FILE RAFB RI5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

COPY

NOV 03 1992

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

Colonel Ira L. Hester
Commander
United States Air Force
49th Support Group
Holloman Air Force Base, New Mexico 88330

file RED

RE: RFI Report for Table 1 Solid Waste Management Units (SWMU's) - Holloman Air Force Base - NM6572124422

Dear Colonel Hester:

We hereby approve your RFI Report for the Table 1 SWMU's dated October 5, 1992, with modifications. Therefore, the approved RFI Report consists of the above mentioned document and the enclosed modifications.

The Phase II RFI Workplan (for specified table 1 SWMU's, see enclosure) will be due December 31, 1992. If you have any further questions concerning this letter, please contact Rich Mayer of my staff at (214) 655-6775.

Sincerely yours,

Jack Divita

for Allyn M. Davis, Director
Hazardous Waste Management Division

Enclosure

cc: Kathleen Sisneros, NMED

RFI TABLE 1 SWMU REPORT APPROVAL, WITH MODIFICATIONS FOR HOLLOMAN AIR FORCE BASE

1. Holloman AFB shall submit a Phase II RFI Workplan (for Table 1 SWMU's) that includes the specific details for defining the full extent of contamination at the following SWMU's: AOC-T; AOC-L; #114; #4; #82; #132; AOC-A; #132; #113; #177; #181; #165; #179 and #229.

   In addition, the Workplan shall also include the specific details for further assessment of the following SWMU's to determine conclusively if contamination exists: #104; #102; and #134.

2. Holloman shall include in the above mentioned Workplan, a detailed monitoring plan for the following SWMU's: #105; #116; #115; and #108. EPA must approve those monitoring requirements before Holloman can initiate a Class III permit modification for those SWMU's.

3. Holloman shall submit to EPA documentation certifying that the administrative control requirements have been met for the following SWMU's: #42; #107; #137; #192; and AOC-G. After approval from EPA, Holloman may then initiate a Class III permit modification.

4. Holloman shall include in the Phase II Workplan a detailed waste/soil removal plan for SWMU #113.

5. The Phase II Workplan shall be due to EPA by December 31, 1992.

6. EPA considers Site 50, the Waste Disposal Pit, a SWMU. However, the investigation results of this SWMU indicate that no further action is needed. Therefore, Holloman shall follow the procedures of comment number 3 for this SWMU.

General Comment: EPA did not see SWMU 111 (IRP Site 42) or IRP Site 51 (not a SWMU) in the draft RFI Report. These sites may have been omitted. Please clarify in the Phase II Workplan.

Letter dated 11/3/92

49th Fighter Wing

49 SG/CEV
Holloman Air Force Base,
New Mexico

ENTERED

Remedial Investigation (RI) Report

Volume I - Text and Plates

Investigation, Study and Recommendation for 29 Waste Sites

(Table I)

October 1992

Prepared Under Contract With:
US Army Corps of Engineers,
Omaha District

RADIAN
CORPORATION

2.0 ENVIRONMENTAL SETTING

The following subsections describe the environmental setting of Holloman AFB, New Mexico. Included in this section are geographic, geologic, and hydrogeologic data compiled from existing Base records, published literature, previous reports, and this field investigation.

2.1 Geographic Setting

2.1.1 Cultural Geography

As shown in Figure 2-1, Holloman AFB is situated in south-central New Mexico, in the northwest-central part of Otero County. The Base occupies about 50,000 acres in the northeast quarter of section T.17S., R.8E. Additional land extending northward is occupied by the White Sands Missile Range testing facilities.

The Base is located about 75 miles northeast of El Paso, Texas, and about seven miles west of Alamogordo, New Mexico. Alamogordo is the county seat of Otero County, and the only town of appreciable size within 30 to 50 miles of the Base. The population of Alamogordo was 23,535 in 1975, and has since grown to about 31,000. The economy of Alamogordo depends largely upon Holloman AFB and other military installations in the area. Approximately 5500 people live at Holloman AFB.

Privately owned, public, and federally owned lands border the Base. The major highway serving the Base is Highway 70, which runs southwest from Alamogordo and forms the boundary between the Base and public lands.

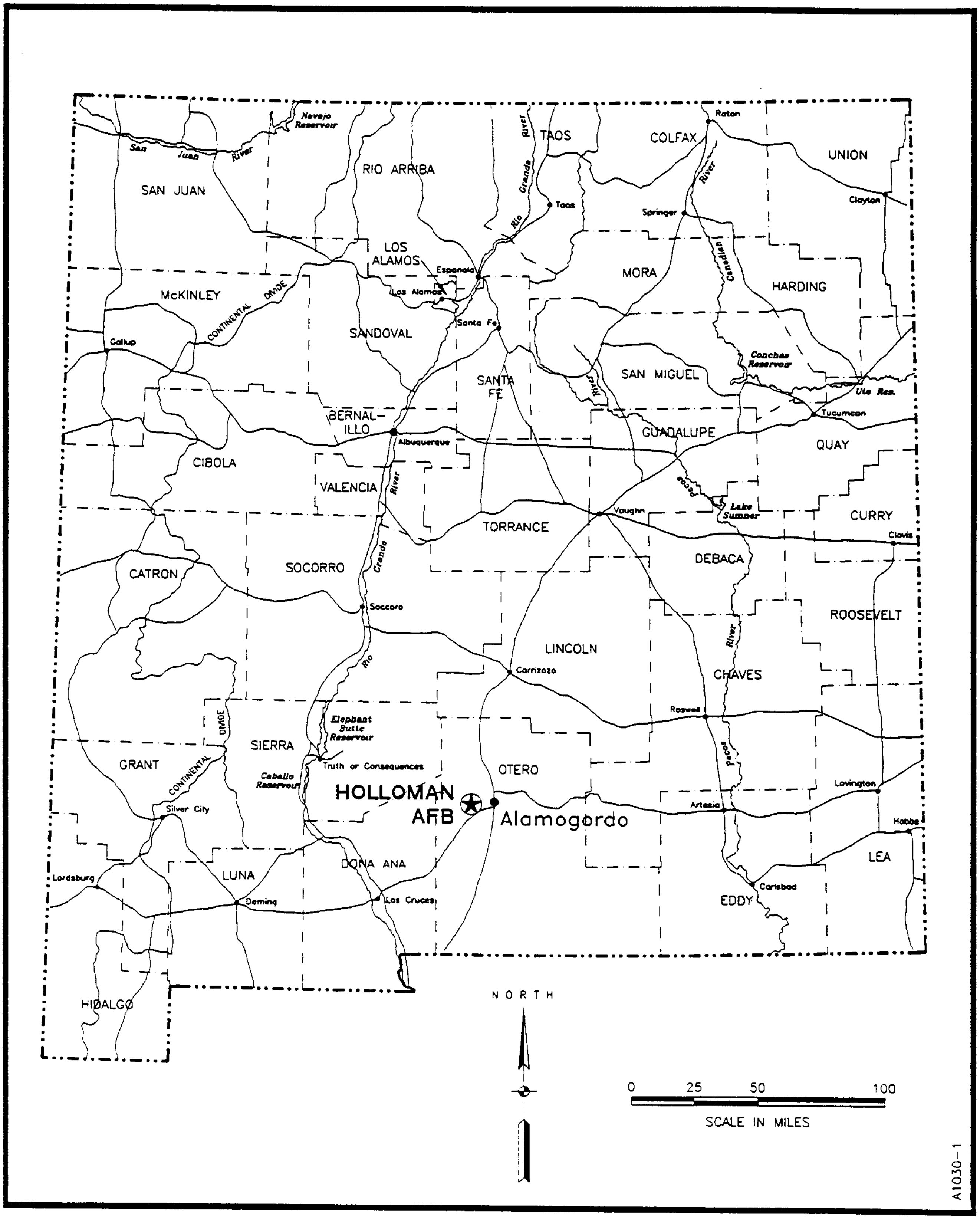

Figure 2-1. Location of Holloman AFB

2.1.2 Physiography

Physiographically, the Base is located in the Tularosa Basin, which is part of a 170-mile-long structural depression. It is bounded on the south by a low topographic divide near the state line; on the west by the uplifted Organ, San Andres, and Oscura Mountains; on the north by Chupadera Mesa; and on the east by the uplifted Jicarilla and Sacramento Mountains. The interior plain has low relief with altitudes ranging from about 4,000 ft in the southwestern portion of the basin to about 4,400 ft in the northeastern portion. The surrounding mountains rise abruptly to altitudes of 7,000 to 12,000 ft.

Surface runoff from the mountains bordering the basin has deposited extensive alluvial fans on the interior plain. The Tularosa Basin is a closed basin from which no surface water drains. Near the Base, the ground surface is gently undulating and is composed of alluvial fan deposits, eolian dunes, and flat-bottomed playas (pan-shaped depressions carved by wind erosion). To the west of the Base lie the gypsum sand dune fields of White Sands National Monument.

2.1.3 Climate

The climate in the Tularosa Basin is arid, with low annual rainfall and low relative humidity. The surrounding mountain ranges greatly influence the local weather. They modify approaching weather systems and provide orographic lifting, which produces summer thunderstorms.

Holloman AFB receives most of its total annual rainfall from thunderstorm activity from May through October. Winter is generally dry and is characterized by clear skies and erratic snowfall. The period from March through May is characterized by strong southerly wind flow and periods of blowing dust and sand. Meteorological data for Holloman AFB are presented in Table 2-1. Mean annual precipitation is 7.9 inches.

Table 2-1

Meteorological Data for Holloman AFB[a]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average or Extreme
Temperature (°F)													
Monthly mean	41	46	52	61	69	81	79	73	62	49	49	42	61
Mean daily high	54	60	66	76	84	93	91	86	76	63	63	55	75
Mean daily low	28	31	37	45	54	68	66	60	48	35	35	26	47
Record high	78	80	90	94	103	108	106	102	92	82	82	75	109
Record low	-11	0	9	23	26	52	54	38	26	3	3	2	-11
Precipitation (in)													
Monthly mean	0.5	0.4	0.3	0.2	0.4	0.7	1.2	1.3	1.2	0.9	0.3	0.5	7.9
Record maximum	1.9	1.4	3.0	0.8	2.9	3.6	3.7	4.4	3.9	4.2	2.5	2.4	4.4
Record minimum	0	T[b]	0	0	0	T	T	0.2	T	0	0	0	0
Relative humidity (%)													
4 a.m. mean	66	61	52	40	42	42	60	66	68	61	61	63	57
1 p.m. mean	42	35	27	19	20	19	31	35	38	34	34	37	31
Surface wind													
Mean velocity (Knots)	4	4	6	7	6	6	5	5	4	4	4	4	5
Prevailing direction	N	N	S	S	S	S	S	S	S	S	S	S	S

[a]Source: Holloman Air Force Base Installation Program Records Search; CH2M Hill; August 1983.
Period of record: September 1942 to December 1981.

[b]T = trace.

The mean annual lake evaporation rate, commonly used as an estimate of the mean annual evapotranspiration rate, is approximately 67 inches per year. Therefore, the annual net precipitation (mean annual net precipitation minus mean annual evapotranspiration) for the Holloman AFB area is approximately minus 59 inches per year, representing a net loss in groundwater due to evapotranspiration. As a result, site soils are generally dry.

2.2 Geology

This subsection describes the regional geologic history and present day features of the Tularosa Basin in relation to Holloman AFB. This information was gathered from existing reports about the geology of the Tularosa Basin. A discussion of the near surface geology on the Base is also included. These data were collected during field activities for this investigation and were interpreted based on existing records and reports about the area.

2.2.1 Geologic Setting

The Tularosa Basin is the easternmost extension of the Basin and Range Province of the western United States. It was created by Cenozoic extensional, or normal, faulting of a sequence of Precambrian- through Tertiary-age sedimentary and igneous rocks. These rocks are exposed in the fault scarps bounding the basin floor. The basin is a graben, or downthrown block, bounded by the upthrown fault blocks of the San Andres and Sacramento Mountains.

During the Permian period of the Paleozoic era (approximately 270 million years ago), southern New Mexico was covered by a shallow sea. Limestone and sandstone were deposited, forming thick sedimentary units. Toward the end of the Mesozoic era (approximately 70 million years ago), the major mountain building activities that formed the Rocky Mountains took place. During these events, southern New Mexico emerged from the ocean as the earth's crust upwarped gently in that area. During the Cenozoic era (beginning approximately 70 million years ago), basin and range formation was initiated in what is now the southwestern United States. Approximately 10 million years ago, Cenozoic faulting formed the graben structure known as the Tularosa Basin. During this process, arched portions of rock collapsed between large-scale, north-south trending faults. The Tularosa Basin is a central downthrown area, bounded on the east and west by fault block mountains. Bedded Permian strata can be seen along the faces of the Sacramento and San Andres Mountains. Permian limestones also occur west of the Base in a low bedrock outcrop near Hurtz Spring. Sediments have been filling the basin continuously since its formation (Orr and Myers, 1986).

Recently (less than 10 million years ago), lava flows erupted along existing fault planes created during active basin development. The Carrizozo lava flow north of the Base is an example of such an eruption.

A geologic map of the present-day Tularosa Basin is presented in Figure 2-2. Permian Hueco and Yeso Limestones are exposed in a north-south bedrock high beginning south of Holloman AFB in the Jarilla Mountains trending north through Tres Hermanos and Twin Buttes. The bedrock high extends through a small outcrop near Hurtz Spring west of the Base and through Tularosa Peak on the Base north of the test track. A schematic east-west cross-sectional view of the southern basin is shown in Figure 2-3. The bedrock outcrops represent a large, buried, down-faulted block. The fault block is tilted to the east slightly and plunges to the north. The fault is en-echelon to the basin-forming fault at the base of the Sacramento Mountains. The fault is buried by sedimentary deposits in the Holloman area, but is suspected to trend north-south in line with the bedrock outcrops described. This tilted fault block divides the larger Tularosa Basin/White Sands area from the Alamogordo sub-basin. The schematic cross-section shows the relationship between the Tularosa Basin and Alamogordo sub-basin. West of Holloman AFB (near Hurtz Spring),

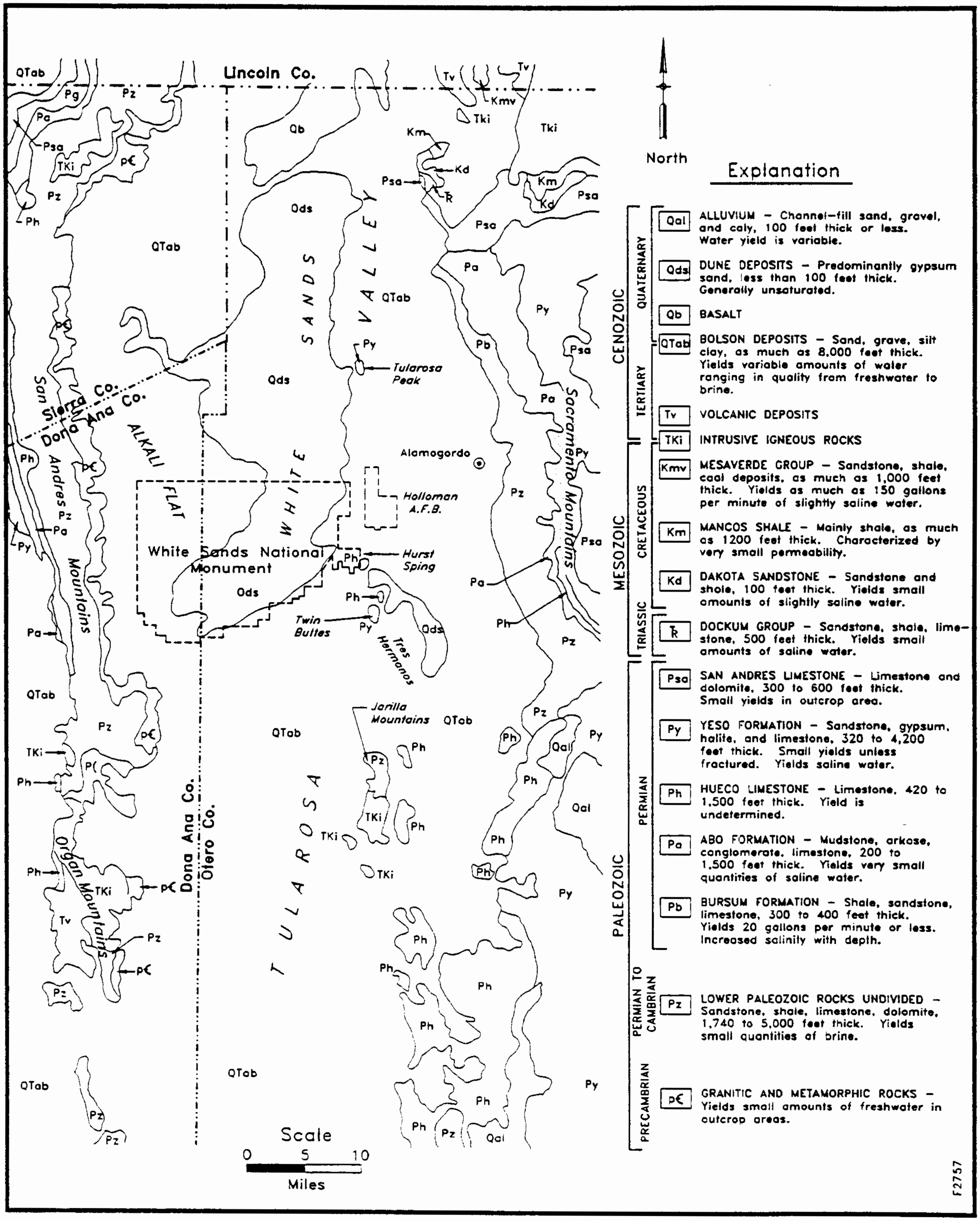

Figure 2-2. Geologic Map of the Tularosa Basin (Orr and Myers, 1986)

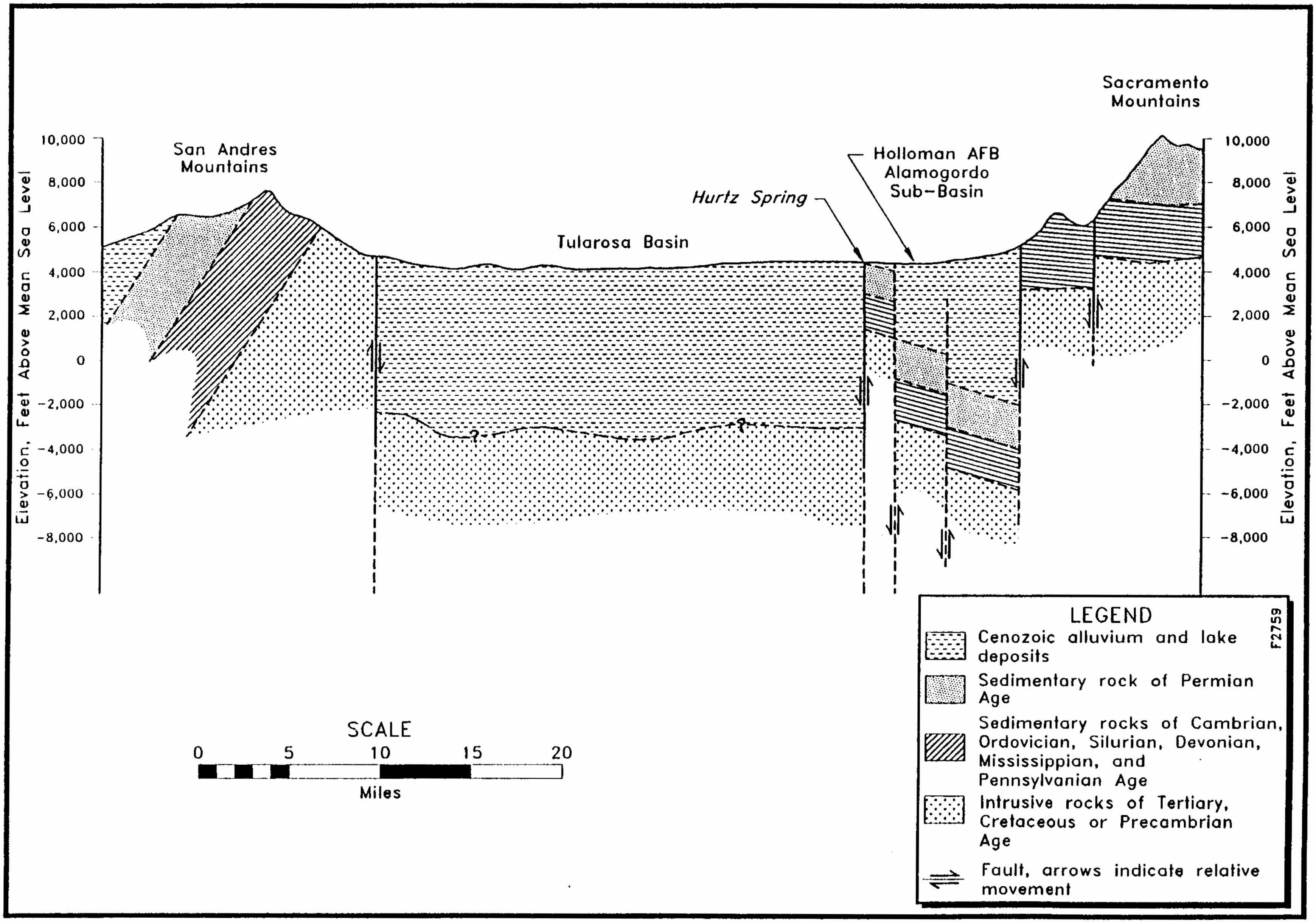

Figure 2-3. Generalized Geologic Cross Section of the Tulorosa Basin

the main Tularosa Basin begins. It is bounded on the east by the near-vertical fault associated with the bedrock high between the Alamogordo sub-basin and the main Tularosa Basin, and on the west by the fault at the foot of the San Andres Mountains. Fault scarps and aligned springs are the predominant physical expression of this faulting. Shallow Permian rocks, including the Yeso and Hueco Formations, are the groundwater source for these springs. The Yeso Formation outcrops several hundred feet south of Hurtz Spring (Orr and Myers, 1986).

The Tularosa Basin is a bolson, or a basin that has no surface drainage outlet. Bolson deposits refer to sediments carried by water into a closed basin. The bolson fill in the Tularosa Basin is derived from the erosion of limestone, dolomite, and gypsum in the surrounding mountains. Coarser material is deposited at the base of the mountains while finer material is carried to the basin's interior. The bolson fill deposits thin out from Alamogordo toward the western edge of the sub-basin, ranging in thickness from 4,000 ft near Alamogordo to less than 100 ft near Hurtz Spring. Bolson fill deposits are 8,000 ft thick or more in the central portion of the Tularosa Basin (Orr and Myers, 1986).

Near-surface geologic conditions at Holloman AFB were studied during the field investigation for this RI. The near-surface bolson deposits consist of sediments that are of alluvial, eolian, and lacustrine or playa origin. Alluvial fan deposits are characteristically laterally discontinuous units of interbedded sands, silts, and clays. The eolian deposits consist of gypsum sands. The eolian and alluvial fan deposits are often indistinguishable because the wind simultaneously reworks alluvial fan sediments and deposits gypsum sands, resulting in an intermingling of the two. Lacustrine or playa deposits in the area consist of medium to high plasticity clays containing gypsum crystals and other salts. Lacustrine deposits are juxtaposed with alluvial fan and eolian deposits throughout the Base. Figure 2-4 is a typical cross section of near-surface geology at Holloman AFB. Silty sands, grading vertically and laterally into silts and small lenses of clay and sand, are seen in the upper 15 ft of the cross section. These are typical alluvial fan sediments, which commonly exhibit

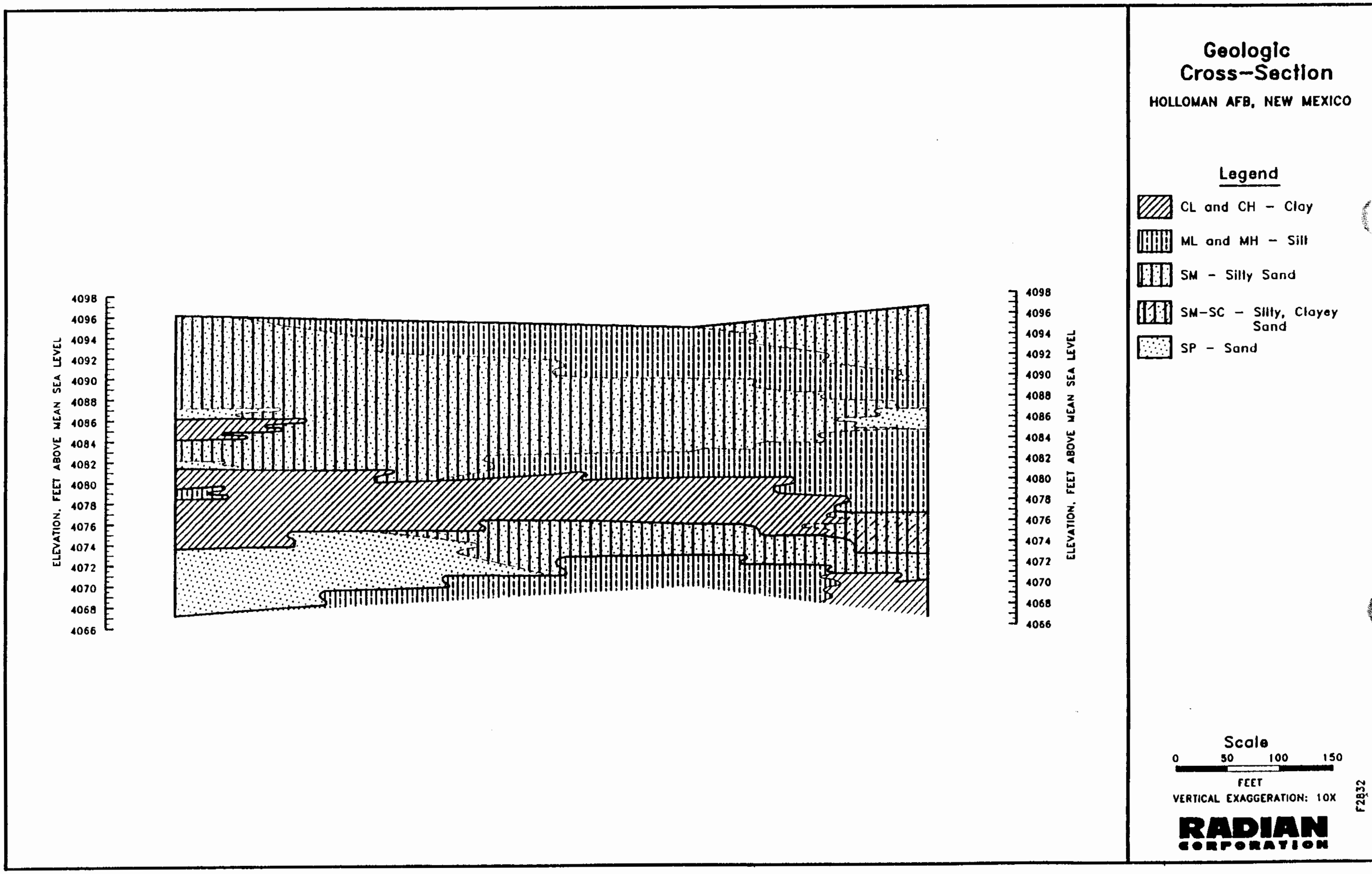

Figure 2-4. Generalized Near-Surface Geologic Cross Section for Holloman AFB

lateral variability because they are deposited as lobes. A clay unit that grades laterally into a silty, clayey sand underlies the alluvial sediments. These are lacustrine or playa deposits. They typically display less vertical variability than alluvial deposits but are also laterally discontinuous. These lacustrine clays almost always are highly plastic and contain abundant gypsum crystals. In the bottom portion of the cross section, the sands grading into silty sands, and underlain by silts, are again characteristic of alluvial fan sediments. The clay in the bottom right corner is another lens or bed of lacustrine clay.

2.2.2 Soils

The U.S.D.A. Soil Conservation Service has identified two soil associations in the vicinity of Holloman AFB: the Holloman-Gypsum Land-Yesum complex, and the Mead silty clay loam. The permeability of these soil horizons ranges from 4×10^{-4} to 1×10^{-3} cm/sec. Figure 2-5 shows the distribution of the soil types in the vicinity of Holloman AFB, according to the U.S.D.A. Soil Conservation Service Soil Survey of Otero Area, New Mexico (U.S.D.A., 1981).

Most of the surficial soils at the Base are the well-drained, sandy loam and gypsum of the Holloman-Gypsum Land-Yesum complex. The soils of this association are formed from alluvial and eolian gypsiferous sediments. The Holloman unit makes up about 35% of the complex. It is a light brown to pink, very fine, sandy loam with a high gypsum content. The soil is moderately permeable, calcareous, and mildly to moderately alkaline. The Gypsum land unit makes up about 30% of the complex. It is soft to hard white gypsum, typically overlain by less than one inch of very fine, sandy loam. The Yesum unit, which makes up 20% of the complex, is light brown to pinkish-white, very fine sandy loam that is also high in gypsum. It is moderately permeable, calcareous, and mildly alkaline (USDA, 1981).

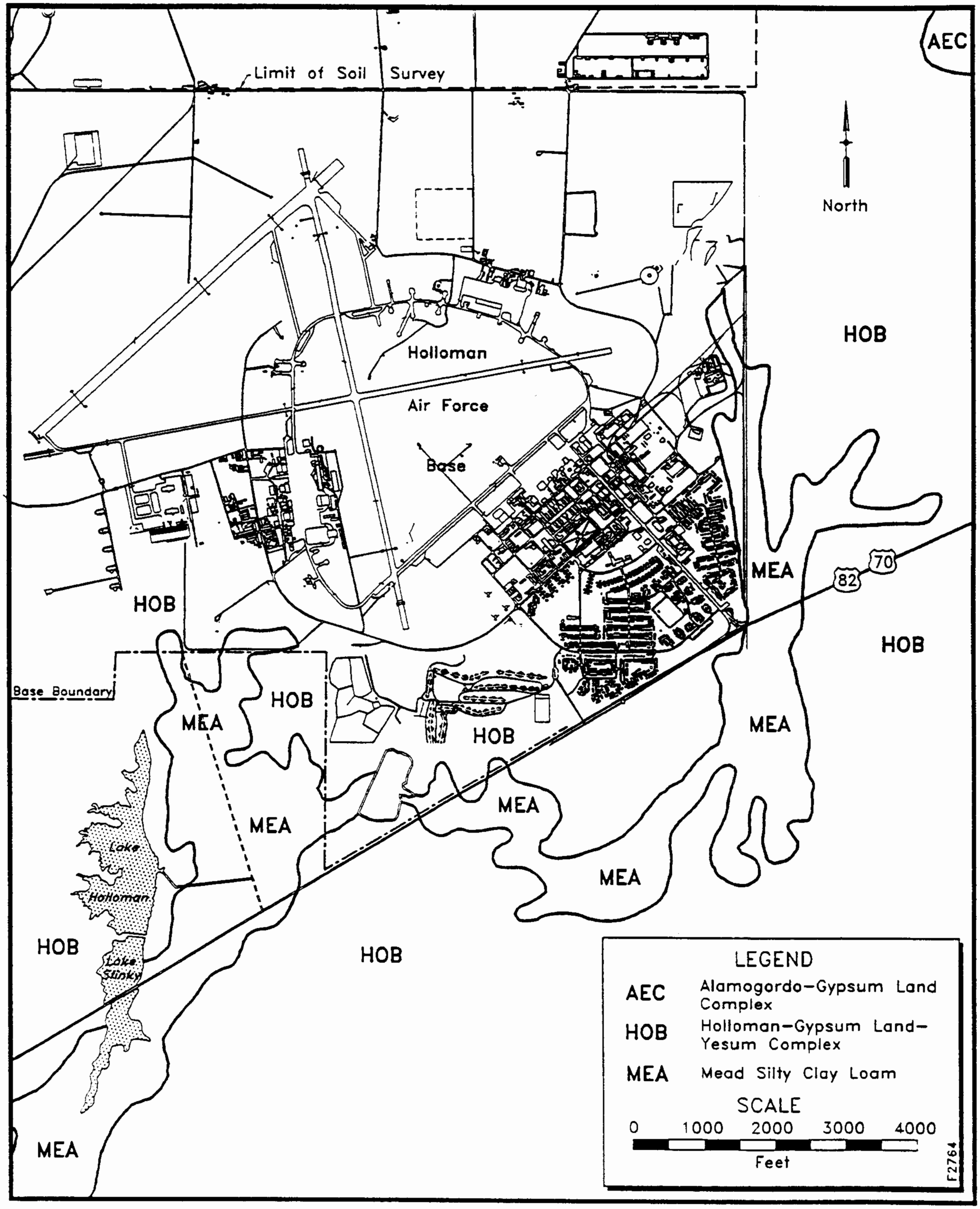

Figure 2-5. Distribution of Soils at Holloman AFB (USDA, 1981)

The Mead silty clay loam soil occurs over a small area of the Base. This soil consists of reddish-brown, silty clay loam, clay loam, and clay with a high salt content. It is derived from fine grained alluvium deposited over lacustrine sediments. The soil has low permeability, and available water capacity is low. It is moderately calcareous, and moderately to strongly alkaline. The soil has a layer of salt that is more soluble than gypsum (USDA, 1981).

2.3 Hydrogeology

This subsection summarizes the regional hydrogeology, including surface water and groundwater, of the Tularosa Basin in the vicinity of Holloman AFB. This information was gathered from Base records and existing reports about the hydrogeology of the Tularosa Basin. A more specific discussion of the hydrogeology of Holloman AFB is also presented based on information collected during field activities for this RI.

2.3.1 Surface Water

The Tularosa Basin is a closed basin with no surface water drainage. Water is lost to evaporation, transpiration, and infiltration, or collects in Lake Lucero, the lowest point in the basin, approximately 20 miles southwest of Holloman AFB. Figure 2-6 shows surface drainage patterns in relation to area topography at Holloman AFB.

The Base is crossed by several southwest-trending arroyos, which control surface drainage in the undeveloped part of the Base. These arroyos are: Hay Draw, in the far northern part of the Base; Malone Draw and Ritas Draw, which drain into Lost River; and Dillard Draw to the east, which runs in a southwesterly direction near the southern boundary of the Base toward the sewage lagoons. Arroyo locations are shown in Figure 2-6. Lost River, the largest arroyo, is dammed near the western boundary of the Base to prevent runoff from the Base from entering White Sands National Monument. Runoff from Lost

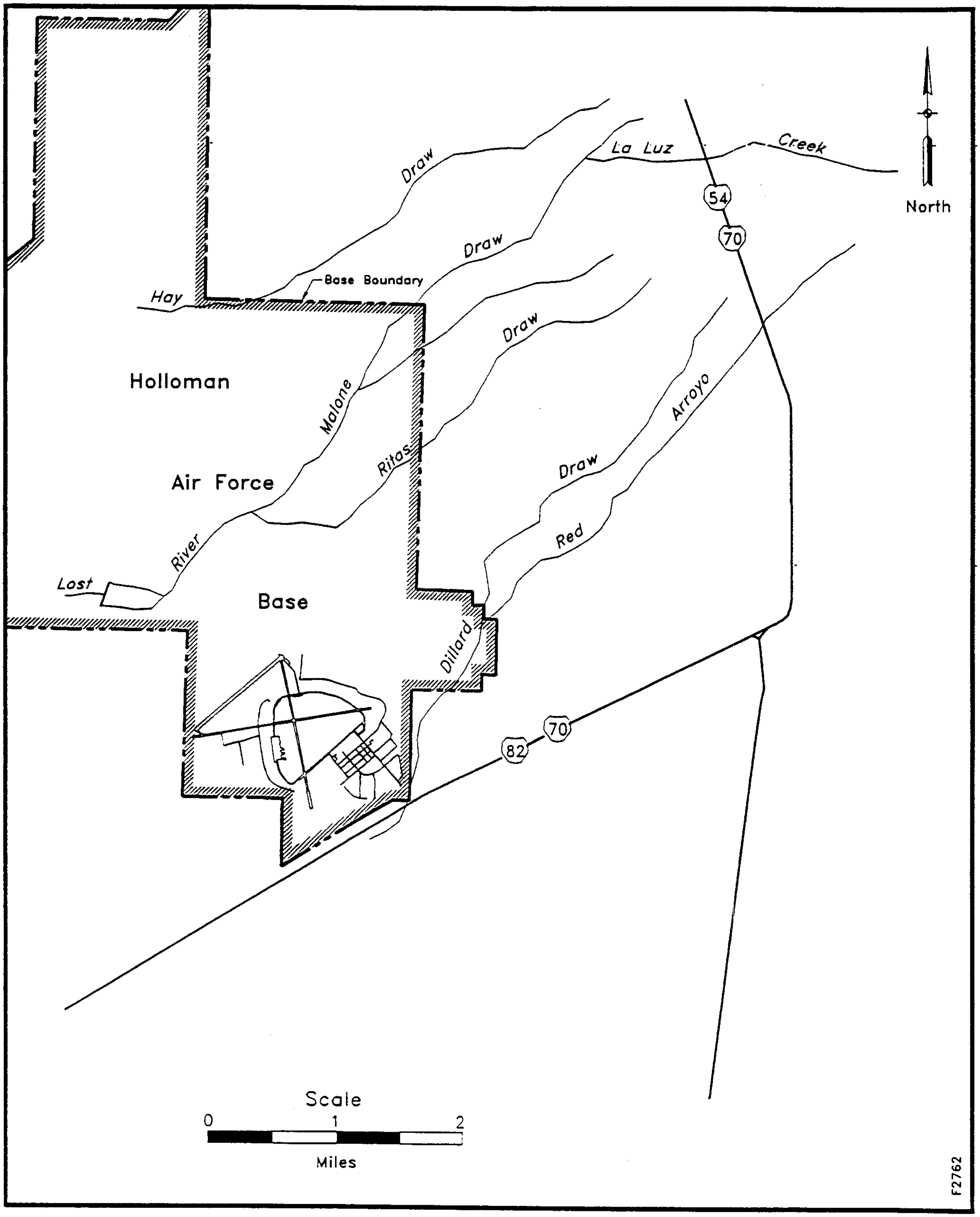

Figure 2-6. Surface Drainages at Holloman AFB

River, Malone Draw, and Ritas Draw collects in the dammed area and either evaporates or infiltrates.

Drainage within the developed portion of the Base flows through ditches and culverts to the sewage lagoons in the southwestern corner of the Base. The wastewater treatment system at Holloman AFB consists of seven aeration/evaporation lagoons. Southwest of these lagoons, a natural playa lake known as Lake Holloman receives runoff from the Base as well as effluent from the sewage lagoons. A dam/dike has been constructed across the southern quarter of Lake Holloman. Seepage through and overflow of the dam have created a small playa lake known as Lake Stinky.

2.3.2 Groundwater

Groundwater occurs in unconfined conditions in the unconsolidated bolson deposits beneath Holloman AFB. The primary source of recharge for groundwater in the bolson aquifer is percolation of rainfall and stream runoff through the coarse, unconsolidated alluvial fan deposits along the western flank of the Sacramento Mountains. Water migrates downward into the bolson fill aquifer and flows downgradient through progressively finer-grained sediments into the basin. The hydraulic gradient is steep in the recharge zones at the base of the mountains, but then flattens out as groundwater migrates into the valley. Results of the field investigation indicate that groundwater gradients at the Base range in magnitude from about 9×10^{-4} to 7×10^{-3}. Groundwater discharge occurs either through evapotranspiration, springs or seeps along steep-sided arroyos, or into closed playa lakes such as Lake Lucero, the regional groundwater discharge area.

The depth to groundwater decreases from 270 ft (or more) near the mountains to less than 40 ft at Holloman AFB. For this investigation, Base-wide water-level surveys were conducted in November 1991 and March 1992. Water levels increased by as much as

2.58 ft between the two surveys, which is probably due to normal seasonal fluctuations, with the water table standing higher in the spring than in the fall.

A potentiometric surface map for groundwater is shown in Plates 2 and 3. In the vicinity of Holloman AFB, groundwater generally flows toward the west and southwest. However, regional and local groundwater flow direction is controlled by the arroyos that drain the basin. In the southeastern portion of the Base, regional groundwater flows southwest, following the Dillard Draw surficial drainage system. In the northern portion of the Base, groundwater flows to the west, following the Ritas Draw, Malone Draw, and Lost River drainages. An apparent divide between these two drainage subsystems is seen in the northeast-central part of the Base between Site 29 and Sites 30&33.

The greatest local effects on groundwater flow direction occur at sites located closest to the arroyos. At Sites 2&5 and 8, located just west of Dillard Draw, groundwater flows east, which is against regional flow and toward the arroyo. The same effect is seen at Sites 4, 38, and 39. Site 4 is located just south of Ritas Draw, and groundwater flow is to the north, into the draw, rather than to the west with regional groundwater flow. Sites 38 and 39 are just north of Lost River, and groundwater flows south-southeast into the drainage, rather than to the west. At sites further from the arroyos, such as Sites 21, 22, and 26, groundwater follows regional flow to the southwest. At Site 9, data from the water level survey of November 1991 indicate that groundwater is flowing to the east, toward Dillard Draw, while data from the March 1992 survey indicate that groundwater flow is to the southwest, with regional groundwater flow. Site 9 is near, but not immediately adjacent to, Dillard Draw. In this case the higher water table conditions in the spring probably diminished the local hydrologic effect of the arroyos.

Eighty-two groundwater monitoring wells were installed during this field investigation. All new wells and one existing well were slug tested to determine the hydraulic conductivity of the aquifer. Calculated hydraulic conductivities ranged from

6.8×10^{-5} to 1.7×10^{-2} ft/min, and averaged between 7×10^{-4} and 2×10^{-3} ft/min. This range of conductivities is typical of silty sands, which comprise the near-surface geology seen during the field investigation. The higher conductivity values are characteristic of clean sands, while the lower values are associated with silts and clays. Slug test data plots are provided in Appendix C, and results are discussed on a site-by-site basis in Section 4. Groundwater flow velocities were calculated for each site using the following: a site average for hydraulic conductivity or a high value and a low value if there was a broad range; the calculated magnitude of the hydraulic gradient for the site; and an estimated effective porosity of 25 percent. Groundwater flow velocities ranged from 0.21 ft/yr to 57 ft/yr Base-wide. Groundwater flow velocity calculations are provided in Appendix C.

2.3.3 Groundwater Use

Groundwater Quality

Water quality in the Tularosa Basin is good near recharge areas, but groundwater becomes progressively more mineralized as it flows downgradient toward the interior of the basin. This decrease in water quality can be attributed to slow groundwater migration from recharge to discharge areas, and the presence of readily soluble minerals in the bolson sediments.

The groundwater beneath Holloman AFB is designated as unfit for human consumption based on New Mexico Water Quality Control Commission Regulations (NM WQCC 82-1, as amended through August 18, 1991, Parts 3-100 through 3-103) because it exceeds New Mexico Human Health Standards (HHSs) for total dissolved solids (TDS) and sulfate. Average values of other groundwater quality parameters measured at the Holloman AFB sites (chloride, fluoride, and nitrate-nitrite) also exceed HHSs; and, except for fluoride in downgradient wells, also exceed federal primary and secondary drinking water maximum contaminant levels (MCLs; SMCLs). Table 2-2 presents the minimum, maximum, and

Table 2-2

Groundwater Quality Parameters

Parameter	Total Number of Analyses	Total Number of Detections	Minimum Result	Maximum Result	Average Result	MCL (mg/L)	SMCL (mg/L)	N.M HHS (mg/L)
Background Wells								
Alkalinity (mg/L)	17	16	100.00	1300.00	390.94	--	--	--
Chloride (mg/L)	17	17	81.00	21000.00	5548.88	--	250	250
Conductivity (μmhos/cm)	17	17	2490.00	51500.00	20682.35	--	--	--
Fluoride (mg/L)	17	16	0.88	4.60	2.05	4	2	1.6
Nitrate-Nitrite (mg/L)	17	17	0.63	110.00	20.27	10	--	10
Sulfate (mg/L)	17	17	1700.00	6700.00	3858.82	400/500	250	600
Total dissolved solids (mg/L)	17	17	3100.00	41000.00	16052.94	--	500	1000
Total phosphorus (mg/L)	17	17	0.06	0.77	0.23	--	--	--
pH	17	17	6.70	7.42	7.17	--	6.5 - 8.5	6.9
Downgradient Wells								
Alkalinity (mg/L)	70	70	60.00	1200.00	313.39	--	--	--
Chloride (mg/L)	66	66	39.00	30000.00	6205.62	--	250	250
Conductivity (μmhos/cm)	70	70	1930.00	80000.00	25564.53	--	--	--
Fluoride (mg/L)	66	66	0.50	4.60	1.87	4	2	1.6
Nitrate-Nitrite (mg/L)	66	64	0.10	130.00	24.72	10	--	10
Sulfate (mg/L)	66	65	1600.00	13000.00	4169.23	400/500	250	600
Total dissolved solids (mg/L)	66	66	2600.00	66000.00	17750.00	--	500	1000
Total phosphorus (mg/L)	66	66	0.07	0.73	0.25	--	--	--
pH	70	70	6.68	7.86	7.24	--	6.5 - 8.5	6.9

average values of groundwater quality parameters at the Holloman AFB sites for background and downgradient wells, and lists the MCLs, SMCLs, and HHSs for each parameter. While some groundwater parameters in the downgradient wells average higher than background concentrations, contaminants at the Holloman AFB sites do not contribute to the degradation of a potable groundwater source. Background water quality parameters reflect that the groundwater in this area is not potable.

Based on the EPA document *Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy* (EPA, 1986), the groundwater can be classified as III B. Class III groundwater, characterized by having a TDS concentration greater than 10,000 mg/L, is not considered a source or a potential source of drinking water. Class III B groundwater is characterized by a low degree of interconnection to adjacent surface waters or groundwaters of a higher class. As shown in Table 2-2, the average TDS value for groundwater is greater than 10,000 mg/L. Because the Tularosa Basin is a closed basin, its groundwater does not discharge or connect to any adjacent aquifers. Adjacent surface waters include groundwater surfacing in Malone Draw and Lake Holloman. TDS in Lake Holloman ranges from a winter low of 12,400 mg/L to a summer high of 17,000 mg/L (Cole, et al., 1981); therefore, groundwater at Holloman AFB is not interconnected with surface water of a higher class.

Historical and Current Water Resources

Because groundwater beneath the Base is not potable, Holloman AFB historically has sought out other drinking water resources. These resources include surface water and potable groundwater collected from the recharge zones at the base of the Sacramento Mountains. Holloman AFB obtained all of its water supply from the town of Alamogordo during its operation as an Army Air Field during World War II and until the summer of 1947. In 1947, Mr. L. C. Boles drilled an irrigation well on his property, part of the present well field, and found that the water was potable. Subsequently, the USAF leased that property, and much of the surrounding property in sections 24 and 25, T.17 S., R.9 E, and sections 18 and 19, T.17 S., R.10 E. During an 8-year period from 1947 to 1955, at least 35 wells and test holes were drilled in the well field area. Of the 35 wells and test holes, only 14 wells have been used or equipped at one time or another to produce water.

Water requirements at the Base were essentially stable during World War II. The amount of water used ranged from 0.4 to 0.5 million gallons per day (mgd). After the war, activities at the Base were curtailed, and water use dwindled to about 0.1 mgd. When the Base was reactivated as a research establishment, the demand for water again increased.

The continued increase in use of water at Holloman AFB reflects the growth in Base population and the expansion of Base operations. Research facilities, on-Base housing facilities, and landscaping have been growing more or less continually, resulting in a rising average use of water per capita. Water use fluctuates seasonally and is largely related to temperature changes.

Holloman AFB, White Sands Missile Range Headquarters, and the community of Alamogordo are the chief water users in the Tularosa Basin. The city of Alamogordo reportedly used 6.4 mgd in 1984. In 1984, about 1.6 mgd was obtained by pipeline from Lake Bonita, 60 miles northeast of the basin. An additional 4.3 mgd was obtained from developed springs in La Luz, Alamo, and Fresnal Canyons in the Sacramento Mountains, and the remaining 0.5 mgd was obtained from wells drilled in alluvial fan deposits at the base of the Sacramento Mountains between Alamogordo and La Luz. At present, the City of Alamogordo is replacing the Bonita pipeline due to continued breaks along the system, and plans to maintain Bonita Lake as the primary fresh water resource.

Total water production at Holloman AFB has averaged 2.6 mgd since 1976. A table listing monthly and yearly totals for water production at Holloman AFB is provided in Appendix C. Sources of fresh water were obtained from a combination of the City of

Alamogordo and the Holloman AFB wells in the Boles, San Andres, and Douglas well fields.

White Sands Missile Range obtains its fresh water supply from alluvial deposits between the Organ and San Andres Mountains, and along the mountain front on the west side of the basin.

2.3.4 Well Inventory

No water supply wells are located on Base because of poor groundwater quality. The nearest production well downgradient of Holloman AFB is a livestock well located 3.5 miles west of the Base (Computrac, Inc., 1986). No other downgradient or near-Base potable or irrigation wells exist.