Section 3

Section 3
Field Activities

3.1 Sampling Objectives, Rationale, and Locations

The objective of the field investigation was to collect the data needed to: characterize the nature and extent of contamination in Site soils to support the data needs of the risk assessment, feasibility study, remedial design, and a ATSDR Public Health Assessment, and Natural Resource Trustee. The data requirements for these goals were identified in the *OSS RI/FS Work Plan* (CDM, September 29, 2003). Historic data were evaluated against the data requirements, and data gaps were identified. The original scope of work for the RI was based upon filling the identified data gaps. Historic data were presented previously in the *Data Summary Report for On-Site Soils* (CDM, December 4, 2001). A brief summary was also provided in the *On-Site Soils RI/FS Work Plan*. The following types of data were collected: analytical data from surface soil, subsurface soil, soil vapor, indoor and outdoor air samples; field lithologic observations during coring; soil conductivity and in situ soil/soil vapor VOC data from MIP borings; and physical soil parameters. In addition to collecting samples, HVAC surveys and chemical usage surveys were conducted during walk-throughs of the buildings on the former Omega Chemical property and other adjacent and nearby facilities.

As data were evaluated from the original scope of work, data gaps were identified in the new consolidated data set. To continue meeting the goals of the RI, additional sampling locations were proposed to and approved by USEPA. These preliminary data evaluations and proposed additional tasks were documented in several memoranda to USEPA from 2004 to 2006. Three technical memoranda summarizing MIP and soil gas sampling results and proposed additional sampling locations are provided in their entirety on the compact disc contained in Appendix B. USEPA comments to these three technical memoranda and OPOG responses to comments, where available, are also provided in Appendix B.

This report compiles the conclusions from the preliminary data evaluations while adding detail to the field and quality assurance quality control (QA/QC) procedures utilized throughout the sampling program. All sample locations are shown in Figure 3-1, with the exception of the air quality sample locations which are shown on Figure 4-27. Analytical summary tables for all samples collected during the RI are included on the compact disc which is provided in Appendix A.

3.1.1 Surface Soil

Twenty surface soil samples were collected at the former Omega Chemical property on April 6 and 7, 2004 (Figures 3-1 and 3-2). The surface soil samples were collected to: 1) characterize the nature and extent of contamination in surface soils to the extent necessary to select the appropriate remedy, 2) generate data to support the HHRA; 3) evaluate potential source areas identified in historical aerial photographs; and

4) generate soil physical characteristics data to evaluate the potential for vapor migration through surface soils.

Sixteen of the 20 surface soil samples were collected based on a systematic sampling strategy. Systematic sampling was selected as the primary sampling design for surface soils. This type of sampling strategy is effective for risk assessment and geostatistical characterizations (USEPA, 1988). Systematic sample locations were established across an area of concern by laying out a grid of sampling locations that follow a regular pattern (square). Rectangular grid patterns were established. The location of the first grid point was randomly selected; the locations of the remaining grid points were determined along a 40-foot fixed spacing grid. Sample locations along the grid were revised slightly to account for the presence of buildings.

The remaining four surface soil sampling locations were targeted for potential source areas (SS-12, 13, 14) and an area of known surface soil contamination (SS-04). The sampling results may overestimate contamination because they are located in possible source areas. The source areas were identified in historic aerial photographs. Because several of the 16 systematic sampling locations were already located in potential source areas, three additional sampling locations should be sufficient for source evaluation.

One soil sample was collected in an area where lead was previously detected in shallow soil sample SB-12 (depth of 1.7 feet bgs) at a concentration of 890 mg/kg. The high lead concentration is bounded by lower concentrations in surrounding sample locations except in the southwest direction. The last surface soil sample was located to evaluate the extent of lead-impacted soil in the southwest direction.

All surface soil samples were collected immediately beneath the paved surface from a depth of approximately zero to six-inches bgs and were analyzed for semi-volatile organic compounds (SVOCs) by USEPA Method 8270, metals by Method 6010B/7471A, pesticides by Method 8081, and poly-chlorinated biphenyls (PCBs) by Method 8082. Two of the systematic surface soil samples were analyzed for soil physical characteristics (moisture, water permeability, hydraulic conductivity, and grain size distribution) to evaluate possible VOC vapor migration through soil into air.

3.1.2 Subsurface Soil

Subsurface soil samples were collected to: 1) provide additional lithologic information; 2) generate data to evaluate the potential for vapor migration; 3) evaluate the potential effectiveness of remedial alternatives; 4) to confirm MIP or soil vapor sampling results and 5) to characterize the distribution of contaminants. Figures 3-1 and 3-3 show the locations of the subsurface soil borings.

Soil Sampling, October 27 to 28, 2003

Borings GP-1, GP-2, and GP-3A were drilled between October 27 and 28, 2003 as proposed in the OSS RI/FS Work Plan (CDM, September 29, 2003). Data from analysis

of samples collected from the borings were used for both the OSS RI and the Phase 1a groundwater investigation. Vironex, Inc. of Santa Ana, California provided direct push drilling services. All borings drilled during this time period were located at the former Omega Chemical property. Total depths were 85 feet bgs.

Detailed drilling, soil sampling, sampling handling, and documentation procedures are provided in Section 3.3.3. Soil samples were collected continuously in acetate liners in five-foot intervals. The bottom six inches of the five-foot interval were divided from the longer interval, labeled, and cooled. The sample liners were opened and examined for coarse grained materials such as sand or gravel. Coarse grained materials were immediately placed into an 8-ounce jar, labeled, and cooled. Soils immediately adjacent to chilled samples were field-screened using an organic vapor monitor (OVM) equipped with a photoionization detector (PID).

The Encore samples and soil core within the acetate sleeve were submitted to Del Mar Analytical Laboratories of Irvine, California, for the following chemical analyses:

- VOCs (USEPA Method 8260B). Encore sub-samples were collected for USEPA extraction method 5035
- 1,4-dioxane (USEPA Method 8270C modified)

The remaining samples were submitted to PTS Laboratories of Santa Fe Springs, California, for physical soil parameters:

- Cation exchange (USEPA Method 9081)
- Oxidation reduction potential (American Society of Testing and Materials [ASTM] D1498)
- Moisture (ASTM D2216)
- Hydraulic conductivity and water permeability (ASTM D5084)
- Grain size distribution (ASTM D422/4464M)
- Redox potential (SM 2580B)
- Total organic carbon (TOC, by the Walkley-Black method)

Boring GP-3A was a replacement for boring GP-3, which was located near the Omega loading dock at a former 500-gallon kerosene UST. The UST had been abandoned by removal and backfilled with gravel. The direct push drilling rig method was insufficient to maintain an open borehole or drill past the backfilled materials. Boring GP-3A was drilled away from the former UST excavation area as a replacement boring for GP-3. MIP screening was originally intended to be conducted at GP-3, but because of the presence of odorous soils, additional samples were collected for VOC

and 1,4-dioxane analysis and the MIP screening was conducted at a borehole drilled at a later date.

Soil sampling, January 20 to 22, 2004

Borings GP-4 through GP-8 were drilled between January 20 to 22, 2004 as proposed in the OSS RI/FS Work Plan and the revised work plan addendum dated October 20, 2004. Boring GP-6 was located at the former Omega property, while borings GP-4, GP-5, GP-7 and GP-8 were located at the adjacent Terra Pave property. Total depths of the borings were 85 feet bgs except for GP-8, which was terminated at 66 feet bgs due to refusal.

MIP screening was conducted at GP-4, GP-5, and GP-6 on January 19, 2004, prior to the subsurface soil sampling. Results from the MIP screening were used to select four or five depths at GP-4 and GP-5 to analyze for VOCs (USEPA Method 8260B) and 1,4-dioxane (USEPA Method 8270C Modified). Samples from GP-6 were analyzed for VOCs and 1,4-dioxane as well as the physical soil parameters conducted in October 2003. For boreholes GP-7 and GP-8, which were not screened with the MIP tool, samples were collected based upon field PID measurements.

Detailed drilling, soil sampling, sampling handling, and documentation procedures are provided in Section 3.3. All samples for VOC analysis were sampled using Encore™ sampler for USEPA extraction method 5035.

Soil sampling, April 13, 2004

Two soil borings were conducted to collect 6-foot deep soil samples on April 13, 2004 as proposed in the *OSS RI/FS Work Plan*. The soil borings were conducted concurrently with soil vapor sampling near soil vapor borings SG-04 and SG-08. The samples were analyzed for physical parameters only and were used to supplement the soil vapor data. The physical parameters were:

- Grain size distribution (ASTM D422/4464M)
- Hydraulic conductivity and water permeability (ASTM D5084)
- Moisture (ASTM D2216)

Subsurface soil sampling, December 2005 and March 2006

Seven additional soil borings were conducted as part of the work proposed in the *On-Site Soils RI/FS Work Plan Addendum No. 2, Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations* (Appendix B, CDM, November 1, 2005) and *On-Site Soils RI/FS Work Plan Addendum No. 2, Summary of Additional Findings from Soil Vapor and MIP Sampling* (Appendix B, CDM, January 27, 2006). The soil borings were conducted to confirm the validity of the MIP findings, provide information regarding contaminants derived from the former Omega Chemical property, and examine the lithology for more permeable

pathways from suspected source areas. Sample depths were selected based upon the MIP results.

Borings B1 (MIP14/VP11), B2 (MIP3), and B3 (MIP1) performed at the former Omega Chemical property, were conducted from December 16 to 19, 2005 as recommended in the *OSS RI/FS Work Plan Addendum No. 2 – Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations* (Appendix B). These borings were advanced to 75 feet bgs regardless of sample depth.

Borings B4 (MIP8/VP13), B5 (MIP22/VP18), B6 (MIP26/VP21), and B7 (VP14/MIP21) were conducted from March 7 to 9, 2006 as requested by USEPA at the Terra Pave property. These borings were advanced one to five feet below the deepest sample.

All boreholes were logged continuously in five-foot intervals by an on-site CDM geologist. All soil samples were analyzed for physical parameters as determined by the MIP soil conductivity results, while selected samples were analyzed for chemicals of concern, as determined by the MIP electron capture detector (ECD), PID, and flame ionization detector (FID) results. The following are the chemical and physical parameters that were analyzed:

- VOCs (USEPA Method 8260B) Encore sub-samples were collected for USEPA extraction method 5035.
- 1,4-dioxane (USEPA Method 8270C modified)
- Density (American Petroleum Institute [API] RP40)
- Moisture (ASTM D2216)
- Hydraulic conductivity and water permeability (ASTM D5084)
- TOC (USEPA Method 9060 or the Walkley-Black method)

3.1.3 Soil Vapor

Soil vapor samples were collected to generate Site boundary data for use in the risk assessment, provide data for use in evaluation of vapor migration, provide additional characterization of potential source areas, and confirm MIP concentrations. Soil vapor locations are shown in Figures 3-1 and 3-4. Only the results of soil vapor sampling conducted from 2004 to 2006 were considered in the evaluation of Site conditions; the historic (pre-2004) sample locations are shown on Figure 3-4. All soil vapor samples from 2004 through 2006 were analyzed for VOCs by method TO-15. The soil vapor samples were collected over several events as described below.

Soil vapor survey – April 12 to 13, 2004

The first soil vapor survey conducted for this RI was conducted from April 12 to 13, 2004. Soil vapor survey locations SG-1 through SG-12 were selected using either systematic (grid) sampling or in potential source areas as identified in historic aerial

photographs as summarized in Table 3-1. Each location was sampled at 6 and 12 feet, bgs. The soil vapor sampling locations and depths were based upon investigations conducted prior to the OSS RI/FS Work Plan. Soil vapor probes were installed and sampled as described in Section 3.3. Immediately after sampling the probes with an evacuated Summa canister, a sample was collected in a Tedlar bag and field screened with a handheld PID.

Table 3-1
SG-01 to SG-12: Sampling Rationale and Locations

Location ID	Rationale
SG-01, 02, 03	To evaluate extent of VOC contamination at the adjacent former Cal-Air property.
SG-04 to SG-09	To provide systematic collection of vapor analysis throughout the former Omega Chemical property.
SG-10, 11, 12	To evaluate potential source areas at the former Omega Chemical property, based on historic aerial photos.

Soil vapor and utility corridor survey – November 9 to 12, 2004

A second soil vapor sampling event at 21 locations was conducted between November 9 and 12, 2004. The event consisted of deeper sampling of soil vapor at locations SG-07 through SG-12 based upon evaluation of the initial shallow soil vapor sampling results, and a focused sampling of backfill along utility corridors (UC boreholes). Depths and rationale are provided below.

Table 3-2
SG-07 to SG-15 and UC-1 to UC-12: Sampling Rationale and Locations

Location ID	Depths (ft bgs)	Rationale
SG-07 to SG-12	18, 24	To assist in determining the relative importance of lateral transport of vapors from shallow soil contamination in comparison to vertical transport derived from the "off-gassing" from groundwater. Because of elevated concentrations at shallow depths and the depth of groundwater (approximately 70 feet bgs), groundwater was not believed to be a source of observed soil vapor VOCs at the time.
SG-13, 14, 15	6, 12	To determine if there are preferential pathways and to assist with evaluation of remedial options at the Skateland facility (which has since been demolished).
UC-1 to UC-12	Between 2 and 11, depending upon the depth of the utility	To evaluate the extent and nature of VOC contamination in soil vapor in the backfill materials surrounding utility lines. The utility lines are potential significant preferential vapor migration pathways. Final locations were based upon the utility maps provided by the City of Whittier and the initial field-screened hand auger boreholes

The soil vapor probes for the SG locations were installed using a direct push rig on November 11, 2006 and sampled in Summa canisters. The drillers utilized the

hydraulic hammer to drill deeper than 18 feet. Summa canisters filled very slowly at the 24-foot depth at SG-8 and SG-9.

The utility corridor soil vapor sampling was conducted in two phases to prevent damaging subsurface utilities. The first phase was performed by advancing a hand auger into backfill material on November 9 and 10, 2004. The fill materials consisted of moist clayey silts and silty clays, except for cobbles at four to five feet bgs at UC-4A, and sand at four feet bgs at UC-11. A sampling probe was driven into the hand augered borehole and a soil vapor probe installed. The probe was evacuated using the pump in the handheld PID instrument and the maximum reading was collected. After all the UC boreholes were hand augered and screened with the PID, sample probes were installed adjacent to the hand augered borehole with a direct push rig and samples were collected in Summa canisters on November 12, 2004

Soil vapor survey – August 15 to 22, 2005

A third soil vapor survey was conducted at 12 locations during the period August 15 to 22, 2005. Depths for this soil vapor sampling event were significantly deeper than the previous investigation with nine of the borings advanced to a depth of 70 feet bgs. After evaluating the previous data, it was hypothesized that volatilization may be occurring from either groundwater and/or the capillary fringe. The event was conducted to: 1) identify probable source areas; 2) determine if elevated soil vapor concentrations are associated with contaminated Site soils; 3) volatilization from groundwater, or both; 4) identify migration pathways from source areas for both soil vapor and groundwater; 5) collect additional characterization data to support remedy selection, including evaluation of both vadose and saturated zones, if appropriate to enhance the effectiveness of the anticipated Engineering Evaluation/Cost Analysis (EE/CA); and 6) characterize the extent of source area contamination. Table 3-3 provides the rationale for the sampling locations. Sample depths were variable and are discussed in the text below.

Table 3-3
VP1 to VP12: Sampling Rationale and Locations

Location ID	Rationale
VP-6, 7, 8 VP-9/MIP-5	To identify potential source locations, near or downgradient of former sumps.
VP-4, 5 VP-3/MIP-2	To identify potential source locations, near or downgradient of former tank areas.
VP-1, 2, 10, 12 VP-11/MIP-14/B1	To determine if previously identified shallow soil vapor contamination persisted at depth.

Three of the locations (VP-5, VP-7, and VP-10) were sampled at approximately 6, 12, 18, 24 and 40 foot depths. Nine of the locations (VP-1, VP-2, VP-3, VP-4, VP-6, VP-8, VP-9, VP-11, and VP-12) were sampled at the above depths, plus the 50, 60 and 70 foot depths. Generally, the shallowest three depths were nested within one direct push

borehole (6, 12, and 18 feet bgs), the next three depths were nested in a second borehole (24, 40, and 50 feet bgs), while the deepest two depths were installed in a third borehole (60 and 70 feet bgs). Therefore, three boreholes were cored at the deeper sampling locations. Field PID measurements were taken at all sampling depths and locations. Exceptions to the above were the following:

- VP-01: The initial boring collapsed to 7.5 feet bgs. The remaining probes were installed in two boreholes: the shallow borehole contained 6-, 12-, 18-, and 24-foot bgs probes, while the deeper borehole contained the 40-, 50-, 60-, and 70-foot probes.

- VP-03: Due to the presence of shallow gravel between 13 and 18 feet bgs, deeper vapor probes were unable to be installed using the standard 1-1/2-inch diameter rods. Larger diameter 2-1/2-inch drilling rods were used to keep the borehole open while installing the deeper probes. Drilling rods broke at the threaded joints during withdrawal, although an alternate location several inches away of the original attempt was successful.

- VP-06: The borehole squeezed after the 70-foot probe had been constructed. Instead of constructing the 60-foot probe, a shallower 50-foot probe had been constructed instead. The 60-foot probe was constructed in an adjacent borehole with the 24- and 40-foot intervals.

- VP-08: A strong odor was noted while boring VP-08 was hand augered to clear to utilities. Drilling was difficult between 50 and 70 feet, and the drilling rods broke at the threaded joints upon withdrawal. An alternate location was successfully completed approximately eight inches northwest of the original attempt.

- VP-09: The borehole squeezed after the 40- and 50-foot vapor probes had already been installed. Therefore, the 24-foot sampling interval was built with the shallow 6-, 12-, and 18-foot probes.

Soil vapor survey – December 12 to 15, 2005

A fourth soil vapor survey was conducted at seven locations during the period December 12 to 15, 2005. Table 3-4 provides the rationale for selecting each of these locations. The sampling interval in these probes was based on a co-located MIP probe, or at the previously specified depths if a MIP probe was not adjacent. The exception was at VP-19, where vapor probes were installed to the depths from the previous sampling event (6, 12, 18, 24, 40, 50, 60, 70 feet bgs). Squeezing at approximately 60 feet bgs was observed at VP-19. Sampling depths were variable and are discussed in the text on the following page.

Table 3-4
VP-13 through VP-19: Sampling Rationale and Locations

VP ID	Other ID	Rationale
VP-13	MIP-8 B4	To check for contaminant signature that is potentially different from the former Omega Chemical property signature and to assess concentration gradients away from the former Omega Chemical property. Sampling occurred to the water table.
VP-14	MIP-21 B7	To check for potential source related to sewer line leaving Terra Pave. Sampling occurred to the water table.
VP-15		To check for declining concentrations away from suspected source areas. Sampling occurred to the water table. This was located upgradient of the highest groundwater concentrations observed in wells along Putnam Street.
VP-16	MIP-18	To check for contaminant signature that is potentially different from the former Omega Chemical property signature on the parcel to the north. Sampling will occur to the water table.
VP-17	MIP-19	To evaluate the extent of contamination in a northern direction along Putnam Street.
VP-18	MIP-22 B5	To evaluate the southern extent of contamination.
VP-19	MIP-16A	To check for declining concentrations away from suspected source areas.

Soil vapor survey – March 6 to 9, 2006 and May 31, 2006

A fifth soil vapor survey was conducted at eight locations during the period March 6 to 8, 2006. Another three locations were sampled on May 31, 2006 due access issues along the grassy parkway between the Whittier Boulevard frontage road and the main thoroughfare, and at Medlin & Son North building. Many of these locations were co-located with MIP sample borings, and the depth of the soil vapor samples was chosen based upon MIP results. These vapor sample locations were primarily above the "30 foot unit". The rationale for the additional borings/sampling provided in Table 3-5. Squeezing was observed at VP-25. All five soil vapor probes were installed in one borehole at VP-21. Sample depths were variable, and are discussed in the text below.

Table 3-5
VP-20 to VP-30: Sampling Rationale and Locations

Direction	Location ID	Rationale
East	VP-25/MIP-30 VP-26 VP-27	A MIP boring and soil vapor sampling were requested by DTSC east the former Omega Chemical property to confirm decreasing contaminant concentrations in this direction.
North	VP-20/MIP-25 VP-29 VP-30	Total VOCs (TVOCs) in soil vapor samples increase going from VP-03 to VP-16 in the 47-50 foot depth range (212 to 2,335 milligrams per cubic meter [mg/m^3]). Investigation at this area was intended to determine if the relatively high TVOC concentration seen at the 47 foot depth at VP-16 and the 30-foot unit extend further to the northwest, and to assist in identifying other sources on this property.
West	VP-21/MIP-26/B6 VP-22/MIP-27	TVOCs in soil vapor samples from several depths were higher at VP-14 and VP-15 than samples to the east of these locations. These

Direction	Location ID	Rationale
	VP-23/MIP-28 VP-28	additional sampling locations were intended to look for decreasing contaminant concentrations to the west and southwest of VP-14, 15, 17 and 18.
South	VP-24/MIP-29	This location was intended to document lower contaminant concentrations to the south of MIP-24 where contamination was indicated in the 30-foot unit. The boring also provided information on the transition zone to thicker sands in the saturated zone that is observed near Washington Street.

3.1.4 MIP

The MIP is a direct push tool that produces real-time, continuous, soil conductivity and qualitative organic vapor monitor profiling. MIP profiles were collected to: determine the nature and extent of contamination; generate data for use in the risk assessment; provide data for use in evaluation of vapor migration; provide characterization of potential source areas; and to provide lithologic information. Similar to soil vapor and soil sample sampling, MIP sampling was conducted over several events. MIP sampling locations are shown on Figure 3-1 and 3-5. The results of the MIP sampling program are discussed in Sections 4 and 5 of this document. The MIP logs are included on the compact disc which is provided in Appendix A.

Because MIP organic vapor monitor profiling heats the surrounding soil and analyzes the vapors with a PID, FID and/or ECD to measure bulk concentrations of volatile compounds, the qualitative data generated are considered a measure of both soil and soil vapor concentration. Soil and soil vapor samples were collected in adjacent boreholes to determine concentrations of individual VOCs to compare with the MIP organic vapor profiling. Likewise, soil conductivity data required physical soil data to properly assign lithology.

MIP Sampling – January 19, 2004

MIP sampling was originally conducted at three locations to better understand the value and utility of the MIP technology. Three MIP boreholes (GP4-MIP, GP5-MIP, and GP6-MIP) were advanced to 85 feet bgs on January 19, 2004. GP6-MIP was advanced to 83 feet bgs until refusal. The organic vapor profiles were used to select soil sample depths at the adjacent borings GP4, GP5, and GP6. After evaluating the MIP data, it was found that MIP profiles were particularly useful for finding source areas and slight changes in lithology that could be potential contaminant migration pathways.

MIP Sampling – September 26 to 30, 2005

A second round of MIP sampling was conducted at 15 locations based upon the results of the soil vapor survey performed in August 2005. This MIP sampling was performed to define the nature and extent of contamination as well as to identify pathways of migration of contaminants in both the vadose and saturated zones. MIP borings were pushed to 85 feet bgs or until refusal. Specific rationale for MIP sampling locations is presented in the following table.

Table 3-6
MIP1 to MIP15 Sampling Rationale and Locations

MIP ID	Other ID	Total Depth	Rationale
MIP1	B3	80	To target data gap areas, suspected source areas, and define limits of contamination at the former Omega Chemical property.
MIP2	VP-3	86	
MIP3	B2	80	
MIP4		83	
MIP5	VP-9	85	
MIP6		85	
MIP13		83	
MIP14	VP-11	84.5	
MIP15		82	
MIP7		80	To define the presence, geometry, and degree of contamination in the postulated sand channel deposits along this trend. Potential source areas may be "back-tracked" from the downgradient locations.
MIP8	B4	77	
MIP9		80	
MIP10		85	
MIP11		73.1	
MIP12		60	

Refusal due to tight subsurface conditions for the MIP probe occurred at all but four locations. Because the MIP was relatively delicate compared to standard direct push rods and drive points, the probe and rods were damaged at three locations during the first three days of drilling:

- MIP1: The MIP probe and eight feet of drill rod were broken at the threaded joints during withdrawal.
- MIP11: The MIP probe and 48 feet of drill rod were broken during withdrawal. The drill crew was able to remove all but the MIP probe and eight feet of drill rod.
- MIP14: Although the MIP borehole was advanced to the desired depth of 85 feet bgs, the drive/probe head was found to be burned and unusable during removal of the tools.

For the last two days of MIP sampling, activities were halted when low to non-observable penetration rates occurred during hydraulic hammering to prevent additional equipment damage.

MIP Sampling – December 5 to 9, 2005

Eight additional MIP borings were advanced upon evaluation of the previous sampling round. All borings were terminated prior to reaching the desired depth of 85 feet due to tight subsurface conditions. The rationale for sampling is provided in the table below.

Table 3-7
MIP16 to MIP23: Sampling Rationale and Locations

MIP ID	Other ID	Total Depth	Rationale
MIP-16	VP-19	45	Located upgradient of elevated organic compound concentrations in MIP-1 and in VP-01. This boring was intended to define the eastern limit of contamination.
MIP-16A		64	This boring was a replacement for MIP-16, which was only drilled to 45 feet bgs before refusal.
MIP-17		69	Located on adjacent property north of elevated concentrations of Freons detected in soil vapor at VP-1. This boring was intended to assist in source definition to determine if a source is located on the adjacent parcel and to assess extent of contamination to the north of the former Omega Chemical property.
MIP-18	VP-16	68	This boring was located on the downgradient side of the building adjacent and north of the former Omega Chemical property. This boring was intended to assess the northern extent of contamination and to assist in identifying potential non-Omega sources.
MIP-19	VP-17	62	This boring was located near Putnam Street at the projected northern limit of coarse materials in the saturated zone. This boring provided lithologic information to assist in the pathway assessment and determine the extent of vadose and saturated zone contamination.
MIP-20		81	This boring was located downgradient of the suspected source area on the former Omega Chemical property and was intended to assess the presence of coarse material in both the vadose zone and saturated zones that may serve as migration pathway. This assisted in defining the extent of contamination in both vadose and saturated zones.
MIP-21	VP-14 B7	59	This boring was located downgradient of an apparent pathway for contaminant migration above the 30-foot unit that was apparent in MIP-7, MIP-8 and the GP-5 location from 2003. This provided both lithologic characterization of potential pathways in the vadose and saturated zones, and assisted in defining the extent of contamination.
MIP-22	VP-18 B5	63	This boring was intended to define the contaminant extent to the south of the Phase 1a area. This boring provided information on the transition zone to thicker sands in the saturated zone that are observed near Washington Street.
MIP-23		36	This boring was located south of the Skateland building and was intended to assess the southern limit of vadose and saturated zone contamination that was observed at MIP-15.

MIP Sampling – February 27 to June 1, 2006

The final round of MIP sampling was conducted during February to June 2006. Six additional MIP borings were advanced to meet the RI OSS Work Plan Addendum No.2 objectives. The rationale for the sampling locations was the same as shown in Table 3-5, but is reiterated below in Table 3-8. Results of the MIP sampling were used to determine the soil vapor sampling depths for the associated probe. As before, all borings were terminated prior to reaching the desired depth of 85 feet due to tight subsurface conditions.

Table 3-8
MIP25 to MIP30: Sampling Rationale and Locations

Direction	Location ID	Total Depth	Rationale
East	VP-25/MIP-30	56	A MIP boring and soil vapor sampling were requested by DTSC east of the former Omega Chemical property to confirm decreasing contaminant concentrations in this direction.
North	VP-20/MIP-25	53	TVOCs in soil vapor samples increased going from VP-03 to VP-16 in the 47-50 foot depth range (212 to 2,335 mg/m^3). Investigation at this area was intended to determine if the relatively high TVOC concentration seen at the 47 foot depth at VP-16 and the 30-foot unit extend further to the northwest, and to assist in identifying other sources on this property.
West	VP-21/MIP-26/B6 VP-22/MIP-27 VP-23/MIP-28	53 53 53	TVOCs in soil vapor samples from several depths were higher at VP-14 and VP-15 than samples to the east of these locations. These additional sampling locations were intended to look for decreasing contaminant concentrations to the west and southwest of VP-14, 15, 17 and 18.
South	VP-24/MIP-29	60 61	This location was intended to document lower contaminant concentrations to the south of MIP-24 where contamination was indicated in the 30-foot unit. The boring also provided information on the transition zone to thicker sands in the saturated zone that is observed near Washington Street.

3.1.5 Soil Vapor Extraction (SVE) Pilot Testing

Initial SVE Well Installation

Ten soil vapor extraction (SVE-1S through SVE-5S and SVE-1M through SVE-5M) wells were installed at the former Omega Chemical property from September 7 to 11, 2006 in accordance with the USEPA approved *Soil Vapor Extraction Pilot Test Work Plan* (CDM, 2006c). They were installed in the portion of the former Omega Chemical property formerly leased by 3 Kings Construction. This location was chosen because:

- Elevated contaminant concentrations exist at all pertinent vadose sampling depths in the area
- The area was secure by fencing
- The area was large enough to accommodate all equipment and wells without disruption to other business activities.

The SVE wells were installed with a hollow stem auger drilling rig as five pairs, with each pair consisting of a well screened from 12 to 22 feet bgs and from 26 to 36 feet bgs. The SVE wells screened from 12 to 22 feet bgs (SVE-1S through SVE-5S) were installed to target shallow soil vapor above the 30 foot clay layer, while the SVE wells screened from 26 to 36 feet bgs (SVE-1M through SVE-5M) targeted the "30 foot unit."

Because each pair was estimated to have a zone of influence of 30 feet, the pairs were installed approximately 30 feet apart from one another. Locations of the initial SVE wells are shown on Figures 3-1 and 3-6. Drilling procedures are provided in Section 3.3.

Initial SVE Well Testing

The SVE well testing was conducted to provide additional data to select, design, and implement the overall soils remedy at the former Omega Chemical property. The testing was expected to:

- Confirm the feasibility of SVE for Site conditions above the "30 foot unit"
- Confirm the ability of vapor phase granular activated carbon (GAC) to treat extracted vapors to appropriate discharge limits
- Estimate the contaminant mass removal rate in extracted vapors to size and select the treatment systems for potential full-scale system and evaluate air discharge permit issues
- Estimate the achievable SVE treatment zone sizes for the thin sand that is generally present above the 30-foot unit and the shallower interval about this unit to select well spacing and construction
- Provide VOC mass removal data from SVE wells screened in two intervals to help determine the VOC vertical distribution in the shallow vadose zone.

The initial SVE testing consisted of two types of tests: step testing and multi-week pilot testing. The step testing was performed to evaluate the relationship between the applied vacuum at the SVE wells and the resulting vapor flows, and the resulting vacuum distributions in the subsurface around the wells. The multi-week test was conducted to provide design information for potential implementation of the SVE technology once near-equilibration conditions were established. Several weeks of operation were conducted because the vacuum distribution was expected to be slow-developing due to the low permeability soils. The procedures and results of the SVE testing were provided in a separate memorandum to USEPA (Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings, CDM, February 5, 2007). The results of the initial SVE pilot testing are presented in Section 4.6.

Additional SVE Well Installations and Expanded SVE Pilot Testing

Expanded pilot testing was recommended in the February 5, 2007 Technical Memorandum. The expanded pilot testing was performed in the Star City Auto Body portion of the former Omega Chemical property according to the methods described in the Revised Second Addendum to February 5, 2007 Technical Memorandum (CDM, April 20, 2007).

Between May 20 and June 10, 2007, three SVE wells (SVE-6S through SVE-8S) and six vapor monitoring probes (VMP-1 through VMP-6) were installed at the former Omega Chemical property. The SVE wells were installed using hollow-stem auger drilling methods, and the VMPs were installed using direct-push drilling methods. Locations of the additional SVE wells and VMPs are illustrated on Figure 3-6.

Expanded pilot testing was performed during the period June 14 through July 20, 2007. The expanded pilot test consisted of three phases of testing, as follows: pneumatic communication testing, step testing, and multi-week extended testing. These tests were conducted to characterize the extent of pneumatic communication through the 30-foot unit and to provide further design information about SVE system operation at near-equilibrium conditions.

Field procedures, field measurement data, analytical results, and findings were presented in the Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings (CDM, August 31, 2007). The results of the expanded testing are briefly summarized in Section 4.6 of this document.

3.1.6 Air

Indoor and outdoor ambient air samples were collected to assess potential VOCs in indoor air quality and to provide background VOC concentration data, respectively. Indoor air samples were collected at the following properties: Star City Auto Body, the building formerly occupied by 3 Kings Construction, Terra Pave, Skateland, Medlin (both north and south buildings), LA Carts, Oncology Care Medical Associates (Oncology), and Bishop Company. Because VOCs in indoor air may originate from subsurface contamination or from chemical usage at the particular building, chemical usage surveys were also conducted at several properties, as follows: Star City Auto Body, Skateland, and Terra Pave in 2004; and LA Carts, Oncology, Bishop Company, and Medlin north building in 2006. Two sets of indoor air samples were collected to evaluate the performance of air purifiers installed in the Skateland facility. All air samples were analyzed for volatile organic compounds by method TO-15 and the results are presented in Section 4.

Outdoor locations were collected upwind, between the former Omega Chemical property and the particular building, or at HVAC intakes. The upwind ambient air locations were selected based upon the results of a 12-hour wind survey. Maximum upwind chemical concentrations were subtracted from Omega Chemical data to estimate contributions from the former Omega Chemical property to chemical concentrations in ambient air.

Also included in this section are tasks that were performed to evaluate conditions affecting air quality. Chemical usage surveys and inventories were performed to determine the source of chemicals found in the indoor air quality samples. HVAC systems (where present) were evaluated to determine whether proper ventilation was being provided, and where intakes were located. Building interiors were evaluated

for cracks which are potential pathways for vapor migration. Air purifiers were installed in Skateland to mitigate soil vapor intrusion. SSD testing was performed at Skateland to determine whether SSD was a possible long-term mitigation measure at that facility.

Wind Survey – May 10, 2004

Prior to all indoor or outdoor air sampling, RES Environmental Inc. conducted a 12-hour wind survey from 7 am to 7 pm. The wind speed and wind direction were recorded throughout the testing period, as well as the barometric pressure, temperature, and relative humidity. These data were collected to determine appropriate upwind ambient air sample locations.

Air Sampling – May 11, 2004

The initial indoor locations were selected in occupied areas, distant from chemical storage areas. The locations were chosen with the concurrence of USEPA and an industrial hygienist (CDM, 2003a). Ten indoor air and five outdoor ambient air samples were collected on May 11, 2004:

Table 3-9
Indoor Air Sampling Locations – May 11, 2004

Building	Address	Location
Star City Auto Body	12504 Whittier Blvd	1) Main work area 2) Rear area of the shop
Former 3 Kings Construction	12512 Whittier Blvd	1) Interior office area 2) Storage and work area
Skateland	12520 Whittier Boulevard	1) Skate rental counter (by the window) 2) Center of skating rink
Medlin & Son South Building (former Cal-Air)	12484 Whittier Boulevard	1) Front office area 2) Production area
Terra Pave	12511 East Putnam Street	1) First floor office area 2) Second floor office area

Table 3-10
Outdoor Ambient Air Sampling Locations – May 11, 2004

Type	Description
Former Omega Chemical property	Between Star City Auto Body and Medlin & Son South Building (former Cal-Air)
Former Omega Chemical property	Between Star City Auto Body and former 3 Kings Construction
Upwind	Rippy Parking Lot
Upwind	Former Merchant Metals Parking Lot
Roof Intake	Medlin & Son South Building HVAC intake

Chemical Usage Survey – May 28, 2004

A chemical usage survey was performed at neighboring Skateland (12520 Whittier Boulevard) and at Star City Auto Body (12504 Whittier Boulevard) on May 28, 2004 to evaluate the possible sources of indoor air contaminants.

Skateland HVAC Survey – July 2004

CDM conducted an HVAC survey at neighboring Skateland (12520 Whittier Boulevard) to determine whether it was providing adequate ventilation. Adequate ventilation and intake location is a major factor in indoor air quality.

Skateland Air Sampling – August 4, 2004

An additional indoor air sampling event was conducted at the neighboring Skateland facility to determine whether increasing outside ventilation and reducing chemical usage would sufficiently lower indoor air contaminant concentrations (CDM, 2004a). Seven samples were collected from the: 1) kitchen; 2) skate rental counter (by the window); 3) boys' restroom; 4) office; 5) dance floor; 6) center of rink; and 7) a rear interior corner by the storage room. Two outdoor air samples were collected by the front door and adjacent to the sewer manhole. The manhole sample location was selected where a recent repair was made to the connection between the facility's sewer line and the city's collection line.

Terra Pave Chemical Use Survey – November 9, 2004

A chemical use survey was conducted at neighboring Terra Pave (12511 East Putnam Street) to evaluate possible sources of indoor air contaminants.

Skateland Air Purifier Installation and Testing – December 2004 and January 2005

Three air purifiers were installed at three locations inside the neighboring Skateland building: at the boys' restroom, the girls' restroom, and the kitchen. The objective of the air purifier installation was to inhibit migration of soil vapor VOCs into the Skateland facility (CDM, 2004b). It was proposed that the soil vapors were preferentially migrating along utility corridors.

Indoor air quality testing was performed to evaluate the effectiveness of the air purifiers. Samples were collected prior to purifier startup (December 30, 2004) and after approximately two weeks of operation on January 2005. Samples were collected at four locations: the girls' restroom, the boys' restroom, the kitchen, and the center of the skating rink.

Air Sampling – September 14, 2005

Re-sampling of the indoor air at the buildings was performed again in September 2005 (CDM, 2005d). The following 12 indoor air and two ambient air samples were collected:

Table 3-11
Indoor Air Sampling Locations – September 14, 2005

Building	Address	Location
Star City Auto Body	12504 Whittier Blvd	1) Main work area 2) Rear area of the shop
Former 3 Kings Construction	12512 Whittier Blvd	1) Interior office area 2) Storage and work area
Skateland	12520 Whittier Boulevard	1) Kitchen 2) Center of skating rink 3) Girls' Restroom 4) Boys' Restroom
Medlin & Son South Building (former Cal-Air)	12484 Whittier Boulevard	1) Front office area 2) Production area
Terra Pave	12511 East Putnam Street	1) First floor office area 2) Second floor office area

Table 3-12
Outdoor Ambient Air Sampling Locations – September 14, 2005

Type	Description
Former Omega Chemical property	Between Star City Auto Body and Medlin & Son South Building (former Cal-Air)
Upwind	Rippy Parking Lot

SSD Investigation and Testing

SSD testing was a proposed mitigation measure for reducing indoor air contamination at the neighboring Skateland facility. SSD is typically utilized to reduce the pressure of sub-slab materials and extracting sub-slab vapors before they enter the building. The system typically consists of a blower or fan connecting one or more pipes within the sub-slab materials. The extracted vapors are either vented directly or treated prior to atmospheric discharge. Typically petroleum hydrocarbons and chlorinated solvents are treated with granular activated carbon. The objectives of the SSD investigation and testing were to evaluate the feasibility of applying SSD at Skateland. Specifically, the objectives were to:

- Evaluate the permeability of sub-slab materials
- Estimate the VOC concentrations in sub-slab vapors to determine the need for vapor treatment and provide a basis for selecting a treatment type if needed
- Determine the vapor extraction rate that can be achieved from the sub-slab at various levels of vacuum
- Estimate the vacuum distribution that is established around a suction point to help determine spacing between extraction points.

The feasibility of applying SSD was determined by applying three general criteria: effectiveness, implementability, and cost. For effectiveness, the ultimate objective of the SSD system was to reduce indoor air contaminant concentrations. The objective is met to the degree that the system can remove contaminants from the majority of sub-slab materials. SSD was considered feasible with regard to effectiveness and implementability if a measurable vacuum (less than or equal to 0.001 inch of water) was produced at all pressure measuring holes that were 15 feet from the suction holes and completed in the sub-slab materials, and if this condition can be met with reasonably sized equipment. If this condition cannot be met, the sub-slab materials were considered too low in permeability for practical implementation of SSD. If a high permeability layer was not present, SSD may be implementable in the sub-slab native soils if the same condition above were met.

HVAC Evaluation and Chemical Usage Survey – June 19, 2006

A building HVAC evaluation and chemical usage survey were performed on June 19, 2006 at the following nearby locations:

- Oncology Care Medical Associates (12535 East Washington Boulevard)
- Bishop Company (12519 East Putnam Street)
- LA Carts Manufacturing (12549 East Washington Boulevard)
- Medlin & Son North Building (12476 East Whittier Boulevard)

These surveys were performed to analyze factors that may influence indoor air quality. The chemical usage survey was performed to evaluate possible sources of indoor air contaminants, while the HVAC evaluation was performed to analyze the ventilation adequacy at each facility. Buildings were also evaluated for floor cracks and other potential pathways for soil vapor migration. Building layouts and facility usage were evaluated to select locations for future indoor air monitoring.

The results and rationale for proposed indoor air quality sampling locations were submitted to USEPA in a HVAC Evaluation and Chemical Use Inventory Results and Proposed Indoor Air Quality Sampling Locations Technical Memorandum (CDM, July 18, 2006).

Air Sampling – September 8, 2006

Following the completion of the June 2006 HVAC and chemical usage survey, additional air sampling was performed on September 8, 2006 at four properties near the former Omega Chemical property. A total of 11 samples were collected (nine indoor air and two ambient air).

Table 3-13
Indoor Air Sampling Locations – September 9, 2006

Building	Address	Location
Bishop Company	12535 E. Washington Blvd.	1) Administration Office 2) Interior Store 3) Warehouse
LA Carts	12549 E. Washington Blvd.	1) Administration Office 2) Large Production Room 3) Small Production Room
Medlin & Son North Building	12476 E. Whittier Blvd.	1) Building Interior
Oncology Care Medical Associates	12535 E. Washington Blvd.	1) Administration office 2) Nurses Station

Table 3-14
Outdoor Ambient Air Sampling Locations – September 9, 2006

Type	Description
Exterior	Exterior fence in rear of Bishop property
Rooftop	Oncology Care facility rooftop by intake vent

3.1.7 Groundwater

Although this RI report focuses upon soil, soil vapor, and air sampling results, groundwater results will be presented to support the Site Conceptual Model. Periodic groundwater sampling has been implemented at the Omega wells since May 2001. Quarterly sampling was conducted during May 2001, August 2001, November 2001, and February 2002. The wells have been sampled semi-annually during February and August of each year beginning in 2002. The most recent sampling event was conducted during February 2007. The purpose of the groundwater sampling was to assist in the selection, design, and implementation of the groundwater remedy in the Phase 1a area, and to support the development of the Site Conceptual Model. Well locations are shown on Figures 3-1 and 3-7.

3.2 Pre-Field Activities

This section describes activities that were completed prior to commencement of field activities. This section also describes demobilization activities that will take place following completion of field activities.

3.2.1 Subcontracting/Procurement

Several activities were performed by subcontractors under the direction or supervision of CDM. The following subcontractors provided services for this RI:

Drilling and Sampling

- Vironex, Inc.: Direct push drilling for soil borings, soil vapor installations, and MIP sampling. Based in Santa Ana, California.
- BC2 Environmental: Hollow stem auger drilling services for SVE well installation. Based in Fullerton, California.
- Blaine Tech Services: Groundwater sampling. Based in Carson, California.

Analytical Laboratories

- Test America (formerly known as Del Mar Analytical): Fixed-based laboratory for soil VOC, 1,4-dioxane, petroleum and metals analytical services. Located in Irvine, California.
- PTS Laboratories: Conducted soil testing for physical parameters. Located in Santa Fe Springs, California.
- Air Toxics Limited: Fixed-based laboratory for air VOC analytical services. Located in Folsom, California.
- B. C. Laboratories: Fixed-based laboratory for surface soil pesticide, PCB, SVOC, metals analytical services. Located in Bakersfield, California.
- Calscience Environmental Laboratories: Fixed-based laboratory for air and soil VOC analytical services. Located in Garden Grove, California.
- Sunstar Laboratories: Fixed-based laboratory for sub-slab depressurization testing VOC analytical services. Located in Tustin, California.

Other

- RES Environmental: Provided Site-specific meteorological services. Located in Colton, California.
- Kerntec Environmental: Provided preliminary building assessment and chemical inventories. Based in Bakersfield, California.

Equipment procurement included procurement of SVE testing materials, disposable sampling equipment and other equipment as required. Health and safety equipment included personal protective equipment (PPE), such as gloves, etc. Miscellaneous equipment such as construction tools, polyethylene liners, etc. were procured on an as-needed basis.

3.2.2 Mobilization/Demobilization

All equipment was delivered to the Site in a clean condition. Mobilization activities included procuring and moving sampling equipment and materials to the Site, as well as health and safety awareness training and Site orientation of field personnel.

Mobilization involved the establishment of a suitable staging area to support the project activities. The staging area included an equipment storage area and general support area. The staging area was located in an area determined by the property owner.

3.2.3 Utility Clearances

For all activities involving digging or drilling, locations were checked for subsurface utilities prior to work. The proposed subsurface sampling locations were outlined in white spray paint and Underground Service Alert was notified at least 48 hours prior to work. If underground utilities were present, any proposed subsurface sampling locations in question were moved to avoid the utility. Borings conducted with a hollow stem auger (diameter of eight inches or greater) were hand augered or evacuated with an air-knife rig prior to drilling to check for utilities.

Prior to the utility corridor soil vapor sampling conducted in November 2004, CDM obtained the approximate location of utilities from the City of Whittier. The borings were hand augered into the materials surrounding the utilities to analyze organic vapors. Direct push drilling was conducted into the utility corridor to install temporary soil vapor probes.

3.2.4 MIP

Response testing was conducted as part of the MIP logging process to monitor the performance of the MIP system and measure trip time. The trip time is the time a contaminant infiltrates the probe, through the trunk line, and into the detectors. The trip time tests are conducted at the beginning of the day, between borings, and at the end of the day. Trip times vary due to weather temperatures and the length of the trunk line. The response test was conducted according to the Geoprobe SOP, technical bulletin MK3010 dated May 2003.

3.3 Field Procedures

This section describes the methods used to collect samples and construct wells. All field work was performed under the supervision of a California Professional Geologist. All maintenance and calibration operations were documented in the field logbook or field data sheets. Prior to use, all field equipment was checked and calibrated to verify that it was in good working order. The calibration, maintenance, and operating procedures for all instruments were based upon manufacturer's instructions and common industry practice.

3.3.1 Pre-Drilling

In addition to the utility clearance tasks performed prior to drilling (Section 3.3.3) most borings located on concrete were cored or saw-cut. To prevent accidental damage to subsurface utilities, all borings were initially advanced with a hand auger or air vacuum rig. Small diameter borings made by the direct push drilling rig were initially advanced using a hand auger. Larger diameter borings for hollow stem auger

drilling were cleared with an air vacuum rig or by hand auger to the desired diameter down to five feet bgs.

3.3.2 Hand Auger

In addition to using the hand auger for pre-drilling activities, the hand auger was used to collect surface soil samples in April 2004 (Section 3.1.1) and advance the initial soil vapor probes for utility corridor sampling in November 2004 (Section 3.1.3).

For surface soil sampling, the hand auger was decontaminated using the triple-rinse method at the beginning of the day, between each sample, and at the end of the day. Each boring was initially cored by Penhall. Attempts at using a core barrel sampler with stainless steel sleeves and a slide hammer were unsuccessful due to the compaction of the soils. Therefore, the core barrel sampler was replaced with a traditional hand auger to sample surface soils. The freshly decontaminated hand auger was used to advance the boring, and new disposable gloves were used to transfer the soil cuttings to stainless steel sleeves. The sample-filled sleeves were sealed on each end with Teflon® sheets and plastic end caps.

For advancing soil vapor probes near utility corridors, the hand auger was advanced to the approximate middle of the backfill materials surrounding the pipelines. A soil vapor probe with a six-inch perforated zone was installed in the borehole. The pump within a PID was used to evacuate the tubing and bring soil vapor to the instrument, and the maximum PID reading was recorded. The field screening results were used to determine the locations for collecting soil vapor samples for laboratory analysis. A second boring was advanced adjacent to the original boring with the hand auger, and the tubing driven in the same manner as above. Summa canisters were connected directly to the end of the tubing, and vacuum from the Summa canisters was used to collect the samples.

3.3.3 Direct Push Drilling

Vironex, Inc. of Santa Ana provided direct push drilling for subsurface soil, MIP, and soil vapor sampling. Direct push drilling consists of a conical drive point and drilling rods that are pushed into the ground, displacing soils around it. The weight of the direct push drilling rig and the force of the hydraulic hammer are used to advance the drill string. The weight of the drilling rig is applied first, while the hydraulic hammer is applied only when additional force is required. Drill cuttings are not produced during direct push drilling except when soil samples are collected. Boreholes produced using direct push drilling are typically less than two inches in diameter.

Subsurface Soil Sampling

For subsurface soil sampling, the tool chain consists of a retractable drive point, a hollow sample barrel fitted with a new cutting shoe on the advancing end, a new disposable plastic liner within the barrel, hollow drilling rods threaded to the top of the barrel, and inner steel rods that hold the retractable drive point in place. The drive point covers the bottom opening of the sample barrel to displace soils and prevent

them from entering the sampler. When a soil core is desired, the operator adds a hollow drilling rod without adding the internal steel rod, allowing the drive point to retract. The hollow outer drilling rods and sample barrel are pushed into the soil while the inner retractable drive point and steel rods remain in place. Undisturbed soil enters the hollow sample barrel and fills the plastic liner. The cutting shoe acts as a one-way valve to prevent soil from exiting the now-filled sample barrel. Both drill strings are removed to retrieve the soil cores. When drilling to the next sampling depth, the drive point displaces any slough in the borehole. All soil borings conducted for the RI (GP-1 through GP-8 and borings B1 through B7 near MIP and VP locations) were sampled continuously. Samples to be submitted for laboratory analysis were sub-sampled for VOC preservation. The remaining core was trimmed with a freshly decontaminated hand saw, and the sleeves were sealed on each end with Teflon® sheets and plastic end caps.

MIP Sampling

For MIP sampling, the drill string consisted of drilling rods and a MIP probe that has a conical tip with a soil conductivity probe to displace soils and measure soil conductivity in microSiemens per meter. The probe heats the surrounding soils up to 120 degrees Celsius to volatilize organic compounds. The volatilized compounds diffuse across a membrane located within the probe. A closed inert gas loop carries these organic vapors to a series of detectors housed at the surface. For this investigation, the detectors consisted of a PID, an FID, and an ECD. The PID generally detected double-bonded compounds from 1 to 20,000 ppm, the ECD detected halogenated compounds from 0.25 to 10 ppm, and the FID detected combustible hydrocarbons from 1 to 100,000 ppm. Because the rate of volatilization was dependent upon soil temperature, attempts are made to advance the MIP probe at a uniform rate so that the soil would heat uniformly. Spikes in bulk VOC concentrations were observed at pauses in drilling, such as when drill rods were being added to the drill string.

Soil Vapor Sampling

For soil vapor sampling, the drill string consisted of a 1.75-inch diameter drive head with an expandable point and point holder, and drilling rods. The expendable point is placed within the point holder and attached to the drive rod. The system is pushed to the total depth and the rods are retracted, leaving the expendable point at total depth and creating a void between the probe tip and drilling rods. The soil vapor probe is installed down the center of the drive rods. For shallow boreholes with cohesive subsurface materials, the driller may choose to drill with a reusable probe tip and remove the entire drill assembly before installing the soil vapor probe in the uncased borehole.

Soil vapor probes were installed using the direct push rig. The soil vapor probes were 1/4-inch diameter Teflon tubing extending from the surface to the desired sampling depth. Permeable sand pack (Lapis Lustre Medium Monterey Sand) was placed approximately one foot below the sampling interval. The bottom six inches of Teflon tubing was perforated and installed through 3/4-inch diameter PVC pipe that was

temporarily placed to guide the tubing to the desired depth. After the tubing was installed to the desired depth and the temporary PVC pipe removed, approximately one foot of sand pack was installed into the borehole to surround the perforated tubing and extend the length of the permeable zone. Up to four sampling intervals were installed within each borehole, with hydrated bentonite crumbles emplaced between sampling intervals to isolate the sampling zones. The bentonite seal was extended from the uppermost sampling interval to approximately 0.5 feet bgs. When more than four sampling intervals were required at any location, additional boreholes were drilled approximately one foot from the original vapor location. The upper end of the soil vapor probe was sealed with a rubber stopper and/or a 1/4-inch diameter steel bolt.

Soil vapor sampling was conducted in accordance with the procedures outlined in the DTSC/Los Angeles Regional Water Quality Control Board Guidance (DTSC and LAWRCB, 2003). One-liter summa canisters were used to collect all soil vapor samples. A flow regulator was placed between the probe and the canister to ensure that the canister was filled at the appropriate flow rate of 200 milliliters per minute (ml/min). Following collection, Summa canisters were labeled with a laboratory-provided sample tag, and shipped to the analytical laboratory with a completed chain-of-custody form.

After soil vapor probes were sampled, the soil vapor probes were abandoned by removal. The Teflon tubing was pulled and cut so that the tubing remained several inches below ground surface. The top six inches of the borehole were finished to match the surrounding ground surface.

3.3.4 Hollow Stem Auger Drilling

BC2 Environmental of Fullerton, California provided hollow stem auger drilling services to drill and install soil vapor extraction wells. The hollow-stem auger rig is a hydraulically powered drill rig that simultaneously rotates and axially advances the hollow-stem augers. Ten-inch outer diameter augers were utilized for drilling and installing the wells. The initial SVE wells consisted of five pairs (ten total) consisting of 22-foot and 36-foot deep well clusters. Boreholes for the initial 10 wells (SVE-1S through SVE-5S and SVE-1M through SVE-5M) were drilled to approximately 23 and 36.5 feet bgs, respectively. Six additional SVE wells (SVE-6S through SVE-8S) for expanded SVE pilot testing were also installed to a depth of 30 feet using the same drilling methods. Soil samples were collected at the 36.5-foot borings only. The 23-foot deep borings were drilled with ten-inch augers fitted with a wooden reaming plug, which was knocked out with a 140-pound hammer prior to installing the well.

Soil samples were collected continuously to collect lithologic information at the 36-foot deep borings. A modified California split-spoon sampler was advanced to the desired depth into the native formation by using a 140-pound hammer with a 30-inch drop. The driller maintained a "blow count" by counting the number of hammer blows to drive the sampler six inches. Three samplers were utilized for every five feet of drilling: two 18-inch long samplers and one 24-inch long sampler.

To acquire a qualitative measurement of organic vapor concentrations, soil in the sampling shoe was placed into a resealable plastic bag labeled with the depth interval. The bagged soil was placed in the sun to warm for at least five minutes to encourage volatility. The bag headspace was screened with a handheld PID by inserting the probe tip fitted with a water vapor filter into the bag. The bag was opened a minimal amount to minimize the loss of volatiles.

The soil core inside the split spoon sampler was placed upon plastic sheeting and immediately screened with a PID. Areas of the core with higher PID readings were removed and placed in a resealable plastic bag for headspace screening. The core was observed for sample recovery and lithology. The on-site geologist maintained a boring log with the following information: blow count, PID headspace screening, sample recovery, Unified Soil Classification System (USCS) to describe soil lithologies, soil type designations, and soil descriptions. Driller's observations such as rocky conditions or slow penetration rates were also recorded.

Upon reaching total depth, four-inch diameter schedule 40 PVC blank casing, ten-foot length 0.020-inch perforated PVC screen, and a 0.25-foot PVC end cap was installed through the hollow augers. The gravel pack (No. 3 Monterey sand) was tremmied through the hollow augers from the total depth of the borehole to approximately two feet above the top of the perforated zone. The bentonite seal (hydrated medium bentonite chips) were installed in the annulus by tremmie with a minimum thickness of 2.5 feet. The augers were withdrawn entirely from the borehole after installing the bentonite seal. The remaining annulus as backfilled with neat Portland cement with five percent powdered bentonite. The wellhead was completed with an 18-inch diameter traffic rated flush-grade well box. The following table shows the vapor extraction well construction details.

Table 3-15
Soil Vapor Extraction Well Construction Details

Well	Date Drilled	Total Depth (ft bgs)	Screen (ft bgs)	Gravel Pack (ft bgs)	Bentonite Seal (ft bgs)
SVE-1S	7 Sep 2006	23	12.5-22.5	10-23	7-10
SVE-1M	8 Sep 2006	36.5	26-36	24-36.5	21-24
SVE-2S	8 Sep 2006	23	12-22	10-23	7-10
SVE-2M	11 Sep 2006	36.5	26-36	23.9-36.5	21-23.9
SVE-3S	7 Sep 2006	23	12.5-22.5	9.8-23	6.8-9.8
SVE-3M	7 Sep 2006	36.5	26-36	24-36.5	20.9-24
SVE-4S	8 Sep 2006	22.5	12-22	9.5-22.5	7-9.5
SVE-4M	8 Sep 2006	36.5	26-36	23.9-36.5	20.5-23.9
SVE-5S	11 Sep 2006	23	12-22	9.9-23	7-9.9
SVE-5M	11 Sep 2006	36.5	26-36	24-36.5	20.5-24
SVE-6S	20 May 2007	30	10-30	7-30	0.5-7
SVE-7S	20 May 2007	30	10-30	7-30	0.5-7
SVE-8S	20 May 2007	30	10-30	7-30	0.5-7

3.3.5 Air Sampling

Indoor air sampling was conducted in accordance with standard U.S. Environmental Protection Agency (USEPA) methods of collection. Indoor and ambient air samples were collected in six-liter, stainless steel Summa canisters under vacuum (approximately 29 inches of mercury). These larger canisters allow lower detection limits for VOCs of interest. At each sampling location, canisters were placed approximately three to five feet above ground or floor surface, to approximate breathing height. The canisters were provided pre-cleaned by Air Toxics LTD laboratory (Air Toxics) located in Folsom, California. Each Summa canister was fitted with a critical-orifice air flow controller that was set and calibrated by Air Toxics for a sampling duration of eight hours.

Following collection, Summa canisters were labeled with a laboratory-provided sample tag, and shipped within 24 hours to the analytical laboratory with a completed chain-of-custody form. All air samples were analyzed by Air Toxics for VOCs using USEPA Method TO-15 SIM analysis.

In conjunction with indoor air sampling, chemical use surveys and an evaluation of HVAC systems and operation was performed at the following properties:

3.3.6 Sample Handling

Labeling

Each collected sample and field QC sample, including duplicates or decontamination rinseate blanks, had a completely filled-in sample label securely attached to it. The label was completely filled in prior to filling the sample container. All field QC samples were shipped "blind" (i.e., the sample is not identified as a QC sample) to the laboratory, but were assigned a unique identification code, discussed below, to facilitate identification of the laboratory results. Labels included the project code number, the location of the sampling site, the type of sample and analysis required, the preservative used, and the time of sampling.

A unique sample identification code was given to each sample for this investigation. At a minimum, the sample was identified by its location name. At borings where multiple depths of samples were collected, the sample was also identified by the sampling depth. Identification codes for many samples also contained a site identifier ("OC" for Omega Chemical), a media identifier such as "SG" for soil gas or "AA" for ambient air, and the sample date.

Packing and Shipment

All filled sample containers were labeled, packed and shipped in accordance with Department of Transportation (DOT) regulations, which included documentation requirements. Filled sample containers had completely filled-out labels and were placed in resealable plastic bags, if appropriate. A chain-of-custody record

accompanied each shipment. All samples were transported by CDM personnel or laboratory courier to the laboratory generally within 24 hours from the time of sample collection.

3.3.7 Equipment Decontamination

Equipment decontamination was conducted for all soil sampling activities and for hollow stem auger drilling. Decontamination occurred before first use and between samples. During soil sample collection, hand augers and direct push sample barrels were decontaminated using the "triple rinse" method. A decontamination station was established with three five-gallon buckets containing a) potable water with laboratory-grade detergent b) potable water, and c) potable water or distilled water. The tools were rinsed and scrubbed at each rinse bucket. For hollow stem auger drilling, the augers and drill bit were cleaned in a decontamination trailer with a pressure washer. All liquids generated from decontamination procedures were contained at the former Omega Chemical property in 55-gallon drums.

3.3.8 Investigation-Derived Waste

Investigation-derived waste (IDW) generated during field activities generally included drill cuttings, decontamination fluids, and solid debris. Soil cuttings were generated from soil sampling and from installing the SVE wells. Soil sample cuttings from direct push drilling were placed in 55-gallon drums, while drill cuttings from SVE well installation were placed in a plastic-lined roll-off bin. All drums were stored at the former Omega Chemical property. Decontamination fluids generated during drilling and sampling activities were stored in 55-gallon drums.

All drums were labeled with a pre-printed, unclassified materials label. The label states that the unclassified materials are being temporarily held pending evaluation of laboratory analyses. The label also notes the Site name, date, type of materials stored, and origin of materials stored.

If the cuttings were considered hazardous, they were transported to approved disposal facilities for treatment and/or disposal accompanied by hazardous waste manifests. If the cuttings were determined to be nonhazardous, they were transported to an approved location for non-hazardous materials.

Used PPE including gloves, Tyvek suits, respirator cartridges, and disposable filters, and other miscellaneous items were double-bagged using plastic trash bags and then disposed as solid waste. Items such as empty cement bags and wrapping materials were placed directly into solid waste dumpsters.

3.3.9 Documentation

Chain-of-Custody

The purpose of chain-of-custody procedures was to document the sample identity and identify who has handled the sample. Custody records trace a sample from its collection through all transfers of custody until it is transferred to the analytical

laboratory. Custody records were used for the samples collected during the field investigation.

Field Custody

CDM field personnel had overall responsibility for sample custody and for field document control during the field investigation. A sample is under custody if one or more of the following criteria are met:

- The sample is in the custodian's (sampler, lab personnel, etc.) possession
- It is in the custodian's view after being in possession
- It was in the custodian's possession and was locked up to prevent tampering
- It is in a designated secure area

Multi-part carbonless copy chains-of-custody were used. A chain-of-custody was filled to accompany each sample shipment from the field to the laboratory. The original custody record traveled with the samples, showing each person who had received and relinquished custody.

Chains-of-custody generally contained the following information:

- The sampler and the responsible project manager: the sampler's name, project manager's name, company name, company address, contact information, and billing information
- The project description: the project name and identification code
- Sample descriptions: sample identification code, sample matrix, date and time of sample collection, number of containers, sample preservatives, and the laboratory analyses requested.
- The turn-around-time for laboratory analysis.
- Signatures of all personnel receiving and relinquishing custody.

The date/time were the same for the signatures relinquishing and receiving custody since custody must be transferred to another person. An exception is when samples are shipped by common carrier such as Federal Express. Sample handling can be tracked by the Federal Express tracking number in this case.

Laboratory Custody Procedures

Custody procedures that were followed by the analytical laboratory are outlined below:

- Upon receipt at the laboratory, each sample shipment was inspected to assess the condition of the shipping container and the individual samples, and the condition or integrity of a received shipment of samples was documented at the time of receipt by the laboratory.

- Enclosed chains-of-custody were cross-referenced with all the samples in the shipment; these records were signed by the sample custodian and placed in the project file. The laboratory sample custodian assigned a unique laboratory number to each sample on receipt identifying the sample through all further handling.

Field Logbooks

Field logbooks were used to record and document all activities at the Site. Entries were made in pen. Field logbooks were bound. The cover of each logbook contained the project name and start date. The inner cover contained contact information for the person responsible for the book. The date and time, sample location, personnel present, events, equipment, instrument calibration, sample methods, and observations were types of items recorded in the logbook. The person making entries signed the bottom of every page.

3.4 Sample Analysis

This section describes analytical methods, sample containers and preservative requirements, and field and laboratory QC samples.

3.4.1 Analytical Methods and Detection Limits

Several laboratories provided analytical services for the RI including Del Mar Analytical (chemical soil testing), B.C. Laboratories (chemical soil testing), PTS Laboratories (physical soil testing), Air Toxics Limited (soil vapor and air VOC testing), and Calscience Environmental Laboratories (chemical soil and soil vapor testing).

All method-specific quality control measures, such as external and internal standard calibration procedures, instrument performance verifications, quantitation using method of standard additions, etc., which are suggested within any referenced method, were performed.

VOCs were analyzed using gas chromatograph/mass spectrometry (GC/MS) methods: USEPA Method 8260 for soil samples and TO-15 SIM for air and soil vapor. Soil samples for VOC analysis were collected using the Encore® sampler. Sample preparation for soil samples was in accordance with USEPA Extraction Method 5035.

Other analyses conducted were metals, semi-volatile organic compounds, pesticides, and PCBs. With the exception of arsenic and mercury, metals in soil were analyzed using USEPA Method 6010B. Arsenic was analyzed using USEPA Method 6020 and mercury was analyzed using USEPA Method 7471A. Semi-volatile organic

compounds were analyzed using USEPA Method 8270C. Pesticides were analyzed using USEPA Method 8081A and USEPA Method 8082 were used to analyze PCBs.

Specified soil samples will also be analyzed for physical characteristics, consisting of redox potential, clay content, organic carbon content, cation exchange capacity, moisture content, and hydraulic conductivity. The analytical methods for these are listed below:

- Redox potential: Standard Method 2580B
- Clay content: ASTM Method D-422 or D4464
- Organic carbon content: SW-846 Method 9060 Mod
- Cation exchange capacity: SW-846 Method 9081
- Moisture content (percent dry weight): ASTM D2216
- Hydraulic Conductivity: ASTM Method D5084

3.4.2 Field Quality Control Samples

Field quality control samples are collected and analyzed to evaluate the quality of the field sampling process. The quality control samples that were used during the field program included duplicate samples, trip blanks, and equipment (decontamination rinsate) blanks. Field sampling quality control procedures are discussed in the following sections. All field QC check samples were submitted "blind" to the laboratory. The laboratory may not use field blanks for duplicate analyses or for matrix spiking. Because all field blanks were submitted "blind", it must be specified to the laboratory which particular field sample(s) are to be used for duplicate and matrix spike analyses.

3.4.2.1 Field Duplicates

Field duplicates were collected to examine laboratory precision. Co-located soil samples were collected by submitting an adjacent portion of the soil core to the original soil sample. Soil vapor duplicate samples were collected sequentially. Ambient and indoor air samples were collected with Summa canisters either with a flow connector or with the canisters side-by-side. All duplicate samples were preserved, packaged, sealed, and analyzed in an identical manner to the original samples. All were given differing names from the original sample so that they were submitted "blind" to the laboratory. Duplicates were collected at the following frequencies for the different sampling events:

- Surface soil samples collected April 6 to 7, 2004: Two duplicates were collected for 20 unique samples.
- Subsurface soil samples collected from October 27 to 28, 2003 (borings GP-1 to GP-3): One duplicate was collected for 14 unique chemical analysis samples.

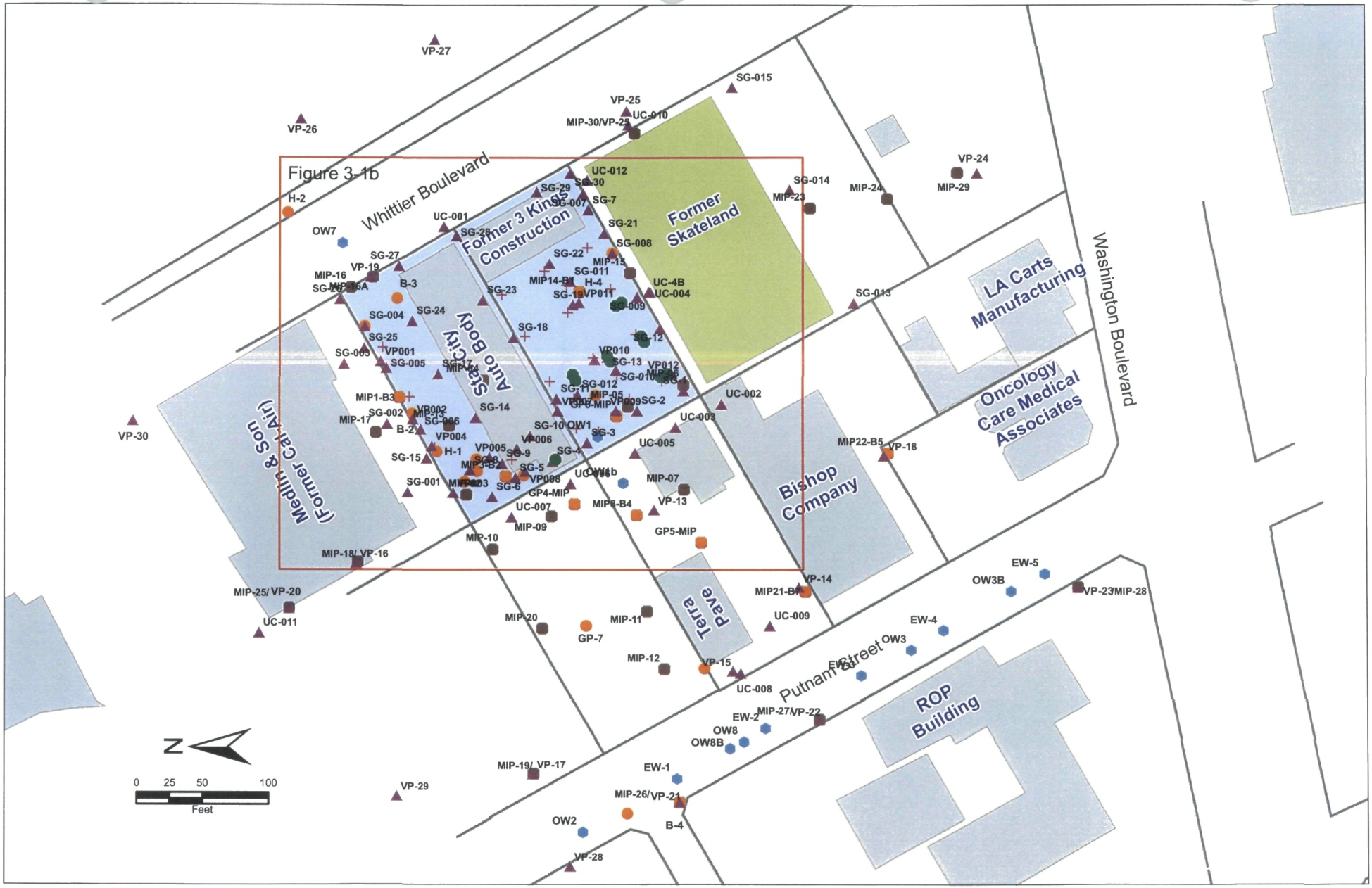
- Subsurface soil samples collected from January 20 to 22, 2004 (borings GP-4 to GP-8): no duplicate samples were collected for the 18 unique chemical analysis samples. These soil sample results were used as a comparison to the MIP logs for borings GP-4 to GP-6.
- Subsurface soil samples collected on April 13, 2004: Only two unique samples were collected for physical parameters only. Therefore, no duplicates were required to be collected.
- Subsurface soil samples collected December 2005 and March 2006 (borings B1 through B7): Four duplicates were collected for 39 unique samples.
- Soil vapor survey from April 12 to 3, 2004 (vapor points SG-01 to SG-12): Seven duplicates were collected for 24 unique samples.
- Soil vapor survey from November 9 to 12, 2004 (vapor points SG-07 to SG-15, and UC-1 to UC-12): Three duplicates were collected for 28 unique samples.
- Soil vapor survey from August 15 to 22, 2005 (vapor points VP-01 to VP-12): Ten duplicates were collected for 87 unique samples.
- Soil vapor survey from December 12 to 15, 2005 (vapor points VP-13 to VP-19): Five duplicates were collected for 42 unique samples.
- Soil vapor survey from March 6 to 9, 2006 and May 31, 2006 (vapor points VP-20 to VP-30): Four duplicates were collected for 41 unique samples.
- Indoor air and outdoor ambient air sampling on May 11, 2004: two duplicates were collected for 15 unique samples.
- Skateland air sampling on August 4, 2004: One duplicate was collected for nine unique samples.
- Skateland air purifier installation and testing, December 2004 and January 2005: one duplicate sample was collected for each testing event, which consisted of four unique samples.
- Air sampling, September 14, 2005: Two duplicates were collected for 14 unique samples.

3.4.2.2 Equipment Blanks

Equipment blanks (i.e., equipment rinsate samples) consisted of the final rinse water from decontamination of equipment. The blank is prepared in the field by pouring the appropriate "blank" water through the sampling equipment and into the appropriate sample containers after equipment decontamination. For blanks targeted for VOC analyses, organic-free water was used as the "blank" water; whereas, deionized/distilled water was used for the collection of blanks targeted for inorganic

analyses. The equipment blank serves as a check to verify the effectiveness of decontamination procedures.

Equipment blanks were performed on all days when soil samples were collected. They were analyzed for the chemicals of concern that were analyzed for other samples collected during the day. Exceptions include the subsurface sampling performed on April 13, 2004, when two subsurface samples were collected for physical parameters only. Because the samples were not analyzed for chemicals of concern, no equipment blank was taken. An equipment blank was also not collected on March 7, 2006 when several soil samples were collected.



Legend

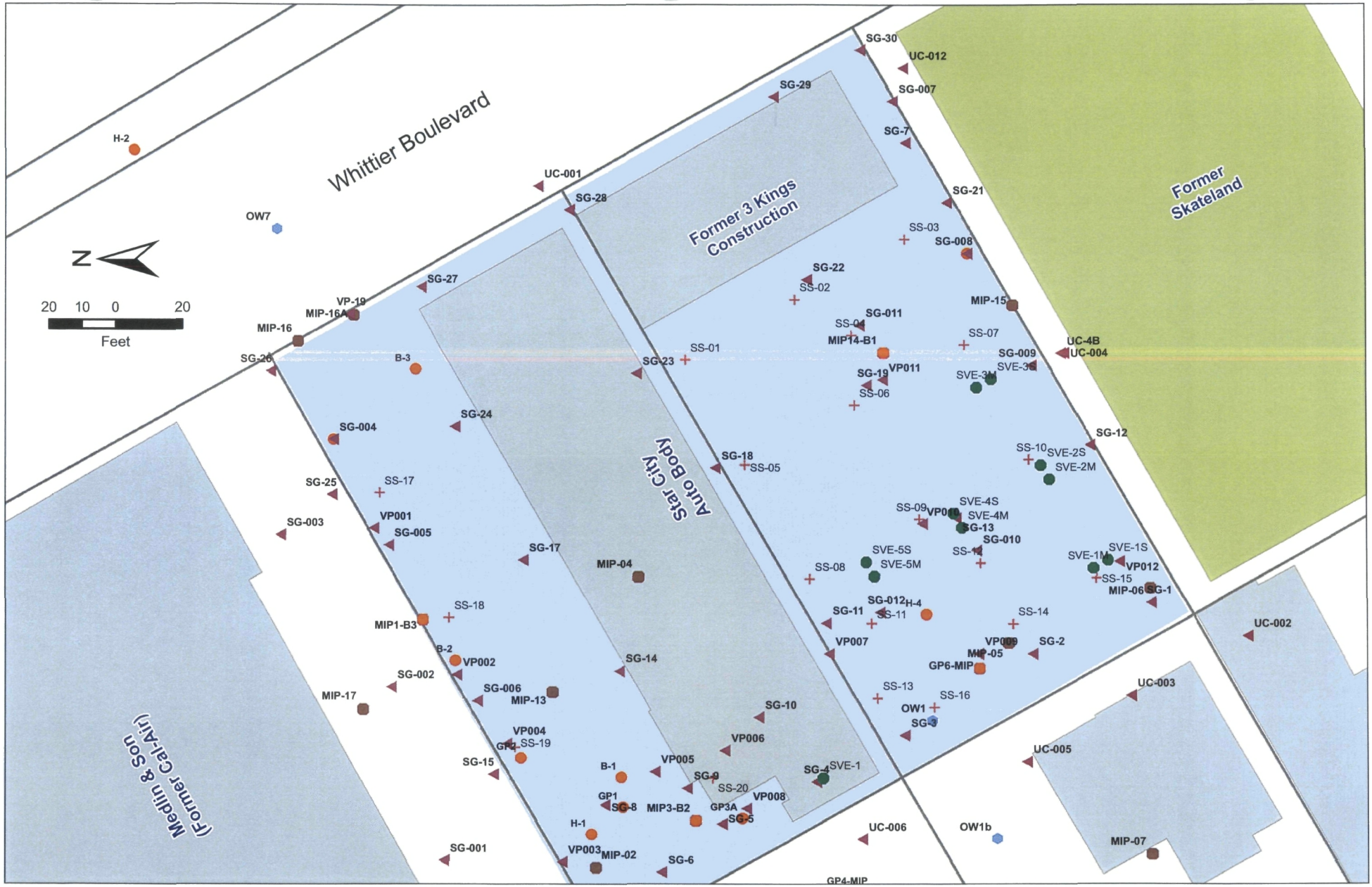
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Soil Vapor Sample Location
- Membrane Interface Probe (MIP)
- SoilVaporExtractionWells
- Groundwater Well Location

CDM

Omega Chemical

Sampling Locations

Figure 3-1



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Soil Vapor Sample Location
- Membrane Interface Probe (MIP)
- SoilVaporExtractionWells
- Groundwater Well Location

CDM

Omega Chemical

Sampling Locations (Inset)

Figure 3-1b

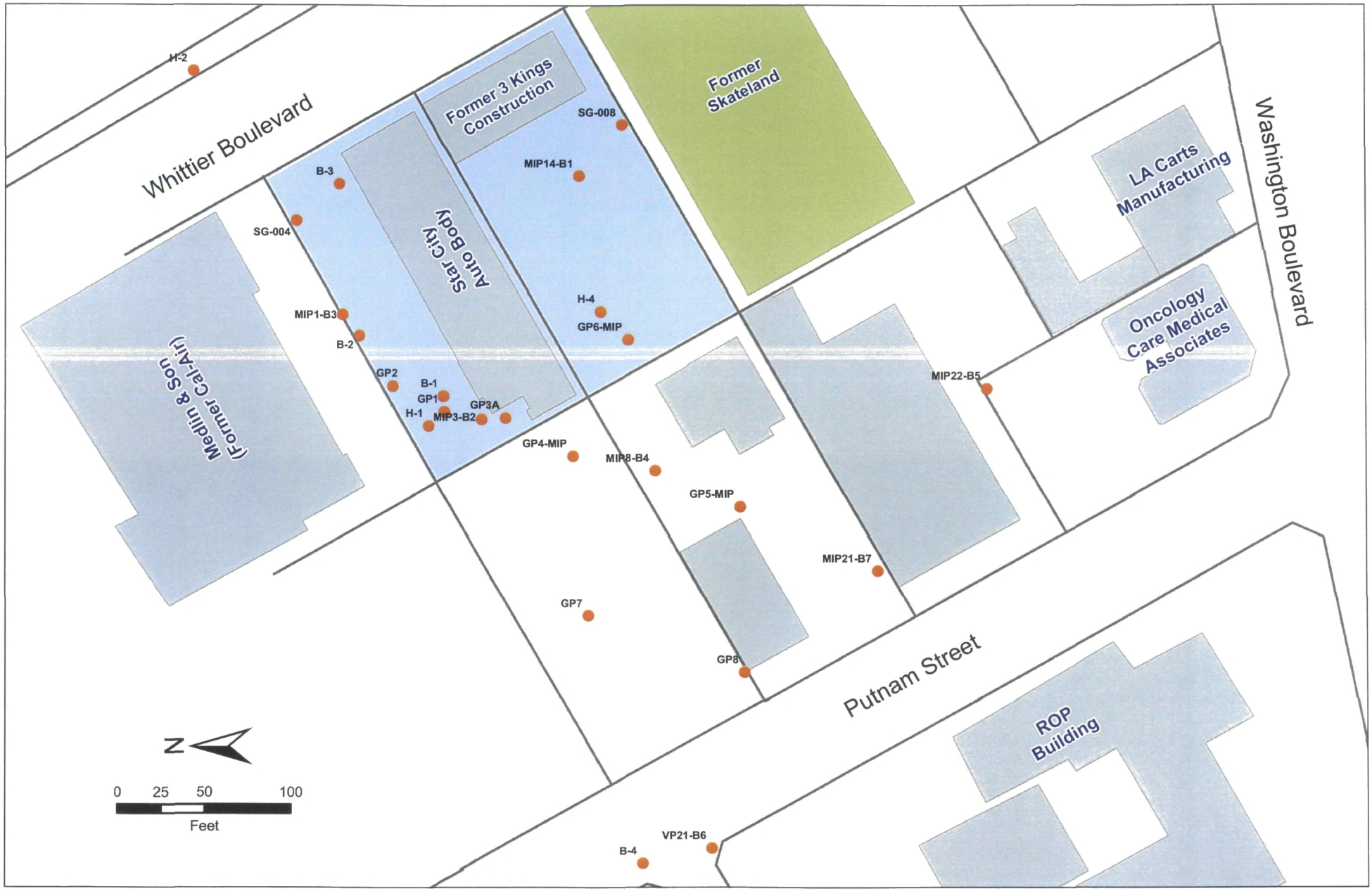
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil

CDM

Omega Chemical
Surface Soil
Sampling Locations

Figure 3-2



Legend

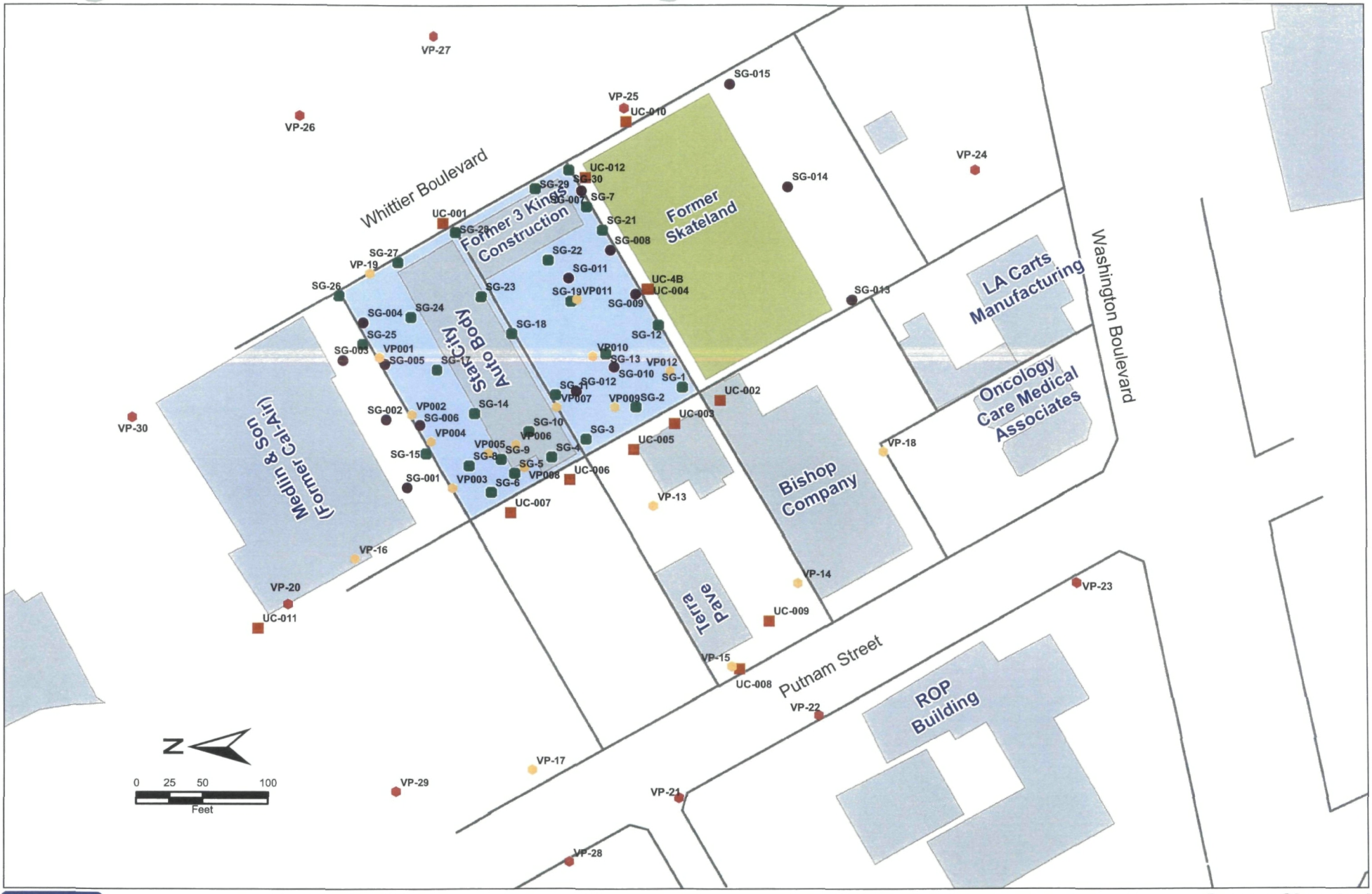
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Subsurface Soil Sample Location

CDM

Omega Chemical

Subsurface Soil Sampling Locations

Figure 3-3



DRAFT

CDM

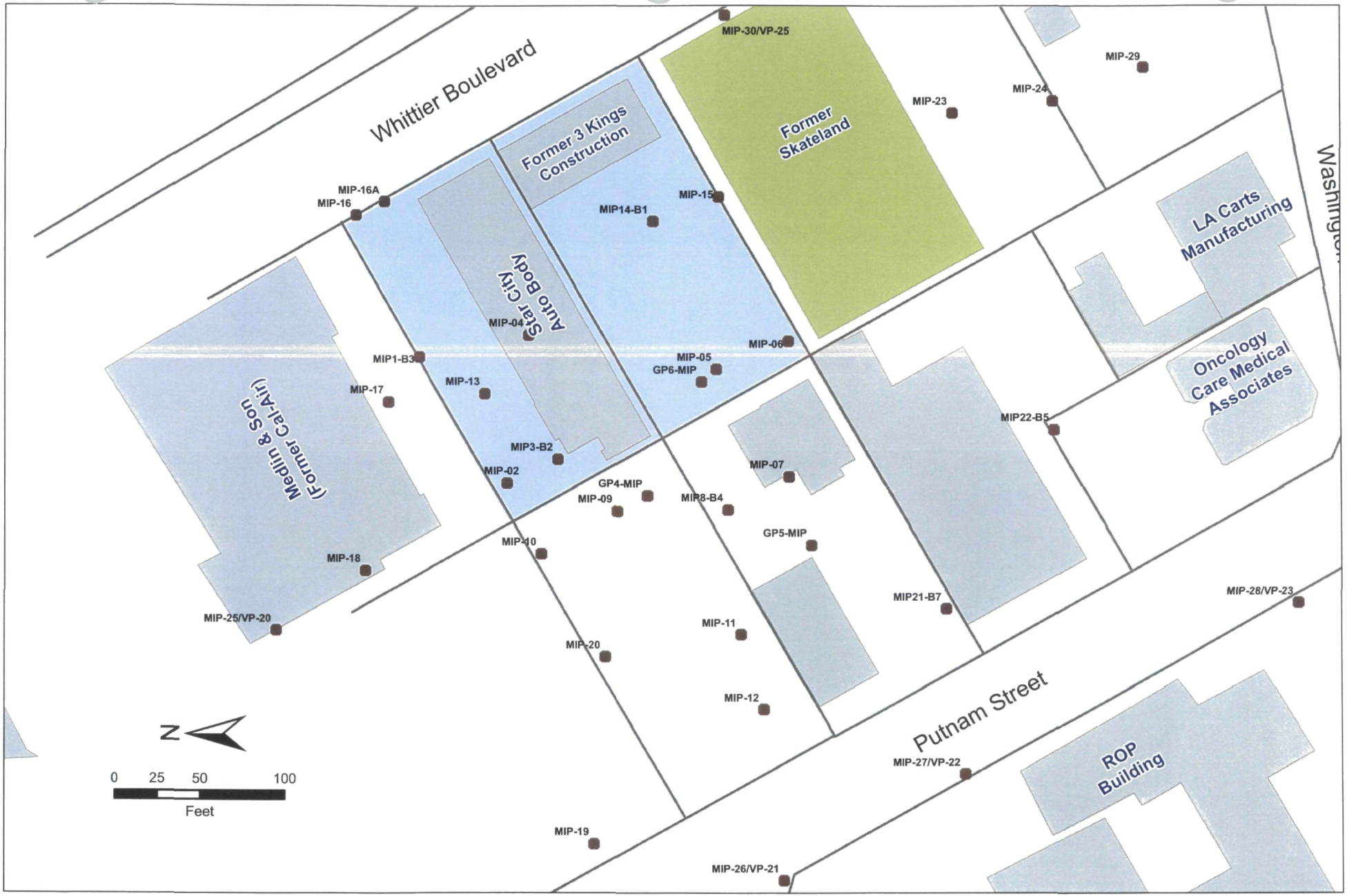
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Historical Soil Gas Sample Location(1995)
- RI Soil Gas Sample Location (2004)
- RI Utility Corridor Soil Gas Sample Location (2004)
- RI Vapor Probe Sample Location (2005)
- RI Vapor Probe Sample Location (2006)

Omega Chemical

Soil Vapor Sampling Locations

Figure 3-4



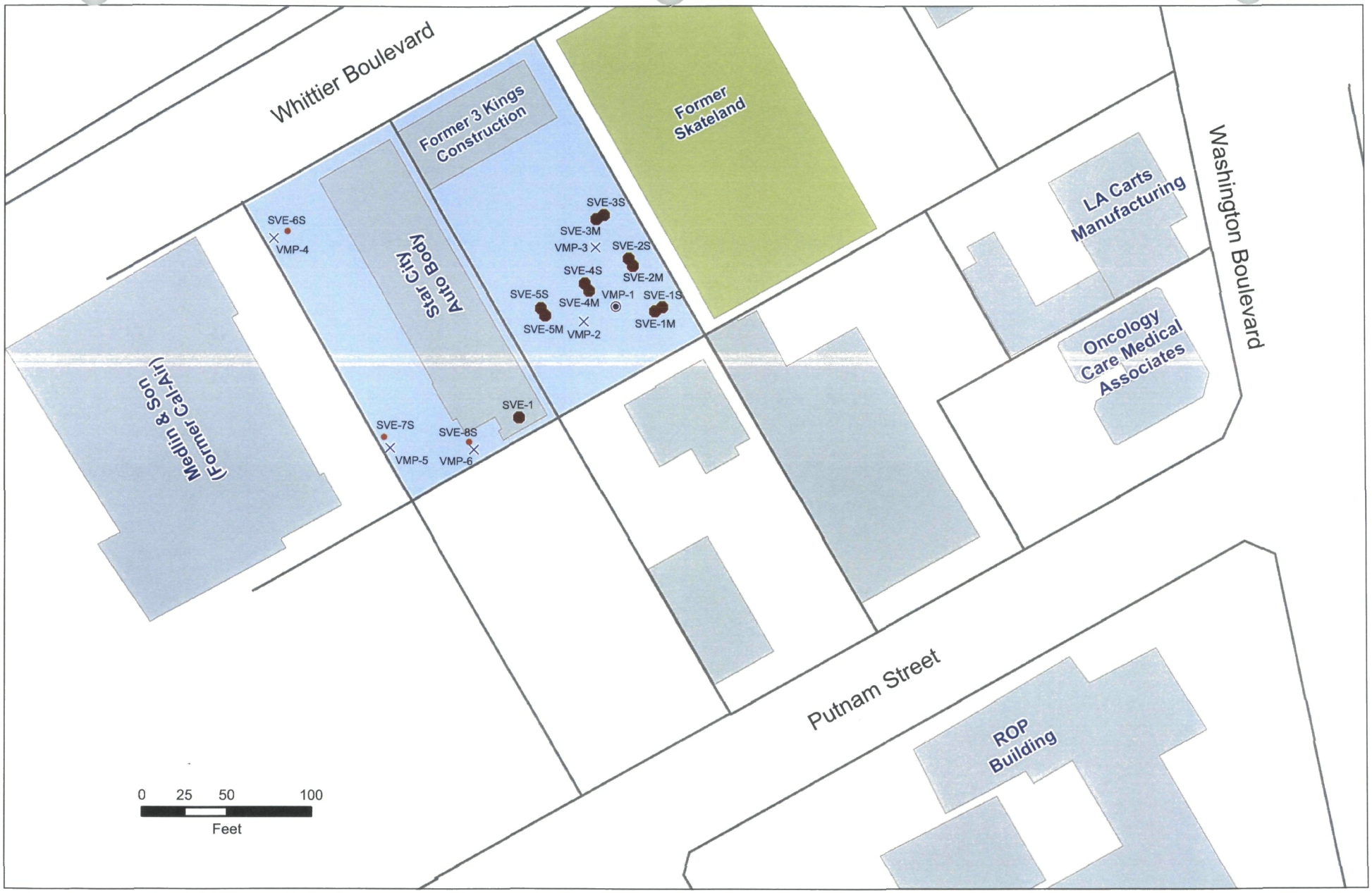
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Membrane Interface Probe (MIP)

CDM

Omega Chemical
Membrane Interface Probe Locations (MIP)

Figure 3-5



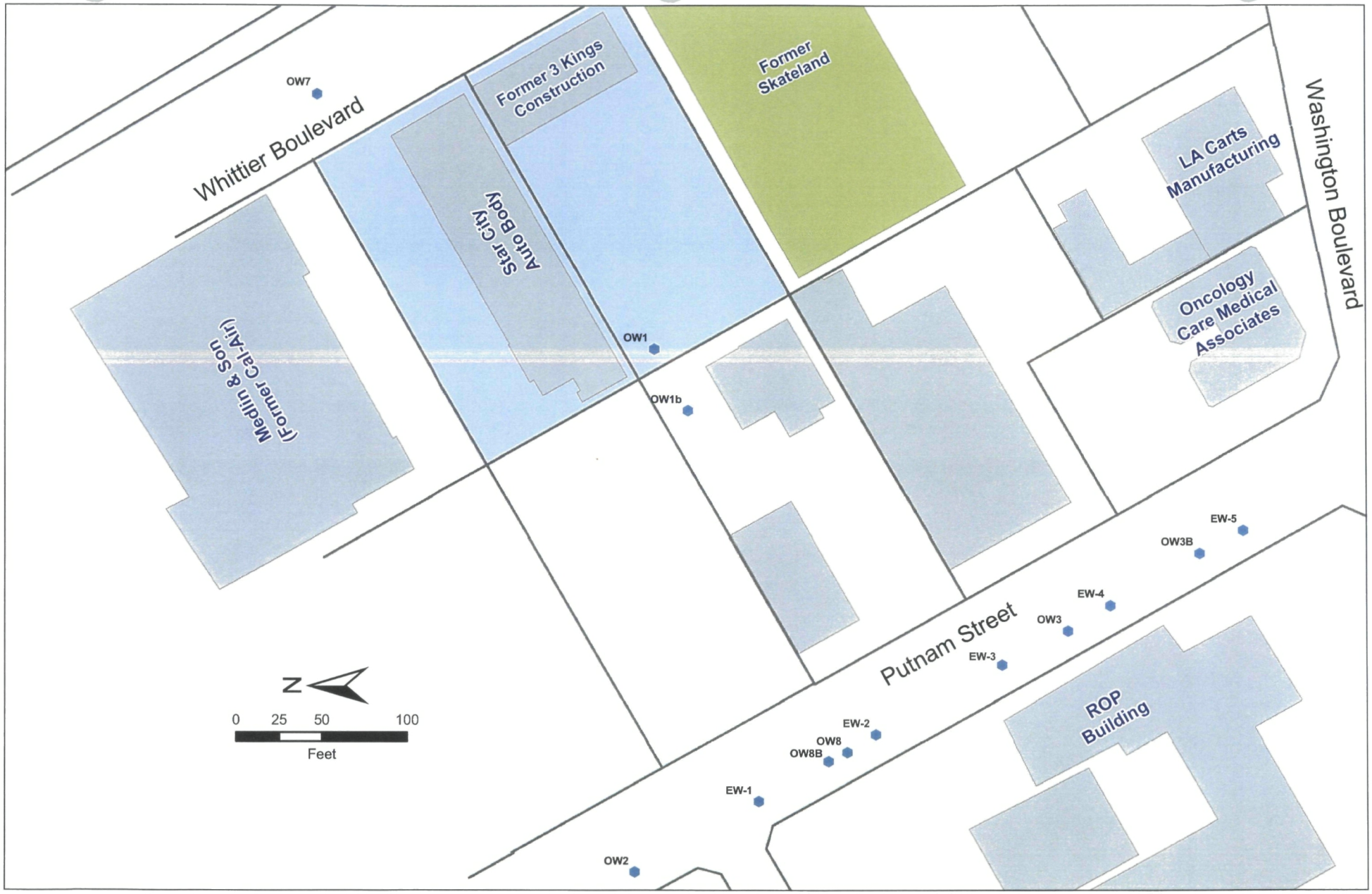
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Soil Vapor Extraction Well
- Soil Vapor Extraction Well
- Vapor Monitoring Probe Below the 30 Foot Unit
- Vapor Monitoring Probe In the 30 Foot Unit

CDM

Omega Chemical
Soil Vapor
Extraction Well Locations

Figure 3-6



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Groundwater Sample Location

CDM

Omega Chemical
Groundwater Well Locations

Figure 3-7