EXECUTIVE SUMMARY

Background and Purpose

The Department of Defense (DOD) is conducting a nationwide environmental program to evaluate waste disposal practices on DOD property, to control the migration of hazardous contaminants, and to control hazards that may result from past or present waste disposal practices. The Installation Restoration Program (IRP) Phase II, is under the technical direction of the USAF Occupational and Environmental Health Laboratory (USAFOEHL), Brooks AFB, Texas. The program consists of four phases: Phase I, Initial Assessment/ Records Search; Phase II, Problem Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Remediation. The United States Air Force (USAF) has initiated an IRP investigation at Hill Air Force Base, Utah.

Phase I studies for the Hill AFB Installation Restoration Program were completed in January 1982. The purpose of the Phase I study was to conduct a records search for the identification of past waste disposal activities which may have caused groundwater contamination and the potential for migration of contaminants off base.

During the Phase I studies, thirteen sites at Hill AFB were identified as possibly containing hazardous waste. Of the thirteen sites identified, four were selected for Phase II (Stage 1) studies. During the Phase II (Stage 1) study two additional sites were added resulting in a total of six sites investigated. The objectives of the program were to determine whether hazardous materials were present in the surface and/or subsurface environments; to determine if hazardous materials were migrating or had the potential to migrate; to recommend actions necessary to evaluate the magnitude and extent of contamination; and to suggest an environmental monitoring program, as needed, to document current conditions and future discharges. The results of

the IRP Phase II (Stage 1) activities were documented in a report and subsequent Stage 2 activities were planned.

During an IRP Phase II (Stage 2) Presurvey meeting in March 1985, additional sites, including Building 220, were identified for inclusion in Stage 2 of the Phase II IRP investigation. The Building 220 underground tanks were added by Hill AFB personnel because of the State of Utah's concern for potential contamination in the subsurface from these tanks. The underground tanks were also added to the investigation as part of the environmental screening process during Base modernization planning. Building 220 has not undergone a Phase I or Phase II (Stage 1) study. Therefore, because little background information was available, this study was conducted as an expanded Stage 1 activity which included elements of Stage 2 efforts. Radian Corporation performed the Phase II (Stage 1) field evaluation at Building 220 under USAF Contract No. F33615-84-D-4402, Delivery Order 0014.

Radian Corporation was authorized to proceed on the Hill AFB Phase II (Stage 1) program on 13 September 1985. Field activities took place from 21 October 1985 to 26 November 1985, and again during 6 and 13 June 1987. The activities consisted of formation sampling, well completion and groundwater sampling of four test wells, as well as formation sampling and abandonment of four test holes. Additionally, direct groundwater flow measurements were taken in three of the groundwater test wells. The direct investigation of the underground tanks was not part of this study.

The initial findings of these IRP field activities were presented in a draft report (January 1986). The results indicated low levels of volatile organic compounds in groundwater and quality control samples collected. But, because of the large amounts of solvents used at Building 220, it was not certain if airborne contaminants biased the program samples analyzed.

The results were discussed at a February 1986 meeting with representatives of USAFOEHL, Base Bioenvironmental Engineers (SGB) and Base Civil

Engineers (DEV). As a result of the meeting, Radian was directed to perform additional groundwater sampling and statistical analysis of the resulting chemical analyses after the underground tanks were removed. The underground tanks were removed during the period December 1986 through May 1987. The additional groundwater sampling was then conducted in June 1987.

Site Location and Description - Building 220 Underground Tanks

Building 220 is located in the southeastern area of Hill AFB (Figure 1). Aircraft painting and stripping operations were conducted at Building 220 for more than 20 years. The three underground tanks were located on the northwest side of the building under a concrete apron adjacent to Building 220 (Figure 2). These underground tanks (A, B, and C, on Figure 2) were used for settling of paint chips and solids generated during paint stripping operations at the building. The reinforced concrete underground tanks were formerly used as oil/water separators. During the data review, a fourth tank, an unused fuel tank (F on Figure 2), was found. Figure 2 also shows the locations of previous foundation borings, and the IRP test hole and well locations. All of these provided data on the local hydrogeology for this study.

Sampling and Analytical Program

The program at Building 220 consisted of the collection of formation and water samples. A total of 51 formation samples, including 5 quality control samples, were collected for chemical analysis. Most of these samples were retrieved from four test holes located at the settling tanks. Groundwater samples were collected from four test wells installed in the study area as part of this investigation. The base potable water used during test well construction was also sampled for analysis. As a quality control measure for the program, a sample of water in which the sand pack material had been soaked was analyzed to determine the effect of the sand pack on sample chemistry. A field blank and a trip blank were also analyzed.

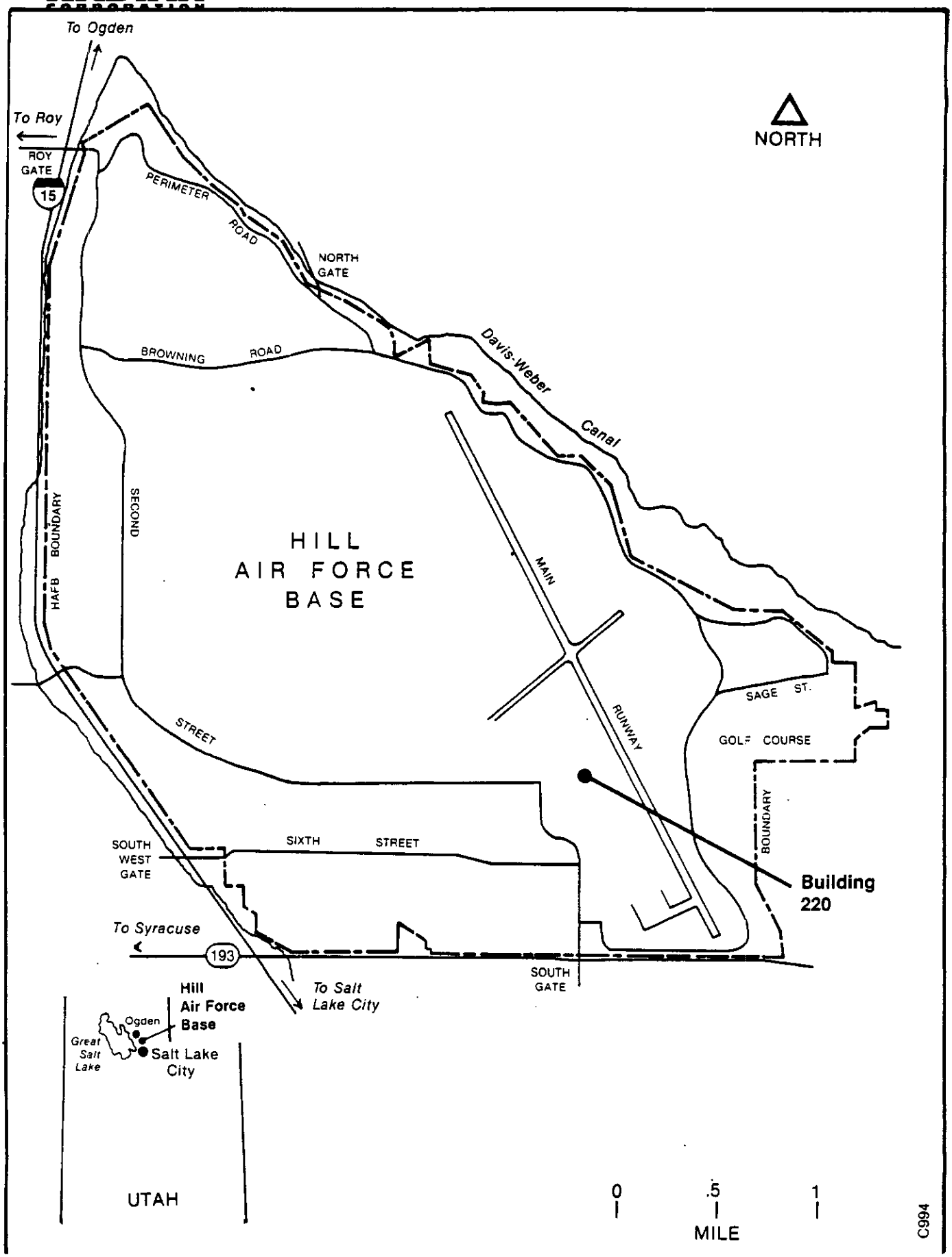

Figure 1. Study Site and Building 220 Aircraft Painting and Stripping Hangar, Hill AFB, Utah

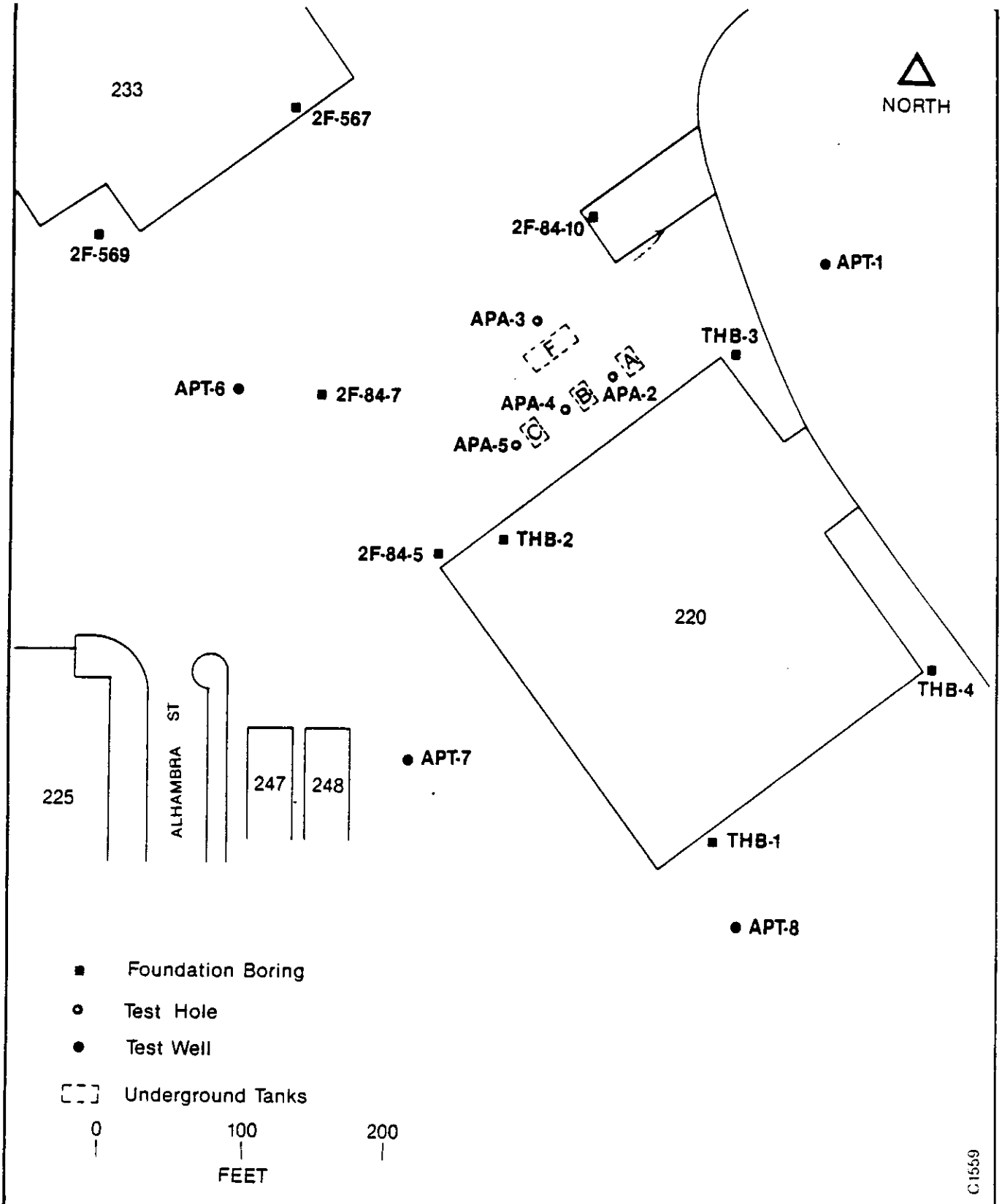

Figure 2. Aircraft Painting and Stripping Building 220
Hill AFB, Utah

All samples were transported to Radian Analytical Services for analysis. Sample splits were also provided to USAFOEHL, Brooks AFB, Texas. The analytical program is shown on Table 1.

Analytical Results

A total of 51 formation samples and 13 groundwater, and potable water samples were collected for chemical analyses. These samples were analyzed by Radian laboratories. In addition, 4 samples obtained from drill cuttings were analyzed for ignitability and purgeable organics. EP toxicity tests were performed on 48 formation samples and compared to criteria for classification of hazardous waste under the Resource Conservation and Recovery Act (RCRA). Chemical analyses were performed as noted on Table 1. Some organic and inorganic compounds were detected in the formation around the underground tanks. Similar compounds were also detected in the groundwater at all sites and to a lesser degree in the quality control (QC) samples collected during the November 1985 sampling. No unusual compounds were detected in the QC sample obtained during the sampling in June 1987. The inorganic and organic parameters that were detected are shown on Tables 2 through 8. The following discussion provides a summary of the resulting formation and groundwater analytical results.

Formation Analytical Results

The chemical analyses of the formation samples indicate, generally, low levels of contaminants in the vicinity of the settling tanks but particularly near Underground Tank "A" (Figure 2) at Test Hole APA-2. Oil and grease were confirmed at Test Hole APA-2 down to 55 feet below land surface. Three organic compounds (Table 3) were detected in formation samples about the site but may not reflect in-situ conditions, but rather fuel and solvent vapors around Building 220 and analytical interferences. All formation and cuttings samples analyzed for EP toxicity and/or ignitability were found non-hazardous

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TABLE 1. ANALYTICAL PROGRAM FOR FORMATION AND WATER SAMPLES, BUILDING 220 HILL, AFB, UTAH

Parameter	Method	Building 220 Samples[a]
Purgeable Aromatic and Volatile Organic Compounds	EPA 601/602, EPA 8010/8020	W, F*
Heavy Metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	EPA 200.7, 206.3, 237.2, 245.1, 270.3	W
Volatile Organic Compounds	EPA 624	W, F*
Oil & Grease (IR)	EPA 413.2	W, F
Phenols	EPA 604 (8040), EPA 604, EPA (420.2)	W, F*
pH	EPA 150.1	W, F
Specific Conductance	EPA 120.1	W, F
Total Organic Carbon	EPA 415.1	W
Hazardous Waste Classification		
EP Toxicity	EPA 1310	F
Ignitibility	40 CFR 261.21	F
Groundwater Classification		
Major Anions and Cations (Ca, Mg, Na, Fe, F, Cl, SO_4, HCO_3)	EPA 200.7, 325.3, 340.2 375.2 A403	W

[a] Samples W = water (groundwater, potable water, sand pack rinse, trip and field blanks.)
F = formation/soil samples.

[b] Analysis for volatile organic compounds by EPA Method 624 was used for confirmation of EPA 601 analyses.

* Additional groundwater sampling conducted 6 and 13 June 1987 for indicated parameters.

TABLE 2. RESULTS OF ANALYSES OF FORMATION SAMPLES, BUILDING 220, HILL AFB, UTAH

TEST HOLE NUMBER	SAMPLE DEPTH (feet)	BASE SAMPLE NUMBER	DATE SAMPLED	EP TOXICITY (mg/L) ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER	OIL & GREASE (ug/g)	PHENOLS EPA 420.1 (ug/g)	FIELD TEMP (o C)	FIELD CONDUCTIVITY (umho/cm)	pH
DETECTION LIMIT (mg/L)				0.06	0.009	0.002	0.005	0.08	0.0002	0.08	0.002	b	b	-	-	-
CRITERIA (mg/L)				5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0	NC	NC			
APT-1	32	R189	10/28/85	< 0.06	0.41	<0.002	0.009 *	< 0.08	<0.0002	<0.08	<0.002	< 18	<0.10	21.0	-	8.7
	60	R188	10/28/85	< 0.06	1.1	<0.002	0.011 *	< 0.08	<0.0002	<0.08	<0.002	220	<0.10	19.0	-	9.0
	90	R187	10/28/85	< 0.06	0.88	<0.002	0.015 *	< 0.08	<0.0002	<0.08	0.004 *	< 18	<0.10	16.0	200	6.9
APA-2	5	R122	10/22/85	< 0.06	0.25	<0.002	0.007 *	< 0.08	<0.0002	<0.08	<0.002	120	<0.11	10.5	37	9.2
	10	R123	10/22/85	< 0.06	0.30	<0.002	<0.005	< 0.08	<0.0002	<0.08	<0.002	110	<0.11	9.0	30	8.5
	15	R124	10/22/85	< 0.06	0.88	<0.002	0.016 *	< 0.08	<0.0002	<0.08	0.006 *	61	<0.11	9.0	45	8.6
	15	R125+	10/22/85	< 0.06	0.48	<0.002	0.010	< 0.08	<0.0002	<0.08	<0.002	180	<0.07	9.0	45	8.6
	20	R126	10/23/85	< 0.06	0.12	<0.002	0.006 *	< 0.08	<0.0001 *	<0.08	<0.002	<9.9	<0.10	10.0	100	7.1
	25	R127	10/23/85	< 0.06	1.1	<0.002	0.017 *	< 0.08	<0.0002	<0.08	0.009 *	<9.9	<0.09	10.0	100	6.7
	30	R128	10/23/85	< 0.06	0.42	<0.002	0.012 *	< 0.08	<0.0002	<0.08	<0.002	73	<0.12	10.0	120	7.3
	35	R129	10/23/85	< 0.06	0.83	<0.002	0.018 *	0.10 *	<0.0002	0.12 *	0.011	< 19	<0.07	10.0	150	7.2
	40	R130	10/23/85	0.09 *	0.39	<0.002	0.018 *	0.11 *	<0.0002	0.15 *	0.018	< 19	<0.06	12.0	150	7.5
	45	R131	10/23/85	< 0.06	1.5	<0.002	0.018 *	0.091 *	<0.0002	0.09 *	0.008 *	< 10	<0.11	14.0	160	7.2
	50	R132	10/23/85	< 0.06	0.52	<0.002	0.013 *	0.09 *	<0.0002	0.11 *	0.008 *	<9.8	<0.10	14.0	130	7.6
	55	R133	10/23/85	< 0.06	0.71	<0.002	0.011	0.085 *	<0.0002	0.08 *	0.002 *	28	<0.05	13.5	130	7.7
	60	R134	10/24/85	0.086 *	0.46	<0.002	0.018 *	0.12 *	<0.0002	0.12 *	0.017	<9.6	<0.07	10.0	100	7.7
	65	R135	10/24/85	< 0.06	0.54	<0.002	0.018 *	0.095 *	<0.0002	0.11 *	0.007 *	< 10	<0.07	11.5	130	7.7
APA-3	5	R160	10/30/85	0.095 *	0.083	<0.002	0.014 *	< 0.08	<0.0002	<0.08	0.012	< 18	<0.09	15.0	22	6.2
	15	R162	10/30/85	< 0.06	0.32	<0.002	0.007 *	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.07	15.0	145	10.6
	25	R164	10/30/85	< 0.06	0.51	<0.002	0.005 *	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.11	15.0	65	9.0
	25	R165+	10/30/85	< 0.06	0.52	<0.002	<0.005	< 0.08	<0.0002	<0.08	<0.002	< 16	<0.10	15.0	65	9.0
	35	R167	10/31/85	< 0.06	0.44	<0.002	<0.005	< 0.08	<0.0002	<0.08	<0.002	< 18	<0.11	8.0	40	9.0
	45	R169	10/31/85	< 0.06	0.81	<0.002	0.011 *	< 0.08	<0.0002	<0.08	0.007 *	< 13	<0.11	11.0	51	8.0
APA-4	10	R149	10/29/85	< 0.06	0.57	<0.002	0.011 *	< 0.08	<0.0002	<0.08	0.009 *	< 17	<0.12	0.0	150	6.8
	20	R151	10/29/85	< 0.06	0.50	<0.002	0.015 *	< 0.08	<0.0002	<0.08	0.012	< 16	<0.10	10.0	150	8.5
	30	R153	10/29/85	< 0.06	0.59	<0.002	0.010 *	< 0.08	<0.0002	<0.08	0.010	< 15	<0.09	12.0	350	8.4
	40	R155	10/29/85	< 0.06	0.76	<0.002	0.015 *	< 0.08	<0.0002	<0.08	0.010	< 16	<0.12	12.0	490	10.2

Continued

TABLE 2. (Cont.)

TEST HOLE NUMBER	SAMPLE DEPTH (feet)	BASE SAMPLE NUMBER	DATE SAMPLED	EP TOXICITY (mg/L) ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER	OIL & GREASE (ug/g)	PHENOLS EPA 420.1 (ug/g)	FIELD TEMP (o C)	FIELD CONDUCTIVITY (umho/cm)	pH
DETECTION LIMIT (mg/L)				0.06	0.009	0.002	0.005	0.08	0.0002	0.08	0.002	b	b	-	-	-
CRITERIA (mg/L)				5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0	NC	NC			
	50	R157	10/29/85	< 0.06	0.56	<0.002	0.014 *	< 0.08	<0.0002	<0.08	0.009 *	< 16	<0.11	15.0	380	9.9
	50	R158+	10/29/85									< 17	<0.12	15.0	380	9.9
APA-5	5	R136	10/25/85	< 0.06	0.26	<0.002	<0.005	< 0.08	<0.0002	<0.08	<0.002	< 14	<0.08	18.5	190	9.0
	10	R137	10/25/85	< 0.06	0.28	<0.002	0.009 *	< 0.08	0.0002 *	<0.08	0.003 *	< 15	<0.10	11.5	300	10.0
	15	R138	10/25/85	< 0.06	0.35	<0.002	0.005 *	< 0.08	<0.0002	<0.08	0.004 *	< 17	<0.13	17.0	150	9.0
	20	R139	10/25/85	0.12 *	1.2	<0.002	0.025 *	< 0.08	<0.0002	<0.08	0.020	< 16	<0.11	17.0	500	10.9
	25	R140	10/25/85	< 0.06	1.5	<0.002	0.014 *	< 0.08	<0.0002	<0.08	0.011	< 16	<0.10	13.5	500	10.6
	30	R141	10/25/85	< 0.06	0.57	<0.002	0.018 *	< 0.08	<0.0002	<0.08	0.013	< 17	<0.14	14.5	410	10.5
	35	R142	10/25/85	< 0.06	0.66	<0.002	0.008 *	< 0.08	<0.0002	<0.08	<0.002	< 18	<0.09	15.0	700	11.0
	40	R143	10/28/85	< 0.06	0.45	<0.002	0.013 *	< 0.08	<0.0002	<0.08	0.010 *	< 17	<0.10	14.0	190	11.4
	45	R144	10/28/85	< 0.06	0.29	<0.002	0.005 *	< 0.08	<0.0002	<0.08	0.003 *	< 16	<0.05	13.0	130	9.0
	45	R145+	10/28/85	< 0.06	0.34	<0.002	<0.005	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.08	13.0	130	9.0
	50	R146	10/28/85	< 0.06	0.32	<0.002	0.009 *	< 0.08	<0.0002	<0.08	0.003 *	< 16	<0.08	12.0	150	8.4
	55	R147	10/28/85	< 0.06	0.41	<0.002	0.010 *	< 0.08	<0.0002	<0.08	0.010 *	< 17	<0.13	13.0	250	9.8
APT-6	30	R170	11/1/85	< 0.06	0.30	<0.002	0.011 *	< 0.08	<0.0002	<0.08	0.009 *	< 14	<0.10	12.0	46	7.8
	30	R171	11/1/85	< 0.06	0.49	<0.002	0.010 *	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.12	12.0	46	7.8
	30	R177+	11/1/85	< 0.06	0.85	<0.002	0.007 *	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.11	12.0	46	7.8
	100	R176	11/4/85	< 0.06	0.036	<0.002	0.009 *	< 0.08	<0.0002	<0.08	<0.002	< 17	<0.10	20.0	590	7.0
APT-7	35	R174	11/5/85	< 0.06	0.39	<0.002	0.007 *	< 0.08	0.001 *	<0.08	<0.002	< 15	<0.11	7.0	82	8.4
	60	R175	11/5/85	< 0.06	0.91	<0.002	0.010 *	< 0.08	<0.0002	<0.08	0.003 *	< 16	<0.05	7.0	60	9.1
APT-8	30	R172	11/4/85	0.072 *	0.80	<0.002	0.021 *	< 0.08	<0.0002	<0.08	0.013	< 15	<0.12	18.0	100	8.2
	65	R173	11/4/85	< 0.06	0.36	<0.002	0.014 *	< 0.08	<0.0002	<0.08	0.008 *	< 19	<0.13	17.0	70	8.3

Note: * = Measured value less than five times the detection limit.
+ = Quality control sample.
a = Maximum concentration of contaminants for EP toxicity characterization.
b = Detection limits denoted by "<" symbol
NC = No Criteria.

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TABLE 3. RESULTS OF ANALYSES FOR VOLATILE ORGANIC COMPOUNDS IN FORMATION SAMPLES, BUILDING 220, HILL AFB, UTAH

Test Hole Number	Sample Depth (feet)	Base Sample Number	Date Sampled	Trichlorofluoro-Methane SW 8010 (ug/Kg)	Trichloroethylene SW 8010 (ug/Kg)	Methylene Chloride SW 8010 (ug/Kg)
Detection Limit				6.25	0.2[a]	4.8
APA-2	40	R130	10/23/85	78		
APA-2	45	R131	10/23/85	49		
APA-3	45	R169	10/31/85	50	53	
APA-5	30	R141	10/25/85	535		290
APT-6	100	R176	11/4/85		12	
APT-7	35	R174	11/5/85		24	
	60	R175	11/5/85		12	
APT-1			10/28/85	No organic compounds detected		
APA-4			10/29/85	No organic compounds detected		
APT-8			11/4/85	No organic compounds detected		

[a] Detection limit for Sample R169 is 0.3 ug/kg.

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TABLE 4. RESULTS OF VOLATILE ORGANICS ANALYSES OF (EPA Method 624) AND IGNITABILITY TESTS ON CUTTINGS FROM TEST HOLE APA-2, BUILDING 220, HILL AFB, UTAH

APA-2 Cuttings	Base Sample Number	Date Sampled	EPA Method 8240 Benzene (ug/Kg)	EPA Method 8240 Methylene Chloride (ug/Kg)	EPA Method 8240 Toluene (ug/Kg)	40 CFR, Sub. C 261.21 Ignitability
Detection Limit			4.4	2.8	6.0	
Barrels 1-6	R178-181	11/8/85	N/A	N/A	N/A	>140°F
Barrel 1	R182	11/8/85	*BL	5 BL		N/A
Barrel 3	R183	11/8/85	*BL	4.7 BL		N/A
Barrel 4	R184	11/8/85	2.6 BL	5.7 BL		N/A
Barrel 5	R185	11/8/85	*BL	9.5 BL	*	N/A
Reagent Blank			1.1	10		N/A

NOTE: BL - Analyte detected in reagent blank, background subtraction not performed.
N/A - Not analyzed.

*Trace-value less than the detection limit.

TABLE 5. COMPOUNDS DETECTED IN WATER (mg/L), NOVEMBER 1985, VICINITY OF BUILDING 220, HILL AFB, UTAH

SAMPLE LOCATION	BASE SAMPLE NUMBER	ARSENIC	BARIUM	CADMIUM	CHROMIUM	FLUORIDE	LEAD	MERCURY	SELENIUM	SILVER	TOTAL ORGANIC CARBON	OIL AND GREASE
DETECTION LIMIT (mg/L)		0.003	0.009	0.002	0.005	0.1	0.002	0.0002	0.003	0.002	1	1
CRITERIA a (mg/L)		0.05	1.0	0.01	0.05	1.4-2.4	0.05	0.002	0.01	0.05	NC	NC
GROUNDWATER												
Upgradient												
APT-1	R212	0.006 b	0.17	<0.002	<0.005	1.0	0.017	<0.0002	<0.03 c	<0.002	3 b	<1
Downgraidient												
APT-6	R213	<0.003	0.21	<0.002	<0.005	0.8	0.006 b	<0.0002	<0.003	<0.002	1 b	<1
APT-7	R214	<0.003	0.36	<0.002	0.013 b	0.9	0.002 b	<0.0002	<0.003	0.003 b	<1	<1
APT-7	R216 (QC)	0.005 b	0.38	<0.002	<0.005	0.9	0.002 b	<0.0002	<0.03 c	<0.002	<1	<1
APT-8	R215	<0.003	0.36	<0.002	0.096	0.8	0.010 b	<0.0002	<0.003	<0.002	1 b	<1
POTABLE WATER B220	R219	0.003 b	0.21	<0.002	<0.005	1.0	<0.002	<0.0002	<0.003	<0.002	<1	<1
SAND PACK RINSE WATER B249	R220	<0.003	0.054	<0.002	<0.005	<0.1	<0.002	<0.0002	<0.003	<0.002	<1	<1

a -- Primary and secondary drinking water standards.

b -- Indicates a value less than 5 times the detection limit.

c -- Analysis required sample dilution to circumvent interferences resulting in a higher detection limit.

NC -- No criteria.

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TABLE 6. RESULTS OF WATER ANALYSES FOR MAJOR ANIONS AND CATIONS FOR GROUNDWATER CLASSIFICATION, VICINITY OF BUILDING 220, HILL AFB, UTAH

SAMPLE LOCATION	BASE SAMPLE NUMBER	DATE SAMPLED	CALCIUM	MAGNESIUM	SODIUM	IRON	BICARBONATE	CHLORIDE	SULFATE
			(concentrations in mg/L)						
GROUNDWATER									
APT-1	R212	11/19/85	72	33	48	0.72	320	18	26
APT-6	R213	11/18/85	85	20	15	0.37	280	17	14
APT-7	R214	11/20/85	68	29	27	0.24	310	17	26
APT-7	R216 (QC)	11/20/85	72	31	29	0.40	310	17	27
APT-8	R215	11/19/85	95	19	31	1.0	310	13	23
POTABLE WATER B220	R219	11/21/85	77	18	20	0.096	240	26	28
SAND PACK RINSE WATER B249	R220	11/21/85	0.93	0.19	0.72	0.79	2	1.0	4.7

TABLE 7. ORGANIC COMPOUNDS DETECTED IN WATER (ug/L), NOVEMBER 1985, VICINITY OF BUILDING 220, HILL AFB, UTAH

SAMPLE LOCATION	BASE SAMPLE NUMBER	METHYLENE CHLORIDE	TRICHLORO-FLUORO-METHANE	1,1-DICHLOR ETHENE	1,1-DI-CHLORO-ETHANE	1,2-DI-CHLORO-ETHANE	1,1,1-TRI-CHLORO-ETHANE	CHLORO-FORM	TRICHLORO-ETHENE	TOLUENE	BENZENE
EPA METHOD		601	601	601	601	601	601	601	601	602	602
DETECTION LIMIT (ug/L)		0.3b	0.1	0.1	0.09	0.03	0.09	0.05	0.2	0.2	0.2
CRITERIA,a (ug/L)		NC	NC	7	NC	5	200	*	*	2000	5
GROUND WATER											
Upgradient											
APT-1	R012 (R)						1.28				
Downgradient											
APT-6	R011 (R)			0.53			24.3	0.17	12.3		
APT-7	R214	2.36	2.47	4.10	1.69	2.74	7.16	2.88	12.9	1.54	
APT-7	R216 (QC)	2.06	2.37	4.24	1.68	2.88	72.9	2.63	11.9	1.41	
APT-8	R215	1.82	2.66	5.46	3.63	6.50	72.1	1.23	1.33	4.57	
POTABLE WATER B220	R219							3.42			
SAND PACK RINSE WATER (DISTILLED) B249	R220						0.23	0.25		1.30	
TRIP BLANK	R218									0.52	
FIELD BLANK	R013 (R)	0.42									

Notes: a -- Federal water quality criteria.
b -- Detection limit for samples R220 and 218 is 0.6 ug/L.

* -- Primary drinking water MCL for all trihalomethanes, sum less than 100 ug/L.
NC -- No criteria.
R -- Resampled 1/20/86. Holding times exceeded on original samples.

TABLE 7 (Con't)

SAMPLE LOCATION	BASE SAMPLE NUMBER	BROMO-DICHLORO-METHANE	DIBROMO-CHLORO-METHANE	BROMOFORM	CARBON TETRA-CHLORIDE	p-CHLORO-m-CRESOL	4-NITRO-PHENOL	4,6-DINITRO o-CRESOL
EPA METHOD		601	601	601	601	604	604	604
DETECTION LIMIT (ug/L)		0.1	0.2	0.3	0.1	0.2	0.7	0.75
CRITERIA (ug/L)		*	*	NC	5	NC	NC	NC
GROUNDWATER								
Upgradient								
APT-1	R012 (R)				0.32			
Downgradient								
APT-6	R011 (R)							
APT-7	R214							
APT-7	R216 (QC)							
APT-8	R215							
POTABLE WATER	R219	2.80	2.54	0.53		0.35	2.8	2.8
	B220							
SAND PACK RINSE WATER (DISTILLED)	R220							16
	B249							
TRIP BLANK	R218							
FIELD BLANK	R013 (R)							

TABLE 8. ORGANIC COMPOUNDS DETECTED IN WATER (ug/L), JUNE 1987, VICINITY OF BUILDING 220, HILL AFB, UTAH

SAMPLE LOCATION	BASE SAMPLE NUMBER	SAMPLE COLLECTION DATE	TRICHLORO-FLUORO-METHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE	1,2-DICHLORO-ETHANE	1,1,1-TRI-CHLORO-ETHANE	CHLOROFORM	TRICHLORO-ETHENE
EPA METHOD			601	601	601	601	601	601	601
DETECTION LIMIT (ug/L)			0.10	0.10	0.10	0.10	0.20	0.10	0.20
CRITERIA (ug/L)			NC	7	NC	5	200	*	5
GROUNDWATER									
Upgradient									
APT-1	R641	06-Jun-87							
APT-1	R646	13-Jun-87							
Downgradient									
APT-6	R642	06-Jun-87	2.2 B	4.6	1.5 DL		34	0.46 DL	15
APT-6	R642	duplicate	1.9 B	4.2	1.2 DL		>62 JC	0.43 DL	>37 JC
APT-6	R648	13-Jun-87					42		15
APT-7	R643	06-Jun-87	1.7 B	3.5	1.3 DL	1.5 DL	30	1.3 DL	7.9
APT-7	R649	13-Jun-87					20		
APT-8	R644	06-Jun-87	1.8 B	9.2	6.7 DL	6.8 DL	360	0.59 DL	2.6 DL
APT-8	R650	13-Jun-87		29	4.8	4.5	940		
FIELD BLANK	R647	13-Jun-87							

Notes:

-- Blank fields indicate analyte below detection.

B -- Analyte detected in reagent blank at 2.7 ug/L. Background subtraction not performed.

DL -- No second column confirmation. Sample diluted to bring other analytes within range of detector.

JC -- Concentration outside range of detector, insufficient sample remained for re-analysis.

NC -- No criteria.

* -- Primary drinking water MCL for all trihalomethanes, sum less than 100 ug/L.

na -- Not analyzed.

TABLE 8. (Con't)

SAMPLE LOCATION	BASE SAMPLE NUMBER	SAMPLE COLLECTION DATE	TRANS-1,2-DICHLORO-'ETHYLENE	PHENOL	2,4-DICHLORO-PHENOL	PENTACHLORO-PHENOL
EPA METHOD			601	604	604	604
DETECTION LIMIT (ug/L)				0.2	0.50	7.5
CRITERIA (ug/L)			70	3500	3090	220
GROUNDWATER						
Upgradient						
APT-1	R641	06-Jun-87		1.0	0.56	240
APT-1	R646	13-Jun-87				53
Downgradient						
APT-6	R642	06-Jun-87	0.78 DL		0.66	440
APT-6	R642	duplicate	0.73 DL	na	na	na
APT-6	R648	13-Jun-87			0.68	310
APT-7	R643	06-Jun-87	0.71 DL	1.7		110
APT-7	R649	13-Jun-87		2.5	0.84	120
APT-8	R644	06-Jun-87		0.78		340
APT-8	R650	13-Jun-87		2.8		1400
FIELD BLANK	R647	13-Jun-87				

according to RCRA criteria. For convenience, the criteria are listed with the analytical results on Table 2.

Groundwater Analytical Results

Low level contamination was detected in the groundwater in samples taken in November, 1985. Of the inorganic parameters, one sample at Test Well APT-8 had a detectable concentration of chromium. All water samples had low levels of barium, apparently reflecting natural conditions. Low levels of organic contaminants were detected in groundwater and QC samples in November 1985. However, these compounds may indicate cross contamination by airborne contaminants from Building 220 activities and/or analytical interferences. Fewer organic solvent contaminants were detected (Table 7) at the upgradient area (Test Well APT-1) than downgradient (Test Wells APT-6, 7, and 8). Test Well APT-1 was also upwind during the field work while the other test wells were generally downwind and closer to Building 220 where organic solvents are commonly used. Due to the uncertainties concerning the impact of airborne contaminants from Building 220 and/or analytical interferences, the low levels of contaminants in the groundwater could not be reliably attributed to the underground tanks based on the first round of sampling data. However, the additional two rounds of groundwater sampling during June 1987 were conducted without the possible influence of Building 220 activity effects and confirm low levels of organic contaminants in the groundwater. This sampling was accomplished after the removal of the Building 220 underground tanks. The analytical results of the additional samples collected in June 1987 are presented on Table 8. As can be seen on Table 8, no volatile organic compounds were detected in the upgradient Test Well APT-1, while eight solvent compounds were detected downgradient. Three phenolic compounds were detected in up-and downgradient areas. The field blank analytical results show no organic compounds detected which indicate no airborne contaminants from Building 220.

A statistical analysis was performed on the analytical data after the additional rounds of samples were analyzed. This was performed to determine if there were any chemical differences between groundwater in the upgradient versus downgradient areas as well as between individual wells. The statistical analysis confirmed that volatile organic concentrations are greater downgradient than upgradient.

Analysis of inorganic chemical data suggests that the groundwater in all the wells tested is from chemically similar aquifers and most likely has common recharge sources. In addition to the chemical data, drilling and water level observations at Test Well APT-8 indicate a possible leaking utility line in this area. Although not within the scope of this study, further investigation to determine the existence and magnitude of the suspected leak is suggested.

Comparisons of Groundwater Analytical Results to Standards or Guidelines

In order to determine whether and to what extent the underground tanks have affected the local groundwater quality, the inorganic and organic compounds detected in the groundwater samples were compared to various criteria. These criteria were taken from federal and State of Utah drinking water regulations. The parameters analyzed, along with the criteria are shown on Tables 9 and 10. The use of human health criteria for comparison of groundwater contamination at Hill AFB provides stringent evaluations of observed contaminant concentrations. Since the shallow groundwater at Building 220 and the Base is not used as a water supply source, contaminants in-situ have neither human health nor environmental consequences. The potential for human contact and exposure exists when water comes to the land surface, as groundwater discharge to streams, springs, or into drinking water sources. No known springs are used as a drinking water source.

Parameters that exceeded federal and/or state standards are shown in Table 11. Also provided in the table is the standard and/or guidelines along with the range of values detected above the criteria.

TABLE 9. REGULATORY GUIDELINES FOR INORGANIC COMPOUNDS DETECTED IN GROUNDWATER NEAR BUILDING 220, HILL AFB, UTAH

Parameter[a]	Federal and State Standard (mg/L)
Arsenic (P)	0.05
Barium (P)	1.0
Silver (P)	0.05
Cadmium (P)	0.010
Chromium (P)	0.05
Lead (P)	0.05
Mercury (P)	0.002
Selenium (P)	0.01
Chloride (S)	250
Iron (S)	0.3
Fluoride (P)	*
Sulfate (S)	250
Sulfate (P)[B]	1000
Calcium	No Criteria
Magnesium	No Criteria
Sodium	No Criteria
Bicarbonate	No Criteria

[a]Federal and State of Utah primary and secondary drinking water standards for primary (P) maximum contaminant levels based upon health effects and secondary (S) recommended contaminant levels (R) based upon other than health effects. Regulatory references: 40 CFR 141; 40 CFR 143; Utah Department of Health Public Drinking Water Regulations, revised 6 April 1984, and Standards of Quality for Waters of the States revised 6 November 1984.

[b]Maximum allowable Primary Drinking Water Standard by the State of Utah.

*The maximum contaminant level for fluoride varies with the mean annual air temperature ranging from 2.4 mg/L at 12 degrees C and below to 1.4 mg/L at 26.3 to 32.5 degrees C.

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TABLE 10. REGULATORY GUIDELINES FOR ORGANIC COMPOUNDS DETECTED IN GROUNDWATER NEAR BUILDING 220, HILL AFB, UTAH

	Proposed MCLs[a] (ug/L)	RMCLs[a] (ug/L)	Other Guidelines (ug/L)
Purgeable Compounds			
Trichlorofluoromethane	No Criteria		
1,1,1-Trichloroethane	200	200	
Trichloroethylene	5	0	
1,2-Dichloroethane	5	0	
Methylene Chloride	No Criteria		
Chloroform	[b]		
Bromodichloromethane	[b]		
1,1-Dichloroethylene	7	7	
1,1-Dichloroethane	No Criteria		
Benzene	5	0	
Toluene		2000[c]	
1,1,2,2-Tetrachloroethane	No Criteria		
Carbon Tetrachloride	5	0	
trans-1,2-Dichloroethylene		70[c]	
Dibromochloromethane	[b]		
Bromoform	No Criteria		
1,1,2,2-Tetrachloroethane			6[d,e]
Phenols			
Phenol			3500[d]
p-Chloro-m-cresol	No Criteria		
4-Nitrophenol	No Criteria		
4,6-Dinitro-o-cresol	No Criteria		
2,4-Dichlorophenol			3090[d]
Pentachlorophenol		220[c]	
Oil and Grease	No Criteria		
Total Organic Carbon	No Criteria		

[a]Federal Register, 46904, 13 November 1985.

[b]Primary drinking water MCL for all trihalomethanes, sum less than 100 ug/L. Regulatory reference: Title 40 Code of Federal Regulations, Part 141 - National Interim Primary Drinking Water Regulations.

[c]Federal Register, 47022, 13 November 1985.

[d]Based on available toxicity data to protect public health. Regulatory reference EPA 440/5-86-001, Quality Criteria for Water 1986.

[e]Level which may result in incremental increase of cancer risk over lifetime estimated at 10^{-5}.

TABLE 11. SUMMARY OF WATER ANALYSES EXCEEDING FEDERAL AND/OR STATE STANDARDS AND/OR GUIDELINES, BUILDING 220, HILL AFB, UTAH

SAMPLE LOCATION	BASE SAMPLE NUMBER	PARAMETER							
		CHROMIUM	SELENIUM c	IRON d	1,1-DICHLORO-ETHENE	1,2-DICHLORO-ETHANE	1,1,1-TRI-CHLOROETHANE	TRICHLORO-ETHYLENE	PENTACHLORO-PHENOL
CRITERIA a,b		0.05 mg/L	0.01 mg/L	0.3 mg/L	7 ug/L	5 ug/L	200 ug/L	5 ug/L	220 ug/L
GROUNDWATER									
Upgradient									
APT-1	R212		X	X					
	R641								X
Downgradient									
APT-6	R213			X	X			X	
	R642							X	X
	R642(QC)							X	
	R648							X	X
APT-7	R214				X			X	
	R216 (QC)		X	X	X			X	
	R643							X	
APT-8	R215	X		X	X	X			
	R644				X	X	X		X
	R650				X		X		X
POTABLE WATER	R219								
	B220								
SAND PACK RINSE WATER	R220			X					
	B249								
VALUE OR RANGE OF VALUES DETECTED		0.096 mg/L	<0.03 mg/L	0.37-1.0 mg/L	1.20-29 ug/L	6.8 ug/L	360-940 ug/L	7.9->37 ug/L	240-1400 ug/L

a -- Federal primary and secondary drinking water standards.

b -- Proposed maximum contaminant levels.

c -- Detection limit exceeding regulatory limits prevailed for two samples which required dilution to circumvent matrix interferences.

d -- Groundwater for the Hill AFB area has naturally occurring iron, often exceeding secondary standards.

Direct Groundwater Flow Measurements

It was anticipated that multiple aquifer subsystems (e.g., water table and/or confined) might be encountered, making determination of the direction(s) of groundwater flow difficult. Therefore, as a part of this expanded Stage 1 effort, in-situ ground-water flow measurements were conducted.

Measurements were made in three of the test wells. For the fourth well (APT-7) the instrument system broke off above the water level and groundwater flow could not be directly measured. The general direction of groundwater flow is to the southwest, however, it is to the north at Test Well APT-1. The hydrogeologic data at Test Well APT-1 suggest that a perched groundwater system may exist in which limited northward flow could be expected. Problems encountered during test well installation could also affect the measured groundwater flow direction. The presence of sticky clays as found here could have impeded settling and resulted in a nonuniform sand pack. Also, these clays may have been smeared along the borehole during drilling, thereby reducing the effectiveness of well development.

The average groundwater flow velocities were determined to be 0.9 and 1.1 feet per day at Test Wells APT-1 and APT-6, respectively. In contrast, the flow rate at Test Well APT-8 was 2.9 feet per day. The higher flow velocity in Test Well APT-8 may suggest that an old stream channel deposit has been penetrated. Higher velocities also could be associated with recharge due to leaking utility lines which is suggested by the chemical data and field observations. Groundwater flow rates beyond the site are unknown. However, if the measured southwesterly flow rates were applicable beyond the site, then contamination might take 6 to 18 years to reach the Base boundary. Considering the travel distance involved, the complexity of the hydrogeology, and the low levels of compounds detected, it is expected that any contamination would be diluted to nondetectable levels and/or attenuated before it passed the Base boundary. Since Base potable water is supplied from deeper aquifers and off-base sources, there is no known threat to the potable water supply

from the contamination observed in the vicinity of the Building 220 underground tanks.

Conclusions

Various inorganic and organic compounds were analyzed and/or detected in formation, groundwater and QC water samples collected in the vicinity of Building 220. The reliability of the original sample data was suspect due to possible influences by Building 220 activities and/or analytical interferences. However, additional groundwater sampling and statistical analyses confirmed the presence of organic contaminants in groundwater. Most compounds detected did not exceed federal or state criteria. Additionally, all formation and/or cutting samples were found to be nonhazardous by EP toxicity and ignitability testing.

Although contaminants were detected in groundwater in up and downgradient areas, there appears to be no immediate health threat because the shallow groundwater on base is not used as a drinking water source and the Base property line is a large distance of approximately one mile from Building 220.

The significant findings are summarized below:

- No major aquifer was encountered;
- Groundwater beneath the site apparently exists in three systems: a sand dominated water table aquifer, a probable perched system (a special water table condition) and a confined aquifer subsystem;
- The underground settling tanks and nearby waste water line have apparently leaked in the past;

- Minor contamination was detected in the formation and groundwater near the settling tanks;

- Formation samples and cuttings are not hazardous according to EP toxicity and ignitability criteria;

- Organic compounds were mainly detected in the downgradient test wells; and

- Three inorganic species and five organic compounds were detected in groundwater at concentrations which exceeded federal and/or state regulations or guidelines.

Alternative Measures

Alternative measures or considerations for additional field activities were examined as they relate to the potential exposures of candidate receptors which in this case are the installation boundary, a de facto receptor, and Base water supply wells.

Two potential areas of environmental concern were considered in examining alternative measures at Building 220. First is the shallow groundwater contamination under Building 220, and second, is the potential for contamination in the formation around the tanks to cause future degradation of the environment. Although contamination of the formation was confirmed under the tanks, it appears that little possibility exists for leachate generation because impermeable concrete roadway and buildings around the area restrict infiltration. Therefore, the contamination in the formation does not appear to represent a significant threat to human health or the environment. Since base removal of the tanks in coordination with the state has been accomplished, no other IRP remedial action appears to be warranted for the tanks or formation around the tanks. Therefore, consideration of alternative measures in this investigation was limited to measures to address potential impacts of shallow groundwater contamination in the vicinity of the underground tanks.

The alternative measures considered were:

- Monitoring of the existing test wells;
- Installation of additional test wells;
- Additional test hole drilling and formation sampling; and
- No further activities.

Recommendations

According to U.S. Air Force criteria, a site examined under the IRP is to be assigned to one of the following categories: no further action required (Category I); site requiring additional monitoring or work to assess the extent of current or future contamination (Category II); or site ready for remedial action (Category III).

The Building 220 site investigated during this Stage 1 program falls into Category II, requiring additional monitoring and statistical analysis to more clearly define and verify the character of contamination. The hydrogeologic and formation data from around the underground tanks were sufficient to assess the nature of the subsurface for the Stage 1 activities and verified the existence of groundwater contamination and the complex nature of the formation. Remedial actions pertaining to the formation around the underground tanks has been conducted by the base and the area has been capped. On the other hand, the additional analytical data for groundwater samples collected in June 1987 showed an apparent rise in the contaminant values. This may indicate some contaminants were mobilized during the tank removal activities. Continued groundwater monitoring of existing wells will allow evaluation of this possibility.