Section 7

Baseline Human Health Risk Assessment and Ecological Risk Assessment

This section provides an evaluation of the estimated risk associated with GWP site contaminants. **Appendix A** provides data and calculations used in the BHHRA, a copy of the CLC blending program for CLC Well No. 21, and the Ecological Risk Screening Checklist.

7.1 Baseline Human Health Risk Assessment

This section presents the approach, assumptions, and conclusions of the BHHRA for the GWP site.

7.1.1 Chemical of Potential Concern Selection Process

EPA used a two-step screening process to identify COPCs in soil vapor and ground water for the BHHRA. The process evaluated the FOD and risk-based screening levels obtained from various EPA sources.

7.1.1.1 Data Used in the Screening Process

This section describes the specific data inputs to the BHHRA, for both soil vapor and ground water. The detailed laboratory analytical reports and COC forms are provided in **Appendix C**.

7.1.1.1.1 Soil Vapor

Soil vapor data were available from the immediate vicinity of three areas: (1) eight adjacent residences; (2) the PAL Boxing Facility; and (3) the Meerscheidt Recreation Center. Soil vapor samples collected from shallow depths from 3 to 10 ft bgs in November 2005 were used in the BHHRA. Although some soil vapor samples were also available from 2002, these samples were concluded to be too old to represent current site conditions. In addition, they were collected with the intent of characterizing nature and extent of contamination, and not for the purpose of evaluating soil vapor intrusion. Therefore, the newer (November 2005) data were used. The data were grouped for the BHHRA based on the locations where samples were collected (i.e., near specific residential locations, at the PAL Boxing Facility, and at the Meerscheidt Recreation Center). Sampling locations are presented on **Figure 2-7** and a summary of soil vapor analytical data is provided in **Table A1-2.1** through **Table A1-2.3** of **Appendix A1**.

7.1.1.1.2 Ground Water

Ground water data collected by the CLC and EPA within the last two years (the sampling event in January 2004 and the second mobilization sampling event in December 2005) were used in the BHHRA. Well locations are provided on **Figure 2-8** and a summary of ground water analytical data is provided in **Table A1-2.4** through **Table A1-2.8** of **Appendix A1**. Potential current exposure points were identified in ground water at locations where municipal supply wells or reservoirs distribute water directly to users (e.g., the Upper Griggs Reservoir, one private well [LRG-3191], and CLC wells that are not blended or are currently off-line). Potential future ground water exposure points were identified in the Mesilla Basin under the scenario where additional CLC wells installed in the future or existing CLC wells become impacted with COPCs from ground water migration. The ground water data were grouped for the BHHRA based on the current use (i.e., water that is distributed to city residents) and potential future use (i.e., ground water in the Mesilla Basin) as follows:

- Municipal supply wells and reservoir currently distributing potable water to city residents—this data group includes the Upper Griggs Reservoir and CLC wells (excluding five CLC wells blended in the Upper Griggs Reservoir and CLC wells 18 and 19).
- One private well—this data group includes the data collected from private well LRG-3191. The well is currently used for irrigation purposes only and is not the source of drinking water at the residence, although the resident may consume water from the well on an infrequent basis.
- CLC wells blended in the Upper Griggs Reservoir —this data group includes the data collected from the five CLC wells (CLC wells 10, 21, 29, 32, and 60) providing water to the Upper Griggs Reservoir (the detailed CLC blending plan is provided in **Appendix A4**). The data collected from the Upper Griggs Reservoir are a better representation of concentrations at exposure points than are the five wells.
- CLC wells 18 and 19—this data group includes the data collected from two CLC wells previously used as part of the public water supply. CLC wells 18 and 19 have not been used since 1996 and 2005, respectively and, therefore, there are no current exposures to these wells.
- Monitor wells—this data group includes the ground water data collected during the RI from 24 monitor wells. The specific data used were the most recent available, i.e., from the December 2005 sampling event. In the future, one or more of the following scenarios may occur: (1) the CLC may install additional wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs, (2) the CLC may discontinue their ground water blending program and chemical

concentrations in CLC wells may exceed MCLs, or (3) ground water in the Mesilla Basin will likely continue to migrate and impact currently-used CLC wells at levels above MCLs. Therefore, future concentrations in CLC wells may be at levels above MCLs and pose an unacceptable risk (**EPA, 1991**).

7.1.1.2 Potential Receptors Considered in the Screening Levels

Adult and child residents, industrial workers, and adolescent recreational users were identified as current and future receptors near the GWP site. These receptors were considered when identifying the appropriate screening levels for site data. Future land uses and activities are assumed the same as present.

The Agency for Toxic Substances and Disease Registry (ATSDR), created by CERCLA, is required to conduct public health assessments for all sites listed on the NPL. A public health assessment includes a preliminary assessment of the potential threats that individual sites pose to human health. The public health assessment is required to be completed "to the maximum extent practicable" before completion of the RI/FS. ATSDR uses the same general risk assessment framework as the EPA BHHRA. ATSDR's public health assessments are intended to help public health and regulatory officials (e.g., EPA) determine if actions should be taken to reduce exposure to hazardous substances and to recommend whether additional information on human exposure and associated risk is needed. EPA considers the information in the public health assessment and the results of the BHHRA when evaluating the potential health threats posed by a site.

In 2005, the ATSDR (**ATSDR, 2005**) released their Public Health Assessment for the GWP site, wherein they evaluated the potential indoor air impacts from residential use of evaporative coolers and use of the municipal water supply for irrigating residential gardens. Their findings indicated that use of evaporative coolers posed an insignificant risk to residents when water supply concentrations are equal to the drinking water standard (MCL) for PCE. In addition, ATSDR indicated that PCE does not accumulate in plants and therefore associated risks are not significant. Therefore, evaporative cooler use and use of the municipal water supply to irrigate residential gardens were not addressed in the BHHRA.

The human health CSM presents potential chemical sources, release mechanisms, receptors (current and future), and exposure routes. The CSM is provided in **Table A1-1 (in Appendix A1)**. The table identifies which receptors and exposure pathways are quantified in the BHHRA.

7.1.1.3 Screening Step 1: Frequency of Detection Evaluation

The frequency at which each chemical was detected was evaluated. Those constituents detected at a frequency of 5 percent or less in soil vapor or ground water were considered for elimination from the BHHRA. However, Screening Step 2 was performed on these constituents to evaluate the extent of exceedances above screening levels, if any (see **Section 7.1.1.4**).

With the exception of cis-1,3-dichloropropene, all chemicals with a frequency of detection of 5 percent or less were also less than screening levels. Cis-1,3-dichloropropene was detected in only 1 of 79 ground water samples, and was detected at a concentration only slightly higher than its screening level (0.41 μg/L versus 0.40 μg/L).

7.1.1.4 Screening Step 2: Comparison to Screening Levels

For each analyte carried to Step 2, the maximum detected concentration was compared to its human health risk-based screening levels identified below:

Soil Vapor– EPA draft generic screening levels for deep soil vapor concentrations for indoor air vapor intrusion, based on a residential scenario, a target excess lifetime cancer risk (ELCR) of 1×10^{-5}, and a non-cancer hazard index (HI) of 1 (**EPA, 2002a**).

Ground Water – The federal MCL, if one is available (**EPA, 2002b**). For those chemicals without MCLs, the EPA Region 6 MSSL for tap water based on a residential scenario, a target ELCR of 1×10^{-6}, and a non-cancer HI of 1 (**EPA, 2005b**).

7.1.1.5 Summary of COPC Selection

Those chemicals evaluated in Step 2 that exceeded risk-based screening levels were identified as COPCs for the specific exposure area. Results of the COPC selection process are provided in **Tables A1-2.1** through **A1-2.7** of **Appendix A1**.

At each location, PCE was identified as the COPC at 7 of 8 residential locations, and at the PAL Boxing Facility. Based on the comparison to screening levels, EPA identified no COPCs for soil vapor at one residential location and at the Meerscheidt Recreation Center.

EPA identified benzene, MTBE, PCE, and uranium as COPCs for ground water. Maximum detected concentrations of benzene, MTBE, and PCE at current exposure points (Upper Griggs Reservoir, CLC wells currently on-line and not blended, and one private well) are less than MCLs. However, future concentrations of these three COPCs at exposure points may exceed MCLs if the current blending program fails to maintain concentrations in the Upper Griggs Reservoir below MCLs, if additional wells are installed in the GWP site plume within the Mesilla Basin, or if online wells become impacted via ground water plume migration. If MCLs are exceeded, unacceptable risks may be posed by the water supply (**EPA, 1991**). Therefore, future remedial actions at the site should assure that human health risk is reduced to acceptable levels.

The CLC detected uranium above drinking water standards in seven CLC wells. However, elevated concentrations of uranium are naturally occurring. The CLC is addressing the elevated uranium concentrations in the drinking water supply as part of compliance with the SDWA, and uranium is not addressed further in the BHHRA. If the uranium concentrations exceed MCLs at the distribution point, unacceptable risks may be posed by the water supply (**EPA, 1991**). It is EPA's intent that the CLC's actions to address uranium in the water supply will be coordinated with remedial actions selected to address PCE contamination.

In addition, reporting limits (RLs) were compared to screening levels for analytes that were not detected in any samples in a given data group. The comparison of RLs to screening levels is provided in **Appendix A2**. As shown, reporting limits for TCE in soil vapor slightly exceeded screening levels (10 ppbv versus 4.1 ppbv) at most locations. Additionally, reporting limits for 6 VOCs in ground water exceed screening levels.

Those chemicals identified as COPCs were carried forward and quantitative analysis of COPCs for specific exposure pathways were performed in subsequent section of the BHHHA.

7.1.2 Exposure Pathways Quantified in the BHHRA

The following exposure pathways were evaluated to estimate potential risks for the indicated receptors:

Current/Future Resident (adult and child) – Inhalation of indoor air at each individual home.

Current/Future Industrial Worker – Inhalation of indoor air at the PAL Boxing Facility.

Current/Future Recreational user (adolescent) – Inhalation of indoor air at the PAL Boxing Facility.

The maximum detected concentration of the COPC for each exposure point was used as the exposure point concentration (EPC) under a reasonable maximum exposure (RME) scenario. If the potential risks associated with an RME scenario exceeded acceptable risk levels, a central tendency (CT) scenario was quantified using the arithmetic mean concentration of the COPC as the EPC. The EPCs for each exposure area are provided in **Tables A1-3.1 RME** and **A1-3.1 CTE** of **Appendix A1**.

Potential future unacceptable exposures to ground water concentrations above MCLs (from the Mesilla Basin) were not quantified in this BHHRA. MCLs are ARARs for public drinking water supply systems. As stated in EPA policy presented in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (**EPA, 1991**), "For ground water actions, MCLs and non-zero MCLGs will generally be used to gauge whether remedial action is warranted."

7.1.2.1 Exposure Point Concentrations

Exposure point concentrations are used in the intake calculations. Using the Johnson and Ettinger model, EPA calculated the indoor air concentrations of PCE resulting from soil vapor intrusion. Maximum detected concentrations of PCE in soil vapor were used when quantifying RME scenarios, while the arithmetic mean concentration of PCE in soil vapor was used when quantifying the CT scenarios. EPA evaluated potential indoor air exposures to PCE by adult and child residents at the seven residences, and by industrial workers and adolescent recreational users at the PAL Boxing Facility. Summaries of the input parameters used in the Johnson and Ettinger model and the modeled indoor air EPCs are provided in **Table A1-3 Supplement** tables in **Appendix A1**. Detailed Johnson and Ettinger Model parameters that were used to calculate soil vapor-to-indoor air attenuation factors for a residential building and an industrial facility are presented in **Appendix A3**.

7.1.2.2 Exposure Factors

The exposure factors used to estimate intakes for each quantified exposure scenario are presented in **Tables A1-4.1** of **Appendix A1**. Standard default exposure factors presented in EPA guidance were used for adult/child residents and industrial workers, while a combination of exposure factors based on EPA guidance and best professional judgment was used for adolescent recreational users. For the CT exposure scenario, the same set of exposure factors as the RME exposure scenario was used (i.e., only the EPC was different) (**Table A1-4.1** of **Appendix A1**).

7.1.3 Toxicity Assessment

Toxicity data were identified for the COPCs and were subsequently used to calculate potential carcinogenic and non-carcinogenic risks to receptors. The following hierarchy of sources was used to obtain toxicity data for the COPCs:

- Integrated Risk Information System (IRIS) (**EPA, 2006**).
- California Environmental Protection Agency (California EPA) Toxicity Values recommended by EPA's Office of Solid Waste and Emergency Response (OSWER) (**EPA, 2003b**).

- National Center for Environmental Assessment (NCEA as cited in the EPA Region 6 MSSL Table; **EPA, 2005b**).
- Health Effects Assessment Summary Tables (HEAST; **EPA, 1997a**).

The current EPA carcinogenic classification for benzene is A (human carcinogen). The EPA has no current carcinogenic classification for MTBE or PCE. The International Agency for Research on Cancer (IARC) classification for PCE is 2A (probably carcinogenic to humans). Non-cancer toxicity values used in the BHHRA are presented in **Tables A1-5.1** and **A1-5.2** of **Appendix A1**, while cancer toxicity values are provided in **Tables A1-6.1** and **A1-6.2** of **Appendix A1**. The oral non-cancer toxicity values for benzene are based on effects on the blood and immune system, while the oral non-cancer toxicity values for PCE are based on liver toxicity. The inhalation non-cancer toxicity values for benzene are also based on effects on the blood, while the oral non-cancer toxicity values for MTBE and PCE are based on liver and kidney toxicity.

The following toxicity information for PCE was excerpted from the *Toxicological Profile for Tetrachloroethylene* (**ATSDR, 1997**).

> Tetrachloroethylene [i.e. PCE] has been used safely as a general anesthetic agent, so at high concentrations, it is known to produce loss of consciousness. When concentrations in air are high—particularly in closed, poorly ventilated areas—single exposures can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Irritation may result from repeated or extended skin contact with the chemical. As you might expect, these symptoms occur almost entirely in work (or hobby) environments when individuals have been accidentally exposed to high concentrations or have intentionally abused tetrachloroethylene to get a "high”. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not definitely known. However, at levels found in the ambient air or drinking water, risk of adverse health effects is minimal. The effects of exposing babies to tetrachloroethylene through breast milk are unknown. Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethylene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. However, it is not known for sure if tetrachloroethylene was responsible for these problems because other possible causes were not considered.
>
> Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage and liver

and kidney cancers even though the relevance to people is unclear. Although it has not been shown to cause cancer in people, the U.S. Department of Health and Human Services has determined that tetrachloroethylene may reasonably be anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) has determined that tetrachloroethylene is probably carcinogenic to humans. Exposure to very high levels of tetrachloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant. Rats that were given oral doses of tetrachloroethylene when they were very young, when their brains were still developing, were hyperactive when they became adults. How tetrachloroethylene may affect the developing brain in human babies is not known.

7.1.4 Risk Characterization

Potential ELCRs and HIs were calculated for the COPCs using RME assumptions for the receptors and exposure pathways identified in **Section 7.1.3** (**Tables A1-7.1 RME** through **A1-7.2 RME** of **Appendix A1**, and summarized in **Tables A1-9.1 RME** through **A1-9.2 RME** of **Appendix A1**).

EPA's target range (i.e., acceptable risk range) for excess lifetime carcinogenic risk associated with CERCLA sites and specified in the NCP (40 Code of Federal Regulations [CFR] 300.430) is 1-in-10,000 (1×10^{-4}) to 1-in-1,000,000 (1×10^{-6}) in the human population. That is, the risk associated with site-related exposures should not exceed this target range.

Estimated ELCRs associated with an RME scenario exceeded an ELCR of 1×10^{-6} at the seven residential properties; therefore, a CT scenario was quantified for these receptors (**Table A1-7.1 CTE** of **Appendix A1** and summarized in **Table A1-9.1 CTE** of **Appendix A1**). The following potential risks were calculated:

7.1.4.1 Current/Future Resident (Adult and Child)

The following inhalation exposures were estimated from samples collected in the residential neighborhood northeast of East Hadley Avenue and North Walnut Street.

Property A – Inhalation exposures to PCE at Property A were estimated. An ELCR of 3×10^{-5} and HIs of 0.03 and 0.06 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of 2×10^{-6}; therefore, a CT scenario was quantified. An ELCR of 8.8×10^{-6} was calculated for the CT scenario.

Property B – Inhalation exposures to PCE at Property B were estimated. An ELCR of $4x10^{-5}$ and HIs of 0.03 and 0.07 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $1.3x10^{-5}$ was calculated for the CT scenario.

Property C – Inhalation exposures to PCE at Property C were estimated. An ELCR of $3x10^{-5}$ and HIs of 0.02 and 0.05 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $9x10^{-6}$; therefore, a CT scenario was quantified. An ELCR of $1.8x10^{-5}$ was calculated for the CT scenario.

Property D – Inhalation exposures to PCE at Property D were estimated. An ELCR of $1x10^{-5}$ and HIs of 0.01 and 0.03 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $9x10^{-6}$; therefore, a CT scenario was quantified. An ELCR of $1.2x10^{-5}$ was calculated for the CT scenario.

Property E – Inhalation exposures to PCE at Property E were estimated. An ELCR of $2x10^{-5}$ and HIs of 0.02 and 0.05 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $9.4x10^{-6}$ was calculated for the CT scenario.

Property F – Inhalation exposures to PCE at Property F were estimated. An ELCR of $1x10^{-5}$ and HIs of 0.01 and 0.02 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $1.6x10^{-5}$ was calculated for the CT scenario.

Property G – Inhalation exposures to PCE at Property G were estimated. An ELCR of $2x10^{-5}$ and HIs of 0.02 and 0.04 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $2x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $9.7x10^{-6}$ was calculated for the CT scenario.

7.1.4.2 Current/Future Adult Industrial Worker

Inhalation exposures to PCE at the PAL Boxing Facility were estimated. An ELCR of $7x10^{-7}$ and an HI of 0.02 were calculated.

7.1.4.3 Current/Future Recreational User (Adolescent)

Inhalation exposures to PCE at the PAL Boxing Facility were estimated. An ELCR of 4×10^{-8} and a HI of 0.02 were calculated.

In summary, estimated ELCRs at the seven residential properties and the PAL Boxing Facility were within EPA's acceptable risk range (1×10^{-4} to 1×10^{-6}). Estimated non-cancer HIs were also below the EPA's target HI level (less than or equal to one). Therefore, current and future exposures to indoor air concentrations from vapor intrusion are within acceptable levels.

Current risks associated with the municipal water supply are within acceptable levels due to the well management and blending activities implemented by the municipality. However, in the future, benzene, MTBE, and PCE concentrations at drinking water exposure points may exceed MCLs if the current well management and blending program is not continued, if additional wells are installed in the Mesilla Basin, or if on-line wells become impacted via ground water plume migration (**EPA, 1991**).

CLC and NMED have detected uranium above drinking water standards in seven CLC wells. However, elevated concentrations of uranium are naturally occurring in the area (**JSAI, 2006b**). The CLC is addressing the elevated uranium concentrations in the drinking water supply as part of compliance with the SDWA and therefore risks associated with uranium in drinking water are not addressed in this BHHRA. If the uranium concentrations exceed MCLs at the distribution point, unacceptable risks may be posed by the water supply (**EPA, 1991**). It is EPA's intent that the CLC's actions to address uranium in the water supply will be coordinated with remedial actions selected to address PCE contamination.

7.1.4.4 Future Ground Water User at Wells above MCLs

In the future, one or more of the following scenarios may occur, resulting in unacceptable concentrations in potable wells above MCLs:

- The CLC may install additional wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs.
- Private landowners may install wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs.
- The blending program that is currently in place could experience a malfunction.

- Ground water in the Mesilla Basin will continue to migrate and impact additional potable wells not currently impacted.

If any of the above scenarios were to occur, PCE concentrations in potable wells may exceed the MCL and therefore pose an unacceptable risk. As stated in EPA policy presented in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (**EPA, 1991**), "For ground water actions, MCLs and non-zero MCLGs will generally be used to gauge whether remedial action is warranted."

7.1.5 Uncertainty Assessment

The following discussion presents the major uncertainties associated with this BHHRA.

7.1.5.1 Data Issues

RLs for some analytes in soil vapor and ground water samples exceeded their respective screening levels (**Appendix A2**)**.** The RL (10 ppbv) of TCE in soil vapor exceeded its screening level of 4.1 ppbv. However, in accordance with the QAPP (**CH2M HILL, 2005c**), 10 percent of these field soil vapor samples were collected in Summa canisters and sent to an offsite laboratory for confirmation analysis by EPA Method TO-15, which can achieve lower RL (0.1 ppbv). As indicated in **Appendix G-1**, there was good agreement between the field screening method applied for the soil vapor samples and the fixed laboratory results. Therefore, use of a field screening method for identifying soil vapor concentrations is not expected to contribute a significant level of uncertainty to the BHHRA.

The isomer-specific RLs (0.5 µg/L) of two TCL analytes (cis- and trans- 1,3-dichloropropene) in ground water exceeded their screening level of 0.4 µg/L (for total 1,3-dichloropropene). Cis-1,3-dichloropropene was detected in only one sample, and at a concentration (0.41 µg/L) slightly above its screening level; trans-1,3-dichloropropene was not detected in ground water samples. The detected concentration of cis-1,3-dichloropropene was reported as a "J" qualified" value. If trans-1,3-dichloropropene was actually present at a concentration exceeding its screening level, then typically the laboratory would have reported it as an estimated concentration ("J" qualified) instead of non-detect. Therefore, the elevated RLs of these compounds are not expected to affect significantly the BHHRA or its conclusions.

7.1.5.2 Indoor Air EPCs

Initially, maximum detected concentrations of PCE in soil vapor were used to model the EPCs in indoor air. However, this approach assumes that an individual is exposed daily to these concentrations and that the maximum concentration is present uniformly underneath the building. Therefore, indoor air EPCs modeled based on attenuation factors developed using the Johnson and Ettinger model are expected to be overpredicted. The Johnson and Ettinger model conservatively estimates the risks posed to PCE in indoor air through the soil vapor intrusion pathway. Use of the arithmetic mean PCE concentrations in soil vapor (for the CT scenario) to model the EPCs in indoor air more likely represents the lifetime average concentrations in indoor air.

7.1.5.3 PCE Toxicity Value

At the current time, the cancer toxicity values to be used for evaluating potential exposure to PCE are under review. In the absence of relevant toxicity values in IRIS (**EPA, 2006**) or an NCEA Preliminary Peer-Reviewed Toxicity Value (PPRTV)—the first two tiers of human health toxicity values in the EPA Superfund hierarchy—EPA supports use of the California EPA Air Toxic Hot Spots Program inhalation unit risk factor of 5.9×10^{-6} $(\mu g/m^3)^{-1}$ in the Superfund Program until an EPA-promulgated toxicity value becomes available. In general, California EPA develops its toxicity values in a manner that is quite similar to the EPA IRIS program, in that many of the same databases and considerations are used. California EPA assessment used information from some of the same sources that EPA typically considers in the IRIS program, including the most recent relevant studies known to exist, and considered this information in a manner similar to the EPA IRIS program. Documentation on the California EPA Air Toxics Hot Spots Program inhalation unit risk factor for PCE is available on-line at http://www.oehha.ca.gov/air/hot_spots/pdf/TSDNov2002.pdf (**OEHHA, 2002**).

7.1.5.4 Applicability of Soil Vapor Data

Potential exposures and risks associated with the vapor intrusion pathway were evaluated using shallow soil vapor sampling data collected during November 2005, which were then modeled using the Johnson & Ettinger model. Using the November 2005 data set, the excess lifetime cancer risk associated with potential exposure to PCE in indoor air was estimated to be from one to four in 100,000 in the residential area (i.e. 1×10^{-5} to 4×10^{-5}).

There are two issues to consider when using this estimation of risk for decision-making related to further action associated with shallow soil vapor. First is the question of seasonal variation – are the data collected in November 2005 representative of conditions throughout the year? The second is the question of using one set of data to estimate risk, as opposed to two or more events. An additional factor to consider when weighing the relative importance of either one of these issues is the conservative nature of the Johnson & Ettinger model, which is thought, in general, to over-estimate risk.

Seasonal variability. The data set used to estimate risk was collected in November when ambient temperatures were relatively mild for the Las Cruces area (temperatures during the sampling event historically are in the high 50s to low 60s (degrees F). In the summer, temperatures are generally in the mid to high 90s. Higher summer temperatures might contribute to some warming of surface soils within the top 2 feet, but is less likely to influence significantly temperatures in slightly deeper soils, where the November data was collected. In addition, barometric pressures are relatively uniform throughout the year in this area, so that there is no significant seasonal "pumping" effect affecting soil vapor flux.

The vapor intrusion pathway is more significantly affected by advective transport of soil vapor from the subsurface to indoor air. This advective transport is driven by differences in pressure between indoors and the subsurface, resulting from indoor/outdoor temperature differences (the "stack effect") and turbulence induced by the operation of heating, ventilating, and air conditioning (HVAC) systems. Some regulatory guidance suggests that there is significant seasonal variability in indoor air concentrations with higher concentrations under winter conditions where the stack effect is presumably greater (**MADEP, 2002**). However, modeling of air infiltration and radon entry into residences suggests that the stack effect will have little seasonal impact for houses with slab or crawl-space construction (**Sherman, 1992**), as is found in Las Cruces. The stack effect would be a more important driving force for vapor entry into structures with basements under "hard" winter-time conditions, and not for slab-on-grade construction in more temperate climates such as that observed in Las Cruces.

Use of one sampling event to estimate risk. The November 2005 sampling event was actually the second time shallow soil vapor samples have been collected in the residential area of the site. The first was in 2002, when EPA collected over 600 soil vapor samples at the site, including the residential area. The data between the 2002 and 2005 sampling events are not directly comparable, having been collected through different methods and for a different purpose (site characterization vs. evaluation of risk to indoor air). With that caveat, it may be helpful to note the overall similarity or variation in concentrations detected in the residential area in 2002 and 2005.

For example, PCE was detected in August 2002 at about 1,108 and 736 ppbv at depths of 10 feet below ground surface (bgs) residential street sample locations R9002 and R9004, located >50 feet from any residence, in the middle of the street). In November 2005, PCE was detected at concentrations ranging from 240 to 644 ppbv at depths of 10 feet bgs in the front yards of lots facing this cul-de-sac.

Overall, the average PCE concentration detected in soil vapor at all depths during the 2005 sampling event is, in general, somewhat lower than the average concentration detected at all depths during the 2002 sampling event. It is unlikely this difference is due to the effects of seasonal variability (based on the discussion presented in the previous section). The apparent reduction in PCE concentrations could be the result of the attenuation of PCE in the soil vapor over time, the variation in depths sampled (the 2002 data was collected from 10 feet bgs or more, the 2005 data was collected from 10 feet bgs or less), the locations sampled (the street vs. the yards), and/or the different method of collection. The sampling conducted in 2005 was designed for the estimation of risk; it is more suitable for evaluation of vapor intrusion pathways because the samples were located near structures.

Note, both PCE and TCE were analyzed in 2002 and 2005. In 2005, TCE was not detected in any samples. In 2002, TCE was detected in only 3 out of 32 locations sampled in the residential area. The maximum detection of TCE in the residential area was 15 ppbv at 30 feet bgs at location R9002.

Conservative nature of the Johnson & Ettinger model. Potential indoor air concentrations were estimated from soil vapor using the Johnson and Ettinger model. The assumptions used in the Johnson and Ettinger model were conservative, providing an overstatement of the potential risks associated with inhalation of indoor air. The modeling is conservative principally because of the use of assumptions that calculate a high rate of soil vapor flow into indoor spaces. The key assumptions were that soils underlying the foundations were highly porous, that the houses were very “leaky,” but that the outside air exchange rate was very low. This produces a situation unlikely to be present in the real world, because leaky houses also would have high outside air exchange rates. The conservative nature of these assumptions was confirmed by comparing the modeled soil vapor flow rate with the range of values that have been reported in the literature (**Johnson, 2002**). The modeled rates used for this site were at the high end of the range of literature values.

Also, the soil vapor concentrations used for the assessment of vapor intrusion risks were developed from laboratory analyses that were based on atmospheric pressure at sea level. This would provide soil vapor concentrations for use in modeling and risk assessment that would be slightly higher compared with soil vapor concentrations under site-specific conditions (site-specific conditions being 3,896 feet above MSL). Use of analytical data calculated on a sea-level basis therefore results in slightly higher estimates of indoor air concentrations and risks than would be anticipated under site-specific conditions.

7.2 Ecological Considerations

An ecology checklist was prepared for the GWP site following the format provided by EPA (**EPA, 1997b**). Information regarding the ecological condition of the site as well as aerial photographs of the site were gathered during site visits and the field investigation. The ecology checklist is presented in **Appendix A5**. This site exists within a moderately developed area, and limited ecological habitat exists. Some disturbed, barren fields exist within the vicinity of East Griggs Avenue and North

Walnut Street, but are either devoid of vegetation or only sparsely vegetated. Except for small isolated areas of remnant desert scrub/shrub habitat, the majority of the vegetation is in the form of ornamental landscaping, and turf maintained at recreational soccer/baseball fields.

Some of the wildlife observed during the field sampling events included roadrunners, other bird species, including migratory birds, and prairie dogs. Most of these observations were made within the sampling areas, at the recreational park areas, and at the DACTD maintenance facility. The few undeveloped lots near the site demonstrate the presence of desert scrub species including invader shallow rooted non-native vegetation, commonly found on highly disturbed desert landscape. Given the land use of this urban environment (i.e., the last 30 years), this site does not appear to be critical habitat because of the urban setting. Soil vapor detections begin at least 10 ft bgs, and it is unlikely that a complete exposure pathway exists for biota (flora or fauna, particularly burrowing organisms) to the VOCs. Additionally, the contaminated ground water does not discharge to surface water. Ground water does not discharge naturally to the surface at the GWP site and the contaminants are too deep for biota exposure, therefore, it can be concluded that no complete ecological exposure pathways exist.