundwater Ingestion**	**Soil Ingestion**	**Dust Particulates Inhalation**	**Soil Dermal Contact**	**Total**
On-Site						
Resident						
Child	25	183	0.9	0.5	0.9	210
Adult	5	39	0.1	0.1	0.6	45
Commercial/Industrial Worker	0.2	-	0.007	0.06	0.03	0.3
Trespasser						
Juvenile	0.03	-	0.003	0.007	0.03	0.07
Adult	0.007	-	0.001	0.002	0.01	0.02
2-Year Construction Worker	1	-	0.0000002	0.5	0.09	2
Off-Site						
Neighboring Resident						
Child	0.7	-	-	0.5	-	1
Adult	0.3	-	-	0.1	-	0.4
2-Year Construction Neighbor						
Child	7	-	-	0.9	-	8
Adult	2	-	-	0.2	-	2

Notes:
1 - *Baseline Risk Assessment* (Brown & Root 1995b)
2 - Hazard Index estimates are unitless.

Table 3
Metals Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Metals [EPA Method 6010B]	**Investigation Date** 2005	2006	2007
Antimony	-	-	X
Arsenic	X	X	X
Barium	X	X	X
Beryllium	-	-	X
Cadmium	-	-	X
Chromium, Total	X	X	X
Cobalt	X	X	X
Copper	X	X	X
Lead	X	X	X
Magnesium[1]	X	-	-
Manganese	X	-	-
Mercury	-	X	X
Molybdenum	-	X	X
Nickel	X	X	X
Potassium[1]	X	-	-
Selenium	-	-	X
Silver	-	-	X
Sodium[1]	X	-	-
Thallium	-	-	X
Vanadium	X	X	X
Zinc	X	X	X

Notes:
1- essential nutrient

Table 4
Pesticides Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Organochlorine Pesticides	Investigation Date		
[EPA Method 8081A]	2005	2006	2007
4,4'-DDD	X	X	-
4,4'-DDE	X	X	-
4,4'-DDT	X	X	-
alpha-Chlordane	X	X	-
Chlordane	X	-	-
Sum of Chlordane Isomers by EIA	-	X	-
Dieldrin	X	X	-
Endosulfan II	X	-	-
Endosulfan sulfate	X	-	-
Endrin	X	-	-
Endrin aldehyde	X	-	-
gamma-Chlordane	X	X	-
Heptachlor	X	X	-
Heptachlor epoxide	X	-	-

Table 5
Volatile Organic Compounds Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Volatile Organic Chemicals (VOCs) [EPA Method 8260B]	Investigation Date		
	2005	2006	2007
1,1,2,2-Tetrachloroethane	-	-	X
1,2,4-Trichlorobenzene	-	-	X
1,2,4-Trimethylbenzene	-	X	X
1,2-Dichlorobenzene	-	-	X
1,2-Dichloropropane	-	-	X
1,3,5-Trimethylbenzene	-	-	X
1,3-Dichlorobenzene	-	-	X
1,4-Dichlorobenzene	-	X	X
2-Butanone (methyl ethyl ketone)	-	-	X
2-Chlorotoluene	-	-	X
4-Chlorotoluene	-	-	X
4-Methyl-2-Pentanone	-	-	X
Acetone	-	X	X
Benzene	-	-	X
Carbon disulfide	-	X	X
Chlorobenzene	-	-	X
Chloroethane (Ethyl chloride)	-	-	X
cis-1,2-Dichloroethene	-	X	X
Dichlorodifluoromethane	-	-	X
Ethylbenzene	-	X	X
Isopropylbenzene	-	X	X
Methylene chloride	-	-	X
Methyl-t-Butyl Ether (MTBE)	-	-	X
Naphthalene	-	-	X
n-Butylbenzene	-	-	X
n-Propylbenzene	-	X	X
p-Isopropyltoluene	-	-	X
sec-Butylbenzene	-	X	X
Styrene	-	-	X
tert-Butylbenzene	-	-	X
Tetrachloroethene	-	-	X
Toluene	-	X	X
trans-1,2-Dichloroethene	-	-	X
Trichloroethene	-	-	X
Trichlorofluoromethane	-	-	X
Vinyl chloride	-	-	X
m,p-Xylene	-	-	X
m,p-Xylene (Sum of Isomers)	-	X	-
o-Xylene	-	X	X

Table 6
Semi-Volatile Organic Compounds Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Semi-Volatile Organic Compounds (SVOCs) [EPA Method 8270C]	Investigation Date		
	2005	2006	2007
1,4-Dichlorobenzene	-	-	X
3/4-Methylphenol	-	-	X
4-Nitrophenol	-	-	X
Benzo (a) Pyrene	-	X	-
Benzo (g,h,i) Perylene	-	X	-
Benzo (k) Fluoranthene	-	X	-
Benzo(a)anthracene	-	X	-
Benzo(b)fluoranthene	-	X	-
bis(2-Ethylhexyl)phthalate	-	-	X
Butyl benzyl phthalate	X	-	-
Chrysene	-	X	-
Fluoranthene	-	X	X
Indeno(1,2,3-c,d)pyrene	-	X	-
Naphthalene	-	-	X
N-Nitrosodiphenylamine	-	-	X
Phenanthrene	-	X	X
Phenol	-	-	X
Pyrene	-	X	X
Pyridine	-	-	X

Table 7
Polycyclic Aromatic Hydrocarbons (PAHs)
Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Polycyclic Aromatic Hydrocarbons	Investigation Date		
[EPA Method 8310]	**2005**	**2006**	**2007**
Acenaphthene	-	X	X
Acenaphthylene	-	-	X
Anthracene	-	X	X
Benzo (a) Pyrene	-	X	X
Benzo (b and k) Fluoranthenes	-	-	X
Benzo (g,h,i) Perylene	-	X	X
Benzo (k) Fluoranthene	-	X	X
Benzo(a)anthracene	-	X	X
Benzo(b)fluoranthene	-	X	-
Chrysene	-	X	X
Dibenz (a,h) Anthracene	-	-	X
Fluoranthene	-	X	X
Fluorene	-	-	X
Indeno(1,2,3-c,d)pyrene	-	X	X
Naphthalene	-	X	X
Phenanthrene	-	X	X
Pyrene	-	X	X

Table 8
PCBs Detected in Cover Soil Samples
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Polychlorinated biphenyls (PCBs) [EPA Method 8082]	Investigation Date		
	2005	2006	2007
Aroclor-1016	-	-	X
Aroclor-1248	-	-	X
Aroclor-1254	-	X	X
Aroclor-1260	X	X	X
Aroclor-1262	X	-	-

Table 9
Comparison of Metal Concentrations in Cover Soil with Local and California Background Soil
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

				Local Background			California Background			
		Cover Soil Data		Del Amo Gardens			Bradford et al. (1996)[1]		Lawrence Berkeley Lab[2]	
Metal	**Units**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**95th percentile**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
Antimony	mg/kg	0.29	1.67	ND	ND	ND	0.15	1.95	0.7	15
Arsenic	mg/kg	0.187	18	2.93	7.84	7.6	0.6	11	0.25	63
Barium	mg/kg	45.7	1,580	93	2,190	947	133	1,400	0.5	1,300
Beryllium	mg/kg	0.0199	1.13	0.302	0.645	0.62	0.25	2.7	0.05	2.7
Cadmium	mg/kg	0.106	3.23	0.639	2.9	2.4	0.05	1.7	0.05	7.5
Chromium	mg/kg	6..69	178	11.9	34	30.8	23	1,579	4.1	478
Cobalt	mg/kg	3.11	35	6.19	13.3	13.25	2.7	46.9	1.7	39
Copper	mg/kg	5.61	369	14.3	58.4	44.7	9.1	96.4	0.3	250
Lead	mg/kg	2.92	281	3.9	29.7	26.2	12.4	97.1	0.5	31
Manganese	mg/kg	207	446	NL	NL	NL	253	1,687	NL	NL
Mercury	mg/kg	0.00896	0.355	0.0926	0.205	0.15	0.05	0.9	0.05	2.2
Molybdenum	mg/kg	0.0254	26.1	0.266	0.641	0.62	0.1	9.6	NL	NL
Nickel	mg/kg	4.12	191	10.4	32.2	31.5	9	509	6	309
Selenium	mg/kg	0.233	15.6	ND	ND	ND	0.015	0.43	0.5	28
Silver	mg/kg	0.526	0.776	0.274	0.605	0.43	0.1	8.3	0.2	130
Thallium	mg/kg	0.123	1.09	ND	1.39	1.07	0.17	1.1	NL	NL
Vanadium	mg/kg	12	117	24.7	56.1	50.6	39	288	0.5	6.5
Zinc	mg/kg	19.2	505	46.2	117	96.7	88	236	3.8	174

Definitions:

mg/kg - milligrams per kilogram
ND - Not detected
NL - Not analyzed

Notes:

1 - Background concentrations in soil are from *Background Concentrations of Trace and Major Elements in California Soils* (Bradford et al. 1996).
2 - Background concentrations in soil are from *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Lab* (LBNL 1995).

Table 10
Exposure Parameters for Soil Management Goals
Future On-site Workers
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Nonvolatile Carcinogens

$$C_s = \frac{TR \times BW \times AT}{EF \times ED \times \left[\left(\frac{IR \times SF_o}{10^6\ mg/kg} \right) + \left(\frac{SA \times AF \times ABS \times SF_o}{10^6\ mg/kg} \right) + \left(\frac{INR \times ET \times SF_i}{PEF} \right) \right]}$$

Nonvolatile Noncarcinogens

$$C_s = \frac{THQ \times BW \times AT}{EF \times ED \times \left[\left(\frac{IR}{RfD_o \times 10^6\ mg/kg} \right) + \left(\frac{SA \times AF \times ABS}{RfD_o \times 10^6\ mg/kg} \right) + \left(\frac{INR \times ET}{PEF \times RfD_i} \right) \right]}$$

Volatile Carcinogens

$$C_s = \frac{TR \times BW \times AT}{EF \times ED \times \left[\left(\frac{IR \times SF_o}{10^6\ mg/kg} \right) + \left(\frac{SA \times AF \times ABS \times SF_o}{10^6\ mg/kg} \right) + \left(\frac{INR \times ET \times SF_i}{VF} \right) \right]}$$

Volatile Noncarcinogens

$$C_s = \frac{THQ \times BW \times AT}{EF \times ED \times \left[\left(\frac{IR}{RfD_o \times 10^6\ mg/kg} \right) + \left(\frac{SA \times AF \times ABS}{RfD_o \times 10^6\ mg/kg} \right) + \left(\frac{INR \times ET}{VF \times RfD_i} \right) \right]}$$

Variable	Parameter	Value	Source/Rationale
C_s	Risk based remedial goal for soil	mg/kg	Units for soil
TR	Target Risk	10^{-5} (-)	Target risk used for non-volatile constituents; a target risk of 1 x 10^{-6} was used for volatile constituents (DTSC 1999; USEPA 1989, 1991a).
THQ	Target HQ	1 (-)	Target hazard used for non-volatile constituents; a target hazard of 0.1 was used for volatile constituents (DTSC 1999; USEPA 1989, 1991a).
AT	Averaging Time		
	Carcinogen	70 years x 365 days/year	Lifetime (U.S. EPA 1989)
	Non-carcinogen	ED x 365 days/year	U.S. EPA 1989
EF	Exposure Frequency		
	On-site Worker	250 days/year	Working 5-days per week (DTSC 1992, 2005; USEPA 1989, 1991a)
BW	Body Weight		
	On-site Worker	70 kg	Adult (DTSC 1992, 1999, 2005; USEPA 1989, 1991a)
ED	Exposure Duration		
	On-site Worker	25 years	Upper-bound occupational tenure (DTSC 1992, 2000a, 2005; USEPA 1991a, 2004)
IR	Soil Ingestion Rate		
	On-site Worker	100 mg/day	Adult soil ingestion rate (DTSC 2005; USEPA 2002b)
SF_o	Oral/dermal carcinogenic slope factor	chemical-specific	see Table 16
SF_i	Inhalation carcinogenic slope factor	chemical-specific	see Table 17
RfD_o	Oral/dermal reference dose	chemical-specific	see Table 18

Table 10
Exposure Parameters for Soil Management Goals
Future On-site Workers
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Variable	Parameter	Value	Source/Rationale
RfD_i	Inhalation reference dose	chemical-specific	see Table 19
SA	Skin surface area		
	On-site Worker	5,700 cm^2/day	Exposed head, hands, forearms, and lower legs (DTSC 2005; USEPA 1997)
AF	Soil Adherence Factor		
	On-site Worker	0.2 mg/cm^2	50th percentile for utility workers (USEPA 2004b)
ABS	Absorption Fraction	chemical-specific	see Table 11
INR	Inhalation rate		
	On-site Worker	2.5 m^3/hour	Mean for heavy activity by outdoor workers (USEPA 1997)
PEF	Particulate Emissions Factor		
	On-site Worker	4.23E+10 m^3/kg	see Table 12
ET	Exposure time		
	On-site Worker	8 hours/day	Workday (USEPA 1991a)
VF	Volatilization factor	chemical-specific	see Tables 14 and 15

Definitions:
mg/kg - milligrams per kilogram
kg - kilograms
mg/day - milligrams per day
cm^2/day - square centimeters per day
mg/cm^2 - milligrams per square centimeters
m^3/hour - cubic meters per hour
m^3/kg - cubic meters per kilogram
hours/day - hours per day

Table 11
Dermal Absorption Values (ABS)
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Absorption Factor
1,1,2,2-Tetrachloroethane	0.1
1,2,4-Trichlorobenzene	0.1
1,2,4-Trimethylbenzene	0.1
1,2-Dichlorobenzene	0.1
1,2-Dichloropropane	0.1
1,3,5-Trimethylbenzene	0.1
1,3-Dichlorobenzene	0.1
1,4-Dichlorobenzene	0.1
2-Butanone (methyl ethyl ketone)	0.1
2-Chlorotoluene	0.1
3/4-Methylphenol	0.1
4'4-DDD	0.05
4'4-DDE	0.05
4'4-DDT	0.05
4-Chlorotoluene	0.1
4-Methyl-2-Pentanone	0.1
4-Nitrophenol	-
Acenaphthene	0.15
Acenaphthylene	0.15
Acetone	0.1
alpha-Chlordane	0.05
Anthracene	0.15
Antimony	0.01
Aroclor-1016	0.15
Aroclor-1248	0.15
Aroclor-154	0.15
Aroclor-1260	0.15
Aroclor-1262	0.15
Arsenic	0.03
Barium	0.01
Benzene	0.1
Benzo (a) Pyrene	0.15
Benzo (g,h,i) Perylene	-
Benzo (k) Fluoranthene	0.15
Benzo(a)anthracene	0.15
Benzo(b)fluoranthene	0.15
Beryllium	0.01
bis(2-Ethylhexyl)phthalate	0.1
Butyl benzyl phthalate	0.1
Cadmium	0.001
Carbon disulfide	0.1
Chlordane	0.05
Chlorobenzene	0.1
Chloroethane (Ethyl chloride)	0.1
Chromium, Total	0.01
Chrysene	0.15
cis-1,2-Dichloroethene	0.1
Cobalt	0.01
Copper	0.01
Dibenz (a,h) Anthracene	0.15
Dichlorodifluoromethane	0.1

Table 11
Dermal Absorption Values (ABS)
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Absorption Factor
Dieldrin	0.05
Endosulfan II	0.05
Endosulfan sulfate	0.05
Endrin	0.05
Endrin aldehyde	0.05
Ethylbenzene	0.1
Fluoranthene	0.15
Fluorene	0.15
gamma-Chlordane	0.05
Heptachlor	0.05
Heptachlor epoxide	0.05
Indeno(1,2,3-cd)pyrene	0.15
Isopropylbenzene	0.1
Lead	0.01
Manganese	0.01
Mercury	0.01
Methylene chloride	0.1
Methyl-t-Butyl Ether (MTBE)	0.1
Molybdenum	0.1
Naphthalene	0.15
n-Butylbenzene	0.1
Nickel	0.01
N-Nitrosodiphenylamine	0.1
n-Propylbenzene	0.1
Phenanthrene	0.15
Phenol	0.1
p-Isopropyltoluene	0.1
Pyrene	0.15
Pyridine	0.1
sec-Butylbenzene	0.1
Selenium	0.01
Silver	0.01
Styrene	0.1
tert-Butylbenzene	0.1
Tetrachloroethene	0.1
Thallium	0.01
Toluene	0.1
trans-1,2-Dichloroethene	0.1
Trichloroethene	0.1
Trichlorofluoromethane	0.1
Vanadium	0.01
Vinyl chloride	0.1
Xylenes	0.1
Zinc	0.01

Source: DTSC 1999

Table 12
Particulate Emissions Factor Calculation for the Onsite Future Worker Scenario
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

$PEF = Q/C \times 3600\ s/h / (0.036 \times (1-V) \times (U_m/U_t)^3 * F(x))$ **Equation 4-5 (USEPA, 2002)**

$Q/C_{wind} = A \times \exp[(\ln A_s \times B)^2 / C]$ **Exhibit D-2 (USEPA, 2002)**

Parameter	Description	Value	Source
A_s	areal extent of site suface soil contamination for Q/C calculation (acres)	12	Site-specific soil contamination area
A	constant for Q/C_{wind} calculation (-)	11.911	Exhibit D-2 (USEPA, 2002)
B	constant for Q/C_{wind} calculation (-)	18.4385	Exhibit D-2 (USEPA, 2002)
C	constant for Q/C_{wind} calculation (-)	209.7845	Exhibit D-2 (USEPA, 2002)
Q/C_{wind}	inverse of ratio of the geometric mean air concentration to the emission flux at the center of a square site (g/m^2-s per kg/m^3)	40.1	Exhibit D-2 (USEPA, 2002)
V	fraction vegetative cover (-)	0.2	Site-specific
U_m	mean annual windspeed (m/s)	3.31	Appendix D (USEPA 1996) for Los Angeles, CA location
U_t	equivalent threshold value of windspeed at 7m (m/s)	11.32	Appendix D (USEPA 1996) for Los Angeles, CA location
F(x)	function dependent on Um/Ut derived from Cowherd et al., 1985	4.74E-03	Appendix D (USEPA 1996) for Los Angeles, CA location
PEF	particulate emission factor (m^3/kg)	4.23E+10	Equation 4-5 (USEPA, 2002)

Definitions:

g/m^2-s per kg/m^3 - Grams per square meters-second per kg per cubic meter.
m/s - Meters per second.
m^3/kg - Cubic meters per kilogram.

Table 13
Physical-Chemical Properties of Volatile Organic COPCs
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	**Henry's law constant H (-)**	**Diffusivity in air, Da (cm^2/s)**	**Diffusivity in water, Dw (cm^2/s)**	**Organic carbon partition coefficient, Koc (cm^3/g)**
1,1,2,2-Tetrachloroethane	1.4E-02	7.1E-02	7.9E-06	9.3E+01
1,2,4-Trichlorobenzene	5.8E-02	3.0E-02	8.2E-06	1.8E+03
1,2,4-Trimethylbenzene	2.5E-01	6.1E-02	7.9E-06	1.4E+03
1,2-Dichlorobenzene	7.8E-02	6.9E-02	7.9E-06	6.2E+02
1,2-Dichloropropane	1.1E-01	7.8E-02	8.7E-06	4.4E+01
1,3,5-Trimethylbenzene	2.4E-01	6.0E-02	8.7E-06	1.4E+03
1,3-Dichlorobenzene	1.3E-01	6.9E-02	7.9E-06	2.0E+03
1,4-Dichlorobenzene	9.8E-02	6.9E-02	7.9E-06	6.2E+02
2-Butanone	2.3E-03	8.1E-02	9.8E-06	2.3E+00
2-Chlorotoluene	1.4E-01	7.2E-02	8.7E-06	1.6E+02
4-Chlorotoluene	1.4E-01	7.2E-02	8.7E-06	1.6E+02
4-Methyl-2-Pentanone	5.6E-03	7.5E-02	7.8E-06	9.1E+00
Acenaphthene	6.3E-03	4.2E-02	7.7E-06	7.1E+03
Acenaphthylene	4.7E-03	4.4E-02	6.6E-06	5.6E+03
Acetone	1.6E-03	1.2E-01	1.1E-05	5.8E-01
Anthracene	2.7E-03	3.2E-02	5.9E-06	1.9E+04
Benzene	2.3E-01	8.8E-02	9.8E-06	5.9E+01
Carbon disulfide	1.2E+00	1.0E-01	1.0E-05	4.6E+01
Chlorobenzene	1.5E-01	7.3E-02	8.7E-06	2.2E+02
Chloroethane (Ethyl chloride)	3.6E-01	2.7E-01	1.2E-05	4.4E+00
cis-1,2-Dichloroethene	1.7E-01	7.4E-02	1.1E-05	3.6E+01
Dichlorodifluoromethane	1.4E+01	6.7E-02	9.9E-06	4.6E+02
Ethylbenzene	3.2E-01	7.5E-02	7.8E-06	3.6E+02
Fluorene	2.6E-03	3.6E-02	7.9E-06	1.4E+04
Isopropylbenzene	4.7E+01	6.5E-02	7.1E-06	4.9E+02
Methyl-t-Butyl Ether (MTBE)	2.6E-02	1.0E-01	1.1E-05	7.3E+00
Methylene chloride	9.0E-02	1.0E-01	1.2E-05	1.2E+01
Naphthalene	2.0E-02	5.9E-02	7.5E-06	2.0E+03
n-Butylbenzene	5.4E-01	5.7E-02	8.1E-06	1.1E+03
n-Propylbenzene	4.4E-01	6.0E-02	7.8E-06	5.6E+02
Phenanthrene	1.6E-03	5.5E-02	5.9E-06	5.2E+03
p-Isopropyltoluene	3.8E-01	6.0E-02	7.1E-06	5.0E+03
sec-Butylbenzene	5.7E-01	5.7E-02	8.1E-06	9.7E+02
Styrene	1.1E-01	7.1E-02	8.0E-06	7.8E+02
tert-Butylbenzene	4.9E-01	5.7E-02	8.0E-06	7.7E+02
Tetrachloroethene	7.5E-01	7.2E-02	8.2E-06	1.6E+02
Toluene	2.7E-01	8.7E-02	8.6E-06	1.8E+02
trans-1,2-Dichloroethene	3.8E-01	7.1E-02	1.2E-05	5.3E+01
Trichloroethene	4.2E-01	7.9E-02	9.1E-06	1.7E+02
Trichlorofluoromethane	4.0E+00	8.7E-02	9.7E-06	5.0E+02
Vinyl chloride	1.1E+00	1.1E-01	1.2E-05	1.9E+01
Xylenes	3.0E-01	7.0E-02	7.8E-06	4.1E+02

Reference:

Johnson and Ettinger model user's manual (USEPA 2003).

Available online at: http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

Table 14
Volatilization Factor Calculation
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

$VF = Q/C \times (3.14 \times D_a \times T)^{0.5} \times 10^4 \;/\; (2 \times \rho_b \times D_a)$ — **Equation 4-8 (USEPA 2002)**

$D_a = [\, \theta_a^{(10/3)} \times D_i \times H \times \theta_w^{(10/3)} \times D_w) / n^2 \;] / (\rho_b \times K_d \times \theta_w \times \theta_a \times H')$

$Q/C_{vol} = A \times \exp[\, (\ln A_s \times B)^2 / C \,]$ — **Exhibit D-3 (USEPA 2002)**

Parameter	Description	Value	Source
D_a	apparent diffusivity (cm^2/s)	chemical-specific	
A_s	areal extent of site suface soil contamination for Q/C calculation (acres)	12	Site-specific soil contamination area
A	constant for Q/C_{vol} calculation (-)	11.911	Exhibit D-3 (USEPA 2002)
B	constant for Q/C_{vol} calculation (-)	18.4385	Exhibit D-3 (USEPA 2002)
C	constant for Q/C_{vol} calculation (-)	209.7845	Exhibit D-3 (USEPA 2002)
Q/C_{vol}	inverse of ratio of the geometric mean air concentration to the volatilization flux at the center of a square site (g/m^2-s per kg/m^3)	40.1	Exhibit D-3 (USEPA 2002)
$Q/C_{offsite}$	inverse of ratio of the geometric mean air concentration to the volatilization flux at the boundary of a square site (g/m^2-s per kg/m^3)	63.5	Exhibit D-4 (USEPA 2002)
T	exposure interval (s)	9.5E+08	Equation 4-8 (USEPA 2002)
ρ_b	dry soil bulk density (g/cm^3)	1.62	JE Model default for sandy loam
θ_a	air-filled soil porosity	0.284	JE Model default for sandy loam
n	total soil porosity	0.387	JE Model default for sandy loam
θ_w	water-filled soil porosity	0.103	JE Model default for sandy loam[1]
D_i	diffusivity in air (cm^2/s)	chemical-specific (see Table 13)	
H'	dimensionless Henry's law constant	chemical-specific (see Table 13)	
D_w	diffusitivity in water (cm^2/s)	chemical-specific (see Table 13)	
K_d	soil -water partition coefficient (cm^3/g)	$K_{oc} \times f_{oc}$	
K_{oc}	soil organic carbon partition coefficient (cm^3/g)	chemical-specific (see Table 13)	
f_{oc}	fraction organic carbon in soil (g/g)	0.006	Default value (USEPA 2002)
VF	volatilization factor (m^3/kg)	chemical-specific (see Table 15)	

Definitions:

cm^2/s - Square centimeters per second.
cm^3/g - Cubic centimeters per gram.
g/g - Gram per gram.
g/cm^3 - Grams per cubic centimeter.
g/m^2-s per kg/m^3 - Grams per square meters-second per kg per cubic meter.
m^3/kg - Cubic meters per kilogram.
s - Seconds.

Note:

1 - Moisture content consistent with measurements of cover soil (ABBL 2007a); i.e., average of 4 predominant soil types (clay, sandy silt, silt, silty sand) = 0.105

Table 15
Predicted Volatilization Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	On-site Volatilization Factor (m^3/kg)
1,1,2,2-Tetrachloroethane	6.8E+03
1,2,4-Trichlorobenzene	2.1E+04
1,2,4-Trimethylbenzene	6.3E+03
1,2-Dichlorobenzene	7.2E+03
1,2-Dichloropropane	1.7E+03
1,3,5-Trimethylbenzene	6.4E+03
1,3-Dichlorobenzene	1.0E+04
1,4-Dichlorobenzene	6.4E+03
2-Butanone	5.5E+03
2-Chlorotoluene	2.7E+03
4-Chlorotoluene	2.7E+03
4-Methyl-2-Pentanone	4.5E+03
Acenaphthene	1.1E+05
Acenaphthylene	1.1E+05
Acetone	5.0E+03
Anthracene	3.1E+05
Benzene	1.3E+03
Carbon disulfide	5.6E+02
Chlorobenzene	3.1E+03
Chloroethane (Ethyl chlorid	3.4E+02
cis-1,2-Dichloroethene	1.4E+03
Dichlorodifluoromethane	6.4E+02
Ethylbenzene	2.6E+03
Fluorene	2.5E+05
Isopropylbenzene	6.4E+03
Methyl-t-Butyl Ether (MTB	1.8E+03
Methylene chloride	1.1E+03
Naphthalene	2.8E+04
n-Butylbenzene	4.0E+03
n-Propylbenzene	3.1E+03
Phenanthrene	1.6E+05
p-Isopropyltoluene	9.8E+03
sec-Butylbenzene	3.7E+03
Styrene	6.6E+03
tert-Butylbenzene	3.6E+03
Tetrachloroethene	1.2E+03
Toluene	1.9E+03
trans-1,2-Dichloroethene	1.1E+03
Trichloroethene	1.6E+03
Trichlorofluoromethane	8.9E+02
Vinyl chloride	4.8E+02
Xylenes	3.0E+03

Definitions:

m^3/kg - Cubic meters per kilogram.

Table 14
Volatilization Factor Calculation
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

$VF = Q/C \times (3.14 \times D_a \times T)^{0.5} \times 10^4 \; / \; (2 \times \rho_b \times D_a)$ **Equation 4-8 (USEPA 2002)**

$D_a = [\theta_a^{(10/3)} \times D_i \times H \times \theta_w^{(10/3)} \times D_w) / n^2 \;] / (\rho_b \times K_d \times \theta_w \times \theta_a \times H')$

$Q/C_{vol} = A \times \exp[(\ln A_s \times B)^2 / C]$ **Exhibit D-3 (USEPA 2002)**

Parameter	Description	Value	Source
D_a	apparent diffusivity (cm^2/s)	chemical-specific	
A_s	areal extent of site suface soil contamination for Q/C calculation (acres)	12	Site-specific soil contamination area
A	constant for Q/C_{vol} calculation (-)	11.911	Exhibit D-3 (USEPA 2002)
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C	constant for Q/C_{vol} calculation (-)	209.7845	Exhibit D-3 (USEPA 2002)
Q/C_{vol}	inverse of ratio of the geometric mean air concentration to the volatilization flux at the center of a square site (g/m^2-s per kg/m^3)	40.1	Exhibit D-3 (USEPA 2002)
$Q/C_{offsite}$	inverse of ratio of the geometric mean air concentration to the volatilization flux at the boundary of a square site (g/m^2-s per kg/m^3)	63.5	Exhibit D-4 (USEPA 2002)
T	exposure interval (s)	9.5E+08	Equation 4-8 (USEPA 2002)
ρ_b	dry soil bulk density (g/cm^3)	1.62	JE Model default for sandy loam
θ_a	air-filled soil porosity	0.284	JE Model default for sandy loam
n	total soil porosity	0.387	JE Model default for sandy loam
θ_w	water-filled soil porosity	0.103	JE Model default for sandy loam[1]
D_i	diffusivity in air (cm^2/s)	chemical-specific (see Table 13)	
H'	dimensionless Henry's law constant	chemical-specific (see Table 13)	
D_w	diffusitivity in water (cm^2/s)	chemical-specific (see Table 13)	
K_d	soil -water partition coefficient (cm^3/g)	$K_{oc} \times f_{oc}$	
K_{oc}	soil organic carbon partition coefficient (cm^3/g)	chemical-specific (see Table 13)	
f_{oc}	fraction organic carbon in soil (g/g)	0.006	Default value (USEPA 2002)
VF	volatilization factor (m^3/kg)	chemical-specific (see Table 15)	

Definitions:

cm^2/s - Square centimeters per second.
cm^3/g - Cubic centimeters per gram.
g/g - Gram per gram.
g/cm^3 - Grams per cubic centimeter.
g/m^2-s per kg/m^3 - Grams per square meters-second per kg per cubic meter.
m^3/kg - Cubic meters per kilogram.
s - Seconds.

Note:

1 - Moisture content consistent with measurements of cover soil (ABBL 2007a); i.e., average of 4 predominant soil types (clay, sandy silt, silt, silty sand) = 0.105

Table 15
Predicted Volatilization Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	On-site Volatilization Factor (m^3/kg)
1,1,2,2-Tetrachloroethane	6.8E+03
1,2,4-Trichlorobenzene	2.1E+04
1,2,4-Trimethylbenzene	6.3E+03
1,2-Dichlorobenzene	7.2E+03
1,2-Dichloropropane	1.7E+03
1,3,5-Trimethylbenzene	6.4E+03
1,3-Dichlorobenzene	1.0E+04
1,4-Dichlorobenzene	6.4E+03
2-Butanone	5.5E+03
2-Chlorotoluene	2.7E+03
4-Chlorotoluene	2.7E+03
4-Methyl-2-Pentanone	4.5E+03
Acenaphthene	1.1E+05
Acenaphthylene	1.1E+05
Acetone	5.0E+03
Anthracene	3.1E+05
Benzene	1.3E+03
Carbon disulfide	5.6E+02
Chlorobenzene	3.1E+03
Chloroethane (Ethyl chlorid	3.4E+02
cis-1,2-Dichloroethene	1.4E+03
Dichlorodifluoromethane	6.4E+02
Ethylbenzene	2.6E+03
Fluorene	2.5E+05
Isopropylbenzene	6.4E+03
Methyl-t-Butyl Ether (MTB	1.8E+03
Methylene chloride	1.1E+03
Naphthalene	2.8E+04
n-Butylbenzene	4.0E+03
n-Propylbenzene	3.1E+03
Phenanthrene	1.6E+05
p-Isopropyltoluene	9.8E+03
sec-Butylbenzene	3.7E+03
Styrene	6.6E+03
tert-Butylbenzene	3.6E+03
Tetrachloroethene	1.2E+03
Toluene	1.9E+03
trans-1,2-Dichloroethene	1.1E+03
Trichloroethene	1.6E+03
Trichlorofluoromethane	8.9E+02
Vinyl chloride	4.8E+02
Xylenes	3.0E+03

Definitions:

m^3/kg - Cubic meters per kilogram.

Table 16
Oral Carcinogenic Slope Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	Oral Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence	Tumor	Test Species	Slope Factor Source	Date
1,1,2,2-Tetrachloroethane	2.7E-01	C	Liver	Mouse	CalEPA	Nov-07
1,2,4-Trichlorobenzene	3.6E-03	D	Liver	Mouse	CalEPA	Nov-07
1,2,4-Trimethylbenzene	-	-	-	-	1	-
1,2-Dichlorobenzene	-	D	-	-	1	-
1,2-Dichloropropane	3.6E-02	B2	Liver	Mouse	CalEPA	Nov-07
1,3,5-Trimethylbenzene	-	-	-	-	1	-
1,3-Dichlorobenzene	-	D	-	-	1	-
1,4-Dichlorobenzene	5.4E-03	-	Kidney	Mouse	CalEPA	Nov-07
2-Butanone (methyl ethyl ketone)	-	-	-	-	1	-
2-Chlorotoluene	-	-	-	-	1	-
3/4-Methylphenol	-	-	-	-	1	-
4'4-DDD	2.4E-01	B2			CalEPA	Nov-07
4'4-DDE	3.4E-01	B2			CalEPA	Nov-07
4'4-DDT	3.4E-01	B2			CalEPA	Nov-07
4-Chlorotoluene	-	-	-	-	1	-
4-Methyl-2-Pentanone	-	-	-	-	1	-
4-Nitrophenol	-	-	-	-	1	-
Acenaphthene	-	-	-	-	1	-
Acenaphthylene	-	D	-	-	1	-
Acetone	-	-	-	-	1	-
Anthracene	-	D	-	-	1	-
Antimony	-	-	-	-	1	-
Arsenic	9.5E+00	A	Skin	Human	CalEPA	Nov-07
Barium	-	D	-	-	1	-
Benzene	1.0E-01	A	Leukemia	Human	CalEPA	Nov-07
Benzo (a) Pyrene	1.2E+01	B2	Stomach	Mouse	CalEPA	Nov-07
Benzo (g,h,i) Perylene	-	D	-	-	1	-
Benzo (k) Fluoranthene	1.2E+00	B2	-	-	CalEPA	Nov-07
Benzo(a)anthracene	1.2E+00	B2	-	-	CalEPA	Nov-07
Benzo(b)fluoranthene	1.2E+00	B2	-	-	CalEPA	Nov-07
Beryllium	-	-	-	-	1	-
bis(2-Ethylhexyl)phthalate	3.0E-03	B2	Liver	Rat, mouse	CalEPA	Nov-07
Butyl benzyl phthalate	-	-	-	-	1	-
Cadmium	-	-	-	-	1	-
Carbon disulfide	-	-	-	-	1	-
Chlordane[2]	1.3E+00	B2	Liver	Mouse	CalEPA	Nov-07
Chlorobenzene	-	-	-	-	1	-
Chloroethane (Ethyl chloride)	2.9E-03	-	-	-	PRG	Oct-04
Chromium, Total	-	B2	-	-	1	-
Chrysene	1.2E-01	B2	-	-	CalEPA	Nov-07
cis-1,2-Dichloroethene	-	D	-	-	1	-
Cobalt	-	-	-	-	1	-
Copper	-	D	-	-	1	-
Dibenz (a,h) Anthracene	4.1E+00	B2	Lung	Mouse	CalEPA	Nov-07
Dichlorodifluoromethane	-	-	-	-	1	-
Dieldrin	1.6E+01	B2	Liver	Mouse	CalEPA	Nov-07
Endosulfan II	-	-	-	-	1	-
Endosulfan sulfate	-	-	-	-	1	-
Endrin	-	-	-	-	1	-
Endrin aldehyde	-	-	-	-	1	-
Ethylbenzene 0.011	-	D	Kidney	Rat	CalEPA	Nov-07
Fluoranthene	-	D	-	-	1	-
Fluorene	-	D	-	-	1	-
Heptachlor	4.1E+00	B2	Liver	Mouse	CalEPA	Nov-07

Table 16
Oral Carcinogenic Slope Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	Oral Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence	Tumor	Test Species	Slope Factor Source	Date
Heptachlor epoxide	5.5E+00	B2	Liver	Mouse	CalEPA	Nov-07
Indeno(1,2,3-cd)pyrene	1.2E+00	B2	-	-	CalEPA	Nov-07
Isopropylbenzene	-	D	-	-	1	-
Lead[3]	-	B2	-	-	1	-
Manganese	-	-	-	-	-	-
Mercury	-	C	-	-	1	-
Methylene chloride	1.4E-02	B2	Lung	Mouse	CalEPA	Nov-07
Methyl-t-Butyl Ether (MTBE)	1.8E-03	-	.iver, Kidney, Teste	Rat, mouse	CalEPA	Nov-07
Molybdenum	-	-	-	-	1	-
Naphthalene	1.2E-01	-	Nasal	Rat	CalEPA	Nov-07
n-Butylbenzene	-	-	-	-	1	-
Nickel	-	-	-	-	1	-
N-Nitrosodiphenylamine	9.0E-03	B2	Liver	Rat, mouse	CalEPA	Nov-07
n-Propylbenzene	-	-	-	-	1	-
Phenanthrene	-	D	-	-	1	-
Phenol	-	-	-	-	1	-
p-Isopropyltoluene[4]	-	D	-	-	1	-
PCBs[5]	5.0E+00	B2	Liver	Rat	CalEPA	Nov-07
Pyrene	-	D	-	-	1	-
Pyridine	-	-	-	-	1	-
sec-Butylbenzene	-	-	-	-	1	-
Selenium	-	D	-	-	1	-
Silver	-	-	-	-	1	-
Styrene	-	-	-	-	1	-
tert-Butylbenzene	-	-	-	-	1	-
Tetrachloroethene	5.4E-01	-	Lung	Mouse	CalEPA	Nov-07
Thallium	-	D	-	-	1	-
Toluene	-	D	-	-	1	-
trans-1,2-Dichloroethene	-	-	-	-	1	-
Trichloroethene	1.3E-02	-	Liver, Lung	Mouse	CalEPA	Nov-07
Trichlorofluoromethane	-	-	-	-	1	-
Vanadium	-	-	-	-	1	-
Vinyl chloride	2.7E-01	A	Lung	Mouse	CalEPA	Nov-07
Xylenes	-	-	-	-	1	-
Zinc	-	D	-	-	1	-

Definitions:

Cal EPA - California Environmental Protection Agency.
IRIS - Integrated Risk Information System.
SF - Slope Factor
$(mg/kg/day)^{-1}$ - risk per milligram per kilogram per day

Notes:

All weight of evidence classifications were obtained from USEPA (2007) Integrated Risk Information System (IRIS).

1 - No SFs available from USEPA or CalEPA
2 - Measured as chlordane, alpha-chlordane, and gamma chlordane
3 - Lead evaluated using USEPA Adult Lead Model (ALM)
4 - Isopropylbenzene used as a surrogate.
5 - PCB mixtures Aroclor 1016, 1248, 1254, 1260, and 1262

Table 17
Inhalation Carcinogenic Slope Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence	Tumor	Test Species	Slope Factor Source	Date
1,1,2,2-Tetrachloroethane	2.0E-01	C	Liver	Mouse	1	-
1,2,4-Trichlorobenzene	3.6E-03	D	Liver	Mouse	CalEPA	Nov-07
1,2,4-Trimethylbenzene	-	-	-	-	2	-
1,2-Dichlorobenzene	-	D	-	-	2	-
1,2-Dichloropropane	3.6E-02	B2	Liver	Mouse	CalEPA	Nov-07
1,3,5-Trimethylbenzene	-	-	-	-	2	-
1,3-Dichlorobenzene	-	D	-	-	2	-
1,4-Dichlorobenzene	4.0E-02	-	Kidney	Mouse	CalEPA	Nov-07
2-Butanone (methyl ethyl ketone	-	-	-	-	2	-
2-Chlorotoluene	-	-	-	-	2	-
3/4-Methylphenol	-	-	-	-	2	-
4'4-DDD	2.4E-01	B2			CalEPA	Nov-07
4'4-DDE	3.4E-01	B2			CalEPA	Nov-07
4'4-DDT	3.4E-01	B2			CalEPA	Nov-07
4-Chlorotoluene	-	-	-	-	2	-
4-Methyl-2-Pentanone	-	-	-	-	2	-
4-Nitrophenol	-	-	-	-	2	-
Acenaphthene	-	-	-	-	2	-
Acenaphthylene	-	D	-	-	2	-
Acetone	-	-	-	-	2	-
Anthracene	-	D	-	-	2	-
Antimony	-	-	-	-	2	-
Arsenic	1.2E+01	A	Lung	Human	CalEPA	Nov-07
Barium	-	D	-	-	2	-
Benzene	1.0E-01	A	Leukemia	Human	CalEPA	Nov-07
Benzo (a) Pyrene	3.9E+00	B2	Respiratory	Hamster	2	-
Benzo (g,h,i) Perylene	-	D	-	-	2	-
Benzo (k) Fluoranthene	3.9E-01	B2	-	-	CalEPA	Nov-07
Benzo(a)anthracene	3.9E-01	B2	-	-	CalEPA	Nov-07
Benzo(b)fluoranthene	3.9E-01	B2	-	-	CalEPA	Nov-07
Beryllium	8.4E+00	B2	Lung	Human	CalEPA	Nov-07
bis(2-Ethylhexyl)phthalate	8.4E-03	B2	Liver	Rat, mouse	CalEPA	Nov-07
Butyl benzyl phthalate	-	-	-	-	2	-
Cadmium	1.5E+01	B1	Lung	Human	CalEPA	Nov-07
Carbon disulfide	-	-	-	-	2	-
Chlordane[3]	1.2E+00	B2	Liver	Mouse	CalEPA	Nov-07
Chlorobenzene	-	-	-	-	2	-
Chloroethane (Ethyl chloride)	2.9E-03	-	-	-	PRG	Oct-04
Chromium, Total[4]	-	D	-	-	2	-
Chrysene	3.9E-02	B2	-	-	CalEPA	Nov-07
cis-1,2-Dichloroethene	-	D	-	-	2	-
Cobalt	9.8E+00	-	Lung	Mouse	PPRTV	Jan-02
Copper	-	D	-	-	2	-
Dibenz (a,h) Anthracene	4.1E+00	B2	Lung	Mouse	CalEPA	Nov-07
Dichlorodifluoromethane	-	-	-	-	2	-
Dieldrin	1.6E+01	B2	Liver	Mouse	CalEPA	Nov-07
Endosulfan II	-	-	-	-	2	-
Endosulfan sulfate	-	-	-	-	2	-
Endrin	-	-	-	-	2	-
Endrin aldehyde	-	-	-	-	2	-
Ethylbenzene	8.7E-03	D	Kidney	Rat	CalEPA	Nov-07
Fluoranthene	-	D	-	-	2	-
Fluorene	-	D	-	-	2	-
Heptachlor	4.1E+00	B2	Liver	Mouse	CalEPA	Nov-07
Heptachlor epoxide	5.5E+00	B2	Liver	Mouse	CalEPA	Nov-07

Table 17
Inhalation Carcinogenic Slope Factors
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence	Tumor	Test Species	Slope Factor Source	Date
Indeno(1,2,3-cd)pyrene	3.9E-01	B2			CalEPA	Nov-07
Isopropylbenzene	-	-	-	-	2	-
Lead[5]	-	-	-	-	2	-
Manganese	-	-	-	-	-	-
Mercury	-	C	-	-	2	-
Methylene chloride	3.5E-03	B2	Lung	Mouse	CalEPA	Nov-07
Methyl-t-Butyl Ether (MTBE)	9.1E-04	-	Kidney, Testes	Rat, mouse	CalEPA	Nov-07
Molybdenum	-	-	-	-	2 (non)	-
Naphthalene	1.2E-01	-	Nasal	Rat	CalEPA	Nov-07
n-Butylbenzene	-	-	-	-	2 (non)	-
Nickel	9.1E-01	A	Lung	Human	CalEPA	Nov-07
N-Nitrosodiphenylamine	9.0E-03	B2	Liver	Rat, mouse	CalEPA	Nov-07
n-Propylbenzene	-	-	-	-	2 (non)	-
Phenanthrene	-	D	-	-	2	-
Phenol	-	-	-	-	2	-
p-Isopropyltoluene[6]	-	-	-	-	2	-
PCBs[7]	2.0E+00	B2	Liver	Rat	CalEPA	Nov-07
Pyrene	-	-	-	-	2	-
Pyridine	-	-	-	-	2	-
sec-Butylbenzene	-	-	-	-	2	-
Selenium	-	-	-	-	2	-
Silver	-	-	-	-	2	-
Styrene	-	-	-	-	2	-
tert-Butylbenzene	-	-	-	-	2	-
Tetrachloroethene	2.1E-02	-	Lung	Mouse	CalEPA	Nov-07
Thallium	-	D	-	-	2	-
Toluene	-	D	-	-	2	-
trans-1,2-Dichloroethene	-	-	-	-	2	-
Trichloroethene	7.0E-03	-	Liver, Lung	Mouse	CalEPA	Nov-07
Trichlorofluoromethane	-	-	-	-	2	-
Vanadium	-	-	-	-	2	-
Vinyl chloride	2.7E-01	A	Lung	Mouse	CalEPA	Nov-07
Xylenes	-	-	-	-	2	-
Zinc	-	D	-	-	2	-

Definitions:

Cal EPA - California Environmental Protection Agency.
IRIS - Integrated Risk Information System.
SF - Slope Factor
$(mg/kg/day)^{-1}$ - risk per milligram per kilogram per day

Notes:

All weight of evidence classifications were obtained from USEPA (2007) Integrated Risk Information System (IRIS).

1 - 1,1,1,2-trichloroethane used as a surrogate
2 - No SFs available from USEPA or CalEPA
3 - Measured as chlordane, alpha-chlordane, and gamma chlordane
4 - Cal EPA (2008) inhalation slope factor for hexavalent chromium is 5.1E+02 $(mg/kg/day)^{1}$
5 - Lead evaluated using USEPA Adult Lead Model (ALM)
6 - Isopropylbenzene used as a surrogate.
7 - PCB mixtures Aroclor 1016, 1248, 1254, 1260, and 1262

Table 18
Chronic Oral Reference Doses
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
1,1,2,2-Tetrachloroethane	3.0E-02	Low	1	3000	Kidney mineralization, males; hepatic clear cell change, females	Rat	IRIS	Nov-07
1,2,4-Trichlorobenzene	1.0E-02	Medium	1	1,000	Increased adrenal weight	Rat	IRIS	Nov-07
1,2,4-Trimethylbenzene	5.0E-02	-	-	-	-	-	1	
1,2-Dichlorobenzene	9.0E-02	Low	1	1,000	No effects observed	Rat	IRIS	Nov-07
1,2-Dichloropropane	1.1E-03	-	-	-	-	-	2	
1,3,5-Trimethylbenzene	5.0E-02	Low	1	3,000	Increase hepatic weight	Rat	PPRTV	Aug-03
1,3-Dichlorobenzene	3.0E-02	-	-	-	-	-	PRG	Oct-04
1,4-Dichlorobenzene	3.0E-02	-	-	-	-	-	IRIS	Nov-07
2-Butanone (methyl ethyl ketone)	6.0E-01	Low	1	1,000	Decreased pup body weight	Rat	IRIS	Nov-07
2-Chlorotoluene	2.0E-02	Low	1	1,000	Decrease in body weight gain	Rat	IRIS	Nov-07
3/4-Methylphenol	5.0E-02	Medium	1	1,000	Decrease in body weight and neurotoxicity		IRIS	Nov-07
4'4-DDD	5.0E-04	-	-	-	-	-	3	-
4'4-DDE	5.0E-04	-	-	-	-	-	3	-
4'4-DDT	5.0E-04	Medium	1	100	Liver lesions	Rat	IRIS	Nov-07
4-Chlorotoluene	7.0E-02	Low	1	3,000	Decreased body weight gain, lesions in liver, kidney, adrenal, and stomach	Rat	PPRTV	Dec-04
4-Methyl-2-Pentanone	8.0E-02						PRG	Oct-04
4-Nitrophenol	-	-	-	-	-	-	NA	-
Acenaphthene	6.0E-02	Low	1	3,000	Liver toxicity	Mouse	IRIS	Nov-07
Acenaphthylene	2.0E-02	-	-	-	-	-	4	-
Acetone	9.0E-01	Medium	1	1,000	Nephropathy	Rat	IRIS	Nov-07
Anthracene	3.0E-01	Low	1	3,000	No observed effects	Mouse	IRIS	Nov-07
Antimony	4.0E-04	Low	1	1,000	Longevity, blood glucose, and cholesterol	Rat	IRIS	Nov-07
Arsenic	3.0E-04	Medium	1	3	Hyperpigmentation, keratosis, and possible vascular complications	Human	IRIS	Nov-07
Barium	2.0E-01	Medium	1	300	Nephropathy	Mouse	IRIS	Nov-07
Benzene	4.0E-03	Medium	1	300	Decreased lymphocyte count	Human	IRIS	Nov-07
Benzo (a) Pyrene	2.0E-02	-	-	-	-	-	4	-
Benzo (g,h,i) Perylene	-	-	-	-	-	-	NA	-
Benzo (k) Fluoranthene	2.0E-02	-	-	-	-	-	4	-
Benzo(a)anthracene	2.0E-02	-	-	-	-	-	4	-
Benzo(b)fluoranthene	2.0E-02	-	-	-	-	-	4	-
Beryllium	2.0E-03	Low to Medium	1	300	Small intestinal lesions	Dog	IRIS	Nov-07
bis(2-Ethylhexyl)phthalate	2.0E-02	Medium	1	1,000	Increased relative liver weight	Guinea pig	IRIS	Nov-07
Butyl benzyl phthalate	2.0E-01	Low	1	1,000	Significantly increased	Rat	IRIS	Nov-07
Cadmium	1.0E-03	High	1	10	Significant proteinuria	Human	IRIS	Nov-07
Carbon disulfide	1.0E-01	Medium	1	100	Fetal toxicity/malformations	Rabbit	IRIS	Nov-07
Chlordane[3]	5.0E-04	Medium	1	300	Hepatic necrosis	Mouse	IRIS	Nov-07
Chlorobenzene	2.0E-02	Medium	1	1,000	Histopathologic changes in liver	Dog	IRIS	Nov-07
Chloroethane (Ethyl chloride)	4.0E-01	-	-	-	-	-	PRG	Oct-04

Table 18
Chronic Oral Reference Doses
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
Chromium, Total	1.5E+00	Low	10	100	No effects observed	Rat	IRIS	Nov-07
Chrysene	2.0E-02	-	-	-	-	-	4, 5	-
cis-1,2-Dichloroethene	1.0E-02	Low	1	1,000	Anemia	Rat	PPRTV	Mar-06
Cobalt	2.0E-02	Low/medium	1	10	Hematological effects	Human	PPRTV	Jan-02
Copper	3.7E-02	-	-	-	Gastrointestinal irritation	Human	PRG	Oct-04
Dibenz (a,h) Anthracene	2.0E-02	-	-	-	-	-	4	-
Dichlorodifluoromethane	2.0E-01	Medium	1	100	Reduced body weight	Rat	IRIS	Nov-07
Dieldrin	5.0E-05	Medium	1	100	Liver lesions	Rat	IRIS	Nov-07
Endosulfan II	6.0E-03	-	-	-	-	-	6	-
Endosulfan sulfate	6.0E-03	-	-	-	-	-	6	-
Endrin	3.0E-04	Medium	1	100	Mild histological lesions in liver, occasional convulsions	Dog	IRIS	Nov-07
Endrin aldehyde	3.0E-04	-	-	-	-	-	7	-
Ethylbenzene	1.0E-01	Low	1	1,000	Liver and kidney toxicity	Rat	IRIS	Nov-07
Fluoranthene	4.0E-02	Low	1	3,000	Nephropathy, increased liver weights, hematological alterations, clinical effects	Mouse	IRIS	Nov-07
Fluorene	4.0E-02	Low	1	3,000	Decreased RBCs, packed cell volume and hemoglobin	Mouse	8	-
Heptachlor	5.0E-04	Low	1	300	Liver weight increases, males	Rat	IRIS	Nov-07
Heptachlor epoxide	1.3E-05	Low	1	1,000	Increased liver to body weight	Dog	IRIS	Nov-07
Indeno(1,2,3-cd)pyrene	2.0E-02	-	-	-	-	-	4	-
Isopropylbenzene	1.0E-01	Low	1	1,000	Increased kidney weight in females	Rat	IRIS	Nov-07
Lead	-	-	-	-	-	-	9	-
Manganese	1.40E-01	Medium	1	1	CNS effects	Human	IRIS	Nov-07
Mercury	3.0E-04	High	1	1,000	Autoimmune effects	Rat	IRIS	Nov-07
Methylene chloride	6.0E-02	Medium	1	100	Liver toxicity	Rat	IRIS	Nov-07
Methyl-t-Butyl Ether (MTBE)	8.6E-01	-	-	-	-	-	IRIS	Nov-07
Molybdenum	5.0E-03	Medium	1	30	Increased uric acid levels	Human	IRIS	Nov-07
Naphthalene	2.0E-02	Low	1	3,000	Decreased mean body weight	Rat	IRIS	Nov-07
n-Butylbenzene	4.0E-02	-	-	-	-	-	PRG	Oct-04
Nickel	2.0E-02	Medium	1	300	Decreased body and organ weights	Rat	IRIS	Nov-07
N-Nitrosodiphenylamine	2.0E-02	-	-	-	-	-	PRG	Oct-04
n-Propylbenzene	4.0E-02	-	-	-	-	-	PRG	Oct-04
PCB	2.0E-05	Medium	1	300	Ocular exudate, inflamed Meibomian glands, distorted nail growth, decreased antibody response	Monkey	IRIS, 10	Nov-07
Phenanthrene	2.0E-02	-	-	-	-	-	4	-
Phenol	3.0E-01	Medium to High	1	300	Decreased maternal weight gain	Rat	IRIS	Nov-07
p-Isopropyltoluene	1.0E-01	-	-	-	-	-	11	-

Table 18
Chronic Oral Reference Doses
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
Pyrene	3.0E-02	Low	1	3,000	Renal tubular pathology, decreased kidney weight	Mouse	IRIS	Nov-07
Pyridine	1.0E-03	Medium	1	1,000	Increased liver weight	Rat	IRIS	Nov-07
sec-Butylbenzene	4.0E-02	-	-	-	-	-	PRG	Oct-04
Selenium	5.0E-03	High	1	3	Clinical selenosis	Human	IRIS	Nov-07
Silver	5.0E-03	Low	1	3	Argryia	Human	IRIS	Nov-07
Styrene	2.0E-01	Medium	1	1,000	Red blood cell and liver effects	Dog	IRIS	Nov-07
tert-Butylbenzene	4.0E-02	-	-	-	-	-	PRG	Oct-04
Tetrachloroethene	1.0E-02	Medium	1	1,000	Hepatotoxicity in mice, weight gain in rats	Mouse, Rat	IRIS	Nov-07
Thallium	8.0E-05	Low	1	3,000	No adverse effects	Rat	IRIS	Nov-07
Toluene	8.0E-02	Medium	1	3,000	Increased kidney weight	Rat	IRIS	Nov-07
trans-1,2-Dichloroethene	2.0E-02	Low	1	1,000	Increased serum alkaline phosphatase in males	Mouse	IRIS	Nov-07
Trichloroethene	3.0E-04	-	-	-	-	-	PRG	Oct-04
Trichlorofluoromethane	3.0E-01	Medium	1	1,000	Survival and histopathology	Rat, Mouse	IRIS	Nov-07
Vanadium	1.0E-03	-	-	-	-	-	PRG	Oct-04
Vinyl chloride	3.0E-03	Medium	1	30	Liver cell polymorphism	Rat	IRIS	Nov-07
Xylenes	2.0E-01	Medium	1	1,000	Decreased body weight, increased mortality	Rat	IRIS	Nov-07
Zinc	3.0E-01	Medium/High	1	3	Decreases in erythrocyte Cu, Zn-superoxide dismutase (ESOD) activity	Human	IRIS	Nov-07

Definitions:

Cal EPA - California Environmental Protection Agency.
IRIS - Integrated Risk Information System.
NA - none available
PPRTV - provisional peer reviewed toxicity value
PRG - preliminary remediation goal (USEPA Region 9)
RfD - Reference Dose
mg/kg/day - milligram per kilogram per day

Notes:

1 - 1,3,5-trimethylbenzene used as a surrogate
2 - route to route extrapolation
3 - DDT used as a surrogate
4 - naphthalene used as a surrogate
5 - Oral RfD for hexavalent chromium is 3E-03 mg/kg/day (IRIS, March 2008)
6 - endosulfan used as a surrogate
7 - endrin used as a surrogate
8 - fluoranthene used as a surrogate
9 - Lead evaluated using USEPA Adult Lead Model (ALM)
10 - PCB mixtures Aroclor 1016, 1248, 1254, 1260, and 1262 based on RfD for Aroclor 1254; RfD for Aroclor 1016 = 7E-05 mg/kg/day
11 - isopropylbenzene used as a surrogate

Table 19
Chronic Inhalation Reference Doses and Reference Concentrations
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	RfC (mg/m^3)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
1,1,2,2-Tetrachloroethane	3.0E-02	-	-	-	-	-	-	1	-
1,2,4-Trichlorobenzene	1.0E-03	4.0E-03	Low to Mediun	-	1,000	Porphyria	Rat	PPRTV	Oct-02
1,2,4-Trimethylbenzene	1.7E-03	6.0E-03	Low	-	3,000	Adverse respiratory, neurological, and hematological effects	Human	PPRTV	
1,2-Dichlorobenzene	5.7E-02	2.0E-01	-	-	1,000	Decreased weight gain	Rat	PRG	Oct-04
1,2-Dichloropropane	1.1E-03	4.0E-03	Medium	1	300	Hyperplasia of nasal mucosa	Rat	IRIS	Nov-07
1,3,5-Trimethylbenzene	1.7E-03	6.0E-03	Low	-	3,000	Adverse respiratory, neurological, and hematological effects	Human	PPRTV	Aug-03
1,3-Dichlorobenzene	3.0E-02	-	-	-	-	-	-	PRG	Oct-04
1,4-Dichlorobenzene	2.3E-01	8.0E-01	Medium	1	100	Increased liver weights in P1 males	Rat	IRIS	Nov-07
2-Butanone (methyl ethyl ke	1.4E+00	5.0E+00	Medium	1	300	Developmental toxicity (skeletal variations)	Mouse	IRIS	Nov-07
2-Chlorotoluene	2.0E-02	-	-	-	-	-	-	1	-
3/4-Methylphenol	5.0E-02	-	-	-	-	-	-	1	-
4'4-DDD	5.0E-04	-	-	-	-	-	-	1	-
4'4-DDE	5.0E-04	-	-	-	-	-	-	1	-
4'4-DDT	5.0E-04	-	-	-	-	-	-	1	-
4-Chlorotoluene	7.0E-02	-	-	-	-	-	-	1	-
4-Methyl-2-Pentanone	8.6E-01	3.0E+00		1	300	Reduced fetal body weight, skeletal variations, increased fetal death	Mouse, Ra	IRIS	Nov-07
4-Nitrophenol	-	-	-	-	-	-	-	NA	-
Acenaphthene	6.0E-02	-	-	-	-	-	-	IRIS	Nov-07
Acenaphthylene	8.6E-04	-	-	-	-	-	-	2	-
Acetone	9.0E-01	-	-	-	-	-	-	IRIS	Nov-07
Anthracene	3.0E-01	-	-	-	-	-	-	IRIS	Nov-07
Antimony	4.0E-04	-	-	-	-	-	-	IRIS	Nov-07
Arsenic	3.0E-04	-	-	-	-	-	-	1	-
Barium	1.4E-04	5.0E-04	-	-	1,000	Fetotoxicity	Rat	PRG	Oct-04
Benzene	8.6E-03	3.0E-02	-	-	-	-	-	IRIS	Nov-07
Benzo (a) Pyrene	8.6E-04	-	-	-	-	-	-	2	-
Benzo (g,h,i) Perylene	-	-	-	-	-	-	-	NA	-
Benzo (k) Fluoranthene	8.6E-04	-	-	-	-	-	-	2	-
Benzo(a)anthracene	8.6E-04	-	-	-	-	-	-	2	-
Benzo(b)fluoranthene	8.6E-04	-	-	-	-	-	-	2	-
Beryllium	5.7E-06	2.0E-03	Medium	1	10	Beryllium sensitizationand progression to Chronic Beryllium Disease	Human	IRIS	Nov-07
bis(2-Ethylhexyl)phthalate	2.0E-02	-	-	-	-	-	-	1	-
Butyl benzyl phthalate	2.0E-01	-	-	-	-	-	-	1	-

Table 19
Chronic Inhalation Reference Doses and Reference Concentrations
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	RfC (mg/m^3)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
Cadmium	1.0E-03	-	-	-	-	-	-	1	-
Carbon disulfide	2.0E-01	7.0E-01	Medium	1	30	Peripheral nervous system dysfunction	Human	IRIS	Nov-07
Chlordane	2.0E-04	7.0E-04	Low	1	1,000	Hepatic effects	Rat	IRIS	Nov-07
Chlorobenzene	1.4E-02	5.0E-02	Low	1	1,000	Liver and kidney lesions	Rat	PPRTV	Oct-06
Chloroethane (Ethyl chlorid	2.9E+00	1.0E+00	Medium	1	300	Delayed fetal ossification	Mouse	IRIS	Oct-04
Chromium, Total	1.5E+00	-	-	-	-	-	-	IRIS,3	Nov-07
Chrysene	8.6E-04	-	-	-	-	-	-	2	-
cis-1,2-Dichloroethene	1.0E-02	-	-	-	-	-	-	1	-
Cobalt	5.7E-06	2.0E-05	Medium/low	1	100	Lung function	Human	PPRTV	Jan-02
Copper	3.7E-02	-	-	-	-	-	-	PRG	Oct-04
Dibenz (a,h) Anthracene	8.6E-04	-	-	-	-	-	-	2	-
Dichlorodifluoromethane	5.7E-02	-	-	-	-	-	-	PRG	Oct-04
Dieldrin	5.0E-05	-	-	-	-	-	-	1	-
Endosulfan II	6.0E-03	-	-	-	-	-	-	4	-
Endosulfan sulfate	6.0E-03	-	-	-	-	-	-	4	-
Endrin	3.0E-04	-	-	-	-	-	-	1	-
Endrin aldehyde	3.0E-04	-	-	-	-	-	-	1	-
Ethylbenzene	2.9E-01	1.0E+00	Low	1	300	Developmental toxicity	Rat, rabbi	IRIS	Nov-07
Fluoranthene	4.0E-02	-	-	-	-	-	-	1	-
Fluorene	4.0E-02	-	-	-	-	-	-	1	-
Heptachlor	5.0E-04	-	-	-	-	-	-	1	-
Heptachlor epoxide	1.3E-05	-	-	-	-	-	-	1	-
Indeno(1,2,3-cd)pyrene	8.6E-04	-	-	-	-	-	-	2	-
Isopropylbenzene	1.1E-01	4.0E-01	Medium	1	1,000	Increased kidney weights in females; increased adrenal weights	Rat	IRIS	Nov-07
Lead	-	-	-	-	-	-	-	5	-
Manganese	1.4E-05	5.0E-05	Medium	1	1,000	Impairment of neurobehavioral function	Human	IRIS	Nov-07
Mercury	3.0E-04	-	-	-	-	-	-	1	-
Methylene chloride	8.6E-01	3.0E+00	-	-	-	-	-	IRIS	Nov-07
Methyl-t-Butyl Ether (MTB	8.6E-01	3.0E+00	Medium	1	100	Increased liver and kidney weights, severity of spontaneous renal lesions (females), and swollen periocular tissue	Rat	IRIS	Nov-07
Molybdenum	5.0E-03	-	-	-	-	-	-	IRIS	Nov-07
Naphthalene	8.6E-04	3.0E-03	Medium	1	3,000	Nasal effects	Mice	IRIS	Nov-07
n-Butylbenzene	4.0E-02	-	-	-	-	-	-	PRG	Oct-04
Nickel	2.0E-02	-	-	-	-	-	-	1	-
N-Nitrosodiphenylamine	2.0E-02	-	-	-	-	-	-	PRG	Oct-04
n-Propylbenzene	4.0E-02	-	-	-	-	-	-	PRG	Oct-04
PCB	2.0E-05	-	-	-	-	-	-	1	-
Phenanthrene	8.6E-04	-	-	-	-	-	-	2	-
Phenol	3.0E-01	-	-	-	-	-	-	1	-

Table 19
Chronic Inhalation Reference Doses and Reference Concentrations
Avalon at South Bay
(formerly Carson Marketplace)
Carson, California

Chemical	RfD (mg/kg/day)	RfC (mg/m^3)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date
p-Isopropyltoluene	1.1E-01	-	-	-	-	-	-	6	-
Pyrene	3.0E-02	-	-	-	-	-	-	IRIS	Nov-07
Pyridine	1.0E-03	-	-	-	-	-	-	1	-
sec-Butylbenzene	4.0E-02	-	-	-	-	-	-	PRG	Oct-04
Selenium	5.0E-03	-	-	-	-	-	-	1	-
Silver	5.0E-03	-	-	-	-	-	-	1	-
Styrene	2.9E-01	1.0E+00	Medium	1	30	CNS effects	Human	IRIS	Nov-07
tert-Butylbenzene	4.0E-02	-	-	-	-	-	-	PRG	Oct-04
Tetrachloroethene	1.0E-02	-	-	-	-	-	-	IRIS	Nov-07
Thallium	8.0E-05	-	-	-	-	-	-	IRIS	Nov-07
Toluene	1.4E+00							IRIS	Nov-07
trans-1,2-Dichloroethene	2.0E-02	-	-	-	-	-	-	1	-
Trichloroethene	1.0E-02	-	-	-	-	-	-	PRG	Oct-04
Trichlorofluoromethane	2.0E-01	-	-	-	-	-	-	PRG	Oct-04
Vanadium	1.0E-03	-	-	-	-	-	-	PRG	Oct-04
Vinyl chloride	2.9E-02	1.0E-01	Medium	1	30	Liver cell polymorphism	Rat	IRIS	Nov-07
Xylenes	2.9E-02	1.0E-01	Medium	1	300	Impaired motor coordination	Rat	IRIS	Nov-07
Zinc	3.0E-01	-	-	-	-	-	-	IRIS	Nov-07

Definitions:

Cal EPA - California Environmental Protection Agency.
IRIS - Integrated Risk Information System.
NA - none available
PPRTV - provisional peer reviewed toxicity value
PRG - preliminary remediation goal (USEPA Region 9)
RfC - Reference Concentration
RfD - Reference Dose
mg/m^3 - milligrams per cubic meter
mg/kg/day - milligram per kilogram per day

Notes:

1 - route to route extrapolation
2 - naphthalene used as a surrogate
3 - Inhalation RfD for hexavalent chromium is 2.86E-05 mg/kg/day, based on a RfC of 1E-04 mg/m^3 (IRIS, March 2008)
4 - endosulfan used as a surrogate
5 - Lead evaluated using USEPA Adult Lead Model (ALM)
6 - isopropylbenzene used as a surrogate

Table 20
Soil Management Goals (SMGs)
Protective of Future On-site Workers
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Carcinogenic SMGs[1]	Non-Carcinogenic SMGs[1]	Background 95th Percentile
Metals			
Antimony	-	367	ND
Arsenic	2.3	228	7.6
Barium	-	>100,000	947
Beryllium	>100,000	1,832	0.6
Cadmium	>100,000	1,010	2.4
Chromium, Total[2]	-	>100,000	30.8
Cobalt	>100,000	18,079	13.2
Copper	-	33,944	45
Lead	-	800	26.2
Manganese	-	>100,000	-
Mercury	-	275	0.15
Molybdenum	-	2,388	0.6
Nickel	>100,000	18,348	31.5
Selenium	-	4,587	ND
Silver	-	4,587	0.4
Thallium	-	73	1
Vanadium	-	917	50.6
Zinc	-	>100,000	97
Chlorinated Pesticides			
4,4'-DDD	76	325	-
4,4'-DDE	54	325	-
4,4'-DDT	54	325	-
alpha-Chlordane	14	325	-
Chlordane	14	325	-
Dieldrin	1.1	33	-
Endosulfan II	-	3,906	-
Endosulfan sulfate	-	3,906	-
Endrin	-	195	-
Endrin aldehyde	-	195	-
gamma-Chlordane	14	325	-
Heptachlor	4	325	-
Heptachlor epoxide	3	8	-
Sum of Chlordane Isomers	-	-	-
Polychlorinated Biphenyls (PCBs)			
Total PCBs[3]	2.1	8	-
Volatile Organic Compounds			
1,1,2,2-Tetrachloroethane	0.4	97	-
1,2,4-Trichlorobenzene	69	11	-
1,2,4-Trimethylbenzene	-	5	-
1,2-Dichlorobenzene	-	200	-
1,2-Dichloropropane	0.7	1	-
1,3,5-Trimethylbenzene	-	6	-

Table 20
Soil Management Goals (SMGs)
Protective of Future On-site Workers
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Carcinogenic SMGs[1]	Non-Carcinogenic SMGs[1]	Background 95th Percentile
1,3-Dichlorobenzene	-	138	-
1,4-Dichlorobenzene	2.3	491	-
2-Butanone (methyl ethyl ketone	-	3,549	-
2-Chlorotoluene	-	27	-
4-Chlorotoluene	-	95	-
4-Methyl-2-Pentanone	-	1,307	-
Acetone	-	2,183	-
Benzene	0.2	6	-
Carbon disulfide	-	57	-
Chlorobenzene	-	22	-
Chloroethane (Ethyl chloride)	461	482	-
cis-1,2-Dichloroethene	-	7	-
Dichlorodifluoromethane	-	19	-
Ethylbenzene	4	357	-
Isopropylbenzene	-	347	-
m,p-Xylene	-	43	-
Methylene chloride	4	413	-
Methyl-t-Butyl Ether (MTBE)	27	760	-
Naphthalene	2.4	12	-
n-Butylbenzene	-	1,910	-
n-Propylbenzene	-	62	-
o-Xylene	-	43	-
p-Isopropyltoluene	-	513	-
sec-Butylbenzene	-	72	-
Styrene	-	875	-
tert-Butylbenzene	-	70	-
Tetrachloroethene	0.6	6	-
Toluene	-	1,030	-
trans-1,2-Dichloroethene	-	11	-
Trichloroethene	3	5	-
Trichlorofluoromethane	-	90	-
Vinyl chloride	0.03	7	-
Semi-volatile Organic Compounds			
1,4-Dichlorobenzene	2.3	491	-
3/4-Methylphenol	-	23,878	-
4-Nitrophenol	-	-	-
Benzo (a) Pyrene	0.9	7,541	-
Benzo (g,h,i) Perylene	-	-	-
Benzo (k) Fluoranthene	9	7,541	-
Benzo(a)anthracene	9	7,542	-
Benzo(b)fluoranthene	9	7,542	-
bis(2-Ethylhexyl)phthalate	4,457	9,551	-
Butyl benzyl phthalate	-	95,514	-

Table 20
Soil Management Goals (SMGs)
Protective of Future On-site Workers
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Carcinogenic SMGs[1]	Non-Carcinogenic SMGs[1]	Background 95th Percentile
Chrysene	88	7,541	-
Fluoranthene	-	15,085	-
Indeno(1,2,3-cd)pyrene	9	7,542	-
Naphthalene	2.4	12	-
N-Nitrosodiphenylamine	1,486	9,551	-
Phenanthrene	-	65	-
Phenol	-	>100,000	-
Pyrene	-	11,314	-
Pyridine	-	478	-
Polycyclic Aromatic Hydrocarbons			
Acenaphthene	-	1,344	-
Acenaphthylene	-	45	-
Anthracene	-	9,123	-
Benzo (a) Pyrene	0.9	7,541	-
Benzo (b and k) Fluoranthenes	9	7,542	-
Benzo (g,h,i) Perylene	-	-	-
Benzo (k) Fluoranthene	9	7,541	-
Benzo(a)anthracene	9	7,542	-
Benzo(b)fluoranthene	9	7,542	-
Chrysene	88	7,541	-
Dibenz (a,h) Anthracene	3	7,541	-
Fluoranthene	-	15,085	-
Fluorene	-	1,168	-
Indeno(1,2,3-cd)pyrene	9	7,542	-
Naphthalene	2.4	12	-
Phenanthrene	-	65	-
Pyrene	-	11,314	-

Definitions:

HQ - hazard quotient
ND - not detected
SMG - soil management goal
UTL - upper tolerance limit

Notes:

All units are in milligrams per kilogram (mg/kg)
Goals expressed as per USEPA (2004) approach, i.e., goals exceeding 100,000 mg/kg shown as >100,000 mg/kg

1 - Carcinogenic SMGs based on a target risk of 1E-06 for volatile chemicals and a target risk of 1E-05 for non-volatile chemicals; Non-carcinogenic SMGs based on a HQ of 0.1 for volatile chemicals and a HQ of 1 for non-volatile chemicals. See text Section 5.1.3 and Table 13 for identification of volatile

2 - SMGs for chromium would be 83,071 mg/kg for a target risk of 1E-05 (using a 1:6 ratio between hexavalent and trivalent chromium, as per USEPA 2004; although Tetra Tech [2008] soil cover sampling results indicate the ratio could differ) and 3,064 mg/kg for a target HQ of 1.

3 - Total PCBs consist of Aroclors 1016, 1248, 1254, 1260, and 1262.

Table 21
Comparison of Maximum Concentrations of COPCs in Soil
and Soil Management Goals
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Maximum Concentration	Carcinogenic SMGs	Non-Carcinogenic SMGs	Background 95th percentile
Metals				
Antimony	1.67	-	367	ND
Arsenic	**18**	2.3	228	7.6
Barium	1,580	-	>100,000	947
Beryllium	1.13	>100,000	1,832	0.6
Cadmium	3.23	>100,000	1,010	2.4
Chromium, Total[1]	178	-	>100,000	30.8
Cobalt	35	>100,000	18,079	13.2
Copper	369	-	33,944	45
Lead	281	-	800	26.2
Manganese	415	-	>100,000	-
Mercury	0.355	-	275	0.15
Molybdenum	29	-	2,388	0.6
Nickel	191	>100,000	18,348	31.5
Selenium	15.6	-	4,587	ND
Silver	0.776	-	4,587	0.43
Thallium	0.49	-	73	1.1
Vanadium	117	-	917	50.6
Zinc	505	-	>100,000	96.7
Chlorinated Pesticides				
4,4'-DDD[2]	0.316	76	325	-
4,4'-DDE[2]	2.3	54	325	-
4,4'-DDT[2]	0.86	54	325	-
alpha-Chlordane	0.0577	14	325	-
Chlordane	0.0202	14	325	-
Dieldrin	0.0146	1.1	33	-
Endosulfan II	0.00285	-	3,906	-
Endosulfan sulfate	0.00548	-	3,906	-
Endrin	0.00146	-	195	-
Endrin aldehyde	0.00964	-	195	-
gamma-Chlordane	0.0646	14	325	-
Heptachlor	0.0174	4	325	-
Heptachlor epoxide	0.00105	3	8	-
Sum of Chlordane	0.122	-	-	-
Polychlorinated Biphenyls				
Total PCBs[3]	**10.1**	2.1	8	
Volatile Organic Compounds				
1,1,2,2-Tetrachloroetha	0.0027	0.4	97	-
1,2,4-Trichlorobenzene	0.0025	69	11	-
1,2,4-Trimethylbenzen	**12**	-	5	-
1,2-Dichlorobenzene	4.3	-	200	-
1,2-Dichloropropane	0.00066	0.7	1	-
1,3,5-Trimethylbenzen	3.7	-	6	-
1,3-Dichlorobenzene	0.0013	-	138	-

Table 21
Comparison of Maximum Concentrations of COPCs in Soil
and Soil Management Goals
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Chemical	Maximum Concentration	Carcinogenic SMGs	Non-Carcinogenic SMGs	Background 95th percentile
1,4-Dichlorobenzene	0.047	2.3	491	-
2-Butanone (methyl etl	0.16	-	3,549	-
2-Chlorotoluene	0.0003	-	27	-
4-Chlorotoluene	0.00017	-	95	-
4-Methyl-2-Pentanone	0.07	-	1,307	-
Acetone	0.947	-	2,183	-
Benzene	0.1	0.2	6	-
Carbon disulfide	1.2	-	57	-
Chlorobenzene	0.037	-	22	-
Chloroethane (Ethyl ch	0.00058	461	482	-
cis-1,2-Dichloroethene	0.16	-	7	-
Dichlorodifluorometha	0.00059	-	19	-
Ethylbenzene	**120**	4	357	-
Isopropylbenzene	3.7	-	347	-
m,p-Xylene	2.2	-	43	-
Methylene chloride	**22**	4	413	-
Methyl-t-Butyl Ether (l	0.0034	27	760	-
Naphthalene	**4.7**	2.4	12	-
n-Butylbenzene	13	-	1,910	-
n-Propylbenzene	9.2	-	62	-
o-Xylene	0.45	-	43	-
p-Isopropyltoluene	4.4	-	513	-
sec-Butylbenzene	11	-	72	-
Styrene	0.026	-	875	-
tert-Butylbenzene	0.012	-	70	-
Tetrachloroethene	0.015	0.6	6	-
Toluene	0.082	-	1,030	-
trans-1,2-Dichloroethe	0.0012	-	11	-
Trichloroethene	0.011	3	5	-
Trichlorofluoromethan	0.00099	-	90	-
Vinyl chloride	0.012	0.03	7	-
Semi-volatile Organic Compounds				
1,4-Dichlorobenzene	0.3	2.3	491	-
3/4-Methylphenol	0.34	-	23,878	-
4-Nitrophenol	0.13	-	-	-
Benzo (a) Pyrene	0.446	0.9	7,541	-
Benzo (g,h,i) Perylene	0.399	-	-	-
Benzo (k) Fluoranthen	0.36	9	7,541	-
Benzo(a)anthracene	0.437	9	7,542	-
Benzo(b)fluoranthene	0.357	9	7,542	-
bis(2-Ethylhexyl)phtha	4.3	4,457	9,551	-
Butyl benzyl phthalate	0.283	-	95,514	-
Chrysene	0.566	88	7,541	-
Fluoranthene	1.26	-	15,085	-
Indeno(1,2,3-cd)pyren	0.37	9	7,542	-
Naphthalene	0.25	2.4	12	-

Table 21
Comparison of Maximum Concentrations of COPCs in Soil and Soil Management Goals
Avalon at South Bay (formerly Carson Marketplace)
Carson, CA

Chemical	Maximum Concentration	Carcinogenic SMGs	Non-Carcinogenic SMGs	Background 95th percentile
N-Nitrosodiphenylamii	1	1,486	9,551	-
Phenanthrene	6.13	-	65	-
Phenol	1.4	-	>100,000	-
Pyrene	1.15	-	11,314	-
Pyridine	0.34	-	478	-
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	0.6	-	1,344	-
Acenaphthylene	6.1	-	45	-
Anthracene	2.4	-	9,123	-
Benzo (a) Pyrene[4]	**1.7**	0.9	7,541	-
Benzo (b and k) Fluora	0.18	9	7,542	-
Benzo (g,h,i) Perylene	1.2	-	-	-
Benzo (k) Fluoranthen	2	9	7,541	-
Benzo(a)anthracene	0.373	9	7,542	-
Benzo(b)fluoranthene	0.416	9	7,542	-
Chrysene	0.746	88	7,541	-
Dibenz (a,h) Anthracer	0.72	3	7,541	-
Fluoranthene	1.54	-	15,085	-
Fluorene	0.26	-	1,168	-
Indeno(1,2,3-cd)pyren	0.444	9	7,542	-
Naphthalene	**4.7**	2.4	12	-
Phenanthrene	38	-	65	-
Pyrene	1.56	-	11,314	-

Notes:

All units are in milligrams per kilogram (mg/kg)

BOLD are concentrations exceeding soil management goals (see Tables 22 and 23 for samples exceeding SMGs).

ND - not detected

1 - Additional soil sampling has been conducted to characterize hexavlent chromium concentrations in cover soil and develop a site-specific ratio between hexavalent and total chromium concentrations (Tetra Tech 2008). The maximum total chromium concentration shown above is lower than the SMGs (83,071 mg/kg and 3,064 mg/kg) shown in Table 20 for a target risk of 1E-05 and a target HQ of 1, respectively.

2 - The sums of DDD/DDE/DDT detected in each sample were also compared to the lowest SMG for the three compounds and none exceeded the SMG.

3 - Aroclor 1254 in combination with Aroclor 1248 in the same sample (SBO04-9.5) exceeds the goal for PCBs (i.e., Aroclor mixtures).

4 - Benzo(a)pyrene-equivalent (BaP-equivalent) concentrations for each sample were also calculated according to DTSC (1999) guidance and compared to the benzo(a)pyrene SMG. Only the maximum BaP-equivalent concentration (1.9 mg/kg) exceeded the SMG, and in the same location as the maximum benzo(a)pyrene concentration (see Table 22).

Table 22
Cover Soil Samples with Organic COPC Concentrations Exceeding Soil Management Goals
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Landfill Cell	Sample Location	Depth (feet)	Chemical	Analytical Method	Concentration (mg/kg)	Exceeds Carcinogenic SMG	Exceeds Non-carcinogenic SMG
A3	B-49/52 (L7-SS3L)	0.0-2.0	PCBs (Aroclor-1262)	SW8082	3.98	X	
A3	B-49/52 (L7-SS4L)	0.0-2.0	PCBs (Aroclor-1262)	SW8082	10.1	X	X
A3	B-49C	0.0-2.0	PCBs (Aroclor-1260)	SW8082	5.1	X	
A3	B-49C-S	0.0-2.0	PCBs (Aroclor-1260)	SW8082	2.7	X	
A4	SBN07-14.5	14.5	Benzo (a) Pyrene	EPA 8310	1.7	X	
A4	SBN07-14.5	14.5	Naphthalene	EPA 8310	4.7	X	
A2	SBO04-9.5	9.5	PCBs (Aroclors 1248 and 1254)	EPA 8082	2.4	X	
A2	SBP06-24.0	24	1,2,4-Trimethylbenzene	EPA 8260B	12	-	X
A2	SBP06-24.0	24	Ethylbenzene	EPA 8260B	120	X	
A2	SBP06-24.0	24	Methylene chloride	EPA 8260B	22.0	X	
A2	SBP06-24.0	24	Naphthalene	EPA 8260B	4.7	X	
A2	SBR05-PS2-3.5	3.5	PCBs (Aroclor-1248)	EPA 8082	3	X	

Definitions:

COMP -	composite sample
mg/kg	milligrams per kilogram
PCBs -	polychlorinated biphenyls
SMG -	soil management goal

Table 23
Cover Soil Samples with Arsenic Concentrations
Exceeding Soil Management Goals and the 95th Percentile Background Concentration
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Landfill Cell	Sample Location	Depth (feet)	Analytical Method	Concentration[1] (mg/kg)
A2*	A2-N3-SB43-10'-D	10	SW6010B	11.4
A2	L4-SS1L	0.0-2.0	EPA 6010B	7.7
A2	SBO02-T2-4.5	4.5	EPA 6010B	8.28
A2*	SBO04-9.5	9.5	EPA 6010B	12.4
A2	SBP04-14.0	14	EPA 6010B	7.98
A2	SBP05-26.0	26	EPA 6010B	7.87
A2*	SBQ04-0.5	0.5	EPA 6010B	10.1
A2	SBQ04-4.0	4	EPA 6010B	8.8
A2*	SBQ05-15.0-17.0 (COMP)	15.0-17.0	EPA 6010B	10.5
A2	SBR06-9.0	9	EPA 6010B	9.43
A2	SBR07-0.5-6.0	0.5-6.0	EPA 6010B	7.85
A2*	SBR07-8.0	8	EPA 6010B	10.4
A2	SBS10-0.5-8.0	0.5-8.0	EPA 6010B	8.28
A2	SBTUV-0.5	0.5	EPA 6010B	8.36
A2	SBTUV-1.0	1	EPA 6010B	8.68
A2	SBUV-0.5	0.5	EPA 6010B	8.97
A2	SBUV-1.0	1	EPA 6010B	8.13
A2	SBV09-T3-8.0	8	EPA 6010B	7.96
A2	SBV11-6.0	6	EPA 6010B	8.57
A2	SBV12-0.5-1.5	0.5-1.5	EPA 6010B	8.61
A2*	SBV12-PS1-15.0	15	EPA 6010B	12.3
A3	SBE03-PS1-15.0	15	EPA 6010B	9.64
A3	SBG08-8.0	8	EPA 6010B	9.57
A3	SBH06-0.5	0.5	EPA 6010B	7.99
A3	SBH106-0.5	0.5	EPA 6010B	8.73
A3	SBI07-0.5	0.5	EPA 6010B	8.08
A3	SBI08-0.5	0.5	EPA 6010B	8.88
A3	SBI108-0.5	0.5	EPA 6010B	7.67
A3	SBI11-10.0	10	EPA 6010B	7.65
A3*	SBIJ-0.5 (COMP)	0.5	EPA 6010B	9.91
A3	SBIJ-1.0	1	EPA 6010B	7.61
A3	SBJ11-0.5-5.0	0.5-5.0	EPA 6010B	8.1
A3	SBJ12-0.5-5.0	0.5-5.0	EPA 6010B	8.25
A3	SBJ13-PS1-2.5	2.5	EPA 6010B	7.64
A4	SBI03-0.5	0.5	EPA 6010B	7.96
A4	SBI03-4.0	4	EPA 6010B	**12.4**
A4*	SBI04-8.0	8	EPA 6010B	10.9
A4*	SBJ03-6.5	6.5	EPA 6010B	9.43
A4*	SBJ05-0.5	0.5	EPA 6010B	11.1
A4*	SBJ06-0.5	0.5	EPA 6010B	9.5
A4*	SBK03-4.0	4	EPA 6010B	7.92
A4*	SBK04-4.0	4	EPA 6010B	9.09
A4*	SBK05-0.5	0.5	EPA 6010B	9.37
A4*	SBK05-3.5'	3.5	EPA 6010B	11.8
A4*	SBK08-0.5	0.5	EPA 6010B	13.7
A4	SBL04-0.5	0.5	EPA 6010B	8.55
A4*	SBL04-4.0	4	EPA 6010B	12.2
A4	SBL05-0.5	0.5	EPA 6010B	8.62
A4	SBL05-4.0	4	EPA 6010B	9.1
A4*	SBL06-0.5-2.0	0.5-2.0	EPA 6010B	9
A4	SBL07-0.5-2.5	0.5-2.5	EPA 6010B	9.22
A4*	SBL07-6.5	6.5	EPA 6010B	10.7
A4*	SBL09-0.5	0.5	EPA 6010B	8.61

Table 23
Cover Soil Samples with Arsenic Concentrations
Exceeding Soil Management Goals and the 95th Percentile Background Concentration
Avalon at South Bay
(formerly Carson Marketplace)
Carson, CA

Landfill Cell	Sample Location	Depth (feet)	Analytical Method	Concentration[1] (mg/kg)
A4*	SBM05-0.5	0.5	EPA 6010B	8.26
A4	SBM06-0.5	0.5	EPA 6010B	9.48
A4*	SBM07-5.0	5	EPA 6010B	9.7
A4*	SBM08-0.5-10.0	0.5-10.0	EPA 6010B	9.4
A4*	SBM08-14.5	14.5	EPA 6010B	8.68
A4*	SBM09-0.5	0.5	EPA 6010B	9.23
A4*	SBN07-14.5	14.5	EPA 6010B	8.52
A4	SBN08-0.5-14.0	0.5-14.0	EPA 6010B	9.01
A4*	SBN08-18.5	18.5	EPA 6010B	9.66
A4	SBN09-0.5-10.0 (COMP)	0.5-10.0	EPA 6010B	9.89
A4*	SBN09-10.0	10	EPA 6010B	9.06
A4*	SBN09-13.5	13.5	EPA 6010B	9.41
A4*	SBO08-0.5-5.0	0.5-5.0	EPA 6010B	9.73
A4*	SBO08-10.0	10	EPA 6010B	7.84
A4*	SBO09-15.0-20.0	15.0-20.0	EPA 6010B	8.59
A4*	SBO09-25.0	25	EPA 6010B	11.6
A4	SBP09-15.0-20.0	15.0-20.0	EPA 6010B	8.34
A4*	SBP09-24.5	24.5	EPA 6010B	18
A4*	SBU11-5.5	5.5	EPA 6010B	8.26
A4*	SBU12-0.5-2.0	0.5-2.0	EPA 6010B	7.9
A5	L8-SS7L	0.0-2.0	EPA 6010B	7.8
A5	SBNO-0.5	0.5	EPA 6010B	8.94
A5	SBNO-1.0	1	EPA 6010B	8.58
A5	SBNOP-0.5	0.5	EPA 6010B	7.76
A5	SBNOP-1.0	1	EPA 6010B	9.67
A5	SBO112-0.5	0.5	EPA 6010B	8.07
A5	SBP12-10.0	10	EPA 6010B	**10.6**
A5	SBP13-PS2-4.0	4	EPA 6010B	7.8
A5	SBPQ0.5	0.5	EPA 6010B	8.46
A5	SBPQ-1.0	1	EPA 6010B	9.56
A5	SBQ11-15.0	15	EPA 6010B	7.81
A5	SBQRST-1.0	1	EPA 6010B	8.11
A5	SBR12-0.5-15.0	0.5-15.0	EPA 6010B	7.75
A5	SBS12-0.5	0.5	EPA 6010B	8.02

Definitions:

COMP -	composite sample
DDC -	deep dynamic compression
mg/kg	milligrams per kilogram
SMG -	soil management goal
UCL_{95} -	upper confidence limit on the mean

Notes:

Background 95th percentile for arsenic = 7.6 mg/kg

* Sample location is currently situated below LLDPE geomembrane or will be below LLDPE geomembrane elevation following DDC.

Sample with concentration in **bold** would be moved to be below LLDPE geomembrane (see text).

1 - Average arsenic concentrations in cover soil in cells A2, A3, and A-5 (UCL_{95} concentrations of 5.4, 5.0, and 6.3 mg/kg, respectively) are lower than the average background concentration (UCL_{95} of 6.5 mg/kg).

FIGURES

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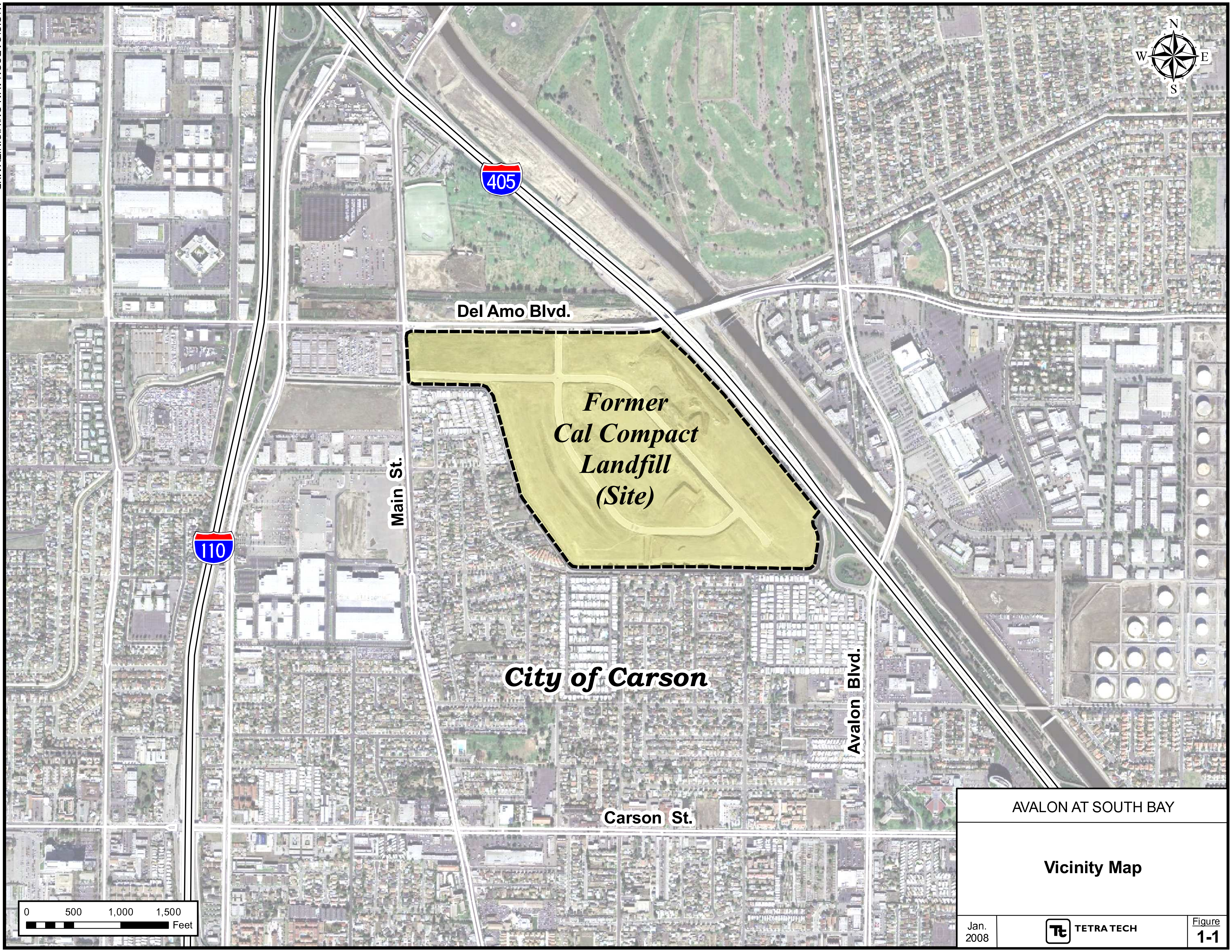

AVALON AT SOUTH BAY

Vicinity Map

Jan. 2008	TETRA TECH	Figure 1-1

AVALON AT SOUTH BAY

Site Map

Jan. 2008

TETRA TECH

Figure 1-2

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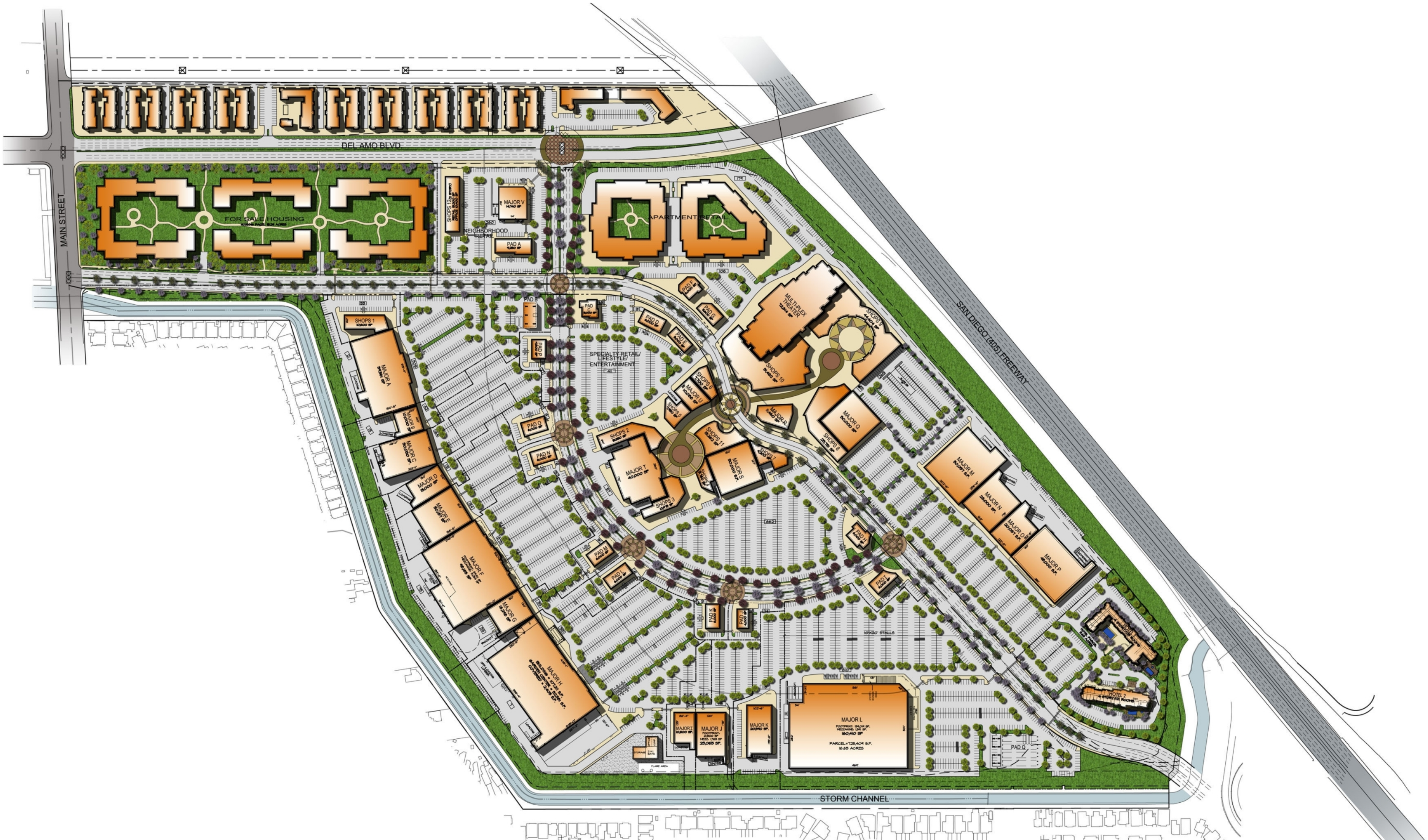

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Development Plan Date: September 17, 2007

AVALON AT SOUTH BAY

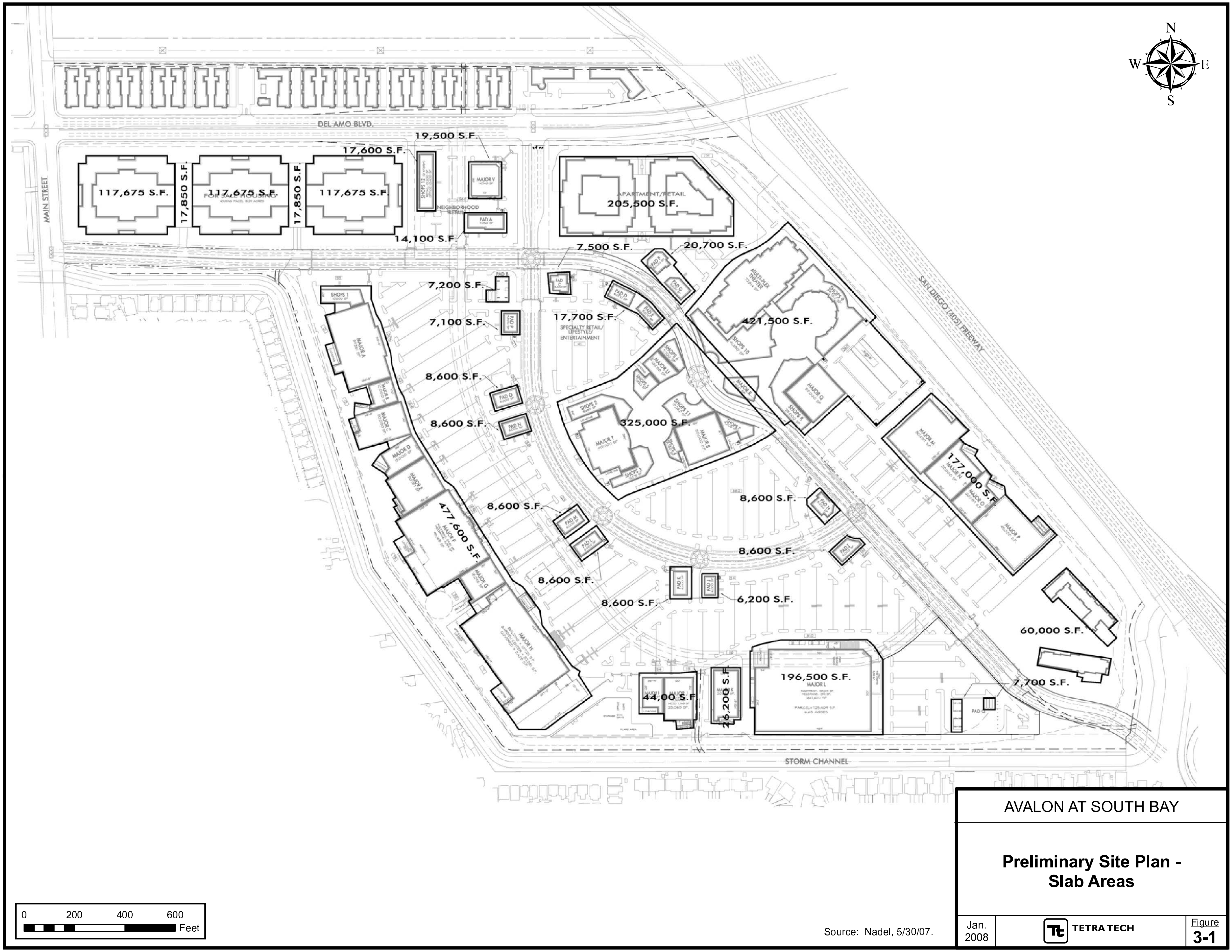
Development Plan

Jan. 2008

TETRA TECH

Figure **1-3**

X:\GIS\CARSON-AVALON\SLAB AREAS.MXD



Source: Nadel, 5/30/07.

AVALON AT SOUTH BAY

Preliminary Site Plan - Slab Areas

Jan. 2008

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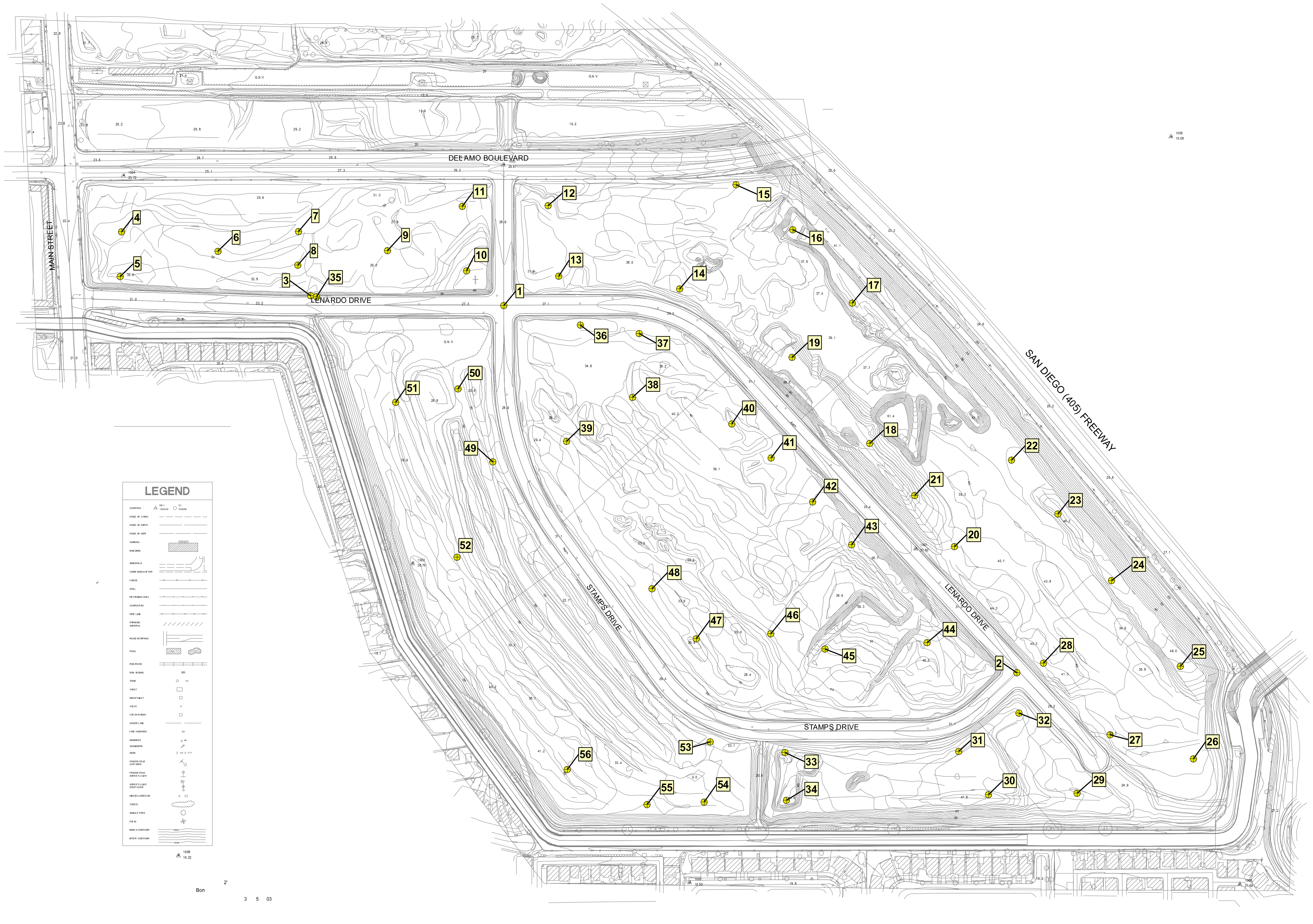
Figure 3-1

X:\GIS\CARSON-AVALON\NEAR SURFACE SAMPLE.MXD



NOTES	DATE
BASE MAP SOURCE: A.L.T.A. LAND TITLE SURVEY	3/2003

TC # 15119	
Drawn by:	SH
Checked by:	JW
Approved by:	

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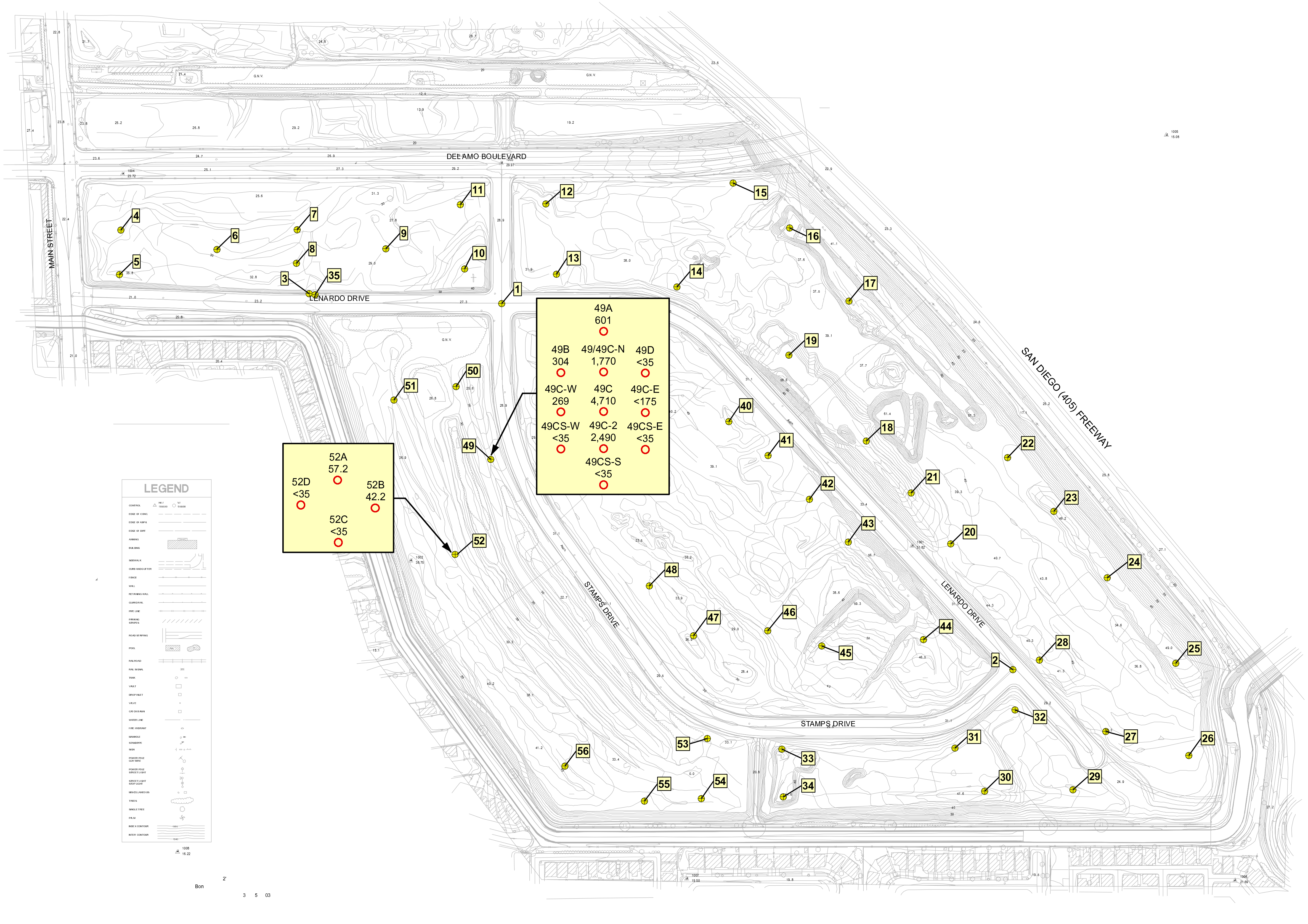
AVALON AT SOUTH BAY

Near-Surface Sampling Locations March 4 and 7, 2005

Figure **4-1**

X:GISCARSON-AVALONNEAR SURFACE SAMPLE-EXPANDED.MXD



NOTES	DATE
BASE MAP SOURCE: A.L.T.A. LAND TITLE SURVEY	3/2003

TC # 15119	
Drawn by:	SH
Checked by:	JW
Approved by:	

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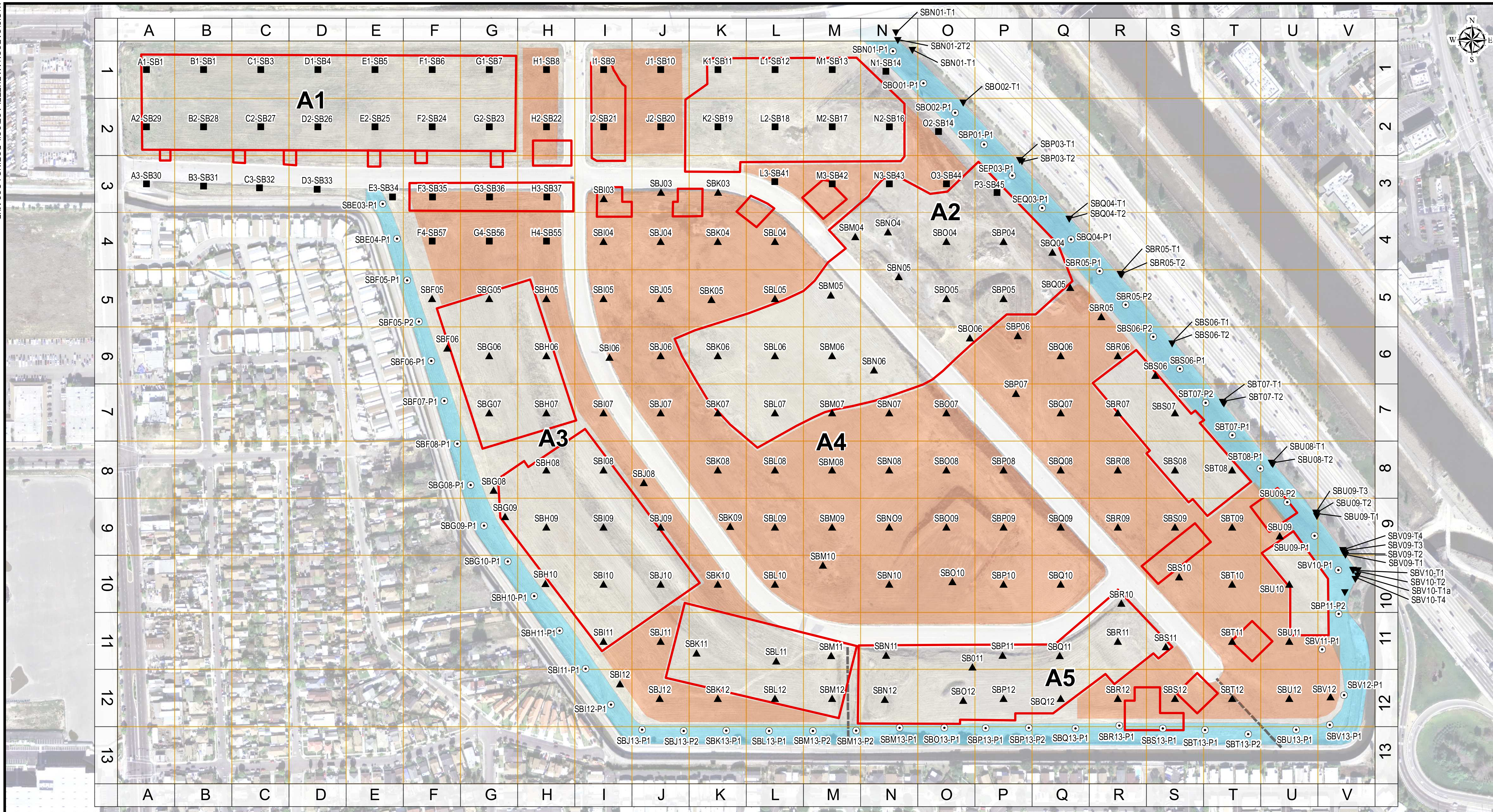
AVALON AT SOUTH BAY

Expanded Near-Surface Sampling Locations, April 8 and 19, 2005

Figure 4-2



X:\GIS\CARSON MARKETPLACE\SOIL BORING LOCS.MXD

LEGEND

- ▲ Interior Cover Soil Boring Location (Arcadis)
- ■ Interior Cover Soil Boring Location (Tetra Tech)
- ⊙ Perimeter Slope Cover Soil Boring Location
- ▼ Toe of Slope Cover Soil Boring Location
- Proposed Slab Location
- Deep Dynamic Compaction Area
- Approximate Slope Area

0 300 600 Feet

NOTE: Grid size measured 200 x 200 ft.

AVALON AT SOUTH BAY

Cover Soil Sampling Locations Year 2006 / 2007

Jan. 2008

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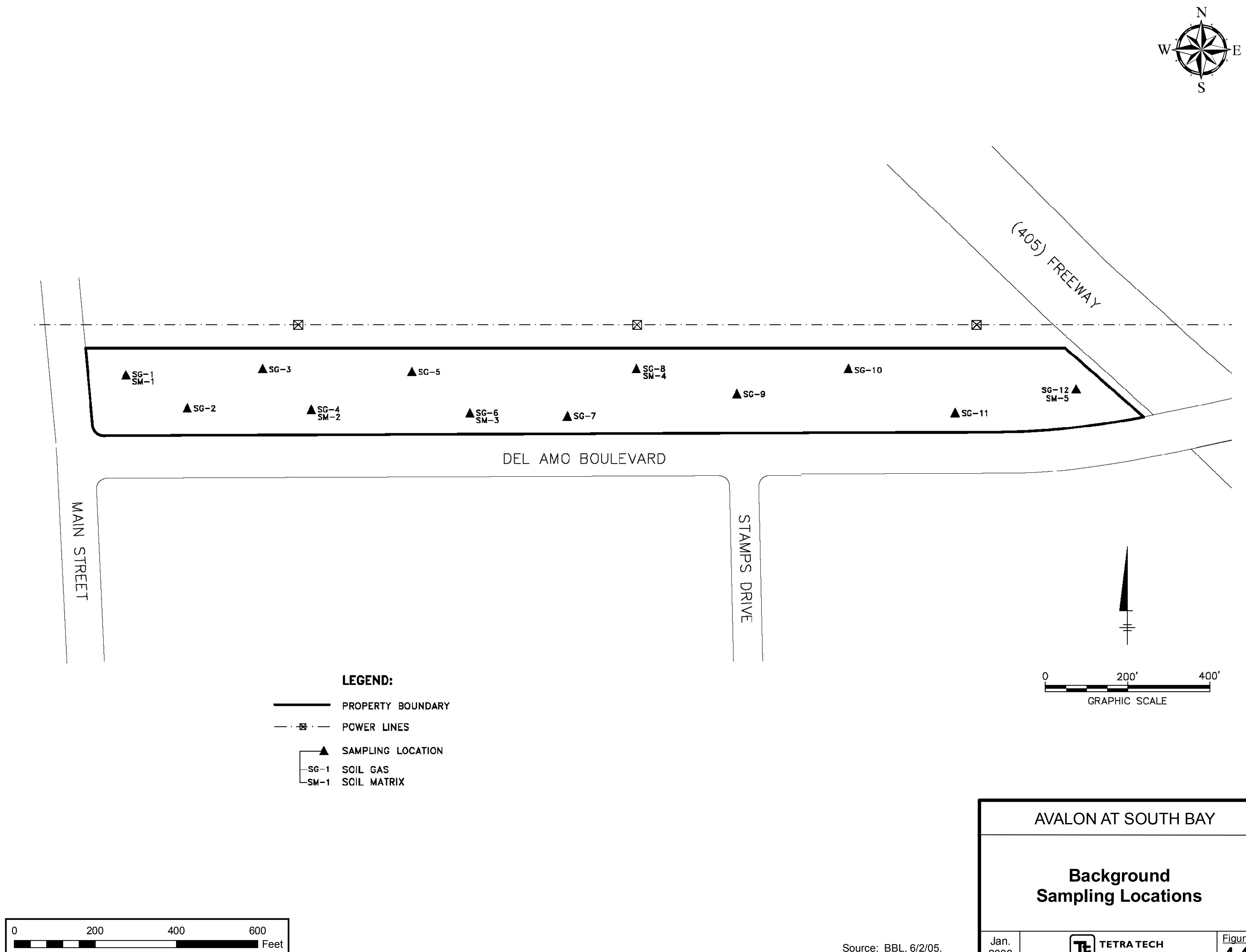
Figure 4-3



X:\GIS\CARSON-AVALON\SAMPLE LOCATIONS.MXD

Source: BBL, 6/2/05.

AVALON AT SOUTH BAY

Background Sampling Locations

Jan. 2008

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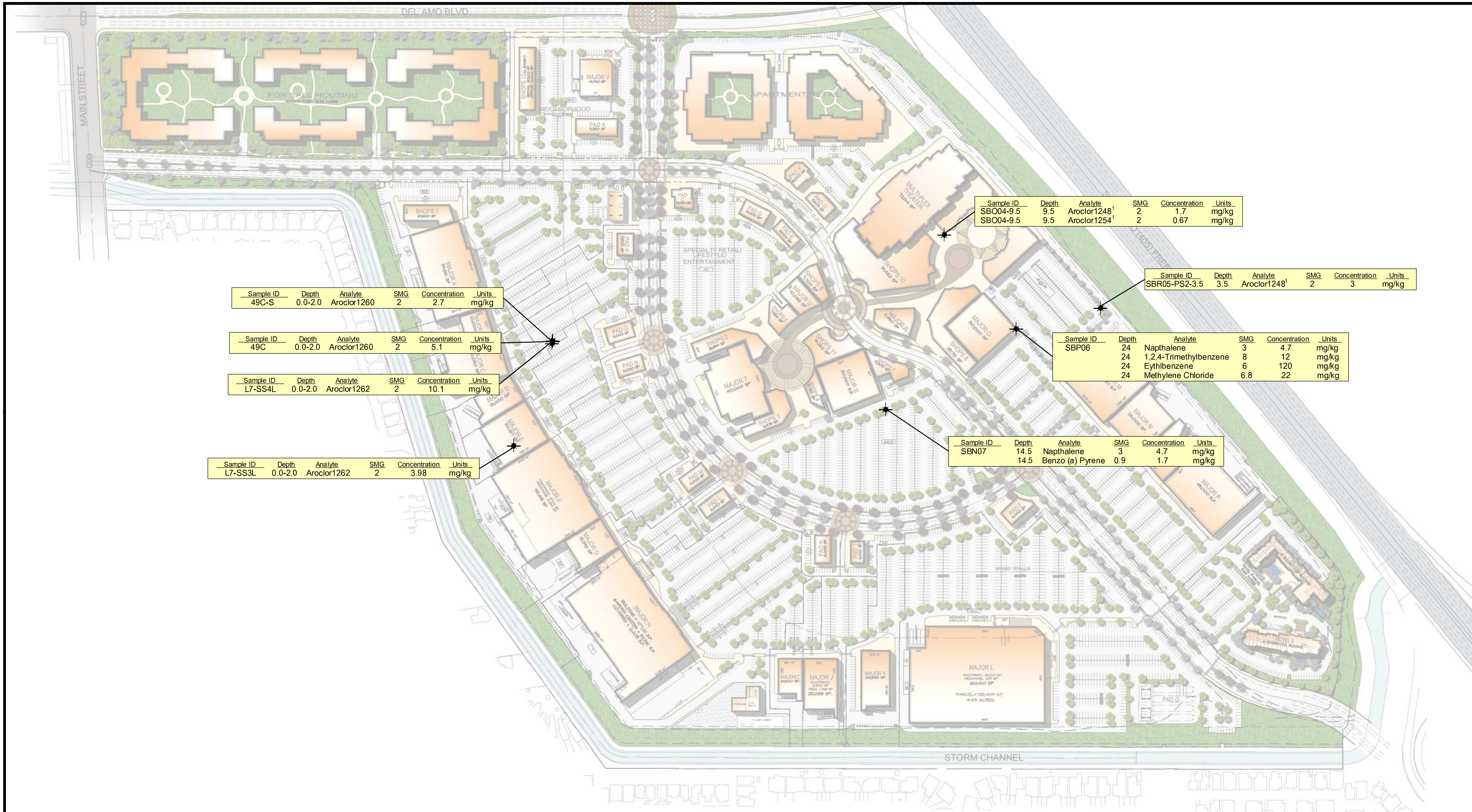
Figure 4-4

X:\GIS\CARSON-AVALON\COPC_SMG.MXD



Sample ID	Depth	Analyte	SMG	Concentration	Units
SBO04-9.5	9.5	Aroclor1248[1]	2	1.7	mg/kg
SBO04-9.5	9.5	Aroclor1254[1]	2	0.67	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
SBR05-PS2-3.5	3.5	Aroclor1248[1]	2	3	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
SBP06	24	Napthalene	3	4.7	mg/kg
	24	1,2,4-Trimethylbenzene	8	12	mg/kg
	24	Eythlbenzene	6	120	mg/kg
	24	Methylene Chloride	6.8	22	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
SBN07	14.5	Napthalene	3	4.7	mg/kg
	14.5	Benzo (a) Pyrene	0.9	1.7	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
49C-S	0.0-2.0	Aroclor1260	2	2.7	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
49C	0.0-2.0	Aroclor1260	2	5.1	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
L7-SS4L	0.0-2.0	Aroclor1262	2	10.1	mg/kg

Sample ID	Depth	Analyte	SMG	Concentration	Units
L7-SS3L	0.0-2.0	Aroclor1262	2	3.98	mg/kg

LEGEND

Soil Sample Location

Notes:

SMG = soil management goal

Sampling depth reported in ft. below ground surface.

(1) The sum of the two PCB mixtures (Aroclor 1248 and 1254) in this sample exceeded the carcinogenic SMG for PCBs.

Grid size measured 200 x 200 ft.

N

0 200 400

SCALE IN FEET

TETRA TECH
348 W. HOSPITALITY LN. SUITE 100
SAN BERNARDINO, CALIFORNIA 92408
(909) 381-1674

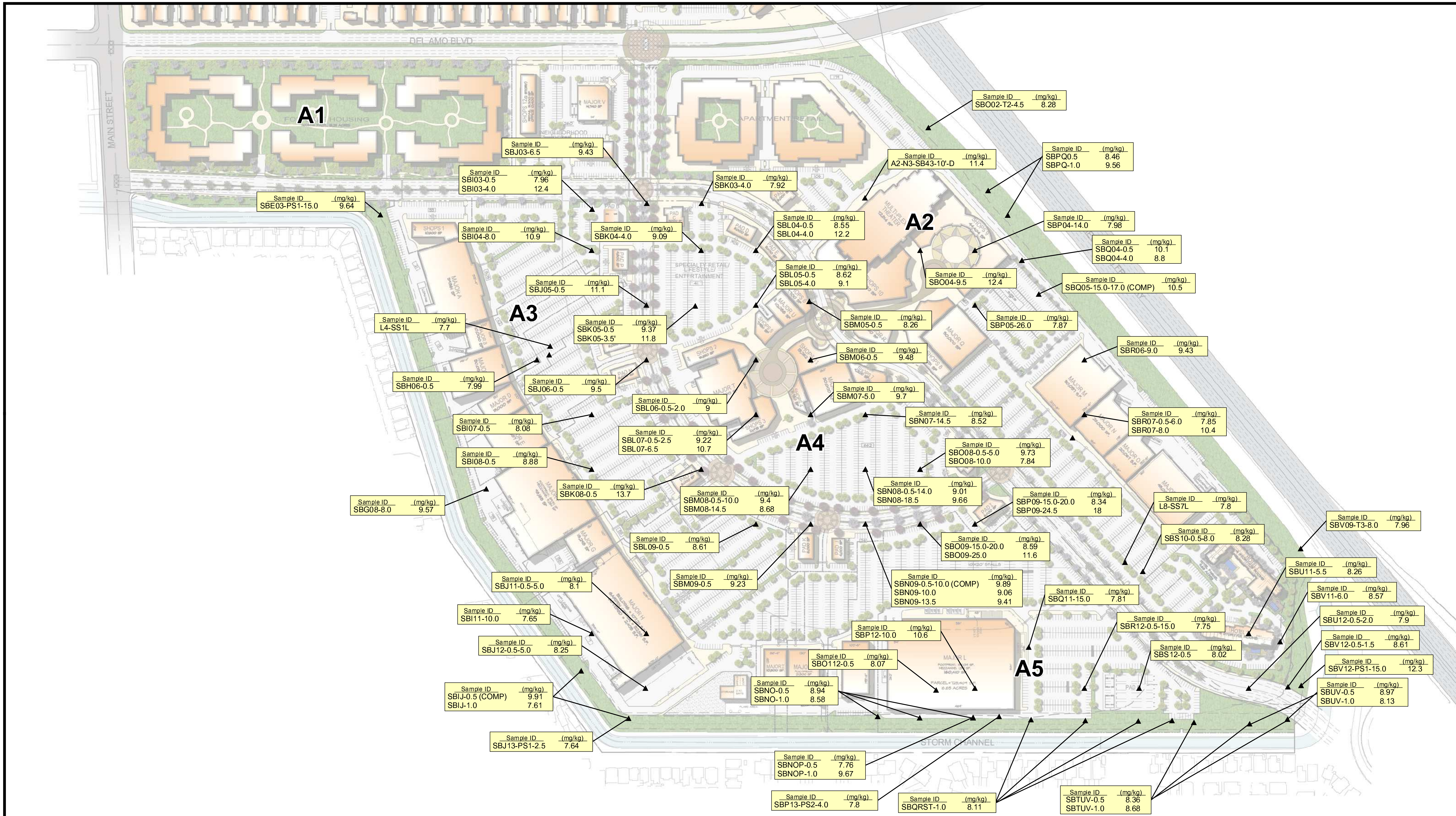
TC # 21868.1.1.01

DRAWN BY:	SH	03/25/08
CHECKED BY:		
APPROVED BY:		

AVALON AT SOUTH BAY

AVALON AT SOUTH BAY

Figure 5-1
Cover Soil Samples with Organic COPC Concentrations Exceeding SMGs



LEGEND

▲ Soil Sample Location

Notes:

95th percentile background = 7.6 mg/kg.

Sampling depth reported in ft. bgs.

Sample ID SBIJ is comprised of samples collected from alpha

0 200 400
SCALE IN FEET

TETRA TECH
348 W. HOSPITALITY LN. SUITE 100
SAN BERNARDINO, CALIFORNIA 92408
(909) 381-1674

TC # 21868.1.1.01		
DRAWN BY:	SH	03/20/08
CHECKED BY:		
APPROVED BY:		

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AVALON AT SOUTH BAY

Figure 5-2
Cover Soil Samples with Arsenic Concentrations Exceeding 95th Percentile Background