

Appendix D
Risk Assessment Memorandum

This technical memorandum presents a human health, toxicology, and ecological risk analysis to support the 5-year review of the Applied Materials Building 1 Superfund Site (AM1 site) in Santa Clara, California.

In an effort to determine whether the remedy at the AM1 site remains protective of human health and the environment, this memorandum discusses changes in site conditions, changes in exposure pathways, and changes in toxicity values since selection of the site remedy.

Site Background

The Applied Materials Building 1 (AM1) Superfund site in Santa Clara, CA is the location of a former semi-conductor wafer manufacturing facility that began operations in 1974. The AM1 site is located in an industrial area that developed rapidly between the 1960s and the 1980s with multiple silicon chips and computer component manufacturing facilities. Currently, AM1 is one of many sites in an area known as the South Bay Site (SBS), where historical industrial activities have resulted in a broad area of solvent- contaminated groundwater. AM1 was converted to offices and educational facilities in 2003, eliminating research and manufacturing activity on-site.

AM1 site characterization and initial remedial activities began in 1983, with final listing on the NPL in 1987. In 1983, AM discovered that underground tank leadkage and/or spills had resulted in the contamination of soil and shallow groundwater with volatile organic compounds (VOCs). The following VOCs were found in shallow groundwater, principally 1,1,1-trichloroethane (1,1,1 TCA) at concentrations up to 12,000 parts per billion (ppb), with lower concentrations of 1,1-dichloroethane (1,1 DCA), 1,1-dichloroethylene (1,1 DCE), and with trace amounts of perchloroethylene (PCE), Freon 113, and other Volatile organic compounds (VOCs).

The groundwater extraction remedy was phased-out starting in 1996 and terminated completely in 2002, due to low recovery of COCs. Three of the four extractions were destroyed in 2003, with the only remaining AM1-5E extraction well being used as a monitoring well. Several monitoring wells were also abandoned between 1990 and 2005, as permitted by the Regional Board.

Identified Exposure Pathways

The AM1 site overlies the Santa Clara Valley ground water basin. Ground water for human consumption is extracted from wells from about 150 to 500 ft deep in the Santa Clara Valley. The nearest drinking water supply well to the AM site is located 3,500 ft upgradient, to the southwest. The AM1 site became a Superfund site primarily because of the past chemical release posed potential threat to the ground water resource.

Under the Regional Board Orders 1989, 1990, and 1993 and the 1990 EPA ROD, Groundwater cleanup objectives are: (a) restore the quality of a polluted water source to its potential suitability as a drinking water supply, (b) prevent exposure to polluted water, and (c) prevent pollution of the deeper aquifers (C zone) which presently supply water for domestic (drinking) and other beneficial uses.

The only exposure pathway considered is the use of contaminated groundwater as a drinking water supply in on- and off-site well locations.

There are no new pathways that need to be addressed.

Toxicity Values

Table D-1 provides the ARARs from the Regional Board Orders 1989, 1990, and 1993 and the 1990 EPA ROD

Table D-1: Cleanup Standards for Groundwater

Chemical	Cleanup Standard (µg/L or ppb)
1,1-Dichloroethane (1,1-DCA) ¹	5
1,2-Dichloroethane (1,2-DCA) ¹	0.5
1,1 -Dichloroethene (1,1 -DCE) ¹	6
cis-1,2 -Dichloroethene (cis-1,2 -DCE)	6
trans-1,2 -Dichloroethene (trans-1,2 -DCE)	10
Tetrachloroethylene (PCE) ¹	5
1,1,1 -Trichloroethane (1,1,1 -TCA)	200
1,1,2 -Trichloroethane (1,1,2 -TCA) ¹	3 ²
Trichloroethene (TCE) ¹	5
Freon 113	1,200
Freon 11	150
Chloroform	6
Vinyl chloride ¹	0.5

Note: ¹ The combined total concentration of all carcinogens shall not exceed 5.0 ppb or µg /l, based upon an aggregate excess cancer risk of 1×10^{-4} through ingestion of drinking water. At the same time, the total HI calculated for non-carcinogens shall not exceed one.

² Initial value was 6 ppb, changed to 3 ppb in 1994.

Final cleanup standards for VOC concentrations shall be determined for each well identified herein and all other onsite wells that may be installed for monitoring or extraction, unless otherwise determined by the Executive Officer:

Table D-2: List of Wells on AM1

Extraction Wells	Monitoring Wells	Piezometers
AM1-1	AM1-2	P-1
AM1-5E	AM1-3	P-2
AM1-EP	AM1-4	P-3
AM1-10	AM1-5 & AM1-5B	
	AM1-6	
	AM1-7	
	AM1-8	
	AM1-9	

These cleanup standards shall also apply to two offsite monitoring wells immediately north of the Building 1 site, identified as HP-1 and HP-6.

Summary of Analysis

There have been no changes in the last 5 years to the AM1 site conditions or to the exposure pathways in consideration of both human health and ecological risk. Although some toxicity values for specific constituents of concern found in soil and groundwater at the site have changed, these changes have not significantly affected the protectiveness of the remediation standards.

A comprehensive risk assessment was done for all the wells, using the last three years of monitoring data collected at each well.

The RAOs require that final cleanup standards for all onsite and offsite wells not to exceed the given cleanup standards in any instantaneous measurement. The note in Table D-1 also stated that the combined total concentration of all carcinogens shall not exceed 5.0 ppb or $\mu\text{g/l}$, based upon an aggregate excess cancer risk of 1×10^{-4} through ingestion of drinking water, and the total HI calculated for non-carcinogens shall not exceed one.

As shown in Table D-3, given that several CoC have MCL at 5 ppb, the combined concentration for all standards with carcinogenic effects is 27 ppb, with a baseline aggregate risk of 1.3×10^{-4} . Table D-3 summarizes the results from the risk assessment for both carcinogenic and non carcinogenic risks for the standards. Aggregate cancer risk include Chloroform, 1,1-DCA, 1,2-DCA, PCE, 1,1,2-TCA, TCE and Vinyl Chloride. Aggregate noncancer risk include 1,1 DCE, cis- and trans-1,2 DCE and 1,1,1 TCA.

Table D-3: Baseline Risk Assessment for Standards

Contaminants of Concern	Standards WB orders/ ROD in ppb	Current (ppb)	Cancer Screening Levels at 10E-6 Target Cancer Risk (ug/l or ppb)	Noncancer Screening Levels at HI = 1 (ug/l or ppb)	Cancer Risk at Standard levels	HI at Standard levels
Acetone	4000	4000		21800		
Chloroform	6	6	0.2		3.11E-05	
1,1-DCA	5	5	2.4		2.07E-06	
1,2-DCA	0.5	0.5	0.1		3.36E-06	
1,1-DCE	6	6		340		1.76E-02
cis-1,2-DCE	6	6		365		1.64E-02
trans-1,2-DCE	10	10		107		9.35E-02
1,2-DCP						
Methylene Chloride						
PCE	5	5	0.1		4.63E-05	
1,1,1-TCA	200	200		9130		2.19E-02
1,1,2-TCA	5	3	0.2		1.24E-05	
TCE	5	5	2.0		2.49E-06	
Vinyl	0.5	0.5	0		3.09E-05	
Freon 113	1200	1200				
Freon 11	150	150				
Aggregate level for cancer risk	27.0 ¹	25.0 ¹	5.1	9942.0	1.3E-04	1.5E-01

Note: ¹ Aggregate sum of Contaminants of concern with cancer risk only

Table D-4 estimates both the cancer and noncancer risks for the aggregate annual average concentration of the last three years of monitoring at all locations where data are available on and around AM1, and compares the results to the standards aggregate concentration and risks. A “Y” in the last column means that the respective concentration and risks are below that of the standard values.

Table D-4: Risk Assessment of most current monitoring data

Well ID	Last 3 years of data	Aggregate Average Concentration for Cancer Risk	Aggregate Cancer Risk	Aggregate HI	Is Aggregate value below Standard?	Is Aggregate Cancer Risk below Standard?	Is Aggregate HI below Standard?
AM1- 1	2001-2003	9.8	7.5E-05	2.0E-02	Y	Y	Y
AM1- 2	2001-2003	3.5	4.4E-05	7.6E-03	Y	Y	Y
AM1- 3	2001-2003	3.5	4.4E-05	7.6E-03	Y	Y	Y
AM1- 4	1988-1990	2.4	2.74E-05	3.9E-03	Y	Y	Y
AM1- 5	1997-1999	12.2	4.74E-05	4.8E-02	Y	Y	Y
AM1- 5B	2001-2003	3.5	4.4E-05	7.6E-03	Y	Y	Y
AM1- 5E	2007-2009	9.3	4.87E-05	2.0E-02	Y	Y	Y
AM1- 6	2007-2009	8.1	4.84E-05	2.2E-02	Y	Y	Y
AM1- 7	2007-2009	7.8	4.8E-05	2.0E-02	Y	Y	Y
AM1- 8	1988-1990	22.4	3.3E-05	9.9E-02	Y	Y	Y
AM1- 9	2001-2003	9.9	4.71E-05	7.6E-03	Y	Y	Y
AM1-10	2001-2003	46.6	8.18E-05	1.9E-02	N	Y	Y
AM1-11	2007-2009	6.2	4.74E-05	1.9E-02	Y	Y	Y
AM1-12	1999-2001	7.6	4.6E-05	7.6E-03	Y	Y	Y
AM1-14	2001-2003	3.5	4.4E-05	7.6E-03	Y	Y	Y
AM1-EP	2001-2003	6.3	4.51E-05	9.6E-03	Y	Y	Y
AV- 1A	2002-2004	5.8	4.49E-05	7.6E-03	Y	Y	Y
AV- 1B	2004-2006	8.3	4.71E-05	1.3E-02	Y	Y	Y
AV- 7A	2002-2004	4.7	4.46E-05	2.2E-02	Y	Y	Y
EFFLUENT	1999-2001	3.4	4.3E-05	7.4E-03	Y	Y	Y
HP- 1	1988-1990	8.7	2.89E-05	3.8E-03	Y	Y	Y
HP- 2	2003-2005	29.6	5.8E-05	1.4E-02	Y	Y	Y
HP- 3	1983-1988	4.7	5.9E-05	1.9E-02	Y	Y	Y
HP- 4	1983-1988	4.7	5.9E-05	1.0E-02	Y	Y	Y

HP- 5	2003-2005	19.1	5.4E-05	7.6E-03	Y	Y	Y
HP- 6	2003-2005	5.1	4.5E-05	7.6E-03	Y	Y	Y
HP- 7	1983-1985	7.0	8.8E-05	1.5E-02	Y	Y	Y
HP- 8	2003-2005	8.5	4.64E-05	7.6E-03	Y	Y	Y
HP- 9B	1988-1990	4.6	4.96E-05	8.3E-03	Y	Y	Y
INFLUENT	1999-2001	162.7	0.000292	1.6E-01	N	N	N
MW-1	2005-2007	6.9	4.72E-05	3.4E-02	Y	Y	Y
MW-2	2005-2007	13.0	4.95E-05	3.6E-02	Y	Y	Y
S.T.A.CREEK	1992-1994	4.3	6.24E-05	7.6E-03	Y	Y	Y
S.T.A.CREEK 1	1997-1998	3.5	4.4E-05	7.6E-03	Y	Y	Y
S.T.A. CREEK 2	1997-1998	3.5	4.4E-05	7.6E-03	Y	Y	Y
Travel Blank	1999-2002	3.5	4.4E-05	7.6E-03	Y	Y	Y

The results in Table D-4 showed that for all the wells listed in Table D-2, both the aggregate cancer and noncancer risks are below those of the aggregate standards.