E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
FORMER COOLING TOWERS SOUTHEAST OF BUILDING 51 (AOC 9-11)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

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A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

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CONTENTS

LIST OF ABBREVIATIONS

AOC	Area of Concern
Berkeley Lab	Ernest Orlando Lawrence Berkeley National Laboratory
bgs	below ground surface
CAL-EPA	California Environmental Protection Agency
CAP	Corrective Action Program
CMS	Corrective Measures Studies
COPC	Constituent of Potential Concern
DCA	dichloroethane
DTSC	Cal-EPA Department of Toxic Substances Control
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
µg/L	micrograms per liter (10^{-6} grams per liter)
NFA	No Further Action
NFI	No Further Investigation
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RWQCB	Regional Water Quality Control Board
SVOCs	Semi-volatile organic compounds
SWMU	Solid Waste Management Unit
TCA	trichloroethane
THC	total hydrocarbons
USEPA	U. S. Environmental Protection Agency
VOCs	volatile organic compounds

SECTION 1

INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the environmental investigations conducted at the Former Cooling Towers Southeast of Building 51 (Area of Concern [AOC] 9-11) and request approval of No Further Action (NFA) status for AOC 9-11 under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) at Lawrence Berkeley National Laboratory (Berkeley Lab). The California Environmental Protection Agency (CAL/EPA) Department of Toxic Substances Control (DTSC) is the lead regulatory agency for the CAP and has the authority to approve NFA status for this unit. If NFA status is approved, no additional soil sampling would be required and the unit will not be included in the site-wide risk assessment. However, groundwater monitoring would continue at the unit, in accordance with requirements of the Regional Water Quality Control Board (RWQCB).

1.2 CHRONOLOGY OF REGULATORY REVIEW OF AOC 9-11

Berkeley Lab previously submitted requests to the DTSC for approval of No Further Investigation (NFI) status for AOC 9-11 and provided responses to DTSC's comments on those requests. Following is the chronology of Berkeley Lab's previous submittals, DTSC's comments on the requests, and Berkeley Lab's responses to DTSC's comments.

- July 1998 — Berkeley Lab submitted a request to DTSC for No Further Action (NFA) or No Further Investigation (NFI) status approval for several solid waste management units (SWMUs) and AOCs, including AOC 9-11 (Berkeley Lab, 1998a).
- September 1998 — DTSC approved NFA and NFI status for all SWMUs and AOCs in the request report, except AOC 9-11 for which DTSC required further justification for Berkeley Lab's NFI status request (DTSC, 1998).

- September 1998 Berkeley Lab responded to DTSC's request for further justification on AOC 9-11 (Berkeley Lab, 1998b). Berkeley Lab's response contained a summary of results of groundwater investigations at the site.
- November 1998 The DTSC verbally requested that Berkeley Lab sample water from the drain lines that collect shallow groundwater immediately downgradient from the former containment basins.
- April 1999 Berkeley Lab submitted a second request for NFI status approval for AOC 9-11 (Berkeley Lab, 1999a), which included results of the drain line sampling requested by DTSC.
- May 1999 The DTSC provided comments on Berkeley Lab's April 20, 1999 request and requested clarification on several issues (DTSC, 1999a).
- June 1999 Berkeley Lab responded to the DTSC comments of May 1999 (Berkeley Lab, 1999b).
- September 1999 Based on Berkeley Lab's response to DTSC's May 1999 comments and a meeting held with DTSC on July 1, 1999, Berkeley Lab submitted an additional request for NFI status approval for AOC 9-11 (Berkeley Lab, 1999c).
- September 1999 DTSC provided comments to Berkeley Lab's September 1999 request (DTSC, 1999b).
- January 2000 Berkeley Lab submitted a workplan to DTSC (Berkeley Lab, 2000) for review and approval that contained responses to the DTSC's September 1999 comment letter and addressed their concerns. The workplan specified additional soil investigations at the unit and the installation of a new groundwater monitoring well.

1.3 SCOPE

This current NFA request summarizes the information contained in the previous NFI approval requests and provides the results of the soil and groundwater sampling that was specified in the January 2000 workplan (Berkeley Lab, 2000). The objectives of the investigations conducted in 2000 were to collect data to evaluate the presence of analytes previously detected in soil at AOC 9-11 and help assess the magnitude and extent of any contamination.

The data collected during the RCRA Facility Assessment (RFA) and during the RCRA Facility Investigation (RFI) prior to January 2000 are discussed in Section 3.2 of this report. Results of the investigations that were conducted in accordance with requirements specified in

Berkeley Lab's January 2000 workplan (Berkeley Lab, 2000) are discussed in Section 3.3. The rationale for requesting NFA status for AOC 9-11 is provided in Section 4.

SECTION 2

DESCRIPTION OF UNIT

2.1 SITE DESCRIPTION AND HISTORY

A map of Berkeley Lab showing the location of the AOC 9-11 is included as Figure 1. Maps of the southern Building 51 area showing the locations of the former cooling towers are included as Figure 2 and Figure 3. Water that was used to cool the Bevatron magnet ring inside Building 51 was routed to three cooling towers (CT-4, CT-5, and CT-6) located southeast of the building, prior to recirculation. About 1962, discharge water from cooling towers was redirected from the storm drain system to the sanitary sewers. Prior to 1983, the cooling tower cleaning activities may have released rinse water. The system was designed to catch any released water in drainholes of a subsurface drainage system that routed water to a sump located next to the CT-4 containment basin (Figure 3), which in turn discharged to the sanitary sewer. The Bevatron is no longer operational. Two of the towers have been removed and one inactive tower is still in place.

A sub-surface tile drain that collects groundwater from a wide area, including the area next to AOC 9-11, lies along the southern perimeter of Building 51 (the "Building 51 Drain" on Figure 2). A second sub-surface drain (the "Building 51 Spring Drain" on Figure 2) intersects a historical spring southwest of Building 51, that was mapped prior to construction of the building. Near the historical spring location, the two drain lines are within approximately 4 feet of each other, both vertically and horizontally. The drains discharge into a storm water catch basin located inside Building 51A (Figure 2). The water from the catch basin ultimately discharges to the storm drain outfall on North Fork Strawberry Creek (Figure 4).

2. 2 GEOLOGY AND HYDROGEOLOGY

2.2.1 Geology

The bedrock geology of the Building 51 and surrounding areas is shown on Figure 5. Rocks of the Orinda Formation underlie the location of the former cooling towers. The contact between the Orinda Formation and rocks of the older Great Valley Group is west of AOC 9-11, and dips moderately to the northeast. In the Building 51 area, the Orinda Formation consists mostly of fine-grained sediments that dip moderately to the north and northeast.

Geologic cross-sections at the former cooling tower site are shown on Figure 6 and Figure 7. The locations of the cross-sections are shown on Figure 3. Artificial fill, consisting primarily of silty, sandy, and gravelly clay increases in thickness from approximately 5 to 11 feet southeast of the former cooling towers to 20 feet at Building 51 toward the northwest. Interlayered claystone, siltstone, and sandstone of the Orinda Formation underlie the fill.

2.2.2 Hydrogeology

A water level elevation map of the Building 51 area based on water levels measured in groundwater monitoring wells screened near the water table is included as Figure 8. Groundwater flow at AOC 9-11 is northwestward toward North Fork Strawberry Creek. Groundwater levels measured in February 2000 are included on the geologic cross sections (Figure 6 and Figure 7). Depth to groundwater at the site was approximately 3 to 4 feet bgs at that time.

Based on results of slug tests conducted in monitoring wells, the Orinda Formation has the lowest values of hydraulic conductivity of any of the geologic formations at Berkeley Lab (approximately 10^{-7} to 10^{-9} meters per second).

SECTION 3

NATURE AND EXTENT OF CONTAMINATION

3.1 SCREENING PROCESS FOR NO FURTHER ACTION (NFA) STATUS

Soil sample analytical results were compared to background levels in order to evaluate what might constitute environmental contamination. For compounds that are not naturally occurring, such as many organic compounds, any detection of that compound is assumed to be contamination, unless other sources such as laboratory contamination of the sample can be documented. For naturally-occurring constituents such as metals, analytical results are compared to statistically-estimated background levels to identify with a certain degree of confidence which constituents are present at concentrations that represent contamination. Berkeley Lab used a statistical method (Berkeley Lab, 1995) to estimate the background concentrations of metals in soil. This method adopts the upper tolerance limit method as defined by USEPA (USEPA, 1989).

As approved by the DTSC, Berkeley Lab uses USEPA Region IX Preliminary Remediation Goals (PRGs) (USEPA, 1999) as a screening tool to help assess whether further action is required at a site (i.e. whether the unit will be included in the site wide risk assessment). DTSC PRGs (Cal-Modified PRGs) are used where Region IX PRGs either have not been established, or are greater than the DTSC values. To implement a conservative approach for site screening purposes, Berkeley Lab uses PRGs established for soil at residential sites instead of less-stringent PRGs defined for soil at industrial sites.

Where concentrations of contaminants in soil are within Berkeley Lab background levels or below PRGs for residential soil, the SWMU or AOC is recommended for NFA status. Where concentrations of contaminants in soil are above both Berkeley Lab background levels and PRGs for residential soil, the SWMU or AOC is recommended for NFI status. No further site

characterization will be required by DTSC for SWMUs and AOCs approved for either NFA or NFI status. SWMUs and AOCs approved for NFI status will be included in the risk assessment to be conducted as part of the Corrective Measures Studies (CMS) phase of the RCRA CAP. SWMUs and AOCs that are approved for NFA status will not be included in the CMS.

3.2 INVESTIGATIONS CONDUCTED PRIOR TO 2000 AT AOC 9-11

The results discussed in this section are based on environmental investigations conducted during the RFA and during the RFI prior to January 2000. These investigations included the collection of soil, groundwater, surface water, sediment, and drainline samples. Soil and groundwater samples were collected at locations most likely to have been impacted from any releases that may have occurred at the former cooling towers using an authoritative (judgement) sampling approach. To evaluate potential contaminant migration pathways from the former cooling tower area, water was sampled from the drain line ("Building 51 Drain") that collects shallow groundwater adjacent to the former containment basins. Surface water and sediment samples were also collected from the North Fork of Strawberry Creek, where the drain lines ultimately discharge, and analyzed for chemicals of potential concern from upgradient sources, including AOC 9-11.

The locations of the soil borings, groundwater monitoring wells, piezometers, and temporary groundwater sampling points discussed in this section are included on Figure 3. Surface water and sediment sampling locations and the location of the "Building 51 Drain" are shown on Figure 4. Analytical results are presented in Table 1 (soil organics and pH), Table 2 (soil metals), Table 3 (groundwater organics and metals), Tables 4a and 4b(surface water VOCs and metals), Tables 5a and 5b (sediment organics and metals), and Table 6 (subdrain water organics and hexavalent chromium).

3.2.1 Soil Sampling

Sampling Locations

During the RFA, a soil sample was collected from a depth of 9 feet below ground surface (bgs) (SS51S-07) to assess possible leakage from the cooling tower or sanitary sewer (Berkeley

Lab, 1992). The sample was analyzed for volatile organic compounds (VOCs) and Total Hydrocarbons (THC). Also during the RFA, soil samples were collected from two borings (51-92-2 and 51-92-3) drilled along the southeast side of the former cooling tower basins. Samples were analyzed for VOCs and metals. The shallowest sample at each location was also analyzed for semi-volatile organic compounds (SVOCs), and samples from 51-92-2 were analyzed for pH. Boring 51-92-2 was completed as a monitoring well (MW51-92-2) and boring 51-92-3 was completed as a series of five nested piezometers (PZ51-92-3).

In April 1996, soil samples were collected from two borings (SB51-96-19 and SB51-96-20) located next to surface drainholes adjacent to the former cooling tower basins CT-5 and CT-6, and from one boring (SB51-96-22) next to the sump adjacent to former cooling tower basin CT-4. Samples were analyzed for VOCs, metals, and pH. In September 1996, two soil samples were collected from SB51-96-20A (adjacent to SB51-96-20) at 1.1 and 2.1 feet bgs and analyzed for hexavalent chromium.

Analytical Results

Benzene (0.01 mg/kg) was detected in one soil sample collected at 15 feet in MW51-92-2. Trace concentrations (<0.2 mg/kg) of ethylbenzene, toluene, isopropylbenzene, and 1,1,1-trichloroethane (TCA) were detected at a depth of 9 feet in SS51S-07. THC (3.09 mg/kg) was also detected. Levels of pH measured at the site ranged from 8.18 to 9.00. No SVOCs were detected.

Seven metals were detected at concentrations above Berkeley Lab background levels: arsenic (1 sample), barium (1 sample), chromium (3 samples), cobalt (1 sample), lead (1 sample), nickel (1 sample), and thallium (1 sample). Except for one chromium and one thallium sample, all metal results were within approximately 10% of background levels. Detections of naturally-occurring metals at concentrations above a statistically determined background level are expected. Arsenic (maximum 21 mg/kg), chromium (maximum 270 mg/kg), and thallium (maximum 14 mg/kg) were detected at concentrations above both background levels and PRGs for residential soil in one sample each.

To further assess the elevated concentration (above background and the PRG) of chromium detected in SB51-96-20, two soil samples were collected from SB51-96-20A (adjacent to SB51-96-20) at 1.1 and 2.1 feet bgs and analyzed for hexavalent chromium. Hexavalent chromium was not detected.

Concentrations of organic analytes detected and concentrations of metals detected above both PRGs for residential soil and Berkeley Lab background levels for the samples collected prior to 2000 are included on the cross sections (Figures 9 and 10). Results of sampling conducted in January 2000 are also included on these figures for comparison purposes.

3.2.2 Groundwater Sampling

Sampling Locations

Groundwater samples have been collected from MW51-92-2 as part of quarterly monitoring since December 1992. In addition, groundwater samples were collected from the five nested piezometers (PZ51-92-3) in November 1993, and grab groundwater samples were collected from temporary sampling points SB51-96-20 or SB51-96-22 in April, September, and November in 1996, in December 1997, and in October 1999.

Analytical Results

Chloroform (2.1 μg/L) and 1,1-dichloroethane (1,1-DCA) (1.0 μg/L) were the only organic compounds detected in groundwater at the site. They were detected in one grab groundwater sample (April 1996) from SB51-96-22, located near the sump. No VOCs were detected in SB51-96-22 during subsequent sampling in November 1996.

Hexavalent chromium was detected at a maximum concentration of 93 μg/L (range of 3 μg/L to 93 μg/L) in grab samples collected from SB51-96-20. The Maximum Contaminant Level (MCL) for drinking water for total chromium (including hexavalent chromium) is 50 μg/L. Hexavalent chromium was not detected in the sample collected from SB51-96-20 in October 1999 nor has it been detected in samples from SB51-96-22 next to the sump. Cadmium was detected above its MCL for drinking water in one groundwater sample (5.7 μg/L in PZ51-92-3 in

November 1993; the MCL is 5 μg/L). No other metal has been detected in groundwater samples at a concentration above MCLs.

3.2.3 Surface Water and Sediment Sampling

Sampling Locations

As previously described, the storm drain system near AOC 9-11 discharges to North Fork Strawberry Creek. Surface water and sediment samples were collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 9-11. From April 1993 to April 1999, 9 surface water samples from North Fork Strawberry Creek were analyzed for CAM 17 metals and 15 for VOCs. During the same period, 11 sediment samples from North Fork Strawberry Creek were analyzed for CAM 17 metals and 2 for VOCs. In July 1999, surface water and sediment samples were collected from the North Fork Strawberry Creek erosion control basin and from North Fork Strawberry Creek at the site boundary (Figure 4) and analyzed for hexavalent chromium. These samples were collected in response to comments issued by the DTSC (DTSC, 1999a).

In November and December 1998, water samples were collected from the "Building 51 Drain" and the “Building 51 Spring Drain”. The samples were collected from the nearest accessible sampling location downflow from AOC 9-11, which is the catch basin inside Building 51A (Figure 2). The samples were analyzed for VOCs and hexavalent chromium.

Analytical Results

Surface Water Sampling

Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in soil samples, only arsenic and chromium were detected in the surface water samples from North Fork Strawberry Creek. Arsenic and chromium were each detected in three of eleven surface water samples at a maximum concentration of 4.2 μg/L and 8.6 μg/L, respectively. The maximum concentrations of arsenic and chromium detected in the surface water samples are well below DHS Water Quality Criteria

(150 μg/L for arsenic and 210 μg/L for chromium) and drinking water Maximum Contaminant levels (MCLs).

Hexavalent chromium (4.2 μg/L) was detected in the surface water sample collected from North Fork Strawberry Creek at the boundary fence in July 1999, but was not detected in water collected upstream at the erosion control basin. The detected concentration is below the MCL for drinking water (50 μg/L) and the DHS Water Quality Criteria of 11 μg/L for protection of freshwater aquatic life. Except for one sample collected in May 1995 that showed a trace concentration (<1 μg/L) of 1,1,1-trichloroethane (TCA), no VOCs were detected. The MCL for 1,1,1-TCA is 200 μg/L.

The potential impact to the environment from contaminants detected in surface water will be evaluated in the ecological risk assessment.

Sediment Sampling

Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in soil samples at AOC 9-11, only chromium and thallium were detected in sediment samples from North Fork Strawberry Creek at concentrations above Berkeley Lab background levels. Chromium (129 mg/kg maximum) and thallium (5.4 mg/kg) were detected above the background level in 1 of 11 samples each. The maximum concentrations detected are below the PRGs for residential soil.

A trace concentration of toluene (0.013 mg/kg) was the only VOC detected. Hexavalent chromium was not detected in either of the sediment samples collected at the same locations where surface water was sampled for hexavalent chromium.

The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Drainline Sampling

Various halogenated VOCs were detected in samples from both drain lines, and methyl tert-butyl ether (MTBE) was detected in one sample from the "Building 51 Drain" line. The

source(s) of these VOCs are unknown. Hexavalent chromium was detected in samples from both drain lines at a maximum concentration of 4 μg/L, which is well below the MCL for drinking water (50 μg/L). A potential source of the hexavalent chromium is the former cooling towers (AOC 9-11). The similar concentrations of hexavalent chromium and halogenated VOCs detected from both drain lines indicate that both lines intercept the same area of contaminated groundwater, or that there is cross-flow between the two drain lines. A groundwater monitoring well (MW51-99-1) was installed at the location of the historical spring to evaluate if the spring was a source area or migration pathway of contamination detected in the drainlines. No VOCs were detected in the groundwater sample collected from this well.

3.3 RESULTS OF SAMPLING SPECIFIED IN THE JANUARY 2000 WORKPLAN

The January 2000 Work Plan for Further Investigation of Contamination at Former Cooling Towers Southeast of Building 51 (AOC 9-11) (Berkeley Lab, 2000) established the procedures for evaluating the data previously collected at AOC 9-11 and assessing the extent of contamination. The work plan also provided the rationale for limiting the constituents of potential concern (COPCs) for further site investigation to arsenic, chromium, and thallium. In addition, to more thoroughly address the historical data collected at the site, the presence of VOCs previously detected in the soil and hexavalent chromium in the groundwater were included for assessment in the workplan.

3.3.1 Soil Sampling

Soil sampling results are included in Table 1 (organics) and Table 2 (metals). Soil sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
VOCs To evaluate the potential presence and the extent of VOCs in the soil, samples will be collected at three depths from two soil borings, one drilled within 3 feet of SS51S-07 and one within 3 feet of MW 51-92-2 to assess whether VOCs are actually present. One sample will be collected at the same depth that contaminant(s) were detected previously and the other two will be collected 3 feet above and 3 feet below the target depth. The samples will be analyzed for VOCs by EPA Method 8260.	SS51-00-3 was drilled within 3 feet of the estimated location of SS51S-07. SB51-00-2 was drilled 3 feet from MW51-92-2. Three samples were collected from each boring at the elevations specified in the workplan. No VOCs were detected. Sampling locations are shown in cross section on Figure 10.
Metals *Arsenic* To evaluate the potential presence and investigate the extent of elevated arsenic concentrations at PZ51-92-3, two soil borings will be drilled within 3 feet of PZ51-92-3. Two soil samples will be collected from each borehole, one at 3 feet bgs and the other at 6 feet bgs.	SS51-00-1 and SB51-00-4 were drilled 2 feet and 3 feet, respectively, from PZ51-92-3. Two samples were collected from each boring at the elevations specified in the workplan. Arsenic was detected at a maximum concentration of 6.3 mg/kg. All concentrations detected were within the Berkeley Lab background level. Sampling locations and analytical results are shown in cross section on Figure 10.
Chromium To evaluate the potential presence and investigate the extent of elevated chromium concentrations near SB51-96-20, soil samples will be collected at depths of 1 and 5 feet at two locations within approximately 5 feet of SB51-96-20.	MW51-00-01 and SB51-96-20R were drilled 2 feet and 3 feet, respectively, from SB51-96-20. Two samples were collected from each boring at the elevations specified in the workplan. Chromium was detected at a maximum concentration of 99 mg/kg. All concentrations detected were within the Berkeley Lab background level. Sampling locations and analytical results are shown in cross section on Figure 9.
Thallium To evaluate the potential presence and investigate the extent of elevated thallium concentrations at PZ51-92-3, soil samples will be collected at depths of 10, 15, and 20 feet from one boring drilled within approximately 5 feet of PZ51-92-3.	SB51-00-01 was drilled 2 feet from PZ51-92-3. Three samples were collected from the boring at the elevations specified in the workplan. Thallium was not detected. Detection limits were below the Berkeley Lab maximum background level. Sampling locations and analytical results are shown in cross section on Figure 10.
If any of these samples contain metals above the Berkeley Lab background level, Berkeley Lab will assess whether the results are indicative of contamination and may collect additional samples to characterize the extent of potential contamination.	All detected concentrations of metals were within Berkeley Lab background levels.

3.3.2 Groundwater Sampling

Groundwater sampling results are included in Table 3. Groundwater sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
A new groundwater monitoring well will be installed between the former cooling towers and the subdrain. The analysis of water sample from this well should help to evaluate potential sources of VOCs detected in the subdrain.	Groundwater monitoring well MW51-00-1 and temporary groundwater sampling point SB51-96-20R were installed between the former cooling towers and the subdrain. These two wells are immediately downgradient from former cooling tower basins CT-5 and CT-6 and together provide vertical characterization of groundwater quality (Figure 2 and Figure 6). No VOCs were detected in the sample collected from these wells, indicating that the former cooling towers are not the source of the VOCs detected in the subdrain.
Water samples from the other existing wells in the area of the former cooling towers will also be collected and tested for VOCs at the same time, to provide comparable results for evaluation.	Groundwater samples were collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') on February 22 or February 24, 2000 and analyzed for VOCs. No VOCs were detected, indicating that the former cooling towers are not the source of the VOCs detected in the subdrain.
To further evaluate the presence of hexavalent chromium in this area, a groundwater sample will be collected from a newly proposed monitoring well to be installed within 10 ft. of SB51-96-20. The other wells in the area of the former cooling towers will be sampled concurrently for hexavalent chromium and CAM 17 metals to provide comparable results for evaluation.	Groundwater samples were collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') on February 22 or February 24, 2000 and analyzed for hexavalent chromium and CAM 17 metals. Results are shown at the well locations on Figure 11. Hexavalent chromium was only detected in SB51-96-20R. Concentrations of metals (including hexavalent chromium) were below MCLs.
Cadmium was detected in one groundwater sample at a concentration slightly above the MCL (5.7 μg/L, MCL=5 μg/L) at a depth of 42 feet in multi-level well PZ51-92-3. Wells in the area of the former cooling towers will be sampled concurrently for CAM 17 metals to provide comparable results and help assess whether cadmium is present at an elevated concentration in the area of the former cooling towers.	Samples were collected from all levels of the multi-level well PZ51-92-3 on January 10, 2000 and analyzed for CAM 17 metals. Cadmium was not detected in any of the samples (<1 μg/L). In addition, cadmium was not detected in the samples collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') in February 2000. The results show that cadmium is not present at an elevated concentration in the groundwater in the area of the former cooling towers.

3.3.3 Surface Water Sampling

Surface water sampling results are included in Table 4a (VOCs) and Table 4b (metals). Surface Water sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
Another water sample will be collected from North Fork Strawberry Creek and tested for metals to confirm the previous findings. (Of the three metals [arsenic, chromium, and thallium] identified as COPCs at AOC 9-11, only arsenic and chromium were detected in the previous surface water samples from North Fork Strawberry Creek. The maximum concentrations of arsenic and chromium detected were well below DHS Water Quality Criteria and MCLs.)	A surface water sample was collected from North Fork Strawberry Creek at the site boundary in January 2000 and analyzed for CAM 17 metals. Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in previous soil samples collected at AOC 9-11, only chromium (2.5 μg/L) was detected in the surface water sample. The concentration of chromium detected is well below the DHS Water Quality Criteria (210 μg/L) and drinking water standard (MCL) of 50 μg/L. Results were consistent with the previous findings. A second sample collected at the site boundary in January 2000 was analyzed for hexavalent chromium. No hexavalent chromium was detected (<2 μg/L). Hexavalent chromium (4.2 μg/L) had been detected at the same location previously.
A water sample will be collected from North Fork Strawberry Creek and tested for VOCs to confirm the previous findings. (Except for one sample collected in May 1995 that showed a trace concentration [<1 μg/L] of 1,1,1-trichloroethane [TCA], no VOCs were detected.)	A surface water sample was collected from North Fork Strawberry Creek at the site boundary in January 2000 and analyzed for VOCs. No VOCs were detected. Results were consistent with the previous findings.

SECTION 4

RATIONALE FOR NFA RECOMMENDATION

4.1 INTRODUCTION

The Former Cooling Towers Southeast of Building 51 (AOC 9-11) is recommended for No Further Action status. The magnitude and extent of soil contamination, the impact of soil contamination on the groundwater, and the potential migration of contaminants to surface water have been evaluated. These criteria were discussed in Section 3 of this report and are summarized below. In addition, Berkeley Lab has provided responses to all DTSC comments on AOC 9-11.

4.2 RESPONSE TO DTSC COMMENTS

Berkeley Lab submitted a workplan to DTSC on January 10, 2000 (Berkeley Lab, 2000) to address concerns expressed by DTSC in their September 1999 comment letter (DTSC, 1999b). The workplan specified additional soil, groundwater, and surface water sampling for AOC 9-11 and the installation of a new groundwater monitoring well.

In response to DTSC's comments and in accordance with Berkeley Lab's responses to the comments the activities listed in the following table were completed. Those activities and the results were described in detail in Section 3 of this report.

Comment (DTSC, 1999b)	Action Completed
1. The request identifies soil, groundwater and possible surface contamination resulting from releases of arsenic, chromium, and thallium at AOC 9-11 but does not provide any information on the horizontal or vertical extent of this contamination for any of the mediums in question.	Additional soil samples were collected to evaluate the magnitude and extent of the elevated concentrations of arsenic, chromium, and thallium previously detected in the soil. An additional surface water sample was collected from North Fork Strawberry Creek and analyzed for metals. Groundwater samples were collected from 5 wells at AOC 9-11 and concurrently sampled for metals.
2. The request fails to establish actual paths of contamination to surface water if any.	Potential pathways of contamination to surface water were discussed in the January 2000 workplan and are discussed in this report. The storm drain system near AOC 9-11 discharges to North Fork Strawberry Creek. An additional surface water sample was collected from North Fork Strawberry Creek and analyzed for VOCs and metals.
3. Groundwater data reported for the contaminants identified as having been released come from some of the sampled wells, but not from others, and the data dates from various times in the past. This spotiness in the record makes it impossible to evaluate the data and to ascertain a clear contamination profile.	Concurrent samples were collected from the two monitoring wells, two groundwater sampling points, and piezometers located at AOC 9-11 and analyzed for CAM 17 metals, hexavalent chromium, and VOCs.

4.3 RECOMMENDATION FOR NFA STATUS

The initial list of Chemicals of Potential Concern (COPCs) for AOC 9-11 consisted of chromates, chromium, arsenic, zinc, and acids. Based on the information provided in the January 2000 workplan (Berkeley Lab, 2000) and in Section 3.2 of this report, and DTSC's comments of September 22, 1999 (DTSC, 1999b), the list of COPCs at AOC 9-11 was reduced to arsenic, chromium, and thallium. To more thoroughly address the historical data, Berkeley Lab also included evaluation of VOCs and hexavalent chromium in the groundwater in the workplan.

The following paragraphs summarize Berkeley Lab's justification for the NFA request:

Soil Contamination

Based on the results of sampling conducted in accordance with the January 2000 workplan (Berkeley Lab, 2000), there is no evidence of soil contamination at AOC 9-11.

Concentrations of arsenic, chromium, and thallium detected in soil were all within Berkeley Lab background levels. No VOCs were detected.

Magnitude and Extent of Groundwater Contamination

The horizontal and vertical extent of groundwater contamination have been addressed. Two groundwater monitoring wells, two temporary groundwater sampling points, and one piezometer in the area of AOC 9-11 were concurrently sampled for VOCs, CAM 17 metals, and hexavalent chromium in February 2000. No VOCs were detected. Concentrations of metals detected were below MCLs. Hexavalent chromium, which was only detected in SB51-96-20R, was the only contaminant identified in the groundwater. The detection only in SB51-96-20R indicates that the horizontal extent of the contamination is limited. SB51-96-20R is screened from approximately 5 to 15 feet bgs in the fill. Hexavalent chromium was not detected in adjacent (within 5 feet) monitoring well MW51-00-01, which is screened from 20 to 25 feet bgs in the Orinda Formation, indicating that the vertical extent of the contamination is limited.

Potential Migration of Contaminants to Surface Water and Sediment

The storm drain system near AOC 9-11 discharges 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 9-11. Based on the sampling conducted in 2000, the only COPC in soil or groundwater at AOC 9-11 is hexavalent chromium. Hexavalent chromium was detected (4.2 μg/L) in the surface water sample collected from North Fork Strawberry Creek at the boundary fence in July 1999, but was not detected in water collected upstream at the erosion control basin. The detected concentration is below the MCL for drinking water (50 μg/L) and the DHS Water Quality Criteria of 11 μg/L for protection of freshwater aquatic life. Hexavalent chromium was not detected in either of the sediment samples collected at the same surface water sampling locations. Furthermore, hexavalent chromium was not detected (<2 μg/L) in the surface water sample collected from North Fork Strawberry Creek in January 2000.

SECTION 5

REFERENCES

Berkeley Lab, 1992. *RCRA Facility Assessment* at the Lawrence Berkeley Laboratory, Environmental Restoration Program. September 30, 1992.

Berkeley Lab, 1995. *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL).* Environmental Restoration Program, Lawrence Berkeley National Laboratory. August 1995.

Berkeley Lab, 1998a. *Request for No Further Action (NFA) or No Further Investigation (NFI) Status for Selected Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs).* Environmental Restoration Program, Lawrence Berkeley Laboratory, Berkeley, California. July 1998.

Berkeley Lab, 1998b. *Responses to DTSC Comments dated September 29, 1998 Regarding the Two Units Not Approved for NFA or NFI Status in Requests Made by Berkeley Lab Dated July 1998.* Lawrence Berkeley National Laboratory Environmental Restoration Program. Telecopy from Iraj Javandel (LBNL) to Bernie Edrada (DTSC). September 29, 1998.

Berkeley Lab, 1999a. *Request for No Further Investigation (NFI) Status, Former Cooling Towers Southeast of Building 51 (AOC 9-11).* Environmental Restoration Program, Lawrence Berkeley Laboratory, Berkeley, California. April 20, 1999.

Berkeley Lab, 1999b. *Lawrence Berkeley National Laboratory Environmental Restoration Program Response to Department of Toxic Substances Control Comments on NFI Status Request for Area of Concern 9-11 Dated May 5, 1999.* Letter from Iraj Javandel (LBNL) to Tony Natera (DTSC), June 4, 1999.

Berkeley Lab, 1999c. *Request for No Further Investigation (NFI) Status for Former Cooling Towers Southeast of Building 51 (AOC 9-11).* Environmental Restoration Program, Lawrence Berkeley Laboratory, Berkeley, California. September 8, 1999.

Berkeley Lab, 2000. *Workplan for Further Investigation of Contamination at Former Cooling Towers Southeast of Building 51 (AOC 9-11).* Environmental Restoration Program, Lawrence Berkeley Laboratory, Berkeley, California. January 2000.

DTSC, 1998. *Approval for No Further Action and No Further Investigation Status for SWMUs and AOCs, Lawrence Berkeley National Laboratory, Berkeley, California, EPA ID No. CA4 890 008 986.* Letter from Bernie Edrada (DTSC) to Iraj Javandel (LBNL), September 30, 1998.

DTSC, 1999a. *Comments on NFI Status Request for Area of Concern 9-11 at Lawrence Berkeley National Laboratory, Berkeley, CA, EPA ID No. CA 4890 008 986.* Letter from Tony Natera (DTSC) to Iraj Javandel (RWQCB). May 5, 1999.

DTSC, 1999b. *Comments on NFI Status Request for Area of Concern 9-11 at Lawrence Berkeley National Laboratory, Berkeley, CA, EPA ID No. CA 4890 008 986.* Letter from Tony Natera (DTSC) to Iraj Javandel (LBNL), September 22, 1999.

USEPA, 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* Interim Final Guidance, United States Environmental Protection Agency. Publication number PB89-151047. February 1989.

USEPA, 1999. *Region 9 Preliminary Remediation Goals (PRGs) 1999.* USEPA Region IX.

LIST OF FIGURES

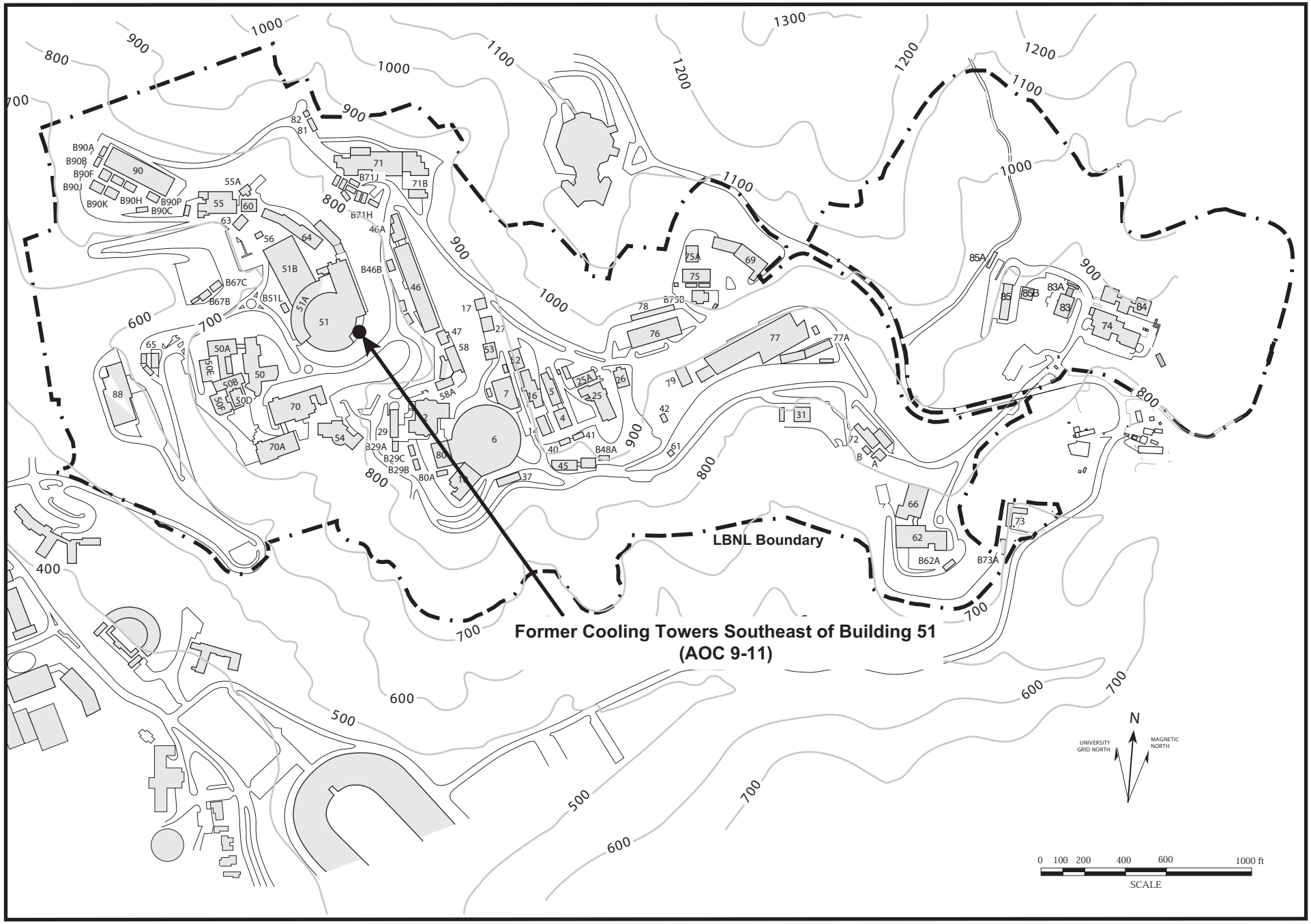


Figure 1. Map of Lawrence Berkeley National Laboratory and Location of Former Cooling Towers Southeast of Building 51 (AOC 9-11).

1-LocMap.ai
10/99

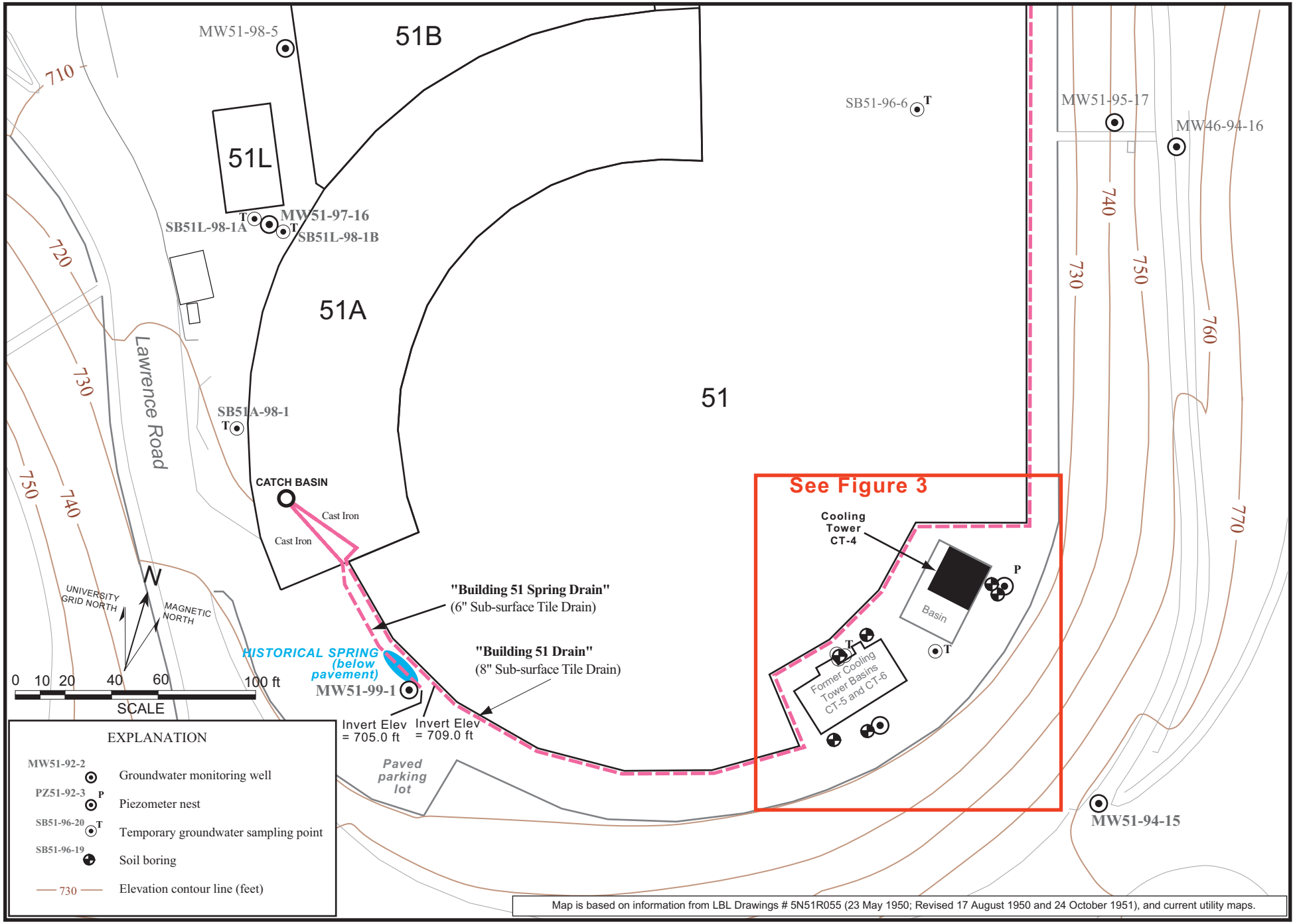


Figure 2. Map of the Southern Portion of the Building 51 Area.

2-B51.ai
3/00

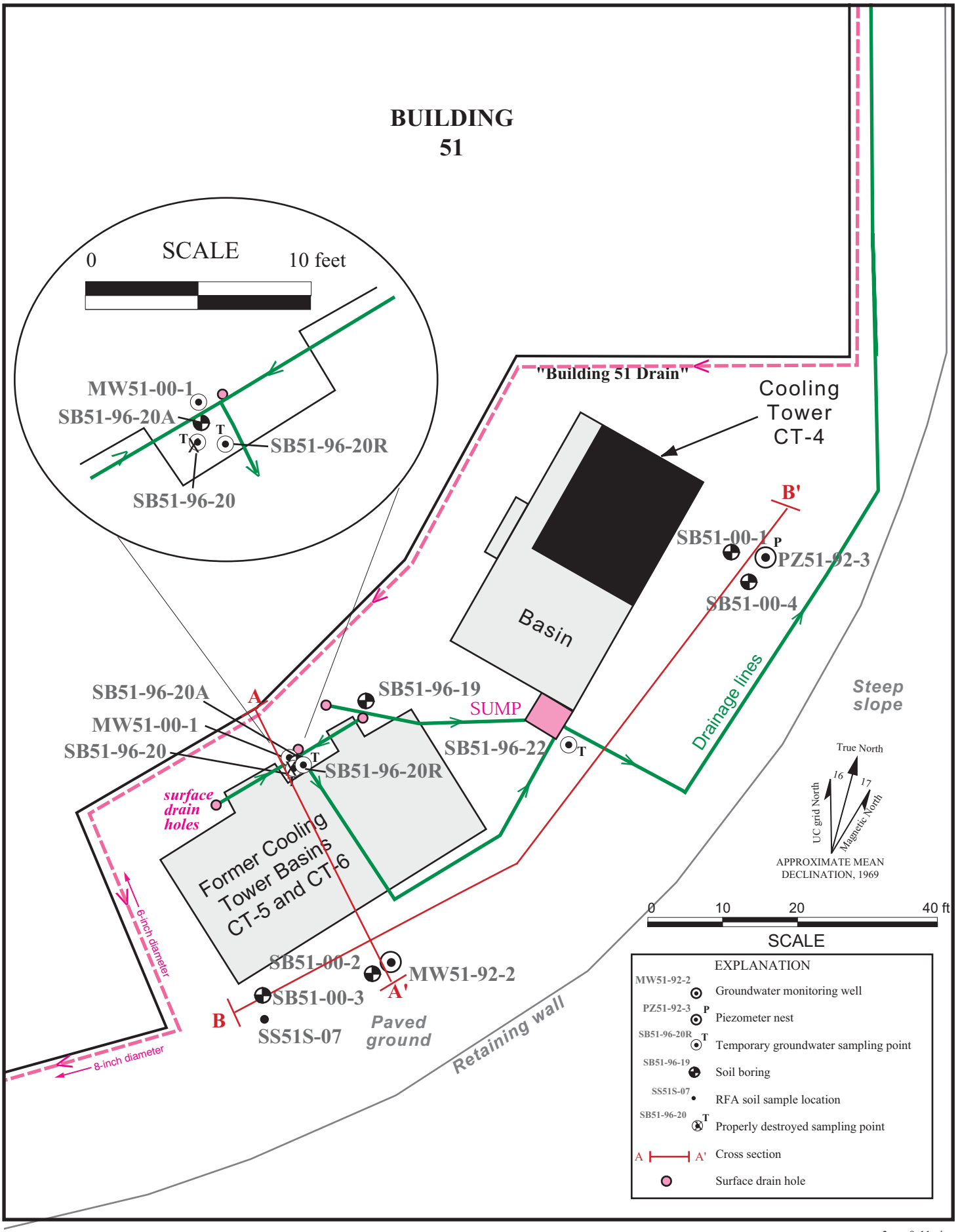


Figure 3. Site Map, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

3-aoc9-11.ai
2/00

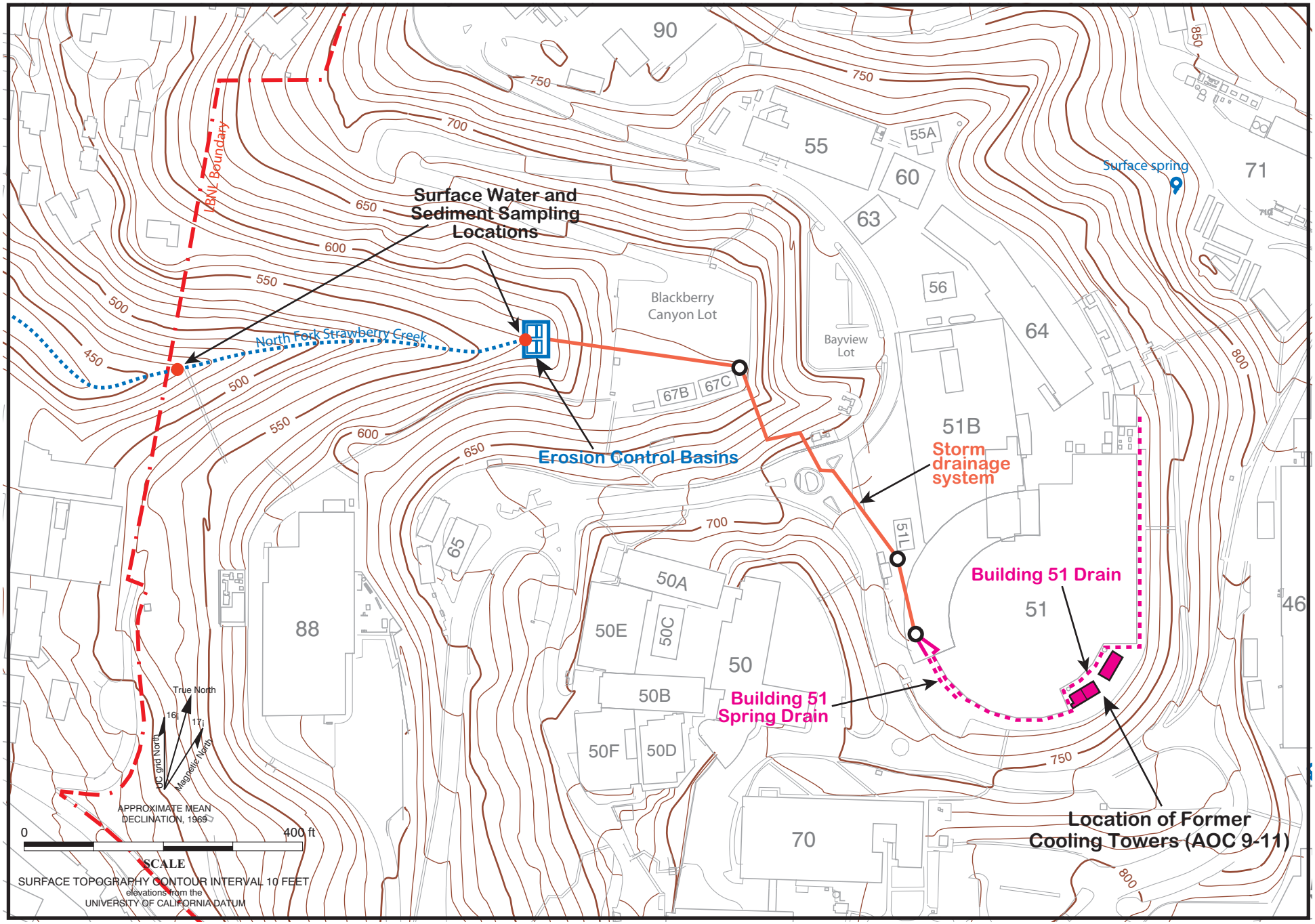


Figure 4. Potential Migration Pathway of Contamination to Surface Water from Former Cooling Towers Southeast of Building 51 (AOC 9-11) .

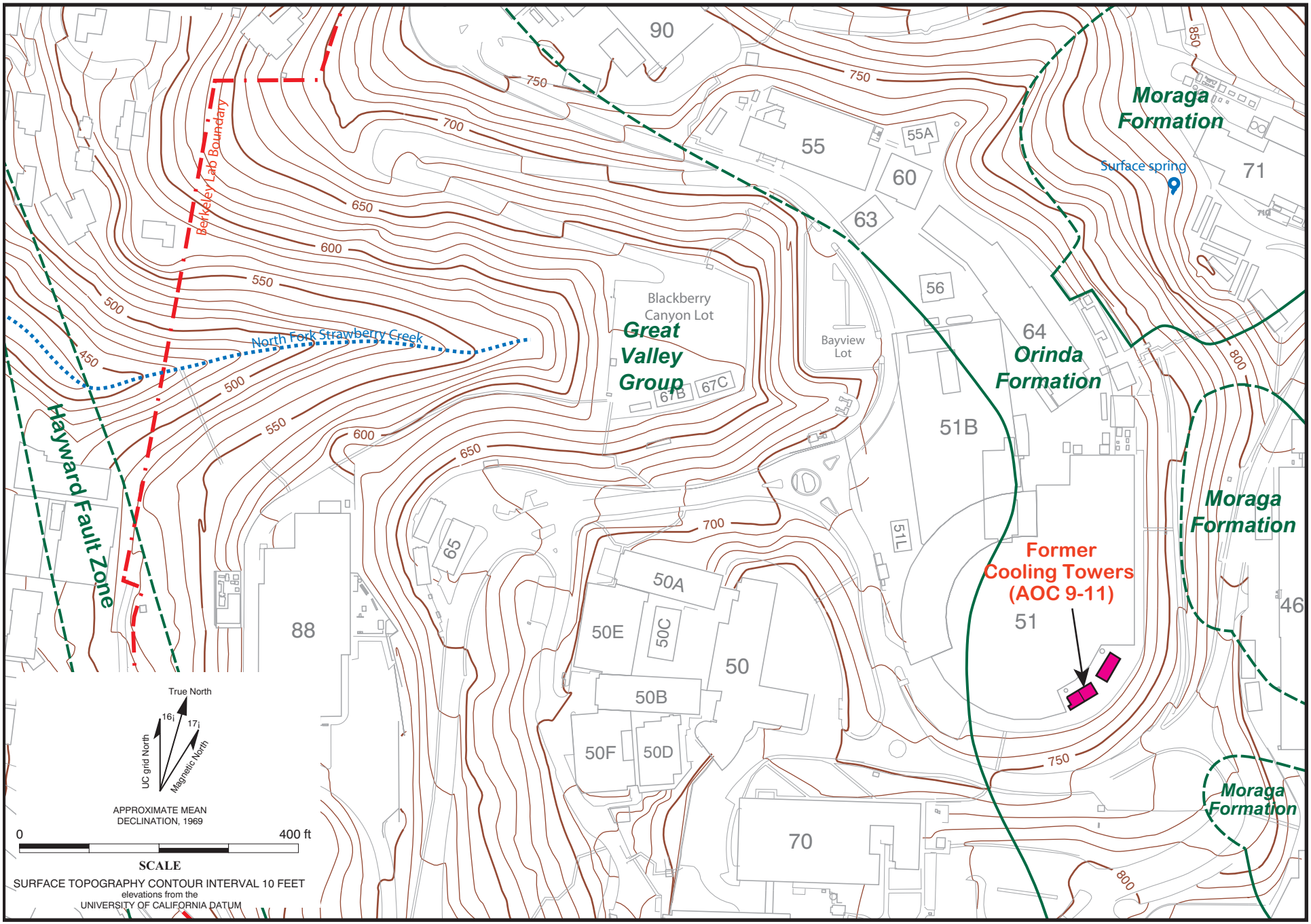


Figure 5. Bedrock Geology Map in the Vicinity of the Former Cooling Towers Southeast of Building 51 (AOC 9-11).

5-AOC9-11geol.ai
3/2000

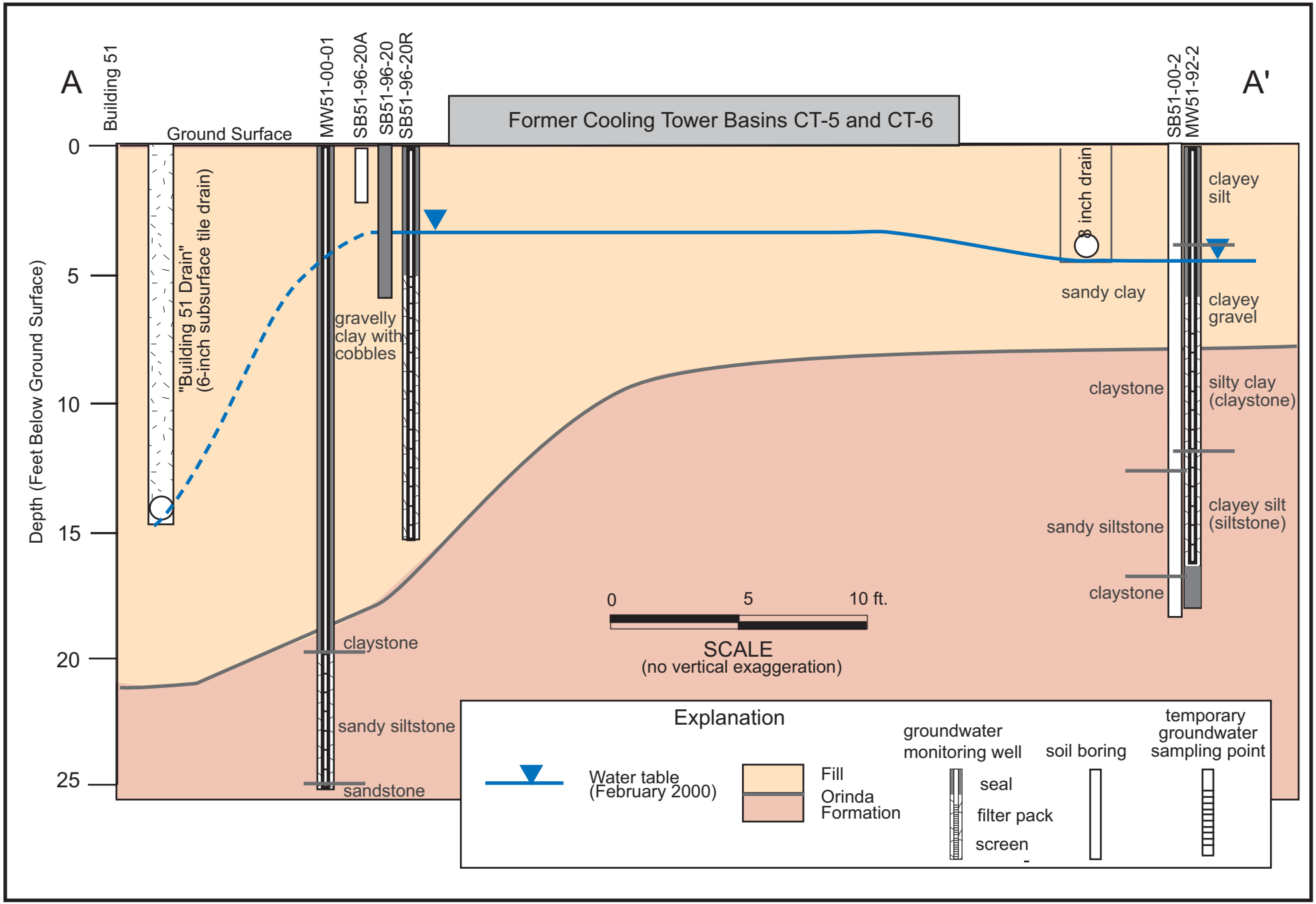


Figure 6. **Cross Section A-A' Showing Geology, Former Cooling Towers Southeast of Building 51 (AOC 9-11).**

7-XsecAA.ai
10/99

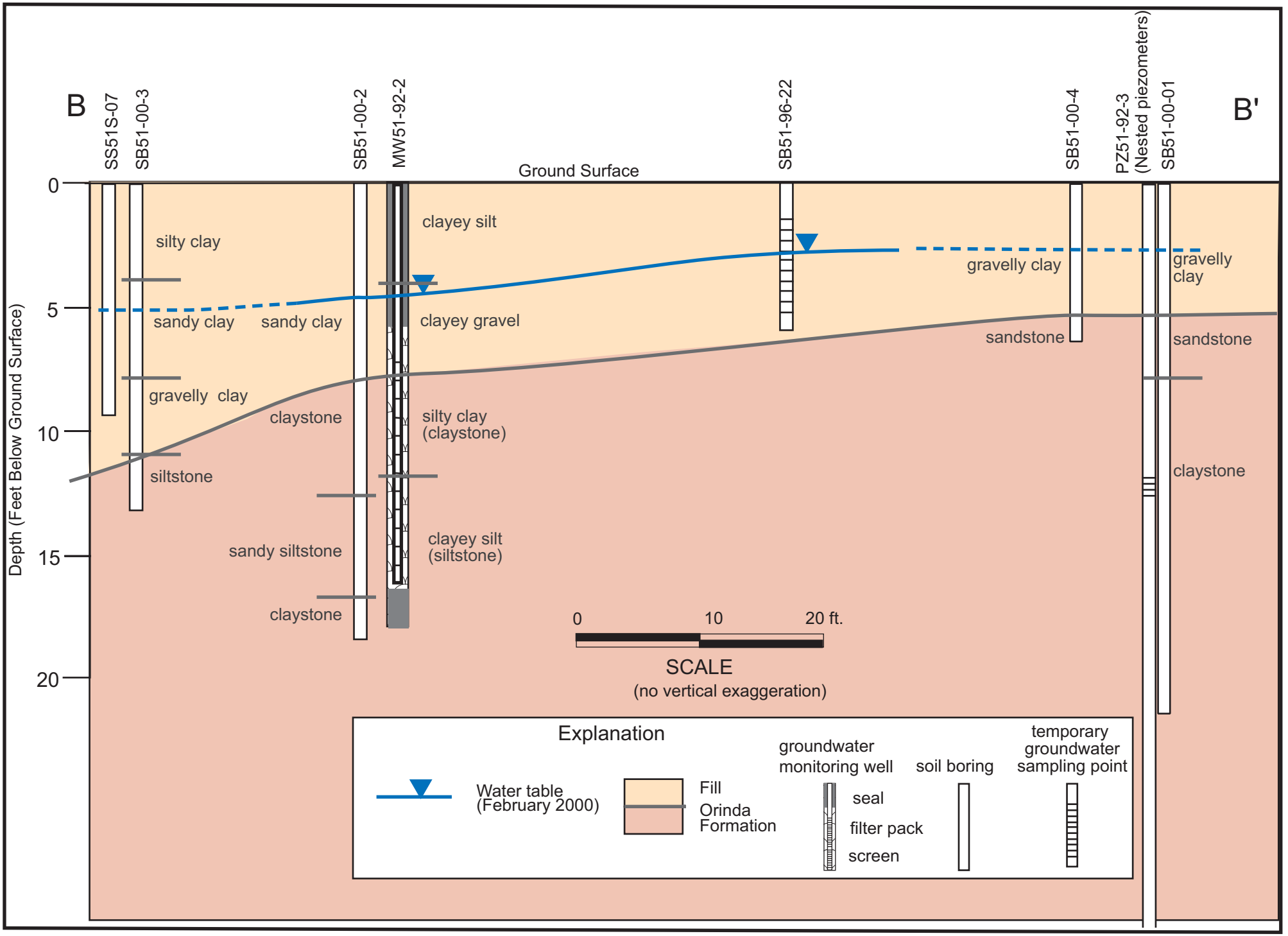
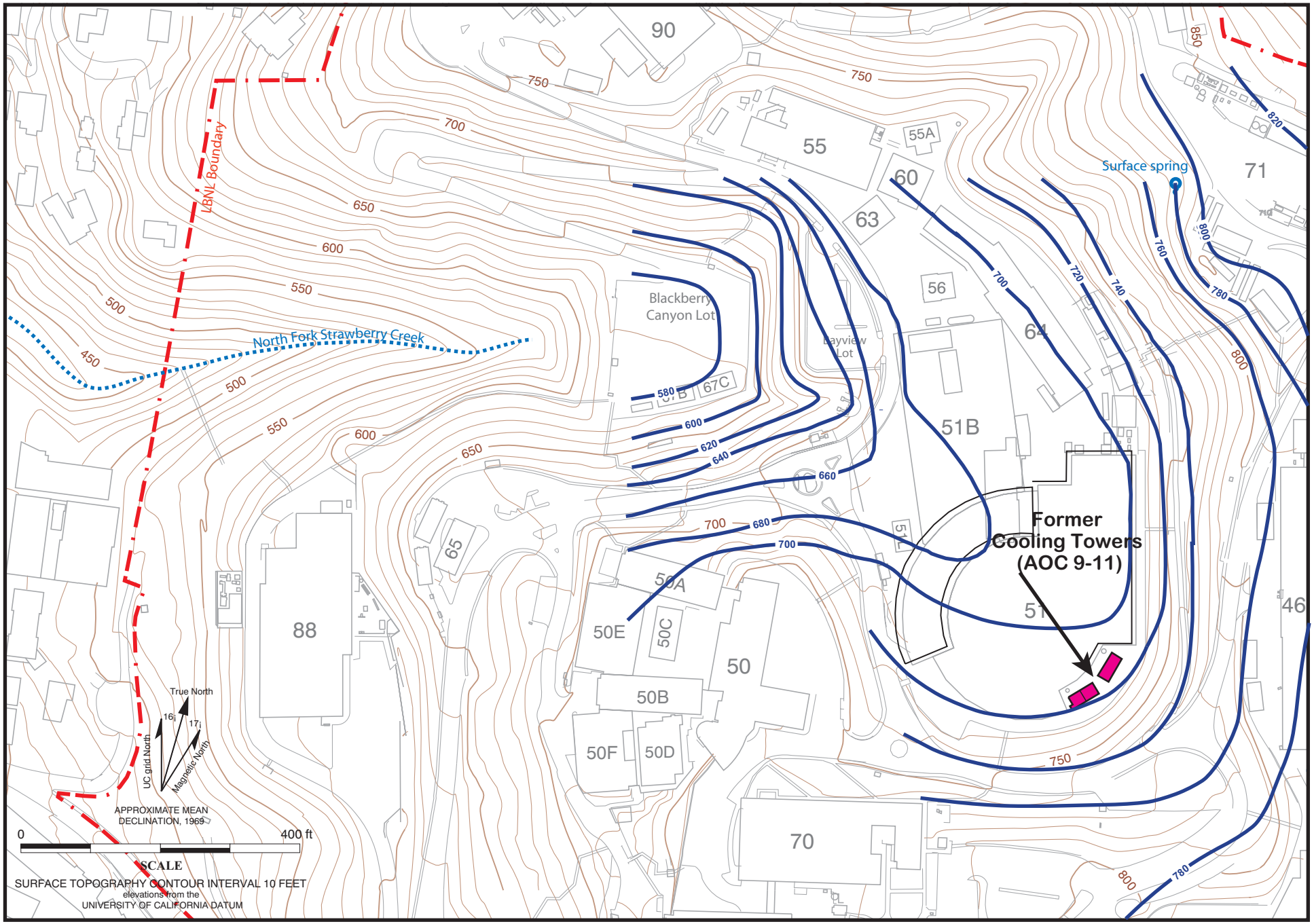


Figure 7. Cross Section B-B' Showing Geology, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

7-XseB-B.ai
2/00



8-WLMap.ai
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Figure 8. Water Level Elevation Map (4th Quarter Fiscal Year 1999), Former Cooling Towers Southeast of Building 51 (AOC 9-11).

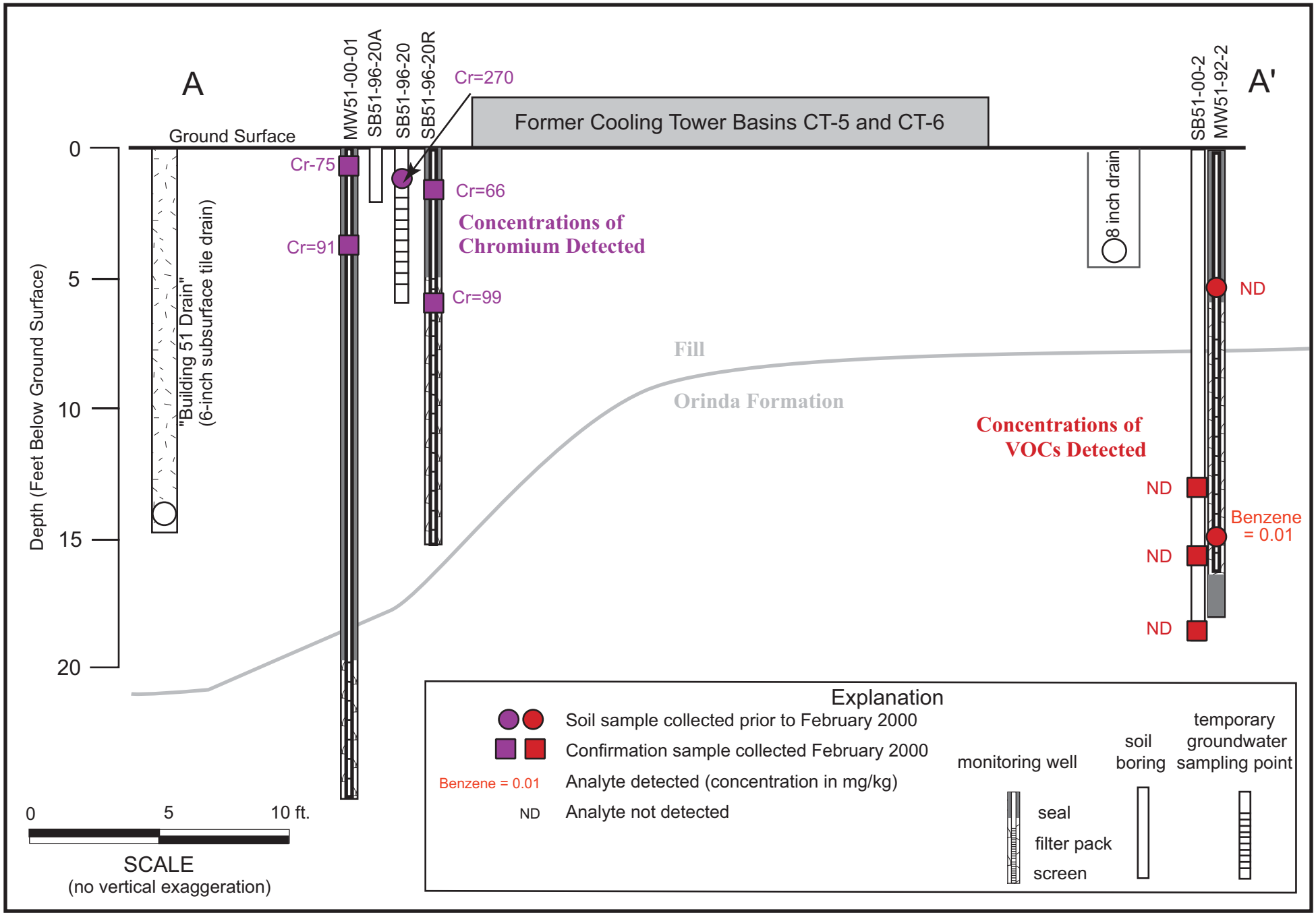

Figure 9. Cross Section A-A' Showing Soil Sampling Results, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

9-XsecAA.ai
2/00

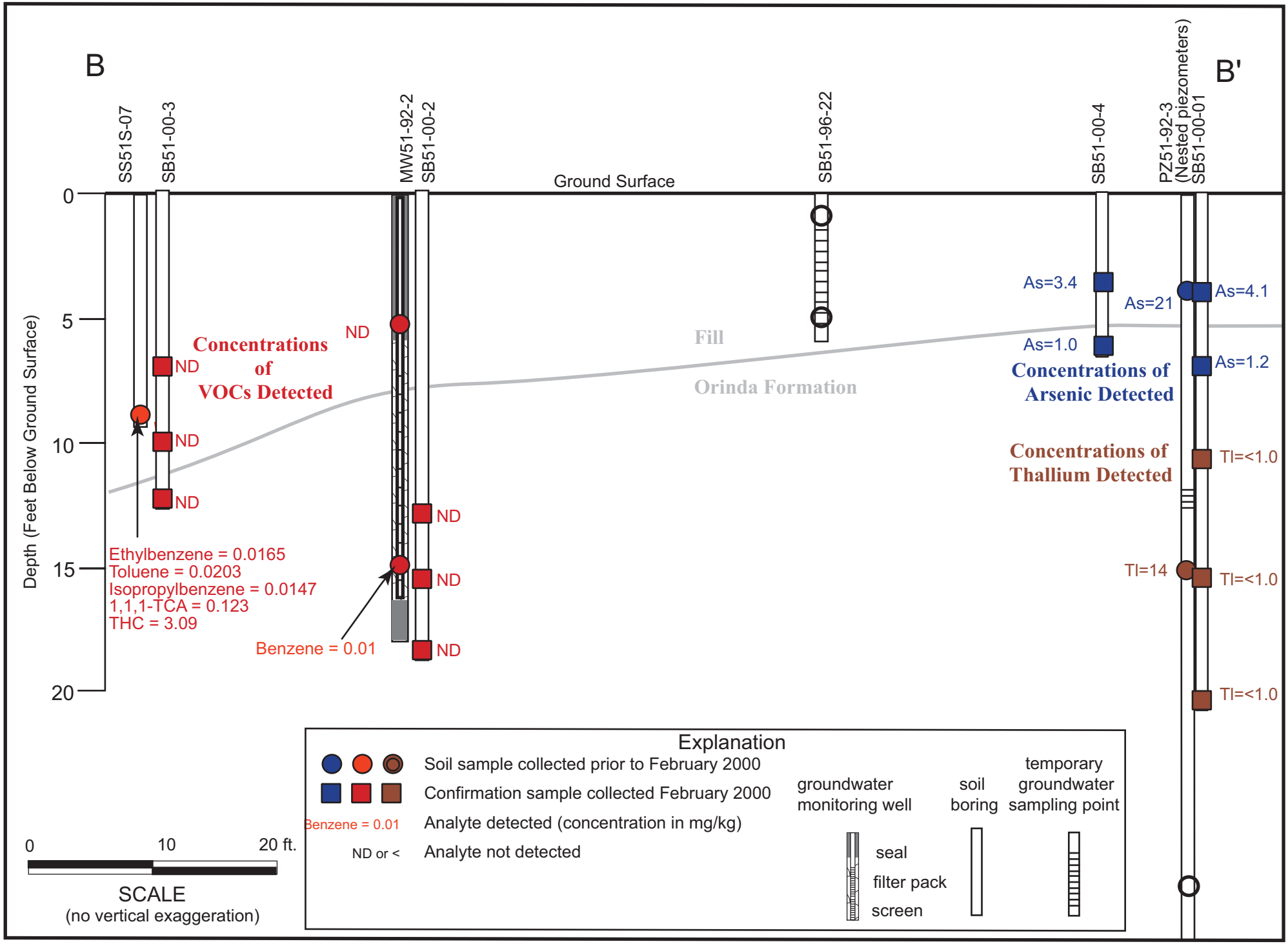

Figure 10. Cross Section B-B' Showing Soil Sampling Results, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

10-XseB-B.ai
2/00

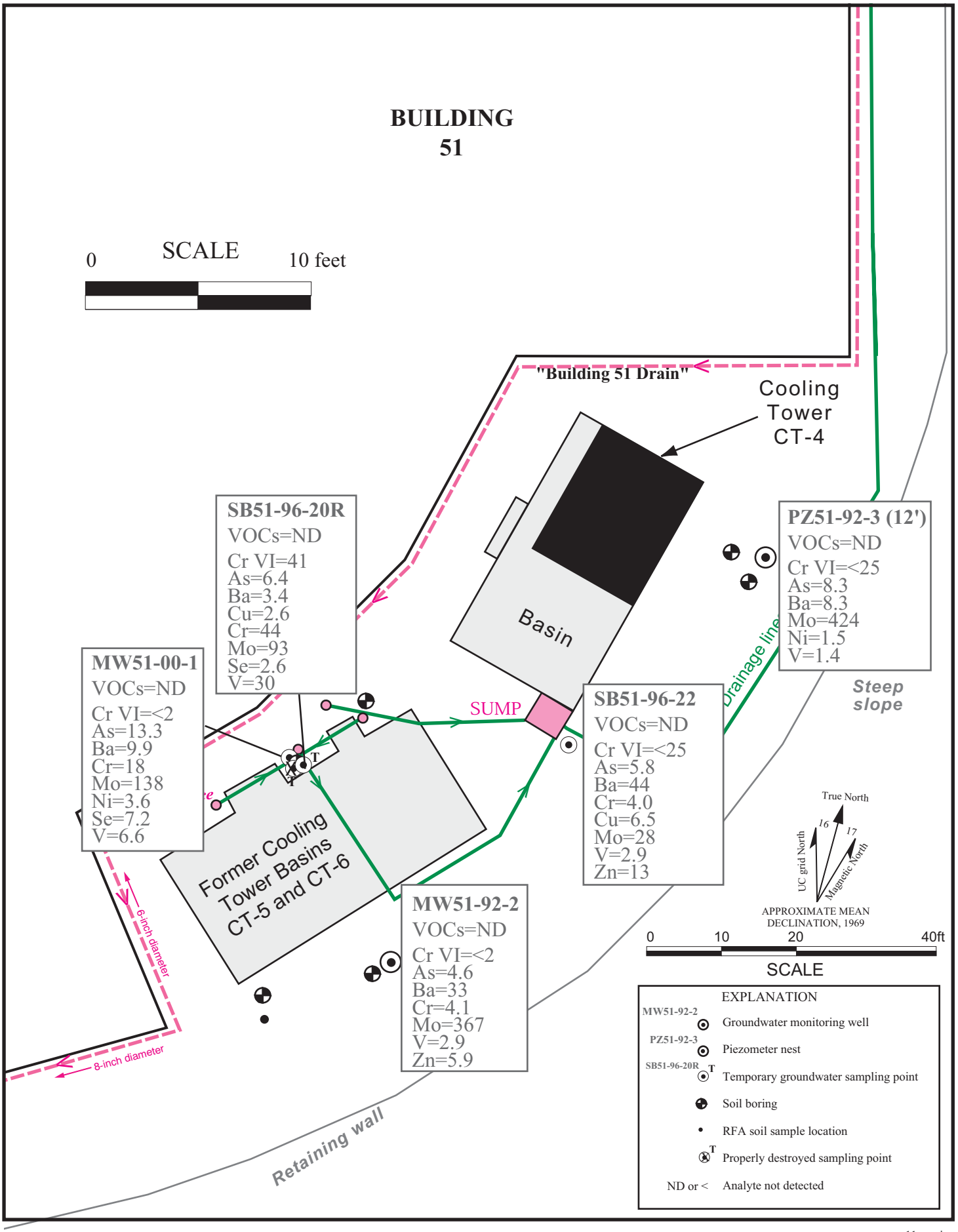

Figure 11. Concentrations of Analytes Detected in Groundwater (µg/L) February 2000, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

11gw.ai
3/00

LIST OF TABLES

Table 1
Soil Sampling Results for Organics and pH
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

		Analyte		VOCs		SVOCs	Total Hydrocarbons	pH
		Method		8240	8260	8270		9040
Boring/Sample	Depth (feet bgs)	Date	Lab	mg/kg	mg/kg	mg/kg	mg/kg	S.U.
SS-51S-07	9	Aug-91	H	Ethylbenzene = 0.0165 Toluene = 0.0203 Isopropylbenzene = 0.0147 1,1,1-TCA = 0.123			3.09	
MW51-92-2	5	Mar-92	Q	ND		ND		
	15			Benzene = 0.01				
PZ51-92-3	4	Mar-92	Q	ND		ND		
	15			ND				
	28			ND				
	38			ND				
	49			ND				
	61			ND				
SB51-96-19	1	Apr-96	CLS		ND			9.00
	3				ND			8.53
	5				ND			8.18
SB51-96-20	1	Apr-96	CLS		ND			8.69
SB51-96-22	0.8	Apr-96	CLS		ND			8.75
	5				ND			8.89
SB51-00-2	12.4	Feb-00	BC		ND			
	15				ND			
	18				ND			
SB51-00-3	6.3	Feb-00	BC		ND			
	9.4				ND			
	12				ND			

BC = Analysis by BC Laboratories
CLS - Analysis by California Laboratory Services
H - Analysis by Hydro Geo Chem
Q - Analysis by Quanteq Laboratories

ND = Not Detected
= Not Analyzed

Table 2
Soil Sampling Results for Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

			Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		Metal																		
		LBNL Estimated Background Level	5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	7.6	74.3	106.1
		USEPA Region 9 PRGs	30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
		California Modified PRGs					9		0.2			130			150					
Boring/Sample	**Depth (feet bgs)**	**Date**	*All results given are in mg/kg*																	
MW51-92-2	5	Mar-92	<2	9.0	93	0.6	0.4	71		18	20	10	<0.2	<0.6	49	<2	<0.2	<3	61	54
	15		<2	9.0	330	0.8	0.2	89		14	33	12	<0.2	0.6	110	<2	<0.2	<3	44	67
PZ51-92-3	4	Mar-92	<2	**21**	110	0.7	0.3	77		16	22	10	<0.2	<0.6	81	<2	<0.2	<3	65	46
	15		<2	9.0	280	0.9	0.4	110		23	34	17	<0.2	1.1	120	<2	<0.2	**14**	56	87
	28		<2	14	300	0.9	0.5	100		13	32	14	<0.2	1.6	110	<2	<0.2	6.0	62	85
	38		<2	6.0	240	1.0	0.2	39		10	60	14	<0.2	1.4	40	<2	<0.2	<3	51	76
	49		<2	6.0	260	0.9	<0.2	35		11	22	14	<0.2	1.2	34	<4	<0.2	<3	33	56
	61		<2	14	280	0.7	0.2	34		14	26	13	<0.2	<0.6	54	2.0	0.4	<3	36	71
SB51-96-19	1	Apr-96	<5	11	130	0.39	1.6	64		14	18	12	0.061	<2.5	59	0.3	<1	<4	51	51
	3		<5	3.1	160	0.39	1.8	70		13	21	15	<0.05	<2.5	68	<0.5	<1	<4	58	54
	5		<5	3.9	160	0.36	1.6	76		18	18	12	<0.05	<2.5	74	0.5	<1	<4	63	48
SB51-96-20	1	Apr-96	<5	4.8	150	0.38	1.6	**270**		12	22	16	<0.05	<2.5	69	<0.5	<1	<4	49	56
SB51-96-20A	1.1	Sep-96							<0.2											
	2.1								<1.0											
SB51-96-22	0.8	Apr-96	<6	3.0	37	0.23	<0.5	49		8.0	25	4.6	0.06	<2.5	32	<0.5	<1	<4	37	46
	5		<6	2.6	35	0.20	<0.5	38		6.2	32	5.9	<0.05	<2.5	27	<0.5	<1	<4	31	58
SB51-96-20R	1.5	Feb-00						66												
	5.4							99												

Table 2 (Cont'd)
Soil Sampling Results for Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

			Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		Metal																		
		LBNL Estimated Background Level	5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	7.6	74.3	106.1
		USEPA Region 9 PRGs	30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
		California Modified PRGs					9		0.2			130			150					
Boring/Sample	**Depth (feet bgs)**	**Date**	*All results given are in mg/kg*																	
MW51-00-1	1	Feb-00						75												
	5							91												
SB51-00-1	3:3	Feb-00		4.1																
	6			1.2																
	10.1																	*<1*		
	15																	*<1*		
	20																	*<1*		
SB51-00-4	3	Feb-00		3.4																
	6			1.0																

	= Not analyzed
<5	= Not detected above quantitation limit
270	= Concentration (shown in boldface font) is above both background and PRG.

Table 3
Groundwater Sampling Results for Organics and Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

			Metals												
Sample Location	**Sample Date**	**VOCs**	**Sb**	**As**	**Ba**	**Cd**	**Cr**	**CrVI**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**V**	**Zn**
		MCL:	**6**	50	1000	5	50	(a)	1000(b)	15(c)	none	100	50	none	5000(b)
SB51-96-20	Apr-96	ND	<50	7.2	21	<10	31		<10	<50	220	<50	<2	<20	<20
	Sep-96							3.0							
	Nov-96							26							
	Nov-96							45							
	Nov-96(S)							93							
	Dec-97							49							
	Dec-97(D)							56							
	Oct-99							<2.0							
SB51-96-20R	Feb-00	ND	<2	6.4	3.4	<2	44.1	41	2.6	<1	92.9	<1	2.6	30.2	<5
SB51-96-22	Apr-96	Chloroform = 2.1 1,1-DCA = 1.0	<50	3.7	<50	<40	<50		<50	<40	125	<50	<1	<50	<20
	Nov-96	ND													
	Dec-97							<10							
	Dec-97(D)							<10							
	Oct-99							<2.0							
	Feb-00	ND	<2	5.8	43.9	<2	4	<25	6.5	<1	27.6	<1	<2	2.9	13.4
MW51-92-2	Dec-92	ND	<2	43	<32.5	<33	3.9		4.7	<31	840	<8	9.3	<6.7	<38.5
	Mar-93	ND													
	Jun-93	ND	<10	50	60	<9	<7		<5.5	<43.5	970	<61	<1	<24.5	<16.5
	Aug-93	ND													
	Oct-93	ND													
	Feb-94	ND	<100	10	20	<10	<10		10	<50	610	<50	<10	<10	20
	Aug-94	All ND*													
	Feb-95	ND													
	May-95		<4	10	<100	<5	<10		<10	<5	350	<50	<2	<50	<10
	Sep-95	ND													
	Feb-96	ND	<50	11.7	<50	<40	<50		<50	<40	386	<50	<1	<50	<20
	Jun-96					<5									
	Aug-96	ND													
	Mar-97	ND													
	May-97		<4	9.0	<50	<5	<5		<5	<5	460	<50	<2	<5	<20
	Aug-97	ND													
	May-98	ND		11							404				
	May-99	ND		14.4							430				
	Jun-99							<2							
	Feb-00	ND	<2	4.6	33.2	<2	4.1	<2	<1	<1	367	<1	<2	2.9	5.9

Table 3 (Cont'd)
Groundwater Sampling Results for Organics and Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

			Metals												
Sample Location	**Sample Date**	**VOCs**	**Sb**	**As**	**Ba**	**Cd**	**Cr**	**CrVI**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**V**	**Zn**
		MCL:	6	50	1000	5	50	(a)	1000(b)	15(c)	none	100	50	none	5000(b)
PZ51-92-3-12 ft	Nov-93	ND													
	Jan-00		<1	8.6	5.9	<1	5.5		<1	<1	360	1.7	<2	4.2	<5
	Feb-00	ND	<2	8.3	8.3	<2	<1	<25	<1	<1	424	1.5	<2	1.4	<5
PZ51-92-3-32 ft	Nov-93	ND	<100	20	<100	<5	30		<10	<5	148	<50	2.6	<50	80
	Jan-00		4.1	6.9	21.7	<1	14.2		6.9	<1	75.5	<1	<2	5.0	<5
PZ51-92-3-42 ft	Nov-93	ND	<100	22	<100	5.7	27		<10	7.4	239	<50	5.2	<50	90
	Jan-00		<1	11.5	12.2	<1	5.6		<1	<1	344	2.3	<2	3.1	5.5
PZ51-92-3-52 ft	Nov-93	ND	<100	19	<100	<5	21		<10	5.2	282	<50	6.6	<50	63
	Jan-00		1.0	12.6	21.4	<1	7.2		1.3	<1	380	2.3	<2	4.2	8.1
PZ51-92-3-62 ft	Nov-93	ND	<100	18	<100	<5	14		<10	10.8	370	<50	<2	<50	61
	Jan-00		<1	22.7	56.1	<1	7.2		<1	<1	489	1.2	<2	3.1	7.5
MW51-00-1	Feb-00	ND	<2	13.3	9.9	<2	18		<1	<1	138	3.6	7.2	6.6	<5
			<4	8.6	<100	<0.2	<10	<2	<10	<5	120	<10	7.1	<10	<10

(S) = split sample
(D) = duplicate sample
ND = not detected above quantitation limit
< = not detected above quantitation limit
[ ] = not analyzed
* = No SVOCs detected (EPA Method 8270) and TPH-D <200 in Aug-94 samples.
(a) = same as for total chromium (50 ug/L)
(b) = secondary MCL
(c) = action level
Metals shown above are those detected in at least one sample at the site.
Metals not detected in any samples: beryllium, cobalt, mercury, silver, and thallium.

Table 4a
North Fork Strawberry Creek Surface Water Sampling Results
VOCs

Location	Date		8260 µg/L
North Fork Strawberry Creek	Feb-93	(L)	ND
	Feb-93 (a)	(L)	ND
	Apr-93	(L)	ND
	Aug-93	(L)	ND
		(L)	ND (D)
	Mar-94	(L)	ND
	Jul-94	(L)	ND
		(BC)	ND (D)
	Jan-95	(BC)	ND
	May-95	(BC)	**1,1,1-TCA=0.95**
		(BC)	**1,1,1-TCA=0.91 (D)**
	Jul-95	(L)	ND
	Jan-96	(L)	ND
	Apr-96 (b)	(L)	ND
	Apr-97	(L)	ND
	Jan-98	(L)	ND
	Apr-98	(L)	ND
	Apr-99	(L)	ND
	Jan-00	(L)	ND

(BC) - Analysis by BC Laboratories
(L) = Analysis by LBNL
(D) = Duplicate sample

ND = Not detected above quantitation limit

(a) = Women's Faculty Club on the U.C. Berkeley campus
(b) = Sample missed holding time for 8260 analysis

Table 4b
North Fork Strawberry Creek Surface Water Sampling Results
Metals
(All Concentrations in µg/L)

			Sb	As	Ba	Be	Cd	Cr	Cr6	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		MCL:	6	50	1000	4	5	50		NS	1000 (a)	15 (b)	2	NS	100	50	100 (a)	2	NS	5000 (a)
LOCATION	**LAB**	**DATE**																		
North Fork Strawberry Creek	(C)	Aug-93	<20	<5	96	<1	<1	<10		<10	<5	<10	<1	15	<20	<10	7	<10	<10	93
			<20	<5	45	<1	<1	<10		<10	<5	<10	<1	<5	<20	<10	<5	<10	40	8
	(BC)	Jul-94	<100	<2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
			<100	2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	(BC)	Jul-95	<4	<2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	(BC)	Jan-96	<4	2.4	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	LBNL	Apr-96	<50	<2	<50	<5	<40	<50		<50	<50	<40	<0.20	<50	<50	<1	<50	<50	<50	<20
	LBNL	Apr-97	<4	<2	104	<4	<5	<5		<5	<5	<5	<0.20	<50	<50	<2	<5	<1	<5	<20
	LBNL	Jan-98	<1	<2	40.2	<1	<1	<5		<5	2.3	<1	<0.10	<5	<5	<2	<1	<1	4.3	8.8
	LBNL	Apr-98	<1	<2	48.7	<1	<1	1.0		<1	1.9	2.9	<0.20	1.4	<1	5.2	<1	<1	5.1	6.9
	LBNL	Apr-99	<1	4.2	76.9	<1	<1	8.6		<1	1.2	<1	<0.25	2.5	<1	4.5	<1	<1	15.9	9.3
	BC	Jul-99							4.2											
	BC	Jul-99							<2											
	LBNL	Jan-00	<1	<2	41.0	<1	<1	2.5		<1	4.6	<1	<0.10	1.6	1.5	<2	<1	<1	5.4	51.6
	BC	Jan-00							<2											

MCL: Maximum contaminant level for drinking water (determined by California DTSC)
(BC) = Analysis by BC Laboratories
(C) = Analysis by Chromalab
LBNL: Analysis by Lawrence Berkeley National Laboratory

(a): secondary MCL
(b): action level
NS: Not Specified

< = Not detected above quantitation limit
= Not analyzed

Table 5a
North Fork Strawberry Creek Sediment Sampling Results
Organics and Fuels

Location	Sample ID	Date	Lab	8240 mg/kg	TPH-Gas mg/kg	TPH-Diesel mg/kg
North Fork Strawberry Creek	SSBC-1/2A-0.4	Apr-93	Q	ND	49*	<0.2
	SSBC-3/4A-0.5			Toluene 0.013	<5*	<0.2

BC = Analysis by BC Laboratories
Q = Analysis by Quanteq
* = Oil detected

ND = Not detected above quantitation limit
< = Not detected above quantitation limit

Table 5b
North Fork Strawberry Creek Sediment Sampling Results
Metals
(Concentrations in mg/kg)

Location	Sample ID	Date	Lab	Sb	As	Ba	Be	Cd	Cr	Cr6	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
North Fork Strawberry Creek	SSBC-1/2A-0.4	Apr-93	Q	<2	3	140	<0.2	0.6	59		8.9	47	180	0.3	0.6	32	<2	3.5	<3	28	160
	SSBC-3/4A-0.5	Apr-93	Q	<2	5	79	<0.2	0.6	45		11	40	53	0.6	<0.6	38	<2	<0.2	<3	35	160
	SS-ERBAS-N-L-1-0	Jan-95	BC											<0.2							
	SS-ERBAS-N-U-1-0													<0.2							
	SS-ERBAS-S-U-1-0													<0.2							
	SS-ERBAS-S-L-1-0													<0.2							
	SS-ERBAS-S-U-2-0	Jul-95	BC	<5	2.6	334	<0.5	<0.5	36		6.8	28	17	<0.2	<2.5	26	<0.5	<1	5.4	31	130
	SS-ERBAS-S-U-3-0			<5	1.9	93	<0.5	0.57	42		6.5	38	73	<0.2	<2.5	29	<0.5	<1	<5	32	259
	SS-ERBAS-S-U-4-0			<5	2.0	52	<0.5	0.5	33		8.0	55	45	0.22	<2.5	27	<0.5	<1	<5	29	182
	SS-ERBAS-S-U-5-0			<5	2.5	47	<0.5	<0.5	79	<1	6.8	216	69	<0.2	<2.5	27	<0.5	<1	<5	32	314
	SS-Nfstraw-96-1A-0	Aug-96	BC	<10	3.5	98	<1	<1	129		7.1	19	17	<0.2	15	105	1.0	<2	<10	37	109
	SS-Nfstraw-96-2A-0			<10	4.7	83	<1	1.2	43		8.7	30	49	<0.2	<5	27	1.6	<2	<10	53	108
	SS-Nfstraw-96-3A-0			<10	9.2	1300	<1	2.5	21		13	44	21	<0.2	<5	181	2.6	<2	<10	48	148
	SS-Nfstraw-96-4A-0			<10	4.1	78	<1	<1	31		6.1	18	20	<0.2	<5	20	1.1	<2	<10	37	115
	SS-Nfstraw-96-5A-0			<10	4.2	81	<1	<1	29		7.3	26	19	<0.2	<5	22	1.0	<2	<10	49	144
North Fork Strawberry Creek Boundary/Fence Line	SS-NFStraw-FL-99-1-0	Jul-99	BC							<0.1											
North Fork Strawberry Creek Erosion Control Basin	SS-NFStraw-BSN-99-1-0									<0.1											

BC = Analysis by BC Laboratories
Q = Analysis by Quanteq

< = Not detected above quantitation limit
= Not analyzed

Table 6
Building 51 Drain Water Sampling Results
Organics and Hexavalent Chromium
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

Sample Location and Date	VOCs	CrVI
Building 51 Drain		
Nov-98	MTBE = 0.83	<2
Dec-98	PCE = 68.4 TCE = 26.9 cis-1,2-DCE = 11.2 1,1-DCA = 2.0	4