8.0 IMPLICATIONS OF DATA QUALITY, MONITORING, AND CONTINUING CLEANUP FOR PUBLIC HEALTH ASSESSMENT AND FUTURE LAND USE

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8.1 Overview

The presence of contaminants does not necessarily imply that exposure levels will be a human health concern. Health risk depends on numerous factors, including the transport of contaminants from the source to the exposure locations, level of contamination in the various media (e.g., air, water, soil, vegetation) at the exposure locations, exposure frequency, exposure duration, characteristics of the target human receptor (e.g., age distribution, activity patterns), and resulting contaminant uptake rate via various routes of exposure (e.g., inhalation, ingestion, dermal contact). Although this study does not focus on quantitative risk assessment—as discussed in Chapter 6—in order to evaluate the relevant present and future public health hazards, one must consider the quality of the data, monitoring, and continuing cleanup efforts associated with SSFL. Accordingly, the next section of this chapter summarizes the main issues of concern: inadequacies in sampling and monitoring protocols, limitations of modeling results, and gaps in data. The following sections outline the public health implications of the present study and make recommendations about future land use.

8.2 Data Quality

In 1990 and again in 1997, EPA's Las Vegas office identified problems with SSFL sampling and sample processing techniques (EPA, 1989a). Specific problems involved survey instrument calibration procedures; use of spacing grids that were too large and un-comprehensive; filtering of water samples, which was suspected of removing potential mobile metals and radioactivity; drying of soil samples at excessively high temperatures, which may have led to volatilization of radionuclides of interest; and washing of vegetation samples, which would have led to removal of a certain fraction of adsorbed contaminant (Dempsey, 1990, 1997). These deficiencies in sampling and analytical protocols could have resulted in an under-reporting of contamination.

The removal of mobile metals by filtration was an issue identified and assessed by the EPA as early as 1989 (EPA, 1989b). The results of the Area IV Phase III Investigation and the background study indicated that filtration of groundwater samples had a significant impact on the analysis of turbid samples with high sediment content (GRC, 1990b). Unfiltered samples collected from wells constructed in shallow alluvial deposits at the facility consistently had higher radioactivity than filtered samples from the same well (for both gross alpha and gross beta; see GRC, 1990b). Curiously, the consistent protocol, followed in the bimonthly reporting, was to filter water samples to remove sediment particles (GRC, 1990b). The soil was sieved through a coors crucible to obtain uniform particle size (specifically, a size at which approximately 10 percent of the soil would not pass through). Because of absorption of the alpha and beta radionuclides within the soil, the procedure of filtering water samples had highly variable results (EPA, 1989a). It was also noted that attempts to correct for this variability were inadequate (EPA, 1989a). Spiked samples (samples with known radioactivity) were not run to verify the accuracy and precision of this method (EPA, 1989a). Thus, even though gross alpha and beta radiation were detected, it is reasonable to surmise that these detections were underestimations, and not a true representation of conditions at the site. This sampling protocol is of concern because these techniques were used regularly at SSFL over more than 10 years.

Similar problems were observed with other sample processing protocols (EPA, 1989a). For example, vegetation samples collected until 1986 were washed with warm tap water to remove external foreign matter. If past operations had produced airborne contamination that settled on the surface of the vegetation, then washing would have removed a significant fraction of the surface-accumulated contaminants that would have been volatilized during the ashing at 500 degrees. SSFL stopped collecting vegetation in 1986 (EPA, 1989a), and meat was not monitored for radioactivity. Although there are deer and squirrels in the vicinity of SSFL, they have not been tested. Also of concern to EPA was the fact that the contract laboratory conducting the radioanalysis of strontium-89/90 was not audited for its performance (EPA, 1989a). As stated by EPA (1989a), "The Strontium-89/90 analysis is extremely difficult and tedious and it will be necessary to verify lab performance before samples are generated so worthless data is not generated." EPA concluded that the radiological lab needed updating "very badly" (EPA, 1989a). EPA inspectors went on to say:

> *SSFL sampling, placement of sample locations, and analysis cannot guarantee that past actions have not caused offsite impacts. If the environmental program stays uncorrected, SSFL cannot guarantee that unforeseen or undetected problems onsite will not impact offsite environments in the future. It is clear to us that Rocketdyne does not have a good handle on where radiation has been inadvertently dumped onsite. Most of the evidence for onsite spills is incompletely documented or anecdotal*. (EPA, 1989a).

EPA's opinion that "Rocketdyne does not have a good handle on where radiation has been inadvertently dumped onsite" is consistent with the fact that, despite repeated statements that 99.99 percent of all radioactivity has been removed from the site (Lafflam, S., 1993, 2004), recent findings have revealed tritium levels as high as 83,000 pCi/L in new wells on site (Area IV, DOE Community Meeting, Simi Valley, 6/3/2004).

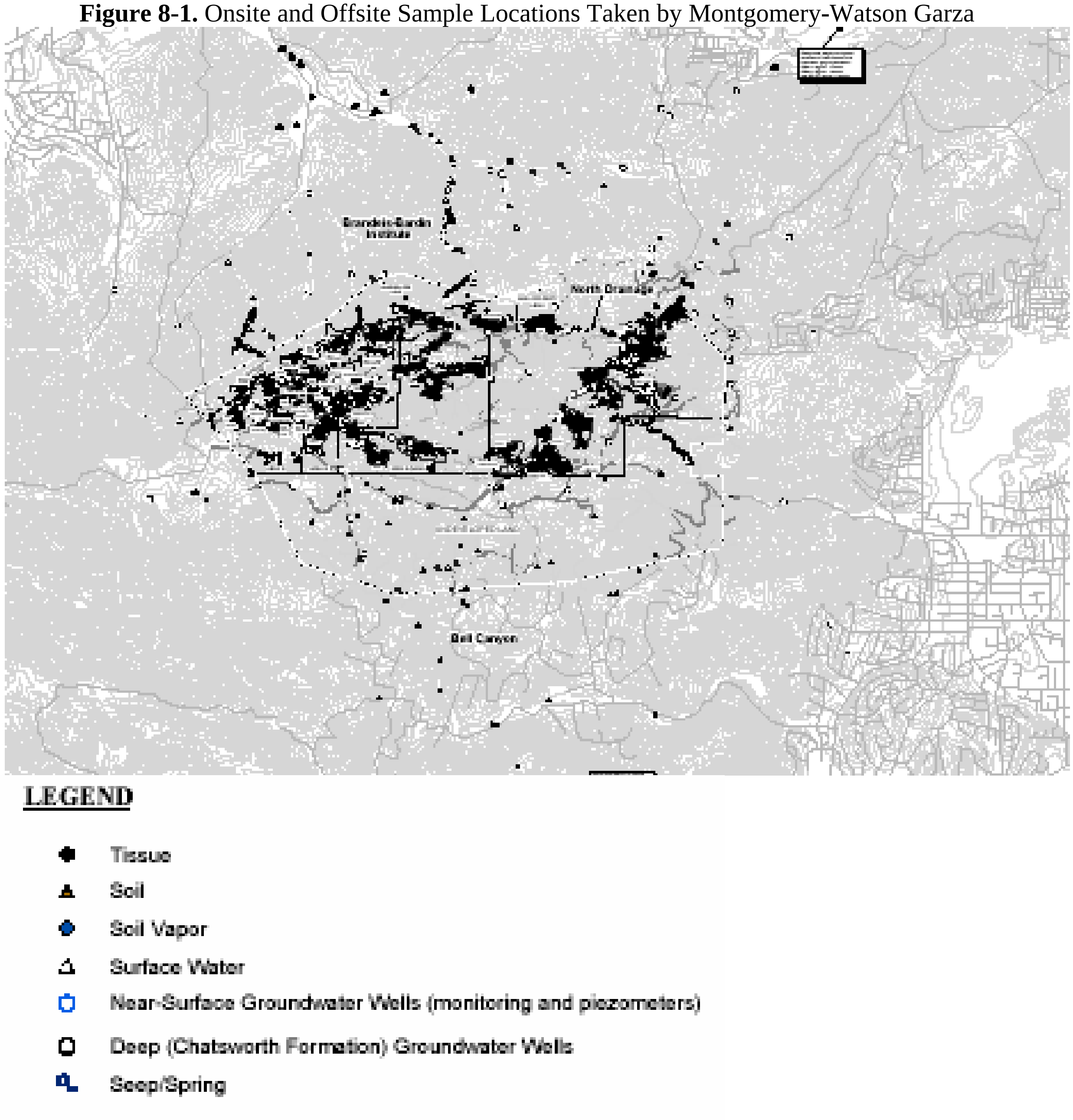
8.3 Monitoring Needs

Despite extensive monitoring at and around the SSFL facility, there is public concern that the extent of contamination off site is uncertain. These concerns arise, in part, from limited monitoring in some offsite areas, concentration that were detected for some contaminants above levels of regulatory concern, and the inability to clearly identify the sources of contaminants detected in some offsite areas. This section summarizes the major concerns that illustrate the need for more extensive monitoring data.

Storm water from SSFL flows north, south and east from SSFL. While the areas north and south have been monitored (McLaren Hart, 1993–1995; Ogden, 1998a; Appendix H), the areas to the east of SSFL lack monitoring data. Onsite and offsite sample locations were surveyed by Montgomery-Watson Harza (MWH, 2004) for work conducted up to December 2003 (Boeing, 2004). This survey (Fig. 8-1) illustrates that there are regions at and around SSFL that have either not been monitored or only sparsely monitored.

Storm water can flow northeast and east from SSFL. Eastern offsite areas are approximately 500 feet lower in elevation than operational areas within the northeast portions of SSFL's Area I, thus drainage to this area is highly probable (MWG, 2004). Therefore, there is merit for additional monitoring in the above areas to accurately map the extent of groundwater and surface water contamination and the likely transport to offsite areas.

Figure 8-1. Onsite and Offsite Sample Locations Taken by Montgomery-Watson Garza

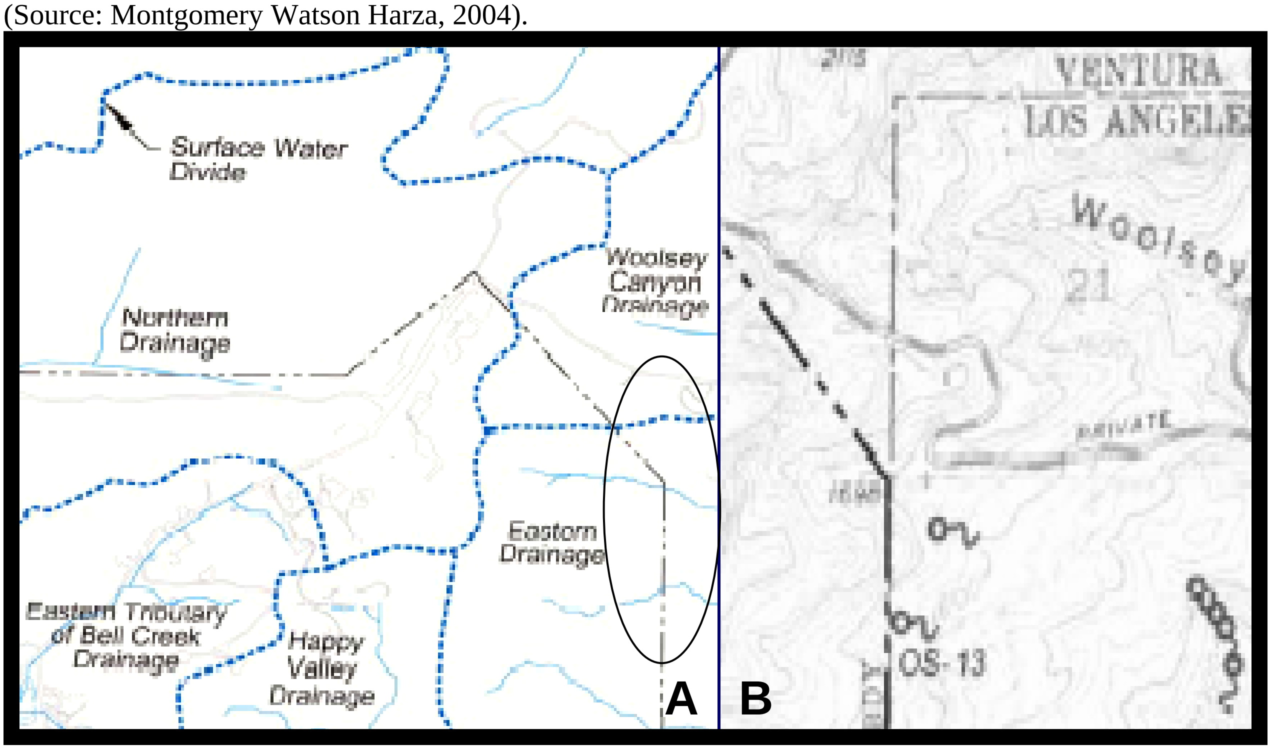


Monitoring of perchlorate in Area I (Happy Valley) was first reported in 2000 (Boeing, 2002). Since then perchlorate has been detected in drainages to the east of SSFL (Outfall 008 and Dayton Canyon; CA Regional Water Quality Control Board (RWQCB), 2006; Allwest

Remediation, 2005; (Table H-1, Appendix H). These detections are not surprising as regulated storm water flows east from Area I Happy Valley through Outfall 008 into Dayton Creek. Past monitoring of areas east of SSFL (Dayton Creek and Outfall 008) was limited considering the potential for offsite contaminant transport to these areas by surface and groundwater, and the potential for population exposure to population residing in the hills to the east of SSFL[8-1]. It is noted that monitoring of Outfalls 008 and Dayton Creek was recently initiated by the RWQCB and the Dept. of Toxic Substances Control (DTSC).

The northeast area of SSFL is a source of surface and groundwater to five different drainage systems (Figure 8-2a). All drainages are ephemeral when flowing. The northern drainage flows toward Simi Valley via Meier, Runckle and Black Creeks; the remaining four drainages flow into San Fernando Valley via Woolsey, Dayton and Bell Creeks. Recently, field reconnaissance was performed to identify groundwater drainages east of SSFL (MWG, 2004). The recent drainage survey identified six previously unidentified springs east of SSFL (Figure 8-2b). One other spring was identified in earlier studies. Work is presently underway to characterize the nature of the water discharging to and from these locations (MWG, 2004).

Figure 8-2. SSFL's Northeast Area Drainage System and Newly Identified Springs. (Source: Montgomery Watson Harza, 2004).



A. The northeastern drainage at SSFL. ***B.*** The area circled in A was blown up (B) to present the newly identified springs located east of SSFL. Springs are identified by the empty circles and squiggly lines.

Woolsey and Black Canyons are of particular concern as storm water collects runoff from the SSFL's former NASA LOX plant (Areas 1 and 2 landfills) and exits at Outfall 009 which drains into these canyons (RWQCB, 2006). The drainage flows through these areas, through Sage Ranch– an area of past agricultural operations and where a shooting range is located, and into the Chatsworth Reservoir and the Arroyo Simi. This location (northeast area including Sage Ranch

[8-1] For example, Dayton Creek flows east to West Hills and into Orcutt Ranch, a community garden.

and Woolsey Canyon) has only been sampled once in the past[8-2]. Various contaminants were detected in wells at Sage Ranch, as well as at the Chatsworth Reservoir[8-3] (Appendix H). Additional monitoring data would provide information regarding the potential for transport of SSFL-related contaminants to areas east and northeast of SSFL.

8.4 Continuing Cleanup and Associated Future Monitoring

Continued groundwater remediation via pump and treat should decrease the dispersion of contaminants emanating from the SSFL subsurface. Therefore, exposure estimates based on the current level of contamination are likely to overestimate the risk. Clearly, future retardation of contaminant migration from the SSFL site will depend on effective continual remediation of the site. Continued monitoring will assist efforts to assess the success of remedial actions taken and the natural attenuation of contaminants. Monitoring, however, should be conducted in relation to knowledge of existing transport pathways. For example, soil should be sampled more than once a year, during appropriate seasons and at various depths and locations. Areas of water contamination should be monitored before and after rainfall events, and air should be monitored in locations near SSFL where wind dispersion is likely to have the greatest impact (see Chapters 3 and 6). Precautions should be taken with respect to sample preparation and preservation, and analytical protocols should be carefully evaluated to ensure that contaminant loss from the samples is minimized. The reliability, accuracy, and precision of the analytical data should be assessed with blind controls sent to multiple laboratories, prior to sample analysis. A thorough monitoring program should also include sampling and analysis of offsite vegetation and animals for chemicals that have the potential to bioaccumulate. It is recognized that realistic assessment of residents' exposure to contaminants of concern would probably be best achieved by personal monitoring of residents in locations of concern. Such an endeavor would require significant resources, but would likely provide more information on actual exposure levels than possible even by the most comprehensive exposure assessment models.

[8-2] In 1987, Rockwell conducted a study of the quality of non-regulated storm water drainage from the facility (Ecology and Environment, 1991). Health-based standards were exceeded for arsenic, lead, chromium and beryllium in offsite samples taken east of SSFL (including Woolsey Canyon, Sage Ranch and Chatsworth Reservoir; see Tables 4-1 and H-5 in Appendix H). The source of arsenic, lead and chromium at the above locations has not been established; beryllium is likely to have come from SSFL as rocket fuel used at SSFL contained beryllium. It is reported that Rocketdyne removed beryllium-contaminated soils after the use of beryllium-containing fuels was discontinued (Ecology and Environment, 1991). Monitoring results for surrounding soils, however, do not rule out that beryllium persists at concentrations of concern in offsite areas (Ecology and Environment, 1991). Additional monitoring would be needed to establish the extent and level of contamination, especially relative to background levels and levels at SSFL.

[8-3] The origin of contamination detected at the Chatsworth Reservoir is unclear. It is known that from 1966 to 1976 Rocketdyne occupied the Hughes Aircraft Company site (8433 Fallbrook Avenue, Canoga Park, south of Chatsworth Reservoir; the "Canoga Facility") with Hughes and Bunker Ramo. Soil and groundwater at the northwest and southwest portions of the site (now the DeVries Institute) are contaminated with VOCs (TCE, 1,1-DCE, 1,2-DCE, benzene, toluene, xylene, 1,1,1-TCA, 1,1-DCA, and PCE). Soil and groundwater at the east and southeast portion of the site are contaminated with TCE, 1,1-DCE, 1,1,1-TCA, freon-11, and alpha radioactivity (McLaren/Hart, 1990). Groundwater from the northeastern portion of SSFL is contaminated with VOCs (TCE, 1,1-DCE, cis-1,2-DCE, and benzene). Given the available data, it is not possible to establish if the contamination levels are due to past operations at the former Hughes Aircraft Company site or due to migration via surface water or groundwater pathways from SSFL.

8.5 Justification of Future Restricted Land Use for SSFL Based on Proposed DOE Cleanup Levels

Remediation activities at SSFL are currently ongoing, so the level of future residual contamination can only be assessed through continued monitoring in the post-cleanup period. Possible future uses of the site have been considered by various stakeholders. The potential residential use of the site has been a topic of great interest and concern.

EPA has assessed DOE's cleanup levels for the ETEC site in Area IV (EPA, 2003b). DOE, the primary responsible party for radiologic cleanup at SSFL, proposed to remediate the site to its own approved standards (DOE, 2004). These standards are not consistent with EPA's CERCLA standards or those of the California Department of Health Services, Radiologic Health Branch (EPA, 2003b). The DOE proposal calls for site radionuclide decontamination such that a future site resident would not be exposed to more than an additional 15 millirems annually above background—that is, would not experience an additional lifetime cancer risk above 3×10^{-4}. (EPA, 2003b). It appears that EPA's assessment did not agree with DOE's justification of the proposed cleanup levels and that the proposed DOE cleanup levels would not meet the relaxed (3×10^{-4}) standard of lifetime cancer risk (EPA, 2003b).

In an unpublished letter (EPA, 2003b), EPA expressed concern over earlier decommissioning which, at the allowed residual radionuclide levels, could "result in cancer risks exceeding the CERCLA risk range of 10^{-6} to 10^{-4}." EPA further stated that the current DOE "cleanup goal of 15 mrem/yr corresponds to a residual cancer risk of approximately 3×10^{-4}," and that the risk at this dose limit "may vary by an order of magnitude or more depending upon the radionuclide present and the selected land use." EPA concluded that the proposed cleanup level will not satisfy standards for unrestricted land use. EPA also expressed concerns regarding inadequate subsurface and groundwater characterization—stating, for example, that sampling (in terms of number of samples and location) is insufficient to justify an unrestricted land use decision. In addition, EPA expressed concern about the use of insensitive and non-specific radiological survey methods.

These EPA opinions on the inadequacy of DOE's cleanup goals, monitoring deficiencies, and the recent detection of tritium at levels as high as 83,000 pCi/L in new wells onsite (Area IV, DOE Community Meeting, Simi Valley, 6/3/2004) cast doubt on the suggestion that the SSFL site can be declared suitable for unrestricted use. Even if DOE met EPA's radiologic cleanup goals, it can be argued, the SSFL site may not be suitable for residential land use due to the massive and likely long-lasting TCE plume beneath the site. This conclusion is consistent with the summary conclusions of a 1990 U.S. Army Corps of Engineers–sponsored baseline public health risk assessment for the SSFL property (Techlaw, 1990). This latter assessment concluded that there may be a concern for potential public health risk associated with onsite *personnel* and *residential* use of the property. It was concluded that exposure of site residents to TCE via multiple pathways could lead to cancer risks exceeding the 1×10^{-6} level (Techlaw, 1990).

8.6 Health Implications

The exposure analysis presented in this study provides upper limit estimates of contaminant dose relative to acceptable dose measures in order to rank the various chemicals and exposure locations of concern. The estimated dose ratios, along with detailed analysis of the various exposure pathways, estimates of emissions, and critical assessment of available monitoring studies, should provide the public and decision makers with a reasonable indication of the potential for exposure to SSFL-associated contaminants and help in evaluating future site management with respect to remedial action, monitoring, and future land use.

Assessing health impacts in a quantitative manner is beyond the scope of the present study. A study of SSFL's impact on community health would have to directly assess community health through detailed epidemiological studies and comparison of community health relative to other regions of similar character. In 1992, the California Department of Health Services (DHS) released a preliminary statistical report that indicated that a higher-than-usual number of lung cancers had been diagnosed from 1983 to 1987 in Ventura County residents near SSFL, as well as a higher-than-average rate of bladder cancer among Los Angeles County residents near SSFL (DHS, 1992). In 1999, an occupational study by UCLA School of Public Health researchers reported positive associations between measures of hydrazine exposure and the rates of terminal cancers of the lung, kidney, and bladder (Morgenstern, 1999). The 1999 UCLA study and the earlier DHS study could not rule out confounding impacts by other chemical carcinogens, such as TCE, to which many subjects were likely exposed.

TCE, 1,1-DCE, and vinyl chloride, which were identified as contaminants of concern (Chapter 2), are carcinogens that can target the liver, lung, bladder, kidney, biliary tract, and skin. Systemic diseases associated with these contaminants include non-Hodgkin's lymphoma; liver, kidney, and nervous system toxicity; peripheral neuropathy; anemia; and skin diseases. Epidemiological studies on cancer incidence in workers exposed to TCE demonstrated a measurable association between TCE exposure and non-Hodgkin's lymphoma, esophageal cancer, kidney cancer, bladder cancer, and prostate cancer.[8.4] Exposure to 1, 1-DCE has been linked to liver and kidney toxicity (ATSDR, 1990). Vinyl chloride is a known Class A human carcinogen by the oral and inhalation routes (ASTDR, 1990). Studies of occupational exposure have identified the liver and the central nervous system as the two primary target organs of vinyl chloride toxicity (ASTDR, 1990). Other health effects include fatigue, damage to the lungs, poor circulation, and angiosarcoma, rare malignant cancer of the blood vessels (ASTDR, 1990).

This study suggests that the major contaminant of concern is TCE, and that exposure could be of concern for lifelong residents of West Hills, Bell Canyon, Dayton Canyon, Simi Valley, Canoga Park, Santa Susana Knolls, Chatsworth, Woodland Hills, and Hidden Hills. Exposure of residents to 1,1-DCE could have occurred in the northeast quadrant offsite of SSFL through use of private groundwater wells. In order to arrive at more definitive answers, it may be worthwhile to revisit and expand on the 1992 DHS epidemiology study. However, one would have to carefully consider the mobility of the population in the region and the intermittent nature of exposure to contaminants associated with SSFL.

[8-4] Non-Hodgkin's lymphoma: SIR = 3.5, n = 8; esophageal cancer: SIR = 4.2, n = 6; Hansen et al., 2001.
Kidney cancer: RR = 1.89, 95% CI = 0.85–4.23; bladder cancer: RR = 1.41, 95% CI = 0.52–3.81;
prostate cancer: RR = 1.47, 95% CI = 0.85–2.55; Morgan et al., 1998.