Revised Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Prepared for

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LIST OF ACRONYMS

1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethylene, also called 1,1-Dichloroethene
1,2-DCA	1,2-Dichloroethane
1,1,1-TCA	1,1,1-Trichloroethane
ABS	Dermal-Absorption factor
ADD	Average Daily Dose
AF	Soil-Adherence Factor
ASTM	American Society for Testing and Materials
AT	Averaging Time
B[a]P	Benzo(a)pyrene
BW	Body Weight
BTEX	Benzene, Toluene, Ethyl benzene, and Xylenes
Cal/EPA	California Environmental Protection Agency
cis-1,2-DCE	cis-1,2-Dichloroethylene, also called cis-1,2-Dichloroethene
cfm	cubic feet per minute
Cgw	Exposure point concentration (EPC) in groundwater
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
CTE	Central Tendency Estimate
DNA	Deoxyribonucleic acid, commonly called DNA with further description
DTSC	Department of Toxic Substances Control
EA	Endangerment Assessment
EBS	Environmental Baseline Survey
ED	Exposure Duration
EF	Exposure Frequency
EPC	Exposure Point Concentration
ET	Exposure Time
FOD	Frequency of Detection
FS	Feasibility Study
HEAST	Health Effects Assessment Summary Tables
HHAG	Human Health Assessment Group
HHRA	Human Health Risk Assessment

HI	Hazard Index
HLA	Harding Lawson Associates, now MACTEC
HQ	Hazard Quotient
IR	Ingestion Rate
IRIS	Integrated Risk Information System
IRS	Ingestion Rate for Soil
Kp	Dermal permeability constant
LADD	Lifetime Average Daily Dose
LMS	Linearized Multistage model
LOAEL	Lowest-Observed-Adverse-Effect Level
MCF	Mass Conversion Factor
MCL	Maximum Contaminant Level
MEW	Middlefield Ellis Whisman (Superfund Site)
MFA	Moffett Federal Airfield
MDL	Method Detection Limit
µg/kg	Micrograms per Kilogram
mg/kg	Milligrams per Kilogram
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NCEA	National Center for Environmental Assessment
NOAEL	No-Observed-Adverse-Effect Level
NRP	NASA Research Park
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene, also called Tetrachloroethlyene or Perchloroethylene
PEF	Particulate-Emission Factor
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QC	Quality Control
RA	Risk Assessment
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure

ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SA	Body Surface Area
SF	Slope Factor
SFo	Slope Factor, Oral
SFi	Slope Factor, Inhalation
SVOC	Semivolatile Organic Compound
TCE	Trichloroethene, also called Trichloroethylene
TCL	Target Cleanup Level
TPH	Total Petroleum Hydrocarbons
trans-1,2-DCE	trans-1,2-Dichloroethylene, also called trans-1,2-Dichloroethene
TTO	Total Toxic Organics
UCL	Upper Confidence Limit
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VCF	Volume Conversion Factor
VF	Volatilization Factor
VFa	Volatilization Factor for VOCs from groundwater to ambient air
VOC	Volatile Organic Compound
WATS	West-Side Aquifers Treatment System
WP	Work Plan

1.0 INTRODUCTION

MACTEC Engineering and Consulting, Inc. (MACTEC, formerly Harding ESE) has prepared this Human Health Risk Assessment (HHRA) to assess the health risks associated with Parcels 1 through 9 and 12 through 19 of the NASA Research Park (NRP-Site). The NRP site, located in Moffett Field, CA, is comprised of 213 acres is being planned for redevelopment as a collaborative research and educational campus, with associated facilities. For planning purposes, NRP was divided into 19 parcels as part of the Final Programmatic Environmental Impact Statement (*DCE, 2002*). The location of the parcels is shown in Plate 1. Based on their historical use and the proposed future use, Parcels 1 through 8 and 12, 13, 14, 15, 17, 18, and 19 were selected for evaluation as part of the HHRA. No contamination sources have been identified in Parcels 9, 10, 11, and 16 and they have been eliminated from further consideration. MACTEC conducted this assessment and prepared this report under contract to PAI/ISSi on behalf of NASA Ames Research Center.

Contaminated groundwater is the primary environmental medium of concern at the Site. Exposure to chemicals in the groundwater is primarily the result of transport of volatile organic compounds (VOCs) from the groundwater to the ground surface. Once at the surface, these VOCs enter the outdoor atmosphere or infiltrate the indoor building environment. The risks resulting from potential exposure to VOC vapors were calculated using (1) groundwater data, and (2) air quality data. Soil surface flux measurements were used in the selection of GW COPCs (see section 3.3 and Appendix A).

Although soil containing metals, PAHs, SVOCs, and VOCs, have been detected, most of the source areas and surrounding soil have been removed. However, a residual soil data set (i.e., representing post-remediation conditions following the removal of contamination sources) was not available for this HHRA. This HHRA is intended to reflect potential risks associated with current use and future development of the Site. Because a soil data set representing current chemical concentrations in soil at the five parcels could not be compiled, due to lack of post-remediation soil samples, quantitative risks could not be estimated. Instead, a discussion of applicable target cleanup levels (TCLs) for soil is presented. Comparison of the TCLs to measured soil concentrations can then be used to support any further removal action decisions.

Only exposure to groundwater and air were evaluated in this HHRA. This HHRA does not address potential exposure to lead-based paint in soil as this issue will be addressed separately. Prior to building demolition, soil contaminated with lead will be removed to the Risk Based Screening Level (RBSL) of 200 mg/kg.

This HHRA is consistent with the methods and assumptions presented in the *HHRA Work Plan, NASA Research Park, Moffett Field, California* (*HLA, 2002*), and is based on risk assessment guidance provided by the U.S. Environmental Protection Agency (USEPA) and the California Environmental Protection Agency (Cal/EPA). As discussed below, the Work Plan activities were amended to include the collection of soil flux samples.

The purpose of this HHRA is to provide guidance for development of the NRP parcels consistent with the land uses described in the Final Environmental Impact Statement (FEIS) prepared by Design, Community, and Environment (*DCE, 2002*). Development of the site is planned to occur over the next eleven years, while ground water remediation will require between 20 and 100 years. Therefore, it is expected that the developers of each site will conduct their own detailed, site-specific assessment as part of the proposed development. All requirements for environmental remediation levels for volatile organic compounds are set forth in the MEW Record of Decision (*USEPA, 1989b*) and these levels are not changed because of this HHRA.

This HHRA is organized as follows:

- Section 1 – Introduction: Describes the organization and content of the HHRA.
- Section 2 - Background: Describes the physical setting of Moffett Field and the groundwater and soil contamination at the Site. Previous risk assessments at Moffett Field are also discussed.
- Section 3 - Data Evaluation and Selection of Chemicals of Potential Concern: Describes methods to select chemicals of potential concern evaluated in the HHRA. A description of the data sets used in the HHRA is also included.
- Section 4 - Exposure Assessment: Describes the potential exposed populations, exposure pathways, exposure assumptions, methods of assessing chemical uptake, and estimation of exposure point concentrations (see also Appendix B).
- Section 5 - Toxicity Assessment: Describes the types of adverse health effects and dose-response criteria used to assess the potential for toxic effects for the chemicals of potential concern. Uncertainties used to develop the toxicity criteria are also discussed.
- Section 6 - Risk Characterization: Describes the qualitative and quantitative estimates of risk.
- Section 7 - Uncertainty Evaluation: Presents and discusses uncertainties associated with the quantitative results of the assessment and input data and assumptions.
- Section 8 - Summary and Conclusions: Presents a summary of the results of the HHRA.
- Section 9 – References: Provides a list of references cited in the text.

2.0 BACKGROUND

This section presents relevant information about Moffett Field and includes a description of the groundwater and soil contamination at the NRP Site. A summary of previous risk assessments conducted for the Site is also included.

2.1 Physical Setting

Moffett Field lies 35 miles south of San Francisco, 10 miles north of San Jose, and about 1 mile south of San Francisco Bay. The facility encompasses about 2,000 acres in Santa Clara County and borders the cities of Mountain View and Sunnyvale, California. To the north of Moffett Field are saltwater evaporation ponds and wetlands associated with San Francisco Bay; Stevens Creek lies to the west; U.S. Highway 101 runs along the southern perimeter; and Lockheed-Martin Aerospace facilities are located to the east. The Ames Campus is located in the northwest portion of Moffett Field. The area south of U.S. Highway 101 is industrial and includes a group of companies located or formerly located in a 0.5 square-mile area bounded by East Middlefield Road, Ellis Street, Whisman Road, and U.S. Highway 101, referred to as the MEW Superfund Site. These companies are implementing remedial activities for soil and groundwater contamination believed to originate within the MEW Superfund Site. Groundwater beneath the NRP parcels is impacted by migration of chemicals from the MEW Superfund Site and from past Navy operations at Moffett Field (*Tetra Tech, 1998*). The groundwater plumes underneath the NRP parcels are referred to as the West Side Aquifer or Regional Plume.

Moffett Field was operated as a NAS by the U.S. Military beginning on its date of commission in April 1933. The base was designated for closure as an active military base under the U.S. Department of Defense Base Realignment and Closure (BRAC) program. The base was transferred in July 1994 to NASA, except for the military housing units and associated facilities, which were transferred to Onizuka Air Force Base. As described in the Moffett Field Comprehensive Use Plan, Environmental Assessment (*Brady & Associates, 1994*), portions of Moffett Field will be converted from their former military use and redeveloped as a laboratory and associated offices. Other portions of the NRP Site are proposed for development as a collaborative research and educational campus, pursuant to the FEIS (*DCE, 2002*).

2.2 Groundwater Contamination

The remedial investigation (RI) of the MEW area, concluded in 1988 (*HLA, 1988*), demonstrated that VOCs, especially trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA), were the most frequently detected chemicals in groundwater. The MEW companies completed the RI, the feasibility study (FS), and the remedial design, and are currently conducting remedial action activities under USEPA supervision. Construction of the MEW treatment system was completed and routine operations began in October 1998 (*Tetra Tech, 1999a*).

In addition to the MEW Superfund Site, groundwater at the NRP was impacted by past Navy operations. Sources of groundwater contamination included a fuel storage tank farm, a former service station, a former aircraft wash rack sump, and a former dry cleaner. Of these, the former dry cleaner and wash rack are considered the primary sources of VOC contamination. The Navy designed and installed the West Side Aquifers Treatment System (WATS) to extract VOCs and petroleum contamination from groundwater (*Tetra Tech, 1999b*).

The VOCs in groundwater from the West Side Aquifer are being cleaned up to drinking water maximum contaminant levels (MCLs; *USEPA, 1989b*). Water levels are measured on a quarterly basis, and groundwater sampling is conducted periodically by the Navy and the MEW Companies.

2.3 Soil Contamination

Total petroleum hydrocarbons (TPH); benzene, toluene, ethyl benzene, and xylenes (BTEX); metals; polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs); semivolatile organic compounds (SVOCs); and other VOCs such as 1,1,1-TCA, 1,1,-DCE, methylene chloride, and acetone have been detected in soil at the NRP. Contaminated soil at NRP is primarily a result of previous leaks from underground storage tanks (USTs). Releases associated with the USTs are being actively investigated or monitored. Other sources that may have contributed to soil contamination at the Site include sumps and oil/water separators, storage of hazardous wastes, a paint facility, capacitors, transformers, fuel pits, high-speed fuel hydrants, and a fuel pier. Most of the USTs, oil/water separators, and sumps, and surrounding contaminated soils at the Site have been removed (*HLA, 2000a; Harding ESE, 2001a, b*). Exposure to soil contamination was not evaluated; instead, applicable TCLs are presented in Section 6.4.

2.4 Previous Risk Assessment Evaluations

A Baseline HHRA was conducted by the Navy to evaluate human health risks for potential future residential, occupational, and recreational receptors at Moffett Field and was included in the station-wide RI report (*PRC, 1996*) as well as the OU2 RI (*IT, 1993a*). In addition, station-wide ecological risk assessments were conducted (*PRC and MW, 1995 and 1997*). Both of the site wide assessments focused on the wetland areas, the runway, and surrounding hangars and maintenance facilities and did not address the areas occupied by the redevelopment property. The Baseline HHRA estimated cancer risks above $1x10^{-4}$ (or one-in-ten thousand) for residential and occupational receptors at some areas of the Site, suggesting that soil remediation may be necessary and that treatment of the groundwater plume to MCLs would reduce the risk to acceptable levels.

In accordance with the MEW ROD, an Endangerment Assessment (EA) was prepared for the MEW Site (including Moffett Field) to address the potential effects to human health and the environment for environmental conditions at that time (*ICF-Clement, 1988*). The EA evaluated the potential risks posed by contamination existing in 1988 without considering future remedial actions proposed for the Site. The assessment focused primarily on risks from exposure to contaminated groundwater, but also qualitatively evaluated risks to construction workers, which were included as a worst-case scenario, assuming residential units would be constructed. The EA concluded that there was not a significant risk over most of the MEW area because of the relatively low VOC concentrations in exposed surface soils under the then-current use conditions. However, the EA did qualitatively note that redevelopment of the Site could lead to significant exposure to contaminants present in subsurface soils through inhalation of vapors or dust, assuming that no remedial action was taken at the Site. In addition, the EA did not evaluate inhalation of contaminated indoor air.

3.0 DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This section describes the groundwater, air, and flux data used for the HHRA. The methods for selecting chemicals of potential concern (COPCs) that were evaluated in the HHRA are also discussed.

3.1 Areas Defined for Evaluation of Risk

The 213 acre NRP is being planned for redevelopment as a collaborative research and educational campus, with associated facilities. For planning purposes, NRP was divided into 19 parcels as part of the Final Programmatic Environmental Impact Statement (*DCE, 2002*). The location of the parcels is shown in Plate 1 (*DCE, 2002*). Based on their historical use and the proposed future use, Parcels 1 through 9 and 12 through 19 were selected for evaluation as part of the HHRA. No contamination sources have been identified in Parcels 9, 10, 11, and 16 and they have been eliminated from further consideration. Groundwater sampling and/or treatment wells in the upper aquifer (A aquifer) are located in parcels 1, 2, 4, 5, 6, 7, 8, 12, 12a, 13, 15, 17, 18, and 19. No A aquifer wells are present in parcels 3 and 14. Air samples were taken in and around buildings located in parcels 1, 2, 3, 4, 6, 12, 13, 15, 17, and 18. Only parcel 14 did not have either air sample or groundwater sample data associated with its location.

3.2 Data Evaluation

Groundwater monitoring data collected from the uppermost (A1) aquifer at the Site from February 1996 to July 2000 (i.e., the five most recent sampling years) from Parcels 1 through 8, and 12, 13, 14, 15, 17, 18, and 19 were compiled. Table 1 lists the wells from which data were evaluated for this Risk Assessment. VOCs were the only chemicals for which the groundwater samples were analyzed for this HHRA. For each chemical, in each well, the following descriptive statistics for groundwater were calculated for each VOC: number of detections, number of analyses, frequency of detection, minimum and maximum detected values, and arithmetic mean. Per USEPA guidance, for a non-detect sample, half the detection limit was used in the statistical calculations. A statistical summary for groundwater is detailed in Table 2. Groundwater sample locations are shown in Plate 2. (The full groundwater data set is provided in Appendix C.) Groundwater wells were not present in parcels 3 and 14.

Predicted indoor air concentrations for VOCs (*USEPA, 2000b*), based upon the measured groundwater concentrations were compared to indoor air concentrations (*HLA, 2000b; Harding ESE, 2001d; SAIC, 1999, 2000*) measured in numerous buildings and outdoors throughout the NRP (Section 7.3). Table 3 lists those buildings on the NRP site for which air data was available. The building locations are shown in Plate 3. In some of the indoor air samples, chemicals detected in the groundwater were not present (e.g., vinyl chloride). To confirm this result, surface soil flux was measured. The measured surface soil flux is primarily due to contaminants in the groundwater on the Site, but some contribution may also be from VOCs in soil.

Indoor and outdoor air quality measurements have been conducted at several locations at NRP (*SAIC, 1999, 2000; HLA, 2000b; Harding ESE, 2001d*). These data were used to calculate indoor and outdoor risk. Descriptive statistics for the air data, for each chemical, in each building, are provided in Table 4. (The full air data set is provided in Appendix D.)

C.E. Schmidt, Ph.D., Environmental Consultant, Red Bluff, California, performed flux measurements at 22 locations (Appendix A) on March 20 and April 24, 2001, under subcontract to Harding ESE, now MACTEC Engineering and Consulting. Dry-season measurements were made on August 8, 2001, at the same 22 locations, plus 1 new additional location; total 23 flux sample locations. Flux measurements were performed following the USEPA flux chamber protocol (*USEPA, 1986b*) and all surface flux samples were shipped offsite for chemical analyses using USEPA Test Method TO-14/gas chromatography mass spectroscopy (GC/MS) for selected VOCs (Section 3.2), operated in the selective ion mode (SIM). A technical memorandum, which includes descriptions of the flux chamber methodology, locations of samples, and a discussion of the results, is included as Appendix A.

3.3 COPC Selection

According to USEPA guidance (*1989a*), a risk assessment should focus on the chemicals that pose the greatest risk to human health. USEPA provides selection criteria for excluding from the assessment those chemicals that are nonhazardous or not site-related. Because the groundwater is not used for drinking, (i.e. drinking water PRG does not apply to vapor intrusion of VOCs from groundwater) there were no readily available toxicity criteria against which to screen groundwater contaminants.

For all chemicals detected in groundwater, NRP air and flux samples were used to verify the presence of VOCs in the air. If a chemical was detected in the groundwater, but there were no detections in any air or flux samples, then those chemicals were not carried through the air exposure route to the risk assessment. However, some chemicals, which were detected in the groundwater, but not detected in air, were not analyzed for in the surface flux samples. Erring on the conservative side, these chemicals were kept as COPCs when estimating risk based upon the groundwater volatilization modeling. Similarly, if a chemical is detected in air samples, but was not present in any of the groundwater samples, it was not carried through to the risk assessment because it was assumed to be due to background air, not to site groundwater contamination. Table 5 lists all the chemicals that were selected as COPCs.

Onsite indoor and outdoor air samples were analyzed for a full suite of volatile organic compounds. Only benzene, TCE, PCE, and 1,4-dioxane were consistently detected in air across the Site.

The following chemicals were evaluated during the soil flux sampling:

- Vinyl Chloride
- 1,1-Dichloroethene
- Methylene chloride
- trans-1,2-Dichloroethene
- 1,1-Dichloroethane
- cis-1,2-Dichloroethene
- Chloroform
- 1,1,1-Trichloroethane
- 1,2-Dichloroethane
- Benzene
- 1,4-Dioxane
- Trichloroethene (TCE)
- Tetrachloroethene (PCE)

3.4 Background Evaluation of Air Concentration

Measurement of indoor and outdoor air on the NRP Site may detect chemicals present because of volatilization through the soil from the groundwater plume, but they may also represent a background of chemicals normally present in the urban atmosphere. Data from the Bay Area Air Quality Management District (BAAQMD), Mountain View monitoring station (*BAAQMD, 2000*) were evaluated. Based on geographical considerations, the 1999 BAAQMD Mountain View data were used for comparison to air measurements on the NRP site. (Note: 2000 BAAQMD data was not available for the Mountain View monitoring station.) The principal contaminants in the BAAQMD data are benzene, TCE, and PCE. A statistical summary of this data is provided in Table 6. A background correction could only be applied to the contaminants listed in Table 6. In as much as other contaminants were detected in the NRP samples, but were not on the BAAQMD analyte list, a background correction of the NRP air sample data could not be made.

Concentrations of benzene, due to emissions from burning of fossil fuel (e.g., automobile exhaust), are significantly higher than any of the other organic chemicals routinely measured by BAAQMD. In the evaluation of risk based upon air measurements, the BAAQMD data were used to correct the onsite air measurements for background benzene that would normally be present in the air, above any contribution from benzene in the groundwater.

4.0 EXPOSURE ASSESSMENT

An exposure assessment evaluates how much of a specific substance a receptor may ingest, inhale, or absorb through the skin over a specified time period. This section describes the potential receptors and exposure pathways selected for quantitative risk characterization. Exposure assumptions (or factors), equations used to estimate doses for the selected receptors, and methods used to derive exposure point concentrations (EPCs) are also described. The methodology for exposure point concentrations utilized in this risk assessment applies to both current and future land use. For purposes of this risk assessment, both current and future land use are described by the exposure parameters chosen in the following sections.

4.1 Exposure Setting and Land Use

Moffett Field was operated as a NAS by the U.S. Military beginning on its date of commission in April 1933. The base was designated for closure as an active military base under the U.S. Department of Defense Base Realignment and Closure (BRAC) program. Currently, the building and facilities are used as described below (*HLA, 2000a; Harding ESE, 2001b,c*):

- Buildings are used by NASA and other federal agencies for administration, research support, storage, base support services, retail, motor pool operations, or are vacant.
- Dormitories and administrative buildings associated with the Space Camp Operations are present in the western portion of the site; however, because of their location relative to the contamination, they are not included further in this HHRA.
- Hangar 1 is used for special events, and houses a museum of the former NAS Moffett Field. The buildings immediately adjacent to Hangar 1 are vacant.
- In the areas adjacent to the airfield, buildings are used for office operations, air traffic control, or are vacant. A large portion of these areas (Parcel 19) have been identified as a habitat area for burrowing owls, a California species of special concern, and will not be developed.

4.2 Identification of Receptors and Pathways

Pathways of exposure are the means through which an individual may contact a chemical. Determinants of complete exposure pathways include environmental/geographic considerations, locations and activity patterns of the potentially exposed populations, and the potential for a chemical to migrate within a particular medium (e.g., air transport) or from one medium to another (e.g., release of particulates from soil to air). Each of the following components must be present for an exposure pathway to be complete (*USEPA, 1989a*):

- A potential source of a toxic substance must be present in an environmental medium, such as groundwater.
- A potential receptor must be present, such as a resident living near or on the potential source.
- A contact point must also be present, such as a construction worker touching groundwater contaminated with some substance.
- There must also be a route for the substance to enter the body, such as the inhalation of vapors by a child playing outside.

The potential receptors, exposure routes, and pathways considered in this HHRA are described in the sections below. A conceptual site model (CSM) illustrating these exposure routes and pathways are discussed and presented in Figure 1.

4.3 Potential Receptors

Potential receptors are members of a population who may be exposed to contaminated media during the course of daily living and working in the areas of concern. The receptors to be evaluated in the HHRA were identified based on the current and future land uses, which are research and development, education, office, and may include dormitory style housing and childcare facilities. On the basis of discussions with NASA, contractor personnel and regulators, (Harding, 2002), four receptors were evaluated for this HHRA:

1. Construction worker – This receptor represents construction workers and laborers who could have direct contact with groundwater.

2. Indoor worker – This receptor is representative of all persons who would spend the majority of their working day on site indoors. This would include researchers, lecturers, office personnel, students, as well as maintenance workers whose primary duties involve indoor activities (e.g. electricians and plumbers).

3. Adult and child residents – some dormitory style housing is planned for the site. It is assumed that residents would primarily be comprised of students living on site, as well as their spouses and children.

4. EPA default 30 year resident - this is comprised of a 6 year child exposure (0 to 6 years of age) and a 24 year adult exposure.

It is assumed that all receptors are exposed to chemicals present in the air. Since subsurface building foundations and below ground utility work would be required, it is assumed that construction workers could be in direct contact with the shallow groundwater aquifer present at the site.

4.4 Exposure Pathways

Receptors could be exposed to the COPCs by any of the following pathways:

- Inhalation of volatile chemicals
- Dermal absorption due to direct contact with groundwater (construction worker only)

Dermal absorption of COPCs is a result of chemicals being absorbed into the body from any direct skin contact with contaminated groundwater. Contact by construction workers with subsurface groundwater is assumed to involve exposure to greater body surface areas due to the type of below ground level manual work involved. Chemicals absorbed through the skin are potentially absorbed into the blood stream.

VOCs present in groundwater have the ability to volatilize from the groundwater, and via migration of the soil vapors, into indoor and ambient air. Once in the air, humans can inhale the gas. Once inhaled, the VOCs can potentially be absorbed into the blood stream.

4.5 Conceptual Site Models

A conceptual site model (CSM) is a representation of the possible combinations of receptors, exposure routes, and exposure pathways possible for a site. Figure 1 shows the CSM for each receptor considered as part of the HHRA. Dermal exposure due to direct contact with the shallow groundwater at the site was evaluated for construction workers and the inhalation exposure pathway was evaluated for all receptors.

4.6 Exposure Point Concentrations

To provide a range of risk estimates, two types of exposure scenarios were used in this HHRA: a reasonable maximum exposure (RME) and a central tendency exposure (CTE). A RME, as defined by USEPA (*1989a*), is the "highest exposure that is reasonably expected to occur" and is estimated using a combination of average and upper-bound values of human exposure parameters. A CTE provides an estimate for exposure at a site by the use of average or site-related exposure parameters.

According to USEPA (*1992a*), the measure of exposure appropriate for a risk assessment is the average concentration of a contaminant throughout an exposure unit, or a geographic area to which humans are exposed. This premise is based on the assumption that, over a long enough period of time, a receptor would contact all parts of the exposure unit. A receptor would not likely be exposed to only the maximum or any other particular detected concentration of a chemical for the full period of exposure. Therefore, for the CTE scenario, the arithmetic average concentration for each COPC for each well or building was used as the EPC.

For each chemical, in each well or building, if the chemical was detected above the method detection limit (MDL) in at least one sample, it was assumed that the chemical was present. When calculating the EPC, all other non-detect results for that chemical were then set at one-half the MDL (*USEPA, 1989a*). However, if all of the samples for a given chemical, within a well or building, were non-detects, it was assumed that the chemical was not present, and therefore EPCs were not calculated.

A conservative estimate of the average concentration of a chemical across an exposure unit is the 95 percent upper confidence limit (95 percent UCL) on the mean, which was the EPC used for the RME scenario. Different methods are available to estimate the 95 percent UCL, depending upon the underlying distribution of the data set. In the HHRA, arithmetic, Land, and Chebyshev 95 percent UCLs were calculated for each data set (*USEPA, 1997b; Schulz and Griffin, 1999*). If the results of the W-test (*Shapiro and Wilk, 1965*) indicated that the data were normally distributed, then the arithmetic 95 percent UCL was used. If the W-test suggested that the sample set was log-normally distributed, Land's method (*Land, 1975*) was used to determine the 95 percent UCL. If the W-test indicated that the data set was neither normal nor lognormal, Chebyshev's inequality (*Singh et al., 1997, USEPA, 2002*) was used to provide an upper-bound estimate of the 95 percent UCL.

EPCs for the RME scenario were selected based upon the results of the relationship between the most appropriate 95 percent UCL and the maximum sample value. In those cases where the 95 percent UCL exceeded the highest measured sample result, the maximum detected concentration was used as the EPC (*USEPA, 1992a*). If the 95 percent UCL did not exceed the maximum detected value, the 95 percent UCL was selected as the EPC.

EPCs for groundwater were calculated (Table 2) to assess risk due to direct exposure to groundwater and to volatiles from groundwater. EPCs were calculated for each well. These results were then used to generate iso-risk contours, which are presented in Plates 4 through 22. Separate EPCs were calculated for the air measurements in each building (Table 4). These measured air values result from the presence of contaminants in the groundwater and/or soil, as well as other non-site specific contaminant sources (e.g.

background). Therefore, the measured air EPCs used for calculating the indoor and ambient air risk, were corrected using the 1999 BAAQMD background data from the monitoring station located in Mountain View presented in Table 6.

4.7 Chemical Intake Estimates

Intake estimates were calculated for each COPC and exposure pathway, using air concentrations estimated using the groundwater volatilization model and direct air measurement. Intake, or dose, is defined as the average amount of chemical systematically taken in by the body over a given period of time. For noncarcinogenic effects, the intake is averaged over the period of time that receptors are exposed to the COPCs and is referred to as the average daily dose (ADD). For carcinogenic effects, the intake is averaged over a receptor's lifetime and is referred to as the lifetime average daily dose (LADD). The general equations employed to estimate intakes for each exposure pathway considered in the HHRA are presented in Sections 4.7.1 through 4.7.4.

Quantification of exposure intake is dependent on chemical EPCs, as well as general exposure assumptions, or parameters. Exposure parameters are single-point estimates used to develop the intake estimates for each scenario. They are based on information that is highly conservative in nature and are intended to overestimate exposure to be protective of sensitive members of the population, such as children or the elderly.

Both CTE and RME assumptions were used in the exposure assessment and subsequent risk calculations. The parameters used to assess exposure in the HHRA are summarized in the sections below and are provided in Tables 7 through 10.

4.7.1 General Exposure Assumptions

General exposure assumptions are used in the intake calculations for all exposure pathways evaluated in the HHRA. General exposure assumptions include body weight, exposure duration, exposure frequency, and averaging time. These assumptions are provided in Tables 7 through 10 and detailed below:

- Body weight (BW): It was assumed that the BW for an adult is 70 kilograms (kg) for the CTE and RME scenarios (*USEPA, 1997a*). A BW of 15 kg was used for the CTE and RME child (*USEPA, 1997a*).

- Exposure duration (ED): For maintenance and indoor workers, a CTE ED of 4 years, corresponding to an average employee tenure (*USEPA, 1997a*), and an RME ED of 25 years were used (*USEPA, 1997a*). Construction workers were considered to be onsite for relatively short periods of time; consequently, a CTE ED of 1 year and an RME ED of 2 years were assumed for this receptor. The EDs for adult and child residents were assumed to be 5 years for the CTE scenario (related to an average post-doctoral tenure) and 10 years for the RME scenario (corresponding to an extended post-doctoral tenure). A separate default 30 yr residential exposure, consisting of a 6-year child exposure and a 24-year adult exposure was also evaluated.

- Exposure frequency (EF): An EF of 250 days per year was used for both the CTE and RME scenarios for outdoor maintenance, construction, indoor worker, and student receptors. This value is based on a 5-day workweek, 50 weeks per year. However, for a construction worker, it was assumed that direct contact with groundwater would only occur 50 days per year for both the CTE and RME scenarios. For the CTE scenario, it was assumed that adult and child residents would be exposed to chemicals at the Site 300 days per year; for the RME scenario as well as the default 30 year residential scenario, the EF for adult and child residents was assumed to be 350 days per year (*USEPA, 1991a*).

- Averaging time (AT): As explained above in Section 4.7, intake calculations are averaged over periods of time. For noncarcinogenic effects, the AT is equal to the period of time that receptors are exposed to the COPCs, or 365 days per year multiplied by the ED; these ATs vary for each receptor. For carcinogenic effects, the AT is equal to a receptor's lifetime, or 365 days per year multiplied by 70 years. Accordingly, the AT for carcinogenic effects was 25,550 days.

4.7.2 Exposure Parameters and Equations for Dermal Contact with Groundwater

Exposure assumptions used in the intake calculation for dermal contact with groundwater are shown in Tables 7 through 10 and detailed below:

- Body surface area (SA): The SA is the total amount of skin surface that can be exposed to contaminated media. The construction worker was assumed to have hands, feet, and lower legs exposed and in contact with groundwater; therefore, SAs of 4,860 cm^2 and 6,140 cm^2 were used for the CTE and RME scenarios, respectively, for groundwater exposure (*USEPA, 1997a*).

- Dermal permeability constant (Kp): The Kp is a measure of the rate at which a chemical is absorbed from a medium through the skin. Permeability constants are typically derived from animal experiments. Each Kp is associated with a specific chemical, absorbed from a specified solvent. For VOCs in water, Kp values were compiled from USEPA (*2001e*). The Kp values are presented in Table 11.

- Exposure time (ET): For dermal contact with groundwater, an ET parameter was applied to the intake estimates to account for the amount of time during one day that a construction worker would contact COPCs in groundwater. For the CTE scenario, an ET of 1 hour (for 50 days per year) was used. For the RME scenario, an ET of 2 hours (for 50 days per year) was applied.

Chemical intake via dermal contact with groundwater was estimated according to the following equation:

$$\text{Intake} = \frac{C_{gw} \text{ x SA x Kp x ET x EF x ED x VCF}}{\text{BW x AT}}$$

where:

Intake	=	Intake, or dose, for each COPC (mg/kg-day)
C_{gw}	=	EPC in groundwater (milligrams/liter [mg/L])
SA	=	Body surface area (cm^2)
Kp	=	Dermal permeability constant (cm/hr)
ET	=	Exposure time (hrs/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
VCF	=	Volume conversion factor (10^{-3} L/cm^3)
BW	=	Body weight (kg)
AT	=	Averaging time (days).

4.7.3 Groundwater Volatilization Model

Evaluation of the inhalation exposure routes requires estimations of indoor and outdoor air concentrations based upon the amount of chemical contamination present in groundwater. For each groundwater COPC, the Johnson and Ettinger Volatilization model (*EPA, 2000b*) was used to estimate indoor air concentrations and a volatilization factor (VF), taken from the ASTM methodology (*ASTM, 1995*), was used to calculate the fraction of each chemical present in the contaminated media that would evaporate to the air (outdoor).

Details of the Johnson and Ettinger model can be found in the USEPA Users Guide (*EPA, 2000b*). The EPA Johnson and Ettinger (*EPA, 2002*) spreadsheet cannot be utilized due to the number of chemicals and number of wells that must be evaluated to generate the risk isopleths. Consequently, only the Tier 1 Infinite Source equations from Johnson and Ettinger (as implemented by EPA, *(EPA, 2000)*) were extracted and used to develop a database model capable of handing the large amount of site groundwater data. The ASTM VF equations for outdoor air were also incorporated into the database model.

Assumptions required for use of the building parameters employed in the volatilization model are detailed in Table 14. It was assumed, based upon projected land use, that the typical structure that will be constructed would be a three story, 90,000 square foot (30,000 square feet per floor) office/research building. Nominal dimensions were 200' by 150' by 40' tall. Planning factors for office buildings typically allocate a total of 250 square feet person (including personal office space as well as common areas such as conference rooms and break rooms). ASHRAE Standard 62-1999 (*ASHRAE, 2000*) sets a ventilation rate of 20 cubic feet per minute (cfm) per person for office buildings. Multiplying the ASHRAE ventilation rate times the floor space requirements, and converting units, results in a ventilation rate of 3,400,000 cm^3/sec.

VFs were calculated based on models and recommendations presented by the American Society of Testing and Materials (ASTM) in *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (*ASTM, 1995*).

$$C_a = VF_a \bullet C_{gw}$$

$$VF_a = \text{Volatilization Factor for ambient air}$$

$$VF_a\left[\frac{(mg/m^3-air)}{(mg/L-H_2O)}\right] = \frac{H}{1+\left[\frac{U_{air}\ ht\ L_{gw}}{WD_{ws}^{eff}}\right]} x10^3\frac{L}{m^3}$$

H	Henry's law constant (unitless)
C_{gw}	EPC in groundwater (milligrams/liter [mg/L])
Lgw	Depth to groundwater (cm)
ht	Ambient Air mixing zone height (cm)
U_{air}	Wind speed above ground surface in ambient mixing zone (cm/sec)
W	Width of source area parallel to wind, or groundwater flow direction (cm)
D_{ws}^{eff}	Effective aqueous diffusion coefficient
L	liters
m^3	cubic meters
mg	milligrams

ASTM makes use of a simple, yet conservative, approach to the prediction of outdoor ambient air concentrations by the use of a "box model." The box model is a simple mass-balance equation that uses the concept of a theoretically enclosed space or box over the area of interest. The model assumes the emission of compounds into a box, with the removal of the compounds based on wind speed. Airborne concentrations for the area can then be estimated and used to represent the onsite air concentrations.

For both the volatilization model and direct air measurements, the CTE concentrations were based upon the average modeled or measured value for each contaminant. RME concentrations were based on the calculated EPC for each modeled or measured contaminant air concentration. These calculated or measured air concentrations then formed the basis for the risk assessment.

Both the EPA Johnson and Ettinger and the ASTM model are based on a number of conservative and health-protective assumptions; accordingly, modeled indoor and outdoor air concentrations could be greater than actual concentrations that could occur at the Site, and risks and hazards estimated using these methods could err on the side of conservatism. However, in many cases at this site, the risk due to measured air concentrations is higher than the risk estimated from the groundwater volatilization model.

Input parameters used in the model were default values provided by EPA (2002) and ASTM (*1995*), with the exception of available site-specific parameters. Boring logs from representative monitoring wells were evaluated and available site-specific data were extracted and entered into the model. Soil and groundwater characteristics data, used in the volatilization model, are provided in Table 12. Chemical and site-specific inputs used in the model are listed in Tables 13 and 14, respectively.

Intermediate model results (EPA J & E Intercalc Table) and the calculated indoor and outdoor air concentrations are provided in appendix E.

4.7.3.1 Differences between Draft Addendum and Revised Final HHRA

In the Draft Addendum HHRA dated December 16, 2003 a value for of 200 cm was used for the depth below grade to the bottom of the enclosed floor space (Lf). This has been changed to 15 cm, based upon comments received from one of the reviewers. In addition, the calculation of the area of the enclosed space below grade (Ab) and the crack-to-total area ratio (η) were incorrectly linked to the floor-wall seam perimeter (Xcrack). Due to use of incorrect building crack data (which was too large), that was not linked to the theoretical building dimensions, the failure to properly link the actual building dimensions to the enclosed space below grade parameter resulted in an estimate of the total crack length being much greater than that present in the theoretical future building. This resulted in exaggerated estimates of indoor air concentration, and hence risk. This has been corrected and the values used in calculation of the air concentrations are shown in table 14 and appendix E. These changes were made based upon comments received on the Draft Addendum HHRA dated December 16, 2003 (see appendix F). Overall, correction of this error results in a lower risk estimate to the indoor worker.

4.7.4 Exposure Parameters and Equations for Inhalation of Volatiles from Groundwater

This HHRA addresses inhalation of volatile COPCs migrating from the underlying groundwater and/or soil. Exposure assumptions used in the intake calculations include inhalation rate and exposure time. These factors are shown in Tables 7 through 10 and detailed below:

- Inhalation rate (IR): Inhalation rates for adults differ depending upon the receptor. For construction workers, a CTE IR of 1.5 cubic meters per hour (m^3/hr; moderate activity level for outdoor work) and a RME IR of 2.5 m^3/hr (heavy activity level for outdoor work) were used (*USEPA, 1997a*). IRs for indoor workers were 1.0 m^3/hr (light activity level for indoor work) and 1.6 m^3/hr (moderate activity level for indoor work) for the CTE and RME exposure scenarios, respectively (*USEPA, 1997a*). Based on a 24-hour average, a CTE IR of 0.63 m^3/hr (*USEPA, 1997a*) and a RME IR of 0.83 m^3/hr (*USEPA, 2000a*) were used for adult residents. For children 6 to 8 years of age, a CTE IR of 0.34 m^3/hr (*USEPA, 1997a)* and an RME IR of 0.42 m^3/hr are recommended (*USEPA, 2000*). These are the highest recommended IRs for a child within the age range of 1 through 6 years. These values were used as conservative estimates of inhalation for children.

- Exposure time (ET): An ET parameter was applied to the intake estimates to account for the amount of time during one day that a receptor can potentially inhale COPCs. For construction and indoor worker receptors, ETs were based upon a typical workday of 8 hours for the CTE scenario and an extended workday of 12 hours for the RME scenario (*USEPA, 1997a*). For the indoor worker it was assumed that 1 hour for the CTE scenario and 2 hours for the RME scenario would be spent outdoors. For the CTE scenario, an ET of 17.75 hours (16 hours indoors and 1.75 hours outdoors; *USEPA, 1997a*) was assumed for adult and child residents. The RME ET assumed for child and adult residents was 24 hours (22.25 hours indoors and 1.75 hours outdoors; *USEPA, 1997a*), which is very conservative because residents are typically not exposed all day to contaminants at their place of residence (indoors or outdoors).

Chemical intake via inhalation of volatiles in indoor air was estimated according to the following equation:

$$\text{Intake} = \frac{C_{in} \times IR \times EF \times ET \times ED}{BW \times AT}$$

Chemical intake via inhalation of volatiles in the outdoor air, based upon flux measurements, was estimated according to the following equation:

$$\text{Intake} = \frac{C_{a} \times IR \times EF \times ET \times ED}{BW \times AT}$$

where:

Intake	=	Intake, or dose, for each COPC (mg/kg-day)
C_{in}	=	EPC in indoor air (mg/m^3) - measured or modeled
C_a	=	EPC in ambient air (mg/m^3) - measured or modeled
IR	=	Inhalation rate (m^3/hr)
EF	=	Exposure frequency (days per year)
ET	=	Exposure time (hours per day)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days).

5.0 TOXICITY ASSESSMENT

This section presents the toxicity assessment for the COPCs evaluated in the HHRA. The toxicity assessment includes identification of the types of potential toxicity associated with each COPC (i.e., noncancer and carcinogenic effects) and the chemical-specific dose-response relationships. The dose-response characterizes the relationship between the dose of a chemical and the probability of an adverse health effect in an exposed population.

5.1 Noncarcinogenic Toxicity Criteria

Dose-response criteria for assessing the potential for noncancer health effects from exposure to chemicals have been developed by USEPA on the principle (supported by scientific data) that noncancer health effects occur only after a threshold dose is reached. This threshold dose is usually estimated from the "No Observed Adverse Effect Level" (NOAEL) or the "Lowest Observed Adverse Effect Level" (LOAEL) determined from chronic (i.e., long-term) animal studies. The NOAEL is defined as the highest dose at which no adverse effects are observed, while the LOAEL is defined as the lowest dose at which adverse effects are observed.

Uncertainty factors, or safety factors, are applied to the NOAEL or LOAEL observed in animal studies or human epidemiological studies to establish reference doses (RfDs). A chronic RfD, as defined by USEPA, is an estimate of continuous (i.e., chronic) exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime (*USEPA, 1989a)*.

In most cases, the RfD is calculated using non-toxic exposure levels in animals extrapolated to humans and reduced further using individual uncertainty factors ranging from 1 to 10. Uncertainty factors are used in an attempt to account for limitations in the quality or quantity of available dose-response data. For example, an uncertainty factor of 10 is applied to account for variation of the sensitivity of the human population. If the toxic endpoints are based upon animal studies, but applied to humans, an additional factor of 1 to 10 is applied. Ideally, the RfD is based upon the NOAEL. In those cases where only the LOAEL is available, another factor of 1 to 10 is applied. Similarly, if only sub-chronic data are available, then an uncertainty factor of 1 to 10 is applied. Finally, RfDs can be adjusted downward using a modifying factor of 1 to 10 to account for the quality of the toxicological studies or results. Thus, the uncertainty factors and the modifying factors provide an inherently more conservative RfD. If all uncertainty and modifying factors are applied at their maximum value of 10, then the endpoint doses observed in animal studies may be reduced by an overall factor of 10,000 for estimation of human exposures.

RfDs developed by USEPA were used to evaluate noncarcinogenic health hazards in the HHRA. The current RfDs were compiled from USEPA's Integrated Risk Information System (IRIS; *USEPA, 2001a*). If values for a particular chemical were not in IRIS, the *Health Effects Assessment Summary Tables* (HEAST; *USEPA, 1997c*) were consulted, as suggested in USEPA's risk assessment guidelines (*USEPA, 1989a*). If RfDs were not available in HEAST, RfDs were compiled from the National Center for Environmental Assessment (NCEA) as cited in USEPA (*2000a*).

The noncancer toxicity criteria for the COPCs are listed in Table 15 and discussed in Section 5.3 for each chemical. For purposes of this assessment and consistent with USEPA guidance (*USEPA, 1998*), oral RfDs were used to represent dermal RfDs (*USEPA, 1989a*). Where inhalation toxicity criteria were not available, oral toxicity criteria were used.

5.2 Carcinogenic Toxicity Criteria

Chemical carcinogens are generally divided into two classes, based upon the mechanism by which they cause cancer. These two classes are genotoxic agents (capable of causing DNA damage) and non-genotoxic (toxic through mechanisms not related to DNA damage). For genotoxic carcinogens, it is generally assumed that no threshold exists below which the agent cannot cause cancer. In other words, no matter how small the dose, there is some carcinogenic response, even if that response cannot be measured in animal experiments or in an exposed human population. In contrast to this, non-genotoxic carcinogens are likely to have a threshold dose, below which no adverse toxicological impact would be expected to occur. However, regulatory agencies, such as USEPA, have traditionally treated all chemical carcinogens as if there was no threshold for the carcinogenic effect. This is the most health conservative (i.e., most protective) approach to extrapolation of animal studies to humans.

The dose-response curve used by regulatory agencies is typically derived using the linearized multistage (LMS) model, which extrapolates the tumor response observed in animals exposed to high doses (commonly reaching the maximum tolerated exposure) of a chemical to a theoretical cancer risk for humans exposed to low doses. The LMS model is considered highly conservative because: (1) it does not allow for adjustments from metabolism or known DNA repair mechanisms that may prevent tumor formation at low doses, thus providing a threshold for the carcinogenic effect, and (2) it does not account for species differences that may result in chemical carcinogenicity by a mechanism only relevant to the specific laboratory animal.

The LMS model provides policymakers with an upper-bound risk estimate. Accordingly, USEPA acknowledges that the LMS model estimates are likely to greatly overestimate cancer risks (*USEPA, 1986a*):

> It should be emphasized that the linearized multistage procedure leads to a plausible upper limit to risk that is consistent with some proposed mechanisms of carcinogenesis. Such an estimate, however, does not necessarily give a realistic prediction of the risk. The true value of the risk is unknown, and may be as low as zero. The range of risks defined by the upper limit given by the chosen model and the lower limit which may be as low as zero, should be explicitly stated. An established procedure does not yet exist for making "most likely" or "best" estimates of risk within the range of uncertainty defined by the upper and lower limit estimates.

In 1996, USEPA published proposed *Guidelines for Carcinogen Risk Assessment* (*USEPA, 1996*). The proposed guidelines are a revision of USEPA's 1986 *Guidelines for Carcinogen Risk Assessment*, and when finalized, will replace the 1986 cancer guidelines. The proposed guidelines are intended to improve upon the 1986 guidelines by incorporating recent scientific advances in the understanding of carcinogenesis. Whereas the existing guidelines only allow for a default approach (the LMS model) for extrapolating low-exposure risks to humans from high-exposure studies, the proposed guidelines allow for the application of biologically based models that incorporate an understanding of a chemical's mechanism of action. Thus, where scientific studies of a chemical provide strong indication that a threshold is necessary for the initiation or promotion of carcinogenesis, the updated dose-response assessment can incorporate a threshold dose (*USEPA, 1996*). Because the current methodology does not incorporate this mechanism of action (including possible threshold response), toxicity values derived using the 1986 cancer guidelines may result in greater overestimates of the potential risk of chemicals.

Cancer risks for exposure to carcinogens are defined in terms of probabilities. The probabilities identify the likelihood (based on the assumptions established in the model) of a carcinogenic response in a member of the exposed population who receives a given dose of a particular chemical (based on mathematical modeling of the dose-response data). The probabilities are expressed in terms of the slope factor (SF). The SF represents the probability of a carcinogenic response (per unit dose). The SF, multiplied by the predicted chemical dose, provides an estimate of the upper-bound theoretical excess cancer risk over the course of a 70-year lifetime.

SFs for this assessment were compiled from Cal/EPA's Toxicity Criteria Database (*Cal/EPA, 2001*) and IRIS (*USEPA, 2001a*). For each COPC and exposure route, the higher SF from these two sources was used.

An important component of the toxicity assessment is an evaluation of the weight-of-evidence for human toxicity of each chemical. In assessing the carcinogenic potential of a chemical, USEPA's Human Health Assessment Group (HHAG) classifies the chemical into one of the following groups, according to the weight-of-evidence from epidemiologic and animal studies (*USEPA, 1997c*):

- Group A - Human carcinogen (sufficient evidence of carcinogenicity in humans)
- Group B - Probable human carcinogen ("B1" indicates limited evidence of carcinogenicity in humans; "B2" indicates sufficient evidence of carcinogenicity in animals, with inadequate or lack of evidence in humans)
- Group C - Possible human carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
- Group D - Not classifiable as to human carcinogenicity (inadequate or no evidence)
- Group E - Evidence of non-carcinogenicity for humans (no evidence of carcinogenicity in adequate studies).

Generally, quantitative carcinogenic risks are evaluated only for chemicals in Groups A and B and on a case-by-case basis for chemicals in Group C. The SFs, RfDs, and USEPA classifications for COPCs are presented in Table 15 and discussed in Section 5.3.

5.3 Toxicity Criteria for the COPCs

The following sections summarize the toxicity associated with the detected soil and groundwater contaminants, and COPCs evaluated in this HHRA and the derivation of cancer SFs and noncancer RfDs for each COPC. This information is summarized in Table 15.

Soil Only Contaminants

- **Arsenic**
  Arsenic is a known human carcinogen (Group A) based on increased lung cancer in human populations exposed via inhalation. In addition, liver, kidney, lung, bladder, and skin cancers have been observed from consumption of drinking water containing large amounts of inorganic arsenic. The oral noncancer toxicity value is based on hyperpigmentation, keratosis, and vascular complications. An inhalation RfD is not available for arsenic.

- **Cadmium**
  Cadmium is a Group B1, or probable, carcinogen based on human, occupational, and epidemiologic studies, as well as studies on laboratory rats and mice. An RfD associated with food intake was applied to this HHRA based on human studies involving chronic exposures. There is no recommended inhalation RfD for cadmium.

- **Chromium (VI)**
  Chromium (VI) is classified as Group A carcinogen via the inhalation route only, based on a relationship between occupational exposure and lung cancer. Carcinogenicity via the oral route has not been verified and thus, it is a Group D carcinogen by this pathway. The oral RfD is based on the NOAEL in experimental animals. The inhalation RfD was derived from occupational exposure via inhalation.

- **Mercury**
  Toxicity data for mercuric chloride were used to evaluate mercury in the HHRA. The RfD is based on oral and subcutaneous administration to laboratory animals. The inhalation RfD is based on the oral RfD. Due to a lack of evidence in humans and limited data in animals, mercury is classified as a Group C, or possible, carcinogen; no SFs are recommended for mercury.

- **Thallium**
  Thallium carbonate was used as a surrogate compound for thallium. The oral RfD was derived from observed increases in hormone levels in experimental animals. The oral RfD was used for the inhalation pathway. Thallium is a Group D carcinogen due to a lack of carcinogenicity data in humans and animals.

- **Carcinogenic PAHs**
  The carcinogenic PAHs detected in onsite soil were benzo(a)anthracene, B(a)P, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene. These compounds are classified as Group B2, or probable carcinogens. The SFs for these compounds are based on toxicity data for B(a)P (EPA, 1993). In multiple animal studies, B(a)P has been carcinogenic via several exposure routes. These compounds have not been demonstrated as causing noncancer health effects.

- **Bis(2-ethylhexyl)phthalate**
  Bis(2-ethylhexyl)phthalate is a probable carcinogen (Group B2). Increased liver tumors have been observed in laboratory animals exposed to the compound orally. Liver abnormalities were observed in animals exposed to the compound orally resulting in the oral RfD value. The inhalation RfD was based on the oral value in this assessment.

- **Naphthalene**
  Naphthalene is classified by USEPA as a possible carcinogen (Class C). However, recent studies by the National Toxicology Program (NTP) suggest that naphthalene is a carcinogen. The National Institute of Environmental Health Services of the National Institute of Health has indicated that naphthalene is a carcinogen via the inhalation route in laboratory animals (NTP, 2001). A SF has not yet been developed for naphthalene, however. The oral RfD for naphthalene is based on a NOAEL in animal studies. The inhalation RfD was derived from animal studies in which nasal effects were observed.

- **Pentachlorophenol**
  Pentachlorophenol is a Class B2 carcinogen, based on increases of several tumor types in laboratory animals and limited evidence in humans. The oral RfD is based on liver and kidney effects in laboratory animals. The oral RfD was used for the inhalation route in the HHRA.

- **Polychlorinated Biphenyls**
  PCBs are a Class B2; probable human carcinogen. This is based on a 1996 study that found liver tumors in female rats exposed to Aroclors 1260, 1254, 1242, and 1016, and in male rats exposed to 1260. These mixtures contain overlapping groups of congeners that, together, span the range of congeners most often found in environmental mixtures.

VOCs in Groundwater or Air

- **Benzene**
  Benzene is a known human carcinogen (Group A). This classification is based on epidemiologic studies that have demonstrated tumor responses by all exposure routes. The RfDs were compiled from NCEA (USEPA, 2000a) for which no supporting data were provided.

- **Carbon Tetrachloride**
  Carbon tetrachloride is classified as a probable human carcinogen (Group B2) based on hepatocellular carcinomas in mice, rats, and hamsters. The RfD was derived from the NOAEL based upon liver lesions in rats.

- **Chlorobenzene**
  Chlorobenzene is not classifiable as to carcinogenicity in humans and hence is a Group D carcinogen. Based upon pathological changes in the liver, kidneys, gastrointestinal mucosa, and hematopoietic tissues of male and female beagle dogs, an RfD was derived from the NOAEL.

- **Chloroethane**
  No data on the carcinogenic potential of chloroethane was available. The RfC is based upon fetal toxicity in mice and is derived from the NOAEL.

- **Chloroform**
  Chloroform is a probable human carcinogen (Group B2) based on increased incidences of several tumor types in laboratory animals. The oral RfD was derived from the NOAEL, which is based on liver effects in dogs. In the HHRA, the oral RfD was used for the inhalation pathway in the absence of an inhalation RfD.

- **1,2-Dichlorobenzene**
  1,2-Dichlorobenzene is classified as a Group D carcinogen by U.S. EPA. The RfD, derived from the NOAEL, is based upon liver lesions in mice.

- **1,3-Dichlorobenzene**
  1,3-Dichlorobenzene is classified as a Group D carcinogen by U.S. EPA. The RfD is taken from NCEA. No supporting toxicological details were provided.

- **1,4-Dichlorobenzene**
  1,4-Dichlorobenzene is classified as a Group B2 carcinogen by Cal/EPA. An RfC, based upon significant increases in liver weights for male rats, was derived from the NOAEL.

- **1,1-Dichloroethane**
  1,1-DCA is a Group C, or possible, carcinogen. SFs were developed for 1,1-DCA based on an increased incidence of tumors in laboratory animals exposed to the compound. Oral and inhalation RfDs were derived from NOAEL values based on kidney damage in animals.

- **1,2-Dichloroethane**
  1,2-DCA is classified as a Group B2, or probable, carcinogen. Several tumor types were observed in laboratory animals exposed to the compound by gavage and topical applications. The RfDs for this compound were compiled from NCEA (USEPA, 2000a), which did not provide supporting data for the values.

- **1,1-Dichloroethene**
  1,1-DCE is a Group C, or possible, carcinogen. Tumors were observed in one mouse strain exposed to the compound via inhalation. An inhalation slope factor is no longer available. 1,1-DCE is mutagenic and is known to alkylate and bind with DNA. The oral RfD is based on an observance of hepatic lesions in laboratory animals. There is no inhalation RfD for this compound; thus, the oral RfD was used for the inhalation pathway (for more discussion of the toxicity of 1,1-DCE, see Section 7.10.).

- **Cis-1,2-Dichloroethene**
  There are no data linking cis-1,2-DCE and tumor responses. Therefore, the compound is classified as a Group D carcinogen. The oral RfD was derived from observed blood abnormalities in laboratory animals. There is no recommended inhalation RfD; therefore, the oral RfD was used for this pathway in the assessment.

- **Trans-1,2-Dichloroethene**
  Trans-1,2-DCE does not have a carcinogenic classification, pending an evaluation by USEPA. An oral RfD was derived from an animal study in which subjects were exposed orally to the compound. There is no inhalation RfD; therefore, the oral RfD was used in the HHRA for this pathway.

- **1,2-Dichloropropane**
  1,2-Dichloropropane is not classified a carcinogen by USEPA or Cal/EPA. The RfC is based upon nasal lesions in mice, rats, and rabbits. The RfC was derived from the LOAEL.

- **Cis- and Trans-1,3-Dichloropropene**
  1,3-Dichloropropene (a mixture of cis- and trans- isomers) is classified a probable human carcinogen based upon observations of tumors in F344 rats (forestomach, adrenal and thyroid tumors, and liver nodules) and B6C3F1 mice (forestomach, urinary bladder, and lung tumors), positive mutagenic activity, and structural similarity to known oncogens that produce similar types of tumors in rodents. The RfD was derived from the NOAEL and based upon increased kidney weights in rats. The RfC was based upon observed changes in respiratory and olfactory epithelium in both mice and rats. The RfC was derived from the NOAEL.

- **1,4-Dioxane**
  1,4-Dioxane is classified a probable human carcinogen (Group B2). The classification is based on: (1) induction of nasal cavity and liver carcinomas in multiple strains of rats, (2) liver carcinomas in mice, (3) gall bladder carcinomas in guinea pigs. Oral and inhalation RfDs are not available for non-carcinogenic effects.

- **Ethyl benzene**
  Ethyl benzene is currently classified as Group D by USEPA. The RfD is based on histopathologic changes in the liver and kidneys of female rats and derived from the NOAEL.

- **Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)**
  No information on the carcinogenicity of Freon 113 was available. The RfD was derived from the NOAEL, and based upon slight impairment of psychomotor performance in male human volunteers. No supporting toxicological data was available on the derivation of the RfC.

- **Methylene Chloride**
  Methylene chloride is a Group B2, or probable carcinogen. Increased incidences in several tumor types have been observed in animals exposed to the compound. The oral and inhalation RfDs are based on observed liver toxicity in laboratory studies.

- **1,1,2,2-Tetrachloroethane**
  1,1,2,2-Tetrachloroethane is a group C carcinogen (possible human carcinogen) based on increased incidence of hepatocellular carcinomas in mice. No supporting toxicological data was available for the RfD.

- **Tetrachloroethene (PCE)**
  USEPA has not classified the carcinogenic potential of PCE. Cal/EPA (2001) has developed SFs for PCE based on liver carcinomas in laboratory animals. An oral RfD for this compound was derived experimentally based on observed liver toxicity in animals. The inhalation RfD was compiled from NCEA (*USEPA, 2000a*) and no supporting data were provided.

- **Toluene**
  Toluene is a Group D (not classified) carcinogen. The RfD is based upon histopathologic changes in the liver and kidneys, as well as increased liver and kidney weights, in rats. This RfD was derived from the NOAEL.

- **1,1,1-Trichloroethane**
  1,1,1-Trichloroethane does not have a carcinogenic classification (Group D). The oral and inhalation reference doses were compiled from NCEA (USEPA, 2000a) and no supporting data were provided.

- **1,1,2-Trichloroethane**
  11,2-Trichloroethane is classified group C; possible human carcinogen. This is based on hepatocellular carcinomas and pheochromocytoma in one strain of mice forms the basis for this classification. Carcinogenicity was not shown in rats. 1,1,2-Trichloroethane is structurally related to 1,2-dichloroethane, a probable human carcinogen. The RfD was derived from the NOAEL and based upon adverse liver effects in mice.

- **Trichloroethene (TCE)**
  USEPA recently reviewed the carcinogenic potential of TCE (*USEPA, 2001d*). The upper bound slope factor of 0.4 $(mg/kg\text{-}day)^{-1}$ calculated in this document was used for this HHRA. Cal/EPA (2001) has developed SFs for TCE based on liver and lung carcinomas in laboratory animals. The RfDs were compiled from NCEA (*USEPA, 2002a*) and no supporting data were provided. Based upon the revised TCE risk assessment (*USEPA, 2001d*) and the USEPA Region IX PRG tables (*USEPA, 2002a*), an inhalation reference dose of 0.01 mg/kg-day was used to estimate non-carcinogenic health effects. Epidemiologic studies have associated TCE exposure with excess risks of kidney cancer, liver cancer, lympho-hematopoietic cancer, cervical cancer, and prostate cancer. Observed non-carcinogenic effects include neurotoxicity, immunotoxicity, developmental toxicity, liver and kidney toxicity, and endocrine effects (see also Section 7.11).

- **Vinyl Chloride**
  VC is classified as a known human carcinogen (Group A). The classification is based on (1) epidemiologic evidence for inhalation exposure in occupational scenarios, (2) carcinogenicity in laboratory animals, (3) mutagenicity and DNA adduct formation in in-vitro tests, and (4) the rapid absorption of VC following exposure. The oral and inhalation RfDs are based on observed liver cell changes in laboratory animals.

- **Xylenes**
  Xylene (dimethylbenzene) exists in three isomeric forms; o-Xylene (ortho or 1,2-dimethlybenzene), m-Xylene (meta or 1,3-dimethylbenzene), and p-Xylene (para or 1,4-dimethylbenzene). Due to their close physical and toxicological properties, all three isomers are grouped together as one chemical "Xylenes" by USEPA and classified as non-carcinogenic (class D). CNS toxicity and respiratory effects have been observed in rats at relatively high doses. Xylenes have been observed to be fetotoxic and teratogenic at high doses in mice. The inhalation RfD was based on the oral RfD.

6.0 RISK CHARACTERIZATION

In risk characterization, the information, results, and conclusions from the data evaluation, exposure assessment, and toxicity assessment are integrated. Numerical risk estimates calculated for each COPC and exposure route and pathway are combined to estimate total theoretical noncancer hazards and, for carcinogens, total lifetime excess cancer risks. The critical uncertainties affecting risk calculations are also addressed.

6.1 Noncarcinogenic Hazard

Noncarcinogenic effects for each exposure route and pathway, and for each chemical are evaluated by comparing an average dose to a RfD for the same time period, generally one day. The ratio of the average daily dose to RfD is called a hazard quotient (HQ), which is calculated as follows:

$$HQ = \frac{ADD}{RfD}$$

Where:

HQ = Theoretical noncancer hazard quotient for a specific chemical and exposure pathway

ADD = Average Daily Dose (mg/kg-day) for chemical and exposure pathway

RfD = Reference Dose (mg/kg-day) for chemical and exposure pathway.

The HQ assumes that there is a dose below which adverse health effects are unlikely (*USEPA, 1989a*). If the average daily dose is below the threshold RfD (i.e., the ratio is less than 1), it is unlikely that noncarcinogenic effects would occur. The HQ is specific to chemicals and exposure pathway combination. Therefore, to assess the overall potential for noncarcinogenic effects from a particular exposure scenario, HQs for the relevant individual exposure pathways (e.g., ingestion, dermal contact, and inhalation) and individual chemicals are summed to obtain the hazard index (HI) for the populations evaluated.

In general, it is USEPA's position that a theoretical HI value at or below 1 indicates that there is unlikely to be an increased health risk, even for sensitive populations (*USEPA, 1989a*). At the same time, a HI greater than 1 does not necessarily indicate that adverse effects will occur, because the RfD used in the calculation contains a substantial measure of conservatism. As previously discussed, the RfD is conservative because it is typically derived by applying multiple safety factors to a level at which no adverse effects have been observed or to the lowest level at which effects have been observed in the most sensitive animal species that have been tested.

A significant limitation of the HIs is related to the assumption of additivity. Additivity is most properly applied to compounds that induce the same effect by the same mechanism of action. Summing HIs for a number of compounds that are not expected to induce the same type of effects or that do not act by the same mechanism is likely to further overestimate the potential for effects. However, for this HHRA, all of the COPCs are assumed to have similar toxicological endpoints, because they are all solvents with similar mechanisms of action. Thus, summing of HIs is likely appropriate and is not expected to result in significant overestimation of risk.

6.2 Cancer Risks

The theoretical lifetime excess cancer risks associated with the lifetime average daily doses are calculated as the product of the lifetime average daily dose (LADD) and the SF for each chemical and exposure pathway as shown below:

Risk = SF x LADD

Where:

Risk = Theoretical lifetime excess cancer risk for chemical and exposure pathway

SF = Slope Factor for chemical and exposure pathway

LADD = Lifetime Average Daily Dose for chemical and exposure pathway.

The quantitative risk estimate for suspected carcinogens is expressed as the lifetime theoretical excess (or additional) risk of contracting cancer above the actual incidence of cancer in the U.S. population. The likelihood of actually developing cancer is 1-in-2 for a male and 1-in-3 for a female (*American Cancer Society, 1999*). The risk estimate is chemical- and exposure pathway-specific. Therefore, the total upper-bound theoretical excess cancer risk is calculated by combining the risks across exposure pathways and chemicals as follows:

Total lifetime theoretical excess risk = Sum of risks by chemical and pathway.

USEPA has provided guidance on the role of risk assessment in federal Superfund remedy selection (*USEPA, 1991b*). USEPA considers a target lifetime theoretical excess risk range of $1x10^{-6}$ to $1x10^{-4}$ (between one-in-one-million and one-in–ten thousand) to be "safe and protective of public health."

According to USEPA, where the total lifetime theoretical excess cancer risk to an individual (based on an RME scenario for both current and future land use) is less than $1x10^{-4}$ and the theoretical noncarcinogenic HI is less than 1, remedial action is generally not warranted unless there are other adverse environmental impacts or an applicable or relevant and appropriate requirement (ARAR) is exceeded. Even risks slightly greater than $1x10^{-4}$ may be considered to be acceptable (i.e., protective) if justified based on site-specific conditions, including uncertainties about the nature and extent of contaminants and associated risks. Alternatively, on a case-by-case basis, action may be recommended for sites within the $1x10^{-4}$ to $1x10^{-6}$ risk range. Where remedial action is warranted, guidance for remedy selection is provided in the USEPA directive entitled *Land Use in the CERCLA Remedy Selection Process* (*USEPA, 1995*). The directive notes that it is not USEPA's intent that acceptable risk standards be based solely on categories of land use (e.g., with residential cleanups at a $1x10^{-6}$ level or industrial cleanups at a $1x10^{-4}$ level). The Regional Water Quality Control Board, San Francisco Bay Region has accepted $1x10^{-5}$ cleanup levels on a site-specific basis. Therefore, the risk range provides the risk manager with the necessary flexibility to address technical and cost limitations, and the performance and risk uncertainties inherent in all site remediation efforts.

6.3 Risk Characterization Results

In this section, the quantitative evaluations of theoretical noncancer hazards and lifetime theoretical excess cancer risks are presented for each applicable receptor for air concentrations estimated using the groundwater volatilization model and direct air measurements evaluated. Quantitative risks and hazards were estimated under RME and CTE conditions for the data sets described in Section 3.0 (i.e., using groundwater and air). These estimates are summarized in Tables 16 through 25, and Plates 4 through 22. Quantitative risks were compared to the USEPA risk management range of $1x10^{-6}$ to $1x10^{-4}$. Lifetime excess carcinogenic risks within the risk management range may be managed through construction techniques (indoor air) to reduce risks to an acceptable level and the use of appropriate personal protective equipment (PPE, construction). For the NRP, the acceptable lifetime excess cancer risk level is $1x10^{-6}$. Where risk management techniques are not available to achieve acceptable risk, NASA will implement land use controls. Noncancer hazards were compared to a HI of 1. As discussed in Section 1.0, analytical data for residual soil contamination were not available. Therefore, applicable clean-up target contamination levels (TCLs) for soil were compiled and are discussed in Section 6.4.

As discussed previously, EPCs for individual contaminants were calculated for each well (groundwater) and each building (air). Within each well or building, risks and hazards were calculated based upon the EPC of the COPCs in groundwater and measured air values using the appropriate models. Tables 16 through 25 contain the detailed risks and HIs for individual chemicals for each well or building.

When calculating risks and HIs, special consideration must be given to vinyl chloride (VC), benzene, and 1,4-dioxane. Although VC was detected in some of the groundwater samples, it was not detected in any of the flux or air samples. When calculating risk using groundwater data, the groundwater volatilization model used to estimate air concentrations would tend to overestimate risks because of the presence of VC. In particular, the GW-to-Indoor air model predicted indoor concentrations for VC at levels above the average indoor air measurement detection levels. Since the air measurement technique employed should have detected VC if present at the predicted model levels, it appears that the model, as used, over predicts indoor air VC concentrations. The calculated risk, at the average detection limit of the indoor air sampling, corresponds to a risk less than $1x10^{-6}$. Therefore, where VC was present in the groundwater, risks were estimated by subtracting out the VC risk. These VC corrected risks and HIs formed the basis for the data used to generate the iso-risk and HI contours in Plates 4 through 22.

Contaminant levels measured in air may include multiple sources for any given chemical. In particular, benzene risks based upon the air data can be greater than that expected from the groundwater data. Benzene is ubiquitous in the urban atmosphere, primarily due to vehicle exhausts. For many of the estimated risks and HIs that were based on air measurements, benzene was the single largest contributor to the total risk, even where it was not detected in the underlying groundwater plume. Therefore, it was concluded that the presence of benzene in the air data could be, for certain buildings, primarily a result of background concentrations, and not because of significant soil vapor migration from the groundwater plume. Consequently, concentrations due to the presence of background benzene in the air data were subtracted from the measured benzene concentrations. In addition to benzene, background corrections (Table 6) were also applied for toluene, methylene chloride, 1,1,1-trichloroethane, tetrachloroethene (PCE), and trichloroethene (TCE). As discussed previously, 1999 data for the BAAQMD Mountain View monitoring station was used to make this adjustment. Improvements in automobile emissions controls and the use of reformulated gasoline since 1999 should result in decreased background ambient air concentrations for some of these chemicals (e.g. benzene). However, only BAAQMD data for 1998 and 1999 were available for the Mountain View location. For benzene, toluene, methylene chloride, and trichloroethene the 1998 mean values were greater then the 1999 mean values; a trend towards improving air quality. However, for perchloroethlyene and trichloroethylene the 1999 mean values were greater than the 1998 mean values. Indoor air measurements were taken in 1999 and 2000, therefore these background concentrations are likely representative of the actual background concentrations in the air during the site sampling.

The third chemical requiring additional consideration, 1,4-dioxane, was detected in many flux and air samples, but was not part of the suite of chemicals historically analyzed in the groundwater. Recent sampling has detected 1,4-dioxane only at low levels and only in some of the samples from the A1 aquifer underlying the site. The presence of 1,4-dioxane in the indoor air could result from off gassing of building materials, from other solvent-containing products used in the buildings, or be present as a background contaminant in urban air. However, although risks calculated from air data may be overestimated under these circumstances (i.e., airborne 1,4-dioxane concentrations are higher than would be expected from the groundwater data), no correction is incorporated because background air data from the BAAQMD were not available for 1,4-dioxane.

The overall carcinogenic risks and noncancer HIs for the NRP are summarized in Section 6.3.1 for each receptor. Section 6.3.2 presents the calculations of risks and HIs from the groundwater volatilization model. Section 6.3.3 presents the risks and HIs estimated using the measured air concentration data.

6.3.1 Risk Characterization Summary

In general, the highest estimated lifetime excess cancer risks were located primarily in parcels 1, parts of 2 and 5, 7, 13, 14, 15, 17, and 18 (see Plates 4 through 22). The estimated lifetime excess cancer risks and HIs for all receptors were highest in Parcel 15 or the space east of 15 (wells W9-18, W9-35, WIC-11, and WIC-12, see Tables 16 through 20). For construction workers and adult residents (10 year RME, 5 year CTE), RME and CTE risks estimated from the groundwater volatilization model were within the risk management range. For the indoor worker, child resident (10 year RME, 5 year CTE), and default 30-year residential receptor, the lifetime excess cancer risks estimated from the groundwater volatilization model were above the risk management range for at least one well in Parcel 15 (W9-18, W9-35, WIC-11, or WIC-12). Estimated lifetime excess cancer risk based on the measured air concentrations were above the risk management range for buildings within or adjacent to Parcel 15, for all receptors except the construction worker. In addition, lifetime excess cancer risks estimated from groundwater volatilization modeling for the eastern portions of Parcels 12 and 12a, the northern portion of Parcel 5, and parts of Parcels 1, 2, and 7 were within the risk management range for all receptors.

For some of the buildings (e.g. 21, 22, 476, 148, and 156) on the western boundary of the plume, the estimated lifetime excess cancer risks, based upon the measured air data for some exposure scenarios, were many orders of magnitude greater than that which would have been predicted using the groundwater volatilization model and measured groundwater concentrations for wells in the vicinity of the building. This discrepancy may be due to: 1) contaminants present in the background air but which could not be corrected for due to a lack of BAAQMD background data; 2) differences between actual building parameters (such as ventilation rate or building floor wall perimeter crack length and modeled building parameters); 3) contaminant sources other than groundwater which have not been identified nor for which data were available to correct the air measurement data; 4) inaccuracy in the groundwater volatilization model.

The results of the HHRA for each receptor are summarized as follows:

- Maximum RME lifetime excess cancer risk for construction workers was within the USEPA risk management range ($1x10^{-6}$ to $1x10^{-4}$) based upon the groundwater volatilization modeling and direct air measurement results. The maximum estimated RME and CTE HIs for the construction worker, based upon the groundwater volatilization modeling and direct air measurements were greater than 1. This is primarily due to direct exposure to the contaminated groundwater.

- RME lifetime excess cancer risks for indoor workers, estimated from the groundwater volatilization model, were within or below the risk management range, except for one well in parcel 15 (W9-35). RME lifetime excess cancer risk estimated from the air measurements was above the risk management range (2.3E-4) for four buildings (Building 156, 566, 6 and Hangar 1), but within the risk management range for the remaining buildings. However, lifetime estimated excess cancer risks estimated from wells near Buildings 6, 156 and 566 were all in the lower end of the risk management range. This high estimated lifetime excess cancer risk for Buildings 156 and 566 may due to sources other than contaminated groundwater (note that Building 156 is very close to highway 101) or there may be high contaminant levels in the soil or groundwater close to the building, but which are not detected in the current monitoring wells. If the results for Building 156 are considered anomalous, then Hangar 1 has the highest estimated lifetime excess cancer risk. This building is adjacent to Well W9-35, which has the highest estimated lifetime excess cancer risk based upon the groundwater volatilization modeling. This suggests that the results for Hangar 1 are associated with contaminants in the groundwater. Maximum RME HIs for indoor workers estimated from both the groundwater volatilization model and direct air measurements were less than or equal to 1 and the CTE HIs were less than 1.

- Maximum RME and CTE lifetime excess cancer risks for adult residents (10 year and 5 year exposure duration, respectively), estimated from the groundwater volatilization model, were within or below the risk management range. RME lifetime excess cancer risks estimated from the air measurements were above the risk management range for Building 156, 6, and Hangar 1 but within the risk management range for the remaining buildings. The high estimated lifetime excess cancer risk for Building 156 may due to sources other than contaminated groundwater, because the risks estimated from wells in the vicinity of this building were all below or at the low end of the risk management range. If the results for Building 156 are considered anomalous, then Hangar 1 has the highest estimated lifetime excess cancer risk. CTE lifetime excess cancer risks estimated from the air measurements were below the risk management range for Building 111, and within the risk management range for the remaining buildings. Maximum RME HIs for adult residents (10 year exposure duration) estimated from the groundwater volatilization model were less than 1. Maximum RME HIs based upon direct air measurements were greater than 1 (Building 6), but the CTE (5 year exposure duration) HIs for all buildings were less than 1.

- RME lifetime excess cancer risks for child residents (10 year exposure duration), estimated from the groundwater volatilization model, were within or below the risk management range except for two wells (W9-35 and W9-2) in parcels 15 and 13. CTE lifetime excess cancer risks for child residents (5 year exposure duration), estimated from the groundwater volatilization model, were within or below the risk management range for all parcels. RME lifetime excess cancer risk estimated from the air measurements was above the risk management range for Buildings 148, 2, 21, 566, 156, 6, and Hangar 1. As discussed previously, the results for Buildings 566, 21 and 156 may be due to sources other than groundwater contamination. However, the results for the remaining buildings appear to be associated with groundwater contaminants, based upon comparison to lifetime excess cancer risk estimated from wells near these buildings using the groundwater volatilization model. Maximum RME lifetime excess cancer risk estimated from contaminant concentrations in wells near Buildings 566, 21 and 156 were between one to two orders of magnitude lower than risks estimated from the indoor air measurements. Maximum RME (10 year exposure duration) and CTE (5 year exposure duration) HIs for child residents estimated from the groundwater volatilization model were less than 1. Maximum RME (10 year exposure duration) HIs for child residents estimated from direct air measurements were greater than 1 for Building 6, but less than or equal to 1 for the remaining buildings. Maximum CTE (5 year exposure duration) child resident HIs were less than or equal to 1 for all buildings.

- Maximum RME lifetime excess cancer risk for 30-year residents, estimated from the groundwater volatilization model, was above the risk management range. RME lifetime excess cancer risk estimated from the air measurements was also above the risk management range for Buildings 148, 156, 2, 21, 476, 566, 6, and Hangar 1. As discussed previously, the results for Buildings 566, 156, 21 and 476 may be due to sources other than groundwater contamination. The maximum excess lifetime cancer risks estimated from contaminant concentrations in wells in the vicinity of these buildings were all lower by at least one order of magnitude. However, the results for the other buildings do appear to be associated with groundwater contaminants, based upon comparison to lifetime excess cancer risk estimated from wells near these buildings using the groundwater volatilization model. Maximum adult and child HIs, estimated from both the groundwater volatilization model and direct air measurements, were greater than 1.

6.3.1.1 Differences between Draft Addendum and Revised HHRA

As discussed in section 4.7.3.1, the groundwater to air volatilization model was revised based upon comments received on the Draft Addendum HHRA dated December 16, 2003. Overall, these changes result in lower risk estimates for most wells.

6.3.2 Risk Estimated from Groundwater Volatilization Model

The individual estimated lifetime excess carcinogenic risks and HIs for each well and receptor are presented in Tables 16 through 20 and Plates 4,5,8,9,12,13,16,17, and 20. As shown in the tables, risks and HIs were calculated with vinyl chloride (VC) present, as well as VC subtracted from the total risk and HI. As discussed in Section 6.3, VC was detected in the groundwater but not in the air or soil flux samples. Therefore, although the presence or absence of VC in the various media is noted for each of the wells, the most applicable total risk estimates do not take into account the presence of VC in the groundwater. All of the iso-risk plots presented in the plates are exclusive of VC. The risks discussed below for each receptor are exclusive of VC. Other chemicals, such as carbon tetrachloride, were not detected in air, but were also not on the flux analytes list. As discussed in section 3.3, under these circumstances, in order to err on the conservative side, these chemicals were kept as COPCs.

Since the groundwater volatilization model is based upon contaminant groundwater concentrations, no correction for contaminant concentrations in background air is required. Consequently, Benzene and the other contaminants measured by BAAQMD in the background air were included in the risks that were estimated using the groundwater data without correction.

Construction Workers

Table 16 and Plates 4, 5, 6, and 7.

Lifetime excess RME and CTE cancer risk for all of the parcels were within or below the risk management range. The space east of Parcel 15 (well W9-35) had the highest ($3.1x10^{-5}$) maximum lifetime excess cancer risk. RME lifetime excess cancer risks were within the risk management range for Parcels 1, 2, 3, 4, 5, 6, 7,12, 12a, 13, 14, 15 and the space east of 15, 17, and 18. CTE lifetime excess cancer risks were within the risk management range for Parcels 5, 13, 15 and the space east of 15, and 17. RME HIs were above 1 for parcels 2, 5, 13, 14, 15 and the open space east of 15, and 17. CTE HIs were above 1 for Parcels 13, 15 and the open space east of 15.

Indoor Workers

Table 17 and Plates 8, 9, 10, and 11.

Lifetime excess RME and CTE cancer risk for all of the parcels were within or below the risk management range. The space east of Parcel 15 (well W9-35) had the highest ($1.3x10^{-4}$) maximum lifetime excess cancer risk. This was the only well above the risk management range, however the results for this one well does not significantly impact the risk estimate (within the risk management range) for the entire parcel. RME lifetime excess cancer risks were within the risk management range for Parcels 1, 2, 4, 5, 7, the eastern portions of 12 and 12A, 13, 14, 15 and the space east of 15, 17, and 18. Parcels 13, 15 and the space east of 15, and 17 had CTE lifetime excess cancer risks within the risk management range. The remaining parcels all had CTE lifetime excess cancer risks below the risk management range. All parcels had an RME and CTE HIs less than 1.

Adult (10-year RME, 5-year CTE)

Table 18 and Plates 12, 13, 14, and 15.

Lifetime excess RME and CTE cancer risk for all of the parcels were within or below the risk management range. The space east of Parcel 15 (well W9-35) had the highest ($8.3x10^{-5}$) maximum lifetime excess cancer risk. RME lifetime excess cancer risks were within the risk management range for Parcels 1, 2, 4, 5, 7, the NE corner of 12A, 13, 14, 15 and the space east of 15, 17, and 18. CTE lifetime excess cancer risks for Parcels 1, 2, 3, 5, 13, 14, 15 and the space east of 15, 17, and 18 were within the risk management range. RME and CTE HIs for all parcels were less than 1.

Child (10-year RME, 5-year CTE)

Table 19 and Plates 16, 17, 18, and 19.

Lifetime excess RME cancer risk for Parcels 13 and 15 and the space east of Parcel 15 was above the risk management range. The space east of Parcel 15 lifetime excess cancer risk ($2x10^{-4}$ well W9-35). RME lifetime excess cancer risks were within the risk management range for Parcels 1, 2, 3, 4, 5, 6, 7, 12A, the eastern edge of 12, 14, 17, and 18. CTE lifetime excess cancer risks for Parcels 1, 2, 3, 4, 5, 7, the eastern edge of 12 and 12A, 13, 14, 15 and the space east of 15, 17, and 18 were within the risk management range. RME and CTE HIs were less than 1 for all parcels.

Default 30-year Resident

Table 20 and Plates 20, 21, and 22.

The estimated maximum lifetime excess cancer risk for the default 30-year residential receptor for Parcels 13, 14, 15 and the space east of Parcel 15, and NE corner of 17 were above the risk management range. Well W9-35, in Parcel 15, had the highest estimated lifetime excess cancer risk ($3.2x10^{-4}$). RME lifetime excess cancer risks were within the risk management range for all other parcels. For Parcels 12 and 12A, only the very eastern portions were within the risk management range. The remainders of these two parcels were below the risk management range. Both adult and child RME HIs (10 year exposure) were less than 1 for all parcels.

6.3.3 Risk Estimated from Air Measurements

Because benzene is present in ambient air, background benzene concentration, based upon the BAAQMD monitoring station in Mountain View was subtracted from the total measured benzene concentration (Table 6). In addition to benzene, background corrections (Table 6) were also applied for toluene, methylene chloride, 1,1,1-trichloroethane, tetrachloroethene (PCE), and trichloroethene (TCE). Since VC was not detected in any air sample, the risks presented for each building do not include a contribution from VC. Risks associated with these background concentrations, for each receptor, are provided in Table 26.

For the construction worker receptor risks were the result of exposure to groundwater (dermal) as well as air. Risks for all other receptors are based only on the direct air measurements. In order to account for the construction worker dermal exposure, the groundwater concentrations are based upon the maximum for each chemical for groupings of wells in closest proximity (within approximately 500' radius) to the building in question. (For GW vapor transport into buildings, each well was considered individually.) For the CTE exposure scenario, the maximum of the average of any chemical/well was used. For the RME exposure scenario, the maximum EPC for any well/chemical was used.

Construction Workers

Table 21 and Plates 4, 5, 6, and 7.

Lifetime excess RME and CTE cancer risk for all of the buildings were within the risk management range except Building 111, which was below the risk management range. CTE lifetime excess cancer risks were within the risk management range for Buildings 148, 15, 2, 476, 555, 566, 583C, 6, and Hangar 1. RME HIs were equal to or greater than 1 for Buildings 148, 15, 2, 476, 555, 566, 583C, 6, and Hangar 1. Hangar 1 had the highest RME HI (9). CTE HIs were greater than 1 for Buildings 15, 6, and Hangar 1. For most receptors, the Building 6 HI is greater than that calculated for Hangar 1. For the construction worker, the Hangar 1 HI is equal to the HI for Building 6 due to the assumption of direct dermal exposure to groundwater. As explained above, groups of groundwater wells in closest proximity to the building were used to evaluate the dermal exposure. Different wells were considered for Building 6 and Hangar 1 based upon the 500' radius from each well. The result is that for many chemicals, the groundwater concentration used to evaluate the dermal exposure was the same for these two buildings. However, for one well associated with Hangar 1, WU4-10, 1,4-dioxane was detected. None of the wells associated with Building 6 had 1,4-dioxane. Due to the 1,4-dioxane RfD, the HI for the Hangar 1 construction worker equals the HI for the Building 6 construction worker.

Indoor Workers

Table 22 and Plates 8, 9, 10, and 11.

Lifetime excess RME cancer risks for all of the buildings were within the risk management range, except Buildings 156 (2.3×10^{-4}), 566 (1.1×10^{-4}), 6 (1.5×10^{-4}) and Hangar 1 (1.7×10^{-4}) which were above the risk management range. However, Plate 8 reveals that Building 566 and 156 are located on the very edge of the known groundwater plume. Lifetime excess cancer risks estimated from the groundwater volatilization model for wells near this building were all significantly lower by about two orders of magnitude. In addition, Building 156 is located relatively close to State Highway 101. These factors seem to indicate that the measured concentrations for this building might be due to sources other than contaminated groundwater. All of the buildings had CTE lifetime excess cancer risks within or below the risk management range. RME and CTE HIs for all buildings were less than or equal to 1.

Adult (10-year RME, 5-year CTE)

Table 23 and Plates 12, 13, 14, and 15.

Lifetime excess RME cancer risks for Buildings 156, 6, and Hangar 1 were above the risk management range, however all of the remaining buildings were within the risk management range. Wells closest to Building 156 had estimated lifetime excess cancer risks based upon contaminant concentrations in the groundwater at least two orders of magnitude lower than the risk estimated for Building 156 from the measured indoor air concentrations. As discussed previously, the indoor air concentration of contaminants in Building 156 may be due to sources other than the underlying groundwater. All of the buildings had CTE lifetime excess cancer risks within the risk management range, except Building 111, which was below the risk management range. Only Building 6 had an RME HI greater than 1. CTE HIs for all buildings were less than 1.

Child (10-year RME, 5-year CTE)

Table 24 and Plates 16, 17, 18, and 19.

Lifetime excess RME cancer risks for Buildings 148, 156, 2, 21, 566, 6, and Hangar 1 were above the risk management range. Lifetime excess RME cancer risks for the remaining buildings were all within the risk management range. As previously discussed, the results for Building 21, 566, and 156 may be due to sources other than contaminated groundwater. Lifetime excess cancer risk based upon contaminant concentrations in wells closest to these buildings were all at least one order of magnitude lower than the estimate based upon the measured indoor air concentrations. All of the buildings had CTE lifetime excess cancer risks within the risk management range. Only Building 6 and Hanger 1 had RME HIs greater than or equal to 1. CTE HIs for all buildings were less than or equal to 1.

Default 30-year Resident

Table 25 and Plates 20, 21, and 22.

The estimated maximum lifetime excess cancer risk for the default 30-year residential receptor for Buildings 148, 156, 2, 21, 576, 566, 6, and Hangar 1 were all above the risk management range. RME lifetime excess cancer risks were within the risk management range for all the other buildings. As per the previous discussion, the results for Buildings 21, 156, 476, and 566 may be due to sources other than contaminated groundwater, based upon risk estimates for wells near these buildings. Only Building 6 had an Adult or Child HI greater than 1.

6.4 Soil Target Cleanup Levels

Soil TCLs were obtained from the U.S. EPA Region IX PRGs (*USEPA, 2000a*), Cal/EPA RBSLs, and the MEW ROD (*USEPA, 1989b*). These data are summarized in Table 26. For an individual chemical, the lowest soil TCL from the three data sources will be used to assess future measured soil concentrations. Use of the values selected will result in conservative soil cleanup levels to support future removal action decisions. If TCLs are less than background metals, background concentrations will be used as the TCL.

7.0 UNCERTAINTY EVALUATION

Uncertainty is inherent in many aspects of the risk assessment process. Direct measurements are not available for many of the criteria upon which the risk estimates are dependent (e.g., human exposure parameters, and the toxicity criteria used to assess the potential for adverse effects at very low dose levels). Therefore, conservative assumptions and methodologies were employed to reduce the possibility of underestimating risk. The following sections provide more detailed information on some, but not all, of the most significant areas of uncertainty.

7.1 Toxicity Criteria and Factors

Many toxicity factors used in human health risk assessments are based on animal data and, therefore, potentially overestimate risk. In most cases, the noncancer RfD is calculated using animal data for nontoxic exposures that are extrapolated to humans and the RfD is further reduced using uncertainty and modifying factors (Section 5.1). These factors provide an inherently conservative RfD. For chemicals that are classified as probable human carcinogens (i.e., lacking evidence of carcinogenicity in humans), the USEPA method for developing cancer SFs extrapolates data from high-dose animal experiments to low-dose human exposures, and thus is associated with a high potential for overestimating risk. Actual SFs could be lower but are unlikely to be higher. The linearized multistage model used to perform this extrapolation is considered conservative (Section 5.2).

For chronic and lifetime exposures, the simplifying assumption that all chemical concentrations will remain constant is employed. This assumption is likely to result in an overestimate of chronic or lifetime exposure for chemicals that biodegrade over time or are undergoing remediation.

When humans are exposed to more than one chemical in a medium, it is normally assumed that the adverse effects of the different chemicals are additive (*USEPA, 1989a*). However, in some cases synergistic or antagonistic interactions may occur. Although there are no data to suggest that synergistic or antagonistic interactions occur between the COPCs at the Site, this possibility is nevertheless a source of uncertainty in the HHRA.

7.2 Exposure Pathways and Parameters

A large part of the risk assessment is the estimation of lifetime theoretical excess cancer risks and theoretical noncancer hazards that are conditional on the occurrence of the exposure conditions analyzed. Although residential receptors were evaluated (adults and children), commercial parameters were used for the building inputs because the onsite residents would reside in dormitory-type housing that is better approximated by commercial building parameters. Although other receptors might be present at a particular parcel (e.g., utility-worker receptors), the receptors evaluated for that parcel are those associated with the highest potential exposures in terms of frequency and duration and are the most sensitive (e.g., children).

The exposure parameters (e.g., exposure frequency and duration, dermal surface area, and oral and pulmonary absorption rates) have the potential for overestimating risk. Factors used to estimate exposure are assumed applicable for all human population groups. Therefore, to minimize the possibility of underestimating risks, such factors are generally conservative and represent the portion of the population with the greatest potential for exposure. For example, the hypothetical HHRA indoor worker receptor is assumed present for 250 days of the year over a 25-year period for the RME calculation. The hypothetical RME resident is also assumed home 24 hours daily, breathing vapors that are emitted from groundwater through the soil (either indoors or outdoors). Few people, including children, are likely to be at home for 24 hours daily for the entire exposure period assumed. Consequently, the theoretical noncancer hazards and lifetime excess cancer risks are likely to be overestimated for the hypothetical receptors.

7.3 Laboratory and Sampling Results

Potential laboratory errors can also result in uncertainty in the chemical concentrations used in the exposure assessment. For well-designed analytical methods, there should be no significant systematic errors present. However, uncertainty in measured concentrations due to random errors cannot be eliminated. These random errors may result from:

- Precision of experimental measurements
- Random fluctuation in equipment performance
- Normal variation in experimental technique.

These errors are expected to be relatively small, but nonetheless will affect the overall uncertainty in the results. The contribution of these random errors to under- or overestimation of risk cannot be ascertained.

7.4 Soil Target Cleanup Levels

The soil TCLs discussed in Section 6.4 and shown in Table 26 are not based on site-specific soil characteristics or site-specific receptors. While the PRGs and RBSLs can be re-calculated employing site-specific data, it is not expected to result in significant changes in the cleanup levels shown in Table 26.

7.5 Site Air Concentration Measurements

SAIC and Harding ESE have conducted several indoor air quality investigations (*SAIC, 1999, 2000a; HLA, 2000ab; Harding ESE, 2001d*).

Comparison of the risks based upon measured air concentrations, and groundwater volatilization modeling shows after correcting for VC (groundwater) and benzene (air) that the estimated risks based upon air and groundwater are in general agreement, although, the air-based risks are almost always higher than the groundwater-based estimates. Differences between risks based upon measured air concentrations versus groundwater-modeled air concentrations may differ, in part, from the limited ability of the models to accurately predict air concentrations because of the simplifying assumptions necessary to construct the models. For indoor air concentrations, some examples of these discrepancies are: (1) differences between the building ventilation rate used in the model and the actual rate, and (2) the assumed foundation surface crack fraction available for infiltration versus the actual building value.

In addition to uncertainty resulting from model simplification, comparison of lifetime excess cancer risks based upon volatilization modeling and lifetime excess cancer risks based upon direct air measurements, is complicated by the multiple contaminant sources being detected in the air measurements. Besides the normal background chemicals measured by the BAAQMD, off gassing of contaminants from building materials, solvents, glues, toners, etc. used in buildings increases the measured concentrations above the groundwater contribution. It is not possible to adjust for these additional contaminant sources; therefore, the lifetime excess cancer risks based upon air measurements will tend to overestimate risks. For example, the BAAQMD does not measure 1,4-dioxane, which was present in most of the air samples.

Therefore, no correction for background was possible, even though it is likely that some of the 1,4-dioxane in the air samples is not from groundwater.

Risks based on measured air values must be corrected for benzene because measured air values at NRP are similar to the ambient levels measured in the Mountain View area, based upon the 1999 BAAQMD data. Ambient benzene air concentrations measured at NRP ranged from non-detect to 1.6 ppbv. Concentrations of benzene in the ambient air in Mountain View ranged from a low of 0.1 ppbv to a high of 2.80 ppbv (mean 0.65 ppbv). In addition, there were many areas where benzene was detected in the air, but not in the groundwater. Under such circumstances, the levels of benzene detected in the onsite measurements are likely normal urban airborne benzene levels.

Because the urban air in the Mountain View area appears to have relatively high levels of benzene, the lifetime incremental cancer risks to persons living or working at NRP are likely to be higher from benzene from vehicle exhausts, than from volatilization of chemicals present in the contaminated groundwater.

It should be noted that only single 8-hour outdoor samples were collected. While these samples are representative of the central tendency for this 8-hour period, there may be considerable variation: throughout a full 24-hour monitoring period, from day-to-day and additional seasonal variation. A recent paper (*Johnson, 2003*) noted that for sites involving chlorinated hydrocarbon contamination, only minor seasonal variation in air concentrations were observed. Data on diurnal variation was not available. NASA will be conducting a long term air monitoring study commencing June 30, 2003. Current plans call for the collection of both 8-hour and 24-hour samples during the work week through December, 2003. These data will be used to evaluate both the diurnal and seasonal variation in air concentrations.

7.6 Flux Measurements

Most of the chemicals detected during flux sampling were also present in the groundwater samples. In a few instances, chemicals that were not detected in the groundwater sampling were detected during the flux sampling events. For a site with uniform lithology and a single VOC groundwater contaminant, some level of correlation between the groundwater concentration and the measured flux can be expected. However, for a site as large as NRP, with complicated lithology, shallow groundwater, and its density of underground utilities, correlation between VOC groundwater concentrations and measured flux will be poor, as observed at other South Bay sites.

Other factors that will affect the correlation between groundwater and flux are the presence of small soil contaminant sources located in close proximity to the flux sample sites, and variation in capillary fringe (capillary rise) thickness due to local variation in soil properties. Variation in soil lithology can include the presence of clay layers that can retard and alter the vapor transport pathway, or soil lenses with high organic carbon content that can strongly adsorb VOCs. Use of fill, if present during construction activities, can also have a large local influence on soil vapor transport. Perturbations in lithology, whether due to natural variation or human efforts (fill or utilities), can result in either enhanced or reduced measured flux values depending on the location of the perturbation with respect to the groundwater and the site of the flux measurement.

In addition to soil- and site-specific factors, differences in chemical physical properties and the interaction of the chemicals with soil and groundwater also affect flux. Some of these factors include the chemical's Henry's constant, diffusion coefficient in air and water, solubility in water, and organic carbon absorption coefficient (K_{oc}). All of these factors, plus others, results in a complex relationship between these physical factors and the resulting surface soil flux values.

7.7 Calculation of Modeled Airborne VOC Concentrations

Indoor air concentrations were calculated from groundwater data based on assumptions about the proportion of the building foundation through which vapors could potentially migrate and building ventilation rate. Conservative assumptions were made for both of these parameters. If these assumptions are greater than actual building parameters, the resulting risks will be overestimates of the actual risk.

Outdoor air concentrations are based on a simple box model that requires assumptions about the width of the box, the height of the receptor, and wind speed. Of these three parameters, only wind speed is based on site-specific data. Width of the box (30 meters) is based on estimates of the likely distance between buildings. This value can vary depending upon the actual location of the receptor relative to the location of the buildings on site.

7.8 Volatilization Model

The volatilization model described in Section 4.7.3 is an infinite-source model that incorporates the following conservative assumptions:

- A constant chemical concentration in subsurface soil and/or groundwater.
- For groundwater sources, equilibrium partitioning between dissolved chemicals in groundwater and chemical vapors at the groundwater table.
- Steady state vapor- and liquid-phase diffusion through the capillary fringe, vadose zone, and foundation cracks.
- No loss of chemical mass as it diffuses towards the ground surface, (e.g., no biodegradation).
- Steady, well-mixed atmospheric dispersion of the emanating vapors within the enclosed space, where convective transport into the building through the foundation cracks is negligible compared to diffusive transport.

Because few site-specific parameters were available, conservative default parameters were used in most cases. These assumptions, as well as a conservative air exchange rate, may add a factor of 5 to 20 and may result in potentially overestimated indoor air concentrations.

Although different models were used to estimate ambient air and indoor air concentrations, similar assumptions were used for both models. Additional conservative assumptions used in the ambient air model include: steady, well-mixed atmospheric dispersion of the emanating vapors within the breathing zone as modeled by the “box model” for air dispersion. Site-specific parameters were used where possible; however, these models are intentionally conservative to avoid underestimating ambient air concentrations.

7.9 1,1-DCE Carcinogenicity Assessment

IRIS (*USEPA, 2001a*) lists 1,1-DCE as a Class C carcinogen.. Recently, the USEPA published an external-review draft of the toxicological review of 1,1-DCE (*USEPA, 2001b*). An external-review draft of a new IRIS summary has also been published (*USEPA, 2001c*). Both documents contain data that call into question the currently published IRIS SF for 1,1-DCE. The IRIS external review summary, resulted in withdrawal of the SF of 0.6 $(mg/kg\text{-}day)^{-1}$ for 1,1-DCE (i.e., 1,1-DCE would no longer be considered a carcinogen in risk assessments). Thus, calculation of total risk excluded 1,1-DCE. If additional information comes to light that results in re-instatement of the slope factor, then this HHRA will result in underestimation of risk for those wells and buildings where 1,1-DCE was detected. Only a small number of wells would have contributions to lifetime excess cancer risk due to 1,1-DCE greater than $1x10^{-6}$, none of which would be greater than $1x10^{-5}$. Therefore, this is not likely to have a significant impact on the overall results.

7.10 TCE Health Risk Assessment

USEPA recently evaluated the health risk from exposure to TCE. Recently, an external review draft of the *Trichloroethylene Health Risk Assessment* has been published (*USEPA, 2001d*). This assessment emphasizes the role that TCE metabolites play in both the carcinogenic and non-carcinogenic health effects and the importance of metabolites (such as trichloroethanol) that also result from exposure to chemicals other than TCE, such as PCE. Consequently, exposure to chemicals (such as alcohol) and pharmaceuticals (e.g., acetaminophen) that use the same enzymatic pathways as TCE may have important impacts on the overall toxicity of TCE to the exposed population.

In addition, new cancer risk slope factors and reference concentrations are presented in the USEPA assessment. The new cancer risk slope factor ranges from $2x10^{-1}$to $4x10^{-1}$ $(mg/kg\text{-}day)^{-1}$ for both the inhalation and oral ingestion pathways. As presented in Table 15, the inhalation cancer risk slope factor (SF_i) used in this HHRA was 0.4 $(mg/kg\text{-}day)^{-1}$. If the new slope factors are not adopted, the estimated risk due to TCE exposure in this HHRA is overestimated by a factor of 20 to 40, relative to the older value. The current SFi published in the Cal/EPA Toxicity Criteria Database (*Cal/EPA, 2001*) for TCE is $7x10^{-3}$ $(mg/kg\text{-}day)^{-1}$. USEPA is also suggesting changing the current inhalation reference concentration (RfC) from $6x10^{-3}$ mg/kg-day to $4x10^{-2}$ mg/kg-day (the value used in this HHRA). Adoption of the new RfC value means that this HHRA underestimates the potential non-carcinogenic health effects due to TCE inhalation exposures by a factor of approximately 7, if the new RfC is not adopted.

7.11 Benzene Health Risk Assessment

SFs for this assessment were compiled from Cal/EPA's Toxicity Criteria Database (*Cal/EPA, 2001*) and IRIS (*USEPA, 2001a*). For each COPC and exposure route, the higher SF from these two sources was used. The Cal/EPA Toxicity Criteria Database (*Cal/EPA, 2001*) SFo and SFi for benzene are both $1x10^{-1}$ $(mg/kg\text{-}day)^{-1}$, whereas the U.S. EPA SFo for benzene is $1.5\text{-}5.5x10^{-2}$. Use of the Cal/EPA derived slope factor could result in over estimation of benzene risk by approximately factor of 2 to 7, relative to the range of slope factors derived by the U.S. EPA. If the U.S. EPA derived SFo is used in the calculation of carcinogenic benzene risk, then uncertainty in the resulting risk spans approximately a 3-fold range (but lower than the estimated using the Cal/EPA SFo).

7.12 Factoring Out Vinyl Chloride Concentrations

Based upon review of Tables 16 to 20, factoring out the vinyl chloride concentrations from the risk calculation where it was present in the groundwater, but not flux or air samples, will have only minor impacts on the overall risks. Of the 89 wells, 29 had vinyl chloride concentrations that significantly affected the risk. Of these 29 wells, the difference between risks calculated with vinyl chloride and without vinyl chloride were less than 10% for 23 of the 29 wells. This analysis suggests that while there may be some very significant differences for some individual wells, exclusion of vinyl chloride from the final risk calculations had no material impact on the overall risk results.

8.0 SUMMARY AND CONCLUSIONS

The HHRA was conducted to evaluate risks to human health at 17 of the 19 parcels that comprise the NRP. Four parcels (9, 10, 11, and 16) were not included because: (1) concentrations of VOCs in groundwater beneath these areas were detected below regulatory criteria, and (2) hazardous materials or wastes at the four parcels, if present, do not appear to have impacted the environment (*Harding ESE, 2001c*).

The HHRA evaluated potential health risks to indoor workers, construction workers, adult residents, child residents, and a default 30 year resident (6 years child and 24 years adult).

Only the default 30-year residential receptor had multiple wells for which the estimated excess lifetime cancer risks were above $1x10^{-4}$. For the other receptors, the lifetime excess risks were mostly within the USEPA risk management range.

RME and CTE HIs for the construction worker were greater than 1 for numerous wells, based upon the groundwater volatilization model results. Appropriate use of personnel protective equipment, enforcement of applicable institutional controls, and use of soil TCLs should be sufficient to reduce exposures to acceptable levels.

In general, the lifetime excess cancer risks and HIs were highest for wells and buildings within, or just adjacent to, parcel 15. The results of the HHRA are summarized as follows:

- Maximum RME lifetime excess cancer risk for construction workers was within the USEPA risk management range ($1x10^{-6}$ to $1x10^{-4}$) based upon the groundwater volatilization modeling and direct air measurement results. The maximum estimated RME and CTE HIs for the construction worker, based upon the groundwater volatilization modeling and direct air measurements were greater than 1. This is primarily due to direct exposure to the contaminated groundwater.

- RME lifetime excess cancer risks for indoor workers, estimated from the groundwater volatilization model, were within or below the risk management range, except for one well in parcel 15 (W9-35). RME lifetime excess cancer risk estimated from the air measurements was above the risk management range (2.3E-4) for four buildings (Building 156, 566, 6 and Hangar 1), but within the risk management range for the remaining buildings. However, lifetime estimated excess cancer risks estimated from wells near Buildings 156 and 566 were all in the lower end of the risk management range. This high estimated lifetime excess cancer risk for Buildings 156 and 566 may due to sources other than contaminated groundwater (note that Building 156 is very close to highway 101) or there may be high contaminant levels in the soil or groundwater close to the building, but which are not detected in the current monitoring wells. If the results for Building 156 are considered anomalous, then Hangar 1 has the highest estimated lifetime excess cancer risk. This building is adjacent to Well W9-35, which has the highest estimated lifetime excess cancer risk based upon the groundwater volatilization modeling. This suggests that the results for Hangar 1 are associated with contaminants in the groundwater. Maximum RME HIs for indoor workers estimated from both the groundwater volatilization model and direct air measurements were less than or equal to 1 and the CTE HIs were less than 1.

- Maximum RME and CTE lifetime excess cancer risks for adult residents (10 year and 5 year exposure duration, respectively), estimated from the groundwater volatilization model, were within or below the risk management range. RME lifetime excess cancer risks estimated from the air measurements were above the risk management range for Building 156, 6, and Hangar 1 but within the risk management range for the remaining buildings. The high estimated lifetime excess cancer risk for Building 156 may due to sources other than contaminated groundwater, because the risks estimated from wells in the vicinity of this building were all below or at the low end of the risk management range. If the results for Building 156 are considered anomalous, then Hangar 1 has the highest estimated lifetime excess cancer risk. CTE lifetime excess cancer risks estimated from the air measurements were below the risk management range for Building 111, and within the risk management range for the remaining buildings. Maximum RME HIs for adult residents (10 year exposure duration) estimated from the groundwater volatilization model were less than 1. Maximum RME HIs based upon direct air measurements were greater than 1 (Building 6), but the CTE (5 year exposure duration) HIs for all buildings were less than 1.

- RME lifetime excess cancer risks for child residents (10 year exposure duration), estimated from the groundwater volatilization model, were within or below the risk management range except for two wells (W9-35 and W9-2) in parcels 15 and 13. CTE lifetime excess cancer risks for child residents (5 year exposure duration), estimated from the groundwater volatilization model, were within or below the risk management range for all parcels. RME lifetime excess cancer risk estimated from the air measurements was above the risk management range for Buildings 148, 2, 21, 566, 156, 6, and Hangar 1. As discussed previously, the results for Buildings 566, 21 and 156 may be due to sources other than groundwater contamination. However, the results for the remaining buildings appear to be associated with groundwater contaminants, based upon comparison to lifetime excess cancer risk estimated from wells near these buildings using the groundwater volatilization model. Maximum RME lifetime excess cancer risk estimated from contaminant concentrations in wells near Buildings 566, 21 and 156 were between one to two orders of magnitude lower than risks estimated from the indoor air measurements. Maximum RME (10 year exposure duration) and CTE (5 year exposure duration) HIs for child residents estimated from the groundwater volatilization model were less than 1. Maximum RME (10 year exposure duration) HIs for child residents estimated from direct air measurements were greater than 1 for Building 6, but less than or equal to 1 for the remaining buildings. Maximum CTE (5 year exposure duration) child resident HIs were less than or equal to 1 for all buildings.

- Maximum RME lifetime excess cancer risk for 30-year residents, estimated from the groundwater volatilization model, was above the risk management range. RME lifetime excess cancer risk estimated from the air measurements was also above the risk management range for Buildings 148, 156, 2, 21, 476, 566, 6, and Hangar 1. As discussed previously, the results for Buildings 566, 156, 21 and 476 may be due to sources other than groundwater contamination. The maximum excess lifetime cancer risks estimated from contaminant concentrations in wells in the vicinity of these buildings were all lower by at least one order of magnitude. However, the results for the other buildings do appear to be associated with groundwater contaminants, based upon comparison to lifetime excess cancer risk estimated from wells near these buildings using the groundwater volatilization model. Maximum adult and child HIs, estimated from both the groundwater volatilization model and direct air measurements, were greater than 1.

Based upon both the groundwater volatilization and direct air measurement results, there do appear to be some receptors (primarily construction workers, children, and the 30 year residents) with exposure to contaminants that potentially could result in adverse health effects. These exposures can be reduced to acceptable levels by using appropriate and applicable construction and HVAC technologies in existing buildings and in new construction and use of PPE by workers during construction. Institutional controls that would limit land use may also be appropriate.

As previously discussed (Sections 4.7.3.1 and 6.3.1.1), these results are lower than the results presented in the Draft Addendum HHRA dated December 16, 2003, due to changes, based upon received comments (see appendix F), in some of the input parameters for the groundwater to air volatilization model.

The Environmental Issues Management Plan (EIMP)

Although most risks estimated in the HHRA were below or within USEPA's risk management range, uncertainties in the data and in Site conditions will require the known and unexpected risks to be carefully managed. An Environmental Issues Management Plan (EIMP) is being prepared by Erler & Kalinowski, Inc. (EKI; *EKI, 2001*). This plan provides a decision framework that will be used to manage potential residual chemicals in soil and groundwater in a manner that is acceptable to NASA and the regulatory agencies, and is protective of human health and the environment. For the NRP, $1x10^{-6}$ is the acceptable lifetime excess cancer risk level.

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James C. Breitlow
Senior Principal Environmental Scientist

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TABLES

Table 1. Groundwater Wells Sampled
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Aquifer	Well Owner	Well Type	Parcel Number	Well Number	Aquifer	Well Owner	Well Type	Parcel Number
65A	A	MEW	monitoring	5	W9SC-14	A1	Navy	monitoring	15
72A	A	MEW	monitoring	2	W9SC-17	A1	Navy	monitoring	5
73A	A	MEW	monitoring	7	W9SC-7	A1	Navy	monitoring	13
74A	A	MEW	monitoring	5	WIC-1	A1	Navy	monitoring	15
75A	A	MEW	monitoring	6	WIC-10	A1	Navy	monitoring	15
81A	A	MEW	monitoring	5	WIC-11	A1	Navy	monitoring	15
82A	A	MEW	monitoring	1	WIC-12	A1	Navy	monitoring	15
88A	A	MEW	monitoring	12A	WIC-3	A1	Navy	monitoring	15
89A	A	MEW	monitoring	12A	WIC-5	A1	Navy	monitoring	15
EA1-1	A1	Navy	extraction	15	WIC-6	A1	Navy	monitoring	15
EA1-2	A1	Navy	monitoring	18	WIC-7	A1	Navy	monitoring	15
EA1-3	A1	Navy	extraction	13	WIC-8	A1	Navy	monitoring	15
EA1-5	A1	Navy	monitoring	18	WIC-9	A1	Navy	monitoring	15
REG-2A	A	MEW	extraction	2	WNX-1	A1	Navy	monitoring	5
REG-3A	A	MEW	extraction	5	WNX-3	A1	Navy	monitoring	5
REG-4A	A	MEW	extraction	5	WT14-1	A1	Navy	monitoring	8
REG-5A	A	MEW	extraction	2	WU4-1	A1	Navy	monitoring	2
REG-7A	A	MEW	extraction	12A	WU4-10	A1	Navy	monitoring	18
REG-8A	A	MEW	extraction	6	WU4-21	A1	Navy	monitoring	18
REG-9A	A	MEW	extraction	12	WU4-25	A1	Navy	monitoring	18
W14-10	A1	Navy	monitoring	19	WU4-3	A1	Navy	monitoring	5
W14-11	A1	Navy	monitoring	19	WU4-8	A1	Navy	monitoring	18
W14-12	A1	Navy	monitoring	19	WW-10A	A1	Navy	monitoring	15
W14-2	A1	Navy	monitoring	19	WW-10C	A1	Navy	monitoring	15
W14-3	A1	Navy	monitoring	19	WW-10D	A1	Navy	monitoring	15
W14-4	A1	Navy	monitoring	19	WW-11	A1	Navy	monitoring	15
W29-3	A1	Navy	monitoring	13	WW-12	A1	Navy	monitoring	15
W29-4	A1	Navy	monitoring	13	WW-13A	A1	Navy	monitoring	15
W56-2	A1	Navy	monitoring	13	WW-14	A1	Navy	monitoring	15
W89-1	A1	Navy	monitoring	4	WW-15	A1	Navy	monitoring	15
W89-2	A1	Navy	monitoring	4	WW-16A	A1	Navy	monitoring	15
W89-5	A1	Navy	monitoring	12	WW-17A	A1	Navy	monitoring	15
W89-8	A1	Navy	monitoring	12A	WW-18A	A1	Navy	monitoring	15
W89-9	A1	Navy	monitoring	12A	WW-1A	A1	Navy	monitoring	15
W9-1	A1	Navy	monitoring	13	WW-2	A1	Navy	monitoring	15
W9-16	A1	Navy	monitoring	12	WW-3	A1	Navy	monitoring	15
W9-18	A1	Navy	monitoring	15	WW-4A	A1	Navy	monitoring	15
W9-19	A1	Navy	monitoring	17	WW-5	A1	Navy	monitoring	15
W9-2	A1	Navy	monitoring	13	WW-6	A1	Navy	monitoring	15
W9-23	A1	Navy	monitoring	13	WW-7A	A1	Navy	monitoring	15
W9-35	A1	Navy	monitoring	15	WW-8A	A1	Navy	monitoring	15
W9-37	A1	Navy	monitoring	5	WW-9A	A1	Navy	monitoring	15
W9-44	A1	Navy	monitoring	17	WWR-1	A1	Navy	monitoring	18
W9-45	A1	Navy	monitoring	18	WWR-2	A1	Navy	monitoring	7
W9SC-13	A1	Navy	monitoring	13	WWR-3	A1	Navy	monitoring	5

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
65A	1,1-Dichloroethane	36	36	100%	3.10E-03	1.40E-02	9.13E-03	3.74E-03	Failed	-4.81E+00	5.18E-01	Failed	1.02E-02	1.11E-02	1.31E-02	1.31E-02	1.31E-02	Chebychev 95 UCL limit
65A	1,1-Dichloroethene	30	36	83%	5.30E-03	2.60E-02	1.54E-02	9.32E-03	Failed	-4.51E+00	9.83E-01	Failed	1.80E-02	2.64E-02	3.22E-02	3.22E-02	2.60E-02	Maximum Value
65A	cis-1,2-Dichloroethene	36	36	100%	5.00E-02	1.90E-01	1.31E-01	4.75E-02	Failed	-2.12E+00	4.56E-01	Failed	1.44E-01	1.53E-01	1.79E-01	1.79E-01	1.79E-01	Chebychev 95 UCL limit
65A	trans-1,2-Dichloroethene	4	24	17%	8.30E-03	8.30E-03	3.20E-03	2.46E-03	Failed	-6.01E+00	7.62E-01	Failed	4.06E-03	4.69E-03	5.69E-03	5.69E-03	5.69E-03	Chebychev 95 UCL limit
65A	Trichloroethene (TCE)	30	30	100%	4.20E-01	1.80E+00	1.29E+00	5.24E-01	Failed	1.40E-01	5.34E-01	Failed	1.45E+00	1.61E+00	1.92E+00	1.92E+00	1.80E+00	Maximum Value
65A	1,1,1-Trichloroethane	30	30	100%	3.70E-03	9.70E-03	7.58E-03	2.15E-03	Failed	-4.93E+00	3.42E-01	Failed	8.25E-03	8.59E-03	9.81E-03	9.81E-03	9.70E-03	Maximum Value
72A	Tetrachloroethene (PCE)	9	9	100%	6.70E-03	6.90E-03	6.83E-03	1.00E-04	Failed	-4.99E+00	1.47E-02	Failed	6.90E-03	6.90E-03	6.98E-03	6.98E-03	6.90E-03	Maximum Value
72A	Trichloroethene (TCE)	15	15	100%	1.60E-02	2.50E-02	2.03E-02	3.81E-03	Failed	-3.91E+00	1.89E-01	Failed	2.21E-02	2.23E-02	2.48E-02	2.48E-02	2.48E-02	Chebychev 95 UCL limit
72A	cis-1,2-Dichloroethene	18	18	100%	2.30E-03	3.10E-03	2.77E-03	3.50E-04	Failed	-5.90E+00	1.32E-01	Failed	2.91E-03	2.93E-03	3.15E-03	3.15E-03	3.10E-03	Maximum Value
72A	1,1-Dichloroethene	18	18	100%	1.00E-03	1.80E-03	1.40E-03	3.36E-04	Failed	-6.60E+00	2.48E-01	Failed	1.54E-03	1.57E-03	1.77E-03	1.77E-03	1.77E-03	Chebychev 95 UCL limit
72A	1,1-Dichloroethane	18	18	100%	3.80E-03	3.80E-03	3.80E-03	7.53E-11	--	-5.57E+00	1.72E-07	--	--	--	--	--	3.80E-03	Maximum Value
72A	1,1,1-Trichloroethane	15	15	100%	9.00E-04	1.00E-03	9.33E-04	4.88E-05	Failed	-6.98E+00	5.14E-02	Failed	9.56E-04	9.56E-04	9.89E-04	9.89E-04	9.89E-04	Chebychev 95 UCL limit
73A	1,1-Dichloroethane	15	15	100%	6.60E-03	2.50E-02	1.73E-02	8.48E-03	Failed	-4.21E+00	6.07E-01	Failed	2.12E-02	2.56E-02	3.06E-02	3.06E-02	2.50E-02	Maximum Value
73A	1,1-Dichloroethene	15	15	100%	1.00E-02	1.60E-02	1.32E-02	2.40E-03	Failed	-4.34E+00	1.89E-01	Failed	1.43E-02	1.45E-02	1.61E-02	1.61E-02	1.60E-02	Maximum Value
73A	cis-1,2-Dichloroethene	10	10	100%	1.50E-01	2.90E-01	2.36E-01	6.20E-02	Failed	-1.48E+00	2.88E-01	Failed	2.72E-01	2.87E-01	3.33E-01	3.33E-01	2.90E-01	Maximum Value
73A	trans-1,2-Dichloroethene	8	10	80%	2.70E-03	7.20E-03	4.22E-03	1.89E-03	Not failed	-5.56E+00	4.60E-01	Not failed	5.32E-03	5.95E-03	7.01E-03	5.32E-03	5.32E-03	Arith. 95 UCL
73A	Trichloroethene (TCE)	10	10	100%	6.20E-01	1.20E+00	8.24E-01	2.48E-01	Failed	-2.32E-01	2.87E-01	Failed	9.68E-01	9.97E-01	1.16E+00	1.16E+00	1.16E+00	Chebychev 95 UCL limit
73A	Vinyl chloride	2	10	20%	2.60E-03	2.60E-03	1.75E-03	6.07E-04	Not failed	-6.41E+00	3.65E-01	Not failed	2.10E-03	2.27E-03	2.67E-03	2.10E-03	2.10E-03	Arith. 95 UCL
73A	1,1,1-Trichloroethane	12	15	80%	4.70E-03	9.00E-03	5.76E-03	2.37E-03	Not failed	-5.26E+00	5.15E-01	Failed	6.84E-03	7.88E-03	9.45E-03	6.84E-03	6.84E-03	Arith. 95 UCL
74A	1,1,1-Trichloroethane	15	15	100%	2.40E-03	4.10E-03	3.27E-03	7.19E-04	Failed	-5.75E+00	2.28E-01	Failed	3.59E-03	3.66E-03	4.13E-03	4.13E-03	4.10E-03	Maximum Value
74A	trans-1,2-Dichloroethene	8	12	67%	7.00E-04	1.00E-03	6.50E-04	3.22E-04	Failed	-7.49E+00	6.14E-01	Failed	8.17E-04	1.03E-03	1.21E-03	1.21E-03	1.00E-03	Maximum Value
74A	Trichloroethene (TCE)	15	15	100%	7.80E-02	9.30E-02	8.70E-02	6.71E-03	Failed	-2.44E+00	7.90E-02	Failed	9.01E-02	9.03E-02	9.49E-02	9.49E-02	9.30E-02	Maximum Value
74A	1,1-Dichloroethane	18	18	100%	4.30E-03	6.30E-03	5.57E-03	9.25E-04	Failed	-5.21E+00	1.78E-01	Failed	5.95E-03	6.02E-03	6.62E-03	6.62E-03	6.30E-03	Maximum Value
74A	cis-1,2-Dichloroethene	18	18	100%	1.60E-02	2.40E-02	2.00E-02	3.36E-03	Failed	-3.93E+00	1.71E-01	Failed	2.14E-02	2.15E-02	2.36E-02	2.36E-02	2.36E-02	Chebychev 95 UCL limit
74A	1,1-Dichloroethene	18	18	100%	5.80E-03	7.80E-03	7.07E-03	9.25E-04	Failed	-4.96E+00	1.38E-01	Failed	7.45E-03	7.50E-03	8.10E-03	8.10E-03	7.80E-03	Maximum Value
75A	Vinyl chloride	12	15	80%	7.00E-04	9.00E-04	7.20E-04	1.78E-04	Failed	-7.27E+00	2.97E-01	Failed	8.01E-04	8.42E-04	9.74E-04	9.74E-04	9.00E-04	Maximum Value
75A	1,1-Dichloroethane	30	30	100%	4.20E-03	5.60E-03	4.86E-03	5.40E-04	Failed	-5.33E+00	1.12E-01	Failed	5.03E-03	5.04E-03	5.31E-03	5.31E-03	5.31E-03	Chebychev 95 UCL limit
75A	1,1-Dichloroethene	30	30	100%	1.10E-03	3.70E-03	3.02E-03	9.99E-04	Failed	-5.89E+00	4.74E-01	Failed	3.33E-03	3.67E-03	4.33E-03	4.33E-03	3.70E-03	Maximum Value
75A	cis-1,2-Dichloroethene	30	30	100%	1.50E-01	1.90E-01	1.72E-01	1.63E-02	Failed	-1.76E+00	9.52E-02	Failed	1.77E-01	1.77E-01	1.85E-01	1.85E-01	1.85E-01	Chebychev 95 UCL limit
75A	trans-1,2-Dichloroethene	20	20	100%	1.10E-03	1.30E-02	5.20E-03	5.13E-03	Failed	-5.83E+00	1.11E+00	Failed	7.18E-03	1.10E-02	1.18E-02	1.18E-02	1.18E-02	Chebychev 95 UCL limit
75A	Trichloroethene (TCE)	25	25	100%	2.90E-02	5.00E-02	4.06E-02	7.32E-03	Failed	-3.22E+00	1.91E-01	Failed	4.31E-02	4.35E-02	4.76E-02	4.76E-02	4.76E-02	Chebychev 95 UCL limit
81A	Vinyl chloride	6	9	67%	3.00E-03	4.90E-03	2.97E-03	1.69E-03	Failed	-6.01E+00	7.05E-01	Failed	4.01E-03	6.04E-03	6.31E-03	6.31E-03	4.90E-03	Maximum Value
81A	Trichloroethene (TCE)	15	15	100%	2.60E-01	5.10E-01	3.90E-01	1.06E-01	Failed	-9.79E-01	2.88E-01	Failed	4.38E-01	4.52E-01	5.22E-01	5.22E-01	5.10E-01	Maximum Value
81A	trans-1,2-Dichloroethene	12	12	100%	2.90E-03	1.20E-02	6.90E-03	3.96E-03	Failed	-5.14E+00	6.06E-01	Failed	8.96E-03	1.07E-02	1.25E-02	1.25E-02	1.20E-02	Maximum Value
81A	cis-1,2-Dichloroethene	18	18	100%	6.10E-01	9.50E-01	7.90E-01	1.44E-01	Failed	-2.52E-01	1.89E-01	Failed	8.49E-01	8.58E-01	9.48E-01	9.48E-01	9.48E-01	Chebychev 95 UCL limit
81A	1,1-Dichloroethane	18	18	100%	4.50E-02	6.00E-02	5.20E-02	6.34E-03	Failed	-2.96E+00	1.21E-01	Failed	5.46E-02	5.48E-02	5.87E-02	5.87E-02	5.87E-02	Chebychev 95 UCL limit
81A	1,1-Dichloroethene	18	18	100%	3.60E-02	6.20E-02	5.20E-02	1.18E-02	Failed	-2.98E+00	2.49E-01	Failed	5.68E-02	5.82E-02	6.59E-02	6.59E-02	6.20E-02	Maximum Value
82A	Tetrachloroethene (PCE)	15	15	100%	1.60E-03	1.10E-02	6.68E-03	4.05E-03	Failed	-5.25E+00	7.86E-01	Failed	8.52E-03	1.19E-02	1.37E-02	1.37E-02	1.10E-02	Maximum Value
82A	1,1-Dichloroethane	30	30	100%	2.80E-03	2.50E-02	1.45E-02	8.47E-03	Failed	-4.50E+00	8.36E-01	Failed	1.71E-02	2.24E-02	2.73E-02	2.73E-02	2.50E-02	Maximum Value
82A	Trichloroethene (TCE)	25	25	100%	3.00E-01	2.40E+00	1.48E+00	8.60E-01	Failed	1.39E-01	8.18E-01	Failed	1.78E+00	2.35E+00	2.85E+00	2.85E+00	2.40E+00	Maximum Value
82A	trans-1,2-Dichloroethene	4	20	20%	1.60E-02	1.60E-02	5.16E-03	5.79E-03	Failed	-5.89E+00	1.18E+00	Failed	7.40E-03	1.19E-02	1.24E-02	1.24E-02	1.24E-02	Chebychev 95 UCL limit
82A	Chloroform	4	10	40%	2.20E-03	2.50E-03	3.20E-03	1.03E-03	Failed	-5.79E+00	2.95E-01	Not failed	3.79E-03	3.89E-03	4.53E-03	3.89E-03	3.89E-03	Land 95 UCL
82A	1,1-Dichloroethene	30	30	100%	3.90E-03	2.70E-02	1.68E-02	9.29E-03	Failed	-4.31E+00	7.47E-01	Failed	1.97E-02	2.40E-02	2.93E-02	2.93E-02	2.70E-02	Maximum Value
82A	cis-1,2-Dichloroethene	30	30	100%	4.90E-02	2.00E-01	1.18E-01	5.78E-02	Failed	-2.28E+00	5.57E-01	Failed	1.36E-01	1.47E-01	1.76E-01	1.76E-01	1.76E-01	Chebychev 95 UCL limit
88A	1,2-Dichloroethane	3	3	100%	1.60E-03	1.70E-03	1.67E-03	5.77E-05	Failed	-6.40E+00	3.50E-02	Failed	1.76E-03	1.77E-03	1.82E-03	1.82E-03	1.70E-03	Maximum Value
88A	cis-1,2-Dichloroethene	4	12	33%	5.00E-04	5.00E-04	3.33E-04	1.23E-04	Failed	-8.06E+00	3.41E-01	Failed	3.97E-04	4.09E-04	4.80E-04	4.80E-04	4.80E-04	Chebychev 95 UCL limit
88A	Trichloroethene (TCE)	12	12	100%	2.30E-02	2.80E-02	2.57E-02	2.15E-03	Failed	-3.67E+00	8.47E-02	Failed	2.68E-02	2.69E-02	2.85E-02	2.85E-02	2.80E-02	Maximum Value
89A	1,1,1-Trichloroethane	6	15	40%	1.80E-03	1.80E-03	1.19E-03	5.21E-04	Failed	-6.82E+00	4.38E-01	Failed	1.43E-03	1.51E-03	1.80E-03	1.80E-03	1.80E-03	Maximum Value

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
89A	1,1-Dichloroethane	15	15	100%	8.10E-03	1.10E-02	9.88E-03	1.14E-03	Failed	-4.62E+00	1.19E-01	Failed	1.04E-02	1.05E-02	1.12E-02	1.12E-02	1.10E-02	Maximum Value
89A	1,1-Dichloroethene	15	15	100%	6.80E-03	1.20E-02	9.84E-03	2.00E-03	Failed	-4.64E+00	2.19E-01	Failed	1.08E-02	1.10E-02	1.24E-02	1.24E-02	1.20E-02	Maximum Value
89A	cis-1,2-Dichloroethene	20	20	100%	6.30E-02	1.50E-01	1.07E-01	2.99E-02	Failed	-2.28E+00	3.00E-01	Failed	1.18E-01	1.22E-01	1.39E-01	1.39E-01	1.39E-01	Chebychev 95 UCL limit
89A	Freon 113	4	10	40%	1.10E-02	1.80E-02	1.01E-02	4.51E-03	Failed	-4.67E+00	4.02E-01	Failed	1.27E-02	1.34E-02	1.58E-02	1.58E-02	1.58E-02	Chebychev 95 UCL limit
89A	trans-1,2-Dichloroethene	15	15	100%	1.50E-03	7.00E-03	2.90E-03	2.16E-03	Failed	-6.03E+00	5.90E-01	Failed	3.88E-03	4.01E-03	4.80E-03	4.80E-03	4.80E-03	Chebychev 95 UCL limit
89A	Trichloroethene (TCE)	20	20	100%	2.70E-01	4.30E-01	3.68E-01	5.52E-02	Failed	-1.01E+00	1.63E-01	Failed	3.89E-01	3.94E-01	4.29E-01	4.29E-01	4.29E-01	Chebychev 95 UCL limit
EA1-1	Tetrachloroethene (PCE)	2	2	100%	4.10E-02	1.00E-01	7.05E-02	4.17E-02	--	-2.75E+00	6.30E-01	--	--	--	--	--	1.00E-01	Maximum Value
EA1-1	Trichloroethene (TCE)	2	2	100%	1.70E-01	6.72E-01	4.21E-01	3.55E-01	--	-1.08E+00	9.72E-01	--	--	--	--	--	6.72E-01	Maximum Value
EA1-1	1,1-Dichloroethene	2	2	100%	3.90E-02	6.00E-02	4.95E-02	1.48E-02	--	-3.03E+00	3.05E-01	--	--	--	--	--	6.00E-02	Maximum Value
EA1-1	1,1-Dichloroethane	1	2	50%	3.20E-02	3.20E-02	2.85E-02	4.95E-03	--	-3.57E+00	1.75E-01	--	--	--	--	--	3.20E-02	Maximum Value
EA1-1	cis-1,2-Dichloroethene	2	2	100%	1.97E+00	2.69E+00	2.33E+00	5.09E-01	--	8.34E-01	2.20E-01	--	--	--	--	--	2.69E+00	Maximum Value
EA1-2	1,1,1-Trichloroethane	6	6	100%	9.00E-03	1.00E-02	9.50E-03	5.48E-04	Failed	-4.66E+00	5.77E-02	Failed	9.95E-03	9.98E-03	1.05E-02	1.05E-02	1.00E-02	Maximum Value
EA1-2	1,1-Dichloroethene	6	6	100%	1.80E-02	2.00E-02	1.90E-02	1.10E-03	Failed	-3.96E+00	5.77E-02	Failed	1.99E-02	2.00E-02	2.10E-02	2.10E-02	2.00E-02	Maximum Value
EA1-2	cis-1,2-Dichloroethene	8	8	100%	1.60E-01	1.68E-01	1.64E-01	4.28E-03	Failed	-1.81E+00	2.61E-02	Failed	1.67E-01	1.67E-01	1.71E-01	1.71E-01	1.68E-01	Maximum Value
EA1-2	Trichloroethene (TCE)	8	8	100%	7.25E-01	7.40E-01	7.33E-01	8.02E-03	Failed	-3.11E-01	1.09E-02	Failed	7.38E-01	7.38E-01	7.45E-01	7.45E-01	7.40E-01	Maximum Value
EA1-3	Freon 113	2	2	100%	3.50E-02	1.00E-01	6.75E-02	4.60E-02	--	-2.83E+00	7.42E-01	--	--	--	--	--	1.00E-01	Maximum Value
EA1-3	Trichloroethene (TCE)	2	2	100%	1.80E+00	2.93E+00	2.37E+00	7.99E-01	--	8.31E-01	3.45E-01	--	--	--	--	--	2.93E+00	Maximum Value
EA1-3	cis-1,2-Dichloroethene	2	2	100%	4.10E-01	5.06E-01	4.58E-01	6.79E-02	--	-7.86E-01	1.49E-01	--	--	--	--	--	5.06E-01	Maximum Value
EA1-3	1,1-Dichloroethene	2	2	100%	3.70E-02	5.40E-02	4.55E-02	1.20E-02	--	-3.11E+00	2.67E-01	--	--	--	--	--	5.40E-02	Maximum Value
EA1-5	trans-1,2-Dichloroethene	8	8	100%	1.70E-02	2.70E-02	2.20E-02	5.35E-03	Failed	-3.84E+00	2.47E-01	Failed	2.56E-02	2.66E-02	3.06E-02	3.06E-02	2.70E-02	Maximum Value
EA1-5	Trichloroethene (TCE)	8	8	100%	3.70E-02	8.00E-02	5.85E-02	2.30E-02	Failed	-2.91E+00	4.12E-01	Failed	7.39E-02	8.36E-02	9.70E-02	9.70E-02	8.00E-02	Maximum Value
EA1-5	Vinyl chloride	4	4	100%	2.20E-01	2.44E-01	2.32E-01	1.39E-02	Failed	-1.46E+00	5.98E-02	Failed	2.48E-01	2.50E-01	2.63E-01	2.63E-01	2.44E-01	Maximum Value
EA1-5	cis-1,2-Dichloroethene	8	8	100%	4.52E-01	6.65E-01	5.59E-01	1.14E-01	Failed	-6.01E-01	2.06E-01	Failed	6.35E-01	6.52E-01	7.41E-01	7.41E-01	6.65E-01	Maximum Value
REG-2A	Tetrachloroethene (PCE)	6	15	40%	5.70E-03	6.90E-03	3.99E-03	2.03E-03	Failed	-5.65E+00	5.14E-01	Failed	4.91E-03	5.36E-03	6.42E-03	6.42E-03	6.42E-03	Chebychev 95 UCL limit
REG-2A	1,1-Dichloroethane	12	30	40%	5.50E-03	1.10E-02	4.77E-03	3.41E-03	Failed	-5.56E+00	6.44E-01	Failed	5.83E-03	6.05E-03	7.33E-03	7.33E-03	7.33E-03	Chebychev 95 UCL limit
REG-2A	Vinyl chloride	3	15	20%	2.30E-03	2.30E-03	2.43E-03	4.03E-04	Failed	-6.03E+00	1.56E-01	Failed	2.61E-03	2.62E-03	2.87E-03	2.87E-03	2.87E-03	Chebychev 95 UCL limit
REG-2A	Trichloroethene (TCE)	25	25	100%	9.10E-01	1.60E+00	1.22E+00	2.63E-01	Failed	1.75E-01	2.16E-01	Failed	1.31E+00	1.32E+00	1.46E+00	1.46E+00	1.46E+00	Chebychev 95 UCL limit
REG-2A	trans-1,2-Dichloroethene	16	20	80%	1.60E-03	2.60E-02	9.46E-03	9.14E-03	Failed	-5.13E+00	1.03E+00	Failed	1.30E-02	1.86E-02	2.08E-02	2.08E-02	2.08E-02	Chebychev 95 UCL limit
REG-2A	cis-1,2-Dichloroethene	30	30	100%	1.30E-01	3.20E-01	1.88E-01	6.91E-02	Failed	-1.72E+00	3.16E-01	Failed	2.09E-01	2.08E-01	2.36E-01	2.36E-01	2.36E-01	Chebychev 95 UCL limit
REG-2A	1,1,1-Trichloroethane	10	25	40%	4.70E-03	6.00E-03	3.61E-03	1.56E-03	Failed	-5.71E+00	4.31E-01	Failed	4.14E-03	4.28E-03	5.04E-03	5.04E-03	5.04E-03	Chebychev 95 UCL limit
REG-2A	1,1-Dichloroethene	24	30	80%	5.10E-03	1.20E-02	6.67E-03	3.02E-03	Failed	-5.11E+00	4.45E-01	Failed	7.61E-03	7.82E-03	9.17E-03	9.17E-03	9.17E-03	Chebychev 95 UCL limit
REG-2A	1,2-Dichlorobenzene	1	5	20%	1.20E-03	1.20E-03	2.21E-03	7.09E-04	Not failed	-6.16E+00	3.56E-01	Not failed	2.89E-03	3.53E-03	3.79E-03	2.89E-03	2.89E-03	Arith. 95 UCL
REG-2A	Freon 113	2	10	20%	8.80E-03	8.80E-03	2.15E-02	7.80E-03	Not failed	-3.92E+00	4.56E-01	Failed	2.60E-02	3.05E-02	3.60E-02	2.60E-02	2.60E-02	Arith. 95 UCL
REG-3A	1,1-Dichloroethene	30	30	100%	1.10E-02	2.10E-02	1.74E-02	3.67E-03	Failed	-4.08E+00	2.39E-01	Failed	1.85E-02	1.89E-02	2.09E-02	2.09E-02	2.09E-02	Chebychev 95 UCL limit
REG-3A	Vinyl chloride	3	15	20%	1.70E-03	1.70E-03	2.12E-03	3.49E-04	Failed	-6.17E+00	1.66E-01	Failed	2.28E-03	2.30E-03	2.53E-03	2.53E-03	2.50E-03	Maximum Value
REG-3A	Trichloroethene (TCE)	25	25	100%	8.60E-01	1.30E+00	1.07E+00	1.47E-01	Failed	6.04E-02	1.38E-01	Failed	1.12E+00	1.13E+00	1.20E+00	1.20E+00	1.20E+00	Chebychev 95 UCL limit
REG-3A	trans-1,2-Dichloroethene	16	20	80%	1.90E-03	1.90E-02	7.02E-03	6.47E-03	Failed	-5.35E+00	9.01E-01	Failed	9.52E-03	1.19E-02	1.39E-02	1.39E-02	1.39E-02	Chebychev 95 UCL limit
REG-3A	Tetrachloroethene (PCE)	3	15	20%	2.20E-03	2.20E-03	2.22E-03	2.73E-04	Failed	-6.12E+00	1.27E-01	Failed	2.34E-03	2.36E-03	2.55E-03	2.55E-03	2.50E-03	Maximum Value
REG-3A	cis-1,2-Dichloroethene	30	30	100%	1.40E-01	2.00E-01	1.68E-01	2.17E-02	Failed	-1.79E+00	1.29E-01	Failed	1.75E-01	1.75E-01	1.86E-01	1.86E-01	1.86E-01	Chebychev 95 UCL limit
REG-3A	1,1-Dichloroethane	30	30	100%	8.30E-03	1.30E-02	1.06E-02	1.69E-03	Failed	-4.56E+00	1.61E-01	Failed	1.12E-02	1.12E-02	1.20E-02	1.20E-02	1.20E-02	Chebychev 95 UCL limit
REG-3A	1,1,1-Trichloroethane	20	25	80%	5.70E-03	7.20E-03	5.64E-03	1.69E-03	Failed	-5.24E+00	3.92E-01	Failed	6.22E-03	6.65E-03	7.76E-03	7.76E-03	7.20E-03	Maximum Value
REG-3A	Freon 113	2	10	20%	1.20E-02	1.20E-02	2.02E-02	5.14E-03	Failed	-3.94E+00	2.87E-01	Failed	2.32E-02	2.45E-02	2.85E-02	2.85E-02	2.50E-02	Maximum Value
REG-4A	trans-1,2-Dichloroethene	4	20	20%	1.40E-02	1.40E-02	7.80E-03	3.44E-03	Failed	-4.93E+00	3.96E-01	Failed	9.13E-03	9.26E-03	1.09E-02	1.09E-02	1.09E-02	Chebychev 95 UCL limit
REG-4A	1,1,1-Trichloroethane	5	25	20%	8.00E-03	8.00E-03	6.60E-03	1.49E-03	Failed	-5.05E+00	2.29E-01	Failed	7.11E-03	7.18E-03	7.97E-03	7.97E-03	7.97E-03	Chebychev 95 UCL limit
REG-4A	Trichloroethene (TCE)	25	25	100%	1.60E+00	3.80E+00	2.50E+00	7.42E-01	Failed	8.76E-01	2.86E-01	Failed	2.75E+00	2.78E+00	3.14E+00	3.14E+00	3.14E+00	Chebychev 95 UCL limit
REG-4A	cis-1,2-Dichloroethene	30	30	100%	1.70E-01	2.70E-01	2.10E-01	3.70E-02	Failed	-1.58E+00	1.71E-01	Failed	2.21E-01	2.22E-01	2.39E-01	2.39E-01	2.39E-01	Chebychev 95 UCL limit
REG-4A	1,1-Dichloroethane	30	30	100%	1.90E-02	4.20E-02	2.76E-02	8.02E-03	Failed	-3.63E+00	2.71E-01	Failed	3.01E-02	3.02E-02	3.37E-02	3.37E-02	3.37E-02	Chebychev 95 UCL limit

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
REG-4A	1,1-Dichloroethene	30	30	100%	1.50E-02	7.40E-02	3.86E-02	2.01E-02	Failed	-3.39E+00	5.28E-01	Failed	4.48E-02	4.71E-02	5.62E-02	5.62E-02	5.62E-02	Chebychev 95 UCL limit
REG-5A	1,1,1-Trichloroethane	5	25	20%	6.30E-03	6.30E-03	5.50E-03	1.80E-03	Failed	-5.25E+00	3.15E-01	Failed	6.12E-03	6.19E-03	7.07E-03	7.07E-03	7.07E-03	Chebychev 95 UCL limit
REG-5A	1,1-Dichloroethane	30	30	100%	2.20E-02	3.00E-02	2.50E-02	2.80E-03	Failed	-3.69E+00	1.08E-01	Failed	2.59E-02	2.59E-02	2.72E-02	2.72E-02	2.72E-02	Chebychev 95 UCL limit
REG-5A	1,1-Dichloroethene	30	30	100%	1.00E-02	3.90E-02	2.40E-02	9.52E-03	Failed	-3.82E+00	4.53E-01	Failed	2.70E-02	2.85E-02	3.35E-02	3.35E-02	3.35E-02	Chebychev 95 UCL limit
REG-5A	cis-1,2-Dichloroethene	30	30	100%	1.40E-01	2.30E-01	1.70E-01	3.22E-02	Failed	-1.79E+00	1.75E-01	Failed	1.80E-01	1.80E-01	1.94E-01	1.94E-01	1.94E-01	Chebychev 95 UCL limit
REG-5A	Tetrachloroethene (PCE)	12	15	80%	1.00E-02	1.40E-02	1.09E-02	1.86E-03	Failed	-4.53E+00	1.68E-01	Failed	1.17E-02	1.18E-02	1.30E-02	1.30E-02	1.30E-02	Chebychev 95 UCL limit
REG-5A	trans-1,2-Dichloroethene	8	20	40%	9.00E-03	1.40E-02	8.01E-03	3.73E-03	Failed	-4.94E+00	4.93E-01	Failed	9.45E-03	1.01E-02	1.21E-02	1.21E-02	1.21E-02	Chebychev 95 UCL limit
REG-5A	Trichloroethene (TCE)	25	25	100%	1.70E+00	3.20E+00	2.32E+00	5.64E-01	Failed	8.14E-01	2.37E-01	Failed	2.51E+00	2.53E+00	2.81E+00	2.81E+00	2.81E+00	Chebychev 95 UCL limit
REG-7A	Tetrachloroethene (PCE)	1	5	20%	1.00E-03	1.00E-03	1.07E-03	1.75E-04	Not failed	-6.85E+00	1.66E-01	Not failed	1.24E-03	1.28E-03	1.42E-03	1.24E-03	1.24E-03	Arith. 95 UCL
REG-7A	Vinyl chloride	2	10	20%	9.00E-04	9.00E-04	1.05E-03	1.80E-04	Failed	-6.87E+00	1.70E-01	Failed	1.15E-03	1.17E-03	1.30E-03	1.30E-03	1.25E-03	Maximum Value
REG-7A	Trichloroethene (TCE)	20	20	100%	4.50E-01	7.50E-01	6.38E-01	1.13E-01	Failed	-4.66E-01	1.93E-01	Failed	6.82E-01	6.91E-01	7.62E-01	7.62E-01	7.50E-01	Maximum Value
REG-7A	trans-1,2-Dichloroethene	15	15	100%	2.00E-03	1.70E-02	9.74E-03	5.72E-03	Failed	-4.86E+00	7.90E-01	Failed	1.23E-02	1.76E-02	2.02E-02	2.02E-02	1.70E-02	Maximum Value
REG-7A	cis-1,2-Dichloroethene	20	20	100%	1.50E-01	1.70E-01	1.58E-01	1.01E-02	Failed	-1.85E+00	6.29E-02	Failed	1.62E-01	1.62E-01	1.68E-01	1.68E-01	1.68E-01	Chebychev 95 UCL limit
REG-7A	1,1-Dichloroethene	15	15	100%	2.40E-03	1.80E-02	1.23E-02	5.49E-03	Failed	-4.59E+00	7.59E-01	Failed	1.48E-02	2.20E-02	2.56E-02	2.56E-02	1.80E-02	Maximum Value
REG-7A	1,1-Dichloroethane	15	15	100%	9.10E-03	1.30E-02	1.14E-02	1.37E-03	Failed	-4.48E+00	1.26E-01	Failed	1.20E-02	1.21E-02	1.31E-02	1.31E-02	1.30E-02	Maximum Value
REG-7A	1,1,1-Trichloroethane	6	15	40%	2.10E-03	2.20E-03	1.53E-03	5.46E-04	Failed	-6.54E+00	3.70E-01	Failed	1.78E-03	1.87E-03	2.20E-03	2.20E-03	2.20E-03	Chebychev 95 UCL limit
REG-7A	Freon 113	2	10	20%	1.60E-02	1.60E-02	1.19E-02	2.70E-03	Not failed	-4.45E+00	2.28E-01	Not failed	1.35E-02	1.38E-02	1.57E-02	1.35E-02	1.35E-02	Arith. 95 UCL
REG-8A	Trichloroethene (TCE)	25	25	100%	1.90E-01	5.40E-01	4.38E-01	1.29E-01	Failed	-8.88E-01	3.97E-01	Failed	4.82E-01	5.19E-01	6.06E-01	6.06E-01	5.40E-01	Maximum Value
REG-8A	1,1-Dichloroethane	30	30	100%	4.50E-03	7.00E-03	5.46E-03	8.79E-04	Failed	-5.22E+00	1.54E-01	Failed	5.73E-03	5.74E-03	6.15E-03	6.15E-03	6.15E-03	Chebychev 95 UCL limit
REG-8A	1,1-Dichloroethene	30	30	100%	2.90E-03	1.00E-02	6.12E-03	2.32E-03	Failed	-5.17E+00	4.03E-01	Failed	6.84E-03	7.09E-03	8.23E-03	8.23E-03	8.23E-03	Chebychev 95 UCL limit
REG-8A	cis-1,2-Dichloroethene	30	30	100%	1.80E-01	4.90E-01	2.60E-01	1.18E-01	Failed	-1.42E+00	3.67E-01	Failed	2.97E-01	2.92E-01	3.36E-01	3.36E-01	3.36E-01	Chebychev 95 UCL limit
REG-8A	trans-1,2-Dichloroethene	20	20	100%	6.70E-03	2.00E-02	1.25E-02	5.95E-03	Failed	-4.49E+00	4.74E-01	Failed	1.48E-02	1.55E-02	1.85E-02	1.85E-02	1.85E-02	Chebychev 95 UCL limit
REG-9A	Trichloroethene (TCE)	20	20	100%	2.00E-01	3.30E-01	2.68E-01	5.44E-02	Failed	-1.34E+00	2.12E-01	Failed	2.89E-01	2.93E-01	3.25E-01	3.25E-01	3.25E-01	Chebychev 95 UCL limit
REG-9A	trans-1,2-Dichloroethene	9	15	60%	9.00E-04	2.70E-03	1.11E-03	8.45E-04	Failed	-7.02E+00	6.50E-01	Failed	1.49E-03	1.63E-03	1.94E-03	1.94E-03	1.94E-03	Chebychev 95 UCL limit
REG-9A	cis-1,2-Dichloroethene	20	20	100%	6.80E-03	3.70E-02	1.49E-02	1.15E-02	Failed	-4.41E+00	6.03E-01	Failed	1.93E-02	1.95E-02	2.35E-02	2.35E-02	2.35E-02	Chebychev 95 UCL limit
REG-9A	1,1-Dichloroethene	15	15	100%	2.30E-03	5.60E-03	3.20E-03	1.26E-03	Failed	-5.80E+00	3.32E-01	Failed	3.78E-03	3.78E-03	4.42E-03	4.42E-03	4.42E-03	Chebychev 95 UCL limit
REG-9A	1,1,1-Trichloroethane	3	15	20%	7.00E-04	7.00E-04	5.30E-04	1.29E-04	Failed	-7.57E+00	2.44E-01	Failed	5.89E-04	5.99E-04	6.80E-04	6.80E-04	6.80E-04	Chebychev 95 UCL limit
REG-9A	1,1-Dichloroethane	15	15	100%	1.40E-03	2.70E-03	1.98E-03	4.74E-04	Not failed	-6.25E+00	2.40E-01	Not failed	2.20E-03	2.23E-03	2.53E-03	2.20E-03	2.20E-03	Arith. 95 UCL
W14-10	Benzene	1	1	100%	6.00E-03	6.00E-03	6.00E-03	--	--	-5.12E+00	--	--	--	--	--	--	6.00E-03	Maximum Value
W14-10	Ethylbenzene	1	1	100%	6.00E-04	6.00E-04	6.00E-04	--	--	-7.42E+00	--	--	--	--	--	--	6.00E-04	Maximum Value
W14-10	Xylenes	1	1	100%	1.00E-03	1.00E-03	1.00E-03	--	--	-6.91E+00	--	--	--	--	--	--	1.00E-03	Maximum Value
W14-11	Benzene	2	2	100%	9.00E-02	9.20E-02	9.10E-02	1.41E-03	--	-2.40E+00	1.55E-02	--	--	--	--	--	9.20E-02	Maximum Value
W14-11	Xylenes	2	2	100%	4.00E-03	8.00E-03	6.00E-03	2.83E-03	--	-5.17E+00	4.90E-01	--	--	--	--	--	8.00E-03	Maximum Value
W14-11	Ethylbenzene	2	2	100%	4.00E-03	4.00E-03	4.00E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.00E-03	Maximum Value
W14-12	Benzene	1	1	100%	1.60E-02	1.60E-02	1.60E-02	--	--	-4.14E+00	--	--	--	--	--	--	1.60E-02	Maximum Value
W14-12	Ethylbenzene	1	1	100%	2.00E-03	2.00E-03	2.00E-03	--	--	-6.21E+00	--	--	--	--	--	--	2.00E-03	Maximum Value
W14-12	Toluene	1	1	100%	2.00E-04	2.00E-04	2.00E-04	--	--	-8.52E+00	--	--	--	--	--	--	2.00E-04	Maximum Value
W14-12	Xylenes	1	1	100%	2.00E-03	2.00E-03	2.00E-03	--	--	-6.21E+00	--	--	--	--	--	--	2.00E-03	Maximum Value
W14-2	Benzene	1	1	100%	1.60E-02	1.60E-02	1.60E-02	--	--	-4.14E+00	--	--	--	--	--	--	1.60E-02	Maximum Value
W14-2	Toluene	1	1	100%	4.00E-04	4.00E-04	4.00E-04	--	--	-7.82E+00	--	--	--	--	--	--	4.00E-04	Maximum Value
W14-3	1,1-Dichloroethene	6	18	33%	6.00E-04	6.00E-04	3.67E-04	1.70E-04	Failed	-8.00E+00	4.25E-01	Failed	4.36E-04	4.48E-04	5.31E-04	5.31E-04	5.31E-04	Chebychev 95 UCL limit
W14-3	cis-1,2-Dichloroethene	18	18	100%	7.00E-04	1.10E-03	9.33E-04	1.75E-04	Failed	-6.99E+00	2.00E-01	Failed	1.00E-03	1.02E-03	1.13E-03	1.13E-03	1.10E-03	Maximum Value
W14-3	1,1-Dichloroethane	18	18	100%	1.10E-03	1.40E-03	1.27E-03	1.28E-04	Failed	-6.68E+00	1.04E-01	Failed	1.32E-03	1.32E-03	1.41E-03	1.41E-03	1.40E-03	Maximum Value
W29-3	1,1-Dichloroethene	4	4	100%	3.00E-02	6.40E-02	4.68E-02	1.40E-02	Not failed	-3.10E+00	3.14E-01	Not failed	6.33E-02	7.92E-02	7.94E-02	6.33E-02	6.33E-02	Arith. 95 UCL
W29-3	cis-1,2-Dichloroethene	4	4	100%	4.80E-01	1.80E+00	1.12E+00	6.34E-01	Not failed	-3.01E-02	6.30E-01	Not failed	1.86E+00	5.82E+00	2.65E+00	1.86E+00	1.80E+00	Maximum Value
W29-3	Freon 113	4	4	100%	3.00E-02	8.00E-02	5.38E-02	2.29E-02	Not failed	-3.00E+00	4.47E-01	Not failed	8.07E-02	1.33E-01	1.07E-01	8.07E-02	8.00E-02	Maximum Value
W29-3	Tetrachloroethene (PCE)	4	4	100%	1.60E-02	3.00E-02	2.13E-02	6.08E-03	Not failed	-3.88E+00	2.66E-01	Not failed	2.84E-02	3.22E-02	3.38E-02	2.84E-02	2.84E-02	Arith. 95 UCL

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
W29-3	trans-1,2-Dichloroethene	1	4	25%	1.00E-02	1.00E-02	1.78E-02	1.39E-02	Failed	-4.21E+00	6.45E-01	Failed	3.41E-02	9.66E-02	4.13E-02	4.13E-02	3.85E-02	Maximum Value
W29-3	Trichloroethene (TCE)	4	4	100%	1.60E+00	2.85E+00	2.00E+00	5.91E-01	Not failed	6.63E-01	2.72E-01	Not failed	2.69E+00	3.07E+00	3.20E+00	2.69E+00	2.69E+00	Arith. 95 UCL
W29-3	1,1-Dichloroethane	2	4	50%	1.70E-02	1.90E-02	2.18E-02	1.15E-02	Not failed	-3.92E+00	4.76E-01	Not failed	3.53E-02	5.87E-02	4.41E-02	3.53E-02	3.53E-02	Arith. 95 UCL
W29-4	Freon 113	3	4	75%	1.00E-02	1.30E-02	1.08E-02	1.50E-03	Failed	-4.54E+00	1.31E-01	Failed	1.25E-02	1.28E-02	1.39E-02	1.39E-02	1.30E-02	Maximum Value
W29-4	trans-1,2-Dichloroethene	1	4	25%	4.00E-03	4.00E-03	7.63E-03	5.34E-03	Not failed	-5.10E+00	7.98E-01	Not failed	1.39E-02	1.01E-01	2.07E-02	1.39E-02	1.39E-02	Arith. 95 UCL
W29-4	Trichloroethene (TCE)	4	4	100%	3.20E-02	1.30E-01	6.10E-02	4.67E-02	Failed	-2.98E+00	6.54E-01	Not failed	1.16E-01	3.49E-01	1.44E-01	3.49E-01	1.30E-01	Maximum Value
W29-4	1,1-Dichloroethene	4	4	100%	2.20E-02	6.90E-02	4.13E-02	2.09E-02	Not failed	-3.28E+00	5.02E-01	Not failed	6.58E-02	1.23E-01	8.65E-02	6.58E-02	6.58E-02	Arith. 95 UCL
W29-4	1,1-Dichloroethane	4	4	100%	2.20E-02	4.50E-02	3.23E-02	1.00E-02	Not failed	-3.47E+00	3.11E-01	Not failed	4.41E-02	5.41E-02	5.45E-02	4.41E-02	4.41E-02	Arith. 95 UCL
W29-4	cis-1,2-Dichloroethene	4	4	100%	6.50E-01	1.20E+00	8.77E-01	2.45E-01	Not failed	-1.59E-01	2.72E-01	Not failed	1.17E+00	1.35E+00	1.41E+00	1.17E+00	1.17E+00	Arith. 95 UCL
W56-2	trans-1,2-Dichloroethene	1	4	25%	3.00E-03	3.00E-03	1.58E-02	2.32E-02	Not failed	-5.43E+00	2.23E+00	Not failed	4.31E-02	8.08E+06	8.64E-02	4.31E-02	4.31E-02	Arith. 95 UCL
W56-2	Trichloroethene (TCE)	4	4	100%	7.50E-03	2.00E+00	6.16E-01	9.45E-01	Not failed	-2.31E+00	2.68E+00	Not failed	1.73E+00	1.95E+12	3.38E+00	1.73E+00	1.73E+00	Arith. 95 UCL
W56-2	Freon 113	2	4	50%	2.00E-02	4.80E-02	1.96E-02	2.06E-02	Not failed	-4.96E+00	2.31E+00	Not failed	4.38E-02	6.02E+07	1.52E-01	4.38E-02	4.38E-02	Arith. 95 UCL
W56-2	cis-1,2-Dichloroethene	4	4	100%	2.10E-02	8.80E-01	4.25E-01	4.54E-01	Not failed	-1.83E+00	1.90E+00	Not failed	9.59E-01	8.87E+05	2.11E+00	9.59E-01	8.80E-01	Maximum Value
W56-2	Benzene	1	2	50%	1.00E-03	1.00E-03	2.55E-02	3.46E-02	--	-4.95E+00	2.77E+00	--	--	--	--	--	1.00E-03	Maximum Value
W56-2	1,1-Dichloroethene	2	4	50%	1.60E-02	2.00E-02	2.16E-02	2.08E-02	Not failed	-4.83E+00	2.36E+00	Not failed	4.60E-02	1.72E+08	1.82E-01	4.60E-02	4.60E-02	Arith. 95 UCL
W56-2	1,1-Dichloroethane	1	4	25%	8.00E-03	8.00E-03	1.71E-02	2.24E-02	Not failed	-5.18E+00	2.23E+00	Not failed	4.34E-02	9.89E+06	1.10E-01	4.34E-02	4.34E-02	Arith. 95 UCL
W56-2	1,1,1-Trichloroethane	1	4	25%	4.00E-03	4.00E-03	1.61E-02	2.30E-02	Not failed	-5.35E+00	2.22E+00	Not failed	4.31E-02	6.93E+06	9.15E-02	4.31E-02	4.31E-02	Arith. 95 UCL
W56-2	Vinyl chloride	2	4	50%	6.00E-04	4.10E-02	2.34E-02	2.58E-02	Not failed	-4.96E+00	2.21E+00	Not failed	5.37E-02	7.78E+06	1.34E-01	5.37E-02	5.00E-02	Maximum Value
W89-1	1,1-Dichloroethane	18	18	100%	3.60E-03	8.30E-03	5.47E-03	2.10E-03	Failed	-5.27E+00	3.63E-01	Failed	6.33E-03	6.47E-03	7.58E-03	7.58E-03	7.58E-03	Chebychev 95 UCL limit
W89-1	1,1-Dichloroethene	18	18	100%	3.90E-03	8.70E-03	5.73E-03	2.18E-03	Failed	-5.22E+00	3.56E-01	Failed	6.63E-03	6.76E-03	7.90E-03	7.90E-03	7.90E-03	Chebychev 95 UCL limit
W89-1	cis-1,2-Dichloroethene	18	18	100%	2.80E-02	5.80E-02	3.87E-02	1.41E-02	Failed	-3.31E+00	3.38E-01	Failed	4.44E-02	4.51E-02	5.25E-02	5.25E-02	5.25E-02	Chebychev 95 UCL limit
W89-1	trans-1,2-Dichloroethene	12	12	100%	1.50E-02	2.20E-02	1.80E-02	3.07E-03	Failed	-4.03E+00	1.67E-01	Failed	1.96E-02	1.97E-02	2.19E-02	2.19E-02	2.19E-02	Chebychev 95 UCL limit
W89-1	Trichloroethene (TCE)	15	15	100%	3.50E-01	4.60E-01	4.10E-01	4.71E-02	Failed	-8.98E-01	1.18E-01	Failed	4.31E-01	4.34E-01	4.66E-01	4.66E-01	4.60E-01	Maximum Value
W89-2	1,1-Dichloroethane	18	18	100%	5.00E-04	4.50E-03	3.00E-03	1.83E-03	Failed	-6.18E+00	1.04E+00	Failed	3.75E-03	7.03E-03	7.59E-03	7.59E-03	4.50E-03	Maximum Value
W89-2	Vinyl chloride	3	9	33%	1.20E-03	1.20E-03	5.67E-04	4.75E-04	Failed	-7.77E+00	7.84E-01	Failed	8.61E-04	1.24E-03	1.21E-03	1.21E-03	1.20E-03	Maximum Value
W89-2	Trichloroethene (TCE)	15	15	100%	5.40E-03	1.00E-01	6.71E-02	4.52E-02	Failed	-3.29E+00	1.41E+00	Failed	8.77E-02	3.74E-01	2.58E-01	2.58E-01	1.00E-01	Maximum Value
W89-2	trans-1,2-Dichloroethene	8	12	67%	5.00E-04	7.00E-04	4.83E-04	1.92E-04	Failed	-7.72E+00	4.48E-01	Failed	5.83E-04	6.50E-04	7.73E-04	7.73E-04	7.00E-04	Maximum Value
W89-2	1,1,1-Trichloroethane	10	15	67%	5.00E-04	7.00E-04	4.83E-04	1.91E-04	Failed	-7.72E+00	4.44E-01	Failed	5.70E-04	6.22E-04	7.42E-04	7.42E-04	7.00E-04	Maximum Value
W89-2	1,1-Dichloroethene	12	18	67%	1.50E-03	2.70E-03	1.48E-03	1.03E-03	Failed	-6.90E+00	1.04E+00	Failed	1.91E-03	3.41E-03	3.68E-03	3.68E-03	2.70E-03	Maximum Value
W89-2	cis-1,2-Dichloroethene	18	18	100%	6.00E-04	7.30E-03	4.93E-03	3.16E-03	Failed	-5.77E+00	1.20E+00	Failed	6.23E-03	1.50E-02	1.46E-02	1.46E-02	7.30E-03	Maximum Value
W89-5	1,1-Dichloroethane	12	12	100%	5.00E-04	1.00E-03	7.50E-04	1.88E-04	Not failed	-7.23E+00	2.62E-01	Not failed	8.48E-04	8.75E-04	1.01E-03	8.48E-04	8.48E-04	Arith. 95 UCL
W89-5	1,1-Dichloroethene	12	12	100%	1.00E-03	1.40E-03	1.23E-03	1.54E-04	Failed	-6.71E+00	1.31E-01	Failed	1.31E-03	1.32E-03	1.43E-03	1.43E-03	1.40E-03	Maximum Value
W89-5	cis-1,2-Dichloroethene	16	16	100%	1.80E-03	2.40E-03	2.00E-03	2.53E-04	Failed	-6.22E+00	1.21E-01	Failed	2.11E-03	2.11E-03	2.27E-03	2.27E-03	2.27E-03	Chebychev 95 UCL limit
W89-5	Trichloroethene (TCE)	16	16	100%	8.60E-02	1.10E-01	1.01E-01	1.04E-02	Failed	-2.30E+00	1.06E-01	Failed	1.05E-01	1.06E-01	1.13E-01	1.13E-01	1.10E-01	Maximum Value
W89-8	cis-1,2-Dichloroethene	8	12	67%	1.10E-03	1.60E-03	9.83E-04	5.82E-04	Failed	-7.18E+00	8.37E-01	Failed	1.29E-03	2.10E-03	2.23E-03	2.23E-03	1.60E-03	Maximum Value
W89-8	1,1-Dichloroethane	3	9	33%	7.00E-04	7.00E-04	4.00E-04	2.25E-04	Failed	-7.95E+00	5.15E-01	Failed	5.39E-04	6.11E-04	7.04E-04	7.04E-04	7.00E-04	Maximum Value
W89-9	Vinyl chloride	8	8	100%	1.00E-03	3.00E-03	1.90E-03	9.29E-04	Failed	-6.38E+00	5.19E-01	Failed	2.52E-03	3.10E-03	3.48E-03	3.48E-03	3.00E-03	Maximum Value
W89-9	Trichloroethene (TCE)	16	16	100%	1.00E-01	2.50E-01	1.63E-01	5.81E-02	Failed	-1.88E+00	3.50E-01	Failed	1.88E-01	1.94E-01	2.27E-01	2.27E-01	2.27E-01	Chebychev 95 UCL limit
W89-9	trans-1,2-Dichloroethene	12	12	100%	9.00E-04	2.80E-03	1.65E-03	7.55E-04	Failed	-6.50E+00	4.42E-01	Not failed	2.04E-03	2.19E-03	2.60E-03	2.19E-03	2.19E-03	Land 95 UCL
W89-9	cis-1,2-Dichloroethene	16	16	100%	5.80E-02	3.40E-01	1.65E-01	1.11E-01	Failed	-2.02E+00	6.70E-01	Failed	2.13E-01	2.46E-01	2.94E-01	2.94E-01	2.94E-01	Chebychev 95 UCL limit
W89-9	1,1-Dichloroethane	12	12	100%	2.90E-03	5.70E-03	4.30E-03	1.23E-03	Failed	-5.49E+00	2.95E-01	Failed	4.94E-03	5.13E-03	5.96E-03	5.96E-03	5.70E-03	Maximum Value
W89-9	1,1-Dichloroethene	12	12	100%	2.50E-03	5.40E-03	4.23E-03	1.29E-03	Failed	-5.52E+00	3.35E-01	Failed	4.90E-03	5.19E-03	6.09E-03	6.09E-03	5.40E-03	Maximum Value
W9-1	1,1-Dichloroethane	2	6	33%	3.40E-02	3.40E-02	6.38E-02	5.72E-02	Failed	-3.04E+00	7.94E-01	Not failed	1.11E-01	2.24E-01	1.50E-01	2.24E-01	1.65E-01	Maximum Value
W9-1	Trichloroethene (TCE)	6	6	100%	2.18E+00	5.00E+00	3.82E+00	9.68E-01	Not failed	1.31E+00	2.89E-01	Not failed	4.61E+00	5.13E+00	5.85E+00	4.61E+00	4.61E+00	Arith. 95 UCL
W9-1	Freon 113	5	6	83%	7.00E-02	1.20E-01	8.33E-02	3.38E-02	Not failed	-2.59E+00	5.71E-01	Not failed	1.11E-01	1.81E-01	1.75E-01	1.11E-01	1.11E-01	Arith. 95 UCL
W9-1	cis-1,2-Dichloroethene	6	6	100%	2.50E-01	3.50E-01	3.00E-01	4.00E-02	Not failed	-1.21E+00	1.34E-01	Not failed	3.33E-01	3.38E-01	3.73E-01	3.33E-01	3.33E-01	Arith. 95 UCL
W9-1	1,1-Dichloroethene	3	6	50%	5.00E-02	6.20E-02	7.67E-02	4.96E-02	Not failed	-2.74E+00	6.40E-01	Not failed	1.17E-01	1.88E-01	1.66E-01	1.17E-01	1.17E-01	Arith. 95 UCL

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
W9-16	Vinyl chloride	8	8	100%	9.40E-03	3.20E-02	1.71E-02	9.56E-03	Failed	-4.19E+00	5.05E-01	Not failed	2.35E-02	2.70E-02	3.06E-02	2.70E-02	2.70E-02	Land 95 UCL
W9-16	1,1,1-Trichloroethane	9	12	75%	1.90E-03	5.30E-03	2.59E-03	1.66E-03	Failed	-6.11E+00	5.56E-01	Failed	3.45E-03	3.74E-03	4.42E-03	4.42E-03	4.42E-03	Chebychev 95 UCL limit
W9-16	1,1-Dichloroethane	12	12	100%	1.40E-02	1.60E-02	1.55E-02	9.05E-04	Failed	-4.17E+00	6.04E-02	Failed	1.60E-02	1.60E-02	1.67E-02	1.67E-02	1.60E-02	Maximum Value
W9-16	1,1-Dichloroethene	12	12	100%	8.40E-03	1.10E-02	9.80E-03	9.69E-04	Failed	-4.63E+00	1.01E-01	Failed	1.03E-02	1.04E-02	1.11E-02	1.11E-02	1.10E-02	Maximum Value
W9-16	cis-1,2-Dichloroethene	16	16	100%	3.90E-02	5.50E-02	4.98E-02	6.59E-03	Failed	-3.01E+00	1.43E-01	Failed	5.26E-02	5.32E-02	5.77E-02	5.77E-02	5.50E-02	Maximum Value
W9-16	trans-1,2-Dichloroethene	3	12	25%	2.00E-03	2.00E-03	1.34E-03	4.34E-04	Failed	-6.66E+00	3.17E-01	Failed	1.56E-03	1.62E-03	1.89E-03	1.89E-03	1.89E-03	Chebychev 95 UCL limit
W9-16	Trichloroethene (TCE)	16	16	100%	4.60E-01	6.80E-01	5.53E-01	8.43E-02	Failed	-6.04E-01	1.49E-01	Failed	5.89E-01	5.92E-01	6.44E-01	6.44E-01	6.44E-01	Chebychev 95 UCL limit
W9-18	cis-1,2-Dichloroethene	4	4	100%	7.58E+00	1.90E+01	1.47E+01	4.95E+00	Not failed	2.63E+00	4.13E-01	Not failed	2.05E+01	3.27E+01	2.83E+01	2.05E+01	1.90E+01	Maximum Value
W9-18	Ethylbenzene	1	2	50%	3.30E-02	3.30E-02	2.67E-01	3.30E-01	--	-2.05E+00	1.92E+00	--	--	--	--	--	3.30E-02	Maximum Value
W9-18	Tetrachloroethene (PCE)	1	4	25%	2.80E-02	2.80E-02	1.70E-01	2.22E-01	Failed	-2.39E+00	1.25E+00	Not failed	4.31E-01	7.48E+01	5.40E-01	7.48E+01	5.00E-01	Maximum Value
W9-18	Toluene	1	2	50%	4.50E-02	4.50E-02	2.73E-01	3.22E-01	--	-1.90E+00	1.70E+00	--	--	--	--	--	4.50E-02	Maximum Value
W9-18	trans-1,2-Dichloroethene	1	4	25%	9.40E-02	9.40E-02	1.86E-01	2.11E-01	Failed	-2.09E+00	9.82E-01	Not failed	4.34E-01	8.24E+00	5.29E-01	8.24E+00	5.00E-01	Maximum Value
W9-18	Vinyl chloride	3	4	75%	1.30E-01	5.30E-01	4.03E-01	1.85E-01	Not failed	-1.04E+00	6.69E-01	Failed	6.20E-01	2.62E+00	1.02E+00	6.20E-01	5.30E-01	Maximum Value
W9-18	1,4-Dichlorobenzene	1	4	25%	3.50E-02	3.50E-02	1.71E-01	2.21E-01	Failed	-2.34E+00	1.18E+00	Not failed	4.31E-01	3.94E+01	5.26E-01	3.94E+01	5.00E-01	Maximum Value
W9-18	Xylenes	1	2	50%	9.50E-02	9.50E-02	2.98E-01	2.86E-01	--	-1.52E+00	1.17E+00	--	--	--	--	--	9.50E-02	Maximum Value
W9-18	Trichloroethene (TCE)	1	4	25%	5.10E-02	5.10E-02	1.75E-01	2.18E-01	Failed	-2.24E+00	1.08E+00	Not failed	4.31E-01	1.70E+01	5.13E-01	1.70E+01	5.00E-01	Maximum Value
W9-18	1,1,2,2-Tetrachloroethane	1	4	25%	3.60E-02	3.60E-02	1.72E-01	2.21E-01	Failed	-2.33E+00	1.17E+00	Not failed	4.31E-01	3.66E+01	5.24E-01	3.66E+01	5.00E-01	Maximum Value
W9-18	1,3-Dichlorobenzene	1	4	25%	3.50E-02	3.50E-02	1.71E-01	2.21E-01	Failed	-2.34E+00	1.18E+00	Not failed	4.31E-01	3.94E+01	5.26E-01	3.94E+01	5.00E-01	Maximum Value
W9-18	1,2-Dichloropropane	1	4	25%	3.40E-02	3.40E-02	1.71E-01	2.21E-01	Failed	-2.34E+00	1.19E+00	Not failed	4.31E-01	4.25E+01	5.27E-01	4.25E+01	5.00E-01	Maximum Value
W9-18	1,2-Dichloroethane	1	4	25%	5.30E-02	5.30E-02	1.63E-01	2.25E-01	Failed	-2.41E+00	1.14E+00	Failed	4.27E-01	2.55E+01	4.69E-01	4.69E-01	4.69E-01	Chebychev 95 UCL limit
W9-18	1,2-Dichlorobenzene	1	4	25%	3.50E-02	3.50E-02	1.71E-01	2.21E-01	Failed	-2.34E+00	1.18E+00	Not failed	4.31E-01	3.94E+01	5.26E-01	3.94E+01	5.00E-01	Maximum Value
W9-18	1,1-Dichloroethene	3	4	75%	1.40E-01	2.30E-01	1.60E-01	8.37E-02	Not failed	-1.99E+00	7.09E-01	Not failed	2.58E-01	1.29E+00	4.16E-01	2.58E-01	2.30E-01	Maximum Value
W9-18	1,1-Dichloroethane	1	4	25%	8.10E-02	8.10E-02	1.83E-01	2.13E-01	Failed	-2.13E+00	9.98E-01	Not failed	4.33E-01	9.13E+00	5.20E-01	9.13E+00	5.00E-01	Maximum Value
W9-18	1,1,2-Trichloroethane	1	4	25%	3.30E-02	3.30E-02	1.71E-01	2.21E-01	Failed	-2.35E+00	1.20E+00	Not failed	4.31E-01	4.62E+01	5.29E-01	4.62E+01	5.00E-01	Maximum Value
W9-18	Benzene	1	2	50%	3.80E-02	3.80E-02	2.69E-01	3.27E-01	--	-1.98E+00	1.82E+00	--	--	--	--	--	3.80E-02	Maximum Value
W9-18	Chlorobenzene	1	4	25%	3.30E-02	3.30E-02	1.71E-01	2.21E-01	Failed	-2.35E+00	1.20E+00	Not failed	4.31E-01	4.62E+01	5.29E-01	4.62E+01	5.00E-01	Maximum Value
W9-19	Vinyl chloride	3	3	100%	9.00E-03	1.20E-02	1.05E-02	1.50E-03	Not failed	-4.56E+00	1.44E-01	Not failed	1.30E-02	1.42E-02	1.44E-02	1.30E-02	1.20E-02	Maximum Value
W9-19	Trichloroethene (TCE)	3	3	100%	2.60E-03	2.70E-02	1.25E-02	1.28E-02	Not failed	-4.80E+00	1.17E+00	Not failed	3.41E-02	5.10E+03	4.47E-02	3.41E-02	2.70E-02	Maximum Value
W9-19	trans-1,2-Dichloroethene	2	3	67%	6.00E-04	7.00E-04	2.10E-03	2.51E-03	Failed	-6.66E+00	1.18E+00	Not failed	6.33E-03	1.03E+03	7.06E-03	1.03E+03	5.00E-03	Maximum Value
W9-19	cis-1,2-Dichloroethene	3	3	100%	3.20E-02	1.80E-01	9.48E-02	7.65E-02	Not failed	-2.59E+00	8.64E-01	Not failed	2.24E-01	1.06E+02	2.88E-01	2.24E-01	1.80E-01	Maximum Value
W9-19	1,1-Dichloroethene	3	3	100%	2.40E-03	1.40E-02	6.87E-03	6.24E-03	Not failed	-5.26E+00	9.01E-01	Not failed	1.74E-02	1.40E+01	2.09E-02	1.74E-02	1.40E-02	Maximum Value
W9-19	1,1-Dichloroethane	3	3	100%	8.70E-03	2.40E-02	1.39E-02	8.78E-03	Failed	-4.40E+00	5.79E-01	Failed	2.87E-02	3.20E-01	3.34E-02	3.34E-02	2.40E-02	Maximum Value
W9-2	Trichloroethene (TCE)	4	4	100%	4.04E+00	5.70E+00	4.99E+00	7.64E-01	Not failed	1.60E+00	1.58E-01	Not failed	5.88E+00	6.20E+00	6.74E+00	5.88E+00	5.70E+00	Maximum Value
W9-2	1,1-Dichloroethene	3	4	75%	6.00E-02	7.40E-02	9.18E-02	4.92E-02	Failed	-2.48E+00	4.58E-01	Not failed	1.50E-01	2.32E-01	1.82E-01	2.32E-01	1.65E-01	Maximum Value
W9-2	1,1-Dichloroethane	1	4	25%	3.90E-02	3.90E-02	6.98E-02	6.43E-02	Not failed	-2.93E+00	8.07E-01	Not failed	1.45E-01	9.35E-01	1.83E-01	1.45E-01	1.45E-01	Arith. 95 UCL
W9-2	Freon 113	4	4	100%	7.00E-02	1.20E-01	9.28E-02	2.20E-02	Not failed	-2.40E+00	2.36E-01	Not failed	1.19E-01	1.33E-01	1.42E-01	1.19E-01	1.19E-01	Arith. 95 UCL
W9-2	cis-1,2-Dichloroethene	4	4	100%	2.10E-01	3.80E-01	2.83E-01	7.80E-02	Not failed	-1.29E+00	2.73E-01	Not failed	3.74E-01	4.35E-01	4.54E-01	3.74E-01	3.74E-01	Arith. 95 UCL
W9-23	1,1-Dichloroethane	2	4	50%	4.10E-02	4.20E-02	3.64E-02	1.64E-02	Not failed	-3.44E+00	6.37E-01	Failed	5.57E-02	2.01E-01	8.89E-02	5.57E-02	5.00E-02	Maximum Value
W9-23	1,1-Dichloroethene	4	4	100%	2.20E-02	7.10E-02	5.18E-02	2.10E-02	Not failed	-3.05E+00	5.24E-01	Not failed	7.64E-02	1.71E-01	1.13E-01	7.64E-02	7.10E-02	Maximum Value
W9-23	cis-1,2-Dichloroethene	4	4	100%	2.40E-01	2.20E+00	1.18E+00	1.02E+00	Not failed	-2.48E-01	1.13E+00	Not failed	2.37E+00	1.92E+02	3.99E+00	2.37E+00	2.20E+00	Maximum Value
W9-23	Trichloroethene (TCE)	3	4	75%	5.60E-02	2.24E+00	9.24E-01	1.07E+00	Not failed	-1.19E+00	2.03E+00	Not failed	2.18E+00	1.34E+07	4.63E+00	2.18E+00	2.18E+00	Arith. 95 UCL
W9-23	Vinyl chloride	1	4	25%	1.60E-02	1.60E-02	2.40E-02	1.92E-02	Not failed	-4.03E+00	9.67E-01	Not failed	4.66E-02	1.05E+00	7.45E-02	4.66E-02	4.66E-02	Arith. 95 UCL
W9-35	Tetrachloroethene (PCE)	4	4	100%	7.10E-02	1.60E-01	1.01E-01	4.04E-02	Not failed	-2.34E+00	3.61E-01	Not failed	1.49E-01	1.92E-01	1.81E-01	1.49E-01	1.49E-01	Arith. 95 UCL
W9-35	Trichloroethene (TCE)	4	4	100%	2.20E+00	9.00E+00	5.35E+00	2.89E+00	Not failed	1.55E+00	5.97E-01	Not failed	8.75E+00	2.40E+01	1.24E+01	8.75E+00	8.75E+00	Arith. 95 UCL
W9-35	Freon 113	3	4	75%	7.30E-02	1.70E-01	1.29E-01	6.58E-02	Not failed	-2.15E+00	5.39E-01	Not failed	2.06E-01	4.47E-01	2.81E-01	2.06E-01	2.00E-01	Maximum Value
W9-35	cis-1,2-Dichloroethene	4	4	100%	1.90E-01	3.70E-01	2.85E-01	7.42E-02	Not failed	-1.28E+00	2.78E-01	Not failed	3.72E-01	4.45E-01	4.62E-01	3.72E-01	3.70E-01	Maximum Value
W9-35	1,1-Dichloroethene	1	4	25%	5.40E-02	5.40E-02	9.73E-02	8.33E-02	Not failed	-2.80E+00	1.32E+00	Not failed	1.95E-01	1.08E+02	3.90E-01	1.95E-01	1.95E-01	Arith. 95 UCL

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
W9-37	Trichloroethene (TCE)	20	20	100%	3.09E-01	3.40E+00	2.42E+00	1.28E+00	Failed	5.57E-01	1.03E+00	Failed	2.92E+00	5.52E+00	6.16E+00	6.16E+00	3.40E+00	Maximum Value
W9-37	1,1-Dichloroethane	12	24	50%	9.00E-03	2.90E-02	4.08E-02	3.58E-02	Failed	-3.56E+00	8.73E-01	Failed	5.33E-02	6.38E-02	7.67E-02	7.67E-02	7.67E-02	Chebychev 95 UCL limit
W9-37	1,1-Dichloroethene	12	24	50%	1.00E-02	5.00E-02	4.63E-02	3.49E-02	Failed	-3.40E+00	8.70E-01	Failed	5.85E-02	7.48E-02	8.99E-02	8.99E-02	8.99E-02	Chebychev 95 UCL limit
W9-37	cis-1,2-Dichloroethene	24	24	100%	3.24E-01	5.70E-01	3.96E-01	1.03E-01	Failed	-9.54E-01	2.33E-01	Failed	4.32E-01	4.31E-01	4.80E-01	4.80E-01	4.80E-01	Chebychev 95 UCL limit
W9-37	Freon 113	4	8	50%	6.00E-03	4.60E-02	4.43E-02	3.76E-02	Not failed	-3.55E+00	1.10E+00	Not failed	6.94E-02	2.45E-01	1.32E-01	6.94E-02	6.94E-02	Arith. 95 UCL
W9-37	Methylene chloride	1	4	25%	6.20E-02	6.20E-02	4.38E-02	4.57E-02	Not failed	-3.80E+00	1.48E+00	Not failed	9.76E-02	2.81E+02	1.75E-01	9.76E-02	9.76E-02	Arith. 95 UCL
W9-37	1,1,1-Trichloroethane	5	20	25%	1.30E-02	1.30E-02	3.58E-02	3.88E-02	Failed	-3.91E+00	1.12E+00	Failed	5.07E-02	7.60E-02	8.13E-02	8.13E-02	8.13E-02	Chebychev 95 UCL limit
W9-44	cis-1,2-Dichloroethene	6	6	100%	2.10E-01	4.60E-01	3.52E-01	1.05E-01	Not failed	-1.09E+00	3.30E-01	Not failed	4.38E-01	4.98E-01	5.65E-01	4.38E-01	4.38E-01	Arith. 95 UCL
W9-44	Trichloroethene (TCE)	6	6	100%	2.15E+00	3.70E+00	3.06E+00	6.17E-01	Not failed	1.10E+00	2.16E-01	Not failed	3.56E+00	3.76E+00	4.26E+00	3.56E+00	3.56E+00	Arith. 95 UCL
W9-44	Tetrachloroethene (PCE)	2	6	33%	6.00E-03	6.00E-03	3.87E-02	3.69E-02	Failed	-3.76E+00	1.19E+00	Not failed	6.90E-02	5.93E-01	1.25E-01	5.93E-01	8.50E-02	Maximum Value
W9-44	Freon 113	5	6	83%	2.10E-02	6.30E-02	4.42E-02	1.82E-02	Not failed	-3.20E+00	4.70E-01	Not failed	5.91E-02	7.77E-02	8.25E-02	5.91E-02	5.91E-02	Arith. 95 UCL
W9-44	1,1-Dichloroethene	4	6	67%	3.30E-02	6.70E-02	5.25E-02	2.20E-02	Not failed	-3.03E+00	4.53E-01	Not failed	7.06E-02	8.96E-02	9.63E-02	7.06E-02	7.06E-02	Arith. 95 UCL
W9-44	1,1,1-Trichloroethane	2	6	33%	1.10E-02	1.20E-02	4.05E-02	3.50E-02	Failed	-3.54E+00	9.03E-01	Not failed	6.93E-02	2.03E-01	1.05E-01	2.03E-01	8.50E-02	Maximum Value
W9-44	1,1-Dichloroethane	2	6	33%	3.40E-02	3.70E-02	4.85E-02	2.87E-02	Failed	-3.16E+00	5.64E-01	Not failed	7.21E-02	1.00E-01	9.76E-02	1.00E-01	8.50E-02	Maximum Value
W9-44	Carbon tetrachloride	1	6	17%	2.40E-02	2.40E-02	3.95E-02	3.59E-02	Failed	-3.63E+00	1.01E+00	Not failed	6.90E-02	2.85E-01	1.11E-01	2.85E-01	8.50E-02	Maximum Value
W9-45	cis-1,2-Dichloroethene	4	4	100%	1.52E-01	2.20E-01	1.86E-01	2.81E-02	Not failed	-1.69E+00	1.53E-01	Not failed	2.19E-01	2.29E-01	2.49E-01	2.19E-01	2.19E-01	Arith. 95 UCL
W9-45	Trichloroethene (TCE)	4	4	100%	4.23E-01	5.00E-01	4.64E-01	3.69E-02	Not failed	-7.70E-01	8.01E-02	Not failed	5.07E-01	5.14E-01	5.47E-01	5.07E-01	5.00E-01	Maximum Value
W9-45	trans-1,2-Dichloroethene	1	4	25%	9.00E-04	9.00E-04	5.73E-03	6.09E-03	Not failed	-5.63E+00	1.17E+00	Not failed	1.29E-02	1.33E+00	1.92E-02	1.29E-02	1.29E-02	Arith. 95 UCL
W9-45	Freon 113	3	4	75%	9.00E-03	1.50E-02	9.75E-03	4.11E-03	Not failed	-4.70E+00	4.54E-01	Not failed	1.46E-02	2.46E-02	1.95E-02	1.46E-02	1.46E-02	Arith. 95 UCL
W9-45	1,1-Dichloroethene	4	4	100%	1.80E-02	2.20E-02	2.05E-02	1.73E-03	Not failed	-3.89E+00	8.76E-02	Not failed	2.25E-02	2.29E-02	2.45E-02	2.25E-02	2.20E-02	Maximum Value
W9-45	1,1-Dichloroethane	3	4	75%	1.00E-02	1.30E-02	1.19E-02	2.25E-03	Not failed	-4.45E+00	1.88E-01	Not failed	1.45E-02	1.55E-02	1.69E-02	1.45E-02	1.45E-02	Maximum Value
W9-45	1,1,1-Trichloroethane	2	4	50%	4.00E-03	6.00E-03	6.75E-03	5.36E-03	Not failed	-5.22E+00	7.46E-01	Not failed	1.31E-02	6.40E-02	1.73E-02	1.31E-02	1.31E-02	Arith. 95 UCL
W9-45	Tetrachloroethene (PCE)	1	4	25%	1.00E-03	1.00E-03	5.75E-03	6.06E-03	Not failed	-5.61E+00	1.13E+00	Not failed	1.29E-02	9.13E-01	1.88E-02	1.29E-02	1.29E-02	Arith. 95 UCL
W9SC-13	Toluene	1	4	25%	9.00E-03	9.00E-03	1.09E-02	7.18E-03	Not failed	-4.86E+00	1.13E+00	Not failed	1.93E-02	2.05E+00	4.01E-02	1.93E-02	1.65E-02	Maximum Value
W9SC-13	Trichloroethene (TCE)	3	4	75%	3.00E-03	1.30E-02	8.00E-03	4.40E-03	Not failed	-4.97E+00	6.46E-01	Not failed	1.32E-02	4.55E-02	1.94E-02	1.32E-02	1.30E-02	Maximum Value
W9SC-13	1,1-Dichloroethene	4	4	100%	2.00E-02	3.10E-02	2.63E-02	5.19E-03	Not failed	-3.66E+00	2.05E-01	Not failed	3.24E-02	3.54E-02	3.83E-02	3.24E-02	3.10E-02	Maximum Value
W9SC-13	trans-1,2-Dichloroethene	3	4	75%	3.00E-02	1.10E-01	5.51E-02	4.81E-02	Not failed	-3.56E+00	1.71E+00	Not failed	1.12E-01	7.88E+03	2.94E-01	1.12E-01	1.10E-01	Maximum Value
W9SC-13	Vinyl chloride	4	4	100%	2.10E-02	9.40E-02	5.53E-02	3.92E-02	Not failed	-3.13E+00	8.21E-01	Not failed	1.01E-01	8.47E-01	1.53E-01	1.01E-01	9.40E-02	Maximum Value
W9SC-13	1,2-Dichloroethane	3	4	75%	4.00E-03	9.00E-03	8.88E-03	5.48E-03	Not failed	-4.86E+00	6.05E-01	Not failed	1.53E-02	4.07E-02	2.04E-02	1.53E-02	1.53E-02	Arith. 95 UCL
W9SC-13	1,1-Dichloroethane	4	4	100%	3.50E-02	5.40E-02	4.40E-02	7.87E-03	Not failed	-3.14E+00	1.79E-01	Not failed	5.33E-02	5.67E-02	6.16E-02	5.33E-02	5.33E-02	Arith. 95 UCL
W9SC-13	cis-1,2-Dichloroethene	3	3	100%	6.03E-01	8.20E-01	7.03E-01	1.10E-01	Not failed	-3.61E-01	1.54E-01	Not failed	8.87E-01	9.81E-01	9.82E-01	8.87E-01	8.20E-01	Maximum Value
W9SC-13	Benzene	4	4	100%	9.00E-03	3.50E-02	1.70E-02	1.21E-02	Failed	-4.23E+00	5.99E-01	Not failed	3.12E-02	7.46E-02	3.83E-02	7.46E-02	3.50E-02	Maximum Value
W9SC-14	Freon 113	1	4	25%	1.00E-02	1.00E-02	2.24E-02	8.52E-03	Not failed	-3.88E+00	4.92E-01	Failed	3.24E-02	6.53E-02	4.71E-02	3.24E-02	2.95E-02	Maximum Value
W9SC-14	Vinyl chloride	3	4	75%	5.00E-02	1.60E-01	8.53E-02	5.19E-02	Not failed	-2.58E+00	5.50E-01	Not failed	1.46E-01	3.06E-01	1.86E-01	1.46E-01	1.46E-01	Arith. 95 UCL
W9SC-14	Trichloroethene (TCE)	4	4	100%	2.20E-01	1.82E+00	9.70E-01	6.58E-01	Not failed	-2.72E-01	8.91E-01	Not failed	1.74E+00	2.45E+01	2.91E+00	1.74E+00	1.74E+00	Arith. 95 UCL
W9SC-14	trans-1,2-Dichloroethene	1	4	25%	2.00E-03	2.00E-03	2.04E-02	1.24E-02	Not failed	-4.28E+00	1.29E+00	Failed	3.50E-02	1.88E+01	8.66E-02	3.50E-02	2.95E-02	Maximum Value
W9SC-14	Methylene chloride	1	4	25%	2.70E-02	2.70E-02	2.49E-02	1.56E-02	Not failed	-4.04E+00	1.19E+00	Failed	4.33E-02	8.09E+00	9.70E-02	4.33E-02	4.00E-02	Maximum Value
W9SC-14	cis-1,2-Dichloroethene	4	4	100%	4.20E-01	3.34E+00	1.50E+00	1.32E+00	Not failed	9.73E-02	9.19E-01	Not failed	3.06E+00	4.41E+01	4.35E+00	3.06E+00	3.06E+00	Arith. 95 UCL
W9SC-14	1,1-Dichloroethene	2	4	50%	2.20E-02	1.00E-01	4.41E-02	3.74E-02	Failed	-3.33E+00	6.97E-01	Not failed	8.81E-02	3.12E-01	1.07E-01	3.12E-01	1.00E-01	Maximum Value
W9SC-14	1,1-Dichloroethane	1	4	25%	1.70E-02	1.70E-02	2.41E-02	5.20E-03	Not failed	-3.74E+00	2.34E-01	Not failed	3.02E-02	3.44E-02	3.67E-02	3.02E-02	2.95E-02	Maximum Value
W9SC-14	1,1,1-Trichloroethane	1	4	25%	6.00E-03	6.00E-03	2.14E-02	1.05E-02	Not failed	-4.00E+00	7.45E-01	Failed	3.37E-02	2.14E-01	5.79E-02	3.37E-02	2.95E-02	Maximum Value
W9SC-14	Tetrachloroethene (PCE)	2	4	50%	5.00E-03	3.90E-02	2.46E-02	1.43E-02	Not failed	-3.94E+00	9.25E-01	Not failed	4.15E-02	8.16E-01	7.75E-02	4.15E-02	3.90E-02	Maximum Value
W9SC-17	cis-1,2-Dichloroethene	24	24	100%	3.60E+00	7.49E+00	5.04E+00	1.52E+00	Failed	1.58E+00	2.79E-01	Failed	5.57E+00	5.60E+00	6.33E+00	6.33E+00	6.33E+00	Chebychev 95 UCL limit
W9SC-17	Trichloroethene (TCE)	20	20	100%	1.51E+00	4.20E+00	2.63E+00	1.12E+00	Failed	8.77E-01	4.33E-01	Failed	3.06E+00	3.20E+00	3.80E+00	3.80E+00	3.80E+00	Chebychev 95 UCL limit
W9SC-17	trans-1,2-Dichloroethene	4	16	25%	8.00E-03	8.00E-03	4.89E-02	4.84E-02	Failed	-3.57E+00	1.13E+00	Failed	7.01E-02	1.25E-01	1.21E-01	1.21E-01	1.21E-01	Chebychev 95 UCL limit
W9SC-17	Vinyl chloride	9	12	75%	1.30E-01	5.90E-01	2.57E-01	2.28E-01	Failed	-2.12E+00	1.66E+00	Failed	3.75E-01	3.94E+00	1.28E+00	1.28E+00	5.90E-01	Maximum Value
W9SC-17	1,1-Dichloroethene	24	24	100%	9.40E-02	2.10E-01	1.41E-01	4.34E-02	Failed	-2.00E+00	2.93E-01	Failed	1.56E-01	1.58E-01	1.79E-01	1.79E-01	1.79E-01	Chebychev 95 UCL limit

Table 2. Statistical Data Summary of Chemicals in Groundwater
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Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
W9SC-17	1,1-Dichloroethane	18	24	75%	3.50E-02	9.90E-02	7.48E-02	3.92E-02	Failed	-2.74E+00	5.65E-01	Failed	8.85E-02	9.60E-02	1.16E-01	1.16E-01	1.16E-01	Chebychev 95 UCL limit
W9SC-17	Methylene chloride	1	4	25%	6.00E-02	6.00E-02	5.35E-02	5.25E-02	Not failed	-3.38E+00	1.16E+00	Not failed	1.15E-01	1.20E+01	1.82E-01	1.15E-01	1.15E-01	Arith. 95 UCL
W9SC-17	Tetrachloroethene (PCE)	6	12	50%	7.40E-02	1.20E-01	6.41E-02	4.07E-02	Not failed	-3.03E+00	8.80E-01	Failed	8.52E-02	1.46E-01	1.51E-01	8.52E-02	8.52E-02	Arith. 95 UCL
W9SC-7	Benzene	4	4	100%	7.00E-02	3.84E-01	1.84E-01	1.38E-01	Not failed	-1.89E+00	7.01E-01	Not failed	3.46E-01	1.35E+00	4.54E-01	3.46E-01	3.46E-01	Arith. 95 UCL
W9SC-7	Xylenes	4	4	100%	2.50E-02	6.60E-02	4.13E-02	1.74E-02	Not failed	-3.25E+00	4.00E-01	Not failed	6.18E-02	8.74E-02	7.75E-02	6.18E-02	6.18E-02	Arith. 95 UCL
W9SC-7	Vinyl chloride	4	4	100%	2.80E-01	6.36E-01	4.37E-01	1.48E-01	Not failed	-8.70E-01	3.37E-01	Not failed	6.11E-01	7.81E-01	7.63E-01	6.11E-01	6.11E-01	Arith. 95 UCL
W9SC-7	Trichloroethene (TCE)	3	4	75%	8.00E-03	4.10E-02	2.81E-02	1.42E-02	Not failed	-3.73E+00	7.43E-01	Not failed	4.48E-02	2.76E-01	7.58E-02	4.48E-02	4.10E-02	Maximum Value
W9SC-7	trans-1,2-Dichloroethene	2	4	50%	3.00E-03	1.00E-02	1.23E-02	1.46E-02	Not failed	-4.95E+00	1.20E+00	Not failed	2.94E-02	3.76E+00	3.97E-02	2.94E-02	2.94E-02	Arith. 95 UCL
W9SC-7	Freon 113	1	4	25%	8.00E-03	8.00E-03	1.23E-02	1.43E-02	Not failed	-4.88E+00	1.10E+00	Not failed	2.91E-02	1.41E+00	3.75E-02	2.91E-02	2.91E-02	Arith. 95 UCL
W9SC-7	cis-1,2-Dichloroethene	4	4	100%	3.80E-02	3.10E-01	1.97E-01	1.32E-01	Not failed	-1.90E+00	9.83E-01	Not failed	3.52E-01	1.00E+01	6.37E-01	3.52E-01	3.10E-01	Maximum Value
W9SC-7	1,2-Dichloroethane	1	4	25%	1.30E-02	1.30E-02	1.25E-02	1.50E-02	Not failed	-5.16E+00	1.58E+00	Not failed	3.01E-02	2.75E+02	5.11E-02	3.01E-02	3.01E-02	Arith. 95 UCL
W9SC-7	1,1-Dichloroethene	1	4	25%	8.00E-03	8.00E-03	1.23E-02	1.43E-02	Not failed	-4.88E+00	1.10E+00	Not failed	2.91E-02	1.41E+00	3.75E-02	2.91E-02	2.91E-02	Arith. 95 UCL
W9SC-7	1,1-Dichloroethane	3	4	75%	1.20E-02	2.00E-02	2.04E-02	9.34E-03	Not failed	-3.97E+00	4.34E-01	Not failed	3.14E-02	4.79E-02	3.97E-02	3.14E-02	3.14E-02	Arith. 95 UCL
W9SC-7	Ethylbenzene	4	4	100%	1.50E-01	3.62E-01	2.48E-01	8.70E-02	Not failed	-1.44E+00	3.60E-01	Not failed	3.50E-01	4.71E-01	4.46E-01	3.50E-01	3.50E-01	Arith. 95 UCL
WIC-1	Benzene	1	8	13%	3.00E-03	3.00E-03	1.98E-02	3.41E-02	Failed	-5.51E+00	2.17E+00	Not failed	4.26E-02	9.76E+00	9.73E-02	9.76E+00	1.00E-01	Maximum Value
WIC-1	1,1,1-Trichloroethane	3	10	30%	7.00E-03	1.00E-02	2.99E-02	3.77E-02	Failed	-4.35E+00	1.68E+00	Not failed	5.17E-02	7.09E-01	1.42E-01	7.09E-01	1.00E-01	Maximum Value
WIC-1	Trichloroethene (TCE)	10	10	100%	1.31E+00	3.60E+00	2.24E+00	8.07E-01	Not failed	7.47E-01	3.69E-01	Not failed	2.71E+00	2.91E+00	3.43E+00	2.71E+00	2.71E+00	Arith. 95 UCL
WIC-1	1,1-Dichloroethene	6	10	60%	4.00E-02	5.80E-02	5.06E-02	2.87E-02	Not failed	-3.14E+00	6.10E-01	Not failed	6.72E-02	8.48E-02	9.63E-02	6.72E-02	6.72E-02	Arith. 95 UCL
WIC-1	Vinyl chloride	1	10	10%	1.00E-03	1.00E-03	1.78E-02	3.04E-02	Failed	-5.30E+00	1.84E+00	Not failed	3.54E-02	5.75E-01	7.17E-02	5.75E-01	1.00E-01	Maximum Value
WIC-1	trans-1,3-Dichloropropene	1	10	10%	3.00E-03	3.00E-03	1.96E-02	3.02E-02	Failed	-5.21E+00	2.02E+00	Not failed	3.71E-02	1.63E+00	1.07E-01	1.63E+00	1.00E-01	Maximum Value
WIC-1	trans-1,2-Dichloroethene	1	9	11%	3.00E-03	3.00E-03	3.13E-02	3.99E-02	Failed	-4.33E+00	1.54E+00	Not failed	5.60E-02	5.00E-01	1.15E-01	5.00E-01	1.00E-01	Maximum Value
WIC-1	Tetrachloroethene (PCE)	7	10	70%	1.50E-02	3.60E-02	3.90E-02	3.30E-02	Failed	-3.50E+00	7.15E-01	Not failed	5.81E-02	7.16E-02	7.71E-02	7.16E-02	7.16E-02	Land 95 UCL
WIC-1	Freon 113	5	8	63%	3.90E-02	6.20E-02	4.72E-02	2.65E-02	Not failed	-3.21E+00	6.24E-01	Not failed	6.49E-02	9.04E-02	9.58E-02	6.49E-02	6.49E-02	Arith. 95 UCL
WIC-1	cis-1,3-Dichloropropene	1	10	10%	3.00E-03	3.00E-03	1.96E-02	3.02E-02	Failed	-5.21E+00	2.02E+00	Not failed	3.71E-02	1.63E+00	1.07E-01	1.63E+00	1.00E-01	Maximum Value
WIC-1	cis-1,2-Dichloroethene	9	9	100%	1.70E-01	3.50E-01	2.54E-01	5.39E-02	Not failed	-1.39E+00	2.14E-01	Not failed	2.88E-01	2.95E-01	3.36E-01	2.88E-01	2.88E-01	Arith. 95 UCL
WIC-1	1,1-Dichloroethane	5	10	50%	2.10E-02	2.60E-02	3.87E-02	3.26E-02	Failed	-3.49E+00	6.62E-01	Failed	5.75E-02	6.57E-02	7.29E-02	7.29E-02	7.29E-02	Chebychev 95 UCL limit
WIC-1	Chloroform	2	10	20%	8.00E-04	9.00E-04	2.82E-02	3.89E-02	Failed	-4.64E+00	1.73E+00	Not failed	5.07E-02	6.63E-01	1.16E-01	6.63E-01	1.00E-01	Maximum Value
WIC-1	Methylene chloride	1	10	10%	7.00E-03	7.00E-03	4.65E-02	6.63E-02	Failed	-4.60E+00	2.36E+00	Not failed	8.49E-02	2.29E+01	3.61E-01	2.29E+01	2.00E-01	Maximum Value
WIC-1	Xylenes	1	8	13%	7.00E-03	7.00E-03	3.06E-02	4.36E-02	Failed	-5.06E+00	2.36E+00	Not failed	5.98E-02	6.28E+01	2.10E-01	6.28E+01	1.00E-01	Maximum Value
WIC-10	1,1-Dichloroethane	5	5	100%	1.00E-03	2.00E-03	1.60E-03	5.48E-04	Failed	-6.49E+00	3.80E-01	Failed	2.12E-03	2.67E-03	2.82E-03	2.82E-03	2.00E-03	Maximum Value
WIC-10	Trichloroethene (TCE)	5	5	100%	4.00E-02	1.90E-01	8.50E-02	6.21E-02	Not failed	-2.64E+00	6.33E-01	Not failed	1.44E-01	2.56E-01	1.87E-01	1.44E-01	1.44E-01	Arith. 95 UCL
WIC-10	Tetrachloroethene (PCE)	5	5	100%	1.00E-03	1.40E-02	4.80E-03	5.36E-03	Failed	-5.78E+00	1.02E+00	Not failed	9.91E-03	6.64E-02	1.35E-02	6.64E-02	1.40E-02	Maximum Value
WIC-10	Freon 113	3	4	75%	7.00E-04	7.00E-03	2.55E-03	3.04E-03	Not failed	-6.51E+00	1.19E+00	Not failed	6.13E-03	6.74E-01	8.19E-03	6.13E-03	6.13E-03	Arith. 95 UCL
WIC-10	1,1-Dichloroethene	3	5	60%	4.00E-04	2.00E-03	1.03E-03	8.90E-04	Failed	-7.23E+00	9.60E-01	Not failed	1.88E-03	1.11E-02	2.92E-03	1.11E-02	2.00E-03	Maximum Value
WIC-10	cis-1,2-Dichloroethene	5	5	100%	2.00E-03	8.00E-03	4.00E-03	2.55E-03	Not failed	-5.67E+00	6.04E-01	Not failed	6.43E-03	1.12E-02	8.69E-03	6.43E-03	6.43E-03	Arith. 95 UCL
WIC-11	Toluene	1	5	20%	3.00E-04	3.00E-04	5.16E-03	8.55E-03	Failed	-6.78E+00	2.05E+00	Not failed	1.33E-02	1.73E+02	1.94E-02	1.73E+02	2.00E-02	Maximum Value
WIC-11	1,1-Dichloroethane	3	5	60%	2.00E-03	4.00E-03	6.80E-03	7.46E-03	Failed	-5.35E+00	8.74E-01	Not failed	1.39E-02	4.70E-02	1.71E-02	4.70E-02	2.00E-02	Maximum Value
WIC-11	Trichloroethene (TCE)	5	5	100%	9.60E-02	4.20E-01	2.21E-01	1.30E-01	Not failed	-1.64E+00	5.81E-01	Not failed	3.45E-01	5.82E-01	4.73E-01	3.45E-01	3.45E-01	Arith. 95 UCL
WIC-11	trans-1,2-Dichloroethene	2	5	40%	7.00E-04	2.00E-03	5.59E-03	8.27E-03	Failed	-6.20E+00	1.70E+00	Not failed	1.35E-02	7.94E+00	2.18E-02	7.94E+00	2.00E-02	Maximum Value
WIC-11	Freon 113	2	4	50%	2.00E-03	2.00E-03	6.25E-03	9.18E-03	Failed	-5.81E+00	1.31E+00	Not failed	1.71E-02	4.80E+00	1.90E-02	4.80E+00	2.00E-02	Maximum Value
WIC-11	1,1-Dichloroethene	3	5	60%	1.00E-03	2.00E-03	5.80E-03	8.11E-03	Failed	-5.85E+00	1.27E+00	Not failed	1.35E-02	3.04E-01	1.74E-02	3.04E-01	2.00E-02	Maximum Value
WIC-11	cis-1,2-Dichloroethene	5	5	100%	7.00E-03	4.60E-02	2.10E-02	1.63E-02	Not failed	-4.12E+00	8.05E-01	Not failed	3.65E-02	1.16E-01	5.37E-02	3.65E-02	3.65E-02	Arith. 95 UCL
WIC-11	Tetrachloroethene (PCE)	3	5	60%	4.00E-03	4.00E-03	7.40E-03	7.06E-03	Failed	-5.15E+00	7.02E-01	Failed	1.41E-02	2.67E-02	1.66E-02	1.66E-02	1.66E-02	Chebychev 95 UCL limit
WIC-12	Chloroform	1	3	33%	2.50E-01	2.50E-01	9.20E-02	1.37E-01	Not failed	-3.99E+00	2.77E+00	Not failed	3.24E-01	6.26E+30	5.37E-01	3.24E-01	2.50E-01	Maximum Value
WIC-12	Trichloroethene (TCE)	3	3	100%	3.20E+00	4.00E+00	3.53E+00	4.16E-01	Not failed	1.26E+00	1.15E-01	Not failed	4.24E+00	4.46E+00	4.58E+00	4.24E+00	4.00E+00	Maximum Value
WIC-12	Tetrachloroethene (PCE)	2	3	67%	4.20E-02	5.70E-02	6.63E-02	3.01E-02	Not failed	-2.78E+00	4.40E-01	Not failed	1.17E-01	4.05E-01	1.40E-01	1.17E-01	1.00E-01	Maximum Value
WIC-12	cis-1,2-Dichloroethene	2	3	67%	2.50E-01	2.60E-01	2.03E-01	8.96E-02	Not failed	-1.68E+00	5.41E-01	Not failed	3.54E-01	3.17E+00	4.82E-01	3.54E-01	2.60E-01	Maximum Value

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NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WIC-12	1,1-Dichloroethene	2	3	67%	4.40E-02	5.10E-02	6.50E-02	3.05E-02	Not failed	-2.80E+00	4.38E-01	Not failed	1.16E-01	3.89E-01	1.36E-01	1.16E-01	1.00E-01	Maximum Value
WIC-12	1,1-Dichloroethane	1	3	33%	2.00E-02	2.00E-02	4.83E-02	4.48E-02	Not failed	-3.30E+00	8.72E-01	Not failed	1.24E-01	6.04E+01	1.43E-01	1.24E-01	1.00E-01	Maximum Value
WIC-12	1,1,1-Trichloroethane	1	3	33%	5.00E-03	5.00E-03	4.33E-02	5.01E-02	Not failed	-3.76E+00	1.50E+00	Not failed	1.28E-01	7.50E+07	1.80E-01	1.28E-01	1.00E-01	Maximum Value
WIC-12	Freon 113	2	3	67%	8.70E-02	1.00E-01	9.57E-02	7.51E-03	Failed	-2.35E+00	8.04E-02	Failed	1.08E-01	1.11E-01	1.16E-01	1.16E-01	1.00E-01	Maximum Value
WIC-3	Freon 113	3	5	60%	3.80E-02	6.40E-02	7.08E-02	2.82E-02	Not failed	-2.72E+00	4.21E-01	Not failed	9.77E-02	1.28E-01	1.30E-01	9.77E-02	9.77E-02	Arith. 95 UCL
WIC-3	Vinyl chloride	2	7	29%	9.00E-04	9.00E-04	9.26E-03	1.10E-02	Failed	-5.46E+00	1.42E+00	Not failed	1.73E-02	2.02E-01	3.13E-02	2.02E-01	2.50E-02	Maximum Value
WIC-3	Trichloroethene (TCE)	7	7	100%	1.90E+00	2.90E+00	2.43E+00	3.15E-01	Not failed	8.80E-01	1.34E-01	Not failed	2.66E+00	2.70E+00	2.98E+00	2.66E+00	2.66E+00	Arith. 95 UCL
WIC-3	trans-1,2-Dichloroethene	2	6	33%	2.00E-03	2.00E-03	3.98E-02	4.74E-02	Failed	-4.22E+00	1.77E+00	Not failed	7.88E-02	1.66E+01	1.79E-01	1.66E+01	1.00E-01	Maximum Value
WIC-3	Tetrachloroethene (PCE)	5	7	71%	2.20E-02	3.10E-02	4.69E-02	3.64E-02	Failed	-3.28E+00	6.81E-01	Failed	7.36E-02	1.05E-01	9.83E-02	9.83E-02	9.83E-02	Chebychev 95 UCL limit
WIC-3	Chloroform	2	7	29%	6.00E-04	7.00E-04	3.41E-02	4.58E-02	Failed	-4.80E+00	2.16E+00	Not failed	6.78E-02	5.27E+01	1.88E-01	5.27E+01	1.00E-01	Maximum Value
WIC-3	1,1-Dichloroethene	4	7	57%	4.00E-02	4.60E-02	5.67E-02	3.03E-02	Failed	-2.98E+00	5.07E-01	Not failed	7.90E-02	9.62E-02	1.05E-01	9.62E-02	9.62E-02	Land 95 UCL
WIC-3	1,1-Dichloroethane	4	7	57%	1.80E-02	2.40E-02	4.39E-02	3.84E-02	Failed	-3.41E+00	7.64E-01	Failed	7.21E-02	1.15E-01	9.70E-02	9.70E-02	9.70E-02	Chebychev 95 UCL limit
WIC-3	1,1,1-Trichloroethane	3	7	43%	6.00E-03	9.00E-03	3.69E-02	4.36E-02	Failed	-3.94E+00	1.20E+00	Not failed	6.89E-02	3.25E-01	1.05E-01	3.25E-01	1.00E-01	Maximum Value
WIC-3	cis-1,2-Dichloroethene	6	6	100%	2.20E-01	2.90E-01	2.55E-01	2.35E-02	Not failed	-1.37E+00	9.28E-02	Not failed	2.74E-01	2.77E-01	2.98E-01	2.74E-01	2.74E-01	Arith. 95 UCL
WIC-5	Trichloroethene (TCE)	5	5	100%	1.80E-01	6.80E-01	3.18E-01	2.05E-01	Failed	-1.27E+00	5.19E-01	Not failed	5.14E-01	7.01E-01	6.32E-01	7.01E-01	6.80E-01	Maximum Value
WIC-5	Vinyl chloride	2	5	40%	5.00E-04	1.00E-03	2.02E-03	2.26E-03	Failed	-6.59E+00	9.25E-01	Not failed	4.17E-03	1.75E-02	5.27E-03	1.75E-02	6.00E-03	Maximum Value
WIC-5	trans-1,2-Dichloroethene	1	5	20%	3.00E-03	3.00E-03	6.85E-03	1.03E-02	Failed	-6.00E+00	1.73E+00	Not failed	1.67E-02	1.27E+01	2.76E-02	1.27E+01	2.50E-02	Maximum Value
WIC-5	Tetrachloroethene (PCE)	2	5	40%	8.00E-04	4.00E-03	7.01E-03	1.03E-02	Failed	-5.99E+00	1.78E+00	Not failed	1.68E-02	2.03E+01	2.97E-02	2.03E+01	2.50E-02	Maximum Value
WIC-5	Freon 113	4	4	100%	1.00E-02	8.60E-02	3.35E-02	3.57E-02	Not failed	-3.78E+00	9.78E-01	Not failed	7.55E-02	1.47E+00	9.67E-02	7.55E-02	7.55E-02	Arith. 95 UCL
WIC-5	Chloroform	2	5	40%	7.00E-04	1.00E-03	6.54E-03	1.05E-02	Failed	-6.01E+00	1.51E+00	Not failed	1.65E-02	1.66E+00	2.02E-02	1.66E+00	2.50E-02	Maximum Value
WIC-5	Benzene	2	5	40%	8.00E-04	1.00E-03	2.76E-03	2.53E-03	Failed	-6.27E+00	9.79E-01	Not failed	5.17E-03	3.21E-02	7.80E-03	3.21E-02	6.00E-03	Maximum Value
WIC-5	1,1-Dichloroethene	5	5	100%	1.80E-02	6.40E-02	3.48E-02	1.73E-02	Not failed	-3.45E+00	4.56E-01	Not failed	5.13E-02	6.71E-02	6.59E-02	5.13E-02	5.13E-02	Arith. 95 UCL
WIC-5	1,1-Dichloroethane	5	5	100%	2.70E-02	4.80E-02	3.60E-02	7.68E-03	Not failed	-3.34E+00	2.08E-01	Not failed	4.33E-02	4.55E-02	5.09E-02	4.33E-02	4.33E-02	Arith. 95 UCL
WIC-5	1,1,1-Trichloroethane	2	5	40%	1.00E-03	1.00E-03	6.60E-03	1.04E-02	Failed	-5.94E+00	1.44E+00	Failed	1.65E-02	1.02E+00	1.99E-02	1.99E-02	1.99E-02	Chebychev 95 UCL limit
WIC-5	cis-1,2-Dichloroethene	5	5	100%	2.60E-01	5.50E-01	3.50E-01	1.16E-01	Not failed	-1.09E+00	2.93E-01	Not failed	4.61E-01	5.00E-01	5.53E-01	4.61E-01	4.61E-01	Arith. 95 UCL
WIC-6	Carbon tetrachloride	1	5	20%	8.00E-04	8.00E-04	5.71E-03	6.25E-03	Failed	-6.04E+00	1.72E+00	Not failed	1.17E-02	1.08E+01	2.61E-02	1.08E+01	1.25E-02	Maximum Value
WIC-6	Vinyl chloride	1	5	20%	3.00E-04	3.00E-04	3.91E-03	5.05E-03	Not failed	-6.46E+00	1.70E+00	Not failed	8.73E-03	5.87E+00	1.66E-02	8.73E-03	8.73E-03	Arith. 95 UCL
WIC-6	Trichloroethene (TCE)	5	5	100%	9.90E-01	1.10E+00	1.06E+00	5.76E-02	Failed	5.52E-02	5.51E-02	Failed	1.11E+00	1.12E+00	1.17E+00	1.17E+00	1.10E+00	Maximum Value
WIC-6	Toluene	2	5	40%	7.00E-04	1.00E-03	1.33E-02	2.11E-02	Failed	-5.51E+00	1.79E+00	Not failed	3.34E-02	3.92E+01	4.91E-02	3.92E+01	5.00E-02	Maximum Value
WIC-6	Tetrachloroethene (PCE)	3	5	60%	6.00E-03	1.60E-02	1.89E-02	1.78E-02	Failed	-4.25E+00	7.87E-01	Not failed	3.58E-02	9.46E-02	4.61E-02	9.46E-02	5.00E-02	Maximum Value
WIC-6	Freon 113	2	4	50%	1.40E-02	2.00E-02	2.35E-02	1.81E-02	Not failed	-3.95E+00	6.93E-01	Not failed	4.48E-02	1.66E-01	5.75E-02	4.48E-02	4.48E-02	Arith. 95 UCL
WIC-6	1,1,1-Trichloroethane	3	5	60%	1.00E-03	7.00E-03	1.51E-02	1.99E-02	Failed	-4.91E+00	1.42E+00	Not failed	3.41E-02	2.49E+00	5.45E-02	2.49E+00	5.00E-02	Maximum Value
WIC-6	Chloroform	1	5	20%	9.00E-04	9.00E-04	1.32E-02	2.11E-02	Failed	-5.74E+00	2.10E+00	Not failed	3.34E-02	8.67E+02	5.89E-02	8.67E+02	5.00E-02	Maximum Value
WIC-6	1,1-Dichloroethene	4	5	80%	5.00E-04	3.30E-02	2.55E-02	1.83E-02	Not failed	-4.33E+00	1.86E+00	Failed	4.29E-02	2.61E+02	1.74E-01	4.29E-02	4.29E-02	Arith. 95 UCL
WIC-6	1,1-Dichloroethane	4	5	80%	8.00E-03	2.40E-02	2.40E-02	1.57E-02	Not failed	-3.90E+00	6.56E-01	Not failed	3.90E-02	7.93E-02	5.50E-02	3.90E-02	3.90E-02	Arith. 95 UCL
WIC-6	cis-1,2-Dichloroethene	5	5	100%	1.20E-01	2.60E-01	2.06E-01	5.59E-02	Not failed	-1.62E+00	3.10E-01	Not failed	2.59E-01	3.04E-01	3.34E-01	2.59E-01	2.59E-01	Arith. 95 UCL
WIC-7	Freon 113	3	4	75%	1.30E-02	2.60E-02	2.58E-02	1.72E-02	Not failed	-3.81E+00	6.28E-01	Not failed	4.60E-02	1.31E-01	6.02E-02	4.60E-02	4.60E-02	Arith. 95 UCL
WIC-7	trans-1,2-Dichloroethene	2	5	40%	3.00E-03	3.00E-03	1.38E-02	2.08E-02	Failed	-5.32E+00	1.73E+00	Not failed	3.36E-02	2.53E+01	5.44E-02	2.53E+01	5.00E-02	Maximum Value
WIC-7	Trichloroethene (TCE)	5	5	100%	9.60E-01	1.40E+00	1.21E+00	1.63E-01	Not failed	1.85E-01	1.41E-01	Not failed	1.37E+00	1.41E+00	1.55E+00	1.37E+00	1.37E+00	Arith. 95 UCL
WIC-7	Tetrachloroethene (PCE)	3	5	60%	1.10E-02	2.00E-02	2.21E-02	1.60E-02	Failed	-3.97E+00	5.97E-01	Not failed	3.74E-02	5.96E-02	4.70E-02	5.96E-02	5.00E-02	Maximum Value
WIC-7	Chloroform	2	5	40%	8.00E-04	8.00E-04	1.29E-02	2.14E-02	Failed	-5.99E+00	2.21E+00	Not failed	3.33E-02	2.53E+03	5.32E-02	2.53E+03	5.00E-02	Maximum Value
WIC-7	1,1-Dichloroethene	4	5	80%	2.10E-02	3.20E-02	3.22E-02	1.08E-02	Not failed	-3.48E+00	3.13E-01	Not failed	4.25E-02	4.75E-02	5.22E-02	4.25E-02	4.25E-02	Arith. 95 UCL
WIC-7	cis-1,2-Dichloroethene	5	5	100%	1.80E-01	2.80E-01	2.16E-01	3.91E-02	Not failed	-1.54E+00	1.71E-01	Not failed	2.53E-01	2.60E-01	2.90E-01	2.53E-01	2.53E-01	Arith. 95 UCL
WIC-7	1,1-Dichloroethane	4	5	80%	2.10E-02	2.30E-02	2.74E-02	1.27E-02	Failed	-3.66E+00	3.74E-01	Failed	3.95E-02	4.47E-02	4.74E-02	4.74E-02	4.74E-02	Chebychev 95 UCL limit
WIC-7	1,1,1-Trichloroethane	3	5	60%	6.00E-03	6.00E-03	1.61E-02	1.92E-02	Failed	-4.55E+00	9.23E-01	Failed	3.44E-02	1.34E-01	4.08E-02	4.08E-02	4.08E-02	Chebychev 95 UCL limit
WIC-7	Vinyl chloride	2	5	40%	4.00E-04	6.00E-04	3.55E-03	5.24E-03	Failed	-6.69E+00	1.66E+00	Not failed	8.55E-03	3.46E+00	1.27E-02	3.46E+00	1.25E-02	Maximum Value
WIC-8	Chloroform	3	8	38%	8.00E-04	8.00E-04	1.60E-02	2.16E-02	Failed	-5.56E+00	2.10E+00	Not failed	3.05E-02	5.64E+00	8.24E-02	5.64E+00	5.00E-02	Maximum Value

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WIC-8	Vinyl chloride	1	8	13%	6.00E-04	6.00E-04	4.39E-03	5.24E-03	Failed	-6.34E+00	1.61E+00	Not failed	7.90E-03	1.38E-01	1.73E-02	1.38E-01	1.25E-02	Maximum Value
WIC-8	Trichloroethene (TCE)	8	8	100%	9.20E-01	1.60E+00	1.25E+00	2.02E-01	Not failed	2.13E-01	1.65E-01	Not failed	1.39E+00	1.41E+00	1.58E+00	1.39E+00	1.39E+00	Arith. 95 UCL
WIC-8	trans-1,2-Dichloroethene	3	8	38%	1.00E-03	8.00E-03	1.69E-02	2.10E-02	Failed	-5.13E+00	1.80E+00	Not failed	3.10E-02	1.35E+00	7.89E-02	1.35E+00	5.00E-02	Maximum Value
WIC-8	Tetrachloroethene (PCE)	6	8	75%	1.20E-02	2.10E-02	2.39E-02	1.63E-02	Failed	-3.90E+00	5.84E-01	Failed	3.48E-02	4.16E-02	4.52E-02	4.52E-02	4.52E-02	Chebychev 95 UCL limit
WIC-8	cis-1,2-Dichloroethene	8	8	100%	1.70E-01	2.90E-01	2.15E-01	3.46E-02	Not failed	-1.55E+00	1.52E-01	Not failed	2.38E-01	2.40E-01	2.66E-01	2.38E-01	2.38E-01	Arith. 95 UCL
WIC-8	1,1-Dichloroethene	6	8	75%	2.10E-02	3.50E-02	3.26E-02	1.16E-02	Not failed	-3.47E+00	3.35E-01	Not failed	4.04E-02	4.28E-02	4.99E-02	4.04E-02	4.04E-02	Arith. 95 UCL
WIC-8	1,1-Dichloroethane	6	8	75%	1.90E-02	2.30E-02	2.81E-02	1.36E-02	Failed	-3.65E+00	4.13E-01	Failed	3.72E-02	3.98E-02	4.62E-02	4.62E-02	4.62E-02	Chebychev 95 UCL limit
WIC-8	1,1,1-Trichloroethane	3	8	38%	6.00E-03	7.00E-03	1.80E-02	2.01E-02	Failed	-4.78E+00	1.66E+00	Not failed	3.15E-02	8.60E-01	8.91E-02	8.60E-01	5.00E-02	Maximum Value
WIC-8	Freon 113	3	7	43%	2.00E-02	2.60E-02	2.43E-02	2.01E-02	Not failed	-4.46E+00	1.71E+00	Failed	3.91E-02	3.04E+00	1.33E-01	3.91E-02	3.91E-02	Arith. 95 UCL
WIC-9	Benzene	1	4	25%	2.00E-04	2.00E-04	3.11E-03	3.33E-03	Failed	-6.76E+00	1.90E+00	Failed	7.04E-03	6.22E+03	1.52E-02	1.52E-02	6.00E-03	Maximum Value
WIC-9	Trichloroethene (TCE)	4	4	100%	5.50E-01	8.30E-01	6.95E-01	1.41E-01	Not failed	-3.80E-01	2.05E-01	Not failed	8.60E-01	9.38E-01	1.01E+00	8.60E-01	8.30E-01	Maximum Value
WIC-9	trans-1,2-Dichloroethene	1	4	25%	1.00E-03	1.00E-03	8.06E-03	1.16E-02	Not failed	-6.00E+00	2.02E+00	Not failed	2.17E-02	9.22E+04	3.73E-02	2.17E-02	2.17E-02	Arith. 95 UCL
WIC-9	Tetrachloroethene (PCE)	2	4	50%	1.20E-02	1.30E-02	1.40E-02	7.96E-03	Not failed	-4.39E+00	5.84E-01	Not failed	2.34E-02	5.87E-02	3.18E-02	2.34E-02	2.34E-02	Arith. 95 UCL
WIC-9	Freon 113	3	4	75%	7.00E-03	1.50E-02	1.45E-02	7.72E-03	Not failed	-4.34E+00	5.35E-01	Not failed	2.36E-02	4.94E-02	3.14E-02	2.36E-02	2.36E-02	Arith. 95 UCL
WIC-9	1,1-Dichloroethene	3	4	75%	6.00E-03	1.20E-02	1.38E-02	8.02E-03	Not failed	-4.41E+00	5.83E-01	Not failed	2.32E-02	5.73E-02	3.12E-02	2.32E-02	2.32E-02	Arith. 95 UCL
WIC-9	1,1-Dichloroethane	2	4	50%	6.00E-03	8.00E-03	1.13E-02	9.22E-03	Failed	-4.69E+00	6.79E-01	Not failed	2.21E-02	7.26E-02	2.69E-02	7.26E-02	2.50E-02	Maximum Value
WIC-9	1,1,1-Trichloroethane	1	4	25%	1.00E-03	1.00E-03	8.06E-03	1.16E-02	Not failed	-6.00E+00	2.02E+00	Not failed	2.17E-02	9.22E+04	3.73E-02	2.17E-02	2.17E-02	Arith. 95 UCL
WIC-9	cis-1,2-Dichloroethene	4	4	100%	6.90E-02	9.10E-02	7.80E-02	1.05E-02	Not failed	-2.56E+00	1.33E-01	Not failed	9.03E-02	9.32E-02	1.01E-01	9.03E-02	9.03E-02	Arith. 95 UCL
WIC-9	Chloroform	2	4	50%	5.00E-04	6.00E-04	8.03E-03	1.16E-02	Not failed	-5.96E+00	1.89E+00	Not failed	2.17E-02	1.11E+04	3.34E-02	2.17E-02	2.17E-02	Arith. 95 UCL
WNX-1	Methylene chloride	1	7	14%	8.00E-03	8.00E-03	1.51E-02	1.28E-02	Failed	-4.68E+00	1.19E+00	Not failed	2.45E-02	1.50E-01	4.93E-02	1.50E-01	2.95E-02	Maximum Value
WNX-1	Vinyl chloride	6	21	29%	1.70E-02	1.80E-02	1.94E-02	9.11E-03	Failed	-4.10E+00	6.22E-01	Failed	2.28E-02	2.71E-02	3.28E-02	3.28E-02	2.95E-02	Maximum Value
WNX-1	trans-1,2-Dichloroethene	8	28	29%	5.00E-03	5.00E-03	1.58E-02	1.13E-02	Failed	-4.45E+00	8.23E-01	Failed	1.94E-02	2.33E-02	2.84E-02	2.84E-02	2.84E-02	Chebychev 95 UCL limit
WNX-1	cis-1,2-Dichloroethene	42	42	100%	9.09E-01	1.20E+00	1.01E+00	8.44E-02	Failed	6.06E-03	7.94E-02	Failed	1.03E+00	1.03E+00	1.06E+00	1.06E+00	1.06E+00	Chebychev 95 UCL limit
WNX-1	1,1-Dichloroethene	42	42	100%	5.40E-02	7.60E-02	6.21E-02	6.74E-03	Failed	-2.78E+00	1.05E-01	Failed	6.39E-02	6.39E-02	6.66E-02	6.66E-02	6.66E-02	Chebychev 95 UCL limit
WNX-1	1,1-Dichloroethane	42	42	100%	4.10E-02	5.20E-02	4.74E-02	3.50E-03	Failed	-3.05E+00	7.59E-02	Failed	4.83E-02	4.84E-02	4.99E-02	4.99E-02	4.99E-02	Chebychev 95 UCL limit
WNX-1	Trichloroethene (TCE)	35	35	100%	5.60E-01	7.16E-01	6.27E-01	5.71E-02	Failed	-4.71E-01	8.95E-02	Failed	6.43E-01	6.43E-01	6.69E-01	6.69E-01	6.69E-01	Chebychev 95 UCL limit
WNX-3	Trichloroethene (TCE)	20	20	100%	6.70E-01	7.11E-01	6.88E-01	1.56E-02	Failed	-3.75E-01	2.25E-02	Failed	6.94E-01	6.94E-01	7.03E-01	7.03E-01	7.03E-01	Chebychev 95 UCL limit
WNX-3	1,1-Dichloroethane	18	24	75%	9.00E-03	1.10E-02	1.21E-02	3.83E-03	Failed	-4.45E+00	2.83E-01	Failed	1.35E-02	1.35E-02	1.53E-02	1.53E-02	1.53E-02	Chebychev 95 UCL limit
WNX-3	1,1-Dichloroethene	24	24	100%	1.40E-02	2.00E-02	1.70E-02	2.28E-03	Failed	-4.08E+00	1.36E-01	Failed	1.78E-02	1.79E-02	1.91E-02	1.91E-02	1.91E-02	Chebychev 95 UCL limit
WNX-3	cis-1,2-Dichloroethene	24	24	100%	1.30E-01	1.90E-01	1.51E-01	2.38E-02	Failed	-1.90E+00	1.48E-01	Failed	1.59E-01	1.59E-01	1.71E-01	1.71E-01	1.71E-01	Chebychev 95 UCL limit
WNX-3	Freon 113	2	8	25%	6.00E-03	6.00E-03	8.00E-03	6.62E-03	Failed	-5.10E+00	7.68E-01	Not failed	1.24E-02	1.89E-02	1.75E-02	1.89E-02	1.85E-02	Maximum Value
WNX-3	Methylene chloride	1	4	25%	5.00E-03	5.00E-03	7.38E-03	7.52E-03	Not failed	-5.26E+00	9.30E-01	Not failed	1.62E-02	2.27E-01	2.09E-02	1.62E-02	1.62E-02	Arith. 95 UCL
WT14-1	1,1-Dichloroethene	9	9	100%	5.00E-04	6.00E-04	5.67E-04	5.00E-05	Failed	-7.48E+00	9.12E-02	Failed	5.98E-04	6.01E-04	6.44E-04	6.44E-04	6.00E-04	Maximum Value
WT14-1	1,1-Dichloroethane	9	9	100%	3.60E-03	4.00E-03	3.73E-03	2.00E-04	Failed	-5.59E+00	5.27E-02	Failed	3.86E-03	3.86E-03	4.03E-03	4.03E-03	4.00E-03	Maximum Value
WT14-1	1,1,1-Trichloroethane	9	9	100%	6.60E-03	7.80E-03	7.10E-03	5.41E-04	Failed	-4.95E+00	7.49E-02	Failed	7.44E-03	7.45E-03	7.89E-03	7.89E-03	7.80E-03	Maximum Value
WU4-1	Freon 113	2	10	20%	3.10E-02	3.10E-02	3.91E-02	7.51E-03	Failed	-3.26E+00	1.93E-01	Failed	4.35E-02	4.42E-02	4.98E-02	4.98E-02	4.98E-02	Chebychev 95 UCL limit
WU4-1	Vinyl chloride	6	15	40%	1.00E-02	1.10E-02	6.86E-03	3.11E-03	Failed	-5.08E+00	4.45E-01	Failed	8.27E-03	8.76E-03	1.04E-02	1.04E-02	1.04E-02	Chebychev 95 UCL limit
WU4-1	Trichloroethene (TCE)	25	25	100%	1.80E+00	3.40E+00	2.66E+00	5.54E-01	Failed	9.56E-01	2.21E-01	Failed	2.85E+00	2.89E+00	3.19E+00	3.19E+00	3.19E+00	Chebychev 95 UCL limit
WU4-1	Tetrachloroethene (PCE)	3	15	20%	3.60E-03	3.60E-03	4.01E-03	6.43E-04	Failed	-5.53E+00	1.61E-01	Not failed	4.30E-03	4.33E-03	4.76E-03	4.33E-03	4.33E-03	Land 95 UCL
WU4-1	cis-1,2-Dichloroethene	30	30	100%	3.80E-01	4.90E-01	4.12E-01	4.14E-02	Failed	-8.91E-01	9.53E-02	Failed	4.25E-01	4.25E-01	4.44E-01	4.44E-01	4.44E-01	Chebychev 95 UCL limit
WU4-1	1,2-Dichlorobenzene	1	5	20%	4.50E-03	4.50E-03	4.19E-03	6.78E-04	Not failed	-5.49E+00	1.71E-01	Not failed	4.84E-03	5.05E-03	5.63E-03	4.84E-03	4.84E-03	Arith. 95 UCL
WU4-1	1,1-Dichloroethene	30	30	100%	1.80E-02	4.40E-02	2.86E-02	8.97E-03	Failed	-3.60E+00	3.04E-01	Failed	3.14E-02	3.17E-02	3.58E-02	3.58E-02	3.58E-02	Chebychev 95 UCL limit
WU4-1	1,1-Dichloroethane	30	30	100%	1.40E-02	2.50E-02	1.90E-02	4.22E-03	Failed	-3.99E+00	2.24E-01	Failed	2.03E-02	2.05E-02	2.25E-02	2.25E-02	2.25E-02	Chebychev 95 UCL limit
WU4-1	1,1,1-Trichloroethane	5	25	20%	3.10E-03	3.10E-03	3.91E-03	7.27E-04	Failed	-5.56E+00	1.86E-01	Failed	4.16E-03	4.18E-03	4.57E-03	4.57E-03	4.57E-03	Chebychev 95 UCL limit
WU4-1	trans-1,2-Dichloroethene	12	20	60%	4.50E-03	2.20E-02	8.87E-03	6.94E-03	Failed	-4.95E+00	6.39E-01	Failed	1.16E-02	1.19E-02	1.44E-02	1.44E-02	1.44E-02	Chebychev 95 UCL limit
WU4-10	Tetrachloroethene (PCE)	2	4	50%	6.00E-04	6.00E-04	4.05E-03	3.98E-03	Failed	-6.16E+00	1.46E+00	Failed	8.74E-03	2.00E+01	1.62E-02	1.62E-02	7.50E-03	Maximum Value
WU4-10	cis-1,2-Dichloroethene	8	8	100%	9.90E-02	1.40E-01	1.20E-01	2.19E-02	Failed	-2.14E+00	1.85E-01	Failed	1.34E-01	1.37E-01	1.55E-01	1.55E-01	1.40E-01	Maximum Value

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Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WU4-10	trans-1,2-Dichloroethene	4	8	50%	6.00E-04	6.00E-04	4.05E-03	3.69E-03	Failed	-6.16E+00	1.35E+00	Failed	6.52E-03	4.82E-02	1.40E-02	1.40E-02	7.50E-03	Maximum Value
WU4-10	Freon 113	6	6	100%	5.70E-03	1.30E-02	9.35E-03	4.00E-03	Failed	-4.76E+00	4.52E-01	Failed	1.26E-02	1.59E-02	1.71E-02	1.71E-02	1.30E-02	Maximum Value
WU4-10	1,1-Dichloroethene	6	6	100%	1.20E-02	1.50E-02	1.35E-02	1.64E-03	Failed	-4.31E+00	1.22E-01	Failed	1.49E-02	1.51E-02	1.65E-02	1.65E-02	1.50E-02	Maximum Value
WU4-10	1,1-Dichloroethane	8	8	100%	1.20E-02	1.50E-02	1.35E-02	1.60E-03	Failed	-4.31E+00	1.19E-01	Failed	1.46E-02	1.47E-02	1.60E-02	1.60E-02	1.50E-02	Maximum Value
WU4-10	1,1,1-Trichloroethane	3	6	50%	3.90E-03	3.90E-03	5.70E-03	1.97E-03	Failed	-5.22E+00	3.58E-01	Failed	7.32E-03	8.38E-03	9.43E-03	9.43E-03	7.50E-03	Maximum Value
WU4-10	Chloroform	3	6	50%	1.00E-03	1.00E-03	4.25E-03	3.56E-03	Failed	-5.90E+00	1.10E+00	Failed	7.18E-03	4.60E-02	1.31E-02	1.31E-02	7.50E-03	Maximum Value
WU4-10	Trichloroethene (TCE)	8	8	100%	1.28E-01	3.00E-01	2.14E-01	9.19E-02	Failed	-1.63E+00	4.55E-01	Failed	2.76E-01	3.22E-01	3.70E-01	3.70E-01	3.00E-01	Maximum Value
WU4-21	1,1-Dichloroethane	12	12	100%	1.00E-03	2.00E-03	1.47E-03	4.29E-04	Failed	-6.56E+00	2.96E-01	Failed	1.69E-03	1.75E-03	2.03E-03	2.03E-03	2.00E-03	Maximum Value
WU4-21	cis-1,2-Dichloroethene	12	12	100%	4.20E-03	6.00E-03	4.80E-03	8.86E-04	Failed	-5.35E+00	1.76E-01	Failed	5.26E-03	5.29E-03	5.89E-03	5.89E-03	5.89E-03	Chebychev 95 UCL limit
WU4-21	Methylene chloride	1	3	33%	5.00E-04	5.00E-04	4.67E-04	5.77E-05	Failed	-7.68E+00	1.29E-01	Failed	5.64E-04	6.09E-04	6.22E-04	6.22E-04	5.00E-04	Maximum Value
WU4-21	trans-1,2-Dichloroethene	8	12	67%	4.00E-04	1.00E-03	5.50E-04	3.38E-04	Failed	-7.68E+00	6.01E-01	Failed	7.25E-04	8.40E-04	9.85E-04	9.85E-04	9.85E-04	Chebychev 95 UCL limit
WU4-21	Trichloroethene (TCE)	4	12	33%	1.00E-03	1.00E-03	8.33E-04	2.46E-04	Failed	-7.14E+00	3.41E-01	Failed	9.61E-04	1.03E-03	1.21E-03	1.21E-03	1.00E-03	Maximum Value
WU4-25	1,1,1-Trichloroethane	3	9	33%	6.00E-04	6.00E-04	7.00E-04	2.29E-04	Failed	-7.31E+00	3.11E-01	Failed	8.42E-04	8.78E-04	1.02E-03	1.02E-03	1.00E-03	Maximum Value
WU4-25	Trichloroethene (TCE)	12	12	100%	2.30E-03	3.47E-02	2.00E-02	1.40E-02	Failed	-4.40E+00	1.25E+00	Failed	2.73E-02	9.52E-02	6.63E-02	6.63E-02	3.47E-02	Maximum Value
WU4-25	trans-1,2-Dichloroethene	4	12	33%	9.00E-04	9.00E-04	8.00E-04	2.26E-04	Failed	-7.17E+00	3.19E-01	Failed	9.17E-04	9.72E-04	1.14E-03	1.14E-03	1.00E-03	Maximum Value
WU4-25	Freon 113	6	9	67%	5.00E-04	7.00E-04	5.67E-04	1.00E-04	Failed	-7.49E+00	1.68E-01	Failed	6.29E-04	6.34E-04	7.09E-04	7.09E-04	7.00E-04	Maximum Value
WU4-25	cis-1,2-Dichloroethene	12	12	100%	1.60E-02	6.70E-02	4.30E-02	2.19E-02	Failed	-3.31E+00	6.33E-01	Failed	5.43E-02	6.97E-02	8.12E-02	8.12E-02	6.70E-02	Maximum Value
WU4-25	Chloroform	3	9	33%	7.00E-04	7.00E-04	6.50E-04	3.27E-04	Failed	-7.49E+00	6.23E-01	Failed	8.53E-04	1.17E-03	1.29E-03	1.29E-03	1.00E-03	Maximum Value
WU4-25	Benzene	2	2	100%	2.00E-03	2.00E-03	2.00E-03	0.00E+00	--	-6.21E+00	0.00E+00	--	--	--	--	--	2.00E-03	Maximum Value
WU4-25	1,1-Dichloroethane	12	12	100%	5.70E-03	1.06E-02	8.77E-03	2.28E-03	Failed	-4.77E+00	2.92E-01	Failed	9.95E-03	1.04E-02	1.21E-02	1.21E-02	1.06E-02	Maximum Value
WU4-25	1,1-Dichloroethene	6	9	67%	2.00E-03	3.00E-03	1.83E-03	1.09E-03	Failed	-6.54E+00	8.14E-01	Failed	2.51E-03	4.55E-03	4.32E-03	4.32E-03	3.00E-03	Maximum Value
WU4-3	cis-1,2-Dichloroethene	36	36	100%	3.60E-03	4.40E-01	2.31E-01	1.31E-01	Failed	-2.05E+00	1.65E+00	Failed	2.68E-01	1.22E+00	1.21E+00	1.21E+00	4.40E-01	Maximum Value
WU4-3	Trichloroethene (TCE)	30	30	100%	4.30E-03	5.20E+00	3.15E+00	1.59E+00	Failed	1.85E-01	2.57E+00	Failed	3.65E+00	3.10E+02	8.70E+01	8.70E+01	5.20E+00	Maximum Value
WU4-3	trans-1,2-Dichloroethene	4	24	17%	1.00E-03	1.00E-03	4.39E-03	2.95E-03	Failed	-5.88E+00	1.18E+00	Failed	5.42E-03	1.10E-02	1.21E-02	1.21E-02	8.50E-03	Maximum Value
WU4-3	Vinyl chloride	3	18	17%	8.00E-04	8.00E-04	4.38E-03	2.97E-03	Failed	-5.86E+00	1.12E+00	Failed	5.60E-03	1.16E-02	1.19E-02	1.19E-02	8.50E-03	Maximum Value
WU4-3	1,1-Dichloroethene	30	36	83%	3.00E-02	7.80E-02	3.80E-02	2.33E-02	Failed	-4.00E+00	1.97E+00	Failed	4.46E-02	4.30E-01	3.34E-01	3.34E-01	7.80E-02	Maximum Value
WU4-3	1,1-Dichloroethane	30	36	83%	1.70E-02	5.30E-02	2.27E-02	1.58E-02	Failed	-4.46E+00	1.78E+00	Failed	2.72E-02	1.55E-01	1.41E-01	1.41E-01	5.30E-02	Maximum Value
WU4-3	1,1,1-Trichloroethane	5	30	17%	3.00E-03	3.00E-03	4.71E-03	2.64E-03	Failed	-5.75E+00	1.20E+00	Failed	5.53E-03	1.19E-02	1.37E-02	1.37E-02	8.50E-03	Maximum Value
WU4-3	Tetrachloroethene (PCE)	3	18	17%	3.70E-03	3.70E-03	4.83E-03	2.61E-03	Failed	-5.72E+00	1.22E+00	Failed	5.89E-03	1.65E-02	1.59E-02	1.59E-02	8.50E-03	Maximum Value
WU4-3	Freon 113	2	12	17%	5.10E-02	5.10E-02	5.02E-02	2.67E-02	Failed	-3.69E+00	2.00E+00	Failed	6.41E-02	3.77E+00	4.91E-01	4.91E-01	8.50E-02	Maximum Value
WU4-8	trans-1,2-Dichloroethene	8	16	50%	1.10E-02	1.40E-02	7.63E-03	5.16E-03	Failed	-5.14E+00	7.88E-01	Failed	9.88E-03	1.29E-02	1.51E-02	1.51E-02	1.40E-02	Maximum Value
WU4-8	Trichloroethene (TCE)	16	16	100%	3.00E-03	5.50E-03	3.63E-03	1.12E-03	Failed	-5.66E+00	2.71E-01	Failed	4.11E-03	4.12E-03	4.72E-03	4.72E-03	4.72E-03	Chebychev 95 UCL limit
WU4-8	cis-1,2-Dichloroethene	16	16	100%	1.00E-01	2.07E-01	1.44E-01	4.39E-02	Failed	-1.98E+00	2.99E-01	Failed	1.63E-01	1.66E-01	1.92E-01	1.92E-01	1.92E-01	Chebychev 95 UCL limit
WU4-8	Benzene	4	4	100%	1.00E-03	2.00E-03	1.50E-03	5.77E-04	Failed	-6.56E+00	4.00E-01	Failed	2.18E-03	3.19E-03	2.83E-03	2.83E-03	2.00E-03	Maximum Value
WU4-8	1,1-Dichloroethene	3	12	25%	1.00E-03	1.00E-03	1.94E-03	8.73E-04	Failed	-6.35E+00	4.80E-01	Failed	2.39E-03	2.67E-03	3.17E-03	3.17E-03	3.00E-03	Maximum Value
WU4-8	1,1-Dichloroethane	16	16	100%	6.00E-03	7.80E-03	6.95E-03	6.59E-04	Failed	-4.97E+00	9.65E-02	Failed	7.24E-03	7.26E-03	7.70E-03	7.70E-03	7.70E-03	Chebychev 95 UCL limit
WU4-8	Vinyl chloride	8	8	100%	7.00E-03	3.80E-02	2.00E-02	1.40E-02	Failed	-4.17E+00	7.89E-01	Failed	2.94E-02	5.07E-02	4.58E-02	4.58E-02	3.80E-02	Maximum Value
WW-10A	1,1-Dichloroethane	1	4	25%	2.00E-03	2.00E-03	1.06E-03	7.18E-04	Not failed	-7.08E+00	8.72E-01	Not failed	1.91E-03	2.36E-02	3.13E-03	1.91E-03	1.91E-03	Arith. 95 UCL
WW-10A	cis-1,2-Dichloroethene	1	4	25%	1.00E-03	1.00E-03	6.25E-04	4.33E-04	Failed	-7.60E+00	8.00E-01	Failed	1.13E-03	8.41E-03	1.70E-03	1.70E-03	1.00E-03	Maximum Value
WW-10A	Trichloroethene (TCE)	4	4	100%	8.00E-04	1.10E-02	3.45E-03	5.03E-03	Failed	-6.36E+00	1.24E+00	Failed	9.37E-03	1.33E+00	1.01E-02	1.01E-02	1.01E-02	Chebychev 95 UCL limit
WW-10C	1,1-Dichloroethane	4	5	80%	7.00E-04	2.00E-03	1.30E-03	6.48E-04	Not failed	-6.75E+00	5.02E-01	Not failed	1.92E-03	2.80E-03	2.59E-03	1.92E-03	1.92E-03	Arith. 95 UCL
WW-10C	cis-1,2-Dichloroethene	4	5	80%	9.00E-04	5.00E-03	1.98E-03	1.75E-03	Failed	-6.47E+00	7.27E-01	Not failed	3.65E-03	7.96E-03	4.62E-03	7.96E-03	5.00E-03	Maximum Value
WW-10C	Trichloroethene (TCE)	5	5	100%	3.00E-03	2.50E-02	1.06E-02	8.62E-03	Not failed	-4.80E+00	8.03E-01	Not failed	1.88E-02	5.82E-02	2.70E-02	1.88E-02	1.88E-02	Arith. 95 UCL
WW-10D	cis-1,2-Dichloroethene	3	5	60%	1.00E-03	7.00E-03	2.20E-03	2.68E-03	Failed	-6.52E+00	8.70E-01	Failed	4.76E-03	1.43E-02	5.29E-03	5.29E-03	5.29E-03	Chebychev 95 UCL limit
WW-10D	Trichloroethene (TCE)	5	5	100%	4.00E-03	2.00E-02	7.40E-03	7.06E-03	Failed	-5.15E+00	7.02E-01	Failed	1.41E-02	2.67E-02	1.66E-02	1.66E-02	1.66E-02	Chebychev 95 UCL limit
WW-10D	1,1-Dichloroethane	1	5	20%	2.00E-03	2.00E-03	1.05E-03	6.22E-04	Not failed	-7.05E+00	7.59E-01	Not failed	1.64E-03	5.10E-03	2.70E-03	1.64E-03	1.64E-03	Arith. 95 UCL
WW-11	Trichloroethene (TCE)	5	5	100%	5.50E-01	1.20E+00	9.56E-01	2.49E-01	Not failed	-7.86E-02	3.06E-01	Not failed	1.19E+00	1.40E+00	1.54E+00	1.19E+00	1.19E+00	Arith. 95 UCL

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NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WW-11	1,1,1-Trichloroethane	3	5	60%	3.00E-03	6.00E-03	1.03E-02	8.96E-03	Not failed	-4.86E+00	8.30E-01	Not failed	1.88E-02	6.23E-02	2.64E-02	1.88E-02	1.88E-02	Arith. 95 UCL
WW-11	Vinyl chloride	2	5	40%	4.00E-04	6.00E-04	2.70E-03	2.36E-03	Not failed	-6.37E+00	1.19E+00	Not failed	4.95E-03	1.04E-01	9.27E-03	4.95E-03	4.95E-03	Arith. 95 UCL
WW-11	Tetrachloroethene (PCE)	3	5	60%	7.00E-03	1.40E-02	1.35E-02	7.00E-03	Not failed	-4.40E+00	4.84E-01	Not failed	2.02E-02	2.77E-02	2.63E-02	2.02E-02	2.02E-02	Arith. 95 UCL
WW-11	Methylene chloride	1	5	20%	2.30E-01	2.30E-01	5.27E-02	9.96E-02	Failed	-4.58E+00	2.00E+00	Not failed	1.48E-01	9.19E+02	1.65E-01	9.19E+02	2.30E-01	Maximum Value
WW-11	Freon 113	2	5	40%	1.60E-02	2.30E-02	1.73E-02	6.52E-03	Not failed	-4.12E+00	3.91E-01	Not failed	2.35E-02	2.94E-02	3.08E-02	2.35E-02	2.35E-02	Arith. 95 UCL
WW-11	cis-1,2-Dichloroethene	5	5	100%	1.80E-01	2.50E-01	2.14E-01	2.88E-02	Not failed	-1.55E+00	1.36E-01	Not failed	2.41E-01	2.47E-01	2.72E-01	2.41E-01	2.41E-01	Arith. 95 UCL
WW-11	Chloroform	1	5	20%	7.00E-04	7.00E-04	8.54E-03	1.03E-02	Not failed	-5.51E+00	1.45E+00	Not failed	1.84E-02	1.70E+00	3.10E-02	1.84E-02	1.84E-02	Arith. 95 UCL
WW-11	1,1-Dichloroethene	5	5	100%	2.40E-02	2.90E-02	2.60E-02	2.00E-03	Not failed	-3.65E+00	7.55E-02	Not failed	2.79E-02	2.81E-02	2.99E-02	2.79E-02	2.79E-02	Arith. 95 UCL
WW-11	1,1-Dichloroethane	4	5	80%	2.10E-02	2.30E-02	2.26E-02	1.52E-03	Not failed	-3.79E+00	6.58E-02	Not failed	2.40E-02	2.41E-02	2.56E-02	2.40E-02	2.40E-02	Arith. 95 UCL
WW-12	Vinyl chloride	2	7	29%	2.00E-03	2.00E-03	2.92E-03	4.31E-03	Failed	-6.58E+00	1.31E+00	Not failed	6.09E-03	3.77E-02	8.69E-03	3.77E-02	1.25E-02	Maximum Value
WW-12	1,1-Dichloroethene	5	7	71%	2.00E-03	8.20E-02	1.48E-02	2.98E-02	Failed	-5.36E+00	1.39E+00	Failed	3.67E-02	1.89E-01	3.29E-02	3.29E-02	3.29E-02	Chebychev 95 UCL limit
WW-12	Benzene	1	7	14%	3.00E-04	3.00E-04	2.76E-03	4.41E-03	Failed	-6.85E+00	1.49E+00	Not failed	6.00E-03	7.39E-02	8.64E-03	7.39E-02	1.25E-02	Maximum Value
WW-12	Chloroethane	1	7	14%	6.00E-04	6.00E-04	4.66E-03	4.80E-03	Not failed	-5.93E+00	1.20E+00	Not failed	8.18E-03	4.50E-02	1.43E-02	8.18E-03	8.18E-03	Arith. 95 UCL
WW-12	cis-1,2-Dichloroethene	7	7	100%	7.20E-02	3.60E-01	1.42E-01	1.04E-01	Failed	-2.12E+00	5.77E-01	Not failed	2.19E-01	2.64E-01	2.75E-01	2.64E-01	2.64E-01	Land 95 UCL
WW-12	Tetrachloroethene (PCE)	1	7	14%	7.10E-02	7.10E-02	1.24E-02	2.61E-02	Failed	-6.04E+00	1.87E+00	Not failed	3.15E-02	1.70E+00	3.44E-02	1.70E+00	7.10E-02	Maximum Value
WW-12	Trichloroethene (TCE)	5	7	71%	5.00E-03	3.40E+00	4.90E-01	1.28E+00	Failed	-4.65E+00	2.76E+00	Failed	1.43E+00	1.29E+04	5.59E-01	5.59E-01	5.59E-01	Chebychev 95 UCL limit
WW-12	1,1-Dichloroethane	7	7	100%	1.40E-02	3.40E-02	2.01E-02	7.20E-03	Not failed	-3.95E+00	3.24E-01	Not failed	2.54E-02	2.69E-02	3.11E-02	2.54E-02	2.54E-02	Arith. 95 UCL
WW-13A	cis-1,2-Dichloroethene	2	5	40%	6.00E-04	4.00E-03	1.37E-03	1.50E-03	Failed	-7.01E+00	1.01E+00	Not failed	2.80E-03	1.79E-02	3.87E-03	1.79E-02	4.00E-03	Maximum Value
WW-13A	Trichloroethene (TCE)	1	5	20%	2.00E-03	2.00E-03	9.00E-04	7.20E-04	Not failed	-7.32E+00	9.30E-01	Not failed	1.59E-03	8.65E-03	2.56E-03	1.59E-03	1.59E-03	Arith. 95 UCL
WW-13A	1,1-Dichloroethane	4	5	80%	6.00E-03	9.00E-03	5.80E-03	2.95E-03	Not failed	-5.36E+00	8.80E-01	Failed	8.61E-03	4.76E-02	1.70E-02	8.61E-03	8.61E-03	Arith. 95 UCL
WW-13A	Chloroethane	3	5	60%	6.00E-04	1.00E-03	8.80E-04	1.79E-04	Failed	-7.05E+00	2.25E-01	Failed	1.05E-03	1.14E-03	1.28E-03	1.28E-03	1.00E-03	Maximum Value
WW-14	1,1-Dichloroethane	4	5	80%	1.00E-03	4.00E-03	1.60E-03	1.34E-03	Failed	-6.63E+00	6.20E-01	Failed	2.88E-03	4.53E-03	3.41E-03	3.41E-03	3.41E-03	Chebychev 95 UCL limit
WW-14	Chloroethane	1	5	20%	6.00E-04	6.00E-04	6.20E-04	3.75E-04	Not failed	-7.56E+00	6.98E-01	Not failed	9.78E-04	2.37E-03	1.48E-03	9.78E-04	9.78E-04	Arith. 95 UCL
WW-14	cis-1,2-Dichloroethene	4	5	80%	4.00E-04	2.00E-03	9.60E-04	6.23E-04	Not failed	-7.10E+00	6.02E-01	Not failed	1.55E-03	2.66E-03	2.08E-03	1.55E-03	1.55E-03	Arith. 95 UCL
WW-14	Trichloroethene (TCE)	2	5	40%	3.00E-04	1.00E-03	5.60E-04	4.02E-04	Failed	-7.70E+00	7.30E-01	Failed	9.43E-04	2.34E-03	1.35E-03	1.35E-03	1.00E-03	Maximum Value
WW-15	1,1-Dichloroethane	4	5	80%	5.00E-04	2.00E-03	1.30E-03	6.71E-04	Not failed	-6.77E+00	5.80E-01	Not failed	1.94E-03	3.45E-03	2.81E-03	1.94E-03	1.94E-03	Arith. 95 UCL
WW-15	cis-1,2-Dichloroethene	5	5	100%	5.00E-04	5.00E-03	1.64E-03	1.89E-03	Failed	-6.80E+00	8.85E-01	Not failed	3.44E-03	1.17E-02	4.09E-03	1.17E-02	5.00E-03	Maximum Value
WW-15	Trichloroethene (TCE)	5	5	100%	3.00E-03	3.00E-02	8.80E-03	1.19E-02	Failed	-5.25E+00	9.97E-01	Failed	2.01E-02	9.94E-02	2.23E-02	2.23E-02	2.23E-02	Chebychev 95 UCL limit
WW-16A	Trichloroethene (TCE)	5	5	100%	3.10E-02	1.10E+00	7.70E-01	4.32E-01	Not failed	-7.39E-01	1.54E+00	Failed	1.18E+00	4.14E+02	4.10E+00	1.18E+00	1.10E+00	Maximum Value
WW-16A	Vinyl chloride	1	5	20%	6.00E-04	6.00E-04	1.89E-03	2.35E-03	Failed	-6.83E+00	1.18E+00	Not failed	4.13E-03	6.28E-02	5.80E-03	6.28E-02	6.00E-03	Maximum Value
WW-16A	trans-1,2-Dichloroethene	1	5	20%	2.00E-03	2.00E-03	6.70E-03	1.04E-02	Failed	-5.94E+00	1.52E+00	Not failed	1.66E-02	2.01E+00	2.21E-02	2.01E+00	2.50E-02	Maximum Value
WW-16A	Tetrachloroethene (PCE)	3	5	60%	5.00E-03	1.10E-02	1.02E-02	9.12E-03	Not failed	-5.02E+00	1.20E+00	Not failed	1.89E-02	4.36E-01	3.64E-02	1.89E-02	1.89E-02	Arith. 95 UCL
WW-16A	Methylene chloride	1	5	20%	9.10E-02	9.10E-02	2.43E-02	3.87E-02	Failed	-5.36E+00	2.38E+00	Not failed	6.11E-02	4.31E+04	1.26E-01	4.31E+04	9.10E-02	Maximum Value
WW-16A	cis-1,2-Dichloroethene	5	5	100%	2.00E-02	2.40E-01	1.72E-01	8.76E-02	Failed	-2.03E+00	1.05E+00	Failed	2.55E-01	3.42E+00	5.96E-01	5.96E-01	2.40E-01	Maximum Value
WW-16A	Chloroform	2	5	40%	5.00E-04	8.00E-04	6.46E-03	1.05E-02	Failed	-6.13E+00	1.61E+00	Not failed	1.65E-02	3.81E+00	2.08E-02	3.81E+00	2.50E-02	Maximum Value
WW-16A	1,1-Dichloroethene	4	5	80%	2.00E-03	3.00E-02	2.08E-02	1.08E-02	Failed	-4.18E+00	1.14E+00	Failed	3.11E-02	6.80E-01	7.79E-02	7.79E-02	3.00E-02	Maximum Value
WW-16A	1,1-Dichloroethane	4	5	80%	5.00E-03	2.30E-02	1.88E-02	8.01E-03	Not failed	-4.11E+00	6.73E-01	Failed	2.64E-02	6.82E-02	4.55E-02	2.64E-02	2.50E-02	Maximum Value
WW-16A	1,1,1-Trichloroethane	2	5	40%	4.00E-03	5.00E-03	8.00E-03	9.64E-03	Failed	-5.34E+00	1.14E+00	Not failed	1.72E-02	2.16E-01	2.45E-02	2.16E-01	2.50E-02	Maximum Value
WW-16A	Freon 113	3	5	60%	1.20E-02	1.80E-02	1.40E-02	8.80E-03	Not failed	-4.66E+00	1.29E+00	Failed	2.24E-02	1.14E+00	5.84E-02	2.24E-02	2.24E-02	Arith. 95 UCL
WW-17A	Vinyl chloride	3	5	60%	1.00E-03	1.00E-03	7.00E-04	4.11E-04	Failed	-7.46E+00	7.59E-01	Failed	1.09E-03	3.36E-03	1.78E-03	1.78E-03	1.00E-03	Maximum Value
WW-17A	Chloroethane	1	5	20%	1.00E-03	1.00E-03	7.50E-04	3.54E-04	Failed	-7.32E+00	6.20E-01	Failed	1.09E-03	2.27E-03	1.70E-03	1.70E-03	1.00E-03	Maximum Value
WW-17A	cis-1,2-Dichloroethene	3	5	60%	2.10E-02	2.90E-02	1.60E-02	1.40E-02	Not failed	-4.96E+00	1.78E+00	Failed	2.94E-02	6.18E+01	8.39E-02	2.94E-02	2.90E-02	Maximum Value
WW-17A	Toluene	2	5	40%	6.00E-04	7.00E-04	7.10E-04	3.13E-04	Not failed	-7.36E+00	5.69E-01	Not failed	1.01E-03	1.85E-03	1.54E-03	1.01E-03	1.00E-03	Maximum Value
WW-17A	Trichloroethene (TCE)	2	5	40%	5.00E-04	4.00E-03	1.35E-03	1.52E-03	Failed	-7.05E+00	1.03E+00	Not failed	2.80E-03	1.96E-02	3.84E-03	1.96E-02	4.00E-03	Maximum Value
WW-17A	1,1-Dichloroethane	4	5	80%	8.00E-03	1.90E-02	1.00E-02	6.63E-03	Not failed	-4.95E+00	1.15E+00	Not failed	1.63E-02	3.25E-01	3.64E-02	1.63E-02	1.63E-02	Arith. 95 UCL
WW-18A	Trichloroethene (TCE)	5	5	100%	4.00E-04	1.00E-02	2.60E-03	4.14E-03	Failed	-6.73E+00	1.25E+00	Not failed	6.55E-03	1.11E-01	7.02E-03	1.11E-01	1.00E-02	Maximum Value
WW-18A	cis-1,2-Dichloroethene	2	5	40%	1.00E-03	4.00E-03	1.30E-03	1.56E-03	Failed	-7.19E+00	1.16E+00	Not failed	2.78E-03	3.83E-02	3.97E-03	3.83E-02	4.00E-03	Maximum Value

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WW-18A	1,1-Dichloroethane	2	5	40%	1.00E-03	2.00E-03	1.05E-03	6.22E-04	Not failed	-7.05E+00	7.59E-01	Not failed	1.64E-03	5.10E-03	2.70E-03	1.64E-03	1.64E-03	Arith. 95 UCL
WW-18A	Chloroethane	1	5	20%	7.00E-04	7.00E-04	6.90E-04	3.25E-04	Not failed	-7.39E+00	5.79E-01	Not failed	1.00E-03	1.84E-03	1.50E-03	1.00E-03	1.00E-03	Arith. 95 UCL
WW-1A	1,1-Dichloroethane	2	5	40%	1.00E-03	3.00E-03	1.25E-03	1.03E-03	Not failed	-6.97E+00	8.82E-01	Not failed	2.23E-03	9.71E-03	3.44E-03	2.23E-03	2.23E-03	Arith. 95 UCL
WW-1A	Chloroethane	1	5	20%	5.00E-04	5.00E-04	6.00E-04	3.79E-04	Not failed	-7.60E+00	6.93E-01	Not failed	9.61E-04	2.24E-03	1.42E-03	9.61E-04	9.61E-04	Arith. 95 UCL
WW-1A	Trichloroethene (TCE)	1	5	20%	2.00E-03	2.00E-03	7.50E-04	7.71E-04	Failed	-7.60E+00	9.80E-01	Failed	1.48E-03	8.58E-03	2.07E-03	2.07E-03	2.00E-03	Maximum Value
WW-2	Methylene chloride	2	6	33%	2.20E-01	4.60E-01	1.23E-01	1.85E-01	Failed	-3.84E+00	2.39E+00	Not failed	2.75E-01	6.67E+03	6.51E-01	6.67E+03	4.60E-01	Maximum Value
WW-2	1,1,1-Trichloroethane	3	6	50%	6.00E-03	8.00E-03	1.79E-02	1.73E-02	Failed	-4.35E+00	8.57E-01	Not failed	3.21E-02	7.54E-02	4.39E-02	7.54E-02	5.00E-02	Maximum Value
WW-2	trans-1,2-Dichloroethene	1	6	17%	8.00E-03	8.00E-03	1.64E-02	1.86E-02	Not failed	-4.91E+00	1.66E+00	Not failed	3.17E-02	3.63E+00	7.66E-02	3.17E-02	3.17E-02	Arith. 95 UCL
WW-2	Trichloroethene (TCE)	6	6	100%	7.70E-01	2.00E+00	1.50E+00	4.39E-01	Not failed	3.59E-01	3.40E-01	Not failed	1.86E+00	2.15E+00	2.43E+00	1.86E+00	1.86E+00	Arith. 95 UCL
WW-2	Tetrachloroethene (PCE)	4	6	67%	8.00E-03	2.00E-02	2.25E-02	1.46E-02	Not failed	-3.95E+00	6.05E-01	Not failed	3.45E-02	5.07E-02	4.70E-02	3.45E-02	3.45E-02	Arith. 95 UCL
WW-2	cis-1,2-Dichloroethene	6	6	100%	2.00E-01	2.80E-01	2.47E-01	3.20E-02	Not failed	-1.41E+00	1.34E-01	Not failed	2.73E-01	2.78E-01	3.07E-01	2.73E-01	2.73E-01	Arith. 95 UCL
WW-2	Chloroform	1	6	17%	8.00E-04	8.00E-04	1.55E-02	1.93E-02	Not failed	-5.07E+00	1.62E+00	Not failed	3.13E-02	2.24E+00	6.16E-02	3.13E-02	3.13E-02	Arith. 95 UCL
WW-2	1,1-Dichloroethane	4	6	67%	2.40E-02	2.70E-02	2.95E-02	1.01E-02	Failed	-3.56E+00	2.80E-01	Failed	3.78E-02	3.89E-02	4.43E-02	4.43E-02	4.43E-02	Chebychev 95 UCL limit
WW-2	1,1-Dichloroethene	5	6	83%	2.80E-02	4.10E-02	3.67E-02	7.76E-03	Not failed	-3.32E+00	2.02E-01	Not failed	4.31E-02	4.43E-02	5.02E-02	4.31E-02	4.31E-02	Arith. 95 UCL
WW-2	Freon 113	4	6	67%	2.00E-02	3.20E-02	2.90E-02	1.10E-02	Failed	-3.59E+00	3.29E-01	Not failed	3.81E-02	4.07E-02	4.62E-02	4.07E-02	4.07E-02	Land 95 UCL
WW-3	cis-1,2-Dichloroethene	4	4	100%	5.80E-02	2.20E-01	1.18E-01	7.16E-02	Not failed	-2.27E+00	5.66E-01	Not failed	2.02E-01	4.52E-01	2.60E-01	2.02E-01	2.02E-01	Arith. 95 UCL
WW-3	Trichloroethene (TCE)	3	4	75%	2.00E-03	1.10E-02	4.25E-03	4.57E-03	Not failed	-5.86E+00	1.01E+00	Not failed	9.63E-03	2.37E-01	1.26E-02	9.63E-03	9.63E-03	Arith. 95 UCL
WW-3	Chloroethane	1	4	25%	5.00E-04	5.00E-04	3.50E-03	4.42E-03	Not failed	-6.28E+00	1.29E+00	Not failed	8.70E-03	2.59E+00	1.18E-02	8.70E-03	8.70E-03	Arith. 95 UCL
WW-3	1,1-Dichloroethene	2	4	50%	2.00E-03	3.00E-03	4.00E-03	4.08E-03	Not failed	-5.88E+00	9.66E-01	Not failed	8.80E-03	1.62E-01	1.16E-02	8.80E-03	8.80E-03	Arith. 95 UCL
WW-3	1,1-Dichloroethane	4	4	100%	1.20E-02	2.20E-02	1.78E-02	4.35E-03	Not failed	-4.06E+00	2.66E-01	Not failed	2.29E-02	2.70E-02	2.83E-02	2.29E-02	2.20E-02	Maximum Value
WW-3	Vinyl chloride	1	4	25%	2.00E-03	2.00E-03	1.29E-03	1.13E-03	Not failed	-7.08E+00	1.15E+00	Not failed	2.62E-03	2.55E-01	4.41E-03	2.62E-03	2.50E-03	Maximum Value
WW-4A	1,1-Dichloroethane	3	4	75%	4.00E-03	1.50E-02	8.00E-03	6.58E-03	Not failed	-5.26E+00	1.24E+00	Not failed	1.57E-02	3.94E+00	3.03E-02	1.57E-02	1.50E-02	Maximum Value
WW-4A	Benzene	1	4	25%	3.00E-04	3.00E-04	2.63E-04	2.50E-05	Failed	-8.25E+00	9.12E-02	Failed	2.92E-04	2.95E-04	3.16E-04	3.16E-04	3.00E-04	Maximum Value
WW-4A	Chloroethane	2	4	50%	6.00E-04	7.00E-04	8.25E-04	2.06E-04	Not failed	-7.12E+00	2.58E-01	Not failed	1.07E-03	1.23E-03	1.30E-03	1.07E-03	1.00E-03	Maximum Value
WW-4A	cis-1,2-Dichloroethene	2	4	50%	2.00E-03	4.00E-03	1.81E-03	1.63E-03	Not failed	-6.73E+00	1.18E+00	Not failed	3.72E-03	5.09E-01	6.51E-03	3.72E-03	3.72E-03	Arith. 95 UCL
WW-4A	Vinyl chloride	1	4	25%	7.00E-04	7.00E-04	4.25E-04	2.18E-04	Not failed	-7.86E+00	5.16E-01	Not failed	6.81E-04	1.34E-03	9.04E-04	6.81E-04	6.81E-04	Arith. 95 UCL
WW-5	cis-1,2-Dichloroethene	1	5	20%	8.00E-04	8.00E-04	6.60E-04	3.83E-04	Not failed	-7.51E+00	7.24E-01	Failed	1.03E-03	2.78E-03	1.63E-03	1.03E-03	1.00E-03	Maximum Value
WW-5	Trichloroethene (TCE)	1	5	20%	5.00E-04	5.00E-04	6.00E-04	3.79E-04	Not failed	-7.60E+00	6.93E-01	Not failed	9.61E-04	2.24E-03	1.42E-03	9.61E-04	9.61E-04	Arith. 95 UCL
WW-5	Chloroethane	1	5	20%	7.00E-04	7.00E-04	6.40E-04	3.76E-04	Not failed	-7.53E+00	7.09E-01	Not failed	9.99E-04	2.55E-03	1.55E-03	9.99E-04	9.99E-04	Arith. 95 UCL
WW-5	1,1-Dichloroethane	5	5	100%	2.00E-03	8.00E-03	4.60E-03	2.79E-03	Not failed	-5.55E+00	6.62E-01	Not failed	7.26E-03	1.55E-02	1.06E-02	7.26E-03	7.26E-03	Arith. 95 UCL
WW-6	cis-1,2-Dichloroethene	3	4	75%	1.00E-03	5.00E-03	2.00E-03	2.00E-03	Failed	-6.51E+00	8.05E-01	Failed	4.35E-03	2.59E-02	5.12E-03	5.12E-03	5.00E-03	Maximum Value
WW-6	Trichloroethene (TCE)	4	4	100%	3.00E-03	3.00E-02	1.38E-02	1.15E-02	Not failed	-4.59E+00	9.47E-01	Not failed	2.73E-02	5.08E-01	4.17E-02	2.73E-02	2.73E-02	Arith. 95 UCL
WW-6	1,1-Dichloroethane	2	4	50%	1.00E-03	2.00E-03	1.25E-03	5.00E-04	Failed	-6.73E+00	3.47E-01	Failed	1.84E-03	2.28E-03	2.20E-03	2.20E-03	2.00E-03	Maximum Value
WW-7A	Chloroform	1	5	20%	9.00E-04	9.00E-04	1.05E-02	2.21E-02	Failed	-6.70E+00	2.18E+00	Not failed	3.15E-02	8.61E+02	2.50E-02	8.61E+02	5.00E-02	Maximum Value
WW-7A	Trichloroethene (TCE)	5	5	100%	3.00E-02	1.80E+00	9.00E-01	8.15E-01	Not failed	-1.02E+00	1.93E+00	Not failed	1.68E+00	1.39E+04	5.21E+00	1.68E+00	1.68E+00	Arith. 95 UCL
WW-7A	trans-1,2-Dichloroethene	2	5	40%	1.00E-03	2.00E-03	1.09E-02	2.19E-02	Failed	-6.26E+00	1.98E+00	Not failed	3.17E-02	1.30E+02	2.95E-02	1.30E+02	5.00E-02	Maximum Value
WW-7A	Tetrachloroethene (PCE)	2	5	40%	1.40E-02	1.60E-02	1.63E-02	2.02E-02	Not failed	-5.32E+00	2.20E+00	Not failed	3.55E-02	4.33E+03	1.02E-01	3.55E-02	3.55E-02	Arith. 95 UCL
WW-7A	Methylene chloride	1	5	20%	5.00E-03	5.00E-03	1.13E-02	2.17E-02	Failed	-6.36E+00	2.25E+00	Not failed	3.20E-02	2.99E+03	3.89E-02	2.99E+03	5.00E-02	Maximum Value
WW-7A	cis-1,2-Dichloroethene	5	5	100%	5.00E-03	3.00E-01	1.62E-01	1.33E-01	Not failed	-2.54E+00	1.76E+00	Not failed	2.89E-01	5.48E+02	9.09E-01	2.89E-01	2.89E-01	Arith. 95 UCL
WW-7A	Vinyl chloride	1	5	20%	7.00E-04	7.00E-04	2.84E-03	5.40E-03	Failed	-7.17E+00	1.62E+00	Failed	7.99E-03	1.42E+00	7.41E-03	7.41E-03	7.41E-03	Chebychev 95 UCL limit
WW-7A	Benzene	1	5	20%	4.00E-04	4.00E-04	2.73E-03	5.46E-03	Failed	-7.42E+00	1.71E+00	Failed	7.94E-03	2.55E+00	6.50E-03	6.50E-03	6.50E-03	Chebychev 95 UCL limit
WW-7A	1,1-Dichloroethene	4	5	80%	5.00E-04	3.90E-02	2.49E-02	2.15E-02	Not failed	-4.53E+00	1.94E+00	Not failed	4.54E-02	4.97E+02	1.59E-01	4.54E-02	4.54E-02	Arith. 95 UCL
WW-7A	1,1-Dichloroethane	3	5	60%	7.00E-03	2.60E-02	2.05E-02	1.93E-02	Not failed	-4.77E+00	2.09E+00	Not failed	3.89E-02	2.16E+03	1.53E-01	3.89E-02	3.89E-02	Arith. 95 UCL
WW-7A	1,1,1-Trichloroethane	2	5	40%	4.00E-03	7.00E-03	1.25E-02	2.12E-02	Failed	-5.74E+00	2.00E+00	Not failed	3.26E-02	2.99E+02	5.19E-02	2.99E+02	5.00E-02	Maximum Value
WW-7A	Freon 113	4	4	100%	3.00E-04	6.00E-02	2.01E-02	2.80E-02	Not failed	-5.45E+00	2.47E+00	Not failed	5.30E-02	1.02E+09	1.14E-01	5.30E-02	5.30E-02	Arith. 95 UCL
WW-8A	cis-1,2-Dichloroethene	4	5	80%	1.30E-01	2.10E-01	1.46E-01	8.69E-02	Not failed	-2.76E+00	2.33E+00	Failed	2.29E-01	3.07E+05	1.59E+00	2.29E-01	2.10E-01	Maximum Value
WW-8A	Trichloroethene (TCE)	2	5	40%	1.00E-03	2.70E-02	8.00E-03	1.13E-02	Failed	-5.79E+00	1.57E+00	Failed	1.88E-02	3.69E+00	2.77E-02	2.77E-02	2.70E-02	Maximum Value

Table 2. Statistical Data Summary of Chemicals in Groundwater
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Analyte	Number of Detections	Number of Analyses	Frequency of Detection	Minimum Value (mg/L)	Maximum Value (mg/L)	Arithmetic Average (mg/L)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/L)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/L)	Land's 95% UCL (mg/L)	Approximate Chebychev's Limit on the 95% UCL (mg/L)	Appropriate 95% UCL (mg/L)	EPC (mg/L)	Basis for EPC
WW-8A	Vinyl chloride	1	5	20%	1.00E-03	1.00E-03	8.80E-04	9.57E-04	Failed	-7.46E+00	9.98E-01	Not failed	1.79E-03	1.09E-02	2.43E-03	1.09E-02	2.50E-03	Maximum Value
WW-8A	1,1-Dichloroethane	5	5	100%	1.00E-03	2.00E-02	1.50E-02	8.09E-03	Failed	-4.58E+00	1.31E+00	Failed	2.27E-02	1.44E+00	6.52E-02	6.52E-02	2.00E-02	Maximum Value
WW-8A	1,1-Dichloroethene	3	5	60%	2.00E-03	1.00E-02	6.60E-03	4.67E-03	Failed	-5.39E+00	1.10E+00	Failed	1.11E-02	1.57E-01	2.21E-02	2.21E-02	1.00E-02	Maximum Value
WW-8A	Benzene	2	5	40%	4.00E-04	6.00E-04	9.50E-04	9.11E-04	Not failed	-7.29E+00	8.86E-01	Not failed	1.82E-03	7.19E-03	2.51E-03	1.82E-03	1.82E-03	Arith. 95 UCL
WW-9A	1,1-Dichloroethane	2	4	50%	1.00E-03	5.00E-03	2.00E-03	2.00E-03	Failed	-6.51E+00	8.05E-01	Failed	4.35E-03	2.59E-02	5.12E-03	5.12E-03	5.00E-03	Maximum Value
WW-9A	Chloroethane	2	4	50%	5.00E-04	5.00E-04	7.50E-04	2.89E-04	Failed	-7.25E+00	4.00E-01	Failed	1.09E-03	1.60E-03	1.41E-03	1.41E-03	1.00E-03	Maximum Value
WW-9A	Trichloroethene (TCE)	1	4	25%	1.00E-03	1.00E-03	6.25E-04	4.33E-04	Failed	-7.60E+00	8.00E-01	Failed	1.13E-03	8.41E-03	1.70E-03	1.70E-03	1.00E-03	Maximum Value
WWR-1	Benzene	2	32	6%	1.00E-03	1.00E-03	5.47E-03	8.91E-03	Failed	-6.72E+00	1.73E+00	Failed	8.14E-03	1.54E-02	1.36E-02	1.36E-02	1.36E-02	Chebychev 95 UCL limit
WWR-1	trans-1,2-Dichloroethene	4	16	25%	1.00E-03	1.00E-03	5.88E-03	5.64E-03	Failed	-5.60E+00	1.02E+00	Failed	8.35E-03	1.28E-02	1.35E-02	1.35E-02	1.35E-02	Chebychev 95 UCL limit
WWR-1	Tetrachloroethene (PCE)	12	20	60%	8.00E-04	8.00E-04	2.78E-03	4.39E-03	Failed	-6.59E+00	1.05E+00	Failed	4.48E-03	4.55E-03	5.03E-03	5.03E-03	5.03E-03	Chebychev 95 UCL limit
WWR-1	Freon 113	9	12	75%	5.00E-03	8.00E-03	6.00E-03	1.28E-03	Failed	-5.14E+00	2.01E-01	Failed	6.66E-03	6.71E-03	7.55E-03	7.55E-03	7.55E-03	Chebychev 95 UCL limit
WWR-1	Chloroform	6	30	20%	7.00E-04	7.00E-04	3.04E-03	4.26E-03	Failed	-6.42E+00	1.05E+00	Failed	4.36E-03	4.63E-03	5.52E-03	5.52E-03	5.52E-03	Chebychev 95 UCL limit
WWR-1	Trichloroethene (TCE)	40	40	100%	2.90E-01	5.90E-01	4.64E-01	1.02E-01	Failed	-7.93E-01	2.34E-01	Failed	4.91E-01	4.96E-01	5.42E-01	5.42E-01	5.42E-01	Chebychev 95 UCL limit
WWR-1	1,1-Dichloroethene	27	30	90%	1.00E-02	2.00E-02	1.27E-02	2.77E-03	Failed	-4.39E+00	1.89E-01	Failed	1.36E-02	1.35E-02	1.46E-02	1.46E-02	1.46E-02	Chebychev 95 UCL limit
WWR-1	1,1-Dichloroethane	36	40	90%	8.00E-03	1.10E-02	1.06E-02	1.77E-03	Failed	-4.56E+00	1.57E-01	Failed	1.11E-02	1.11E-02	1.18E-02	1.18E-02	1.18E-02	Chebychev 95 UCL limit
WWR-1	1,1,1-Trichloroethane	30	30	100%	5.00E-03	1.80E-02	1.15E-02	4.18E-03	Not failed	-4.54E+00	4.10E-01	Failed	1.28E-02	1.34E-02	1.56E-02	1.28E-02	1.28E-02	Arith. 95 UCL
WWR-1	cis-1,2-Dichloroethene	16	16	100%	1.00E-01	1.60E-01	1.28E-01	2.23E-02	Failed	-2.07E+00	1.74E-01	Failed	1.38E-01	1.39E-01	1.53E-01	1.53E-01	1.53E-01	Chebychev 95 UCL limit
WWR-2	Freon 113	2	3	67%	2.00E-04	6.00E-03	5.40E-03	4.93E-03	Not failed	-6.08E+00	2.13E+00	Not failed	1.37E-02	3.20E+16	3.42E-02	1.37E-02	1.00E-02	Maximum Value
WWR-2	Trichloroethene (TCE)	12	12	100%	2.20E-02	9.50E-01	6.79E-01	3.18E-01	Failed	-8.15E-01	1.41E+00	Failed	8.44E-01	5.70E+00	3.09E+00	3.09E+00	9.50E-01	Maximum Value
WWR-2	Vinyl chloride	2	12	17%	6.00E-04	6.00E-04	2.77E-03	2.33E-03	Failed	-6.42E+00	1.17E+00	Failed	3.98E-03	1.02E-02	7.85E-03	7.85E-03	5.00E-03	Maximum Value
WWR-2	trans-1,2-Dichloroethene	2	6	33%	5.00E-03	5.00E-03	5.17E-03	4.25E-03	Not failed	-5.83E+00	1.40E+00	Failed	8.66E-03	2.51E-01	2.11E-02	8.66E-03	8.66E-03	Arith. 95 UCL
WWR-2	Tetrachloroethene (PCE)	2	6	33%	1.00E-03	2.00E-03	3.50E-03	3.55E-03	Not failed	-6.10E+00	1.08E+00	Not failed	6.42E-03	3.32E-02	1.03E-02	6.42E-03	6.42E-03	Arith. 95 UCL
WWR-2	cis-1,2-Dichloroethene	6	6	100%	4.00E-03	1.20E-01	7.53E-02	5.58E-02	Failed	-3.31E+00	1.72E+00	Failed	1.21E-01	2.65E+01	4.11E-01	4.11E-01	1.20E-01	Maximum Value
WWR-2	Chloroform	1	6	17%	1.00E-03	1.00E-03	3.58E-03	3.51E-03	Not failed	-6.07E+00	1.08E+00	Not failed	6.47E-03	3.43E-02	1.07E-02	6.47E-03	6.47E-03	Arith. 95 UCL
WWR-2	Benzene	1	7	14%	3.00E-04	3.00E-04	1.04E-03	1.75E-03	Failed	-7.54E+00	1.04E+00	Failed	2.33E-03	4.60E-03	2.27E-03	2.27E-03	2.27E-03	Chebychev 95 UCL limit
WWR-2	1,1-Dichloroethene	18	18	100%	3.00E-04	1.70E-02	1.04E-02	5.37E-03	Failed	-5.03E+00	1.43E+00	Failed	1.26E-02	5.78E-02	4.55E-02	4.55E-02	1.70E-02	Maximum Value
WWR-2	1,1,1-Trichloroethane	18	18	100%	4.00E-04	3.30E-02	1.72E-02	1.16E-02	Failed	-4.64E+00	1.54E+00	Failed	2.20E-02	1.18E-01	8.18E-02	8.18E-02	3.30E-02	Maximum Value
WWR-2	1,1-Dichloroethane	12	18	67%	6.00E-03	1.30E-02	8.75E-03	4.42E-03	Failed	-5.10E+00	1.18E+00	Failed	1.06E-02	2.81E-02	2.78E-02	2.78E-02	1.30E-02	Maximum Value
WWR-3	Trichloroethene (TCE)	15	15	100%	3.70E-02	4.10E-02	3.83E-02	1.95E-03	Failed	-3.26E+00	5.01E-02	Failed	3.92E-02	3.92E-02	4.06E-02	4.06E-02	4.06E-02	Chebychev 95 UCL limit
WWR-3	1,1,1-Trichloroethane	15	15	100%	9.00E-03	1.00E-02	9.33E-03	4.88E-04	Failed	-4.68E+00	5.14E-02	Failed	9.56E-03	9.56E-03	9.89E-03	9.89E-03	9.89E-03	Chebychev 95 UCL limit
WWR-3	1,1-Dichloroethane	18	18	100%	8.00E-03	1.00E-02	9.00E-03	8.40E-04	Failed	-4.71E+00	9.38E-02	Failed	9.34E-03	9.36E-03	9.89E-03	9.89E-03	9.89E-03	Chebychev 95 UCL limit
WWR-3	1,1-Dichloroethene	18	18	100%	1.10E-02	1.30E-02	1.20E-02	8.40E-04	Failed	-4.43E+00	7.02E-02	Failed	1.23E-02	1.24E-02	1.29E-02	1.29E-02	1.29E-02	Chebychev 95 UCL limit
WWR-3	Carbon tetrachloride	1	3	33%	1.00E-03	1.00E-03	2.08E-03	2.55E-03	Not failed	-6.83E+00	1.50E+00	Not failed	6.39E-03	3.48E+06	8.35E-03	6.39E-03	5.00E-03	Maximum Value
WWR-3	Chloroform	2	6	33%	2.00E-04	2.00E-04	2.07E-03	2.30E-03	Failed	-6.91E+00	1.44E+00	Not failed	3.96E-03	1.08E-01	7.60E-03	1.08E-01	5.00E-03	Maximum Value

%	Percent.
mg/L	Milligrams per liter.
EPC	Exposure point concentration.
--	Not available or not calculated.

Table 3. Locations of AIr Samples Taken at NRP
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Parcel
2	13
6	15
15	17
21	12
22	12
111	2
148	1
156	4
476	6
543	6
555	3
566	12
583C	1
Hangar 1	18

Table 4. Statistical Data Summary of Chemicals in Air (adjusted for background)
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Location	Analyte	Number of Detections	Number of Analyses	Frequency of Detection (%)	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Arithmetic Average (mg/m3)	Background Corrected Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Background Corrected EPC (mg/m3)	Basis for EPC
111	in	1,1,1-Trichloroethane	2	2	100.0%	5.44E-04	6.66E-04	6.05E-04	1.91E-04	8.63E-05	--	-7.42E+00	1.43E-01	--	--	--	--	--	6.66E-04	2.13E-04	Maximum Value
111	in	1,4-Dichlorobenzene	1	2	50.0%	2.87E-04	2.87E-04	4.34E-04	4.34E-04	2.07E-04	--	-7.80E+00	4.98E-01	--	--	--	--	--	2.87E-04	2.87E-04	Maximum Value
111	in	1,4-Dioxane	1	2	50.0%	8.42E-04	8.42E-04	1.26E-03	1.26E-03	5.95E-04	--	-6.73E+00	4.90E-01	--	--	--	--	--	8.42E-04	8.42E-04	Maximum Value
111	in	Benzene	2	2	100.0%	1.56E-03	2.02E-03	1.79E-03	0.00E+00	3.22E-04	--	-6.34E+00	1.81E-01	--	--	--	--	--	2.02E-03	0.00E+00	Maximum Value
111	in	Chlorobenzene	2	2	100.0%	3.28E-04	4.68E-04	3.98E-04	3.98E-04	9.93E-05	--	-7.85E+00	2.52E-01	--	--	--	--	--	4.68E-04	4.68E-04	Maximum Value
111	in	cis-1,2-Dichloroethene	1	2	50.0%	3.02E-04	3.02E-04	3.43E-04	3.43E-04	5.70E-05	--	-7.99E+00	1.67E-01	--	--	--	--	--	3.02E-04	3.02E-04	Maximum Value
111	in	Ethylbenzene	2	2	100.0%	5.29E-04	5.73E-04	5.51E-04	5.51E-04	3.12E-05	--	-7.50E+00	5.66E-02	--	--	--	--	--	5.73E-04	5.73E-04	Maximum Value
111	in	m,p-xylenes	2	2	100.0%	1.28E-03	1.63E-03	1.46E-03	1.46E-03	2.49E-04	--	-6.54E+00	1.72E-01	--	--	--	--	--	1.63E-03	1.63E-03	Maximum Value
111	in	Methylene chloride	1	2	50.0%	1.27E-03	1.27E-03	7.94E-04	0.00E+00	6.74E-04	--	-7.36E+00	9.80E-01	--	--	--	--	--	1.27E-03	0.00E+00	Maximum Value
111	in	Tetrachloroethene (PCE)	2	2	100.0%	3.31E-04	4.20E-04	3.76E-04	0.00E+00	6.33E-05	--	-7.89E+00	1.69E-01	--	--	--	--	--	4.20E-04	0.00E+00	Maximum Value
111	in	Toluene	2	2	100.0%	3.83E-03	2.76E-02	1.57E-02	1.07E-02	1.68E-02	--	-4.58E+00	1.40E+00	--	--	--	--	--	2.76E-02	2.11E-02	Maximum Value
111	in	Trichloroethene (TCE)	1	2	50.0%	2.24E-04	2.24E-04	3.71E-04	9.22E-05	2.08E-04	--	-7.98E+00	5.94E-01	--	--	--	--	--	2.24E-04	0.00E+00	Maximum Value
111	out	Benzene	1	1	100.0%	4.55E-04	4.55E-04	4.55E-04	0.00E+00	--	--	-7.70E+00	--	--	--	--	--	--	4.55E-04	0.00E+00	Maximum Value
111	out	m,p-xylenes	1	1	100.0%	1.19E-03	1.19E-03	1.19E-03	1.19E-03	--	--	-6.73E+00	--	--	--	--	--	--	1.19E-03	1.19E-03	Maximum Value
111	out	Methylene chloride	1	1	100.0%	6.35E-04	6.35E-04	6.35E-04	0.00E+00	--	--	-7.36E+00	--	--	--	--	--	--	6.35E-04	0.00E+00	Maximum Value
111	out	Tetrachloroethene (PCE)	1	1	100.0%	5.79E-04	5.79E-04	5.79E-04	0.00E+00	--	--	-7.45E+00	--	--	--	--	--	--	5.79E-04	0.00E+00	Maximum Value
111	out	Toluene	1	1	100.0%	2.14E-03	2.14E-03	2.14E-03	0.00E+00	--	--	-6.14E+00	--	--	--	--	--	--	2.14E-03	0.00E+00	Maximum Value
148	in	1,1,1-Trichloroethane	8	9	88.9%	4.50E-04	4.83E-03	1.01E-03	5.93E-04	1.43E-03	Failed	-7.30E+00	7.45E-01	Failed	1.90E-03	1.82E-03	1.84E-03	1.84E-03	1.84E-03	1.38E-03	Chebychev 95 UCL limit
148	in	1,1-Dichloroethane	1	9	11.1%	1.77E-04	1.77E-04	3.68E-04	3.68E-04	7.14E-05	Failed	-7.93E+00	2.64E-01	Failed	4.12E-04	4.46E-04	5.16E-04	5.16E-04	3.91E-04	3.91E-04	Maximum Value
148	in	1,4-Dichlorobenzene	7	9	77.8%	2.99E-04	9.78E-04	5.28E-04	5.28E-04	2.09E-04	Not failed	-7.61E+00	3.68E-01	Not failed	6.58E-04	6.97E-04	8.18E-04	6.58E-04	6.58E-04	6.58E-04	Arith. 95 UCL
148	in	1,4-Dioxane	8	9	88.9%	8.05E-04	2.78E-02	7.69E-03	7.69E-03	8.57E-03	Failed	-5.34E+00	1.05E+00	Not failed	1.30E-02	2.89E-02	2.01E-02	2.89E-02	2.78E-02	2.78E-02	Maximum Value
148	in	Benzene	9	9	100.0%	8.78E-04	2.05E-03	1.34E-03	0.00E+00	3.58E-04	Not failed	-6.64E+00	2.56E-01	Not failed	1.56E-03	1.61E-03	1.86E-03	1.56E-03	1.56E-03	0.00E+00	Arith. 95 UCL
148	in	Chlorobenzene	3	9	33.3%	3.09E-04	2.48E-03	6.69E-04	6.69E-04	6.82E-04	Failed	-7.54E+00	5.98E-01	Failed	1.09E-03	1.06E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	Chebychev 95 UCL limit
148	in	cis-1,2-Dichloroethene	6	9	66.7%	3.30E-04	1.09E-03	5.94E-04	5.94E-04	2.82E-04	Failed	-7.52E+00	4.54E-01	Not failed	7.69E-04	8.55E-04	9.98E-04	8.55E-04	8.55E-04	8.55E-04	Land 95 UCL
148	in	Ethylbenzene	8	9	88.9%	4.15E-04	1.06E-03	6.34E-04	6.34E-04	1.96E-04	Not failed	-7.40E+00	2.97E-01	Not failed	7.55E-04	7.86E-04	9.16E-04	7.55E-04	7.55E-04	7.55E-04	Arith. 95 UCL
148	in	m,p-xylenes	8	9	88.9%	1.15E-03	4.32E-03	1.88E-03	1.88E-03	1.06E-03	Not failed	-6.43E+00	6.37E-01	Not failed	2.54E-03	3.46E-03	3.78E-03	2.54E-03	2.54E-03	2.54E-03	Arith. 95 UCL
148	in	Methylene chloride	5	9	55.6%	1.27E-03	3.53E-03	1.46E-03	4.22E-04	1.32E-03	Failed	-6.99E+00	1.07E+00	Failed	2.27E-03	5.84E-03	3.96E-03	3.96E-03	3.53E-03	2.25E-03	Maximum Value
148	in	Tetrachloroethene (PCE)	9	9	100.0%	3.58E-04	4.96E-04	4.27E-04	0.00E+00	4.66E-05	Not failed	-7.76E+00	1.10E-01	Not failed	4.56E-04	4.59E-04	4.97E-04	4.56E-04	4.56E-04	0.00E+00	Arith. 95 UCL
148	in	Toluene	9	9	100.0%	1.53E-03	2.22E-02	6.09E-03	1.11E-03	6.35E-03	Failed	-5.42E+00	7.98E-01	Not failed	1.00E-02	1.34E-02	1.29E-02	1.34E-02	1.34E-02	6.89E-03	Land 95 UCL
148	in	Trichloroethene (TCE)	7	9	77.8%	2.68E-04	8.19E-03	1.34E-03	1.06E-03	2.58E-03	Failed	-7.40E+00	1.06E+00	Failed	2.94E-03	3.76E-03	2.58E-03	2.58E-03	2.58E-03	2.22E-03	Chebychev 95 UCL limit
148	out	1,4-Dioxane	1	1	100.0%	8.05E-03	8.05E-03	8.05E-03	8.05E-03	--	--	-4.82E+00	--	--	--	--	--	--	8.05E-03	8.05E-03	Maximum Value
148	out	Benzene	1	1	100.0%	8.45E-04	8.45E-04	8.45E-04	0.00E+00	--	--	-7.08E+00	--	--	--	--	--	--	8.45E-04	0.00E+00	Maximum Value
148	out	Ethylbenzene	1	1	100.0%	1.10E-03	1.10E-03	1.10E-03	1.10E-03	--	--	-6.81E+00	--	--	--	--	--	--	1.10E-03	1.10E-03	Maximum Value
148	out	m,p-xylenes	1	1	100.0%	4.01E-03	4.01E-03	4.01E-03	4.01E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.01E-03	4.01E-03	Maximum Value
148	out	Methylene chloride	1	1	100.0%	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	--	-7.54E+00	--	--	--	--	--	--	5.29E-04	0.00E+00	Maximum Value
148	out	Toluene	1	1	100.0%	6.51E-03	6.51E-03	6.51E-03	1.53E-03	--	--	-5.03E+00	--	--	--	--	--	--	6.51E-03	2.42E-05	Maximum Value
15	in	1,4-Dioxane	2	2	100.0%	2.16E-03	4.03E-03	3.09E-03	3.09E-03	1.32E-03	--	-5.83E+00	4.40E-01	--	--	--	--	--	4.03E-03	4.03E-03	Maximum Value
15	in	Benzene	2	2	100.0%	6.50E-04	9.75E-04	8.13E-04	0.00E+00	2.30E-04	--	-7.14E+00	2.87E-01	--	--	--	--	--	9.75E-04	0.00E+00	Maximum Value
15	in	cis-1,2-Dichloroethene	1	2	50.0%	4.84E-04	4.84E-04	3.26E-04	3.26E-04	2.22E-04	--	-8.16E+00	7.42E-01	--	--	--	--	--	4.84E-04	4.84E-04	Maximum Value
15	in	Ethylbenzene	2	2	100.0%	5.29E-04	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	-7.54E+00	0.00E+00	--	--	--	--	--	5.29E-04	5.29E-04	Maximum Value
15	in	m,p-xylenes	2	2	100.0%	1.76E-03	2.47E-03	2.12E-03	2.12E-03	4.99E-04	--	-6.17E+00	2.38E-01	--	--	--	--	--	2.47E-03	2.47E-03	Maximum Value
15	in	Methylene chloride	2	2	100.0%	7.41E-04	7.77E-04	7.59E-04	0.00E+00	2.50E-05	--	-7.18E+00	3.29E-02	--	--	--	--	--	7.77E-04	0.00E+00	Maximum Value
15	in	Tetrachloroethene (PCE)	2	2	100.0%	2.07E-03	2.96E-03	2.51E-03	1.87E-03	6.33E-04	--	-6.00E+00	2.55E-01	--	--	--	--	--	2.96E-03	2.21E-03	Maximum Value
15	in	Toluene	2	2	100.0%	2.95E-03	3.56E-03	3.26E-03	0.00E+00	4.33E-04	--	-5.73E+00	1.33E-01	--	--	--	--	--	3.56E-03	0.00E+00	Maximum Value
15	in	Trichloroethene (TCE)	2	2	100.0%	4.37E-04	5.46E-04	4.91E-04	2.12E-04	7.72E-05	--	-7.62E+00	1.58E-01	--	--	--	--	--	5.46E-04	1.86E-04	Maximum Value
15	out	Benzene	1	1	100.0%	4.88E-04	4.88E-04	4.88E-04	0.00E+00	--	--	-7.63E+00	--	--	--	--	--	--	4.88E-04	0.00E+00	Maximum Value
15	out	Ethylbenzene	1	1	100.0%	3.84E-04	3.84E-04	3.84E-04	3.84E-04	--	--	-7.87E+00	--	--	--	--	--	--	3.84E-04	3.84E-04	Maximum Value
15	out	m,p-xylenes	1	1	100.0%	1.41E-03	1.41E-03	1.41E-03	1.41E-03	--	--	-6.56E+00	--	--	--	--	--	--	1.41E-03	1.41E-03	Maximum Value
15	out	Methylene chloride	1	1	100.0%	7.06E-04	7.06E-04	7.06E-04	0.00E+00	--	--	-7.26E+00	--	--	--	--	--	--	7.06E-04	0.00E+00	Maximum Value
15	out	Tetrachloroethene (PCE)	1	1	100.0%	1.24E-03	1.24E-03	1.24E-03	6.00E-04	--	--	-6.69E+00	--	--	--	--	--	--	1.24E-03	4.87E-04	Maximum Value
15	out	Toluene	1	1	100.0%	2.11E-03	2.11E-03	2.11E-03	0.00E+00	--	--	-6.16E+00	--	--	--	--	--	--	2.11E-03	0.00E+00	Maximum Value
15	out	Trichloroethene (TCE)	1	1	100.0%	6.55E-04	6.55E-04	6.55E-04	3.76E-04	--	--	-7.33E+00	--	--	--	--	--	--	6.55E-04	2.95E-04	Maximum Value
156	in	1,1,1-Trichloroethane	8	8	100.0%	1.22E-03	4.27E-03	2.90E-03	2.49E-03	1.13E-03	Not failed	-5.92E+00	4.44E-01	Not failed	3.66E-03	4.33E-03	4.99E-03	3.66E-03	3.66E-03	3.20E-03	Arith. 95 UCL
156	in	1,2-Dichloroethane	1	8	12.5%	4.11E-04	4.11E-04	3.93E-04	3.93E-04	7.27E-06	Failed	-7.84E+00	1.81E-02	Failed	3.98E-04	3.98E-04	4.04E-04	4.04E-04	4.04E-04	4.04E-04	Chebychev 95 UCL limit
156	in	1,4-Dichlorobenzene	8	8	100.0%	9.17E-04	4.83E-02	2.40E-02	2.40E-02	1.57E-02	Not failed	-4.14E+00	1.28E+00	Failed	3.45E-02	2.67E-01	9.48E-02	3.45E-02	3.45E-02	3.45E-02	Arith. 95 UCL
156	in	1,4-Dioxane	6	8	75.0%	8.42E-04	7.69E-02	1.21E-02	1.21E-02	2.64E-02	Failed	-5.79E+00	1.53E+00	Failed	2.98E-02	1.57E-01	2.64E-02	2.64E-02	2.64E-02	2.64E-02	Chebychev 95 UCL limit
156	in	Benzene	8	8	100.0%	2.05E-03	5.20E-03	2.76E-03	9.69E-04	1.03E-03	Failed	-5.94E+00	2.98E-01	Failed	3.45E-03	3.48E-03	4.04E-03	4.04E-03	4.04E-03	1.51E-03	Chebychev 95 UCL limit
156	in	Chlorobenzene	5	8	62.5%	2.34E-04	1.22E-03	5.17E-04	5.17E-04	3.23E-04	Failed	-7.70E+00	5.35E-01	Not failed	7.34E-04	8.47E-04	9.45E-04	8.47E-04	8.47E-04	8.47E-04	Land 95 UCL
156	in	cis-1,2-Dichloroethene	6	8	75.0%	1.09E-03	1.25E-03	9.67E-04	9.67E-04	3.67E-04	Failed	-7.04E+00	5.16E-01	Failed	1.21E-03	1.60E-03	1.80E-03	1.80E-03	1.25E-03	1.25E-03	Maximum Value

Table 4. Statistical Data Summary of Chemicals in Air (adjusted for background)
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Location	Analyte	Number of Detections	Number of Analyses	Frequency of Detection (%)	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Arithmetic Average (mg/m3)	Background Corrected Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Background Corrected EPC (mg/m3)	Basis for EPC
156	in	Ethylbenzene	8	8	100.0%	4.37E-04	2.16E-03	1.61E-03	1.61E-03	5.05E-04	Failed	-6.51E+00	5.04E-01	Failed	1.95E-03	2.65E-03	3.00E-03	3.00E-03	2.16E-03	2.16E-03	Maximum Value
156	in	m,p-xylenes	8	8	100.0%	9.26E-04	7.94E-03	5.46E-03	5.46E-03	2.08E-03	Not failed	-5.34E+00	6.81E-01	Failed	6.86E-03	1.20E-02	1.22E-02	6.86E-03	6.86E-03	6.86E-03	Arith. 95 UCL
156	in	Methylene chloride	8	8	100.0%	4.24E-04	2.65E-03	1.53E-03	4.94E-04	6.10E-04	Not failed	-6.58E+00	5.25E-01	Failed	1.94E-03	2.56E-03	2.87E-03	1.94E-03	1.94E-03	6.55E-04	Arith. 95 UCL
156	in	Tetrachloroethene (PCE)	8	8	100.0%	4.69E-04	1.58E-03	1.17E-03	5.29E-04	3.49E-04	Not failed	-6.81E+00	3.84E-01	Failed	1.40E-03	1.64E-03	1.90E-03	1.40E-03	1.40E-03	6.51E-04	Arith. 95 UCL
156	in	Toluene	8	8	100.0%	5.74E-03	1.69E-02	1.09E-02	5.89E-03	3.18E-03	Not failed	-4.56E+00	3.06E-01	Not failed	1.30E-02	1.39E-02	1.62E-02	1.30E-02	1.30E-02	6.51E-03	Arith. 95 UCL
156	in	Trichloroethene (TCE)	7	8	87.5%	1.09E-03	4.59E-03	3.18E-03	2.90E-03	1.53E-03	Failed	-5.95E+00	8.00E-01	Failed	4.21E-03	8.77E-03	7.84E-03	7.84E-03	4.59E-03	4.23E-03	Maximum Value
156	out	1,4-Dioxane	1	1	100.0%	8.05E-03	8.05E-03	8.05E-03	8.05E-03	--	--	-4.82E+00	--	--	--	--	--	--	8.05E-03	8.05E-03	Maximum Value
156	out	Benzene	1	1	100.0%	8.45E-04	8.45E-04	8.45E-04	0.00E+00	--	--	-7.08E+00	--	--	--	--	--	--	8.45E-04	0.00E+00	Maximum Value
156	out	Ethylbenzene	1	1	100.0%	1.10E-03	1.10E-03	1.10E-03	1.10E-03	--	--	-6.81E+00	--	--	--	--	--	--	1.10E-03	1.10E-03	Maximum Value
156	out	m,p-xylenes	1	1	100.0%	4.01E-03	4.01E-03	4.01E-03	4.01E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.01E-03	4.01E-03	Maximum Value
156	out	Methylene chloride	1	1	100.0%	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	--	-7.54E+00	--	--	--	--	--	--	5.29E-04	0.00E+00	Maximum Value
156	out	Toluene	1	1	100.0%	6.51E-03	6.51E-03	6.51E-03	1.53E-03	--	--	-5.03E+00	--	--	--	--	--	--	6.51E-03	2.42E-05	Maximum Value
2	in	1,4-Dichlorobenzene	1	1	100.0%	9.17E-04	9.17E-04	9.17E-04	9.17E-04	--	--	-6.99E+00	--	--	--	--	--	--	9.17E-04	9.17E-04	Maximum Value
2	in	1,4-Dioxane	2	2	100.0%	1.68E-03	3.66E-03	2.67E-03	2.67E-03	1.40E-03	--	-6.00E+00	5.49E-01	--	--	--	--	--	3.66E-03	3.66E-03	Maximum Value
2	in	Benzene	2	2	100.0%	5.20E-04	6.83E-04	6.01E-04	0.00E+00	1.15E-04	--	-7.43E+00	1.92E-01	--	--	--	--	--	6.83E-04	0.00E+00	Maximum Value
2	in	cis-1,2-Dichloroethene	1	2	50.0%	3.79E-04	3.79E-04	2.68E-04	2.68E-04	1.57E-04	--	-8.32E+00	6.22E-01	--	--	--	--	--	3.79E-04	3.79E-04	Maximum Value
2	in	Ethylbenzene	2	2	100.0%	3.44E-04	4.85E-04	4.15E-04	4.15E-04	9.98E-05	--	-7.80E+00	2.43E-01	--	--	--	--	--	4.85E-04	4.85E-04	Maximum Value
2	in	m,p-xylenes	2	2	100.0%	1.28E-03	2.12E-03	1.70E-03	1.70E-03	5.92E-04	--	-6.41E+00	3.56E-01	--	--	--	--	--	2.12E-03	2.12E-03	Maximum Value
2	in	Methylene chloride	2	2	100.0%	8.82E-04	2.97E-03	1.92E-03	8.91E-04	1.47E-03	--	-6.43E+00	8.57E-01	--	--	--	--	--	2.97E-03	1.69E-03	Maximum Value
2	in	Tetrachloroethene (PCE)	2	2	100.0%	8.96E-04	7.58E-03	4.24E-03	3.60E-03	4.73E-03	--	-5.95E+00	1.51E+00	--	--	--	--	--	7.58E-03	6.83E-03	Maximum Value
2	in	Toluene	2	2	100.0%	2.22E-03	3.22E-03	2.72E-03	0.00E+00	7.04E-04	--	-5.92E+00	2.62E-01	--	--	--	--	--	3.22E-03	0.00E+00	Maximum Value
2	in	Trichloroethene (TCE)	2	2	100.0%	4.80E-04	7.64E-04	6.22E-04	3.43E-04	2.01E-04	--	-7.41E+00	3.28E-01	--	--	--	--	--	7.64E-04	4.04E-04	Maximum Value
2	out	Benzene	1	1	100.0%	4.88E-04	4.88E-04	4.88E-04	0.00E+00	--	--	-7.63E+00	--	--	--	--	--	--	4.88E-04	0.00E+00	Maximum Value
2	out	Ethylbenzene	1	1	100.0%	3.84E-04	3.84E-04	3.84E-04	3.84E-04	--	--	-7.87E+00	--	--	--	--	--	--	3.84E-04	3.84E-04	Maximum Value
2	out	m,p-xylenes	1	1	100.0%	1.41E-03	1.41E-03	1.41E-03	1.41E-03	--	--	-6.56E+00	--	--	--	--	--	--	1.41E-03	1.41E-03	Maximum Value
2	out	Methylene chloride	1	1	100.0%	7.06E-04	7.06E-04	7.06E-04	0.00E+00	--	--	-7.26E+00	--	--	--	--	--	--	7.06E-04	0.00E+00	Maximum Value
2	out	Tetrachloroethene (PCE)	1	1	100.0%	1.24E-03	1.24E-03	1.24E-03	6.00E-04	--	--	-6.69E+00	--	--	--	--	--	--	1.24E-03	4.87E-04	Maximum Value
2	out	Toluene	1	1	100.0%	2.11E-03	2.11E-03	2.11E-03	0.00E+00	--	--	-6.16E+00	--	--	--	--	--	--	2.11E-03	0.00E+00	Maximum Value
2	out	Trichloroethene (TCE)	1	1	100.0%	6.55E-04	6.55E-04	6.55E-04	3.76E-04	--	--	-7.33E+00	--	--	--	--	--	--	6.55E-04	2.95E-04	Maximum Value
21	in	1,1,1-Trichloroethane	3	3	100.0%	5.55E-04	1.17E-03	9.44E-04	5.29E-04	3.38E-04	Not failed	-7.02E+00	4.15E-01	Not failed	1.51E-03	4.77E-03	1.94E-03	1.51E-03	1.17E-03	7.13E-04	Maximum Value
21	in	1,4-Dichlorobenzene	3	3	100.0%	4.34E-04	1.53E-03	8.35E-04	8.35E-04	6.02E-04	Not failed	-7.25E+00	6.71E-01	Not failed	1.85E-03	5.65E-02	2.17E-03	1.85E-03	1.53E-03	1.53E-03	Maximum Value
21	in	1,4-Dioxane	2	3	66.7%	1.24E-03	2.16E-02	8.17E-03	8.17E-03	1.16E-02	Failed	-5.64E+00	1.57E+00	Not failed	2.78E-02	8.91E+07	2.97E-02	8.91E+07	2.16E-02	2.16E-02	Maximum Value
21	in	Benzene	3	3	100.0%	1.43E-03	2.28E-03	1.91E-03	1.13E-04	4.33E-04	Not failed	-6.28E+00	2.41E-01	Not failed	2.64E-03	3.55E-03	3.09E-03	2.64E-03	2.27E-03	0.00E+00	Maximum Value
21	in	Chlorobenzene	1	3	33.3%	3.32E-04	3.32E-04	4.07E-04	4.07E-04	6.48E-05	Failed	-7.82E+00	1.68E-01	Failed	5.16E-04	5.92E-04	5.83E-04	5.83E-04	4.45E-04	4.45E-04	Maximum Value
21	in	cis-1,2-Dichloroethene	3	3	100.0%	3.99E-04	1.73E-03	9.39E-04	9.39E-04	7.02E-04	Not failed	-7.16E+00	7.43E-01	Not failed	2.12E-03	1.66E-01	2.60E-03	2.12E-03	1.73E-03	1.73E-03	Maximum Value
21	in	Ethylbenzene	3	3	100.0%	6.17E-04	4.41E-03	2.06E-03	2.06E-03	2.05E-03	Not failed	-6.53E+00	1.01E+00	Not failed	5.52E-03	2.69E+01	6.62E-03	5.52E-03	4.41E-03	4.41E-03	Maximum Value
21	in	m,p-xylenes	3	3	100.0%	1.90E-03	1.72E-02	7.66E-03	7.66E-03	8.32E-03	Not failed	-5.29E+00	1.12E+00	Not failed	2.17E-02	1.14E+03	2.60E-02	2.17E-02	1.72E-02	1.72E-02	Maximum Value
21	in	Methylene chloride	3	3	100.0%	1.69E-03	9.18E-03	4.21E-03	3.18E-03	4.30E-03	Failed	-5.80E+00	9.64E-01	Failed	1.15E-02	2.57E+01	1.30E-02	1.30E-02	9.18E-03	7.90E-03	Maximum Value
21	in	Tetrachloroethene (PCE)	3	3	100.0%	4.07E-04	4.82E-04	4.52E-04	0.00E+00	4.04E-05	Not failed	-7.70E+00	9.15E-02	Not failed	5.21E-04	5.40E-04	5.59E-04	5.21E-04	4.82E-04	0.00E+00	Maximum Value
21	in	Toluene	3	3	100.0%	4.21E-03	3.83E-02	1.56E-02	1.06E-02	1.97E-02	Failed	-4.73E+00	1.27E+00	Failed	4.88E-02	6.44E+04	5.36E-02	5.36E-02	3.83E-02	3.18E-02	Maximum Value
21	in	Trichloroethene (TCE)	3	3	100.0%	7.10E-04	2.57E-03	1.77E-03	1.49E-03	9.54E-04	Not failed	-6.47E+00	6.83E-01	Not failed	3.37E-03	1.44E-01	4.79E-03	3.37E-03	2.57E-03	2.21E-03	Maximum Value
21	out	1,1,1-Trichloroethane	1	1	100.0%	5.38E-04	5.38E-04	5.38E-04	1.24E-04	--	--	-7.53E+00	--	--	--	--	--	--	5.38E-04	8.54E-05	Maximum Value
21	out	1,4-Dichlorobenzene	1	1	100.0%	3.06E-04	3.06E-04	3.06E-04	3.06E-04	--	--	-8.09E+00	--	--	--	--	--	--	3.06E-04	3.06E-04	Maximum Value
21	out	Benzene	1	1	100.0%	1.14E-03	1.14E-03	1.14E-03	0.00E+00	--	--	-6.78E+00	--	--	--	--	--	--	1.14E-03	0.00E+00	Maximum Value
21	out	cis-1,2-Dichloroethene	1	1	100.0%	3.47E-04	3.47E-04	3.47E-04	3.47E-04	--	--	-7.97E+00	--	--	--	--	--	--	3.47E-04	3.47E-04	Maximum Value
21	out	Ethylbenzene	1	1	100.0%	4.41E-04	4.41E-04	4.41E-04	4.41E-04	--	--	-7.73E+00	--	--	--	--	--	--	4.41E-04	4.41E-04	Maximum Value
21	out	m,p-xylenes	1	1	100.0%	1.19E-03	1.19E-03	1.19E-03	1.19E-03	--	--	-6.73E+00	--	--	--	--	--	--	1.19E-03	1.19E-03	Maximum Value
21	out	Tetrachloroethene (PCE)	1	1	100.0%	4.07E-04	4.07E-04	4.07E-04	0.00E+00	--	--	-7.81E+00	--	--	--	--	--	--	4.07E-04	0.00E+00	Maximum Value
21	out	Toluene	1	1	100.0%	3.83E-03	3.83E-03	3.83E-03	0.00E+00	--	--	-5.56E+00	--	--	--	--	--	--	3.83E-03	0.00E+00	Maximum Value
22	in	1,1,1-Trichloroethane	1	1	100.0%	7.77E-05	7.77E-05	7.77E-05	0.00E+00	--	--	-9.46E+00	--	--	--	--	--	--	7.77E-05	0.00E+00	Maximum Value
22	in	1,4-Dioxane	1	1	100.0%	2.60E-03	2.60E-03	2.60E-03	2.60E-03	--	--	-5.95E+00	--	--	--	--	--	--	2.60E-03	2.60E-03	Maximum Value
22	in	Benzene	1	1	100.0%	1.63E-03	1.63E-03	1.63E-03	0.00E+00	--	--	-6.42E+00	--	--	--	--	--	--	1.63E-03	0.00E+00	Maximum Value
22	in	cis-1,2-Dichloroethene	1	1	100.0%	3.34E-04	3.34E-04	3.34E-04	3.34E-04	--	--	-8.00E+00	--	--	--	--	--	--	3.34E-04	3.34E-04	Maximum Value
22	in	Ethylbenzene	1	1	100.0%	1.50E-03	1.50E-03	1.50E-03	1.50E-03	--	--	-6.50E+00	--	--	--	--	--	--	1.50E-03	1.50E-03	Maximum Value
22	in	m,p-xylenes	1	1	100.0%	4.41E-03	4.41E-03	4.41E-03	4.41E-03	--	--	-5.42E+00	--	--	--	--	--	--	4.41E-03	4.41E-03	Maximum Value
22	in	Methylene chloride	1	1	100.0%	7.77E-03	7.77E-03	7.77E-03	6.73E-03	--	--	-4.86E+00	--	--	--	--	--	--	7.77E-03	6.49E-03	Maximum Value
22	in	Tetrachloroethene (PCE)	1	1	100.0%	6.75E-04	6.75E-04	6.75E-04	3.47E-05	--	--	-7.30E+00	--	--	--	--	--	--	6.75E-04	0.00E+00	Maximum Value
22	in	Toluene	1	1	100.0%	1.61E-02	1.61E-02	1.61E-02	1.11E-02	--	--	-4.13E+00	--	--	--	--	--	--	1.61E-02	9.60E-03	Maximum Value
22	in	Trichloroethene (TCE)	1	1	100.0%	2.84E-04	2.84E-04	2.84E-04	4.85E-06	--	--	-8.17E+00	--	--	--	--	--	--	2.84E-04	0.00E+00	Maximum Value

Table 4. Statistical Data Summary of Chemicals in Air (adjusted for background)
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Location	Analyte	Number of Detections	Number of Analyses	Frequency of Detection (%)	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Arithmetic Average (mg/m3)	Background Corrected Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Background Corrected EPC (mg/m3)	Basis for EPC
22	out	1,1,1-Trichloroethane	1	1	100.0%	5.38E-04	5.38E-04	5.38E-04	1.24E-04	--	--	-7.53E+00	--	--	--	--	--	--	5.38E-04	8.54E-05	Maximum Value
22	out	1,4-Dichlorobenzene	1	1	100.0%	3.06E-04	3.06E-04	3.06E-04	3.06E-04	--	--	-8.09E+00	--	--	--	--	--	--	3.06E-04	3.06E-04	Maximum Value
22	out	Benzene	1	1	100.0%	1.14E-03	1.14E-03	1.14E-03	0.00E+00	--	--	-6.78E+00	--	--	--	--	--	--	1.14E-03	0.00E+00	Maximum Value
22	out	cis-1,2-Dichloroethene	1	1	100.0%	3.47E-04	3.47E-04	3.47E-04	3.47E-04	--	--	-7.97E+00	--	--	--	--	--	--	3.47E-04	3.47E-04	Maximum Value
22	out	Ethylbenzene	1	1	100.0%	4.41E-04	4.41E-04	4.41E-04	4.41E-04	--	--	-7.73E+00	--	--	--	--	--	--	4.41E-04	4.41E-04	Maximum Value
22	out	m,p-xylenes	1	1	100.0%	1.19E-03	1.19E-03	1.19E-03	1.19E-03	--	--	-6.73E+00	--	--	--	--	--	--	1.19E-03	1.19E-03	Maximum Value
22	out	Tetrachloroethene (PCE)	1	1	100.0%	4.07E-04	4.07E-04	4.07E-04	0.00E+00	--	--	-7.81E+00	--	--	--	--	--	--	4.07E-04	0.00E+00	Maximum Value
22	out	Toluene	1	1	100.0%	3.83E-03	3.83E-03	3.83E-03	0.00E+00	--	--	-5.56E+00	--	--	--	--	--	--	3.83E-03	0.00E+00	Maximum Value
476	in	1,4-Dichlorobenzene	2	5	40.0%	7.94E-04	1.04E-03	5.28E-04	5.28E-04	3.66E-04	Not failed	-7.74E+00	6.81E-01	Not failed	8.77E-04	1.87E-03	1.22E-03	8.77E-04	8.77E-04	8.77E-04	Arith. 95 UCL
476	in	1,4-Dioxane	5	5	100.0%	1.83E-03	2.01E-02	6.89E-03	6.89E-03	7.49E-03	Failed	-5.34E+00	8.84E-01	Not failed	1.40E-02	4.99E-02	1.76E-02	4.99E-02	2.01E-02	2.01E-02	Maximum Value
476	in	Benzene	5	5	100.0%	3.90E-04	6.83E-04	4.94E-04	0.00E+00	1.16E-04	Not failed	-7.63E+00	2.19E-01	Not failed	6.04E-04	6.34E-04	7.09E-04	6.04E-04	6.04E-04	0.00E+00	Arith. 95 UCL
476	in	Ethylbenzene	5	5	100.0%	6.61E-04	3.09E-03	1.38E-03	1.38E-03	9.82E-04	Failed	-6.75E+00	5.89E-01	Not failed	2.31E-03	3.64E-03	2.91E-03	3.64E-03	3.09E-03	3.09E-03	Maximum Value
476	in	m,p-xylenes	5	5	100.0%	8.82E-04	4.41E-03	1.98E-03	1.98E-03	1.41E-03	Not failed	-6.38E+00	6.06E-01	Not failed	3.33E-03	5.52E-03	4.27E-03	3.33E-03	3.33E-03	3.33E-03	Arith. 95 UCL
476	in	Methylene chloride	5	5	100.0%	7.77E-04	1.31E-03	1.07E-03	3.32E-05	2.27E-04	Not failed	-6.86E+00	2.20E-01	Not failed	1.28E-03	1.37E-03	1.53E-03	1.28E-03	1.28E-03	2.10E-06	Arith. 95 UCL
476	in	Tetrachloroethene (PCE)	2	5	40.0%	6.89E-04	1.03E-03	5.33E-04	0.00E+00	3.24E-04	Not failed	-7.67E+00	5.67E-01	Not failed	8.42E-04	1.34E-03	1.12E-03	8.42E-04	8.42E-04	8.95E-05	Arith. 95 UCL
476	in	Toluene	5	5	100.0%	8.43E-03	9.57E-02	2.84E-02	2.34E-02	3.77E-02	Failed	-4.05E+00	9.77E-01	Failed	6.44E-02	2.92E-01	7.16E-02	7.16E-02	7.16E-02	6.51E-02	Chebychev 95 UCL limit
476	out	1,4-Dioxane	1	1	100.0%	8.05E-03	8.05E-03	8.05E-03	8.05E-03	--	--	-4.82E+00	--	--	--	--	--	--	8.05E-03	8.05E-03	Maximum Value
476	out	Benzene	1	1	100.0%	8.45E-04	8.45E-04	8.45E-04	0.00E+00	--	--	-7.08E+00	--	--	--	--	--	--	8.45E-04	0.00E+00	Maximum Value
476	out	Ethylbenzene	1	1	100.0%	1.10E-03	1.10E-03	1.10E-03	1.10E-03	--	--	-6.81E+00	--	--	--	--	--	--	1.10E-03	1.10E-03	Maximum Value
476	out	m,p-xylenes	1	1	100.0%	4.01E-03	4.01E-03	4.01E-03	4.01E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.01E-03	4.01E-03	Maximum Value
476	out	Methylene chloride	1	1	100.0%	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	--	-7.54E+00	--	--	--	--	--	--	5.29E-04	0.00E+00	Maximum Value
476	out	Toluene	1	1	100.0%	6.51E-03	6.51E-03	6.51E-03	1.53E-03	--	--	-5.03E+00	--	--	--	--	--	--	6.51E-03	2.42E-05	Maximum Value
543	in	1,1,1-Trichloroethane	1	5	20.0%	4.27E-04	4.27E-04	2.85E-04	0.00E+00	7.95E-05	Failed	-8.19E+00	2.41E-01	Failed	3.61E-04	3.76E-04	4.21E-04	4.21E-04	4.21E-04	0.00E+00	Chebychev 95 UCL limit
543	in	1,4-Dichlorobenzene	2	5	40.0%	5.19E-04	9.17E-04	4.53E-04	4.53E-04	2.79E-04	Failed	-7.83E+00	5.39E-01	Not failed	7.20E-04	1.06E-03	9.24E-04	1.06E-03	9.17E-04	9.17E-04	Maximum Value
543	in	1,4-Dioxane	5	5	100.0%	2.42E-03	1.65E-02	9.27E-03	9.27E-03	5.06E-03	Not failed	-4.85E+00	7.15E-01	Not failed	1.41E-02	3.84E-02	2.30E-02	1.41E-02	1.41E-02	1.41E-02	Arith. 95 UCL
543	in	Benzene	5	5	100.0%	5.85E-04	2.31E-03	1.44E-03	0.00E+00	7.74E-04	Not failed	-6.69E+00	6.45E-01	Not failed	2.17E-03	4.63E-03	3.30E-03	2.17E-03	2.17E-03	0.00E+00	Arith. 95 UCL
543	in	Ethylbenzene	4	5	80.0%	4.85E-04	6.17E-03	2.25E-03	2.25E-03	2.64E-03	Not failed	-6.85E+00	1.45E+00	Not failed	4.76E-03	4.62E-01	8.15E-03	4.76E-03	4.76E-03	4.76E-03	Arith. 95 UCL
543	in	m,p-xylenes	4	5	80.0%	1.76E-03	2.87E-02	9.80E-03	9.80E-03	1.24E-02	Not failed	-5.74E+00	1.98E+00	Not failed	2.16E-02	2.18E+02	4.97E-02	2.16E-02	2.16E-02	2.16E-02	Arith. 95 UCL
543	in	Methylene chloride	5	5	100.0%	4.59E-04	8.47E-04	6.92E-04	0.00E+00	1.70E-04	Not failed	-7.30E+00	2.67E-01	Not failed	8.54E-04	9.53E-04	1.06E-03	8.54E-04	8.47E-04	0.00E+00	Maximum Value
543	in	Toluene	5	5	100.0%	7.66E-04	3.83E-02	1.29E-02	7.95E-03	1.63E-02	Not failed	-5.24E+00	1.62E+00	Not failed	2.84E-02	9.36E+00	5.05E-02	2.84E-02	2.84E-02	2.19E-02	Arith. 95 UCL
543	out	1,4-Dioxane	1	1	100.0%	8.05E-03	8.05E-03	8.05E-03	8.05E-03	--	--	-4.82E+00	--	--	--	--	--	--	8.05E-03	8.05E-03	Maximum Value
543	out	Benzene	1	1	100.0%	8.45E-04	8.45E-04	8.45E-04	0.00E+00	--	--	-7.08E+00	--	--	--	--	--	--	8.45E-04	0.00E+00	Maximum Value
543	out	Ethylbenzene	1	1	100.0%	1.10E-03	1.10E-03	1.10E-03	1.10E-03	--	--	-6.81E+00	--	--	--	--	--	--	1.10E-03	1.10E-03	Maximum Value
543	out	m,p-xylenes	1	1	100.0%	4.01E-03	4.01E-03	4.01E-03	4.01E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.01E-03	4.01E-03	Maximum Value
543	out	Methylene chloride	1	1	100.0%	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	--	-7.54E+00	--	--	--	--	--	--	5.29E-04	0.00E+00	Maximum Value
543	out	Toluene	1	1	100.0%	6.51E-03	6.51E-03	6.51E-03	1.53E-03	--	--	-5.03E+00	--	--	--	--	--	--	6.51E-03	2.42E-05	Maximum Value
555	in	1,1,1-Trichloroethane	2	2	100.0%	5.55E-04	8.88E-04	7.22E-04	3.07E-04	2.35E-04	--	-7.26E+00	3.32E-01	--	--	--	--	--	8.88E-04	4.35E-04	Maximum Value
555	in	Benzene	2	2	100.0%	7.15E-04	8.13E-04	7.64E-04	0.00E+00	6.89E-05	--	-7.18E+00	9.04E-02	--	--	--	--	--	8.13E-04	0.00E+00	Maximum Value
555	in	cis-1,2-Dichloroethene	1	2	50.0%	8.46E-04	8.46E-04	4.96E-04	4.96E-04	4.96E-04	--	-7.96E+00	1.25E+00	--	--	--	--	--	8.46E-04	8.46E-04	Maximum Value
555	in	Ethylbenzene	2	2	100.0%	4.85E-04	5.73E-04	5.29E-04	5.29E-04	6.24E-05	--	-7.55E+00	1.18E-01	--	--	--	--	--	5.73E-04	5.73E-04	Maximum Value
555	in	m,p-xylenes	2	2	100.0%	1.59E-03	2.07E-03	1.83E-03	1.83E-03	3.43E-04	--	-6.31E+00	1.89E-01	--	--	--	--	--	2.07E-03	2.07E-03	Maximum Value
555	in	Methylene chloride	2	2	100.0%	7.06E-04	7.41E-04	7.24E-04	0.00E+00	2.50E-05	--	-7.23E+00	3.45E-02	--	--	--	--	--	7.41E-04	0.00E+00	Maximum Value
555	in	Tetrachloroethene (PCE)	1	2	50.0%	6.75E-04	6.75E-04	4.74E-04	0.00E+00	2.85E-04	--	-7.75E+00	6.43E-01	--	--	--	--	--	6.75E-04	0.00E+00	Maximum Value
555	in	Toluene	2	2	100.0%	2.91E-03	3.22E-03	3.06E-03	0.00E+00	2.17E-04	--	-5.79E+00	7.08E-02	--	--	--	--	--	3.22E-03	0.00E+00	Maximum Value
555	in	Trichloroethene (TCE)	2	2	100.0%	4.53E-04	5.46E-04	5.00E-04	2.21E-04	6.56E-05	--	-7.61E+00	1.32E-01	--	--	--	--	--	5.46E-04	1.86E-04	Maximum Value
555	out	1,4-Dioxane	1	1	100.0%	8.05E-03	8.05E-03	8.05E-03	8.05E-03	--	--	-4.82E+00	--	--	--	--	--	--	8.05E-03	8.05E-03	Maximum Value
555	out	Benzene	1	1	100.0%	8.45E-04	8.45E-04	8.45E-04	0.00E+00	--	--	-7.08E+00	--	--	--	--	--	--	8.45E-04	0.00E+00	Maximum Value
555	out	Ethylbenzene	1	1	100.0%	1.10E-03	1.10E-03	1.10E-03	1.10E-03	--	--	-6.81E+00	--	--	--	--	--	--	1.10E-03	1.10E-03	Maximum Value
555	out	m,p-xylenes	1	1	100.0%	4.01E-03	4.01E-03	4.01E-03	4.01E-03	--	--	-5.52E+00	--	--	--	--	--	--	4.01E-03	4.01E-03	Maximum Value
555	out	Methylene chloride	1	1	100.0%	5.29E-04	5.29E-04	5.29E-04	0.00E+00	--	--	-7.54E+00	--	--	--	--	--	--	5.29E-04	0.00E+00	Maximum Value
555	out	Toluene	1	1	100.0%	6.51E-03	6.51E-03	6.51E-03	1.53E-03	--	--	-5.03E+00	--	--	--	--	--	--	6.51E-03	2.42E-05	Maximum Value
566	in	1,2-Dichlorobenzene	1	13	7.7%	3.67E-02	3.67E-02	3.33E-03	3.33E-03	1.00E-02	Failed	-7.18E+00	1.16E+00	Failed	8.28E-03	4.31E-03	3.58E-03	3.58E-03	3.58E-03	3.58E-03	Chebychev 95 UCL limit
566	in	1,4-Dichlorobenzene	2	13	15.4%	1.10E-03	1.04E-02	1.35E-03	1.35E-03	2.72E-03	Failed	-7.22E+00	8.20E-01	Failed	2.70E-03	1.87E-03	2.06E-03	2.06E-03	2.06E-03	2.06E-03	Chebychev 95 UCL limit
566	in	1,4-Dioxane	7	13	53.8%	4.03E-03	4.39E-02	9.18E-03	9.18E-03	1.24E-02	Failed	-5.33E+00	1.11E+00	Not failed	1.53E-02	2.41E-02	2.11E-02	2.41E-02	2.41E-02	2.41E-02	Land 95 UCL
566	in	Benzene	13	13	100.0%	1.76E-03	3.58E-03	2.23E-03	4.36E-04	5.31E-04	Failed	-6.13E+00	2.11E-01	Failed	2.49E-03	2.49E-03	2.81E-03	2.81E-03	2.81E-03	2.76E-04	Chebychev 95 UCL limit
566	in	Chlorobenzene	1	13	7.7%	9.83E-04	9.83E-04	5.00E-04	5.00E-04	1.90E-04	Failed	-7.65E+00	2.94E-01	Failed	5.94E-04	5.86E-04	6.79E-04	6.79E-04	6.79E-04	6.79E-04	Chebychev 95 UCL limit
566	in	Ethylbenzene	3	13	23.1%	1.01E-03	6.61E-03	1.10E-03	1.10E-03	1.78E-03	Failed	-7.40E+00	9.12E-01	Failed	1.98E-03	1.89E-03	1.97E-03	1.97E-03	1.97E-03	1.97E-03	Chebychev 95 UCL limit
566	in	m,p-xylenes	11	13	84.6%	8.82E-04	2.38E-02	3.37E-03	3.37E-03	6.19E-03	Failed	-6.35E+00	1.02E+00	Failed	6.43E-03	6.87E-03	6.59E-03	6.59E-03	6.59E-03	6.59E-03	Chebychev 95 UCL limit
566	in	Methylene chloride	10	13	76.9%	6.71E-04	2.79E-03	1.15E-03	1.16E-04	7.29E-04	Not failed	-6.98E+00	7.19E-01	Not failed	1.51E-03	1.98E-03	2.27E-03	1.51E-03	1.51E-03	2.29E-04	Arith. 95 UCL

Building	Location	Analyte	Number of Detections	Number of Analyses	Frequency of Detection (%)	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Arithmetic Average (mg/m3)	Background Corrected Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Background Corrected EPC (mg/m3)	Basis for EPC
566	in	Tetrachloroethene (PCE)	1	13	7.7%	4.96E-03	4.96E-03	9.57E-04	3.16E-04	1.20E-03	Failed	-7.22E+00	5.76E-01	Failed	1.55E-03	1.24E-03	1.48E-03	1.48E-03	1.48E-03	7.24E-04	Chebychev 95 UCL limit
566	in	Toluene	13	13	100.0%	2.07E-03	1.84E-02	6.10E-03	1.12E-03	4.18E-03	Failed	-5.25E+00	5.37E-01	Not failed	8.16E-03	8.45E-03	1.01E-02	8.45E-03	8.45E-03	1.97E-03	Land 95 UCL
566	in	trans-1,2-Dichloroethene	1	13	7.7%	2.58E-03	2.58E-03	2.03E-03	2.03E-03	5.21E-04	Failed	-6.22E+00	2.04E-01	Failed	2.29E-03	2.26E-03	2.54E-03	2.54E-03	2.54E-03	2.54E-03	Chebychev 95 UCL limit
566	in	trans-1,3-Dichloropropene	1	13	7.7%	3.27E-03	3.27E-03	6.62E-04	6.62E-04	7.92E-04	Failed	-7.59E+00	5.94E-01	Failed	1.05E-03	8.86E-04	1.05E-03	1.05E-03	1.05E-03	1.05E-03	Chebychev 95 UCL limit
566	in	Trichloroethene (TCE)	2	13	15.4%	7.64E-03	9.83E-03	1.76E-03	1.48E-03	3.13E-03	Failed	-7.18E+00	1.08E+00	Failed	3.31E-03	3.47E-03	3.15E-03	3.15E-03	3.15E-03	2.79E-03	Chebychev 95 UCL limit
566	out	Benzene	3	3	100.0%	1.82E-03	2.02E-03	1.91E-03	1.13E-04	9.93E-05	Not failed	-6.26E+00	5.17E-02	Not failed	2.07E-03	2.09E-03	2.16E-03	2.07E-03	2.02E-03	0.00E+00	Maximum Value
566	out	m,p-xylenes	3	3	100.0%	1.19E-03	1.59E-03	1.40E-03	1.40E-03	1.99E-04	Not failed	-6.58E+00	1.45E-01	Not failed	1.73E-03	1.90E-03	1.92E-03	1.73E-03	1.59E-03	1.59E-03	Maximum Value
566	out	Methylene chloride	3	3	100.0%	8.47E-04	1.20E-03	9.65E-04	0.00E+00	2.04E-04	Failed	-6.96E+00	2.01E-01	Failed	1.31E-03	1.55E-03	1.46E-03	1.46E-03	1.20E-03	0.00E+00	Maximum Value
566	out	Toluene	3	3	100.0%	3.83E-03	5.74E-03	4.60E-03	0.00E+00	1.01E-03	Not failed	-5.40E+00	2.12E-01	Not failed	6.30E-03	7.68E-03	7.09E-03	6.30E-03	5.74E-03	0.00E+00	Maximum Value
583C	in	1,4-Dioxane	1	2	50.0%	9.15E-03	9.15E-03	4.65E-03	4.65E-03	6.36E-03	--	-6.74E+00	2.89E+00	--	--	--	--	--	9.15E-03	9.15E-03	Maximum Value
583C	in	Benzene	2	2	100.0%	4.55E-04	5.53E-04	5.04E-04	0.00E+00	6.89E-05	--	-7.60E+00	1.37E-01	--	--	--	--	--	5.53E-04	0.00E+00	Maximum Value
583C	in	Ethylbenzene	2	2	100.0%	4.37E-04	5.29E-04	4.83E-04	4.83E-04	6.55E-05	--	-7.64E+00	1.36E-01	--	--	--	--	--	5.29E-04	5.29E-04	Maximum Value
583C	in	m,p-xylenes	2	2	100.0%	1.19E-03	1.41E-03	1.30E-03	1.30E-03	1.56E-04	--	-6.65E+00	1.20E-01	--	--	--	--	--	1.41E-03	1.41E-03	Maximum Value
583C	in	Methylene chloride	2	2	100.0%	6.71E-04	7.77E-04	7.24E-04	0.00E+00	7.49E-05	--	-7.23E+00	1.04E-01	--	--	--	--	--	7.77E-04	0.00E+00	Maximum Value
583C	in	Tetrachloroethene (PCE)	1	2	50.0%	7.58E-04	7.58E-04	5.17E-04	0.00E+00	3.41E-04	--	-7.69E+00	7.15E-01	--	--	--	--	--	7.58E-04	5.03E-06	Maximum Value
583C	in	Toluene	2	2	100.0%	2.26E-03	2.64E-03	2.45E-03	0.00E+00	2.71E-04	--	-6.01E+00	1.11E-01	--	--	--	--	--	2.64E-03	0.00E+00	Maximum Value
583C	out	Benzene	1	1	100.0%	4.55E-04	4.55E-04	4.55E-04	0.00E+00	--	--	-7.70E+00	--	--	--	--	--	--	4.55E-04	0.00E+00	Maximum Value
583C	out	m,p-xylenes	1	1	100.0%	1.19E-03	1.19E-03	1.19E-03	1.19E-03	--	--	-6.73E+00	--	--	--	--	--	--	1.19E-03	1.19E-03	Maximum Value
583C	out	Methylene chloride	1	1	100.0%	6.35E-04	6.35E-04	6.35E-04	0.00E+00	--	--	-7.36E+00	--	--	--	--	--	--	6.35E-04	0.00E+00	Maximum Value
583C	out	Tetrachloroethene (PCE)	1	1	100.0%	5.79E-04	5.79E-04	5.79E-04	0.00E+00	--	--	-7.45E+00	--	--	--	--	--	--	5.79E-04	0.00E+00	Maximum Value
583C	out	Toluene	1	1	100.0%	2.14E-03	2.14E-03	2.14E-03	0.00E+00	--	--	-6.14E+00	--	--	--	--	--	--	2.14E-03	0.00E+00	Maximum Value
6	in	1,1,1-Trichloroethane	6	6	100.0%	4.83E-04	5.49E-04	5.15E-04	1.01E-04	2.97E-05	Not failed	-7.57E+00	5.74E-02	Not failed	5.40E-04	5.41E-04	5.69E-04	5.40E-04	5.40E-04	8.67E-05	Arith. 95 UCL
6	in	1,1,2-Trichloroethane	2	6	33.3%	1.17E-03	1.17E-03	7.40E-04	7.40E-04	3.30E-04	Failed	-7.28E+00	4.10E-01	Failed	1.01E-03	1.17E-03	1.29E-03	1.29E-03	1.17E-03	1.17E-03	Maximum Value
6	in	1,1-Dichloroethane	1	5	20.0%	1.52E-04	1.52E-04	3.44E-04	3.44E-04	1.07E-04	Failed	-8.03E+00	4.22E-01	Failed	4.45E-04	6.27E-04	6.39E-04	6.39E-04	3.91E-04	3.91E-04	Maximum Value
6	in	1,2-Dichloroethane	2	6	33.3%	5.75E-04	6.17E-03	1.38E-03	1.38E-03	2.34E-03	Failed	-7.32E+00	1.11E+00	Failed	3.31E-03	1.12E-02	3.16E-03	3.16E-03	3.16E-03	3.16E-03	Chebychev 95 UCL limit
6	in	1,3-Dichlorobenzene	1	6	16.7%	2.99E-04	2.99E-04	5.34E-04	5.34E-04	1.15E-04	Failed	-7.56E+00	2.70E-01	Failed	6.28E-04	7.01E-04	8.00E-04	8.00E-04	5.80E-04	5.80E-04	Maximum Value
6	in	1,4-Dichlorobenzene	4	6	66.7%	3.06E-04	3.42E-04	4.13E-04	4.13E-04	1.30E-04	Failed	-7.83E+00	2.95E-01	Failed	5.20E-04	5.57E-04	6.35E-04	6.35E-04	5.80E-04	5.80E-04	Maximum Value
6	in	1,4-Dioxane	5	6	83.3%	3.18E-03	2.16E-02	1.09E-02	1.09E-02	8.96E-03	Not failed	-4.93E+00	1.08E+00	Not failed	1.82E-02	1.10E-01	3.34E-02	1.82E-02	1.82E-02	1.82E-02	Arith. 95 UCL
6	in	Benzene	6	6	100.0%	1.50E-03	3.58E-03	2.05E-03	2.59E-04	7.81E-04	Failed	-6.24E+00	3.23E-01	Not failed	2.70E-03	2.86E-03	3.25E-03	2.86E-03	2.86E-03	3.24E-04	Land 95 UCL
6	in	Chlorobenzene	3	6	50.0%	4.68E-04	7.49E-02	1.29E-02	1.29E-02	3.04E-02	Failed	-6.77E+00	2.06E+00	Failed	3.79E-02	1.37E+01	2.11E-02	2.11E-02	2.11E-02	2.11E-02	Chebychev 95 UCL limit
6	in	cis-1,2-Dichloroethene	6	6	100.0%	4.84E-04	1.17E-02	3.79E-03	3.79E-03	4.64E-03	Failed	-6.30E+00	1.34E+00	Not failed	7.61E-03	1.09E-01	1.22E-02	1.09E-01	1.17E-02	1.17E-02	Maximum Value
6	in	Ethylbenzene	6	6	100.0%	5.29E-04	1.28E-03	8.75E-04	8.75E-04	2.77E-04	Not failed	-7.08E+00	3.24E-01	Not failed	1.10E-03	1.23E-03	1.39E-03	1.10E-03	1.10E-03	1.10E-03	Arith. 95 UCL
6	in	m,p-xylenes	6	6	100.0%	1.06E-03	4.85E-03	2.97E-03	2.97E-03	1.59E-03	Not failed	-5.97E+00	6.24E-01	Not failed	4.28E-03	7.10E-03	6.41E-03	4.28E-03	4.28E-03	4.28E-03	Arith. 95 UCL
6	in	Methylene chloride	5	6	83.3%	6.35E-04	4.24E-03	2.08E-03	1.05E-03	1.64E-03	Not failed	-6.53E+00	1.02E+00	Not failed	3.43E-03	1.65E-02	6.20E-03	3.43E-03	3.43E-03	2.15E-03	Arith. 95 UCL
6	in	Tetrachloroethene (PCE)	6	6	100.0%	4.75E-04	1.86E-03	9.34E-04	2.93E-04	5.03E-04	Not failed	-7.08E+00	4.86E-01	Not failed	1.35E-03	1.67E-03	1.75E-03	1.35E-03	1.35E-03	5.95E-04	Arith. 95 UCL
6	in	Toluene	6	6	100.0%	3.14E-03	8.43E-03	6.08E-03	1.10E-03	1.78E-03	Not failed	-5.15E+00	3.38E-01	Not failed	7.54E-03	8.72E-03	9.86E-03	7.54E-03	7.54E-03	1.05E-03	Arith. 95 UCL
6	in	Trichloroethene (TCE)	6	6	100.0%	4.37E-04	6.01E-03	3.04E-03	2.76E-03	2.02E-03	Not failed	-6.07E+00	9.37E-01	Not failed	4.70E-03	1.85E-02	8.77E-03	4.70E-03	4.70E-03	4.34E-03	Arith. 95 UCL
6	out	1,1,1-Trichloroethane	1	1	100.0%	4.88E-04	4.88E-04	4.88E-04	7.42E-05	--	--	-7.62E+00	--	--	--	--	--	--	4.88E-04	3.55E-05	Maximum Value
6	out	1,4-Dioxane	1	1	100.0%	1.90E-03	1.90E-03	1.90E-03	1.90E-03	--	--	-6.26E+00	--	--	--	--	--	--	1.90E-03	1.90E-03	Maximum Value
6	out	Benzene	1	1	100.0%	1.40E-03	1.40E-03	1.40E-03	0.00E+00	--	--	-6.57E+00	--	--	--	--	--	--	1.40E-03	0.00E+00	Maximum Value
6	out	cis-1,2-Dichloroethene	1	1	100.0%	2.94E-04	2.94E-04	2.94E-04	2.94E-04	--	--	-8.13E+00	--	--	--	--	--	--	2.94E-04	2.94E-04	Maximum Value
6	out	Ethylbenzene	1	1	100.0%	2.12E-04	2.12E-04	2.12E-04	2.12E-04	--	--	-8.46E+00	--	--	--	--	--	--	2.12E-04	2.12E-04	Maximum Value
6	out	m,p-xylenes	1	1	100.0%	4.85E-04	4.85E-04	4.85E-04	4.85E-04	--	--	-7.63E+00	--	--	--	--	--	--	4.85E-04	4.85E-04	Maximum Value
6	out	Tetrachloroethene (PCE)	1	1	100.0%	6.06E-04	6.06E-04	6.06E-04	0.00E+00	--	--	-7.41E+00	--	--	--	--	--	--	6.06E-04	0.00E+00	Maximum Value
6	out	Toluene	1	1	100.0%	1.61E-03	1.61E-03	1.61E-03	0.00E+00	--	--	-6.43E+00	--	--	--	--	--	--	1.61E-03	0.00E+00	Maximum Value
hanger 1	in	1,1,1-Trichloroethane	13	13	100.0%	3.39E-04	7.22E-04	4.81E-04	6.65E-05	9.18E-05	Not failed	-7.66E+00	1.82E-01	Not failed	5.26E-04	5.30E-04	5.90E-04	5.26E-04	5.26E-04	7.32E-05	Arith. 95 UCL
hanger 1	in	1,2-Dichlorobenzene	1	14	7.1%	2.69E-04	2.69E-04	5.58E-04	5.58E-04	8.33E-05	Failed	-7.51E+00	2.06E-01	Failed	5.98E-04	6.23E-04	6.99E-04	6.99E-04	5.80E-04	5.80E-04	Maximum Value
hanger 1	in	1,2-Dichloroethane	1	14	7.1%	3.12E-04	3.12E-04	3.85E-04	3.85E-04	2.09E-05	Failed	-7.86E+00	5.96E-02	Failed	3.95E-04	3.96E-04	4.12E-04	4.12E-04	3.90E-04	3.90E-04	Maximum Value
hanger 1	in	1,4-Dichlorobenzene	6	14	42.9%	1.89E-04	6.72E-04	5.11E-04	5.11E-04	1.39E-04	Failed	-7.63E+00	3.57E-01	Failed	5.77E-04	6.29E-04	7.40E-04	7.40E-04	6.72E-04	6.72E-04	Maximum Value
hanger 1	in	1,4-Dioxane	13	14	92.9%	2.05E-04	4.03E-02	1.18E-02	1.18E-02	1.28E-02	Failed	-5.19E+00	1.50E+00	Not failed	1.79E-02	7.97E-02	4.49E-02	7.97E-02	4.03E-02	4.03E-02	Maximum Value
hanger 1	in	Benzene	14	14	100.0%	7.80E-04	3.25E-03	1.52E-03	0.00E+00	7.77E-04	Failed	-6.58E+00	4.20E-01	Not failed	1.88E-03	1.91E-03	2.27E-03	1.91E-03	1.91E-03	0.00E+00	Land 95 UCL
hanger 1	in	Chlorobenzene	5	14	35.7%	2.48E-04	2.20E-03	7.46E-04	7.46E-04	6.49E-04	Failed	-7.45E+00	6.63E-01	Failed	1.05E-03	1.10E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	Chebychev 95 UCL limit
hanger 1	in	cis-1,2-Dichloroethene	11	14	78.6%	5.24E-04	2.70E-02	2.86E-03	2.86E-03	6.98E-03	Failed	-6.83E+00	1.09E+00	Failed	6.16E-03	4.79E-03	4.48E-03	4.48E-03	4.48E-03	4.48E-03	Chebychev 95 UCL limit
hanger 1	in	Ethylbenzene	12	14	85.7%	2.69E-04	1.37E-03	5.21E-04	5.21E-04	2.72E-04	Failed	-7.65E+00	4.06E-01	Not failed	6.50E-04	6.47E-04	7.68E-04	6.47E-04	6.47E-04	6.47E-04	Land 95 UCL
hanger 1	in	m,p-xylenes	12	14	85.7%	4.85E-04	4.37E-03	1.35E-03	1.35E-03	1.02E-03	Failed	-6.83E+00	6.78E-01	Not failed	1.83E-03	2.10E-03	2.47E-03	2.10E-03	2.10E-03	2.10E-03	Land 95 UCL
hanger 1	in	Methylene chloride	6	14	42.9%	6.35E-04	1.84E-03	6.98E-04	0.00E+00	5.22E-04	Failed	-7.50E+00	6.96E-01	Failed	9.45E-04	1.10E-03	1.29E-03	1.29E-03	1.29E-03	6.16E-06	Chebychev 95 UCL limit
hanger 1	in	Tetrachloroethene (PCE)	14	14	100.0%	3.17E-04	4.89E-03	1.85E-03	1.21E-03	1.61E-03	Failed	-6.67E+00	9.18E-01	Not failed	2.61E-03	3.80E-03	4.04E-03	3.80E-03	3.80E-03	3.05E-03	Land 95 UCL
hanger 1	in	Toluene	14	14	100.0%	1.30E-03	9.57E-03	3.27E-03	0.00E+00	2.20E-03	Failed	-5.89E+00	5.69E-01	Not failed	4.31E-03	4.59E-03	5.49E-03	4.59E-03	4.59E-03	0.00E+00	Land 95 UCL
hanger 1	in	Trichloroethene (TCE)	12	14	85.7%	5.02E-04	5.46E-03	1.99E-03	1.71E-03	1.70E-03	Failed	-6.54E+00	8.31E-01	Not failed	2.79E-03	3.64E-03	4.06E-03	3.64E-03	3.64E-03	3.28E-03	Land 95 UCL

Table 4. Statistical Data Summary of Chemicals in Air (adjusted for background)
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Location	Analyte	Number of Detections	Number of Analyses	Frequency of Detection (%)	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Arithmetic Average (mg/m3)	Background Corrected Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Background Corrected EPC (mg/m3)	Basis for EPC
hanger 1	out	1,1,1-Trichloroethane	1	1	100.0%	4.38E-04	4.38E-04	4.38E-04	2.43E-05	--	--	-7.73E+00	--	--	--	--	--	--	4.38E-04	0.00E+00	Maximum Value
hanger 1	out	Benzene	1	1	100.0%	4.55E-03	4.55E-03	4.55E-03	2.76E-03	--	--	-5.39E+00	--	--	--	--	--	--	4.55E-03	2.01E-03	Maximum Value
hanger 1	out	cis-1,2-Dichloroethene	1	1	100.0%	1.05E-03	1.05E-03	1.05E-03	1.05E-03	--	--	-6.86E+00	--	--	--	--	--	--	1.05E-03	1.05E-03	Maximum Value
hanger 1	out	Ethylbenzene	1	1	100.0%	2.38E-04	2.38E-04	2.38E-04	2.38E-04	--	--	-8.34E+00	--	--	--	--	--	--	2.38E-04	2.38E-04	Maximum Value
hanger 1	out	m,p-xylenes	1	1	100.0%	4.15E-04	4.15E-04	4.15E-04	4.15E-04	--	--	-7.79E+00	--	--	--	--	--	--	4.15E-04	4.15E-04	Maximum Value
hanger 1	out	Tetrachloroethene (PCE)	1	1	100.0%	2.48E-04	2.48E-04	2.48E-04	0.00E+00	--	--	-8.30E+00	--	--	--	--	--	--	2.48E-04	0.00E+00	Maximum Value
hanger 1	out	Toluene	1	1	100.0%	1.03E-03	1.03E-03	1.03E-03	0.00E+00	--	--	-6.87E+00	--	--	--	--	--	--	1.03E-03	0.00E+00	Maximum Value

% Percent.
mg/L Milligrams per liter.
EPC Exposure point concentration.
-- Not available or not calculated.

Table 5. COPCs for Groundwater and Air
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Analyte	Chemical Abstracts Service Registry Number	Detected in Groundwater	Detected in Air or Flux?	COPC for Volatilization Risk Model?	COPC for Air Measurement Risk Model?	Notes
1,1,1-Trichloroethane	71-55-6	Yes	Yes	Yes	Yes	
1,1,2,2-Tetrachloroethane	79-34-5	Yes	No-Air	Yes	No	Not on flux analyte list, not detected in any air sample.
1,1,2-Trichloroethane	79-00-5	Yes	Yes	Yes	Yes	
1,1-Dichloroethane	75-34-3	Yes	Yes	Yes	Yes	
1,1-Dichloroethene	75-35-4	Yes	Yes	Yes	Yes	
1,2-Dichlorobenzene	95-50-1	Yes	Yes	Yes	Yes	
1,2-Dichloroethane	107-06-2	Yes	Yes	Yes	Yes	
1,2-Dichloropropane	78-87-5	Yes	No-Air	Yes	No	Not on flux analyte list, not detected in any air sample.
1,3-Dichlorobenzene	541-73-1	Yes	Yes	Yes	Yes	
1,4-Dichlorobenzene	106-46-7	Yes	Yes	Yes	Yes	
1,4-Dioxane	123-91-1	Yes	Yes	Yes	Yes	
Benzene	71-43-2	Yes	Yes	Yes	Yes	
Carbon tetrachloride	56-23-5	Yes	No-Air	Yes	No	Not on flux analyte list, not detected in any air sample.
Chlorobenzene	108-90-7	Yes	Yes	Yes	Yes	
Chloroethane	75-00-3	Yes	Yes	Yes	No	Not on flux analyte list, detected in one sample outside NRP.
Chloroform	67-66-3	Yes	Yes-Flux	Yes	No	Detected in flux, but air samples were all ND.
cis-1,2-Dichloroethene	156-59-2	Yes	Yes	Yes	Yes	
cis-1,3-Dichloropropene	542-75-6	Yes	No-Air	Yes	No	Not on flux analyte list, not detected in any air sample.
Ethylbenzene	100-41-4	Yes	Yes	Yes	Yes	
Methylene chloride	75-09-2	Yes	Yes	Yes	Yes	
Tetrachloroethene (PCE)	127-18-4	Yes	Yes	Yes	Yes	
Toluene	108-88-3	Yes	Yes	Yes	Yes	
trans-1,2-Dichloroethene	156-60-5	Yes	Yes	Yes	Yes	
trans-1,3-Dichloropropene	10061-02-6	Yes	Yes	Yes	Yes	
Trichloroethene (TCE)	79-01-6	Yes	Yes	Yes	Yes	
Trichlorotrifluoroethane (Freon 113)	76-13-1	Yes	No-Air	Yes	No	Not on flux analyte list, not detected in any air sample.
Vinyl chloride	75-01-4	Yes	No	No	No	Detected in GW, but not detected in air or flux samples
Xylenes	1330-20-7	Yes	Yes	Yes	Yes	Total Xylenes measured in GW, individual o-Xylene and m,p-Xylenes in air.

Yes Analyte was found above the detection limit.
No Analyte was not found above the detection limit.
No-Air Analyte was not found above the detection limit in air samples, but not evaluated in flux samples.
Yes-Flux Analyte was only found above the detection limit in flux, but not air samples.

Table 6. Statistical Data Summary of Chemicals in Background Air
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Analyte	Minimum Value (mg/m3)	Maximum Value (mg/m3)	Frequency of Detection	Arithmetic Average (mg/m3)	Standard Deviation	W-test for Normality at 95%	Lognormal Average (mg/m3)	Lognormal Standard Deviation	W-test for Logormality at 95%	Arithmetic 95% UCL (mg/m3)	Land's 95% UCL (mg/m3)	Approximate Chebychev's Limit on the 95% UCL (mg/m3)	Appropriate 95% UCL (mg/m3)	EPC (mg/m3)	Basis for EPC
1,1,1-Trichloroethane	2.78E-04	6.10E-04	0.96	4.14E-04	1.18E-04	Not failed	-7.84E+00	3.27E-01	Failed	4.53E-04	4.69E-04	5.36E-04	4.53E-04	4.53E-04	Arith. 95 UCL
Benzene	3.25E-04	5.20E-03	1.00	1.79E-03	1.34E-03	Failed	-6.59E+00	7.56E-01	Not failed	2.23E-03	2.54E-03	3.09E-03	2.54E-03	2.54E-03	Land 95 UCL
Methylene chloride	4.94E-03	4.94E-03	0.04	1.03E-03	7.81E-04	Failed	-6.97E+00	3.32E-01	Failed	1.29E-03	1.12E-03	1.28E-03	1.28E-03	1.28E-03	Chebychev 95 UCL limit
Tetrachloroethene (PCE)	2.07E-04	1.52E-03	1.00	6.41E-04	3.42E-04	Not failed	-7.51E+00	5.98E-01	Not failed	7.53E-04	8.31E-04	1.00E-03	7.53E-04	7.53E-04	Arith. 95 UCL
Toluene	1.53E-03	1.23E-02	1.00	4.98E-03	3.20E-03	Failed	-5.50E+00	6.35E-01	Not failed	6.03E-03	6.49E-03	7.87E-03	6.49E-03	6.49E-03	Land 95 UCL
Trichloroethene (TCE)	4.37E-04	5.46E-04	0.22	2.79E-04	1.19E-04	Failed	-8.25E+00	3.45E-01	Failed	3.18E-04	3.14E-04	3.60E-04	3.60E-04	3.60E-04	Chebychev 95 UCL limit

mg/L Milligrams per liter.
EPC Exposure point concentration.

Data from BAAQMD 1999 Moutain View monitoring station.

Table 7. Exposure Parameters for a Construction Worker
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Parameter	Symbol	Units	CTE Exposure			RME Exposure		
			Value	Source	Rationale	Value	Source	Rationale
Outdoor Exposure Time	ET_o	hours/day	8	USEPA, 1997a	50th percentile work day (8 hours)	12	USEPA, 1997a	95th percentile work day (12 hours)
Exposure Frequency	EF	days/year	250	Prof. Judge.	5 days/week, 50weeks/year	250	Prof. Judge.	5 days/week, 50weeks/year
Exposure Duration	ED	years	1	Prof. Judge.	--	2	Prof. Judge.	--
Inhalation Rate Outdoors	IR_o	m^3/hour	1.5	USEPA, 1997a	moderate activity outdoors	2.5	USEPA, 1997a	heavy activity outdoors
Body Weight	BW	kg	70	USEPA, 1997a	mean for all adults	70	USEPA, 1997a	mean for all adults
Skin Surface Area - GW	SA_g	cm^2	4860	USEPA, 1997a	50th percentile; male feet, lower legs, hands	6140	USEPA, 1997a	95th percentile; male feet, lower legs, hands
Exposure Time - GW	ET_g	hours/day	1	Prof. Judge.	standard work day	2	Prof. Judge.	long work day
Exposure Frequency - GW	EF_g	days/year	50	Prof. Judge.	once per week, 50 weeks/year	50	Prof. Judge.	once per week, 50 weeks/year

CTE	Central tendency exposure.
RME	Reasonable maximum exposure.
m^3	Cubic meters.
cm^2	Squared centimeters.
mg	Milligrams.
GW	Groundwater.
Prof. Judge.	Professional judgement.

Table 8. Exposure Parameters for an Indoor Worker
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Parameter	Symbol	Units	CTE Exposure			RME Exposure		
			Value	Source	Rationale	Value	Source	Rationale
Indoor Exposure Time	ET_i	hours/day	7	USEPA, 1997a	Based on 50th percentile work day	10	USEPA, 1997a	Based on 95th percentile work day
Outdoor Exposure Time	ETo	hours/day	1	Prof. Judge.	--	2	Prof. Judge.	--
Exposure Frequency	EF	days/year	250	Prof. Judge.	5 days/week, 50weeks/year	250	Prof. Judge.	5 days/week, 50weeks/year
Exposure Duration	ED	years	4	USEPA, 1997a	average employee tenture	25	USEPA, 1997a; USEPA, 2000	--
Inhalation Rate Indoors	IR_i	m^3/hour	1	USEPA, 1997a	light activity	1.6	USEPA, 1997a	moderate activity
Body Weight	BW	kg	70	USEPA, 1997a	mean for all adults	70	USEPA, 1997a	mean for all adults

CTE Central tendency exposure.
RME Reasonable maximum exposure.
m^3 Cubic meters.
cm^2 Squared centimeters.
mg Milligrams.
Prof. Judge. Professional judgement.

Table 9. Exposure Parameters for Adult and Child Residents
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Parameter	Symbol	Units	CTE Exposure			RME Exposure		
			Value	Source	Rationale	Value	Source	Rationale
Adult Resident								
Indoor Exposure Time	ET_i	hours/day	16	USEPA, 1997a	50th percentile	22.25	USEPA, 1997a	95th percentile (24 hours - 1.75 hours outdoors)
Outdoor Exposure Time	ET_o	hours/day	1.75	USEPA, 1997a	50th percentile	1.75	USEPA, 1997a	50th percentile
Exposure Frequency	EF	days/year	300	Prof. Judge.	6 days/week, 50weeks/year	350	Prof. Judge.	7 days/week, 50 weeks/year
Exposure Duration	ED	years	5	Prof. Judge.	typical post doctoral tenure	10	Prof. Judge.	extended post doctoral tenure
Inhalation Rate Outdoors	IR_o	m^3/hour	0.63	USEPA, 1997a	mean adult male long term IR	0.83	USEPA, 2000	--
Inhalation Rate Indoors	IR_i	m^3/hour	0.63	USEPA, 1997a	mean adult male long term IR	0.83	USEPA, 2000	--
Body Weight	BW	kg	70	USEPA, 1997a	mean for all adults	70	USEPA, 1997a	mean for all adults
Child Resident								
Indoor Exposure Time	ET_i	hours/day	16	USEPA, 1997a	50th percentile	22.25	USEPA, 1997a	95th percentile (24 hours less 1.75 hours outdoors)
Outdoor Exposure Time	ET_o	hours/day	1.75	USEPA, 1997a	50th percentile	1.75	USEPA, 1997a	50th percentile
Exposure Frequency	EF	days/year	300	Prof. Judge.	6 days/week, 50weeks/year	350	Prof. Judge.	7 days/week, 50 weeks/year
Exposure Duration	ED	years	5	Prof. Judge.	typical post doctoral tenure	10	Prof. Judge.	extended plan
Inhalation Rate Outdoors	IR_o	m^3/hour	0.34	USEPA, 1997a	mean child long term IR	0.42	USEPA, 2000	--
Inhalation Rate Indoors	IR_i	m^3/hour	0.34	USEPA, 1997a	mean child long term IR	0.42	USEPA, 2000	--
Body Weight	BW	kg	15	USEPA, 1997a	50th percentile male, 0-6 years of age	15	USEPA, 1997a	50th percentile male, 0-6 years of age

CTE	Central tendency exposure.
RME	Reasonable maximum exposure.
m^3	Cubic meters.
cm^2	Squared centimeters.
mg	Milligrams.
Prof. Judge.	Professional judgement.

Table 10. Exposure Parameters for 30 yr Residential Receptor
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Parameter	Symbol	Units	RME Exposure Value	RME Exposure Source	RME Exposure Rationale
Adult Resident					
Indoor Exposure Time	ET_i	hours/day	22.25	USEPA, 1997a	95th percentile (24 hours - 1.75 hours outdoors)
Outdoor Exposure Time	ET_o	hours/day	1.75	USEPA, 1997a	50th percentile
Exposure Frequency	EF	days/year	350	Prof. Judge.	7 days/week, 50 weeks/year
Exposure Duration	ED	years	24	Prof. Judge.	extended post doctoral tenure
Inhalation Rate Outdoors	IR_o	m^3/hour	0.83	USEPA, 2000	--
Inhalation Rate Indoors	IR_i	m^3/hour	0.83	USEPA, 2000	--
Body Weight	BW	kg	70	USEPA, 1997a	mean for all adults
Child Resident					
Indoor Exposure Time	ET_i	hours/day	22.25	USEPA, 1997a	95th percentile (24 hours less 1.75 hours outdoors)
Outdoor Exposure Time	ET_o	hours/day	1.75	USEPA, 1997a	50th percentile
Exposure Frequency	EF	days/year	350	Prof. Judge.	7 days/week, 50 weeks/year
Exposure Duration	ED	years	6	Prof. Judge.	extended plan
Inhalation Rate Outdoors	IR_o	m^3/hour	0.42	USEPA, 2000	--
Inhalation Rate Indoors	IR_i	m^3/hour	0.42	USEPA, 2000	--
Body Weight	BW	kg	15	USEPA, 1997a	50th percentile male, 0-6 years of age

CTE	Central tendency exposure.
RME	Reasonable maximum exposure.
m^3	Cubic meters.
cm^2	Squared centimeters.
mg	Milligrams.
Prof. Judge.	Professional judgement.

Table 11. Chemical-Specific Dermal Factors
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

COPC	Kp (cm/hr)
1,1,1-Trichloroethane	1.7E-02
1,1,2,2-Tetrachloroethane	9.0E-03
1,1,2-Trichloroethane	6.4E-03
1,1-Dichloroethane	8.9E-03
1,1-Dichloroethene	1.6E-02
1,2-Dichlorobenzene	4.1E-02
1,2-Dichloroethane	5.3E-03
1,2-Dichloropropane	1.0E-02
1,3-Dichlorobenzene	8.7E-02
1,4-Dichlorobenzene	6.2E-02
1,4-Dioxane	4.0E-04
Benzene	1.0E-01
Carbon tetrachloride	2.2E-02
Chlorobenzene	4.1E-02
Chloroethane	8.0E-03
Chloroform	8.9E-03
cis-1,2-Dichloroethene	1.0E-02
cis-1,3-Dichloropropene	5.5E-03
Ethylbenzene	7.4E-02
Methylene chloride	4.5E-03
Tetrachloroethene (PCE)	4.8E-02
Toluene	3.1E-02
trans-1,2-Dichloroethene	1.0E-02
trans-1,3-Dichloropropene	5.5E-03
Trichloroethene (TCE)	2.0E-01
Trichlorotrifluoroethane (Freon 113)	N/A
Vinyl chloride	7.3E-03
m,p-Xylenes	5.3E-02

COPC: Chemical of potentia
Kp: Dermal permeability
cm/hr: Centimeters per hour
N/A: Data not available.

Table 12. Site-Specific Soil and Groundwater Characteristics
Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Parcel Number	Aquifer	Soil Type	Well Depth (feet bgs)	Average Depth to GW (ft)	Average Depth to GW (cm)	Well Number	Parcel Number	Aquifer	Soil Type	Well Depth (feet bgs)	Average Depth to GW (ft)	Average Depth to GW (cm)
65A	5	A	SC	29.00	8.91	271.71	W9SC-14	15	A1	SC	19.50	4.67	142.29
72A	2	A	SC	27.00	8.22	250.61	W9SC-17	5	A1	C	23.50	5.97	182.07
73A	7	A	SC	27.00	5.18	157.99	W9SC-7	13	A1	SC	20.50	7.90	240.79
74A	5	A	SC	27.00	8.71	265.45	WIC-1	15	A1	SC	23.50	6.31	192.36
75A	6	A	SC	30.00	9.28	282.98	WIC-10	15	A1	SC	17.00	6.46	196.87
81A	5	A	C	25.00	5.37	163.58	WIC-11	15	A1	SC	21.50	6.37	194.13
82A	1	A	SC	33.00	10.45	318.62	WIC-12	15	A1	SC	26.00	6.44	196.37
88A	12A	A	C	32.00	6.93	211.37	WIC-3	15	A1	SC	24.50	6.24	190.16
89A	12A	A	C	30.00	7.60	231.55	WIC-5	15	A1	SC	12.00	6.10	185.87
EA1-1	15	A1	SC	25.00	4.76	145.08	WIC-6	15	A1	SC	16.00	5.93	180.66
EA1-2	18	A1	SC	26.00	3.73	113.61	WIC-7	15	A1	SC	21.50	5.76	175.65
EA1-3	13	A1	SC	27.00	9.20	280.26	WIC-8	15	A1	SC	25.00	5.96	181.80
EA1-5	18	A1	SC	28.00	14.37	437.92	WIC-9	15	A1	SC	12.00	6.40	195.13
REG-2A	2	A	C	25.00	12.43	379.00	WNX-1	5	A1	C	16.50	4.94	150.47
REG-3A	5	A	C	28.00	8.08	246.36	WNX-3	5	A1	C	18.00	3.80	115.80
REG-4A	5	A	C	31.00	13.10	399.23	WT14-1	8	A1	SC	18.00	6.13	186.78
REG-5A	2	A	C	29.00	10.97	334.39	WU4-1	2	A1	SC	29.00	12.07	367.83
REG-7A	12A	A	C	27.00	7.69	234.42	WU4-10	18	A1	SC	30.00	5.49	167.32
REG-8A	6	A	SC	31.00	16.66	507.94	WU4-21	18	A1	SC	19.00	9.52	290.25
REG-9A	12	A	C	27.00	6.89	210.06	WU4-25	18	A1	SC	17.50	5.79	176.58
W14-10	19	A1	SC	20.00	6.50	198.26	WU4-3	5	A1	C	31.00	7.34	223.70
W14-11	19	A1	SC	20.00	6.20	189.02	WU4-8	18	A1	SC	16.50	10.39	316.72
W14-12	19	A1	SC	20.00	6.46	196.76	WW-10A	15	A1	SC	8.50	5.96	181.55
W14-2	19	A1	SC	26.50	6.90	210.46	WW-10C	15	A1	SC	16.50	5.93	180.77
W14-3	19	A1	SC	33.00	7.51	228.87	WW-10D	15	A1	SC	21.00	5.99	182.52
W14-4	19	A1	SC	23.50	6.31	192.39	WW-11	15	A1	SC	20.00	5.87	178.83
W29-3	13	A1	SC	25.00	7.10	216.42	WW-12	15	A1	SC	20.00	6.02	183.55
W29-4	13	A1	SC	20.00	7.16	218.23	WW-13A	15	A1	SC	8.50	5.98	182.33
W56-2	13	A1	SC	25.00	6.76	205.94	WW-14	15	A1	SC	20.00	5.97	181.85
W89-1	4	A1	SC	30.00	11.73	357.40	WW-15	15	A1	SC	19.50	5.90	179.80
W89-2	4	A1	SC	30.00	9.58	291.97	WW-16A	15	A1	SC	9.00	5.86	178.72
W89-5	12	A1	C	25.00	7.38	225.09	WW-17A	15	A1	SC	9.00	6.00	182.94
W89-8	12A	A1	C	27.00	7.87	239.88	WW-18A	15	A1	SC	8.50	5.91	180.03
W89-9	12A	A1	C	24.50	10.01	305.07	WW-1A	15	A1	SC	9.00	6.04	184.18
W9-1	13	A1	SC	30.00	8.53	260.08	WW-2	15	A1	SC	20.50	5.92	180.58
W9-16	12	A1	C	30.00	6.50	198.07	WW-3	15	A1	SC	20.50	6.07	185.07
W9-18	15	A1	SC	25.00	5.07	154.50	WW-4A	15	A1	SC	8.00	6.06	184.71
W9-19	17	A1	SC	32.00	7.31	222.91	WW-5	15	A1	SC	20.00	6.12	186.43
W9-2	13	A1	SC	31.00	7.96	242.66	WW-6	15	A1	SC	20.00	5.89	179.61
W9-23	13	A1	SC	20.00	6.05	184.35	WW-7A	15	A1	SC	9.00	5.90	179.94
W9-35	15	A1	SC	25.00	5.47	166.75	WW-8A	15	A1	SC	9.50	6.07	184.96
W9-37	5	A1	C	21.50	5.86	178.59	WW-9A	15	A1	SC	9.50	6.02	183.52
W9-44	17	A1	SC	25.50	6.20	188.89	WWR-1	18	A1	SC	22.00	3.84	116.95
W9-45	18	A1	SC	24.00	4.24	129.25	WWR-2	7	A1	SC	21.00	4.35	132.56

Table 13. Chemical Physical Properties
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Analyte	Chemical Abstracts Service Registry Number	Organic Carbon Patition Coefficient (cm^3/g)	Diffusivity in Air (cm^2/sec)	Diffusivity in Water (cm^2/sec)	Solubility in Water (mg/L)	Henry's Constant (unitless)	Henry's Constant (atm-cm^3/mol)	Henry's Constant Reference Temperature ^oC	Normal Boiling Point ^oC	Critical Temperature ^oC	Enthalpy of Vaporization at Normal Boiling Point (cal/mol)
1,1,1-Trichloroethane	71-55-6	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.05E-01	1.72E-02	25	347.24	545	7136
1,1,2,2-Tetrachloroethane	79-34-5	9.33E+01	7.10E-02	7.90E-06	2.97E+03	1.41E-02	3.44E-04	25	419.6	661.15	8996
1,1,2-Trichloroethane	79-00-5	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.74E-02	9.12E-04	25	386.15	602	8322
1,1-Dichloroethane	75-34-3	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523	6895
1,1-Dichloroethene	75-35-4	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.61E-02	25	304.75	576.05	6247
1,2-Dichlorobenzene	95-50-1	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.79E-02	1.90E-03	25	453.57	705	9700
1,2-Dichloroethane	107-06-2	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.01E-02	9.78E-04	25	356.65	561	7643
1,2-Dichloropropane	78-87-5	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.80E-03	25	369.52	572	7590
1,3-Dichlorobenzene	541-73-1	6.17E+02	6.90E-02	7.90E-06	7.38E+01	9.96E-02	2.43E-03	25	447.21	684.75	9271
1,4-Dichlorobenzene	106-46-7	6.17E+02	6.90E-02	7.90E-06	7.38E+01	9.96E-02	2.43E-03	25	447.21	684.75	9271
1,4-Dioxane	123-91-1	1.11E+01	2.99E-01	1.02E-05	1.00E+06	1.95E-05	4.88E-06	25	374.3	587.3	8164
Benzene	71-43-2	5.89E+01	8.80E-02	9.80E-06	1.75E+03	2.28E-01	5.56E-03	25	353.24	562.16	7342
Carbon tetrachloride	56-23-5	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.25E+00	3.05E-02	25	349.9	556.6	7127
Chlorobenzene	108-90-7	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.52E-01	3.71E-03	25	404.87	632.4	8410
Chloroethane	75-00-3	1.50E+01	1.15E-01	1.07E-05	5.74E+03	8.20E-02	2.00E-03	25	285.27	460.2	5892
Chloroform	67-66-3	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.4	6988
cis-1,2-Dichloroethene	156-59-2	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192
cis-1,3-Dichloropropene	542-75-6	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.26E-01	1.77E-02	25	381.15	587.38	7900
Ethylbenzene	100-41-4	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.23E-01	7.88E-03	25	409.34	617.2	8501
Freon 113	76-13-1	1.60E+02	2.90E-02	8.10E-06	1.70E+02	2.17E+01	5.30E-01	25	320.7	487.2	6463
Methylene chloride	75-09-2	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.98E-02	2.19E-03	25	313	510	6706
Tetrachloroethene (PCE)	127-18-4	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	1.84E-02	25	394.4	620.2	8288
Toluene	108-88-3	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.63E-03	25	383.78	591.79	7930
trans-1,2-Dichloroethene	156-60-5	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.85E-01	9.39E-03	25	320.85	516.5	6717
trans-1,3-Dichloropropene	10061-02-6	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.26E-01	1.77E-02	25	381.15	587.38	7000
Trichloroethene (TCE)	79-01-6	1.66E+02	7.90E-02	9.10E-06	1.10E+03	4.22E-01	1.03E-02	25	360.36	544.2	7505
vinyl chloride	75-01-4	1.86E+01	1.06E-01	1.23E-05	2.76E+03	1.11E+00	2.71E-02	25	259.25	432	5250
Xylenes	1330-20-7	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.01E-01	7.34E-03	25	412.27	617.05	8523

Table 14. Volatilization Model Parameters
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Parameter	Symbol	Value	Units	Source
depth below grade to bottom of enclosure	Lf	15	cm	model default for building
vadose zone total porosity	nv	0.45	unitless	Site-specific (boring logs)
vadose zone water filled porosity	sigmaVW	0.3	cm3/cm3	Site-specific (boring logs)
builing length	Lb	6096	cm	3-story (40' high) 200' x 150' building (30,000 ft^2 per floor)
building width	Wb	4572	cm	3-story (40' high) 200' x 150' building (30,000 ft^2 per floor)
building height	Hb	1219	cm	3-story (40' high) 200' x 150' building (30,000 ft^2 per floor)
soil bulk density	Db	1.86	g/cm3	Site-specific (boring logs)
cap zone total porosity	ncz	0.45	unitless	Site-specific (boring logs)
soil temp	Ts	22.8	celsius	Site-specific (well sampling logs)
building perimeter	Xcrack	21,336	cm	3-story (40' high) 200' x 150' building (30,000 ft^2 per floor)
required building ventilation rate	er	20	cfm/person	ASHRAE Standard 62-1999
building occupancy	occ	360	number of people	generic office building floor space requirements (250 ft^2 per person)
building ventilation rate	Qbuild	3,400,000	cm3/sec	calculated from building diemensions and ASHRAE standard
Wind speed above ground surface	Uair	427	cm/sec	Site-specific
Width of source parallel to wind	W	1500	cm	Professional Judgement
Height of box representing breathing zone	ht	200	cm	ASTM, 1995

cm^3	Cubic centimeters.
cm	Centimeters.
l	Liters.
sec	Seconds.
ft^2	Square feet
cfm	cubic feet per minute

Table 15. Toxicity Criteria for the COPCs
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

	Cancer Slope Factors						Noncancer Reference Doses			
COPC	Oral (mg/kg-day)$^{-1}$	Source	Weight-of-Evidence [a]	Inhalation (mg/kg-day)$^{-1}$	Source	Weight-of-Evidence [a]	Oral (mg/kg-day)	Source	Inhalation (mg/kg-day)	Source
Metals										
Arsenic	1.5E+00	OHHEA	A	1.5E+01	IRIS	A	3.0E-04	IRIS	3.0E-04	Oral
Cadmium	3.8E-01	OHHEA	B1	1.5E+01	OHHEA	B1	1.0E-03	IRIS	1.0E-03	Oral
Chromium (VI)	1.9E-01	OHHEA	D	5.1E+02	OHHEA	A	3.0E-03	IRIS	2.3E-06	IRIS
Mercury [b]	NC	NC	C	NC	NC	C	3.0E-04	IRIS	3.0E-04	Oral
Thallium [c]	NC	NC	D	NC	NC	D	8.0E-05	IRIS	8.0E-05	Oral
Volatile Organic Compounds (VOCs)										
1,1,1-Trichloroethane	NC	NC	D	NC	NC	D	2.8E-01	NCEA	6.3E-01	NCEA
1,1,2,2-Tetrachloroethane	2.7E-01	OHHEA	B2	2.0E-01	OHHEA	B2	6.0E-02	NCEA	6.0E-02	ORAL
1,1,2-Trichloroethane	7.2E-02	OHHEA	C	5.7E-02	OHHEA	C	4.0E-03	IRIS	4.0E-03	ORAL
1,1-Dichloroethane	5.7E-03	HEAST	C	5.7E-03	OHHEA	C	1.0E-01	HEAST	1.4E-01	HEAST
1,1-Dichloroethene	NC	NC	--	NC	NC	--	5.0E-02	IRIS	5.0E-02	IRIS
1,2-Dichlorobenzene	NC	NC	--	NC	NC	--	9.0E-02	IRIS	5.7E-05	HEAST
1,2-Dichloroethane	9.1E-02	IRIS	B2	9.1E-02	IRIS	B2	3.0E-02	NCEA	1.4E-03	NCEA
1,2-Dichloropropane	6.8E-02	HEAST	--	6.8E-02	ORAL	--	1.1E-03	INHALATION	1.1E-03	IRIS
1,3-Dichlorobenzene	NC	NC	--	NC	NC	--	9.0E-04	NCEA	9.0E-04	NCEA
1,4-Dichlorobenzene	2.4E-02	OHHEA	B2	4.0E-02	OHHEA	B2	3.0E-02	NCEA	2.3E-01	IRIS
1,4-Dioxane	2.7E-02	OHHEA	B2	2.7E-02	OHHEA	B2	NA	NA	NA	AN
Benzene	1.0E-01	OHHEA	A	1.0E-01	OHHEA	A	3.0E-03	NCEA	1.7E-03	NCEA
Carbon tetrachloride	1.5E-01	OHHEA	B2	1.5E-01	OHHEA	B2	7.0E-04	IRIS	7.0E-04	ORAL
Chlorobenzene	NC	NC	--	NC	NC	--	2.0E-02	IRIS	1.7E-02	NCEA
Chloroethane	NC	NC	--	NC	NC	--	4.0E-01	NCEA	2.9E+00	IRIS
Chloroform	3.1E-02	OHHEA	B2	1.9E-02	OHHEA	B2	1.0E-02	IRIS	8.6E-05	NCEA
cis-1,2-Dichloroethene	NC	NC	D	NC	NC	D	1.0E-02	HEAST	1.0E-02	NA
cis-1,3-Dichloropropene	1.8E-01	HEAST	--	1.3E-01	HEAST	--	3.0E-04	IRIS	5.7E-03	IRIS
Ethylbenzene	3.9E-03	INHALATION	--	3.9E-03	NCEA	--	1.0E-01	IRIS	2.9E-01	adj
Methylene chloride	1.4E-02	OHHEA	B2	3.5E-03	OHHEA	B2	6.0E-02	IRIS	8.6E-01	HEAST
Tetrachloroethene (PCE)	5.4E-01	OHHEA	B2	1.5E-01	OHHEA	B2	1.0E-02	IRIS	1.1E-01	NCEA
Toluene	NC	NC	--	NC	NC	--	2.0E-01	IRIS	1.1E-01	IRIS
trans-1,2-Dichloroethene	NC	NC	--	NC	NC	NA	2.0E-02	IRIS	2.0E-02	IRIS
trans-1,3-Dichloropropene	1.8E-01	HEAST	--	1.3E-01	HEAST	--	3.0E-04	IRIS	5.7E-03	IRIS
Trichloroethene (TCE)	4.0E-01	NCEA	B1	4.0E-01	NCEA	B1	3.0E-04	NCEA	1.0E-02	NCEA
Trichlorotrifluoroethane (Freon 113)	NC	NC	--	NC	NC	--	3.0E+01	IRIS	8.6E+00	HEAST
Vinyl chloride	1.5E+00	IRIS	A	2.7E-01	OHHEA	A	3.0E-03	IRIS	2.9E-02	IRIS
Xylenes	NC	NC	--	NC	NC	--	7.0E-01	IRIS	2.9E-02	ORAL

COPC Chemical of potential concern.
mg/kg-day Milligrams per kilogram per day.
NC Non-carcinogenic.
NA Not available.

OHHEA Toxicity Criteria Database (*Cal/EPA, 2002*).
HEAST Health Effects Assessment Summary Tables (*USEPA, 1997*).
NCEA National Center for Environmental Assessment (EPA 2000).
Oral Oral criteria used for the inhalation pathway.

[a] Carcinogenic weight-of-evidence from epidemiologic and animal studies (USEPA, 1997).
[b] Values for mercuric chloride used.
[c] Values for thallium carbonate used.

Table 16. Construction Worker Receptor
Risks and Hazards Estimated from Groundwater Concentrations
using Johnson and Ettinger Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
65A	6.0E-06	6.0E-06	2E+00	2E+00	8.5E-07	8.5E-07	5E-01	5E-01
72A	1.7E-07	1.7E-07	2E-02	2E-02	3.0E-08	3.0E-08	8E-03	8E-03
73A	3.9E-06	3.9E-06	1E+00	1E+00	5.5E-07	5.5E-07	3E-01	3E-01
74A	3.1E-07	3.1E-07	9E-02	9E-02	5.8E-08	5.8E-08	3E-02	3E-02
75A	1.6E-07	1.6E-07	5E-02	5E-02	2.8E-08	2.7E-08	2E-02	2E-02
81A	1.7E-06	1.7E-06	5E-01	5E-01	2.6E-07	2.6E-07	2E-01	2E-01
82A	8.2E-06	8.2E-06	2E+00	2E+00	1.0E-06	1.0E-06	6E-01	6E-01
88A	9.3E-08	9.3E-08	3E-02	3E-02	1.7E-08	1.7E-08	1E-02	1E-02
89A	1.4E-06	1.4E-06	4E-01	4E-01	2.4E-07	2.4E-07	1E-01	1E-01
EA1-1	3.5E-06	3.5E-06	7E-01	7E-01	4.5E-07	4.5E-07	2E-01	2E-01
EA1-2	2.5E-06	2.5E-06	7E-01	7E-01	4.9E-07	4.9E-07	3E-01	3E-01
EA1-3	9.8E-06	9.8E-06	3E+00	3E+00	1.6E-06	1.6E-06	9E-01	9E-01
EA1-5	1.7E-06	2.7E-07	1E-01	9E-02	3.0E-07	3.9E-08	3E-02	3E-02
REG-2A	4.9E-06	4.9E-06	1E+00	1E+00	8.1E-07	8.1E-07	5E-01	5E-01
REG-3A	4.0E-06	4.0E-06	1E+00	1E+00	7.1E-07	7.1E-07	4E-01	4E-01
REG-4A	1.0E-05	1.0E-05	3E+00	3E+00	1.6E-06	1.6E-06	1E+00	1E+00
REG-5A	9.5E-06	9.5E-06	3E+00	3E+00	1.5E-06	1.5E-06	9E-01	9E-01
REG-7A	2.5E-06	2.5E-06	7E-01	7E-01	4.2E-07	4.2E-07	2E-01	2E-01
REG-8A	1.8E-06	1.8E-06	5E-01	5E-01	2.9E-07	2.9E-07	2E-01	2E-01
REG-9A	1.1E-06	1.1E-06	3E-01	3E-01	1.8E-07	1.8E-07	1E-01	1E-01
W14-10	6.3E-09	6.3E-09	7E-04	7E-04	1.3E-09	1.3E-09	3E-04	3E-04
W14-11	9.6E-08	9.6E-08	1E-02	1E-02	1.9E-08	1.9E-08	4E-03	4E-03
W14-12	1.7E-08	1.7E-08	2E-03	2E-03	3.3E-09	3.3E-09	8E-04	8E-04
W14-2	1.7E-08	1.7E-08	2E-03	2E-03	3.3E-09	3.3E-09	8E-04	8E-04
W14-3	3.7E-11	3.7E-11	3E-05	3E-05	6.7E-12	6.7E-12	1E-05	1E-05
W29-3	9.4E-06	9.4E-06	3E+00	3E+00	1.4E-06	1.4E-06	8E-01	8E-01
W29-4	4.4E-07	4.4E-07	2E-01	2E-01	4.1E-08	4.1E-08	3E-02	3E-02
W56-2	6.1E-06	5.8E-06	2E+00	2E+00	4.4E-07	4.1E-07	2E-01	2E-01
W89-1	1.5E-06	1.5E-06	4E-01	4E-01	2.7E-07	2.7E-07	2E-01	2E-01
W89-2	3.4E-07	3.3E-07	1E-01	1E-01	4.5E-08	4.4E-08	3E-02	3E-02
W89-5	3.6E-07	3.6E-07	1E-01	1E-01	6.6E-08	6.6E-08	4E-02	4E-02
W89-8	3.3E-11	3.3E-11	4E-05	4E-05	5.0E-12	5.0E-12	1E-05	1E-05
W89-9	7.7E-07	7.5E-07	2E-01	2E-01	1.1E-07	1.1E-07	6E-02	6E-02
W9-1	1.5E-05	1.5E-05	4E+00	4E+00	2.5E-06	2.5E-06	1E+00	1E+00
W9-16	2.3E-06	2.1E-06	6E-01	6E-01	3.8E-07	3.6E-07	2E-01	2E-01
W9-18	1.2E-05	9.3E-06	2E+00	2E+00	1.2E-06	6.9E-07	4E-01	4E-01
W9-19	1.6E-07	9.1E-08	3E-02	3E-02	2.0E-08	8.4E-09	6E-03	6E-03
W9-2	1.9E-05	1.9E-05	5E+00	5E+00	3.3E-06	3.3E-06	2E+00	2E+00
W9-23	7.6E-06	7.3E-06	2E+00	2E+00	6.4E-07	6.1E-07	4E-01	4E-01
W9-35	3.1E-05	3.1E-05	8E+00	8E+00	3.8E-06	3.8E-06	2E+00	2E+00
W9-37	1.1E-05	1.1E-05	3E+00	3E+00	1.6E-06	1.6E-06	9E-01	9E-01
W9-44	1.3E-05	1.3E-05	4E+00	4E+00	2.1E-06	2.1E-06	1E+00	1E+00
W9-45	1.8E-06	1.8E-06	5E-01	5E-01	3.2E-07	3.2E-07	2E-01	2E-01
W9SC-13	6.3E-07	8.5E-08	4E-02	4E-02	7.3E-08	9.5E-09	1E-02	1E-02
W9SC-14	7.2E-06	6.4E-06	2E+00	2E+00	8.0E-07	7.1E-07	4E-01	4E-01

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
W9SC-17	1.7E-05	1.4E-05	4E+00	4E+00	2.2E-06	1.9E-06	1E+00	1E+00
W9SC-7	4.1E-06	5.5E-07	1E-01	9E-02	5.6E-07	6.3E-08	3E-02	2E-02
WIC-1	1.1E-05	1.0E-05	3E+00	3E+00	1.6E-06	1.6E-06	9E-01	9E-01
WIC-10	6.6E-07	6.6E-07	1E-01	1E-01	6.8E-08	6.8E-08	3E-02	3E-02
WIC-11	1.4E-06	1.4E-06	3E-01	3E-01	1.7E-07	1.7E-07	8E-02	8E-02
WIC-12	1.5E-05	1.5E-05	4E+00	4E+00	2.5E-06	2.5E-06	1E+00	1E+00
WIC-3	1.0E-05	1.0E-05	3E+00	3E+00	1.7E-06	1.7E-06	9E-01	9E-01
WIC-5	2.6E-06	2.6E-06	7E-01	7E-01	2.3E-07	2.3E-07	1E-01	1E-01
WIC-6	4.4E-06	4.3E-06	1E+00	1E+00	7.6E-07	7.5E-07	4E-01	4E-01
WIC-7	5.3E-06	5.2E-06	1E+00	1E+00	8.6E-07	8.6E-07	5E-01	5E-01
WIC-8	5.3E-06	5.2E-06	1E+00	1E+00	9.0E-07	8.9E-07	5E-01	5E-01
WIC-9	3.1E-06	3.1E-06	8E-01	8E-01	5.0E-07	5.0E-07	3E-01	3E-01
WNX-1	2.4E-06	2.2E-06	7E-01	7E-01	4.3E-07	4.1E-07	2E-01	2E-01
WNX-3	2.3E-06	2.3E-06	7E-01	7E-01	4.5E-07	4.5E-07	3E-01	3E-01
WT14-1	1.1E-10	1.1E-10	2E-05	2E-05	2.0E-11	2.0E-11	7E-06	7E-06
WU4-1	1.1E-05	1.1E-05	3E+00	3E+00	1.8E-06	1.8E-06	1E+00	1E+00
WU4-10	1.1E-06	1.1E-06	3E-01	3E-01	1.5E-07	1.5E-07	8E-02	8E-02
WU4-21	3.4E-09	3.4E-09	1E-03	1E-03	5.6E-10	5.6E-10	4E-04	4E-04
WU4-25	1.2E-07	1.2E-07	4E-02	4E-02	1.4E-08	1.4E-08	8E-03	8E-03
WU4-3	1.7E-05	1.7E-05	5E+00	5E+00	2.1E-06	2.1E-06	1E+00	1E+00
WU4-8	2.4E-07	1.8E-08	1E-02	1E-02	2.6E-08	2.7E-09	3E-03	3E-03
WW-10A	3.4E-08	3.4E-08	1E-02	1E-02	2.3E-09	2.3E-09	1E-03	1E-03
WW-10C	6.3E-08	6.3E-08	2E-02	2E-02	7.1E-09	7.1E-09	4E-03	4E-03
WW-10D	5.6E-08	5.6E-08	2E-02	2E-02	4.9E-09	4.9E-09	3E-03	3E-03
WW-11	4.3E-06	4.3E-06	1E+00	1E+00	6.7E-07	6.7E-07	4E-01	4E-01
WW-12	2.8E-06	2.8E-06	6E-01	6E-01	3.6E-07	3.6E-07	2E-01	2E-01
WW-13A	5.6E-09	5.6E-09	2E-03	2E-03	6.3E-10	6.3E-10	4E-04	4E-04
WW-14	3.5E-09	3.5E-09	1E-03	1E-03	3.8E-10	3.8E-10	2E-04	2E-04
WW-15	7.5E-08	7.5E-08	2E-02	2E-02	5.9E-09	5.9E-09	3E-03	3E-03
WW-16A	4.0E-06	3.9E-06	1E+00	1E+00	5.4E-07	5.4E-07	3E-01	3E-01
WW-17A	2.0E-08	1.4E-08	5E-03	5E-03	1.8E-09	9.5E-10	7E-04	7E-04
WW-18A	3.4E-08	3.4E-08	1E-02	1E-02	1.7E-09	1.7E-09	1E-03	1E-03
WW-1A	6.8E-09	6.8E-09	2E-03	2E-03	5.1E-10	5.1E-10	3E-04	3E-04
WW-2	6.7E-06	6.7E-06	2E+00	2E+00	1.1E-06	1.1E-06	6E-01	6E-01
WW-3	4.8E-08	3.3E-08	1E-02	1E-02	4.4E-09	2.9E-09	3E-03	3E-03
WW-4A	4.7E-09	7.2E-10	2E-04	2E-04	5.9E-10	9.8E-11	4E-05	4E-05
WW-5	3.4E-09	3.4E-09	1E-03	1E-03	4.2E-10	4.2E-10	2E-04	2E-04
WW-6	9.2E-08	9.2E-08	3E-02	3E-02	9.1E-09	9.1E-09	5E-03	5E-03
WW-7A	6.1E-06	6.1E-06	2E+00	2E+00	6.4E-07	6.4E-07	3E-01	3E-01
WW-8A	1.1E-07	9.3E-08	3E-02	3E-02	6.6E-09	5.6E-09	5E-03	5E-03
WW-9A	3.5E-09	3.5E-09	1E-03	1E-03	4.3E-10	4.3E-10	2E-04	2E-04
WWR-1	1.9E-06	1.9E-06	5E-01	5E-01	3.2E-07	3.2E-07	2E-01	2E-01
WWR-2	3.3E-06	3.3E-06	9E-01	9E-01	4.7E-07	4.6E-07	3E-01	3E-01
WWR-3	1.5E-07	1.5E-07	4E-02	4E-02	2.6E-08	2.6E-08	2E-02	2E-02

Table 17. Indoor Worker Receptor
Risks and Hazards Estimated from Groundwater Concentrations
using Johnson and Ettinger Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
65A	2.5E-05	2.5E-05	2E-02	2E-02	1.3E-06	1.3E-06	5E-03	5E-03
72A	4.1E-07	4.1E-07	3E-04	3E-04	2.5E-08	2.5E-08	1E-04	1E-04
73A	1.7E-05	1.7E-05	1E-02	1E-02	8.4E-07	8.4E-07	4E-03	4E-03
74A	1.3E-06	1.3E-06	1E-03	1E-03	8.6E-08	8.6E-08	5E-04	5E-04
75A	6.7E-07	6.7E-07	1E-03	1E-03	4.0E-08	4.0E-08	5E-04	5E-04
81A	3.7E-06	3.7E-06	6E-03	6E-03	2.0E-07	2.0E-07	2E-03	2E-03
82A	3.3E-05	3.3E-05	2E-02	2E-02	1.4E-06	1.4E-06	7E-03	7E-03
88A	2.0E-07	2.0E-07	1E-04	1E-04	1.3E-08	1.3E-08	6E-05	6E-05
89A	3.1E-06	3.1E-06	3E-03	3E-03	1.8E-07	1.8E-07	9E-04	9E-04
EA1-1	1.1E-05	1.1E-05	2E-02	2E-02	4.8E-07	4.8E-07	7E-03	7E-03
EA1-2	1.1E-05	1.1E-05	8E-03	8E-03	7.5E-07	7.5E-07	4E-03	4E-03
EA1-3	4.1E-05	4.1E-05	3E-02	3E-02	2.3E-06	2.3E-06	1E-02	1E-02
EA1-5	1.8E-06	1.1E-06	6E-03	3E-03	1.0E-07	5.5E-08	2E-03	1E-03
REG-2A	1.0E-05	1.0E-05	7E-03	7E-03	6.0E-07	6.0E-07	3E-03	3E-03
REG-3A	8.6E-06	8.6E-06	6E-03	6E-03	5.3E-07	5.3E-07	2E-03	2E-03
REG-4A	2.2E-05	2.2E-05	2E-02	2E-02	1.2E-06	1.2E-06	5E-03	5E-03
REG-5A	2.0E-05	2.0E-05	1E-02	1E-02	1.1E-06	1.1E-06	5E-03	5E-03
REG-7A	5.3E-06	5.3E-06	4E-03	4E-03	3.2E-07	3.2E-07	2E-03	2E-03
REG-8A	7.1E-06	7.1E-06	6E-03	6E-03	4.0E-07	4.0E-07	2E-03	2E-03
REG-9A	2.3E-06	2.3E-06	2E-03	2E-03	1.3E-07	1.3E-07	6E-04	6E-04
W14-10	1.2E-08	1.2E-08	2E-04	2E-04	8.3E-10	8.3E-10	8E-05	8E-05
W14-11	1.8E-07	1.8E-07	3E-03	3E-03	1.3E-08	1.3E-08	1E-03	1E-03
W14-12	3.2E-08	3.2E-08	5E-04	5E-04	2.2E-09	2.2E-09	2E-04	2E-04
W14-2	3.1E-08	3.1E-08	5E-04	5E-04	2.2E-09	2.2E-09	2E-04	2E-04
W14-3	1.6E-10	1.6E-10	2E-05	2E-05	9.9E-12	9.9E-12	6E-06	6E-06
W29-3	3.9E-05	3.9E-05	3E-02	3E-02	2.0E-06	2.0E-06	1E-02	1E-02
W29-4	1.9E-06	1.9E-06	8E-03	8E-03	6.1E-08	6.1E-08	2E-03	2E-03
W56-2	2.5E-05	2.5E-05	2E-02	2E-02	6.3E-07	6.2E-07	4E-03	4E-03
W89-1	6.3E-06	6.3E-06	5E-03	5E-03	3.9E-07	3.9E-07	2E-03	2E-03
W89-2	1.4E-06	1.4E-06	1E-03	1E-03	6.6E-08	6.6E-08	3E-04	3E-04
W89-5	7.8E-07	7.8E-07	5E-04	5E-04	5.0E-08	5.0E-08	2E-04	2E-04
W89-8	5.0E-11	5.0E-11	5E-06	5E-06	2.1E-12	2.1E-12	1E-06	1E-06
W89-9	1.6E-06	1.6E-06	2E-03	2E-03	8.0E-08	8.0E-08	5E-04	5E-04
W9-1	6.5E-05	6.5E-05	5E-02	5E-02	3.8E-06	3.8E-06	2E-02	2E-02
W9-16	4.7E-06	4.6E-06	3E-03	3E-03	2.8E-07	2.8E-07	1E-03	1E-03
W9-18	1.5E-05	1.3E-05	1E-01	1E-01	4.4E-07	3.5E-07	4E-02	4E-02
W9-19	4.3E-07	3.9E-07	2E-03	1E-03	1.5E-08	1.3E-08	4E-04	3E-04
W9-2	8.1E-05	8.1E-05	6E-02	6E-02	4.9E-06	4.9E-06	2E-02	2E-02
W9-23	3.2E-05	3.2E-05	3E-02	3E-02	9.4E-07	9.3E-07	7E-03	6E-03
W9-35	1.3E-04	1.3E-04	9E-02	9E-02	5.5E-06	5.5E-06	2E-02	2E-02
W9-37	2.4E-05	2.4E-05	2E-02	2E-02	1.2E-06	1.2E-06	6E-03	6E-03
W9-44	5.3E-05	5.3E-05	7E-02	7E-02	3.1E-06	3.1E-06	2E-02	2E-02
W9-45	7.5E-06	7.5E-06	6E-03	6E-03	4.8E-07	4.8E-07	3E-03	3E-03
W9SC-13	5.5E-07	2.6E-07	7E-03	6E-03	2.3E-08	1.1E-08	2E-03	2E-03
W9SC-14	2.6E-05	2.6E-05	3E-02	3E-02	1.0E-06	1.0E-06	8E-03	7E-03

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
W9SC-17	2.8E-05	2.8E-05	4E-02	4E-02	1.4E-06	1.3E-06	1E-02	1E-02
W9SC-7	3.2E-06	1.3E-06	2E-02	1E-02	1.5E-07	5.5E-08	5E-03	3E-03
WIC-1	4.1E-05	4.1E-05	8E-02	8E-02	2.3E-06	2.3E-06	2E-02	2E-02
WIC-10	2.2E-06	2.2E-06	1E-03	1E-03	8.9E-08	8.9E-08	4E-04	4E-04
WIC-11	5.1E-06	5.1E-06	4E-03	4E-03	2.3E-07	2.3E-07	1E-03	1E-03
WIC-12	5.8E-05	5.8E-05	1E-01	1E-01	3.6E-06	3.6E-06	3E-02	3E-02
WIC-3	3.9E-05	3.9E-05	7E-02	7E-02	2.5E-06	2.5E-06	2E-02	2E-02
WIC-5	1.0E-05	1.0E-05	2E-02	2E-02	3.3E-07	3.3E-07	4E-03	4E-03
WIC-6	1.7E-05	1.7E-05	4E-02	4E-02	1.1E-06	1.1E-06	9E-03	9E-03
WIC-7	2.0E-05	2.0E-05	4E-02	4E-02	1.2E-06	1.2E-06	8E-03	8E-03
WIC-8	2.1E-05	2.1E-05	4E-02	4E-02	1.3E-06	1.3E-06	9E-03	9E-03
WIC-9	1.2E-05	1.2E-05	2E-02	2E-02	7.1E-07	7.1E-07	5E-03	5E-03
WNX-1	4.9E-06	4.8E-06	7E-03	7E-03	3.2E-07	3.2E-07	3E-03	3E-03
WNX-3	5.1E-06	5.1E-06	4E-03	4E-03	3.5E-07	3.5E-07	2E-03	2E-03
WT14-1	4.5E-10	4.5E-10	2E-05	2E-05	2.9E-11	2.9E-11	1E-05	1E-05
WU4-1	4.4E-05	4.4E-05	3E-02	3E-02	2.5E-06	2.5E-06	1E-02	1E-02
WU4-10	4.4E-06	4.4E-06	7E-03	7E-03	2.2E-07	2.2E-07	2E-03	2E-03
WU4-21	1.4E-08	1.4E-08	4E-05	4E-05	8.3E-10	8.3E-10	1E-05	1E-05
WU4-25	5.1E-07	5.1E-07	1E-03	1E-03	2.1E-08	2.1E-08	3E-04	3E-04
WU4-3	3.7E-05	3.7E-05	3E-02	3E-02	1.6E-06	1.6E-06	7E-03	7E-03
WU4-8	1.9E-07	7.0E-08	1E-03	1E-03	8.0E-09	3.8E-09	4E-04	3E-04
WW-10A	1.5E-07	1.5E-07	1E-04	1E-04	3.5E-09	3.5E-09	2E-05	2E-05
WW-10C	2.7E-07	2.7E-07	2E-04	2E-04	1.1E-08	1.1E-08	5E-05	5E-05
WW-10D	2.4E-07	2.4E-07	2E-04	2E-04	7.5E-09	7.5E-09	3E-05	3E-05
WW-11	1.7E-05	1.7E-05	2E-02	2E-02	9.7E-07	9.7E-07	6E-03	6E-03
WW-12	8.8E-06	8.8E-06	8E-03	8E-03	5.0E-07	5.0E-07	2E-03	2E-03
WW-13A	2.4E-08	2.4E-08	3E-05	3E-05	9.5E-10	9.5E-10	7E-06	7E-06
WW-14	1.5E-08	1.5E-08	2E-05	2E-05	5.8E-10	5.8E-10	4E-06	4E-06
WW-15	3.2E-07	3.2E-07	2E-04	2E-04	8.9E-09	8.9E-09	4E-05	4E-05
WW-16A	1.6E-05	1.6E-05	2E-02	2E-02	7.8E-07	7.8E-07	5E-03	5E-03
WW-17A	6.3E-08	6.0E-08	2E-04	2E-04	1.6E-09	1.4E-09	4E-05	4E-05
WW-18A	1.5E-07	1.5E-07	1E-04	1E-04	2.6E-09	2.6E-09	1E-05	1E-05
WW-1A	2.9E-08	2.9E-08	2E-05	2E-05	7.7E-10	7.7E-10	3E-06	3E-06
WW-2	2.7E-05	2.7E-05	3E-02	3E-02	1.5E-06	1.5E-06	1E-02	1E-02
WW-3	1.5E-07	1.4E-07	1E-03	1E-03	4.7E-09	4.4E-09	3E-04	3E-04
WW-4A	4.5E-09	2.3E-09	4E-05	3E-05	1.9E-10	1.0E-10	1E-05	8E-06
WW-5	1.5E-08	1.5E-08	2E-05	2E-05	6.4E-10	6.4E-10	4E-06	4E-06
WW-6	3.9E-07	3.9E-07	3E-04	3E-04	1.4E-08	1.4E-08	6E-05	6E-05
WW-7A	2.5E-05	2.5E-05	4E-02	4E-02	9.2E-07	9.2E-07	6E-03	6E-03
WW-8A	4.0E-07	4.0E-07	1E-03	1E-03	8.5E-09	8.3E-09	4E-04	4E-04
WW-9A	1.5E-08	1.5E-08	1E-05	1E-05	6.5E-10	6.5E-10	3E-06	3E-06
WWR-1	8.1E-06	8.1E-06	9E-03	9E-03	4.8E-07	4.8E-07	3E-03	3E-03
WWR-2	1.4E-05	1.4E-05	1E-02	1E-02	7.0E-07	7.0E-07	4E-03	4E-03
WWR-3	3.3E-07	3.3E-07	3E-03	3E-03	2.0E-08	2.0E-08	6E-04	6E-04

Table 18. Adult Resident (10 yr RME) Receptor
Risks and Hazards Estimated from Groundwater Concentrations
using Johnson and Ettinger Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

	RME				CTE					RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**		**Well Number**	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**			**Less VC**		**Less VC**		**Less VC**		**Less VC**
65A	1.6E-05	1.6E-05	3E-02	3E-02	2.7E-06	2.7E-06	9E-03	9E-03	**W9SC-17**	1.8E-05	1.8E-05	7E-02	6E-02	2.9E-06	2.9E-06	2E-02	2E-02
72A	2.7E-07	2.7E-07	5E-04	5E-04	5.3E-08	5.3E-08	2E-04	2E-04	**W9SC-7**	2.1E-06	8.4E-07	3E-02	2E-02	3.2E-07	1.2E-07	9E-03	6E-03
73A	1.1E-05	1.1E-05	2E-02	2E-02	1.8E-06	1.8E-06	7E-03	7E-03	**WIC-1**	2.7E-05	2.6E-05	1E-01	1E-01	5.0E-06	5.0E-06	3E-02	3E-02
74A	8.4E-07	8.4E-07	2E-03	2E-03	1.9E-07	1.9E-07	8E-04	8E-04	**WIC-10**	1.4E-06	1.4E-06	2E-03	2E-03	1.9E-07	1.9E-07	6E-04	6E-04
75A	4.3E-07	4.3E-07	2E-03	2E-03	8.6E-08	8.6E-08	9E-04	9E-04	**WIC-11**	3.3E-06	3.3E-06	7E-03	7E-03	4.9E-07	4.9E-07	2E-03	2E-03
81A	2.4E-06	2.4E-06	1E-02	9E-03	4.3E-07	4.2E-07	4E-03	4E-03	**WIC-12**	3.8E-05	3.8E-05	2E-01	2E-01	7.8E-06	7.8E-06	6E-02	6E-02
82A	2.2E-05	2.2E-05	4E-02	4E-02	3.1E-06	3.1E-06	1E-02	1E-02	**WIC-3**	2.5E-05	2.5E-05	1E-01	1E-01	5.3E-06	5.3E-06	3E-02	3E-02
88A	1.3E-07	1.3E-07	2E-04	2E-04	2.8E-08	2.8E-08	1E-04	1E-04	**WIC-5**	6.5E-06	6.5E-06	3E-02	3E-02	7.0E-07	7.0E-07	6E-03	6E-03
89A	2.0E-06	2.0E-06	4E-03	4E-03	4.0E-07	4.0E-07	2E-03	2E-03	**WIC-6**	1.1E-05	1.1E-05	6E-02	6E-02	2.4E-06	2.3E-06	1E-02	1E-02
EA1-1	6.9E-06	6.9E-06	3E-02	3E-02	1.0E-06	1.0E-06	1E-02	1E-02	**WIC-7**	1.3E-05	1.3E-05	6E-02	6E-02	2.7E-06	2.7E-06	1E-02	1E-02
EA1-2	7.0E-06	7.0E-06	1E-02	1E-02	1.6E-06	1.6E-06	6E-03	6E-03	**WIC-8**	1.3E-05	1.3E-05	6E-02	6E-02	2.8E-06	2.8E-06	2E-02	2E-02
EA1-3	2.6E-05	2.6E-05	5E-02	5E-02	5.0E-06	5.0E-06	2E-02	2E-02	**WIC-9**	7.8E-06	7.8E-06	3E-02	3E-02	1.5E-06	1.5E-06	8E-03	8E-03
EA1-5	1.2E-06	6.9E-07	9E-03	5E-03	2.2E-07	1.2E-07	4E-03	2E-03	**WNX-1**	3.1E-06	3.1E-06	1E-02	1E-02	6.9E-07	6.8E-07	5E-03	5E-03
REG-2A	6.6E-06	6.6E-06	1E-02	1E-02	1.3E-06	1.3E-06	5E-03	5E-03	**WNX-3**	3.3E-06	3.3E-06	6E-03	6E-03	7.5E-07	7.5E-07	3E-03	3E-03
REG-3A	5.5E-06	5.5E-06	1E-02	1E-02	1.2E-06	1.2E-06	4E-03	4E-03	**WT14-1**	2.9E-10	2.9E-10	4E-05	4E-05	6.4E-11	6.4E-11	2E-05	2E-05
REG-4A	1.4E-05	1.4E-05	2E-02	2E-02	2.6E-06	2.6E-06	9E-03	9E-03	**WU4-1**	2.8E-05	2.8E-05	5E-02	5E-02	5.5E-06	5.5E-06	2E-02	2E-02
REG-5A	1.3E-05	1.3E-05	2E-02	2E-02	2.5E-06	2.5E-06	8E-03	8E-03	**WU4-10**	2.9E-06	2.9E-06	1E-02	1E-02	4.7E-07	4.7E-07	4E-03	4E-03
REG-7A	3.5E-06	3.5E-06	7E-03	7E-03	6.9E-07	6.9E-07	3E-03	3E-03	**WU4-21**	9.2E-09	9.2E-09	6E-05	6E-05	1.8E-09	1.8E-09	2E-05	2E-05
REG-8A	4.6E-06	4.6E-06	1E-02	1E-02	8.7E-07	8.7E-07	4E-03	4E-03	**WU4-25**	3.3E-07	3.3E-07	2E-03	2E-03	4.4E-08	4.4E-08	6E-04	6E-04
REG-9A	1.5E-06	1.5E-06	3E-03	3E-03	2.9E-07	2.9E-07	1E-03	1E-03	**WU4-3**	2.4E-05	2.4E-05	4E-02	4E-02	3.4E-06	3.4E-06	1E-02	1E-02
W14-10	7.6E-09	7.6E-09	3E-04	3E-04	1.8E-09	1.8E-09	1E-04	1E-04	**WU4-8**	1.2E-07	4.5E-08	2E-03	2E-03	1.7E-08	8.1E-09	7E-04	5E-04
W14-11	1.2E-07	1.2E-07	5E-03	5E-03	2.7E-08	2.7E-08	2E-03	2E-03	**WW-10A**	9.4E-08	9.4E-08	2E-04	2E-04	7.5E-09	7.5E-09	3E-05	3E-05
W14-12	2.0E-08	2.0E-08	8E-04	8E-04	4.8E-09	4.8E-09	4E-04	4E-04	**WW-10C**	1.8E-07	1.8E-07	3E-04	3E-04	2.3E-08	2.3E-08	8E-05	8E-05
W14-2	2.0E-08	2.0E-08	8E-04	8E-04	4.7E-09	4.7E-09	4E-04	4E-04	**WW-10D**	1.5E-07	1.5E-07	3E-04	3E-04	1.6E-08	1.6E-08	6E-05	6E-05
W14-3	1.0E-10	1.0E-10	3E-05	3E-05	2.1E-11	2.1E-11	1E-05	1E-05	**WW-11**	1.1E-05	1.1E-05	3E-02	3E-02	2.1E-06	2.1E-06	1E-02	1E-02
W29-3	2.5E-05	2.5E-05	5E-02	5E-02	4.3E-06	4.3E-06	2E-02	2E-02	**WW-12**	5.7E-06	5.6E-06	1E-02	1E-02	1.1E-06	1.1E-06	4E-03	4E-03
W29-4	1.2E-06	1.2E-06	1E-02	1E-02	1.3E-07	1.3E-07	4E-03	4E-03	**WW-13A**	1.5E-08	1.5E-08	5E-05	5E-05	2.1E-09	2.1E-09	1E-05	1E-05
W56-2	1.6E-05	1.6E-05	3E-02	3E-02	1.4E-06	1.3E-06	7E-03	7E-03	**WW-14**	9.6E-09	9.6E-09	3E-05	3E-05	1.3E-09	1.3E-09	7E-06	7E-06
W89-1	4.1E-06	4.1E-06	7E-03	7E-03	8.5E-07	8.5E-07	3E-03	3E-03	**WW-15**	2.1E-07	2.1E-07	4E-04	4E-04	1.9E-08	1.9E-08	7E-05	7E-05
W89-2	9.0E-07	9.0E-07	2E-03	2E-03	1.4E-07	1.4E-07	5E-04	5E-04	**WW-16A**	1.0E-05	1.0E-05	4E-02	4E-02	1.7E-06	1.7E-06	8E-03	8E-03
W89-5	5.1E-07	5.1E-07	8E-04	8E-04	1.1E-07	1.1E-07	4E-04	4E-04	**WW-17A**	4.0E-08	3.8E-08	3E-04	3E-04	3.4E-09	3.1E-09	7E-05	6E-05
W89-8	3.2E-11	3.2E-11	8E-06	8E-06	4.4E-12	4.4E-12	2E-06	2E-06	**WW-18A**	9.3E-08	9.3E-08	2E-04	2E-04	5.7E-09	5.7E-09	2E-05	2E-05
W89-9	1.0E-06	1.0E-06	3E-03	3E-03	1.7E-07	1.7E-07	9E-04	9E-04	**WW-1A**	1.9E-08	1.9E-08	3E-05	3E-05	1.7E-09	1.7E-09	6E-06	6E-06
W9-1	4.2E-05	4.2E-05	7E-02	7E-02	8.1E-06	8.1E-06	3E-02	3E-02	**WW-2**	1.8E-05	1.8E-05	5E-02	5E-02	3.3E-06	3.3E-06	2E-02	2E-02
W9-16	3.0E-06	3.0E-06	5E-03	5E-03	6.0E-07	6.0E-07	2E-03	2E-03	**WW-3**	9.6E-08	9.1E-08	2E-03	2E-03	1.0E-08	9.6E-09	5E-04	5E-04
W9-18	9.5E-06	8.4E-06	2E-01	2E-01	9.5E-07	7.6E-07	7E-02	7E-02	**WW-4A**	2.9E-09	1.5E-09	6E-05	5E-05	4.2E-10	2.2E-10	2E-05	1E-05
W9-19	2.7E-07	2.5E-07	2E-03	2E-03	3.2E-08	2.7E-08	6E-04	5E-04	**WW-5**	9.5E-09	9.5E-09	3E-05	3E-05	1.4E-09	1.4E-09	8E-06	8E-06
W9-2	5.2E-05	5.2E-05	9E-02	9E-02	1.1E-05	1.1E-05	4E-02	4E-02	**WW-6**	2.5E-07	2.5E-07	4E-04	4E-04	3.0E-08	3.0E-08	1E-04	1E-04
W9-23	2.0E-05	2.0E-05	5E-02	5E-02	2.0E-06	2.0E-06	1E-02	1E-02	**WW-7A**	1.6E-05	1.6E-05	6E-02	6E-02	2.0E-06	2.0E-06	1E-02	1E-02
W9-35	8.3E-05	8.3E-05	1E-01	1E-01	1.2E-05	1.2E-05	4E-02	4E-02	**WW-8A**	2.6E-07	2.5E-07	2E-03	2E-03	1.8E-08	1.8E-08	7E-04	7E-04
W9-37	1.6E-05	1.6E-05	3E-02	3E-02	2.6E-06	2.6E-06	1E-02	1E-02	**WW-9A**	9.7E-09	9.7E-09	2E-05	2E-05	1.4E-09	1.4E-09	5E-06	5E-06
W9-44	3.4E-05	3.4E-05	1E-01	1E-01	6.8E-06	6.8E-06	4E-02	4E-02	**WWR-1**	5.2E-06	5.2E-06	1E-02	1E-02	1.0E-06	1.0E-06	5E-03	5E-03
W9-45	4.8E-06	4.8E-06	1E-02	1E-02	1.0E-06	1.0E-06	4E-03	4E-03	**WWR-2**	9.0E-06	9.0E-06	2E-02	2E-02	1.5E-06	1.5E-06	7E-03	6E-03
W9SC-13	3.6E-07	1.7E-07	1E-02	1E-02	4.9E-08	2.3E-08	4E-03	3E-03	**WWR-3**	2.1E-07	2.1E-07	4E-03	4E-03	4.4E-08	4.4E-08	1E-03	1E-03
W9SC-14	1.7E-05	1.7E-05	5E-02	5E-02	2.2E-06	2.2E-06	1E-02	1E-02									

Table 19. Child Resident (10 yr RME) Receptor
Risks and Hazards Estimated from Groundwater Concentrations
using Johnson and Ettinger Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
65A	3.9E-05	3.9E-05	7E-02	7E-02	6.9E-06	6.9E-06	2E-02	2E-02
72A	6.3E-07	6.3E-07	1E-03	1E-03	1.3E-07	1.3E-07	5E-04	5E-04
73A	2.6E-05	2.6E-05	5E-02	5E-02	4.6E-06	4.6E-06	2E-02	2E-02
74A	2.0E-06	2.0E-06	4E-03	4E-03	4.7E-07	4.7E-07	2E-03	2E-03
75A	1.0E-06	1.0E-06	5E-03	5E-03	2.2E-07	2.2E-07	2E-03	2E-03
81A	5.6E-06	5.6E-06	2E-02	2E-02	1.1E-06	1.1E-06	9E-03	9E-03
82A	5.1E-05	5.1E-05	9E-02	9E-02	7.8E-06	7.8E-06	3E-02	3E-02
88A	3.1E-07	3.1E-07	5E-04	5E-04	7.0E-08	7.0E-08	2E-04	2E-04
89A	4.7E-06	4.7E-06	1E-02	1E-02	1.0E-06	1.0E-06	4E-03	4E-03
EA1-1	1.6E-05	1.6E-05	7E-02	7E-02	2.6E-06	2.6E-06	3E-02	3E-02
EA1-2	1.7E-05	1.7E-05	3E-02	3E-02	4.1E-06	4.1E-06	2E-02	2E-02
EA1-3	6.3E-05	6.3E-05	1E-01	1E-01	1.3E-05	1.3E-05	5E-02	5E-02
EA1-5	2.7E-06	1.6E-06	2E-02	1E-02	5.6E-07	3.0E-07	9E-03	5E-03
REG-2A	1.6E-05	1.6E-05	3E-02	3E-02	3.2E-06	3.2E-06	1E-02	1E-02
REG-3A	1.3E-05	1.3E-05	2E-02	2E-02	2.9E-06	2.9E-06	1E-02	1E-02
REG-4A	3.3E-05	3.3E-05	6E-02	6E-02	6.6E-06	6.6E-06	2E-02	2E-02
REG-5A	3.0E-05	3.0E-05	5E-02	5E-02	6.2E-06	6.2E-06	2E-02	2E-02
REG-7A	8.2E-06	8.1E-06	2E-02	2E-02	1.7E-06	1.7E-06	7E-03	7E-03
REG-8A	1.1E-05	1.1E-05	2E-02	2E-02	2.2E-06	2.2E-06	9E-03	9E-03
REG-9A	3.5E-06	3.5E-06	6E-03	6E-03	7.3E-07	7.3E-07	2E-03	2E-03
W14-10	1.8E-08	1.8E-08	7E-04	7E-04	4.5E-09	4.5E-09	4E-04	4E-04
W14-11	2.8E-07	2.8E-07	1E-02	1E-02	6.8E-08	6.8E-08	6E-03	6E-03
W14-12	4.8E-08	4.8E-08	2E-03	2E-03	1.2E-08	1.2E-08	1E-03	1E-03
W14-2	4.8E-08	4.8E-08	2E-03	2E-03	1.2E-08	1.2E-08	1E-03	1E-03
W14-3	2.4E-10	2.4E-10	8E-05	8E-05	5.4E-11	5.4E-11	3E-05	3E-05
W29-3	5.9E-05	5.9E-05	1E-01	1E-01	1.1E-05	1.1E-05	5E-02	5E-02
W29-4	2.8E-06	2.8E-06	3E-02	3E-02	3.3E-07	3.3E-07	1E-02	1E-02
W56-2	3.8E-05	3.8E-05	8E-02	8E-02	3.4E-06	3.4E-06	2E-02	2E-02
W89-1	9.6E-06	9.6E-06	2E-02	2E-02	2.1E-06	2.1E-06	8E-03	8E-03
W89-2	2.1E-06	2.1E-06	4E-03	4E-03	3.6E-07	3.6E-07	1E-03	1E-03
W89-5	1.2E-06	1.2E-06	2E-03	2E-03	2.7E-07	2.7E-07	9E-04	9E-04
W89-8	7.6E-11	7.6E-11	2E-05	2E-05	1.1E-11	1.1E-11	5E-06	5E-06
W89-9	2.4E-06	2.4E-06	7E-03	7E-03	4.4E-07	4.4E-07	2E-03	2E-03
W9-1	9.9E-05	9.9E-05	2E-01	2E-01	2.0E-05	2.0E-05	7E-02	7E-02
W9-16	7.1E-06	7.0E-06	1E-02	1E-02	1.5E-06	1.5E-06	5E-03	5E-03
W9-18	2.2E-05	2.0E-05	5E-01	5E-01	2.4E-06	1.9E-06	2E-01	2E-01
W9-19	6.5E-07	5.9E-07	6E-03	5E-03	8.1E-08	6.8E-08	2E-03	1E-03
W9-2	1.2E-04	1.2E-04	2E-01	2E-01	2.7E-05	2.7E-05	9E-02	9E-02
W9-23	4.8E-05	4.8E-05	1E-01	1E-01	5.1E-06	5.1E-06	3E-02	3E-02
W9-35	2.0E-04	2.0E-04	3E-01	3E-01	3.0E-05	3.0E-05	1E-01	1E-01
W9-37	3.7E-05	3.7E-05	7E-02	7E-02	6.6E-06	6.6E-06	2E-02	2E-02
W9-44	8.1E-05	8.1E-05	3E-01	3E-01	1.7E-05	1.7E-05	9E-02	9E-02
W9-45	1.1E-05	1.1E-05	2E-02	2E-02	2.6E-06	2.6E-06	1E-02	1E-02
W9SC-13	8.4E-07	4.0E-07	3E-02	2E-02	1.2E-07	5.8E-08	1E-02	8E-03
W9SC-14	4.0E-05	3.9E-05	1E-01	1E-01	5.6E-06	5.5E-06	3E-02	3E-02

	RME				CTE			
Well Number	**Risk**		**HI**		**Risk**		**HI**	
		Less VC		**Less VC**		**Less VC**		**Less VC**
W9SC-17	4.3E-05	4.2E-05	2E-01	1E-01	7.4E-06	7.3E-06	6E-02	5E-02
W9SC-7	4.9E-06	2.0E-06	8E-02	5E-02	8.1E-07	3.0E-07	2E-02	1E-02
WIC-1	6.3E-05	6.2E-05	3E-01	3E-01	1.3E-05	1.3E-05	7E-02	7E-02
WIC-10	3.4E-06	3.4E-06	5E-03	5E-03	4.8E-07	4.8E-07	2E-03	2E-03
WIC-11	7.8E-06	7.8E-06	2E-02	2E-02	1.2E-06	1.2E-06	4E-03	4E-03
WIC-12	8.9E-05	8.9E-05	6E-01	6E-01	2.0E-05	2.0E-05	1E-01	1E-01
WIC-3	6.0E-05	6.0E-05	3E-01	3E-01	1.4E-05	1.3E-05	8E-02	8E-02
WIC-5	1.5E-05	1.5E-05	8E-02	8E-02	1.8E-06	1.8E-06	2E-02	2E-02
WIC-6	2.5E-05	2.5E-05	2E-01	2E-01	5.9E-06	5.9E-06	4E-02	4E-02
WIC-7	3.1E-05	3.1E-05	1E-01	1E-01	6.7E-06	6.7E-06	4E-02	4E-02
WIC-8	3.1E-05	3.1E-05	1E-01	1E-01	7.0E-06	7.0E-06	4E-02	4E-02
WIC-9	1.9E-05	1.9E-05	7E-02	7E-02	3.9E-06	3.9E-06	2E-02	2E-02
WNX-1	7.4E-06	7.4E-06	3E-02	3E-02	1.7E-06	1.7E-06	1E-02	1E-02
WNX-3	7.8E-06	7.8E-06	2E-02	2E-02	1.9E-06	1.9E-06	7E-03	7E-03
WT14-1	6.9E-10	6.9E-10	9E-05	9E-05	1.6E-10	1.6E-10	4E-05	4E-05
WU4-1	6.7E-05	6.7E-05	1E-01	1E-01	1.4E-05	1.4E-05	5E-02	5E-02
WU4-10	6.7E-06	6.7E-06	3E-02	3E-02	1.2E-06	1.2E-06	9E-03	9E-03
WU4-21	2.2E-08	2.2E-08	1E-04	1E-04	4.5E-09	4.5E-09	6E-05	6E-05
WU4-25	7.7E-07	7.7E-07	5E-03	5E-03	1.1E-07	1.1E-07	1E-03	1E-03
WU4-3	5.7E-05	5.7E-05	1E-01	1E-01	8.6E-06	8.6E-06	3E-02	3E-02
WU4-8	2.8E-07	1.1E-07	5E-03	4E-03	4.4E-08	2.1E-08	2E-03	1E-03
WW-10A	2.2E-07	2.2E-07	4E-04	4E-04	1.9E-08	1.9E-08	7E-05	7E-05
WW-10C	4.1E-07	4.1E-07	7E-04	7E-04	5.8E-08	5.8E-08	2E-04	2E-04
WW-10D	3.6E-07	3.6E-07	7E-04	7E-04	4.1E-08	4.1E-08	1E-04	1E-04
WW-11	2.7E-05	2.7E-05	8E-02	8E-02	5.3E-06	5.3E-06	3E-02	3E-02
WW-12	1.3E-05	1.3E-05	3E-02	3E-02	2.7E-06	2.7E-06	1E-02	1E-02
WW-13A	3.6E-08	3.6E-08	1E-04	1E-04	5.2E-09	5.2E-09	3E-05	3E-05
WW-14	2.3E-08	2.3E-08	6E-05	6E-05	3.1E-09	3.1E-09	2E-05	2E-05
WW-15	4.9E-07	4.9E-07	9E-04	9E-04	4.8E-08	4.8E-08	2E-04	2E-04
WW-16A	2.5E-05	2.4E-05	9E-02	9E-02	4.3E-06	4.3E-06	2E-02	2E-02
WW-17A	9.5E-08	9.1E-08	6E-04	6E-04	8.7E-09	7.8E-09	2E-04	2E-04
WW-18A	2.2E-07	2.2E-07	4E-04	4E-04	1.4E-08	1.4E-08	6E-05	6E-05
WW-1A	4.4E-08	4.4E-08	7E-05	7E-05	4.2E-09	4.2E-09	1E-05	1E-05
WW-2	4.1E-05	4.1E-05	1E-01	1E-01	8.3E-06	8.3E-06	4E-02	4E-02
WW-3	2.3E-07	2.2E-07	5E-03	4E-03	2.6E-08	2.4E-08	1E-03	1E-03
WW-4A	6.8E-09	3.5E-09	1E-04	1E-04	1.1E-09	5.5E-10	4E-05	4E-05
WW-5	2.2E-08	2.2E-08	6E-05	6E-05	3.5E-09	3.5E-09	2E-05	2E-05
WW-6	6.0E-07	6.0E-07	1E-03	1E-03	7.5E-08	7.5E-08	3E-04	3E-04
WW-7A	3.7E-05	3.7E-05	2E-01	2E-01	5.0E-06	5.0E-06	3E-02	3E-02
WW-8A	6.1E-07	6.0E-07	6E-03	6E-03	4.6E-08	4.5E-08	2E-03	2E-03
WW-9A	2.3E-08	2.3E-08	4E-05	4E-05	3.5E-09	3.5E-09	1E-05	1E-05
WWR-1	1.2E-05	1.2E-05	3E-02	3E-02	2.6E-06	2.6E-06	1E-02	1E-02
WWR-2	2.1E-05	2.1E-05	5E-02	5E-02	3.8E-06	3.8E-06	2E-02	2E-02
WWR-3	5.0E-07	5.0E-07	1E-02	1E-02	1.1E-07	1.1E-07	3E-03	3E-03

Table 20. RME 30 Year Residential Receptor
Risks and Hazards Estimated from Groundwater Concentrations
using Johnson and Ettinger Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Well Number	Total Resident		Adult Risk		Child Risk		Adult HI		Child HI	
		Less VC		Less VC		Less VC		Less VC		Less VC
65A	6.2E-05	6.2E-05	3.9E-05	3.9E-05	2.3E-05	2.3E-05	3E-02	3E-02	7E-02	7E-02
72A	1.0E-06	1.0E-06	6.4E-07	6.4E-07	3.8E-07	3.8E-07	5E-04	5E-04	1E-03	1E-03
73A	4.1E-05	4.1E-05	2.6E-05	2.6E-05	1.5E-05	1.5E-05	2E-02	2E-02	5E-02	5E-02
74A	3.2E-06	3.2E-06	2.0E-06	2.0E-06	1.2E-06	1.2E-06	2E-03	2E-03	4E-03	4E-03
75A	1.7E-06	1.6E-06	1.0E-06	1.0E-06	6.1E-07	6.1E-07	2E-03	2E-03	5E-03	5E-03
81A	9.1E-06	9.0E-06	5.7E-06	5.7E-06	3.4E-06	3.4E-06	1E-02	9E-03	2E-02	2E-02
82A	8.2E-05	8.2E-05	5.2E-05	5.2E-05	3.1E-05	3.1E-05	4E-02	4E-02	9E-02	9E-02
88A	4.9E-07	4.9E-07	3.1E-07	3.1E-07	1.8E-07	1.8E-07	2E-04	2E-04	5E-04	5E-04
89A	7.5E-06	7.5E-06	4.7E-06	4.7E-06	2.8E-06	2.8E-06	4E-03	4E-03	1E-02	1E-02
EA1-1	2.7E-05	2.7E-05	1.7E-05	1.7E-05	9.8E-06	9.8E-06	3E-02	3E-02	7E-02	7E-02
EA1-2	2.7E-05	2.7E-05	1.7E-05	1.7E-05	9.9E-06	9.9E-06	1E-02	1E-02	3E-02	3E-02
EA1-3	1.0E-04	1.0E-04	6.4E-05	6.4E-05	3.8E-05	3.8E-05	5E-02	5E-02	1E-01	1E-01
EA1-5	4.4E-06	2.6E-06	2.8E-06	1.7E-06	1.6E-06	9.8E-07	9E-03	5E-03	2E-02	1E-02
REG-2A	2.5E-05	2.5E-05	1.6E-05	1.6E-05	9.3E-06	9.3E-06	1E-02	1E-02	3E-02	3E-02
REG-3A	2.1E-05	2.1E-05	1.3E-05	1.3E-05	7.8E-06	7.8E-06	1E-02	1E-02	2E-02	2E-02
REG-4A	5.4E-05	5.4E-05	3.4E-05	3.4E-05	2.0E-05	2.0E-05	2E-02	2E-02	6E-02	6E-02
REG-5A	4.9E-05	4.9E-05	3.1E-05	3.1E-05	1.8E-05	1.8E-05	2E-02	2E-02	5E-02	5E-02
REG-7A	1.3E-05	1.3E-05	8.3E-06	8.3E-06	4.9E-06	4.9E-06	7E-03	7E-03	2E-02	2E-02
REG-8A	1.8E-05	1.8E-05	1.1E-05	1.1E-05	6.5E-06	6.5E-06	1E-02	1E-02	2E-02	2E-02
REG-9A	5.7E-06	5.7E-06	3.6E-06	3.6E-06	2.1E-06	2.1E-06	3E-03	3E-03	6E-03	6E-03
W14-10	2.9E-08	2.9E-08	1.8E-08	1.8E-08	1.1E-08	1.1E-08	3E-04	3E-04	7E-04	7E-04
W14-11	4.5E-07	4.5E-07	2.8E-07	2.8E-07	1.7E-07	1.7E-07	5E-03	5E-03	1E-02	1E-02
W14-12	7.8E-08	7.8E-08	4.9E-08	4.9E-08	2.9E-08	2.9E-08	8E-04	8E-04	2E-03	2E-03
W14-2	7.7E-08	7.7E-08	4.9E-08	4.9E-08	2.9E-08	2.9E-08	8E-04	8E-04	2E-03	2E-03
W14-3	3.8E-10	3.8E-10	2.4E-10	2.4E-10	1.4E-10	1.4E-10	3E-05	3E-05	8E-05	8E-05
W29-3	9.5E-05	9.5E-05	6.0E-05	6.0E-05	3.5E-05	3.5E-05	5E-02	5E-02	1E-01	1E-01
W29-4	4.6E-06	4.6E-06	2.9E-06	2.9E-06	1.7E-06	1.7E-06	1E-02	1E-02	3E-02	3E-02
W56-2	6.1E-05	6.1E-05	3.9E-05	3.8E-05	2.3E-05	2.3E-05	3E-02	3E-02	8E-02	8E-02
W89-1	1.6E-05	1.6E-05	9.8E-06	9.8E-06	5.8E-06	5.8E-06	7E-03	7E-03	2E-02	2E-02
W89-2	3.4E-06	3.4E-06	2.2E-06	2.2E-06	1.3E-06	1.3E-06	2E-03	2E-03	4E-03	4E-03
W89-5	1.9E-06	1.9E-06	1.2E-06	1.2E-06	7.2E-07	7.2E-07	8E-04	8E-04	2E-03	2E-03
W89-8	1.2E-10	1.2E-10	7.8E-11	7.8E-11	4.6E-11	4.6E-11	8E-06	8E-06	2E-05	2E-05
W89-9	4.0E-06	3.9E-06	2.5E-06	2.5E-06	1.5E-06	1.5E-06	3E-03	3E-03	7E-03	7E-03
W9-1	1.6E-04	1.6E-04	1.0E-04	1.0E-04	5.9E-05	5.9E-05	7E-02	7E-02	2E-01	2E-01
W9-16	1.2E-05	1.1E-05	7.2E-06	7.1E-06	4.3E-06	4.2E-06	5E-03	5E-03	1E-02	1E-02
W9-18	3.6E-05	3.2E-05	2.3E-05	2.0E-05	1.3E-05	1.2E-05	2E-01	2E-01	5E-01	5E-01
W9-19	1.0E-06	9.5E-07	6.6E-07	6.0E-07	3.9E-07	3.5E-07	2E-03	2E-03	6E-03	5E-03
W9-2	2.0E-04	2.0E-04	1.3E-04	1.3E-04	7.4E-05	7.4E-05	9E-02	9E-02	2E-01	2E-01
W9-23	7.8E-05	7.7E-05	4.9E-05	4.9E-05	2.9E-05	2.9E-05	5E-02	5E-02	1E-01	1E-01
W9-35	3.2E-04	3.2E-04	2.0E-04	2.0E-04	1.2E-04	1.2E-04	1E-01	1E-01	3E-01	3E-01
W9-37	6.0E-05	6.0E-05	3.8E-05	3.8E-05	2.2E-05	2.2E-05	3E-02	3E-02	7E-02	7E-02
W9-44	1.3E-04	1.3E-04	8.3E-05	8.3E-05	4.9E-05	4.9E-05	1E-01	1E-01	3E-01	3E-01
W9-45	1.8E-05	1.8E-05	1.2E-05	1.2E-05	6.8E-06	6.8E-06	1E-02	1E-02	2E-02	2E-02
W9SC-13	1.4E-06	6.5E-07	8.6E-07	4.1E-07	5.1E-07	2.4E-07	1E-02	1E-02	3E-02	2E-02
W9SC-14	6.5E-05	6.4E-05	4.1E-05	4.0E-05	2.4E-05	2.4E-05	5E-02	5E-02	1E-01	1E-01

Well Number	Total Resident		Adult Risk		Child Risk		Adult HI		Child HI	
		Less VC		Less VC		Less VC		Less VC		Less VC
W9SC-17	7.0E-05	6.8E-05	4.4E-05	4.3E-05	2.6E-05	2.5E-05	7E-02	6E-02	2E-01	1E-01
W9SC-7	7.9E-06	3.2E-06	4.9E-06	2.0E-06	2.9E-06	1.2E-06	3E-02	2E-02	8E-02	5E-02
WIC-1	1.0E-04	1.0E-04	6.4E-05	6.3E-05	3.8E-05	3.7E-05	1E-01	1E-01	3E-01	3E-01
WIC-10	5.4E-06	5.4E-06	3.4E-06	3.4E-06	2.0E-06	2.0E-06	2E-03	2E-03	5E-03	5E-03
WIC-11	1.3E-05	1.3E-05	7.9E-06	7.9E-06	4.7E-06	4.7E-06	7E-03	7E-03	2E-02	2E-02
WIC-12	1.4E-04	1.4E-04	9.0E-05	9.0E-05	5.3E-05	5.3E-05	2E-01	2E-01	6E-01	6E-01
WIC-3	9.7E-05	9.6E-05	6.1E-05	6.1E-05	3.6E-05	3.6E-05	1E-01	1E-01	3E-01	3E-01
WIC-5	2.5E-05	2.5E-05	1.6E-05	1.6E-05	9.2E-06	9.2E-06	3E-02	3E-02	8E-02	8E-02
WIC-6	4.1E-05	4.1E-05	2.6E-05	2.6E-05	1.5E-05	1.5E-05	6E-02	6E-02	2E-01	2E-01
WIC-7	5.0E-05	5.0E-05	3.1E-05	3.1E-05	1.9E-05	1.9E-05	6E-02	6E-02	1E-01	1E-01
WIC-8	5.0E-05	5.0E-05	3.2E-05	3.2E-05	1.9E-05	1.9E-05	6E-02	6E-02	1E-01	1E-01
WIC-9	3.0E-05	3.0E-05	1.9E-05	1.9E-05	1.1E-05	1.1E-05	3E-02	3E-02	7E-02	7E-02
WNX-1	1.2E-05	1.2E-05	7.5E-06	7.5E-06	4.5E-06	4.4E-06	1E-02	1E-02	3E-02	3E-02
WNX-3	1.3E-05	1.3E-05	7.9E-06	7.9E-06	4.7E-06	4.7E-06	6E-03	6E-03	2E-02	2E-02
WT14-1	1.1E-09	1.1E-09	7.0E-10	7.0E-10	4.1E-10	4.1E-10	4E-05	4E-05	9E-05	9E-05
WU4-1	1.1E-04	1.1E-04	6.8E-05	6.8E-05	4.0E-05	4.0E-05	5E-02	5E-02	1E-01	1E-01
WU4-10	1.1E-05	1.1E-05	6.8E-06	6.8E-06	4.0E-06	4.0E-06	1E-02	1E-02	3E-02	3E-02
WU4-21	3.5E-08	3.5E-08	2.2E-08	2.2E-08	1.3E-08	1.3E-08	6E-05	6E-05	1E-04	1E-04
WU4-25	1.3E-06	1.3E-06	7.8E-07	7.8E-07	4.6E-07	4.6E-07	2E-03	2E-03	5E-03	5E-03
WU4-3	9.1E-05	9.1E-05	5.8E-05	5.8E-05	3.4E-05	3.4E-05	4E-02	4E-02	1E-01	1E-01
WU4-8	4.6E-07	1.7E-07	2.9E-07	1.1E-07	1.7E-07	6.4E-08	2E-03	2E-03	5E-03	4E-03
WW-10A	3.6E-07	3.6E-07	2.3E-07	2.3E-07	1.3E-07	1.3E-07	2E-04	2E-04	4E-04	4E-04
WW-10C	6.7E-07	6.7E-07	4.2E-07	4.2E-07	2.5E-07	2.5E-07	3E-04	3E-04	7E-04	7E-04
WW-10D	5.9E-07	5.9E-07	3.7E-07	3.7E-07	2.2E-07	2.2E-07	3E-04	3E-04	7E-04	7E-04
WW-11	4.3E-05	4.3E-05	2.7E-05	2.7E-05	1.6E-05	1.6E-05	3E-02	3E-02	8E-02	8E-02
WW-12	2.2E-05	2.2E-05	1.4E-05	1.4E-05	8.0E-06	8.0E-06	1E-02	1E-02	3E-02	3E-02
WW-13A	5.9E-08	5.9E-08	3.7E-08	3.7E-08	2.2E-08	2.2E-08	5E-05	5E-05	1E-04	1E-04
WW-14	3.7E-08	3.7E-08	2.3E-08	2.3E-08	1.4E-08	1.4E-08	3E-05	3E-05	6E-05	6E-05
WW-15	7.9E-07	7.9E-07	5.0E-07	5.0E-07	2.9E-07	2.9E-07	4E-04	4E-04	9E-04	9E-04
WW-16A	4.0E-05	4.0E-05	2.5E-05	2.5E-05	1.5E-05	1.5E-05	4E-02	4E-02	9E-02	9E-02
WW-17A	1.5E-07	1.5E-07	9.7E-08	9.2E-08	5.7E-08	5.4E-08	3E-04	3E-04	6E-04	6E-04
WW-18A	3.6E-07	3.6E-07	2.2E-07	2.2E-07	1.3E-07	1.3E-07	2E-04	2E-04	4E-04	4E-04
WW-1A	7.2E-08	7.2E-08	4.5E-08	4.5E-08	2.7E-08	2.7E-08	3E-05	3E-05	7E-05	7E-05
WW-2	6.7E-05	6.7E-05	4.2E-05	4.2E-05	2.5E-05	2.5E-05	5E-02	5E-02	1E-01	1E-01
WW-3	3.7E-07	3.5E-07	2.3E-07	2.2E-07	1.4E-07	1.3E-07	2E-03	2E-03	5E-03	4E-03
WW-4A	1.1E-08	5.7E-09	6.9E-09	3.6E-09	4.1E-09	2.1E-09	6E-05	5E-05	1E-04	1E-04
WW-5	3.6E-08	3.6E-08	2.3E-08	2.3E-08	1.3E-08	1.3E-08	3E-05	3E-05	6E-05	6E-05
WW-6	9.7E-07	9.7E-07	6.1E-07	6.1E-07	3.6E-07	3.6E-07	4E-04	4E-04	1E-03	1E-03
WW-7A	6.1E-05	6.0E-05	3.8E-05	3.8E-05	2.2E-05	2.2E-05	6E-02	6E-02	2E-01	2E-01
WW-8A	9.9E-07	9.7E-07	6.2E-07	6.1E-07	3.7E-07	3.6E-07	2E-03	2E-03	6E-03	6E-03
WW-9A	3.7E-08	3.7E-08	2.3E-08	2.3E-08	1.4E-08	1.4E-08	2E-05	2E-05	4E-05	4E-05
WWR-1	2.0E-05	2.0E-05	1.3E-05	1.3E-05	7.4E-06	7.4E-06	1E-02	1E-02	3E-02	3E-02
WWR-2	3.4E-05	3.4E-05	2.2E-05	2.2E-05	1.3E-05	1.3E-05	2E-02	2E-02	5E-02	5E-02
WWR-3	8.0E-07	8.0E-07	5.1E-07	5.1E-07	3.0E-07	3.0E-07	4E-03	4E-03	1E-02	1E-02

Table 21. Construction Worker Receptor
Risks and Hazards Estimated from Measured Air Concentrations
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	RME				CTE			
	Risk		HI		Risk		HI	
		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background
111	1.4E-06	2.6E-07	1.E-01	4.E-02	2.7E-07	4.8E-08	5.E-02	1.E-02
148	2.0E-05	1.9E-05	5.E+00	5.E+00	2.6E-06	2.4E-06	1.E+00	1.E+00
15	3.6E-05	3.3E-05	9.E+00	9.E+00	4.6E-06	4.2E-06	2.E+00	2.E+00
156	4.1E-06	3.4E-06	6.E-01	4.E-01	7.8E-07	6.4E-07	2.E-01	2.E-01
2	2.5E-05	2.2E-05	5.E+00	5.E+00	4.0E-06	3.6E-06	2.E+00	1.E+00
21	3.9E-06	2.4E-06	8.E-01	6.E-01	7.0E-07	4.0E-07	3.E-01	2.E-01
22	3.9E-06	2.4E-06	8.E-01	6.E-01	7.0E-07	4.0E-07	3.E-01	2.E-01
476	1.1E-05	1.0E-05	2.E+00	2.E+00	1.5E-06	1.4E-06	6.E-01	6.E-01
543	4.1E-06	3.4E-06	6.E-01	4.E-01	7.8E-07	6.4E-07	2.E-01	2.E-01
555	2.0E-05	1.9E-05	5.E+00	5.E+00	2.6E-06	2.5E-06	1.E+00	1.E+00
566	2.0E-05	1.9E-05	5.E+00	5.E+00	2.5E-06	2.2E-06	1.E+00	1.E+00
583C	1.8E-05	1.7E-05	5.E+00	5.E+00	2.3E-06	2.1E-06	1.E+00	1.E+00
6	3.7E-05	3.5E-05	9.E+00	9.E+00	4.5E-06	4.1E-06	2.E+00	2.E+00
hangar 1	3.6E-05	3.3E-05	9.E+00	9.E+00	4.6E-06	4.2E-06	2.E+00	2.E+00

Table 22. Indoor Worker Receptor
Risks and Hazards Estimated from Measured Air Concentrations
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	RME				CTE			
	Risk		HI		Risk		HI	
		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background
111	2.4E-05	2.0E-06	2.E-01	4.E-02	1.8E-06	3.5E-07	9.E-02	1.E-02
148	1.2E-04	9.6E-05	2.E-01	7.E-02	4.0E-06	2.7E-06	8.E-02	1.E-02
15	5.4E-05	3.1E-05	1.E-01	1.E-02	3.2E-06	1.9E-06	5.E-02	5.E-03
156	2.6E-04	2.3E-04	6.E-01	3.E-01	1.2E-05	1.1E-05	2.E-01	1.E-01
2	9.8E-05	7.6E-05	1.E-01	2.E-02	4.4E-06	3.2E-06	4.E-02	7.E-03
21	1.2E-04	8.8E-05	4.E-01	1.E-01	5.0E-06	3.4E-06	1.E-01	3.E-02
22	2.9E-05	5.7E-06	2.E-01	2.E-02	2.0E-06	4.3E-07	9.E-02	1.E-02
476	4.7E-05	3.6E-05	2.E-01	9.E-02	1.5E-06	9.6E-07	4.E-02	1.E-02
543	4.0E-05	2.7E-05	3.E-01	3.E-02	1.8E-06	1.2E-06	7.E-02	6.E-03
555	2.6E-05	6.8E-06	1.E-01	2.E-02	1.5E-06	4.8E-07	5.E-02	5.E-03
566	1.4E-04	1.1E-04	4.E-01	1.E-01	5.5E-06	3.9E-06	1.E-01	4.E-02
583C	2.5E-05	1.4E-05	6.E-02	3.E-04	1.1E-06	5.0E-07	2.E-02	1.E-04
6	1.9E-04	1.5E-04	1.E+00	1.E+00	8.2E-06	6.5E-06	3.E-01	2.E-01
hangar 1	1.9E-04	1.7E-04	5.E-01	2.E-01	6.5E-06	5.0E-06	1.E-01	7.E-02

Table 23. Adult Resident (10 yr RME) Receptor
Risks and Hazards Estimated from Measured Air Concentrations
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	RME				CTE			
	Risk		HI		Risk		HI	
		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background
111	1.9E-05	1.3E-06	5.E-01	6.E-02	4.9E-06	7.6E-07	2.E-01	2.E-02
148	8.5E-05	6.9E-05	5.E-01	1.E-01	1.1E-05	7.4E-06	2.E-01	3.E-02
15	5.0E-05	2.6E-05	3.E-01	3.E-02	1.1E-05	5.9E-06	1.E-01	1.E-02
156	1.8E-04	1.6E-04	1.E+00	5.E-01	2.8E-05	2.4E-05	4.E-01	2.E-01
2	7.8E-05	5.5E-05	3.E-01	4.E-02	1.3E-05	8.7E-06	1.E-01	2.E-02
21	8.0E-05	5.7E-05	7.E-01	2.E-01	1.2E-05	7.5E-06	3.E-01	6.E-02
22	2.4E-05	4.1E-06	5.E-01	4.E-02	5.7E-06	1.0E-06	2.E-01	2.E-02
476	3.9E-05	3.0E-05	4.E-01	1.E-01	5.5E-06	3.7E-06	1.E-01	3.E-02
543	3.5E-05	2.4E-05	5.E-01	5.E-02	6.2E-06	4.2E-06	2.E-01	1.E-02
555	2.6E-05	1.1E-05	3.E-01	3.E-02	5.6E-06	2.6E-06	1.E-01	1.E-02
566	9.8E-05	7.2E-05	9.E-01	2.E-01	1.3E-05	8.5E-06	3.E-01	8.E-02
583C	2.0E-05	9.0E-06	2.E-01	5.E-04	3.3E-06	1.1E-06	7.E-02	2.E-04
6	1.3E-04	1.0E-04	2.E+00	2.E+00	2.0E-05	1.4E-05	6.E-01	4.E-01
hangar 1	1.4E-04	1.1E-04	1.E+00	6.E-01	1.8E-05	1.3E-05	5.E-01	3.E-01

Table 24. Child Resident (10 yr RME) Receptor

Risks and Hazards Estimated from Measured Air Concentrations

Human Health Risk Assessment

NASA Research Park

Moffett Field, California

Building	RME				CTE			
	Risk		HI		Risk		HI	
		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background
111	4.5E-05	3.1E-06	1.E+00	1.E-01	1.2E-05	1.9E-06	5.E-01	5.E-02
148	2.0E-04	1.6E-04	1.E+00	3.E-01	2.7E-05	1.9E-05	5.E-01	7.E-02
15	1.2E-04	6.1E-05	7.E-01	7.E-02	2.6E-05	1.5E-05	3.E-01	3.E-02
156	4.2E-04	3.7E-04	2.E+00	1.E+00	7.2E-05	6.2E-05	9.E-01	4.E-01
2	1.8E-04	1.3E-04	6.E-01	1.E-01	3.3E-05	2.2E-05	3.E-01	4.E-02
21	1.9E-04	1.4E-04	2.E+00	4.E-01	3.0E-05	1.9E-05	7.E-01	1.E-01
22	5.7E-05	9.6E-06	1.E+00	1.E-01	1.4E-05	2.6E-06	6.E-01	5.E-02
476	9.3E-05	7.0E-05	9.E-01	4.E-01	1.4E-05	9.2E-06	3.E-01	7.E-02
543	8.2E-05	5.6E-05	1.E+00	1.E-01	1.6E-05	1.1E-05	5.E-01	3.E-02
555	6.1E-05	2.5E-05	7.E-01	7.E-02	1.4E-05	6.6E-06	3.E-01	3.E-02
566	2.3E-04	1.7E-04	2.E+00	4.E-01	3.4E-05	2.1E-05	9.E-01	2.E-01
583C	4.7E-05	2.1E-05	4.E-01	1.E-03	8.4E-06	2.7E-06	2.E-01	5.E-04
6	3.0E-04	2.4E-04	5.E+00	4.E+00	5.0E-05	3.6E-05	2.E+00	1.E+00
hangar 1	3.3E-04	2.7E-04	3.E+00	1.E+00	4.5E-05	3.2E-05	1.E+00	7.E-01

Table 25. RME 30 yr Residential Receptor
Risks and Hazards Estimated from Measured Air Concentrations
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

Building	Total Resident		Adult Risk		Child Risk		Adult HI		Child HI	
		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background		Corrected for Background
111	7.3E-05	5.0E-06	4.6E-05	3.2E-06	2.7E-05	1.9E-06	5E-01	6E-02	1E+00	1E-01
148	3.3E-04	2.6E-04	2.0E-04	1.6E-04	1.2E-04	9.7E-05	5E-01	1E-01	1E+00	3E-01
15	1.9E-04	9.8E-05	1.2E-04	6.1E-05	7.0E-05	3.6E-05	3E-01	3E-02	7E-01	7E-02
156	6.8E-04	5.9E-04	4.3E-04	3.7E-04	2.5E-04	2.2E-04	1E+00	5E-01	2E+00	1E+00
2	3.0E-04	2.1E-04	1.9E-04	1.3E-04	1.1E-04	7.8E-05	3E-01	4E-02	6E-01	1E-01
21	3.0E-04	2.2E-04	1.9E-04	1.4E-04	1.1E-04	8.1E-05	7E-01	2E-01	2E+00	4E-01
22	9.2E-05	1.6E-05	5.8E-05	9.8E-06	3.4E-05	5.8E-06	5E-01	4E-02	1E+00	1E-01
476	1.5E-04	1.1E-04	9.5E-05	7.2E-05	5.6E-05	4.2E-05	4E-01	1E-01	9E-01	4E-01
543	1.3E-04	9.1E-05	8.4E-05	5.7E-05	4.9E-05	3.4E-05	5E-01	5E-02	1E+00	1E-01
555	9.8E-05	4.1E-05	6.2E-05	2.6E-05	3.7E-05	1.5E-05	3E-01	3E-02	7E-01	7E-02
566	3.7E-04	2.7E-04	2.4E-04	1.7E-04	1.4E-04	1.0E-04	9E-01	2E-01	2E+00	4E-01
583C	7.7E-05	3.4E-05	4.8E-05	2.2E-05	2.8E-05	1.3E-05	2E-01	5E-04	4E-01	1E-03
6	4.9E-04	3.9E-04	3.1E-04	2.4E-04	1.8E-04	1.4E-04	2E+00	2E+00	5E+00	4E+00
hangar 1	5.3E-04	4.3E-04	3.4E-04	2.7E-04	2.0E-04	1.6E-04	1E+00	6E-01	3E+00	1E+00

Table 26. Background Risks and Hazards

Estimated from Measured BAAQMD Air Concentrations

Human Health Risk Assessment

NASA Research Park

Moffett Field, California

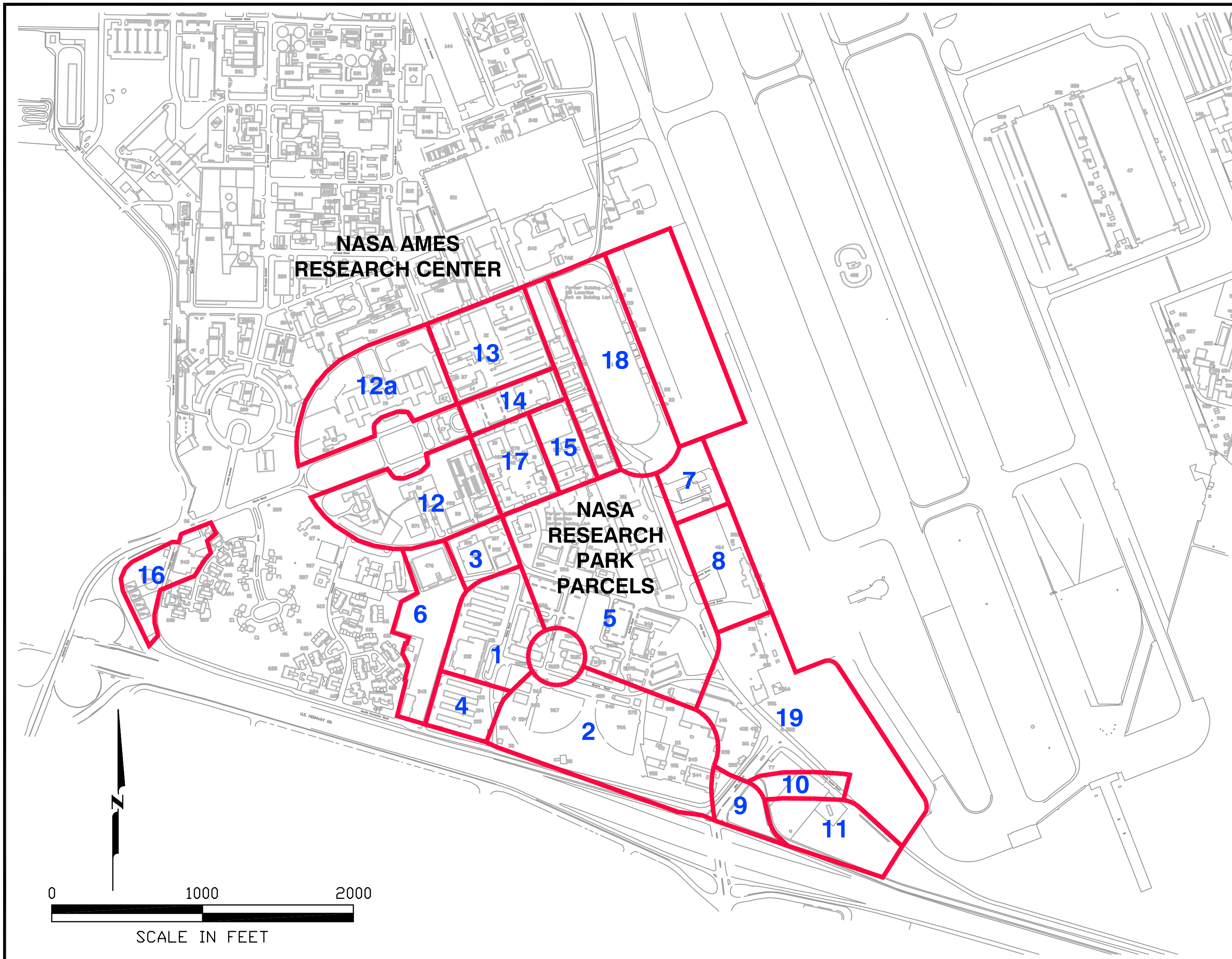
Receptor	RME		CTE	
	Risk	HI	Risk	HI
Construction Worker	4.3E-06	5E-01	6.6E-07	1E-01
Indoor Worker	3.5E-05	3E-01	1.8E-06	9E-02
Adult Resident (10 yr RME)	3.7E-05	8E-01	6.6E-06	3E-01
Child Resident (10 yr RME)	8.8E-05	2E+00	1.7E-05	7E-01
30 yr Resident-Total	1.4E-04	na	na	na
30 Yr Resident-Adult	8.9E-05	8E-01	na	na
30 yr Resident-Child	5.3E-05	2E+00	na	na

Table 27. Comparison of Cleanup Levels for Soil
Human Health Risk Assessment
NASA Research Park
Moffett Field, California

COPC	Residential Soil (<3m bgs) RBSL	Residential Soil 2002 PRG	ROD	Background Metal Concentration[1]
	mg/kg	mg/kg	mg/kg	mg/kg
VOC				
1,1-Dichloroethene	0.018	120	0.6	--
1,2-Dichloroethane	0.04	0.28	0.05	--
Benzene	0.18	0.6	1.5	--
cis-1,2-Dichloroethene	2.7	43	0.6	--
trans-1,2-Dichloroethene	5.3	69	1	--
Chloroform	0.079	3.6	10	--
Methylene chloride	0.89	9.1	0.5	--
Tetrachloroethene (PCE)	0.15	1.5	0.5	--
Trichloroethene (TCE)	0.44	0.053	0.5	--
Vinyl chloride	0.011	0.079	0.05	--
PAH				
Benzo[a]anthracene	0.38	0.62	--	--
Benzo[a]pyrene	0.038	0.062	--	--
Benzo[b]fluoranthene	0.38	0.62	--	--
Benzo[k]fluoranthene	0.38	6.2	--	--
Chrysene	3.8	3.8*	--	--
Naphthalene	1.7	56	--	--
SVOC				
Pentachlorophenol	4.4	3	--	--
bis(2-Ethylhexyl)phthalate	160	35	--	--
Metals				
Arsenic	0.39	0.39	--	5.6
Cadmium and compounds	1.7	1.7*	--	0.7
Total Chromium	13	210	--	17
Mercury	4.7	23#	--	0.1
Thallium	1	5.2	--	1

Green highlighted: lowest soil level
Yellow highlighted: background levels higher than RBSL, PRG, or ROD

PLATES



EXPLANATION

3 PARCEL BOUNDARY AND PARCEL NUMBER

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MACTEC

Property and Parcel Location Map
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
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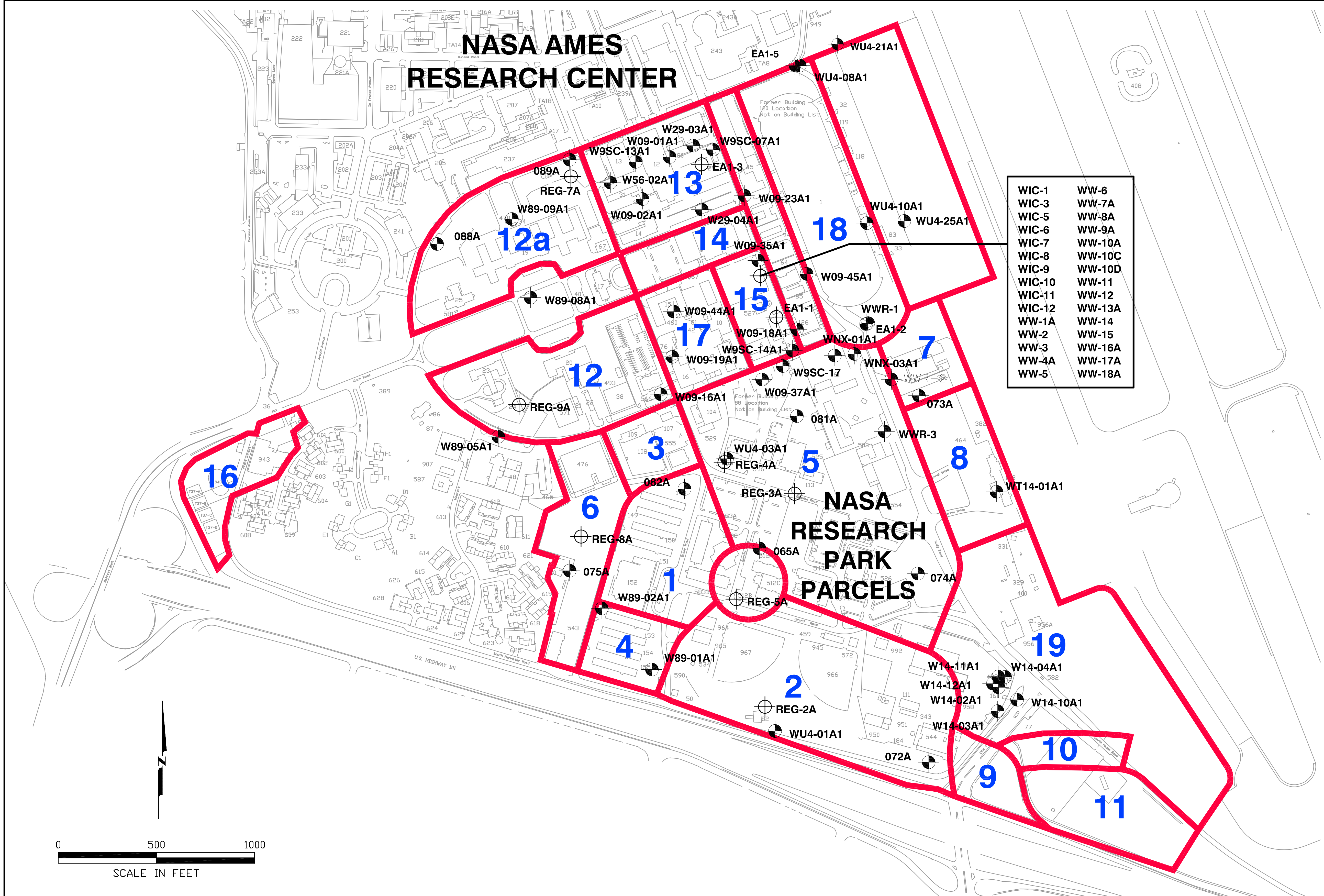

EXPLANATION

3 — PARCEL BOUNDARY AND PARCEL NUMBER

WU4-10A1 — SAMPLE LOCATION

REG-2A — MONITORING WELL LOCATION

54690015.DWG
20030505.1242
100.0

MACTEC

Well Sample Location Map
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, Calironia

PLATE
2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
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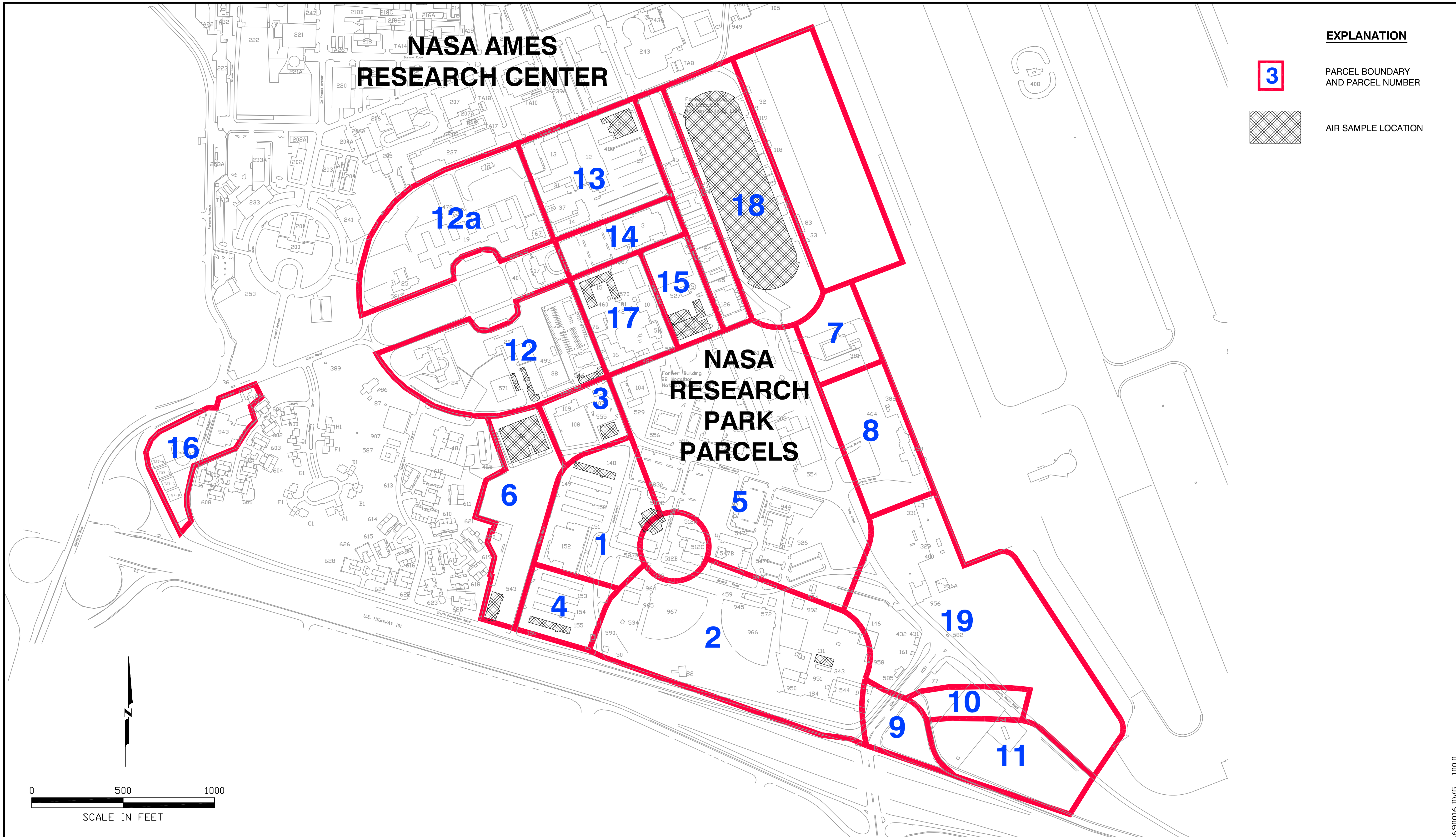

MACTEC

Air Sample Location Map
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
3

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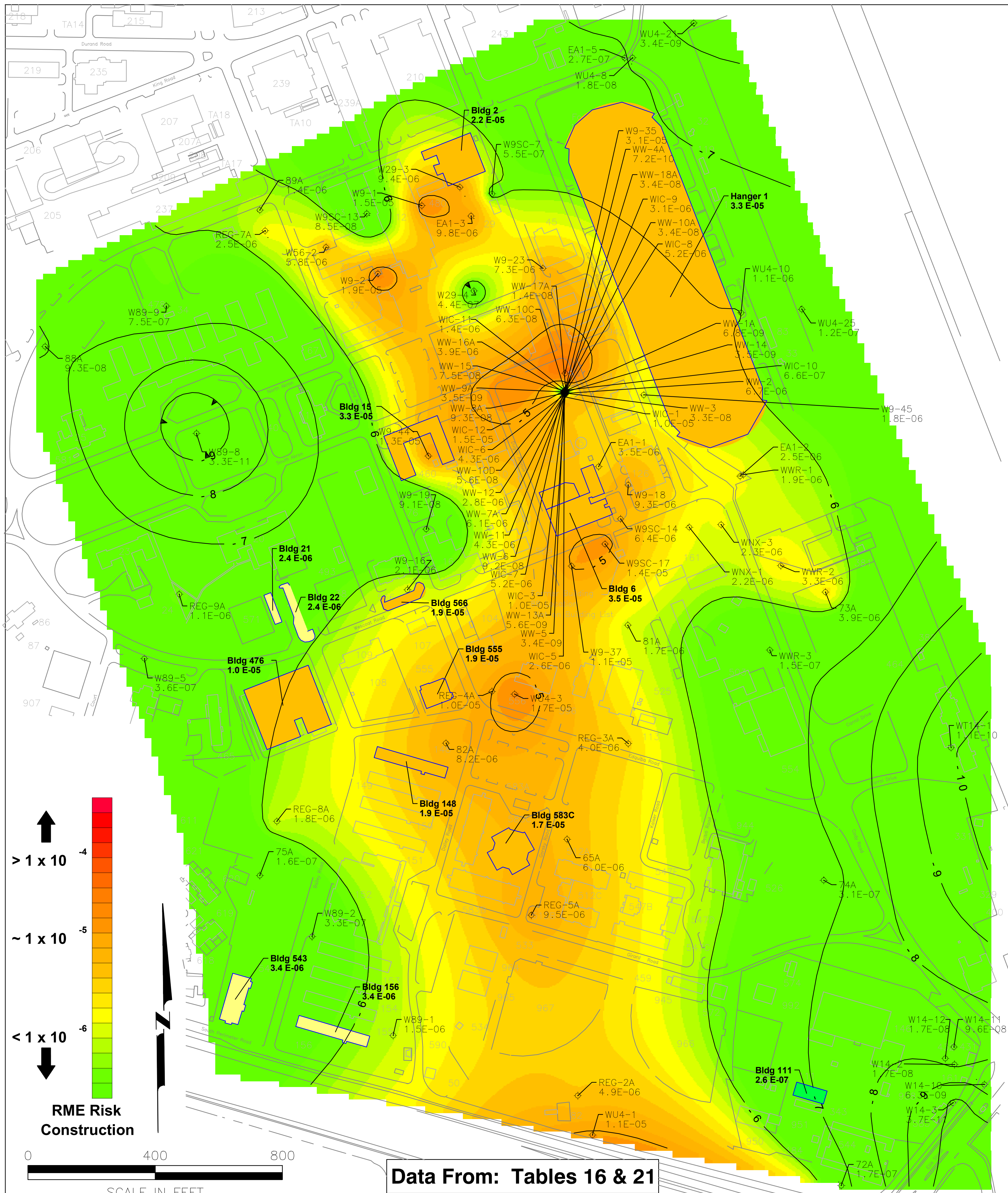

Harding ESE

A MACTEC Company

Construction RME Risk

Human Health Risk Assessment

NASA Research Park Parcels

Moffett Field, California

PLATE

4

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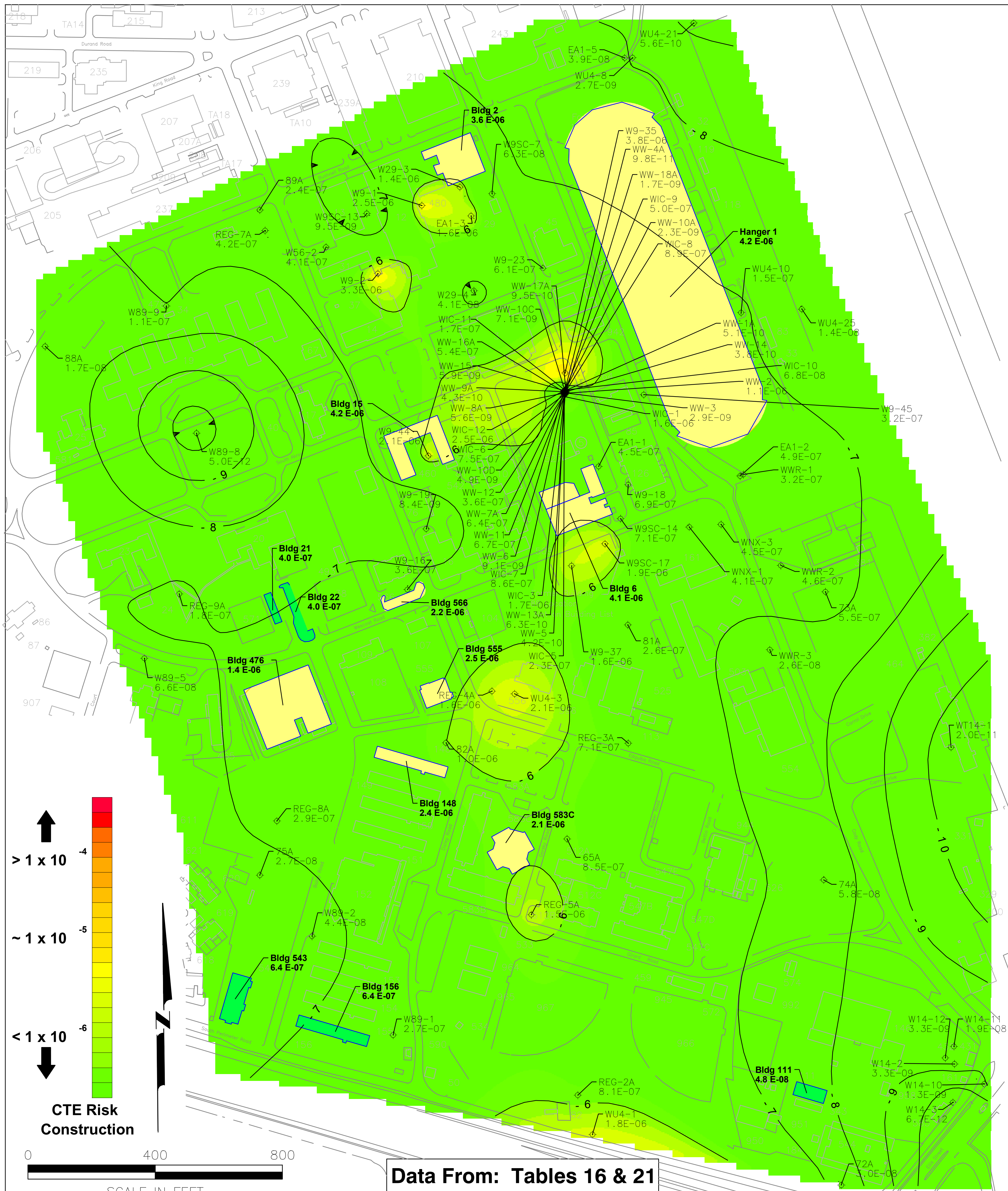
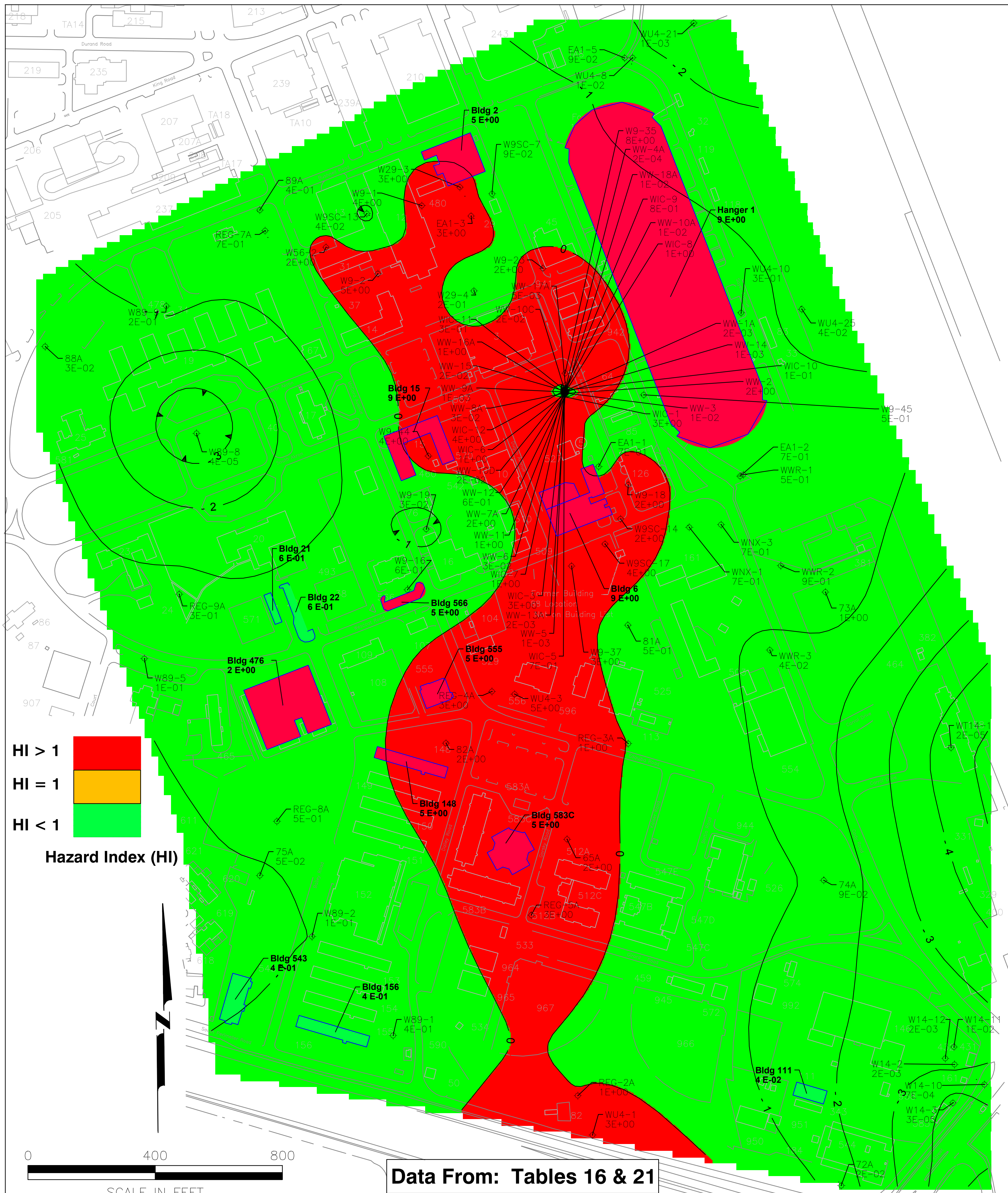


Harding ESE
A MACTEC Company

Construction CTE Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
5

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	



Harding ESE
A MACTEC Company

Construction RME HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
6

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

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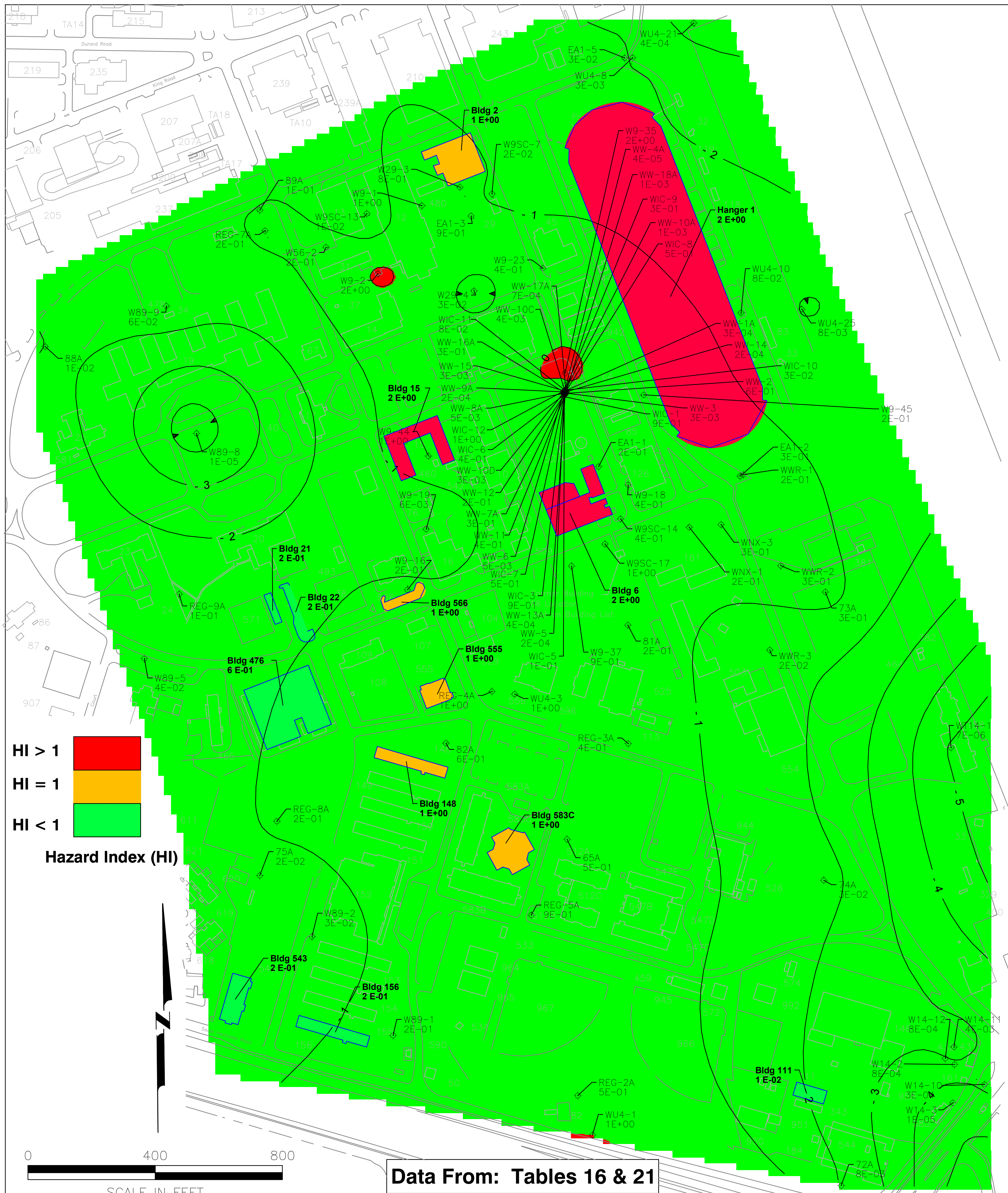

Harding ESE
A MACTEC Company

Construction CTE HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
7

DRAWN	JOB NUMBER	DATE	REVISED DATE
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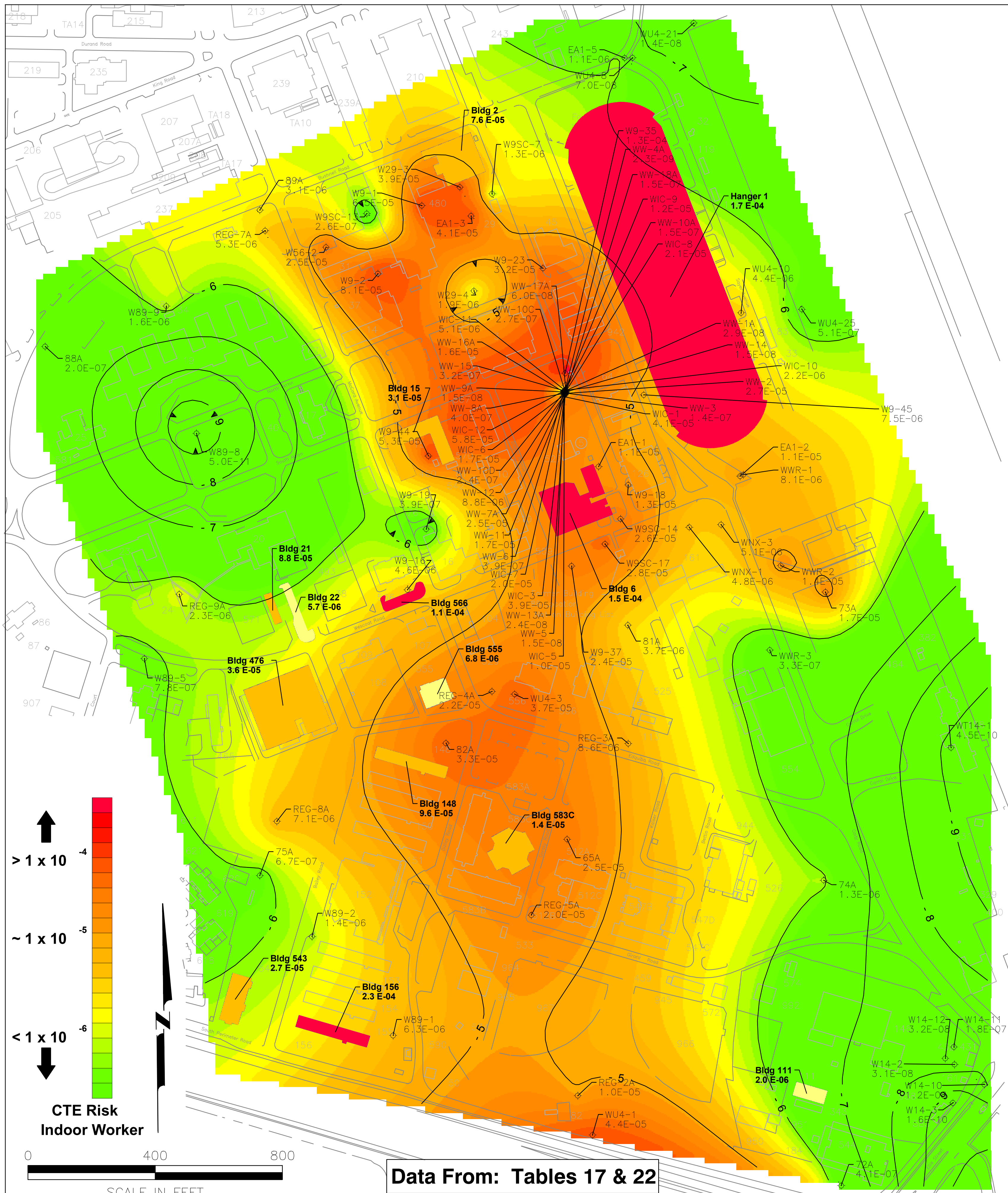

Harding ESE
A MACTEC Company

Indoor Worker RME Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
8

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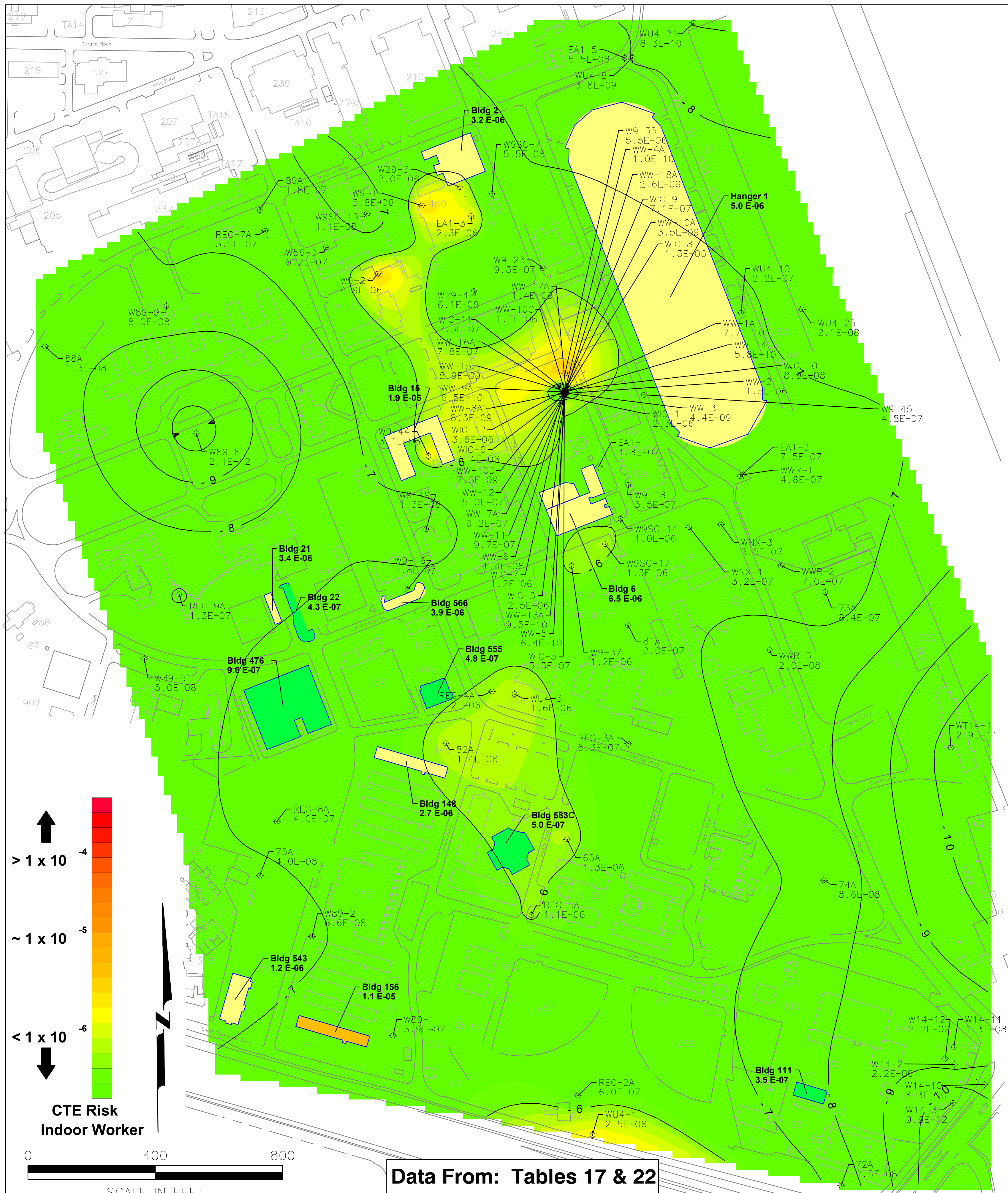

Harding ESE
A MACTEC Company

Indoor Worker CTE Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
9

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

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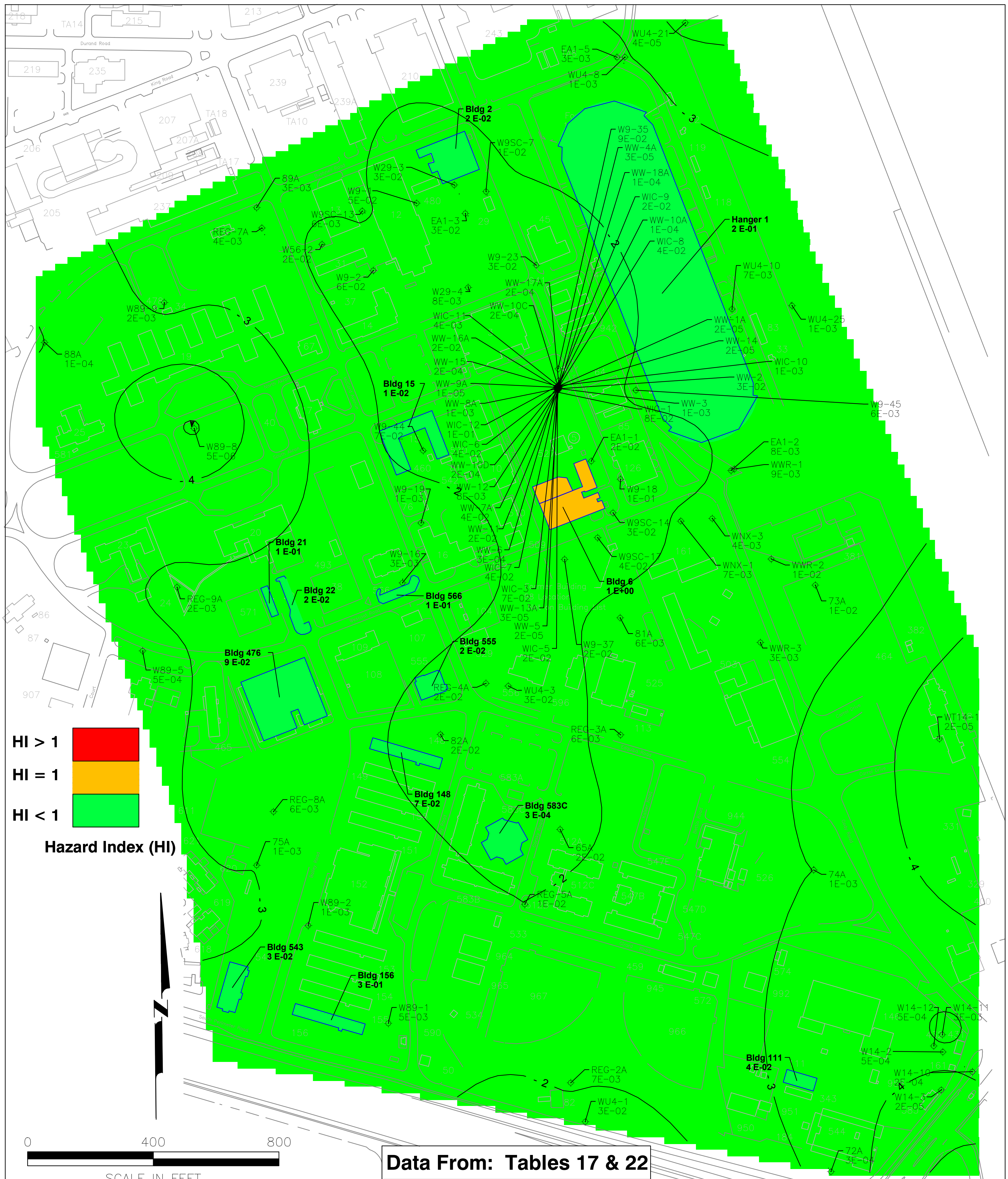

Data From: Tables 17 & 22

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Harding ESE
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Indoor Worker RME HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE **10**

DRAWN	JOB NUMBER	DATE	REVISED DATE
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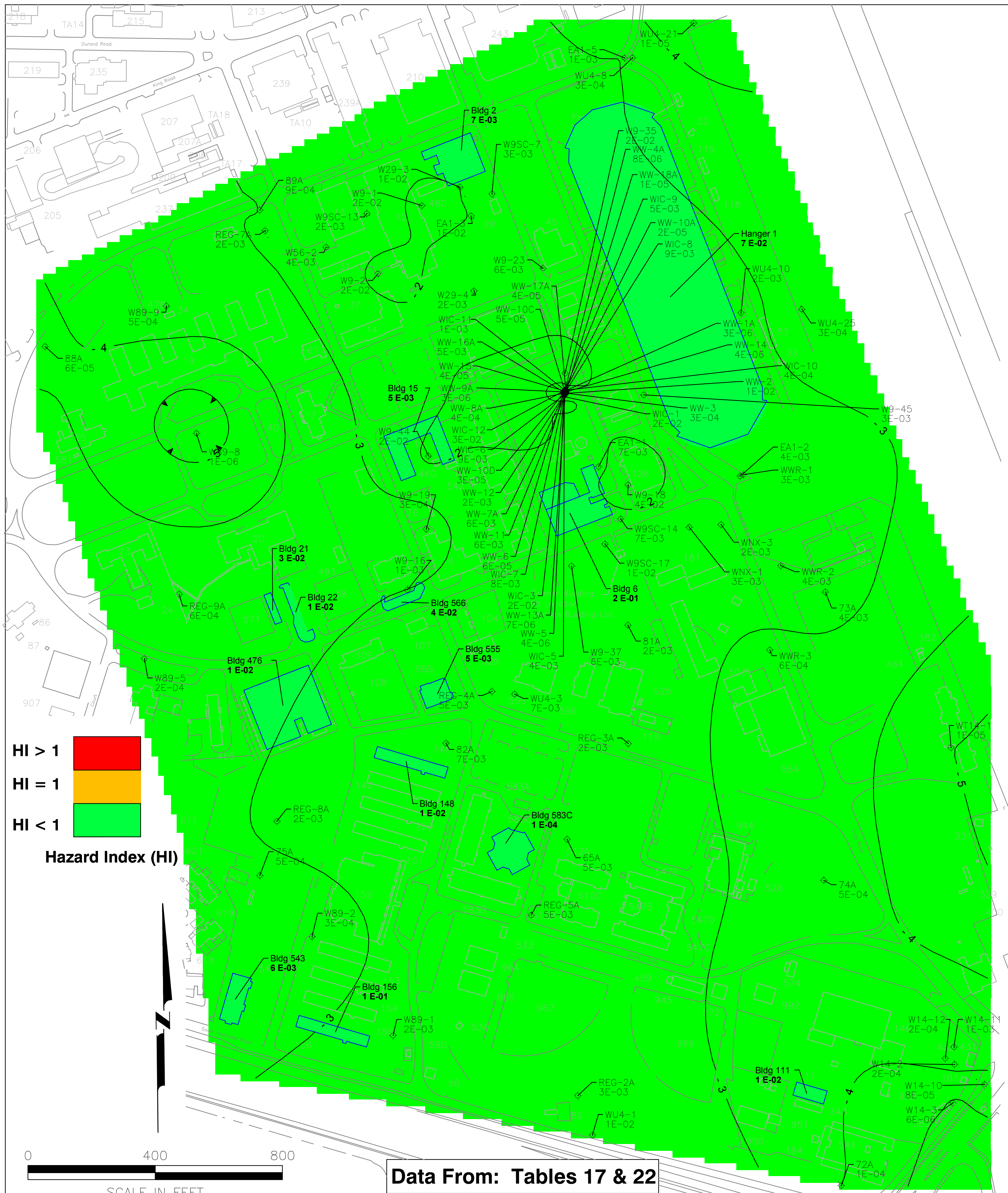

Harding ESE
A MACTEC Company

Indoor Worker CTE HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
11

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

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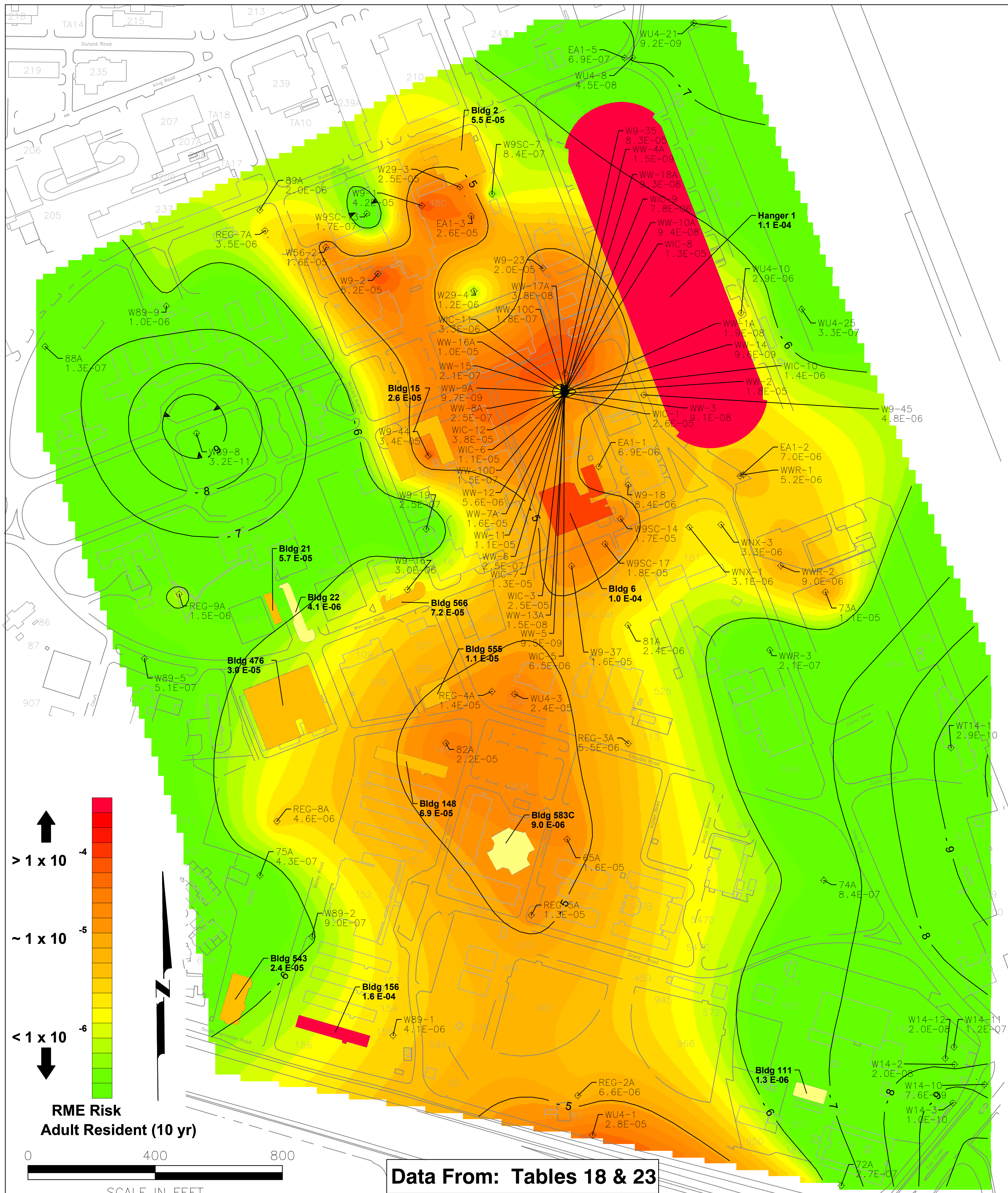
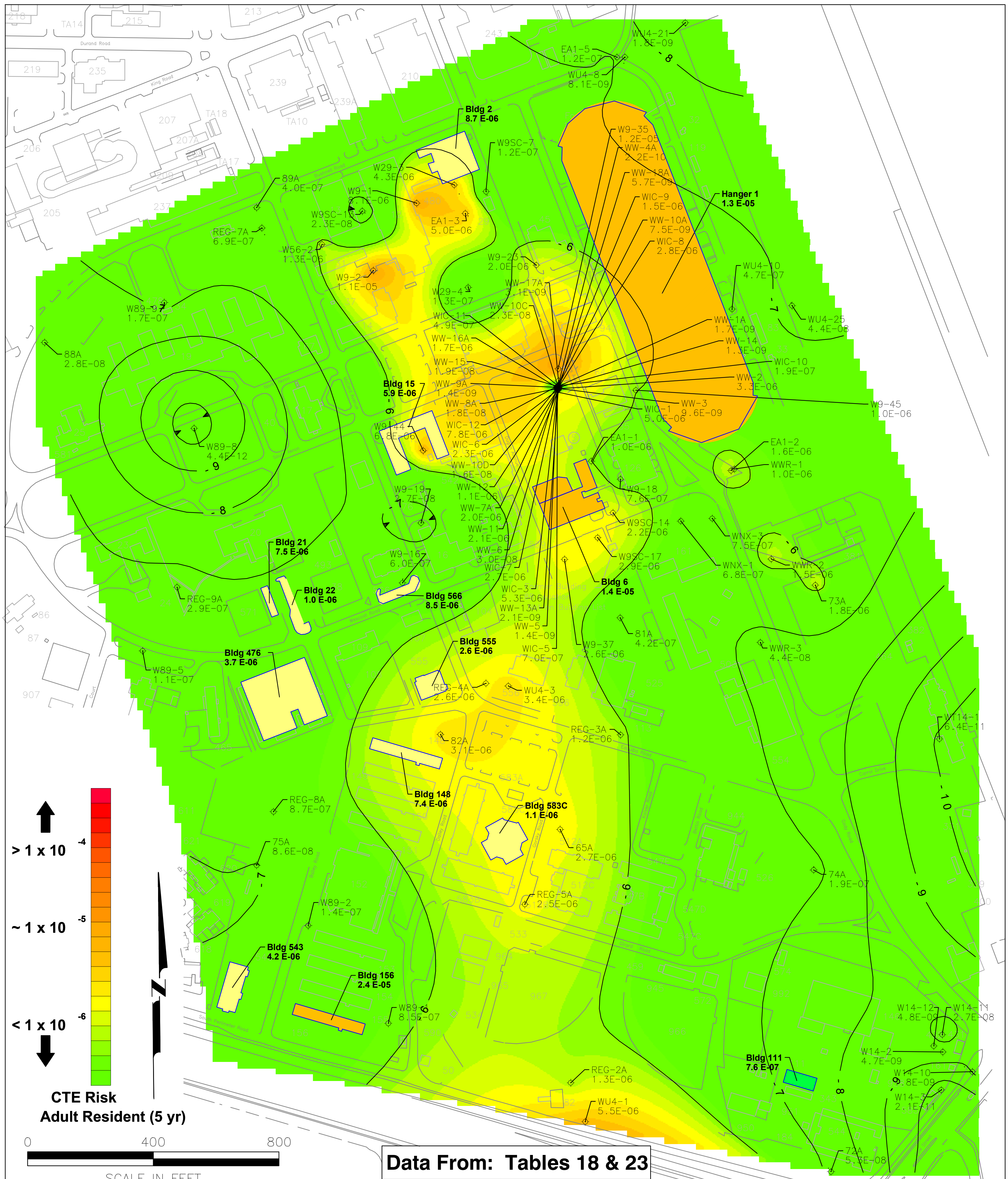


Harding ESE
A MACTEC Company

Adult Resident (10 yr) RME Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
12

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

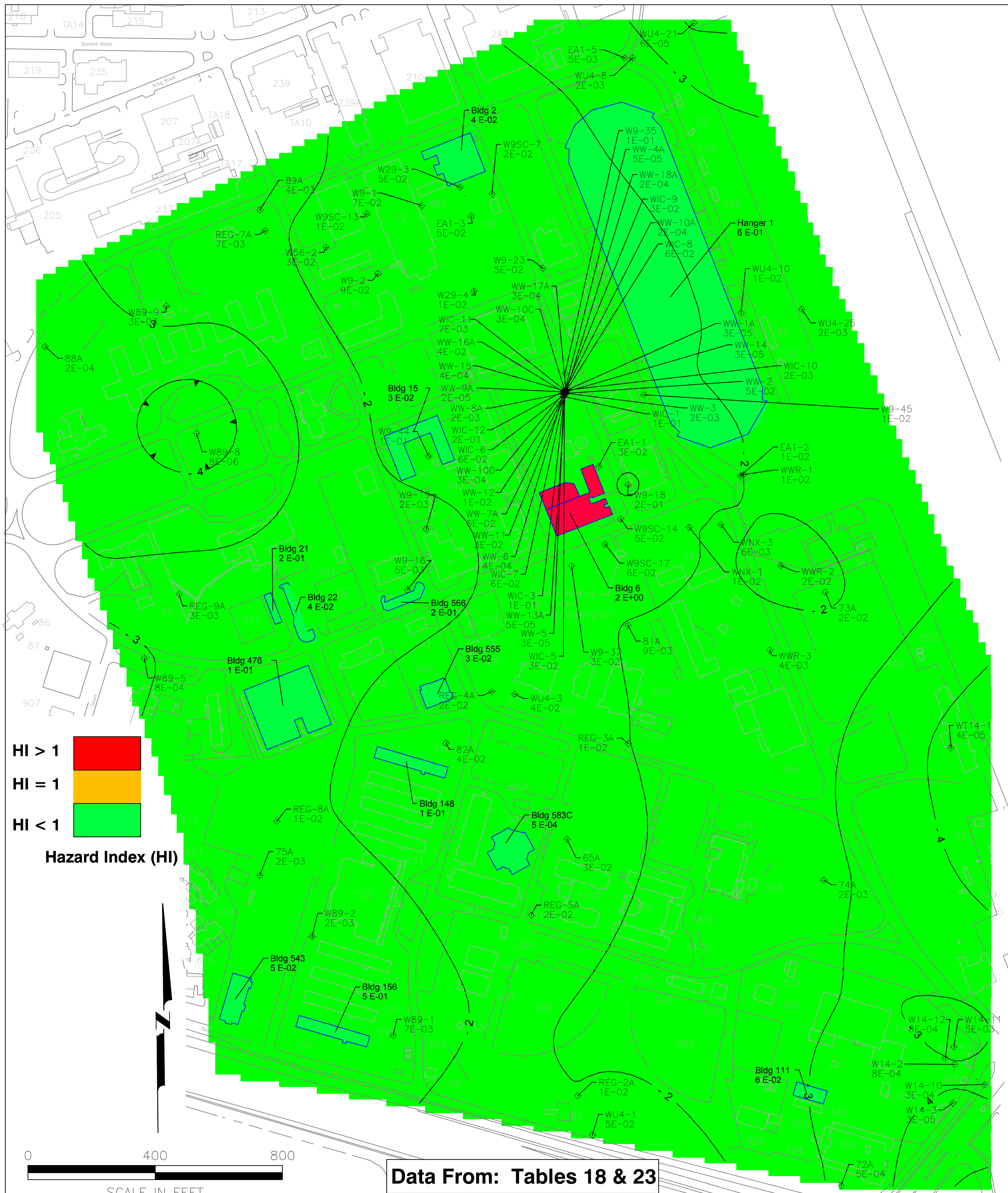


Harding ESE
A MACTEC Company

Adult Resident (5 yr) CTE Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
13

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	



Harding ESE
A MACTEC Company

Adult Resident (10 yr) RME HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
14

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

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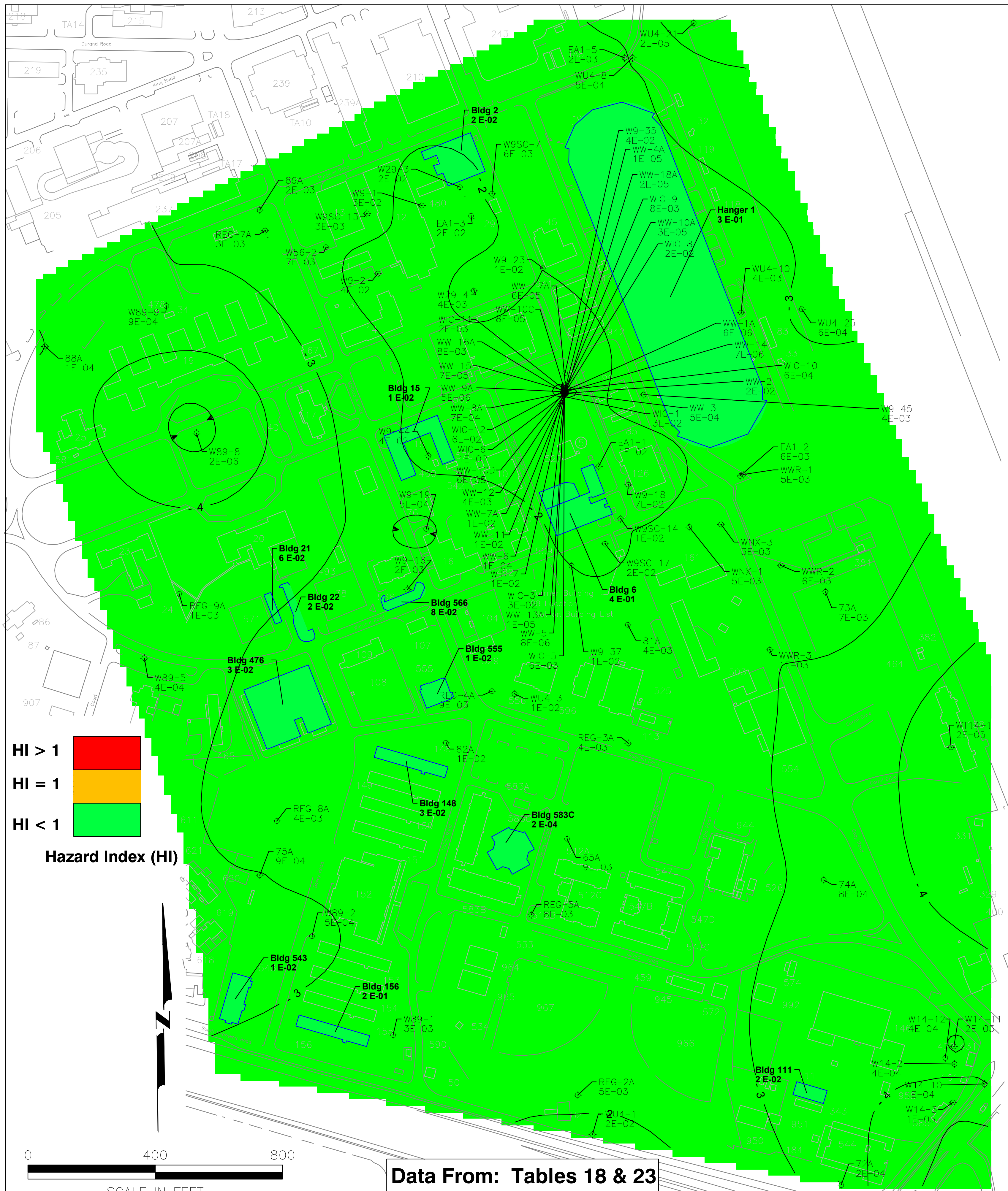

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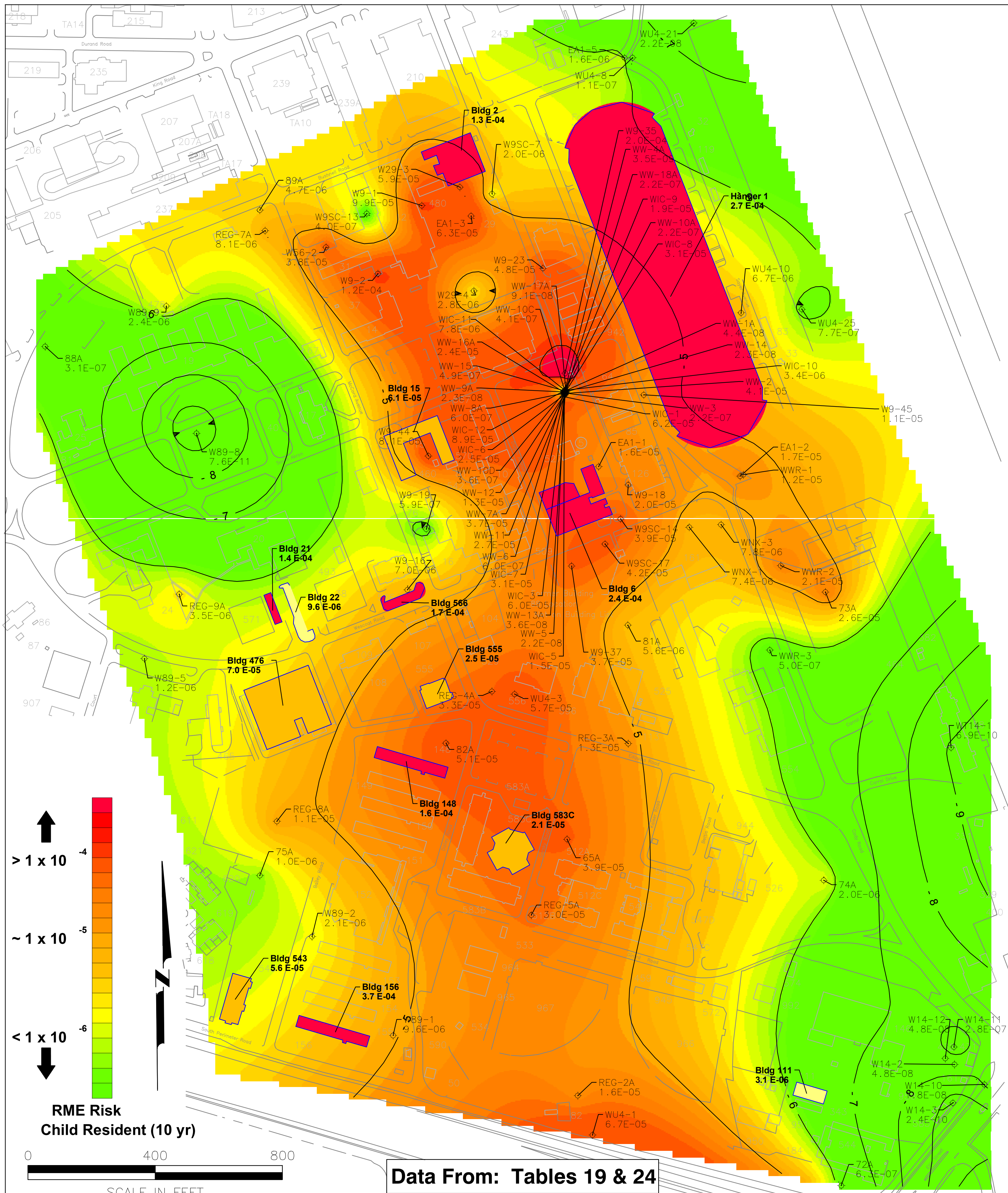
Harding ESE
A MACTEC Company

Adult Resident (5 yr) CTE HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
15

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	



Harding ESE
A MACTEC Company

Child Resident (10 yr) RME Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
16

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

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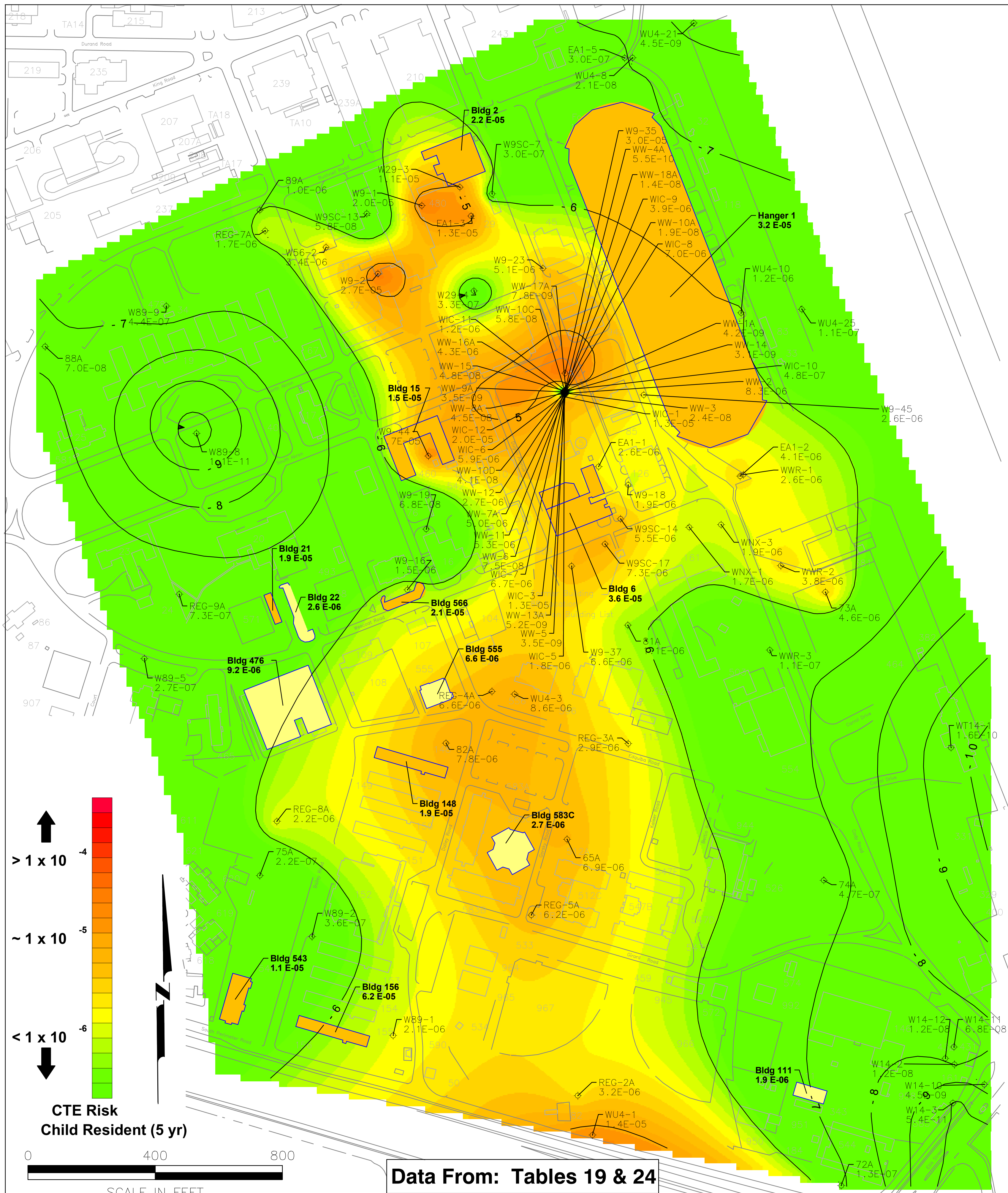

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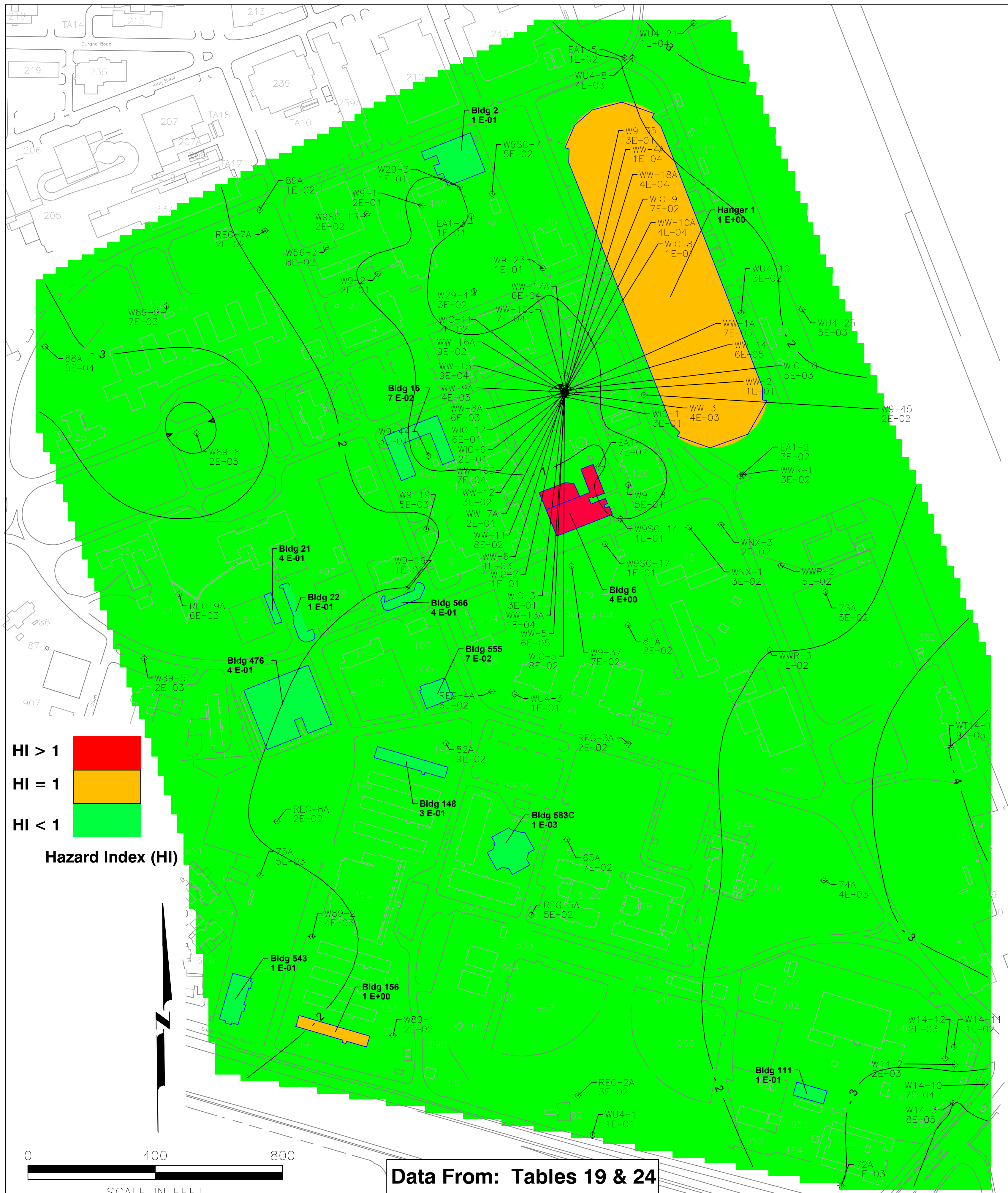
Harding ESE
A MACTEC Company

Child Resident (5 yr) CTE Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
17

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	



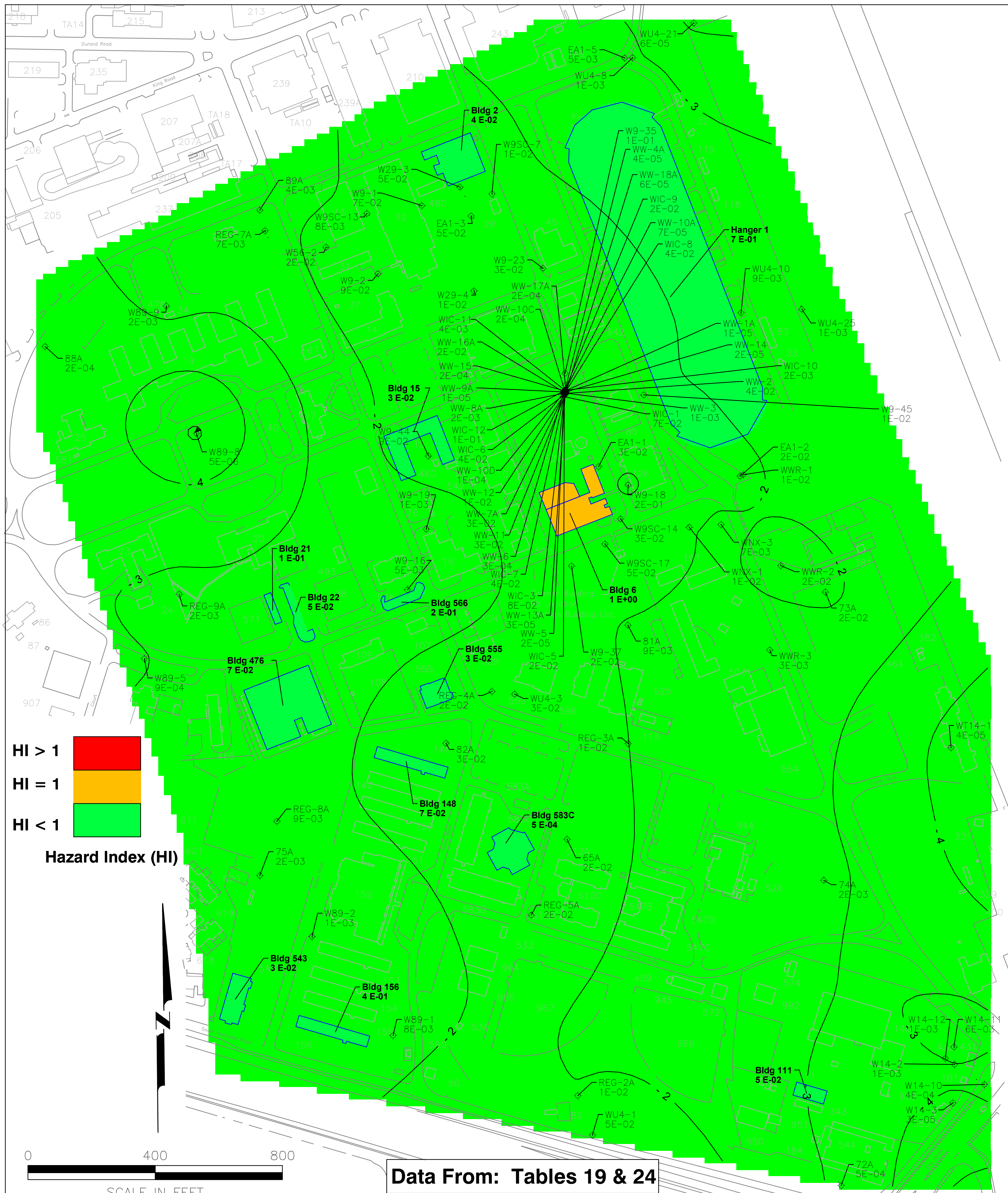
Harding ESE
A MACTEC Company

Child Resident (10 yr) RME HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
18

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

P:\Geophys\NASA Ames



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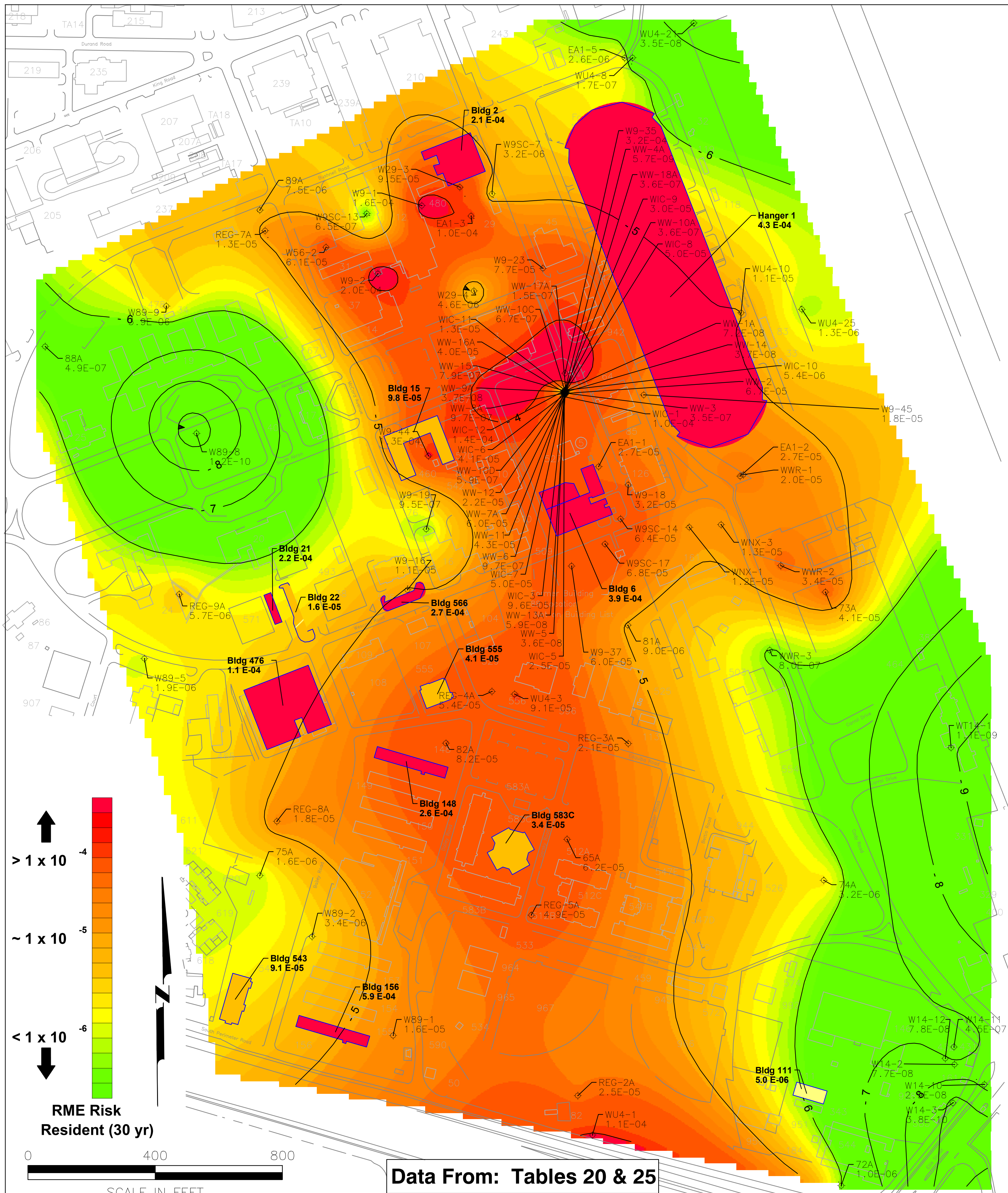
Harding ESE
A MACTEC Company

Child Resident (5 yr) CTE HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
19

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	



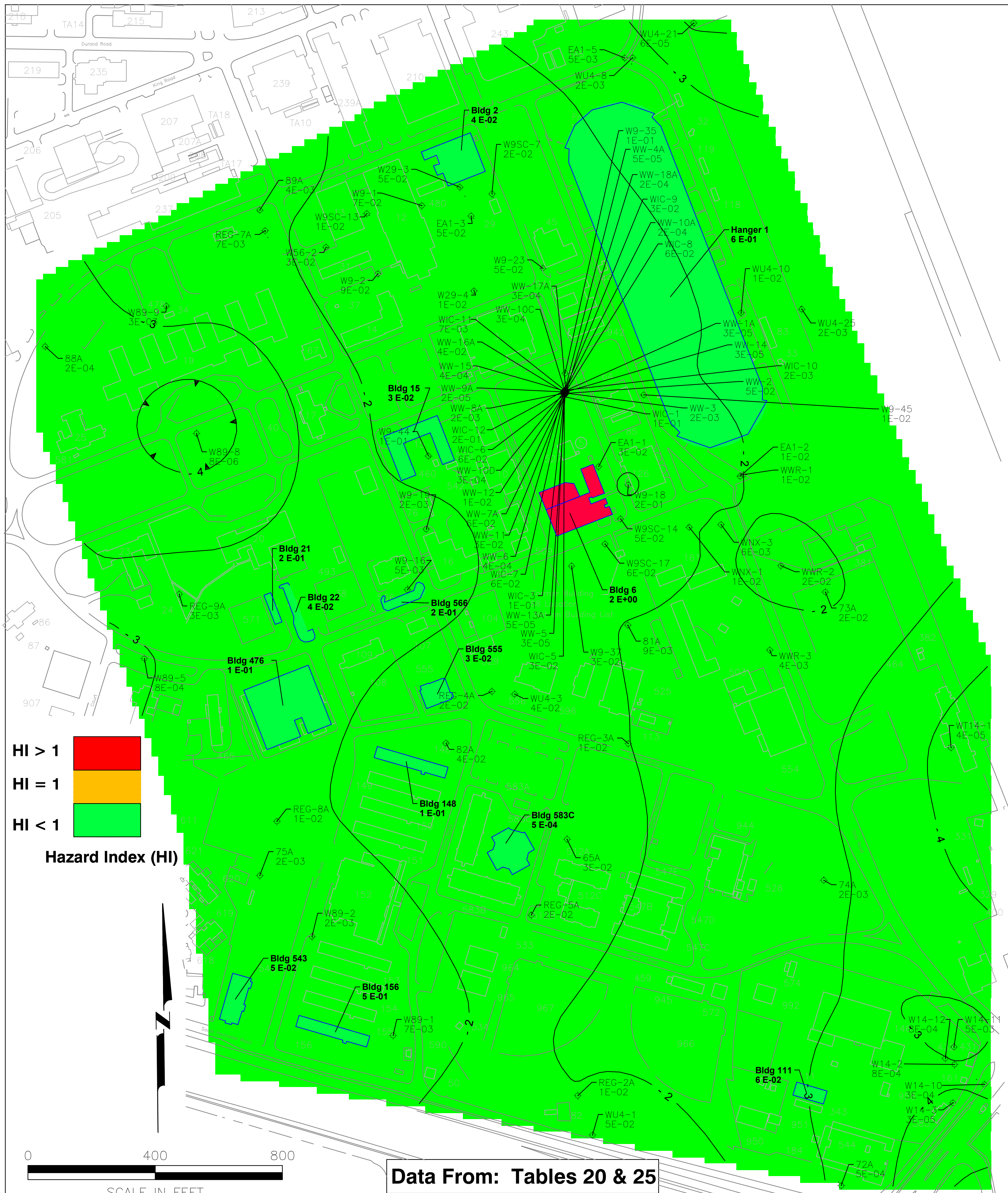
Harding ESE
A MACTEC Company

Resident (30 yr) RME Risk
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
20

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

P:\Geophys\NASA Ames



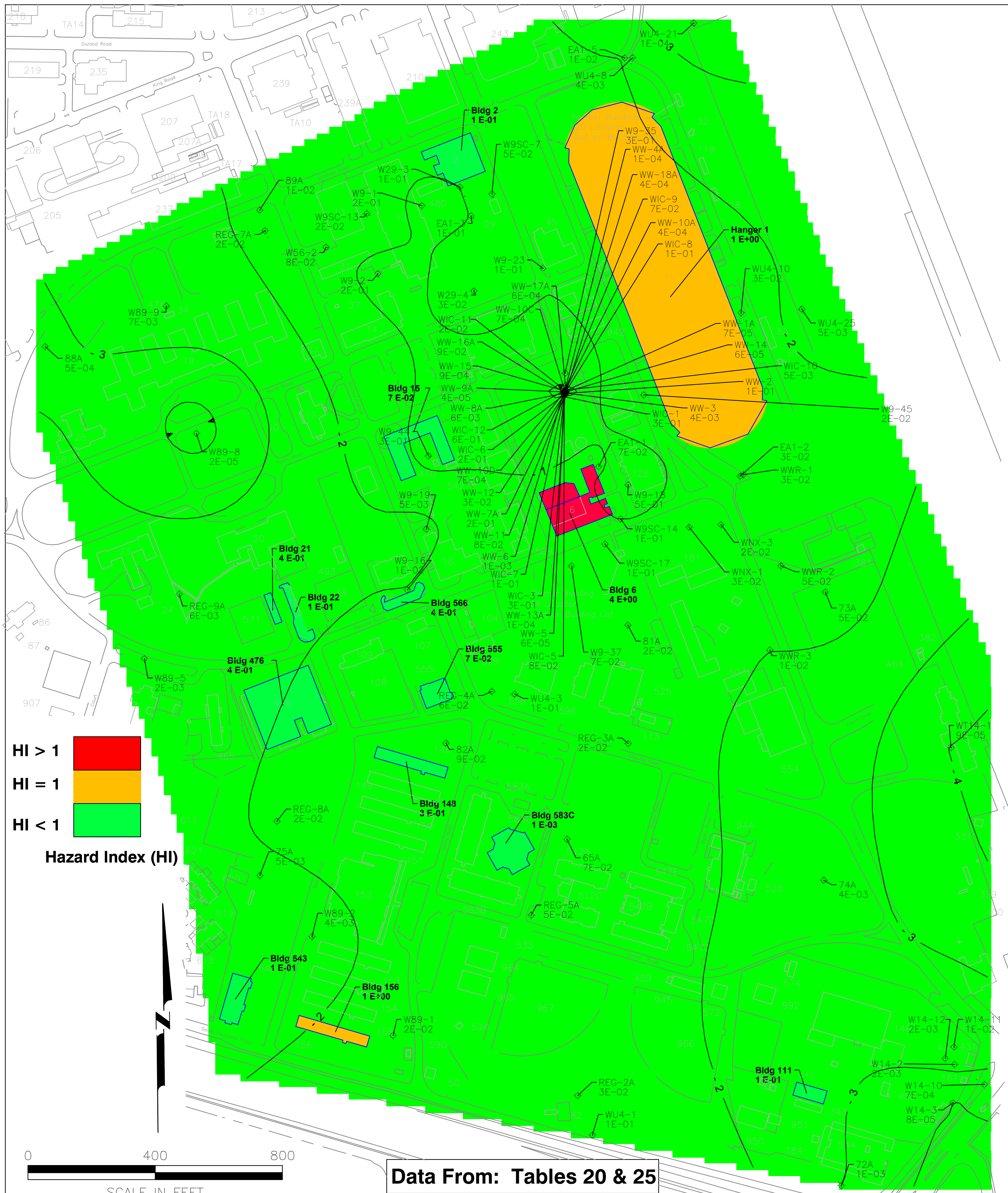
Harding ESE
A MACTEC Company

Resident, Adult (24 yr) HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
21

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

P:\Geophys\NASA Ames



P:\Geophys\NASA Ames

Harding ESE
A MACTEC Company

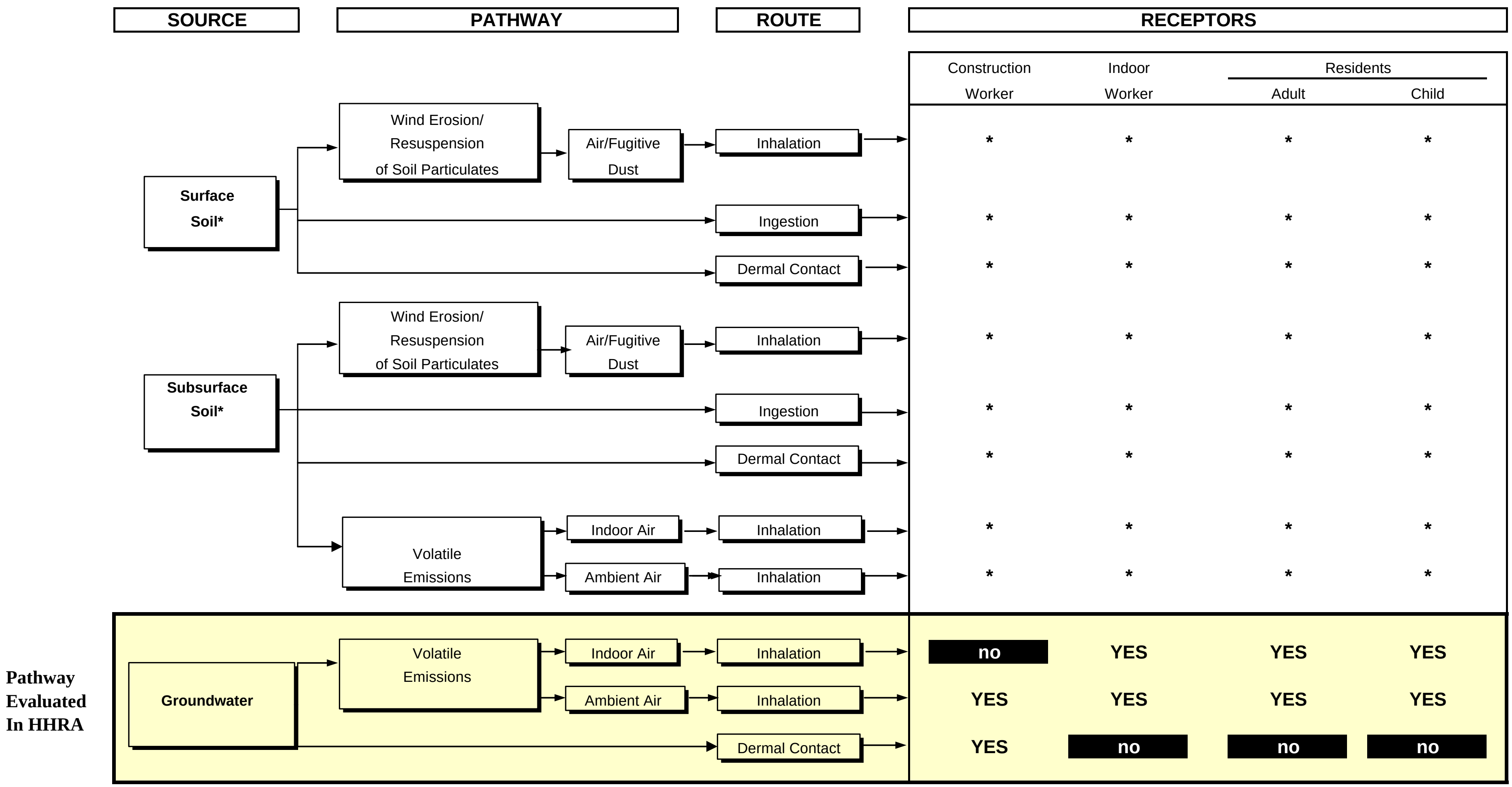
Resident, Child (6 yr) HI
Human Health Risk Assessment
NASA Research Park Parcels
Moffett Field, California

PLATE
22

DRAWN	JOB NUMBER	DATE	REVISED DATE
Rws	56042	04/03	

FIGURES

Figure 1. Conceptual Site Model
Human Health Risk Assessment
NASA Research Park
Moffett Field, California



YES Receptor may be exposed via this route; pathway considered potentially complete and quantitatively evaluated.
no Receptor unlikely to be exposed via this route; no further evaluation required.
* Potential exposure pathway, but not evaluated as part of the HHRA due to lack of post remediation soil data.

APPENDIX A

SURFACE FLUX MEASUREMENT PROGRAM

The surface flux measurement program is available in hard copy.
For a copy, please contact:

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Novato, CA 94949
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APPENDIX B

CALCULATION OF EXPOSURE POINT CONCENTRATIONS

APPENDIX B
CONTENTS

APPENDIX B

B1.0 CALCULATION OF EXPOSURE POINT CONCENTRATIONS

This section describes methods used to select an exposure point concentration (EPC) by calculating an appropriate upper confidence limit on a population mean from a sample set.

In calculating an EPC, it is customary to use the lesser value of the following: (1) the maximum value or (2) the 95 percent upper confidence limit (95 percent UCL) of the population mean from a sample data set (*USEPA, 1992*). Because the calculation of an exact confidence limit is dependent on the underlying population distribution, several methods can be used to calculate confidence limits. Each method makes different assumptions about the underlying population distribution. The following section describes methods used to calculate confidence limits and confidence intervals.

B1.1 Confidence Limits and Confidence Intervals

The UCL of a sample data set mean can be thought of as an "error bar" that describes how well a mean calculated from a sample data set approximates the true population mean. A function calculated from the sample data set's mean, the sample data set's variance (or its square root, the sample data set standard deviation), and the percent confidence is usually used. As the uncertainty in a data set increases, the length of the error bar increases. As the number of points in the data set decrease, the length of the error bar also increases. As the percentage error increases, the length of the error bar increases (95 percent UCL is longer than the 90 percent UCL). In addition, because the sample mean and variance are usually used to calculate a UCL, each sample data set taken from the underlying population may have a different UCL.

Figure A-1 graphically represents the 95 percent confidence intervals (upper and lower confidence limits) for 20 sample sets of 50 data points each. The heavy horizontal line is the true population mean. Notice that the confidence intervals (the vertical lines) include the population mean in nearly every case. However, one confidence interval does not (the wider vertical line). This is to be expected 5 percent of the time (because it is a 95 percent confidence interval). Also notice that the upper confidence limit (the top of each vertical line) is above the population mean 95 percent of the time. By definition, the 95 percent UCL of a sample set is expected to be larger than the true population mean 95 percent of the time. This makes the 95 percent UCL a fairly conservative surrogate for the unknown population mean.

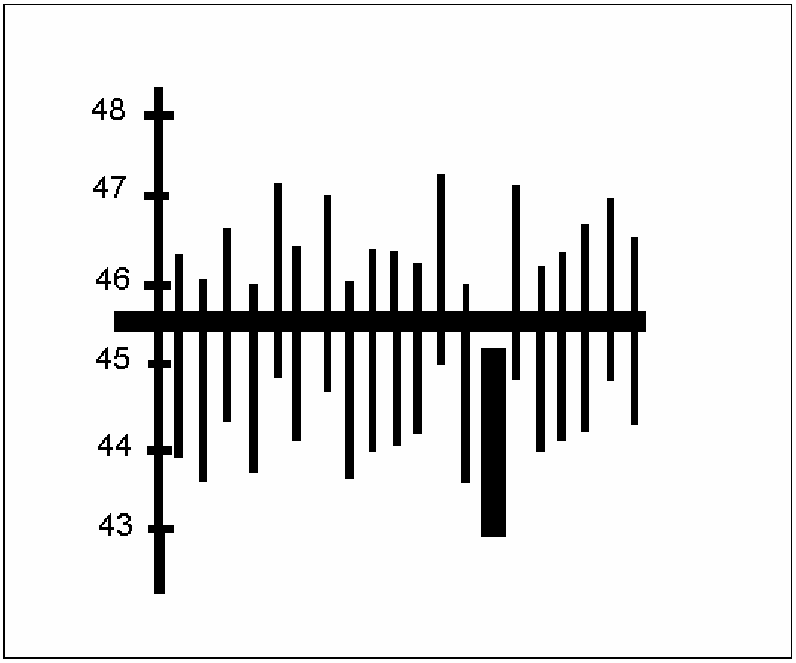

Figure B-1. Graphical Example of Confidence Intervals

The appropriate formula for calculating the UCL depends on the underlying population distribution, as described below.

Unimodal Normal Distribution

If a population is unimodal and normally distributed, the appropriate formula for a UCL from sample data set parameters is given by *Sokal and Rohlf* (*1969*):

$$UCL = xbar + t_{alpha,\ n-1} * \ var\ /sqrt(n) \qquad \text{(Equation 1)}$$

where:

UCL	=	upper confidence limit
xbar	=	sample data set mean
$t_{alpha,\ n-1}$	=	critical value for t score for n-1 degrees of freedom for probability alpha
alpha	=	required probability (0.0 to 1.0 often 0.95)
n	=	number of points in sample set
var	=	sample data set variance
sqrt()	=	square root function

Unimodal Lognormal Distribution

If a population is unimodal and lognormally distributed, Land (*Land, 1975*) provides the appropriate formula for a UCL from sample data set parameters (*Gilbert, 1987*):

$$UCL = exp(ybar + 0.5*sy**2 + sy*H_{1\text{-}alpha} / sqrt(n-1)) \qquad \text{(Equation 2)}$$

where:

UCL	=	upper confidence limit
exp()	=	exponential function (Euler's number raised to the function argument's value, i.e., exp(z) = e^z)
ybar	=	sample data set mean for log transformed data set
sy	=	sample data set variance for log transformed data set
H1-alpha	=	value from Land (1975) or Gilbert (*1987*; Appendix A).
alpha	=	required probability (0.0 to 1.0, often set to 0.95)
n	=	number of points in the sample set
sqrt()	=	square root function

Because the UCL calculated using Equation 2 is dependent on the exponential of the sample variance squared while Equation 1 is dependent on just the variance, Equation 2 will be more sensitive to the magnitude of the data set variance than Equation 1.

Bimodal, Non-normal, or Non-lognormal Distribution

In addition to these UCL formulas, Singh states that there exists a formula to determine the maximum possible value for a UCL (*Singh, et al., 1997*). This limit is a derivative of Chebyshev's theorem and does not depend on the population distribution (*Grinstead and Snell, 1997*). Chebyshev's theorem states:

> *The probability of any random variable taking a value less than or equal to the population mean plus k standard deviations is at least* $1+1/k^2$.

If the random variable in question is a sample mean, then an UCL can be calculated. The calculated UCL will be conservative as long as the true population mean and standard deviation are used in the calculation. If estimates of the mean and standard deviation are used in the calculation, it is less likely that the calculated UCL will be conservative. The following equation is then used to calculate a 95 percent confidence limit on a population mean (*Singh, et al., 1997, USEPA, 2002*):

$$UCL=xbar+4.47sigma/sqrt(n) \qquad \text{(Equation 3)}$$

where:

UCL	=	upper confidence limit
xbar	=	sample data set mean
n	=	number of points in sample set
sigma	=	sample data set standard deviation
sqrt()	=	square root function

If the underlying population distribution is expected to be approximately lognormal, then Singh suggests the following estimations of xbar and sigma:

xbar - estimated by minimum variance, unbiased (MVU) mean estimator described in Gilbert's Equation 13.3.

sigma - estimated by the square root of the MVU estimator of variance described in Gilbert's Equation 13.5.

As formulated above, this is a two-sided confidence limit. Because the underlying distribution cannot be assumed to be symmetrical about the mean, this is also a conservative one-sided limit (assuming all the "remaining probability" was to be placed in the upper tail).

B1.2 Determination of an EPC

As previously stated, determination of an EPC requires calculating a UCL or a limit on the UCL. The first step in this process is to assess which method of calculating the UCL is appropriate. As previously discussed, the method selected is based on the underlying population probability distribution.

One way to assess which probability distribution adequately models the underlying population is to test the probability of a sample being drawn from a population with a particular probability distribution. One such test is the W-test developed by Shapiro and Wilk (*Shapiro and Wilk, 1965*). The W-test assesses whether a sample is from a sample population with a normal probability distribution. The W-test can also be used to evaluate if a sample belongs to a population with a lognormal distribution (after the data have undergone a natural logarithm transformation). The W-test, as developed by Shapiro and Wilk, is limited to a sample data set size of 3 to 50 samples. Royston (*1995*) developed a modification of the W-test to allow its use with data sets as large as 5,000 data points.

The EPC of a data set is determined using the following four-step procedure:

1. A 95 percent UCL is calculated using Equation 1 if the sample data set is not rejected (with a probability of 0.95) by the W-test, as being drawn from a population with a normal distribution

2. If the data set is rejected as being drawn from a population having a normal distribution, the sample data set is natural logarithm transformed and the test is repeated. If the sample data set is not rejected (with a probability of 0.95) by the W-test as being drawn from a population with a lognormal distribution, a 95 percent UCL is calculated using Equation 2.

3. Next, if the data set is rejected from being drawn from a population having either a normal or lognormal distribution (Steps 1 and 2), an upper limit to the 95 percent UCL is calculated using Equation 3.

4. The appropriate 95 percent UCL or 95 percent UCL limit is compared to the maximum value within the sample data set and the lesser of these two values is chosen as the EPC.

B2.0 LITERATURE CITED

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U.S. Environmental Protection Agency (USEPA), 1992. Supplemental Guidance to Risk Assessment Guidance for Superfund Sites (RAGS): Calculating the Concentration Term. Office of Solid Waste and Emergency Response.

_____,2002. *Calculating Upper Confidence Limits for Exposure Point Concentrations At Hazardous Waste Sites*. Office of Emergency and Remedial Response. OSWER 0285.6-10. December

APPENDIX C

GROUNDWATER DATA

The groundwater data is available electronically in spreadsheet or database format.
For a copy, please contact:

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MACTEC Engineering and Consulting, Inc.
90 Digital Dr.
Novato, CA 94949
(415) 884-3153
dbrenner@mactec.com

APPENDIX D

AIR DATA

The air data is available electronically in spreadsheet or database format.
For a copy, please contact:

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(415) 884-3153
dbrenner@mactec.com

APPENDIX E

INTERMEDIATE CALCULATIONS FOR THE GROUNDWATER TO AIR VOLATILIZATION MODEL

The intermediate calculations are available electronically in spreadsheet or database format.
For a copy, please contact:

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dbrenner@mactec.com

APPENDIX F

RESPONSES TO COMMENTS

EPA REVIEW

Revised Draft Human Health Risk Assessment Addendum
NASA Research Park, Moffett Field, California, December 16, 2002

General Comment

The total risk for each exposure scenario is presented in the summary tables (Tables 21 - 25), but in order to focus on the effect of the groundwater via the vapor intrusion pathway, ambient air or "background" air concentrations were subtracted in the risk assessment. While the reference for these "background" values is given as the Bay Area Air Quality Management District's toxic air contaminant report from the Mountain View sampling location in 1999, the actual "background" values used should be presented in a table. The Addendum should also clarify how the "background correction" was subtracted. Was the risk due to "background" calculated and then subtracted for all corresponding chemical values or was the amount of chemical found in any location reduced by the "background" amount but not more than was detected at that location? It appears the latter was the case but it is not clear. Sufficient information needs to be provided so that the reader is able to check the calculations in the tables and interpret the figures.

Response: As stated in the fourth paragraph of section 6.3.3 of the Draft Addendum "Because benzene is present in ambient air, background benzene concentration, based upon the BAAQMD monitoring station in Mountain View was subtracted from the total measured benzene concentration." If the background benzene concentration was greater than the detected concentration then the detected benzene concentration was set to zero. This data was provided in table 6. A reference to this table has been added to this section in the Final Revised HHRA.

Specific Comments

1. Page 5, Section 6.3 Risk Characterization Results. The "background" concentration of benzene should be presented. Was benzene the only "corrected" chemical? The risk at the ambient level should be addressed and the uncertainty should be discussed. Also, the trend of improved air quality (e.g., effect of reformulated gasoline) should also be briefly discussed.

Response: See response to general comment above and your comment 3, below. As stated in the first paragraph of section 6.3.3 "In addition to benzene, background corrections were also applied for toluene, Methylene chloride, 1,1,1-trichloroethane, Tetrachloroethene (PCE), and Trichloroethene (TCE)." Only BAAQMD data for 1998 and 1999 were available for the Mountain View location. For Benzene, Toluene, Methylene chloride, and Trichloroethene the 1998 mean values were greater then the 1999 mean values; a trend towards improving air quality. However, for Perchloroethylene and Trichloroethylene the 1999 mean values were greater than the 1998 mean values. Indoor air measurements were taken in 1999 and 2000, therefore these background concentrations are likely representative of the actual background concentrations in the air during the site sampling.

2. Pages 7 and 8, Section 6.3.1 Risk Characterization Summary. Please revise the following statements and delete "ignored," "If the results of Buildings 155 and 156 are ignored…" and "If the results of Building 156 are ignored.…"

Response: The statements have been revised in the Final Revised HHRA.

3. Page 12, Section 6.3.3 Risk Estimated from Air Measurements. Please provide a table of the actual values used and a table of the subtracted "background corrections" for benzene, toluene, Methylene chloride, 1,1,1-trichlorethane (TCA), Tetrachloroethene (PCE), and Trichloroethene (TCE).

Response: see table 6. Corrected values for all measured air concentrations are provided on a total risk, building by building basis in the existing tables. A table has been added (Table 26) that summarizes the background risk values for each receptor and exposure scenario.

4. Table 22 and Plate 8. The risk levels shown on Plate 8 do not correspond to building risk levels provided in Table 22. Please also confirm the corresponding color-coding of incremental cancer risks.

Response: All plates in the Final Revised HHRA have been updated based upon revisions to the Johnson and Ettinger indoor volatilization model. All plates are in agreement with their corresponding tables.

5. Table 26. The values presented for chromium (VI) appear to be for total chromium. Please confirm and add a footnote for clarification.

Response: Table 26 is now Table 27 in the Revised Final HHRA and has been revised to reflect total chromium values for the RBSL and PRG.

6. Plates 4 - 22. Each plate should reference the corresponding table that provides the total and "corrected for background" risks and hazards (e.g., Tables 21-25).

Response: The plates have been annotated in the Revised Final HHRA.

COMMENTS BY THE UNIVERSITY OF CALIFORNIA

Draft January 31, 2003
Human Health Risk Assessment
NASA Research Park
Mountain View, California

General Comments

The University of California ("the University") is submitting a limited set of comments to NASA concerning the September 16, 2002 Revised Draft Human Health Risk Assessment (HHRA), and the December 16, 2002 Revised Draft HHRA Addendum. The December 16, 2002 "Addendum" is actually a modification and replacement of Section 6 of the September 16, 2002 Revised Draft HHRA; NASA may find that it would be useful to combine these versions of the HHRA into a single version to avoid confusion when the document becomes available for public review.

Response: A merged, final document will be distributed.

The University recognizes that NASA has improved the HHRA analysis greatly by reflecting EPA's current method for screening risks from volatilization of organic compounds from ground water, incorporating EPA's revised cancer potency values for trichloroethylene (TCE), and presenting the results in risk-normalized terms. The University does recommend, however, that NASA use the data that it has available to present not just the incremental risks due to site contamination, but the *total* risk that all receptors would experience at the site, reflecting background exposure in addition to incremental exposure. This approach permits developers and potential tenants to evaluate their overall risk before and after risk mitigation efforts to reduce the exposure resulting from site contamination.

Response: Risks, prior to background correction are provided in Tables 21 to 25.

Although this letter focuses on the Revised Draft HHRA, the HHRA and the next draft of the EIMP are closely related. Because development of the NRP may be phased over time, and thus existing buildings may be used for a longer period of time than originally anticipated, the University recommends that the EIMP address how NASA intends to mitigate the risks associated with existing buildings, as identified in the HHRA.

Response: This comment will be addressed in the EIMP.

Technical Issues

- Surface flux results may not adequately characterize overall volatile organic compound (VOC) emissions at the site: A total of 23 surface flux samples were collected in parcels 1, 2, 3, 4, and 5 in order to represent "worst-case" and representative potential surface emissions of volatile organic compounds (VOCs) from selected areas on each test parcel. The flux and groundwater data sets collectively do not provide a clear understanding of the nature and extent of potential vapor sources at the site. In particular, vinyl chloride was found in numerous groundwater samples, but not found in flux or air samples. As for other VOCs, it would be expected that vinyl chloride would be present in air samples if it is present in the groundwater. Its absence in air samples needs further explanation to justify the exclusion of vinyl chloride from risk totals. We recommend that NASA attempt to reconcile the inconsistent results of the flux and groundwater data sets, and address remaining data gaps related to the nature of the vapor sources, as well as fate and transport of VOCs at the site, particularly with respect to vinyl chloride. NASA should re-examine its conceptual site model to ensure that it includes all potential vapor sources and carefully considers preferential VOC pathways into buildings (underground utility conduits and any basement openings to the subsurface).

  Response: The reviewers underlying assumption that VC detected in GW should also be present in indoor air is likely not valid. Given that VC is a gas at room temperature, it will not behave in a similar manner to VOCs that are normally liquids at room temperature. Two physical measurement techniques, having sufficiently sensitive detection limits were employed to corroborate the J & E model prediction. The weight of the evidence suggests that the model is not a good predictor of VC concentrations in indoor air. Failure to detect VC in flux or indoor air samples is in fact sufficient explanation to exclude it from the risk calculation. In addition, as stated in section 6.3 "In particular, the GW-to-Indoor air model predicted indoor concentrations for VC at levels above the average indoor air measurement detection levels. Since the air measurement technique employed should have detected VC if present at the predicted model levels, it appears that the model, as used, over predicts indoor air VC concentrations. The calculated risk, at the average detection limit of the indoor air sampling, corresponds to a risk less than $1x10^{-6}$." The scope of the risk assessment did not entail identifying all sources for all VOCs. Rather it is meant to provide the best estimate of the risk due to existing groundwater contamination at the site. It should be used as GUIDANCE for developers in the selection of sites and their potential end use. Developers are free to conduct further risk assessment in an attempt to better define the particular sources affecting their site.

- Uncertainty regarding building parameter assumptions in Johnson & Ettinger (J&E) model should be discussed: Section 7.8 in the HHRA should include a discussion regarding the uncertainty associated with building parameter assumptions. Results of the J&E model and subsequent estimates of incremental cancer risk and non-cancer hazards presented in the HHRA are contingent upon the assumptions regarding the most reasonable future building dimensions at the site, namely a hypothetical 90,000 square foot 3-story office/research facility. Risks and hazards presented in this HHRA reflect potential exposures at such hypothetical research buildings. As future development of the site may encompass an assortment of building sizes and configurations, the HHRA should include an analysis of how different building configurations will affect the calculated exposure risk, providing quantification of the variability in risks associated with changes in either the square footage or the configuration of research buildings.

Response: A 90,000 sq ft three story building was chosen as a baseline. It will be the responsibility of individual developers to evaluate their design proposal relative to this baseline.

- EPA's J&E model spreadsheet offers only two Lf default value: 15 centimeters (cm) and 200 cm. The HHRA spreadsheet calculations use a default Lf value of 200 cm for a building with basement. The depth to groundwater at several monitor wells (probably greater than 50 percent of wells) is less than 200 cm. Therefore, the assumption of a future building with a basement floor located within the saturated zone at the site presents a logical flaw in the J&E model. All HHRA J&E model results and subsequent risk/hazard estimates should be recalculated using an Lf value of 15 cm.

  Response: This has been corrected in the final. In combination with the change in the area of enclosed space below grade (A_B) and crack-to-total area ratio (η) [see next comment] these changes result in lower risk estimates for most wells. Site-specific assumptions for floor-wall seam perimeter (Xcrack) and building ventilation rate (Qbuilding) have to be linked to the area of enclosed space below grade (A_B) and crack-to-total area ratio (η). Specific cells within the J&E worksheets were not linked appropriately regarding calculations of A_B or η as a function of the site-specific building parameters, Xcrack and Qbuilding. This is an error in the use of the Excel spreadsheet software and not related specifically to J&E methodology. The J&E worksheet should be revised to establish the correct links and calculations.

  Response: This has been corrected in the final. In combination with changing the depth below grade to the bottom of the enclosed floor space (Lf) to 15 cm. [see previous comment] these changes result in lower risk estimates for most wells.

- The use of normalized risk isopleths is an improvement in the visual representation of risks. However, the University feels that the presentation warrants improvement.
  - ***Color-Coding of Incremental Cancer Risks and Non-Cancer Hazards Is Ambiguous:*** The color gradation on some of the iso-risk plots is difficult to interpret. For example, on Plate 4, the colors corresponding to risks of ~1×10^{-5} and > 1×10^{-4} are very similar.

  Response: Coloring in the plates is sufficient for their intended purpose.

  - ***Plates Should Identify Corresponding Results Tables and Parcel Locations:*** In order to improve understanding of color-coding of the plates, references to results tables (with numerical values for risk and hazards) should be specified in the descriptors for every plate. In order to improve visualization of risks/hazards with respect to parcel locations, the plots should include a parcel location overlay.

  Response: References to the applicable tables has been added to the plates. An overlay was not included because it results in cluttering of the plates and difficulty in reading isopleth and building labels.

- o ***Hazard Index Plates Color-Coding Should Include a Refinement to HI>1:*** In order to provide a better perspective of the magnitude of non-cancer hazard index (HI) values for receptor categories, the HI plates should include additional color-coding categories for HI>1 (e.g. example, HI> 5 and HI>10, etc.).

Response: Any HI above 1 represents a potential adverse health impact. Providing isopleths for values above 1 provides no value added information to the reader.

- o ***Risk/Hazard Isopleth Plots May Not Be Effective Tools for Risk Management Purposes:*** The use of color-coded graphical presentations of incremental cancer risks and non-cancer hazards in the iso-risk plots may mislead risk managers in risk management and reconstruction decisions at the facility. Risks and hazards greater than acceptable levels relate to the presence of exposure scenarios (human receptors exposed at the specified frequency and duration) at a specific location (building or entire area), rather than to the actual location itself. For example, entire parcels or locations within a parcel that are drawn in red may mislead risk managers or other stakeholders into associating risks or hazards with the location itself, rather than the presence of an exposure scenario at that location.

Response: All of the plates, with their associated isopleths are clearly labeled. A risk cannot be presented without an associated exposure scenario. To paraphrase Paracelsus, "The dose makes the poison". Without a specified exposure scenario, risks cannot be properly defined. Careful review of these plates along with the associated text by qualified risk managers will avoid any misinterpretation.

- Exposure to contaminated soils is not addressed in the HHRA (only groundwater and air pathways are considered). Figure 1 notes that soil exposure is a conceptual exposure pathway, but is not evaluated due to a lack of post remediation soil data. Instead, a discussion of applicable target cleanup levels (TCLs) for soil is presented (Section 1.0, p. 2). However, the soil target cleanup levels (TCLs) specified in the HHRA are based on the lowest default value found amongst the EPA PRGs, Cal EPA RBSLs, and the MEW ROD (Addendum Section 6.4, p. 15). No rationale is given for choosing the lowest possible value. EPA PRGs and Cal EPA RBSLs are intended to be used as screening levels only, and are not appropriate for use as default cleanup levels.

  Response: NASA has elected to use the lowest applicable standard in order to provide the greatest level of protection of human health and the environment.

Specific Comments

1. Section 3.3, Page 9 and Table 5 – Exclusion of vinyl chloride as a chemical of potential concern (COPC) should be justified in more detail. See Technical Comments above.

Response: Vinyl Chloride was NOT excluded as a COPC (see table 5). However, based upon the Soil Flux and Indoor air samples to detect VC, risks calculated absent VC more accurately represent site related risk to human health. For completeness, the risks for all receptors with and without inclusion of VC are provided in tables 16 to 20.

2. Section 4.7.3, Pages 19 and 21 – The reference for the Johnson & Ettinger Model (*EPA 2002*) should be added to the reference list in Section 9.

Response: The following reference has been added:

USEPA, 2000b. *User's Guide for the Johnson and Ettinger (1991) model for Subsurface Vapor Intrusion into Buildings (Revised).* Office of Emergency and Remedial Response. September.

3. Section 6.3.2, Addendum Page 9 - The exclusion of vinyl chloride from total risk estimates and iso-risk plots should be justified in more detail. See Technical Comments, above.

Response: See response to general comments, above.

4. Section 6.3.3, Addendum Pages 13-14 – Sources of volatile organic compounds other than contaminated groundwater underlying Buildings 156 and 476 should be addressed in more detail. Estimated risks at these locations for indoor workers and default 30-year residents exceed the upper end (10^{-4}) of EPA's acceptable risk management range.

Response: The focus of the NASA HHRA was to evaluate the potential contribution from contaminated groundwater. Because the contribution of contaminants from other than groundwater will vary greatly from site to site, it will be the individual developer's responsibility to address other contaminant sources once they have selected a site.

5. Section 6.4 "Soil Target Cleanup Levels" - This very short section refers to Table 26, which lists various soil screening levels states that the lowest level will be used for screening and can be used to support any further removal action decisions. It is the opinion of the University's consultant Tetra Tech that only the MEW ROD soil cleanup level is enforceable. While the other levels could be used for screening, the University does not believe that these values could be used to drive further removal actions. See Technical Comments, above.

Response: See response to general comment.

6. Section 7.5 – The uncertainty associated with exclusion of vinyl chloride from total risk estimates should be addressed.

Response: A section has been added in final.

7. Section 7.7, Page 51, Paragraph 2 - The discussion of the measured outdoor air concentrations and the outdoor air concentrations estimated based on groundwater measurements should include a discussion of the representativeness of the samples collected. Short-term variability in air movement is generally high and often poorly understood, and can substantially influence outdoor air concentration measurements.

Response: Additional discussion has been added to section 7.5 in the Revised Final HHRA.

Previous Comments, Unaddressed

Tetra Tech EM Inc. Comment (July 30, 2001)	Not Addressed At All	Not Addressed Adequately	Comment
Sections 4.7.1 through 4.7.4 – exposure time for construction worker of 12 hours per day for RME scenario	√		The revised draft HHRA dated September 16, 2002, uses the same value. See Section 5.0, Specific Comment 3.
Section 5.3, Table 15 – This section presents toxicity criteria for chemicals which are not COPCs	√		The revised draft HHRA includes the same chemicals in section 5.3. See Section 5.0, Specific Comment 4.
Section 6.4 – Enforceability of soil cleanup level other than the MEW ROD values	√		The revised draft HHRA does not address this issue. See Section 5.0, Specific Comment 8.
Section 6.4, Page 45, first paragraph – The soil target cleanup level does not address the need for personal protective equipment use during excavation activities at the site.	√		The revised draft HHRA does not address this issue.
Section 7.4, Page 48, first paragraph – neither soil cleanup levels nor risk estimates address the need for use of personal protective equipment to address health risks associated with potential vapor intrusion into buildings situated over or near such soils.	√		The revised draft HHRA does not address this issue.
Section 7.6, Pages 49-51 – correlations among chemicals in soil and groundwater concentrations at individual locations were not evaluated systematically because detailed		√	The revised draft HHRA does not address this issue adequately.

Tetra Tech EM Inc. Comment (July 30, 2001)	**Not Addressed At All**	**Not Addressed Adequately**	**Comment**
information on groundwater concentrations at various locations, groundwater sampling depths, and sampling times was not available for review.			
Section 7.7, Page 51, second paragraph – Discussion of measured outdoor air concentrations and those estimated based on the flux measurements should include a discussion of the representativeness of the samples collected.		√	The revised draft HHRA does not address this issue adequately.

Sections 4.7.1 through 4.7.4 – exposure time for construction worker of 12 hours per day for RME scenario.

Response: This is a site specific value based upon professional judgment.

Section 5.3, Table 15 – This section presents toxicity criteria for chemicals which are not COPCs.

Response: The toxicity criteria for the soil only chemicals are included for completeness as they are presented in table 27 (formally table 26) for soil cleanup levels.

Section 6.4 – Enforceability of soil cleanup level other than the MEW ROD values

Response: See response to general comments, above.

Section 6.4, Page 45, first paragraph – The soil target cleanup level does not address the need for personal protective equipment use during excavation activities at the site.

Response: Recommendation regarding PPE is beyond the scope of this risk assessment. This issue will be addressed in the EIMP.

Section 7.4, Page 48, first paragraph – neither soil cleanup levels nor risk estimates address the need for use of personal protective equipment to address health risks associated with potential vapor intrusion into buildings situated over or near such soils.

Response: Recommendation regarding PPE is beyond the scope of this risk assessment. This issue will be addressed in the EIMP.

Section 7.6, Pages 49-51 – correlations among chemicals in soil and groundwater concentrations at individual locations were not evaluated systematically because detailed information on groundwater concentrations at various locations, groundwater sampling depths, and sampling times was not available for review.

Response: All identified soil contamination at the site has been removed. The soil screening values provided in table 27 (formally 26) are for use as individual sites are developed. Without the availability of post-remediation soil data correlations to groundwater concentrations cannot be made.

Section 7.7, Page 51, second paragraph – Discussion of measured outdoor air concentrations and those estimated based on the flux measurements should include a discussion of the representativeness of the samples collected.

Response: Additional discussion has been added to section 7.5 in the Revised Final HHRA

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN FRANCISCO BAY REGION

Comments on the Administrative Draft Human Health Risk Assessment and Draft Human Health Risk Assessment Addendum for NASA Research Park, Moffett Field, *California,* Prepared by MACTEC, Inc. and dated November 26, 2001 and December 16, 2002, respectively.

General Comments

To summarize, adequate information is not provided to fully evaluate the indoor-air impact models presented. All risk assessments should be presented as "stand-alone" document. Most obviously, predicted concentrations of chemicals in indoor air are not presented, even though this should have been a focus of the study. The models used also appear to predict greater impacts to outdoor air than indoor air due to subsurface vapor emissions, if this interpretation is correct; it calls into question the adequacy of the models since the opposite is generally true at similar sites. The adequacy of the vapor flux studies is also questionable, since the study did not take into account the potential for convective flow of subsurface vapors into the building. The summary of risks posed to human health is also not clear, although this was partially addressed in the follow up addendum report.

Response: Some of the inputs to the Johnson and Ettinger model have been revised based upon other comments received. Indoor air concentrations predicted by the model are always higher than predicted outdoor air concentrations.

TCE and related compounds identified in indoor air could be coming from outside sources and/or due to emissions from groundwater. To further evaluate this issue, we recommend that soil gas samples be collected from immediately below the buildings foundations (if this hasn't been done already).

Response: Surface soil flux in the vicinity of the buildings has been collected to verify the presence of VOCs in the soil vapor. These measurements were collected over one hour, and as with the soil gas measurements, these values are a snapshot of the presence or absence of VOCs in the soil gas. Therefore, we feel confident that the soil flux measurements are adequate to address this issue. In addition, almost all of the buildings currently on the NRP site will be removed during the development process. Thus, soil gas measurements from below these buildings will not be predictive of future risks for construction.

Specific Comments

November 26, 2001, Risk Assessment

1. Section 4.7.4. Calculation of VOC Air Concentrations - Provide a calculation of VOC concentrations in indoor-air with respect to groundwater emission model and vapor flux model (residential and commercial building scenarios). In spite of the section heading, no calculations of indoor-air concentrations are provided. This basic information is important in evaluating the results of the study and cannot be omitted. Assumed building parameter values for residential housing scenarios should also be clarified (e.g., indoor air exchange rate for residential buildings not provided in Table 38). For indoor-air impacts predicted using groundwater data, the groundwater data should be provided beside the predicted indoor-air concentration. See also Comments *5* and 6 below.

Response: A summary of intermediate model calculations is provided in appendix E. The groundwater volatilization model input parameters are summarized in table 14.

2. Sections 6.1, 6.2 & 6.3. Risk Characterization - Discuss exposure pathways considered; provide the full equations for calculation of the ADD and LADD terms; provide a summary of the calculation results in an appendix. Calculation and presentation of Average Daily Doses is an important part of the risk assessment but is not included in the report. Clearly note the exposure pathways that are considered in the calculations.

Response: Risk isopleths have been derived from groundwater data from 89 wells in the NRP. Because these isopleths represent a composite risk across many wells and COPCs, the presentation of the average daily dose for each chemical will provided limited insight.

3. Groundwater Data Summary Tables - Review and correct data to match table headings. For example, data presented under "Minimum Detected Values" and "Maximum Detected Values" in Table 10 appear to be reversed. Data listed under "Exposure Point Concentration" in Table 10 do not match the stated basis (e.g., basis of TCE Exposure Point Concentration of 5.2 mg/L stated as "Maximum Value" but the Maximum Detected Value presented as 2.8 mg/L).

Response: This has been corrected.

4. Section 4.7.3, Tables 37, 38 - Groundwater Volatilization Model - Provide raw data (boring logs, soil type, sample depth, depth to groundwater, lab data, etc.) for all samples used to define "site-specific" soil property values in the models. Soil moisture ("volumetric water content in vadose-zone soils") is one of the most sensitive parameters in the model for VOC emissions from groundwater. Predicted vapor fluxes decreases dramatically with increasing soil moisture. A relatively high soil moisture content of 30% is presented in Tables 37 and 38 as "site-specific." Given a stated total porosity of 40%, this implies that the soil is 75% saturated with water. Such high water saturation levels are more typical of soils near the capillary fringe, not the upper vadose-zone soils as required for use in the model. The fact that identical porosity and moisture values are used for soil in all five parcels also makes the claim of "site-specific" data more questionable. Detailed soil data should be provided to support the parameter values assumed in the model. Soil moisture data should be collected from well above the capillary fringe zone, preferably from three to five feet from the ground surface in areas of shallow groundwater (or less than half-way from ground surface to the top of the capillary fringe). If adequate site-specific data are not available, then conservative default values should be used.

Response: Site specific values were used as available.

5. Section 4.7.4. Vapor Flux Data **-** Adjust vapor flux data to take into account potential convective flow of subsurface vapors into buildings. The vapor flux data only address the diffusive flow of subsurface vapors to the ground surface. Convection-induced flow of subsurface vapors into buildings can be significantly higher than diffusive flow in some cases, however. This limitation of the indoor-air models should be clearly discussed in the text and estimated indoor-air impacts modified accordingly.

This limitation, is reflected in the models used to estimate indoor-air vs. outdoor-air impacts with respect to flux data. The concentration of VOCs in indoor-air (mg/rn^3) is calculated as the measured (or modeled) flux times a factor of *1.45* (Ci = Flux x Attenuation Factor /Height x Air Exchange Rate). The concentration of VOCs in outdoor air is calculated as the flux times a factor of *3.5* (Ca = Flux x (Mixing Height x Wind Velocity/Width of Source). The models therefore predict that concentrations of VOCs in outdoor air will be more than twice that in for indoor air. This goes against typical field data, which suggest that indoor-air impacts can be orders of magnitude higher than impacts to outdoor air. The problem is most Likely in the assumed vapor flux, rather than the equation itself.

Response: Results of revised model calculations provide estimates of indoor air concentrations greater than outdoor air concentrations.

6. Section 4.7.3. Groundwater VOC Emission Model - Refer to USEPA version of the Johnson & Ettinger model for prediction of potential indoor-air impacts from contaminated groundwater, provide a summary of model equations and all input parameter values. The scaled-down version of the Johnson & Ettinger model presented in the referenced ASTM document only addresses the upward diffusive flow of vapors into a building. Convection-induced flow of subsurface vapors into buildings can be significantly higher than diffusive flow in some cases, however. More recent versions of Johnson & Ettinger model (e.g., *USEPA 1997, 2000*) address both diffusive and convective flow and are more conservative than the older models. A summary of model equations and all input parameter values should be provided iii the appendix. A discussion of the model is provided in our Appendices 1 and 4 of our December 2001 Risk-Based Screening Levels document (www.swrcb.ca.gov/~rwqcb2/rbsl.htm).

Response: The latest version of the EPA Johnson and Ettinger groundwater screen equations have been used in the revised final HHRA.

December 16 2002, Risk Assessment

***7. Section 6.3, Risk Characterization Results* -** Include vinyl chloride in initial estimate of risk posed to Indoor air by emissions from groundwater. The risk posed to indoor air by the potential emission of vinyl chloride from groundwater should not be discounted based on one-time, thirty-minute vapor flux samples. From a risk assessment standpoint, it would be more appropriate to include vinyl chloride the estimated risk based on emissions from groundwater and then qualify the results in the conclusions based on soil gas, vapor flux and/or indoor air samples. The tables as presented can remain, but they should be preceded by tables than include vinyl chloride in the risk estimates.

Response: Estimates of risk based upon the J & E model including vinyl chloride are presented in tables 16 to 20, even though vinyl chloride was not detected in the surface soil flux or air sampling.

***8. Sections 6.1, 6.2 & 6.3. Risk Characterization* -** Discuss exposure pathways considered and provide the full equations for calculation of the ADD and LADD terms; provide a summary of the calculation results in an appendix. Same as Comment 2 for November 26, 2001, HHRA.

Response: Exposure pathways for each receptor are discussed in section 4.5 and presented in Figure 1.

9. Figures - Include figures that summarize groundwater data for key chemicals of concern, including isoconcentration contours. A summary of groundwater data is required to make the risk assessment more of a stand-alone document and assist persons reviewing the document.

Response: The groundwater data are presented in appendix C and summarized in Table 2.

10. Figures - Note exposure pathways considered in figures that summarize and contour calculated risks.

Response: Plates are labeled by receptor and exposure pathways for receptors are presented in Section 4.5 and Figure 1 (see comment 8).