

**Environmental Disclosure: University Terrace Project, Palo Alto, California  
March 2016**

**1.0 Overview**

This disclosure describes the investigation and cleanup of environmental contamination at the University Terrace Project (Project) in Palo Alto. This work was done under the supervision of the Department of Toxic Substances Control (DTSC) at the California Environmental Protection Agency (Cal-EPA). The Project site consists of three former street addresses: 1451 California Avenue, 1501 California Avenue, and 1601 California Avenue (collectively, the Project Site). *Figure 1* shows the location of each of the former parcels and the layout of the 112 condos and 68 single family homes planned for the University Terrace Project.<sup>1</sup> The Project Site was previously occupied by various technology and commercial companies whose operations caused some releases of hazardous substances. A full investigation was done for each parcel and, where necessary, cleanup has been undertaken and mitigation measures will be implemented.

In December 2012, Stanford entered into a voluntary cleanup agreement (VCA) with DTSC to oversee environmental testing and, where needed, cleanup work at the 1451 California Avenue parcel so that it would be made suitable for residential development. Stanford also entered VCAs for each of the other two parcels.<sup>2</sup> The goal was to ensure both the protection of human health and the environment, and to fulfill Stanford's obligations to the City of Palo Alto under a 2005 development agreement.<sup>3</sup> Stanford retained several technical consulting firms, Geomatrix, AMEC and Haley & Aldrich, to perform these tests and, where needed, to direct cleanup activities for each of the three parcels. Two of the parcels -- 1451 California and 1501 California -- required no remediation. A significant cleanup effort was undertaken on the 1601 California Avenue parcel where more than 33,000 tons of soil was removed.

AMEC or Haley & Aldrich prepared a risk evaluation for each parcel and concluded that the entire Project Site is now suitable for redevelopment and there are no unacceptable risks to future residential occupants from soil, groundwater or soil vapor at the Project Site.<sup>4</sup> DTSC

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<sup>1</sup> See Figure 1.

<sup>2</sup> A voluntary cleanup agreement (VCA) was executed for each parcel as follows: 1451 California Avenue dated 20 December 2012; 1501 California Avenue dated 27 August 2013; and, 1601 S. California Avenue dated 19 August 2015. Each of these agreements can be found on the DTSC Envirostor website at <http://www.envirostor.dtsc.ca.gov/public/>. An explanation of the VCA process can be found on the DTSC website at <http://www.dtsc.ca.gov/SiteCleanup/Brownfields/BrownfieldsVoluntaryProgram.cfm>.

<sup>3</sup> 2005 Development Agreement and June 13, 2014 letter from Haley & Aldrich to Mr. Chris Wuthmann of Stanford titled *Environmental Site Assessment Protocols and Regulatory Requirements, 1451, 1501, and 1601 California Avenue (Mayfield Upper California Avenue Housing Site), Palo Alto, California*.

<sup>4</sup> AMEC, 2013, Additional Environmental Investigation Results, 1451 California Avenue, Palo Alto, California, July 11; AMEC, 2013, Additional Environmental Investigation Results

reviewed the technical work plans and risk evaluations prepared by Geomatrix, AMEC, and Haley & Aldrich, and issued “no further action” letters for the 1451 and 1501 California Avenue parcels, finding that they have been adequately evaluated and do not pose a significant threat to human health or the environment under residential land use.<sup>5</sup> DTSC is still reviewing the submittals for the 1601 California parcel, but tentatively indicated in December 2015 that it “concur[s] that there is no significant exposure risk to future site users in areas known to have contaminated soil vapor at depth and that will [be] developed as an open space/park, and that there will not be an unacceptable risk to future residents living in the proposed residences.”<sup>6</sup> DTSC is currently receiving and evaluating public comment on the Draft Supplemental Investigation and Risk Assessment Report for the 1601 California parcel, and Stanford expects that DTSC will issue its final action letter in the near future.

Stanford took care in planning the University Terrace Project to locate condos and single family homes away from former chemical handling areas on the 1601 California Avenue parcel where certain contamination had been found. In some locations on the 1601 California Avenue parcel, up to 15 feet of clean fill was added that further isolates residual chemicals remaining at depth. All single family detached homes at the Project Site will be constructed with a 10-inch thick post-tension slab (the concrete pad on which a home sits) that is resistant to cracking, thus limiting the potential for vapors to migrate into homes. The three on-grade condominium units will all be built with a 5-inch slab that serves the same general purpose. Although not required to do so, Stanford also elected to install a vapor barrier underneath every ground-level, residential structure at the Project Site (on all three parcels), as an extra measure of protection against the possibility of vapor intrusion from chlorinated solvents (chemicals typically found in paints and industrial cleaners) that were previously handled by former technology and commercial tenants. All areas where utilities such as electrical lines and plumbing enter a home will be sealed to prevent the unlikely event of vapor intrusion.

Vapor plugs will be installed in the utility corridors beneath the streets at 1601 California Avenue that prevent vapors from moving through utility lines. Stanford has also agreed to prepare a post-development Site Management Plan for approval by DTSC. Stanford anticipates that this plan will provide maintenance protocols for the vapor plugs and confirm Stanford’s commitment not to build homes or other enclosed structures in the park area on the 1601 California Avenue parcel. The homes at University Terrace will be served by city-supplied water, not local groundwater.

This summary provides an overview of the environmental work done at University Terrace. It also refers the reader to the underlying technical reports, letters and other documents

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and No Further Action Request, 1501 California Avenue, Palo Alto, California; Haley & Aldrich, 2015, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>5</sup> DTSC, “No Further Action” Letter, 1451 California Avenue, Palo Alto, California, July 29, 2013; DTSC, California Avenue Housing Phase II Site, 1501 California Avenue, Palo Alto – No Further Action Letter, December 1, 2013.

<sup>6</sup> DTSC, email from J. Villamater (Hazardous Substances Engineer, DTSC) to A. Walton (Stanford), dated December 8, 2015.

that may be read to get a complete picture of the approach that was taken to investigating and cleaning up past contamination so that the Project Site is now suitable for residential development. These documents are available in electronic form at the following website: <http://fsh.stanford.edu/>. Most of them are also available on DTSC's public websites.<sup>7</sup> Interested readers are encouraged to review these documents.

Any questions should be directed by e-mail to Annette Walton, Director of Environmental Management, Land, Buildings & Real Estate at Stanford. Her e-mail is: [nettie@stanford.edu](mailto:nettie@stanford.edu). Questions may also be directed to Jovanne Villamater, the project manager at DTSC for the voluntary cleanup work. Ms. Villamater's email is: [jovanne.villamater@dtsc.ca.gov](mailto:jovanne.villamater@dtsc.ca.gov).

Dr. Paul Johnson, the president of the Colorado School of Mines, and a well-known expert on soil, groundwater, and soil vapor evaluations, risk assessment, and remediation, also reviewed the technical work on the Project Site for Stanford, in particular for the 1601 California Avenue parcel. Dr. Johnson issued a letter on January 6, 2016, describing his involvement and providing his key conclusions.<sup>8</sup> Dr. Johnson's letter notes his confidence in the use of site data, and confirms his evaluation of the adequacy of the mitigation measures planned to prevent vapor intrusion.

## **2.0 1451 California Avenue**

From 1960 to 2013, the 1451 California Avenue parcel was occupied by commercial and industrial tenants including Link Aviation, General Precision, Lockheed, TAB Products Co., and Media Management Plus.<sup>9</sup> According to DTSC, the 1451 parcel was primarily used for furniture manufacturing and electronic research, development and manufacturing. Before 1965, this parcel was in agricultural use.<sup>10</sup>

AMEC conducted a site investigation at the 1451 California Avenue parcel in 2010 to prepare for redevelopment of the property for the residential Project.<sup>11</sup> AMEC analyzed soil

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<sup>7</sup> 1451 California Avenue:  
[http://www.envirostor.dtsc.ca.gov/public/profile\\_report.asp?global\\_id=60001837](http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=60001837)

1501 California Avenue:  
[http://www.envirostor.dtsc.ca.gov/public/profile\\_report.asp?global\\_id=60001911](http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=60001911)

1601 California Avenue:  
[http://www.envirostor.dtsc.ca.gov/public/profile\\_report.asp?global\\_id=71002581](http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=71002581)

<sup>8</sup> See Letter from Dr. P. Johnson to A. Walton, Stanford, dated January 5, 2016.

<sup>9</sup> AMEC, Additional Environmental Investigation Results, 1451 California Avenue, Palo Alto, California, July 11, 2013.

<sup>10</sup> DTSC, "No Further Action" letter, 1451 California Avenue, Palo Alto, California, July 29, 2013.

<sup>11</sup> AMEC, Revised Phase II Environmental Site Investigation, 1451 California Avenue and 1400 Page Mill Road, Building B, Palo Alto, California, April 13; AMEC, 2013, Additional

samples for metals and polychlorinated biphenyls (PCBs), the latter based on the presence of an on-site electrical transformer. Groundwater and soil vapor were analyzed for volatile organic compounds (VOCs) typically found in industrial solvents and paints. Soil vapor is tested to evaluate whether VOCs could migrate into a future building constructed at the site. This is called “vapor intrusion”.<sup>12</sup> The potential for vapor intrusion is typically evaluated with the collection of soil vapor samples (i.e., sampling of air within the soil column). Additional sampling of soil, groundwater and soil vapor was conducted in 2013.<sup>13</sup> At this time, soil samples also were analyzed for total petroleum hydrocarbons (TPH) quantified as gasoline (TPHg), diesel (TPHd), and motor oil (TPHmo).

The results of all the testing at the 1451 California Avenue parcel were compared with various residential health risk screening criteria established by Cal-EPA, the federal Environmental Protection Agency (US EPA), and the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board). Thus, samples were compared with the Cal-EPA residential human health screening levels (CHHSLs),<sup>14</sup> residential regional screening levels (RSLs) established by US EPA,<sup>15</sup> and residential environmental screening levels (ESLs) developed by the Water Board.<sup>16</sup> These various residential health risk screening criteria are very conservative. Therefore, if chemicals at a site are below these criteria, they are presumptively considered safe and require no further study or remediation. For example, US EPA describes the RSLs as protective for humans (including sensitive groups) over a lifetime.<sup>17</sup> The health risk screening criteria are not, themselves, regulatory cleanup standards or not-to-exceed numbers. Screening values are used to provide context for an initial review of analytical results.<sup>18</sup> If chemicals are detected above the residential health risk screening criteria, a closer evaluation is often undertaken in the form of additional environmental sampling and/or a human health risk assessment. A human health risk assessment is an objective process for evaluating potential

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Environmental Investigation Results, 1451 California Avenue, Palo Alto, California, July 11, 2012.

<sup>12</sup> [://www.dtsc.ca.gov/SiteCleanup/Vapor\\_Intrusion.cfm](http://www.dtsc.ca.gov/SiteCleanup/Vapor_Intrusion.cfm).

<sup>13</sup> AMEC, Additional Environmental Investigation Results, 1451 California Avenue, Palo Alto, California, July 11, 2013.

<sup>14</sup> <http://oehha.ca.gov/risk/chhsltable.html>. In November 2009, DTSC endorsed (with some modifications) the use of regional screening levels (RSLs) published by the US EPA. The use of the CHHSLs in California was subsequently phased out.

<sup>15</sup> <http://www.epa.gov/risk/regional-screening-table>.

<sup>16</sup> [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/esl.shtml](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml).

<sup>17</sup> See EPA website Q&A on regional screening levels. <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FO1> (“Generally, at sites where contaminant concentrations fall below [R]SLs, no further action or study is warranted under the Superfund program”).

<sup>18</sup> See EPA Q&A on risk screening levels, <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FQ3> (“The SLs are generic screening values, not de facto cleanup standards, and should not be applied as such... the SL’s role in site “screening” is to help identify areas, contaminants, and conditions that require further federal attention at a particular site.”).

adverse health effects that may result from human exposure to concentrations of chemicals detected in the environment. This process is conducted in accordance with guidance and protocols established by US EPA and Cal-EPA. The evaluation incorporates pertinent scientific information regarding environmental fate and transport, chemical toxicology, and human exposure activities.

All chemicals tested in soil and soil vapor at the 1451 California Avenue were below the various risk screening criteria for residential use, with the exception of benzene (a common constituent of gasoline) and 1,3-butadiene (a chemical associated with fuel, plastics and rubber). Benzene and 1,3-butadiene were detected in soil vapor at 16 feet below ground surface at concentrations slightly exceeding the screening values in one sample location. Benzene and 1,3-butadiene are associated with motor vehicle emissions and are commonly detected in outdoor air. These compounds also degrade rapidly in the subsurface environment in the presence of oxygen. As such, low concentrations of benzene or 1,3-butadiene at depth are not a vapor intrusion concern. AMEC concluded that the data showed that conditions are appropriate for future residential use of the 1451 California Avenue parcel and no further testing, cleanup actions or mitigation measures were warranted.

AMEC submitted a summary technical report to DTSC detailing this work and the conclusions from its risk evaluation on July 11, 2013.<sup>19</sup> This report, like the other technical work done by AMEC on behalf of Stanford, was done as part of the voluntary cleanup agreement that Stanford entered into with DTSC, so that DTSC could provide oversight on the environmental work done at the University Terrace Project.<sup>20</sup>

On July 29, 2013, DTSC issued a “no further action” letter for the 1451 California Avenue parcel.<sup>21</sup> DTSC concluded, based on multiple lines of evidence, that the isolated detections of benzene and 1,3-butadiene did not appear to pose a significant risk to future residential occupants at the 1451 California Avenue parcel. DTSC’s overall conclusion was that 1451 California Avenue parcel does not pose a significant threat to human health or the environment for future residential land use, and thus no further action is necessary to investigate or remediate the parcel.

### **3.0 1501 California Avenue**

From 1939 to 1956, the 1501 California Avenue parcel was in agricultural use. Between 1969 and 1970, a building was constructed which was leased over a period of years to IBM,

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<sup>19</sup> AMEC, Additional Environmental Investigation Results, 1451 California Avenue, Palo Alto, California, July 11, 2013.

<sup>20</sup> DTSC, Transmittal of fully executed Voluntary Cleanup Agreement for 1451 California Avenue, Palo Alto, California, December 21, 2012; <https://www.dtsc.ca.gov/SiteCleanup/Brownfields/BrownfieldsVoluntaryProgram.cfm> .

<sup>21</sup> DTSC, “No Further Action” letter, 1451 California Avenue, Palo Alto, California, July 29, 2013.

Systemic Gene Therapy, and Alza Corporation. Beginning in October 2008, it was occupied by the Stanford School of Medicine.<sup>22</sup>

AMEC conducted a site investigation at the 1501 California Avenue parcel in 2013 to prepare for redevelopment of the property for the residential University Terrace Project, and also reviewed testing done previously at the site by Geomatrix, another consulting firm, in 2004 and 2008.<sup>23</sup> This report, like the other technical work done by AMEC on behalf of Stanford, was done as part of the voluntary cleanup agreement that Stanford entered into with DTSC, so that DTSC could provide oversight and concurrence on the environmental work done at the University Terrace Project.<sup>24</sup>

The 2004 environmental evaluation of the 1501 California Avenue parcel included testing of soil for metals, pesticides, TPHg, TPHd, TPHmo (gasoline, diesel and motor oil), and volatile organic compounds (VOCs) (typically found in industrial solvents and paints). At that time, the groundwater and soil vapor were sampled for VOCs. A geophysical survey also was performed to evaluate the possible presence of subsurface features (e.g., tanks, piping, etc.) that might be associated with chemical use. During the 2013 sampling, AMEC tested the soil for metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), TPHg, TPHd, TPHmo, and VOCs. AMEC also tested the groundwater and soil vapor for VOCs. Soil vapor is tested to evaluate whether VOCs could migrate into a future building constructed at the site. This is called “vapor intrusion”.<sup>25</sup> The potential for vapor intrusion is typically evaluated with the collection of soil vapor samples (i.e., sampling of air within the soil column).

The results of all the testing at the 1501 California Avenue parcel were compared with various residential health risk screening criteria established by Cal-EPA, the federal Environmental Protection Agency (US EPA), and the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board). Thus samples were compared with the Cal-EPA human health screening levels (CHHSLs),<sup>26</sup> regional screening levels (RSLs) established by US EPA,<sup>27</sup> and environmental screening levels (ESLs) developed by the Water Board.<sup>28</sup> These

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<sup>22</sup> AMEC, Additional Environmental Investigation Results and No Further Action Request, 1501 California Avenue, Palo Alto, California, October 2013.

<sup>23</sup> Geomatrix Consultants, Inc., Geophysical, Soil Vapor, Soil, and Groundwater Investigation Report, 1501 California Avenue, Palo Alto, California, September 13, 2004;

AMEC, Test Pit Observation and Sampling, 1501 California Avenue, Palo Alto, California, February 25, 2009; AMEC, Screening-Level Human Health Risk Assessment, 1501 California Avenue, Palo Alto, California, June 22, 2012.

<sup>24</sup> DTSC, Transmittal of fully executed Voluntary Cleanup Agreement for 1501 California Avenue, Palo Alto, California, September 11, 2013; <https://www.dtsc.ca.gov/SiteCleanup/Brownfields/BrownfieldsVoluntaryProgram.cfm> .

<sup>25</sup> [https://www.dtsc.ca.gov/SiteCleanup/Vapor\\_Intrusion.cfm](https://www.dtsc.ca.gov/SiteCleanup/Vapor_Intrusion.cfm).

<sup>26</sup> <http://oehha.ca.gov/risk/chhsltable.html>.

<sup>27</sup> <http://www.epa.gov/risk/regional-screening-table>.

<sup>28</sup> [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/esl.shtml](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml).

various residential health risk screening criteria are very conservative. The health risk screening criteria are not, themselves, regulatory cleanup standards or not-to-exceed numbers. Screening values are used to provide context for an initial review of analytical results.<sup>29</sup> If chemicals at a site are below these criteria, they are presumptively considered safe and require no further study or remediation. For example, US EPA describes the RSLs as protective for humans (including sensitive groups) over a lifetime.<sup>30</sup> If chemicals are detected above the residential health risk screening criteria, a closer evaluation is often undertaken in the form of additional environmental sampling and/or a human health risk assessment.

AMEC prepared a human health risk assessment to evaluate the chemicals at the 1501 California Avenue parcel that were found to exceed the residential health risk screening criteria described above. Special consideration was given to trichloroethylene (TCE), which was detected at two locations in soil vapor at the 1501 California Avenue parcel. US EPA Region 9 published guidance in July 2014 establishing short-term exposure limits for TCE because of a concern that TCE could cause fetal heart malformations in women exposed to it for even short periods during the first trimester of pregnancy.<sup>31</sup> Like most chemicals, screening levels for TCE are developed based on non-carcinogenic and carcinogenic health effects. "Carcinogenic" means "cancer-causing". The risk-based screening levels protective of long term, chronic exposures for TCE also are protective of short-term, non-carcinogenic health effects (i.e., the screening levels for chronic exposures are lower than the screening levels for short-term exposures).

For long term cancer risks, US EPA and DTSC evaluate, as a point of departure, whether exposure over a 26 year period would cause more than one excess cancer in a population of one million people.<sup>32</sup> This is sometimes referred to as the "1 x 10<sup>-6</sup>" or "one-in-a-million excess cancer risk" standard. In the human health risk assessment prepared by AMEC, both non-carcinogenic and carcinogenic health effects were evaluated for all chemicals, including TCE.

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<sup>29</sup> See EPA Q&A on risk screening levels, <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FQ3> ("The SLs are generic screening values, not de facto cleanup standards, and should not be applied as such... the SL's role in site "screening" is to help identify areas, contaminants, and conditions that require further federal attention at a particular site.").

<sup>30</sup> See EPA website Q&A on regional screening levels. <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FO1> ("Generally, at sites where contaminant concentrations fall below [R]SLs, no further action or study is warranted under the Superfund program".)

<sup>31</sup> US EPA, US EPA Region 9 Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at South Bay National Priority List (NPL) Sites ("Region 9 Guidelines"), December 3; and US EPA, 2014, EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion, July 9, 2013..

<sup>32</sup> DTSC, Preliminary Endangerment Assessment, Guidance Manual, Cal-EPA, Revised, October; DTSC, Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance), Cal-EPA, Final, October 2015.

In groundwater, all chemicals were found to be below the various health risk screening criteria, except for a single detection of TCE at a concentration that exceeded the drinking water standard. Water at University Terrace will be supplied by the city, and will not come from local groundwater. TCE was detected in soil vapor at two locations at concentrations exceeding the published screening level for residential use (CHHSLs and RSLs). At one location, TCE was detected in a soil vapor sample collected at 8 feet below ground surface. However, when the same area was retested, no TCE was found. At a second location, TCE was detected at concentrations above the screening level for residential use at 15 and 25 feet below ground surface. Benzene was detected above the residential health risk screening criteria in soil vapor at seven locations. Based on the low levels, the isolated detections, and the depth of the samples, AMEC concluded that the data showed that conditions are appropriate for future residential use of the 1501 California Avenue parcel and no further testing, cleanup actions or mitigation measures are warranted. The human health risk assessment found no unacceptable risks to future residents from benzene, TCE, or other chemicals identified at the 1501 California Avenue, whether in soil, groundwater, or soil vapor.<sup>33</sup>

AMEC submitted a summary technical report to DTSC detailing this work and the conclusions from its risk evaluation on October 31, 2013.<sup>34</sup> This report, like the other technical work done by AMEC on behalf of Stanford, was done as part of the voluntary cleanup agreement that Stanford had entered into with DTSC, so that DTSC could provide oversight and concurrence on the environmental work done at the University Terrace Project.<sup>35</sup>

On December 13, 2013, DTSC issued a “no further action” letter for the 1501 California Avenue parcel.<sup>36</sup> DTSC concluded, based on the AMEC human health risk assessment, that the limited detections of benzene and TCE at 1501 California Avenue parcel do not present a significant vapor intrusion risk to future residents at the University Terrace Project. DTSC’s overall conclusion was that the 1501 California Avenue parcel does not pose a significant threat to human health or the environment for future residential land use, and thus no further action is necessary to investigate or remediate the parcel. Based on these conclusions, no cleanup work was done on the 1501 California Avenue parcel and DTSC has confirmed that the 1501 California Avenue parcel is suitable for residential development.

#### **4.0 1601 California Avenue**

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<sup>33</sup> See EPA Q&A on risk screening levels, <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FQ3> (“The SLs are generic screening values, not de facto cleanup standards, and should not be applied as such... the SL’s role in site “screening” is to help identify areas, contaminants, and conditions that require further federal attention at a particular site.”).

<sup>34</sup> AMEC, Additional Environmental Investigation Results and No Further Action Request, 1501 California Avenue, Palo Alto, California, December 13, 2013.

<sup>35</sup> DTSC, Transmittal of fully executed Voluntary Cleanup Agreement for 1501 California Avenue, Palo Alto, California, September 11, 2013; <https://www.dtsc.ca.gov/SiteCleanup/Brownfields/BrownfieldsVoluntaryProgram.cfm>.

<sup>36</sup> DTSC, California Avenue Housing Phase II Site, 1501 California Avenue, Palo Alto – No Further Action Letter, December 13, 2013.



## 4.1 Background

Before the late 1950s/early 1960s, the 1601 California Avenue parcel was likely used for agriculture. Beginning in the late 1950s/early 1960s, a commercial building was erected and thereafter the parcel was used for electronics research and development (R&D) and small-scale manufacturing operations. Tenants included Granger and Associates, who leased the site from 1962 to 1969 and manufactured low frequency amplifiers and antennae, and Hewlett-Packard (HP) who leased the site from 1970 to 1999 for the manufacture of electronic analytical instruments. In 1999, HP assigned its lease to Agilent Technologies. Agilent performed R&D for manufacturing gas chromatography/mass spectrometry and liquid chromatography equipment. In 2005, Stanford regained possession of 1601 California Avenue and leased it to Facebook from 2008 to 2012 and to Theranos, who did R&D on medical testing devices there from 2012 through December 2014.

Over the years, tanks, sumps, degreasers, wastewater process lines and sewer lines were employed to handle chemicals associated with the activities of the various tenants. In addition, an electrical transformer was present at 1601 California Avenue.

AMEC conducted a site investigation at the 1601 California Avenue parcel in 2012 and 2013 to prepare for redevelopment of the property for the residential University Terrace Project, and also reviewed testing done previously at the site by Geomatrix, another consulting firm, in 2004.<sup>37</sup> The results of these investigations are compiled in the comprehensive environmental investigation and risk assessment report prepared by Haley & Aldrich in December 2015.<sup>38</sup>

Haley & Aldrich conducted a supplemental site investigation at the 1601 California Avenue parcel in 2015 (after Theranos departed in December 2014 and the buildings could be demolished) in order to further prepare for redevelopment of the property for the University Terrace residential project. Due to the extensive history of chemical handling and the fact that past sampling had shown the parcel had polychlorinated biphenyls (PCBs) in soil and volatile organic compounds (VOCs) in soil vapor, Haley & Aldrich prepared a site management plan to safely handle the demolition of subsurface structures, to manage soil at the parcel and to investigate chemical releases caused by past operations.<sup>39</sup> During the 2015 site investigation, Haley & Aldrich sampled the soil for metals; for PCBs (industrial chemicals typically associated with transformers); for TPHg, TPHd, TPHmo (e.g., gasoline, diesel and motor oil); and for VOCs (typically found in industrial solvents and paints). Soil vapor was sampled for VOCs to evaluate whether VOCs could migrate into future residences planned for the 1601 California Avenue parcel. This is called “vapor intrusion”.<sup>40</sup> The potential for vapor intrusion is typically evaluated with the collection of soil vapor samples (i.e., sampling of air within the soil column).

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<sup>38</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>39</sup> Haley & Aldrich, Site Management Plan, 1601 S. California Avenue, Palo Alto, California, February 10, 2015.

<sup>40</sup> [https://www.dtsc.ca.gov/SiteCleanup/Vapor\\_Intrusion.cfm](https://www.dtsc.ca.gov/SiteCleanup/Vapor_Intrusion.cfm).

And even though VOCs do not typically accumulate in outdoor air to concentrations of concern, as a conservative measure, the consultants considered potential concentrations of VOCs in outdoor air at the location of the future park area at the 1601 California Avenue parcel as part of the technical evaluation (see the discussion below on pages 12 and 13). The December 2015 report on the 1601 California Avenue parcel also included a human health risk assessment. Direct contact (e.g., dermal contact, incidental ingestion) with soil by future residents also was included as a potential exposure pathway in the technical evaluation.

The analysis of the soil samples showed that no VOCs were detected in soil within 30 feet below ground surface at levels above screening criteria. To raise the overall grade and achieve development elevations, up to an additional 15 feet of clean soil was placed throughout the park area at certain locations.

The results of all the testing at the 1601 California Avenue parcel were compared with various residential health risk screening criteria established by Cal-EPA, the federal Environmental Protection Agency (US EPA), and the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board). Samples were compared with regional screening levels (RSLs) established by US EPA<sup>41</sup> and endorsed or modified by DTSC,<sup>42</sup> and environmental screening levels (ESLs) developed by the Water Board.<sup>43</sup> These various residential health risk screening criteria are very conservative. If chemicals at a site are below these criteria, they are presumptively considered safe and require no further study or remediation. For example, US EPA describes the RSLs as protective for humans (including sensitive groups) over a lifetime.<sup>44</sup> The health risk screening criteria are not, themselves, regulatory cleanup standards or not-to-exceed numbers. Screening values are used to provide context for an initial review of analytical results.<sup>45</sup> If chemicals are detected above the residential health risk screening criteria, a closer evaluation is often undertaken in the form of additional environmental sampling and/or a human health risk assessment.

Haley & Aldrich prepared a technical report to describe the results of its sampling on the 1601 California Avenue parcel and submitted it to DTSC in December 2015.<sup>46</sup> This report, like

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<sup>41</sup> <http://www.epa.gov/risk/regional-screening-table>.

<sup>42</sup> DTSC, Human Health Risk Assessment Note 3, DTSC-modified Screening Levels (DTSC-SLs), <https://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-2015-10.pdf>, October 2015.

<sup>43</sup> [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/esl.shtml](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml).

<sup>44</sup> See EPA website Q&A on regional screening levels. <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FO1> (“Generally, at sites where contaminant concentrations fall below [R]SLs, no further action or study is warranted under the Superfund program”).

<sup>45</sup> See EPA Q&A on risk screening levels, <http://www.epa.gov/risk/regional-screening-table-frequent-questions-november-2015#FQ3> (“The SLs are generic screening values, not de facto cleanup standards, and should not be applied as such... the SL’s role in site “screening” is to help identify areas, contaminants, and conditions that require further federal attention at a particular site.”).

<sup>46</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

the other technical work done by Haley & Aldrich on behalf of Stanford, was done as part of the voluntary cleanup agreement that Stanford entered into with DTSC, so that DTSC could provide oversight and concurrence on the environmental work done at the University Terrace Project.<sup>47</sup> This report on the testing done at the 1601 California Avenue parcel also included a human health risk assessment to evaluate the chemicals at the 1601 California Avenue parcel that were found to exceed the residential health risk screening criteria described above.<sup>48</sup>

Special consideration was given to PCBs, which were found in soil at the parcel and to TCE, which was detected in soil vapor at high concentrations near a former industrial plating sump at the west side of the previous building and other operational areas at 1601 California Avenue. US EPA Region 9 published guidance in July 2014 establishing short term exposure limits for TCE because of a concern that TCE could cause fetal heart malformations in women exposed to it for even short periods during the first trimester of pregnancy.<sup>49</sup> Like most chemicals, screening levels for TCE are developed based on non-carcinogenic and carcinogenic health effects. “Carcinogenic” means “cancer-causing”. The risk-based screening levels protective of long term, chronic exposures for TCE also are protective of short-term, non-carcinogenic health effects (i.e., the screening levels for chronic exposures are lower than the screening levels for short-term exposures). For long term cancer risks, US EPA and DTSC evaluate, as a point of departure, whether exposure over a 26 year period would cause more than one excess cancer in a population of one million people.<sup>50</sup> This is sometimes referred to as the “ $1 \times 10^{-6}$ ” or “one-in-a-million excess cancer risk” standard. In the human health risk assessment prepared by Haley & Aldrich, both non-carcinogenic and carcinogenic health effects were evaluated for all chemicals, including TCE.

#### 4.1 PCBs

Testing showed that relatively low levels of PCBs had been distributed in certain areas of the 1601 California Avenue parcel, particularly in the area of the former site building and in the southeast area.<sup>51</sup> For that reason, an extensive remedial excavation was undertaken to remove

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<sup>47</sup> DTSC, Voluntary Cleanup Agreement, August 20, 2015; <https://www.dtsc.ca.gov/SiteCleanup/Brownfields/BrownfieldsVoluntaryProgram.cfm>.

<sup>48</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>49</sup> US EPA, US EPA Region 9 Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at South Bay National Priority List (NPL) Sites (“Region 9 Guidelines”), December 3, 2013; and US EPA, EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion, July 9, 2014..

<sup>50</sup> DTSC, Preliminary Endangerment Assessment, Guidance Manual, Cal-EPA, Revised, October; DTSC, Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance), Cal-EPA, Final, October 2015.

<sup>51</sup> Haley & Aldrich, Remediation Completion Report – Excavation of Soil Containing Polychlorinated Biphenyls, 1601 S. California Avenue, Palo Alto, California, July 31, 2015; Haley & Aldrich, Addendum to the July 2015 Remediation Completion Report – Excavation of Soil Containing Polychlorinated Biphenyls, 1601 S. California Avenue, Palo Alto, California, December 1, 2015.

the PCBs. More than 33,000 tons of PCB-impacted soil was removed from the 1601 California Avenue parcel in 2015 over an area covering approximately 90,000 square feet.<sup>52</sup> The excavation extended to depths typically from 3 to 8 feet below ground surface below the pre-development ground surface, but in some cases, deeper excavation was necessary. Most of the PCB-impacted soil was disposed of as non-hazardous waste, but some was classified as hazardous waste and was sent to a specialized facility for disposal.

After the remedial excavation, confirmation soil samples were collected to evaluate whether the removal was complete. The analytical results of confirmation soil samples were compared to cleanup goals.<sup>53</sup> The following site-specific cleanup goals were used to evaluate whether soil at certain depths had met a health-based cleanup goal for PCBs.

1. **Soil Within 10 feet of the Ground Surface.** It was assumed that soil within the upper 10 feet of the site would be disturbed during grading (thereby potentially exposing construction workers) or could be encountered in the future after residential development during activities such as gardening (thereby potentially exposing future residents). For this depth interval, Haley & Aldrich used the regional screening Level (RSL) which is a risk-based screening level for residential use established by US EPA and endorsed by DTSC for two specific types of PCBs detected at the Project Site (Aroclor 1260 and Aroclor 1254). The numerical value of this RSL cleanup goal is 240 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ), or 240 parts per billion.
2. **Soil 10 feet Below Ground Surface and Deeper.** It was assumed that soil at depths of 10 feet and deeper would not be encountered by future residents. A cleanup goal of 1,000  $\mu\text{g}/\text{kg}$  (or 1,000 parts per billion) established in federal regulations of US EPA for PCBs in “high occupancy areas”<sup>54</sup> was used for this deeper soil.

Soil removal was considered complete when the concentrations of PCBs in discrete samples were less than the applicable cleanup goal for that depth interval, as shown through confirmation sampling.

During the remedial excavation work, a total of 531 confirmation samples were collected (sidewall, bottom, and grid samples) to verify that the cleanup goals were achieved. The

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<sup>52</sup> Haley & Aldrich, Remediation Completion Report – Excavation of Soil Containing Polychlorinated Biphenyls, 1601 S. California Avenue, Palo Alto, California, July 31, 2015.

<sup>53</sup> DTSC, Human Health Risk Assessment Note 3, DTSC-modified Screening Levels (DTSC-SLs), <https://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-2015-10.pdf>, October 2015;

US EPA, 2015, Regional Screening Levels, <http://www.epa.gov/risk/regional-screening-table>.

<sup>54</sup> The Code of Federal Regulations (CFR), Chapter 40, Section 761.61 sets forth a cleanup level for “high occupancy areas” as less than 1000  $\mu\text{g}/\text{kg}$ . “High occupancy area” is defined as an area that could include a residence, school, and day care. PCBs left in place in the area designated as Excavation 1 are below this threshold.

analytical results of final confirmation samples indicated that PCBs, where detected, were less than the cleanup goals at all of the 531 locations, with the following two exceptions:<sup>55</sup>

- **Sample L1-1.0** was a grid sample collected at 1.0 foot below ground surface that contained a PCB concentration of 490 µg/kg (490 parts per billion). Soil samples collected at this location at 3.0 and 5.0 feet below ground surface had no detectable concentrations of PCBs. None of the grid samples surrounding location L1 contained PCBs at concentrations exceeding the cleanup goal of 240 µg/kg (240 parts per billion). As such, because this was an isolated detection, this data point was evaluated with other nearby data points by calculating the 95 percent (%) upper confidence level (UCL)<sup>56</sup> for the general area. The resulting 95% UCL was 158 µg/kg (158 parts per billion), i.e., less than the 240 µg/kg (240 parts per billion) cleanup goal for the shallow soil. No additional soil removal was judged to be necessary in this area. The location of sample L1-1.0 is on Lot 47 and will be covered by the footprint of the home and its driveway.
- **Sample SPC-12** was located on a slope and further soil removal at this location was deemed not practicable. This data point was evaluated with other nearby data points by calculating the 95% UCL for the general area. The 95% UCL concentration was 224.5 µg/kg (224.5 parts per billion), which is less than the cleanup goal of 240 µg/kg (240 parts per billion). From this result, no additional soil removal on the slope was deemed necessary. Sample location SPC-12 is on Lot 27 and will be covered by the footprint of the home.

During the course of the soil removal work on the 1601 California Avenue parcel, it was found that soil at the a nearby property at 1510 Page Mill Road (*Figure 1*) contains PCBs above the cleanup goals established for the Project. The PCB-containing soil at 1510 Page Mill is beneath asphalt paving and within a planter area. This off-site property is used for commercial purpose and is separated from the University Terrace Project with a fence. Thus, it will not be accessible to future residents of University Terrace, and the PCBs are primarily beneath a paved parking area. Stanford is working with the DTSC to separately address this off-site area where PCBs were found.

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<sup>55</sup> Haley & Aldrich, Remediation Completion Report – Excavation of Soil Containing Polychlorinated Biphenyls, 1601 S. California Avenue, Palo Alto, California, July 31, 2015; Haley & Aldrich, Addendum to the July 2015 Remediation Completion Report – Excavation of Soil Containing Polychlorinated Biphenyls, 1601 S. California Avenue, Palo Alto, California, December 1, 2015.

<sup>56</sup> The 95 % upper confidence limit (UCL) is a statistical method frequently used to conservatively estimate the mean concentration (average) of a data set. The 95% UCL is a probability statement concluding with 95% confidence that the distribution of the data has a mean less than or equal to the calculated value. The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated. In this case, the UCL is an estimate of the mean concentration of a chemical constituent in soil. The 95% UCL of the mean was selected as the exposure point concentration, which is considered a reasonable maximum exposure. The U.S. EPA ProUCL

software 5.0 (2013) was used to estimate the 95% UCL.

## 4.2 VOCs and Mitigation Measures

Extensive sampling for VOCs, including TCE, was conducted by Geomatrix, AMEC, and Haley & Aldrich because past testing showed their presence at the 1601 California Avenue parcel.<sup>57</sup> The sampling Haley & Aldrich conducted in 2015 showed that a number of chemicals, including TCE, were present in soil vapor at levels exceeding the health based risk screening levels.<sup>58</sup> TCE was detected most frequently and at the highest concentrations in soil vapor at the 1601 California Avenue parcel, in the vicinity of a former industrial sump and at other former operational areas.<sup>59</sup>

Haley & Aldrich prepared a human health risk assessment for the 1601 California Avenue parcel and submitted it to DTSC on December 17, 2015, as part of its work under the voluntary cleanup agreement.<sup>60</sup> Toxicologists and technical staff at DTSC provided a variety of comments to Haley & Aldrich to direct the preparation of the human health risk assessment.<sup>61</sup> Site-specific health-based risk screening goals for VOCs were established in this human health risk assessment, based on actual conditions at the 1601 California Avenue parcel and the physical property of soils there. At five locations on the 1601 California Avenue parcel, TCE was found at levels that exceeded these site-specific health-based risk screening goals.<sup>62</sup>

Based on the sampling at the 1601 California Avenue parcel and the risk evaluation, Stanford decided to reconfigure the University Terrace Project so that no single family homes or condos would be located over the areas where TCE and other chemicals of concern exceeded the site-specific health-based risk screening levels. Haley & Aldrich's risk assessment concluded

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<sup>57</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 2, 2015.

<sup>58</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>59</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>60</sup> Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

<sup>61</sup> DTSC, 1601 S California Ave – draft comments from HERO on Supplemental Investigation/Risk Assessment, Email, October 9, 2015; Haley & Aldrich, Response to Comments, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, Draft, November 6, 2015; DTSC, 1601 S California – meeting to discuss Risk Evaluation, Email, November 12, 2015; Haley & Aldrich, 1601 S. California - alternative VI modeling scenarios, November 25, 2015; Haley & Aldrich, Summary of 1601 S. California meeting, Email, November 27, 2015; DTSC, 1601 S California - tentative approval of Risk Assessment Report, December 8, 2015; Haley & Aldrich, 1601 S California – construction worker trench scenario, December 10, 2015; Haley & Aldrich, Review of near surface geology, 1601 S. California Ave., Palo Alto site, Memorandum, December 15, 2015.

<sup>62</sup> Page 24 of Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

that there is no unacceptable risk to people using the park or other outdoor areas, including children, because VOCs do not accumulate in outdoor air and because no contamination has been detected in the surficial soil.

Dr. Paul Johnson, President of the Colorado School of Mines, and a well-known expert on soil, groundwater, and soil vapor evaluations, risk assessment, and remediation, also reviewed the technical work on the Project Site for Stanford, in particular for the 1601 California Avenue parcel. Dr. Johnson issued a letter on January 5, 2016, describing his involvement and providing his key conclusions.<sup>63</sup> Dr. Johnson's letter notes his confidence in the use of site data, and states: "Future residences are placed in areas with projected negligible risks and the relatively isolated area of possible concern is open park space in the plan." He further states: "The potential for this [vapor intrusion] is being eliminated in the planned development design by ensuring that utilities are not run through the residual vapor source at the site and by having vapor plugs/seals installed along the utilities."

*Figure 2* shows the layout of the University Terrace Project and the five locations where TCE was found below grade in soil vapor at levels exceeding health-based risk levels. Either a park or a street (not homes) are planned over these five locations to protect against the risk of vapor intrusion. A 50 foot buffer zone was established between homes and the locations affected by TCE in soil vapor. In addition, although not required by DTSC, Stanford has elected to put a vapor barrier under all the ground-level condos and single family homes built at University Terrace (on all three parcels), as an extra measure of protection against vapor intrusion. These mitigation measures are intended to provide additional assurance that VOCs from past operations will not migrate into indoor air into homes at the Project.

The human health risk assessment concluded that with the layout of the homes and the 50 foot buffer zone, the development plan for the University Terrace Project does not present an unacceptable risk to future residents, or to future uses of the park and recreational areas.<sup>64</sup>

The mitigation measures listed below were included in the development plan to further reduce the potential for vapor intrusion and provide additional protection to residents.

- **Additional Fill.** Over the area where TCE was found in soil vapor at concentrations exceeding the site-specific risk-based screening levels clean soil was placed and properly compacted to raise the grade up by as much as 15 feet above the pre-development site grade, thus providing an additional vertical buffer between the ground surface and the residual VOCs remaining at depth.
- **Thick Slab.** Detached homes will be constructed with a 10-inch thick post-tension slab (the concrete pad on which a home sits) that is resistant to cracking, thus further limiting the potential for vapors to migrate into homes. The condo units will have a 5-inch slab that serves the same general purpose.

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<sup>63</sup> See Letter from Dr. P. Johnson to A. Walton, Stanford, dated January 5, 2016.

<sup>64</sup> Page 29 of Haley & Aldrich, Supplemental Investigation and Risk Assessment Report, 1601 S. California Avenue, Palo Alto, California, December 21, 2015.

- **Vapor Barrier.** Foundations for all the ground-level homes at the Project Site will be constructed with a vapor barrier appropriate for residential development. Vapor barriers are sub-slab liners that block the entry of vapors into a building by causing soil vapor to migrate laterally beyond and outside the building footprint.
- **Sealing.** Slab penetrations (areas where the slab on which the building sits are penetrated to accommodate gas, electric and plumbing lines) will be sealed to prevent them from becoming a pathway for vapor intrusion.
- **Vapor Plugs in Utility Lines.** The utility corridors that contain the utility mains and lines beneath the streets at the 1601 California Avenue Parcel will be constructed with vapor plugs. Utility corridors typically contain a layer of porous material beneath the utility pipes that can be more permeable than the surrounding soil and therefore can be a migration pathway for vapors. Each of the plugs act as a “dam” to prevent vapor intrusion.
- **Site Management Plan.** Stanford has also agreed to prepare a post-development Site Management Plan for approval by DTSC. Stanford anticipates that this plan will provide maintenance protocols for the vapor plugs and confirm Stanford’s commitments not to build homes or other enclosed structures in the park area on the 1601 California Avenue parcel. The homes at University Terrace will be served by city-supplied water, and not by local groundwater.

Stanford will continue to work with DTSC on this Project. Stanford has submitted a supplemental investigation and risk assessment for the 1601 California Avenue parcel to the agency for its review and approval. Stanford anticipates that DTSC will follow up its tentative conclusion from December 2015 with a written letter finalizing its concurrence that the proposed development presents no significant risk to health, with institutional land use controls noted above to be placed on the open space park area.