1. INTRODUCTION

This report documents February 2003 through January 2004 Self-Monitoring Program (SMP) data for the ground water monitoring at Applied Materials Building 1, 3050 Bowers Avenue, Santa Clara, California (the Site) (Figure 1). This report is submitted by Applied Materials to satisfy the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), Cleanup Requirements Order No. 90-134, Provisions 2.i.5 and 2.i.6. The Site SMP reporting schedule is presented in Table 1.

The primary volatile organic compounds (VOCs) of concern at the Site are 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), and 1,1-dichloroethene (1,1-DCE). Trichloroethene (TCE) has also been detected in Site ground water, primarily in the vicinity of Applied Materials Building 3, but is associated with Hewlett-Packard's tenure (prior to Applied Materials) and is not considered part of the Site plume.

1.1 Project Personnel

The following Weiss Associates (Weiss) personnel worked on this project from February 2003 through January 2004:

Name and Title	Responsibilities
Mary Stallard, Senior Project Geologist	Technical guidance, report quality assurance, and senior review
Joyce Adams, Project Geologist	Project management, report review
Maureen Wan, Staff Geologist	Report writing, data analysis and synthesis, field coordination and data review
Jim Martin, Field Operations/Database Manager	Field coordination, database management
Mick Box, Field Technician	Ground water monitoring and sampling
Chris Redmond, Field Technician	Ground water monitoring and sampling
Craig Adams, Technical Illustrator	Graphics

2. EXTRACTION AND MONITORING WELL DESTRUCTIONS

In 2003, Applied began remodeling activities on the west side of Building 1. The construction activities included removing the existing equipment pad on the west side of Building 1 and constructing a walkway with a curved architectural feature and planter areas (Weiss, 2003a). Several of the extraction and monitoring wells were located within the construction footprint and were likely to be damaged during construction activities. Therefore, Applied recommended to the RWQCB the destruction of these wells (AM1-EP, AM1-1, AM1-2, AM1-9, AM1-10, and AM1-14) prior to construction activities, along with the air stripper (Figure 2) (Weiss, 2003a). Also, the SCVWD required the removal of well AM1-EP because the well was set in a gravel backfilled pit and the original well seal did not meet current standards (MJO Earthscience Services (MJO), 2004). In addition, wells AM1-3 and AM1-5B were recommended for destruction because they were no longer needed to monitor ground water contamination at the Site (Weiss, 2003a). No replacement wells were recommended because the source area at the Site had been remediated and the wells were no longer needed for monitoring or extracting purposes (Weiss, 2003a).

The RWQCB reviewed and approved Applied's request to destroy eight extraction and monitoring wells and to remove the air stripper from the Site (RWQCB, 2003). The air stripper was removed from the Site in late October 2003. Well destructions were performed on December 8, 2003 by Exploration Geoservices, under the supervision of Michael O'Leary of MJO. Exploration Geoservices destroyed six extraction and monitoring wells: AM1-1, AM1-EP, AM1-2, AM1-9, AM1-10, and AM1-14 (MJO, 2004). Wells AM1-3 and AM1-5B will probably be destroyed later this year. AM1-1 and AM1-9 were completed in the A-zone. AM1-10 and AM1-14 were completed in the A2-zone. Well AM1-2 was completed in the B-zone. Prior to well destruction activities, permits were acquired from SCVWD (MJO, 2004).

The following procedures were used during the well destruction in accordance with the SCVWD requirements (MJO, 2004). The original six-inch diameter casing of well AM1-EP was removed after it was destroyed by overdrilling down the entire 16-feet length of the original casing. Since the casing of well AM1-EP was located in a gravel filled pit, the hole collapsed when the casing and augers were removed, and did not require grout. As part of a separate project, SCVWD had agreed that the gravel filled pit would be injected with grout to create a seal in the spring of 2004.

The remaining five wells were closed in place using the following procedures. Immediately prior to destruction, the well was sounded and any obstructions removed to ensure proper filling and sealing the well. The well box and the annular seal to 3-5 ft below finished grade of original ground were then removed. Next, the filter pack, casing, and other significant voids within the well were filled by pressure grouting. Pressure grouting consisted of lowering a hose to the bottom of the well and connecting the other end to a grout pump. The grout (a neat cement) was pumped from the bottom to the top of the well through the hose. Once the grout reached the surface, pressure was applied at 25 psi and held for 5 minutes. The remaining hole was backfilled with cement to the surface.

3. GROUND WATER FLOW

Potentiometric surface maps of the A water-bearing zone for July 10, 2003 and January 14, 2004 are presented as Figures 3 and 4, respectively. Water level elevations recorded in A-zone wells on these dates are presented in Table 2. Hydrographs for four representative A-zone wells (AM1-3, AM1-6, AM1-9, and AM1-11) are depicted in Figure 5. Water levels were approximately the same or slightly lower in A-zone wells in January 2004 as compared to January 2003. Ground water in the A water-bearing zone flows to the northeast.

Water level elevation measurements from A2- and B-zone wells taken in July 10, 2003 are included in Table 2. Based on water levels in A2-zone well AM1-10 and nearby A-zone well AM1-1, there is an upward vertical gradient between the A- and A2-zones. Based on water levels in B-zone well AM1-5B and nearby A-zone well AM1-5E, there is also an upward vertical gradient between the A- and B-zones. No water level elevation measurements were taken from A2- and B-zone wells on January 14, 2004 because the wells (AM1-10, AM1-14, and AM1-2) had been destroyed on December 8, 2003.

4. GROUND WATER ANALYSES

Ground water from 11 onsite and offsite wells was sampled and analyzed for VOCs in January 2004 as part of the Site Pumping Modification Program (PMP), according to the SMP schedule (Table 1). In addition, ground water from extraction well AM1-10 was sampled on July 10, 2003 and analyzed to demonstrate to the RWQCB that VOC concentrations at the Site remained low and the ground water extraction system should remain suspended.

Historical and current chemical data for ground water are presented in Table 3 and in Table A-1 of Appendix A. As requested by the RWQCB, analytic reports for these samples are not presented in this report (RWQCB, 1996). Chain-of-custody records and tables summarizing the quality assurance and quality control (QA/QC) parameters for the Site are included as Appendix B.

Most monitoring wells were sampled using either dedicated bladder pumps or disposable polyethylene bailers. The ground water sample from HP-8 was collected using a disposable Teflon bailer. The sample from extraction well AM1-5E was collected using a submersible pump. Three casing volumes were purged from each well, and pH, temperature, and conductivity measurements were stabilized prior to sampling. The groundwater samples were collected into volatile organic analysis vials (VOAs), stored in a cooler with ice, and delivered to STL San Francisco in Pleasanton, California, under standard chain-of-custody procedures. Samples were analyzed for VOCs using United States Environmental Protection Agency (USEPA) Method 8260B (all wells).

4.1 Analytic Results

During this reporting period, VOC concentrations were within historical ranges in all wells. Isoconcentration maps for 1,1,1-TCA, 1,1-DCA, and 1,1-DCE in the A-zone are presented as Figures 6 through 8. Isoconcentration maps for other compounds are not presented due to relatively insignificant concentrations and distribution. Concentration maps of VOCs in the A2 water-bearing zone are not presented in this report because A2-zone wells were destroyed before the annual sampling event in January 2004. Figures 9 and 10 show 1,1,1-TCA, 1,1-DCA, and 1,1-DCE concentration trends over the last six years for several key Site and 3175 Bowers Avenue wells. Analytic detections in ground water sampled between February 2003 and January 2004 are discussed in detail below.

4.1.1 1,1,1-TCA

During the February 2003 through January 2004 reporting period, no ground water samples contained 1,1,1-TCA exceeding the 200 parts per billion (ppb) California Department of Health Services (DHS) Maximum Contaminant Level (MCL). Ground water from the following A-zone wells had 1,1,1-TCA detections:

- Concentrations of 1,1,1-TCA in Site boundary wells AM1-6, AM1-7, and AM1-5E remained within the historical range for this analyte; and
- Concentrations of 1,1,1-TCA in offsite wells HP-2 and HP-5 were slightly above the minimum detection limit (MDL) of 0.5 ppb.

During this reporting period, no other ground water samples collected from on- or offsite A-zone wells contained 1,1,1-TCA above the MDL of 0.5 ppb.

In A2-zone well AM1-10, 1,1,1-TCA was detected at 0.66 ppb in July 2003, continuing to decline from 4.3 ppb in January 2003 and 14 ppb in July 2002. This well was destroyed on December 8, 2003.

In B-zone well AV-1B at 3175 Bowers Avenue, 1,1,1-TCA was detected at 3.1 ppb, consistent with historical results for this well.

4.1.2 1,1-DCA

During the February 2003 through January 2004 reporting period, most A-zone ground water samples contained less than the 5 ppb MCL for 1,1-DCA. Additionally, no 1,1-DCA concentration was more than 2 ppb above the MCL in the A-zone. Ground water from the following A-zone wells had 1,1-DCA detections:

- Ground water collected from wells AM1-7 and AM1-11 were the only samples from the Site boundary area to slightly exceed the 1,1-DCA MCL of 5 ppb in the A-zone, although concentrations in these wells remained stable compared to historical results; and
- Concentrations of 1,1-DCA in Site boundary wells AM1-5E and AM1-6, and offsite wells AV-1A and HP-2 remained consistent with concentrations detected in January 2003.

During this reporting period, no other ground water samples collected from on- or offsite A-zone wells contained 1,1-DCA above the 0.5 ppb MDL.

Ground water sampled from A2-zone well AM1-10 in July 2003, contained 2.0 ppb 1,1-DCA, down from 8.1 ppb in January 2003 and 13 ppb in July 2002.

Ground water sampled from B-zone well AV-1B at 3175 Bowers Avenue contained 5.4 ppb 1,1-DCA in January 2004, which is consistent with concentrations in January 2003. This detection is slightly above the 5 ppb MCL for 1,1-DCA.

4.1.3 1,1-DCE

During the February 2003 through January 2004 reporting period, most A-zone ground water samples contained less than the 6 ppb MCL for 1,1-DCE, or were non-detect for the analyte. Ground water from the following A-zone wells had 1,1-DCE detections:

- The highest reported concentration of 1,1-DCE in this reporting period was 12 ppb in Site boundary well AM1-11, which is consistent with concentrations in January 2003 and within the historical range for this well;
- Ground water sampled from Site boundary wells AM1-6, and AM1-7 both contained detections higher than the 6 ppb MCL for 1,1-DCE at 6.7 ppb and 9.5 ppb, respectively. The concentrations are within the respective historical range for each well; and
- Offsite well HP-2 contained 2.3 ppb 1,1-DCE, consistent with the general declining concentration trend.

During this reporting period, no other ground water samples collected from on- or offsite A-zone wells contained 1,1-DCE above the 0.5 ppb MDL.

A2-zone well AM1-10 contained 0.63 ppb 1,1-DCE in July 2003 decreasing from 2.2 ppb 1,1-DCE in January 2003 and 6 ppb 1,1-DCE in July 2002. The concentration is within the historical range for AM1-10.

B-zone well AV-1B at 3175 Bowers Avenue contained 2.4 ppb 1,1-DCE, which is within the historical range for AV-1B.

4.1.4 Other VOCs

Other VOCs detected in Site monitoring wells—which include TCE, Freon 11, and Freon 113—remained within the range of respective historical results. The only analyte detected above its MCL (5 ppb) was TCE in wells HP-2, HP-5, and HP-8, ranging from 7.8 ppb to 24 ppb. TCE, predominantly detected near Building 3, is associated with Hewlett-Packard's tenure at the Site prior to Applied Materials, and is not considered part of the Site plume.

4.2 QA/QC Review

The analytic data and accompanying QA/QC information collected for this project are reviewed in detail to ensure the results are accurate and precise. Furthermore, the analytic data for each sampling point are compared with historical records to affirm they are representative. The QA/QC parameters are summarized in Appendix B.

5. PUMPING MODIFICATION PROGRAM

5.1 Background

On March 22, 1996, the RWQCB approved a PMP for the phased shutdown of Site extraction well AM1-5E, while simultaneously increasing the pumping rate of source area extraction well AM1-1. The intent of the pumping modification program was to accelerate both ground water remediation near the source area and subsequent plume attenuation near the downgradient Site boundary. This focused remediation at the source area was expected to reduce the risk of VOCs being drawn across the Site and possibly into the neighboring property at 3175 Bowers Avenue.

On August 27, 1996, the RWQCB verbally approved proceeding to Phase II of the pumping modification program. Phase II entailed the complete shutdown of well AM1-5E and a simultaneous increase of the AM1-1 extraction rate to about 10 gpm.

On June 15, 1999, Applied Materials received approval from the RWQCB for the third phase of the PMP: ceasing to pump ground water from the A water-bearing zone (RWQCB, 1999). The discontinuation of A-zone extraction has demonstrated that a passive management strategy is at least as effective as continuing with previous remedial efforts, which had experienced declining efficiency during the last five years of operation. Extraction well AM1-1 was completely shut down on July 30, 1999, leaving A2-zone extraction well AM1-10 to be the sole contributor of ground water to the treatment system.

On December 19, 2002, Applied Materials received approval from the RWQCB for the present phase of the PMP: suspending all ground water extraction at the Site (RWQCB, 2002). Extraction well AM1-10 had been off since late February 2002, due to equipment problems that were exacerbated by low permeability and yield of the A2 zone. The RWQCB supported its decision by noting that VOC concentrations in both the A and A2 zones are low and gradually decreasing towards meeting cleanup goals, even in the absence of pumping.

5.2 Analytic Results

During all PMP monitoring events, data evaluation and determination of program success involves comparing 1,1-DCA and 1,1-DCE concentrations in downgradient boundary wells to "trigger" concentrations for these compounds established for each of the downgradient wells (Table 4). The respective trigger concentrations for 1,1-DCA and 1,1-DCE in each well represent the 99% upper confidence level for the mean of data collected during the two years prior to Phase I. These trigger concentrations are used as a benchmark in determining the success of the PMP. Per agreement with the RWQCB, ground water extraction activities at the Site may resume if specific VOC concentrations exceed specified trigger levels in the boundary, guard, or offsite wells (Table 4).

Analytic results, MCLs, and established trigger concentrations for 1,1-DCA and 1,1-DCE in wells AM1-5, AM1-5E, AM1-6, AM1-7, AM1-11, AV-1A, AV-1B, and AV-7A are presented in Table 4, and Figures 9 and 10. During this reporting period, VOC concentrations were within historical ranges for all wells, and no trigger concentrations were exceeded (Table 3).

Given the relatively steady concentration trends in Site wells and the downgradient 3175 Bowers Avenue wells, Weiss concludes the Site PMP is successfully containing the plume onsite. The PMP appears to be at least as effective as continuing with previous remedial efforts in reducing or maintaining downgradient 1,1-DCE and 1,1-DCA concentrations.