Detailed EPA Response, Autumnwood

The Autumnwood Development

In the mid-2000s, the Autumnwood residential development was completed in the city of Wildomar, California (Riverside County). Sixty one homes were built on 11 acres. The first residents moved into their homes in 2006.

The California Department of Toxic Substances Control (DTSC) and others report that the 11 acre area was largely undeveloped before the homes were built. Site preparation included the excavation of 10 to 15 feet of soil, the importation of fill material, and the compaction of stockpiled and imported soil to form a stable base for the homes. Inspection reports indicate that "organics," trash, and other debris were present in the fill material and needed to be removed. There have been reports that some fill material came from a gas station cleanup.

The area is dry but rainfall varies significantly year to year. Rainfall was well above average in 2005, 2010 and 2011 (34.6, 20.5 and 26.9 inches), and near or below average (2.6 to 15.3 inches) in the other years since the homes were first occupied.

Water is supplied to homes in Autumnwood by the Elsinore Valley Municipal Water District (EVMWD), a public water system regulated by the State Water Resources Control Board Division of Drinking Water (SWRCB DDW). In 2014, EVMWD relied on imported water supplied by the Metropolitan Water District of Southern California for the majority of its water (63%). Local groundwater and surface water supplied the remainder of EVMWD's water (37%). Piping is in place to provide recycled water to the development for irrigation of outdoor landscaping.

Reports of Health Effects and Initial Testing

In a letter dated September 2012, the Swanson Law firm, representing some Autumnwood residents, reported that they believed that one death and a variety of serious medical problems were caused by toxic substances in the soil. The letter provides detailed summaries of the health effects experienced by residents at six of the homes, five of which are located on one of four streets in the development (Amaryllis Court). The health effects summary for residents of one of the homes is as follows.

> "Since moving into the ... home, the family members suffered serious health problems ...., including: Lung congestion, respiratory problems, coughing, allergic attacks, asthma, pneumonia, extreme shortness of breath, joint pain, lack of energy, severe migraine headaches, burning throat, watery eyes, dry cough, insomnia, tremors, shaking, anxiety, mood swings, depression, bladder infection, irritability, serious eye burning problems, hives and rashes across the body, swollen tongue, swollen lymph nodes, fever, flu-like symptoms, esophagus problems, gastrointestinal issues, diverticulitis, blurred vision, brain fog, forgetfulness, vertigo and dizzy spells, extreme chemical sensitivity,

> rhinitis, stuffy nose, severe exczma [sic] on eyelids and arms, muscle pain, dizziness, imbalance, chronic throat infection, exhaustion, permanently diminished lung function, hair falling out."

The letter also summarizes testing results for several homes in Autumnwood from May, July, and August 2012 (the "Carraway" testing). A separate August 2012 report prepared by Nancy G. Carraway, a Certified Industrial Hygienist, describes the May and July testing in more detail. (A November 2013 report prepared by the OEHHA and a DTSC compendium summarize the May, July, and August results, as well as results from September 2012, October 2012, and January 2013). Indoor air, outdoor air, and subslab soil gas samples were collected and analyzed for volatile organic chemicals (VOCs), which include chlorinated solvents, Freons, and constituents of gasoline. Indoor air samples collected from four homes in October 2012 were also analyzed for formaldehyde. In the indoor air samples, three compounds were reported to be at concentrations above California Human Health Screening Levels (CHHSLs) established by the CalEPA Office of Environmental Health Hazard Assessment (OEHHA). In the two homes where subslab and indoor air samples were collected, the subslab concentrations of many of the chemicals, including benzene, xylenes, and ethylbenzene, were higher than their indoor air concentrations. The chemical 1,2-DCA was an exception in both homes - it was higher in indoor air.

The letter also reports moisture problems and the presence of mold in three of the homes.

The 2012 Swanson letter notes that some Autumnwood homeowners found "oil rags" and other debris when gardening or digging on their properties and reported that the soil had a strong smell of gasoline.

Additional testing completed by Ami Adini and Associates, Inc. in September 2012 is summarized in a September 2012 report (the "Ami Adini" testing). The testing included the collection and analysis of subsurface soil gas samples from seven locations (at 5' and 10' bgs at most locations), soil matrix samples from six locations, and subslab soil gas samples from two locations. Soil gas samples were analyzed for VOCs and soil samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), TPH, organochlorine pesticides, and PCBs. Soil gas results were below screening levels for vapor intrusion, although screening levels were not available for all detected chemicals. All soil results were below detection limits. The report recommends that additional subslab samples be collected, and analysis of carpet and other materials in the homes that could offgas VOCs.

The Carraway testing and the Ami Adini testing are referred to in this letter as testing by the "residents' consultants."

State Agency Response

Initial DTSC Response

In October 2012, a DTSC toxicologist reviewed the data provided in the Swanson letter and the possibility that VOCs were moving from contaminated soils into homes at the Autumnwood development via "vapor intrusion." A memo summarizing the review concluded that the data in the Swanson letter did not support the conclusion that vapor intrusion was occurring in the

homes that were tested and that the measured concentrations were not high enough to cause the acute health effects reported in the Swanson letter. DTSC subsequently referred the matter to the Riverside County Department of Public Health after concluding that there was insufficient evidence to warrant a DTSC response. In a December 2012 letter, the city of Wildomar repeated its request for DTSC assistance to determine whether toxic substances were present in soil at Autumnwood.

SCAQMD

In January and February 2013, the South Coast Air Quality Management District (SCAQMD) collected and analyzed indoor air, outdoor air, soil matrix, and tapwater samples from homes in the Autumnwood development. SCAQMD collected and analyzed eight indoor and six outdoor air samples from three homes, soil samples from two homes, and tap water samples from one home. One of the indoor samples and one of the outdoor samples were three-hour composites; the rest were grab samples. The indoor air samples were analyzed for VOCs (including "Tentatively Identified Compounds [TICs]); the soil and tapwater samples were analyzed for metals. SCAQMD reported that measured outdoor air and soil concentrations were within expected ranges, and tapwater concentrations met EPA and State drinking water standards. Indoor air results were compared to values measured in two studies of indoor air from California homes. Slightly elevated concentrations of hydrocarbons and 1,2 dichloroethane, consistent with the 2012 “Carraway” testing, were found in several homes. Outdoor samples were compared to levels found elsewhere in the South Coast Air Basin. Soil matrix sample results were reported to be typical of levels reported by the U.S. Geological Survey for the western United States. A sample of "white material found on top of the soil" was reported to have higher than "typical" concentrations of phosphorous, sulfur, and several metals.

SCAQMD initially reported the presence of 1,2-dibromoethane (also known as ethylene dibromide or EDB) in some samples but subsequently concluded that laboratory computer software misidentified a small peak in the chromatograms as 1,2-dibromoethane, and that the compound was not present above detection limits in any samples. The misidentification of 1,2-dibromoethane may reflect the limitations of the analytical method used by SCAQMD for the analysis (gas chromatography by flame ionization detector with conformation by mass spectrometer).

CA Department of Public Health Division of Drinking Water and Environmental Management

In June and July 2013, the DTSC and the California Department of Public Health (CDPH) Division of Drinking Water and Environmental Management reported results from the analysis of tapwater samples from five Autumnwood residences. Twenty-five samples were analyzed for Total Dissolved Solids (TDS). The TDS concentrations were similar in all but one sample, ranging from 510 to 546 milligrams per liter. In one sample the reported concentration was much lower (45 mg/L). CDPH noted that the TDS concentrations were in the range expected given the source of the water and that all results complied with the 1,000 mg/L secondary drinking water limit for TDS. They further noted that the results indicated that the water was potable, and not from the recycled water system constructed to irrigate outdoor landscaping at Autumnwood.

CA DPH Environmental Health Investigations Branch

In September 2013, the CDPH completed a more comprehensive evaluation of the health conditions and symptoms reported by Autumnwood residents. CDPH's Environmental Health Investigations Branch examined information on reported health conditions and environmental data that had been generated to date. The available information included a spreadsheet summarizing self-reported health conditions by 50 Autumnwood residents and a "measles map" listing the health conditions reported at each participating residence.

CDPH considered a number of potential causes of the reported health conditions, including drinking water, nearby pollution sources, "Chinese dry wall," and vapor intrusion from contaminated soil or groundwater. Given the number and diversity of reported health conditions, CDPH concluded that it was highly unlikely that there was a single cause. A primary conclusion was that two of the potential causes, moisture and irritants in indoor air, could help explain some of the reported health conditions. This conclusion followed from resident reports of dampness, visible mold, and mold odors, and CDPH's evaluation of formaldehyde concentrations measured in indoor air in October 2012. Formaldehyde concentrations in three of the four homes tested exceeded ATSDR's acute Minimum Risk Level (MRL).

CDPH noted that 10 chemicals exceeded EPA or CA indoor air screening levels, although the measured concentrations of most of the chemicals were in the range reported in a 2011 EPA review examining background indoor air concentrations in residences.

CDPH recommended that steps be taken to remove moldy materials and reduce moisture levels in affected homes, that affected homes be inventoried to identify the sources of formaldehyde and other VOCs detected in analyses of indoor air, and that steps be taken to increase ventilation in affected homes. CDPH also recommended additional indoor air and groundwater sampling.

CDPH reiterated its recommendations about indoor VOC sources, mold, and moisture in a May 30, 2014 letter.

CalEPA Office of Environmental Health Hazard Assessment (OEHHA)

In November 2013, OEHHA completed an evaluation of the health implications of the Autumnwood environmental data generated to date. OEHHA compared the indoor air data collected between May 2012 and January 2013 to State screening levels. Several chemicals exceeded screening levels corresponding to a cancer risk of one in a million (10^{-6}). OEHHA reported that the measured concentrations were similar or somewhat higher than in two published reports of indoor air contaminant concentrations in homes, and concluded that there may be an unusual source for the chemicals.

OEHHA also evaluated the significance of the measured subsurface and subslab soil gas results. They examined whether the contaminants detected in these samples could pose a risk if they infiltrated through the foundation of a home and affected indoor air quality. They compared the measured values to California screening levels, which assume that contaminant concentrations in soil gas decrease by a factor of 1,000 or more as they move upward, enter a home, and mix with

indoor air. Subslab soil gas concentrations are assumed to decrease by a factor of 20. OEHHA characterized the concentrations of chloroform, benzene, and naphthalene in one of the subslab samples collected by Carraway as high but, after considering results of a second sample from the same home and samples from a second home, concluded that soil gas concentrations did not suggest that the soil was contaminated with VOCs. OEHHA further concluded that the environmental testing to date had not identified any chemicals that could explain the reported health conditions, with the exception that the reported formaldehyde concentrations could account for some of the symptoms and reported illnesses. OEHHA noted that concentrations could have been higher when the homes were first occupied.

DTSC 2013 Field Sampling and Evaluation (and OEHHA and CDPH review)

In November 2013, DTSC and its contractors completed the last known testing effort at the Autumnwood development. It included the analysis of soil samples collected at three locations, subslab soil gas samples from three homes; subsurface soil gas samples collected from 12 locations, and groundwater samples collected from four temporary monitoring wells. The purpose of the investigation was to determine whether hazardous waste constituents were present in soil or groundwater at or near the Autumnwood development and whether the contaminants, if present, posed a human health risk. Except for the subslab samples, samples were collected in the street adjacent to the residences. Soil samples were analyzed for metals, SVOCs, PCBs, and pesticides; groundwater samples were analyzed for VOCs and formaldehyde; soil gas samples were analyzed for VOCs and fuel oxygenate compounds (including formaldehyde); and subslab samples were analyzed for VOCs (including methanol). The VOC data were analyzed to evaluate the potential for VOCs in subsurface soils to enter overlying homes ("vapor intrusion"). A final report, including responses to comments on a January 2014 presentation of preliminary findings, was completed in November 2014.

A number of VOCs were detected in subsurface and subslab soil gas samples. They were primarily chemicals commonly found in gasoline and other petroleum-based fuels, including benzene, toluene, ethylbenzene, and xylenes. In the subsurface soil gas samples, measured concentrations ranged from the detection limit to 0.5 ug/L (except for two xylene results at 0.7 and 1.5 ug/L). In the subslab samples, measured concentrations ranged from the detection limit to 0.2 ug/L (except for two methanol values reported at 0.23 and 0.54 ug/L).

DTSC evaluated a subset of subsurface and subslab soil gas samples to identify "non-target" VOCs detected in the samples but, as is common practice, not identified by the laboratory. DTSC looked at three subsurface and three subslab soil gas samples and reported up to 10 TICs in each sample. Tables 9 and 10 in the DTSC report summarize the results. Most were "aliphatic" hydrocarbons found in gasoline and other petroleum fuels. Fuel oxygenates (e.g., MTBE) typical of gasoline were also identified.

Results from soil analyses were non-detect (PCBs and SVOCs, and organochloride pesticides except for the detection of phthalates in one sample) or reported to be within background levels (metals). Results from groundwater were non-detect (VOCs, PCBs, and formaldehyde) except for the detection of benzene in one sample at a concentration below the 0.5 ug/L reporting limit.

DTSC concluded that low concentrations of fuel-related hydrocarbons and chlorinated compounds were present in "a diffuse pattern" throughout the subsurface but neither the DTSC data nor data generated by others indicated a significant hazardous substance release to the environment. DTSC further concluded that the low concentrations of VOCs detected in soil gas did not pose a significant indoor air risk.

DTSC submitted a draft report to the OEHHA and CDPH for their review. Both agencies agreed with DTSC's conclusions. In a May 27, 2014 letter, OEHHA concluded that "The data is of sufficient quality for DTSC to draw its conclusion that there is no evidence for a hazardous chemical release in the soil and groundwater, and that no detected chemical vapors from the soil are infiltrating homes at concentrations that would explain illnesses reported by the residents." In a May 30, 2014 letter, CDPH concluded that "Based on the data presented in the DTSC Report, CDPH agrees with DTSC's conclusions regarding the investigation of the environmental media underneath the Autumnwood Development."

The DTSC report also comments on some of the previous testing. In particular, in its responses to comments, DTSC questioned the subslab testing results generated as part of the Carraway testing in 2012, noting that the sampling methods did not follow DTSC guidelines and that the report did not include adequate quality control/quality assurance data to validate the representativeness of the results.

Center for Community Action and Environmental Justice

In May 2013, the Center for Community Action and Environmental Justice (CCAEJ) submitted a petition on behalf of Autumnwood residents to ATSDR to conduct a health assessment of the area.

In April 2014, CCAEJ distributed a report titled "American Dream or Toxic Nightmare." The report describes the experiences of four families who left their Autumnwood homes after experiencing a variety of serious health effects. The report includes statements that fill material used at the Autumnwood development consisted, in part, of contaminated soil from a gas station and spoils from an auto dismantling yard.

In July 2015, CCAEJ provided EPA with a flash drive containing raw data from the AQMD and DTSC testing completed in 2013. Accompanying the flash drive was a note that one of the former residents had recently experienced severe respiratory symptoms when briefly reoccupying her home.

EPA's Review

In late 2014, CalEPA and several Autumnwood residents asked US EPA to review the Autumnwood investigations completed to date. We started our evaluation by meeting, in person and through a videoconference, with CCAEJ representatives and several affected residents. We then began to review documents prepared by DTSC, other State agencies, CCAEJ, and others involved in the investigations. In early 2015, we met or spoke with representatives of the Agency for Toxic Substances and Disease Registry (ATSDR), the California Department of Toxic Substances Control (DTSC), the South Coast Air Quality Management District (AQMD), the California Department of Public Health (CDPH) Division of Environmental and Occupational Disease Control, and the SWRCB DDW.

Key Steps in EPA's Review	
Nov 2014	Videoconference with CCAEJ representatives and Autumnwood residents
Nov– Dec 2014	Initial review of Autumnwood documents
Jan - July 2015	Communications with representatives of the ATSDR, DTSC, SCAQMD, CA DPH, SWRCB DDW
Feb 2015	Site visit with CCAEJ and residents, and receipt of letter from CCAEJ
June - Oct 2015	Acquisition and review of "raw data" from DTSC's 2013 investigation
July -Oct 2015	Receipt and review of raw data from CCAEJ

In February, EPA staff traveled to Wildomar to meet with representatives of the CCAEJ and several former residents of the Autumnwood housing development, and to inspect several homes. CCAEJ and the residents explained their concerns that contaminated soil, air, and/or water had caused and were continuing to cause serious health impacts on residents of the Autumnwood development, and their perspectives on environmental testing completed or reviewed by DTSC, AQMD, CDPH and others over the previous two years. EPA staff toured the development, including several abandoned homes and the surrounding area, looking at possible outdoor and indoor sources of contaminants. One of the residents provided a copy of a home inspection report from 2010. The report notes evidence of water penetration into the ceilings of two bedrooms in the residence.

During the visit, CCAEJ provided EPA staff with a letter critiquing DTSC's 2013 investigation and requesting that EPA review the "raw" data generated by the investigation. The letter describes what were believed to be discrepancies and inconsistencies between the raw data generated by the 2013 sampling effort and DTSC's 2014 report summarizing the results. A primary concern identified in the letter was unreported peaks in the chromatograms generated by analysis of soil gas samples collected beneath the concrete slabs in three Autumnwood homes and in streets adjacent to 11 homes as part of the investigation.

Following our February visit, we requested and received from DTSC additional information on Tentatively Identified Compounds (TICs) identified as part of the 2013 investigation. TICs are chemicals present in a sample but not on the "target compound list" for the laboratory method used to analyze the sample. Generally TICs correspond to "unreported" peaks that are not artifacts of the analytical method (such as column bleed and reagent solvents). A TIC may be identified as a particular chemical or as a class of compounds (e.g., alkane). TICs are typically

identified by a laboratory only upon request, and require an experienced analytical chemist with appropriate experience. The identify of chemicals labeled as TICs is tentative because the laboratory equipment used to identify the chemical is not calibrated for that chemical, making its identification uncertain. Concentrations reported for TICs are estimated values and may have significant high or low bias.

In April 2015, after reviewing the information provided by DTSC, we concluded that-additional TICs may be present beyond the (maximum of) 10 TICs reported by DTSC in its 2014 report. EPA requested additional information to determine whether other contaminants were present in the samples, and to further evaluate the TICs identified by DTSC. The presence of additional contaminants was one of the issues raised by CCAEJ in its February 2015 letter to EPA.

DTSC did not possess the additional information we sought but the private laboratory contracted by DTSC to analyze the samples in 2013 did. We worked with DTSC to obtain the data in a usable format and received the data in June. Our specific requests were for the complete raw data for the TICs identified in the 2014 report and for the laboratory to search and provide raw data for additional TICs consistent with the procedures used in EPA's Contract Laboratory Program (EPA CLP Statement of Work 01.1 Exhibit D). DTSC worked with the analytical laboratory to report and provide raw data for up to 30 TICs present in each of the subslab and soil gas samples collected in 2013. This request was technically challenging for the laboratory because they were not set up to provide CLP level TIC reports. We completed our evaluation of the data provided in September.

In July, CCAEJ provided a flash drive with a large number of files providing raw data from DTSC's and AQMD's 2013 investigations. EPA had already received and reviewed the raw data from DTSC. We reviewed the runlogs, chromatograms and peak summary tables from the AQMD testing.

Findings

In 2012 and 2013, approximately 150 environmental samples were collected at the Autumnwood development in response to the health concerns reported by Autumnwood residents. The first two investigations were completed independent of DTSC or other regulatory agencies. The latter two investigations were completed by the AQMD and the DTSC and its contractors.

Indoor Air

Two of the investigations included the analysis of indoor air samples. Indoor air samples provide a relatively direct measure of the residents' exposure to potentially harmful contaminants. Contaminants found in indoor air may enter the home from sub-surface contamination (“vapor intrusion”), result from off-gassing of volatile compounds in the home (e.g., construction materials and commercial products), or both. Sampling of soil gas and groundwater can help determine the source of any contaminants found in indoor air samples.

Many of the chemicals that were analyzed for in indoor air were present at concentrations below reporting limits. The limits were generally sufficient to detect concentrations exceeding health

protective screening levels, indicating that chemicals that were not detected were either not present in the indoor air samples or were present at low, but undetectable, concentrations below levels of potential health concern.

Formaldehyde: Formaldehyde was one of two chemicals detected in indoor air at concentrations above health-based screening levels. Formaldehyde can be an irritant after short-term exposure. As noted in both the CDPH Letter Health Consultation (September 2013) and the OEHHA Evaluation of Sampling Results (November 2013), in four of four homes tested, formaldehyde concentrations exceeded screening levels protective for chronic health effects, such as respiratory tract and eye irritation. Specifically, formaldehyde concentrations in all of the four homes tested in 2012 exceeded OEHHA's chronic Reference Exposure Level (REL) and three exceeded ATSDR's acute Minimum Risk Level (MRL), both protective for respiratory tract irritation. The OEHHA evaluation contains a detailed discussion of the indoor air formaldehyde results and notes in summary that formaldehyde concentrations in the three of the four homes were "above the average level for new homes" even though these homes were six or seven years old at the time of sampling. It is common for formaldehyde to off-gas from some construction materials, furniture and other commercial products. It is therefore possible that indoor air formaldehyde concentrations were higher when the homes were first occupied.

Acrolein: Acrolein was the second chemical detected in indoor air at concentrations exceeding health-based screening levels. Acrolein can also be an irritant after short-term exposure. In the indoor air sampling performed by SCAQMD in three homes, acrolein concentrations ranged from non-detect in one to 0.2-0.3 ppb in the other two. The detected concentrations are more than 10-fold above a U.S. EPA screening level protective for non-cancer hazards from long-term acrolein exposures and more than five-fold above an intermediate-term screening level protective for respiratory irritant effects set by the Agency for Toxic Substances and Disease Control (ATSDR).

These observations may help explain some of the health effects reported by residents, especially those related to irritation of the respiratory tract and mucous membranes (e.g., eyes).

1,2-Dibromoethane: CDPH and OEHHA noted that 1,2-dibromoethane concentrations initially reported by SCAQMD exceeded health-based screening levels but SCAQMD subsequently concluded that 1,2-dibromoethane was not present in the samples.

Other VOCs: A number of volatile hydrocarbons and chlorinated solvents were detected at concentrations above their respective cancer risk-based screening levels. These VOCs include carbon tetrachloride, benzene, 1,2-dichloroethane (1,2-DCA), trichloroethylene (TCE), tetrachloroethylene (PCE), ethylbenzene, 1,3-butadiene, vinyl chloride and 1,2-dichloropropane (the latter two in the SCAQMD sampling).

Cancer risk-based screening levels are set to the lower (most risk protective) end of a protective exposure range for carcinogens. This protective exposure range corresponds to a risk range of 10^{-6} to 10^{-4} (1-in-one-million to 100-in-one-million) used by most regulatory agencies, including U.S. EPA, to define acceptable excess lifetime cancer risks for exposed populations. Thus the cancer risk-based screening levels are exposure concentrations that correspond to an excess lifetime cancer risk of 10^{-6} (1-in-one-million). Inhalation exposure to concentrations exceeding

these cancer risk-based screening levels by a factor less than 100-fold represent exposures within the protective exposure range.

The OEHHA Evaluation of Sampling Results (November 2013) presents a detailed comparison to the 10^{-6} cancer risk-based screening levels of the results from indoor air sampling by the residents' consultants and by SCAQMD. In the consultants' results, the maximum detected 1,2-DCA concentration was above the upper end of the protective exposure range due to exceeding its cancer risk-based screening level by 330-fold; the consultants' median and the SCAQMD results for 1,2-DCA exceeded the screening level by less than 20-fold. 1,2-DCA is a common indoor air contaminant, often due to off-gassing from inexpensive and/or foreign plastics. In both the consultants' and SCAQMD sampling results, maximum detected concentrations for the other VOCs were all less than 100-fold above their respective screening levels; maximum concentrations exceeded screening levels by a range of 1.2-fold (TCE) to 54-fold for (benzene) and, where there were exceedances, median or average concentrations ranged from 1.4-fold (TCE) to 27-fold (benzene).

With the exceptions of formaldehyde, acrolein and 1,2-dibromoethane (discussed above) all of the reported VOC concentrations in both the consultants' and SCAQMD indoor air sampling were below their respective non-cancer screening levels.

With respect to the findings of the indoor air sampling conducted by the residents' consultants and by SCAQMD, U.S EPA agrees with the conclusion stated in the OEHHA report that, with the exception of formaldehyde and acrolein (both of which present a potential irritant threat) the biggest issue from indoor air exposure relates to excess cancer risks from long-term indoor exposure rather than non-cancer hazards.

<u>QC/QC of Consultants' Data</u>: The quality control samples analyzed as part of the Carraway study suggest that some of the results could be overestimated or false positives. However, an evaluation of this data suggests that the hydrocarbons present (including benzene and ethylbenzene) and the 1,2 DCA data is consistent with what was found by the SCAQMD.

In general, hydrocarbon concentrations detected in indoor air were above corresponding outdoor air concentration and, in several houses, at the high end of the range we would expect to find in indoor air. Concentrations of chloroform and 1,2 DCA were elevated, but consistent with results in other homes affected by indoor sources.

<u>Subslab and Subsurface Soil Gas</u>

Three of the four investigations included analysis of subslab soil gas or outdoor subsurface soil gas samples. The results of the subslab soil gas analyses and, less directly, DTSC's neighborhood subsurface soil gas analyses, provide an indication whether contaminants in the soil could be a source of the contaminants measured in indoor air.

Low concentrations of a variety of chemicals were detected in DTSC's subslab samples and, to a lesser extent, soil gas samples collected in streets adjacent to the residences. These results are not expected in clean soil. Although the DTSC subslab and SCAQMD indoor air samples were collected months apart, making the comparison less certain, the higher concentrations in subslab

samples suggest that some of the chemicals detected in indoor air may have originated in the soil or from other outdoor sources. This pattern is most apparent for benzene, toluene, ethylbenzene, and xylenes ("BTEX" compounds). The presence of these contaminants is consistent with reports in the Swanson letter that some Autumnwood homeowners found "oil rags" and other debris on their properties and reported that the soil smelled of gasoline.

In contrast, the absence (in the DTSC testing) or limited detection (in the Carraway testing) of 1,2-DCA in subslab samples supports the interpretation that there were sources of 1,2-DCA in some of the homes. Similarly, formaldehyde was detected in subslab samples at concentrations much less than in indoor air. The higher concentrations measured in indoor air suggest that some or all of this contaminant also came from sources in the home.

Results from the subslab samples collected and analyzed by Carraway are less certain given that they were not collected in accordance with EPA or DTSC protocols but it is notable that the Carraway investigation also detected many of the BTEX compounds detected in the DTSC testing. Benzene and/or toluene were also detected in the two subslab samples analyzed as part of the Adini investigation.

EPA TIC Evaluation

As described above, EPA requested and received additional raw data to determine if other chemicals beyond those previously identified were present in samples collected as part of DTSC's 2013 investigation. EPA evaluated the raw data provided by DTSC and its contract laboratory for each of the six subslab and 30 subsurface soil gas samples.

DTSC was unable to obtain supporting data for the TICs identified in its 2014 report. Instead, DTSC worked with the analytical laboratory to reprocess the raw data and generate a new list of TICs. In May 2015, EPA received the results of the new TIC analysis along with the associated raw data. EPA evaluated the data for all 36 samples. For one subslab sample (#14G SV) and one soil gas sample (#12 SV5 1PV), EPA generated lists representing most of the peaks appearing in the chromatograms. The lists are presented as a series of tables below (Tables 1a - 1d and Tables 2a - 2c).

Table 1a lists chemicals in sample 14G SV previously reported by DTSC in its 2014 report and their reported concentrations. Table 1b lists additional chemicals that the laboratory identified in 2013 but were not previously reported. These results are not TICs; they have been positively identified and are quantitatively certain. Table 1c lists TICs identified by DTSC and/or the laboratory. EPA has refined some of the tentative identifications. Table 1d provides information on additional compounds that appeared to be present in the sample, beyond those included in Tables 1a, 1b, and 1c. Table 1d also provides EPA's possible identifications of several compounds based on retention times and tentative identifications in other subslab samples.

Tables 2a - 2c provide similar results for soil gas sample 12 SV5 1PV. Table 2a lists chemicals previously reported by DTSC in its 2014 report and their reported concentrations. Table 2b lists TICs identified by DTSC and/or the laboratory. Table 2c provides information on additional compounds, beyond those included in Tables 2a and 2b, that appeared to be present in the sample.

Tables 1a and 2a provide the same results included DTSC's 2014 report (although the units may differ). One of the chemicals, 1,1-difluoroethane, was introduced during sampling as a "leak check compound" (i.e., it was not known to be present in the subsurface). Table 1b provides results that were not included in the 2014 report. They are primarily a mix of hydrocarbons, alcohols, and ketones. Tables 1c and 2b provide updated lists of TICs present in the two samples. Tables 1d and 2c list additional compounds identified by EPA that may be present in the two samples. The additional compounds were identified from the Total Ion Chromatogram and Area Percent Report. The lists of chemicals and some of the estimated concentrations in Tables 1c, 1d, 2b, and 2c differ from the TICs identified in the 2014 report but we generally agree with DTSC's conclusion that most of the TICs identified and unknown peaks are likely constituents of petroleum fuels. (DTSC's conclusion is that, in general, the TICs in the subslab and soil gas samples are mostly C5 – C11 aliphatic range fuel hydrocarbons.) Many of the TICs are known constituents of gasoline. Some alcohols, ketones, and aldehydes were also detected in the samples. Some of these compounds may be artifacts of the sampling and analysis methodology (e.g., isopropanol). There may not have been controls in place in the sampling and analytical equipment, reagents, or materials for these compounds as they are not the method target analytes.

Table 1a. Compounds Originally Reported in Subslab Sample 14G.

Chemical originally reported	ppbv	Qualifier[a]	Retention Time	Comments
1,1-Difluoroethane	7.3		2.996	Leak Check Compound
Benzene	8.1		8.420	
Toluene	15.3		10.124	
Ethylbenzene	2.4		11.356	
m,p Xylene	6.9		11.448	
o Xylene	2.6		11.733	
1,2,4 Trimethylbenzene	3.5		12.793	
Chemical added post analysis by request	**ug/m³**	**Qualifier[a]**	**Retention Time**	**Comments**
Methanol	100	J	3.484	
TPHv(C5-C11)	1100	J	NA	

.

Table 1b. Additional Chemicals Definitively Identified in Subslab Sample 14G

Chemical analyzed for but not originally reported	ppbv	Qualifier[a]	Retention Time	Comments
1,1,1,2 Tetrafluoroethane	5.1		2.929	
Proprene	35.4		3.077	
Ethanol	6.9		4.346	
Acetone	47.1		4.837	
Isopropanol	1.1		5.110	
t-Butanol	1.7		5.662	
Carbon Disulfide	2.7		5.991	
2-Butanone	4.1		6.950	
Hexane	10.6		7.408	
Cyclohexane	3.2		8.604	
2,2,4 Trimethylpentane	1.6		9.081	
Heptane	4.8		9.212	
4 Ethyltoluene	1.0		12.475	

a. The tables use the data qualifiers “J” and “NJ.” The “J” qualifier indicates that the result is quantitatively uncertain and estimated. The “NJ” qualifier indicates that the identification of a compound is tentative and that the result is quantitatively uncertain. For tentatively identified compounds quantitative uncertainty can be significant.

b. Quantitation is based on an alternative internal standard.

Table 1c. Tentatively Identified Compounds in Subslab Sample 14G

Tentatively Identified Compound	ppbv	Qualifier[a]	Retention Time	Comments
four carbon alkene	2.8	NJ	3.646	
Butane	17.4	NJ	3.755	Merged (peak split)
six carbon alkane	2.8	NJ	6.786	
six or seven carbon alkene	2.6	NJ	7.079	
4 or 5 carbon alcohol/ester (potentially butanol)	4.1	NJ	8.350	
Octane	13.3	NJ	10.642	
2,4 Dimethylheptane	9.6	NJ	10.958	
Ethyl-methyl or trimethyl Benzene	3.1	NJ	12.447	
Decane	13.0	NJ	12.812	
Dimethyl Decane	4.2	NJ	13.400	
4-methyl-1-undecene	14.5	NJ	13.403	
Undecane	7.9	NJ	13.710	
twelve carbon alkane	5.0	NJ	13.771	

Table 1d. Previously Unidentified Compounds in Subslab Sample 14G.

Chemical Identified by retention time	ppbv	Qualifier[a]	Retention Time	Comments
Acetaldehyde	9.5	NJ	3.431	May be field contamination
Pentane	25.5	NJ	5.366	
Alkene	2.6	NJ	7.971	
seven carbon alkane	3.2	NJ	8.671	
unknown compounds	**ppbv**	**Qualifier[a]**	**Retention Time**	**Comments**
Unknown (possibly ethane or Freon)	70.4	NJ	2.857	
Unknown (possibly propane)	23.3	NJ	3.094	
Unknown	3.7	NJ	6.061	
Unknown	5.1	NJ	6.705	
Unknown	2.7	NJ	7.171	
Unknown	3.3	NJ	8.827	
Unknown	2.6	NJ	10.313	
Unknown	6.9	NJ	11.170	
Unknown	3.1	NJ	11.814	
Unknown	3.0	NJ	12.661	
Unknown	3.1	NJ	13.055	
Unknown	2.5	NJ	13.356	
Unknown	2.8	NJ	13.459	
Unknown	4.5	NJ	13.624	

Table 2a. Compounds Originally Reported in Subsurface Soil Gas Sample 12 SV5 1PV

Chemical originally reported	ug/m3	Qualifier[a]	Retention Time	Comments
1,1-Difluoroethane	470		1.559	Leak Check Compound
Benzene	50		4.560	
Toluene	240		5.890	
Ethylbenzene	150		7.030	
m,p Xylene	610		7.113	
o Xylene	190		7.441	

Table 2b. Tentatively Identified Compounds in Subsurface Soil Gas Sample 12 SV5 1PV

Tentatively Identified Compound	ug/m3	Qualifier[a]	Retention Time	Comments
four carbon alkene	126[b]	NJ	1.833	
five carbon alkene	29[b]	NJ	2.482	
Hexane	91[b]	NJ	3.476	
eight carbon alkane	44	NJ	5.512	
eight carbon alkane	38	NJ	5.518	
nine or ten carbon alkane	211	NJ	6.697	
trimethyl cyclohexane	109	NJ	6.738	
trimethyl cyclohexane	36	NJ	6.744	
3-methyl-octane	197	NJ	6.786	
ten carbon alkene	33	NJ	7.738	
camphene	50	NJ	7.976	
ethyl-methyl or trimethyl benzene	68	NJ	8.131	
ethyl-methyl benzene	88	NJ	8.512	

Table 2c. Previously Unidentified Compounds in Subsurface Soil Gas Sample 12 SV5 1PV.

Chemical Identified by retention time	ug/m3	Qualifier[a]	Retention Time	Comments
acetaldehyde	270[b]	NJ	1.946	field contamination?
octane	138	NJ	5.929	
twelve carbon alkane	316	NJ	8.679	
thirteen carbon alkane	122	NJ	9.054	
unknown "unreported" chemical	**ug/m3**	**Qualifier[a]**	**Retention Time**	**Comments**
unknown	79[b]	NJ	1.850	
Unknown	71[b]	NJ	2.964	
Unknown	76.0	NJ	6.566	
Unknown	86.0	NJ	7.173	
Unknown	138.0	NJ	8.185	
Unknown	316.0	NJ	8.679	
Unknown	334.0	NJ	8.881	

Acetaldehyde *may* have been present in the two samples described in Tables 1 and 2. If present, acetaldehyde could contribute to a potential non-cancer hazard posed by indoor air. Acetaldehyde was reported at a concentration of 20,000 ug/m^3 in one subslab sample (11-SV-5, not shown in the tables); if accurate, the corresponding indoor air concentration predicted by vapor intrusion modeling would be greater than an acute OEHHA screening level protective for respiratory and eye irritation, including bronchoconstriction. The predicted indoor air concentration also exceeds U.S EPA and OEHHA screening levels protective for long-term respiratory effects including degenerative, inflammatory and hyperplastic effects on the respiratory system.

Drinking Water Evaluation

Tapwater: We reviewed the tapwater testing results reported by SCAQMD (inorganics) and DTSC/CDPH (TDS) and confirmed with the SWRCB DDW that since 2007 drinking water supplied by EVMWD to homes in the Autumnwood development has complied with all EPA and State drinking water standards. EVMWD periodically tests the water served to its customers. Most testing occurs at the water source or at EVMWD's water treatment plants. Testing to date cannot rule out the unlikely possibility that water delivered to the Autumnwood development becomes contaminated at some point in the distribution system downstream of the plant but upstream of Autumnwood. We are not aware of any testing for a broad range of possible organic contaminants (i.e., VOCs and SVOCs) in tapwater at Autumnwood homes.

Recycled Water: We also confirmed that recycled water was first delivered to Autumnwood for irrigation of outdoor landscaping in July 2014. Prior to July 2014, the recycled water piping was filled with potable water.

Conclusions /Recommendations

CCAEJ reports that four Autumnwood residents have died of respiratory ailments and others experienced a multitude of illnesses after moving into homes in the Autumnwood development. The reported health effects prompted investigations by several state agencies, including the CDPH, OEHHA, AQMD, and DTSC. As part of their investigations, SCAQMD and DTSC collected and analyzed indoor air, outdoor air, soil matrix, tap water, subslab soil gas, outdoor subsurface soil gas, and groundwater samples from locations in the Autumnwood development.

In late 2014, CalEPA and several Autumnwood residents requested that EPA review the investigation work completed to date. In response, over the last nine months, EPA has met with representatives of CCAEJ and some of the affected residents, visited the Autumnwood community, reviewed technical reports generated by representatives of the residents, DTSC and other State agencies, and completed an in-depth review of some of the environmental data generated by DTSC as part of their 2013-2014 investigation. As part of EPA's in-depth evaluation, we obtained and reviewed raw subslab and soil gas data generated by DTSC in 2013 to identify any chemicals that were present in the samples but not previously reported.

Our evaluation identified additional chemicals in many of the subslab and soil gas samples. Most are constituents of gasoline or other petroleum compounds, consistent with DTSC's findings that

low concentrations of fuel-related hydrocarbons and chlorinated compounds were present in a diffuse pattern throughout the development.

We did not find any evidence that the State agencies altered or manipulated the results of their testing.

We also reviewed the findings and recommendations made by the residents' consultants and the State agencies which investigated the Autumnwood homes and neighborhood. We agree with CDPH and OEHHA that:

- Indoor air concentrations of formaldehyde and acrolein measured in 2012 and 2013 present a potential non-cancer hazard, primarily related to irritant potential. Our conclusion that acetaldehyde, identified as a TIC in the SCAQMD data and a previously unidentified compound in EPA's analysis, may also be present at concentrations posing a potential irritant hazard provides additional support for concluding that exposure to indoor air aldehydes and related compounds may help explain some the reported health effects.

- Aside from the irritant compounds mentioned in the first bullet, the primary health risks from VOCs measured in indoor air relate to potential excess cancer risks from long-term (years to decades) exposures.

- There does not appear to be evidence of significant vapor intrusion from the subsurface.

- Moisture, dampness and potentially related exposures from mold may also contribute to reported health effects. Although we did not observe moisture problems during our February site visit, we agree with CDPH's findings, included in its September 2013 letter, that the presence of moisture, dampness, and/or mold could help explain some of the reported health conditions. We support recommendations made by CDPH that steps be taken to remove moldy materials, reduce moisture levels, and increase ventilation and/or drainage in any homes where moisture remains a problem or reoccurs. Lastly, we note that the health effects reported in the 2012 Swanson letter followed two wetter than average years in 2010 and 2011 (20.5 and 26.9 inches of rain, compared to the 1993-2014 average of about 14 inches).

We believe that it is unlikely that further analysis of the 2012 and 2013 testing results or additional environmental testing will identify the cause or causes of the health effects reported by Autumnwood residents. There would be some value in collected and analyzing additional indoor air samples, particularly for formaldehyde, acrolein, acetaldehyde and related compounds to determine whether indoor air concentrations remain elevated. We recommend, that if additional sampling is completed, that the samples be collected over a period of one or more days to better characterize longer-term exposure.

Autumnwood Documents Reviewed

Date	Author	Adressee	Subject/Title
8/23/2012	Nancy G. Carraway, CIH		Report on Indoor Air Quality Investigation
9/18/2012	Swanson Law Firm	Senator Barbara Boxer	Letter describes health effects experienced by Autumnwood residents, summarizes results from indoor air, outdoor air, subslab and subsurface soil gas, and soil testing completed May through Sept 2012
9/27/12	Ami Adini & Associates	Swanson Law Firm	Preliminary Environmental Assessment Report, Autumnwood Development, Amaryllis Court, Wildomar, California, 92595. Prepared for Swanson Law Firm by Ami Adini & Associates. September 2012
9/27/2012	City of Wildomar	Riverside County Board of Supervisors and Department of Public Health	Notification Pursuant to HSC (Proposition 65) that hazardous substances reportedly found in soil and air at Autumnwood
10/9/2012	Department of Toxic Substances Control (DTSC)		Memorandum from DTSC toxicologist reviewing environmental data provided in 9/27/12 letter (Review of Environmental data collected at Tract 31175, Amaryllis Court, Wildomar, California.
10/24/2012	DTSC	Riverside County Department of Public Health	Letter concluding that the evidence was insufficient to warrant DTSC response and referring the Autumnwood matter to Riverside County.
12/20/2012	City of Wildomar	DTSC	Letter requesting further action (testing) by DTSC.
1/00/2013	AQMD		(Revised) report on air and soil samples taken in Wildomar, CA in January 2013. Downloaded from: http://www.aqmd.gov/home/library/air-quality-data-studies/special-monitoring/wildomar-sampling-reports
2/00/2013	AQMD		Wildomar Report #2: Report on soil and water samples taken in Wildomar, CA in February 2013 . Downloaded from: http://www.aqmd.gov/home/library/air-quality-data-studies/special-monitoring/wildomar-sampling-reports
2/5/2013	City of Wildomar		Press release for public meeting
2/25/2013	Consumer Watchdog		"Golden Wasteland" report, including chapter on Autumnwood. Date estimated. Downloaded from: http://www.consumerwatchdog.org/sites/default/files/resources/goldenwasteland.pdf
5/9/2013			CCAEJ petition to CDC/ATSDR

7/11/2013			ATSDR response
6/24/13	DTSC	CDPH	Letter providing Total Dissolved Solids levels in tapwater samples collected from five Autumnwood homes
7/26/13	CDPH	DTSC	Letter from the CDPH Division of Drinking Water and Environmental Management reviewing the results of tapwater analyses
9/3/2013	CDPH	DTSC	Letter Health Consultation, on behalf of ATSDR
9/17/2013	DTSC	DTSC	Presentation, Vapor Intrusion Evaluation, Autumnwood Development.
11/26/2013	Office of Environmental Health Hazard Assessment (OEHHA)	DTSC	Memorandum evaluating the health implications of the measured environmental contaminant concentrations
12/00/2013	DTSC		Various documents (workplan, work notice, December 2013 draft of final report, presentations) Downloaded from: https://www.dtsc.ca.gov/SiteCleanup/Projects/Autumnwood_Wildomar.cfm
2014	DTSC		Binder ("Wildomar") provided to U.S. EPA with information assembled by DTSC.
1/17/2014	DTSC		Presentation, DTSC Investigation Update. Downloaded from: https://www.dtsc.ca.gov/SiteCleanup/Projects/Autumnwood_Wildomar.cfm
4/8/2014	CCAEJ		"American Dream or Toxic Nightmare," describes the experiences of four Autumnwood families, includes reports of contaminated fill material, and provides a "measles map." Downloaded from: http://media.wix.com/ugd/a0af5d_d5194c15ffe54b3db8c00fb075736880.pdf
6/19/2014	EVMWD		Press release announcing supply of recycled water to Wildomar
7/14/2014	California Senate Office of Oversight and Outcomes		California Senate Office of Oversight and Outcomes report reviewing Golden Wasteland report Downloaded from: http://sooo.senate.ca.gov/sites/sooo.senate.ca.gov/files/FINAL-DTSC%20report%207%2011%2014-EDITED.pdf
9/19/2014	DTSC		Presentation, DTSC Investigation Update. Downloaded from: https://www.dtsc.ca.gov/SiteCleanup/Projects/Autumnwood_Wildomar.cfm
10/00/2014	DTSC		Final DTSC report. Includes attachments A-M. Downloaded from: https://www.dropbox.com/sh/6wtht80gsfop3bt/AAD39XGFIamibBx-JaKJLgmwa?dl=0

8/14/14	Riverside County Flood Control and Water Conservati on District		Rainfall data, downloaded on 9/8/15 from http://rcflood.org/downloads/SMRain2014.pdf
06/00/2015	EVMWD		2014 EVMWD Annual Water Quality Report