Proposed Plan for the Vapor Intrusion Pathway
Middlefield-Ellis-Whisman (MEW) Superfund Study Area
Mountain View and Moffett Field, California

Prepared by

U.S. Environmental Protection Agency Region 9

July 2009

NEW: Public Comment Period Extended

How You Can Comment on EPA's Proposed Plan

EPA will accept comments on this Proposed Plan during a **120-day public comment period** from **July 10 through November 7, 2009**. All written comments can be provided by letter, fax, or e-mail to Alana Lee, EPA Project Manager. Letters must be postmarked by **November 7, 2009**.

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See also EPA's website for EPA Updates:

www.epa.gov/region09/MEW

Contents

1.0 Introduction 1
2.0 Site Background 2
3.0 Site Characteristics 4
4.0 Scope and Role of the Response Action 6
5.0 Summary of Site Risks 6
6.0 Remedial Action Objectives 9
7.0 Summary of Remedial Alternatives 9
8.0 Evaluation of Alternatives 16
9.0 Preferred Alternative 21
10.0 Community Participation 28

Tables

1 EPA's Nine Evaluation Criteria for Superfund Remedial Alternatives
2 Existing Buildings: EPA's Comparison of Alternatives Using the NCP's Nine Evaluation Criteria
3 Future Buildings: EPA's Comparison of Alternatives Using the NCP's Nine Evaluation Criteria
4 Tiering System for Existing Commercial and Existing Residential Buildings in Vapor Intrusion Study Area
5 Tiering System for Future Commercial and Future Residential Buildings in Vapor Intrusion Study Area
6 EPA's Preferred Alternatives for Existing and Future Buildings in Vapor Intrusion Study Area

Figures

1 MEW Site Location and Vicinity
2 Estimated TCE Concentrations in Shallow Groundwater and Vapor Intrusion Study Area
3 Decision Flowchart for Existing Buildings
4 Decision Flowchart for Future Buildings

1.0 Introduction

The U.S. Environmental Protection Agency Region 9 (EPA) is seeking public comments on this **Proposed Plan** to address the potential **vapor intrusion pathway** at the Middlefield-Ellis-Whisman (MEW) Superfund Study Area (or Site) in Mountain View and Moffett Field, California. The vapor intrusion pathway is the means by which Site contamination in the subsurface may enter into buildings and impact indoor air quality. The Proposed Plan provides the Site background, explains the scope of the response action, evaluates alternatives for addressing the vapor intrusion pathway, identifies EPA's Preferred Alternatives, and provides the rationale for those preferences. EPA may modify the Preferred Alternatives or select another response action based on new information or public comments. Therefore, the public is encouraged to review all of the alternatives presented in this Proposed Plan. EPA will review and consider all comments received before it makes a final selection of alternatives.

What is the Vapor Intrusion Pathway?

Vapor intrusion is the migration of volatile chemicals from the subsurface into buildings. Volatile chemicals (i.e., those that evaporate into the air) may migrate upward through soil and enter into buildings through cracks in the floors, plumbing/piping conduits, utility corridors, or elevator shafts. The vapor intrusion pathway is complex, and indoor air quality is affected by many factors other than subsurface vapor intrusion, such as use of consumer products, building construction/use, and contributions from the same chemicals in outdoor air.

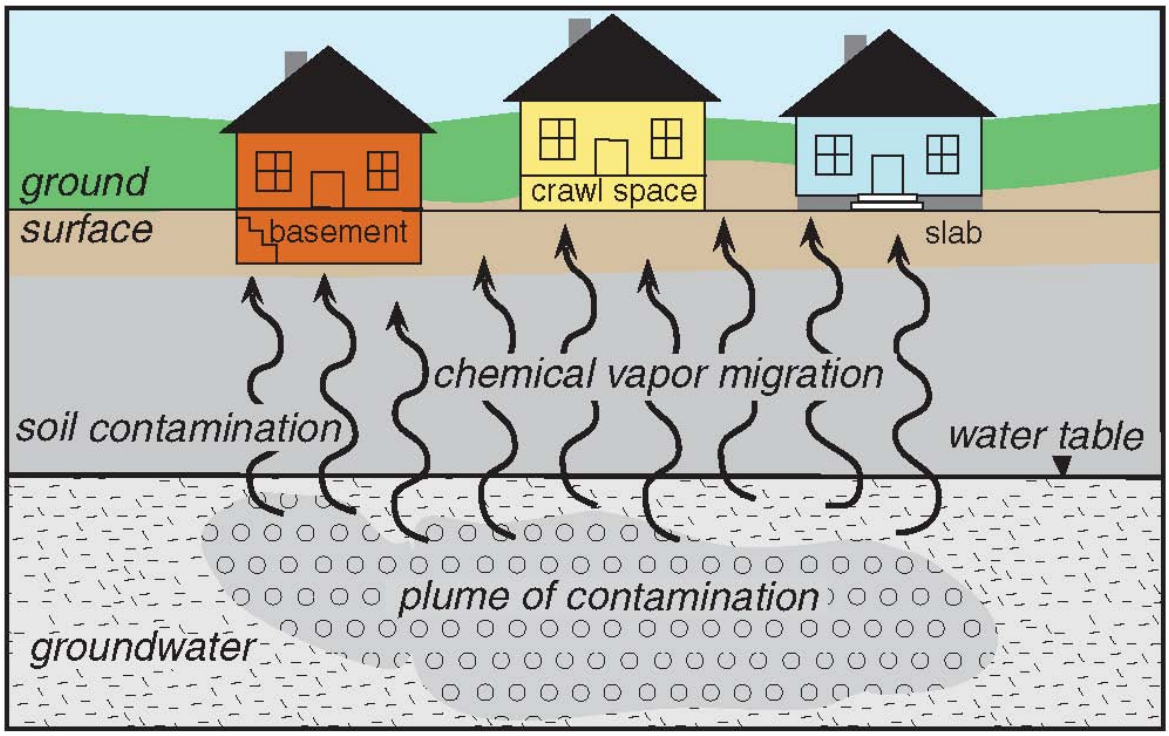
About this Proposed Plan

As the lead agency responsible for cleanup at the MEW Site, EPA has prepared this Proposed Plan to provide an opportunity for the community to participate in EPA's decision-making and remedy selection process for the vapor intrusion remedy. This Proposed Plan is being issued pursuant to the requirements of CERCLA (the **Comprehensive Environmental Response, Compensation, and Liability Act** of 1980), as amended by the Superfund Amendments and Reauthorization Act, also known as the Superfund Act, and to facilitate community involvement in the remedy selection at the MEW Site.

This Proposed Plan summarizes information that can be found in greater detail in the *Final Supplemental* ***Remedial Investigation*** *and* ***Feasibility Study*** *for the Vapor Intrusion Pathway for the MEW Study Area*, Mountain View and Moffett Field, California, dated June 2009 (Supplemental RI and FS), and other documents contained in the MEW Site **Administrative Record** Supplement for the Vapor Intrusion Pathway. These documents are available for public review at the information repositories listed on the back page (page 31) and several documents are posted on EPA's website (**http://www.epa.gov/region09/MEW**).

Consideration of public input is an important part of EPA's remedy selection process. EPA encourages all community members and other interested stakeholders to review this Proposed Plan and provide input to EPA. Your input can influence EPA's remedy selection decision. After consideration of all public comments, EPA will make a final determination and selection of the vapor intrusion remedy to be implemented at the MEW Site. EPA will provide responses to the comments received on the Proposed Plan in a **Responsiveness Summary**. The Responsiveness Summary and EPA's selected vapor intrusion remedy will be documented in an Amendment to EPA's 1989 **Record of Decision** (referred to as a ROD Amendment).

***Terms that appear in bold are defined in the glossary on page 29.**



Schematic of the Vapor Intrusion Pathway

2.0 Site Background

The MEW Site is located in Mountain View and Moffett Field, California, and includes three National Priorities List (NPL) sites or Superfund sites: Fairchild Semiconductor - Mountain View Site; Intel Corporation - Mountain View Site; and Raytheon Company Site. The MEW Site also includes former facilities that operated at the MEW Site, and portions of the former NAS Moffett Field Superfund Site. The groundwater contamination from the MEW area south of U.S. Highway 101 (Bayshore Freeway) migrates northward through the subsurface onto former NAS Moffett Field, where the contamination mixes with U.S. Navy and National Aeronautics and Space Administration (NASA) sources to form what is referred to as the "regional groundwater contamination plume."

The MEW Site location is shown on **Figure 1.**

During the 1960s and 1970s, several industrial companies, the U.S. Navy, and NASA conducted semiconductor, electronics, and other manufacturing and research activities at the MEW Site. Chemicals used in some of these operations were released into the subsurface and subsequently contaminated the soil and groundwater with **volatile organic compounds** (VOCs), primarily a chemical called trichloroethene (TCE).

TCE is a solvent that has been widely used by industry as a cleaning and degreasing agent.

The companies responsible for the contamination south of U.S. Highway 101 (referred to as the MEW Companies) no longer own or operate any facilities at the MEW Site. The land use at the MEW Site is primarily zoned for commercial and light industrial use and the land use over the western portion of the groundwater contamination plume is primarily residential use.

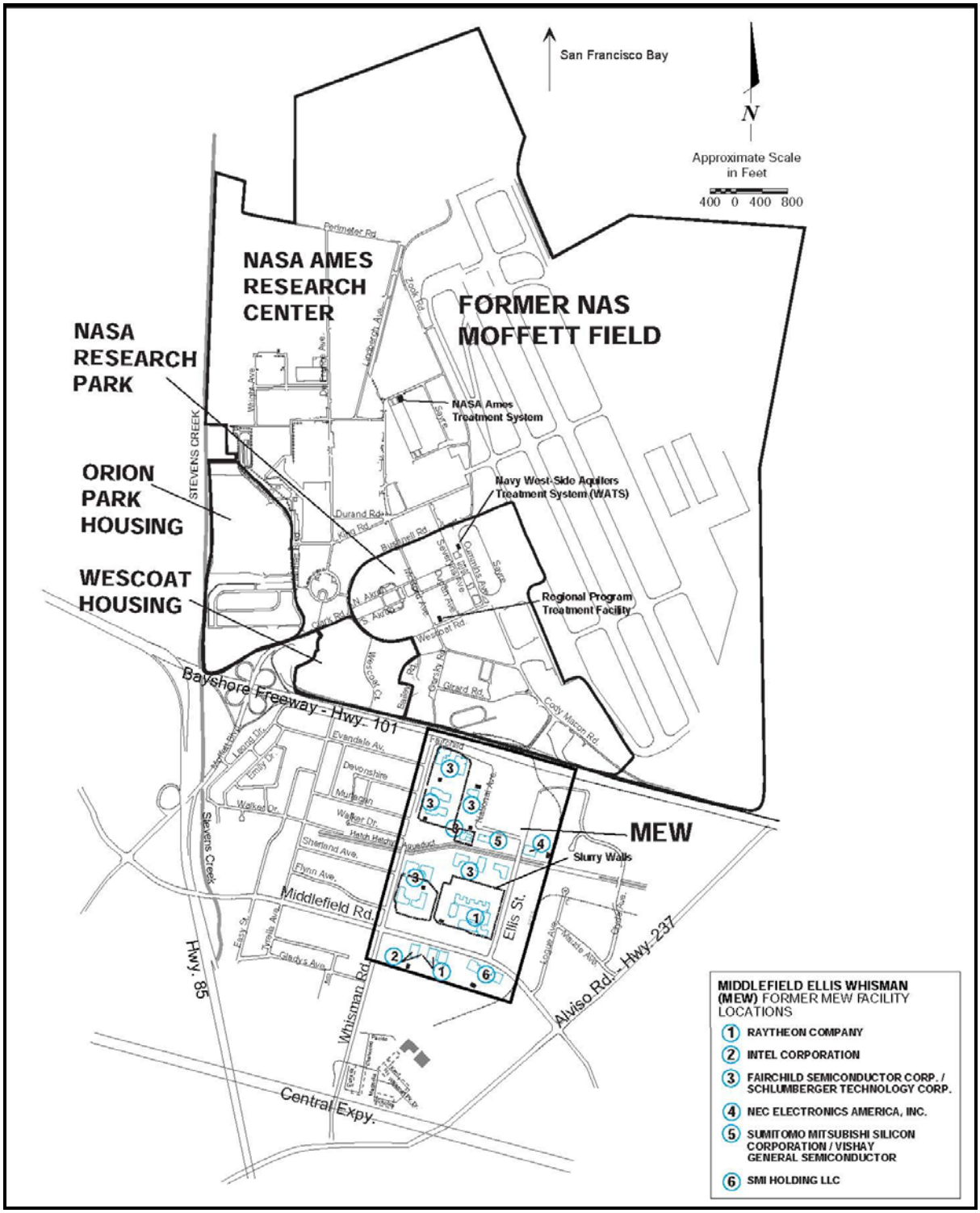


FIGURE 1
MEW Site Location and Vicinity

The former NAS Moffett Field, located just north of U.S. Highway 101, was owned and operated by the U.S. Navy until July 1994 when most of the property was transferred to NASA. The Moffett Community Housing Areas, including Wescoat Housing, were transferred to the Air Force in 1994 and then to the Army in 2001. The Wescoat Housing Area

was redeveloped in 2006 as part of a public-private partnership. Other uses of the former NAS Moffett Field property overlying the groundwater plume include air operations, administrative offices, various storage buildings, and historic structures. Chemicals historically used at the former NAS Moffett Field during dry cleaning, maintenance, and fuel operations were released into the soil and groundwater.

Soil and Groundwater Remedy

In June 1989, EPA issued a Record of Decision selecting the soil and groundwater cleanup remedy for the MEW Site. The soil cleanup remedy includes: (1) excavation, with treatment by aeration; and (2) soil vapor extraction, with treatment by vapor phase granular activated carbon. The soil cleanup has been completed at all the former MEW facilities.

The groundwater cleanup remedy includes: (1) slurry walls (barriers installed in the subsurface) to contain contaminant source areas; and (2) extraction and treatment systems to contain and clean up groundwater contamination using granular activated carbon and/or air strippers. Groundwater extraction and treatment began at the MEW Site in the 1980s and is ongoing. In 2003, based on community concerns, the air strippers were removed and replaced with other alternate treatment technologies.

The groundwater cleanup is expected to continue for many decades until concentrations of TCE and the other MEW Site contaminants of concern meet cleanup standards. It is important to note that groundwater is not currently used for drinking water or other household uses. Optimization efforts for the groundwater remedy are underway and alternative groundwater cleanup technologies to expedite cleanup are currently being evaluated and tested as part of a separate Site-wide Groundwater Feasibility Study.

Enforcement

The MEW Companies are conducting investigation and cleanup activities required by the 1989 ROD under a 1990 Administrative Order and a 1991 Consent Decree. The Navy is conducting cleanup activities pursuant to a Federal Facility Agreement (FFA) with EPA and the State of California for the NAS Moffett Field Site, which requires the Navy to remediate its source areas of contamination within the MEW regional groundwater plume area in accordance with EPA's 1989 Record of Decision for the MEW Site.

3.0 Site Characteristics

Groundwater flows beneath the MEW Site in shallow and deeper aquifers, separated by a clay layer approximately 40 feet thick. The shallow groundwater is approximately 10 to 20 feet below the ground surface south of U.S. Highway 101 and approximately 5 to 10 feet below the ground surface on Moffett Field north of U.S. Highway 101. Groundwater beneath the Site generally flows from the south to the north.

The contaminants of concern at the Site are: TCE, tetrachloroethene (PCE), vinyl chloride, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, chloroform, 1,1-dichloroethane, 1,2-dichlorobenzene, 1,1,1-trichloroethane, and Freon 113.

At this Site, it is the shallow TCE groundwater contamination that is the primary source for vapor intrusion into the existing and future buildings, accordingly, the Vapor Intrusion Study Area is generally defined by the area where TCE concentrations in shallow groundwater are greater than 5 micrograms per liter (µg/L), or parts per billion (ppb).

The Vapor Intrusion Study Area includes a 100 foot buffer zone beyond the estimated 5 ppb TCE plume boundary to account for the uncertainty of the depicted plume boundary. The estimated TCE concentrations in shallow groundwater and the Vapor Intrusion Study Area are shown in **Figure 2**.

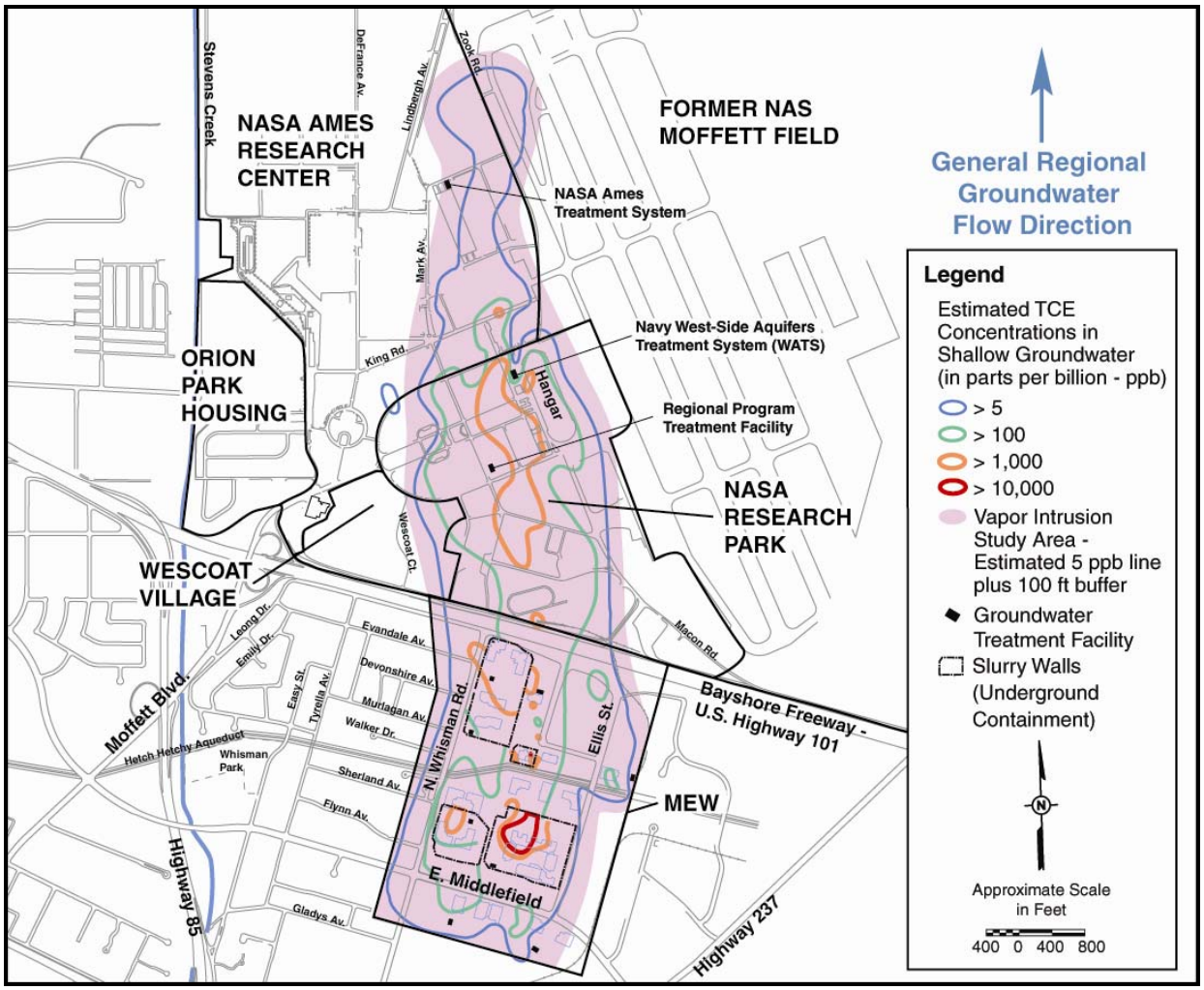


FIGURE 2
Estimated TCE Concentrations in Shallow Groundwater and Vapor Intrusion Study Area

South of U.S. Highway 101, there are over 60 commercial buildings and 80 residences within the Vapor Intrusion Study Area. North of U.S. Highway 101 on Moffett Field, there are an estimated 101 commercial and 14 multi-unit residential buildings within the Vapor Intrusion Study Area. NASA estimates 24 of its buildings are unoccupied and scheduled to be demolished as part of NASA's redevelopment plans.

4.0 Scope and Role of the Response Action

This response action will address the potential health risks associated with long-term exposure to TCE and other MEW Site chemicals of concern through the vapor intrusion pathway in current and future buildings overlying the shallow groundwater contamination at the MEW Site. TCE is the primary contaminant of concern for the vapor intrusion pathway at the MEW Site, although the potential exists for other Site chemicals of concern, such as PCE and vinyl chloride, to enter indoor air at levels of concern. The vapor intrusion pathway may cause exposure to Site-related contaminants for current and future occupants of buildings, including workers and residents, within the Vapor Intrusion Study Area.

This remedy for the vapor intrusion pathway will be incorporated into the overall Site remedy through an amendment to the 1989 Record of Decision.

5.0 Summary of Site Risks

Baseline Human Health Risk Assessment

A baseline human health risk assessment for the MEW Site is summarized in the 1988 "Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California" (Endangerment Assessment). For those exposure pathways that were evaluated in the Endangerment Assessment, the exposure assumptions that were used are considered both conservative and reasonable in evaluating risk. The Environmental Assessment focused on the potential for future exposure to contamination if the groundwater and its contaminant sources were left untreated, and if that water was used for domestic purposes (e.g., drinking, showering, washing). Although groundwater at the MEW Site is not currently used for drinking water or other domestic purposes, cleanup actions are being taken at the Site to restore groundwater to its potential beneficial use.

Based on the understanding of the inhalation pathway at the time, the Endangerment Assessment concluded that potential exposure to Site contaminants through the inhalation pathway presented negligible risks, and no Remedial Action Objectives for mitigating the subsurface vapor intrusion pathway were identified. Therefore, the MEW Site soil and groundwater remedy did not address potential long-term exposure risks from TCE and other chemicals of concern through the vapor intrusion pathway. However, since the issuance of EPA's 1989 Record of Decision, new information has been developed regarding the toxicity of TCE and the potential for vapor intrusion into buildings overlying shallow groundwater contamination.

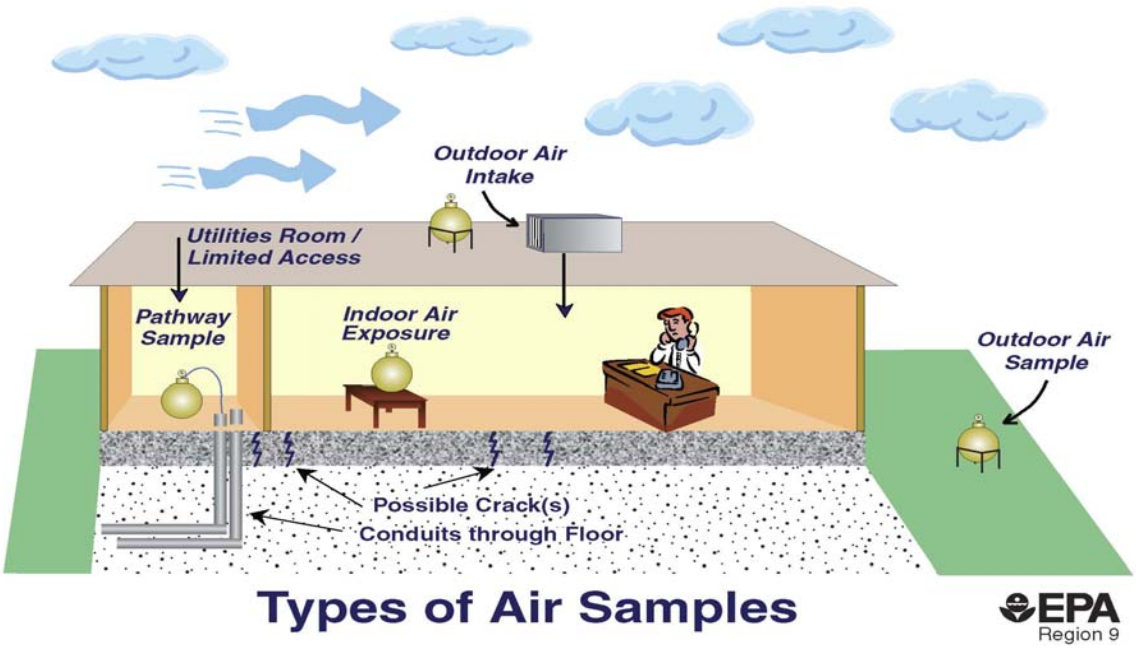
Subsurface Vapor Intrusion Pathway

Since 1988, EPA's understanding of the way chemicals migrate from the subsurface soil and groundwater to the indoor air has evolved. We now understand that volatile contaminants (meaning those that evaporate into the air, such as VOCs) can migrate upward as vapors from the soil and/or groundwater and enter overlying buildings. These vapors can then collect inside the buildings and affect indoor air quality.

In October 2002, EPA required the MEW Companies to evaluate the potential vapor intrusion pathway into buildings overlying shallow TCE groundwater at the MEW Site. In November 2002, EPA issued draft guidance, *"Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils"* that focuses specifically on evaluation of this pathway.

Scope of the Supplemental Remedial Investigation for the Vapor Intrusion Pathway

Between 2003 and 2008, the MEW Companies, NASA, U.S. Navy, and EPA collected over 2,800 air samples from 47 commercial buildings and 31 residences at the Site. The types of samples collected at the Site include indoor air, pathway air, outdoor ambient air, EPA outdoor reference and MEW/NASA background outdoor air, and quality assurance samples. Indoor air samples were collected in occupied or potentially occupied areas in the breathing zone (approximately 3 to 5 feet above the floor). Pathway samples were collected in areas where potential conduits (such as utilities, cracks in the floor, or penetrations through slab) into the building were observed that might provide a direct route for VOC vapor migration into the building. Outdoor ambient air samples were collected immediately outside the building, including near the air intake to a commercial building. The purpose of these samples is to compare them to indoor samples to evaluate the potential contribution of VOCs from outside air to indoor air. Additionally, EPA outdoor reference and MEW/NASA background outdoor air samples were collected at a distance of 0.25 to 1.5 miles away from the MEW Site to assess background levels of VOCs in the general area. The quality assurance samples included: duplicate samples, EPA co-located samples analyzed at EPA's laboratory, and blank samples.



EPA Screening Criteria

The indoor air results were evaluated against EPA's short-term and long-term exposure criteria: (1) short-term health-based screening levels; (2) long-term health-based screening levels, and (3) outdoor ambient air. Importantly, none of the indoor air breathing zone samples taken to date indicates any immediate or short-term health threat to building occupants from the vapor intrusion pathway. Therefore, EPA's focus here is whether the TCE and other Site chemicals of concern in indoor air pose an unacceptable risk of chronic health effects from long-term exposure (defined as 25 years for commercial/non-residential exposure and 30 years for residential exposure). It is EPA's policy not to set cleanup levels or take action to reduce levels that are less than outdoor ambient air concentrations.

Findings of the Supplemental Remedial Investigation for the Vapor Intrusion Pathway

The Supplemental Remedial Investigation presents the data collected and assesses the nature and extent of the potential vapor intrusion pathway by collecting indoor air samples in 47 commercial buildings and 31 residences overlying the shallow groundwater contamination. TCE is the primary chemical of concern and is the focus of the investigation and analysis.

The Supplemental Remedial Investigation supports the following conclusions:

- Indoor air results indicate there are no immediate or short-term health concerns.
- TCE was detected above EPA's interim action level[1] in several commercial buildings and a few residences within the Vapor Intrusion Study Area. Discrete mitigation measures (i.e., sealing conduits, enhanced ventilation, air purifiers, sub-slab vapor mitigation systems for new development) were implemented and were successful in reducing indoor TCE concentrations to below the interim action level.
- There is a general decrease of TCE concentrations with increasing air exchange rates. Vapor intrusion resulting in concentrations above interim action levels appear to be more likely to occur in commercial buildings in the Vapor Intrusion Study Area when HVAC systems do not provide sufficient air exchanges with outside air in all or part of a building.
- In general it appears that buildings overlying the higher groundwater concentrations have a higher likelihood of indoor air samples exceeding the TCE action level.
- The highest indoor TCE concentrations were found in a building with a basement in which there is direct contact with groundwater (644 National Avenue). Elevated concentrations were also found in a NASA building in which the ventilation system introduced air from beneath the raised floor into the building (N210).

Detailed results of the Remedial Investigation are presented in the 2009 *Final Supplemental Remedial Investigation for the Vapor Intrusion Pathway.*

Supplemental Feasibility Study for the Vapor Intrusion Pathway

Based on the findings of the Supplemental Remedial Investigation, the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway* evaluated a range of remedial alternatives that can be used to mitigate potential vapor intrusion into current and future buildings in the Vapor Intrusion Study Area.

EPA developed this Proposed Plan based on information presented in the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway*, as well as other Site documents in the MEW Site Administrative Record.

EPA has determined that the Preferred Alternatives identified in this Proposed Plan are necessary to protect public health of building occupants in the Vapor Intrusion Study Area from actual or threatened releases of hazardous substances into the environment via the subsurface vapor intrusion pathway.

[1] During the Supplemental Remedial Investigation, EPA used an interim action level of 2.7 $\mu g/m^3$ for commercial buildings and 1 $\mu g/m^3$ for residential buildings. Subsequent to the Remedial Investigation, EPA established an action level of 5 $\mu g/m^3$ for commercial buildings and 1 $\mu g/m^3$ for residential buildings. For more information, see the Final Supplemental Feasibility Study for the Vapor Intrusion Pathway.

6.0 Remedial Action Objectives

The Remedial Action Objectives for the Site established in the 1989 ROD were to reduce levels of chemicals in groundwater (and chemical sources to groundwater) so that the groundwater could ultimately be used for domestic and drinking water purposes. At that time, no remedial action objectives for the vapor intrusion pathway were identified.

One of the Remedial Action Objectives to be addressed by the vapor intrusion remedy is to ensure that building occupants (workers and residents) are protected from Site contamination by preventing subsurface Site contaminants from migrating into indoor air or accumulating in enclosed building spaces at levels of concern.

Another Remedial Action Objective is to reduce or minimize the source of vapor intrusion (i.e., Site contaminants in shallow groundwater) to levels that would be protective of current and future building occupants, such that the need for a vapor intrusion remedy would be minimized or no longer be necessary. ***This 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.***

EPA Region 9 Indoor Air Action Levels

Although cleanup standards for VOCs in air have not yet been promulgated, in 2008, EPA Regions 3, 6, and 9 published a set of Regional Risk Screening Levels (RSLs), formerly known in Region 9 as Preliminary Remediation Goals or PRGs, for certain VOCs. RSLs are not cleanup standards, but are risk-based concentrations used to assist risk assessors and others in initial screening-level evaluations of environmental measurements. The RSLs are general in that they are calculated without using site-specific information.

For the MEW Site, EPA used the RSLs and Site-specific information to determine Site-specific risk-based action levels. Specifically, at the MEW Site, EPA is using TCE indoor air action levels of 1 $\mu g/m^3$ of TCE in air for residential buildings and 5 $\mu g/m^3$ of TCE in air for commercial buildings. EPA derived these action levels using the EPA provisional health protective range for TCE and the California EPA's (Cal/EPA's) health-based screening level for long-term exposure to TCE. Action levels also have been developed for the other MEW Site contaminants of concern and are listed in the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway.*

7.0 Summary of Remedial Alternatives

This section summarizes the remedial alternatives developed in the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway*. Because each building type and its associated conditions are different, several alternatives are discussed in order to allow the appropriate one to be selected for a particular building type. Note: EPA combined the "No Action" Alternative with the "Monitoring" Alternative discussed in the Final Supplemental Feasibility Study report to form a single "No Action with Monitoring" Alternative and re-numbered the alternatives accordingly.

Common Elements

Each alternative consists of an appropriate engineering control and institutional control. **Institutional controls** (ICs) are non-engineered remedy components that are part of each of

the remedial alternatives, except the "No Action with Monitoring" Alternative. ICs are necessary for a variety of functions, including ensuring access for sampling, ensuring operation of the remedy itself in certain instances, providing vapor intrusion mitigation requirements for future building construction, and providing information about the Site and the vapor intrusion remedy to the public and prospective property and building owners and tenants.

None of the alternatives presented will rely solely on ICs. EPA's preferred IC for the vapor intrusion remedy is a municipal ordinance, which would apply to all the remedial alternatives, except for the "No Action" Alternative. See the Summary of ICs at the end of this section.

Monitoring to verify the effectiveness of the remedy is a component of each alternative. Additionally because the vapor intrusion remedy will be IC-intensive, ongoing ICs monitoring will be necessary to ensure the remedy is effective over the long-term. This monitoring will be conducted through each of the ICs mechanisms themselves. Monitoring activities, schedules, and task responsibilities will need to be detailed in the Institutional Controls Implementation Plan (ICIP), which will be incorporated into the Operations and Maintenance Plan. For overall monitoring, there will need to be a system for tracking the remedy and its applicable ICs at each property.

Cost estimates provided for each remedial alternative for the commercial building scenario are based on a one-story, 20,000 square-foot building. Cost estimates for the residential building scenario is based on a one-story, 2,000 square-foot building. The **present worth costs** are for 30 years of operation and maintenance of the remedy and are calculated using a real discount rate of 7 percent, in accordance with EPA's *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (2000) for non-federal facilities. The cost estimates presented below are for engineering controls and associated operations and maintenance (O&M) and are on a per-building basis; however, Alternatives 2 through 5 will also have an additional IC cost of a municipal ordinance that would be applied on a Site-wide basis (for the Vapor Intrusion Study Area south of U.S Highway 101 in the City of Mountain View). The estimated cost to prepare and adopt an ordinance is approximately $25,000, and the annual cost to monitor and enforce the performance of the ordinance is approximately $23,000, resulting in a 30-year present worth cost of $310,000. These costs are not included under the alternatives descriptions below because they would be Site-wide costs (for the Vapor Intrusion Study Area south of U.S Highway 101) that would apply regardless of the number of buildings.

Summary of Remedial Alternatives for the Vapor Intrusion Pathway

Alternative	Description
1	No Action with Monitoring
2	Heating, Ventilation, and Air Conditioning (HVAC) System, Monitoring, and ICs
3	Sub-slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs
4A	Sub-slab Depressurization, Monitoring, and ICs
4B	Sub-membrane Depressurization, Monitoring, and ICs
5	Sub-slab Pressurization with Vapor Barrier, Monitoring, and ICs

Alternative 1: No Action with Monitoring

CERCLA requires that a "no action" alternative be evaluated. This establishes a baseline for comparison to other remedial alternatives. Under this alternative, EPA would not utilize any active remedy at the Site to prevent exposure to Site contaminants in indoor air from the vapor intrusion pathway. Only monitoring would be performed to evaluate the potential for vapor intrusion, or to verify the presence or absence of the vapor intrusion pathway, into specific buildings. This monitoring may consist of one or a combination of the following:

- Groundwater monitoring: Trends in groundwater concentrations and water levels can be used to assess whether the potential for vapor intrusion is increasing or decreasing. Definition of the plume boundaries would indicate if the Vapor Intrusion Study Area should be modified.
- Air samples: Indoor and outdoor air samples provide empirical information on the concentrations of Site VOCs in the enclosed space and potential impact on indoor air quality from the vapor intrusion pathway. These results can be used to determine whether a building may need engineering controls to mitigate the vapor intrusion pathway.
- Soil gas samples: Sub-slab soil gas and soil gas samples can be used as one line of evidence to assess the potential vapor intrusion pathway into a building. Site-specific data and other lines of evidence would be necessary to supplement this information.

Multiple lines of evidence would be used in the monitoring strategy.

This Alternative is applicable to existing and future commercial and residential buildings.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $0
Estimated Annual O&M Cost: $2,400
Estimated Present Worth Cost: $30,000

Residential (for a 2,000 square foot building):
Estimated Capital Cost: $0
Estimated Annual O&M Cost: $900
Estimated Present Worth Cost: $11,500

Alternative 2: HVAC System, Monitoring, and ICs

Heating, Ventilation, and Air Conditioning (HVAC) systems provide mechanical ventilation of building air, bringing outdoor air into the building enclosure and venting indoor air to the outdoors. The net effect of using an HVAC system is the exchange of indoor air with outdoor air allowing VOCs to be removed from the building. If the HVAC system is operated at a high enough level, it causes the building to be under positive pressure, preventing contaminants from the subsurface from entering the building; at lower levels it acts to dilute the concentration of VOCs that have already entered the building with outdoor air.

As part of this alternative, all identified direct and leaking conduits that serve as a pathway for vapors from the subsurface to migrate into the building enclosure would be sealed. In addition, air purifier units may be utilized as part of this alternative as an add-on technology to reduce VOC concentrations in where there is inadequate outside make-up air. This alternative requires operation of the HVAC systems at levels sufficient to keep the concentrations of VOCs below action levels for long-term exposure.

This alternative can be implemented in existing and future commercial buildings. HVAC systems are not typically installed in residences in the Vapor Intrusion Study area and are therefore Alternative 2 is not retained for residential buildings.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $4,500 to retrofit existing system; $140,000 for new system
Estimated Annual O&M Cost: $3,400
Estimated Present Worth Cost: $50,000 for existing building; $185,000 for future building

Residential (for a 2,000 square foot building): Not Applicable

Alternative 3: Sub-slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs

A sub-slab passive ventilation system uses slight pressure differences to force contaminant vapors to flow away from the building enclosure rather than allowing contaminant vapors to enter from beneath the building foundation. Construction of a sub-slab passive ventilation system involves installation of a venting layer below the floor slab that allows soil gas to move laterally beyond the building footprint by natural diffusion or pressure gradients. This alternative also requires installation of a vapor barrier, because passive venting relies in part on soil gas not entering the building before it is vented to the outside.

A passive system includes installation of perforated pipes within a gravel and/or sand layer manifolded to vent risers. At the end of the vent risers there is a wind-driven turbine that exerts a slight negative pressure in the subsurface and induces flow from the subsurface to the outside. Also, differential barometric pressures throughout the day can generate a pressure differential and enhance the air flow. A sub-slab passive ventilation system contains no active mechanical equipment. However, the passive ventilation system would be designed so that it could easily be converted to an active ventilation system, if needed, by adding a fan.

This alternative is applicable for future commercial and residential buildings. This alternative is not practical for existing residential or commercial structures because of the difficulty of placing a venting layer under slabs of existing buildings. In addition, a vapor barrier can only be installed in new buildings.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $175,000
Estimated Annual O&M Cost: $2,400
Estimated Present Worth Cost: $207,500

Residential (for a 2,000 square foot building):
Estimated Capital Cost: $25,000
Estimated Annual O&M Cost: $900
Estimated Present Worth Cost: $36,500

Alternative 4A: Sub-slab Depressurization, Monitoring, and ICs

A sub-slab depressurization (SSD) system actively pulls soil gas from beneath the slab and vents it to the atmosphere typically at a height above the roof and away from windows and air supply intakes. The SSD functions by creating a pressure differential across the building slab that acts to draw indoor air down into the subsurface thus keeping subsurface air from moving upward into the building. When the system is operating, soil gas generally cannot flow from under the slab foundation into the building. SSD systems are generally considered

the most reliable, cost effective, and efficient technique for controlling vapor intrusion into buildings.

A SSD system has components similar to a passive venting system except that the SSD system is equipped with a fan or blower that draws soil gas through the sub-slab venting layer. To install SSD systems at existing buildings, one or more holes are cut into the existing slab, soil is removed from beneath the slab to create an open hole or "suction pit," and vertical suction pipes are placed into the holes. The pipes are then manifolded together and connected to a fan or blower that draws soil gas from beneath the slab through the piping and vents it outdoors.

As part of this alternative, all identified direct and leaking conduits that serve as a pathway for vapors from the subsurface to migrate into the building would be sealed prior to implementation of the system. This alternative is applicable to existing and future commercial and residential buildings with slab foundations.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $177,000 for existing building; $113,000 for future building
Estimated Annual O&M Cost: $11,100 for existing building; $9,600 for future building
Estimated Present Worth Cost: $325,000 for existing building; $241,000 for future building

Residential (for a 2,000 square foot building):
Estimated Capital Cost: $5,000 for existing building and $19,200 for future building
Estimated Annual O&M Cost: $1,400
Estimated Present Worth Cost: $24,000 for existing building and $38,000 for future building

Alternative 4B: Sub-membrane Depressurization, Monitoring, and ICs

A sub-membrane depressurization (SMD) system is similar to a SSD system except that a SMD system is typically used for a building with a crawlspace or where a slab foundation is absent (e.g., building with earthen cellar or basement). A membrane is installed to help create the pressure differential in the subsurface. The SMD creates lower sub-membrane air pressure relative to the crawlspace air pressure by use of a fan-powered vent to draw air from soils under the membrane. The membrane could consist of polyethylene materials or plastic liner sheeting placed over the earthen or gravel area. The membrane must be sealed along the edges of the foundation wall or footings and at pipe penetrations through the membrane.

As part of this alternative, all identified direct and leaking conduits that serve as a pathway for vapors from the subsurface to migrate into the building enclosure would be sealed prior to implementation of the system.

This alternative can be implemented in existing and future commercial and residential developments with crawlspaces.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $183,000 for existing building; $76,000 for future building
Estimated Annual O&M Cost: $11,100 for existing building; $9,600 for future building
Estimated Present Worth Cost: $331,000 for existing building; $203,000 for future building

Residential (for a 2,000 square foot building):
Estimated Capital Cost: $18,000 for existing building; $15,000 for future building
Estimated Annual O&M Cost: $1,400
Estimated Present Worth Cost: $60,000 for existing building; $56,500 for future building

Alternative 5: Sub-slab Pressurization with Vapor Barrier, Monitoring, and ICs

A sub-slab pressurization (SSP) system is similar to a SSD system except that fans push air from the building footprint downward into the area below the slab rather than pulling that air out around the building. A SSP system works by increasing sub-slab air pressure above ambient levels, thereby forcing soil gas from the subsurface to the sides of the building where it vents from exhaust vents around the boundary of the building. A SSP system also requires surface coatings or installation of a vapor barrier to prevent air that is forced into the system from entering the building through cracks and openings, which is called short-circuiting. Types of surface coatings include epoxy paints, asphaltic coatings, and polyurethane caulk. Vapor barriers could be either synthetic liners or seamless, spray-applied membranes.

This alternative is applicable for future commercial and residential buildings. This alternative is not practical for existing residential or commercial buildings because of the difficulty of placing a venting layer under the slabs of existing buildings. In addition, the vapor barrier can only be installed beneath new buildings.

Commercial (for a 20,000 square foot building):
Estimated Capital Cost: $ 192,000
Estimated Annual O&M Cost: $9,600
Estimated Present Worth Cost: $318,500

Residential (for a 2,000 square foot building):
Estimated Capital Cost: $ $29,000
Estimated Annual O&M Cost: $1,400
Estimated Present Worth Cost: $48,000

Summary of Institutional Controls (ICs)

ICs are non-engineered legal and administrative instruments that help to minimize the potential for human exposure to contamination and protect the integrity of an engineered remedy. There are four categories of ICs: government controls; proprietary controls; enforcement tools with IC components; and informational devices. Each of these types of ICs can be used, alone or in combination, to ensure the protectiveness of an engineered remedy. Below is a summary of the preferred ICs. See the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway* for more detailed information and an evaluation of each of the ICs considered.

The purpose of the ICs for the vapor intrusion remedy will be to: (1) ensure that the engineering controls used to prevent levels of indoor contaminants associated with the vapor intrusion pathway from reaching EPA's action level are operated and/or monitored as required by the remedy; (2) ensure that the appropriate engineering controls are installed into any new development at the Site; (3) provide information to building owners and occupants regarding the appropriate vapor intrusion remedy for each building; (4) provide information to EPA and the MEW Parties regarding, among other things, new construction and changes of property ownership within the Vapor Intrusion Study Area.

Government controls can include the adoption of a municipal ordinance. With a municipal ordinance, a local government can designate an area that requires special treatment in order to protect health and safety and place requirements on property owners in that area accordingly. Here, a municipal ordinance could include requirements that commercial buildings operate their HVAC systems in compliance with the vapor intrusion remedy; that vapor mitigation

measures be included in newly constructed buildings within the Vapor Intrusion Study Area; and that access be provided for inspection, sampling, and remediation activities.

North of U.S. Highway 101 on Moffett Field, NASA uses its *Environmental Issues Management Plan* as a decision framework for the management of residual chemicals in soil and groundwater at NASA Research Park for new development. The *Environmental Issues Management Plan* already includes certain measures to be implemented in future development at NASA Research Park to address the vapor intrusion pathway. EPA could work with NASA to ensure that other areas on Moffett Field within the Vapor Intrusion Study Area are addressed under a framework like NASA's *Environmental Issues Management Plan*.

Because a municipal ordinance could similarly address the entire Vapor Intrusion Study Area south of U.S. Highway 101, it would be an efficient mechanism to implement the various Preferred Alternatives for each building type and condition. The City of Mountain View itself would have to adopt the ordinance, and even then, a municipal ordinance cannot be considered permanent because a City can revoke an ordinance at will. Once adopted, however, use of a municipal ordinance can be an effective long-term method to ensure remedy implementation.

Recorded covenants act as proprietary controls for a remedy. A recorded covenant is an agreement between one landowner and another to use or refrain from using the property in a certain manner. Covenants could be negotiated between property owners and the MEW Parties, designating EPA as a third party beneficiary. Covenants can achieve, on a building-by-building basis, the same actions that could be required by a municipal ordinance. Covenants only need to be negotiated once for each property, because once recorded, they "run with the land," meaning that they are binding on all subsequent owners of that property, and as a third party beneficiary, EPA would be able to enforce the covenants directly. For these reasons, covenants are considered permanent. However, obstacles to implementation of recorded covenants include the large number of properties involved in the Vapor Intrusion Study Area and potential resistance from property owners to recording such requirements on their title and other community opposition. Additionally, because of the number of covenants required, there may be inconsistency among the covenants.

EPA's Preferred Institutional Control

EPA's Preferred IC for the vapor intrusion remedy is a municipal ordinance for the Vapor Intrusion Study Area south of U.S. Highway 101 in Mountain View because it can achieve the ICs objectives most efficiently and consistently. However, if a municipal ordinance is not adopted, EPA's Preferred IC is recorded covenants. If recorded covenants are determined to be infeasible in certain circumstances, EPA will analyze the other IC mechanisms considered in the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway* and will determine which other mechanisms, or combination thereof, would be able to achieve the IC objectives and adequately protect human health.

8.0 Evaluation of Alternatives

EPA uses nine evaluation criteria specified in the **National Contingency Plan** (NCP) to select a remedy. **Table 1** below summarizes the nine criteria used to evaluate each remedial alternative and compare them to one another. The discussion below evaluates the relative performance of each alternative using the first seven of the nine criteria, noting how it compares to other options under consideration. The two remaining criteria – State Acceptance and Community Acceptance – will be evaluated after public comments are received on this Proposed Plan.

TABLE 1 EPA's Nine Evaluation Criteria for Superfund Remedial Alternatives
1. Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional control, engineering controls, or treatment.
2. Compliance with ARARs evaluates whether the alternative meets Federal and State environmental statues, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
3. Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
8. State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the Remedial Investigation, Feasibility Study, and Proposed Plan.
9. Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

1. Overall Protection of Human Health and the Environment

All of the alternatives, with the exception of Alternative 1 (No Action with Monitoring), would potentially provide adequate protection of human health and the environment as long as they are implemented, operated, and maintained sufficiently. The No Action with Monitoring Alternative (Alternative 1) would not eliminate, reduce, or control risk through any engineering and management controls, and would not be protective of human health and the environment. ***Therefore, Alternative 1 is eliminated from discussion under the remaining eight criteria.***

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Title 22 of the California Code of Regulations, Section 67391.1 may be an applicable or relevant and appropriate requirement (ARAR) for this remedy. This regulation requires the placement of a land use covenant on properties where hazardous wastes, constituents, or substances are left in place such that there cannot be unrestricted land use. However, where other ICs can provide the same level of protectiveness as covenants, this ARAR may be waived. Additionally, Section 67391.1 acknowledges that there may be circumstances where it is determined that placement of a land use covenant is not feasible, and, in those instances, other institutional control mechanisms may be used to require that future land use will be compatible with the level of hazardous substances left on the property. When implemented along with appropriate ICs, or combination of ICs, all of the alternatives would be able to meet this ARAR.

3. Long-term Effectiveness and Permanence

Alternative 3 (Sub-Slab Passive Ventilation with Vapor Barrier, Monitoring, and ICs), Alternatives 4A/B (SSD/SMD, Monitoring, and ICs), and Alternative 5 (SSP with Vapor Barrier, Monitoring, and ICs) all work to prevent the entry of VOCs into the building at levels exceeding action levels for long-term exposure. Indoor concentrations would be similar to outdoor air concentrations, and the risks would be similar to those found from breathing outdoor air. Alternatives 4A/B, in particular, have been demonstrated to be highly effective in controlling vapor intrusion in both new and existing buildings, and is therefore ranked the highest. However, the long-term effectiveness and permanence of these alternatives are dependent on proper operation and maintenance.

Alternative 2 (HVAC System, Monitoring, and ICs) can keep Site-related VOC concentrations in buildings under action levels if the HVAC systems are operated and maintained in accordance with the remedy. However, because the HVAC systems would be operated by building owners/operators and not directly by the PRPs, this remedy would rely heavily on ICs, to ensure that HVAC systems are operated and maintained in accordance with the remedy, so that indoor air concentrations would be reduced to and remain below levels of concern.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Unlike typical remedial alternatives to address contamination, remedial alternatives for vapor intrusion are not necessarily designed to reduce the toxicity, mobility, and volume through treatment of the Site contaminants. This is accomplished by directly addressing the subsurface shallow groundwater contamination, which is not part of the vapor intrusion component of this remedy. Remediation of the subsurface shallow groundwater is being conducted in accordance with the 1989 Record of Decision.

5. Short-term Effectiveness

All of the alternatives are protective of worker's health during construction, if any construction is to occur. Standard construction procedures would be implemented. There are no additional risks to the environment during the implementation of these alternatives. All alternatives could be implemented in a short-term time frame to effectively reduce VOC concentrations to below action levels for long-term exposure.

6. Implementability

Alternative 2 (HVAC System, Monitoring, and ICs) is generally implementable to existing and future commercial buildings. Alternatives 4A/B (SSD/SMD, Monitoring, and ICs) are technically feasible in most buildings, but implementability in large existing building may be difficult in some buildings. Alternative 3 (Sub-Slab Passive Ventilation with Vapor Barrier, Monitoring, and ICs) and Alternative 5 (SSP with Vapor Barrier, Monitoring, and ICs) are highly difficult to implement at existing buildings. All of the alternatives are implementable and feasible for future commercial and residential buildings.

A municipal ordinance requiring that any of the alternatives be implemented would be the most efficient institutional control to ensure implementation of the engineering alternatives. The City has the authority to adopt a health and safety ordinance. However, the actual adoption of an ordinance would require several steps. The ordinance would have to be developed to satisfy the requirements of the remedy and it would have to undergo City Council decision-making including public hearings prior to adoption.

7. Cost

Capital and O&M costs vary with each alternative and its application. Alternative 2 (HVAC System, Monitoring, and ICs) has the lowest cost for commercial buildings. Alternative 4A/B (SSD/SMD, Monitoring, and ICs) has the lowest cost for existing residential buildings, and Alternative 3 (Sub-Slab Passive Ventilation with Vapor Barrier, Monitoring, and ICs) has the lowest cost for future residential buildings. The 30-year present worth costs of each applicable alternative for existing and future buildings, based on the assumption of a 20,000 square foot building for the commercial scenario and 2,000 square foot building for the residential scenario, are summarized in Tables 2 and 3.

EPA's evaluation of alternatives using the NCP's Nine Evaluation Criteria is summarized in **Table 2** (for existing buildings) and **Table 3** (for future buildings).

TABLE 2
Existing Buildings: EPA's Comparison of Alternatives Using the NCP's Nine Evaluation Criteria

Evaluation Criteria	Alternative1: No Action with Monitoring	Alternative 2: HVAC System, Monitoring, and ICs[1]	Alternative 4A/B: Sub-slab/membrane Depressurization, Monitoring, and ICs
Overall Protectiveness of Human Health and the Environment	○	■	■
Compliance with ARARs	-	■	■
Long-term Effectiveness and Permanence	-	▲	■
Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment	-	N/A	N/A
Short-term Effectiveness	-	■	■
Implementability	-	■	■
Cost (Commercial)	-	$50,000 [2]	$325,000 for SSD [2]; $331,000 for SMD [2]
Cost (Residential)	-	N/A	$24,000 for SMD [2]; $60,000 for SMD [2]
State Acceptance - State Acceptance is a modifying criterion that will be evaluated after the public comment period			
Community Acceptance – Community Acceptance is a modifying criterion that will be evaluated after the public comment period			

■ High rating. Meets Criterion Best

▲ Medium rating. Meets Criterion

○ Low rating. Does Not Meet Criterion

[1] Only practical in commercial buildings

[2] Cost estimates are for engineering controls and associated operations and maintenance, on a per-building basis. Not included for each alternative is a Site-wide IC cost (e.g., $310,000) for a municipal ordinance south of U.S. Highway 101 in the Vapor Intrusion Area.

N/A – Not applicable

SSD – Sub-slab Depressurization

SMD – Sub-membrane Depressurization

TABLE 3
Future Buildings: EPA's Comparison of Alternatives Using the NCP's Nine Evaluation Criteria

Evaluation Criteria	Alt 1: No Action with Monitoring	Alt 2: HVAC System, Monitoring, and ICs [1]	Alt 3: Sub-slab Passive Ventilation, Vapor Barrier, (Ability to Convert to Active), Monitoring & ICs	Alt 4A/B: SSD/SMD, Monitoring and ICs	Alt 5: SSP, Vapor Barrier, Monitoring, and ICs
Overall Protectiveness of Human Health and the Environment	○	■	■	■	■
Compliance with ARARs	-	■	■	■	■
Long-term Effectiveness and Permanence	-	▲	▲	■	▲
Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment	-	N/A	N/A	N/A	N/A
Short-term Effectiveness	-	■	■	■	■
Implementability	-	■	■	■	■
Cost (Commercial)	-	$185,000 [2]	$207,500 [2]	$241,000 for SSD [2], $203,000 for SMD [2]	$318,500 [2]
Cost (Residential)	-	N/A	$36,500 [2]	$38,000 for SSD [2], $56,500 for SMD [2]	$48,000 [2]

State Acceptance - State Acceptance is a modifying criterion that will be evaluated after the public comment period

Community Acceptance – Community Acceptance is a modifying criterion that will be evaluated after the public comment period

■ High rating. Meets Criterion Best

▲ Medium rating. Meets Criterion

○ Low rating. Does Not Meet Criterion

[1] Only practical in commercial buildings

[2] Cost estimates are for engineering controls and associated operations and maintenance, on a per-building basis. Not included for each alternative is a Site-wide IC cost (e.g., $310,000) for a municipal ordinance south of U.S. Highway 101 in the Vapor Intrusion Area.

N/A – Not applicable

SSD – Sub-slab Depressurization; SMD – Sub-membrane Depressurization, SSP – Sub-sub Pressurization

9.0 Preferred Alternative

Proposed Evaluation Approach for Determination of Action Required

To evaluate and determine the appropriate level of action that would be required at each building, EPA has developed a tiering system for existing commercial and residential buildings, as well as for future building developments. Buildings may be tiered based on other MEW Site chemicals of concern, as appropriate.

Existing Buildings

For existing commercial and residential buildings, the tiers and the corresponding proposed actions are shown in **Table 4** below, and summarized as a decision flowchart in **Figure 3**.

TABLE 4
Tiering System for Existing Commercial and Existing Residential Buildings in Vapor Intrusion Study Area

Tier	Description	Proposed Action
Tier 1	Buildings with indoor air concentrations that are greater than or equal to the EPA Action Level.	Implement Preferred Alternative to bring indoor air concentrations below the Action level. Once achieved and confirmed, buildings would be recategorized as Tier 2.
Tier 2	Buildings with indoor air concentrations that are above outdoor (background)* concentrations but below the Action Level. Also former Tier 1 buildings that have been mitigated to below the Action Level.	If any engineered remedies are in place, continue operation and maintenance. Implement monitoring and Institutional Controls.
Tier 3	Buildings overlying lower groundwater concentrations and with indoor air concentrations that are below/within outdoor air (background)* concentrations.	Implement Institutional Control to notify future property and building owners of remedy requirements.
Tier 4	Buildings that can demonstrate through multiple lines of evidence that there is no longer the potential for vapor intrusion into the building at levels of concern.	After performance of all necessary confirmation sampling and documentation approved by EPA that all necessary action has been completed, then no action will be required.

* Outdoor concentrations of TCE typically range from below detection limits to 0.4 $\mu g/m^3$.

[1] Lower groundwater concentrations are defined as TCE or PCE <100 μg/L for commercial areas and < 50 μg/L for residential areas; or vinyl chloride < 20 μg/L in commercial areas and < 10 μg/L in residential areas

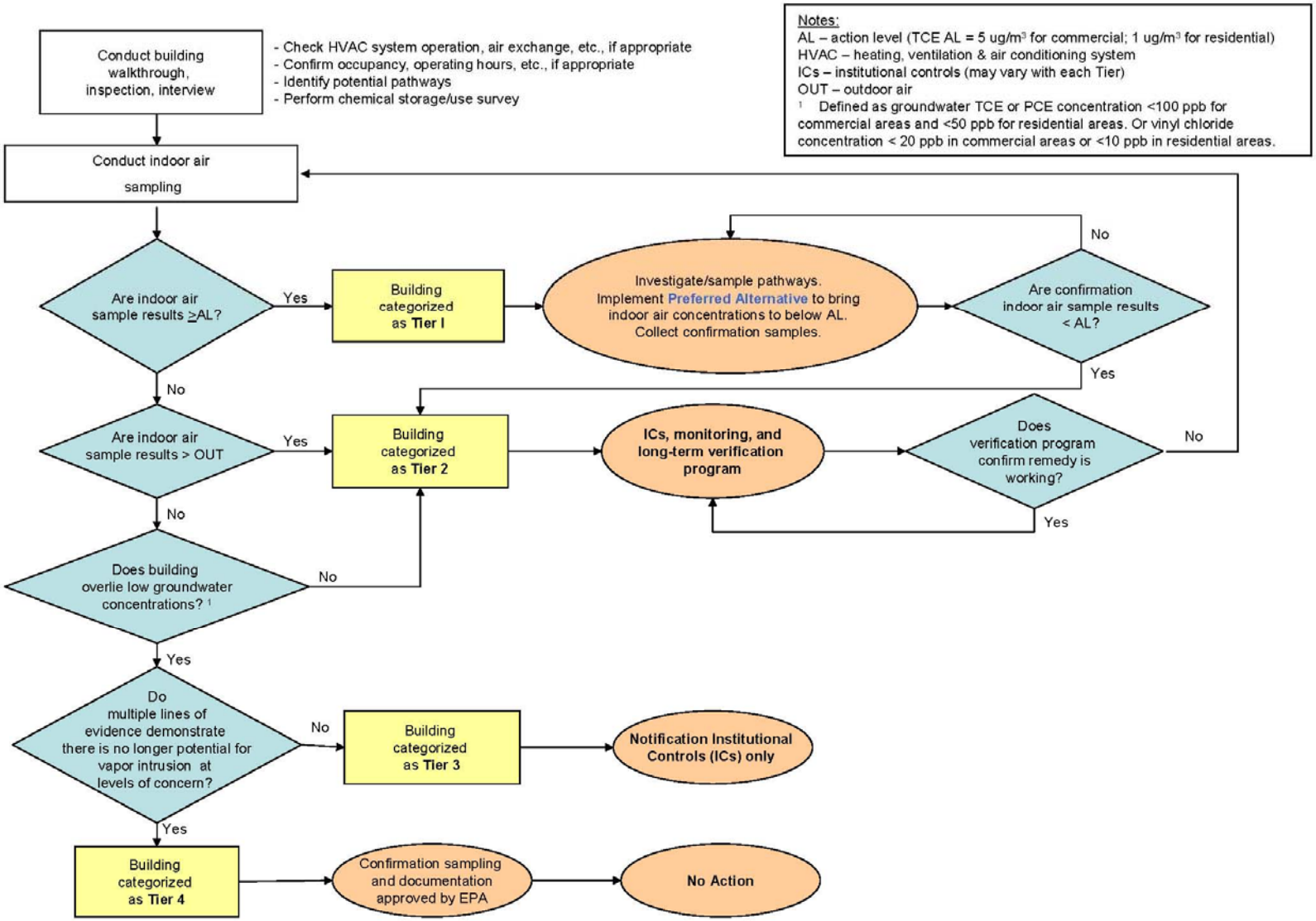


FIGURE 3
Decision Flowchart for Existing Buildings

To determine the appropriate tier for each existing building, each building would be evaluated using results from walk-throughs, interviews, inspections, and indoor air sampling. Once a building has been assigned a tier, the selected action for a building of that tier would be implemented, including engineering and institutional controls. Additional lines of evidence may be collected and evaluated at any time to determine whether a move between tiers would be appropriate. Where multiple lines of evidence indicate that there is no potential for vapor intrusion above levels of concern, the building would be categorized as Tier 4, and no action would be required.

EPA's assumption for existing buildings is that any buildings with concentrations below the TCE indoor air action level that already have an engineered remedy in place (such as HVAC system or sub-slab passive ventilation system with vapor barrier) are relying on that remedy to keep indoor air concentrations below the action level. For those buildings, the remedy would require continued operation and maintenance of those systems.

Future Buildings

For future commercial and residential buildings, the description of tiers and the corresponding proposed actions are shown in **Table 5** below, and summarized as a decision flowchart on **Figure 4**.

TABLE 5
Tiering System for Future Commercial and Future Residential Buildings in Vapor Intrusion Study Area*

Tier	Description	Proposed Action
Tier A	Properties overlying higher groundwater concentrations.[1]	Implement Preferred Alternative 4A/4B. Perform indoor air sampling after building is constructed to confirm remedial action is effective.
Tier B	Properties overlying lower groundwater concentrations.[2]	Implement Preferred Alternative 3. Perform indoor air sampling after building is constructed to confirm remedial action is effective.
Tier C	Properties overlying lower groundwater concentrations[2] and where multiple lines of evidence indicate there is no longer the potential for vapor intrusion into the building at levels of concern.	Perform indoor air sampling after building is constructed to confirm that there is no potential vapor intrusion risk at levels of concern. 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. Perform targeted confirmation air sampling after building is constructed to verify absence of preferred pathways into building.

1 Higher groundwater concentrations are defined as TCE or PCE >100 μg/L for commercial areas and > 50 μg/L for residential areas; or vinyl chloride > 20 μg/L in commercial areas and > 10 μg/L in residential areas.

2 Lower groundwater concentrations are defined as TCE or PCE <100 μg/L for commercial areas and < 50 μg/L for residential areas; or vinyl chloride < 20 μg/L in commercial areas and < 10 μg/L in residential areas.

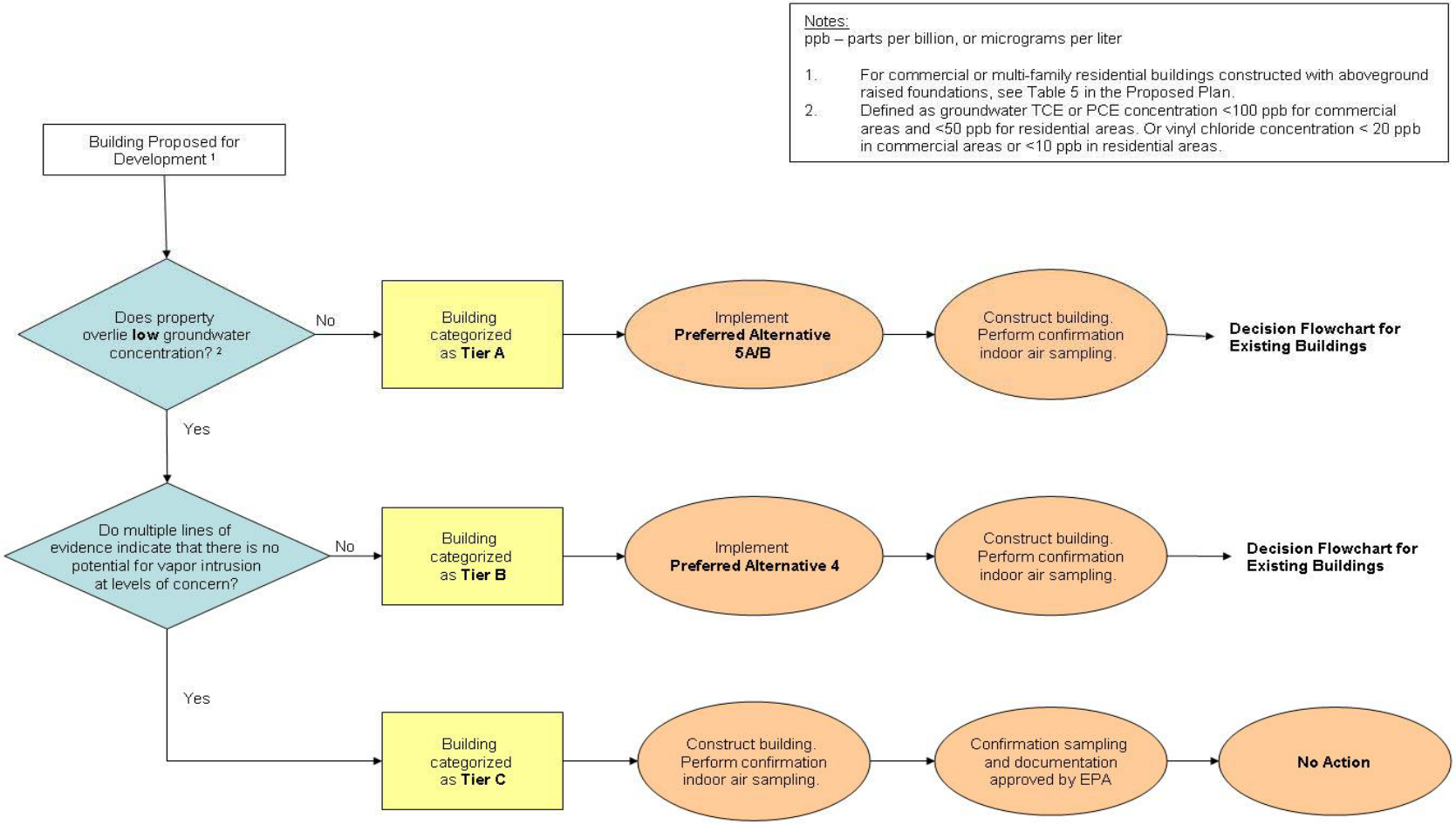


FIGURE 4
Decision Flowchart for Future Buildings

For future buildings, groundwater concentrations would first be used to categorize the building as Tier A, B, or C (Table 5). If the building is proposed in an area overlying higher groundwater concentrations, the building would be categorized as a Tier A building, and the selected action for Tier A buildings would be implemented, including engineering controls and ICs. If the building is proposed in an area overlying lower groundwater concentrations, but there are not multiple lines of evidence indicating that there is not a potential for vapor intrusion above levels of concern, the building would be categorized as a Tier B building, and the selected action for Tier B buildings would be implemented, including engineering controls and ICs. If the building is proposed in an area overlying lower groundwater concentrations, and multiple lines of evidence indicate there is no longer the potential for vapor intrusion into the building at levels of concern, then sampling would be performed after the building is constructed to confirm there is no potential vapor intrusion risk at levels of concern. If confirmed with EPA approval, no action would be required.

Selection of EPA's Preferred Alternative

EPA's Preferred Alternative to address the vapor intrusion pathway and ensure protection of human health is different for existing versus future buildings. Although the sub-slab ventilation and depressurization system remedial alternatives are the most effective to address the vapor intrusion pathway, these alternatives may not be easily implementable in all existing buildings. Use of existing HVAC systems can be effective, but ongoing implementation is complex and not as permanent. Therefore, EPA's Preferred Alternative for future commercial buildings is the installation of the appropriate sub-slab ventilation or depressurization system. For existing commercial buildings, EPA's Preferred Alternative is the use of the existing HVAC system, where such a system is capable of adequately reducing concentrations. However, where operation of the HVAC system is not feasible or easily implementable, EPA's Preferred Alternative for existing commercial buildings is the installation of the appropriate sub-slab/membrane depressurization system. The Preferred IC to support each of these remedial alternatives is a municipal ordinance that requires implementation of the remedy within the Vapor Intrusion Study area.

Based on the information currently available, EPA believes that the Preferred Alternatives selected would be protective of human health, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative technologies to the maximum extent practicable.

Table 6 lists EPA's Preferred Alternatives for Existing and Future Buildings for each building scenario based on the detailed evaluation of alternatives.

TABLE 6
EPA's Preferred Alternatives for Existing and Future Buildings in Vapor Intrusion Study Area

Building Scenario	EPA's Preferred Alternative
Existing Buildings	
Commercial (with existing HVAC system)	Alternative 2: HVAC System, Monitoring, and ICs
Commercial (without existing HVAC system)	Alternative 4A/B: Sub-slab/membrane Depressurization Monitoring, and ICs
Residential	Alternative 4A/B: Sub-slab/membrane Depressurization Monitoring, and ICs
Future Buildings	
Commercial (on properties overlying low groundwater concentrations [1])	Alternative 3: Sub-Slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs
Commercial (on properties overlying higher groundwater concentrations [2])	Alternative 4A/B: Sub-slab/membrane Depressurization, Monitoring, and ICs
Residential (on properties overlying low groundwater concentrations [1])	Alternative 3: Sub-Slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs
Residential (on properties overlying higher groundwater concentrations [2])	Alternative 4A/B: Sub-slab/membrane Depressurization, Monitoring, and ICs

Notes:

ppb = parts per billion, or micrograms per liter

[1] Low groundwater concentrations are defined as TCE or PCE <100 µg/L for commercial areas and < 50 µg/L for residential areas; or vinyl chloride < 20 µg/L in commercial areas and < 10 µg/L in residential areas.

[2] Higher groundwater concentrations are defined as TCE or PCE >100 µg/L for commercial areas and > 50 µg/L for residential areas; or vinyl chloride > 20 µg/L in commercial areas and > 10 µg/L in residential areas.

Existing Commercial Buildings

EPA's Preferred Alternative for existing commercial buildings with existing HVAC systems is Alternative 2: HVAC System, Monitoring, and ICs. This alternative ranks high in technical Implementability, Overall Protection of Human Health and the Environment, and Cost. Management of ICs to demonstrate Long-Term Effectiveness and Permanence for this alternative is more complex than other alternatives due to the fact that the engineered control (HVAC System) would need be operated by building operators/occupants rather than the potentially responsible parties; however, this alternative is selected for existing buildings due to its performance in meeting EPA's other evaluation criteria.

EPA's Preferred Alternative for existing commercial buildings without HVAC systems or for buildings where an existing HVAC system is unable to sufficiently reduce TCE and VOC concentrations below levels of concern is Alternative 4A/B: SSD/SMD, Monitoring, and ICs. Sub-Slab Depressurization would be utilized in buildings with slab-on-grade foundations, and Sub-Membrane Depressurization would be utilized in buildings with crawlspaces. For the building without HVAC system scenario, the significant cost advantage that Alternative 2 has for buildings with existing HVAC systems is greatly reduced; however, Alternative 4A/B outperforms Alternative 2 after balancing the other criteria.

Existing Residential Buildings

EPA's Preferred Alternative for existing residential buildings is Alternative 4A/B: Sub-Slab/Membrane Depressurization, Monitoring, and ICs. Sub-Slab Depressurization is appropriate for buildings with slab-on-grade foundations, and Sub-Membrane Depressurization is appropriate for buildings with crawlspaces. Comparing Alternative 1: No Action with Monitoring and Alternative 4A/B: Sub-Slab/Membrane Depressurization, Monitoring, and ICs, Alternative 4A/B ranks higher in all criteria.

Future Commercial Buildings

The Preferred Alternative for future commercial buildings overlying higher groundwater concentrations (Tier A) is Alternative 4A/B: SSD/SMD, Monitoring, and ICs. Because areas overlying higher TCE groundwater concentrations in the Vapor Intrusion Study Area are considered to have a greater potential for vapor intrusion, Alternative 4A/B is preferred based on long-term effectiveness.

EPA's Preferred Alternative for future commercial buildings overlying lower groundwater concentrations (Tier B) is Alternative 3: Sub-Slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs. Although Alternative 4A/B is considered to have better long-term effectiveness than Alternative 3, areas with lower VOC concentrations in the Vapor Intrusion Study Area are considered to have a lower potential for vapor intrusion, and therefore Alternative 3 is more cost-effective and still protective.

Future Residential Buildings

EPA's Preferred Alternative for future residential buildings overlying higher groundwater concentrations (Tier A) is Alternative 4A/B: Sub-Slab/Membrane Depressurization, Monitoring, and ICs. Areas with residential buildings overlying higher TCE groundwater concentrations in the Vapor Intrusion Study Area are considered to have a higher likelihood of vapor intrusion, and therefore Alternative 4A/B is preferred based on long-term effectiveness.

The Preferred Alternative for future residential buildings overlying lower groundwater concentrations (Tier B) is Alternative 3: Sub-Slab Passive Ventilation with Vapor Barrier (and Ability to Convert to Active), Monitoring, and ICs. Because areas for future residential buildings overlying lower groundwater concentrations in the Vapor Intrusion Study Area are considered to have a lower likelihood of vapor intrusion, Alternative 3 is preferred based on a slight cost advantage over Alternative 4.

Site-wide Cost Estimate

Based on the tiering system and Preferred Alternatives presented, EPA estimated the Site-wide cost of the vapor intrusion remedy. The existing buildings were classified into the appropriate tiers based on available indoor air sampling data (or on available building conditions and site characterization data, if indoor air sampling data were not available), and the Preferred Alternative appropriate to the building scenario was applied to each building.

The resulting 30-year present worth Site-wide cost of the remedy, including ICs and mitigation measures conducted to date, is estimated to range from $7 million to $10 million.

10.0 Community Participation

EPA provides information regarding actions at the MEW Site to the public through public meetings, public notices, fact sheets, the Site Administrative Record, and this Proposed Plan.

Consideration of public input is an important part of the remedy selection process. EPA encourages all community members, business owners, and other interested stakeholders to provide input on the proposed remedy. EPA will select the final remedy for vapor intrusion only after considering the comments submitted during the public comment period.

The dates for the public comment period and the date, location, and time of the public meeting are provided on the front page of this Proposed Plan.

Glossary of Terms

Specialized terms used in this Proposed Plan are defined below.

Action Level - In the Superfund program, the existence of a contaminant concentration in the environment high enough to warrant a cleanup action or response.

Administrative Record - All documents that EPA considered or relied on in proposing and selecting the response action at a Superfund site, culminating in the Record of Decision for remedial action.

Applicable or Relevant and Appropriate Requirements (ARARs) – The Federal and State environmental laws, regulations and requirements that a selected remedy will meet. These requirements may vary among sites and alternatives.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - A Federal act (Public Law 96-510; December 11, 1980) that provides for liability, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive waste disposal sites.

Feasibility Study - A document that assesses cleanup alternatives (including taking no action), their relative strengths and weaknesses, and the trade-offs in selecting one alternative over another.

Institutional Controls (ICs) –ICs are non-engineered legal and administrative instruments that help to minimize the potential for human exposure to contamination and protect the integrity of a remedy. There are four categories of ICs: government controls; proprietary controls; enforcement tools with IC components; and informational devices.

National Contingency Plan (NCP) – The National Oil and Hazardous Substances Pollution Contingency Plan, is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP includes a framework for responding to hazardous substance sites.

Present worth costs – An estimate of total capital and operation and maintenance costs over a period of time, discounted to the common base year. This is a method that allows the evaluation of expenditures that occur over different time periods, and it allows the comparison of costs for different alternatives on the basis of a single figure for each alternative.

Proposed Plan – A public document that briefly summarizes the alternatives studied in the detailed analysis phase of the Remedial Investigation and Feasibility Study (RI/FS), highlighting the key factors that led to identifying EPA's Preferred Alternative.

Record of Decision (ROD) - A public document that explains which cleanup alternatives will be used at a Superfund site. The ROD is based on information and technical analysis generated during the Remedial Investigation/Feasibility Study (RI/FS) and consideration of public comments.

Remedial Investigation (RI) - An in-depth study performed to gather data to determine the nature and extent of contamination; establish site cleanup criteria; identify preliminary alternatives for remedial action; and support technical and cost analyses of alternatives. The remedial investigation is usually conducted with the feasibility study. Together they are referred to as the RI/FS.

Responsiveness Summary - EPA's responses to oral and written public comments on the Proposed Plan and Site Administrative Record submitted to EPA during the public comment period. The Responsiveness Summary is included in the Record of Decision.

Vapor Intrusion Pathway - The means by which volatile chemicals in the subsurface may enter into a building and affect indoor air quality.

Volatile Organic Compounds (VOCs) - An organic compound that evaporates (volatilizes) readily at room temperature.

FOR MORE INFORMATION

This Proposed Plan, the *Final Supplemental Remedial Investigation for the Vapor Intrusion Pathway*, the *Final Supplemental Feasibility Study for the Vapor Intrusion Pathway*, and other selected MEW Site documents can be obtained at:

http://www.epa.gov/region09/MEW

For more information about the MEW Superfund Study Area, please contact:

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Or you may leave a message on EPA's toll-free line at 1.800.231.3075

EPA Region 9
75 Hawthorne Street
San Francisco, California 94105

INFORMATION REPOSITORIES

MEW Site-related documents and the Administrative Record Supplement for the Vapor Intrusion Pathway are available at the following locations:

EPA Region 9 Superfund Records Center
95 Hawthorne Street
San Francisco, CA 94105
Phone: 415.536.2000
Hours: Monday – Friday, 8 am – 5 pm

Mountain View Public Library
585 Franklin Street
Phone: 650.903.6887
Hours: Monday – Thursday, 10 am – 9 pm
Friday and Saturday, 10 am – 6 pm
Sunday, 1 - 5 pm