Module B

Old Town Area

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MODULE B

OLD TOWN AREA

This module is an attachment to Volume 1 of the RCRA Facility Investigation (RFI) Report for Lawrence Berkeley National Laboratory (LBNL). Volume 1 presents an overview of the RFI as it pertains to LBNL as a whole, and also contains information on the overall characteristics of the site (i.e., physical layout, geology, hydrogeology, potential contaminants, contaminant migration pathways, and potential receptors). Volume 1 is accompanied by four modules that correspond to specific areas of LBNL (Figure B-2).

A. Bevalac Area
B. Old Town Area (this module)
C. Support Services Area
D. Outlying Areas.

Each of the modules contain the following area-specific information for RCRA Facility Investigation (RFI) activities conducted since the Phase II Progress Report (LBNL, 1995k):

- the physical characteristics of the module area, including geology and hydrogeology
- a description of Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and other areas that were investigated
- results of contaminant characterization activities that were completed
- Interim Corrective Measures (ICMs) that were implemented
- potential and identified sources of contamination
- contaminant migration pathways.

For reporting purposes, the RCRA facility Assessment (RFA) subdivided LBNL into 15 study areas (LBNL, 1992d). The Old Town Area (Figure B-3) is composed of RCRA Facility Assessment (RFA) Study Areas 2, 7, 10 and 14 (LBNL, 1992d). Table B1-1 lists the SWMUs and AOCs that have been identified in the Old Town Area and indicates which of those are discussed in this module. The SWMUs and AOCs discussed in this module include only those where characterization or ICM activities have been conducted since July 1, 1995, when the Draft

Final RCRA Facility Investigation Phase II Progress Report (LBNL, 1995k) was prepared. Also discussed in this module is the investigation of a potential source area for groundwater contamination that was not identified as a SWMU or AOC. RFI activities conducted at SWMUs and AOCs where investigations were completed prior to July 1, 1995 are documented in the Draft Final RFI Phase I or Phase II Progress Reports (LBNL, 1994l and LBNL, 1995k).

The SWMUs and AOCs discussed in this module are associated with a wide range of laboratory, fabrication shop, and fuel storage operations that have been historically conducted in the Old Town Area. The locations of those units are shown on Figure B-3.

B1 OLD TOWN AREA DESCRIPTION

LBNL (at that time known as the Radiation Lab) moved from the UC Berkeley campus to its present location in 1940 in order to construct the 184-Inch Cyclotron, a historic facility used to accelerate atomic particles for use in nuclear physics experiments. The area of the cyclotron building (the original Building 6) and adjacent support shops and laboratories to the north and east of Building 6 formed the core of LBNL operations throughout the 1940s, and is therefore commonly referred to as "Old Town". Redevelopment of the Old Town Area in the late 1980's resulted in replacement of the 184-Inch Cyclotron building (the original Building 6) with the Advanced Light Source building (the present Building 6) and construction of Building 2, which houses the Advanced Materials Laboratory.

B2 PHYSIOGRAPHY, GEOLOGY AND HYDROGEOLOGY

B2.1 Summary of LBNL Site Physical Characteristics

A detailed discussion of the overall physiography, geology and hydrogeology of LBNL is given in Volume 1 of this report and summarized below:

LBNL is located on the moderate to steep west- and south-facing slopes of the Oakland-Berkeley Hills, with surface elevations ranging from approximately 500 to 1000 feet above mean sea level (msl). The physiography is dominated by a steep southwest-facing slope that has been modified by erosion of several steep stream canyons, by mass movement resulting from

landslides and soil creep, and by cut-and-fill operations associated with construction of LBNL facilities.

Bedrock at LBNL consists primarily of Cretaceous and Miocene sedimentary and volcanic units, as shown on the summary stratigraphic column (Figure B2.1-1). These units form a northeast-dipping, faulted homocline, as shown on the bedrock geologic map (Figure B2.1-2). The homocline is composed of the following three rock units:

- Cretaceous marine mudstones, shales, and sandstones of the Great Valley Group
- Miocene nonmarine sandstones, siltstones, mudstones and conglomerates of the Orinda Formation.
- Miocene andesitic volcanic and volcaniclastic rocks of the Moraga Formation.

Strata of the Cretaceous Great Valley Group form the structurally lowest portion of the homocline and underlie the southern and western slopes of LBNL. The Orinda Formation lies structurally above the Great Valley Group along a fault contact that dips at a shallow angle to the northeast. The Moraga Formation overlies the Orinda Formation along a conformable contact.

Numerous isolated masses of Moraga formation volcanic rock underlie the developed portions of LBNL at lower elevations than the main Moraga Formation outcrop belt. The rock at the contact between these masses and the Orinda Formation is often composed of slickensided, volcaniclastic/sedimentaclastic rocks that have been informally denoted as the "Mixed Unit". These masses are interpreted to be paleolandslide deposits that are younger than the Moraga Formation but older than historically active landslides at LBNL.

In the easternmost portion of LBNL, the homocline is truncated by the north-striking Wildcat and East Canyon faults. The area east of these faults is underlain by marine sedimentary rocks of the Miocene Claremont Formation and the Miocene San Pablo Group (?). At the western LBNL property boundary, the homocline is truncated by the north to northwest striking Hayward Fault, a regionally extensive, active, right-lateral strike-slip fault. Rocks west of the Hayward fault consist of the Jurassic to Cretaceous Franciscan Complex.

A surficial geologic map of LBNL is shown on Figure B2.1-3. The soil is typically a silty clay less than 2-feet thick. Alluvium is present in some of the creek and stream beds. Colluvial deposits, generally less than 20-feet thick, have developed along the bases of slopes and in hillside concavities as a result of mass wasting processes. At least one major, and several minor, landslides are present on the steeper slopes at LBNL; some have moved since construction of LBNL facilities. These landslide deposits differ from the paleolandslide deposits described above in that they have evidence of historic movement.

Groundwater flow directions generally follow the slope of the surface topography. However, at some locations flow directions deviate due to contrasts in subsurface hydraulic conductivity or artificial drainage features such as building subdrains, subhorizontal hillside drains (hydraugers), and slope stability wells. Hydraulic conductivity testing and groundwater well yields show that the Moraga Formation is relatively permeable, and constitutes the main water-bearing unit at LBNL. In contrast, the underlying Orinda Formation is relatively impermeable. Measured hydraulic conductivities in the other units at LBNL are generally intermediate between these two formations.

B2.2 Old Town Area Physiography and Surface Water Hydrology

The most prominent topographic feature in the Old Town Area is a roughly triangular topographic bench bounded on the north by McMillan Road, on the southwest by the Building 6 complex, and on the east by Buildings 25 and 26 (Figure B2.2-1). This relatively flat area is bounded to the north and south by steep south and southwest-facing slopes and to the west by the west- and northwest- facing slope adjacent to the Bevalac Area. Most of the developed portion of the Old Town Area lies atop the bench, although several buildings (Buildings 2, 29, 46, 47 and 58) have also been constructed on the slope below the bench to the west.

Prior to development of the Old Town Area, a drainage course flowed from the vicinity of Building 6 through the current location of Building 58, then continued northwestward through the Bevalac Area to a confluence with North Fork Strawberry Creek in Blackberry Canyon. During grading for the original cyclotron building and subsequently for the Advanced Light Source, this drainage was completely filled, so that it no longer conveys surface water.

The Old Town Area lies across the boundary between the Blackberry Canyon and Strawberry Canyon watersheds (Figure B2.2-2). The main drainages in these watersheds are North Fork Strawberry Creek (in Blackberry Canyon) and Strawberry Creek (in Strawberry Canyon). No natural surface channels are currently present within the developed parts of the area, although the upper reaches of several tributaries in the Strawberry Canyon watershed (Cafeteria Creek, Ravine Creek, Ten-Inch Creek, and Chicken Creek) drain the undeveloped slopes just south of the area. Surface runoff in most of the Old Town Area consists of overland flow off paved and unpaved areas, and discharges from several hydraugers (Figure B2.2-3), most of which is directed to storm sewers. The storm sewer system in the northwest part of the area discharges into North Fork Strawberry Creek. The storm sewer system draining the southern periphery of the area discharges towards Cafeteria Creek, Ravine Creek, Ten-Inch Creek, and Chicken Creek. Water from these creeks is then captured by a storm sewer that lies along the former course of Strawberry Creek near the southern property boundary. Water from these creeks ultimately discharges to San Francisco Bay.

B2.3 Old Town Area Geology

As shown on the bedrock geologic map (Figure B2.3-1) and on cross sections A-A' through H-H' (Figures B2.3-2 through B2.3-9), three main bedrock units underlie the Old Town Area. To the southwest lie marine mudstones, sandstones, and shales of the Great Valley Group. These strata are overlain to the northwest by nonmarine siltstones and fine-grained sandstones of the Orinda Formation. Over much of the northwestern part of the Old Town Area, the Orinda Formation is overlain by volcanic and volcaniclastic rocks of the Moraga Formation. Although some outcrops of Moraga Formation in the Old Town Area appear to be relatively undisturbed, most outcrops consist of loosely consolidated, poorly sorted, angular blocks composed of Moraga Formation rock types (andesitic volcanic breccia, massive or flow-banded andesite, thin sandy siltstone layers, volcaniclastic gravelly sandstone and minor basalt). In addition, rocks found along the contact between the Moraga and Orinda Formations in many places comprise a mixture of rock types common to both the Moraga and Orinda Formations, and have therefore been mapped as the informally named "Mixed Unit". The Mixed Unit appears to represent

structurally interleaved portions of the Moraga and Orinda Formations, and not a separate stratigraphic unit.

The Great Valley Group dips gently northward in the Old Town Area. Bedding attitudes within the overlying Orinda Formation are variable and include: gentle south and southwest dips at Building 48, gentle north-northeast dips east of Building 17 (Borg, 1991), and 15° to 45° dips "into the hillside" (presumably to the northeast) near the southern end of Building 6 (Dames and Moore, 1961). Boring log records indicate that the contact between the two units generally strikes N40°W and dips 20°NE. This contact is interpreted to be a fault, based on its dip discordance with bedding in the underlying and overlying units, and the presence of fractured and slickensided surfaces as recorded on trench logs and sketches made during excavation of the Building 2 foundation (Harding-Lawson Associates, 1987). It should be noted that the subsurface location of the contact between the Great Valley Group and the Orinda Formation is approximate on some cross sections since it was logged in some borings primarily based on color differences.

Volcanic rocks of the Moraga Formation overlie the Orinda Formation over much of the Old Town Area. Boring log data show that the contact between the two units forms an undulatory surface (Figures B2.3-2 through B2.3-9), and that Moraga Formation volcanic rocks and the intervening Mixed Unit generally fill depressions in this surface in six main areas, as shown on Figure B2.3-10 and discussed below:

- A northwest-trending volcanic rock mass extends approximately from Building 52 through the southern portion of Building 46. As shown on Cross section A-A' (Figure B2.3-2), drawn along the axis of this mass, the volcanic rocks are over 100 feet thick. A section of Mixed Unit up to 40 feet thick underlies the southwest edge of the volcanic rocks but pinches out to the northeast, as shown near the intersection of cross sections C-C' and F-F' (Figures B2.3-4 and B2.3-7).
- A shallow northwest-trending volcanic rock mass over 45 feet thick is present in the northern part of Building 6 and extends to the south edge of Building 58, as shown on the central portions of cross sections E-E' and F-F' (Figures B2.3-6 and B2.3-7). Exposures observed in a utility trench near Building 58 indicate that these rocks underlie the volcanic rock mass described in the preceding paragraph. A 10 to 20 foot thick section of the Mixed Unit is present along its western margin in the vicinity of Building 2 as shown on cross section E-E' (Figure B2.3-6).

- A thin mass of volcanic rocks approximately 20 feet thick occupies a very shallow westward plunging trough in the Orinda Formation surface northwest of Building 58, as shown on the west ends of cross sections B-B', C-C', and D-D' (Figures B2.3-3 through B2.3-5).
- A volcanic rock mass approximately 90 feet thick occupies a south-plunging trough in the Orinda Formation surface under Building 25, as shown on cross section H-H' (Figure B.2.3-9) and the eastern ends of cross sections C-C' and D-D' (Figures B2.3-4 and B2.3-5). The volcanic rocks in this mass consist predominantly of massive andesite with minor amounts of basalt. However, the upper 10 feet of rock encountered in borings drilled at western edge of the mass consisted of a distinctive orange brown tuff underlain by 5 to 15 feet of volcaniclastic conglomerate at the north end and volcanic breccia at the south end.
- A small, 25-foot-thick volcanic rock mass is present beneath parts of Buildings 16 and 14. This mass extends toward the west where it is in contact with the volcanic rock mass under Building 6, as shown in cross section D-D' (Figure B2.3-5). Borings drilled in this mass contained an orange brown tuff overlying volcaniclastic conglomerate at its north end and volcaniclastic breccia to the south, similar to the mass encountered west of Building 25.
- An east-west oriented volcanic rock mass is present beneath the central part of Building 46. It occupies a shallow, westward-plunging depression in the surface of the Orinda Formation, both upslope and downslope of the building. This mass contained a 40 feet thick section of volcanic rocks immediately west of Building 46; however, the rock mass both upslope and downslope of Building 46 were excavated to remediate landsliding. A section of Mixed Unit greater than 10-feet thick was encountered at the base of the section west of Building 46.

As described in Volume 1, the undulatory upper contact of the Orinda Formation is interpreted to be an eroded paleosurface. The overlying volcanic rock masses are interpreted to be landslide bodies deposited on this paleosurface, that were derived from Moraga Formation rocks exposed to the north above LBNL. The section of the Mixed Unit found at the base of these masses is interpreted to have originated from mixing of rocks derived from the Orinda and Moraga Formations during downslope landslide movement. Only the volcanic rock mass under Building 46 is known to have moved recently.

Colluvium is present in a variety of locations in the Old Town Area. The thickest sections of colluvium are present in the area beneath and north of Building 52, on the slope south of Building 6, and in the lower part of the former drainage course immediately beneath and west of Building 58.

Up to 40 feet of fill was placed in the drainage course that flowed from the vicinity of Building 6 through the current location of Building 58. The lower part of the fill includes poorly to moderately compacted asphalt, concrete, and other debris, underlain by a discontinuous layer of graphite blocks and a graphitic silt layer up to 6 inches thick. This lower fill is overlain by engineered fill emplaced during construction of the current Building 6.

B2.4 Old Town Area Hydrogeology

Groundwater in the Old Town Area is primarily present in the bedrock units. The surficial units (i.e., alluvium, colluvium and artificial fill) are generally above the water table throughout most of the area, except for the colluvium and artificial fill within the former drainage course that extends from the Building 6 area northwestward beneath Building 58. The hydraulic conductivities of surficial units in the Old Town Area are not known.

The structurally lowest units throughout most of the Old Town Area are the Great Valley Group and the Orinda Formation (Figure B2.3-1). In addition, a thin section of the Mixed Unit overlies the Orinda Formation in a number of locations. Hydraulic conductivities of bedrock units calculated from slug tests and pumping tests of wells in the Old Town Area are shown on Figure B2.4-1. These data indicate that the Great Valley Group, the Orinda Formation, and the Mixed Unit have relatively low hydraulic conductivities. Few wells screened in the Orinda Formation can produce a sustainable yield to allow conducting interference pumping tests. Of particular note is the fact that slug test calculations made on three levels of a four-level well cluster (MW53-92-21) screened in deep horizons (130 feet, 147 feet, and 193 feet) of the Orinda Formation indicated extremely low hydraulic conductivities, on the order of 10^{-12} to 10^{-13} m/sec. Water levels in three of the four levels are still recovering to static since well installation in 1992. However, several slug tests conducted in wells screened in the Orinda Formation in the vicinity of Building 25A yielded relatively high hydraulic conductivities, indicating that the unit may be more permeable in that area. The Moraga Formation volcanic rock masses have generally higher hydraulic conductivities in comparison to the underlying units, and wells screened within them are more productive than wells screened in the other units.

Since the Moraga Formation volcanic rock masses in the Old Town Area either crop out at the surface, or are overlain by only a thin veneer of generally unsaturated surficial materials, groundwater encountered in the Moraga Formation is interpreted to be unconfined. However, it is possible that deeper horizons within the low permeability Mixed Unit, Orinda Formation, and Great Valley Group contain groundwater under confined conditions.

Groundwater flow in the Old Town Area generally follows the topographic slope, as indicated by groundwater elevation contours that are parallel to the surface topographic contours (Figure B2.4-2). However, north of Building 7 groundwater flows northward, oblique to the topographic slope. This flow direction is probably the result of preferential flow through the relatively high permeability Moraga Formation volcanic rock mass that extends from Building 52 through the southern portion of Building 46 (Figure B2.3-10). A similar degree of preferential flow probably exists within the other masses of Moraga Formation volcanic rocks in the Old Town Area. However, since these bodies are relatively small relative to the spacing between monitoring wells, deflections in the groundwater contours that may be associated with them cannot be observed. Figure B2.4-3 shows the distribution of geologic units at the water table in the Old Town Area, and depicts probable preferential flow pathways.

Inspection of the water level elevation contour map indicates that the horizontal component of the hydraulic gradient (dh/dl) is in the range of 0.15 to 0.5 in the Old Town Area. Assuming a hydraulic conductivity (K) of 1×10^{-6} meters per second, which appears to be typical for volcanic rocks of the Moraga Formation, and an effective porosity (n_e) of approximately 0.25, Darcy's law ($v_x = K/n_e \times dh/dl$) indicates that the average linear groundwater velocity (v_x) would be approximately 20 to 60 meters per year within rocks of the Moraga Formation. For the shallow portion of the Orinda Formation, where a typical hydraulic conductivity would be 1×10^{-8} meters per second, the velocity would be approximately 0.2 to 0.6 meters per year. Deeper sections of the Orinda Formation, which have extremely low hydraulic conductivities, would have substantially lower groundwater velocities. It should be noted that due to the variability in gradients and bedrock physical characteristics, these calculations give only rough, order-of-magnitude estimates of likely groundwater flow velocities in the Old Town Area.

Groundwater elevation hydrographs from a number of clustered shallow and deep wells (Figures B2.4-4 to B2.4-13) were examined to evaluate the vertical component of the groundwater potentiometric gradient. Data were available from the following well pairs:

Well Pair	Unit(s) Screened	Cross Section/ Figure Number	Vertical Gradient Direction
MW52-95-2A MW52-95-2B	Moraga Formation Moraga Formation	A-A'/B2.3-2 G-G'/ B2.3-8	Down
MW52A-98-8A MW52A-98-8B	Colluvium Moraga Formation	A-A'/B2.3-2	Down
MW53-93-16-42' MW53-93-16-69'	Moraga Formation Moraga Formation	B-B'/ B2.3-3	Down
MW53-93-16-69' MW53-92-21-167'	Moraga Formation Deep Orinda Formation	B-B'/ B2.3-3	Down
MW53-93-16-69' MW53-96-1	Moraga Formation Mixed Unit	B-B'/ B2.3-3	None
MW52-95-2A MW52-98-9	Moraga Formation Moraga Formation	G-G'/ B2.3-8	Down

Measured gradients were consistently downward except for one well pair that was screened very close together, slightly above and below the Moraga Formation/Mixed Unit contact. One four-well cluster (MW53-92-21-130', MW53-92-21-147', MW53-92-21-167', and MW53-92-21-193') was constructed in 1992 within a single borehole to investigate vertical hydraulic gradient and concentration gradients in the Old Town Area. The hydrograph of only one of these wells (MW53-92-21-167') is stable, indicating that it likely has reached a static condition (Figure B2.4-10). The hydrographs of the remaining three wells (Figure B2.4-13) indicate that they are still recovering to the static level seven years after well installation, and so cannot be used for assessing vertical gradients. This slow recovery indicates extremely low values of hydraulic conductivity for the screened sections of these wells. The water levels in at least two of these wells appear to be asymptotically approaching the water level measured in MW53-92-21-167'. Since the potentiometric surfaces for each of the well levels are unlikely to be coincident, this suggests that pressure equilibration may be occurring between each of the screened sections because the well construction material is more permeable than the adjacent formation materials.

The relative abundances of major cations and anions in groundwater within the Old Town Area are shown as Stiff diagrams on Figure B2.4-14. These diagrams show four main areas with differing groundwater chemical signatures. In general, the highest cation and anion concentrations, particularly summed sodium/potassium ions and bicarbonate ions, are found in groundwater from the Orinda Formation in the western part of the Old Town Area. In contrast, groundwater from the Orinda Formation in the eastern part of the area shows very low cation and anion concentrations. An explanation for this contrast is the substantial contrast in measured Orinda Formation hydraulic conductivities between the two areas, which could result in substantially different groundwater residence times. Stiff diagrams for the Moraga Formation in the central part of the Old Town Area show ion concentrations generally intermediate between the eastern and western areas, and do not show the strong sodium/potassium peak observed in the Orinda Formation to the west. The Great Valley Group and Orinda Formation in the southern part of the area show a variety of geochemical signatures.

B2.5 Old Town Area Conceptual Hydrogeologic Model

The hydrogeologic information discussed above suggests the following conceptual model for groundwater flow in the Old Town Area. Over the northeastern portion of the area, groundwater flow occurs primarily within the volcanic rocks of the Moraga Formation, which represent preferential flow pathways due to their relatively high hydraulic conductivities. Horizontal flow velocities in this area are likely to be on the order of 100 feet per year. Flow velocities are apt to be significantly lower (probably less than 1 foot per year) in the underlying Mixed Unit and Orinda Formation, due to their lower hydraulic conductivities. In the southwestern part of the area, the Moraga Formation is not present, so flow occurs primarily within the Orinda Formation and Great Valley Group, albeit at relatively low velocities.

Groundwater flow generally parallels the slope of the overlying topography, except in the area north of Building 7, where an extensive northwest-trending mass of Moraga Formation volcanic rock forms a significant preferential flow pathway, and causes flow to be directed to the northwest toward Building 46. Apparent vertical gradients observed in well clusters suggest that some degree of flow may occur downwards through the Moraga Formation and into the

underlying Mixed Unit and Orinda Formation. However, groundwater flow within the Orinda Formation is likely to be of minor importance, as indicated by the relatively low values of hydraulic conductivity measured in the unit. No information is available to allow estimation of vertical gradients in the Great Valley Group.

Some groundwater flow is captured by subdrains and hydraugers (Figure B2.2-3). This is particularly true at the base of the slope immediately east of Buildings 46, 47 and 58, the site of two historic springs. The captured water is either routed through the storm drain system to North Fork Strawberry Creek or Strawberry Creek, or is routed through onsite treatment systems then discharged to the sanitary sewer system.

B3 SOIL CONTAMINATION - CHARACTERIZATION ACTIVITIES AND INTERIM CORRECTIVE MEASURES

The following subsections describe the results of the RFI investigations at SWMUs and AOCs in the Outlying Areas where soil characterization activities were conducted subsequent to those included in the Draft Final RFI Phase II Progress Report (LBNL, 1995k) (Table B1-1). As described in Section 1 of this report, the results of these characterization activities were used to help assess whether further action was required at a site (i.e., whether the unit will be included in the site-wide risk assessment). The assessment was made by comparing analytical results to both LBNL background levels and Preliminary Remediation Goals (PRGs) for residential soil (USEPA, 1999). PRGs for metals and organic site contaminants and LBNL background levels for metals are listed in Section 1, Table 1.6-3.

For organic constituents, Chemicals of Potential Concern (COPCs) and soil analytical results are presented in unit-specific tables in each subsection. For metals, soil analytical results are presented for all units in Table B3-1. Metals results are generally discussed in this module only when concentrations exceed both PRG for residential soil and background levels, since metals concentrations that are within background levels are not considered to represent contamination and metals concentrations that are below PRGs for residential soil are not considered to represent a risk to human health.

Surface runoff and storm drain-flow from the Old Town Area drain toward North Fork Strawberry Creek, Chicken Creek, Ten-Inch Creek, Ravine Creek, and Cafeteria Creek. The potential for contaminants detected in soil to migrate to surface water and sediment has been addressed by collecting surface water and sediment samples from these creeks and analyzing them for chemicals of potential concern from potential upgradient sources. This sampling is discussed in Section B4.5. Potential migration of soil contaminants to groundwater has been addressed by installing and sampling groundwater monitoring wells both within and downgradient from the Outlying Areas, as discussed in Sections B4.1 to D4.4.

B3.1 SWMU 2-1: Building 7 Former Plating Shop

Description and History

The Building 7 Former Plating Shop (SWMU 2-1) was located on a concrete pad just north of Building 7 (Figure B-3), and was used from approximately 1958 until 1964. A small office trailer (Building 7B) was placed atop the concrete pad sometime prior to 1992. The trailer was removed in September 1996 to allow soil sampling beneath the concrete pad.

Past activities at the former plating shop are presumed to be similar to practices currently in use at the present Building 77 plating shop, and probably included dipping of metal parts into plating and finishing solutions. The wastes produced at this SWMU probably included acids, cyanide, caustics, metals, and solvents. There is no information on release controls or specific releases.

Pre-ICM Soil Sampling

Prior to removal of the Building 7B office trailer, soil samples were collected around the periphery of the former plating shop. Subsequently, the trailer was removed and soil borings were drilled through the underlying concrete pad. These sample and boring locations are shown on Figure B3.1-1 and described below:

- Surface samples SS7N-1, SS7N-2, and SS7N-3 were collected from the cement-lined drainage ditch just south of Building 7B as part of a 1992 investigation of the Former Building 7 Sump (AOC 2-5). The soil in the ditch was subsequently excavated.

- Samples SS-10-95-7BS-1, SS-10-95-7BS-2, and SS-10-95-7BS-3 were collected approximately 0.5 feet into the sidewall of exposed dirt approximately 0.5 feet below the top of the concrete pad at the former plating shop location.
- Samples were collected at both 0.5 and 4 feet below ground surface (bgs) at sample locations SS-7BTrench-1, SS-7BTrench-2, and SS-7BTrench-3 during installation of a nearby groundwater collection trench.
- Samples were collected to a depth of 4 feet bgs from soil borings 7BS-96-1 through 7BS-96-5 and 7BW-96-6 on the south and west sides of Building 7B to obtain information on the vertical extent of contamination.
- Samples were collected from the upper 2 feet of soil at four locations (7BNE-96-1 and -2, and 7BE-96-3 and -4) east of Building 7B.
- Twelve soil borings (SB7BPL-96-1 through SB7BPL-96-11, and SB7BPL-96-10A) were drilled through the concrete pad underlying the trailer. Samples were collected to a maximum depth of 15 feet bgs, although borings SB7BPL-96-5, SB7BPL-96-7, SB7BPL-96-9 were limited to the upper 2 feet due to obstruction by underground utilities. Boring SB7BPL-96-11 was deepened to 30 feet bgs and converted into a temporary groundwater sampling point.
- Soil sample SS7BW-97-1.0 was collected at a depth of 1-foot bgs near the northwest corner of former Building 7B.

Most of the samples collected beneath and adjacent to the southern portion of the concrete slab contained metals and/or cyanide concentrations greater than both PRGs for residential soil and LBNL background levels (Figure B3.1-2, Tables B3-1, and B3.1-1). Metals exceeding these levels included cadmium, chromium, chromium VI, copper, nickel, lead, mercury and nickel. Concentrations in this area were generally found to decrease to less than maximum background levels and PRGs within the upper 2 feet of soil, and samples collected in adjacent areas to the north, east and northwest generally did not contain either metals or cyanide at concentrations exceeding both PRGs and background.

Tetrachloroethene (PCE), trichloroethylene (TCE), vinyl chloride, benzene and polychlorinated biphenyls (PCBs) were detected at concentrations above PRGs in the same general area as the metals contamination (Figure B3.1-3, Table B3.1-1). Concentrations of these analytes also generally decreased with depth. The maximum concentrations of volatile organic compounds (VOCs) were detected adjacent to the location of the Former Building 7 Sump (AOC

2-5), discussed in Section B3.8, which was probably the source of the major VOC contamination.

Based on the data described above, Figure B3.1-4 was drawn to illustrate the horizontal extent where metals, VOCs, and PCBs were detected at concentrations above both PRGs for residential soil and LBNL background levels.

Interim Corrective Measures (ICMs)

A workplan (LBNL, 1997j) specifying excavation of contaminated soil beneath the former plating shop was prepared prior to initiating ICM activities. The objective of the ICM was to excavate soil with concentrations of contaminants above both PRGs for residential soil and LBNL background levels.

Prior to excavating the plating shop area, a 3.5-foot deep trench was excavated east of the proposed excavation in order to identify adjacent underground utilities. Soil samples 7BEXC-97-1-2.1 and 7BEXC-97-2-3.6 were collected from the floor of the excavation. PCBs were detected at a concentration exceeding the PRG for residential soil in the shallower sample (Table B3.1-1). Th area near 7BEXC-97-1-2.1was excavated to a depth of 40 inches in January 2000 for the placement of a concrete pad. Soil samples (SS-7N-00-1, SS-7N-00-2, SS-7N-00-3, and SS-7N-00-4) were collected from the base of the excavation (Figure B3.1-5, Tables B3-1, and B3.1-1). No PCBs were detected. Metals were detected at concentrations below LBNL maximum background levels or PRGs for residential soil.

In July and August 1998, the concrete pad and underlying abandoned electrical conduits were removed, and contaminated soil was excavated in stages to depths of up to 8 feet bgs. Confirmatory soil samples (SS-7BPL-98-1 through SS-7BPL-98-31) were collected from the floor (Figure B3.1-5) and walls (Figure B3.1-6) of the excavation as excavation progressed. One sample (SS-7BPL-Underpipes) was also collected under the electrical conduit. Contaminant concentrations in the confirmation samples from soil left in place were less than PRGs for residential soil or maximum background levels except for one wall sample (SS7BPL-98-30), along the northeast side of the excavation, where copper and lead were above both PRGs for

residential soil and background levels. However, the excavation could not be extended at the time because access was obstructed by a groundwater treatment system.

After relocation of the groundwater treatment system, the area on the northeast side of the excavation was extended in May and June 1999. Residual contaminant concentrations in confirmatory soil samples (SS-7BPL-99-1 through SS-7BPL-99-13) taken from the floor (Figure B3.1-5) and walls (Figure B3.1-6) of the new excavation area were less than PRGs for residential soil, except for PCBs, which were detected at concentrations up to 0.36 mg/kg in the east wall and adjacent portion of the excavation floor.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 7 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 2-1.

Surface Water and Sediment

Most of the area of soil contamination is covered with concrete and asphalt minimizing the potential for erosion and migration to surface water. PCBs have not been detected in surface water or sediment samples collected from North Fork Strawberry Creek. The only halogenated hydrocarbon detected in surface water or sediment samples collected from North Fork Strawberry Creek has been a trace concentration (<1 μg/L) of 1,1,1-trichloroethane (1,1,1-TCA) in the surface water in May 1995. 1,1,1-TCA has not been detected in the ten surface water samples collected since that time. The MCL for 1,1,1-TCA is 200 μg/L. Concentrations of metals detected in surface water samples collected from North Fork Strawberry Creek have been well below the drinking water standard (maximum contaminant level [MCL]). Except for one nickel sample, concentrations of metals detected in sediment have been below LBNL maximum background levels for soil or PRGs for residential soil. Nickel was detected above the LBNL

soil background level in only one of eleven sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

Groundwater

The area of SWMU 2-1 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3. Temporary groundwater sampling point SB7BPL-96-11 was installed at SWMU 2-1. Groundwater samples collected from the well in 1996 were analyzed for PCBs, metals, and VOCs. No PCBs were detected. Barium, chromium, and vanadium were the only metals detected. The concentrations of barium and chromium were well below MCLs. There is no MCL for vanadium. VOCs were also detected.

Status of Unit

SWMU 2-1 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination.

SWMU 2-1 was approved for NFI rather than NFA status because of the presence of contaminants in soil at concentrations above both LBNL background levels and PRGs for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

Subsequent to the NFI request, approximately 100 cubic yards of contaminated soil at the former plating shop location were excavated and disposed of as an ICM. The objective of the ICM was to remove soil with contaminant concentrations above both LBNL background levels and PRGs for residential soil. This was accomplished except for one limited area. One confirmatory soil sample collected from the east wall of the ICM excavation contained PCBs at a concentration above the PRG for residential soil. The concentration of PCBs detected, however, is below the USEPA self-implementing cleanup level of 1 mg/kg for soil in high-occupancy areas, as defined in the Toxic Substances Control Act (TSCA) (USEPA 1998).

B3.2 SWMU 2-2: Building 52B Abandoned Above-Ground Liquid Waste Storage Tank

Site Description and History

The former Building 52B abandoned liquid-waste aboveground storage tank (TK-01-07) was installed in 1948 and abandoned in 1964. The 1600-gallon steel tank was inset into the concrete foundation beneath Building 52B (Figure B-3), with the west side of the tank exposed along the foundation wall (Figure B3.2-1). The tank was used for storage of waste liquids that were periodically released from Buildings 16 and 53 and routed through drain lines to the tank; these lines are now filled with concrete. A concrete sump was located beneath a drain valve on the exposed west face of the tank.

From 1964 to 1989 when the tank was no longer in use, it would periodically fill with rainwater and overflow through a port at the top of the tank. In 1989, the tank was cleaned and filled with concrete, and the sump was removed. During cleaning operations, several "finger-sized" corrosion holes were noted in the tank.

At various times the waste liquids stored in the tank may have included PCB-containing oil drained from transformers, gasoline, acetone, alcohol, methyl ethyl ketone (MEK), TCE, metals, and kerosene. In 1986, fluid in the tank was sampled and found to contain up to 6000 μg/L of PCBs. Fluid samples collected in 1988 contained chlorinated hydrocarbons (PCE, TCE, 1,1,1-TCA, 1,1,2-TCA, 1,2-dichloroethane [1,2-DCA], 1,1,2,2-tetrachloroethane [1,1,2,2-PCA], chloroform), aromatic hydrocarbons (xylenes, toluene, ethylbenzene, benzene), and heavy petroleum hydrocarbon constituents, tentatively identified as degraded gasoline, oil, or other petroleum products.

In 1986, PCBs were detected in shallow soil samples collected near the tank (7 mg/kg maximum) (LBNL, 1992d). The locations of these samples were not documented. In March 1988, four shallow soil borings (B-1, B-2, B-3, and B-6) were drilled just west of the tank. Boring B-6 was angled beneath the tank (Harding Lawson Associates, 1988c). PCE (28.8 mg/kg) was detected adjacent to the sump and PCBs (1.9 mg/kg) were detected beneath the tank.

Low concentrations of toluene and xylenes were also detected. A soil sample collected beneath the tank during tank closure activities in 1989 contained total petroleum hydrocarbons (TPH) in the diesel range (TPH-D), oil & grease, PCBs, and toluene (LBNL, 1992d).

Pre-ICM RFI Soil Sampling

In July 1995, soil samples were collected to a depth of 30 feet from the boring for monitoring well MW52B-95-13, immediately west of the tank (Figure B3.2-1). MW52B-95-13 was installed to help assess if groundwater had been impacted by releases from the tank.

In June 1996, the steel plate forming the west side of the tank was removed and the concrete was removed from the interior of the tank. Corrosion holes were observed in the north wall, east wall, and bottom of the tank. Holes were drilled in the corroded areas of the tank walls and floor and soil samples were collected at distances up to approximately 1.5 feet from the tank (SS-52BT-WN1 to SS-52BT-WN6 on the north wall, SS-52BT-WE1 to SS-52BT-WE3 on the east wall, and SS-52BT-F-1 on the floor). Additional soil samples were collected from the same locations in July 1996, October 1996, and March 1997 at distances up to approximately 5 feet from the tank walls and floor, to assess the extent of the contamination detected in the June 1996 samples. Samples were also collected at additional locations beneath the floor in March 1997 (SB52BT-97-F2 to SB52BT-97-F4).

Analytical results are included in Table B3.2-1 (organics) and Table B3-1 (metals) Sampling locations and concentrations of contaminants detected are shown on Figures B3.2-2 (PCBs) and Figure B3.2-3 (polynuclear aromatic hydrocarbons [PAHs]). Most of the soil samples collected adjacent to the tank walls and floor contained PCBs (Aroclor-1254) at concentrations greater than the PRG for residential soil and TPH-D and/or TPH in the range of crude/waste oil (TPH-C/WO) at concentrations generally exceeding 1,000 mg/kg. Several samples also contained VOCs, and PAHs, although only one of these samples (sample SS-52BT-F-1-0.5, collected at a depth of 0.5 feet below the floor of the tank) contained organic contaminants (PAHs) at concentrations greater than PRGs. Contaminant concentrations generally decreased with distance from the tank walls and floor. Detected contaminant concentrations were below PRGs at distances exceeding 3 feet laterally from the tank walls, but

PCBs were present at concentrations greater than the PRG at the maximum depth of sampling (4.8 feet) beneath the tank floor. Except for lead in one sample collected immediately adjacent to the tank wall (SS-52BT-WE-3), concentrations of metals were below LBNL maximum background levels or PRGs. The elevated lead level adjacent to the tank wall is suspected to have resulted from tank construction materials.

Several of the soil samples collected west of the tank (B-1, B-2, B-3, B-6, and MW52B-95-13) contained PCBs, oil & grease, toluene, xylenes and PCE. PCBs exceeded PRGs in two shallow samples.

Interim Corrective Measures (ICMs)

The workplan for the ICM was submitted to the regulatory agencies in July 1997 (LBNL, 1997k). The objective of the ICM was to excavate soil with concentrations of organic contaminants above PRGs for residential soil. The ICM, which was conducted in September 1997, consisted of relocation of Building 52B, removal of the tank, excavation of soil, and collection of confirmatory soil samples. Approximately 120 cubic yards of soil was excavated and disposed from the ICM excavations. The tank excavation was then backfilled with lean cement, and the site was paved with asphalt.

Confirmatory soil samples (SS-52BEXC- and SS-53A-97-) were collected from the walls and floor of the excavation as excavation progressed. Based on confirmatory soil sampling results and sampling conducted prior to the ICM, concentrations of contaminants remaining in place are below PRGs for residential soil, except for the following sampling locations (Figure B3.2-4):

- PCBs at two locations on the west wall (0.46 mg/kg in sample SS52Bexc-WWD and 1.9 mg/kg in SS52Bexc-WWC) and one location on the floor of the excavation west of the retaining wall (0.74 mg/kg in sample SS52Bexc-FH).
- PCBs at one location west of the excavation (0.36 mg/kg in sample B-2 at a depth of 0.5 feet)
- Benzo(a)pyrene in the south wall (0.50 mg/kg in sample number SS52BEXC-SWE) and the north wall extension (0.31 mg/kg in sample number SS53A-97-1-4.9) of the excavation.

Except for one sample location (SS52BEXC-WWC at a depth of 4 feet), PCB concentrations in soil remaining in place are below the USEPA self-implementing cleanup level of 1 mg/kg for soil in high-occupancy areas, as defined under TSCA. No PCBs were detected in samples collected at 5.9, 10.8, and 19 feet bgs in boring SB52B-98-1 drilled within approximately 5 feet of SS52BEXC-WWC in March 1998, indicating that the vertical extent of the PCB contamination is limited (Figure B3.2-4). In addition PCB contaminated soil has been excavated from the area west of SWMU 2-2 (Figure B3.1.5).

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 52B area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 2-2.

Surface Water and Sediment

Neither PCBs nor PAHs have been detected in surface water or sediment samples collected from North Fork Strawberry Creek. The only VOCs detected in surface water or sediment samples collected from North Fork Strawberry Creek have been a trace concentration (<1 μg/L) of 1,1,1- TCA in the surface water in May 1995 and a trace concentration of toluene (0.013 mg/kg) in sediment in April 1993. 1,1,1-TCA has not been detected in the ten surface water samples collected since May 1995. The MCL for 1,1,1-TCA is 200 μg/L. Toluene was not detected in five sediment samples collected in 1996. The potential impact to the environment from contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

Groundwater

The area of SWMU 2-2 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3. Groundwater

monitoring well MW52B-95-13 is located at SWMU 2-2. Neither PCBs nor PAHs have been detected in groundwater samples collected from the well. TPH-C/WO and TPH-D (920 μg/L maximum) and halogenated hydrocarbons have been detected. No aromatic hydrocarbons, including benzene, toluene, ethylbenzene, and xylenes (BTEX) have been detected.

Status of Unit

SWMU 2-2 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination
- most of the contaminant mass in the soil was removed as an ICM

SWMU 2-2 was approved for NFI rather than NFA status because PCBs and PAHs remain in the soil at concentrations above PRGs for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

Approximately 120 cubic yards of contaminated soil was excavated and disposed of offsite as an ICM. The objective of the ICM was to remove soil with contaminant concentrations above both LBNL background levels and PRGs for residential soil. This was accomplished except for a few limited areas. PCBs remain in place at concentrations above the PRG for residential soil on the west side of the excavation. Except for one location, concentrations of PCBs in the confirmatory samples are below the USEPA self-implementing cleanup level for soil in high-occupancy areas. In addition, benzo(a)pyrene was detected above the PRG for residential soil in confirmatory samples collected from one location on the north wall and one location on the south wall of the ICM excavation.

Groundwater monitoring will continue in the Building 52 area as required by the RWQCB.

B3.3 SWMU 2-3: Building 17 Former Scrap Yard and Drum Storage Area

Description and History

Building 17 was used as a scrap yard for storage of salvageable materials from 1960 to 1980 and 1985 to 1987 (Figure B-3). In late 1987, the scrap yard at Building 17 was closed and moved to the former LBNL Re-Use Center at Building 42. Materials that were stored at SWMU 2-3 are presumed to be similar to materials that were stored at Building 42, which included batteries, oily metal equipment, transformers and capacitors, mercury vacuum pumps, empty drums, and drums with spent chemicals. Secondary containment was probably not present in the outdoor storage areas next to Building 17. However, Building 17 itself served as secondary containment for materials stored inside.

Pre-ICM Soil Sampling

From 1993 to 1998, soil samples were collected around the periphery of Building 17, initially to evaluate potential contamination derived from SWMU 2-3 and subsequently to assess the extent of contamination. Sampling locations are shown on Figure B3.3-1 and described below:

- In April 1993, one two-point composite shallow soil sample (SS17W-1/2) and two discrete samples (SS17SW-3 and SS17SW-4) were collected on the grass slope southwest of Building 17 to assess impacts from potential runoff from SWMU 2-3.
- In June 1994, seven soil borings (SB17-94-01 through SB17-94-07) were drilled in the area surrounding Building 17. Three of these borings were located on the grass slope on the northwest and southwest corners of Building 17 to sample areas of potential runoff. Two borings were located to investigate the vertical extent of contamination that had been detected in the 1993 samples. The other four borings were drilled adjacent to the north, east, and south sides of the building in order to sample locations where chemicals might have been stored.
- In August 1996, hand-auger samples were collected from ten locations (SB17-96-1 through SB17-96-10) on the slope west of Building 17 to evaluate the extent of PCB contamination detected in the previously collected samples. One sample was collected at a shallow depth in each auger boring, and an additional sample was generally collected at the depth of auger refusal (maximum depth of 4.5 feet bgs).
- In 1997, soil samples were collected from 19 soil borings (SB17-97-1 through SB17-97-19) to provide additional vertical and horizontal characterization of PCBs and diesel contamination detected in the soil.

- In 1998, Soil samples were collected from 26 locations (SB17-98-1 through SB17-98-5 and SS17-98-1 through SS17-98-21) to complete the characterization of soil contamination at the site.

The soil sampling results indicated that PCB concentrations exceeding the PRG (0.2 mg/kg) were present immediately southwest of, and in an area to the north of, Building 17 (Figure B3.3-1), with lower concentrations detected throughout the periphery of Building 17. The maximum concentration of PCBs detected was 16 mg/kg near the southwest corner of the building (Table B3.3-1).

Petroleum hydrocarbons in the range of diesel (TPH-D) and TPH in the range of gasoline (TPH-G) were detected in a number of samples, with maximum concentrations of 110 mg/kg TPH-D and 2.7 mg/kg TPH-G detected near the northwest corner of Building 17 (Table B3.3-1). Freon-12, which was the only VOC detected, was detected in one boring at a concentration less than the PRG for residential soil. The only metal detected above both the background level and PRG for residential soil was nickel, which was detected slightly above the PRG in one sample (Table B3-1).

Interim Corrective Measures (ICMs)

A workplan for an ICM for SWMU 2-3 was submitted to the regulatory agencies in September 1998 (LBNL, 1998m). The objective of the ICM was to excavate soil with concentrations of PCBs above the USEPA self-implementing cleanup level (1 mg/kg) for PCBs in soil in high-occupancy areas, as defined under TSCA. The ICM consisted of excavation of contaminated soil both north and southwest of Building 17.

The first stage of the ICM, which was completed in October 1998, consisted of excavation of approximately 40 cubic yards of soil to a depth of 2 feet from an area north of Building 17 (Figure B3.3-2). Residual PCB concentrations detected in confirmation samples and non-excavated characterization samples were all lower than the 1 mg/kg cleanup level; however, one of the excavation-base samples (SS-17EXCN-98-2) and two samples located west of the excavation (SS17-98-3 and SS17-98-14) contained PCBs at concentrations greater than the PRG for residential soil (Figure B3.3-2).

The second stage of the ICM was conducted in May and June 1999, and consisted of excavation of approximately 200 cubic yards of soil in the area southwest and west of Building 17 (Figure B3.3-3). Residual PCB concentrations detected in confirmation samples and non-excavated characterization samples were all lower than the 1 mg/kg ICM cleanup level, except for one sample (SS-17EXCSW-75B) located beneath Building 17 (Figure B3.3-3). Several samples contained PCBs at concentrations greater than the PRG for residential soil.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.4 (TPH and PCBs). Surface runoff in the Building 17 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 2-3.

Surface Water and Sediment

PCBs have not been detected in either surface water or sediment samples collected from North Fork Strawberry Creek.

Groundwater

Groundwater monitoring well MW1-220 is located near the southeastern corner of Building 17 (Figure B3.3-1). PCBs were not detected in a groundwater sample collected from the well in November 1998.

Status of Unit

SWMU 2-3 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination.

SWMU 2-3 was approved for NFI rather than NFA status because of the presence of PCBs in soil at concentrations above the PRG for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

Subsequent to the NFI request, approximately 240 cubic yards of contaminated soil at the former scrap yard location were excavated and disposed of as an ICM. The objective of the ICM was to remove soil with concentrations of PCBs above the USEPA self-implementing cleanup level (1 mg/kg) for PCBs in soil in high-occupancy areas, as defined under TSCA (USEPA, 1998). Except for one confirmatory soil sample collected under the west end of Building 17, concentration of PCBs detected were below the ICM cleanup level.

B3.4 SWMU 7-5: Building 58 Sumps

Description and History

Building 58 has primarily been used for activities associated with research and development of subatomic particle accelerators (Figure B-3). Three sumps (B58-01-01, B58-01-02, and B58-01-03) located at the southern end of the building were installed to collect spills from activities inside the building (Figure B3.4-1). The sumps are currently closed off, but may have been used for collection of solvents and waste oils when they were operational.

Soil Sampling

In August 1996, soil borings were drilled through the concrete base of each sump and soil samples were collected from both the backfill immediately below the base of each sump and from underlying native soil. Borings SB58-01-01 and SB58-01-03 were drilled to a depth of approximately 5 feet. Boring SB58-01-02 was drilled to a depth of 30 feet.

Low concentrations (38 mg/kg maximum) of TPH-D, TPH-C/WO, and oil & grease were detected in several samples. No PCBs or aromatic hydrocarbons were detected. The only VOCs detected were PCE and TCE in one sample (SB58-01-02) (Figure B3.4-1, Table B3.4-1). The source of the VOCs is interpreted to be the underlying Old Town Groundwater Solvent Plume (AOC

2-4), since this sample was collected beneath the water table within the boundaries of the plume and shallower samples did not contain VOCs.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 58 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 7-5.

Surface Water and Sediment

The area of soil contamination is covered by Building 58, eliminating the potential for erosion and migration to surface water. None of the organic analytes detected in soil at SWMU 7-5 has been detected in surface water or sediment samples collected from North Fork Strawberry Creek.

Groundwater

The area of the SWMU 7-5 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3. Boring SB58-01-02 was converted to a temporary groundwater sampling point. Halogenated hydrocarbons have been detected in the groundwater. No aromatic hydrocarbons, including BTEX, have been detected.

Status of Unit

SWMU 7-5 was approved for NFA status by DTSC in August 1997 (DTSC, 1997) based on the following criteria included in LBNL's request for NFI status (LBNL, 1997d) :

- soil at the sumps was sampled to evaluate whether a release had occurred

- VOCs, which were detected in soil only below the water table, were most likely associated with the Old Town Groundwater Plume and not the Building 58 Sumps.
- concentrations of contaminants in soil were below PRGs for residential soil

B3.5 SWMU 10-4: Building 16 Former Waste Accumulation Area

Description and History

The former waste accumulation area was located on the west side of Building 16 (Figure B-3 and Figure B3.5-1). Waste accumulation began in approximately 1975 and continued until 1990 or 1991, at which time the accumulated wastes were removed. The area was used for storage of 55-gallon drums containing waste oil. The drums were placed directly on an unbermed concrete pad with no release controls or secondary containment. An abandoned 1.5-inch-diameter oil drain line that originated in Building 16 and ran westward to the Building 52B abandoned liquid waste storage tank (SWMU 2-2) crosses beneath the northern part of the waste accumulation area (Figure B3.2-1).

Soil Sampling

Soil samples collected to characterize the magnitude and extent of contamination at SWMU 10-4 and concentrations of contaminants detected are shown on Figures B3.5-1 (PCBs), Figures B3.5-2 (TPH-D and oil & grease), Figures B3.5-3 (VOCs), and Figure B3.5-4 (metals) and discussed below. Samples were collected primarily from the grass-covered slope to the west of SWMU 10-4, where runoff from the unit would have occurred. Sampling beneath the asphalt at the unit was limited due to the high density of underground utilities in that area.

- In April 1993, three soil samples were collected at a depth of approximately 2 feet bgs. Two samples were collected from the grass slope to the west of Building 16 and were composited (SS16W-1 and SS16W-2); a third sample (SS16W-3) was obtained from the north edge of the concrete slab on the west side of the building.
- In June 1994, three shallow borings (SS16-94-01, SS16-94-02, and SS16-94-03) were drilled to a maximum depth of 9 feet on the grass slope west of Building 16 to characterize the vertical extent of soil contamination detected in the April 1993 samples.

- In October 1994, soil boring SB7-94-01 was drilled to a depth of 14 feet in the alley west of Building 16 to assess whether soil contamination extended westward from the grass-covered slope west of Building 16.
- In August 1996, soil borings were drilled at 12 locations (SB16-96-1 through SB16-96-12) to a maximum depth of 3 feet on the grass slope to further characterize the extent of soil contamination.
- In August 1996, samples were collected from 6.5 feet and 9 feet bgs from a soil boring (SB16N-96-1) located along the alignment of an abandoned oil drain pipe on the slope northwest of Building 16. These samples were collected to assess whether the abandoned drain pipe may have been the source of oil & grease contamination detected in previously collected samples.
- In March 1997, soil borings were drilled to a maximum depth of approximately 5 feet at 13 additional locations (SB16-97-1 through SB16-97-10), including one boring (SB16-97-11) in the area where the wastes were stored, in order to complete the characterization of the extent of contamination.

The principal organic contaminants detected were PCBs and petroleum hydrocarbons (Table B3.5-1). Shallow samples (0.5 to 0.8 feet bgs) from three of the 1996 borings (SB16-96-2, SB16-96-3 and SB16-96-5) had PCB concentrations greater than the PRG for residential soil. Only one of the samples contained PCBs at a concentration above the USEPA self-implementing cleanup level (1 mg/kg) for soil in high-occupancy areas, as defined under TSCA. PCBs were either not detected, or detected at a concentration below the PRG, at depths of approximately 2 to 5 feet bgs in adjacent borings installed in 1997 (SB16-97-2, SB16-97-4, and SB16-97-6A).

Petroleum hydrocarbons, characterized as either TPH-D or oil & grease, were detected at most of the soil sampling locations (Figure B3.5-2), with the highest concentrations detected immediately adjacent to the former waste accumulation area. No aromatic hydrocarbons, including BTEX, were detected. The only VOCs detected were PCE, methylene chloride, and acetone, all at concentrations significantly below PRGs for residential soil (Figure B3.5-3).

Cadmium, chromium, hexavalent chromium, mercury, and nickel were sporadically detected at concentrations above background levels and PRGs for residential soil, in the southern portion of the slope (Table B3-1, Figure B3.5-4).

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff from the area west of Building 16 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 10-4.

Surface Water and Sediment

Neither PCBs nor the VOCs detected in soil at SWMU 10-4 has been detected in surface water or sediment samples collected from North Fork Strawberry Creek. Concentrations of metals detected in surface water samples collected from North Fork Strawberry Creek have been below the MCL. Except for nickel in one sample, concentrations of metals detected in sediment have been below LBNL maximum background levels for soil or PRGs for residential soil. Nickel was detected above LBNL soil background levels in only one of eleven sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

The area of SWMU 10-4 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3. Soil boring SB16-97-11 was converted to a temporary groundwater sampling point. Groundwater samples were collected from the well in April 2000 and analyzed for PCBs. Samples collected from downgradient monitoring well MW16-94-13 have also been analyzed for PCBs. PCBs have not been detected in either well. The metals detected in soil at SWMU 10-4 at concentrations above PRGs for residential soil and background levels (cadmium, chromium, mercury, and nickel) have not been detected in MW16-94-13. VOCs have been detected in SB16-97-11 and MW16-94-13. TPH-D and oil & grease have been detected in MW16-94-13; however, no aromatic hydrocarbons, including BTEX have been detected.

Status of Unit

SWMU 10-4 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination

SWMU 2-3 was approved for NFI rather than NFA status because of the presence of PCBs and metals in soil at concentrations above both LBNL background levels and PRGs for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

B3.6 SWMU 10-10: Building 25 Plating Shop Drains

Description and History

The Building 25 plating shop is located on the west side of Building 25 (Figure B-3) and houses a small-scale electroplating and etching operation. Small spills that occurred during operations were rinsed across the floor into floor drains (Figure B3.6-1). The drains are piped to a 40-gallon concrete sump that is located in an underground vault beneath Room 150. The contents of the sump are pumped to an indoor storage tank and then into the Building 25 wastewater treatment system. Plating operations have been performed at Building 25 since approximately 1970. The sump in Room 150 was installed in 1985.

Soil Sampling

In September 1996, during resurfacing of the shop floor, shallow soil samples were collected from 17 locations in the vicinity of the sump and floor drains (Figure B3.6-1). Samples were collected at depths of approximately 1 foot and 3 feet below the floor surface, unless refusal was encountered. The thickness of the concrete floor ranged from approximately 4 to 6 inches.

Chromium, chromium VI, lead, and copper were detected at concentrations above both LBNL background levels and PRGs for residential soil beneath room 140 (Table B3-1, Figure

B3.6-1). Arsenic was detected at concentrations above the PRG for residential soil and slightly above the LBNL background level in the two soil samples collected in Room 145. Levels of pH were less than 5.0 at four locations in Room 140, indicating acidic conditions. None of the samples contained detectable levels of VOCs or cyanide (Table B3.6-1).

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.4 (metals). Surface runoff from the area west of Building 25 area is directed through the storm drain system to Ten Inch Creek. Surface water and sediment samples have been collected from Ten Inch Creek and analyzed for chemicals of potential concern from upgradient sources, including SWMU 10-10.

Surface Water and Sediment

Concentrations of metals detected in surface water samples collected from Ten Inch Creek have been below the MCL. Concentrations of metals detected in sediment have been below LBNL maximum background levels for soil or PRGs for residential soil.

Groundwater

Monitoring well MW25-94-12 is downgradient from SWMU 10-10. Arsenic, barium, molybdenum, selenium, and zinc have been the only metals detected in the groundwater. Concentrations of arsenic, barium, selenium, and zinc have been well below the MCL. There is no MCL for molybdenum.

Status of Unit

Resurfacing of the floor has been completed. SWMU 10-10 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of soil contamination.

SWMU 10-10 was approved for NFI rather than NFA status because of the presence of metals in soil at concentrations above both LBNL background levels and PRGs for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

B3.7 AOC 2-1: Building 7E Former Diesel (Kerosene) UST

Description and History

The former Building 7E underground storage tank (UST) was installed immediately south of Building 7E (Figure B3.7-1), which was demolished during construction of Building 6 (the Advanced Light Source [ALS] building) in 1989. This location is currently between the ALS and the southwest corner of Building 7 (Figure B-3). The UST, which had a capacity of 520-gallons, was discovered on April 19, 1989, while installing underground utilities for the ALS. Based on its condition and construction, it was estimated to have been at least 35 years old. Available information indicated that it had been used for storage of kerosene. At the time of discovery, the tank contained several inches of water and about an inch of floating petroleum product.

On April 21 1989, soil was excavated to a depth of 4 feet bgs and the tank was removed in the presence of City of Berkeley representatives. A sample of the fuel product in the UST was identified as kerosene (LBNL, 1992d). Subsequently, soil was removed from beneath the northwest part of the tank to a depth of approximately 17 feet to assess the extent of soil contamination. In addition, an exploratory 17-foot deep trench was extended to the northwest from the tank excavation. The excavation was initially backfilled with the original excavated material. On June 12, the upper 4-feet of material was removed and replaced with clean gravel. An underground tank release report was prepared by LBNL and submitted to the City of Berkeley Environmental Health Division (LBNL, 1989). Approximately 30 cubic yards of contaminated soil was excavated and disposed of offsite.

Soil Sampling

TPH-D (1,600 ppm) was detected in soil sample S-1, collected directly beneath the tank in the initial tank excavation. Additional sampling was conducted to assess the extent of the soil contamination. On April 24 and 25, 1989, soil samples collected from six soil borings (B-1 through B-6) drilled northwest, west and southwest of the tank location were screened in the field using an organic vapor analyzer (OVA). The two soil samples with the highest detected organic vapor concentrations (from borings B-4 and B-6) were submitted for laboratory analysis (Figure B3.7-2a). On April 26 1989, a 17-foot deep exploratory trench was excavated northwest from the tank excavation to evaluate the lateral and vertical extent of soil contamination (Figure B3.7-2a and Figure B3.7-2b). Soil samples collected from the trench were screened in the field with an OVA. Relatively high OVA readings (generally >1000 ppm) were obtained in the samples from the trench excavation (Figure B3.7-2a and Figure B3.7-2b). Soil sample S-2, from the base of the trench beneath the former tank location, was submitted for laboratory analysis.

In 1992, 1993, and 1995, soil samples were collected from the borings for monitoring wells MW7-92-16 and MW6-95-14 installed to monitor groundwater quality at the former tank site and from MW6-93-4 installed approximately 70 feet to the northwest (downgradient) of the site (Figure B3.7-3). In 1995, four soil borings (SB7-95-1 through SB7-95-4) were drilled immediately north of the former UST location to assess contamination from another potential source in that area (Figure B3.7-3).

Analytical results are included in Table B3.7-1. Results indicated that TPH-D was present at elevated concentrations (>100 mg/kg), to a depth of approximately 40 feet, within the UST excavation area. Samples collected to the north and northwest of the tank excavation (i.e., borings 7-95-1 through 7-95-4, MW6-93-4) indicated that the extent of TPH-D contamination in soil was limited in those directions (Figures B3.7-3, B3.7-4, and B3.7-5). Although TPH-D was not detected at MW6-93-4, TPH in the kerosene range (TPH-K) was detected at a concentration of 1,300 mg/kg in a soil sample collected from beneath the water table (Figure B3.7-4).

The extent of fuel contamination in the soil at concentrations above 100 mg/kg appears to be limited to a vertical zone approximately 20 feet above and 10 feet below the water table in the

areas of monitoring wells MW7-92-16, MW6-95-14, and MW6-93-4. This vertical distribution of contamination is probably the result of seasonal fluctuations in the groundwater table.

Several soil samples contained up to 2.5 mg/kg of aromatic hydrocarbons commonly associated with fuels (including naphthalene, ethylbenzene, toluene, and xylenes) and up to 0.051 mg/kg of halogenated hydrocarbons (PCE, TCE, Freon 113 and cis-1,2 DCE) (Table B3.7-1). Concentrations of these hydrocarbons are well below the PRG for residential soil. The source of the halogenated VOCs is most likely the Old Town Groundwater VOC Plume.

Soil samples from seven soil borings were also analyzed for metals (Table B-3). Only arsenic was detected above both the LBNL background level and the PRG for residential soil (in only one soil sample). Since arsenic is not a COPC at this unit, and was detected at a level (21 mg/kg) only slightly above the background level (19.1 mg/kg), this occurrence is presumed to represent naturally occurring arsenic levels.

Interim Corrective Measures

Short-Term Pilot Test

Pilot testing was conducted at the site from June 21 through June 27 1996 to evaluate the effectiveness of soil vapor extraction (SVE) and groundwater pump and treat for remediating the fuel contaminated soil and groundwater at the site. The pilot test was initiated by pumping groundwater from MW6-95-14 (groundwater extraction well) to lower the water table in the vicinity of the well by approximately 16 feet (Figure B3.7-6). Approximately 1.5 liters of non-aqueous-phase-liquid (NAPL), identified as kerosene, was removed from the water table by skimming. After groundwater extraction sufficiently lowered the water table, the SVE system was started, resulting in removal of approximately 3.2 pounds of vapor-phase contaminants over a four-day period, at a maximum mass removal rate of 0.93 pounds per day.

ICM Installation and Operation

Based on the results of the pilot test, an ICM workplan (LBNL, 1998b) was submitted to the regulatory agencies in February 1998. The ICM was initiated in September 1998 using

similar dual phase extraction (DPE) techniques (i.e., liquid extraction using a submersible pump, combined with SVE using a vacuum blower) as those used during the pilot test. The ICM has operated on a semicontinuous basis through the period of this report. Both groundwater and soil vapor have been extracted from well MW6-95-14 and treated using two separate granular activated carbon (GAC) treatment units located on the east side of Building 6. The treated groundwater has then been discharged to the sanitary system under a permit issued by the East Bay Municipal Utilities District (EBMUD). The treated soil gas has been vented to the atmosphere under a permit issued by the Bay Area Air Quality Management District (BAAQMD). Following is a chronological summary of ICM operation.

Chronology of ICM at Former Building 7E UST Site (AOC 2-1)

Stage	Dates
Begin groundwater extraction	September 18, 1998
Begin SVE	October 20, 1998
Stop SVE for mechanical repairs	November 3, 1998
Resume SVE	November 9, 1998
Begin daytime-only SVE due to working-hour noise issues	November 16, 1998
Resume full-time SVE after installing noise suppression measures	December 2, 1998
Stop SVE for in situ respiration (ISR) test 1	March 16, 1999
Resume SVE	March 29, 1999
Stop SVE for ISR test 2	June 16, 1999
Stop groundwater extraction to monitor for free-product	June 23, 1999
Restart groundwater extraction	October 5, 1999
Restart SVE	November 22, 1999
Stop groundwater extraction	May 17, 2000
Resume groundwater extraction	June 29, 2000

The following parameters are monitored periodically:

- System airflow rates, which are monitored with a thermal anemometer, have varied between approximately 2 and 20 standard cubic feet per minute (scfm).
- Soil gas concentrations are measured using a photoionization detector (PID) at various points in the extracted vapor stream.
- Soil gas is sampled periodically at various points in the extracted vapor stream for laboratory analysis of contaminants by EPA Method TO-3 (TPH) and EPA Method TO-14 (VOCs).
- Water levels are measured in the extraction well using an electric water level meter.

Extracted soil gas contaminant concentrations, contaminant molecular weights, and airflow rate measurements are used to calculate estimated contaminant mass removal rates and cumulative mass removed. As of May 18, 2000, the average mass removal rate was approximately 0.6 pounds per day, and approximately 170 pounds of contaminant mass had been removed by the SVE system.

In situ respiration (ISR) tests were conducted in March and June 1999 to assess whether SVE operations had increased the potential for biodegradation. During these tests, carbon dioxide and oxygen levels in the soil gas were measured both during SVE operation, and during two intervening temporary shutdown periods. Prior to initial SVE shutdown, the oxygen level was approximately 20% and the carbon-dioxide level was approximately 0.25% at the extraction well head, close to values expected for ambient air. One week after initial SVE shutdown, the oxygen level had decreased to approximately 1% and the carbon dioxide level had increased to 7%. SVE operations were then resumed for a 2.5 month period, during which time oxygen levels rose to as much as 18%. The SVE system was then shut down for a second test period and, after two days of soil-gas monitoring, oxygen levels declined to approximately 4% near the extraction well and were approximately 0% in MW6-93-4, located about 60 feet away from the extraction well. Carbon dioxide levels showed a corresponding increase. The depletion of oxygen and increase in carbon dioxide levels observed during both system shutdown periods is interpreted as evidence that the drawing in of ambient atmospheric air during SVE operation results in biologic respiration (biodegradation) in the vadose zone.

The groundwater extraction rate during ICM startup was approximately 1.5 gallons per minute (gpm). Since startup, flow rates have been adjusted periodically in order to maintain a water level of approximately 50 feet bgs. Water level monitoring in well MW7-92-16, located approximately 10 feet from the extraction well, showed that after two weeks of pumping, water levels stabilized at approximately 46 feet bgs, representing a drawdown of 22 feet below the initial static level. Since initiation of SVE from MW6-95-14 on October 20, 1998, water levels measured in well MW7-92-16 have varied between 40 and 55 feet bgs, generally corresponding to variations in the groundwater extraction rate. Based on this information, groundwater

extraction has increased the thickness of the zone available for SVE treatment near the extraction well by 15 to 30 feet over static conditions.

Groundwater extraction was suspended between June 23, 1999 and October 5, 1999 to evaluate whether floating free product was present at the water table. Free product measurements have been periodically conducted in the extraction well (MW6-95-14) and in the adjacent monitoring well (MW7-92-16) both during and after the shutdown period; however, no free product has been detected.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff from the area of the former UST site is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 2-1.

Surface Water and Sediment

TPH-D has not been detected in surface water or sediment samples collected from North Fork Strawberry Creek. Except for toluene in one sediment sample collected in 1993, aromatic hydrocarbons have not been detected in surface water or sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

The Building 7E Former Diesel (Kerosene) UST (AOC 2-1) is the source of a diesel/kerosene groundwater plume, which is discussed in Section 4.4. A small volume of kerosene (approximately 1.5 liters) was skimmed from the water table during the ICM pilot test conducted in 1996. Free product has not been detected during the ICM conducted since 1998.

Status of Unit

AOC 2-1 was approved for NFI status by the City of Berkeley in April 1999 (COB, 1999) based on the following criteria included in LBNL's NFI request (LBNL, 1999a):

- removal of the UST and associated piping and contaminated soil
- characterization of soil contamination
- concentrations of VOCs in the soil below PRGs for residential soil
- concentrations of aromatic hydrocarbons in groundwater have been below MCLs since 1994.

AOC 2-1 will be included in the Human Health Risk Assessment. In addition, LBNL is continuing to operate the ICM systems to remove, to the extent practicable, the residual contaminant mass from the soil and groundwater.

B3.8 AOC 2-5: Former Building 7 Sump

Description and History

In 1992, an abandoned concrete sump and concrete-lined drainage ditch were discovered between Buildings 7 and 7B (Figures B-3, and B3.8-1). The sediment and liquid within the sump and soil covering the ditch were sampled and removed. PCE (free product) was detected in the sump. However, due to the presence of underground utilities, the sump was not removed at that time.

Pre-ICM Sampling

The following soil samples have been collected from the vicinity of the sump:

- In November 1992, soil samples SS7N-1 through SS7N-4 were collected from soil within the cement-lined drainage ditch (including samples from a soil stockpile), and samples were collected from depths up to 4 feet bgs from sample locations SS7N-5 through SS7N-9 in areas adjacent to the sump.
- In December 1992, soil samples were collected to a depth of 30 feet from a soil boring drilled approximately 20 feet west of the sump for installation of a vadose zone monitoring well (VZM-OT-1).

- In August 1993, VZM-OT-2 was installed next to the VZM-OT-1 location. Soil samples were also collected from this boring to a depth of 31 feet.
- In May 1994 soil samples were collected from the boring for monitoring well MW7-94-3 installed to evaluate the potential presence of sources of groundwater contamination upgradient from the sump. In June 1994, SB7-94-3 (samples SS-07-94-03) was installed adjacent to MW7-94-3 to evaluate the extent of shallow TPH-D contamination detected in the well boring.
- In June 1995, soil samples were collected from five 31-foot-deep borings around the sump (SB7B-95-1 through SB7B-95-5) and three inside Building 7 (SB7-95-5 through SB7-95-7) to characterize the horizontal and vertical extent of soil contamination.
- In October 1995, samples SS-10-95-7BS-1, SS-10-95-7BS-2, and SS-10-95-7BS-3 were collected approximately 0.5 feet below the top of the former concrete pad just southwest of the former plating shop as part of the investigation of SWMU 2-1.
- In July 1995, soil samples were collected from depths of 2 feet and 4 feet bgs (SS7N-95-1) from a utility trench excavation immediately west of the sump to determine health and safety requirements for rerouting the underground utility.
- In August 1995, an ICM was conducted which comprised excavation of contaminated soil to a depth of 17 feet bgs (described further in the following subsection). Six soil samples (B7EXC-CTR, B7EXC-SE, B7EXC-SW, B7EXC-NE, B7EXC-NW, and B7EXC-W) were collected from soil cuttings at a depth of approximately 5 feet as the soil was excavated. Six confirmatory soil samples (B7EXC-NNE, B7EXC-N, B7EXC-NNW, B7EXC-SSE, B7EXC-S, and B7EXC-SSW) were collected at the bottom of the excavation.
- In May 1996, four soil borings (SB7-96-1 through SB7-96-4) were drilled along the alignment for the groundwater collection trench downgradient from the sump to determine the design depth of the trench. Soil samples were collected from near the Orinda/Moraga Formation contact and analyzed for VOCs.

Soil near the former sump was contaminated primarily with halogenated VOCs, several of which were present at concentrations exceeding PRGs for residential soil (Table B3.8-1). PCE, which was detected as free liquid within the sump, was the primary contaminant detected in the soil. Other halogenated VOCs included TCE, 1,1,1-TCA, cis-1,2 DCE and 1,1 DCE. The maximum PCE concentration (14,000 mg/kg in soil boring SB7B-95-1) was found at 2.8 feet bgs immediately west of the former sump. Elevated PCE concentrations (>100 mg/kg) were generally restricted to the upper 20 feet of soil within a few feet south and west of the sump (Figures B3.8-2 and B3.8-3). The water table at the site varies seasonally from approximately 10

to 20 feet bgs. PCE concentrations measured in soil below the water table were generally less than 100 mg/kg, although PCE concentrations greater than 1 mg/kg were detected in the Mixed Unit in a zone extending westward from the sump (Figure B3.8-3). The distribution of other halogenated VOCs in soil was similar to that of PCE.

PCBs were detected above the PRG for residential soil at a depth of 2.5 feet near the southwest corner of the sump (0.42 mg/kg in SS7N-7) (Table 3.8-1). Shallow soil samples from soil boring VZM-OT-1 and MW7-94-3 did not contain detectable PCBs.

Both a soil boring (SB7B-95-1) drilled close to the sump location and a shallow soil sample (SS-10-95-7BS-3) collected adjacent to the adjacent former plating shop (SWMU 2-1) contained cadmium and chromium concentrations greater than both background levels and PRGs for residential soil (Figure B3.8-4). Due to the close proximity of these samples to the former plating shop, and the presence of chromium and cadmium in other samples at that unit (as described in Section 3.1) this contamination is most likely derived from SWMU 2-1. Several samples collected both adjacent to and up to 20 feet from the sump at depths up to 30 feet contained nickel concentrations above both background levels and PRGs for residential soil. However, the nickel detected in borings located south and west of the sump (SB7B-95-3, SB7B-95-4, and SB7-95-5) was present at concentrations only slightly above background levels (Table B3-1), and may therefore represent naturally occurring levels. In addition, nickel has been detected above the statistically determined background level at a number of locations where it is not a chemical of potential concern, indicating that the elevated concentrations may represent naturally occurring levels.

Interim Corrective Measures

In 1992, the concrete slab covering the sump was removed, and the sediment and liquid in the sump and soil filling the concrete ditch were removed and disposed of in accordance with regulatory requirements. However, due to the presence of active sanitary sewer and storm-drain lines, the sump could not be removed at that time. To allow for sampling and removal of liquid accumulating in the sump, a 6-inch diameter slotted casing was installed, then the sump was backfilled with gravel and the area was resurfaced with asphalt.

In August 1995, the sewer and storm-drain lines were relocated and the sump was removed. Contaminated soil was excavated to a depth of 17 feet from an area approximately 10 feet long by 7 feet wide around the sump, using 3-foot-diameter solid-stem augers (Figure B3.8-1). The excavation depth was limited to 17 feet both due to concerns regarding stability of the adjacent building foundations and to the presence of saturated soil beneath this depth. Temporary steel casings were installed in the auger borings after reaching the required 17 foot depth. The casings were filled with drain rock, and were then withdrawn, leaving the excavation filled with drain rock. In addition, two PVC well-casings with screened intervals from 5 to 10 feet bgs were installed within the excavation backfill. The purpose of installing the drain rock backfill and well casings was to facilitate the implementation of potential remedial measures, if required. Approximately 70 cubic yards of contaminated soil were excavated and disposed from the sump excavations and utility relocation work.

PCE and TCE were the only VOCs detected in confirmatory soil samples and non-excavated characterization samples in the vicinity of the former sump at concentrations above PRGs for residential soil. As shown on Figure B3.8-3 the highest concentrations of VOCs remaining in the soil lie immediately beneath and to the west of the former sump, above the Orinda Formation in the Mixed Unit.

Chromium and cadmium concentrations exceeding both PRGs for residential soil and background levels remain in place in soil adjacent to SWMU 2-1, which is the likely source.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 7 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 2-5.

Surface Water and Sediment

The only halogenated hydrocarbon detected in surface water or sediment samples collected from North Fork Strawberry Creek has been a trace concentration (<1 μg/L) of 1,1,1-TCA in the surface water in May 1995. 1,1,1-TCA has not been detected in the ten surface water samples collected since that time. The MCL for 1,1,1-TCA is 200 μg/L. PCBs have not been detected in surface water or sediment samples collected from North Fork Strawberry Creek. Concentrations of metals detected in surface water samples collected from North Fork Strawberry Creek have been well below the drinking water standard (maximum contaminant level [MCL]). Except for nickel in one sample, concentrations of metals detected in sediment have been below LBNL maximum background levels for soil or PRGs for residential soil. Nickel was detected above the LBNL soil background level in only one of eleven sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

AOC 2-5 is the primary source of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3. VOCs have been detected in groundwater in the source area at total concentrations greater than 100,000 μg/L. Temporary groundwater sampling point SB7BPL-96-11 was installed at SWMU 2-1, within several feet of AOC 2-5. Analysis of groundwater samples collected from the sampling point in 1996 included PCBs and metals. No PCBs were detected. Barium, chromium, and vanadium were the only metals detected. The concentrations of barium and chromium were well below MCLs. There is no MCL for vanadium.

Status of Unit

AOC 2-5 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination
- Most of the contaminant mass in the soil was removed as an ICM.

AOC 2-5 was approved for NFI rather than NFA status because PCE, TCE, chromium and nickel remain in the soil at concentrations above PRGs for residential soil and LBNL background levels. The unit will therefore be included in the Human Health Risk Assessment.

Approximately 70 cubic yards of contaminated soil was excavated and disposed of offsite as an ICM. The purpose of the ICM was to protect human health and the environment and to remove the source of the groundwater contamination.

Groundwater monitoring will continue in the Building 7 area as required by the RWQCB.

B3.9 AOC 7-1: Building 46 Former Scrap Yard Area

Description and History

The south side of Building 46 was used as a scrap yard for storage of excess, unused metal parts and building material (Figure B-3). The scrap yard began operation in the 1940's and was closed in the 1960's. This area may have been used for storage of hazardous waste drums (LBNL, 1992d); however, there is no evidence that this type of activity occurred. A site drawing from 1950 (Site Study #2: Bldg. 30 / Sheet Metal / Gas Station; Map 21-208-4, March 31, 1950) showed a proposed gasoline station at the same location as the Former Building 46 Scrap Yard. However, employees who worked at LBNL in the late 1950s did not recall a gas station at this location, and no physical evidence of its existence is present, suggesting that the gasoline station was never constructed.

Sampling

The following soil samples have been collected at the unit. Sample locations are shown on Figure B3.9-1.

- In 1992, monitoring well MW46-92-9 was installed approximately 50 feet northwest (downgradient) of the former scrap yard location. Samples were collected to a depth of 80 feet.
- In April 1994, soil boring SB46-94-1 was drilled to approximately 20 feet bgs near the southwest corner of Building 46 at the location of the former scrap yard to assess

whether a release had occurred. Soil samples were collected between 4 and 19 feet bgs.

- In August 1995 soil samples were collected at approximately 5 and 10 feet bgs from two soil borings (SB46-95-1 and SB46-95-2) drilled within the former scrap yard area. These samples were collected to assess potential contamination at the location of the proposed gas station shown on the LBNL drawing.

All samples collected were analyzed for VOCs and metals. Selected samples were also analyzed for fuels, oil & grease, TPH-D, and/or TPH-G. The only organic analyte detected was oil & grease in one sample (Table B3.9-1). The only metal detected at concentrations above both background levels and PRGs for residential soil was nickel in borings SB46-94-1 and SB46-95-1 ((Table B3-1, Figure B3.9-1). Nickel has been detected above the statistically determined background level at a number of locations where it is not a chemical of potential concern, indicating that the elevated concentrations may represent naturally occurring levels.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.4 (metals). Surface runoff in the Building 46 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 7-1.

Surface Water and Sediment

Nickel has been detected in only one of twelve surface water samples collected from North Fork Strawberry Creek. The concentration was well below the MCL. Nickel was detected above LBNL maximum soil background level in only one of eleven sediment samples collected from North Fork Strawberry Creek. In addition, oil has been detected in sediment samples. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

Monitoring well MW46-92-9 is downgradient from the unit. Nickel has not been detected in groundwater samples collected from the well.

Status of Unit

AOC 7-1 was approved for NFA status by DTSC in May 1995 (DTSC, 1995) based on the evaluation of potential contamination included in the Draft Final RFI Phase I Progress Report (LBNL, 1994l).

B3.10 AOC 7-6: Building 58 Former Hazardous Materials Storage Area

Description and History

An asphalt-paved area on the south side of Building 58 (Figure B-3) was used for storing drums of chemicals (including kerosene, solvents). Drums were stored on pallets with no secondary containment or other release controls. The area was used for drum storage from 1985 to 1991, after which time storage activities were transferred to the north side of Building 58. There were no documented releases.

Sampling

During the RFA, two shallow soil samples (SS58-01-3C and SS58-02-2C) were collected where halogenated VOCs had been previously detected in soil gas samples collected adjacent to a sanitary sewer line (Figure B3.10-1). Xylenes and total hydrocarbons (THC) were detected.

During the RFI several groundwater monitoring wells and temporary groundwater sampling points were installed at the unit. The purpose of these wells was to monitor groundwater quality at the site and evaluate potential groundwater migration pathways associated with the Old Town Groundwater Solvent Plume. Soil samples were collected from the borings for these wells, which included:

- In March 1992, soil samples were collected to depths of 30.8 feet from the soil boring drilled for installation of monitoring well MW58-92-8.
- In May 1994, soil samples were collected to a depth of 25 feet bgs from the boring for monitoring well MW58-93-3.
- In May 1995, soil samples were collected to depths of 30 feet from the boring for monitoring well MW58-95-11 and temporary groundwater sampling points SB58-95-1 and SB58-95-2.
- In December 1996, soil samples were collected to a depth of 7 feet from the boring for monitoring well MW58-96-12.

Samples were analyzed for VOCs and metals. In addition, samples from MW58-93-3 were analyzed for SVOCs and fuels. The only organic analyte detected was PCE in three samples (Table B3.10-1), at concentrations substantially lower than PRGs for residential soil. Arsenic and nickel were detected at concentrations above LBNL background levels and PRGs for residential soil (Table B3-1 and Figure B3.10-1). These metals were detected at concentrations only slightly greater than LBNL background levels, and are not considered chemicals of potential concern at this unit. Therefore, these sample results probably represent naturally occurring levels of arsenic and nickel.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 58 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 7-6.

Surface Water and Sediment

Arsenic and nickel have been detected in surface water samples collected from North Fork Strawberry Creek at concentrations well below MCLs. Except for one nickel sample, concentrations of arsenic and nickel detected in sediment samples collected from North Fork

Strawberry Creek have been well below LBNL maximum background levels for soil. Neither PCE nor xylenes have been detected in surface water or sediment samples.

Groundwater

Monitoring well MW58-93-3, MW58-95-11, and MW58-96-12 and temporary groundwater sampling points SB58-95-1 and SB58-95-2 are located at the unit. Except for arsenic in one sample from MW58-95-11 collected in June 1995, arsenic and nickel have either not been detected in the groundwater or detected at concentrations well below MCLs. The elevated concentration of arsenic was not confirmed by a duplicate sample, and concentrations of arsenic in MW58-95-11 have been approximately 2 μg/L or less, well below the MCL, since 1995. Halogenated hydrocarbons have been detected in the groundwater at concentrations above MCLs. The area of AOC 7-6 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3.

Status of Unit

AOC 7-6 was initially proposed for NFI status in the Draft Final RFI Phase II Progress Report (LBNL, 1995k). DTSC requested supplemental information to justify the request in May 1996 (DTSC, 1996c). LBNL provided the requested justification to DTSC in a letter dated July 31, 1997.

AOC 7-6 was approved for NFI status by DTSC in August 1997 (DTSC, 1997) based on the following criteria included in LBNL's letter to DTSC of August 22, 1997 (LBNL, 1997p):

- There is no indication from the soil sampling results that a release has occurred from the unit.
- Arsenic and nickel were the only metals detected at concentrations above LBNL background levels and PRGs for residential soil. Concentrations were only slightly above background.

The unit will be included in the site-wide risk assessment because arsenic and nickel were detected at concentrations above both background levels and PRGs for residential soil.

Groundwater monitoring will continue in the Building 58 area as required by the RWQCB.

B3.11 AOC 10-2: Building 52 Former Hazardous Materials Storage Area

Description and History

Historical aerial photographs taken in 1954 show that a drum storage area was formerly located on the east side of Building 52 (Figure B-3). The drums were stored on a drum storage rack without secondary containment. Since Building 52 once housed a motor generator room and a small particle accelerator, it is suspected that the drums probably contained transformer oil, vacuum pump oil, or solvents.

Sampling

During the RFA, shallow soil samples were collected at seven locations (SS52E01-3C to SS52E 07-3C) immediately east of Building 52. THC was detected in all the samples (Figure B3.11-3). In addition, low concentrations of PCE and xylenes were detected in a single sample each (Figure B3.11-4).

Additional sampling was conducted during the RFI to characterize the magnitude and extent of the contamination previously detected (Table B3.11-1). The following samples were collected:

- In November 1993, soil samples were collected to a depth of 46 feet bgs from the boring for monitoring well MW52-93-14.
- In June 1995, soil borings SB52-95-1 and SB52-95-2 were drilled immediately east of Building 52 near the former storage area.
- In July and August 1996, samples were collected to depths up to 10 feet bgs from ten borings (SB52-96-1 through SB52-96-10) to characterize the lateral extent of contamination detected in SB52-95-1 and SB52-95-2. Borings SB52-96-5 and SB52-96-7 were only completed as shallow borings due to the presence of underground utilities.

- In March 1997, to further investigate the extent of PCB contamination previously detected in soil in the areas of Building 52 and Building 16, shallow soil samples were collected at two locations west of Building 52 (SB52-97-1 and SB52-97-2).

PCBs were detected at most of the sampling locations (Figure B3.11-1). Concentrations of PCBs detected were less than PRGs for residential soil except in the two borings west of Building 52 (SB52-97-1 and SB52-97-2) and in one boring east of the building (SB52-96-10) (Table B3.11-1). Only one of the samples contained PCBs at a concentration above the USEPA self-implementing cleanup level (1 mg/kg) for soil in high-occupancy areas, as defined under TSCA. The concentration detected (1.3 mg/kg at a depth of 0.5 feet) was only slightly above the TSCA level. PCB concentrations appear to decrease to non-detectable levels in the upper 5 feet, except in boring SB52-97-2 on the east side of the building.

Fuel range hydrocarbons and/or oil & grease were detected in most soil samples, with the highest concentrations found in the gravel area just south of the aboveground helium tank on the east side of the building (Figures B3.11-2 and B3.11-3). Except for the extreme northern end of the area (SB52-95-1 and SB52-96-10), concentrations of fuel range hydrocarbons and oil & grease also decrease to non detectable levels in the upper 5 feet. The only VOC detected was chloroform, (Figure 3.11-4), at concentrations substantially lower than PRGs for residential soil.

No metals were detected at concentrations greater than both background levels and PRGs for residential soil.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.4 (TPH and PCBs). Surface runoff in the Building 52 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 10-2.

Surface Water and Sediment

PCBs have not been detected in either surface water or sediment samples collected from North Fork Strawberry Creek. None of the VOCs detected in soil at AOC 10-2 have been detected in surface water or sediment samples. Oil has been detected in sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

Groundwater monitoring well MW52-93-14 is located in the area of soil contamination (Figure B3.11-1). PCBs were not detected in a groundwater sample collected from the well in April 2000. Halogenated hydrocarbons have been detected in the groundwater at concentrations above MCLs. The area of AOC 10-2 is underlain by contaminated groundwater of the Old Town Groundwater Solvent Plume (AOC 2-4), which is discussed in Section B4.3.

Status of Unit

AOC 10-2 was approved for NFI status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- characterization of the magnitude and extent of soil contamination.

AOC 10-2 was approved for NFI rather than NFA status because PCBs remain in the soil at concentrations above PRGs for residential soil. The unit will therefore be included in the Human Health Risk Assessment.

Groundwater monitoring will continue in the Building 52 area as required by the RWQCB.

B3.12 AOC 10-3: Building 25A Sanitary Sewer

Site Description and History

The NFA request for the Building 25A Sanitary Sewer (AOC 10-3) that was submitted to the DTSC in January 2000 (LBNL, 2000a) is included in Appendix C. Following is a summary of the information included in the NFA request.

Two sanitary sewer lines emanate from the east side of Building 25A, merge with another line emanating from the east side of Building 26, and continue beneath the road north and east of Buildings 25A and 26 (Figures B-3 and B3.12-1). Building 25A contains electronics shops, where activities include plastics soldering and electronics fabrication. Cleaning solvents have been used in Building 25A, which contains solvent fume hoods, sinks, floor drains, and a subfloor waste line that flows out of the east side of the building to the sanitary sewer system.

Sewer Line Investigations

The following approach was followed to investigate whether a release may have occurred from the Building 25A Sanitary Sewer (AOC 10-3). LBNL's approach is in accordance with discussions held with the DTSC and the City of Berkeley at LBNL on July 1, 1999.

1. Assess the integrity of the line by conducting a video survey to identify any dislocations, breaks or perforations.
2. If dislocations, breaks, or perforations are identified, collect soil samples to determine whether a release has occurred and to assess the extent of contamination. If no dislocations, breaks, or perforations are identified, request the unit for NFA status.

On October 14, 1999, LBNL conducted a video survey of the sanitary sewer lines east of Building 25A. The segments of the sewer lines that were video surveyed are shown on Figure B3.12-1. No defects, root intrusions, or displacements were observed within any of the lines surveyed. Based on the results of the video surveys there is no indication that a chemical release has occurred from the sewer lines.

Supplemental Environmental Investigations

Analytical results from borings drilled next to the sanitary sewer line were used to supplement the results of the video survey described above in the NFA request. Soil borings drilled in the vicinity of the sanitary sewer lines are described below and shown on Figure B3.12-1.

- In 1992, soil samples were collected to a depth of 30 feet from the boring for monitoring well MW26-92-11. MW26-92-11 was installed adjacent to the sanitary sewer line at a location where a relatively high concentration of PCE had been detected in a soil-gas sample collected during the RFA (LBNL, 1992d).
- In August 1993, soil samples were collected to a depth of 36 feet from the boring for monitoring well MW76-93-7. MW76-93-7 was installed adjacent to a manhole for the Building 25A sewer line to evaluate potential sources for the groundwater contamination detected south of Building 76.
- In April 1995, soil borings SB25-95-2 and SB25-95-3 were drilled next to the sewer lines leading from the east side of Building 25A to help assess whether a release had occurred from the sewer line. Soil samples were collected to depths of approximately 4 feet and 36 feet in SB25-95-2 and SB25-95-3, respectively.
- In 1998, Shallow soil samples were collected at eight locations (SS25A-98-1 through SS25A-98-8) at floor drains and along the sub-floor waste line system of Building 25A that drain to the sanitary sewer system east of Building 25A. The purpose of the sampling was to evaluate if a release from the floor drains or drain lines under the building was the source of the TCE detected in the groundwater west of Building 25A. Soil samples were generally collected at depths of approximately 2 and 4 feet below the surface.
- In 1998 and 1999, soil samples were collected from the borings for groundwater monitoring wells MW25A-98-6, MW25A-98-7, and MW25A-99-2. These wells were installed to help locate the source of the TCE contamination detected in groundwater west of Building 25A. These wells are also located adjacent to the sanitary sewer line beneath the building.

All samples were analyzed for VOCs (Table B3.12-1). In addition selected samples collected in 1992, 1993, and 1995 were analyzed for petroleum hydrocarbons, metals, and/or pH (Tables B3-1 and B3.12-1). TCE and 1,1,1-TCA were each detected in only a single sample at concentrations substantially lower than PRGs for residential soil (Table B3.12-1). Both of these samples were collected from below the water table in an area of known groundwater contamination (as described in Section 4.3). VOCs were not detected in the shallower samples

collected below the sewer line at the same locations. Therefore, it is considered unlikely that these sample results indicate a release from the overlying soil. Petroleum hydrocarbons were not detected in the samples for which it was analyzed.

Nickel was the only metal detected above both the LBNL background level and the PRG for residential soil in two samples (Table B3-1). Nickel was detected above the PRG and background level at a depth of 20 feet in MW26-92-11 and in a composite sample from MW25A-98-7. The two shallower samples in MW26-92-11 contained nickel at a concentration well below the maximum background level. The elevated concentration was detected in the Orinda Formation, with the two shallower samples in the Moraga Formation and Mixed Unit. The elevated nickel concentrations were only slightly above the background level for the Orinda Formation, the geologic formation in which the samples were collected. These results therefore probably represent naturally occurring nickel concentrations.

Levels of pH measured in SB25-95-2 and SB25-95-3 were neutral to slightly basic ranging from 7.6 to 9.0.

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the area east of Building 25A area is directed through the storm drain system to Chicken Creek. Surface water and sediment samples have been collected from Chicken Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 10-3.

Surface Water and Sediment

Halogenated hydrocarbons have not been detected in either surface water or sediment samples collected from Chicken Creek. Nickel was detected in only one surface water sample collected from Chicken Creek, at a concentration well below the MCL. Concentrations of nickel detected in sediment samples collected from Chicken Creek have been well below LBNL maximum background levels for soil.

Groundwater

Two areas of groundwater contamination are present in the vicinity of the Building 25A sanitary sewer line: 1) PCE in groundwater east of Building 25A and 2) TCE in groundwater beneath and to the west of Building 25A. Based on the video survey and soil sampling results, the sanitary sewer line is not the source of the contamination.

Status of Unit

AOC 10-3 was approved for NFA status by DTSC in February 2000 (DTSC, 2000a) based on the following criteria included in LBNL's request for NFA status (LBNL, 2000a):

- Based on the results of the video survey and the associated soil sampling, there is no indication that a chemical release has occurred from the sewer line. No defects, root intrusions, or displacements were observed.

Supplemental information to support the NFA request included the following:

- Only trace concentrations (<0.02 mg/kg) of VOCs were detected. The locations where the VOCs were detected were below the water table in areas of known groundwater contamination. No VOCs were detected in the soil samples collected below the base of the sewer lines and above the water table.
- Nickel was the only metal detected at a concentration above both the LBNL background level and PRG for residential soil. The elevated nickel concentrations appear to be naturally occurring.
- The source area of the groundwater contamination in the area of the Building 25A sanitary sewer has been identified near the western end of Building 25A and it is not associated with the sewer (Section B4.3).

Groundwater monitoring will continue in the Building 25A area as required by the RWQCB.

B3.13 AOC 14-6: Building 10/80 Sanitary Sewers

Description and History

Sanitary sewer lines emanate from Buildings 10, 80, and 2 (Figures B-3 and B3.13-1). Building 10 houses laboratories and offices for Biomedical Research. Building 80 contains a variety of shops, laboratories, and offices. Both buildings were previously used for the central photographic laboratories. Building 2 contains the Materials Science laboratories. The following SWMUs and AOCs were located within these buildings, and therefore could potentially have discharged wastes into the sanitary sewer system:

- Building 10 Silver Recovery Units 1 and 2 (SWMUs 14-3 and 14-4);
- Building 10 Photographic Laboratories (AOC 14-3);
- Building 80 Photographic Laboratory (AOC 14-4);
- Building 2 Acid Waste Neutralization Unit (SWMU 14-1); and,
- Building 2 Temporary Waste Accumulation Area (SWMU 14-2).

Soil Sampling

The following soil samples have been collected at AOC 14-6. Sample locations are shown on Figure B3.13-1.

- In 1996, soil boring SB80-96-1 was drilled adjacent to the Building 80 sanitary sewer and samples were collected at 5 and 10 feet bgs
- Soil-gas monitoring wells 2-96-1 and 2-96-2 were constructed along the sanitary sewer line south of Building 2. No soil samples were collected for laboratory analysis during drilling of these two borings in 1996. However, when the wells were abandoned in 1998, soil samples were collected from the bottom of each boring at depths below the elevation of the sanitary sewer line

All soil samples were analyzed for VOCs and metals, and selected samples were analyzed for SVOCs and fuels. No organic constituents were detected, and no metals were detected at concentrations above LBNL background levels (Table B3.13-1).

Status of Unit

AOC 14-6 was approved for NFA status by DTSC in September 1998 (DTSC, 1998) based on the following criteria included in LBNL's request for NFI status (LBNL, 1998j):

- Sufficient investigations had been conducted to evaluate the potential for a past release and to characterize the magnitude and extent of any contamination.
- No VOCs were detected in the soil samples and concentrations of metals were below LBNL maximum background levels.

B3.14 AOC 2-4: Old Town Groundwater Plume Potential Source Area East of Building 52A

Description and History

Based on isoconcentration maps of VOCs detected in groundwater, as described in Section B4.3, a source of groundwater contamination is located east of Building 52A. Temporary groundwater sampling points were installed in 1998 to help evaluate potential sources for the solvent contaminated groundwater detected in Area 10 (AOC 10-5), including SB52A-98-1, which was installed east of Building 52A (Figure B3). Relatively high concentrations of VOCs (>200 μg/L total concentration) were detected in the groundwater.

Soil Sampling

To help locate the source for the groundwater contamination, soil samples were collected from twenty soil borings (SB52A-00-1 through SB52A-00-20) drilled in the area of SB52A-98-1 in March 2000 (Figure B3.14-1). Samples were collected between the surface and refusal, which generally occurred between approximately 9.5 and 12 feet bgs.

All samples were analyzed for VOCs. Samples from most of the borings contained PCE, TCE and/or cis-1,2-DCE, with the highest concentrations detected at boring SB52A-00-9, which was within 10 feet of SB25A-98-1 (Table B3.14-1, Figure B3.14-2). Sporadic samples collected from borings SB52A-00-5, SB52A-00-13 and SB52A-00-16 contained several non-halogenated

VOCs (Table B3.14-1). None of the detected VOCs were present at concentrations greater than PRGs for residential soil.

Shallow samples from each boring were also analyzed for PCBs, however only borings SB52A-00-1 and SB52A-00-8 contained detectable PCBs, both at concentrations substantially lower than the PRG for residential soil (Table B3.14-1).

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.3 and Section B4.4. Surface runoff in the Building 52 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources.

Surface Water and Sediment

The only halogenated hydrocarbon detected in surface water or sediment samples collected from North Fork Strawberry Creek has been a trace concentration (<1 μg/L) of 1,1,1-TCA in the surface water in May 1995. 1,1,1-TCA has not been detected in the ten surface water samples collected since that time. The MCL for 1,1,1-TCA is 200 μg/L. PCBs have not been detected in surface water or sediment samples collected from North Fork Strawberry Creek. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Groundwater

Relatively high concentrations of VOCs (>200 μg/L total concentration) were detected in the groundwater east of Building 52A. The soil east of Building 52A in the area of SB25A-98-1 appears to be a source for the halogenated hydrocarbon contamination detected in groundwater in this area.

Status of Area

This area has not been designated as a SWMU or AOC, and no contaminants have been detected in the area at concentrations greater than the PRG for residential soil. Based on the sampling results, this area appears to be a source of the groundwater contamination east of Building 52A.

B3.15 Slope West of Building 53

Description and History

Based on interviews of site workers cited in the RFA, wastes may have been disposed of on hillsides in the vicinity of the Old Town Area. Based on this information, soil samples were collected on the slope west of Building 53 during the RFA (LBNL, 1992d). One of these samples contained mercury and copper at concentrations exceeding the background level and/or the PRG for residential soil, indicating the presence of metals contamination.

Soil Sampling

To investigate whether metals contamination on the Building 53 slope could have included hexavalent chromium, soil sample SS53W-3-98 was collected on the slope west of Building 53 in July 1998. The sample was located close to the sample collected during the RFA which had elevated mercury and copper concentrations. This sample contained hexavalent chromium at the same concentration as the PRG for residential soil (0.2 mg/kg). To evaluate the lateral extent of hexavalent chromium contamination, five additional soil samples (SS53Slope-98-1 through SS53Slope-98-5) were collected in October 1998 at depths between 2.5 and 3.5 feet bgs (Figure B3.15-1). Hexavalent chromium was detected in all five of the samples, at concentrations up to 0.6 mg/kg (Table B3-1, Figure B3.15-1).

Potential Migration of Contaminants

Potential migration of contaminants detected in soil in the Old Town area to surface water and sediment is discussed in Section B4.5. Groundwater contamination is discussed in Section B4.4 (metals). Surface runoff in the Building 53 area is directed through the storm drain system to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources.

Surface Water and Sediment

Hexavalent chromium was detected in a surface water sample collected from North Fork Strawberry Creek in July 1999 but was not detected in two subsequent samples. The concentration detected was well below the MCL. Hexavalent chromium has not been detected in sediment samples.

Groundwater

Monitoring well MW27-92-20 is downgradient from the area where hexavalent chromium was detected. Concentrations of metals detected in the well have been well below MCLs since 1992.

Status of Area

This area has not been designated as a SWMU or AOC. Hexavalent chromium is present on the slope at concentrations exceeding the PRG for residential soil. This area will be included in the Human Health Risk Assessment because of the detection of hexavalent chromium at a concentration above the PRG for residential soil.

B3.16 Other Soil Sampling

Soil samples have been collected from a number of locations (primarily monitoring well borings and temporary groundwater sampling points) that are not associated with specific SWMUs or AOCs. These wells were primarily installed to help characterize the magnitude and

extent of groundwater contamination and help locate sources of groundwater contamination. The locations of these borings are shown on Figures B3.16-1 and B3.16-2. Analytical results are included in Tables B3.16-1 and B3-1 (metals). Concentrations of organic analytes detected were well below PRGs for residential soil. The only metal detected at a concentration above both the LBNL background level and PRG for residential soil was nickel in boring BS-MP7-99-1 at 39 and 48.5 feet bgs. Concentrations of nickel detected at shallower depths in this boring were within LBNL background levels.

B4 NATURE AND EXTENT OF CONTAMINATION IN GROUNDWATER AND SURFACE WATER

B4.1 Introduction

The primary contaminants detected in groundwater in the Old Town Area are halogenated non-aromatic VOCs and fuel hydrocarbons (diesel/kerosene and crude/waste oil).

Halogenated non-aromatic VOCs are the most widespread contaminants, and are present in both a broad, multi-lobed plume that covers the central part of the area, and in a small plume near Building 37, toward the south (Figure B4.1-1). Prior reports subdivided the central plume area into two distinct units: AOC 2-4 (Old Town Groundwater Solvent Plume) and AOC 10-5 (Solvent Contaminated Groundwater in Area 10). However, groundwater contaminants from the principal lobes of the central plume commingle to form a broad area of groundwater contamination that overlaps the individual areas designated as AOCs, as shown on Figure B4.1-1. Therefore, the following discussions of the distribution of halogenated non-aromatic VOCs in groundwater in the old Town Area are organized on the basis of the plume lobes shown on Figure B4.1-1, rather than by AOC designation.

The magnitude and extent of groundwater contamination in the Old Town Area are documented in the attached analytical tables, and illustrated on isoconcentration contour maps and cross sections referenced in the following sections. The contamination was characterized

based primarily on groundwater samples collected from monitoring wells and temporary sampling points.

For comparison purposes, Maximum Contaminant Levels for drinking water (MCLs) are referenced on the groundwater sampling result tables. The referenced MCL values represent the more restrictive of either the Federal Standard under the Safe Drinking Water Act (40 CFR 141) or the State of California Standard (Cal-EPA CCR Title 22).

The isoconcentration contour maps (plume maps) display the arithmetic mean of contaminant concentrations detected during Fiscal Year 1999 (FY99) (October 1, 1998 to September 30, 1999). To present a consistent and representative depiction of conditions at the water table, the plume maps were drawn using data from wells screened in the upper portion of the saturated zone (generally within approximately 10 feet of the water table). For wells in which specific chemicals were detected during some, but not all, sampling events, mean concentrations were calculated by using one-half of the laboratory reporting limit as the non-detect concentrations. For each well that was not sampled during FY99, the results from the most recent (pre FY99) sampling event were utilized for contouring unless the results appeared to represent an outlier, in which case results from a prior sampling event were substituted.

The vertical distribution of contaminants in groundwater is depicted on the attached hydrogeologic cross sections. The cross sections show geology, groundwater levels, total halogenated VOC concentrations, and isoconcentration contour lines. These data were based on the isoconcentration contour maps, geological and hydrogeological information collected from monitoring wells and temporary groundwater sampling points, and the conceptual model described in the following section. Significantly lower concentrations of contaminants have been detected in the deeper wells, which is consistent with the conceptual model.

B4.2 Conceptual Model for Contaminant Transport in Groundwater

According to the conceptual hydrogeologic model discussed in Section B2.5, groundwater flow in the Old Town Area takes place primarily within the relatively high permeability Moraga Formation rocks. Groundwater flow within the underlying Orinda

Formation is of minor importance, as is indicated by its relatively low hydraulic conductivity. Groundwater flows generally westward and southward parallel to the surface slope, except in the area north of Building 7, where an extensive northwest-trending mass of Moraga Formation volcanic rock forms a significant preferential flow pathway, and causes flow to be directed to the northwest beneath Buildings 52, 53, 27, and possibly 17 (Figure B2.3-10).

The following conceptual model was developed for contaminant transport, based primarily on the type, concentration, and distribution of contaminants detected in the groundwater.

- Groundwater plumes in the upper portion of the saturated zone are generally elongated along the direction of groundwater flow. This is consistent with advection being the predominant contaminant transport mechanism, as would be expected given the relatively steep groundwater gradients and moderate permeabilities of the upper portion of the saturated zone at LBNL. Several distinct plumes apparently originating from different source areas also coalesce to form larger areas of contaminated groundwater.
- Contaminant concentrations and hydraulic conductivity values decrease with depth, as indicated by analytical data from multi-well clusters and hydraulic test data. These observations indicate that advective transport downward into, and laterally within, the deeper horizons is of relatively small magnitude. They are also consistent with the conceptual groundwater flow model, in which shallow rocks of the Moraga Formation represent preferential flow pathways, whereas the low permeability rocks of the Orinda Formation impede groundwater flow.
- The highest contaminant concentrations in the Old Town Area define the Building 7 Lobe, which lies just northwest (and downgradient) of a known contaminant source (the Building 7 sump). This lobe is roughly coincident with an area where the relatively permeable rocks of the Moraga Formation are thin to absent at the water table, and groundwater flows within lower permeability rocks of the Mixed Unit and Orinda Formation. Rocks of the Moraga Formation flank this plume lobe.
- Organic contaminants are often transformed into other compounds by microbial or chemical processes in the subsurface. Halogenated non-aromatic VOCs usually degrade by sequences of reactions that occur under different environmental conditions. As a result of these reactions, intermediate daughter products are often produced. Depending on site conditions, these intermediate products may further degrade into different end products. Common degradation pathways for halogenated non-aromatic VOCs are shown on Figure B.4.2-1.

B4.3 Halogenated Non-Aromatic VOCs in Groundwater

The halogenated non-aromatic VOCs present in groundwater in the Old Town Area are primarily industrial solvents, (PCE, TCA, carbon tetrachloride), solvent degradation products (DCE, DCA, vinyl chloride, chloroform, etc), or both (TCE). In addition, chloroform, which is both a common constituent in drinking water derived from the disinfection processes and a degradation product of carbon tetrachloride is present in the groundwater. Concentrations of VOCs detected in groundwater are presented in Table B4.3-1 (monitoring wells) and Table B4.3-2 (temporary groundwater sampling points). Isoconcentration maps of total halogenated non-aromatic VOCs, PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCA, vinyl chloride, carbon tetrachloride, chloroform, and methylene chloride in the Old Town Area are presented on Figure B4.3-1a through Figure B4.3-13, respectively. The FY99 mean concentrations of total halogenated non-aromatic VOCs detected in groundwater monitoring wells and temporary groundwater sampling points are shown on cross sections A-A', B-B', C-C', and H-H' (Figure B4.3-15 through Figure B4.3-18). An index map for the cross sections is shown on Figure B4.3-14.

Based on both the distribution of individual chemicals and the constituent and aggregate concentrations of chemicals within the Old Town Area, four apparently distinct plume lobes can be distinguished, as shown on Figures B4.1-1 and B4.3-1a. The principal constituents present in each plume lobe are listed below.

Halogenated VOC Plume Lobes in the Old Town Area

Building 7 Lobe	***Building 52 Lobe***	***Building 25A Lobe***	***Building 37***
Primary Contaminants			
PCE	TCE	TCE	TCE
TCE	PCE	1,1-DCE	PCE
cis-1,2-DCE	Chloroform	Chloroform	
Carbon tetrachloride	cis-1,2-DCE		
1,1-DCE	Carbon tetrachloride		
Chloroform			
Methylene chloride			
Secondary Contaminants			
trans-1,2-DCE; 1,1,1-TCA; 1,1-DCA; 1,2-DCA; vinyl chloride	trans-1,2-DCE; 1,1,1-TCA; 1,1-DCA; methylene chloride	PCE; cis-1,2-DCE; trans-1,2-DCE; 1,1,1-TCA; 1,1-DCA	

B4.3.1 Building 7 Lobe

Description of Contaminants

The Building 7 Lobe contains a number of halogenated non-aromatic VOCs, most of which have been detected at concentrations above MCLs. Maximum concentrations of VOCs detected above MCLs in FY99 are shown in the following table.

Maximum Concentrations (μg/L) of Halogenated non-Aromatic VOCs Detected at Concentrations Above MCLs in FY99 in the Building 7 Lobe

Chemical	Maximum Concentration	Maximum Contaminant Level (MCL)
TCE	45,000	5
PCE	38,300	5
Carbon tetrachloride	1,800	0.5
cis-1,2-DCE	1,200	6
1,1-DCE	280	6
Chloroform	256	100
1,1,1-TCA	220	200
Methylene chloride	160	5
1,1-DCA	51	5
Vinyl chloride	37	0.5
trans-1,2-DCE	10	10
1,2-DCA	1.5	0.5
Total Halogenated non-aromatic VOCs	85,590	-

Lateral Extent of Contamination

The Building 7 Lobe extends northwestward from approximately the former Building 7 sump (AOC 2-5) to the parking area downslope from Building 58. The highest contaminant concentrations are found in wells a few tens of feet northwest (downgradient) of the sump (Figure B4.3-1b). Prior to 1997 the highest concentrations were detected in monitoring well MW7B-95-21, located immediately adjacent to the sump (the presumed contaminant source). Concentrations in groundwater in this area have subsequently declined, due to extraction and treatment of groundwater from the collection trench that was installed downgradient from the sump. Details of these remediation activities are described in the following subsections.

The groundwater gradient in this area is generally northwestward. Both the downgradient (northwestern) edge and the southwestern transgradient edge of the Building 7 lobe are well defined by the absence, or low concentrations, of contaminants in monitoring wells to the northwest and southwest of Building 58 (Figure B4.3-1b). In contrast, the upgradient edge and northeastern transgradient edge of the lobe are less well defined because the lobe coalesces with both the Building 52 and Building 25A plume lobes, as illustrated by the plume maps for total halogenated non-aromatic VOCs (Figure B4.3-1a and Figure B4.3-1b), PCE (Figure B4.3-2), TCE (Figure B4.3-3), cis-1,2-DCE (Figure B4.3-4), carbon tetrachloride (Figure B4.3-11), and chloroform (Figure B4.3-12).

Individual halogenated non-aromatic VOCs constituting the Building 7 Lobe have different lateral extents (Figures B4.3-2 through B4.3-13), most likely as a result of differences in the fate and transport properties of the chemicals, the presence of multiple sources for some constituents, and/or different periods of release. The following discussion of individual chemicals is organized according to the common chemical degradation pathways for PCE, 1,1,1-TCA, and carbon tetrachloride, as shown on Figure B4.2-1.

The lateral extents of detectable PCE, TCE and cis-1,2-DCE in the Building 7 Lobe are similar (Figures B4.3-2 through B4.3-4), indicating that conditions within the lobe are generally favorable for degradation along the PCE, TCE, cis-1,2-DCE pathway (Figure B4.2-1). Trans-1,2-DCE (Figure B4.3-5) and 1,1-DCE (Figure B4.3-6), which are also degradation products of TCE, are less extensive than cis-1,2-DCE, because of their low concentrations relative to cis,1,2-DCE in the source area. These results are consistent with the major degradation pathway for TCE being to cis-1,2-DCE, with minor pathways to trans-1,2-DCE and 1,1-DCE.

The lateral extent of 1,1,1-TCA in the Building 7 Lobe is relatively small (Figure B4.3-7). In contrast, 1,1-DCA (Figure B4.3-8) and 1,1-DCE (Figure B4.3-6), which are primary degradation products of 1,1,1-TCA (1,1-DCE can also be a biodegradation product of TCE), extend significantly farther downgradient than 1,1,1-TCA. This observation suggests that conditions favorable to the complete degradation of 1,1,1-TCA are present downgradient from the source area. The chemical 1,2-DCA, which is a secondary degradation product of 1,1,1-TCA, has a very limited extent (Figure B4.3-9, possibly due to its rapid degradation.

Vinyl chloride, which is a degradation product of DCE, has been detected in two areas within the Building 7 Lobe (Figure B4.3-10). The highest vinyl chloride concentrations have been detected southwest of Building 53, within the core area of DCE groundwater contamination. This observation may indicate that conditions favorable to the degradation of DCE to vinyl chloride are present downgradient from, but not immediately adjacent to, the source area. Vinyl chloride is also present at lower concentrations north of Building 6, although in this area it constitutes a much higher percentage of the total halogenated non-aromatic VOCs in groundwater. This area is not within the core area of the DCE contamination; however, DCE is present in the groundwater. In addition, this area is downgradient from a fuel release site (the former Building 7E diesel UST [AOC 2-1]) where fuel hydrocarbons are present in the groundwater (Section 4.4). The petroleum hydrocarbons in the groundwater in this area may provide a carbon source that promotes the biodegradation of DCE into vinyl chloride.

Carbon tetrachloride (Figure B4.3-11) and chloroform (Figure B4.3-12), its primary degradation product, show a similar extent downgradient from the Building 7 Lobe source area. Methylene chloride (Figure B4.3-13), which is both a common solvent and a secondary degradation product of carbon tetrachloride, has a limited lateral extent relative to carbon tetrachloride and chloroform. This suggests that conditions near the source are favorable for the degradation of methylene chloride.

Vertical Extent of Contamination

The vertical distribution of total halogenated non-aromatic VOCs in the Building 7 Lobe is depicted on cross sections B-B' and C-C' (Figure B4.3-16 and Figure B4.3-17). Cross section C-C' illustrates the vertical distribution of total halogenated non-aromatic VOCs in the core area of the Building 7 Lobe. Isoconcentration contour lines on the cross section depict a steep concentration gradient across the contact between the Moraga and Orinda Formations below the core of the Building 7 Lobe. This depiction conforms to the conceptual model described above, and is supported by sampling results from two groundwater monitoring wells installed in 2000: MW7-00-4 located immediately downgradient from the source area and MW58A-00-3 located

west of Building 58, both screened in the Orinda formation. No VOCs were detected in either well (Table B4.3-1).

Similarly, on the flank of the Building 7 Lobe near Building 53, wells MW53-93-16, MW53-96-1, and MW 53-95-12, which are screened at relatively shallow depths within the Moraga Formation and Mixed Unit, contain total halogenated non-aromatic VOCs at concentrations exceeding 100 μg/L (cross section B-B', Figure B4.3-16). In contrast, only trace concentrations, approximately 3 μg/L or less, were detected in nearby well cluster MW53-92-21, which contains four separate 5-foot screen intervals within the Orinda Formation at depths ranging from 130 to 193 feet bgs.

Potential Sources of Contamination

Potential sources for VOC contaminated groundwater in the Old Town Area include SWMUs and AOCs reported to have stored or used organic solvents (LBNL, 1992d). The locations of these units are shown on Figure B4.3-21; those in the upgradient area of the Building 7 Lobe are listed in the following table.

SWMUs and AOCs in the Building 7 Lobe Source Area that Stored or Used Solvents

Unit Number	Unit Name
SWMU 2-1*	Former Building 7 Plating Shop
SWMU 2-2*	Former Building 52B Liquid Waste Aboveground Storage Tank and Sump
AOC 2-2	Former Building 7 Hazardous Materials Storage Area
AOC 2-3	Present and Former Building 53 Hazardous Materials Storage Area
AOC 2-5*	Former Building 7 Sump

* SWMUs and AOCs discussed in Section B3.

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. Except for the Former Building 7 Sump (AOC 2-5) and the adjacent Former Building 7 Plating Shop (SWMU 2-1), concentrations of halogenated and non-aromatic VOCs detected in soil at the other SWMUs and AOCs identified as potential sources were below PRGs for residential soil. The area of maximum VOC concentrations in groundwater north of Building 7

suggests that the primary source of the VOC plume was apparently leakage and/or overflow from the abandoned sump (AOC 2-5) that was located north of Building 7. This hypothesis has been confirmed by soil sampling in the vicinity of the sump. When the sump was uncovered, it still contained PCE (product). The highest concentrations of PCE (190,000 μg/L) and total halogenated hydrocarbons (approximately 300,000 μg/L) in groundwater in the Old Town Area have been detected in MW7B-95-21, approximately 10 feet northwest and immediately downgradient from the former sump location. PCE was also detected in the soil at the former sump location at concentrations greater than 1,000 mg/kg in a number of samples (Section B3.8).

Plume Management (Interim Corrective Measures)

ICMs, consisting of extraction and treatment of contaminated groundwater, have been implemented in the three portions of the Building 7 Lobe listed in the following table. Locations of these ICM systems are shown on Figure B4.3-1b. In addition, contaminated groundwater captured by a subdrain east of Building 46 is treated. This contamination originates from both the Building 7 and Building 52 Lobes of the plume.

ICMs for the Building 7 Lobe

Location	Name of ICM System
Source area	Building 7 Collection Trench and Treatment System
Lobe core	Building 53/58 Slope Collection Trench and Treatment System
Downgradient edge	Building 58 Collection Trench and Pumping System

In 1996, a groundwater collection trench (Building 7 Collection Trench) was installed immediately downgradient from the source of the Building 7 Lobe, as a source control measure. Groundwater pumped from extraction wells located within the gravel-filled trench is treated by a granular activated carbon (GAC) system. When the system became operational, it was found that continual groundwater extraction from the trench was not possible during periods of little or no rainfall. Therefore, starting in April 1997, treated groundwater was reinjected into the gravel-filled excavation at the former sump location during periods of low rainfall. The extraction and injection process creates a groundwater recirculation system that flushes contaminants from the

subsurface to the collection trench, and allows continual groundwater extraction and treatment during dry-season months. Approximately 1.8 million gallons of groundwater had been treated and approximately 47 kilograms of contaminant mass removed from the groundwater in the source area through June 2000.

In the early to mid 1990's, a series of soil gas probes was installed and sampled on the slope between Buildings 53 and 58. Groundwater monitoring well MW58-96-11 was installed in the area where relatively high concentrations of contaminants were detected in the soil gas. Relatively high concentrations of VOCs (97,000 μg/L maximum) were detected in groundwater samples collected from the well. A second groundwater collection trench (Building 53/58 Slope Collection Trench) was therefore installed in late 1998 in the area of the well, as a source control measure in the downgradient portion of the Building 7 Lobe core area and to prevent the further migration of contaminated groundwater. Eight 24-inch diameter borings were drilled to depths of 35 to 40 feet bgs in a north-south line on 4-foot centers at this location. In an attempt to connect the borings, the lower portion of each boring was expanded to a 5-foot diameter. Eight PVC casings with 20-foot long screened sections were installed, and the annuli of the borings were backfilled with gravel. Groundwater extracted from these casings is pumped to the treatment system at Building 7. A soil vapor extraction (SVE) system was installed in the same wells to remove contaminants in soil in the vadose zone. Extracted vapor is treated on-site by GAC. The collection trench completely penetrates the Moraga Formation and Mixed Unit at this location (Figure B4.3-17), therefore, as shown on Figure B4.3-1b, continued groundwater extraction should capture the core of the plume lobe containing more than 10,000 μg/L total halogenated non-aromatic VOCs. Through March 2000, more than 17,000 gallons of groundwater have been treated at the site.

A third groundwater collection trench (Building 58 Collection Trench) was installed west of Building 58 in 1998 to control further migration of the Building 7 Lobe of the plume at its downgradient extent. The trench was excavated to a depth of approximately 20 feet by backhoe and backfilled with gravel. Two groundwater extraction wells were installed in the backfill. Groundwater is extracted from the wells and pumped to the Building 51 Fire Trail Treatment System (discussed in Module A). This collection trench fully penetrates the Moraga Formation

(Figure B4.3-17) at the downgradient edge of the plume. Monitoring wells MW51-94-15 and MW51-96-3, located downgradient from this location, monitor the effectiveness of the trench in controlling contaminant migration.

Trends in Contaminant Concentrations

Total halogenated VOC concentrations in wells monitoring the Building 7 Lobe have remained relatively stable or have declined during the period of monitoring, except for wells MW58-95-19 and MW7-94-3 (Figures B4.3-19 and B4.3-20). In addition, contaminants have not been detected in monitoring wells MW51-96-3 or MW51-94-15, which are located downgradient from the Building 58 Collection Trench at the downgradient edge of the lobe.

Well MW58-95-19, located on the flank of the lobe downgradient from the Building 53/58 Slope Collection Trench (Figure B4.3-1b), showed a sharp increase in concentrations in March 1997, with concentrations (primarily of TCE) remaining relatively high since that time. However, concentrations in wells located downgradient from MW58-95-19 have either been stable (MW58A-94-14) or show a declining trend (MW 58-95-18), indicating that the downgradient portion of the lobe is generally stable.

Monitoring well MW7-94-3 is located approximately 20 feet upgradient from the Former Building 7 Sump location (Figure B4.3-1b). Concentrations of halogenated VOCs increased significantly water extracted from the Building 7 Collection Trench was reinjected into the sump excavation as part of ICM discussed previously. Reinjection of the water modifies the local groundwater flow direction, resulting in a component of flow from the sump area toward MW7-94-3. Concentrations of PCE in MW7-94-3 have since decreased to levels slightly above the pre-injection levels, while concentrations of other halogenated hydrocarbons have been significantly reduced. Concentrations of halogenated VOCs detected in MW7B-95-21, which is located between the former sump and the collection trench (Figure B4.3-1b), have decreased dramatically since 1995, also the result of the recirculation of the treated groundwater.

The Building 7 Lobe appears to be stable, in that contaminant concentrations detected in most wells monitoring the lobe have remained relatively constant over several years of

monitoring (Figure B4.3-1b). Recent decreases in contaminant concentrations may be related to operation of the Building 7 Collection Trench, which was installed as a source control measure.

B4.3.2 Building 52 Lobe

Description of Contaminants

The Building 52 Lobe contains halogenated non-aromatic VOCs, several of which have been detected at concentrations above MCLs. Concentrations are well below those detected in the Building 7 Lobe of the plume. Maximum concentrations of VOCs detected above MCLs in FY99 are shown in the following table.

Maximum Concentrations (µg/L) of Halogenated non-aromatic VOCs Detected at Concentrations Above MCLs in FY99 in the Building 52 Lobe

Chemical	Maximum Concentration	Maximum Contaminant Level (MCL)
TCE	114	5
PCE	101	5
Chloroform	101	100
cis-1,2-DCE	52	6
Carbon tetrachloride	33	0.5
Total Halogenated non-aromatic VOCs	391	-

Lateral Extent of Contamination

The Building 52 Lobe extends northwestward from the area east of Building 5A to the subdrain along the east side of Building 46 (Figures B4.1-1 and B4.3-1b), with the highest concentrations of halogenated VOCs detected in wells east of Buildings 52 and 52A.

The groundwater gradient in this area is generally westward to northwestward. Both the downgradient (northwestern) edge and the northeastern transgradient edge of the Building 52 Lobe are well-defined by the absence of contaminants in monitoring wells short distances west of Building 46 and southwest of McMillan Road (Figure B4.3-1b). The downgradient edge of the plume lobe appears to be captured by the Building 46 subdrain.

The southwestern transgradient edge of the lobe is less well defined since it coalesces with the Building 7 Lobe in the vicinity of Buildings 52 and 53, as illustrated on the isoconcentration maps (Figure B4.3-1a to Figure B4.3-4 and Figures B4.3-11 and B4.3-12). The upgradient extent of the lobe is indicated by the relatively low concentrations detected in the area of Building 44.

The individual halogenated non-aromatic VOCs in the Building 52 Lobe show varied lateral extents (Figures B4.3-2 through B4.3-13). The extent of PCE (Figure B4.3-2) is similar to that of TCE (Figure B4.3-3) and cis-1,2-DCE (Figure B4.3-4), indicating that conditions within the lobe are generally favorable for degradation along the PCE, TCE, cis-1,2-DCE pathway (Figure B4.2-1). Trans-1,2-DCE (Figure B4.3-5) and 1,1-DCE (Figure B4.3-6), which are also degradation products of TCE, are less extensive than cis-1,2-DCE, because of their low concentrations relative to cis,1,2-DCE in the area of maximum concentrations east of Building 5A. These results are consistent with the major degradation pathway for TCE being to cis-1,2-DCE, with minor pathways to trans-1,2-DCE and 1,1-DCE..

The extent of detectable 1,1,1-TCA and its degradation products (1,1-DCA and 1,1-DCE) is extremely limited, with 1,1,1-TCA detected in only one well (Figures B4.3-7, B4.3-6, and B4.3-8). In addition, the presence of 1,1-DCE may also be explained as the result of biodegradation of TCE, rather than degradation of 1,1,1-TCA. These observations indicate that either 1,1,1-TCA has completely degraded, or was only a minor source of the groundwater contamination.

Vinyl chloride (Figure B4.3-10) was not detected in wells monitoring the building 52 lobe in FY99. The absence of vinyl chloride is probably the result of conditions not being favorable for the degradation of DCE in this lobe of the plume.

Carbon tetrachloride (Figure B4.3-11) and its degradation product chloroform (Figure B4.3-12) are also principal contaminants detected in the Building 52 Lobe that have similar lateral extents. Chloroform is also a common constituent in drinking water derived from the disinfection processes. Methylene chloride (Figure B4.3-13), which is both a common industrial

solvent and a degradation product of chloroform, is found only in one well, probably due to a lack of conditions favorable for the degradation of chloroform.

Vertical Extent of Contamination

The vertical distribution of total halogenated non-aromatic VOCs in the Building 52 Lobe is depicted on cross section A-A' (Figure B4.3-15). The isoconcentration contour lines indicate a steep concentration gradient at the contact between the Moraga and Orinda Formations, consistent with the conceptual model. This depiction is supported by groundwater sampling results from monitoring well MW52A-00-6, which was installed in 2000. No VOCs were detected in this well (Table B4.3-1), which is screened in the Orinda Formation, approximately 30 feet below the contact with the Mixed Unit. In contrast, nearby wells screened in the overlying Moraga Formation and Mixed Unit (MW52A-98-1, MW52A-98-8A, MW 52A-98-8B) contain the highest contaminant concentrations of VOCs detected within this lobe.

Potential Sources of Contamination

SWMUs and AOCs that were reported to have stored or used organic solvents within the Old Town Area (LBNL, 1992d) are shown on Figure B4.3-21. Those located in the upgradient area of the Building 52 Lobe are listed in the following table:

SWMUs and AOCs in the Area of the Building 52 Lobe that Stored or Used Solvents

Unit Number	Unit Name
SWMU 10-3	Former Building 5 Outdoor Radioactive Waste Storage Area
AOC 10-2*	Former Building 52 Hazardous Materials Storage Area

* SWMUs and AOCs discussed in Section B3.

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. Sampling results indicated that halogenated non-aromatic VOCs were either absent, or were present at concentrations substantially lower than PRGs for residential soil (total halogenated non-aromatic VOCs were less than 1 mg/kg) at these units. In addition, based on the northwestward groundwater flow direction within the lobe and concentrations of

contaminants detected in groundwater monitoring wells, the source area should be located east or north of Building 52A (Figure B4.3-1b). Therefore, in 1998, two temporary groundwater sampling points (SB52A-98-1 and SB5A-98-1) were installed east of Building 52A and two groundwater monitoring wells (MW52A-98-8 and MW52-98-9) were installed north of Building 52A to help locate the source of the contamination. Relatively high concentrations of VOCs (>200 μg/L total concentration) were detected in SB52A-98-1.

To assess whether SB52A-98-1 was located in the source area for the groundwater contamination, soil samples were collected in April 2000 from twenty borings in the vicinity of the well. The results, which are discussed in Section B3.14, indicate that the PCE, TCE, and their degradation products detected in groundwater in the Building 52 Lobe of the plume are the result of a release, possibly a spill, in this area. The source of the carbon tetrachloride and chloroform has not been determined, but should be in the same general area, based on the isoconcentration maps.

Plume Management (Interim Corrective Measures)

The downgradient edge of the Building 52 Lobe is intercepted by the Building 46 subdrain. The subdrain was installed as part of a landslide mitigation measure and collects subsurface water draining from the hillside to the east. Groundwater from the subdrain is collected and treated by an on-site GAC system (the Building 46 Treatment System) which was installed in April 1993, when contaminants were detected in the subdrain effluent. Through June 2000, more than 7.7 million gallons of groundwater have been treated at the site and approximately 0.5 kg of contaminant mass removed by the system.

Trends in Contaminant Concentrations

Total halogenated VOC concentrations in wells monitoring the Building 52 Lobe have remained relatively stable or have declined during the period of monitoring (Figure B4.3-22). Wells that have shown consistent long term decreases in concentrations of VOCs include

MW52-95-2B, located within the source area and MW53-93-9 in the mid-lobe area and well MW46-93-12, located at the downgradient edge of the lobe.

The Building 52 Lobe appears to be stable, in that contaminant concentrations detected in most wells monitoring the lobe have remained relatively constant or have declined over several years of monitoring. Capture of the plume at the Building 46 subdrain prevents further migration of the lobe, as indicated by the absence of contaminants in downgradient monitoring wells west of Building 46 (Figure B4.3-1b).

B4.3.3 Building 25A Lobe

Description of Contaminants

The Building 25A Lobe contains halogenated non-aromatic VOCs, several of which have been detected at concentrations above MCLs. Concentrations are well below those detected in the Building 7 Lobe of the plume. Maximum concentrations of VOCs detected above MCLs in FY99 are shown in the following table.

Maximum Concentrations (μg/L) of Halogenated non-aromatic VOCs Detected Above MCLs in FY99 in the Building 25A Lobe

Chemical	Maximum Concentration	Maximum Contaminant Level (MCL)
TCE	352	5
1,1-DCE	134	100
PCE	13	5
cis-1,2-DCE	6.5	6
Carbon tetrachloride	2.5	0.5
Total Halogenated non-aromatic VOCs	443	-

This lobe predominantly contains TCE and 1,1-DCE. This is in contrast to the Building 7 and 52 Lobes, in which PCE and cis-1,2-DCE are major constituents.

Lateral Extent of Contamination

The Building 25A Lobe extends from Building 25A to Building 16 (Figures B4.1-1, B4.3-1a and B4.3-1c), with the highest contaminant concentrations detected in groundwater near the western end of Building 25A. In addition, a segment of this lobe extends southward beneath Building 25. This southern extending segment is approximately coincident with a north-south oriented, thick body of Moraga Formation volcanic rocks that is interpreted to form a preferential southward-directed flow pathway, as discussed in Section B2.

Groundwater elevation data (Figure B2.4-2) indicate that flow is generally to the west, south and southeast, radially away from the area north of Building 25A. The upgradient (northward) boundary of the lobe lies immediately north of Building 25A, as defined by the absence, or low concentrations, of contaminants in wells to the north of the building.

The eastern extent of the lobe lies in the vicinity of Building 26, as shown by low concentrations of contaminants in wells immediately southwest and northwest of Building 26 (Figure B4.3-1c). The western downgradient extent of the Building 25A Lobe lies in the vicinity of Building 6, as defined by wells with relatively low contaminant concentrations just northeast of the building. The Building 25A Lobe coalesces with the Building 7 Lobe in this area. The downgradient limit of the lobe segment that extends south of Building 25 is indicated by the absence of contaminants in the well to the south on Lawrence Road (Figure B4.3-1a).

Individual halogenated non-aromatic VOCs in the Building 25A Lobe show varied lateral extents (Figures B4.3-2 through B4.3-13). TCE has the greatest lateral extent (Figure B4.3-3) and shows the highest concentrations of contaminants in the Building 25A Lobe. TCE forms the primary lobe component extending southwestward from the west end of Building 25A. Lower concentrations of TCE-contaminated groundwater also extend to the area south of Building 25. Except for 1,1-DCE and chloroform, the extent of other VOCs, including degradation products of TCE, in groundwater in the Building 25A Lobe is extremely limited. PCE (Figure B4.3-2) is found only at low concentrations in isolated areas west and east of Building 25A, and south of Building 25. The PCE appears to have originated from a separate source than the TCE, probably located east of Building 25A. The presence of relatively high concentrations of 1,1-DCE (Figure

B4.3-6) approximately co-located with the core of the TCE plume suggests a derivation from degradation of TCE.

Chloroform (Figure B4.3-12) is present at relatively low concentrations in several wells in the Buildings 25 and 25A area. Since carbon tetrachloride (Figure B4.3-11) is not found in wells near Building 25A, the source of the chloroform may have been a leaking water supply line or sanitary sewer or water pipeline leaks instead of a product of the biodegradation of carbon tetrachloride.

Degradation products of TCE, 1,1-DCE, and methylene chloride (Figure B4.3-13) are generally not found in this lobe, indicating a lack of conditions favorable for their biodegradation.

Vertical Extent of Contamination

The vertical distribution of total halogenated non-aromatic VOCs in the Building 25A lobe is depicted on cross sections C-C' (Figure B4.3-17) and H-H' (Figure B4.3-18). These cross sections show that within the source area of the Building 25A Lobe (i.e. the area of highest groundwater concentrations), the Moraga Formation is absent, and the contaminated groundwater lies entirely within the shallow portion of Orinda Formation. Based on slug test results, wells screened within the shallow portion of the Orinda Formation north of Building 25A have substantially higher hydraulic conductivity values than Orinda Formation wells to the west and south in the Old Town Area. The shallow portion of the Orinda Formation near Building 25A may form a preferential flow pathway interconnected with the body of Moraga Formation underlying Building 25. This may explain the migration of contaminants from the source area to the south end of Building 25.

In order to assess the potential for vertical migration of contaminants within the Orinda Formation in the vicinity of Building 25A, monitoring well MW25A-00-5 was installed in 2000. MW25A-00-5 was screened within the Orinda Formation, approximately 20 feet deeper than the adjacent well (MW25A-95-15), where the highest concentration of total halogenated non-aromatic VOCs was detected within the lobe in FY99 (Figures B4.3-14 and B4.3-17). No VOCs

were detected in MW25A-00-5 (Table B4.3-1), indicating that vertical migration of contaminants is limited.

Potential Sources of Contamination

SWMUs and AOCs that were reported to have stored or used organic solvents within the Old Town Area (LBNL, 1992d) are shown on Figure B4.3-21. Those located in the upgradient portion of the Building 25A Lobe are listed in the following table.

SWMUs and AOCs in the Area of the Building 25A Lobe that Stored or Used Solvents

Unit Number	Unit Name
SWMU 10-8	Building 25 Waste Accumulation Area
SWMU 10-10*	Building 25 Plating Shop Floordrains
AOC 10-3*	Building 25A Sanitary Sewer

* SWMUs and AOCs discussed in Section B3.

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. Sampling results indicated that halogenated non-aromatic VOCs were either absent, or were present at concentrations substantially lower than PRGs for residential soil (total halogenated non-aromatic VOCs were less than 1 mg/kg) at these units. In addition, based on the generally westward groundwater flow direction within the lobe and concentrations of contaminants detected in groundwater monitoring wells, source area investigations focussed on the area of Building 25A (Figure B4.3-1c). Beginning in 1996, several temporary groundwater sampling points and groundwater monitoring wells were installed west of Building 25A. Also in 1998, soil gas probes were installed west, north, and beneath Building 25A to help locate the source of the groundwater contamination. Monitoring wells were installed west (MW25A-98-7), north (MW25A-98-3), and inside (MW25A-98-7) Building 25A based on the soil gas sampling results. An additional monitoring well was installed in the gravel filled area, immediately north of the building, an area that was identified as a possible location of spills.

The western half of Building 25A lies at the approximate upgradient edge of TCE-contaminated groundwater within the Building 25A Lobe (Figure B4.3-3). TCE has been detected in five monitoring wells in a relatively small area (MW25A-95-15, MW25A-98-1,

MW25A-98-3, MW25A-98-7, and MW25A-99-2) near the western end of the building at concentrations greater than 100 μg/L. Based on the groundwater sampling results and isoconcentration maps, the source area for the groundwater contamination is located near the western end of Building 25A; however, a specific source has not been identified.

Plume Management (Interim Corrective Measures)

The only ICM that has been implemented in the area of the Building 25A Lobe is the installation of pumps to extract contaminated groundwater present in electrical utility manhole EMH 133 east of Building 6. This system was installed to prevent the potential migration of contaminants through the electrical conduits to the Building 37 area. Extracted groundwater is pumped from EMH 133 to the Building 37 GAC system.

Trends in Contaminant Concentrations

Historical variations in concentrations of total halogenated non-aromatic VOCs in selected wells monitoring the Building 25A Lobe are plotted on Figure B4.3-23. Contaminant concentrations in the source area wells do not show a consistent trend. These wells have generally been monitored for only a limited period. In comparison, the downgradient wells show overall decreases in concentrations during the period of monitoring.

B4.3.4 Building 37 Lobe (AOC 14-5)

Description of Contaminants

Halogenated non-aromatic VOCs (primarily PCE and/or TCE) have consistently been detected in two wells (MWP-7 and MW37-92-6) in the vicinity of Building 37 (Figure B4.3-1c, Table B4.3-1). PCE (Figure B4.3-2) and TCE (Figure B4.3-3) were detected in FY99, at maximum concentrations of 6.6 μg/L and 1.4 μg/L PCE, respectively. Only TCE was detected at a concentration greater than the MCL (5 μg/L).

Extent of Contamination

The lateral extent of the Building 37 Lobe is limited to a zone less that 100 feet wide, as shown by the absence of halogenated non-aromatic VOCs in the wells to the east and the west of the lobe (Figure B4.3-1a). It is conceivable that the Building 37 Lobe is a downgradient extension of the Building 7 and 25A Lobes. However, the lack of contaminants in the wells south of Building 4 and southeast of Building 6 indicates that this is unlikely, and that the upgradient boundary of the lobe lies relatively close to Building 37, as shown on Figure B4.3-1a. It is estimated that the downgradient extent of the lobe is small, based on the low concentrations present and the small width of the plume. In addition, groundwater is extracted from these wells to prevent further migration, as described below.

Monitoring well CD-92-28 was installed on UC-Berkeley property downgradient from the plume in 1992 (Figure B-2). Except for anomalous detections of PCE and TCE in November 1996 and February 1997 (maximum 2.7 μg/L PCE and 1.5 μg/L TCE), VOCs have not been detected in CD-92-28 (Table B4.3-1). The detections of PCE and TCE are attributed to cross-contamination during sampling since anomalous detections of PCE and TCE were reported in several other wells in February 1997.

Potential Sources of Contamination

The source of the Building 37 Lobe has not been determined. None of the SWMUs and AOCs in the Old Town Area that stored or used products containing halogenated non-aromatic VOCs (Figure B4.3-21) is in the area of the contaminated groundwater. Halogenated non-aromatic VOCs have been detected in water within an underground electrical utility conduit under the road west of Buildings 14 and 16. It is possible that contaminants could have migrated from this area through the utility conduits or roadway backfill to the area south of Building 37.

Another potential source of the groundwater contamination is drain 37-01-01. Drain 37-01-01 was installed during construction of an electrical substation southeast of Building 6 in 1988. According to the November 15, 1988 Geotechnical Recommendations letter, water was observed seeping into the north side of the excavation during construction. Drain trenches were

installed that lead to a common collection point. A hydrauger was used to drill a downward sloping hole to the south and a solid PVC pipe was installed to drain the water. Since groundwater north of the former excavation area is known to be contaminated, it is possible that contaminated groundwater was drained through the 37-01-01 conduit and discharged on the slope east of Building 37. No VOCs have been detected in the effluent from drain 37-01-01 since August 1998.

Plume Management (Interim Corrective Measures)

Since January 1994, groundwater has been pumped from the two wells in the Building 37 Lobe (MWP-7 and MW37-92-6) to control migration of the lobe. The extracted water is treated by a GAC system located at the southeast corner of Building 37 (Figure B4.3-1a). Effluent from drain 37-01-01 (Figure B4.3-1a) is also treated by the system. A collection system was installed in manhole EMH 133 east of Building 6 to prevent potential migration of Old Town Plume contaminants through the electrical conduits to the Building 37 Plume area. This water is also treated by the same system. The treated water is used as makeup water for the Building 37 cooling tower. Through June 2000, more than 1 million gallons of groundwater have been treated at the site.

Trends in Contaminant Concentrations

As shown in Table B4.3-1, concentrations of total halogenated non-aromatic VOCs have decreased since groundwater extraction from wells MWP-7 and MW37-92-6 was initiated in March 1994. In addition, several halogenated non-aromatic VOCs that had been detected in the lobe prior to August 1995 (chloroform, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, 1,1,1-TCA, and methylene chloride) subsequently declined to nondetectable levels.

B4.4 Petroleum Hydrocarbons, SVOCs, PCBs and Metals in Groundwater

B4.4.1 Petroleum Hydrocarbons

Two general evaluation methods were used to assess potential releases of fuels or lubricants to groundwater:

1. Groundwater samples collected in the vicinity of SWMUs and AOCs that either stored or used fuel hydrocarbon products, petroleum lubricants, or petroleum wastes were analyzed for TPH and/or Total Oil and Grease (O&G) (Table B4.4-1; Figure B4.4-1).
2. Samples collected from all groundwater monitoring wells and temporary groundwater sampling points have routinely been analyzed for VOCs by EPA method 8260. The target analytes for this method include several classes of organic compounds, including non-aromatic halogenated hydrocarbons (e.g., PCE, TCE, etc.), monoaromatic halogenated hydrocarbons (e.g., 1,2 dichlorobenzene [DCB]), monoaromatic non-halogenated hydrocarbons (e.g., benzene), and polyaromatic non-halogenated hydrocarbons (e.g., naphthalene and other PAHs). The first class of compounds (non-aromatic hydrocarbons) is commonly derived from industrial solvents, which are discussed in detail in the Section B4.3. The last three classes of compounds (all three comprise various aromatic hydrocarbons) include constituents that are commonly present in fuel products. For this reason, compounds in these three classes were evaluated separately from other VOCs. These data are presented in Table B4.3-1 (groundwater monitoring wells) and B4.3-2 (temporary groundwater sampling points) and on Figure B4.4-2.

Total petroleum hydrocarbons were detected in three general areas:

- Kerosene-range hydrocarbons were only detected in the wells immediately north of Building 6, and define a diesel/kerosene groundwater plume at the location of a former kerosene UST (AOC 2-1) (Figure B4.4-1). Non-aqueous-phase-liquid (NAPL) was observed in well MW7-92-16 in 1994 and 1996; however, it has not been observed since implementation of the ICM in 1998. In addition to diesel/kerosene, wells in this area also contained lesser concentrations of petroleum hydrocarbons quantified in the ranges of gasoline and stoddard/white spirits. The UST and associated contaminated soil has been removed and a dual-phase extraction system has been operating as an Interim Corrective Measure (ICM) since 1998 to remove contaminant mass from the source area. Details of soil investigations and the ICM conducted at AOC 2-1 are discussed in Section B3.7.
- Wells in the area north of the diesel/kerosene plume contain petroleum hydrocarbons primarily in the range of crude/waste oil. A number of these wells also contained lesser concentrations of petroleum hydrocarbons quantified in the ranges of diesel,

gasoline, and oil & grease. Potential sources are shown on Figure B4.4-1, and include oil-contaminated soil at the Building 52B abandoned liquid-waste aboveground storage tank (SWMU 2-2). The tank and associated soil has been removed, as discussed in Section B3.2.

- Petroleum hydrocarbons in the range of hydraulic/motor oil and diesel were detected in two wells (MW37-93-5 and MW37-94-9) in the vicinity of Building 37. The source of diesel contamination observed in well MW37-94-9 is attributed to diesel-contaminated soil that was found at the location of the Building 37 Proposed Electrical Substation Site (AOC 14-7). The source of the diesel and hydraulic/motor-oil-range hydrocarbons detected in well MW37-93-5 is unknown.

Aromatic and non-halogenated hydrocarbons were detected in wells within both the kerosene and crude/waste oil plumes, but not in the Building 37 area (Table B4.3-1, Figure B4.4-2). The majority of the listed chemicals have not been detected in the most recent sampling events.

Plume Management (Interim Corrective Measures)

Since September 1998, groundwater in the kerosene plume has been extracted from well MW6-95-14 and treated by a granular activated carbon (GAC) treatment unit located on the east side of Building 6. Groundwater extraction has been conducted in conjunction with source removal activities described in Section B3.7. Through June 2000, more than 500,000 gallons of groundwater have been treated at the unit.

The area of primarily crude/waste-oil-contaminated groundwater to the north of the kerosene plume lies within the area of the Building 7 lobe of the Old Town Groundwater Solvent Plume. As discussed in Section B4.3 above, that plume is controlled by several groundwater extraction systems.

Trends in Contaminant Concentrations

As shown in Table B4.3-1, concentrations of aromatic and non-halogenated hydrocarbons have declined throughout the Old Town Area over the last several years. In particular, concentrations of these constituents in wells MW7-92-16 and MW6-95-14, located within the source area of the kerosene plume have declined to non-detectable levels. For all but one well

(MW7-95-23) in the Old Town Area, aromatic and non-halogenated hydrocarbons were detected at concentrations lower than MCLs during the most recent sampling event where laboratory quantitation limits were lower than or equal to the MCLs. For that well, benzene was detected in June 1996 at a concentration of 1.8 ug/L, slightly exceeding the MCL (1 ug/L) (Table B4.3-1). Due to the high sample dilutions needed to quantify concentrations of halogenated non-aromatic hydrocarbons in that well, subsequent samples have not had sufficiently low detection levels to determine whether benzene concentrations have declined below MCLs.

B4.4.2 Semi-Volatile Organic Compounds (SVOCs) in Groundwater

Samples collected from several Old Town Area monitoring wells in 1994 (and MW52B-95-13 from 1996-1998) were analyzed for SVOCs (Table B4.4-2 and Figure B4.4-3). Except for results from MW7-92-16, the only SVOC detected was bis(2-ethylhexyl)phthalate (DEHP). DEHP was also detected in 35 of the 79 wells sampled site-wide during 1994, and in five of the seven field (rinse) blanks. No DEHP was detected in laboratory QC samples. Since DEHP is a common laboratory contaminant, the presence of DEHP in these samples is interpreted to have resulted from sample contamination. The results are therefore not representative of groundwater contamination.

Naphthalene, 2-methylnaphthalene and phenanthrene were detected in MW7-92-16 in addition to DEHP (Figure B4.4-3). These chemicals are polycyclic aromatic hydrocarbons (PAHs) that are constituents of diesel fuel and possibly in kerosene. MW7-92-16 monitors groundwater quality in the diesel/kerosene plume north of Building 6 that is the probable source of the PAHs (Section B4.4-1). The concentrations of these chemicals were significantly higher in the August 1994 than in the subsequent December 1994 samples due to the presence of NAPL in the earlier samples. The UST and associated contaminated soil has been removed and a dual-phase extraction system has been operating as an ICM since 1998 to remove contaminant mass from the source area. Investigations and the ICM at AOC 2-1 are discussed in Section B3.7. Other potential source areas of SVOCs are shown on Figure B4.4-3.

B4.4.3 Polychlorinated Biphenyls (PCBs) in Groundwater

SWMUs and AOCs where PCBs were stored or used and areas of PCB contaminated soil are shown on Figure B4.4-4. PCBs were detected in soil at the following SWMUs and AOCs in the Old Town Area:

- Building 7 Former Plating Shop (SWMU 2-1)
- Building 52B Abandoned Liquid Waste Aboveground Storage Tank and Sump (SWMU 2-2)
- Building 17 Former Scrap Yard and Drum Storage Area (SWMU 2-3)
- Building 16 Former Waste Accumulation Area (SWMU 10-4)
- Former Building 7 Sump (AOC 2-5)
- Building 52 Former Hazardous Materials Storage Area (AOC 10-2)

ICMs have been implemented to remove PCB contaminated soil at all of these units except SWMU 10-4 and AOC 10-2. Except for one sample at AOC 10-2, concentrations of PCBs at these two units were below the USEPA self-implementing cleanup level for PCBs in high occupancy areas. Soil characterization activities and ICMs implemented to remove PCB-contaminated soil at these units are discussed in Section B3.

Groundwater samples were collected from wells in the areas of PCB-contaminated soil, and analyzed for PCBs. No PCBs were detected (Table B4.4-3). Locations of the wells sampled for PCBs are shown on Figure B4.4-4.

B4.4.4 Metals in Groundwater

Initial groundwater samples collected after development of each new groundwater monitoring well are analyzed for metals, and subsequently in accordance with RWQCB requirements. In addition, several wells located adjacent to units where COPCs included metals have been monitored annually for metals. With only a few exceptions, metals have been detected at concentrations lower than MCLs (Table B4.4-4, Figure B4.4-5). The table below lists all groundwater samples in which metals concentrations exceeded MCLs.

Concentrations of Metals Detected in Groundwater Above MCLs, Old Town Area

Metal	MCL (μg/L)	Well	Detected Concentrations (μg/L) and Date
Antimony	6	MW90-2	90* (May 1993)
		MW7-1	28* (Jan 1993)
		MW46-92-9	20* (Jan 1993)
		MW37-92-18A	**7 and 11**
Arsenic	50	MW1-220	55* (Mar 1996)
		MW58-95-11	76* (Jun 1995)
		MW25A-95-15	51* (Sep 1995)
		MW37-92-18A	**60 to 123**
Cadmium	5	MW37-94-9	6* (May 1995)
Chromium	50	MW27-92-20	60* (Oct 1992)
Mercury	2	MW53-93-16-69'	2.1* (Mar 1994)
		MW7B-95-24	2.3* (Jun 1998)
Selenium	50	MW7-92-19	60* (Oct 1992)
		MW27-92-20	100* (Oct 1992)
		MW58-95-18	62* (Sep 1995)
Thallium	2	MW7-92-19	10* (Oct 1992)
		MW27-92-20	40* (Oct 1992)

* Metal was detected above the MCL during only one sampling event.

Antimony and arsenic in MW37-92-18A are the only metals consistently detected at concentrations above their MCL (6 and 50 μg/L, respectively). This well is located adjacent to Building 35 (an electrical substation) which was constructed in an area where soil was found to be contaminated with TPH-Diesel. MW37-92-18A is screened from 49 to 69 feet bgs in the Great Valley Group. Arsenic was not detected (<2 μg/L) in adjacent well MW37-92-18, which is screened in the Orinda Formation from 19 to 29 feet bgs. Antimony was not detected in MW37-92-18; however, the minimum detection limit for antimony in samples collected from MW37-92-18 was 10 μg/L. Based on the results from MW37-92-18 and the fact that there is no known source of arsenic or antimony in this area, the elevated concentrations of arsenic and antimony in MW37-92-18A are probably naturally occurring.

All other groundwater samples that contained metals at concentrations exceeding MCLs were reported in only one sampling event, which was followed by one or more sampling events where the metal was either not detected or detected below the MCL.

B4.5 Potential Migration of Contaminants to Surface Water

The Old Town Area is located within two watersheds: the Blackberry Canyon Watershed and the Strawberry Canyon Watershed (Figure B4.5-1). Surface runoff and storm drain flow within the Blackberry Canyon Watershed portion of the Old Town Area drain to the northwest toward North Fork Strawberry Creek. Surface runoff and storm drain flow within the Strawberry Canyon Watershed drain toward tributaries of Strawberry Creek: Cafeteria Creek, Ravine Creek, and Ten-Inch Creek. Minor surface runoff from the extreme eastern part of the area may also flow to Chicken Creek. In addition, some groundwater flowing from the Old Town Area may be intercepted by these creeks.

Surface water samples have been routinely collected from site creeks and analyzed for VOCs and metals. In addition, surface water and sediment samples have been collected from the five above mentioned creeks and analyzed for chemicals of potential concern from upgradient sources. Surface water sampling results for organics and metals are included in Tables B4.5-1 and B4.5-3, respectively. Sediment sampling results for organics and metals are included in Tables B4.5-2 and B4.5-4. Surface water and sediment sampling locations are shown on Figure B4.5-1 and Figure B4.5-2, respectively. The potential impact to the environment from contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

B4.5.1 North Fork Strawberry Creek

Surface water samples have been collected from North Fork Strawberry Creek and analyzed for VOCs, SVOCs, metals, and hexavalent chromium. Samples were collected primarily at the site perimeter, but samples were also collected upstream at the erosion control basins and at the Women's Faculty Club on the UC campus. The only VOC detected was a trace concentration of 1,1,1-TCA (0.95 μg/L) at the erosion control basins in 1995. 1,1,1-TCA has not been detected in the ten surface water samples collected since that time. The MCL for 1,1,1-TCA is 200 μg/L. Diethylphthalate (2.2 μg/L), which was detected in April 1998, has been the only SVOC detected. Diethylphthalate was not detected in a subsequent sample collected in July 1998. In addition, phthalates are common laboratory contaminants, indicating that this result

may not be representative of surface water contamination. No PCBs were detected. Metals were either not detected or detected at concentrations well below MCLs. Hexavalent chromium was detected in a surface water sample collected from the creek at the site boundary in July 1999, but was not detected in water collected upstream at the erosion control basin. Hexavalent chromium was not detected in a subsequent sample collected from the creek at the boundary in January 2000. The detected concentration of hexavalent chromium (4.2 μg/L) is below the MCL for drinking water for total chromium (50 μg/L) and the State of California Department of Health Services (DHS) Water Quality Criteria of 11 μg/L for protection of freshwater aquatic life.

Sediment samples have been collected from North Fork Strawberry Creek and analyzed for VOCs, SVOCs, PCBs, fuels, metals, and hexavalent chromium. Samples analyzed for metals and SVOCs were collected from several locations along the creek (Figure B4.5-2). The only VOC detected was a trace concentration of toluene (0.013 mg/kg) in April 1993 at the site boundary. Neither SVOCs nor PCBs were detected. TPH quantified as 'oil' (within the diesel range) was also detected at low concentrations (49 mg/kg maximum). The only metal detected at concentrations above both LBNL background levels for soil and PRGs for residential soil were lead and nickel. Lead was detected in a sediment sample collected in the erosion control basin in April 1993 at a concentration above both the LBNL soil background level and PRG for residential soil. Nickel was detected at a concentration above both the LBNL soil background level and PRG for residential soil in one of the five samples collected in August 1996. No hexavalent chromium was detected.

B4.5.2 Chicken Creek

Surface water samples have been collected from Chicken Creek and analyzed for VOCs, SVOCs, and metals. Surface water samples were primarily collected at the site perimeter. No VOCs or SVOCs were detected. Metals were either not detected or detected at concentrations well below MCLs.

Sediment samples have been collected from Chicken Creek and analyzed for VOCs, SVOCs, PCBs, PAHs, fuels, pesticides, and metals. Samples analyzed for metals, SVOCs, PAHs, and PCBs were collected from several locations along the creek (Figure B4.5-2). The

only VOC detected was p-isopropyltoluene (0.0058 mg/kg) in one of six samples. SVOCs were not detected. TPH quantified as 'oil' (within the diesel range) was detected. Two PAHs, benzo(a)pyrene (0.075 mg/kg) and chrysene (0.028 mg/kg) were detected in one sediment sample collected in January 1998. PAHs were not detected in a subsequent sediment sample collected from the same location in February 1998; however, a trace concentration of PCBs (0.014 mg/kg) was detected. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

B4.5.3 Ten-Inch Creek

Surface water samples have been collected from Ten-Inch Creek and analyzed for VOCs and metals. Samples were collected near the location where the creek enters the storm drain system along Strawberry Creek. No VOCs were detected. Metals were all detected at concentrations below MCLs.

Sediment samples have been collected from Ten-Inch Creek and analyzed for SVOCs and metals. Samples were collected from several locations along the creek south of the LBNL boundary (Figure B4.5-2). No SVOCs were detected. Metals were detected at concentrations within LBNL background levels for soil.

B4.5.4 Ravine Creek

Surface water samples have been collected from Ravine Creek and analyzed for VOCs and metals. Samples were collected near the location where the creek enters the storm drain system along Strawberry Creek. No VOCs were detected. Metals were all detected at concentrations below MCLs.

Sediment samples were collected from Ravine Creek and analyzed for metals. Samples were collected from several locations along the creek south of the LBNL boundary (Figure B4.5-2). Metals were detected at concentrations within LBNL background levels for soil.

B4.5.5 Cafeteria Creek

Surface water samples have been collected from Cafeteria Creek and analyzed for VOCs and metals. The samples were collected near Cyclotron Road where the creek enters the storm drain system. No VOCs were detected. Metals were all detected at concentrations below MCLs.

Sediment samples have been from Cafeteria Creek and analyzed for metals and cadmium. Cadmium was the only metal detected at a concentration above the LBNL maximum background levels. Cadmium was not detected in four sediment samples collected in January 1998 to assess the elevated concentration of cadmium previously detected.

B5 AIR SAMPLING

Ambient air samples were collected both inside and outside of buildings in the Old Town area and analyzed for VOCs, to provide data required for the human health risk assessment.

B5.1 Outdoor Air Sampling

Twenty-four hour outdoor air samples were collected at six locations in the Old Town area in November 1997. Sampling locations are shown on Figure B5.1-1. Also included on the figure is a windrose that covers the period when the outdoor air samples were collected. The windrose shows the percentage of the time the wind was blowing from directions spaced at 30° intervals. For most of the sampling period the wind was blowing either directly from the east or from the west.

Concentrations of analytes detected are listed in the table below. Also included in the table are Bay Area Air Quality Management District (BAAQMD) and California Air Resources Board (ARB) data from nearby monitoring stations, for comparison.

Outdoor Air Sample Results, Old Town Area

Sample Number	Location	Concentration (ppbv)					
		Vinyl chloride	Freon-113	Chloroform	Carbon Tetrachloride	TCE	PCE
LBNL Old Town Area Outdoor Air Sample Results							
A97-3-5.4	Southeast of Building 37	<0.46	0.11	0.12	0.14	0.045	0.12
A97-5-5.2	West of Building 58A	<0.32	0.11	0.052	0.095	0.034	0.069
A97-7-5.1	North of Building 7	<0.15	0.10	0.047	0.10	<0.15	0.078
A97-8-4.9	North of Building 25A	<0.19	0.065	0.052	0.097	0.029	0.049
A97-9-5.0	East of Building 58	<0.18	0.087	0.044	0.10	0.082	0.15
A97-11-5.0	Duplicate	<0.16	0.089	0.041	0.092	0.051	0.15
A97-10-5.0	North of Building 52	<0.16	0.080	0.036	0.099	<0.16	0.034
A97-10-5.0	Duplicate	<0.20	0.079	0.037	0.10	<0.20	0.027
A97-1-12	QC sample (blank)	<0.1	<0.1	<0.1	<0.1	0.059	0.033
BAAQMD and ARB Comparison Results							
Oakland (November 1997)		NA	NA	<0.02	0.1	<0.08	0.06
Fremont (median 1996)		NA	NA	0.03	0.08	0.01	0.06
Fremont (90th percentile 1996)		NA	NA	0.05	0.09	0.01	0.12
Richmond (median 1996)		NA	NA	0.02	0.08	0.01	0.03
Richmond (90th percentile 1996)		NA	NA	0.04	0.08	0.04	0.06

<0.18: Not detected (showing detection limit in ppbv)
NA: Not analyzed

B5.2 Indoor Air Sampling

Twenty-four hour indoor air samples were collected in March 1999 inside nine buildings in the Old Town area. In addition a background sample was collected from the second floor of Building 90. Sampling locations are shown on Figure B5.1-1.

Of the approximately 50 chemicals detected in soil gas, the following seven were selected for indoor air monitoring in the Old Town Area:

- PCE
- TCE
- benzene
- 1,1-DCE
- carbon tetrachloride
- chloroform
- vinyl chloride.

These chemicals are among the most commonly detected in soil gas and they have the most potential to present a health risk should their vapors infiltrate into buildings. Concentrations of analytes detected are listed in the following table. Also listed in the table are the California OSHA Permissible Exposure Limits (PELs). Elevated concentrations (relative to the background sample from Building 90) of chloroform, carbon tetrachloride, and TCE were detected in Building 53. Elevated concentrations of PCE were detected in Buildings 7, 7C, 53, and 58. The source of the PCE appears to be volatilization of contaminants from groundwater in the Building 7 Lobe area of the Old Town Plume. The source of the elevated concentrations of chemicals detected in Building 53 may also be the groundwater, but could be chemicals used in the building.

Indoor Air Sample Results, Old Town Area

		Concentration (ppbv)						
		1,1-DCE	**benzene**	**chloroform**	**carbon tetrachloride**	**TCE**	**PCE**	**vinyl chloride**
	PELs **Action Level**	1000	1000 500	2000	2000	25,000	25,000	1000
Sample No.	***Building No.***							
IA25A-99-1	25A	<0.031	0.54	<0.031	0.072	<0.16	<0.078	<0.12
IA58-99-1	58	<0.03	0.43	<0.03	0.059	<0.15	0.11	<0.12
IA58A-99-1	58A	<0.033	0.17	<0.033	<0.033	<0.16	<0.082	<0.13
IA7-99-1	7	<0.032	0.58	0.059	0.073	<0.16	0.41	<0.13
IA7C-99-1	7C	<0.027	0.73	0.072	0.092	<0.14	0.21	<0.11
IA53-99-1	53	0.065	0.59	0.12	0.17	1.1	11.0	<0.12
IA52-99-1	52	<0.031	0.49	<0.031	<0.031	<0.16	<0.078	<0.12
IA5-99-1	5	<0.029	0.52	0.099	0.062	<0.15	0.088	<0.12
IA44-99-1	44	<0.03	0.46	<0.03	0.065	<0.15	<0.075	<0.12
IA90-99-1 (Building 90 background)	90	<0.03	0.52	0.064	0.071	<0.15	<0.076	<0.12

PEL: California OSHA Permissible Exposure Limit
<0.03: Not detected (showing detection limit in ppbv)

B6. SUMMARY AND CONCLUSIONS

B6.1 Status of Solid Waste Management Units and Areas of Concern

Except for groundwater AOCs, all identified SWMUs and AOCs in the Old Town area have been approved for either No Further Action (NFA) or No Further Investigation (NFI) Status by the DTSC or the City of Berkeley. The status of SWMUs and AOCs in the Old Town Area is listed in Table B1-1. No further site characterization is required for SWMUs and AOCs approved for either NFA or NFI status, and units that have been approved for NFA status will not be included in the Corrective Measures Studies (CMS) phase of the RCRA Corrective Action Program (CAP). However, SWMUs and AOCs approved for NFI status will be included in the site wide risk assessment to be conducted as part of the CMS.

B6.2 Management of Groundwater AOCs

Halogenated non-aromatic VOCs are the most widespread contaminants in the Old Town Area, and are present in both a broad, multi-lobed plume that covers the central part of the area, and in a small plume near Building 37, toward the south (Figure B4.1-1). Each lobe has a distinct source(s). In addition, groundwater contaminants from the principal lobes of the central plume commingle to form a broad area of groundwater contamination that overlaps the individual areas designated as AOCs. The three primary lobes of the central plume are designated as:

- Building 7 Lobe
- Building 52 lobe
- Building 25A Lobe

These lobes correspond to areas of groundwater contamination that were previously identified as:

- Old Town Groundwater Solvent Plume (AOC 2-4)
- Area 10 Solvent Contaminated Groundwater (AOC 10-5)

In addition, the southern Building 37 Lobe corresponds to the Building 37 Solvent Plume (AOC 14-5). A plume of diesel/kerosene contaminated groundwater is also present in the area north of Building 6.

Groundwater plume AOCs were evaluated for the following criteria, which were described in Section B4 and are summarized below:

- sources of groundwater contamination have been located and sources have been removed or will be removed
- the magnitude and extent of contamination have been characterized
- the plumes are stable.

B6.2.1 Building 7 Lobe

Source Identification and Removal

The primary source of the Building 7 Lobe was apparently leakage and/or overflow from the Former Building 7 Sump (AOC 2-5), which was located north of Building 7 (Section B3.8). In August 1995, the sump was removed. Contaminated soil was excavated to a depth of 17 feet around the sump.

In 1996, a groundwater collection trench (Building 7 Collection Trench) was installed immediately downgradient from the former sump location, as a source control measure. Contaminated groundwater is extracted from the collection trench. Following treatment to a non-detectable level, the groundwater is reinjected into the gravel-filled excavation at the former sump location during periods of low rainfall to recirculate groundwater and flush contaminants from the subsurface to the collection trench. Through June 2000, approximately 47 kilograms of contaminant mass had been removed from the groundwater in the source area.

Plume Characterization

The Building 7 Lobe extends northwestward from the Former Building 7 Sump area to the parking area downslope from Building 58. Currently the highest contaminant concentrations

are detected in groundwater in wells 20 to 30 feet northwest (downgradient) of the sump (Figure B4.3-1b). Both the downgradient (northwestern) edge and the southwestern transgradient edge of the Building 7 Lobe are well defined by the absence, or low concentrations, of contaminants in monitoring wells to the northwest and southwest of Building 58. In contrast, the upgradient edge and northeastern transgradient edge of the lobe are less well defined because the lobe coalesces with both the Building 52 and Building 25A plume lobes. As discussed in Section B4.3.1, individual halogenated non-aromatic VOCs constituting the Building 7 Lobe have different lateral extents.

The vertical extent of groundwater contamination is limited. VOCs were not detected in two deeper wells that were installed in 2000 to characterize the vertical extent of contamination. These wells were installed in the source area (MW7-00-4) and downgradient from the core area (MW58A-00-3), with the screened interval entirely in the Orinda Formation. In addition, only trace concentrations, approximately 3 μg/L or less of VOCs, were detected in well cluster MW53-92-21 near the core area. MW53-92-21 contains four separate screened intervals at depths ranging from 130 to 193 feet bgs within the Orinda Formation.

Plume Stability and Potential Migration of Contaminants

Monitoring wells are located downgradient and transgradient from the Building 7 Lobe to monitor plume stability. The Building 7 Lobe appears to be stable, in that contaminant concentrations detected in wells monitoring the plume have shown a decreasing trend or remained relatively constant over several years of monitoring. Also, contaminants have not been detected in downgradient monitoring wells. Groundwater monitoring will continue in accordance with requirements of the RWQCB.

Two additional groundwater collection trenches have been installed to prevent further migration of contaminated groundwater. The Building 53/58 Slope Collection Trench was installed on the slope east of Building 58 to prevent the further migration of contaminated groundwater in that area. The Building 58 Collection Trench was installed west of Building 58 to control further migration of the Building 7 Lobe at its downgradient extent.

B6.2.2 Building 52 Lobe

Source Identification and Removal

Soil sampling results, which are discussed in Section B3.14, indicate that the source of the PCE, TCE, and their degradation products detected in groundwater in the Building 52 Lobe is located east of Building 52A. The source of the carbon tetrachloride and chloroform has not been determined, but should be in the same general area, based on the isoconcentration maps. An ICM is being considered to excavate the soil, which is the source of the contamination.

Plume Characterization

The Building 52 Lobe extends northwestward from the area east of Building 5A to the subdrain along the east side of Building 46 (Figures B4.1-1 and B4.3-1b), with the highest concentrations of halogenated VOCs detected in wells east of Buildings 52 and 52A. Both the downgradient (northwestern) edge and the northeastern transgradient edge of the Building 52 Lobe are well-defined by the absence of contaminants in monitoring wells short distances west of Building 46 and southwest of McMillan Road. The downgradient edge of the plume lobe appears to be captured by the Building 46 subdrain. The southwestern transgradient edge of the lobe is less well defined since it coalesces with the Building 7 Lobe in the vicinity of Buildings 52 and 53. The upgradient extent of the lobe is indicated by the relatively low concentrations detected in the area of Building 44. As discussed in Section B4.3.2, individual halogenated non-aromatic VOCs constituting the Building 52 Lobe have different lateral extents.

The vertical extent of groundwater contamination is limited. VOCs were not detected in a deeper monitoring well (MW52A-00-6) that was installed in 2000 to characterize the vertical extent of groundwater contamination. MW52A-00-6 was installed in the source area with a screened interval entirely in the Orinda Formation, approximately 30 feet below the contact with the Mixed Unit. In contrast, nearby wells screened in the overlying Moraga Formation and Mixed Unit contain the highest contaminant concentrations of VOCs detected within this lobe.

Plume Stability and Potential Migration of Contaminants

The Building 52 Lobe appears to be stable, in that contaminant concentrations detected in most wells monitoring the lobe have remained relatively constant or have declined over several years of monitoring. Capture of the plume at the Building 46 subdrain prevents further migration of this lobe, as indicated by the absence of contaminants in downgradient monitoring wells west of Building 46. Groundwater monitoring will continue in accordance with requirements of the RWQCB.

B6.2.3 Building 25A Lobe

Source Identification and Removal

Based on the groundwater sampling results and isoconcentration maps, the source area for the Building 25A Lobe groundwater contamination is located near the western end of Building 25A.

Plume Characterization

The Building 25A Lobe extends from Building 25A to Building 16 (Figures B4.1-1, B4.3-1a, and B4.3-1c), with the highest contaminant concentrations detected in groundwater near the western end of Building 25A. In addition, a segment of this lobe extends southward beneath Building 25. The upgradient (northward) boundary of the lobe lies immediately north of Building 25A, as defined by the absence, or low concentrations, of contaminants in wells to the north of the building. The eastern extent of the lobe lies in the vicinity of Building 26, as shown by low concentrations of contaminants in wells immediately southwest and northwest of Building 26. The western downgradient extent of the Building 25A Lobe lies in the vicinity of Building 6, as defined by wells with relatively low contaminant concentrations just northeast of the building. The Building 25A Lobe coalesces with the Building 7 Lobe in this area. The downgradient limit of the lobe segment that extends south of Building 25 is indicated by the absence of contaminants in the well to the south on Lawrence Road. As discussed in Section

B4.3.3, individual halogenated non-aromatic VOCs constituting the Building 25A Lobe have different lateral extents.

The vertical extent of groundwater contamination is limited. Monitoring well MW25A-00-5 was installed in the source area of the Building 25A Lobe in 2000 to characterize the vertical extent of groundwater contamination. The well was installed with a screened interval entirely in the Orinda Formation, approximately 20 feet deeper than adjacent monitoring well (MW25A-95-15). The maximum concentrations of VOCs detected in wells monitoring the Building 25A lobe (>400 μg/L) have been detected in MW25A-95-15. No VOCs were detected in groundwater samples collected from MW25A-00-5.

Plume Stability and Potential Migration of Contaminants

The Building 25A Lobe appears to be stable. Contaminant concentrations in the source area wells do not show a consistent trend. These wells have generally been monitored for only a limited period. In comparison, the downgradient wells show overall decreases in concentrations during the period of monitoring.

As an ICM, pumps have been installed to extract contaminated groundwater present in electrical utility manhole EMH 133 east of Building 6. This system was installed to prevent the potential migration of contaminants through the electrical conduits to the Building 37 area. The downgradient portions of the Building 25A Lobe coalesces with the Building 7 and Building 52 Lobes for which measures have been implemented to prevent further migration. Groundwater monitoring will continue in accordance with requirements of the RWQCB.

B6.2.4 Building 37 Lobe

Source Identification and Removal

Potential sources for the Building 37 Lobe include migration of contaminants through the underground electrical utility conduit under the road west of Buildings 14 and 16 and drain 37-01-01. These are no longer potential sources since the contaminated water in the electrical

manhole and effluent from drain 37-01-01 are extracted and treated. In addition, no VOCs have been detected in the effluent from drain 37-01-01 since August 1998.

Plume Characterization

The lateral extent of the Building 37 Lobe is limited to a zone less that 100 feet wide, as shown by the absence of halogenated non-aromatic VOCs in the wells to the east and the west of the lobe (Figure B4.3-1a). It is estimated that the downgradient extent of the lobe does not extend far beyond MWP-7, based on the low concentrations of VOCs detected in the well. Presently, contaminant levels in this lobe are below or only slightly above the MCL. In addition, groundwater is extracted from MWP-7 and adjacent well MW37-92-6 to prevent further migration, as described below.

Plume Stability and Potential Migration of Contaminants

The Building 37 Lobe appears to be stable. Concentrations of total halogenated non-aromatic VOCs have decreased since groundwater extraction from wells MWP-7 and MW37-92-6 was initiated in March 1994. In addition, several halogenated non-aromatic VOCs that had been detected in the lobe prior to August 1995 have declined to nondetectable levels.

Since January 1994, groundwater has been pumped from MWP-7 and MW37-92-6 to control migration of the lobe. Effluent from drain 37-01-01 is also treated by the system. In addition, a collection system was installed in manhole EMH 133 east of Building 6 to prevent potential migration of contaminants through the electrical conduits to the Building 37 Plume area. Groundwater monitoring will continue in accordance with requirements of the RWQCB.

B6.2.5 The Building 7 Diesel / Kerosene Plume

Source Identification and Removal

The source of the groundwater contamination is the former Building 7E underground storage tank (UST) (AOC 2-1) that was located immediately south of Building 7E. On April 21 1989, the tank was removed.

Construction of a dual-phase SVE and groundwater extraction system ICM was completed in 1998. Two treatment systems were installed (one for contaminated groundwater and one for extracted soil gas) on a concrete pad on the east side of Building 6. Pumping groundwater started on September 18, 1998. Vapor extraction was started on October 19, 1998 when the water table was lowered to the required level.

Plume Characterization

Kerosene-range hydrocarbons have only been detected in the three monitoring wells (MW7-92-16, MW6-93-4, and MW6-95-14) immediately north of Building 6. Non-aqueous-phase-liquid (NAPL) was observed in well MW7-92-16 in 1994 and 1996; however, it has not been observed since implementation of the ICM in 1998. In addition to kerosene, wells in this area also contained lesser concentrations of petroleum hydrocarbons quantified in the ranges of diesel, gasoline, and stoddard/white spirits. Neither TPH-D nor TPH-K has been detected in monitoring wells MW90-2 located north of the former tank site, indicating that the lateral extent of the plume is limited.

Plume Stability and Potential Migration of Contaminants

The plume appears to be stable. Concentrations of aromatic and non-halogenated hydrocarbons in wells MW7-92-16 and MW6-95-14, located within the source area of the kerosene plume, have declined to non-detectable levels.