3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

TEAD-S has a semi-arid, cold desert climate characterized by hot, dry summers and cold, snowy winters. The average monthly temperature ranges from a high of 75 °F in July to a low of 28 °F in January (Donohue 1990). There are from 120 to 160 frost-free days per year.

Annual precipitation is 10 to 12 inches per year with about 6 inches occurring as winter snowfall. Relative humidity averages 44 percent. Summer thunderstorms occur sporadically, but flash floods are possible because of an annual-average precipitation of 40 inches in the mountains surrounding Rush Valley (Montgomery 1987).

Local winds are light—the average annual wind speed is 8.7 miles per hour—and circulate through the valley because of uneven heating and cooling of land surfaces (Donohue 1990). Prevailing winds are from south to north toward the Great Salt Lake during summer months and from the north to the south during winter months (Donohue 1990). Figure 3-1 is a windrose developed by TEAD-S personnel based on meteorological data (Table 3-1) collected from one meteorological station at TEAD-S. It illustrates the predominance of NNW and SE airflow. It also shows the increasing variability at lower wind speeds.

3.2 GEOLOGY

3.2.1 Physiography

Rush Valley is located near the eastern margin of the Basin and Range Physiographic Province in north-central Utah. This province, which encompasses much of the western United States, includes Nevada, western Utah, southern Arizona, and southwestern California, as well as adjacent Mexico. TEAD-S lies in the southeastern portion of Rush Valley.

Rush Valley is a typical Basin and Range Province type valley. It consists of a depressed and relatively flat-floored basin, measuring about 30 miles long by 17 miles at its widest point. The valley is part of a 470,000-acre drainage basin and has a total ground-floor surface of approximately 250,000 acres. The valley floor slopes gently northward and, near its center line, has developed multiple playa lake depressions which culminate into Rush Lake, a closed lake located in the northern part of the valley. Coalescing alluvial fans and colluvial slopes adjoin the surrounding mountain ranges with the valley floor. These surrounding ranges are composed of igneous, metamorphic, and sedimentary rock units that exhibit complex folding and faulting. The rock units display extensive intrusive and compressional uplifting features that have been followed by extensional horst and graben block-faulting typical of Basin and Range Province terrain.

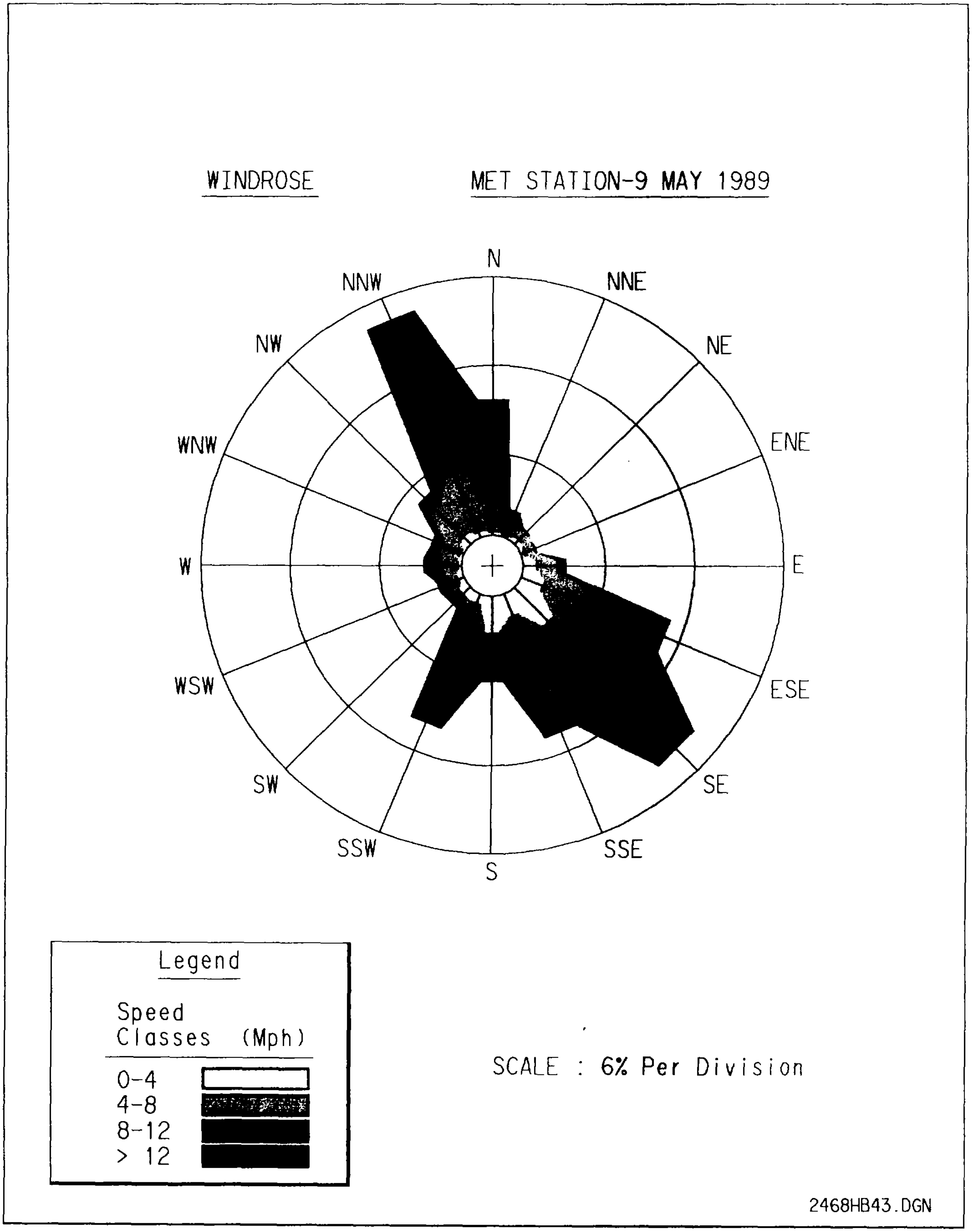

Figure 3-1. TEAD-S Windrose from Meteorological Station 9, May 1989

Table 3-1. TEAD-S Wind Frequency Distribution Data from Meteorological Station 9, May 1989

Wind Frequency Data
MS-9 May 1989
Percent

Wind Direction	Wind Speed Class (Mph)				Total
	0-4	4-8	8-12	>12	
N	0.4	2.4	3.2	3.8	9.7
NNE	0.3	0.7	0.6	0.4	2.0
NE	0.6	0.7	0.0	0.0	1.3
ENE	0.4	0.7	0.0	0.0	1.1
E	1.1	1.5	0.4	0.0	3.0
ESE	1.8	5.7	2.6	0.8	10.9
SE	3.5	9.0	2.2	1.3	16.0
SSE	1.7	6.5	1.4	0.7	10.3
S	2.8	1.7	0.8	0.8	6.1
SSW	0.8	1.1	1.0	7.0	9.9
SW	0.8	0.6	0.1	0.3	1.8
WSW	0.6	0.6	0.3	0.4	1.9
W	0.3	1.1	0.4	0.7	2.5
WNW	0.3	1.5	0.6	0.0	2.4
NW	1.0	2.5	0.8	0.3	4.6
NNW	0.7	4.0	5.0	6.8	16.5

The present topographic relief in the valley is the result of block-faulting and erosional processes, evaporite accumulation, and lacustrine deposition onto the valley floor. The relief features, which form this closed valley, bound the valley on four sides and, with the exception of the Stockton Bar, are composed primarily of uplifted and metamorphosed Paleozoic carbonates and quartz arenites. The Oquirrh-East Tintic Mountains bound the valley to the east; the Stansbury-Onaqui Mountains bound it to the west; the Sheeprock-West Tintic Mountains bound it to the south; and the South Mountain and the Stockton Bar, which consists of Quaternary coarse gravels and sand, bound it to the north. The mountain-valley contrasts show extreme relief, as evidenced by the 4,900-foot elevation found on the valley floor versus the 10,572-foot elevation at Lowe Peak, which is less than 7 miles to the east in the Oquirrh Mountains (Figure 3-2). This contrast in elevation is not the exception. The Stansbury Mountain Range to the west has developed similar relief features with elevations ranging from 10,305 to 11,031 feet. To the south, the Sheep Rock Mountains rise to heights of 8,964 feet. The lowest boundary elevation for the valley is 5,175 feet at the Stockton Bar, which is a bay mouth bar that, along with the South Mountain Horst (an east-west trending exposed horst, dividing Tooele Valley and Rush Valley), forms the northern boundary of the valley between the Stansbury Range to the west and the Oquirrh Range to the east. The topography of TEAD-S is characterized by a gentle slope from the east to the west. The slope flattens out in the vicinity of SWMU 13 near the center of Rush Valley.

3.2.2 Structural Geology

Rush Valley is constructed of complex multiple en echelon (i.e., step-like, multiple, staggered, and overlapping fault blocks that show relatively parallel faulting features) down-dropped fault blocks filled with erosional debris (Figure 3-3). Evidence of the major structural events that created the valley can be seen in the bounding mountain structures. These structures developed primarily in Paleozoic sedimentary carbonates and sandstone. These strata reached depths of nearly 21,000 feet before they were intruded and uplifted during the Larimide Orogeny of late Cretaceous and early Tertiary times. The mountain-building forces during the uplift produced complex anticlinal and synclinal folding, which was subsequently followed by reverse fault shearing. Following this uplift cycle, extensive rift-type extensional normal faulting evolved. This north-south-trend faulting is responsible for forming the down-dropped fault blocks characteristic to the region. Rush Valley constitutes one of these down-dropped fault blocks, which has been subsiding since early Miocene times between the Oquirrh-East Tintic ranges to the east and the Stansbury-Onaqui ranges to the west (Gilluly 1932).

3.2.3 Valley Deposits

The Rush Valley fill material is composed primarily of alluvial deposits that resulted from erosion of the adjoining ranges and subsequent deposition onto the valley floor during Tertiary times. The depths of fill material vary from 300 to 400 feet on the eastern side, but may exceed depths greater than 1,000 feet on the western side of the valley (Figure 3-3).

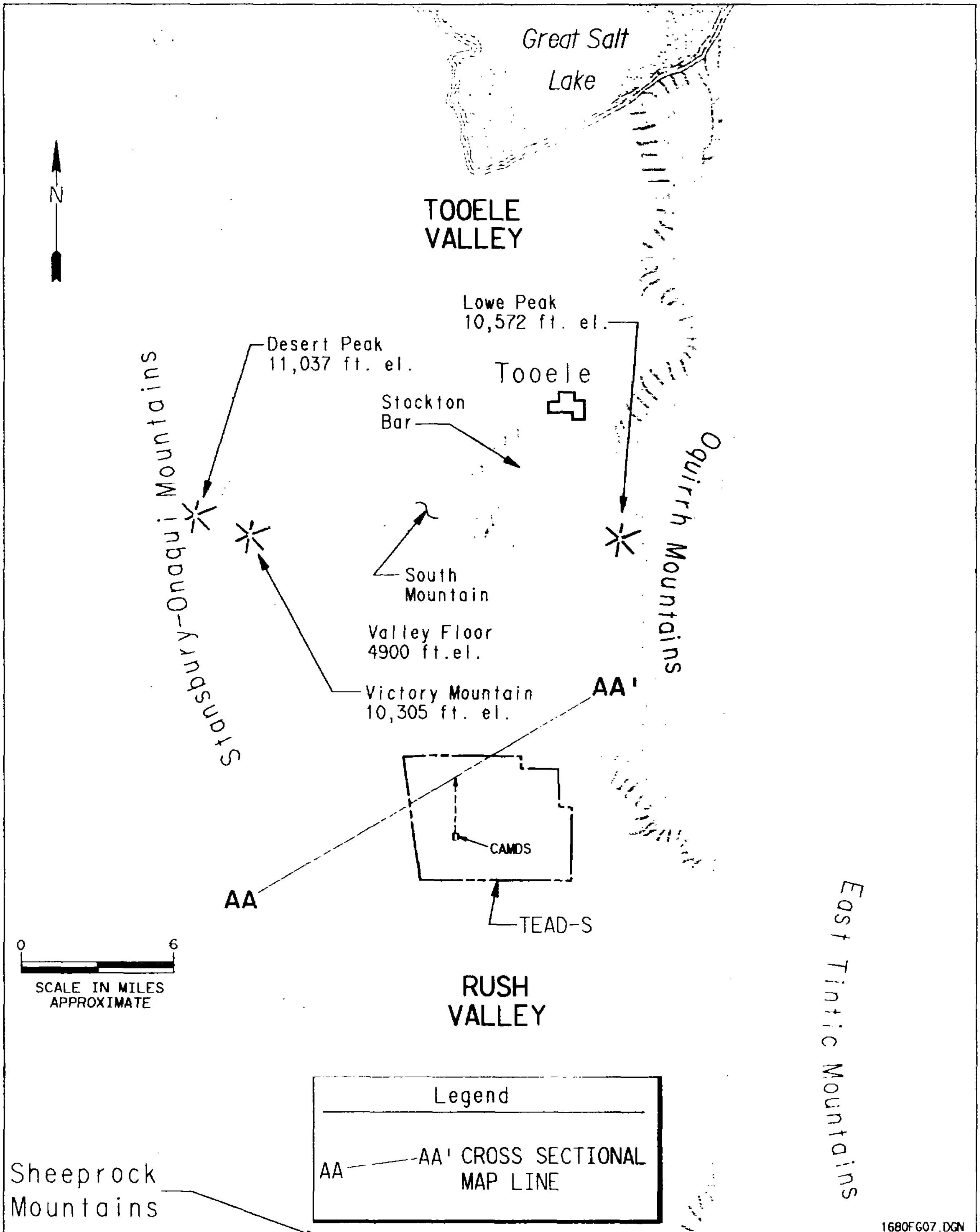

Figure 3-2. Relief and Cross Section Support Map of Rush Valley

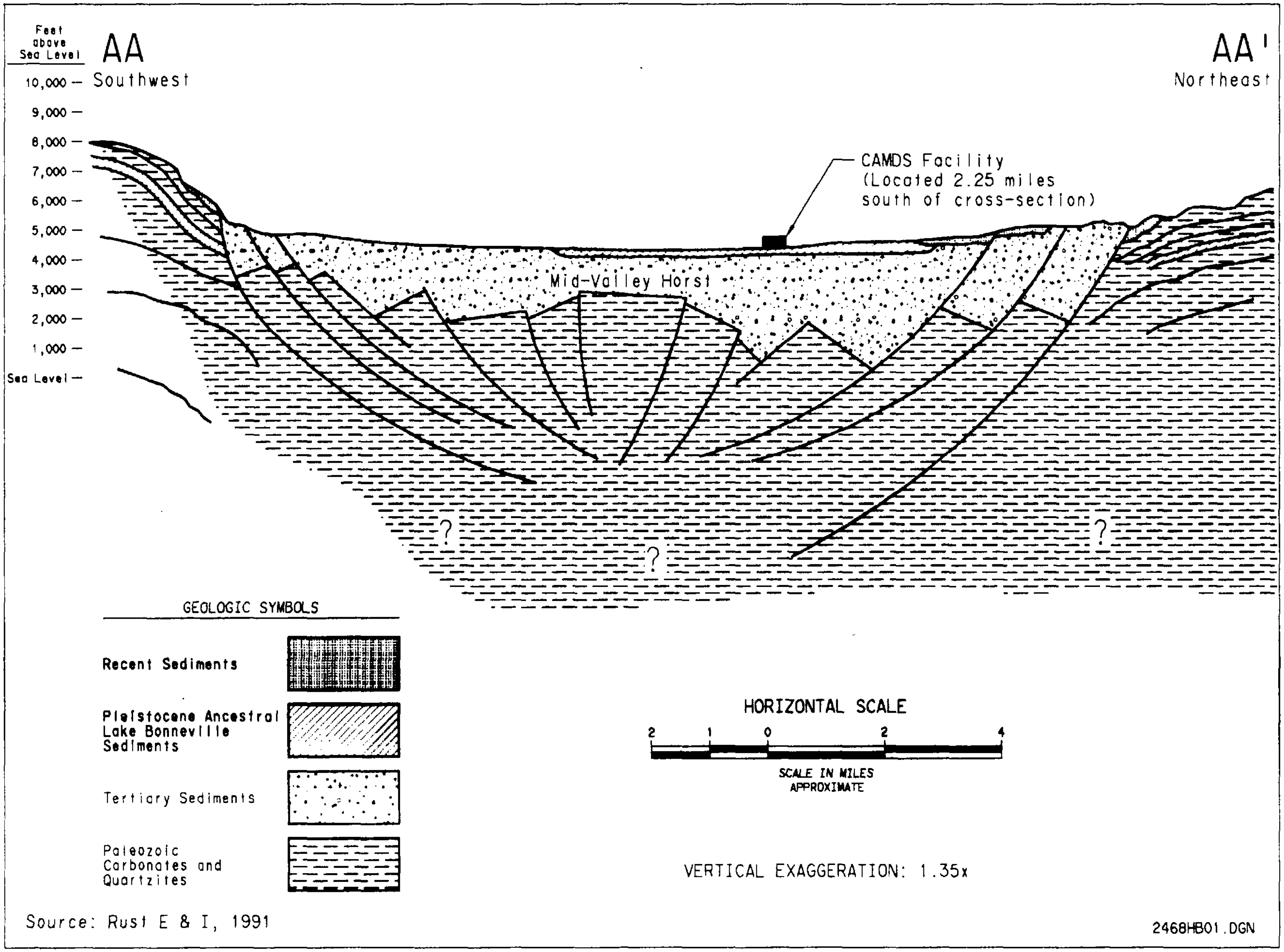

Figure 3-3. TEAD-S Structural Cross Section of Rush Valley

The fill has been generated from the regional uplift-subsidence cycles. The fill consists primarily of Tertiary age alluvial deposits, which have been named the Salt Lake Group. The Salt Lake Group deposits are primarily comprised of unconsolidated to moderately consolidated alluvial sands and gravels, and playa lake silts and clays that show slight-to-moderate dipping from post-deposition deformation during late Tertiary times. The deposits generally grade from predominantly fine to coarse-grained sediments from the valley center to the valley margins. Overlying and coalescing with the Salt Lake Group deposits are massive Quaternary alluvial fans that emanate from the surrounding mountain valleys and cover much of the peripheral valley floor. Lacustrine well-bedded silts and shoreline sands and gravels from Ancestral Lake Bonneville, along with playa lake evaporite-type materials, cover the lowest part of the valley floor. These Pleistocene age lacustrine and playa lake deposits have mixed with and covered many of the Tertiary and lower portions of the early Quaternary fan and fanglomerate deposits in the valley (see Figure 3-3).

3.2.4 Site-Specific Geology

The underlying geologic features at TEAD-S generally conform to the structural features existing throughout Rush Valley. Horst and graben fault-block structures of Paleozoic carbonates and quartzites form the valley basement under the installation. Moderately deformed Salt Lake Group alluvial deposits overlay these blocks and constitute most of the underlying valley sediments. The Salt Lake Group deposits outcrop on the eastern margins of the installation as coarse gravel conglomerate pediment surfaces, containing brown to red clay matrices. These pedimentary surfaces unconformably intertongue with, and have been overridden by, wide Quaternary bajadas formed by the coalescing alluvial fans that descend gently to the valley floor from the mountain-foot slopes immediately to the east of the installation. One of these alluvial fans outfalls from Ophir canyon and spreads across the installation in a west-to-southwest fanned array, forming most of the ground surface in the northern and western portion of TEAD-S. This massive fan enters the installation from the northeast, spreading westward and southward as it eventually thins in the southwestern area of TEAD-S. Deposits from this fan are generally coarse sand-gravel facies near the northeastern portion of TEAD-S, but as the slopes descend into the valley floor in a southwesterly direction and the deposition zones become more remote, the deposits trend toward more fining sand-silt-clay facies. Underlying deposits of lacustrine clay-silt facies near the valley floor show that much of the ancient Lake Bonneville clay deposits were not eroded away in this area and may remain intact under the more recent thin veneer of distal streams and playa lake ground-surface deposits.

3.2.4.1 *CAMDS Area (SWMU 13) Site Surficial Geology*

The CAMDS facility is located at the toe of a complex of coalescing Holocene alluvial fans that form undulating alluvial aprons along the western margins of the Oquirrh Mountain Range. The fans were derived primarily from streams coursing from Ophir Canyon, Silverado Canyon, and Mercur Canyon as they outfall into Rush Valley. Sediments from these fans overlap lake sediments of Lake Bonneville, which underlie the CAMDS facility on the valley floor. Soils along these fan toes are typical distal alluvial fan sediments that are very discontinuous across the CAMDS facility.

3.2.4.2 *Deactivation Furnace (SWMU 17) Site Geology*

The Deactivation Furnace rests on the Holocene-aged alluvial fan emanating from Ophir Canyon and the Oquirrh Mountains. This fan has channeled through and unconformably overridden the (Pre-Lake Bonneville) Tertiary-aged fans that had formed along the eastern margin of Rush Valley (Everitt and Kaliser 1980). These deposits are primarily arid alluvial fan deposits of unconsolidated materials, ranging from clays to large boulder-sized gravels.

3.3 HYDROLOGY

3.3.1 Regional Surface Water

Precipitation in the mountains surrounding the Rush Valley drainage basin is transported to the valley floor through a system of well defined tributary channels. Few streams in the valley are perennial; those that are perennial are sustained at periods of low flow by groundwater discharge in the form of springs and seeps at higher altitudes. Flow of these perennial streams is variable during the year, reaching a maximum discharge during the spring (Hood, Price, and Waddell 1969).

The majority of the streams in Rush Valley are intermittent. Loss of flow in these streams is the result of water infiltrating into the subsurface during transportation across the alluvial slopes. Most streams receive runoff only from snowmelt and summer rainfall during above-normal-precipitation years. Any flow remaining in the streams after water loss due to infiltration and evaporation eventually reaches Rush Lake, the major surface water body in northern Rush Valley. Rush Lake's water supply is further supplemented by springs (caused by groundwater discharging to the surface) along the eastern side of the lake (Hood, Price, and Waddell 1969).

3.3.2 Local Surface Water

TEAD-S lies in the north-central portion of Rush Valley, where the topography is dominated by moderate slopes of 5 percent in the northeast to nearly flat slopes in the southwest. In this region, all surface-water flow is restricted to intermittent streams. In addition to smaller, unnamed streams in the area, the principal intermittent streams located in the vicinity of TEAD-S include Ophir and Mercur Creeks, both originating in the Oquirrh Mountains to the east, and Faust Creek, which originates in the southern portion of the drainage basin (Weston 1991). Figure 3-4 shows these drainage features.

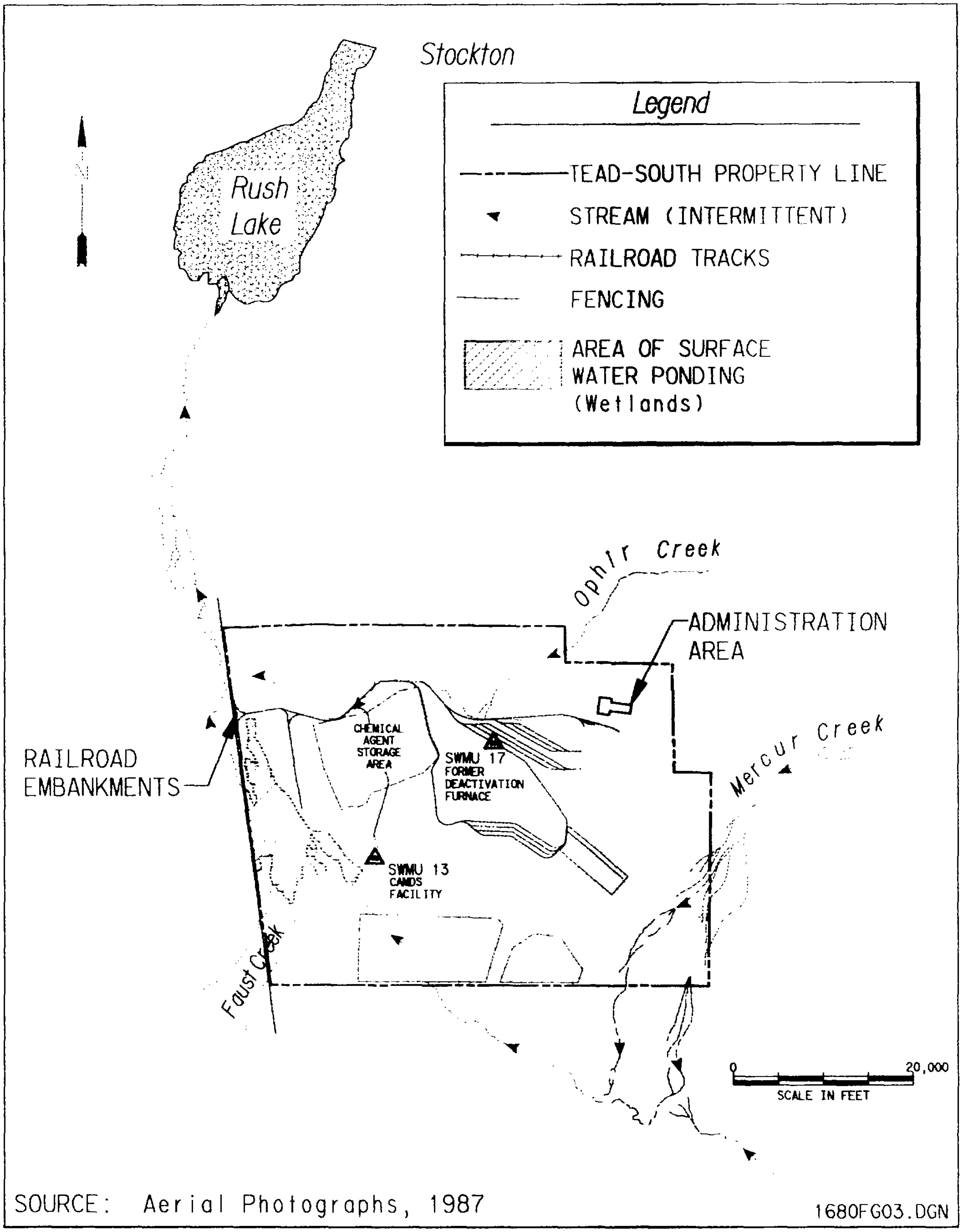

Figure 3-4. Northern Rush Valley Surface Water Features

Both Ophir Creek and Mercur Creek flow southwest from the Oquirrh Mountains toward the installation. Prior to reaching the site, the streams decrease in discharge, and a majority of the water is diverted away from flowing through TEAD-S. Flow in Ophir Creek is diverted for irrigation purposes before it reaches the facility boundary; however, during periods of high flow, runoff flows through the northeastern corner of the TEAD-S facility. Mercur Creek is intercepted by a drainage ditch along the eastern boundary, and the flow is redirected towards the south.

Faust Creek flows in a northerly direction down the center of the valley to Rush Lake, carrying surface water from numerous tributaries originating in the southern half of Rush Valley. This stream enters the southwestern corner of TEAD-S and flows north, where it eventually becomes dammed by two earthen railroad embankments (Union Pacific Railroad and Clover Siding, a railroad spur of TEAD-S). These embankments are located in the west-central perimeter of the installation and produce a shallow lake by backing Faust Creek up during high-precipitation periods of the year. Water gradually infiltrates the embankments and continues north to the natural Ophir Creek drainage. The last reported major flooding event occurred during the summer of 1989. Ponded water (up to 5 feet deep) covered several hundred acres of land between CAMDS and the embankment junction from May to early August of that year (Ebasco 1991). Any water north of the embankments flows into the natural Ophir Creek drainage system, which directs the runoff to the concrete culvert that passes through the railroad embankment to the west of TEAD-S, and then to the north to Rush Lake (Weston 1991).

Evidence suggests that there have been previous flooding events at other regions of the installation. A playa exists along the perimeter in the south-central region of TEAD-S that controls flow onto the installation from the off-site area to the south. During periods of heavy precipitation, this normally dry playa is exposed to shallow, lowland flooding, which causes low points of the southern perimeter road to be covered.

3.4 HYDROGEOLOGY

3.4.1 Regional Hydrogeology

Groundwater recharge in Rush Valley is primarily the direct result of precipitation on mountains within the drainage basin. Precipitation at lower elevations tends to be held by the soil and contributes a significantly smaller volume to the groundwater system (Hood, Price, and Waddell 1969). Recharge to the water table typically occurs through the infiltration of streams that flow from the mountains onto more permeable sediments of the alluvial fans in the basin.

Groundwater in the Salt Lake Group is generally unconfined. Confined conditions are restricted to the lower slopes of the alluvial fans, where interbedded thin beds of clay control groundwater flow. In areas of structural distortion of older unconsolidated rocks, a few springs and groundwater seeps exist on the alluvial slopes. In the vicinity of Rush Lake, springs are believed to be the result of an abrupt lateral change in grain size within the unconsolidated rocks, retarding groundwater flow and moving it to the surface (Hood, Price, and Waddell 1969). A regional groundwater divide extends from the mouth of Ophir Canyon in the Oquirrh Mountains to the eastern edge of the Onaqui Mountains (located along the western border of the drainage basin). This groundwater divide is the result of recharge in the area of the Ophir Creek alluvial fan.

North of the divide, groundwater moves from the northern Onaqui and southern Stansbury Mountains eastward, from the Oquirrh Mountains westward to the center of Rush Valley. The groundwaters from both mountain areas then merge and flow northward toward Rush Lake. Once in the vicinity of Rush Lake, groundwater is discharged from Rush Valley by (1) becoming part of the Rush Lake water body through springs and seeps along the eastern boundary of the lake; (2) releasing into the atmosphere by evapotranspiration, due to the shallow depths of groundwater in this area and the presence of numerous phreatophytes; or (3) discharging a small, but significant amount, from Rush Valley to Tooele Valley by flow underneath the Stockton Bar (Hood, Price, and Waddell 1969).

South of the divide, groundwater generally flows southeast. Discharge points in this region occur as springs and seeps through deposits of unconsolidated alluvium located at Five Mile Pass and Ten Mile Pass.

3.4.2 Existing Groundwater Monitoring Wells

Figure 3-5 shows the approximate location of existing production and groundwater monitoring wells at TEAD-S.

Numerous studies at TEAD-S have resulted in the installation of 107 groundwater monitoring wells. These wells were installed during several different field efforts, by different contractors. Table 3-2 lists these wells along with completion dates, surveyed elevations, and important construction data. Additional monitoring well information is presented in Appendix C.

Eleven wells (S-1 through S-8, S-10, S-12, and S-14) were installed in 1982 during an exploratory survey performed by ERTEC (ERTEC 1982). These wells were located within and around the boundary of TEAD-S. In 1986, four wells were installed by EA Engineering, Science, and Technology, Inc. (EA 1988) as part of a Preliminary Assessment/Site Investigation. Three of these wells (S-CAM-1, S-CAM-2, and S-CAM-3) were installed in the vicinity of the CAMDS facility and one (S-SBR-1) along the northern boundary of TEAD-S. S-CAM-3 was destroyed at a later date.

In 1988, 16 wells (S-16-88 through S-31-88) were installed by Roy F. Weston, Inc. (Weston), as part of the Phase I RFI. A majority of these wells were installed near CAMDS (Weston 1991). As part of another Phase I RFI, Ebasco installed 54 wells and 3 piezometers at TEAD-S in 1990, 1992, and 1993. The majority of these wells (S-32-90 through S-51-90, S-53-90 through S-71-90, S-74-90, S-75-90, S-93-92, S-95-92 through S-102-92, S-108-93 through

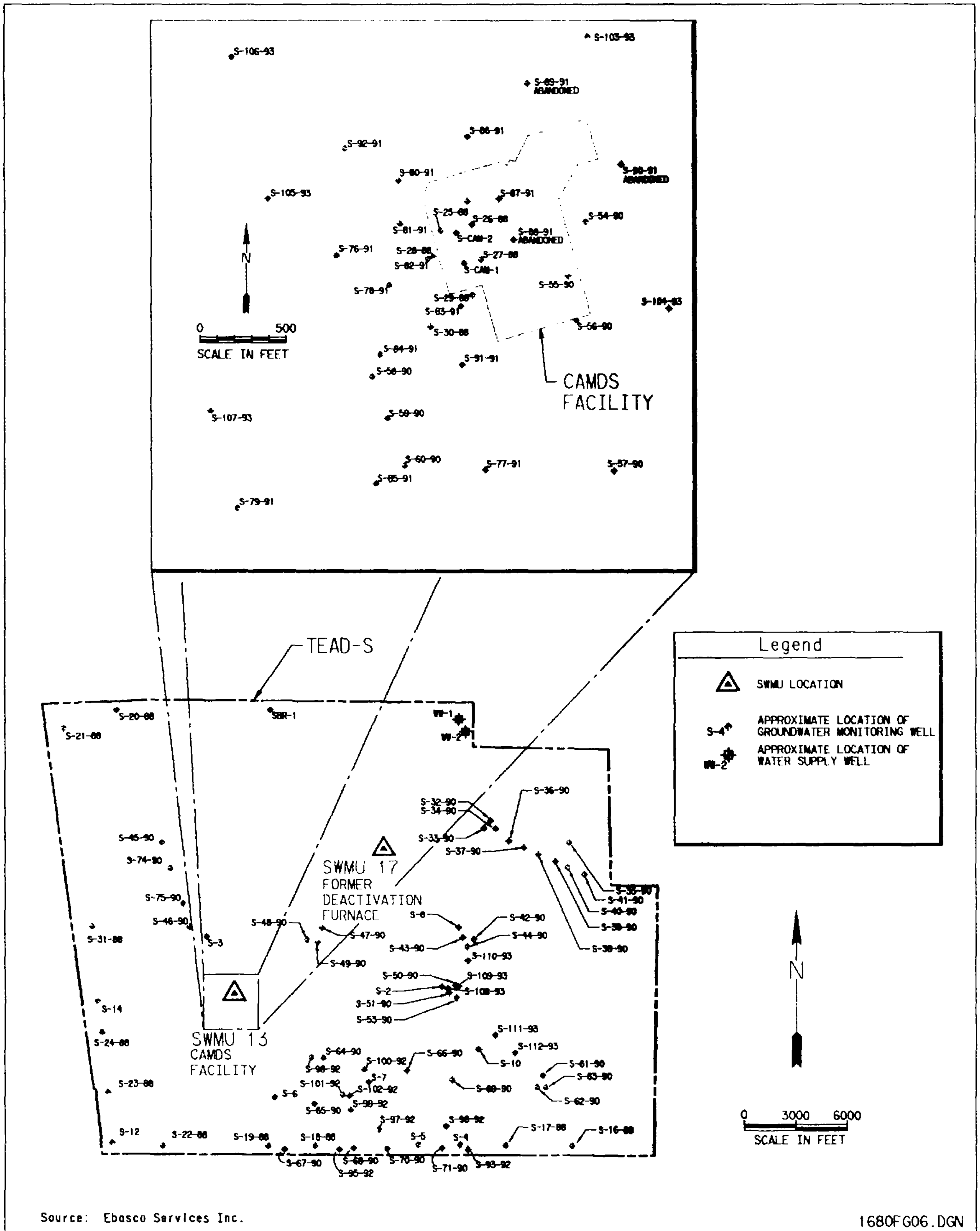

Figure 3-5. TEAD-S Location of Production and Monitoring Wells

Table 3-2. TEAD-S Well Construction Data

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-1	5-27-82	ERTEC	30	26.00	10.30	10	4	2.0	7.90	5040.01	5029.71	
S-2	2-19-82	ERTEC	5	86.50	56.50	20	4	2.82	50.00	5148.42	5091.92	
S-3	2-5-82	ERTEC	2	56.00	24.00	20	4	2.33	20.80	5053.63	5029.63	
S-4	1-21-82	ERTEC	1	91.00	64.00	20	4	2.64	34.50	5066.64	5002.64	
S-5	1-19-92	ERTEC	1	71.50	37.60	20	4	3.47	27.80	5052.07	5014.47	
S-6	2-10-82	ERTEC	25	46.00	15.30	20	4	3.03	10.00	5039.93	5024.63	
S-7	2-9-82	ERTEC	25	71.00	34.00	20	4	2.87	23.00	5048.77	5014.77	
S-8	3-2-82	ERTEC	21,22	100.00	65.00	20	4	2.78	50.60	5190.18	5125.18	
S-9	2/12/82	ERTEC	1	111.00	NA[e]	NA	NA	NA	NA	NA	NA	Dry
S-10	1-31-82	ERTEC	NA	101.50	70.00	20	4	3.1	57.00	5125.60	5055.60	
S-11	2/22/82	ERTEC	26	81.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-12	1-23-82	ERTEC	NA	46.50	34.00	5	4	3.26	27.50	5054.36	5020.36	
S-13	NA	ERTEC	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-14	1-30-82	ERTEC	NA	45.00	12.00	20	4	3.23	9.00	5039.13	5027.13	
S-15	2/20/82	ERTEC	NA	37.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-CAM-1	7-10-86	EA	30	23.00	5.60	16	2	2.54	3.20	5038.90	5033.30	
S-CAM-2	7-14-86	EA	30	23.98	5.50	18	2	2.53	3.50	5039.53	5034.03	

Table 3-2. TEAD-S Well Construction Data (continued)

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-CAM-3	7/14/86	EA	NA	21.00	5.50	15	2					
S-SBR-1	7-1-86	EA	NA	150.00	108.50	40	5	2.56	103.50	5229.38	5120.88	
S-16-88	10-19-88	WESTON	NA	172.00	131.00	40	4	1.7	119.00	5099.46	4968.46	
S-17-88	2-10-88	WESTON	NA	79.50	57.50	20	4	1.56	47.50	5077.28	5019.78	
S-18-88	2-11-88	WESTON	25	39.50	16.70	20	4	1.61	10.50	5037.68	5020.98	
S-19-88	2-11-88	WESTON	25	39.50	14.40	20	4	1.92	7.00	5059.79	5045.39	
S-20-88	6-29-88	WESTON	NA	122.00	77.00	40	4	1.77	70.00	5096.81	5019.81	
S-21-88	8-9-88	WESTON	NA	23.00	13.00	10	4	1.73	9.00	5026.67	5013.67	
S-22-88	3-14-88	WESTON	NA	23.00	12.50	10	4	2.08	9.00	5046.89	5034.39	
S-23-88	3-17-88	WESTON	NA	23.10	11.70	10	4	1.53	5.50	5053.63	5041.93	
S-24-88	3-16-88	WESTON	NA	20.50	9.70	10	4	1.92	6.30	5041.32	5031.62	
S-25-88	3-22-88	WESTON	NA	23.50	9.50	10	4	flush	5.70	5039.04[f]	5029.54	
S-26-88	3-23-88	WESTON	30	21.50	9.40	10	4	flush	6.00	5039.64[f]	5030.24	
S-27-88	3-29-88	WESTON	30	22.00	10.10	10	4	flush	6.10	5038.97[f]	5028.87	
S-28-88	3-31-88	WESTON	30	18.20	7.50	10	4	2.5	4.50	5041.09	5033.59	
S-29-88	4-1-88	WESTON	30	20.00	8.30	10	4	2.3	4.80	5038.79	5030.79	
S-30-88	4-7-88	WESTON	30	20.50	7.70	10	4	2.3	4.60	5037.67	5029.97	
S-31-88	4-9-88	WESTON	NA	18.80	7.90	10	4	1.97	5.50	5036.99	5029.09	

Table 3-2. TEAD-S Well Construction Data (continued)

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-49-90	6-16-90	EBASCO	15	109.30	99.00	10	4	2.2	94.00	5140.63	5041.63	
S-50-90	6-1-90	EBASCO	5	69.15	56.95	10	4	2.4	52.00	5153.09	5096.14	
S-51-90	6-18-90	EBASCO	5	70.00	56.00	10	4	2.3	51.00	5148.18	5092.18	
S-52-90	NA	EBASCO	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-53-90	6-19-90	EBASCO	5	70.50	59.50	10	4	2.3	54.00	5149.99	5090.49	
S-54-90	6-15-90	EBASCO	30	29.00	17.50	10	4	2.5	12.50	5050.63	5033.13	
S-55-90	6-16-90	EBASCO	30	19.00	8.00	10	4	2.5	5.00	5042.40	5034.40	
S-56-90	6-20-90	EBASCO	30	50.00	39.00	10	4	2.5	34.00	5052.69	5013.69	
S-57-90	6-28-90	EBASCO	30	20.00	7.00	10	4	2.5	5.00	5037.94	5030.94	
S-58-90	6-3-90	EBASCO	30	16.00	4.00	10	4	2.5	2.50	5036.53	5032.53	
S-59-90	6-6-90	EBASCO	30	16.00	5.00	10	4	2.5	3.00	5035.72	5030.72	
S-60-90	6-13-90	EBASCO	30	18.00	7.00	10	4	2.5	3.00	5034.91	5027.91	
S-61-90	6-11-90	EBASCO	3	97.00	86.70	10	4	2.6	81.00	5122.94	5036.24	
S-62-90	7-1-90	EBASCO	3	105.00	83.30	20	4	2.5	78.90	5117.99	5034.69	
S-63-90	6-17-90	EBASCO	3	105.00	84.00	20	4	2.5	78.30	5118.45	5034.45	
S-64-90	7-10-90	EBASCO	25	35.00	24.50	10	4	2.5	17.10	5045.45	5020.95	
S-65-90	6-29-90	EBASCO	25	28.00	15.00	10	4	2.5	10.00	5038.17	5023.17	
S-66-90	7-3-90	EBASCO	25	95.00	84.00	10	4	2.5	78.00	5058.86	4974.86	
S-67-90	5-14-90	EBASCO	25	39.00	26.00	10	4	2.5	21.00	5038.86	5012.86	

Table 3-2. TEAD-S Well Construction Data (continued)

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-69-90	7-16-90	EBASCO	1	125.50	112.70	10	4	2.5	106.60	5104.42	4991.72	
S-70-90	7-10-90	EBASCO	1	50.00	40.00	10	4	2.5	34.00	5060.95	5020.95	
S-71-90	7-13-90	EBASCO	1	70.00	58.00	10	4	2.5	50.00	5056.24	4998.24	
S-72-90	NA	EBASCO	31	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-73-90	NA	EBASCO	31	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-74-90	5-23-90	EBASCO	11	30.00	19.25	10	4	2.5	14.00	5052.54	5033.29	
S-75-90	5-23-90	EBASCO	11	25.00	15.00	10	4	2.5	10.00	5049.62	5034.62	
S-P1-90	NA	EBASCO	15	131.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-P2-90	NA	EBASCO	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-P3-90	5-4-90	EBASCO	25	17.00	10.00	5	2	2.5	7.00	5041.42	5031.42	
S-P4-90	5-3-90	EBASCO	25	22.50	6.50	5	2	2.5	4.00	5036.48	5029.98	
S-P5-90	5-3-90	EBASCO	2	12.50	5.00	5	2	2.5	3.50	5035.11	5030.11	
S-P6-90	NA	EBASCO	NA	80.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-76-91	6-18-91	RUST E&I	13	23.5	8.00	15	4	2.07	6.00	5038.89	5028.82	
S-77-91	6-23-91	RUST E&I	13	18.0	8.00	10	4	1.86	7.00	5034.14	5024.28	
S-78-91	5-29-91	RUST E&I	13	22.70	7.70	15	4	2.08	6.00	5038.34	5028.58	
S-79-91	6-17-91	RUST E&I	13	17.00	7.00	10	4	1.92	6.00	5035.20	5026.28	
S-80-91	5-28-91	RUST E&I	13	22.65	7.65	15	4	2.11	6.00	5041.52	5031.76	

Table 3-2. TEAD-S Well Construction Data (continued)

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-81-91	5-28-91	RUST E&I	13	22.65	7.65	15	4	1.86	6.00	5040.87	5031.36	
S-82-91	5-16-91	RUST E&I	13	23.00	13.00	10	4	1.93	9.50	5040.35	5025.42	
S-83-91	5-17-91	RUST E&I	13	23.50	13.50	10	4	1.72	9.50	5037.97	5022.75	
S-84-91	5-18-91	RUST E&I	13	25.35	5.35	20	4	1.94	4.50	5036.24	5028.95	
S-85-91	5-20-91	RUST E&I	13	21.65	6.65	15	4	1.99	5.00	5034.12	5025.48	
S-86-91	6-21-91	RUST E&I	13	16.65	11.65	5	4	2.08	8.00	5045.90	5032.17	
S-87-91	5-14-91	RUST E&I	13	17.00	7.00	10	4	flush	4.65	5041.69	5034.69	
S-88-91	5-15-91	RUST E&I	13	44.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-89-91	5-30-91	RUST E&I	13	31.00	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-90-91	NA	RUST E&I	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Drilled
S-91-91	5-19-91	RUST E&I	13	23.70	3.70	20	4	1.85	3.70	5036.55	5031.00	
S-92-91	6-20-91	RUST E&I	13	25.65	10.65	15	4	1.89	8.00	5041.41	5028.87	
S-93-92	12/9/92	EBASCO	1	151.5	136	15.5	4	2.8	23.5	5072.95	4934.15	
S-94-92	NA	EBASCO	NA	NA	NA	NA	NA	NA	NA	NA	NA	Abandoned
S-95-92	11/18/92	EBASCO	25	128	102.5	25.5	4	2.1	31.0	5046.06	4941.46	
S-96-92	11/19/92	EBASCO	1	114.5	99.5	15	4	2.3	20.0	5071.51	4969.71	
S-97-92	12/2/92	EBASCO	25	83	72.5	10.5	4	2.6	18.0	5086.54	5011.44	
S-98-92	12/3/92	EBASCO	25	39.2	28.7	10.5	4	2.5	15.9	5048.76	5017.56	

Table 3-2. TEAD-S Well Construction Data (continued)

Well No.	Date Installed	Contractor	SWMU No.	Total Depth[a] (ft)	Depth Top Of Screen (ft)	Screen Length (ft)	Casing Diameter (in)	Stickup (ft)	Depth Top Filter Pack (ft)	TOC[b] Elev. (MSL)[d]	TOS[c] Elev. (MSL)	Comment
S-99-92	12/7/92	EBASCO	25	38.5	28	10.5	4	2.4	15.5	5048.94	5018.54	
S-100-92	12/10/92	EBASCO	25	74.3	59.3	15	4	2.2	20.3	5076.88	5015.38	
S-101-92	12/6/92	EBASCO	25	50.5	40	10.5	4	2.5	16.5	5059.32	5016.82	
S-102-92	12/7/92	EBASCO	25	44	33.5	10.5	4	2.2	16.0	5053.76	5018.06	
S-103-93	8-19-93	RUST E&I	13	49.4	40.1	10	4	2.3	35.4	5056.52	5014.12	
S-104-93	8-8-93	RUST E&I	13	71.4	62.1	10	4	2.3	56.5	5068.26	5003.86	
S-105-93	8-5-93	RUST E&I	13	17.4	8.1	10	4	2.2	5.8	5038.37	5028.07	
S-106-93	8-20-93	RUST E&I	13	51.0	41.0	10	4	2.5	40.0	5040.61	4997.11	
S-107-93	8-21-93	RUST E&I	13	48.8	38.7	10	4	2.5	34.8	5034.61	4993.36	
S-108-93	10/11/93	EBASCO	5	77.0	65.0	10	4	1.7	57.0	5146.11	5079.41	
S-109-93	10/29/93	EBASCO	5	74.3	62.5	10	4	2.0	57.0	5150.42	5085.92	
S-110-93	11/1/93	EBASCO	9	83.6	73.0	10	4	2.3	67.4	5164.69	5089.39	
S-111-93	11/12/93	EBASCO	9	72.75	62.0	10	4	2.3	57.0	5127.35	5063.05	
S-112-93	11/10/93	EBASCO	9	80.2	70.2	10	4	2.3	64.8	5125.35	5052.85	

[a]All depth measurements are from ground surface.
[b]TOC=top of casing.
[c]TOS=top of screen.
[d]MSL=mean sea level.
[e]NA=not applicable.
[f]Elevation uncertain in flush-mounted wells.

S-112-93, S-P3-90, S-P4-90, and S-P5-90) have some association with CAMDS. No wells have been placed on or around the DF/MC Site (SWMU 17). Rust E&I installed 19 wells (S-76-91 through S-87-91, S-91-91, S-92-91, and S-103-93 through S-107-93) in the vicinity of SWMU 13 as part of this Phase II RFI.

3.4.3 Local Hydrogeology

Figure 3-6 is a groundwater contour map for the entire TEAD-S facility based on water level data collected in February 1991 by Ebasco (Table 3-3). As the figure shows, there are three main flow directions for groundwater underlying the site: west, southwest, and south-southeast. The flow line trending to the southwest approximately follows the location of the groundwater divide described by Hood, Price, and Waddell (1969).

As a general rule, groundwater monitoring wells have been screened in the top of the shallowest aquifer. Groundwater is generally encountered under unconfined conditions; however, there are a number of wells associated with confined groundwater. Depths to groundwater range from 7 feet bgs in the southwestern portion of the site to 289 feet bgs in the northeastern region of TEAD-S (Ebasco 1991). This difference in depth to groundwater is the result of the northeastern portion of the installation being topographically higher than the southwestern portion of the site.

According to slug test results from wells across the facility, groundwater flow velocities range from 4 to 24 feet per day. The higher velocities were encountered in the northeastern half of TEAD-S, where the surface material is predominantly alluvial gravels and sands. The lower flow velocities occur in the southwestern portion of the site, where the groundwater flow is restricted by silt and clay lake bed deposits.

Seasonal fluctuations in groundwater elevations are generally 2 to 3 feet, with the lowest elevations occurring in October/November and the highest in April/May. The maximum reported seasonal variation was 6 feet (Ebasco 1991). These seasonal variations produce no large-scale differences in the overall flow directions. According to data collected in 1987 and 1991, the groundwater elevations in various wells have decreased only 1 to 2 feet during this time period. Historical groundwater elevation data collected since 1982 are included in Appendix A.

3.5 TERRESTRIAL ECOLOGY AND BIOTA

3.5.1 Water Use

A Utah Division of Water Rights (UDWR) records search was conducted to determine water uses and points of diversion in the vicinity of SWMU 13 and SWMU 17. Within a 5-mile radius of these sites, water uses include irrigation, domestic, livestock, and mining. The point

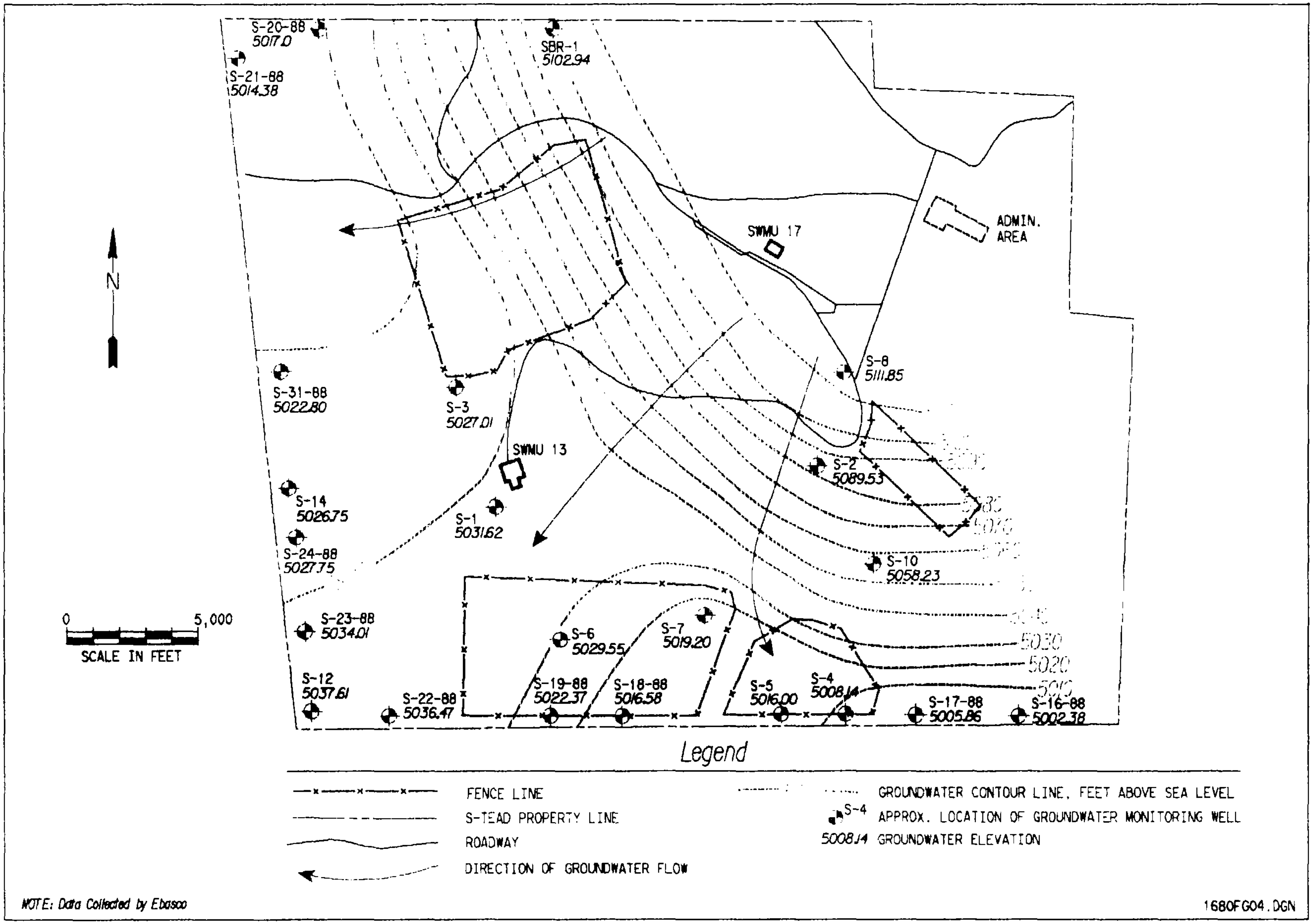

Figure 3-6. TEAD-S Groundwater Contour Map February, 1991

Table 3-3. TEAD-S Groundwater Elevation Data

Well Number	TOC[a] Elev (ft)	DTW[b] (ft)	GW[c] Elev (ft)
S-1	5,040.00	8.38	5,031.62
S-2	5,148.42	58.89	5,089.53
S-3	5,053.63	26.62	5,027.01
S-4	5,066.64	58.50	5,008.14
S-5	5,052.07	36.07	5,016.00
S-6	5,039.93	10.38	5,029.55
S-7	5,048.77	29.57	5,019.20
S-8	5,190.18	78.33	5,111.85
S-10	5,125.60	67.37	5,058.23
S-12	5,054.36	16.75	5,037.61
S-14	5,039.13	12.48	5,026.65
S-16-88	5,099.46	97.08	5,002.38
S-17-88	5,077.28	71.42	5,005.86
S-18-88	5,037.68	21.10	5,016.58
S-19-88	5,059.79	37.42	5,022.37
S-20-88	5,096.81	79.81	5,017.00

Table 3-3. TEAD-S Groundwater Elevation Data (continued)

Well Number	TOC[a] Elev (ft)	DTW[b] (ft)	GW[c] Elev (ft)
S-21-88	5,026.67	12.29	5,014.38
S-22-88	5,046.89	10.42	5,036.47
S-23-88	5,053.63	19.62	5,034.01
S-24-88	5,041.32	13.57	5,027.75
S-31-88	5,036.99	14.19	5,022.80
SBR-1	5,229.38	126.44	5,102.94

Note.—Data collected by Ebasco, February 1991.
[a]TOC Elev=top of casing elevation above sea level.
[b]DTW=depth to water measured from top of casing.
[c]GW Elev=groundwater elevation above sea level.

at which a water resource is diverted for specific use is called a point of diversion. Points of diversions are mainly in the form of wells; however, some diversions are associated with nearby creeks and washes.

According to UDWR records, there are 38 diversions within a 5-mile radius of SWMU 13, and 85 diversions within 5 miles of SWMU 17. Figure 3-7 shows the approximate locations of the diversions that Rust E&I was able to identify. All of the diversions are used for domestic purposes. It is important to note that these locations are approximate because exact locations are not provided in UDWR records. As a result, locations shown in Figure 3-7 are based on township, range, and quarter section information. Additional data on these wells and the other diversions (e.g., water right number, type, use, etc.) are included in Appendix A.

The majority of these diversions are privately owned wells located in the vicinity of the town of Clover, northwest of TEAD-S. These wells are on average 100 to 150 feet deep. Along the base of the Oquirrh Mountains to the northeast, there are also a number of wells. All of these wells, which are commercially owned and used for mining activity, are approximately 1,000 feet deep.

3.5.2 Land Use

Private land along Faust Creek adjoining the southwestern border of TEAD-S is fenced for the grazing of beef cattle. The Faust Creek area is grazed from November 1 through April 30. The summer months are too hot for grazing, and water is not available for feed crops.

The land to the west is grazed by sheep in the winter months, with the exception of a fenced area on the northwestern border of TEAD-S. This area is the Clover Riparian Project, an area closed to human traffic and intended as habitat for waterfowl (e.g., Canada geese, mallard ducks, etc.). The project was initiated after heavy rains and flooding produced a pond and wetlands area. Normal annual precipitation resulted in insufficient water in the project area to maintain year-round surface water. Riparian species have not been sighted in the project area in recent years; however, there is potential for their return if heavy rains recur.

The area immediately north of TEAD-S is used for grazing sheep; whereas, the area north of Highway 73 is used for grazing beef cattle. The northern part of the eastern side of TEAD-S is used for grazing sheep. These same sheep also graze around the south side, up to the fenced area where the beef cattle graze along Faust Creek. The sheep that graze around TEAD-S are raised as food (i.e., primarily to produce lambs). All of this grazing ground around TEAD-S is permitted by the Bureau of Land Management (BLM).

Recreational use of the land surrounding TEAD-S includes hunting (for dove, jackrabbits, and, to a lesser extent, deer, antelope, coyote, and badger), off-highway vehicling (with motorcycles and four-wheelers being the most common north and south of TEAD-S), and camping and hiking (often at the BLM park located at Rush Lake 6.6 miles north of TEAD-S

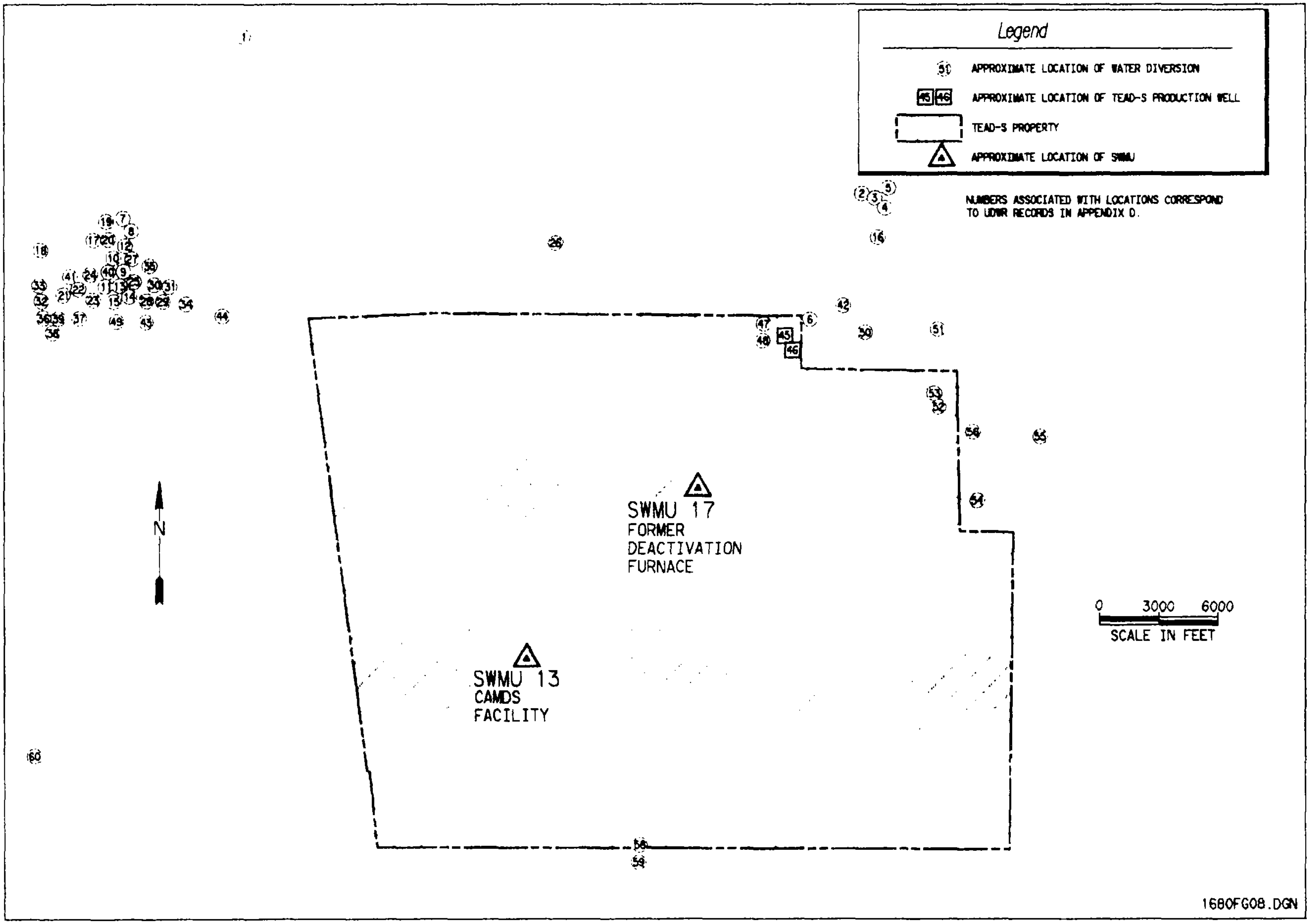

Figure 3-7. TEAD-S Domestic Water Diversion Locations

and on the Pony Express Trail south of TEAD-S). The Ajax Historical Site, a former general store and boarding house, is located near the southwestern corner of TEAD-S but is not considered a major recreational land-use area.

3.5.3 Soils

This section contains general information regarding the environmental setting of soils in the TEAD-S area, soil-mapping unit descriptions, and land-use capability. Also included is a soil map for TEAD-S (labeled Plate 1 and located inside the back jacket of the binder in a plastic envelope). The U.S. Soil Conservation Service (SCS) Soil Survey Report for Tooele County (SCS 1992) was the basis and primary source of information for the soils survey at the TEAD-S site.

3.5.3.1 *Regional Soils*

Parent material is the material from which a soil is formed through a variety of physical and chemical processes. The type of parent material greatly influences the type of soils that develop. The soils of TEAD-S are derived from alluvium and lacustrine deposits (see Section 3.2.4). Surficial soils at TEAD-S are derived from two primary sources: (1) lake-bed sediments with low to moderate permeability and (2) colluvial and alluvial deposits with moderate to high permeability.

Climate influences soil development and productivity in several important ways: the accumulation of organic matter in the surface layer; the translocation of soluble salts, minerals, and clays; and the formation of distinct soil horizons. Annual precipitation in this region ranges from about 10 to 12 inches per year with about half (i.e., 6 inches) occurring as winter snowfall. Flash flooding may occur in the valley primarily as a result of summer thunderstorms.

Because of the low precipitation, soil productivity within this region is low and concretionary layers may form (SCS 1992), resulting in decreased vegetative cover. This, in turn, reduces the amount of organic matter in the soil, which decreases water-holding capacity. Additionally, because of the low precipitation, the translocation of salts, minerals, and clays, and the resulting formation of soil horizons are limited. With a water deficiency, dry soils do not develop strong diagnostic horizons (identification layering) except for salt crusts or concretionary layers. During dry periods, water can be drawn through the soil by capillary action and evaporate either in the soil profile or at the ground surface. Calcium carbonate, or caliche layers, may form in desert soils under these conditions.

Soil crusting also affects soil productivity. It reduces infiltration rates, thereby limiting both the depth to which salts are leached and the depth to which roots can penetrate. Many of the soils in this area are susceptible to forming a surface crust. The sparse vegetative cover exposes more soil to raindrop impact, which tends to compact the soil surface and break down the soil surface structure into a massive condition. This reduces the amount of large pore space available for infiltration. The high sodium content of many soils in the region disperses soil particles, which results in a naturally poor soil surface structure.

The natural erosion rates of soils within the region are high. This is caused by low vegetative cover, soil crusting, low organic matter content, and easily eroded parent materials. Additionally, the dispersal property of sodium makes soil particles more easily detached by wind and water.

Topographic relief significantly affects soil development in terms of its drainage, elevation, aeration, aspect, steepness of slope, and susceptibility to erosion. Generally, steep south-facing and west-facing slopes are warmer and drier than north-facing and east-facing slopes. The result is that snow and moisture accumulate to a greater extent on the cooler, north-facing and east-facing slopes; the vegetative composition is more dense, thereby accumulating more organic matter.

3.5.3.2 *Survey Methodology*

The basis and primary source of information for the soil survey of TEAD-S was the SCS soil survey report for Tooele County (SCS 1992). Supplemental literature included Weston (1991) and Welsh (1987). These sources were utilized to coordinate data and information obtained during the RFI.

The SCS office in Midvale, Utah, was contacted in order to coordinate soils in the TEAD-S facility area with the National Cooperative Soil Survey. Established or proposed soil series for this area were used. Soils mapping for this report consisted primarily of refining soil delineations previously established by the SCS survey (SCS 1992). The TEAD-S site was mapped in an analogous manner to the SCS survey, and the mapping detail was only slightly increased.

3.5.3.3 *Soil Survey Results*

3.5.3.3.1 ***Mapping Unit Descriptions***. The soil types identified on the TEAD-S facility are summarized in Table 3-4, along with the approximate number of acres and percentage each occupies within the facility area. The soil mapping unit descriptions follow. The following paragraphs provide a detailed description of the soils listed in Table 3-4.

These soil mapping unit descriptions have been summarized from the unpublished SCS soil mapping unit and soil series descriptions. Summaries are provided in order to briefly characterize and describe the soils present on the TEAD-S facility area. The soil mapping units are ordered according to soil productivity, from least productive to most productive, with the two miscellaneous units (Slickens and Mine Dumps, and Pits) described last.

Table 3-4. TEAD-S Facility Area Soils and Acreages

Type	Avg. Slope (%)	Acres at TEAD-S	Percentage of TEAD-S
Skumpah silt loam	0-1	928	5
Cliffdown gravelly sandy loam	2-15	1,203	6
Tooele fine sandy loam	0-5	2,979	15
Timpie silt loam	0-3	144	1
Taylorsflat loam, saline	0-3	2,066	11
Skumpah silt loam, saline	0-2	754	4
Hiko Peak gravelly loam	2-15	5,543	29
Taylorsflat loam	1-5	3,601	19
Bramwell silt loam	0-2	1,402	7
Birdow loam	1-4	331	2
Logan silt loam	0-1	191	1
Slickens & Mine Dumps	None	207	1
Pits	None	52	>1

Skumpah silt loam, wet substratum, saline, 0 to 1 percent slopes. This very deep, well drained soil is found in depressional areas on lake terraces. It formed in alluvium and lacustrine sediments derived from mixed rock sources. Slopes are long and linear.

Typically, the surface layer is slightly saline, light gray silt loam 2 inches thick. The upper 7 inches of the subsoil is moderately saline, very pale brown silty clay loam. The lower part to a depth of 23 inches is moderately to strongly saline, very pale brown and light gray silt loam and silty clay loam. The substratum to a depth of 60 inches or more is a strongly saline, white silt loam. The soil has accumulations of sodium below 2 inches and gypsum below 9 inches. In some areas the surface layer is silty clay loam. In other areas, the underlying material is clay loam.

This unit is used for rangeland and wildlife habitat; however, the suitability for livestock grazing is poor because of low forage production. This mapping unit is in Capability Subclass VIIs, nonirrigated (see Section 3.5.3.3.2 for description of Capability Classes and Subclasses).

Cliffdown gravelly sandy loam, 2 to 15 percent slopes. This very deep, somewhat excessively drained soil occurs on fan terraces. It formed in alluvium derived dominantly from sedimentary rocks. Slopes are medium to long and are linear or convex.

Typically the surface layer is moderately alkaline, pale brown fine gravelly sandy loam 5 inches thick. The underlying material to a depth of 60 inches or more is strongly alkaline, very slightly saline to slightly saline, very pale brown very gravelly sandy loam. In some areas the surface layer is gravelly loam or very gravelly sandy loam, and the underlying material contains thin layers of very gravelly loamy sand. In a few areas, slopes are 15 to 30 percent.

This unit is used for rangeland and wildlife habitat. Small irrigated areas are used for alfalfa, barley, and pasture. The suitability for livestock grazing is poor because of low forage production. This mapping unit is in Capability Subclass IVe, irrigated and VIIs, nonirrigated.

Tooele fine sandy loam, 0 to 5 percent slopes. This very deep, well drained soil is on lake terraces and fan terraces. It formed in eolian material, lacustrine sediments, and alluvium derived from mixed rock sources. Slopes are long and linear or slightly convex.

Typically, the surface layer is very slightly saline, pale brown fine sandy loam 3 inches thick. The upper 39 inches of the underlying material is slightly saline, very pale brown fine sandy loam. The lower part to a depth of 60 inches or more is moderately saline, very pale brown fine sand. In some areas the surface layer is silt loam or loam. Some areas are very fine sandy loam or fine sandy loam to a depth of 60 inches or more.

This unit is used for rangeland and wildlife habitat. Small irrigated areas are used for alfalfa, barley, and pasture. The suitability for livestock grazing is fair because of moderate forage productivity. This mapping unit is in Capability Subclass IVs, irrigated, and in VIIs, nonirrigated.

Timpie silt loam, 0 to 3 percent slopes. This very deep, well drained soil is on lake terraces and fan terraces. It formed in lacustrine sediments and alluvium derived dominantly from limestone and quartzite. Slopes are long and linear to slightly convex.

Typically the surface layer is pale brown silt loam 5 inches thick. The upper 9 inches of the underlying material is slightly saline, very pale brown silt loam. The lower part to a depth of 60 inches or more is strongly saline, very pale brown silt loam. In some areas the surface layer is fine sandy loam or loam.

This unit is used for rangeland and wildlife habitat. Small irrigated areas are used for alfalfa, barley, and pasture. The suitability for livestock grazing is fair because of moderate forage production. The Capability Subclass is IVs, irrigated, and VIIs, nonirrigated.

Taylorsflat loam, saline, 0 to 3 percent slopes. This very deep, well drained soil is on lake terraces and fan terraces. It formed in alluvium and lacustrine sediments derived from mixed rock sources. Slopes are medium in length and are linear to slightly convex.

Typically, the surface layer is strongly alkaline and very slightly saline, pale brown loam 3 inches thick. The upper 6 inches of the subsoil is very strongly alkaline and very slightly saline, light yellowish brown loam. The lower 38 inches is very strongly alkaline and slightly saline to moderately saline, very pale brown loam. The substratum to a depth of 60 inches or more is strongly alkaline and moderately saline, pale brown loam. In some areas the surface layer is silt loam. Some areas are silt loam throughout the profile and some areas are gravelly loam below a depth of 40 inches.

This unit is used for rangeland, wildlife habitat, building site development, irrigated alfalfa, irrigated barley, and irrigated pasture. The suitability for livestock grazing is fair because of moderate forage production. This mapping unit is in Capability Subclass IVs, irrigated, and VIs, nonirrigated.

Skumpah silt loam, saline, 0 to 2 percent slopes. This very deep, well drained soil is on lake terraces. It formed in alluvium and lacustrine sediments derived from mixed rock sources. Slopes are long and linear.

Typically, the surface layer is slightly saline, light gray silt loam 4 inches thick. The upper 7 inches of the subsoil is moderately saline, light yellowish brown silty clay loam. The lower 16 inches is strongly saline, white silty clay loam. The substratum to a depth of 60 inches or more is strongly saline, white silty clay loam. This soil has accumulations of sodium below 4 inches and gypsum below 18 inches. In some areas the surface layer is silty clay loam.

This unit is used for rangeland and wildlife habitat; however, the suitability of this unit for livestock grazing is poor because of low forage production and the relative unpalatability of the dominant plants. The Capability Subclass is VIIs, nonirrigated.

Hiko Peak gravelly loam, 2 to 15 percent slopes. This very deep, well drained soil is on fan terraces. It formed in alluvium derived from mixed rock sources. Slopes are medium in length and are convex.

Typically, the surface layer is pale brown loam 4 inches thick. The upper 8 inches of the subsoil is light yellowish brown very gravelly loam. The lower part to a depth of 60 inches or more is very pale brown and light yellowish brown very gravelly loam or stony sandy loam. In some areas the subsoil is very cobbly loam.

This unit is used for rangeland; irrigated alfalfa, pasture, and grain; building site development; and wildlife habitat. The suitability for livestock grazing is good, and the suitability for rangeland seeding is fair because of low precipitation, slope, and rock fragments. The Capability Subclass is IVe, irrigated, and VIs, nonirrigated.

Taylorsflat loam, 1 to 5 percent slopes. This very deep, well drained soil is on lake terraces and fan terraces. It formed in alluvium and lacustrine sediments derived from mixed rock sources. Slopes are medium in length and are linear to convex.

Typically, the surface layer is moderately alkaline, pale brown loam 4 inches thick. The next layer is moderately alkaline, light yellowish brown loam 5 inches thick. The underlying layer to a depth of 60 inches or more is strongly alkaline and very slightly saline to moderately saline, very pale brown loam. In some areas the surface layer is silt loam or sandy loam. Some areas are gravelly loam or gravelly sandy loam below a depth of 40 inches.

This unit is used for rangeland, wildlife habitat, building site development, irrigated alfalfa, irrigated barley, and irrigated pasture. The suitability for livestock grazing is good. This mapping unit is in Capability Subclass IIIs, irrigated, and in VIs, nonirrigated.

Bramwell silt loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on low lake terraces and stream terraces. It formed in alluvium and lacustrine sediments derived from mixed rock sources. Slopes are medium in length and are linear to concave.

Typically, the surface layer is slightly saline, light brownish gray silt loam 6 inches thick. The subsoil is moderately saline, light brownish gray silt loam 14 inches thick over light gray silty clay loam 16 inches thick. The substratum is moderately saline, light gray silty clay loam to a depth of 60 inches or more. In some areas the surface layer is loam. In some areas the subsoil and substratum are fine or very fine sandy loam. This unit is slightly saline to moderately saline except in areas that have been leached by irrigation water.

This unit is used mainly for irrigated crops and pasture. It is also used for rangeland and building site development. The suitability for livestock grazing is good. The Capability Subclass is IVw, irrigated, and VIIw, nonirrigated.

Birdow loam, 1 to 4 percent slopes. This very deep, well drained soil is on flood plains, stream terraces, and alluvial fans. It formed in alluvium derived dominantly from limestone and quartzite. Slopes are long and are linear or slightly concave.

Typically, the surface layer is grayish brown to brown loam 28 inches thick. The upper 22 inches of the underlying material is pale brown loam. The lower part to a depth of 60 inches or more is brown loam. In some areas the soil is sandy loam. Some areas have gravelly layers in the profile.

This unit is used for rangeland, wildlife habitat, building site development, irrigated pasture, and irrigated cropland. The suitability for livestock grazing is good. The Capability Subclass is IIe, irrigated, and VIs, nonirrigated.

Logan silt loam, 0 to 1 percent slopes. This very deep, poorly drained soil is on flood plains. It formed in alluvium derived from mixed rock sources. Slopes are medium in length and are linear to slightly concave.

Typically, the surface layer is very slightly saline, dark grayish brown to dark gray silt loam 15 inches thick. The underlying material to a depth of 60 inches or more is gray to white silty clay loam. In some areas the underlying material is silt loam or silty clay. Some areas are nonsaline in the surface layer.

This unit is used mainly for meadow hay, pasture, and wildlife habitat, and the suitability for livestock grazing is good. This unit is poorly suited for cropland, unless drained and irrigated; the main limitations are a high water table and occasional flooding. The Capability Subclass is VIIw, nonirrigated.

Slickens and Mine Dumps. Slickens are accumulations of fine-textured material, such as that separated in placer-mine and ore-mill operations. Slickens from ore mills consist largely of freshly ground rock that commonly has undergone chemical treatment during the milling process. Such material is usually detrimental to plant growth. This unit contains high amounts of toxic chemicals, less than 10 percent vegetative cover, and large deep gullies.

Mine dumps consist mostly of rock fragments removed in mining operations and left in piles. The material commonly contains arsenic and sulfur in amounts high enough to be toxic to plants. This land supports little vegetation and has no agricultural value. The Capability Class is VIII.

Pits. Pits is a miscellaneous land type that consists of open excavations from which soil and underlying material have been removed for road construction, municipal uses, and other purposes. Pits are usually located in gravelly and sandy soils. Some sites have been excavated to bedrock. The sides of the pits are steep, and the material that remains supports few plants and has no farming value. Pits are generally not suited for use as range but may have some value for wildlife habitat or industrial use. Pits are in Capability Class VIII.

3.5.3.3.2 *Soil Capability Class*. Generally, the land capability classification shows the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Generally, the higher the land use capability class, the more severe the limitations are with respect to its use for crop production. Class I has the fewest limitations and is, therefore, better for use as cropland, etc. Class VIII is the least-productive classification. The subclasses e, w, and s refer to the soil's limitation with respect to erosion capacity; water or wetness; and shallow, draughty, or stony soil, respectively. These interpretations were obtained from the unpublished SCS soil survey for Tooele County and are listed for each soil-mapping unit in Section 3.5.3.3 (SCS 1992).

3.5.3.3.3 *Soils of the TEAD-S Facility Area*. The soils of the TEAD-S facility are similar in origin and character to those of the region (see Section 3.2). These soils are primarily derived from alluvium and lacustrine deposits of mixed rock sources (SCS 1992; Weston 1991). Additionally, some of the soils on the site formed in alluvium derived dominantly from limestone and quartzite, and some derived from eolian material. The two surficial soil types are (1) lake bed sediments with low to moderate permeability and (2) colluvium and alluvium deposits with moderate to high permeability. Soils on TEAD-S are generally very deep, well drained soils, with textures ranging from silty clay loam to loam.

The soils of the facility and adjacent areas are developing under cool and arid conditions, and are rather weakly developed overall. The reasons for this are several fold. First, because the facility area receives little precipitation (10 to 12 inches a year) and because about half of the precipitation falls during the summer months, when the moisture is used by plants, very little moisture ultimately passes through the soil profile. The air temperature averages 75 °F in July and 28 °F in January; the average freeze-free period is 120 to 160 days (SCS, Unpublished 1992). These relatively cool, year-around temperature conditions also limit soil development.

Specifically, within the northeastern portion of the TEAD-S facility area, elevations range from 5,600 to 5,200 feet, and the soils are primarily classified as Hiko Peak gravelly loam, on fan terraces. The southeastern portion of the TEAD-S facility area is primarily dominated by the Tooele fine sandy loam mapping unit. The north-central portion of the site is largely dominated by the Taylorsflat loam mapping unit. In the south-central area of the site, the soils are considerably mixed with the mapping units being dominated by the Tooele fine sandy loam and the Cliffdown gravelly sandy loam mapping units. The western portion of the facility area is comprised of soils from the Skumpah silt loam; Taylorsflat loam, saline; and the Bramwell silt loam mapping units. The soils map, presented as Plate 1, shows each soil-mapping unit identified within the TEAD-S area.

3.5.4 Vegetation

The vegetation types located on the TEAD-S facility area are largely based upon the SCS soil survey and range site types for Tooele County (SCS 1992; Section 3.5.4.1.2). Site-specific range sites/vegetation communities have been added where appropriate. A plant species list was also developed for the area. These and other data sources were utilized to coordinate data and information for this report (see Section 3.5.3.2). The vegetation map, presented as Plate 2 at the back of this binder, identifies vegetation areas discussed in this section.

A total of 12 range site types were identified within the TEAD-S facility area; 10 of these types are predominant at the site and include: (1) Desert Salt Flat--Sickle Saltbush, (2) Desert Gravelly--Shadscale, (3) Desert Loam--Shadscale, (4) Semidesert Alkali--Black Greasewood, (5) Alkali Flat--Black Greasewood, (6) Semidesert Loam--Wyoming Big Sagebrush, (7) Semidesert Gravelly--Wyoming Big Sagebrush, (8) Loamy Bottom--Basin Wildrye, (9) Alkali Bottom--Alkali Sacaton, and (10) Wet Saline Meadow. Two types, (11) Riparian and (12) Disturbed Areas, occur to a limited extent within the TEAD-S area. Each range site type is described in the following subsections and includes information on dominant plant species, soils, and annual average vegetative production.

3.5.4.1 *Regional Vegetation*

The climate of a region profoundly influences soil and vegetation development. The Rush Valley region is classified as a cold desert, dominated by sagebrush and saltbush plant species. Soil and plant-community development are, to a great extent, a function of precipitation and temperature (Welsh et al. 1987). The amount of precipitation available during the growing season is a primary factor in determining the type of species present, the number of individuals, and the general productivity of the vegetation and soils of the area. In addition to adapting to low precipitation and high evaporation rates, plants in this area have adapted to a moderately eroded soil, and some have adapted to alkaline and saline soils. The valley bottoms within the TEAD-S region are typically filled with the erosional deposits from surrounding mountain ranges and are frequently occupied in part by saline pans, salt flats, or fresh to saline lakes or ponds (Welsh et al. 1987).

Distribution of plant species tends to be correlated with the geology and soils present on a site (Welsh et al. 1987). The geology of this area consists primarily of lacustrine and sedimentary material of mixed rock origins (SCS 1992). The soils of Rush Valley are generally alluvium (Welsh et al. 1987); the gently sloping alluvial fans of the site are dominated by deep and very deep soils. According to Welsh and others (1987), plants that inhabit alluvial soils in Utah tend to be generalists; that is, those plants that can tolerate a wider degree of habitat variation and more persistent competition by other generalist plants. According to vegetation community descriptions by Welsh and others, the plant communities that may occur on TEAD-S include Salt Desert Shrub, Riparian Communities, Cool Desert Shrub, and Juniper-Pinyon.

3.5.4.1.1 ***Survey Methodology***. A general vegetation survey of the TEAD-S facility area was conducted. The purposes of this survey were to (1) derive a plant species list for the TEAD-S facility area, (2) identify and qualitatively describe the range site types within the facility area, and (3) delineate and map these range site types.

The plant species list for the facility area was obtained by a reconnaissance survey in which plant species observed within the area were recorded. Plant species that could not be identified in the field were collected for later identification. Botanical nomenclature used follows Welsh and others (1987), and Weber (1987). Plants lacking complete structures needed for field identification were collected and sent to Stanley Welsh, Brigham Young University, in Provo, Utah, and to Hugo Ferchau, Western State College, in Gunnison, Colorado, for identification and verification.

Information from the SCS soil-mapping unit, range-site descriptions, aerial photography, selected literature, and field reconnaissance were combined to develop the range site descriptions and mapping unit delineations presented in this report.

3.5.4.1.2 ***Survey Results of Range Site Types.*** The range site types identified in the TEAD-S facility area are identified in Table 3-5. Included are the approximate number of acres they cover and percentage of area each occupies within the facility area. Plate 2 (located in the back of this binder) shows the distribution of range-site types within the facility area. The following descriptions for the range-site types address species composition, abundance, and production based upon SCS evaluations (SCS 1992). Range site descriptions are ordered by vegetation production, from least to most productive. The miscellaneous range site type "Disturbed" follows. Plant species are identified by their common name within each range-site

Table 3-5. TEAD-S Range Site Types and Acreages

Range Site Types	Acres at TEAD-S	Percentage of TEAD-S
Desert Salt Flat—Sickle Saltbush	840	4
Desert Gravelly—Shadscale	1,018	5
Desert Loam—Shadscale	2,814	15
Semidesert Alkali—Black Greasewood	2,543	13
Alkali Flat—Black Greasewood	552	3
Semidesert Loam—Wyoming Big Sagebrush	3,159	17
Semidesert Gravelly—Wyoming Big Sagebrush	5,669	30
Loamy Bottom—Basin Wildrye	128	1
Alkali Bottom—Alkali Sacaton	1,376	7
Wet Saline Meadow	207	1
Riparian—Tamarisk	90	<1
Disturbed	731	4

description; the scientific names for each plant species are presented in Table 3-6, which summarizes the observed or potential plant species for the TEAD-S area. Detailed descriptions of soil types referenced in this section are presented in Section 3.5.3.3.1.

Desert Salt Flat—Sickle Saltbush. This range site type occurs on the soil Skumpah silt loam, wet substratum, saline, and 0-to-1-percent slopes (SCS 1992). The vegetation present in most areas is sickle saltbush, gray molly, seepweed, and bottlebrush squirreltail. The potential plant community for this unit consists of about 10 percent perennial grasses, 10 percent forbs, and 80 percent shrubs (SCS 1992). The important plant species for this range site type include sickle saltbush (55 percent); gray molly (15 percent); and bottlebrush squirreltail and seepweed at 5 percent relative cover each. The average annual production ranges from approximately 100 to 400 pounds per acre (lbs/ac), with an annual average production during normal years of approximately 300 lbs/ac.

Desert Gravelly Loam—Shadscale. This range site type occurs on the soil Cliffdown gravely sany loam, 2 to 15 percent slopes. In most areas, the present vegetation is shadscale, Indian ricegrass, rabbitbrush, spiny horsebrush, and cheatgrass. The potential plant community on this range-site type is about 40 percent perennial grasses, 5 percent forbs, and 55 percent shrubs. Important plant species include shadscale (20 percent), galleta (20 percent), bud sagebrush (10 percent), and Indian ricegrass (10 percent). Each of the following plant species

Table 3-6. TEAD-S Potential Plant Species

Latin Name	Common Name	Observed at TEAD-S
SHRUBS AND SUBSHRUBS		
FAMILY ANACARDIACEAE	SUMAC	
Rhus aromatica	Squaw berry	
FAMILY ACERACEAE		
Acer negundo	Boxelder	
FAMILY ASTERACEAE	COMPOSITE	
Artemisia nova	Black sagebrush	
Artemisia spinescens	Bud sagebrush	x
Artemisia tridentata	Wyoming big sagebrush	x
Chrysothamnus nauseosus	Tall rabbitbrush	x
Chrysothamnus viscidiflorus	Viscid rabbitbrush	
Tetradymia glabrata	Littleleaf horsebrush	x
Tetradymia spinosa	Spiny horsebrush	x
FAMILY CAPRIFOLIACEAE	HONEYSUCKLE	
Sambucus caerulea	Blue elder	
FAMILY CHENOPODIACEAE	GOOSEFOOT FAMILY	
Atriplex canesceus	Four-wing saltbrush	
Atriplex confertifolia	Shadscale	x
Atriplex falcata	Sickle saltbush	x
Atriplex gardneri	Gardner saltbush	x
Atriplex rosea	Tumbling saltweed	x
Atriplex tridentata	Trident saltbush	x
Sarcobatus vermiculatus	Black greasewood	x
FAMILY EPHEDRACEAE	JOINT FIR	
Ephedra viridis	Mormon tea	x
FAMILY ROSACEAE	ROSE	
Coleogyne remosissima	Blackbrush	
Prunus virginiana ssp. melanocarpa	Chokecherry	x
Purshia mexicana var. stansburiana	Cliff-rose	x
Purshia tridentata	Antelope bitterbrush	x
TREES		
FAMILY ELAEAGNUS	OLEASTER	
Elaeagnus angustifolia	Russian olive	
FAMILY PINACEAE		
Juniperus osteosperma	Utah juniper	x

Table 3-6. TEAD-S Potential Plant Species (continued)

Latin Name	Common Name	Observed at TEAD-S
FAMILY SALICACEAE	WILLOW	
Populus sargentii	Plains cottonwood	
Salix exigua	Coyote willow	x
FAMILY TAMARICACEAE	TAMARISK	
Tamarix chineusis	Tamarisk	x
FAMILY ULMACEAE	ELM	
Ulmus pumila	Chinese elm	x
CACTI		
FAMILY CACTACEAE	CACTUS	x
Opuutia polyacantha	Plains prickly pear	
FORBS		
FAMILY AGROSTIDEAE	REDTOP	x
Sporobolos cryptandrus	Sand dropseed	
FAMILY ASCLEPIADACEAE	MILKWEED	
Asclepias speciosa	Showy milkweed	x
FAMILY ASTERACEAE	COMPOSITE	
Antennaria mirophylla	Rosy pussytoes	x
Chaenactis douglasii	Dusty miller	
Chaenactis stevioides	Pincushion	x
Cirsium arvense	Canadian thistle	
Cirsium neomexicanum	New Mexican thistle	
Cirsium vulgare	Bull thistle	x
Crepis acuminata	Tapertip hawksbeard	x
Crepis occidentalis	American hawksbeard	x
Erigeron divergens	Spreading fleabane	
Erigeron engelmannii	Engelmann daisy	x
Erigeron flagellaris	Trailing daisy	x
Grindelia squarrosa var. Serrulata	Curlycup gumweed	x
Haplopappus acaulis	Stemless goldenweed	x
Helianthus annuus	Common sunflower	x
Lactuca serriola	Prickly wild lettuce	x
Senecio spartiodes var. Multicapitatus	Broom groundsel	x
Tragopogon dubius ssp. Major	Yellow goatsbeard	x
FAMILY BORAGINACEAE	BORAGE	
Cryptantha humilis	Cryptantha	x
Cryptantha micrantha	Purpleroot	
Cynoglossum officinale	Hound's tongue	x

Table 3-6. TEAD-S Potential Plant Species (continued)

Latin Name	Common Name	Observed at TEAD-S
FAMILY CHENOPODIACEAE	GOOSEFOOT	
Allenrolfea spp.	Pickleweed	x
Chenopodium album	Pigweed	
Eurotia lanata	Winterfat	x
Kochia americana	Green molly	x
Kochia scoparia	Gray molly	x
Salsola iberica	Russian thistle	x
Suaeda occidentalis	Western seepweed	x
FAMILY COMPOSITAE	SUNFLOWER	
Arctium minus	Burdock	x
Balsamorhiza hookeri	Hooker's balsamroot	x
Chrysothomnus viscidiflorus	Sticky-flowered rabbitbrush	x
Gutierrezia sarothrae	Broom snakeweed	x
Leucelene ericoides	Heath aster	x
Lygodesmia grandiflora	Rush pink	x
Machaeranthere canesceus	Hoary aster	x
Salvia dorrii	Desert sage	x
Tetradymia canesceus	Littleleaf horsebrush	x
Tragopogon dubius	Western yellow goatsbeard	x
Xonothocephalum sarothrae	Snakeweed	x
FAMILY CONVOLVULACEAE	BINDWEED	
Convolvulus arvensis	Creeping-Jenny (Bindweed)	x
FAMILY CRUCIFERAE	MUSTARD	
Capsella bursa-pastoris	Shepard's purse	x
Cardaria draba	Whitetop (Peppergrass)	x
Camelima microcarpa	False flax	x
Chorispora tenella	Purple mustard	x
Conringia orientalis	Hare's ear	x
Descurainia pinnata	Pinnate tansymustard	x
Descurainia sophia	Flixweed tansymustard	x
Erysimum aperum	Wallflower	x
Hutchinsia procumbens	Slenderweed	x
Lepidium densiflorum	Prairie peppergrass	x
Lepidium montanum	Peppergrass	x
Lepidium perfoliatum	Clasping peppergrass	x
Lesquerella occidentalis	Western bladderpod	x
Sisymbrium altissimum	Jim Hill mustard	x
Sisymbrium officiale	Hedge mustard	x

Table 3-6. TEAD-S Potential Plant Species (continued)

Latin Name	Common Name	Observed at TEAD-S
FAMILY CRUCIFERAE (cont.)		
Stanleya pinnata	Prince's plume	x
Thelypodiopsis vermicularis	Thelypody	x
Thelypodium sagittatum	Arrowleaf thelypody	x
FAMILY EUPHORIBIACEAE	SPURGE	
Euphorbia glyptosperma	Euphorb	
FAMILY FABACEAE	PEA	
Astragulus bekwithii	Beckwith milkvetch	x
Astragulus calycosus	Torrey milkvetch	x
Astragalus cibarius	Browse milkvetch	
Astragalus convallarius	Timber milkvetch	x
Astragalus speciosa	Showy milkvetch	x
Astragalus utahensis	Utah milkvetch	
Lathyrus brachycalyx	Shortcalyx peavine	x
Lupiunus brevicoulis	Shortstem lupine	
Lupinus caudatus	Spurred lupine	
Melilotus alba	White sweetclover	
Melilotus officinalis	Yellow sweetclover	
FAMILY GENTIANACEAE	FILAREE	
Erodium cicutarium	Cutleaf filaree (Storksbill)	x
FAMILY LABIATAE	CATNIP	
Nepeta cataria	Catnip	x
FAMILY LEGUMINOCAE	LEGUMES	
Medicago satiua	Alfalfa	
FAMILY LILLIACEAE	LILLY	
Allium acuminatum	Pointed wild onion	
Allium nevadense	Onion	x
Calochortus nuttallii	Mariposa (Sego lily)	x
Zigadeuus paniculatus	Death camus	
FAMILY LOASACEAE	BLAZINGSTAR	
Acrolasia albicaulis	Acrolasia	x
Mentzelia albicaulis	Whitestem blazingstar	x
FAMILY MALVACEAE	GLOBEMALLOW	
Sphaeralcea coccinea ssp. dissecta	Scarlet globemallow	x
Sphaeralcea grossulariifolia	Gooseberryleaf globemallow	x

Table 3-6. TEAD-S Potential Plant Species (continued)

Latin Name	Common Name	Observed at TEAD-S
FAMILY ONAGRACEAE	EVENING PRIMROSE	
Oenothera caespitosa	Morning lily	x
Oenothera pallida	Evening primrose	
FAMILY POLEMONIACEAE	PHLOX	
Gilia aggregata	Scarlet gilia	x
Gilia leptomeria	Gilia	x
Phlox hoodii ssp. canescens	Hood phlox	x
Phlox longifolia	Longleaf phlox	x
FAMILY POLYGONACEAE		
Eriogonum ovalifolium var. nevadensis	Wild buckwheat	x
Erigonum unbellatum	Sulfur buckwheat	x
Rumex crispus	Curly dock	x
FAMILY RANUNCULACEAE	BUTTERCUP	
Ranunculus testiculatus	Bur buttercup	x
FAMILY SCROPHULARIACEAE	FIGWORT	
Castilleja chromosa	Paintbrush	x
Penstemon linarioides ssp. coloradoensis	Creeping penstemon	x
Verbascum thapsus	Mullein	x
Verbascum vergatum	Wand mullein	
Veronica biloba	Bilobed speedwell	
FAMILY TYPHACEAE	CATTAIL	
Typha augustifolia	Narrowleaf cattail	
Typha latifolia	Common cattail	
FAMILY VERBENACEAE	VERBENA	
Verbena bracteata	Vervain	x
GRAMINOIDS		
FAMILY HORDEAE	BARLEY	
Elymus smithii	Smith's wild rye	x
Hordeum jubatum	Wild barley	x
FAMILY JUNCACEAE	SEDGE	
Juncus arcticus ssp. vallicola	Artic rush	x
FAMILY POACEAE (GRAMINEAE)	GRASS	
Agropyron cristatum ssp. desertorum	Crested wheatgrass	x
Agropyron smithii	Western wheatgrass	x

Table 3-6. TEAD-S Potential Plant Species (continued)

Latin Name	Common Name	Observed at TEAD-S
FAMILY POACEAE (GRAMINEAE)		
Alopecurus pratensis	Meadow foxtail	x
Aristida purpurea	Three-awn	x
Bouteloua gracilis	Blue gramagrass	x
Bromus tectorum	Cheatgrass	x
Distichlis stricta	Inland saltgrass	x
Elymus cinerus	Basin wildrye	x
Elymus elongatus	Tall wheatgrass	x
Elymus elymoides	Squirreltail	x
Elymus spicatus	Bluebunch wheatgrass	x
Hilaria jamesii	Galleta grass	x
Phragmites communis	Common reed	x
Poa bulbosa	Bulbous bluegrass	x
Poa compressa	Canada bluegrass	x
Poa fendleriana	Muttongrass	x
Poa secunda	Sandberg bluegrass	x
Puccinellia spp.	Alkali grass	x
Sitanion hystrix	Bottlebrush squirreltail	x
Spartina gracilis	Alkali cordgrass	x
Sporobolus airoides	Alkali sacaton	x
Stipa comata	Needle-and-threadgrass	x
Stipa hymenoides	Indian ricegrass	x

average about 5 percent relative cover: bottlebrush squirreltail, winterfat, horsebrush, Mormon tea, and Douglas rabbitbrush. Vegetation production ranges from about 300 to 500 lbs/ac, with an average annual production of about 400 lbs/ac.

Desert Loam—Shadscale. This range site type occurs on the soil Tooele fine sandy loam, 0 to 5 percent slopes, and on the soil Timpie silt loam, 0 to 3 percent slopes. The vegetation present in most areas consists of shadscale, cheatgrass, Indian ricegrass, and horsebrush. The potential plant community for this unit consists of about 35 percent perennial grasses, 15 percent forbs, and 50 percent shrubs. Important plant species include shadscale (20 percent), Indian ricegrass (20 percent), bud sagebrush (10 percent), bottlebrush squirreltail (10 percent), winterfat (10 percent), and scarlet globemallow, and milkvetch each with 5 percent relative cover. Under favorable conditions, the annual production is about 600 lb/ac; under normal conditions, production is 500 lbs/ac; and under unfavorable conditions, the production is about 400 lbs/ac (SCS 1992).

Semidesert Alkali Loam—Black Greasewood. This range site type occurs on the soil Taylorsflat loam, saline, 0 to 3 percent slopes. In most areas, the present vegetation consists of black greasewood, cheatgrass, shadscale, and Indian ricegrass. The potential plant community is about 30 percent perennial grasses, 15 percent forbs, and 55 percent shrubs. Important plant species include black greasewood (20 percent), Wyoming big sagebrush (20 percent), and lebrush squirreltail (15 percent). Indian ricegrass, Nevada bluegrass, scarlet globemallow, milkvetch, shadscale, and Douglas rabbitbrush each comprise approximately 5 percent of the cover. The annual production ranges from 300 to 750 lbs/ac; average production is about 600 lbs/ac (SCS 1992).

Alkali Flat—Black Greasewood. This range site type occurs primarily on the soil Skumpah silt loam, saline, 0 to 2 percent slopes. The present vegetation in most areas is black greasewood, gray molly, seepweed, and bottlebrush squirreltail (SCS 1992). The potential plant community on this unit is about 25 percent perennial grasses, 10 percent forbs, and 65 percent shrubs. Important plant species include black greasewood (50 percent), bottlebrush squirreltail (15 percent); alkali sacaton, seepweed, shadscale, and trident saltbush each comprise about 5 percent of the vegetation cover. The annual vegetation production ranges from 350 lbs/ac in an unfavorable year to 1,000 lbs/ac in a favorable year; this type averages about 700 lbs/ac in normal years (SCS 1992).

Semidesert Loam—Wyoming Big Sagebrush. This range site type occurs primarily on the soil Taylorsflat loam, 1 to 5 percent slopes. The vegetation present in most areas is Wyoming big sagebrush, Indian ricegrass, and cheatgrass (SCS 1992). The potential plant community for this range site type consists about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plant species include bluebunch wheatgrass (25 percent), Wyoming big sagebrush (20 percent), Indian ricegrass (10 percent), and bottlebrush squirreltail (10 percent). Needle-and-threadgrass, scarlet globemallow, penstemon, Hood phlox, and Douglas rabbitbrush each comprise about 5 percent of the vegetation (SCS 1992). Under favorable conditions, annual vegetation production is 900 lbs/ac (SCS 1992). Under normal and unfavorable conditions, vegetation production is estimated from 500 to 700 lbs/ac (SCS 1992).

Semidesert Loam Gravelly—Wyoming Big Sagebrush. This range site type occurs on the soil Hiko Peak gravelly loam, 2 to 15 percent slopes. The present vegetation is Wyoming big sagebrush, Douglas rabbitbrush, Indian ricegrass, and cheatgrass. The potential plant community is about 45 percent perennial grasses, 15 percent forbs, and 40 percent shrubs. Important plant species include Wyoming big sagebrush (25 percent), bluebunch wheatgrass (20 percent), Indian ricegrass (10 percent), bottlebrush squirreltail (5 percent), Nevada bluegrass (5 percent), Hood phlox (5 percent), rose pussytoes (5 percent), shadscale (5 percent), and Douglas rabbitbrush (5 percent). The average annual production ranges from approximately 500 to 1,000 lbs/ac; during normal years the average annual production is about 800 lbs/ac.

Loamy Bottom—Basin Wildrye. This range site type occurs on the soil Birdow loam, 1 to 4 percent slopes. The vegetation present in most areas is basin big sagebrush, bluebunch wheatgrass, rabbitbrush, and basin wildrye (SCS 1992). The potential plant community is about 70 percent perennial grasses, 10 percent forbs, and 20 percent shrubs. Important plant species are basin wildrye (50 percent), basin big sagebrush (10 percent), western wheatgrass (5 percent), Nevada bluegrass (5 percent), tapertip hawksbeard (5 percent), and rubber rabbitbrush (5 percent). Annual vegetation production ranges from 1,000 to 2,500 lbs/ac, with an average annual yield of about 1,500 lbs/ac.

Alkali Bottom—Alkali Sacaton. This range site type occurs primarily on the soil Bramwell silt loam, 0 to 2 percent slopes. The vegetation in areas not cultivated is mainly inland saltgrass, alkali sacaton, alkali bluegrass, sedges, and black greasewood. The potential plant community for this unit consists of about 70 percent perennial grasses, 10 percent forbs, and 20 percent shrubs. Important plant species are inland saltgrass (20 percent), alkali sacaton (20 percent), alkali bluegrass (15 percent), and basin wildrye (10 percent). Sedge, black greasewood, trident saltbush, and rush each occur with approximately 5 percent vegetative cover. Under normal conditions, total annual production averages 1,750 lbs/ac, with production ranging from 1,000 to 2,500 lbs/ac per year.

Wet Saline Meadow. This range site type is the most productive type in the TEAD-S facility area and occurs mainly on Logan silt loam, 0 to 1 percent slopes (SCS 1992). The vegetation present in most areas is wiregrass, sedges, inland saltgrass, and rushes. The potential plant community is about 75 percent perennial grasses, 20 percent forbs, and 5 percent shrubs. Important plant species include alkali sacaton (20 percent), rush (10 percent), inland saltgrass (10 percent), bulrush (10 percent), sedge (10 percent), swampfire (10 percent), alkali bluegrass (5 percent), alkali cordgrass (5 percent), common reed (5 percent), western seepweed (5 percent), showy milkweed (5 percent), and pickleweed (5 percent). Annual production ranges from about 2,000 to 4,000 lbs/ac, with an average annual production of about 3,000 lbs/ac.

Riparian. This range site type is the least abundant type on TEAD-S and occurs mainly on Taylorsflat loam, 1 to 5 percent slopes (soil) along the northern boundary of the Bunker Storage Area in the northwest quadrant of the installation on the banks of Ophir Creek. The predominant vegetation consists of salt cedar or tamarisk, which creates a canopy at 6 to 8 feet above the ground, and other plants able to take advantage of groundwater when present but not dependent on it for their survival, such as saltbush.

Disturbed. This mapping unit includes a variety of soil and vegetation types that reflect disturbances resulting from human activities. This mapping unit includes the Slickens/Mine Dumps and Pits soil mapping units (Section 3.5.3.3), as well as other areas of the facility which have been disturbed. The soil textures in these areas vary, but they frequently contain potentially toxic chemicals or metals that could adversely affect plant growth. Much of this range site type supports less than 10 percent vegetative cover, and has no agricultural value. Some of the Pits areas, however, may have some value for wildlife habitat or industrial use. Floral composition varies, but species are generally weedy invaders, such as cheatgrass, Indian ricegrass, and rabbitbrush.

3.5.4.1.3 *Variety of Vegetation*. Plant species observed on the facility area are noted in the column "Observed at TEAD-S" in Table 3-6. A total of 155 species in 40 families have been identified within the facility area. Of these, 6 tree species, 22 shrub or subshrub species, 100 forbs, 26 graminoids, and 1 cacti were identified.

A search of information revealed no known occurrences of federal candidate species of plants in the TEAD-S facility area. One record of the Category 2 candidate plant Cryptantha compacta has been located about 6 miles south of the southern unit, in Section 33 of T7S R5W. Its habitat is given as a black sagebrush community on low tuffaceous hills. To date, this occurrence is unverified; most known occurrences of this plant are much farther to the southwest in the west-desert part of Utah (Tuhy, Coordinator for Utah Natural Heritage Program, personal communication).

3.5.4.1.4 *Correlation of Range Site Types and Soils*. Vegetation composition and growth are significantly dependent upon the chemical and physical characteristics of the soils, as well as the available soil moisture. A definite plant/soil relationship is expressed in the TEAD-S site area. However, other factors such as fire, grazing, facility activities, or other past land-management practices have significantly influenced this relationship as well. The general plant/soil relationships for the site area are shown in Table 3-7.

Table 3-7. TEAD-S Soil/Vegetation Relationships

Soils	Range Site
Skumpah silt loam	Desert Salt Flat—Sickle Saltbush
Cliffdown gravelly sandy loam	Desert Gravelly—Shadscale
Tooele fine sandy loam	Desert Loam—Shadscale
Timpie silt loam	Desert Loam—Shadscale
Taylorsflat loam, saline	Semidesert Alkali—Black Greasewood
Skumpah silt loam, saline	Alkali Flat—Black Greasewood
Taylorsflat loam	Semidesert Loam—Wyoming Big Sagebrush
Hiko Peak gravelly loam	Semidesert Gravelly—Wyoming Big Sagebrush
Birdow loam	Loamy Bottom—Basin Wildrye
Bramwell silt loam	Alkali Bottom—Alkali Sacaton
Logan silt loam	Wet Saline Meadow
Slickens & Mine Dumps	None Assigned
Pits	None Assigned

3.5.4.2 *Vegetation of the Facility Area*

Generally, the vegetation composition and range site types of the TEAD-S facility are quite similar to the regional vegetation. Additionally, the vegetation of the facility area reflects site-specific conditions such as slope, moisture condition, aspect, and soils of the area, as well as the facility's history and its human activities. A total of 10 range site types were identified within the TEAD-S facility. Table 3-5 delineates the range site types within the facility, the associated number of acres, and the percentage of the facility area each occupies. Of the total 19,127 acres available for vegetative growth (excluding buildings, roads, and paved parking areas) within the facility area, 1,711 acres are dominated by grassland communities, 16,595 acres by shrublands, 90 acres by Riparian, and 731 acres by Disturbed Area. The vegetation within the TEAD-S facility area is profoundly influenced by the arid/semi-arid climate. Drought-resistant and drought-tolerant species are typically associated with shadscale/big sagebrush habitat. The associated species vary, but one or both dominant species are usually present. The Semi-Desert Gravelly—Wyoming Big Sagebrush range site is the most dominant type, occupying approximately 30 percent of the total area. The distribution of the range-site types at TEAD-S is shown in Plate 2 (located in the back of the binder).

The second most dominant type is the Semi-Desert Loam—Wyoming Big Sagebrush range site, occupying 17 percent of the area. Thus, nearly half (47 percent) of the total TEAD-S facility area is dominated by Wyoming Big Sagebrush and its associated species. An additional quarter (24 percent) of the site is occupied by Desert range site types; these types are dominated by saltbush, shadscale, and their associated species. Black greasewood is also prevalent across the facility area, dominating approximately 16 percent of the total area. Four range site types, which vary from semi-moist to riparian, occupy the remainder of the facility. These range site types include the Loamy Bottom—Basin Wildrye, Alkali Bottom—Alkali Sacaton, Wet Saline Meadow, and Riparian—Tamarisk. Disturbed areas occupy about 730 acres (4 percent) of the total TEAD-S facility area.

The Riparian vegetation type occurs primarily in the western portion of the site along waterways and areas where the groundwater level is relatively close to the surface. Phreatophytes, such as tamarisk, flourish in these areas. The Mercur Creek outwash area, located in the southeastern corner of TEAD-S, is characterized by brown-red soils that consist mainly of mine tailings. Metals present in these tailings appear to inhibit plant growth, and the vegetation is scattered and less productive. Like species are considerably shorter and less dense in this area than in tailings-free areas. In contrast, in the Ophir Creek area, these toxic soils are not present. Consequently, Wyoming big sagebrush reaches 8 feet high, and willows grow along the waterways.

3.5.5 Wildlife

A general wildlife survey of the TEAD-S facility area was conducted. The purpose of this investigation was to collate and summarize information concerning the wildlife resources of the TEAD-S facility area. Specifically, the purposes of this survey were to (1) develop a wildlife species list for the TEAD-S facility area and (2) identify and qualitatively describe the status, physical characteristics, behavior, and general diet requirements as background for the ecological risk assessment. The wildlife species list was prepared using a potential species list prepared for the facility (Donohue 1990).

Five protected, sensitive, or endangered bird species have been either identified in the region or have been actually observed on the TEAD-S facility area: the bald eagle, the ferruginous hawk, the long-billed curlew, the peregrine falcon, and the golden eagle.

3.5.5.1 *Regional Wildlife Information*

The extant plant species and vegetation communities as well as the climate in Rush Valley have affected the available forage and accessible animal niches. The animals in this region have adapted to these environmental factors by specializing as hibernators, estivators, and diurnal or nocturnal species. The region is inhabited by a wide variety of animal species, ranging from mammals to protozoans. These species may occur as permanent, temporary, or seasonal residents, or on a migratory basis.

Historically, several wildlife species were known to inhabit the Rush Valley region, including bison, grizzly bear, elk, black bear, and mountain sheep. Reintroduction efforts in the mountainous areas surrounding TEAD-S have been undertaken for the mountain sheep and elk; similar efforts have targeted pronghorn antelope for the valley region.

3.5.5.2 *Methodology*

A site-specific wildlife species list for the facility area was obtained by a road reconnaissance survey during which observed species were recorded. In addition, information from selected literature sources, field and road reconnaissance, the U.S. Fish and Wildlife Service, and the BLM was combined to develop this report.

3.5.5.3 *Threatened and Endangered Species*

Four threatened, endangered, or candidate species of birds are known to occur within the TEAD-S region: the bald eagle, the peregrine falcon, the ferruginous hawk, and the long-billed curlew. These species are protected by the Endangered Species Act of 1973, Section 668-668d. Additionally, the golden eagle, which is protected under 16 USC 668-668d, has also been observed on the TEAD-S facility.

3.5.5.4 *Natural History of Selected Wildlife Species*

Table 3-8 lists 112 vertebrate species identified in the TEAD-S vicinity. There are 39 species of mammals, 68 species of birds and several species of amphibians and reptiles. Information regarding several commonly observed wildlife species is presented below.

3.5.5.4.1 *Raptors.* Raptors return to central Utah between mid-February and early April, depending on weather conditions. Early in the breeding season, raptors will return to their traditional nesting sites or construct new ones in the area. Eggs are usually laid during March or April. Nest occupation continues until the chicks are fledged which, depending on the species and when nesting activities begin, occurs from early June to mid-August. Ferruginous hawks fledge at about 41 days of age, golden eagles at about 64 days, prairie falcons at about 30 days, and American kestrels at about 28 days (Pendleton et al. 1987).

Raptors are of special concern in all areas of the United States where development activities may destroy nesting or key foraging sites, or where an increase in the number of people in an area may disturb nesting activities and cause nest abandonment. Raptor species vary considerably in their tolerance to man's activities.

Bald Eagle. The bald eagle, *Haliaceetus leucocephalus spp. alascanus*, inhabits most of Utah, including the TEAD-S facility area, and its habitat in the area is considered critical.

The bald eagle has commercial value in the black market because of its highly prized feathers and other parts. It is not considered a threat to agricultural interests in general. The bald eagle is considered a winter resident in Rush Valley, with the first bald eagles arriving in late November. The adults arrive before juveniles because they are stronger fliers and more experienced navigators. Bald eagles winter where the conditions are mild and food can be found for the entire winter. Rush Valley supplies moderate weather and satisfactory amounts of food, and has been a wintering site for bald eagles since the early 1960s.

Bald eagle behavior varies from season to season. During the spring when they nest, bald eagles do not socialize with other eagles or tolerate human disturbances near nesting sites. They generally roost singularly, or sometimes with a mate, in or near the nest tree. Their hunting is conducted from the nest tree to the water, shoreline, or other hunting areas. During the winter, bald eagles become more tolerant of disturbances from both man and other animals. They may socialize with other eagles and have communal roosts. Additionally, they may hunt cooperatively in small groups of two or three birds when food is scarce.

Eagles in Rush Valley begin to roost each day from as early as 4:00 p.m. to dusk. As many as 25 eagles have been seen in one stand of cottonwood trees on the valley floor when the weather is mild. Approximately 1 hour before dawn, the eagles leave the roost for the first feeding period of the day. If the weather is particularly harsh, bald eagles will

Table 3-8. Observed and Potential Wildlife at TEAD-S

Scientific Name	Common Name	Observed	Habitat	Sensitive
	Phylum: Chordata			
	Class: Amphibia (Amphibians)			
Order: Anura				
Family: Bufonidae	**True Toads**			
Bufo cognatus	Great Plains toad		2[a]	
Bufo woodhousei	Western woodhouse toad		2	
Family: Pelobatidae	**Spadefoot**			
Scaphiopus intermontanus	Great Basin spadefoot		1[b]	
Family: Ranidae	**Ranids**			
Rana pipiens	Northern leopard frog		2	
	Class: Reptilia (Reptiles)			
Order: Squamata	**Lizards and Snakes**			
Suborder: Sauria	**Lizards**			
Family: Iguanidae	**Iguanids**			
Crotaphytus collaris	Collared lizard		2	
Gambelia wislizenii	Long-nosed leopard lizard		1	
Phrynosoma platyrhinos	Desert horned lizard	x[c]	1	
Phrynosoma douglassi	Short-horned lizard		2	
Sceloporus graciosus	Sagebrush lizard	x	1	
Uta stansburiana	Side-blotched lizard	x	1	
Family: Scincidae	**Skinks**			
Eumeces skiltonianus	Western skink		1	
Family: Teiidae	**Whiptails and Race-runners**			
Cnemidophorus tigris	Western whiptail		1	
Suborder: Serpentes	**Snakes**			
Family: Colubridae	**Colubrids**			
Coluber constrictor	Western yellow-bellied racer		1	
Hypsiglena torquata	Night snake		1	
Masticophis taeniatus	Striped whipsnake		1	
Pituophis melanoleucus deserticola	Great Basin gopher snake	x	1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Pituophis melanoleucus sayi	Bullsnake	x	1	
Thamnophis elegans vagrans	Wandering garter snake		2	
Family: Viperidae	**Vipers**			
Crotalus viridis lotosus	Great Basin rattlesnake	x	1	
	Class: Aves (Birds)			
Order: Anseriformes	**Waterfowl**			
Family: Anatidae	**Geese and Ducks**			
Anas acuta	Northern pintail	x	2	
Anas americana	American wigeon		2	
Anas clypeata	Northern shoveler		2	
Anas crecca	Green-winged teal	x	2	
Anas cyanoptera	Cinnamon teal	x	2	
Anas discors	Blue-winged teal	x	2	
Anas platyrhynchos	Mallard duck	x	2	
Anas strepera	Gadwall	x	2	
Aythya affinis	Lesser scaup	x	2	
Aythya americana	Redhead		2	
Branta canadensis	Canada goose	x	2	
Bucephala albeola	Bufflehead		2	
Mergus merganser	Common merganser		2	
Oxyura jamaicensis	Ruddy duck		2	
Order: Apodiformes	**Swifts and Hummingbirds**			
Family: Apodidae	**Swifts**			
Aeronautes saxatilis	White-throated swift	x	2	
Family: Trochilidae	**Hummingbirds**			
Archilochus alexandri	Black-chinned hummingbird		1	
Selasphorus platycercus	Broad-tailed hummingbird	x	2	
Selasphorus rufus	Rufous hummingbird		2	
Order: Caprimulgiformes	**Goatsuckers**			
Family: Caprimulgidae	**Nightjars**			
Chordeiles minor	Common nighthawk	x	1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Phalaenoptilus nuttallii	Common poorwill		1	
Order: Charadriiformes	**Shorebirds**			
Family: Charadriidae	**Plovers**			
Charadrius alexandrinus	Snowy plover		2	FCC2[d]
Charadrius montanus	Mountain plover	x	1	FCC2
Charadrius vociferus	Killdeer	x	1	
Family: Laridae	**Gulls**			
Larus californicus	California gull	x	1	
Larus delawarensis	Ring-billed gull		2	
Larus pipixcan	Franklin's gull		1	
Family: Scolopacidae	**Sandpipers and Phalaropes**			
Gallinago gallinago	Common snipe		2	
Numenius americanus	Long-billed curlew		2	FCC2
Order: Ciconiformes	**Herons and Storks**			
Family: Ardeidae	**Herons and Bitterns**			
Ardea herodias	Great blue heron		2	
Family: Threskiornithidae	**Ibises**			
Plegadis chihi	White-faced ibis		2	FCC2
Order: Columbiformes	**Pigeons**			
Family: Columbidae	**Pigeons and Doves**			
Zenaida macroura	Mourning dove	x	1	
Order: Falconiformes	**Birds of Prey**			
Family: Accipitridae	**Hawks and Eagles**			
Accipiter cooperi	Cooper's hawk	x	2	
Accipiter gentilis	Northern goshawk		2	USS[e]
Accipiter striatus	Sharp-shinned hawk		2	
Aquila chrysaetos	Golden eagle	x	1	EP[f]
Buteo jamaicensis	Red-tailed hawk	x	1	
Buteo lagopus	Rough-legged hawk	x	2	
Buteo regalis	Ferruginous hawk	x	1	UTS[g]/FCC2
Buteo swainsoni	Swainson's hawk		1	FCC2
Circus cyaneus	Marsh hawk (Northern harrier)	x	1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Haliaeetus leucocephalus	Bald eagle	x	2	EP
Family: Cathartidae	**Vultures**			
Cathartes aura	Turkey vulture	x	1	
Family: Falconidae	**Falcons**			
Falco columbarius	Merlin		1	
Falco mexicanus	Prairie falcon	x	1	
Falco peregrinus	Peregrine falcon		2	FE[h]
Falco sparverius	American kestrel	x	1	
Order: Galliformes	**Gallinaceous Birds**			
Family: Phasianidae	**Fowl-like birds**			
Alectoris chukar	Chukar		1	
Centrocercus urophasianus	Sage grouse	x	1	
Phasianus colchicus	Ring-necked pheasant		2	
Order: Passeriformes	**Perching Birds (Passerines)**			
Family: Aegithalidae	**Bushtit**			
Psaltriparus minimus	Bushtit	x	1	
Family: Alaudidae	**Larks**			
Eremophila alpestris	Horned lark		1	
Family: Bombycillidae	**Waxwings**			
Bombycilla cedrorum	Cedar waxwing		1	
Bombycilla garrulus	Bohemian waxwing		1	
Family: Certhiidae	**Creepers**			
Certhia americana	Brown creeper		2	
Family: Corvidae	**Jays, magpies, and crows**			
Aphelocoma coerulescens	Scrub jay		1	
Corvus brachyrhynchos	American crow	x	1	
Corvus corax	Common raven	x	1	
Cyanocitta stelleri	Steller's jay		1	
Gymnorhinus cyanocephalus	Pinon jay	x	1	
Pica pica	Black-billed magpie	x	1	
Family: Emberizidae	**Grosbeaks and sparrows**			
Amphispiza belli	Sage sparrow		1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Amphispiza bilineata	Black-throated sparrow		1	
Chondestes grammacus	Lark sparrow		1	
Passerculus sandwichensis	Savannah sparrow	x	2	
Passernina amoena	Lazuli bunting	x	1	
Pheucticus melanocephalus	Black-headed grosbeak	x	2	
Pipilo chlorurus	Green-tailed towhee	x	2	
Pipilo erythrophthalmus	Rufous-sided towhee		2	
Pooecetes gramineus	Vesper sparrow	x	1	
Spizella arborea	American tree sparrow		1	
Spizella breweri	Brewer's sparrow		1	
Spizella passerina	Chipping sparrow	x	1	
Zonotrichia leucophrys	White-crowned sparrow		1	
Subfamily: Icteridae	**Blackbirds and orioles**			
Agelaius phoeniceus	Red-winged blackbird	x	1	
Euphagus cyanocephalus	Brewer's blackbird	x	1	
Molothrus ater	Brown-headed cowbird	x	1	
Sturnella neglecta	Western meadowlark	x	1	
Xanthocephalus xanthocephalus	Yellow-headed blackbird	x	2	
Subfamily: Parulinae	**Wood warbler**			
Dendroica coronata	Yellow-rumped warbler	x	2	
Dendroica nigrescens	Black-throated gray warbler		2	
Dendroica petechia	Yellow warbler	x	2	
Geothlypis trichas	Common yellowthroat	x	1	USS
Icteria virens	Yellow-breasted chat	x	2	USS
Oporornis tolmiei	MacGillivray's warbler	x	2	
Vermivora celata	Orange-crowned warbler		2	
Vermivora virginiae	Virginia's warbler		1	
Subfamily: Thraupinae	**Tanagers**			
Piranga ludoviciana	Western tanager		2	
Family: Fringillidae	**Finches**			
Carduelis pinus	Pine siskin	x	2	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Carduelis tristis	American goldfinch		2	
Carpodacus cassinii	Cassin's finch		1	
Carpodacus mexicanus	House finch		1	
Coccothraustes vespertinus	Evening grosbeak		2	
Leucosticte arctoa	Rosy finch		2	
Loxia curvirostra	Red crossbill		2	
Family: Hirundinidae	**Swallows**			
Hirundo pyrrhonota	Cliff swallow		2	
Hirundo rustica	Barn swallow	x	2	
Stelgidopteryx serripennis	Northern rough-winged swallow	x	2	
Tachycineta bicolor	Tree swallow		2	
Tachycineta thalassina	Violet-green swallow		2	
Family: Laniidae	**Shrikes**			
Lanius excubitor	Northern shrike		1	
Lanius ludovicianus	Loggerhead shrike	x	1	USS
Family: Mimidae	**Mockingbirds and Thrashers**			
Mimus polyglottos	Northern mockingbird		1	
Oreoscoptes montanus	Sage thrasher		1	
Family: Paridae	**Chickadees and titmice**			
Parus atricapillus	Black-capped chickadee	x	2	
Family: Passeridae	**Old World Sparrows**			
Passer domesticus	House sparrow	x	1	
Family: Sittidae	**Nuthatches**			
Sitta canadensis	Red-breasted nuthatch		2	
Sitta carolinensis	White-breasted nuthatch		2	
Family: Sturnidae	**Starlings**			
Sturnus vulgaris	European starling	x	1	
Family: Troglodytidae	**Wrens**			
Catherpes mexicanus	Canyon wren		1	
Cistothorus palustris	Marsh wren		2	
Salpinctes obsoletus	Rock wren	x	1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Troglodytes aedon	House wren	x	1	
Troglodytes troglodytes	Winter wren		2	
Family: Muscicapidae	**Thrushes, solitaires, bluebirds,**			
Catharus guttatus	Hermit thrush		1	
Myadestes townsendi	Townsend's solitaire		1	
Polioptila caerulea	Blue-gray gnatcatcher		1	
Regulus calendula	Ruby-crowned kinglet	x	2	
Regulus satrapa	Golden-crowned kinglet	x	2	
Sialia currucoides	Mountain bluebird	x	2	
Sialia mexicana	Western bluebird		2	USS
Turdus migratorius	American robin	x	1	
Family: Tyrannidae	**Flycatchers**			
Contopus borealis	Olive-sided flycatcher		2	
Contopus sordidulus	Western wood-pewee	x	2	
Empidonax difficilis	Western flycatcher		2	
Empidonax hammondii	Hammond's flycatcher		2	
Empidonax oberholseri	Dusky flycatcher		2	
Empidonax traillii	Willow flycatcher		2	USS
Myiarchus cinerascens	Ash-throated flycatcher		1	
Sayornis saya	Say's phoebe		1	
Tyrannus verticalis	Western kingbird	x	1	
Family: Vireonidae	**Vireos**			
Vireo gilvus	Warbling vireo		2	
Vireo solitarius	Solitary vireo		2	
Order: Piciformes	**Woodpeckers**			
Family: Picidae	**Woodpeckers**			
Colaptes auratus	Northern flicker (red shafted, yellow)	x	1	
Picoides pubescens	Downy woodpecker	x	2	
Picoides villosus	Hairy woodpecker	x	1	
Sphyrapicus nuchalis	Red-naped sapsucker		2	
Order: Strigiformes				
Family: Strigidae	**Owls**			

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Asio flammeus	Short-eared owl		1	USS
Asio otus	Long-eared owl		2	
Athene cunicularia	Burrowing owl		1	USS
Bubo virginianus	Great horned owl	x	1	
Otus kennicotti	Western screech-owl	x	1	
Family: Tytonidae				
Tyto alba	Barn owl	x	1	
	Class: Mammalia (Mammals)			
Order: Artiodactyla	**Even-toed Ungulates**			
Family: Antilocapridae	**Pronghorn**			
Antilocapra americana	Pronghorn antelope	x	1	
Family: Cervidae	**Deer**			
Cervus canadensis	Elk		2	
Odocoileus hemionus	Mule deer	x	1	
Order: Carnivora	**Carnivores**			
Family: Canidae	**Wolves, Foxes, and the Coyote**			
Canis latrans	Coyote	x	1	
Vulpes fulva	Red fox	x	1	
Vulpes macrotis	Kit fox		1	USS
Family: Felidae	**Cats**			
Felis concolor	Mountain lion		2	
Lynx rufus	Bobcat		1	
Family: Mustelidae	**Weasels, Skunks, and Badgers**			
Mephitis mephitis	Striped skunk	x	1	
Mustela erminea	Short-tailed weasel		1	
Mustela frenata	Long-tailed weasel		2	
Mustela vison	Mink		2	
Taxidea taxus	Badger	x	1	
Family: Procyonidae	**Ringtails**			
Bassariscus astutus	Ringtail		2	USS
Order: Chiroptera	**Bats**			

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Family: Molossidae	**Free-tailed Bats**			
Tadarida brasiliensis	Mexican free-tailed bat		2	USS
Family: Vespertilionidae	**Plainnose bats**			
Eptesicus fuscus	Big brown bat	x	1	
Euderma maculata	Spotted bat		1	FCC2
Lasionycteris noctivagans	Silver-haired bat	x	1	
Lasiurus cinereus	Hoary bat		1	
Myotis californicus	California myotis	x	1	
Myotis evotis	Long-eared myotis		2	
Myotis lucifugus	Little brown myotis		1	
Myotis subulatus	Small-footed myotis		1	
Myotis thysanodes	Fringed myotis		1	
Myotis volans	Long-legged myotis		1	
Pipistrellus hesperus	Western pipistrel		1	
Order: Insectivora	**Insectivores**			
Family: Soricidae	**Shrews**			
Sorex merriami	Merriam's shrew	x	1	
Sorex obscurus	Dusky shrew	x	2	
Sorex vagrans	Vagrant shrew	x	2	
Order: Lagomorpha	**Lagomorphs**			
Family: Leporidae	**Rabbits and Hares**			
Lepus californicus	Black-tailed jackrabbit	x	1	
Lepus townsendi	Whitetail jackrabbit		2	
Sylvilagus auduboni	Desert cottontail	x	1	
Sylvilagus idahoensis	Pygmy rabbit		2	
Sylvilagus nuttalli	Mountain cottontail		1	
Order: Rodentia	**Rodents**			
Family: Muridae	**Mice, rats, lemmings, and voles**			
Clethrionomys gapperi	Boreal redback vole	x	2	
Lagurus curtatus	Sagebrush vole	x	1	
Microtus longicaudus	Longtail vole	x	1	
Microtus montanus	Mountain vole	x	2	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Microtus pennsylvanicus	Meadow vole	x	2	
Mus musculus	House mouse	x	1	
Neotoma cinerea	Bushytail woodrat		2	
Neotoma lepida	Desert woodrat		1	
Onychomys leucogaster	Northern grasshopper mouse		1	
Peromyscus boylii	Brush mouse	x	1	
Peromyscus crinitus	Canyon mouse		2	
Peromyscus maniculatus	Deer mouse	x	1	
Peromyscus truei	Pinon mouse	x	1	
Phenacomys intermedius	Heather vole	x	1	
Rattus norvegicus	Norway rat		1	
Reithrodontomys megalotis	Western harvest mouse	x	1	
Family: Erethizontidae	Porcupines			
Erethizon dorsatum	Porcupine	x	1	
Family: Geomyidae	**Pocket gophers**			
Thomomys bottae	Valley pocket gopher	x	1	USS
Thomomys talpoides	Northern pocket gopher	x	2	USS
Family: Heteromyidae	**Pocket mice and Kangaroo rats**			
Dipodomys microps	Great Basin kangaroo rat	x	1	
Dipodomys ordii	Ord's kangaroo rat	x	2	
Microdipodops megacephalus	Dark kangaroo mouse	x	1	
Perognathus fasciatus	Wyoming pocket mouse		1	
Perognathus longimembris	Little pocket mouse	x	1	
Perognathus parvus	Great Basin pocket mouse	x	1	
Family: Dipodidae	**Jumping mice**			
Zapus princeps	Western jumping mouse	x	2	
Family: Sciuridae	**Squirrels**			
Ammospermophilus leucurus	Whitetail antelope squirrel		1	
Citellus townsendii	Townsend's ground squirrel	x	1	
Citellus variegatus	Rock squirrel	x	1	

Table 3-8. Observed and Potential Wildlife at TEAD-S (continued)

Scientific Name	Common Name	Observed	Habitat	Sensitive
Eutamias dorsalis	Cliff chipmunk	x	1	
Eutamias minimus	Least chipmunk	x	1	
Eutamias umbrinus	Uinta chipmunk	x	1	
Marmota flaviventris	Yellow-bellied marmot		2	
Tamiasciurus hudsonicus	Red squirrel		1	

Note.—Protection status classification is based on the State of Utah's draft document "Division of Wildlife Resources Classification" (SPEC.CON/, Rev. 8/20/92).

[a]Limited. Habitat exists but will not support capacity populations that would exist in an ideal habitat situation.
[b]Observed.
[c]Habitat exists to support large population.
[d]Federal Candidate Category 2 species.
[e]Utah State Sensitive species.
[f]Protected under Eagle Protection Act.
[g]Utah Threatened Species.
[h]Federal Endangered Species.

Primary reference for vertebrates: *Checklist of Vertebrates of the United States, the U.S. Territories, and Canada*; edited by Richard Banks, Roy W. Diarmid, and Alfred L. Gardner; U.S. Department of the Interior, Fish and Wildlife Service Resource Publication 166, Washington, D.C., 1987.

continue to roost all day in the canyon without hunting. They will only roost on the valley floor if weather is moderate. Population surveys of Rush and Cedar Valley indicate that the number of eagles at a roost varies with the weather. The total number of eagles from all the roost sites in the valley is a good indication of population changes (Gerrard and Bortolotti 1988).

As raptors, bald eagles are generally classified as tertiary consumers and carnivores; they are opportunistic and will feed on carrion as well. While bald eagles prefer fish, they can often be found eating rabbits and waterfowl in winter (Gerrard and Bortolotti 1988). Winter-kills of sheep, rabbits, and mule deer are also consumed by bald eagles. Hunter-kills of mule deer, pronghorn antelope, and rabbits supplement bald eagle food supplies, as well. The primary food sources for bald eagles of Rush Valley are black-tailed jackrabbits and desert cottontails. Other animals of the area that could be opportunistically consumed by bald eagles if killed by winter, disease, or hunters include coyote, kit fox, great basin gopher snake, great basin rattlesnake, long-tailed weasel, long-tailed pocket mouse, and Ord's kangaroo rat.

The UDWR takes an annual census of eagles in Rush Valley and Ophir Canyon. The 1991 standardized count totals conducted by the regional offices were as follows: 1,204 eagles in all of Utah, 310 eagles (approximately 25 percent of the states total) in the central region, and 100 eagles in Ophir Creek Canyon near TEAD-S. Bald eagles were observed on TEAD-S during the RFI, Phase II site investigations. The bald eagle population in the TEAD-S area is generally associated with nightly roosting sites. Currently, Rush Valley and Cedar Valley (between Rush Valley and Utah Lake) support four roosting sites: two roosts in Rush Valley and two roosts in Cedar Valley. In Rush Valley, one roost is in the Ophir Canyon and one is near Vernon, 13 miles south of TEAD-S on the valley floor. The exact number of eagles at each roost typically changes with the weather because eagles roost on the valley floor in cottonwood trees if the weather is mild and in the canyon when the weather is severe.

Peregrine Falcon. Though once common across the United States, the peregrine falcon (*Falco peregrinus*) was eliminated east of the Mississippi from the 1940s to the 1960s and became listed as an endangered species in 1969. The decline in population was linked to the increased use of dichlorodiphenyltrichloroethane (DDT) and its derivatives as agricultural pesticides. Though particularly concentrated in the southeastern portion of Utah, colonies and isolated breeding pairs are also known to exist in the northwestern portion of the state and south of Salt Lake City.

Usually preferring open country and cliffs, peregrine falcons appear to be highly adaptable with regard to habitat. While many pairs have been successfully introduced into cities where they nest on buildings and feed on pigeons, peregrine falcons are sensitive to human interference at nesting sites. Because of their endangered status and their sensitivity to human disturbances, consideration should be given to these factors when determining future land use. Peregrine falcons are year-round residents in the TEAD-S facility area, and several nesting pairs have been observed.

Ferruginous Hawks. The ferruginous hawk (*Buteo regalis*), which occurs within the TEAD-S facility area, is a wildlife species of special concern. The status of this hawk throughout its range is generally unknown, but its total population is believed to be relatively small when compared to golden eagles, prairie falcons, northern harriers, or other Buteos.

Ferruginous hawk populations are known to fluctuate considerably over a period of years. The reason for this probably relates to changes in prey populations (e.g., cottontails, jackrabbits, ground squirrels, and prairie dogs). Additionally, the ferruginous hawk is considered to be very sensitive to human disturbances. They will sometimes abandon their nests after only one or two direct human disturbances within 50 yards of it. Ferruginous hawks are especially sensitive to disturbances during the courtship and egg-laying period. It should also be noted, however, that individual birds apparently vary considerably in their sensitivity to human activities and to the type of activity. For these reasons, raptor biologists are particularly concerned about land use, resource developments, or human disturbances within a 1/2-to-1-mile range of any active ferruginous hawk nest. Ferruginous hawks have been observed in the TEAD-S facility area, including nesting pairs; however, no nests were located.

Golden Eagle. Golden eagles (*Aquila chrysaetos*) are abundant throughout the year at TEAD-S and are protected by the Migratory Bird Act. They range throughout the western U.S., Canada, and Alaska (Peterson 1987).

Golden eagles are large dark birds with a golden crown and nape. These raptors stand 3 to 3.5 feet high, with a wing span of 76 to 92 inches. Golden eagles are territorial birds and will aggressively defend a 5-square-mile area during nesting activities. Golden eagles tend to nest along canyon walls, using the same nests year after year. They feed primarily on rabbits and large rodents, but will frequently scavenge carrion. Golden eagles are relatively tolerant of human-related disturbances, as long as the adult birds are undisturbed for sufficient periods of time to feed their young. Adults will generally leave the nest when anyone is observed approaching; they may leave the nest even when the intruder is several hundred yards away and will remain away from the nest until the humans leave the area.

3.5.5.4.2 *Grazing Mammals*

Pronghorn Antelope. The pronghorn antelope (*Antilocapridae americana*) once populated all parts of Utah, except the highest elevations and densely forested areas. Throughout the 1800s, the species was almost eradicated from Utah because of over-hunting, grazing competition with sheep and cattle, and fencing of open range. Since 1945, controlled hunting by permit is used as a population management tool.

Antelope habitat consists of a wide variety of vegetative types comprised of a high density of grasses, forbs, and shrubs. This species generally prefers wide open, flat terrain. Classified as primary consumers and herbivores, antelope utilize grasses, forbs, and shrubs throughout the year. However, during the winter months, antelope require shrubs of sufficient nutritional quality and availability as forage. During the winter, pronghorn rely heavily on selected browse species (Wyoming big sagebrush, basin big sagebrush, bud sagebrush, greasewood, Douglas rabbitbrush, curlleaf mountain mahogany, serviceberry, spiny hopsage, and rubber rabbitbrush) to provide nutrition and maintain health. Of these, big sagebrush—particularly Wyoming big sagebrush—is the most important winter browse species for antelope (Sundstrom, Hepworth, and Diem 1973).

In addition to quality forage, another important environmental factor that antelope require is available water. While antelope commonly use snow during the winter months, they tend to concentrate near flowing water (Irwin et al., 1984). Habitats located a long distance from available water are not used by antelope. Pronghorn antelope are adapted to open range and are not readily able to jump obstacles, such as fences. Common three-strand barbwire fences are frequently fatal to animals, and many animals become entangled in range fences and die. Antelope are more likely to go under a fence than over it and, while TEAD-S is surrounded by a high chain-link fence, pronghorn antelope have been observed going under the fence in order to browse on the base.

The pronghorn antelope population has commercial value. The pronghorn hunting industry affects the Utah economy because (1) local landowners receive money for permits to hunt on private land, (2) hunting-license fees, collected by the state, support range and wildlife management programs in the UDWR, (3) sales of hunting equipment and supplies support local economies, and (4) hunting attracts out-of-state hunters. Utah estimated its pronghorn population at approximately 10,000 animals in 1983. Currently, there are 190 pronghorn in Rush Valley, up from 118 in 1989. A total of 35 bucks, 105 does, and 50 fawns were counted in the preseason survey. There was a ratio of 48 fawns to 100 does in the population and a ratio of 33 bucks to 100 does. Five hunting permits for bucks were issued in 1989 and 1990.

The pronghorn antelope is a resident species of the facility area. No herd migration is associated with this species unless it is to find a new water hole or better grazing. Normally, the herds are made up of 1 male buck with as few as 5 does and as many as 18 to 20 does of various ages. Some harems have had as many as 35 does, but this occurs when over-hunting of dominant males has occurred. Breeding takes place in late September and early October.

Mule Deer. The mule deer (*Odocoileus hemionus*) is a year-round resident of TEAD-S. These deer are characterized by large ears and a stiff-legged bounding gait. The males are larger than the females and weigh 110 to 475 pounds; females weigh from 70 to 160 pounds (Burt 1980).

Mule deer range throughout the western U.S. and southwestern Canada. They migrate seasonally to avoid heavy snow and to find adequate food. Mule deer habitats include riparian forest, shrubland, juniper woodland, and aspen woodlands. Wintering areas, which are extremely important to mule deer survival, are often located at lower elevations in juniper, big sagebrush, and riparian habitat types. During the winter months, mule deer browse available trees and shrubs, primarily willows, aspen, juniper, and sagebrush. In the summer, they forage primarily on herbaceous plants, including grasses and forbs. Home range for these animals is between 90 and 600 acres. The mule deer is the most important big game animal in the Western United States (Burt 1980).

3.5.5.4.3 *Small Mammals*

Deer Mouse. The deer mouse (*Peromyscus maniculatus*) is not confined to any single habitat, but is found in most ecosystems, with one of the widest ranges of all species of North American mammals. Because of its ability to adapt, the deer mouse occupies more habitats than more specialized species of mice. The deer mouse is found throughout TEAD-S. While primarily herbivores, this species is sometimes omnivorous. During the winter and summer months, they feed on seeds, fruits, roots, tubers, and nuts. Invertebrates also form a component of the diet.

Females may breed at less than 2 months of age, and a female deer mouse born in March could bear four or five litters during her first summer. Litter size averages more than four. About 90 percent of these recruits mature and are taken by predators without disrupting the stability of the population. Deer mice are active the whole year, but in extended periods of extremely cold weather, they may enter temporary torpor.

Black-tailed Jackrabbit. The black-tailed jackrabbit (*Lepus californicus*) ranges from 17 to 21 inches in body length, about 6 to 7 inches in ear length, and 3 to 7 pounds in weight. They occupy prairies, grassland, and other open, sparsely vegetated areas of the western United States. They are most active from evening through morning, and forage on almost any green, herbaceous vegetation such as chokecherry, snakeweed, bitterbrush, sagebrush, and a variety of grasses.