

## MEMORANDUM

**TO:** Center for Public Environmental Oversight  
**FROM:** Peter Strauss  
**DATE:** June 2020  
**SUBJ:** **The MEW Superfund Site: Future Residential Development Issues**

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### Introduction

I was tasked with writing a memo concerning new residential development issues related to building on the Middlefield-Ellis-Whisman (MEW) Superfund Study Area and adjacent areas. Specifically, two questions were asked:

- What can the community do to ensure that residents and other occupants of new residential developments above the Regional Plume are safe?
- Will residents and other occupants be aware of potential risks and what has been done to address them?

I am the Technical Advisor to the Center for Public Environmental Oversight (CPEO), which supports my work under a U.S. EPA Technical Assistance Grant for the MEW Superfund site, so this memo is limited to activities at MEW. This includes areas of Moffett Field that are impacted by the Moffett-MEW Regional Plume (the large plume of contaminated groundwater emanating from the MEW Site, including additional contamination released by the Navy at former Moffett Naval Air Station). **Figure 1** shows the area, highlighted in pink and blue, where my work is focused. However, I believe that many of the observations, analysis, and recommendations regarding future residential development can be applied to both residential and commercial development outside of this area as it pertains to subsurface contamination by TCE (trichloroethylene) or PCE (tetrachloroethylene) in the City of Mountain View.

### MEW

The MEW site is named for the three Mountain View City streets: Middlefield Road, Ellis Street, and Whisman Road that bound it, along with U.S. Highway 101. The MEW Study Area is larger than this area, as the plume extends beyond the street boundaries. Officially, the area is comprised of four separate "Superfund" or National Priorities List sites: Raytheon Corporation, Intel Corporation, Fairchild Semiconductor Corporation, and portions of the former Naval Air Station Moffett Field. The Navy transferred stewardship of Moffett to NASA in 1994, but the Navy remains responsible for a share of the cleanup. Contamination at the MEW Site was first discovered by Intel in the early 1980s. Cleanup at the site has been ongoing since then. Recently, EPA extended the MEW area to include contamination that had migrated west of Whisman Road to Stevens Creek. This area is known as Operable Unit (OU) 3.

Contamination of the groundwater is primarily from chlorinated volatile organic compounds (VOCs) used as solvents, the most prevalent being TCE. The upper-most aquifer is shallow and contaminants have the potential to volatilize and rise through the sub-surface and make their way into overlying structures. This is known as *vapor intrusion*.

As cleanup has progressed and industrial activity has wound down, the MEW area and surrounding areas have transitioned to office and residential uses. At Moffett, areas have been leased for educational and residential development. The MEW area, with the exception of OU 3 lies within Mountain View's East Whisman Precise Plan area (see **Figures 3 and 4**). It represents a large share of potential new residential development there.

## Recommendations

I offer the following recommendations for the environmental regulatory agencies, the City of Mountain View, and NASA:

1. EPA should complete the Record of Decision (ROD) Amendment for accelerating groundwater cleanup as soon as possible. Preliminary standards regarding soil vapor and groundwater lines of evidence need further discussion and documentation.
2. The ROD Amendment should resolve the questions regarding the adequacy of passive systems. EPA should establish criteria to guide property owners when to transform these systems to active mitigation.
3. EPA should err on the side of caution and require active mitigation in new construction above areas of the plume with particularly high TCE concentrations. It should establish a bright line to guide where active systems are mandatory.
4. The parties responsible for cleanup, in consultation with building owners and operators as well as EPA, should develop a regional long-term management framework to guide building-specific Operations, Maintenance and Monitoring (OM&M) Plans.
5. The Responsible Parties should fund development-related monitoring and mitigation activities within OU 3. When the area along Evandale was first identified, the MEW Responsible Parties paid for additional investigation, including indoor air monitoring in circumscribed areas, and they funded a pilot study using in-situ chemical oxidation. However, the RPs have since refused to fund additional investigations and implementation of mitigation systems for properties within OU 3. EPA itself does not have funds for additional investigation or mitigation.<sup>1</sup>
6. EPA should continue to hold community outreach sessions. EPA and/or NASA should consider placing placards on buildings, other than single-family homes, that lie above the regional plume. The placards should explain the historic contamination, what has been done to protect occupants, and provide contact information. Additionally, EPA should provide guidance on how to notify prospective owners and occupants in addition to the normal real estate disclosure process.
7. The City of Mountain View should amend its policy in areas with known VOC contamination to require that developers take steps to reduce the potential for lateral migration of VOCs in utility corridors.

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<sup>1</sup> Conversation with Alana Lee, U.S. EPA Project Manager, February 13, 2020

8. The City of Mountain View should require developers of properties outside the VI Study Area to conduct soil vapor screening if the properties are located adjacent to or downgradient from known TCE or similar plumes. Adjacency distances may vary with plume containment, depth, and annual movement, but at a minimum, properties within 200 feet of a known plume should be evaluated.
9. NASA should develop strong notification requirements for newly constructed homes and buildings on leased lands in its upcoming Environmental Issues Management Plan. These will need to be monitored by NASA staff. The various federal and state agencies (the US Army, NASA, UC Berkeley) that have properties on Moffett Field should coordinate with NASA.

## Organization

This memo is divided into two parts. **Part 1** describes the major threats from contaminants in the subsurface, the regulatory framework for these areas of concern, descriptions of remedial requirements for new housing, and descriptions of proposed housing areas and potential issues. **Part 2** analyzes major issues and explains my recommendations.

### Part 1: Major Threats

#### Vapor Intrusion

The Regional Plume contains a number of chlorinated volatile organic compounds, the most prevalent which is trichloroethylene (TCE). The threat does not come from drinking water, because no one is drinking the groundwater in or near the MEW plume. This is because the groundwater is high in salts and dissolved solids, which would make it expensive to clean-up and utilize, regardless of the contamination levels. However, this groundwater is still protected by California law as a potential drinking water source.

The major potential risk to new and existing homes that lie over the MEW plume is vapor intrusion.<sup>2</sup> Even if groundwater cleanup has not yet been completed, unacceptable exposures can be prevented through the installation of mitigation systems, also known as engineering controls. EPA requires that newly constructed housing within the Vapor Intrusion (VI) Study Area include a sub-slab depressurization system (SSDS), a ventilated garage beneath living spaces, *or* a passive venting system (with the ability to be converted into an active SSDS), as well as a vapor barrier. It requires that mitigation systems be maintained and that floors and slabs be periodically checked for deterioration (and repaired if necessary).

Vapor intrusion begins when a VOC such as TCE or PCE in the soil or groundwater volatilizes into soil gas. Toxic vapors fill the spaces around the soil particles (called pore space) above the groundwater table. The degree to which VOCs volatilize into soil gas depends on variety of factors, including vapor pressure, water solubility, and tendency to adsorb to soil particles.

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<sup>2</sup> See *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*, U.S. EPA, June 2015, <https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf>. Also for an introduction to vapor intrusion, see Lenny Siegel's "A Stakeholders Guide to New Construction at Vapor Intrusion Sites," CPEO, December 2016 (<http://www.cpeo.org/pubs/SGNC.pdf>).

Liquid contamination spreads with groundwater in the direction of the groundwater flow, , and soil vapor contamination moves radially. Vapor concentrations in the soil generally attenuate (decrease) as they move away from a subsurface source. Vapors can move faster and further along preferential pathways, such as utility corridors or more porous zones of soil or rock, or even beneath asphalt. At Moffett Field, TCE found its way through abandoned steam tunnels.

Soil gas also migrates upward, pulled by the lower vapor (air) pressures found in most buildings. It can enter overlying buildings through cracks in basements and foundations, utility conduits (electrical, cable, sewer), elevators and stairwells, and other openings in the building envelope. As soil gas enters buildings, concentrations are significantly attenuated. Indoor air concentrations are influenced by changes in air pressure; changes in wind direction and speed; and the operation of ventilation systems and combustion devices that vent gases to the outside. All building types, regardless of foundation type (*e.g.*, basement, crawlspace, slab-on-grade) have openings that render them potentially vulnerable to vapor intrusion.

Mitigation systems prevent exposures to VOCs by reversing the flow of gas between buildings and subsurface and by ventilating the subsurface contamination to the outdoors before it reaches regularly occupied spaces.

### **Regulatory Framework**

EPA is the principal regulatory authority for the MEW Site, OU 3, and Moffett Field, and the Bay Area Regional Water Quality Control Board (RWQCB) assists at Moffett Field. The City of Mountain View has the authority to issue building permits for all MEW areas south of Highway 101. NASA approves development at Moffett Field, in consultation with EPA and the RWQCB.

There are four principal documents that provide guidance for developing housing on and around the MEW Superfund Site:

- the 1989 Record of Decision (ROD)
- the 2010 Vapor Intrusion ROD Amendment
- the City of Mountain View's Policy
- NASA's Environmental Issues Management Plan (EIMP) for new development at Moffett Field

Basically, these documents have a common thread with regards to new residential development. When new housing development is considered and built within the VI Study Area, developers have the burden of proof to demonstrate that potential health risks are mitigated in compliance with EPA and California state requirements and that new owners and occupants will be informed of the contamination. Long-term management of the sites is usually necessary to provide a durable, safe living environment. In addition to these documents, EPA is expected to again amend the 1989 ROD for groundwater to accelerate groundwater cleanup of the shallow aquifer to reduce the source of vapors.

### 1989 Record of Decision<sup>3</sup>

The 1989 ROD required the companies responsible for releases of contamination in the soil and groundwater to remediate the site. Following the removal of contaminated soil, the principal remedy was groundwater extraction and treatment, also known as pump and treat. The groundwater cleanup standards for TCE and other solvents were set at 5 parts per billion (5 micrograms per liter, or 5 µg/L). Soil cleanup levels were set at 5 micrograms per kilogram (or 5 parts per million), an approximate level below which EPA believed soil contamination would not further contaminate groundwater.<sup>4</sup> Some cleanup began before the ROD was signed.

Contamination from MEW had already migrated under Moffett Field. Because the Navy and NASA also used a similar mix of chemicals at Moffett, they too bore some responsibility. For a major portion of Moffett, the Navy agreed to adopt the 1989 MEW ROD.

In 1989, if a developer wanted to build on a toxic site anywhere in the United States, it would not be free of potential liability from past contamination under CERCLA's<sup>5</sup> "strict, joint, and several liability" provision. Under this legal doctrine, "strict" means that potentially responsible parties (PRPs)—the businesses that released the contamination into the environment—are liable whether or not they acted carelessly or unreasonably. "Joint and several" means that any and all of the PRPs can be forced to pay for all the damages in case of an indivisible harm where the proportion of total harm attributable to each wrongdoer cannot be determined. Landowners, whether or not they owned the land when a release took place, were potentially liable. This provision acted as a major impediment for redevelopment of Superfund sites.

In 2002 Congress enacted the Brownfields Amendments. This changed the liability for purchasers of property so if new owners meet certain site-specific criteria and agree to continuing obligations (*e.g.*, not impeding the performance of a response action, retaining all institutional controls, granting access for routine monitoring and maintenance, and promising not to release chemicals to the subsurface), they won't be held liable for past contamination. Agreements with EPA known as Bona Fide Prospective Purchaser (BFPP) agreements are used to memorialize these terms. Sometimes, a BFPP is used to require additional measures, such as monitoring soil gas or even conducting some cleanup before the purchaser is released from liability.

The MEW companies, the Navy, and NASA have performed groundwater remedy optimization—actions to enhance the pump-and-treat remedy—including pilot treatability studies to target contaminant mass removal, consolidating treatment systems, modifying pumping rates, and removal of source control extraction wells to enhance overall cleanup effectiveness and efficiency. Pilot treatability study tests of *in-situ* remediation and

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<sup>3</sup> "Record of Decision, Fairchild, Intel, and Raytheon Sites," U.S. EPA, June 9, 1989.

<https://semspub.epa.gov/work/09/88167245.pdf>

<sup>4</sup> There is no record of how this soil standard was established. Communications with EPA indicate that it was most likely set to avoid recontamination of the upper aquifer.

<sup>5</sup> CERCLA is the Comprehensive Environmental Response, Compensation, and Liability Act—the federal Superfund law.

phytoremediation have shown promising results in reducing contaminant concentrations in groundwater.

In addition, Federal Superfund sites require that the remedies be reviewed every five years to determine if they are protective and to set goals for the next five years. The most recent MEW Five-Year Review, stated, even though the groundwater remedy was operating as intended:

analysis of monitoring data indicates that TCE concentration in the groundwater plume are levelling off at concentrations above the cleanup level. The declining efficiency of the operations of the current groundwater remedy indicates that groundwater cleanup levels will not be achieved in shallow groundwater for many decades.<sup>6</sup>

Toxicity data for TCE has also changed since the time of remedy selection. However, these changes do not affect the official protectiveness finding, because the cleanup target remains within EPA's acceptable risk range.

#### 2010 Vapor Intrusion (VI) ROD Amendment<sup>7</sup>

The 2010 VI ROD Amendment requires existing and prospective building owners within the VI Study Area (see **Figure 1**) to mitigate vapor intrusion. For new buildings, the ROD requires all future buildings be built with vapor barriers and be equipped at least with passive sub-slab ventilation systems. It also requires monitoring and the establishment of institutional controls. Although active sub-slab depressurization systems (SSDS) are considered more effective and reliable than passive systems, there are some areas at the edges of the plume that have a low potential for vapor intrusion in excess of indoor air action levels. In these cases, passive systems are effective. However, these areas may change, and there are locations within the VI Study Area where passive systems are unlikely to meet cleanup goals. Therefore, passive system must be designed to made active, through the operation of an exhaust fan, should post-construction monitoring show unacceptable indoor air contamination.

Depending on the indoor air monitoring results and operation of the system before occupancy, a developer may choose whether to begin with an active or passive mitigation system. The ROD contains a tier system that owners of future buildings within the vapor intrusion study area are required to address. **Table 1** describes the two tiers for new construction. The ROD allows an owner or developer to demonstrate that no vapor intrusion potential could exist at a particular location.

EPA established TCE indoor air cleanup levels of 5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) for commercial buildings and 1  $\mu\text{g}/\text{m}^3$  for residential buildings. See **Table 2** for list of vapor contaminants found at MEW and Moffett with their indoor air cleanup standards.

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<sup>6</sup> *Fourth Five-Year Review of the Middlefield-Ellis-Whisman (MEW) Study Area Superfund Study Area*, U.S. EPA, September, 2009, p. 27. Available on line at <https://semspub.epa.gov/work/09/100018492.pdf>

<sup>7</sup> "Record of Decision Amendment for the Vapor Intrusion Pathway," U.S. EPA, August 16, 2010. <https://semspub.epa.gov/work/09/1163792.pdf>

The ROD Amendment also requires implementation of institutional controls (ICs) and monitoring to ensure the long-term effectiveness of the remedy. The ICs include the following requirements:

- (1) notice to future property/building owners of the vapor intrusion remedy and requirements;
- (2) access for sampling, remedy operation, and maintenance, and monitoring; and,
- (3) notice to EPA and the MEW Responsible Parties when there are changes to building ownership or operation that could impact the vapor intrusion remedy at that property.<sup>8</sup>

Future building construction requires that recorded agreements remain in place and be layered with governmental controls (*i.e.*, City of Mountain View procedures and requirements for new building construction within the VI Study Area). EPA is using a tracking service to ensure that proper notification of EPA and the MEW Responsible Parties about changes of ownership and construction that could affect the remedy. While the ICs require notification of environmental conditions for changes in ownership, it is unclear how notification of environmental conditions to future non-owner occupants will be transmitted. (More detail on mitigation techniques, ICs, and long-term management are described in the section on remedial options.)

In the Fourth Five Year Review for the MEW Site, EPA determined that the vapor intrusion remedy is functioning as intended. All occupied commercial/non-residential buildings have been sampled. Institutional controls are in place for new building construction and building improvements that may interfere with the vapor intrusion remedy. Many existing residential buildings have been sampled (although owners have the right to deny sampling). Changes to toxicity values since the 2010 ROD Amendment also have occurred, but those changes have not affected MEW action levels because the calculated risk for exposures at those levels remains within EPA's acceptable risk range.

#### Mountain View Policy and Authority<sup>9</sup>

The City of Mountain View administers zoning and issues building permits through its Community Development Department. The City's policy is to administratively include EPA's remedy and mitigation requirements in the permitting process to ensure that permits are consistent with EPA requirements. The City identifies projects with *known VOC contamination* when developers seek approval. The City can also require mitigation for projects subject to the California Environmental Quality Act (CEQA). It is the developer's responsibility to demonstrate compliance with those requirements prior to building occupancy.

For example, a CEQA Mitigated Negative Declaration at a Mountain View housing development across town from the MEW area stated:

The developer shall install vapor intrusion mitigation systems beneath all buildings to effectively eliminate vapor intrusion. The mitigation system shall either be an active or passive sub-slab depressurization system. The developer shall also provide measures in the VIMP [Vapor Intrusion Mitigation Plan] to confirm the vapor

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<sup>8</sup> *ibid.*, p. 37.

<sup>9</sup> Randal Tsuda, "City Permit Process for MEW Projects," City of Mountain View Memorandum, November 6, 2009. See Attachment 3 at <http://www.cpeo.org/pubs/MV-VIPolicy.pdf>.



intrusion mitigation system works as designed. The developer shall provide financial assurances of adequate funds for long-term operation and maintenance, if required by the VIMP.<sup>10</sup>

Mountain View has only required mitigation for properties on or near sites with state or federal environmental regulatory oversight, so the city has been in a position of reinforcing an approach that has been developed by government officials with knowledge and experience with vapor intrusion. In general, the City does not conduct monitoring of the subsurface: instead, it relies on data and information from the EPA (if it is a Superfund or other federally regulated property), the State (either the Department of Toxic Substances Control or the RWQCB), or Santa Clara County to identify conditions that might warrant mitigation or monitoring.

Mountain View has required notification of prospective residents at some developments, but I do not know to what extent that has been implemented.

#### NASA Environmental Issues Management Plan (EIMP)<sup>11</sup>

For new development at NASA Research Park at Moffett Field, long-term monitoring and management relies on procedures already in place by NASA. NASA uses its March 2005 *Environmental Issues Management Plan* (EIMP) as a decision framework for the management of residual chemicals in soil and groundwater. The ROD Amendment states, “Additionally, similar requirements to those in the EIMP should be adopted for new construction within the Moffett Field Area and for ongoing implementation and monitoring of the remedy.”

A second EIMP was issued for the lease of property to Planetary Ventures (PV). NASA is updating the EIMP for the areas on Moffett Field that are being considered for new housing. The PV EIMP addresses protective measures for new construction in contaminated areas as well as the protection of construction workers. Requirements include measures to mitigate vapor intrusion potential from solvents in the groundwater and soil. The EIMP also includes mitigation measures designed to prevent the flow of contaminated groundwater and vapor through horizontal or vertical conduits.

As is the case with the City of Mountain View, it is not clear how notification of environmental conditions to students and non-owner residential occupants is handled. Some renters at Wescoat military housing, just west of NASA’s proposed housing developments, have complained to EPA that they were not notified about the potential for vapor intrusion. The

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<sup>10</sup> “Mora Drive Residential Project, Initial Study/Draft Mitigated Negative Declaration,” City of Mountain View,” January 2016, page 4. Available as Attachment 1 at <https://mountainview.legistar.com/LegislationDetail.aspx?ID=2559810&GUID=FE44FE38-85B4-4796-9504-B0DAA10177AD&Options=&Search=>

<sup>11</sup> *Environmental Issues Management Plan for NASA Research Park*, Erler & Kalinowski, March 1, 2005, [https://www.nasa.gov/centers/ames/pdf/578499main\\_EIMP%20-%20Complete%20Document%20-%20FINAL%201%20March%202005%5B7%5D.pdf](https://www.nasa.gov/centers/ames/pdf/578499main_EIMP%20-%20Complete%20Document%20-%20FINAL%201%20March%202005%5B7%5D.pdf). *Environmental Issues Management Plan, MFA Leasehold*, Erler & Kalinowski, March 3, 2015, [https://documents.geotracker.waterboards.ca.gov/regulators/deliverable\\_documents/9177503287/MFA%20Leasehold%20EIMP%20-%20Final%2020150303.pdf](https://documents.geotracker.waterboards.ca.gov/regulators/deliverable_documents/9177503287/MFA%20Leasehold%20EIMP%20-%20Final%2020150303.pdf).

See also the “Environmental Baseline Survey, NRP South Housing Area,” June 19, 2019, AECOM. <https://semspub.epa.gov/work/09/100018360.pdf>



developer selected by NASA for developing new housing is affiliated with Wescoat Village management.

#### Future Shallow-Surface ROD Amendment

As long as contamination remains above certain levels in the shallow groundwater, it poses a risk to potential residents. The shallow groundwater acts as a repository of contaminants that could turn to vapor and migrate through the soil and enter residences. This exposure pathway was not considered by the 1989 ROD. The 2010 ROD Amendment deferred action on a Remedial Action Objective (RAO) to accelerate reduction of the source of vapor intrusion (*i.e.*, contaminants in shallow groundwater) to levels that would be protective of current and future building occupants, so the need for a vapor intrusion remedy would be minimized or no longer be necessary. The Proposed Plan stated:

[T]his Remedial Action Objective will not be addressed by this proposed vapor intrusion remedy; instead, it will be addressed by the current groundwater remedy, which is now being re-evaluated in a separate Supplemental Site-wide Groundwater Feasibility Study for the Site.<sup>12</sup>

The most recent Five-Year Review of the MEW site stated

The declining efficiency of the operations of the current groundwater remedy indicates that groundwater cleanup levels will not be achieved in shallow groundwater for many decades. This prolonged period of time is inconsistent with the vapor intrusion remedy RAO to accelerate the reduction of the source of vapor intrusion (*i.e.*, Site contaminants in shallow groundwater and soil gas) to levels that are protective of current and future building occupants, such that the need for a vapor intrusion remedy would be minimized or no longer be necessary.<sup>13</sup>

For the remedy to remain protective, the Five-Year Review recommended:

Evaluate alternative cleanup technologies that will accelerate TCE contaminant reduction and vapor intrusion source reduction in the Shallow Zone (soil gas and A aquifer zone) to address the vapor intrusion source remedial action objectives and prepare Shallow Zone Focused Feasibility Study, Proposed Plan and ROD Amendment to support and change the current remedy.<sup>14</sup>

The milestone for the new ROD Amendment, which has been a decade in the works, is now December 1, 2021. I expect that it will include soil-gas standards to ensure that even if a site currently meets indoor air action levels, it will be safe for future occupants. For example, at 277 Fairchild Avenue, after a substantial vapor intrusion system was designed, testing of groundwater and soil gas indicated that they were too contaminated for EPA to approve redevelopment. That is, EPA concluded that the potential risk to future occupants would be too high, even with the mitigation system operating. The developer agreed to perform *in-situ* bioremediation of groundwater (the source of TCE vapor) to reduce groundwater

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<sup>12</sup> *Proposed Plan for the Vapor Intrusion Pathway, Middlefield-Ellis-Whisman (MEW) Superfund Study Area*, U.S. Environmental Protection Agency, July, 2009. Page 9 (page 11 of PDF), available on line at <https://semspub.epa.gov/work/09/1121394.pdf>.

<sup>13</sup> *Fourth Five-Year Review*, p. 27.

<sup>14</sup> *ibid.*, p. 29.

concentrations and soil-vapor extraction to reduce soil-gas concentrations prior to construction.

Responding to an early draft of the Site-Wide Feasibility Study, CPEO and its Community Advisory Board proposed that the introduction of new remedial technologies “be focused on addressing the problems that led us all to initiate the cleanup decades ago, those portions of the plume that pose the greatest risk to human health and the environment.” Specifically, CPEO suggested that the new technologies focus on the following:

- Areas with high mass
- Areas that continue to act as a source
- Areas that reduce the need for long-term vapor intrusion mitigation
- Where the detectable plume encroaches on residential areas, schools, and other sensitive uses
- To enable reasonable future use of the property.

EPA responded positively to these suggestions and agreed to incorporate these concepts into the Proposed Plan for shallow groundwater.

### **Remedial Requirements**

This section covers a detailed discussion of mitigation techniques, institutional controls (ICs), and long-term management.

#### Mitigation Techniques

For new buildings, the VI ROD requires that the selected remedy for future buildings be passive sub-slab ventilation with a vapor barrier (with the capability to convert the system to active), unless the developer demonstrates that there is no potential for vapor intrusion at the site.

There are several mitigation approaches for preventing subsurface vapors from intruding into homes and other buildings. The most common approach is a sub-slab depressurization system (SSDS).<sup>15</sup> Because air pressure in most homes and buildings is usually lower than the vapor pressure in the underlying soil, vapors may be drawn into the building. Depressurization lowers the pressure under and around the foundation. Even if there are holes, cracks, or other pathways between the building and the subsurface, vapors tend to flow downward, not upward. Therefore, a well-designed depressurization system prevents toxic vapors from intruding above. The active SSDS is operated continuously, but mechanical parts must be maintained. In active systems, sub-slab pressure probes can be used to monitor differential pressures for a direct indication of system performance.

In new construction, a sub-slab venting layer, such as gravel, is installed below the slab. In an active system, a fan is used to draw soil gas through the gravel underlying the slab prior to discharging it to the atmosphere. In a passive system, wind and differential pressure between the subsurface and the roof-top vents moves some vapor from below the slab. In warmer months and climates, ambient pressure at the roofline may be greater than the subsurface, so passive systems may provide little help. Passive systems are generally less

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<sup>15</sup> See <http://www.cpeo.org/techtree/ttdescript/ssvd.htm> for a description of SSDS.

predictable and less efficient than active SSDS at preventing vapor intrusion than active system, so they may require more monitoring.

The air and soil gases withdrawn from beneath a building during SSDS operation and passive venting are exhausted to the atmosphere. The emissions may need to be treated to remove VOCs to the extent required by the Bay Area Air Quality Management District (“BAAQMD”) based on the estimated VOC emission rate for each system. For example, the new system at 277 Fairchild is piped to a central point and emissions are treated prior to being exhausted.

Major differences between active and passive systems can be found in **Table 3**.

The Planetary Ventures EIMP requires that the developer reduce the potential for lateral migration of VOCs in utility corridors. If utilities are buried below the groundwater, it is possible that groundwater or soil gas could migrate through utility backfill material. Additionally, groundwater containing chemicals of concern can infiltrate into the utility line at leaky pipe joints buried below the water table. As such, the EIMP requires that mitigation measures be used when installing new utilities to reduce the potential for lateral migration of vapors. Mitigation measures may include:

- Use of low permeability backfill and/or cutoff features
- Watertight utility pipes and their joints

#### Institutional Controls (ICs)

ICs, as opposed to active engineering controls, are administrative and legal controls that minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. ICs can be used to restrict or grant access to a property, ensure that response activities are maintained by a responsible party, inform owners of the need for mitigation in future construction, provide notice to owners and occupants of buildings, and inform the public. The 2010 ROD Amendment identified a combination of ICs for use at the site. For future building construction in the south-of-101 MEW Area, ICs are implemented through the City of Mountain View.

The City of Mountain View has a mapping database to help ensure that parties interested in properties within the MEW Study Area are informed of the appropriate construction requirements. Similarly, at Moffett Field, ICs will be implemented by NASA. NASA requires the operation and maintenance of remedial measures endorsed by EPA and incorporation of the such measures in new construction.

EPA recommends that permanent placards be placed on each mitigation system to describe the system’s purpose and operational requirements, as well as instructions on what to do if the system does not operate as designed (for example, a phone number to call for corrective action).

An important role of ICs is *notification* of future occupants and owners of buildings of vapor intrusion and vapor intrusion mitigation.

EPA (in response to comments on the 2010 ROD) stated that it requires notice to property owners and occupants for the remedy and mitigation in addition to the normal real estate disclosure process. It is not clear how this is enforced.

EPA has already conducted numerous outreach forums informing residential owners and occupants of vapor intrusion, remedies, ongoing efforts, and the availability of indoor air testing. Where renters desire to have their residences sampled, EPA will contact the property owner to facilitate agreement for access into the residence. However, it is EPA's policy that the owner must grant access to the property to conduct such sampling.<sup>16</sup>

### Long-Term Management (LTM)

Comprehensive long-term management is essential to ensure that mitigation designed into new construction remains safe for the life of the building or the life of the underlying contamination. EPA does not have an official definition of LTM, but environmental professionals generally include many of the following components in their definition of LTM at vapor intrusion sites<sup>17</sup>:

- Monitoring of subsurface contamination
- Periodic inspections of possible pathways from the subsurface to indoors
- Operation, maintenance, monitoring, and inspection of mitigation systems
- Training building maintenance personnel
- Controlling and monitoring of mitigation system emissions
- Periodically monitoring indoor and outdoor air
- Establishing institutional controls to limit activities and uses at the site and to ensure continuation of the activities above
- Periodically reviewing of the protectiveness and/or efficiency of the response
- Developing a decision-making process for when to activate or deactivate an SSDS
- Preparing reports documenting all of the above.

The 2010 VI ROD Amendment requires that responsible parties implement Institutional Controls (ICs) and monitoring to ensure the long-term effectiveness of the remedy. However, long-term monitoring periods are not defined. It also includes language stating: "Monitoring activities, schedules, and task responsibilities will need to be detailed in each building's operations, maintenance and monitoring plan, which will be incorporated into the Site's ICs Implementation Plan."<sup>18</sup>

As of this date, there is no Site ICs Implementation Plan. Currently the only buildings and properties with long-term operations, maintenance, and monitoring plans are those with vapor intrusion control systems. This falls short of the elements listed above.

In response to several comments in the VI ROD, EPA stated that it would develop long-term management plans. Included in these statements were the following:

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<sup>16</sup> To date, numerous building owners have objected to granting access, but upon meeting or discussing the issue with EPA, they have acquiesced. Based on conversation with Alana Lee, EPA Project Manager, September 30, 2019. At one apartment building, the management company reversed its opposition when the *Mountain View Voice* called attention to its reluctance to cooperate.

<sup>17</sup> See Lenny Siegel, "A Stakeholder's Guide to Long-Term Management at Vapor Intrusion Sites," CPEO, April, 2016 (<http://www.cpeo.org/brownfields/reports/N-Z/VILTM.pdf>) for further information

<sup>18</sup> "Record of Decision Amendment for the Vapor Intrusion Pathway," p. 23.

EPA will continue to confirm the effectiveness of vapor intrusion control systems and *will develop long-term operations, maintenance and monitoring plans*. [emphass added]

A long-term operations, maintenance, and monitoring plan will be developed and baseline sampling will be conducted at a representative number of units. The sampling frequency will be determined in the long-term monitoring plan.

When conditions in a building change or the subsurface conditions change such that the remedy may not be able to keep the subsurface contamination from entering the building at levels exceeding indoor air cleanup levels, samples will be required to confirm the adequacy of the remedy. This sampling will not occur on a scheduled basis but will be required when certain changes occur.

EPA recognizes the importance of a long-term management plan to ensure that the vapor intrusion remedy is effective and health protective. Long-term management will be included in the building-specific operations, maintenance, and monitoring plan and in the Institutional Controls Implementation Plan, or ICIP. Because of the building-by-building nature of the remedy, the ICIP will likely be extensive, and it will also have to be robust.

The ICIP must include several components: (1) notice provisions to new owners and occupants regarding the remedy; (2) notice requirements to EPA and the MEW Responsible Parties for changes in building configuration, ownership, or occupancy; (3) access for monitoring in accordance with each building's operations, maintenance, and monitoring Plan; (4) requirements for remedy changes where necessary in each building; and (5) enforcement of these requirements. Each of these elements will be incorporated into Site institutional controls. There may be one or more institutional control that incorporates each element.

EPA will conduct five- year reviews to evaluate continued protectiveness of the remedy in the future. These reviews will consider the impact of any new information on the protectiveness of the remedy.<sup>19</sup>

Each year the responsible parties prepare a series of Annual Reports, some for specific locations and others that cover the regional plume. The Annual Reports addressing vapor intrusion describe and document the following:

- VI work and activities taken in the year
- Work activities, including sampling, reporting, community involvement and meetings, interim VI measures, and remedial design and remedial action activities
- Sampling and monitoring data results by building or property address
- The boundaries of the VI Study Area using the most recent shallow A Zone groundwater concentration data and other lines of evidence, as appropriate.
- VI work planned for the year.
- All issues/problems encountered and actual or anticipated delays, with proposed solutions to address these.

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<sup>19</sup> *ibid.*, pp. 4, 11, 27-28, 28 of Responsiveness Summary

## Potential Housing Areas

### Moffett Field (NASA)

In October 2017, NASA issued a Request for Proposal (RFP) to develop a minimum of 1,930 housing units on 46 acres at the south end of Moffett Field, located east of Wescoat Village, just north of Highway 101. The development will consist of apartments of varying sizes, housing 4,900 people. NASA selected Mountain View Housing Ventures, LLC, as the preferred lessee to develop housing on NASA property in Moffett Field. Development is to occur sometime in the next 3 to 5 years. The development site has approximately 425,000 square feet of existing structures that require demolition. **Figure 2** shows the location of the housing development area as well as buildings marked for demolition.

A significant portion of the site lies over some of the higher concentrations of TCE in the Regional Plume. In addition to solvents, contaminants include polychlorinated biphenyls (PCBs), oils and greases, and fuels. There were four underground storage tanks within the eastern portion of the site. Although the tanks have been removed, concentrations of gasoline, diesel, and benzene exceeding California screening levels are present. Because of its location, the new development design will likely require minimization of soil disturbance (e.g., no basement levels, or the use of pile foundations).

It is assumed that the developer will seek a Bona Fide Prospective Purchasers (BFPP) Agreement from EPA that would release it from liability for past contamination. The Navy is currently operating a remedial system (bioremediation and soil vapor extraction) there, and there is a pilot phytoremediation study nearby. These groundwater remediation techniques may be continued, and they may eventually reduce the contamination levels in the shallow aquifer so an active VI mitigation SSDS can be changed to a passive system.

Additionally, UC Berkeley, on behalf of the University of California system and its constituent campuses, is exploring the feasibility of developing up to 36.2 acres at Moffett Field into a mixed-use site for public and private sector research, professional education, and housing. It would include approximately 200 multi-family units for undergraduate and graduate students, faculty, staff, and industry partner employees. This site is located north of the previously described housing proposal, and it is within the boundaries of the NASA Research Park. UC envisions creating a state-of-the-art research and education hub that advances the University's education, scientific research, and public service purposes, in cooperation with NASA's mission to pioneer the future in space exploration, scientific discovery, and aeronautics research. This proposal is still in the preliminary planning stages. NASA's lease authority expired on December 31, 2019. It is not known whether this is still an active proposal, given the COVID-19 pandemic and associated limitations on work.

### Operable Unit 3 (OU 3)

OU 3 (shown in blue in **Figure 1**) was first delineated after a Five-Year Review for MEW determined that the western boundary of the VI Study area and the Regional Plume had not been adequately characterized. An investigation followed, and EPA found that several areas along Evandale Road and Fairchild Drive were highly contaminated with TCE. EPA found that the most likely source had been a company or companies within the MEW area that had disposed of TCE through Mountain View's sewer lines in the early 1960s. An old, leaky sewer

line along Evandale Road is the most likely culprit. EPA has considered expanding OU 3 across 101 because the sewer main that succeeded the Evandale pipes goes under the freeway.

The MEW companies have not accepted responsibility for this additional contamination. When the area along Evandale was first identified, they paid for additional investigation, including indoor air monitoring in circumscribed areas, and they funded an *in-situ* chemical oxidation pilot study. Recently, however, the same responsible parties have refused to fund additional investigations or the implementation of mitigation systems for properties within OU 3. EPA also does not have funds for additional investigation or mitigation.<sup>20</sup>

Several residential properties within OU 3 are either in the process of development or had to be retrofitted to accommodate the potential for vapor intrusion. These are discussed in detail below.

### 277 Fairchild Drive

The Warmington Group purchased the Mountain View Motel property at 277 Fairchild Drive in 2015, and it is redeveloping it into four single-family residences and four multi-family buildings. It designed a system to mitigate vapor intrusion (VI) that includes vapor barriers and an active SSDS. The vapors would be conveyed to an effluent pipe and treated with Granular Activated Charcoal (GAC) filters. Treated air from the all of buildings will be discharged through vertical stacks at two locations. The SSDS emissions need to comply with applicable Bay Area Air Quality Management District (BAAQMD) regulations.

After soil, soil-gas, and groundwater data were collected in August 2016, EPA determined that TCE soil-gas levels and groundwater levels were too high at three residential properties to protect future occupants, even though the mitigation plans conformed with the VI ROD. EPA established an interim soil-gas standard [TCE levels greater than 20,000 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ )], and a groundwater action level of 1,500  $\mu\text{g}/\text{L}$ . Soil-gas samples indicated a very high TCE soil gas concentration of 110,000  $\mu\text{g}/\text{m}^3$  at 5 feet below ground surface (bgs). Groundwater samples indicated that TCE was present at a maximum concentration of 6,000  $\mu\text{g}/\text{L}$ . Before Warmington could proceed with construction, it was required to reduce contamination to these action levels. EPA has advised the Responsible Parties that it is developing similar soil-gas removal and groundwater removal action levels for TCE in the future ROD Amendment for Shallow Groundwater.

Under the terms of a 2017 Bonafide Prospective Purchaser Agreement between Warmington and EPA, Warmington conducted additional response actions to reduce TCE hot spot areas exceeding 20,000  $\mu\text{g}/\text{m}^3$  in soil gas and 1,500  $\mu\text{g}/\text{L}$  in shallow groundwater. The developer operated a soil-vapor extraction and treatment system from October 2017 to June 2018 and performed enhanced anerobic bioremediation at the property by injecting carbon amendments to facilitate reductive dechlorination.

In one new building, pre-occupancy indoor air sampling showed that all contaminants *except PCE* were below their respective residential indoor air cleanup action levels, as specified in the VI ROD. Warmington attempted to identify the source of PCE and ventilate the building, after which indoor air samples were again collected. However, PCE was still detected at a

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<sup>20</sup> Based on conversation with Alana Lee, EPA Project Manager, February 13, 2020



concentration greater than its action level. Warmington will continue its efforts to identify the source(s) of PCE detected in this building.<sup>21</sup>

Several new private developments have been identified since 2016. Most were classified as Tier B (that is, no action would be required to mitigate). However, it is reported that “EPA has yet to provide concurrence with the Tier B determinations made for properties located at 310 North Whisman Road, Residence 156, and another Private Residence.”<sup>22</sup>

### East Whisman Precise Plan (EWPP)

From 2017-19, the City of Mountain View prepared the East Whisman Precise Plan (EWPP). The EWPP established land use plans for future development in an area encompassing the MEW study area and the portion of the VI Study area south of Highway 101 properties (see **Figure 3**). The EWPP is would transform the 368-acre commercial area into a live-work neighborhood. The city’s vision calls for 5,000 units of new housing that would be built near 2.3 million square feet of office space. Proposed projects within the Precise Plan are described below.

#### 355/365, 401, and 415 East Middlefield

Prior to 1965, this site was used for agricultural purposes. Beginning 1965, Union Carbide manufactured semiconductor products at 365 and 415 East Middlefield Road, using TCE as part of the manufacturing process. In 1968, the site was sold to Raytheon and Intel. Raytheon occupied 415 East Middlefield Road, and Intel occupied 365 East Middlefield Road. Both companies manufactured semiconductors, and both used TCE in the process.

In 1981, Intel discovered contamination of soil and groundwater adjacent to an underground concrete storage vault that contained solvent waste storage tanks. In 1984 it removed soil in the area.

The Annual Report for this location also identifies potential sources near the Site that may have contributed to the soil and groundwater contamination. These included the Tracor facility at 345 East Middlefield Road; the upgradient City of Mountain View’s Municipal Operation Center at 231 North Whisman Road; and the upgradient GTE site at 100 Ferguson Drive.

In 2005, Intel and Raytheon initiated an Enhanced In Situ Bioremediation Pilot Test to accelerate cleanup of VOCs in groundwater at 401 East Middlefield Road. The vapor intrusion tests performed at 355/365 East Middlefield Road buildings showed contamination below the long-term commercial indoor air cleanup levels—that is, acceptable.

With this background, Summerhill Homes LLC (Summerhill) introduced plans to redevelop 355/365, 401, and 415 East Middlefield Road as multi-family housing, plus a small park. Plans consist of 447 residential units offering three distinct housing types:

- 48 Flats in 4-story buildings ranging from 1,300 to 2,300 square feet

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<sup>21</sup> Haley & Aldrich, “2109 Annual Vapor Intrusion Progress Report,” April 2020.  
<https://semspub.epa.gov/work/09/100020044.pdf>

<sup>22</sup> *ibid.*, p. 11.

- 134 Condominiums in a 7-story building ranging from 850 to 1,735 square feet
- 265 Apartments in a 7-story building ranging from 585 to 1,115 square feet

In October 2018, Summerhill initiated an investigation to identify any areas of the Site subsurface where TCE concentrations in soil gas exceeds  $20,000 \mu\text{g}/\text{m}^3$  or in shallow groundwater exceeds  $1,500 \mu\text{g}/\text{L}$ . A secondary objective was to determine if areas with TCE soil-gas concentrations between  $6,700$  and  $20,000 \mu\text{g}/\text{m}^3$  were absent or localized. According to the Annual Report for this site, EPA initially stated that TCE soil-gas concentrations below  $6,700 \mu\text{g}/\text{m}^3$  would not necessitate an active SSDS in new buildings. The results of this investigation had demonstrated that soil-gas concentrations and groundwater concentrations at locations across the site were below the EPA screening levels.

During a later meeting, EPA stated that active ventilation would not be required if TCE concentrations in TCE soil-gas concentrations are below  $2,000 \mu\text{g}/\text{m}^3$ . The Annual Report also stated that EPA told Summerhill that if additional remedial actions are taken to address two areas with groundwater TCE concentrations exceeding  $100 \mu\text{g}/\text{L}$ , U.S. EPA would concur with design and installation of a passive system (with the ability to be made active) in all proposed buildings.<sup>23</sup> These two action levels would be new, if the Report is accurate. It should be noted that none of the above action levels were stated in the 2010 Intrusion Vapor ROD Amendment.

Based on the results, the VI remedy as set forth in the 2010 VI ROD Amendment would be installed if the site is redeveloped for residential use. In addition, most new multi-family housing is separated from the surface by a ground-level parking garage (with active ventilation). If adequately ventilated, this will provide an extra level of protection.

#### 455 and 485/487 and 501/505 East Middlefield Road

These East Middlefield Road sites (owned Symantec, later called Norton LifeLock) are within the MEW area. There are two existing commercial buildings that are now almost vacant. Although not currently scheduled for residential redevelopment, these parcels are within the East Whisman Precise Plan area. Future uses may include housing. The Responsible Party for this site (SMI Holding LLC) is planning a pilot test that involves injecting zero-valent iron (ZVI) to reduce TCE in the subsurface.<sup>24</sup>

Google had planned to purchase the site and possibly add new housing. However, those plans are on hold because of economic uncertainties due to COVID-19.

#### 500 Logue

500 Logue currently contains three single-story commercial structures surrounded by parking lots. Google has plans to develop new 330 new residential units and almost an equal amount of commercial space. 500 Logue does not lie within the MEW area or the VI Study Area. However, it is downstream from the HP plume (see **Figure 4**). The City of Mountain View may impose requirements on development, such as sampling of soil gas prior to

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<sup>23</sup> "2019 Annual Progress Report for Former Intel Mountain View Facility," Weiss Associates, April 10, 2020, p. 13. <https://semspub.epa.gov/work/09/100020039.pdf>

<sup>24</sup> "Work Plan for Sulfidated Zero Valent Iron In Situ Pilot Test," SMI Holding LLC, June 17, 2019. <https://semspub.epa.gov/work/09/100017835.pdf>

construction, installation of vapor mitigation systems, or sampling of indoor air prior to occupancy.

#### VTa Middlefield Station Development

Google has proposed a new campus surrounding the VTA Light Rail Middlefield station. It proposes 660,000 square feet of offices and approximately 1,400 new homes. This proposal is in its early stages. Because this location falls outside of the Vapor Intrusion Study Area, it is not subject to the VI remedy. However, if evidence of contamination is turned up during development, the City of Mountain View could require vapor mitigation.

#### Ferguson Drive

Ferguson Drive is not within the MEW Area nor the East Whisman Precise Plan Area. However, it is proximate, and it serves as an example of how the City policy described above can be implemented. In November 2006, soil vapor testing was completed at 500 Ferguson Drive on behalf of the City of Mountain View. VOCs associated with the former GTE site had been detected along the southern property boundary of 500 Ferguson Drive. In 2015 the City of Mountain View approved residential redevelopment of 500 Ferguson Drive (east of the light rail line), conditioned on a vapor mitigation plan and vapor barrier, due to the presence of VOCs in the shallow groundwater and soil vapor.

### **PART 2: Analysis**

A number of questions have come to the fore while researching this memo. These include:

- Will the long-delayed upper aquifer groundwater ROD include soil vapor and other lines of evidence to help guide new construction and mitigation strategies?
- Can passive mitigation systems provide an adequate margin of safety, given that they are less predictable in their ability to prevent vapor intrusion?
- Are regulatory standards and protocols sufficient to guide safe development of future construction in areas above the plume that have of high concentrations of TCE?
- Are long-term operations, maintenance, and monitoring (OMM) plans adequate?
- Are the Institutional Controls adequate to ensure that long-term management plans are properly implemented?
- To what degree should the City of Mountain View require sampling and vapor intrusion remedies in areas that are not within the boundaries of the MEW Vapor Intrusion Study Area?
- Should the NASA Environmental Issues Management Plan's (EIMP) requirements regarding preferential subsurface pathways be replicated to other areas of the VI Study Area.

#### New Shallow Groundwater ROD Amendment

As this memo is being written, EPA is attempting to complete the Feasibility Study and Proposed Plan first called for in the 2009 Five-Year Review. It will likely contain some

guidance on mitigation strategies above different portions of the plume. Preliminary guidelines are the following<sup>25</sup>:

- If TCE soil-gas concentrations are above 20,000 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) construction will not be permitted until concentrations are reduced
- An active mitigation system will be required if TCE in soil gas is above either 2,000  $\mu\text{g}/\text{m}^3$  or 6,700  $\mu\text{g}/\text{m}^3$ .
- If TCE concentrations are below 33  $\mu\text{g}/\text{m}^3$  in soil gas, no mitigation will be required.
- If TCE concentrations are above 1,500  $\mu\text{g}/\text{L}$  in groundwater, residential building will not be permitted until concentrations are reduced

### Passive Remediation Systems

The 2010 VI ROD requires that any new housing in the VI Study Area be constructed with a vapor barrier and a passive mitigation system that can be made active with the addition and operation of venting fans. However, there is no guidance in the VI ROD Amendment that gives guidance on when a new building equipped with a passive remedy will be required to activate its system with an SSDS fan). EPA is comfortable with the passive mitigation method, as most residential developments to date have been on properties with relatively low levels of groundwater contamination.

But passive systems are unpredictable, as they rely on changing outdoor air pressure to provide a negative pressure. In warmer months and climates, ambient pressure at the roofline may be greater than the subsurface, and passive systems may provide little help. In most cases, they do not create the same pressure differential between the sub-surface and the indoor air as an active system; they may merely vent harmful vapors intermittingly. EPA reported in 1993 that passive sub-slab systems are 30 to 90 percent as efficient as active systems. Another source stated that a passive system is 10-50% as effective as an active system. (See **Table 3.**)

### Regulatory Standards and Protocols

The Groundwater ROD Amendment may lay out guidelines for when to activate a passive system, what areas should start with an SSDS, and what action levels must be met to facilitate development opportunities.

### Long-term OMM

The VI Study Area *does not have an area-wide long-term management or operations, maintenance, and monitoring plan*. Rather, the public, owners, and regulators rely upon site-specific building OMM plans. These plans only apply to buildings that have a mitigation system. Plans vary, depending on the building type and the mitigation system. Some may involve periodic indoor air monitoring. Additionally, should the regulatory agencies or and responsible party detect significant changes in groundwater concentrations or building-specific mitigation changes, additional monitoring of soil vapor or indoor air may be required.

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<sup>25</sup> Based on conversation with Alana Lee, EPA Project Manager, September 30, 2019

I find that an area-wide long-term management framework would provide better guidance to developers, regulators, and the City.

### Institutional Controls

In most regards I found that the ICs are adequate. However, there is still no site-wide Institutional Controls Implementation Plan as envisioned by the VI ROD Amendment.

Additionally, EPA (in response to comments on the 2010 ROD) stated that it requires notice to property owners and building occupants about the contamination and the remedy. Other than the standard documents associated with real estate purchase, it appears that this is not happening. Potential occupants of newly constructed buildings may be unaware that they are living, studying, or working on a federal Superfund Site or that there is TCE contamination under their buildings. Most are unaware if the air within their buildings has been tested.

One solution is to continue to hold outreach forums to inform residential owners and occupants about the nature of vapor intrusion. Another may be placing placards on buildings with information on the mitigation techniques employed. Another may be for the City and NASA to require building owners and employers to provide notice to occupants.

### Mountain View Requirements

While the City of Mountain View has worked closely with EPA and state environmental regulators since the discovery of contamination, reinforcing regulator oversight, it is unable to prescribe a vapor intrusion remedy in the absence of federal or state data.

It is possible that the City could require developers within all areas near known contamination to independently sample soil gas and use EPA's guidelines for determining mitigation strategies. Additionally, the City could require an assessment of preferential pathways, similar to those that are suggested in NASA's EIMP.

### NASA Development Requirements

NASA has produced two EIMP's: one on the NASA Research Park and the second for the Planetary Ventures lease. Each has included the requirement that the developer reduce the potential for lateral migration of VOCs in utility corridors. This is in addition to the VI ROD requirements for new construction. I've concluded that these requirements are a positive step in reducing some of the preferential pathways likely to accompany new construction. These requirements could be replicated by other jurisdictions where new construction is expected.

## **Recommendations**

The following is a list of recommendation, keeping in mind that initial questions that guided this memo:

- What can we as a community do to ensure that residents and other occupants of buildings above the Regional Plume are safe?
- Will residents and other occupants be aware of potential risks and what has been done to address them?

1. The ROD Amendment for accelerating groundwater cleanup should be completed as soon as possible. Preliminary standards regarding soil vapor and groundwater lines of evidence need further discussion and documentation.
2. The ROD Amendment should resolve the questions regarding the adequacy of passive systems. EPA should establish criteria to guide owners when to transform these systems to active mitigation.
3. EPA should err on the side of caution and require active mitigation in new construction above areas of the plume with high soil-gas and groundwater TCE concentrations. It should establish a bright line to guide where active systems are mandatory.
4. The parties responsible for cleanup, in consultation with building owners and operators as well as EPA, should develop a regional long-term management framework to guide building-specific Operations, Maintenance and Monitoring (OM&M) plans.
5. The Responsible Parties should fund development-related monitoring and mitigation activities within OU 3. When the area along Evandale was first identified, the MEW PRPs paid for additional investigation, including indoor air monitoring in circumscribed areas, and they funded a pilot study using in-situ chemical oxidation. However, the RPs have since refused to fund additional investigations and implementation of mitigation systems for properties within OU 3. EPA itself does not have funds for additional investigation or mitigation.<sup>26</sup>
6. EPA should continue to hold community outreach sessions. EPA and/or NASA should consider placing placards on buildings, other than single-family homes, that lie above the regional plume. The placards should explain the historic contamination, what has been done to protect occupants, and provide contact information. Additionally, EPA should provide guidance on how to notify owners and occupants in addition to the normal real estate disclosure process.
7. The City of Mountain View should amend its policy in areas with known VOC contamination to require that developers take steps to reduce the potential for lateral migration of VOCs in utility corridors.
8. The City of Mountain View should require developers of properties outside the VI Study Area to conduct soil vapor screening if the properties are located adjacent to or downgradient from known TCE or similar plumes. Adjacency distances may vary with plume containment, depth, and annual movement, but at a minimum, properties within 200 feet of a known plume should be evaluated.
9. NASA should develop strong notification requirements for newly constructed homes and buildings on leased lands in its upcoming Environmental Issues Management Plan. These will need to be monitored by NASA staff. Various federal and state agencies (the US Army, NASA, UC Berkeley) that have properties on Moffett Field should coordinate with NASA.

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<sup>26</sup> Based on conversation with Alana Lee, EPA Project Manager, February 13, 2020

## TABLES

Table 1: Tiering System for Future Construction

Response Action Tiering System for Future Commercial and Residential Buildings in Vapor Intrusion Study Area*		
Tier	Description	Response Action
<b>Tier A</b>	Future (new) building on property where lines of evidence (soil gas, sub-slab soil gas, crawlspace) indicate that there is the potential for vapor intrusion into the new building above indoor air cleanup levels.	Implement selected remedy to meet RAOs. Perform indoor air sampling after construction to confirm remedial action is effective.  Implement governmental and proprietary ICs (see Table 8).  Re-categorize as Tier 2 Existing Building.
<b>Tier B</b>	Future (new) buildings on properties where lines of evidence indicate there is no potential for vapor intrusion into the building exceeding EPA's indoor air cleanup levels.	Perform indoor air sampling after building is constructed to confirm that there is no potential vapor intrusion risk and indoor air cleanup levels are met.  If confirmed with EPA approval, then no action is required.
* Commercial or multi-family residential buildings constructed with aboveground raised foundations typically would be separated from the ground by a parking garage, which would allow adequate ventilation to prevent vapor intrusion into the occupied spaces. For this construction, perform targeted confirmation air sampling after building is constructed to verify absence of preferred pathways into building and to confirm indoor air cleanup levels are met. Site-specific soil gas screening levels may also be developed.		

Table 2: Maximum Concentrations Detected in Indoor Air—Residential Area

	MEW Area	Moffett Field Area	
Chemical	Maximum Indoor Air Concentration ( $\mu\text{g}/\text{m}^3$ )	Maximum Indoor Air Concentration ( $\mu\text{g}/\text{m}^3$ )	Indoor Air Screening Level ( $\mu\text{g}/\text{m}^3$ )
TCE	<b>1.3</b>	<b>4.2</b>	1
PCE	<b>13</b>	NT	0.4
Vinyl Chloride	0.13	0.03	0.2
Chloroform	<b>33*</b>	NT	0.1

Notes:

\*Result likely from indoor sources and not subsurface vapor intrusion

**Bold** indicates concentration exceeds indoor air screening level.

NT = Not tested

 $\mu\text{g}/\text{L}$  = micrograms per liter $\mu\text{g}/\text{m}^3$  = micrograms per cubic meter



**Table 3: Active versus Passive Mitigation Systems**

<b>Active</b>				<b>Passive</b>			
	Limitations	Benefits	Costs*		Limitation	Benefits	Costs*
Placement of venting system consisting of horizontal and vertical vent pipes installed under the slab and connected to a vacuum pump to extract the vapors from beneath the slab. Installed with a vapor barrier.	Requires on-going monitoring and maintenance of mitigation system.  Less favored by developers.  O&M costs and energy requirements  Perceived stigma	Up to 99% reduction in vapor intrusion is possible.  Easily tested (sub-surface pressure)  Easily modified  Can initially be passive (convert to active system if necessary)	Capital: \$1500–\$5,000, not including vapor barrier costs  Annual O&M: \$50 - \$400	Same as active system except not connected to a vacuum pump.	Vapor barriers must be robust  Integrity should be tested (more difficult to test than active)  Passive venting less effective and may not occur at all times  10-50% as effective as active systems	Favored by many developers  No active components or costs  Less stigma perceived	Capital: \$500–\$3,000, not including vapor barrier costs  Annual O&M: N/A.

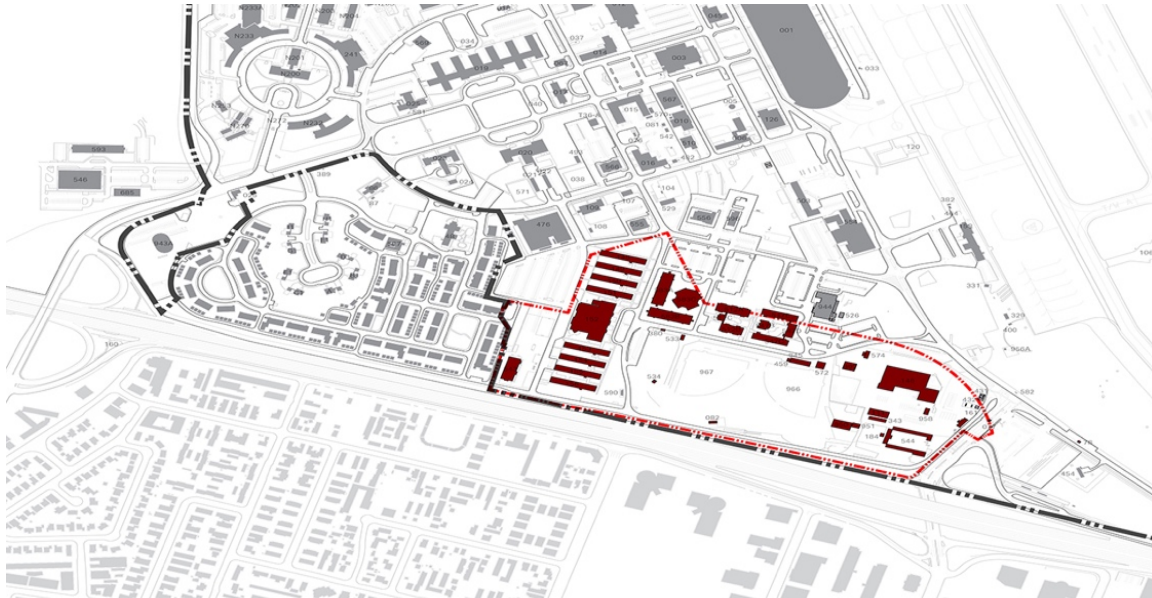
\* Cost information may be dated

Sources include <https://nepis.epa.gov/Adobe/PDF/P100AE72.pdf> and from **Vapor Intrusion Mitigation Workshop** April/May 2015 Presented by Robin Mongeon, P.E. NH Department of Environmental Services

**Figure 1: Vapor Intrusion Study Area and OU-3**



**Figure 2: Proposed New Housing and Development Area at Moffett Field**



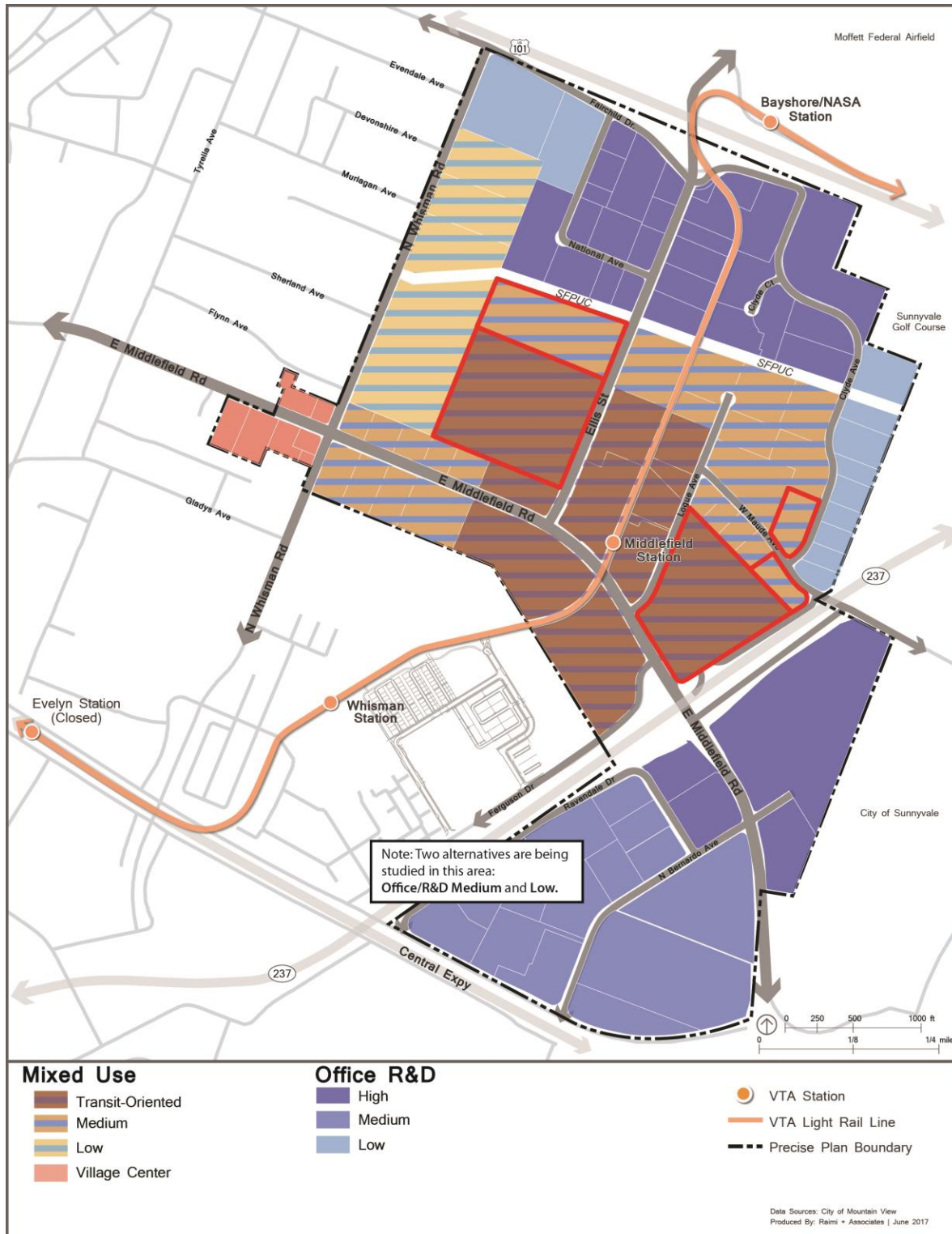
Source: NASA

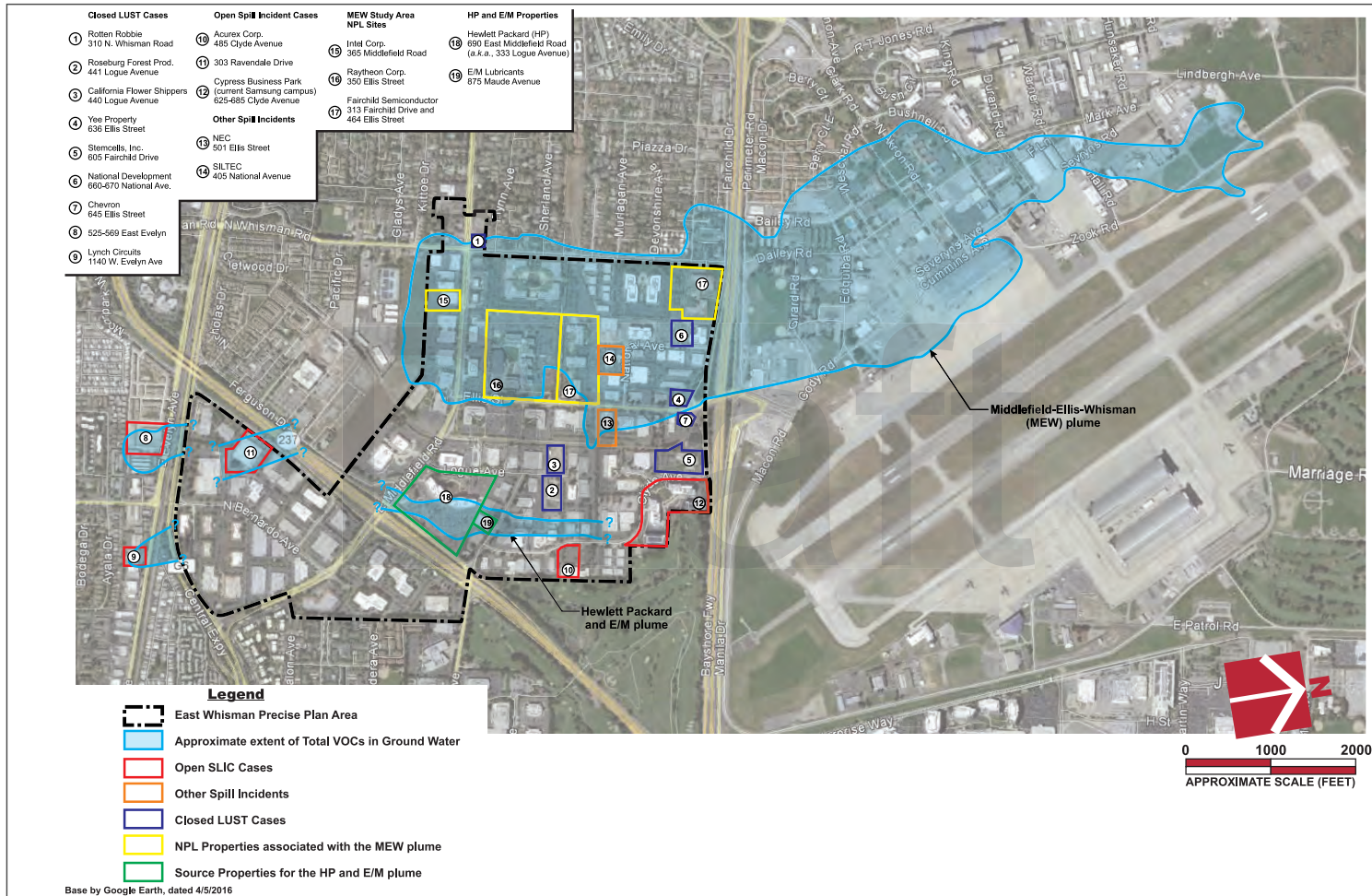


Source: University of California



Figure 3: East Whisman Precise Plan



**Figure 4: Overlay of EWPP with areas of known contamination**

SPILL INCIDENTS AND CONTAMINATED GROUNDWATER

East Whisman Precise Plan  
City of Mountain View

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Draft Environmental Impact R  
June

FIGURE 3.8