Appendix Q
Village Concept Alternative
Health Risk Assessment

ENVIRON

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TECHNICAL MEMORANDUM

To: Trixie Martelino, PBS&J

From: Elizabeth Miesner
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Subject: Village Concept Alternative
Human Health Risk Assessment
Construction and Incremental Operational Emissions
Proposed Stanford University Medical Center Facilities Renewal and Replacement Project
Palo Alto, California

At the request of PBS&J, ENVIRON International Corporation (ENVIRON) performed an additional human health risk assessment (HHRA) of the incremental increase of diesel particulate matter (DPM) emissions associated with the construction and operation of the proposed Stanford University Medical Center Facilities Renewal and Replacement Project (SUMC Project) to evaluate the potential health impacts at three housing sites proposed as part of the Village Concept Alternative to the SUMC Project. This additional analysis has been conducted as part of Draft Environmental Impact Report (DEIR) for the SUMC Project which is being prepared by PBS&J on behalf of the City of Palo Alto Planning and Community Environment Department. This analysis estimates excess lifetime cancer risks and chronic noncancer hazard indices (HIs) for adult and child residents at the three proposed housing sites and compares them to the Bay Area Air Quality Management District (BAAQMD or District) California Environmental Quality Act (CEQA) thresholds of significance.

For the main SUMC Project, ENVIRON conducted a HHRA to evaluate the potential health impacts from construction and operational emissions on onsite workers, offsite workers, current offsite residents and offsite sensitive (e.g., school child) receptors (herein referred to as "SUMC Project HHRA"). The SUMC Project HHRA did not evaluate potential impacts of emissions on future onsite residents at locations identified in the Village Concept Alternative. This analysis for the Village Concept Alternative was conducted with the same methodologies used in the SUMC Project HHRA and as such, this technical memorandum presents the methods and results for the analysis of housing sites associated with the proposed Village Concept Alternative when they differ from those presented in the SUMC Project HHRA.

1. Background

The proposed Village Concept Alternative will include the SUMC Project, as proposed, plus housing units, pedestrian linkages, and other potential uses. A total of 490 residential units have been approved at the three sites:

a) 240 units at Quarry Road/Arboretum Drive
(occupancy within 4 years of the first building permit for the SUMC Project)

b) 180 units at Quarry Road/El Camino Real
(occupancy within 2 years of the first building permit for the SUMC Project)

c) 70 units at Sand Hill/Pasteur Drive
(occupancy within 4 years of the first building permit for the SUMC Project)

The locations of the proposed housing sites are presented in Figure 1. Table 1 summarizes the location, number of housing units, and year of completion estimated based on the recommended construction duration for each housing site.

2. Estimated Emissions

Potential future adult and child residents at the three proposed housing sites in the Village Concept Alternative could be exposed to DPM emissions associated with the proposed SUMC Project. The estimation of DPM emissions from construction activities, emergency generators, and delivery vehicles servicing loading docks are presented in Section 3.1 of the SUMC Project HHRA.

3. Estimated Air Concentrations

As discussed in the SUMC Project HHRA, two-meter high receptors are used to estimate the DPM air concentration for future residents at the proposed Village Concept Alternative sites. Figure 1 shows the receptors locations at these sites where exposure concentrations of DPM in air were evaluated. Details of the modeling are presented in Section 3.2 of the SUMC Project HHRA.

4. Human Health Risk Analysis

As discussed in detail in Section 4 of the SUMC Project HHRA, ENVIRON evaluated the potential health effects associated DPM exposure from the increase in emissions of the proposed SUMC Project. The same evaluation was conducted for the future residents associated with the proposed Village Concept Alternative.

4.1 Construction Emissions

Adult and child residents were assumed to be exposed to construction emissions for the applicable portion of the project duration estimated based on the proposed completion year of the housing projects (Table 1). The exposure period specific to each housing site is presented in Table 2. Consistent with California Environmental Protection Agency (Cal/EPA 2003) guidance, the exposure duration assumed for a child resident is nine years as shown in Table 4.1a of the SUMC Project HHRA. The duration of exposure to the construction sources at Quarry Road/Arboretum Drive and Sand Hill/Pasteur Drive housing site are both eight years and that at Quarry Road/El Camino Real is 10 years as shown in Table 2. To evaluate a child resident at Quarry Road/El Camino Real, it was assumed that the child would be exposed to the maximum nine year rolling average concentration within the 10-year exposure period.

4.2 Operational Emissions

Consistent with Cal/EPA (2003) guidance, the exposure duration assumed for a child resident is 9 years and 70 year for an adult resident, as shown in Section 4.4.2 and Table 4.1a of the SUMC Project HHRA. DPM emissions from routine testing of the standby emergency generators remain constant over the entire exposure period for both adult and child resident receptors. As discussed in the SUMC Project HHRA, DPM emissions associated with delivery vehicles were assumed to change over time as a result of a ramp up of traffic as the Project proceeds and emissions reduction technologies are implemented into the delivery fleet in accordance with California Air Resources Board (CARB) and United States Environmental Protection Agency (USEPA) requirements. For the adult resident, a 70-year exposure duration was assumed. To evaluate a child resident, however, it was assumed that the child would be exposed to the maximum nine year rolling average concentration within the 70-year exposure period, as discussed in the SUMC Project HHRA.

5. Results of Estimated Excess Lifetime Cancer Risk and Chronic Noncancer Hazard Indices

This section presents the results for this Village Concept Alternative HHRA. Similar to the SUMC Project HHRA, the estimated excess lifetime cancer risks and chronic noncancer HIs at the proposed housing sites are discussed relative to the significance thresholds for toxic air contaminants (TACs) identified in the BAAQMD CEQA Guidelines for the maximally exposed individual (MEI, per BAAQMD 1999). According to the BAAQMD CEQA Guidelines, the significance threshold for TACs is a cancer risk greater than ten in a million (10×10^{-6}) and a non-cancer HI of greater than one (1.0) for the MEI. Projects that do not have the potential to expose the public to TACs in excess of these thresholds would not be considered to have a significant air quality impact.

For additional reference, the National Contingency Plan (NCP) (40 CFR § 300) is commonly cited as the basis for target risk for risk assessments. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}), and noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., HI greater than one).

This HHRA was performed to evaluate the potential health effects associated with the incremental increase in DPM emissions resulting from the SUMC Project. Thus, the HHRA results presented below are focused on the potential health impacts associated with construction and operational sources of DPM related to the SUMC project.

5.1 Estimated Excess Lifetime Cancer Risks and Chronic Noncancer Hazard Indices Associated with DPM from Construction Sources

ENVIRON estimated the excess lifetime cancer risks and chronic noncancer HIs associated with potential exposures to DPM from construction sources. The potential risks to offsite residents at the three proposed housing sites were evaluated based on the same resident exposure assumptions described in Section 5.1.2.2 of the SUMC Project HHRA. As shown in Table 2, the estimated excess lifetime cancer risk associated with emissions from the construction activities at the MEI – adult resident (0.1 in a million) is below the BAAQMD

significance threshold of 10 in a million. For the MEI – child resident, the estimated excess lifetime cancer risk (0.2 in a million) is also below the BAAQMD CEQA significance threshold of 10 in a million. The chronic noncancer HI for both the adult and child residents (0.00064) is well below the BAAQMD threshold of significance of 1.0. Table 2 presents the maximum adult and child resident cancer risks and chronic HIs estimated at each of the three proposed housing sites.

The health risk contributions from the construction sources to the three proposed housing sites are low for a variety of reasons:

a. *Housing at Quarry Road/Arboretum Drive and Quarry Road/El Camino Real*

   Based in Tables 3.1 of the SUMC Project HHRA and Table 1 of this HHRA, the construction of Hoover Pavilion medical office building and parking structure, the only developments of the proposed SUMC Project that are adjacent to these two proposed housing sites (Figures 2.2 of the SUMC Project HHRA and Figure 1 of this HHRA), will be completed before occupancy of the two housing sites and therefore the future residents will not be exposed to construction emissions from these activities. The other construction areas of the Project are far enough away from these two locations such that their contribution to the estimated excess cancer risk contributions are insignificant.

b. *Housing at Sand Hill/Pasteur Drive*

   As presented in Table 3.1 of the SUMC Project HHRA, about 75% of the project emissions will occur before 2014, the proposed completion year of the housing site at Sand Hill/Pasteur Drive, and therefore the future residents will be potentially exposed to only a fraction of the total construction emissions. In addition, based on the construction sources presented in Figures 3.11a – 3.11l of the SUMC Project HHRA and windrose presented in Figure 3.3 the SUMC Project HHRA, this proposed housing site is not directly down wind of the construction sources.

5.2 Estimated Excess Lifetime Cancer Risks and Chronic Noncancer Hazard Indices Associated with DPM from Operational Sources

ENVIRON estimated the excess lifetime cancer risk and chronic noncancer HI associated with potential exposures to DPM from facility operations (e.g., emergency generators and delivery vehicles servicing the loading docks). The results of this HHRA indicate that potential exposures to facility operation-related DPM at the three proposed housing sites yield cancer risks and HIs estimates that are below the BAAQMD significance thresholds. The estimated excess lifetime cancer risks and chronic noncancer HIs from facility operations (e.g., emergency generators and delivery vehicles servicing the loading docks) are presented in this section.

5.2.1 Emergency Generators

The potential health impacts to offsite residents at the three proposed housing sites were evaluated using the same methodology described in Section 5.2.1 of the SUMC Project HHRA. The estimated excess lifetime cancer risk associated with emissions from the emergency generators at the MEI – adult resident (0.3 in a million) and MEI – child resident (0.08 in a

million) are below the BAAQMD significance threshold of 10 in a million, as shown in Table 3. The chronic noncancer HI for both the MEI – adult and child residents (0.0002) is well below the BAAQMD threshold of significance of 1.0. Table 3 presents the maximum estimated adult and child resident excess lifetime cancer risks and chronic HIs at each of the three proposed housing sites.

5.2.2. Delivery Vehicles Servicing Loading Docks

The potential health impacts to offsite residents at the proposed housing sites were evaluated using the same methodology described in Section 5.2.2 of the SUMC Project HHRA. The estimated excess lifetime cancer risk associated with emissions from the emergency generators at the MEI – adult resident (0.5 in a million) and MEI – child resident (0.2 in a million) are below the BAAQMD significance threshold of 10 in a million, as shown in Table 4. The chronic noncancer HI for the MEI – adult resident (0.00034) and child resident (0.00046) are well below the BAAQMD threshold of significance of 1.0. Table 4 presents the maximum estimated adult and child resident excess lifetime cancer risks and chronic HIs at each of the three proposed housing sites.

5.3 Estimated Excess Lifetime Cancer Risks from Construction Activities and Operational Sources

This section presents the estimated excess lifetime cancer risks and chronic noncancer HIs associated with simultaneous exposure at the proposed housing sites of the Village Concept Alternative to DPM from construction and operational sources of the SUMC Project.

To evaluate the potential health effects associated with simultaneous exposures to construction and operational DPM emission sources, the excess lifetime cancer risks and chronic noncancer HIs from both source types were evaluated. As shown in Table 5, the combined cancer risk for the MEI – adult resident (0.9 in a million) and MEI – child resident (0.3 in a million) are below the BAAQMD significance threshold of 10 in a million. Similarly, the estimated chronic noncancer HIs are all well below the BAAQMD threshold of significance of 1.0.

6. Conclusion

ENVIRON estimated the excess lifetime cancer risks and chronic noncancer HIs associated with potential exposures at the three housing sites proposed in the Village Concept Alternative to DPM from construction and operational sources related to the SUMC Project. The results of this HHRA were then compared to current BAAQMD CEQA significance thresholds. Pursuant to current BAAQMD CEQA Guidelines (BAAQMD 1999), projects that expose the public to TACs in excess of the following thresholds would be considered to have a significant air quality impact:

- Probability of contracting cancer for the MEI exceeds ten in a million (10×10^{-6}); and
- Ground level concentrations of non-carcinogenic toxic air contaminants would result in a HI greater than 1.0 for the MEI.

The results of this HHRA indicate that potential exposures of residents at the three proposed housing sites in the Village Concept Alternative to emissions of DPM from construction and operational sources associated with the SUMC Project are below an excess lifetime cancer risk of 10 in a million and chronic noncancer HI of 1.0 at all locations and thus the Project should not have a significant impact on air quality, according to BAAQMD guidelines.

Further, estimated excess lifetime cancer risks associated with DPM emissions from both construction and operational sources are below or within the target risk range of one in a million (1×10^{-6}) to 1 in 10,000 (1×10^{-4}) generally considered protective of human health by the USEPA (40 CFR § 300).

The many conservative assumptions that have been used in this assessment regarding the estimation of emissions, ambient air concentrations, exposure assumptions, and carcinogenic potency lead to an overestimate of potential risks, the magnitude of which could likely be substantial. The USEPA (1989) explains the effect of using conservative assumptions in regulatory risk assessments as follows:

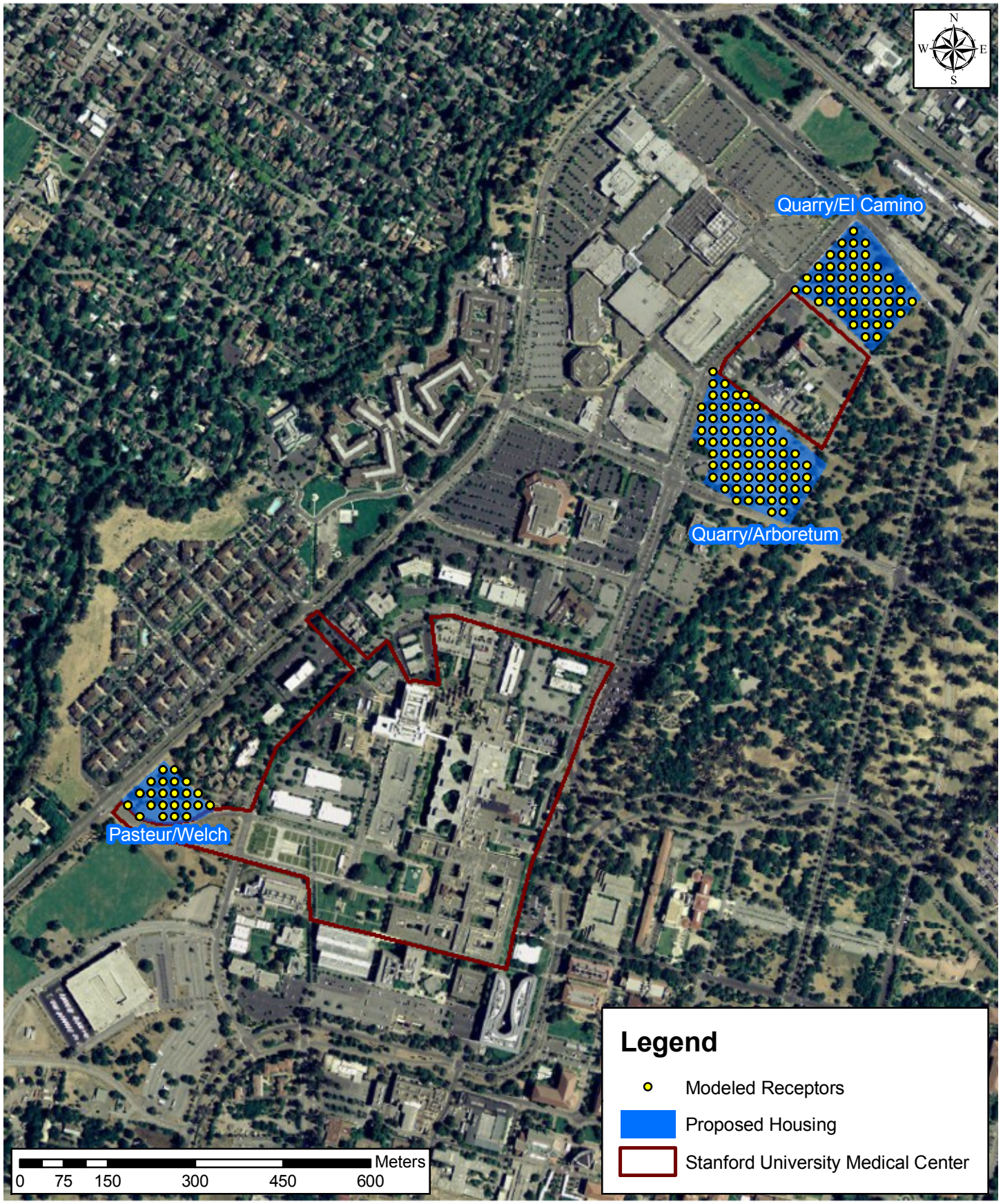
> *"These values are upper-bound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

7. References

Bay Area Air Quality Management District (BAAQMD). 1999. *BAAQMD CEQA Guidelines: Assessing the Air Quality Impacts of Projects and Plans.* December.

California Environmental Protection Agency (Cal/EPA). 2003. *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments.* Office of Environmental Health Hazard Assessment. August.

United States Environmental Protection Agency (USEPA). 1989b. *Risk Assessment Guidance for Superfund Human Health Risk Assessment: U.S. EPA Region IX Recommendations (Interim Final).* San Francisco, CA. December 15.



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Village Concept Alternative
Proposed Housing Receptor Locations
Stanford University Medical Center
Palo Alto, California

Figure
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Drafter: KZ Date: 11/16/2009 Contract Number: 0320376A

Table 1: Proposed Housing Projects
Stanford University Medical Center Facilities Renewal and Replacement Project
Village Concept Alternative
Palo Alto, California

Location of Proposed Housing	Units	Proposed Year of Completion[1]
Quarry Road / Arboretum Drive	240	2014
Quarry Road / El Camino Real	180	2012
Sand Hill / Pasteur Drive	70	2014

Notes:

1. Estimated based on the project duration:
   a. Quarry Road / Arboretum Drive: within 4 years of the first building permit for the SUMC Project;
   b. Quarry Road / El Camino Real: within 2 years of the first building permit for the SUMC Project;
   c. Sand Hill / Pasteur Drive: within 4 years of the first building permit for the SUMC Project.

Source:

Department of Planning and Community Environment. 2009. *SUMC Project EIR Changes and Adjustments.* September.

Abbreviations:

SUMC: Stanford University Medical Center

Table 2: Estimated Excess Lifetime Cancer Risks and Chronic Noncancer Hazard Indices
Construction Emissions[1]
Stanford University Medical Center Facilities Renewal and Replacement Project
Village Concept Alternative
Palo Alto, California

Proposed Housing Site	Population	Exposure Period	UTMx	UTMy	Average DPM Concentration	Cancer Risk	Chronic HI
			(m)		($\mu g/m^3$)	(in one million)	
Quarry Road / Arboretum Drive	Adult	2014-2021	573,437	4,143,909	1.0E-03	0.04	0.0002
	Child		573,437	4,143,909	1.0E-03	0.07	0.0002
Quarry Road / El Camino Real	Adult	2012-2021	573,577	4,144,249	1.0E-03	0.04	0.0002
	Child		573,577	4,144,249	1.0E-03	0.08	0.0002
Sand Hill / Pasteur Drive	Adult	2014-2021	572,537	4,143,389	3.2E-03	0.1	0.0006
	Child		572,537	4,143,389	3.2E-03	0.2	0.0006

Notes:
1. This table presents estimated excess lifetime cancer risks and chronic noncancer HIs associated with adult and child resident exposure to DPM from construction activities related to the Project.

Abbreviations:
DPM: Diesel Particulate Matter
HI: Hazard Index
m: meter
UTM: Universal Transverse Mercator
$\mu g/m^3$: microgram per cubic meter

Table 3: Estimated Excess Lifetime Cancer Risks and Chronic Noncancer Hazard Indices
Emergency Generators[1]
Stanford University Medical Center Facilities Renewal and Replacement Project
Village Concept Alternative
Palo Alto, California

Proposed Housing Site	Population	UTMx	UTMy	Average DPM Concentration	Cancer Risk	Chronic HI
		(m)		($\mu g/m^3$)	(in one million)	
Quarry Road / Arboretum Drive	Adult	573,397	4,144,129	1.0E-03	0.3	0.0002
	Child	573,397	4,144,129	1.0E-03	0.08	0.0002
Quarry Road / El Camino Real	Adult	573,597	4,144,329	1.0E-03	0.3	0.0002
	Child	573,597	4,144,329	1.0E-03	0.08	0.0002
Sand Hill / Pasteur Drive	Adult	572,537	4,143,389	9.5E-05	0.03	0.00002
	Child	572,537	4,143,389	9.5E-05	0.007	0.00002

Notes:
1. This table presents estimated excess lifetime cancer risks and chronic noncancer HIs associated with adult and child resident exposure to DPM from operational sources (emergency generators).

Abbreviations:
DPM: Diesel Particulate Matter
HI: Hazard Index
m: meter
UTM: Universal Transverse Mercator
$\mu g/m^3$: microgram per cubic meter

Table 4: Estimated Excess Lifetime Cancer Risk and Chronic Noncancer Hazard Indices
Loading Docks[1]
Stanford University Medical Center Facilities Renewal and Replacement Project
Village Concept Alternative
Palo Alto, California

Scenario[2]	Proposed Housing Site	Population	UTMx	UTMy	Average DPM Concentration	Cancer Risk	Chronic HI
			(m)		($\mu g/m^3$)	(in one million)	
US-101	Quarry Road / Arboretum Drive	Adult	573,377	4,144,049	1.7E-03	0.5	0.0003
		Child	573,377	4,144,009	2.3E-03	0.2	0.0005
	Quarry Road / El Camino Real	Adult	573,537	4,144,269	1.4E-03	0.4	0.0003
		Child	573,537	4,144,269	1.7E-03	0.1	0.0003
	Sand Hill / Pasteur Drive	Adult	572,537	4,143,389	2.9E-05	0.01	0.000006
		Child	572,537	4,143,389	3.1E-05	0.002	0.000006
I-280	Quarry Road / Arboretum Drive	Adult	573,377	4,144,009	1.4E-03	0.5	0.0003
		Child	573,377	4,144,009	2.0E-03	0.2	0.0004
	Quarry Road / El Camino Real	Adult	573,537	4,144,269	4.9E-04	0.2	0.0001
		Child	573,537	4,144,269	7.3E-04	0.06	0.0001
	Sand Hill / Pasteur Drive	Adult	572,417	4,143,409	7.9E-04	0.3	0.0002
		Child	572,417	4,143,409	7.2E-04	0.06	0.0001

Notes:
1. This table presents estimated excess lifetime cancer risks and chronic noncancer HIs associated with adult and child resident receptor exposure to DPM from operational sources (loading docks).
2. ENVIRON evaluated two traffic route scenarios:
   Scenario 1: all delivery trucks approach the facility via I-280.
   Scenario 2: all delivery trucks approach the facility via US 101.

Abbreviations:
DPM: Diesel Particulate Matter
HI: Hazard Index
m: meter
UTM: Universal Transverse Mercator
$\mu g/m^3$: microgram per cubic meter

Table 5: Estimated Excess Lifetime Cancer Risks and Chronic Noncancer Hazard Indices
Combined Construction and Operational Emissions[1]
Stanford University Medical Center Facilities Renewal and Replacement Project
Village Concept Alternative
Palo Alto, California

Proposed Housing Site	Population	UTMx	UTMy	Cancer Risk	Chronic HI
		(m)		(in one million)	
Quarry Road / Arboretum Drive	Adult	573,377	4,144,049	0.9	6.8E-04
	Child	573,377	4,144,049	0.3	4.6E-04
Quarry Road / El Camino Real	Adult	573,537	4,144,269	0.8	6.6E-04
	Child	573,537	4,144,269	0.3	5.3E-04
Sand Hill / Pasteur Drive[3]	Adult	572,477	4,143,449	0.3	7.2E-04
	Child	572,537	4,143,389	0.2	1.1E-04

Notes:

1. This table presents estimated excess lifetime cancer risks and chronic noncancer HIs associated with adult and child resident exposure to DPM from construction and operational sources (emergency generators and loading docks) combined.
2. ENVIRON evaluated two traffic route scenarios:
   Scenario 1: all delivery trucks approach the facility via I-280.
   Scenario 2: all delivery trucks approach the facility via US 101.
   Results from the higher from the two scenarios are shown in this table.
3. For the proposed Sand Hill/Pasteur Drive housing site, the maximum cancer risks and chronic HIs occur at different receptor locations. The coordinates presented in the table are associated with the receptor locations of the maximum cancer risks. The locations of the maximum chronic HIs are:

Population	UTMx	UTMy
Adult:	572537	4143389
Child:	572417	4143409

Abbreviations:

DPM: Diesel Particulate Matter
HI: Hazard Index
m: meter
UTM: Universal Transverse Mercator
$\mu g/m^3$: microgram per cubic meter