

PUBLIC HEALTH ASSESSMENT

TUCSON INTERNATIONAL AIRPORT AREA TUCSON, PIMA COUNTY, ARIZONA

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TABLE OF CONTENTS

[EXECUTIVE SUMMARY](#)

[1.0 BACKGROUND](#)

- [1.1 Introduction](#)
- [1.2 Purpose](#)
- [1.3 Site Description and History](#)
- [1.4 Site Visits](#)
- [1.5 Demographics, Land Use, Natural Resources](#)
- [1.6 Health Outcome Data](#)

[2.0 COMMUNITY HEALTH CONCERNS](#)

[3.0 ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS](#)

- [3.1 Data](#)

[4.0 DISCUSSION](#)

- [4.1 Environmental Data Evaluation](#)
- [4.2 Previous Public Health Reports and Findings](#)
- [4.3 Health Outcome Data Evaluation](#)
- [4.4 Child Health Initiative](#)

[5.0 CONCLUSIONS](#)

[6.0 RECOMMENDATIONS](#)

[7.0 PUBLIC HEALTH ACTION PLAN](#)

REFERENCES

PREPARERS OF REPORT

APPENDIX

March 1999 Plume Outlines and Tucson International Airport Area (TIAA) Site
Contaminated Municipal Wells, Tucson, Arizona
Private Wells Sampled by Pima County Department of Environmental Quality
Indoor Air Concentrations: Jury Model
Public Comments and Responses
Glossary
Certification Page

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EXECUTIVE SUMMARY

The purpose of this document is to summarize the body of environmental [health investigation](#) work that has been developed for the Tucson International Airport Area (TIAA) [Superfund](#) Site. The report includes a summary of previous reports and new data.

Contaminated groundwater was discovered in the area in 1981. The pollution included trichloroethylene (TCE). Investigations revealed the TCE was moving in a north to northwest direction.

TCE was also discovered in production wells used by Tucson Water in 1981. These wells were shut down shortly after the contamination was discovered. No groundwater data exist prior to 1981. Since historical [exposure](#) levels are unknown prior to 1981, exposure to contaminated groundwater posed an unknown [public health hazard](#). Municipal groundwater posed [no public health hazard](#) after the contaminated municipal wells were closed.

Currently the levels of contamination in private wells are not of public health concern. However, no regulation prevents persons from installing private drinking water wells in the contaminated groundwater, or from converting contaminated irrigation wells to drinking water wells. Because the pollutants in the groundwater may be of public health concern if it were used for drinking water, the site may pose a public health [hazard](#) unless actions are taken to prevent such use. Because of this potential pathway, ADHS finds the TIAA site may pose [an indeterminate public health hazard](#) unless further actions are taken. It should also be noted that a groundwater aquifer is a dynamic system, and pollution levels can and do vary over time. Consequently, private drinking wells should be monitored to ensure that [contaminant](#) levels remain below levels of health concern.

1.0 BACKGROUND

1.1 Introduction

The Tucson International Airport Area (TIAA) Superfund Site is located on the south side of Tucson, Arizona. The site is approximately bounded by Ajo Way to the north, Hughes Access Road to the east and south, and Highway 89 to the west ([Appendix: Figure 1](#)). In May 1981, contaminated groundwater was discovered beneath part of the site, beginning a number of investigations evaluating the nature and extent of contamination in the area. From these investigations, at least three separate areas of contamination, potentially from different sources, have been identified. The TIAA Superfund Site was officially added to the [National Priorities List \(NPL\)](#) in 1983.

Various environmental sampling reports and health evaluations have been conducted over the years (for example - Hargis & Montgomery, 1982; PCDEQ, 1994; D.B. Stephens, 1995; Baseline Risk Assessment ADHS, 1996; ATSDR, 2000a; ATSDR, 2000b; ATSDR, 2000c). In addition to reports focusing on individual areas of contamination, the Agency for Toxic Substances and Disease Registry (ATSDR) released a [Public Health Assessment \(PHA\)](#) for the TIAA in 1988 and a draft version of a subsequent Public Health Assessment Addendum for the TIAA in 1996.

This PHA is prepared by the Arizona Department of Health Services (ADHS) in cooperative agreement with the ATSDR. Because this current document is able to make use of a substantial body of public health evaluations previously unavailable, it is laid out differently than the 1996 ATSDR document. This PHA is essentially a new document (rather than a revised version of a previous document).

1.2 Purpose

The purpose of this document is to summarize the body of environmental health investigation work that has been developed regarding the TIAA site. The report includes data available since previous documents were created, and develops and presents the overall public health findings for the TIAA site based on the current body of available data.

1.3 Site Description and History

The Tucson Airport and surrounding area has been the site of various aviation, aerospace, and industrial facilities that have occupied portions of the site since 1942. The TIAA site includes one main contaminated groundwater [plume](#) with smaller areas of groundwater contamination located east of the main plume. Areas of contaminated soil have also been identified as part of the site. [Figure 1 in the Appendix](#) shows the location of the site and specific areas mentioned in this text.

Approximately 20 facilities have operated at various times in the TIAA vicinity. Known waste handling activities related to the TIAA site consisted of:

- surface discharge of waste liquids, containing several organic compounds, into soils, disposal ponds, and unlined landfills, and
- burning of wastes for use in fire training exercises (flammable wastes ignited in unlined fire pit areas, followed by application of water to extinguish the blaze).

Main Plume Area

In May 1981 contaminated groundwater was discovered at the site beneath Air Force Plant No. 44 (AFP44), which was operated for the Air Force at that time by Hughes Aircraft Corporation. This area is currently operated by Raytheon Corporation. Further investigations of the site revealed a sizable area of groundwater contamination, called the main plume, containing several organic compounds, including trichloroethylene (TCE), and chromium. Investigations revealed the contaminated groundwater plume was moving off-site in a north to northwest direction.

In 1987, the area of the plume was approximately 4 miles long and 3,000 feet wide covering an area located from the northwest corner of the AFP44 facility to near Irvington Road. A cooperative agreement between the USEPA and the United States Air Force (USAF) divided the plume into two major remedial areas with Los Reales Road as the dividing point. The portions of the main plume south of Los Reales Road are treated with a reclamation well field and full-scale air stripping facility that began operation in 1987 at the AFP44 site. North of Los Reales Road, the main plume is contained by extraction wells which feed the Tucson Aquifer Remediation Project (TARP) plant. [Figure 1 in the Appendix](#) displays a recent overview of the main plume.

Plume B Area

East of the main plume are smaller areas of contamination indicated by soil and water quality analyses from sampling programs conducted in the TIAA area. Based on the analyses conducted to date and a review of historical activities at the facilities in the area, the contamination (primarily TCE and chromium) may have resulted from operations of any of the following: the Tucson Airport, the Burr-Brown facility, the former West Cap property, General Electric, and the Arizona Air National Guard. In this report, these smaller areas of contaminated groundwater have been collectively referred to as "Plume B." The Plume B area is the subject of a separate Public Health Assessment (ATSDR, 2000c).

Other Areas

In addition to the areas of groundwater contamination, areas of soil and sediment contamination related to surface water runoff from the site were also identified during site investigations. A primary area was associated with the "Three Hangars" area of the airport. The Three Hangars area has been used for aircraft modification operations, general aircraft and vehicle maintenance, synthetic rubber and plastics manufacturing, charter services, and other industrial activities. Soil contaminated by runoff from this area has been discussed in a recent Public Health Assessment subtitled "El Vado Residential Properties" (ATSDR, 2000a).

1.4 Site Visits

In addition to numerous site visits, ADHS also obtained information about the area from the ATSDR, the Pima County Department of Environmental Quality (PCDEQ), Arizona Department of Environmental Quality (ADEQ), USEPA, and from residents who attended numerous community meetings over the last several years.

Additional groundwater data were obtained from the TCE library located at the El Pueblo Community Center in south Tucson. The TCE library collects data and information that are provided by various governmental and community sources relating to the TIAA Superfund Site. This information is available to the public at the TCE Library located at 101 W. Irvington, Tucson, Arizona.

1.5 Demographics, Land Use, Natural Resources

Demographics and Land Use

The area around the TIAA site is an area of mixed commercial and residential usage. Areas closest to the airport tend to be more commercial than areas slightly further from the airport. The greatest [concentrations](#) of residences are west and north of the airport. Approximately 55,000 people live within one mile of the site (1990 census).

Natural Resources

Climate

The climate of Tucson, Arizona is semi-arid with an average of between 10 and 11 inches of rainfall annually. Annual evaporation is about four times greater than the average annual precipitation. Summertime high temperatures average about 100 degrees Fahrenheit. Winter high temperatures average in the upper 60s.

Water Resources

Most of the residential community obtains their water supply from the Tucson municipal water system. However, there are some residences in the area which still use private wells for drinking or irrigation purposes. Surface water is not a significant source of water supply in the Tucson area.

Natural surface waters in the site area are intermittent and occur primarily as runoff from storm events. The Airport Wash is the dominant surface water feature at the Tucson Airport, and is located in the northeastern part of the airport. The other major surface water feature consists of the Diversion Channel, which flows from Aero Park Road to the Hughes Access Road on the western side of the main runway. Under current land use conditions, artificial surface coverings including pavement and tarmacs essentially prevent soil or groundwater contaminants from coming into contact with surface water. These coverings do allow the potential for surface water runoff to contaminate soils in areas where surface waters pond during storm events.

Geology

The upper 200 feet of sedimentary materials within the area show a general coarsening trend from east to west. Predominately fine-grained material is interbedded with layers and lenses of sand and gravel in a complex manner exist east of the Nogales Highway (PCDEQ, 1998).

General Hydrogeology

The regional aquifer system at the TIAA site is hydrogeologically complex due to lateral and vertical lithologic changes. Three units of the regional aquifer system (the upper zone, lower zone, and undivided regional aquifer) are present within the boundaries of the TIAA Site. The middle aquitard divides the regional aquifer into upper and lower zones under most of the TIAA site.

Transport and fate of groundwater contamination has been associated mainly with the upper zone regional aquifer. The vertical extent of contamination has been limited by the presence of the middle aquitard. In this area, the upper zone regional aquifer is about 70 - 100 feet thick, extending from the water table, which occurs at depths of about 85 - 100 feet below the ground surface (bgs), to the top of the middle aquitard at a depth of about 175 feet bgs. As a consequence of the heterogeneous geology and groundwater pumpage, the depth to groundwater, nature of the aquifer system (unconfined versus confined), and direction of groundwater flow vary within the area depending on location and depth (ADEQ, 1998).

1.6 Health Outcome Data

Several health studies have been conducted over the past 15 years to determine the health effects to residents in the TIAA area from exposures to trichloroethylene (TCE) in drinking water. Although these studies focus on exposures to TCE in drinking water primarily from the larger Main Plume, they are also applicable to the Plume B area since it also is contaminated with TCE and chromium similar to the Main Plume (ADHS, 1996; ATSDR, 1994). In many cases, the studies included participants or databases which covered both areas. These studies are as follows:

- ***Mortality Rates on Tucson's Southside. Caldwell G. ADHS. 1986.***
- ***An Association of Human Congenital Cardiac Malformations and Drinking Water Contamination. Goldberg SJ, Lebowitz MD, Graver EJ, Hicks S. Journal of the American College of Cardiology. 1990; 16;1:155-164.***
- ***Maricopa and Pima County Birth Defects Study. ADHS. 1987.***
- ***A Comparison of Homebound Program Admission Rates in the Tucson Unified and Sunnyside School Districts. K. Komatsu, ADHS. 1986.***
- ***Historical Prospective Mortality Study of Hughes Aircraft Employees at Air Force Plant #44. ENSR. 1990.***
- ***The Incidence of Childhood Leukemia and Testicular Cancer in Pima County, 1970-1986. ADHS. 1990.***
- ***Effects on Neurobehavioral Performance of Chronic Exposure to Chemically Contaminated Well Water. Kilburn KH, Warshaw RH, University of Southern California, Los Angeles, CA. 1994.***
- ***Prevalence of Symptoms of Systemic Lupus Erythematosus (SLE) and of Fluorescent Antinuclear Antibodies Associated with Chronic Exposure to Trichloroethylene and other Chemicals in Well Water: Kilburn KH, Warshaw RH. Environmental Research. 1992; 57:1-9.***

These studies have been summarized and discussed in previous documents (ATSDR, 1996a; ATSDR, 2000c) and the reader is referred to those documents for further interest. A brief summary of the findings from these is found in [Section 4.3, "Health Outcome Data Evaluation."](#)

Other available [Health Outcome Data](#) include a Disease and Symptom Prevalence Survey for part of the TIAA site area conducted by ATSDR (ATSDR, 1996b), and information emerging from the ongoing National Exposure Registry - Trichloroethylene (TCE) Subregistry developed by ATSDR (see ATSDR, 1999 for a recent summary report of the [Registry](#) program). Information from these projects is discussed in [Section 4.3, "Health Outcome Data Evaluation."](#)

2.0 COMMUNITY HEALTH CONCERNS

This section describes general concerns voiced by community residents who live near the TIAA site. Detailed descriptions of these concerns have been documented in previous reports (ATSDR, 1988; ATSDR, 1996a; ATSDR, 2000c). These concerns have already been discussed in detail in the 1996 PHA Addendum (ATSDR, 1996a).

Groundwater contamination in southwest Tucson has been a concern of residents living near the TIAA site for many years. The community includes many residents who understand the history of the site, the exposure scenarios, and what is happening with the remediation activities. Some believe that public drinking water is still contaminated. While many residents have switched over to City water, a few believe that drinking water out of

a contaminated private well is safer than drinking the "contaminated Tucson Water" and have chosen not to hook up to city water (ATSDR, 2000c; PCDEQ, 1998). ADHS has made recommendations in previous documents (ATSDR, 2000c) to address potential exposure due to use of private wells.

In the past, residents in southwest Tucson have expressed concerns about the prevalence of congenital heart disease, lupus, and, cancer in their community that they associate with exposure to the contaminated groundwater (ATSDR, 1988, 1996a). Several studies have been conducted to address these concerns, as described in [Section 1.5, "Health Outcome Data,"](#) and [Section 4.3, "Discussion: Health Outcome Data Evaluation."](#)

In addition, former workers from the AFP44 facility have expressed concerns about potential workplace exposures. ADHS was unable to locate environmental data to evaluate past conditions inside the facility. Investigations of workplace health concerns are the authority of the Occupational Safety and Health Administration (OSHA) and the Occupational Safety and Health Division of the Arizona Industrial Commission, and are beyond the scope of this report.

3.0 ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

In this section, contamination in the site area will be discussed based on the medium (air, soil, water) and where the chemicals are, or have been, found. For issues which have been addressed by previous documents, the reader will be referred to those documents for detailed discussion.

3.1 Data

Air

No air sampling data were located for public exposures in the site area. No significant air exposure pathway appears likely based on site contaminants and conditions and past public health evaluations did not find a need for any air sampling (ATSDR, 1988, 1996a). On-site soil gas samples have been collected and evaluated for part of the site (ATSDR, 2000b). The available data are discussed in [section 4.1 "Environmental Data Evaluation."](#)

Soil

Evidence of past off-site soil contamination related to drainage system runoff from the TIAA site has been detected. This contamination was evaluated in the PHA document subtitled "El Vado Residential Properties" (ATSDR, 2000a). Other areas of contaminated soil were found on-site and are discussed in [section 4.1, "Environmental Data Evaluation."](#)

Water

As noted previously, no significant perennial surface waterways exist in the TIAA site area, and surface water is not considered to be a pathway of public health significance. However, the site has multiple areas of significant groundwater contamination associated with it, and groundwater is the main source of drinking water supply for the TIAA site area. For ease of discussion, groundwater contamination will be discussed in separate detail for the past and present timeframes.

Past Groundwater Data

Past groundwater conditions have been evaluated for the time period 1981 to 1999 in previous documents (ATSDR, 1988, 1996a, 2000c). No sampling data were located which indicate groundwater chemical conditions prior to 1981. ATSDR (1996a) did evaluate scenarios to estimate potential levels of groundwater contaminants prior to 1981 in the draft PHA. However, comments on that draft text indicated that the model oversimplified the complex hydrogeology of the site. ATSDR's text accompanying the modeling effort also indicated that the estimates were only for purposes of estimating approximate dates of contamination in wells and that the numbers should not be used to evaluate public health exposures. In addition, ADHS notes that the definition of multiple distinct areas of contamination (e.g., Main Plume and Plume B) is more complex than the model effort incorporated. Based on these comments, ADHS finds the existing database inadequate to evaluate groundwater exposures prior to 1981. The ADHS could not locate any actual data or detailed estimates suitable for use in public health evaluation of groundwater contaminant concentrations prior to 1981.

Present Groundwater Data

Groundwater sampling of the two plumes associated with the site continues at present. ADHS's most recent evaluation of this data was published in 2000 (ATSDR, 2000c). Additional data on groundwater conditions are routinely reported by USEPA and AFP44. These data are publicly available from USEPA or at the TCE Library at 101 W. Irvington, Tucson. USEPA drinking water regulations also require the Tucson Municipal Water authority to notify customers if any of the municipal drinking water is not meeting EPA standards for maximum contaminant levels. Current data indicate local drinking water contains less than 5 micrograms per liter ($\mu\text{g/L}$) of TCE.

4.0 DISCUSSION

ADHS evaluates a site by considering the level of exposure in potential or completed exposure pathways. An exposure pathway is the way chemicals may travel through the environment and enter a person's body to cause a health effect. It includes all of the steps between the release of the chemical and the population exposed: (1) a chemical release source, (2) chemical movement, (3) a place where people can come into contact with the chemical, (4) a route of human exposure, such as inhalation or ingestion, and (5) a population that is exposed. ADHS considers which chemicals, if any, from a site are present at levels of public health concern (i.e., above an appropriate comparison value) through all five elements of a completed pathway when determining the public health implications of a site.

4.1 Environmental Data Evaluation

This section presents ADHS's evaluation of the available data based either on data listed in the section titled "[Environmental Contamination](#)" or on previously published reports as identified in the text.

Quality Assurance and Quality Control

Procedures for sampling, analysis, and data reporting were evaluated in the previous investigations that are summarized in this document. Quality assurance and quality control measures were determined to be adequate and no major problems with field or laboratory procedures were reported.

Air

No data were found indicating large-scale chemical releases to the air which would affect the ambient air around the TIAA site. Limited data from a portion of the site were evaluated (ATSDR, 2000b) and are summarized in Table 1. Estimated indoor air concentrations of contaminants were determined by applying the [Jury Model \(Appendix\)](#) to the highest measured levels of contaminants in soil vapor. Modeled concentrations were then compared to ATSDR Environmental Media Evaluation Guide (EMEG) comparison values to determine potential for health risk. The EMEGs are media-specific chemical levels that do not represent a health concern. The modeled concentrations were well below the corresponding EMEG values, as shown in Table 1. Based on this limited available data, activities conducted at the TIAA site, and the nature of the soil and groundwater contamination, ADHS does not find any public health issues from ambient air exposures to site-related chemicals for either the past, present, or future timeframes.

Table 1: Maximum Contaminant Concentrations of On-Site Soil Gas Samples, Modeled Indoor Air Concentrations and ATSDR's Air Comparison Values.

Contaminant	Concentration Range in Soil Vapor (µg/L) [†]	Maximum Concentration in Samples (µg/L)	Modeled Air Concentration* (µg/L)	ATSDR Air CV [‡] (µg/L)	Exceed ATSDR CV?
TCE §	ND [¶] - 387	387 ^b	2.3E-05	5.4E-01 ²	NO
PCE**	ND - 121	121 ^b	8.6E-06	2.7E-01 ¹	NO
1,1-DCE ^{††}	ND - 140	140 ^c	7.5E-07	8.0E-02 ²	NO
1,1,1-TCA ^{‡‡}	ND - 4.3	4.3 ^a	2.5E-07	3.8 ²	NO

[†] µg/L = micrograms per liter; * Jury Model used to estimate indoor air concentration;

[‡] CV = Comparison Values; [¶] ND = non-detect;

§ TCE = trichloroethylene; ** PCE = tetrachloroethene; ^{††} 1,1-DCE = 1,1-dichloroethylene; ^{‡‡} 1,1,1-TCA = 1,1,1 trichloroethane.

a= 1996 sampling data; b= from sample WC-1, 2000 data; c= from sample WC-2, 1997 data.

1= ATSDR chronic Environmental Media Evaluation Guide (EMEG); 2= ATSDR intermediate EMEG

Soil

Previous investigations found that elevated levels of polychlorinated biphenyls (PCBs) in the drainage areas at the TIAA site had migrated off-site into residential areas. This contamination was evaluated in previous public health assessments (ATSDR, 1988, 1996a, 2000a). As presented in the document subtitled "El Vado Residential Properties," (ATSDR, 2000a), remediation of these areas has occurred to below Residential Arizona Soil Remediation Levels (SRLs). SRLs are levels of contaminants in soils promulgated by administrative rule that do not represent a health risk. A summary table of representative soil data is presented as [Table 2](#).

Other areas of contaminated soil related to AFP44 and the airport itself have either been remediated or are being remediated as part of ongoing TIAA site work (EPA, 2000). The AFP44 and airport property soil sites are completely fenced to restrict site access and the fencing is routinely monitored. Based on this restriction of access, ADHS finds no public health concern from on-site soil contamination because there currently is no completed pathway of exposure. Worker exposures to on-site soil contamination were evaluated in a previous investigation (ADHS 1996). PCBs were detected above screening levels in some areas, but were not found to pose a health threat to on-site personnel.

Table 2: Soil Sample Results From Remediated Areas in El Vado Residential Area (1997).

Remediation Area	Number of Samples	Range of Polychlorinated Biphenyl (PCB) Concentrations in milligram per kilogram (mg/kg)	Mean (mg/kg)	Soil Remediation Levels (SRLs) for PCBs (mg/kg)	Above SRL
AREA A: Drainage Area	12	0.643 - <0.033	0.32	2.5	NO
AREA B: Vacant Lot	9	0.182 - <0.033	0.100	2.5	NO

AREA C: Backyards of Residences	5	0.122 - <0.033	0.076	2.5	NO
AREA D1: Vacant Area North of the Church	3	0.120 - 0.045	0.07	2.5	NO
AREA D2: Vacant Area West of the Church	2	0.039 - 0.035	0.037	2.5	NO

Results from Conestoga (1997) as reported in ATSDR (2000a).

Water

Past Groundwater Conditions

As noted previously, insufficient data exist to evaluate groundwater contamination prior to 1981. Therefore, ADHS finds that pre-1981 groundwater exposure is an indeterminate public health concern.

Groundwater conditions since 1981 have been evaluated in previous public health reports (ATSDR, 1988, 1996a, 2000c). Summarizing these documents, ADHS finds that groundwater offsite was contaminated with trichloroethylene (TCE) at levels above public health guidelines prior to 1981. However, there have been no significant exposures since site monitoring and remedial activities began in 1981. A summary of past municipal well monitoring data is presented in Table 3. Municipal supply well locations are depicted in [Figure 2 in the Appendix](#).

Table 3. Maximum Contaminant Concentrations, Tucson Municipal Supply Wells Removed from Service.

Well	Month/Year Removed from Use	trichloroethylene (TCE) parts per billion	Sample Date (month/year)
SC-007A	5/81	122	11/81
C-062B	6/81	126	5/82
C-064B	10/81	10	9/81
C-066A	8/83	9	8/83
C-072A	?/70	22	3/82
B-087A	11/81	43	5/82
B-101A	8/81	112	5/82
B-102A	10/78	239	5/82
MCL		5	

data source: ATSDR, 1996

MCL = current EPA drinking water standard (Maximum Contaminant Level)

Present Groundwater Conditions

Contaminated groundwater is currently being extracted, treated to remove pollutants, and placed into the Tucson municipal drinking water distribution system at the Tucson Aquifer Remediation Project Plant. No current private drinking water wells contain TCE at levels of health concern. A number of private irrigation wells and some private drinking water wells that are not in-use are contaminated with TCE. Potential exposures to contaminated irrigation well groundwater during both residential and occupational irrigation purposes were evaluated and found to pose no public health threat (ATSDR, 2000c). A summary of recent private drinking water well data is provided in Table 4. [Figure 3 in the Appendix](#) shows the location of the private wells that were sampled. The site currently poses no apparent public health concern from exposure to groundwater.

Table 4: Maximum Contaminant Concentrations in 12 Private Drinking Wells and Comparison to Corresponding MCLs*, Tucson International Airport Area (TIAA) Site.

Well ID #	Present Status	TCE† MCL=5 µg/L‡	Chromium MCL=100 µg/L	Above MCL?
25	Cemetery	N.D.§	N.D.	NO

28	Private residence	N.D.	N.D.	NO
29	Private residence	N.D.	N.D.	NO
3	Private residence	N.D.	2.2	NO
12	Mobile Home Park	0.8	6.3 **	NO
9	Private residence	N.D.	3.0 **	NO
18	Private residence	N.D.	5.6 **	NO
21	Private residence	N.D.	5.8 **	NO
17	Private residence	N.D.	1.2 **	NO
7	Private residence	4 **	N.D.	NO
13	Mobile Home Park	3.6	7	NO
15	Private residence	3 **	6.3 **	NO

* MCLs = maximum contaminant levels; † TCE = trichloroethylene; ‡ µg/L = micrograms per liter; § N.D. = non-detect;

** Indicates an increase in contaminant level between sampling periods (1994 samples to 1998 samples, or 1998 to 2000 samples)

Table from: ATSDR, 2000c

Future Groundwater Conditions

Levels of TCE and chromium did increase in some wells between sampling events, as shown in Table 4. Due to potential fluctuations in contaminant levels, private drinking water wells should be monitored to ensure that contaminant levels remain below levels of health concern. The presence of private irrigation wells contaminated with TCE and the possibility that these wells could be converted for drinking water use presents a potential public health concern. ADHS has recommended that safeguards be enacted to preclude private use of any contaminated irrigation well for drinking water purposes until site remediation has been completed (ATSDR, 2000c). ADHS affirms that recommendation in this current document.

4.2 Previous Public Health Reports and Findings

As noted previously, a number of public health evaluations have been conducted over the last several years regarding the TIAA site. Some of the key reports are listed below along with a brief summary of their public health findings:

- o Public Health Assessment for Tucson International Airport Site (ATSDR, 1988) - This report evaluated the (limited) available data and concluded that public drinking water supplies posed *no public health concern*. The report also found a lack of adequate information on previous conditions which left past conditions as an *indeterminate public health concern*.
- o Baseline Human Health Risk Assessment (ADHS, 1996) - This document used formal risk assessment methods following EPA's "Risk Assessment Guidance for Superfund" and found that off-site soils posed a potential public health risk due to PCB contamination. These soils have since been remediated. No completed pathway of groundwater exposure was identified, and no health risk was found from groundwater.
- o Petitioned Public Health Assessment Addendum for Tucson International Airport Area (ATSDR, 1996a) - This document evaluated a large body of environmental data and found that groundwater and municipal drinking water posed *no apparent public health hazard*. Soils in wash areas were of *public health concern* based on the presence of polychlorinated biphenyls (PCBs). Note that the wash areas have since been remediated and were discussed in the document regarding the "El Vado Residential Properties" (ATSDR, 2000a).
- o Public Health Assessment for Tucson International Airport Area (a/k/a El Vado Residential Properties) (ATSDR, 2000a) - This public health assessment evaluated off-site soil contamination west of the Tucson Airport property. The contamination was apparently the result of surface water runoff from the western portion of the airport near the three hangars area. ATSDR found that soils had been remediated to an acceptable level and the site posed *no public health hazard*.
- o Public Health Consultation for Tucson International Airport (a/k/a West Cap Facility) (ATSDR, 2000b) - This consultation evaluated specific concerns regarding soil contamination and soil gas vapors inside buildings on the former West-Cap property. Indoor air concentrations modeled from soil gas data were found to present *no public health hazard*.
- o Public Health Assessment for Tucson International Airport Area (Plume B Area) (ATSDR, 2000c) - This PHA evaluated private wells in the Plume B area north of the airport. Twelve private drinking water wells were evaluated and were found to pose *no public health hazard*. In addition to private drinking water wells, a number of private wells used for irrigation purposes were also evaluated and three were found to contain TCE at levels above drinking water standards. Because it is possible to convert an existing irrigation well to a drinking water source or to install a new private well for drinking use in the area, this was considered to be a *potential public health concern for the future*. Actions to prevent any exposures of public health concern were recommended.

4.3 Health Outcome Data Evaluation

ATSDR and ADHS have reviewed the eight studies listed in [Section 1.4](#). A brief summary of the findings of these studies is presented here. Readers are referred to the PHA - "Plume B Area" (ATSDR, 2000c), the 1996 PHA Addendum (ATSDR, 1996a), or the specific study documents for more

details about the findings and limitations of each study.

No statistically significant results were found for the following outcomes studied: a) homebound program admission rates in the Tucson Unified and Sunnyside school districts, b) mortality rates of Hughes aircraft employees, and, c) childhood leukemia and testicular cancer incidence in Pima County.

In the reviewed studies, the reported results were suggestive, but not conclusive, for the following outcomes: a) congenital heart disease, b) musculoskeletal birth defects (county-year interactions), c) mortality due to asthma, d) neurobehavioral performance, and, e) prevalence of systemic lupus erythematosus.

Numerous and significant limitations exist in the eight studies. These limitations prevent definitive conclusions on the causal relationship between exposure and health outcomes. Almost no exposure information is available besides that of residence in the contaminated census tract or work. This is a poor surrogate for exposure, since the contamination plume does not occupy the whole census tract. Using the tract level for analysis rather than block level is likely to lead to exposure misclassification resulting in an underestimation of the outcome effect. It is recommended that any further studies use block level analysis of morbidity and mortality data.

Although a number of serious limitations exist in the above studies, it is recommended that the outcomes for which results were suggestive be included in any future studies of the Tucson TCE contamination problem when possible. It is also recommended that a trend analysis be done to determine if the elevations in specific birth defects or other outcomes were persistent after public water supply sources were used.

In addition to these studies, ATSDR has conducted two additional activities pertinent to the trichloroethylene (TCE) in groundwater at the TIAA site. First, ATSDR conducted a "Disease and Symptom Prevalence Survey" (ATSDR, 1996b) in an area around the site. In addition to the survey, ATSDR has developed a National Exposure Subregistry of persons significantly exposed to TCE at various locations in the US. The TCE Subregistry began in 1989 and is ongoing. The most recent report (ATSDR, 1999) covers data collected through 1997 and incorporates information collected from nearly 5,000 persons.

The Disease and Symptom Prevalence Survey (ATSDR, 1996a) found "a statistically significantly greater proportion of residents from the target area than the comparison area reported having had most of the general and neurological-specific disease and symptoms with onset since moving into the home occupied at the time of the survey." The conclusions then note that "the association between the reported health outcomes and TCE exposure could not be determined without.....more detailed exposure information."

ATSDR compares data from the TCE Subregistry to the National Health Interview Survey conducted throughout the US (ATSDR, 1999). In the information reported to date, TCE registrants reported some conditions at a higher rate than the general population. The health conditions reported in excess at one or more interview time periods were: anemia, diabetes, hearing impairment, hypertension, kidney disease, liver problems, skin rashes, speech impairment, stroke, and urinary tract disorders (ATSDR, 1999). ATSDR notes that these results do not identify a causal relationship between TCE exposure and adverse health effect because the excess reporting of some health conditions might be explained by methodological differences in data collection. ATSDR states it intends to continue the registry and follow-up evaluation (ATSDR, 1999).

4.4 Child Health Initiative

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to hazardous substances emitted from waste sites and emergency events. They are more likely to be exposed because they play outdoors, they often bring food into contaminated areas, and the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. ADHS has considered the special needs of children in the evaluation of the TIAA site.

5.0 CONCLUSIONS

Based upon the available data and previously published reports, ADHS has reached the following conclusions regarding the potential public health hazards posed by the Tucson International Airport Area (TIAA) site.

Past Conditions

Since no groundwater sampling data exist for site-related contaminants prior to 1981, the TIAA site posed an **indeterminate public health hazard** prior to 1981. Groundwater represented **no apparent public health hazard** after the contaminated municipal wells were closed.

Soils in wash areas were a potential public health concern due to the presence of polychlorinated biphenyls (PCBs) prior to the soil remediation activities conducted in 1996. However, after the clean up effort, the soils represented **no apparent public health hazard**.

Current Conditions

ADHS finds no current completed exposure pathways at levels of public health concern. The TIAA site currently poses **no apparent public health hazard**.

Future Conditions

ADHS notes that ongoing remedial activities (descriptions of activities presented in the Background Section of this PHA), should improve local environmental conditions. The potential currently exists for people to install private drinking water wells in currently contaminated groundwater. Because of this potential pathway, ADHS finds the TIAA site may pose an **indeterminate public health hazard** unless further actions are taken. ADHS will share these findings with EPA site managers and parties responsible for the ongoing remedial activities in an effort to prevent any future public health hazard from occurring.

6.0 RECOMMENDATION

ADHS recommends the following for the TIAA site:

- o ongoing remedial efforts should continue at the TIAA site to reduce on-site contaminant levels;
- o actions should be taken to prevent potential future use of contaminated groundwater by private well users;
- o TCE and chromium levels should continue to be monitored in contaminated private drinking water wells to ensure that contaminants remain below levels of health concern; and
- o health outcomes for which results were suggestive be included in any future studies of the Tucson TCE contamination problem when possible. It is also recommended that a trend analysis be done to determine if the elevations in specific birth defects or other outcomes were persistent after public water supply sources were used.

In the event additional data become available regarding the TIAA site, ADHS will consider modifying, or issuing an addendum to, this Public Health Assessment as appropriate.

7.0 PUBLIC HEALTH ACTION PLAN

ADHS has actively participated in regular site-related meetings with the local community (Unified Community Advisory Board - UCAB), regulatory agencies (USEPA and ADEQ), and parties responsible for site remediation activities (AFP44, Tucson Airport Authority, contractors) to provide public health evaluations throughout the site investigation and remediation process. ADHS will continue to participate as needed in site-related remedial activities to address public health concerns related to the TIAA site.

ADHS will also work to educate the local community about the use of private wells and health concerns that may be related to that use.

ATSDR will continue the TCE Subregistry and follow-up evaluation.

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PUBLIC HEALTH ASSESSMENT

TUCSON INTERNATIONAL AIRPORT AREA TUCSON, PIMA COUNTY, ARIZONA

APPENDIX



Figure 1. March 1999 Plume Outlines and Tucson International Airport Area (TIAA) Site. Map from: [Arizona Department of Environmental Quality, Southern Region Office.](#)



Figure 2. Contaminated Municipal Wells, Tucson, Arizona

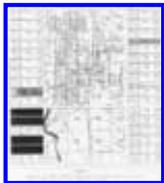


Figure 3. Results of 1994 & 1998 Private Well Studies Conducted by [Pima County Department of Environmental Quality](#)

Indoor Air Concentrations: Jury Model

Soil gas exposures were evaluated using the Juror Indoor Air Model to estimate indoor air exposure concentrations. The model assumes that gas entering a structure is instantaneously mixed within the entire volume. VOC concentrations within a building are a function of the flux from the soil, the area and volume of the building, and the rate of air exchange for the structure. This is a common assumption for assessments of this type and is intended as an upper bound estimate. It should be recognized that anytime a model is used the uncertainty of the estimated quantities is greater than if an accurate measurement were taken. These estimates assume that each VOC detected in soil gas is uniformly present beneath each building at the maximum concentration detected during the investigation. Therefore, this screening level analysis very likely overestimates concentrations of soil gas contaminants in indoor air.

Data used for the soil gas exposure assessment included all results previously presented in this health assessment. Indoor air concentrations were estimated using the following model:

Jury Model

Jury et al. have developed an equation for estimating the flux of a contaminant from a finite source of contaminated soil (Jury et al. 1990). The model is applicable when contamination extends from the surface for a known fixed thickness in the soil column. The model is applicable when there is no clean soil layer above the contamination. The following assumptions were used to derive this simplified equation:

- Uniform soil properties (homogeneity)
- Instantaneous linear equilibrium adsorption
- Linear equilibrium liquid-vapor partitioning
- Uniform initial contaminant concentration
- Contaminants present at less than saturation
- No clean soil layer
- No water evaporation or leaching
- No biological or chemical degradation

$$J_s = C_o \left(\frac{D_A}{\pi \tau} \right)^{1/2} \left[1 - \exp \left(- \frac{d_s^2}{4D_A \tau} \right) \right]$$

Equation - E where:

- J_s = contaminant flux at ground surface ($\text{g}/\text{cm}^2\text{-s}$)
 C_o = uniform contaminant concentration at $\tau = 0$ (g/cm^3)
 D_A = apparent diffusivity (cm^2/s)
 π = 3.14
 τ = time(s)
 d_s = depth from the soil surface to the bottom of contamination at $\tau=0$ (cm),
 and where:

Equation - F

where:

- Θ_a = air-filled soil porosity ($L_{\text{air}}/L_{\text{soil}} = n - \Theta_w$)
 n = total soil porosity ($L_{\text{pore}}/L_{\text{soil}} = 1 - (\rho_b/\rho_s)$)
 Θ_w = water-filled soil porosity ($L_{\text{water}}/L_{\text{soil}} = w \rho_b/\rho_w$)
 ρ_b = soil dry bulk density (g/cm^3)
 ρ_s = soil particle density (g/cm^3)
 w = average soil moisture content (g/g)
 ρ_w = water density (g/cm^3)
 D_i = diffusivity in air (cm^2/s)
 H = dimensionless Henry's law constant = $41 \times H$
 H = Henry's law constant ($\text{atm}\cdot\text{m}^3/\text{mol}$)
 D_w = diffusivity in water (cm^2/s)
 K_d = soil-water partition coefficient (cm^3/g) = $K_{oc} f_{oc}$
 K_{oc} = soil organic carbon partition coefficient (cm^3/g)
 f_{oc} = organic carbon content of soil (g/g)

To estimate the average contaminant flux over 30 years, the time-dependent contaminant flux must be solved for various times and the results averaged. A simple computer program or spreadsheet can be used to calculate the instantaneous flux of contaminants at set intervals and numerically integrate the results to estimate the average contaminant flux. The time-step interval must be small enough (e.g., 1-day intervals) to ensure that the cumulative loss through volatilization is less than the total initial mass. Inadequate time steps can lead to mass-balance violations (USEPA 1996a).

Alternatively, the EMSOFT computer program developed by the USEPA Office of Research and Development National Center for

Environmental Assessment (NCEA) may be used to estimate average flux. The computer program provides an average emission flux over time by using an analytical solution to the integral, thereby eliminating the problem of establishing adequate time steps for numerical integration. EMSOFT is available through the NCEA in Washington, D.C.

Public Comments and Responses

ADHS and ATSDR provided an opportunity for public comments in the final draft stage of this document from November 7, 2000 to April 5, 2000. Comments were provided by The U.S. Air Force, the Air National Guard, Sustainable Borderlands Planning, the USEPA, and Pima County Department of Environmental Quality (PCDEQ). These comments and ADHS responses are summarized below.

Comment A:

The PCDEQ wrote several comments on the public health assessment as follows:

Comment A-1a:

The executive summary does not make it clear that the report is only summarizing and commenting on current and future exposures. It would be helpful to clarify this, as was done in the November 13, 2000 report.

Response A-1a:

While we do not attempt to quantify exposures prior to 1981, we do comment on past conditions, and conclude that due to lack of data, past groundwater conditions were an indeterminate public health hazard.

Comment A-1b:

In the summary only trichlorethylene (TCE) is identified as a pollutant. It should also be mentioned that additional pollutants of concern were found, including chromium.

Response A-1b:

We intentionally focused only on TCE as the primary pollutant in order to simplify the summary as much as possible.

Comment A-1c:

The summary makes the comment "There is currently no exposure of public health concern." Although this is technically true since no one is currently drinking water contaminated above an MCL, I recommend further clarification that an aquifer is a dynamic system and that pollution levels can and do vary over time. Indications from private well sampling study show TCE and chromium levels rising over time in some areas.

Response A-1c:

See revised text in the final document.

Comment A-2

ADEQ should be referenced as the source of information for the "General Hydrogeology" section rather than PCDEQ.

Response A-2

See revised text in the final document.

Comment A-3

Under the heading of "Water" on page 10 of the report this statement is made: "However, there have been no significant exposures since site monitoring and remedial activities began in 1981." This may be true for regulated public water systems, however, EPA Region 9 and PDEQ identified a private well in 1994, within the TIAASS, that was being used for drinking purposes. This well had TCE and Chromium contamination levels significantly above the respective MCL's.

A similar comment is made under "Past Conditions" on page 15 of the report, "Groundwater represented no apparent public health hazard after the contaminated municipal wells were closed." Again, a clarification should be made that this may only apply to water from a public water system and not water from private wells.

Response A-3

The "South side TCE Private Well Investigation, Tucson International Airport Area Superfund Site (PDEQ, 1994) page 5-3, contains the statement, "None of the fourteen wells used for drinking water exceeded the EPA's designated safe levels, which are known as Maximum Contaminant Levels (MCL)... For the wells that exceeded an MCL, none are being used for drinking or other household purposes."

Comment B:

Environmental Resources Management (ERM) wrote with several comments on behalf of the Air National Guard (ANG) as follows:

Comment B-1:

The General Electric facility was not named as a potential source of contamination in the Plume B Area in this report, while the facility was named as a potential source for this plume in the public health assessment report for the Plume B.

Response B-1:

See revised text in final document.

Comment B-2:

A supporting figure would be useful to display the locations of municipal supply and private drinking water wells listed in Tables 3 and 4 in addition to the private irrigation wells sampled by the PDEQ.

Response B-2:

Please see [Figures 2](#) and [3](#) in the Appendix of the final document.

Comment B-3:

Chromium: It is recommended that additional information be included regarding the presence of chromium. Specifically, the Assessment should include discussion of background levels of chromium in regional soil and groundwater... should clarify whether the concentrations of chromium reported in groundwater were associated with filtered or unfiltered samples....should describe the results of any hexavalent chromium analyses that have been performed.

Response B-3:

Detected levels of Chromium were not above MCL's, so chromium was screened out as a chemical of concern, and additional information regarding chromium was not considered necessary. Chromium levels in private drinking wells are listed in [Table 4](#).

Comment B-4:

Data quality: It is recommended that additional information should be provided regarding sample collection and sample quality assurance/ quality control procedures. From this information, the document should briefly evaluate usability of the analytical data for the purposes of this Assessment.

Response B-4:

Please see revised text in the final document.

Comment B-5:

Detection limits should be provided for all analytical data reported in the document.

Response B-5:

Although detection limits are not listed in the document, verification of appropriate detection limits was included in data review.

Comment B-6:

Soil gas: It is agreed that the reported concentrations of constituents in soil gas are unlikely to pose an unacceptable risk. However, additional information should be provided regarding the calculation of modeled air concentrations and the comparison values (CVs) used to screen the modeled concentrations. The term EMEG should be defined, and a source provided for the EMEG values. Cited CVs seem quite high, and it is recommended that the units of the CVs be verified.

Response B-6:

Thank you for notifying us of our mistake in conversion of the ATSDR air comparison values and our omission of supporting information. See revised text and [Table 1](#) in the final document.

Comment B-7:

Soil: The Assessment includes soil data for poly-chlorinated biphenyls (PCB's). The primary focus of the health assessment is TCE-contaminated groundwater. PCB's are not identified as contaminants of concern. Text should be revised to explain the inclusion of this data. Additional soil data should also be presented to allow a more detailed evaluation of current soil conditions.

Response B-7:

As noted in the document, soil contamination was evaluated in greater detail in the previous environmental health investigations referenced in the text. Readers are referred to the former investigations for more detailed evaluation of soil contamination. PCB contamination of soils is not emphasized further in this summary document, since no current or potential future exposures to levels of public health concern were identified.

Comment B-8:

Soil: It is recognized that access to the site is restricted. However, even under such conditions, certain populations may still have the opportunity to be exposed to site soil (e.g., workers). It is recommended that the potential for exposure to soil be more fully discussed.

Response B-8:

Please see revised text in the final document.

Comment B-9:

Groundwater: The assessment states that contaminated groundwater is not being used for potable supply. However, the text does not discuss other possible uses of groundwater (industrial supply, fire suppression, etc.). It is recommended that the Assessment include discussion of this issue before concluding that site groundwater poses "no apparent public health concern."

Response B-9:

We contacted the South Tucson fire department and verified the use of Tucson Water municipal supplies for fire suppression. For discussion of other uses of groundwater, please see revised text in the final document.

Comment B-10

Health studies: Section 4.3 states that several of the studies were suggestive for various outcomes. Extreme caution must be used when interpreting the results of these studies, since ecological studies ...may lead to either an underestimation or an overestimation of outcome effect. The principal utility of such studies lies not in suggesting a relationship between exposure and outcome, but in identifying avenues for further study. It is recommended that the text be revised to emphasize the uncertainties associated with the health studies cited.

Response B-10

See revised text in the final document.

Comment B-11

The recommendations from the health studies contained in the Appendix to the Public Health Assessment for Plume B should be included in the body of this Public Health Assessment.

Response B-11

See revised text in the final document.

Comment C

The U.S. Air Force provided several comments as follows:

Comment C-1

The Executive Summary reads, "There is currently no exposure of public health concern." Recommend this sentence be rewritten as, "Currently the levels of contamination in private drinking wells are not of public health concern." The concern....about people converting their irrigation wells should be expressed in this Executive Summary paragraph. Exposure to TCE in groundwater does exist via private wells, but at a level that is not of public health concern.

Response C-1

See revised text in final document.

Comment C-2

The site boundaries described in the Introduction do not match the boundaries shown in Figures 1 & 2. Figure 3 airport boundary does not match Figures 1 & 2. It is necessary to clarify what is meant by site boundary and ensure that the text description matches the boundaries shown in the figures.

Response C-2

See revised text in the final document.

Comment C-3

Why is Plume B referred to as West Plume B even though it is on the east side of the site?

Response C-3

Plume B is located on the east side of the site, but Plume B is composed of discrete areas of contamination, designated West Plume B, and East Plume B. West Plume B is located north of Valencia Road, extending westward toward the larger Plume A ([Figure 1](#)).

Comment C-4

Page 11, Section 4.1. *Present Groundwater Conditions*: The first sentence reads, "Current groundwater data indicate that contaminated groundwater from the site is not being used as a drinking water source (ATSDR 2000c)." This sentence should be revised since contaminated groundwater from the site is extracted, treated and placed into the Tucson drinking water distribution system at the Tucson Aquifer Remediation Project (TARP) plant.

Response C-4

See revised text in the final document.

Comment C-5

This document does not include the ATSDR future health study activities in the Public Health Action Plan (PHAP). It appears that any health study efforts by ATSDR are totally disconnected from the local efforts by the ADHS or Pima County and it is not clear that ADHS and Pima County are actively pursuing health study initiatives on their own. How are ATSDR studies being communicated to the public and does ADHS act as an advocate for these studies? Section 4.3 of the draft PHA discusses the TCE Subregistry to the National Health Interview Survey and ATSDR's intention to continue the registry and follow-up evaluation. This information should be included in the PHAP.

Response C-5

Please see revised text in the final document.

Comment D

The USEPA provided comments recommending inclusion of more recent data in the PHA as summarized below:

Comment D-1

Table 1: Additional soil gas samples have been collected at the former West Cap property since the 1997 data cited in this table. A summary of this recent data is attached (table 1). The recent data should be incorporated into the report since concentrations in some wells have increased since 1997.

Response D-1

See revisions to [Table 1](#) in the final document.

Comment D-2

Table 4: Additional private well sampling was performed by PDEQ in 2000. Please see the attached table 2 for a summary of the recent data. The recent data should be incorporated as appropriate.

Response D-2

See revisions to [Table 4](#) in the final document.

Comment E

Sustainable Borderlands Planning provided comments as summarized below:

Comment E-1

The literature reviewed appears to be a selection of articles that are unavailable to the general public, and the selection excludes many scientific articles which address the public health effects of contaminants being released from this facility. To our knowledge there has never been any serious epidemiological study of health effects directly related to this CERCLA site. The studies you cite pick very limited populations to examine. They do not reflect the population which live and have lived in the contamination area. For example, there are reports of a testicular cancer cluster among the faculty who taught college classes at the Three Hangars location of this site.

We ... urge the ATSDR to include information ...that documents adverse health effects rather than just publish information based on your small selection of studies that looks at only marginally related populations- and finds nothing to worry about.

Response E-1

All formal (health) studies conducted by county or state health department or university researchers in the contaminated area surrounding the Tucson International Airport were selected for review. The ADHS and a number of academic researchers familiar with the Tucson Airport problem were contacted to see if any additional studies had been conducted and were available for review. Only formal studies were selected in which either human subjects were studied or existing health data on morbidity/mortality was analyzed. Court affidavits, petitions, and opinions were not included in the review.

Limitations of these studies were cited in the draft PHA pg.17, including difficulties in accurately identifying exposed populations, due to use of the census tract level rather than the block level for analysis. Rather than "finding nothing to worry about," we concluded results of several of the studies were suggestive for several health outcomes, but limitations of the studies prevented establishing a relationship between exposure and effect. Recommendations were made for further study to investigate the suggestive outcomes.

Comment E-2

Your review begins assessment of data available since 1981. The statement "No sampling data were located which indicates groundwater chemical conditions prior to 1981," is grossly misleading. There is a wealth of information about this site going back to at least the 1950s, when several local lawsuits were filed regarding polluted private drinking wells.

Response E-2

As noted in the response to comment E-1, court affidavits, petitions, and opinions were not included as reference material in this Assessment.

Glossary

aquifer:

a permeable rock stratum below the earth's surface through which groundwater moves; generally capable of producing water for a well.

chemicals of concern:

chemicals whose concentrations are above the appropriate screening level.

clean:

this word is used to describe water quality. This indicates that the water quality in question is in compliance with federal water quality standards developed by the United States Environmental Protection Agency.

detection limit:

the minimum concentrations that must be accurately and precisely measured by the laboratory and/or specified in the quality assurance plan.

dose:

the amount of contamination absorbed or deposited in the body of an exposed organism for an increment of time. A total dose is the sum of doses received by a person from a contaminant in a given interval resulting from interaction with all environmental media that contain the contaminant. Units of dose and total dose are often converted to units of mass per volume of physiological fluid or mass of tissue.

exposure:

an event that occurs when there is contact at a boundary between a human being and the environment with a contaminant for a specific concentration for an interval of time: the units of exposure are concentration multiplied by time.

exposure pathway:

the process by which an individual is exposed to contaminants that originate from some source of contamination and are categorized as inhalation, dermal, and/or ingestion exposures.

gene mutation:

a persistent change in a single gene.

latency:

the period between stimulus application and response onset.

maximum contaminant levels:

enforceable drinking water standards that are protective of public health to the extent feasible with current technology.

minimal risk level:

an estimate of daily exposure of a human being to a chemical (in mg/kg/day) that is likely to be without an appreciable risk of adverse noncancerous effects over a specified duration of exposure.

particulate:

small, discrete, solid or liquid bodies, especially those suspended in a liquid or gaseous medium.

parts per million:

one part per million (ppm) equals 1 pound chemical per million pounds of water.

public health assessment:

an evaluation of relevant environmental data, health outcome data, and community concerns associated with a site where hazardous substances have been released.

quality assurance:

a planned system of activities whose purpose is to provide assurance of the reliability and defensibility of the data.

quality control:

a routine application of procedures for controlling the monitoring process. QC is the responsibility of all those performing hands-on operations in the field and in the laboratory.

route of exposure:

means by which the contaminant actually enters or contacts the body, such as ingestion, inhalation, dermal contact, and dermal absorption.

soil remediation levels (SRLs):

health-based soil screening levels. SRLs protect against toxic doses of systemic toxicants and limit excess lifetime cancer risk to one-in-one-million.

volatile compounds:

compounds amenable to analysis by the purge and trap techniques, also referred to as purgable compounds.

volatilization:

the conversion of a liquid or solid into vapors.

CERTIFICATION

This Tucson International Airport Public Health Assessment was prepared by the Arizona Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Tammie McRae, MS
Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.

Richard Gillig
Chief, State Program Section, DHAC, ATSDR

Figure 1. March 1999 Plume Outlines and Tucson International Airport Area (TIAA) Site. Map from: Arizona Department of Environmental Quality, Southern Region Office.

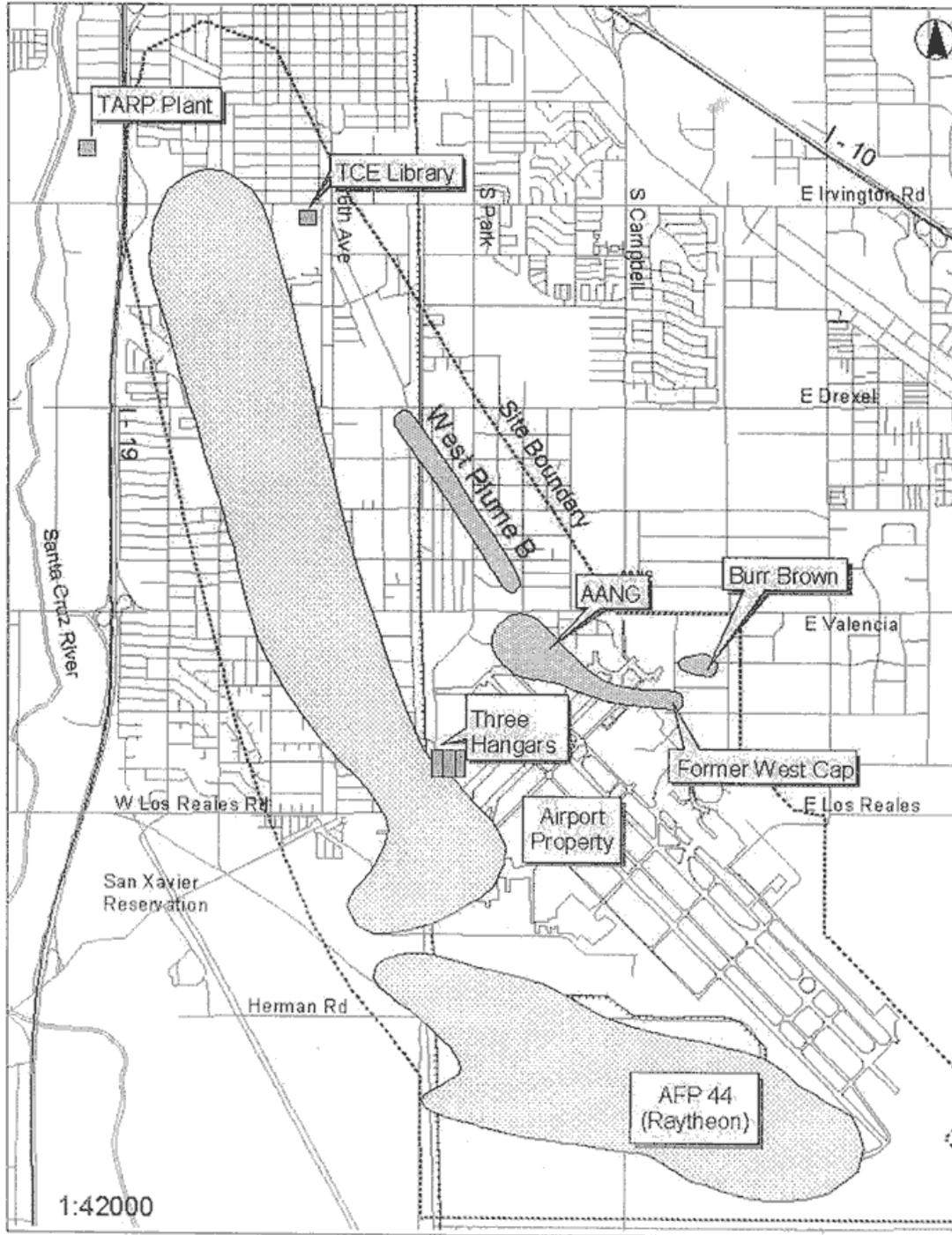
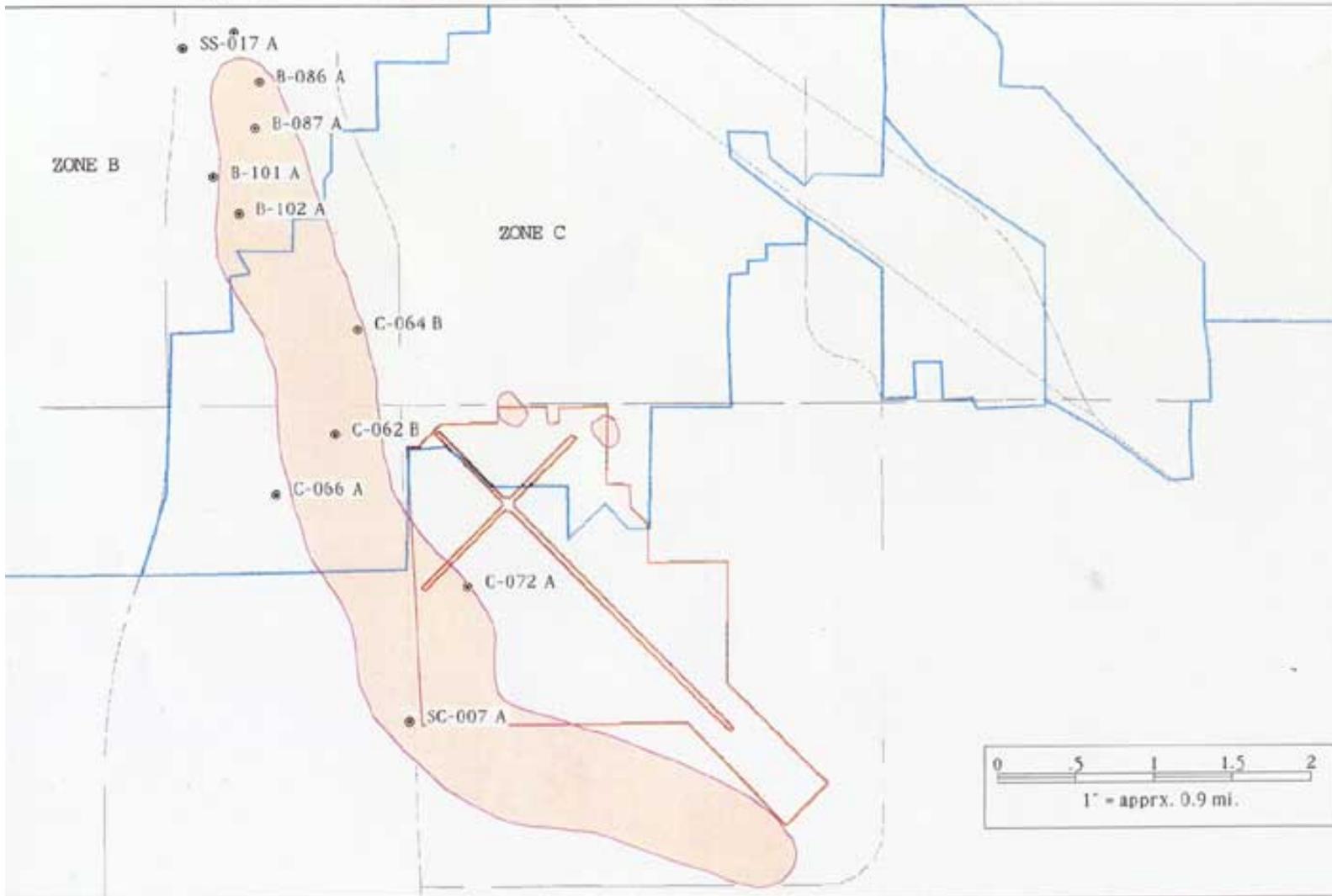


Figure 2 - Contaminated Municipal Wells, Tucson, Arizona



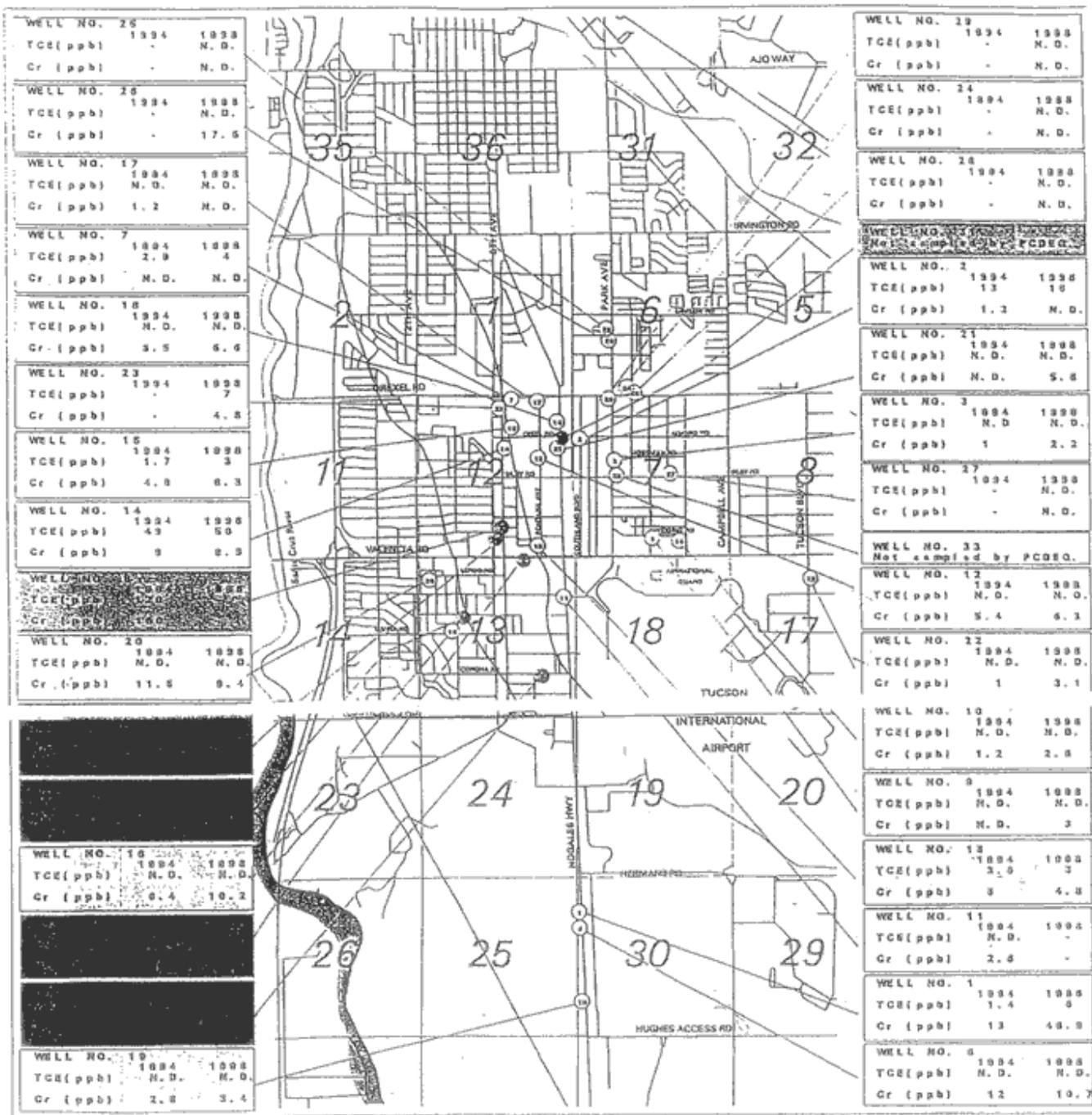


Figure 3

Results of 1994 & 1998 Private Well Studies Conducted by Pima County Department of Environmental Quality