

Appendix A
Detailed Site Chronology

November 1983	Applied Materials voluntarily investigates their underground tank locations.
November 1983	Extraction Well AM1-1 is installed near the tank area.
April–June 1984	Monitoring wells AM1-2, AM1-3, AM1-4 and AM1-5 are installed.
October 1984	US EPA proposes the AM1 site for the National Priorities List (NPL).
November 1984	Piezometers AM1-P1, AM1-P2 and AM1-P3 are installed adjacent to the underground tanks.
November 1984	Applied Materials initiates ground water extraction from well AM1-1 with granular activated carbon treatment.
January 1985	Monitoring well AM1-5B and extraction well AM1-5E are installed.
January 1985	Applied Materials implements interim remedial measures, including soil excavation, underground tank removal, and construction of an extraction pit and well AM1-EP.
March–July 1985	An air stripper system with connections and pumps at wells AM1-1, AM1-5E, and AM1-EP is installed and tested.
April 1985	Downgradient monitoring wells AM1-6, AM1-7, AM1-8, and AM1-9 are installed.
June 1985	RWQCB adopts Waste Discharge Requirements Order (WDRO) No. 85-70 and NPDES permit NO. CA0028851.
August 1985	Applied Materials initiates a ground water monitoring program with extraction from wells AM1-1, AM1-5E, and AM1-EP.
September 1986	RWQCB adopts WDRO No. 86-71.
July 1987	The AM1 site is added to the final NPL.
February 1988	Applied Materials submits the Remedial Investigation/Feasibility Study (RI/FS) report to regulatory agencies.
December 1988	RWQCB adopts WDRO No. 88-171.
June 1989	US EPA and RWQCB accept the revised RI/FS report.
September 1989	RWQCB issues Site Cleanup Order No. 89-167. The Self-Monitoring Program (SMP) includes tri-annual VOC analysis for ground water from AM1 wells and off-site wells HP-1 and HP-6.
November 1989	Applied Materials submits a Progress report on the Assessment of VOCs in Soil.
January 1990	Applied Materials submits a second Progress report on the Assessment of VOCs in Soil.
March 1990	Extraction Well AM1-10 is installed.

June 1990	RWQCB renews NPDES permit No. CA0028851, and adopts WDRO No. 90-077.
June 1990	Monitoring wells AM1-4 and AM1-8 are sealed and abandoned to provide access for construction of the new Applied Materials Building 3 on the former Hewlett-Packard (HP) site adjacent to the north of AM1. Replacement wells will be installed after the construction. In addition, one of the monitoring wells on the former HP site (well HP-1) is sealed and abandoned.
July 1990	Applied Materials submits Updated Feasibility Study Alternatives Evaluation.
September 1990	RWQCB adopts revised Site Cleanup Order No. 90-134.
September 1990	US EPA and RWQCB approve ROD for ground water remediation.
October 1990	Applied Materials submits Assessment of VOCs in Soil – Phase 2.
January 1991	Applied Materials submits Soil Cleanup Evaluation and Proposal.
1991	SMP is modified to remove off-site well HP-1, which had been sealed and abandoned, and wells HP-2 and HP-5 and the neighboring Avantek site wells AV-1A, AV-1B, and AV-7A are added.
March 1991	Applied Materials submits a Best Management Practices Program (BMPP) for AM1 to the RWQCB in fulfillment of Provision 7 of RWQCB Order No. 90-077 of NPDES Permit No. CA0028851.
February 1991	Monitoring wells AM1-11 and AM1-12 are installed to replace sealed and abandoned wells AM1-4 and AM1-8.
September 1991	Monitoring well AM1-14 is installed to help define the northwestern extent of the A2-zone VOC plume.
December 1991	Applied Materials submits the A2 Water-Bearing Zone Investigation.
March 1992	Pump at extraction pit AM1-EP is shut off and disconnected due to drought-associated low ground water extraction rates.
April 1992	Additional source area soil investigations conducted.
August 1992	Feasibility Study concludes that additional soil investigations have no health or cost benefit.
April 1993	Applied Materials submits VOC Characterization in Vadose Zone.
June 1993	RWQCB adopts Site Cleanup Order No. 93-056.
August 1993	US EPA approves ROD for soil and ground water remediation.
May 1994	Twin-tower air stripper is replaced by shallow-tray air stripper.
June 1994	RWQCB approves reduced self-monitoring and NPDES monitoring and reporting schedule. The amended site cleanup SMP reduces water level measurements from bi-monthly to quarterly, well sampling from tri-annual to

	semi-annual or annual for many wells, and reporting from tri-annual to semi-annual. NPDES reporting and influent sampling are reduced from monthly to quarterly.
July 1994	A revised BMPP Addendum for the Ground Water Extraction System at Building 1 and an updated Hazardous Materials Inventory Statement, which updates the Hazardous Materials Management Plan (HMMP), are submitted to the RWQCB.
September 1994	First Five-Year Status Report and Effectiveness Evaluation submitted to RWQCB.
March 1996	RWQCB approves Pumping Modification Program (PMP) for the phased shutdown of site extraction well AM1-5E, while simultaneously increasing the pumping rate of source area extraction well AM1-1.
April 1996	Phase I of PMP initiated at AM1, including an increase of AM1-1 and reduction of AM1-5E extraction rates.
June 1996	In well AM1-10 the extraction pump malfunctions and can not be removed from the bottom of the well. Therefore, the well is reconstructed by placing a 2-inch diameter casing inside the existing 4-inch diameter casing. The bottom of the 2-inch well is placed slightly above the abandoned pump, approximately 37.5 feet below ground surface.
September 1996	Phase II of PMP initiated at AM1, including complete shutdown of well AM1-5E and a simultaneous increase of the AM1-1 extraction rate to about 10 gallons per minute (gpm). As part of Phase II, the sampling frequency of wells AM1-5, AM1-5E, AM1-6, AM1-7, AV-1A, AV-1B and AV-7A is modified to a monthly frequency for three months.
January 1997	With the approval of the RWQCB, wells AM1-5, AM1-5E, AM1-6, AM1-7, and AV-1B are reduced to bi-monthly sampling, AV-1A is reduced to semi-annual sampling, and AV-7A is reduced to annual sampling beginning January 1997.
September 1997	The RWQCB approves reducing the monitoring frequency for wells AM1-5, AM1-5E, AM1-6, and AM1-7 from bi-monthly to tri-annually, and reducing sampling of AV-1B to semiannually.
February 1998	Shallow-tray air stripper replaced with Carbonair, stainless steel, low-profile air stripper.
June 1999	RWQCB approves reduced self-monitoring and NPDES monitoring schedule, approves discontinuation of ground water extraction from the A water-bearing zone, and approves contingency plan to monitor the effectiveness of A-zone shutdown.
July 1999	Extraction discontinued from well AM1-1, leaving A2-zone well AM1-10 the sole contributor of ground water to the AM1 treatment system.
September 1999	Second Five-Year Status Report and Effectiveness Evaluation submitted to the RWQCB.

1999-2000	The SMP is revised to closely monitor the plume with the approved discontinuation of ground water extraction from the A water-bearing zone. SMP increases monitoring of boundary wells AM1-5E, AM1-6, and AM1-7, and guard well AM1-11 to monthly sampling for three months and then bi-monthly sampling for six months. Well AM1-1 continues to be sampled semi-annually. Sampling of well AM1-10 is reduced from semi-annually to annually. As initiated in September 1999, offsite wells AV-1A and AV-1B are sampled bi-monthly until July 2000, and AV-7A continues to be sampled yearly.
January 2001	As per the agreement with the RWQCB, if adequate remedial effects were maintained for one year after terminating A-zone extraction, reductions in the frequency of SMP sampling would be implemented (RWQCB, 1999). The extraction and treatment program appears to provide hydraulic containment of the plume and is progressing toward cleanup standards in an acceptable manner. Therefore, beginning in January 2001, sampling of all site wells (plus off-site wells AV-1A, AV-1B, and AV-7A) occurs annually, and ground water elevations are measured bi-annually.
January 2001	After RWQCB approval, three piezometers (AM1-P1, AM1-P2, and AM1-P3) and four ground water monitoring wells (HP-4, HP-7, AM1-5, and AM1-12) are destroyed. Wells HP-4 and HP-7 were off-site wells used solely for A-zone bi-annual ground water elevation measurements and were not sampled. Nearby off-site wells HP-2, HP-3, HP-5, and HP-8 provide sufficient data to accurately assess ground water flow in this area, and the data collected from HP-4 and HP-7 are not critical components of ground water flow maps for the site. In 1999, ground water sampling from AM1-5 was discontinued with RWQCB approval, and since then had only been used for bi-annual ground water elevation measurements (RWQCB, 1999). Extraction well AM1-5E is constructed in a nearly identical manner to AM1-5. Considering the proximity of the two wells and the redundancy of their construction, AM1-5 was destroyed. Due to the presence of AM1-5E, the removal of AM1-5 in no way compromises Applied Materials' ability to continue monitoring ground water quality at their downgradient property boundary. To date, the Building 1 plume has been monitored for 17 years, and the downgradient extent of contamination has been clearly defined and documented. Wells AM1-9 and AM1-11 are better situated to provide data on the A-zone plume than well AM1-12, which is located cross-gradient of the A-zone plume, therefore this well was destroyed.
May 2001	Air stripper continues treatment of extracted ground water. However, the discharge has been re-routed from the storm drain system to the sanitary sewer. Therefore, monitoring is now conducted in accordance with criteria specified in the site Sanitary Sewer Discharge Permit instead of in accordance with criteria specified in the site NPDES Permit.
February 2002	Extraction well AM1-10 is shut down due to equipment problems exacerbated by low permeability and yield of the A2 zone, suspending all

	ground water extraction at the AM1 site.
December 2002	RWQCB approves shutdown of the last active extraction well, AM1-10.
November 2003	In 2003, all of the labs in Building 1 were closed, with most of the labs converted into office space. The remodeling of Building 1 included removing the existing equipment pad and air stripper on the west side of the Building 1. Since several of the extraction and monitoring wells were located within the construction footprint, Applied Materials requested that several wells be destroyed. It was proposed that these wells would not be replaced, as they are no longer needed to provide adequate site monitoring. The RWQCB approves destruction of three former extraction wells (AM1-EP, AM1-1 and AM1-10) and five monitoring wells (AM1-2, AM1-9, AM1-3, AM1-14 and AM1-5B), as well as removal of the air stripper and associated equipment pad.
December 2003	Three former extraction wells (AM1-EP, AM1-1 and AM1-10) and three ground water monitoring wells (AM1-2, AM1-9 and AM1-14) are destroyed. Although permission was granted to destroy AM1-3 and AM1-5B, Applied opted not to destroy these wells during this time.
March 2004	The extraction pit surrounding the destroyed well (AM1-EP) is filled with grout. Because VOC concentrations at the neighboring Building 3 site are low, stable, and generally declining, Applied Materials proposed destroying off-site wells HP-3, HP-5, HP-6 and HP-8 in Ground Water Monitoring Annual Report, November 2002 – October 2003 (Weiss 2004a). Applied Materials proposed to retain well HP-2, which exhibits the highest TCE concentrations and is closest to the downgradient AM1 site boundary.
July 2004	Applied has decided to not destroy well AM1-3 but will destroy well AM1-5B in the near future.
September 2004	Applied submits Third Five-Year Status Report and Effectiveness Evaluation to the RWQCB on September 28, 2004. Applied proposes MCL attainment criteria.
December 2004	On December 17, the RWQCB approves further reductions in the SMP requirements for the site based on the very low and generally declining plume concentrations. The revised SMP requires monitoring in only four A-zone wells (AM1-5E, AM1 6, AM1-7 and AM1-11) and in off-site A2-zone well AV-1B. The SMP approved discontinuing monitoring of wells AV-1A and AV-7A, (RWQCB, 2004).
February 2005	On February 8, the RWQCB approves discontinuing monitoring of wells HP-2, HP-5 and HP-6 (RWQCB, 2005). Additionally, Applied Materials has formally requested site closure of the Applied Materials Building 3 area at which monitoring is required by the RWQCB per a 1989 agreement. The Applied Materials Building 3 TCE plume presents no significant risk to human health and the environment. The plume has concentrations of 23 µg/L

	or less, is contained on-site and in the shallowest (“A-Zone”) ground water, and is slowly attenuating over time due to natural processes. Pending RWQCB approval of Building 3 site closure, Applied Materials plans to destroy the five remaining wells in the Building 3 area, including the three HP wells that were until recently part of the Building 1 SMP.
June 2005	Applied Materials receives RWQCB approval for site closure of the Applied Materials Building 3 area and all site closure activities (i.e., monitoring well destructions) are completed. Applied Materials Building 3 monitoring wells HP-5, HP-6, HP-8 and Applied Materials Building 1 well AM1-5B are destroyed on June 23 and 24.
August 2005	US EPA conducts an Evaluation of Ecological Risk for the Five-Year Review of Applied Materials B1. Based on the evaluation, the US EPA concludes that no complete exposure pathways to ecological receptors exist at this site and therefore there is no ecological risk. Consequently, the remedy under five year review is protective of the environment.
October 2005	As part of the Applied Materials Building 3 site closure activities, monitoring wells HP-2 and HP-3 are destroyed on October 25 with permission from the RWQCB.
June 2006	On June 26, Applied Materials and the US EPA meet to discuss statistical evaluation results and Focused Feasibility Study (FFS) contents and how statistical results will be incorporated into that report.
August 2006	RWQCB transfers site back to EPA.
August 2006	Applied Materials submits draft FFS to US EPA on August 8.
September 2006	The RWQCB rescinds Site Cleanup Requirements Order No.980092 for HP site (formerly the Avantek site) at 3175 Bowers Avenue on September 13, 2006. All site wells were destroyed shortly after.
January 2007	Applied Materials receives comments from US EPA on draft FFS on January 16.
February 2007	Applied Materials submits response to US EPA’s comments on the draft FFS to US EPA on February 5. Applied Materials and US EPA meet on February 13 to discuss FFS.
March 2007	Applied Materials submits draft final FFS to US EPA on March 9. The revised FFS addresses both US EPA’s written comments from January 16 and US EPA’s input during the February 13 meeting.
December 2007	Applied Materials receives comments from US EPA on draft final FFS on December 21, 2007.
February 2009	Based on decreases in VOC results for January 2008 and January 2009, Applied Materials resumes correspondence with US EPA regarding moving the site forward to NPL close-out and deletion.
April 2009	On April 27, Applied Materials meets with US EPA to discuss rationale and

	statistics to support the argument that the wells should be grouped together to determine MCL attainment.
October 2009	Applied Materials receives a letter from US EPA on October 23 providing a template for the Fourth Five-Year Review due in 2010. The letter states that a separate letter laying out EPA's proposal on Applied Materials' request for closing out the site will be sent.
January 2010	On January 13, Applied Materials and US EPA Region IX and US EPA Headquarters have a conference call on the Five-Year Review process. There is some discussion of determining MCL attainment but it is not the primary focus.

Appendix B
Documents Reviewed
