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Quantitative Risk Assessment of the Fairchild Semiconductor Corporation Superfund Site in San Jose, California

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Overview

1. Hazard Identification
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization
5. Risk Communication
6. Risk Management

1. Hazard Identification

Site History

Fairchild Semiconductor Corp. Timeline

1977 — Fabrication Plant Begins Production

1981 — Fractured Pipeline Discovered

Unknown when this fracture occurred

identified high VOC concentrations in the surrounding groundwater system

1982 — Cleanup Begins

Removal of underground storage tanks, piping, and contaminated soils

Groundwater extraction/treatment

1983 — Fabrication Plant Ceases Operations

2022 — Retail Shopping Center

Solvents containing volatile organic compounds (VOCs):

- 1,1,1-trichloroethane (1,1,1-TCA)
- trichloroethylene (TCE)
- 1-dichloroethylene (1,1-DCE)

Present Concern

- Today: Bernal Plaza (San Jose, CA)
- 1,4-dioxane is present in groundwater inside the slurry wall
- **The Five-Year Review** vapor intrusion evaluation indicated a potential for vapor intrusion in the source area under residential scenario land use
- Potential for VOC exposure among adult and child residents/shoppers via ingestion of tap water and vapor intrusion

Source: *New York Times*

Site Maps

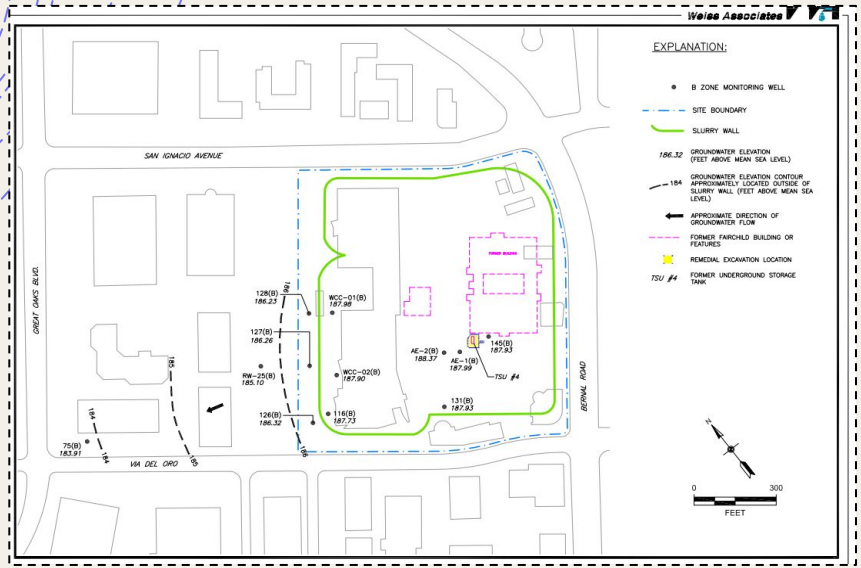


Figure 1: Groundwater elevations for the B Zone, September 10, 2018

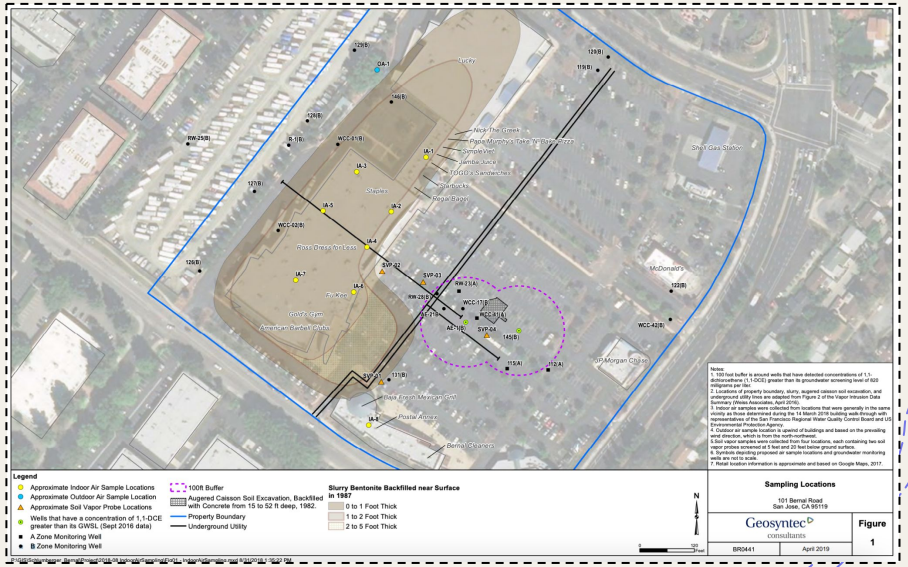


Figure 2. Aerial view of site and monitoring wells

Data Collection

Data Source

+ The data is courtesy of Weiss Associates from the California Regional Water Quality Control Board's memorandum of the 2018 groundwater monitoring report

Sampling Location

+ Groundwater samples were collected from 13 wells (8 inside, 5 outside) located on and around the superfund site
+ Only measurements of the water contained within the slurry wall of the wells obtained from latest sample data (September 10, 2018) were used in our analysis (n = 8)

Data Collection

Sampling Method

- HydraSleeves and a bladder pump were used to sample 8 wells inside the slurry wall
- Pumps lifted water from the well
  - Following pH and electrical conductivity stabilization to within acceptable levels, the sample was collected
- The samples were collected, preserved, and sent to TestAmerica to be examined
  - The samples were tested for VOCs by USEPA Method 8260B and select samples were tested for 1,4-dioxane by USEPA Method 8270

Data Quality

- Laboratory analysis included 5QA/QC samples, matrix spikes (and their duplicates), as well as field/travel blanks and primary sample duplicates to test for replicability/homogeneity of sample collection
- All duplicates were determined comparable to the original samples
- The laboratory data satisfied quality specifications, and thus, the data are usable for their intended purpose

Sample Site Maps

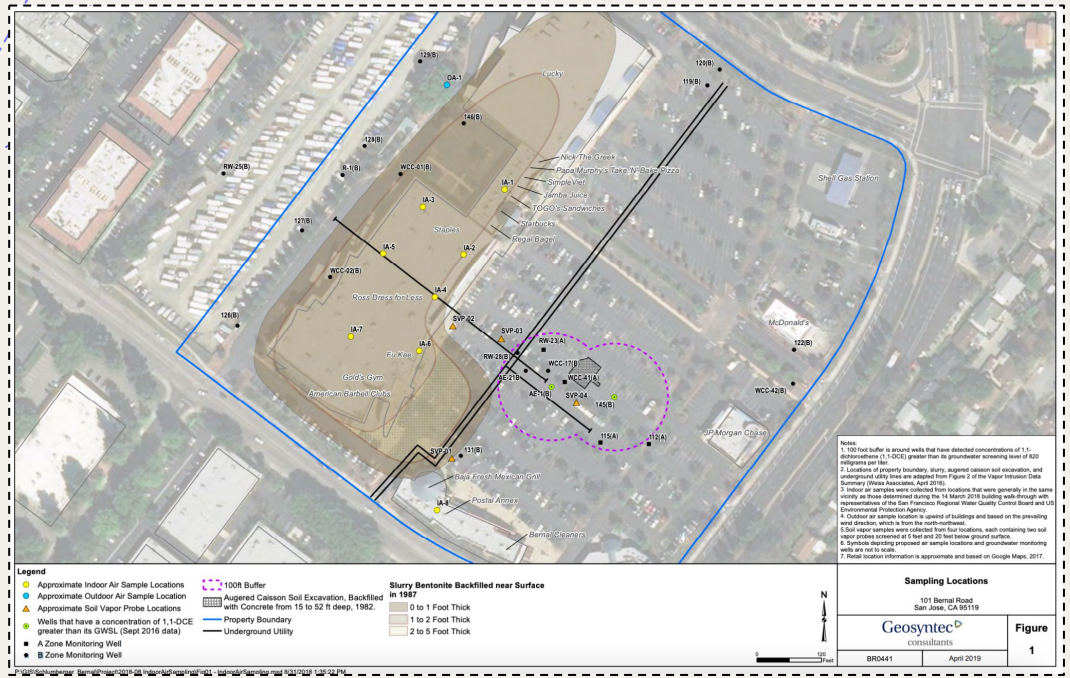


Figure 3. Aerial view of site and monitoring wells

Chemicals of Potential Concern

- Samples were compared to EPA's Regional Screening Level (RSL) - Generic Tables and the Maximum Contaminant Levels (MCLs) for each compound identified
  - Well WCC-41(A) was the only location that presented sampling levels above the EPA MCLs

Chemical	Highest Sample Concentration on 9/10/18 (ug/L)	Tap Water Screening Level (ug/L)
1,1-DCA (Dichloroethane)	1,700	2.8
1,2-DCA (Dichloroethane)	6.1	0.17
1,1-DCE (Dichloroethylene)	5,400	280
cis-1,2-DCE (*cis*-Dichloroethane)	43	36
1,4-Dioxane	1,300	0.46
Isopropanol	< 1,000	410
TCE (Trichlorethylene)	6	0.49
Vinyl Chloride	8.1	0.019

2. Exposure Assessment

Demographics

According to the American Community Survey (2016-2020), within a 1 mile radius of the site (potentially impacted area):

+ Population: ~16,595 people
+ 68% people of color
+ 40% Hispanic ethnicity
+ 45% White, 4% Black, 1% American Indian, and 32% Asian
+ 51% male
+ 75% 18 years of age or older
+ 42% speak another language besides English at home

Hazard Sources and Routes of Exposure

Potential *sources* of exposure:

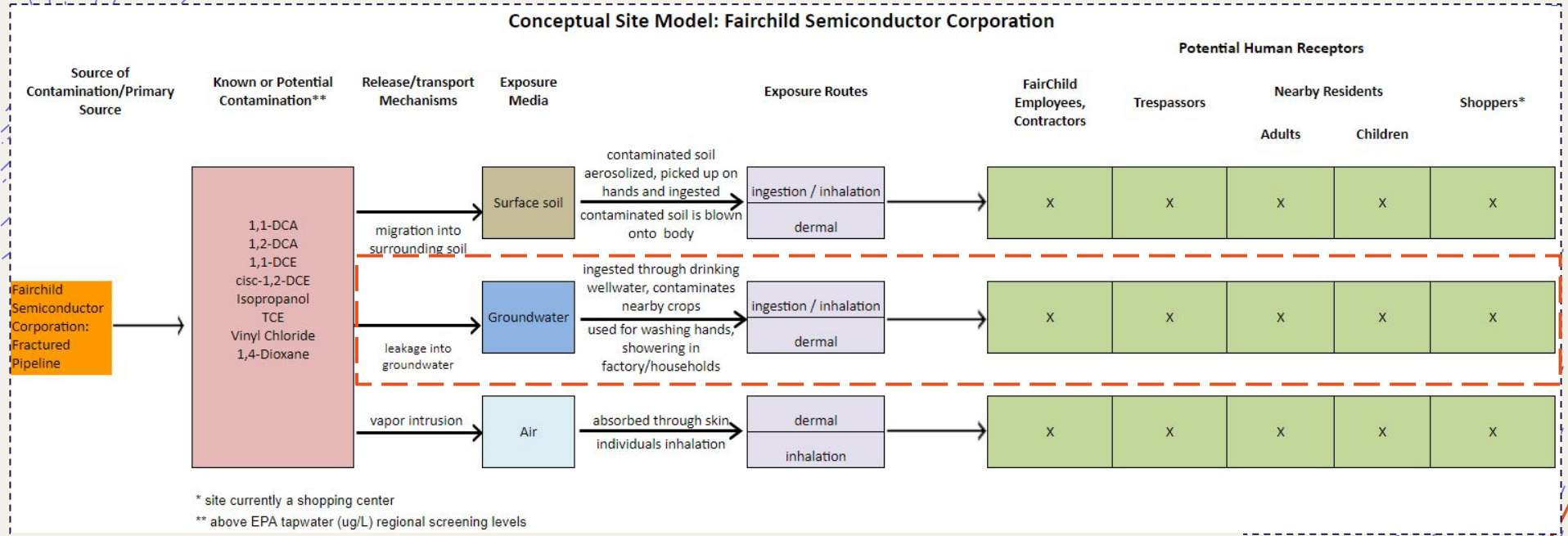
- ★ Fractured pipeline at the facility which released from a waste solvent storage tank
- ★ Other accidental spills from the waste solvent storage tank
- ★ Spills from non-waste solvents and hazardous materials
- ★ Underground storage tank failure

Potential *routes* of exposure:

- ★ Inhalation from VOCs
- ★ Dermal from touching contaminated soils and groundwater
- ★ Ingestion from contaminated groundwater
- ★ Ingestion from agriculture grown with contaminated groundwater

Potentially exposed populations:

- ★ Fairchild Semiconductor employees, contractors, and visitors
- ★ Regulatory officers
- ★ Contaminated site mitigation workers
- ★ Nearby residents
- ★ Consumers of agriculture grown with contaminated groundwater
- ★ Future site usage occupants and current shoppers (i.e. in the shopping center that was built on top of this site after it was decommissioned)



*Although this is a comprehensive CSM, our analysis focused on groundwater exposure

3. Toxicity Assessment

Table 1a. T Summarized Toxicity Assessment for 8 Contaminants of Potential Concern from Fairchild Semiconductor San Jose, CA Plant.

	RfC (mg/m3)	RfD (mg/kg-day)	Critical Effect	Target Organ/System	Carcinogenicity WOE	Source	Yr of Assmt.
1,1-DCA (Dichloroethane)	Data inadequate	Chronic: 2 x 10^-1 Subchronic: 2	Renal injury (chronic and subchronic)	Kidneys/Urinary system (chronic and subchronic)	C (Possible human carcinogen) - from IRIS	PPRTV	2006
1,2-DCA (Dichloroethane)	Not Evaluated	Not Evaluated	Hemangiosarcomas	N/A	B2 (Probable human carcinogen)	IRIS	1987
1,1-DCE (Dichloroethylene)	2 x 10^-1	5 x 10^-2	Liver toxicity (fatty change)	Liver, Kidney, and the Clara cells of the lung	C (Possible human carcinogen)	IRIS	2002
cisc-1,2-DCE (Dichloroethylene)	Not Evaluated	2X10^-3	Urinary	N/A	Inadequate information to assess carcinogenic potential	IRIS	2010
Isopropanol	2 x 10^-1	Chronic: 2 Subchronic: 2	Decreased fetal body weight (chronic and subchronic)	Developmental	Inadequate information to assess carcinogenic potential	PPRTV	2014
TCE (Trichloroethylene)	2X10^-3	5 x 10^-4	Developmental and Immune	Kidney, Liver, and lymphoid tissues	Carcinogenic to humans	IRIS	2011
Vinyl Chloride	1 x 10^-1	3 x 10^-3	Hepatic System	Hepatic System	Known/likely human carcinogen	IRIS	2000
1,4-Dioxane	3 x 10^-2	3 x 10^-2	Hepatic, Nervous, Respiratory, and Urinary Systems	Gastrointestinal, Hepatic, Reproductive, Respiratory, and Urinary Systems	Likely to be carcinogenic to humans	IRIS	2013

Potential Health Effects of Concern

- TCE, Vinyl Chloride, and 1,4- Dioxane chemicals of concern.
  - TCE is carcinogenic to humans (A)
    - Critical Effect: Developmental and Immune
    - TCE can cause irritation of the eyes and skin. With high exposure can cause dizziness, headaches, sleepiness, confusion, nausea, liver damage, or death (CDC,2019)
  - Vinyl Chloride is known/likely carcinogenic to humans (B)
    - Critical Effect: Hepatic System
    - Increased risk of liver cancer, brain and lung cancer, lymphoma, and leukemia (NCI, 2022)
  - 1,4-Dioxane is likely carcinogenic to humans (B)
    - Critical Effet: Hepatic, Nervous, Respiratory, and Urinary System
    - Exposure to high levels can result in kidney and liver damage or death. Low level exposure can result in eye and nose irritation (ATSDR, 2015)

4. Risk Characterization

Table 2. Carcinogenic risk and non-carcinogenic hazard index (HI) for residents exposed to tap water (one significant figure)

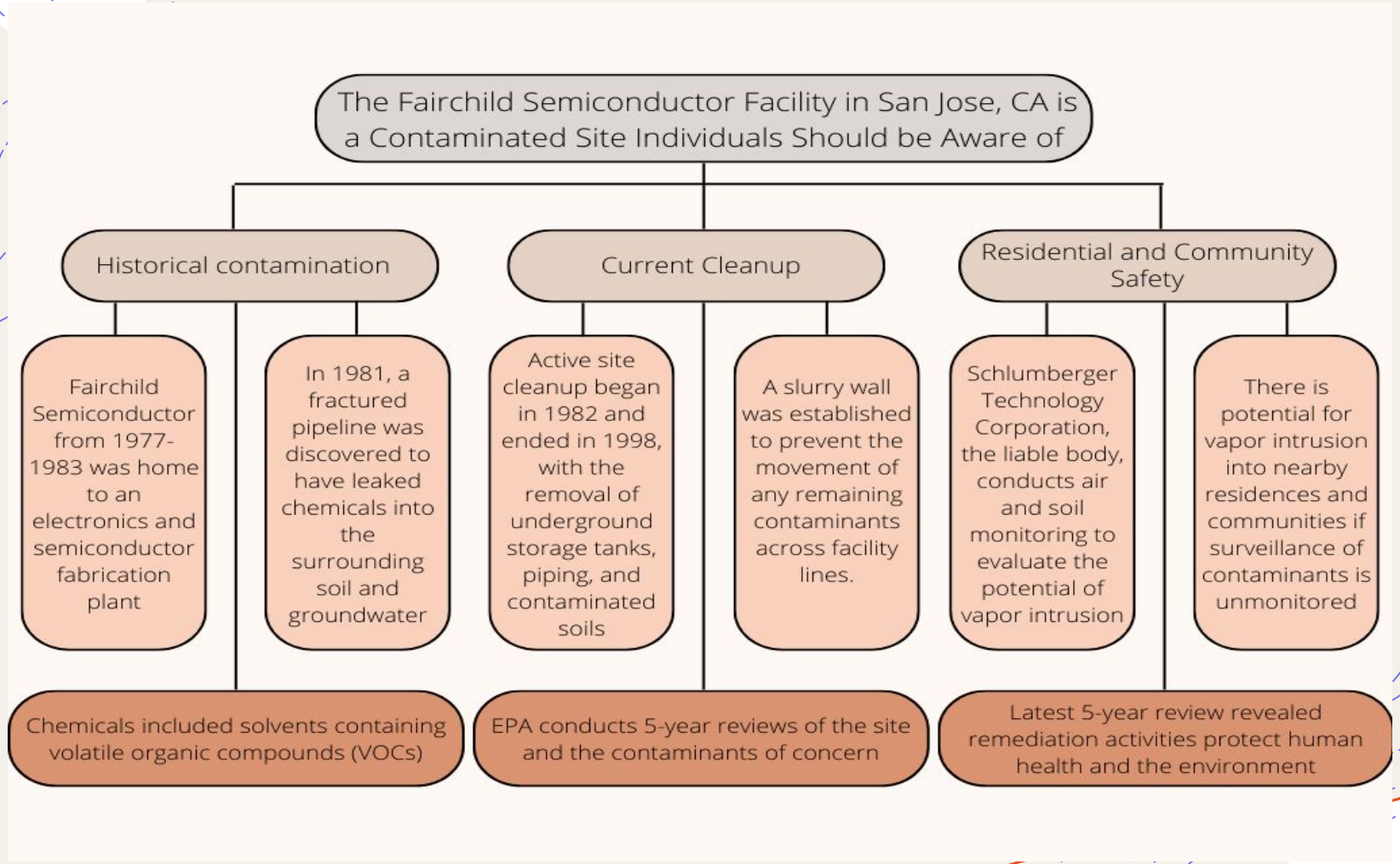
Contaminants of potential concern	Tap Water Concentration (µg/L)	Non-Carcinogenic HI (Child)	Non-Carcinogenic HI (Adult)	Carcinogenic Risk
1,1-DCA	1700	0.5	0.3	6×10^{-4}
1,2-DCA	6.1	0.5	0.5	4×10^{-5}
1,1-DCE	5400	19	17	-
cis-1,2-DCE	43	2	1	-
1,4-Dioxane	1300	23	22	3×10^{-3}
Isopropanol	1000	2	2	-
TCE	6	2	2	1×10^{-5}
Vinyl Chloride	8.1	0.2	2	4×10^{-4}
Total Risk/HI		*49*	*45*	*4×10^{-3}*

DCA, Dichloroethane; DCE, Dichloroethylene; TCE, Trichloroethylene

Limitations and Uncertainties

- Measurement error can occur when sampling and sample processing
- Uncertainties in toxicological data
  - RfC for 1,2-DCA and 1,2-DCE are not evaluated
  - Target system/organ for these chemicals is not assessed
- Risk Characterization
  - Assumed exposure values are residents, workers, and shoppers
  - Biologically effective dose may be different than the direct values measured from the water samples

5. Risk Communication


The Fairchild Semiconductor Facility in San Jose, CA is a Contaminated Site Individuals Should be Aware of
Historical contamination
Current Cleanup
Residential and Community Safety
Fairchild Semiconductor from 1977-1983 was home to an electronics and semiconductor fabrication plant
In 1981, a fractured pipeline was discovered to have leaked chemicals into the surrounding soil and groundwater
Active site cleanup began in 1982 and ended in 1998, with the removal of underground storage tanks, piping, and contaminated soils
A slurry wall was established to prevent the movement of any remaining contaminants across facility lines.
Schlumberger Technology Corporation, the liable body, conducts air and soil monitoring to evaluate the potential of vapor intrusion
There is potential for vapor intrusion into nearby residences and communities if surveillance of contaminants is unmonitored
Chemicals included solvents containing volatile organic compounds (VOCs)
EPA conducts 5-year reviews of the site and the contaminants of concern
Latest 5-year review revealed remediation activities protect human health and the environment

6. Risk Management

Public Health Actions

- Launch an awareness campaign
  - Inform and educate the surrounding population about the risks of exposure and mitigation techniques
  - Hold open forums to provide updates on hazard monitoring and for community members to voice concerns
- Recommend alternative water sources contingent upon contamination levels
- Suggest individuals exercise caution when consuming crops grown with contaminated groundwater
  - Advise vulnerable populations against consumption
- With the EPA, establish a POC (risk management specialist), to handle communications and field community inquiries

Questions?

Thank you!

References

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Table 1a. Toxicity Assessment for 8 Contaminants of Potential Concern from Fairchild Semiconductor San Jose, CA Plant.

	RfC (mg/m3)	RfD (mg/kg-day)	Cancer Slope Factors	Critical Effect	Target Organ/System	POD	UF	Carcinogenicity WOE	Source	Yr of Assmt.
1,1-DCA (Dichloroethane)	Data inadequate	Chronic: 2 x 10^-1 Subchronic: 2	Data inadequate	Renal injury (chronic and subchronic)	Kidneys/Urinary system (chronic and subchronic)	NOAEL: 714.3 mg/kg-day (chronic and subchronic)	Chronic: 3000 Subchronic: 300	C (Possible human carcinogen) - from IRIS	PPRTV	2006
1,2-DCA (Dichloroethane)	Not Evaluated	Not Evaluated	Oral: 9.1 x 10^-2 (mg/kg)/day Inhalation: 2.6 x 10^-5 µg/m3	Hemangiosarcomas	N/A	N/A	N/A	B2 (Probable human carcinogen)	IRIS	1987
1,1-DCE (Dichloroethylene)	2 x 10^-1	5 x 10^-2	N/A	Liver toxicity (fatty change)	Liver, Kidney, and the Clara cells of the lung	RfD: BMDL 10: 4.6 mg/kg-day RfC: BMCL10 (HEC): 6.9 mg/m3	RfD: 100 RfC: 30	C (Possible human carcinogen)	IRIS	2002
cisc-1,2-DCE (Dichloroethylene)	Not Evaluated	2X10^-3	N/A	Urinary	N/A	RfD: BMDL10: 5.1 mg/kg-day	RfD: 3000	Inadequate information to assess carcinogenic potential	IRIS	2010

Table 1b. Toxicity Assessment for 8 Contaminants of Potential Concern from Fairchild Semiconductor San Jose, CA Plant.

	RfC (mg/m3)	RfD (mg/kg-day)	Cancer Slope Factors	Critical Effect	Target Organ/System	POD	UF	Carcinogenicity WOE	Source	Yr of Assmt.
Isopropanol	2 x 10^-1	Chronic: 2 Subchronic: 2	N/A	Decreased fetal body weight (chronic and subchronic)	Developmental	Chronic: LOAEL: 221 mg/m3 Subchronic: NOAEL(HEC): 662.3 mg/m3	Chronic: 1000 Subchronic: 100	Inadequate information to assess carcinogenic potential	PPRTV	2014
TCE (Trichloroethylene)	2X10^-3	5 x 10^-4	Oral: 4.6 x 10^-2 (mg/kg)/day Inhalation: 4.1 x 10^-6 µg/m3	Developmental and Immune	Kidney, Liver, and lymphoid tissues	N/A (Multiple Results)	N/A (Multiple Results)	Carcinogenic to humans	IRIS	2011
Vinyl Chloride	1 x 10^-1	3 x 10^-3	Oral: 7.2 x 10^-2 to 7.5 x 10^-1 mg/kg-day Inhalation: 4.4 x 10^-6 per µg/m3 *continuous lifetime exposure during adulthood	Hepatic System	Hepatic System	RfC: NOAEL (HEC): 2.5 mg/m3 RfD: NOAEL (HED): 9 x 10^-2 mg/kg-day	RfD: 30 RfC: 30	Known/likely human carcinogen	IRIS	2000
1,4-Dioxane	3 x 10^-2	3 x 10^-2	Oral: 0.1 mg/kg-day Inhalation: 5 x 10^-6 per µg/m3	Hepatic, Nervous, Respiratory, and Urinary Systems	Gastrointestinal, Hepatic, Reproductive, Respiratory, and Urinary Systems	RfD: NOAEL: 9.6 mg/kg-day RfC: LOAEL:: 32.2 mg/m^3	RfD: 300 RfC: 1000	Likely to be carcinogenic to humans	IRIS	2013