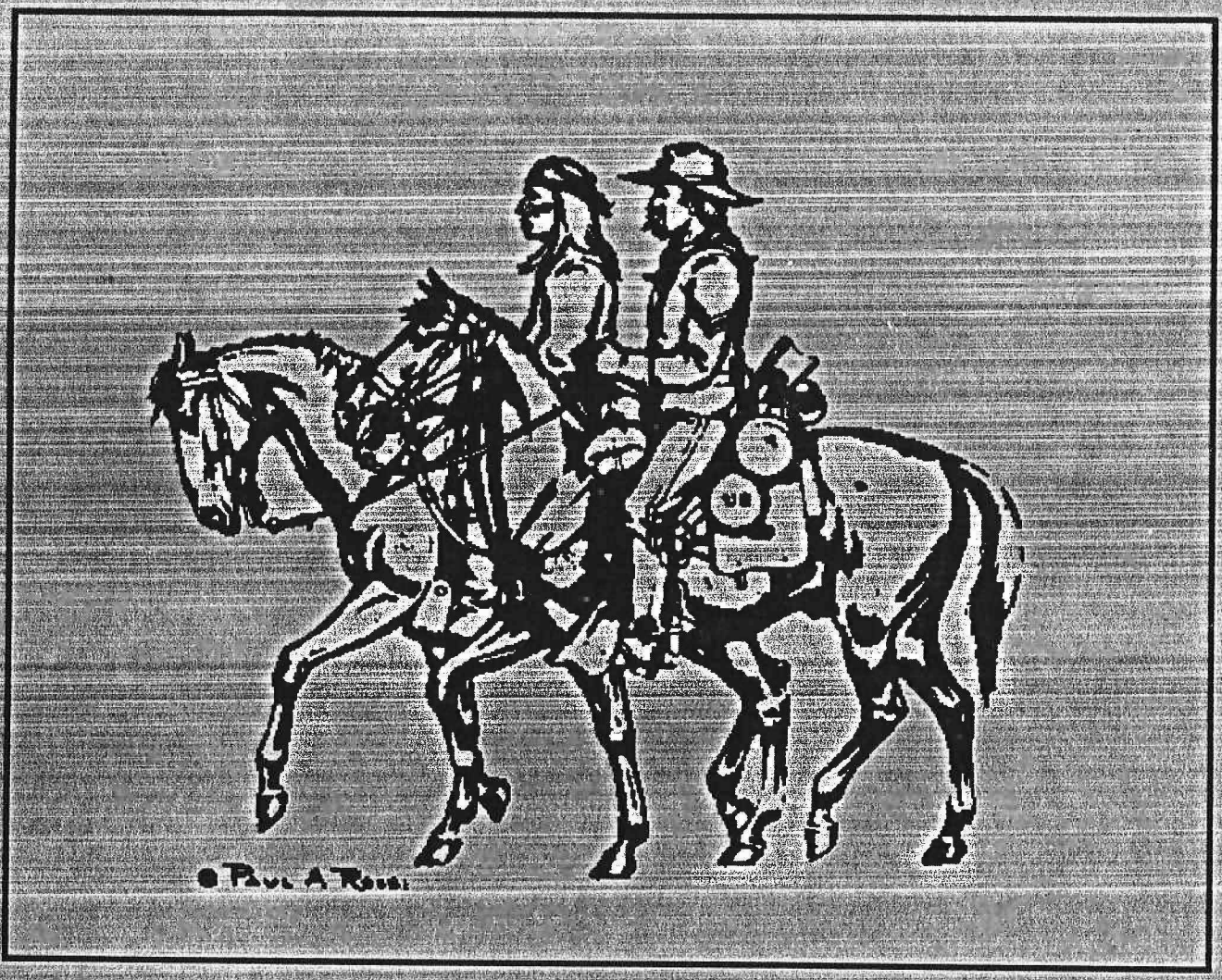

March 1992
Prefinal Submittal

Fort Huachuca, AZ
Mobilization Master Plan Report

Prepared Under the Direction of
US Army Corps of Engineers
Sacramento District

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SECTION V - UTILITY SYSTEMS & SOLID WASTE ANALYSIS

5.1 PURPOSE. The purpose of this analysis is to determine the impact of mobilization on utility and solid waste systems at Fort Huachuca. Systems discussed include water, sanitary sewer, storm drainage, electrical, telephone and communications, heating and cooling fuels, and solid, industrial, and hazardous waste.

5.2 CRITERIA. Mobilization capability is accomplished by determining the existing capability of each utility system and comparing it to the existing demand for service. The capability over and above existing projected requirements, also referred to as residual capacity, is used to define the expansion potential of the utility system to meet mobilization requirements. In addition to the pertinent Army Regulations (AR) and Technical Manuals (TM), three existing documents have been used for this analysis: Future Development Master Plan, Fort Huachuca, AZ, Master Plan Narrative, 1991; Fort Huachuca Base Realignment Utilities Analysis, 1990; and the Fort Water and Sewer System Study, Fort Huachuca, August 1991.

5.3 EFFECTIVE POPULATIONS. The capacity of a utility system is best expressed in terms of Effective Population (EP), which is that population supported by a system's output. EP is defined as the number of persons working and living on-post, plus one third the number of persons working on-post but living off-post.

The EP fluctuates during peacetime and even more so during mobilization when the number of persons living and working on-post will dramatically increase. The additional population includes reservists and other units mobilizing and deploying from the Fort, and personnel mobilizing to the Fort but **not** deploying. The Fort population and full Mobilization EP are listed in *Table C-1 & C-2, Appendix C.*

5.4 WATER SYSTEMS

5.4.1 General. The Fort maintains systems for water, sewer, drainage and fire protection services which are independent from the City of Sierra Vista utility services. Within the City water is furnished by four independent water systems.

- Ft. Huachuca
- Belle Vista
- Cochise Water Company
- Pueblo del Sol

All of the City's water systems depend on wells which on average are about 700 feet deep. None of them connect to Fort Huachuca's water system. The Fort dropped plans to obtain additional supply from local water companies, mainly because Fort Huachuca lies on a higher elevations than the City of Sierra Vista.

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In an emergency, the Fort's Fire Department can receive assistance from the City of Sierra Vista. However, their response is limited to two fire trucks with a pumping capability of 1000 GPM for each truck.

5.4.2 **Water Supply.** Six wells near the East and the Main Gate and one well northeast of Libby Army Air Field, furnish water to a 450,000 gallon reservoir in the Upper Pressure Zone A, a 1,500,000 gallon reservoir in the Middle Pressure Zone B, and a 3,000,000 gallon Reservoir in the Lower Pressure Zone C. All zones are interconnected for an "as needed" transfer of supply. Total reservoir storage is 4,950,000 gallons. The majority of the Fort population, about 55% - 65%, lives and works in the Middle Pressure Zone B. The Fort's expansion, including BRAC, will take place in the lower pressure zone and in the western portion of the middle pressure zone B. Well locations and pressure zones are illustrated in *Figure 5-1* and *Figure 5-2*, respectively.

5.4.2.1 **Well Pumping Capacity.**[1] Most wells have a rated capacity of about 700 gallons per minute (GPM). *Table 5-1* shows a listing.

Table 5-1
Rated Well Pumping Capacity

Well	Rated Pumping(GPM)	Location
1	500	Main Gate
2	750	Main Gate
3	700	East Gate
4	700	East Gate
5	700	East Gate
6	750	East Gate
7	750	East Range
Total	**4,850**	

The estimated total pumping capacity of 4,000 GPM or 5,760 million gallons per day (MGD) is less than the rated capacity of 4,850 GPM. The lower rate accounts for downtime or maintenance and repair of the pumps.

5.4.2.2 **Well Production.** Monthly well productions for 1988, 1989 and 1990 presented in *Table 5-2* average **2.64 MGD** (2.49 + 2.53 + 2.89)/3 = 2.64). *Figure 5-3* illustrates the three-year average well production relative to residual capacity and total pumping capacity.

[1] Source: Condensed TAB, June 1989

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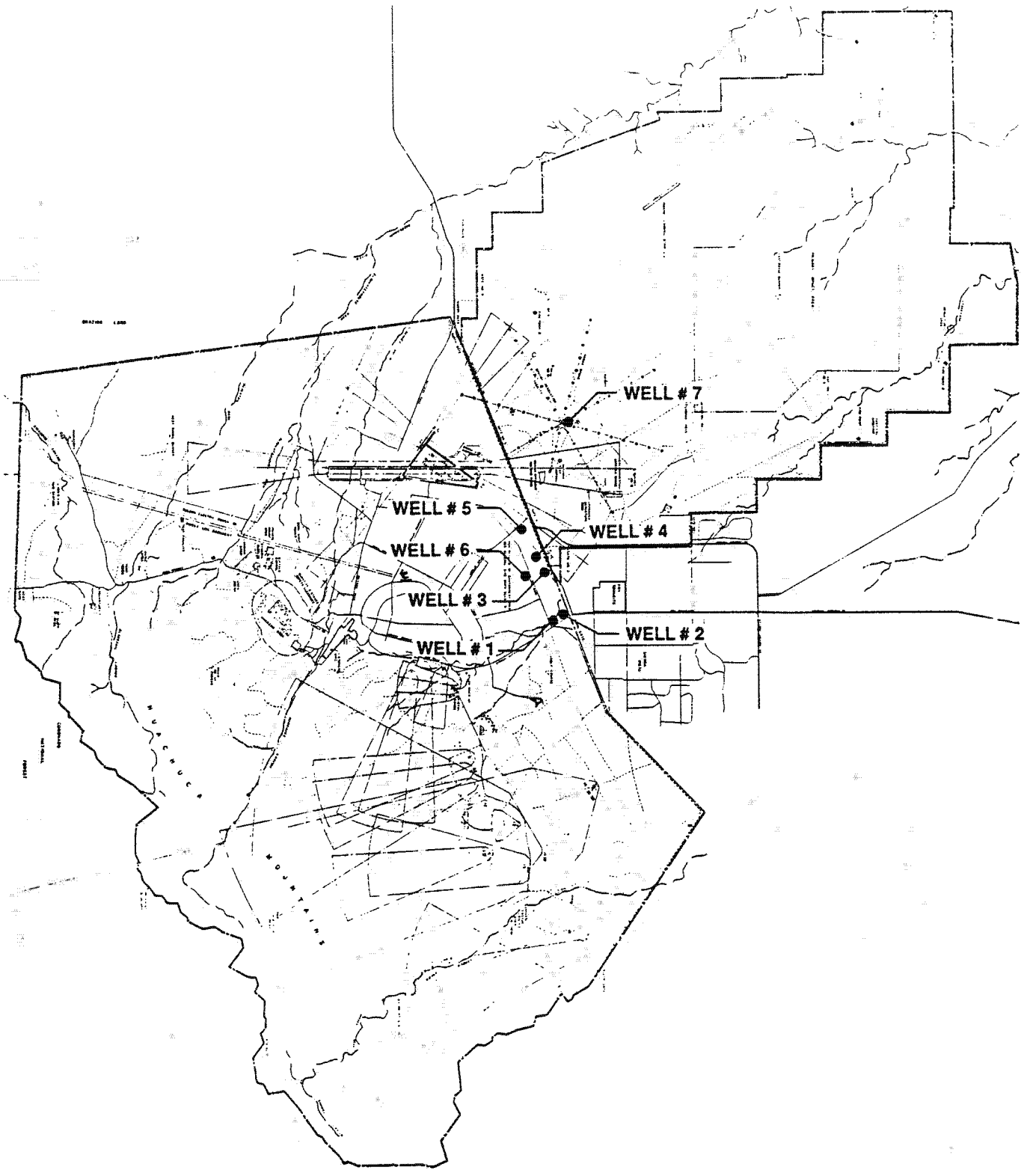

Figure 5-1

Fort Huachuca Well Locations

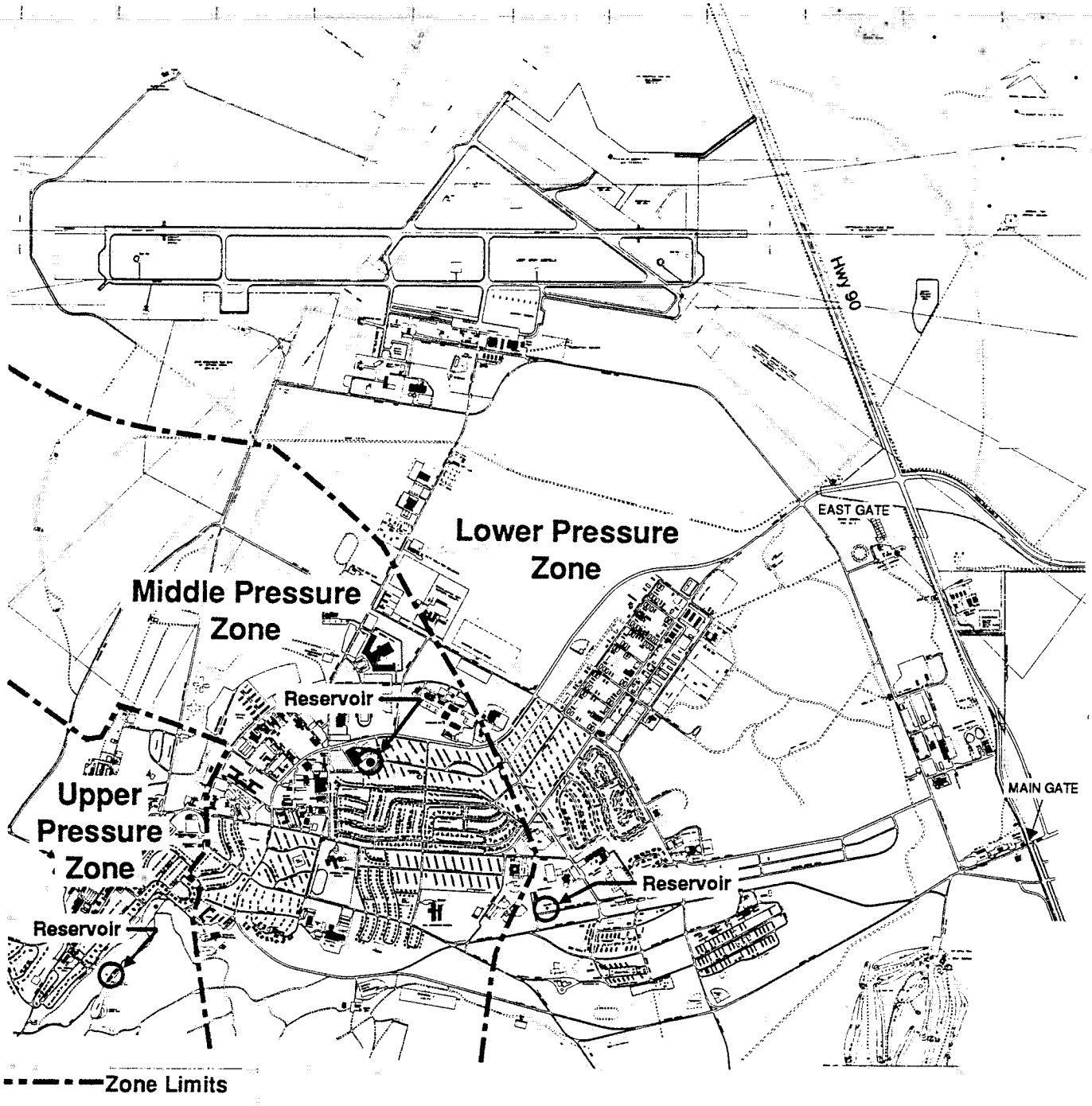

Figure 5-2

Utility Zone Delineation Map

Table 5-2
Well Production - 1990[2]

	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL #6	EAST RANGE	TOTAL KGALS
JAN	5397	13351	273	22697	0	12315	121	55861
FEB	4077	14189	24337	37	0	11589	0	54229
MAR	5175	14383	11466	18372	3642	19556	0	75040
APR	2522	17778	21304	16963	14012	19726	0	92305
MAY	749	18430	24271	17936	14509	18463	0	97912
JUN	0	23518	27222	19661	13577	18757	17175	119910
JUL	0	14935	28336	19248	7011	4147	858	78159
AUG	0	14800	26656	21436	465	4595	0	70370
SEP	0	19600	700	21849	16346	11509	0	70004
OCT	0	20100	0	22106	16815	9484	0	70708
NOV	0	15660	0	21119	18083	1892	0	56754
DEC	600	1680	3223	21643	17763	7263	0	54239
TOTAL	18520	188424	167788	223067	122223	139296	18154	895491

(or 2.49 MGD)

Well Production - 1989

	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL #6	EAST RANGE	TOTAL KGALS
JAN	17319	14417	697	14567	1077	30851	0	78928
FEB	14591	11218	4210	8060	0	18979	0	57058
MAR	15969	12472	15376	11088	937	20014	28242	104098
APR	10877	7647	9457	15091	6178	20259	31205	100714
MAY	14475	8298	14700	16323	11569	22440	26310	114115
JUN	2535	21479	19302	18655	8524	24080	33371	127946
JUL	7360	16185	16874	16137	9247	17884	10014	93701
AUG	4405	15934	15019	11945	14105	11899	936	74243
SEP	6009	21053	20215	14916	10873	19379	4274	96719
OCT	7473	14406	11481	11122	4809	29201	1357	79849
NOV	7241	16945	7140	8287	605	22570	0	62788
DEC	5263	14441	351	22083	0	11421	0	55388
Total	113517	174495	134822	168274	67924	248977	135709	909561

(or 2.53 MGD)

[2] Source: DEH, Nov 1989, Jan 1990; unit measure in thousand gallons

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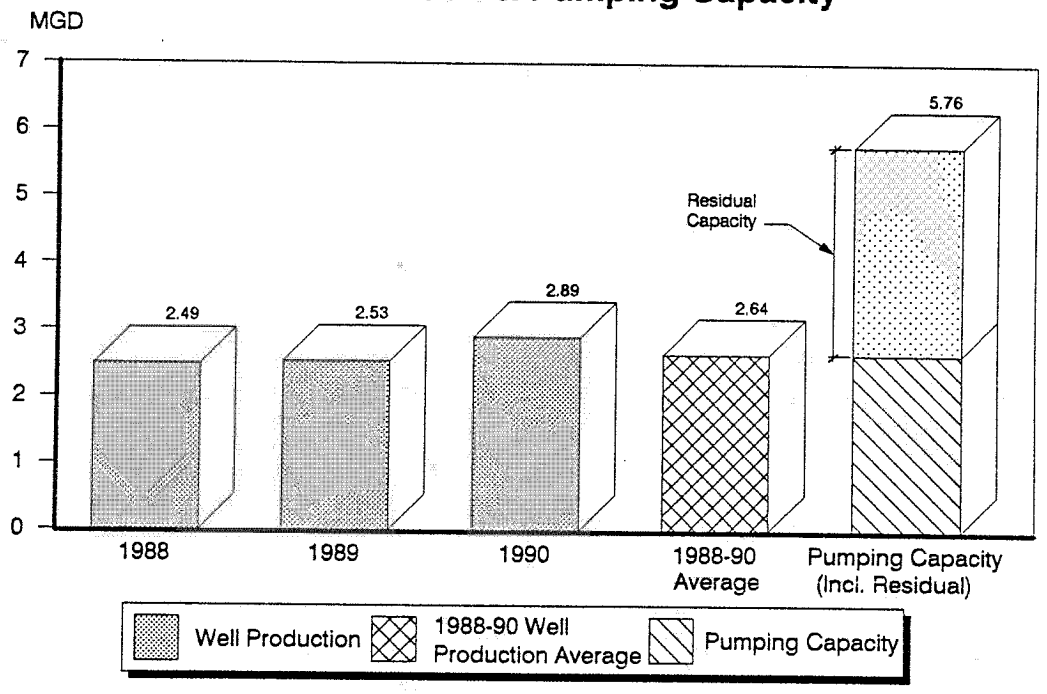
Well Production - 1988

	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL #6	EAST RANGE	TOTAL KGALS
JAN	9499	0	0	10161	1390	6807	30537	58394
FEB	6382	0	0	9365	1096	0	43932	60775
MAR	6639	0	0	18454	9638	25520	32066	92317
APR	4744	15660	0	18578	0	28957	27724	95663
MAY	1781	21029	231	20054	0	29464	44382	116941
JUN	997	20593	0	19907	0	28268	56774	126539
JUL	3658	17184	0	12140	1061	29912	33814	97769
AUG	7850	0	6303	12092	0	4920	47673	78838
SEP	12001	360	22160	20074	0	28295	0	82890
OCT	11105	18008	26078	10692	420	16813	0	83116
NOV	14477	8214	21681	10519	559	18777	0	74227
DEC	10917	19404	1382	16053	0	27973	0	75729
Total	90050	120452	77835	178089	14164	245706	316902	1043198

(or 2.89 MGD)

Figure 5-3

Well Production & Pumping Capacity



5.4.3 Projected Domestic Demand. To gain a better understanding of the domestic water demand at M+4, it is first of all necessary to review the current and projected domestic peacetime demand.

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A. **Current and Projected Domestic Peacetime Demand.** The following quantity data[3] are used for evaluating the water system and consumption:

Pumping capacity	5,760	MGD
Well production (average 1988-90)	2,640	MGD
Domestic peacetime demand (projected)	1,790	MGD
Reservoir storage	4,950	MGD
Wastewater treatment	1,700	MGD
Effective population	11,530	EP
Allowance factor gallons per capita per day (GPCD)	150	GPCD

Domestic Use 64%
Other Uses 36% (fire flushing, testing, commercial, industrial, irrigation)

$$\text{Domestic Use} = \frac{\text{Waste Water Treatment } 1.7 \text{ MGD}}{\text{Well Production} = 2.64 \text{ MGD}} = 64\%$$

$$\text{Projected Use} = \frac{2.64 \text{ MGD}}{11{,}530 \text{ Effective Population}} = 229 \text{ GPCD}$$

Projected Use (64% x 229) = 146 GPCD < 150 GPCD allowable
Other Uses (36% x 2.64) = 0.95 MGD

B. **Projected Domestic Demand at M+4.** In determining projected demand and corresponding well production at M+4, the peacetime data will change with regard to effective population and per capita water allowance. In this changing scenario, the remaining constants are the "other uses" of 0.95 MGD and the capacity factor which is the cushion that will absorb fluctuations in demand.

- Per person allowance for water is predetermined at 100 GPCD.[4]
- Design population: 20,379 EP x 1.15 Capacity Factor = 23,436 EP
- Projected domestic demand: 23,436 EP x 100 GPCD = 2.343 MGD or 1,600 GPM (2,343,600/24 hrs x 60 minutes)
- Total projected demand: domestic demand + other uses; 2.343 MGD + 0.95 MGD = **3.29 MGD**

[3] Source: Future Development Plan, Fort Huachuca, AZ, Master Plan Narrative, August 1991

[4] Source: Supplemental Scope of Work-Enclosure 6, CESPK-ED-M, April 16, 1991.

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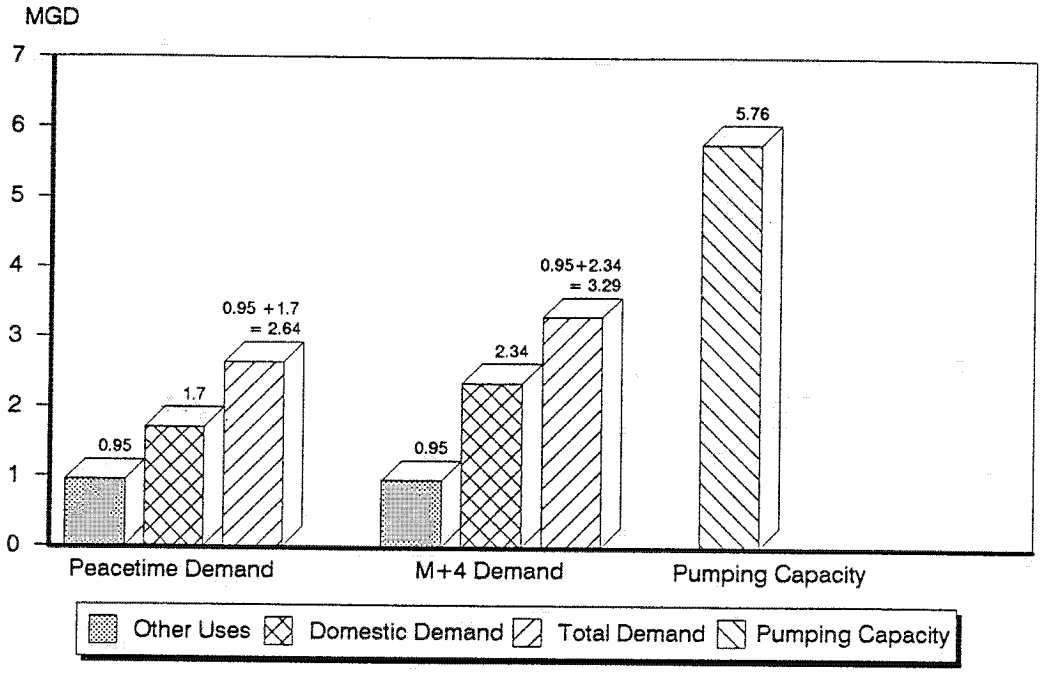
Figure 5-4 shows the water demand for peacetime and M+4 relative to the total water pumping capacity.

Figure 5-4

Water Demand Peacetime & M+4



5.4.4 Fire Demand. Water requirements to extinguish fires falls into the categories water supply and water flow. A comparison of the two determines the weakest link in the water system as it relates to fire suppression.

A. Water Supply. Water supply for fire protection is based on meeting the largest demand under variable conditions. The "worst case" occurs when aircraft hangar fires at Libby Army Airfield (LAA) must be extinguished. For instance, the 35,800 SF hangar (Bldg 91114) requires the following fire flow:

Type Flow	Rate	Duration	Quantity
Hose Stream	1,000 GMP[5]	120 Min	120,000 Gal
Fire Sprinklers	12,530 GPM[6]	105 Min	1,316,000 Gal
	Total Fire Flow		**1,436,000 Gal**

[5] Source: TM 5-813-6 Water Supply for Fire Protection, Table VII

[6] Source: MIL-HDBK-1008A, Table 10

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The water system is required to support the sum of the fire flow and 50% of the average domestic demand, or:

Fire Flow	1,436,000	Gal	
Plus 50% domestic avg	96,000	Gal	[(1,600 GPM x 120 Min)/2 = 96,000 GP]
Total	**1,522,000**	**Gal**	

The 1,522,000 Gal (1.522 MGD) requirement is less than the 4.95 MGD storage capacity. At this point it is important to note that the total water storage is replenishable within 14.7 hours by drawing on the 2.65 MGD (110,400 GPH) excess pumping capacity.

B. Water Flow. A computer model was used to analyze the flow rates of the water supply system.[7] The findings show that the system is capable of supporting the design fire demand flows according to TM 5-813-6 Water Supply for Fire Protection, except that some areas have less than optimum water flow characteristics. For example, the system in the southwestern residential area cannot support 1,000 GPM while maintaining a 20 PSI residual pressure, causing the flow drop to 750 GPM during a fire. Unless the pressure system is upgraded, the reduced flow will remain an unavoidable yet temporary inconvenience.

Two other areas in the water system need improvements:

- The existing manifold at the 1.5 MG reservoir cannot support the required fire flow at a residual 20 PSI pressure and should be upgraded.

- The system in the expanded campus area is capable of supporting the required flows, a 12 inch connecting link from the northeast corner of this area to the existing main along Jeffords Road to the east will improve the system's capability.

More than 500 fire hydrants equipped with two standard 2" hose connections and one 4" pumper connection provide service points throughout the built-up area. All are in good working order. Hydrants will be added when new lines or new buildings are constructed. So far, more than 60 buildings are protected by a fire sprinkler system.

5.4.5 Limitation of the Water Supply System. Although the 3.29 MGD total projected demand exceeds the 2.64 MGD average current demand by 23.1 %, it is still well below 5.76 MGD pumping capacity. If needed, pumps can operate at 100% capacity for 24 hours to make up for shortfalls and still allow time to maintain and repair other parts of the system. Excess pumping capacity can replace reservoir storage in less than a day and on short notice. Reservoir storage is more than 2.15 times the daily domestic demand (4.95 MGD/2.343 MGD = 2.11). Except for the possibility of diminished pressure in the

[7] Source: Post Water and Sewer System Study, Fort Huachuca, AZ, August 1991

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event of two simultaneous hangar fires, the water system is adequate to meet mobilization requirements.

5.5 SANITARY SEWER SYSTEMS

5.5.1 Sewer Collection and Treatment. Two treatment plants and a sewage collection system serve the Fort independently from systems in adjacent communities. The sewer network in the Cantonment consists of 6-inch and 8-inch collector lines which discharge through 12 and 15-inch mains into treatment Plant 2. Plant 1 is not in operation and used for water storage. Its two holding ponds are used for non-potable water distribution. Both plants operate on the trickling filter principle of aerobic wastewater treatment. The flowsheet of both plants includes the treatment stages listed below.

Except for one small lift station, all flows are gravity. Septic tanks are used to treat sewage flow in outlying areas.

- bar screen and grit chamber
- primary clarifier
- trickling filter
- secondary clarifier
- digester (for clarifying solids)

Plant 2 was designed for 3.0 MGD capacity. Flow records into Plant 2, furnished by DEH and listed in *Table 5-3*, indicate periods of high and low flows. Subtracting the average inflow from the water production leaves a residual that is used for irrigation, fire, leaks, and other water uses not entering into the system. No allowance is made for infiltration.

The following example illustrates this calculation:

Water Production (1988)	2.89 MGD
Average inflow into Plant 2	1.70 MGD
Remainder	1.29 MGD

Table 5-3
Fort Huachuca - Highest Seasonal Flow Rate*
Sewage Treatment Plant 2

Time	June '88		July '88		Aug '88	
	Workday	Non-Wkday	Workday	Non-Wkday	Workday	Non-Wkday
000	1.502647	1.346621	1.112399	1.281582	1.229539	1.346621
100	1.216526	1.008221	0.943081	1.047294	1.034270	1.177484
200	1.112399	0.877918	0.825769	0.917019	0.903986	0.434002

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Table 5-3 (continued)

0300	1.047294	0.864882	0.956111	0.877918	0.864882	0.473243
	1.060317	0.877918	0.812729	0.877918	1.047294	0.434002
	1.372631	0.943081	0.825769	0.851846	1.112399	0.394743
	1.944288	1.229539	1.242551	1.281582	1.632604	0.289945
	2.476161	1.086360	1.892360	1.788481	1.892360	0.447085
	2.242738	1.372631	2.216794	2.048122	**2.566905**	1.489648
	2.372432	1.918325	1.892360	2.087052	2.320559	1.892360
	2.255709	2.346496	**2.307590**	2.346496	1.892360	1.996208
	2.125979	2.190849	2.061099	2.100029	1.866393	2.087052
1200	2.113004	2.125979	1.918325	2.100029	1.866393	1.957268
	2.100029	1.905342	2.035144	2.022166	1.736530	1.827439
	2.100029	1.957268	1.762507	1.801468	1.762507	1.749519
	1.931306	1.905342	1.684571	1.658589	1.476649	1.632604
	1.944288	1.710552	1.580628	1.645597	1.606617	1.879377
	1.996208	1.827439	1.567633	1.671580	1.567633	1.853409
	1.931306	1.892360	1.853409	1.970249	1.632604	1.892360
	1.866393	1.749519	1.905342	2.074076	2.138954	1.957268
	1.723541	1.788481	1.892360	1.918325	2.087052	2.216794
	1.853409	1.827439	1.879377	2.087052	1.866393	1.957268
	1.736530	1.892360	1.892360	1.970249	1.697562	1.762507
2300	1.736530	1.697562	1.398639	1.697562	1.515645	1.606617
AVG.	1.823404	1.597604	1.602454	1.671762	1.638254	1.448118

* Flow rate in MGD; influent flow adjusted from "9" to a 12" flume.

5.5.2 Limitation of the Sanitary Sewer System. The projected 2.343 MGD average inflow into Plant 2 exceeds the current 1.7 MGD average inflow by 35.29 %. That inflow is less than the plant's 3.0 MGD design capacity but is not taking the peak inflow into consideration. The peak flow on M+4 is calculated by setting the adjusted August 1989 peak inflow of 2.567 MG (refer to *Table 5-3*) and the 1989 effective population of 9,938[8] in proportion to the projected inflow of 2.343 MGD and effective population of 23,436. The 2.567 MG peak inflow is based on 150 GPCD peacetime water consumption and must be adjusted to 70 GPCD for mobilization.

$$\text{Adjusted peak inflow} = \frac{2{,}567 \text{ MG} \times 70 \text{ GPCD}}{150 \text{ GPCD}} = 1.2 \text{ MG}$$

[8] Base Realignment Utility Analysis, Fort Huachuca, February 1990

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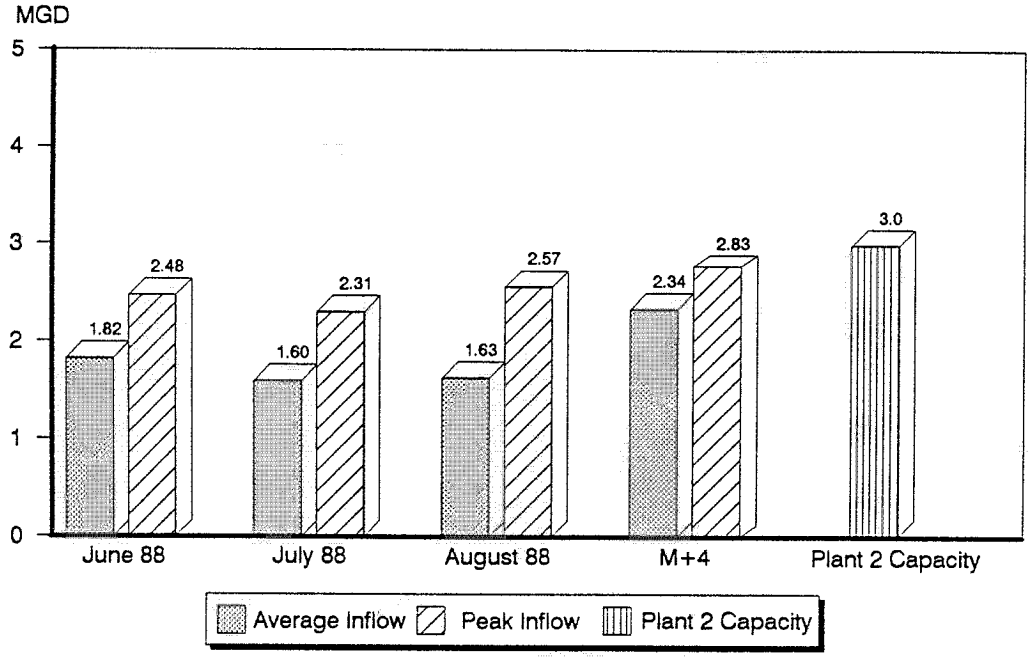
$$\text{Projected peak inflow} = \frac{23{,}436 \text{ EP} \times 1.2 \text{ MG}}{9{,}938 \text{ EP}} = 2.83 \text{ MG} < 3.0 \text{ MG capacity}$$

$$\text{Max EP for Plant 2} = \frac{3.0 \text{ MG} \times 9{,}938 \text{ EP}}{1.2 \text{ MG}} = 24{,}845 \text{ EP}$$

The above example demonstrates that through drastically reduced inflow of 70 GPCD Plant 2 can support 24,845 EP leaving a residual capacity of 1,409 EP (24,845 - 23,436 = 1,409). *Figure 5-5* relates the treatment capacity of Plant 2 to peacetime and M+4 inflows.

Figure 5-5

Water Treatment Peacetime & M+4



5.6 STORM DRAINAGE & FLOOD HAZARDS. The "General Storm Drainage Maps" for the built-up areas indicate that water from the Huachuca Mountains runs into Huachuca Canyon and Soldier Creek. As shown in *Figure 5-6 Cantonment/Libby Army Airfield Natural Constraints,* both watercourses skirt the developed areas, Greely Hall and the runway watershed flood during heavy rainstorms without causing damage.

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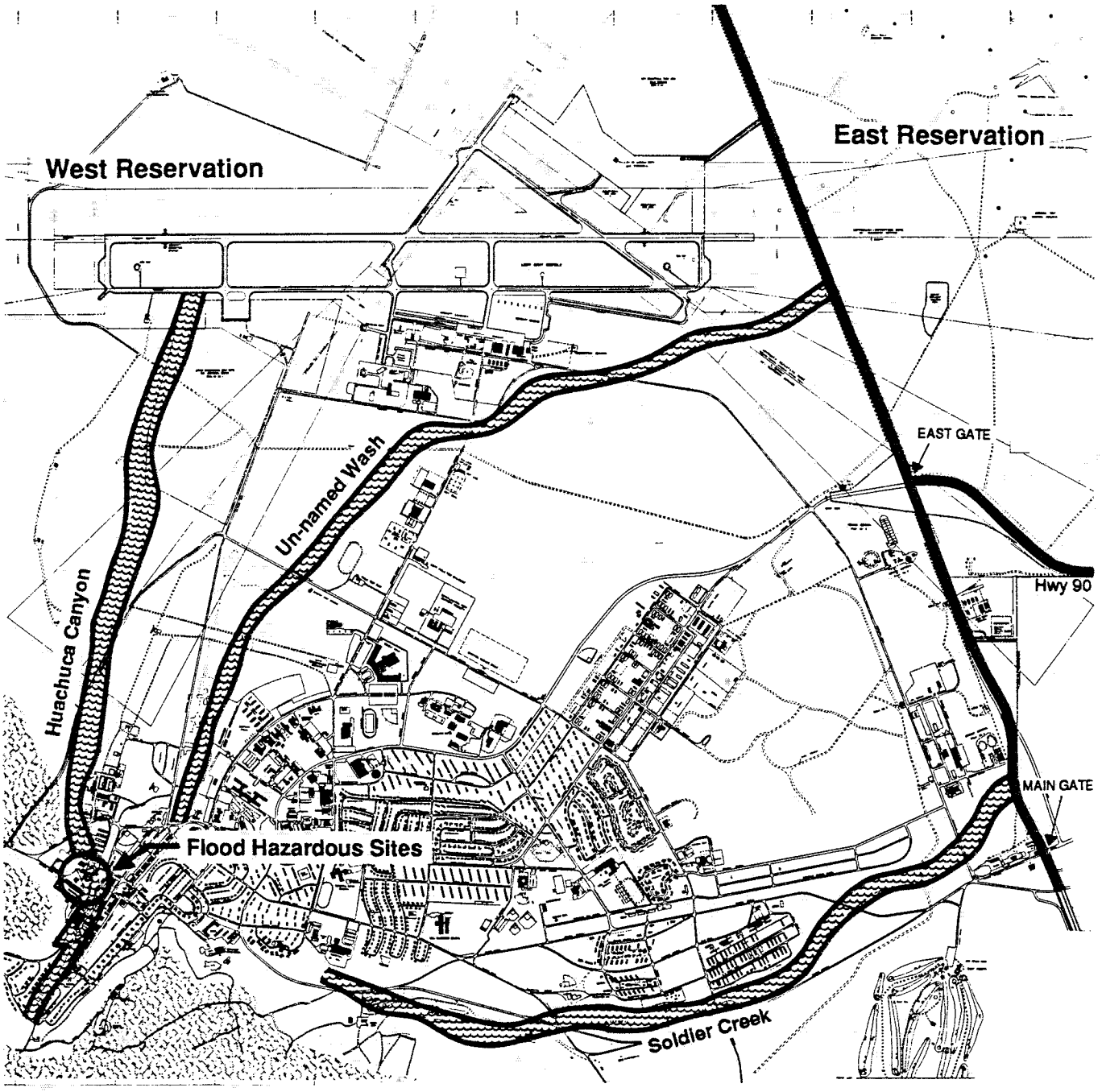

Wooded/Forested Land

100 - Year FloodPlain

Figure 5-6

Cantonment/Libby Army Airfield Natural Constraints

Floods occur along Huachuca Canyon wash and have the potential to damage facilities close to Butler Road and Clarkson Street, and in areas near the old power plant north of Butler Road, just west of Clarkson Street. Stormwater that has not evaporated or percolated, eventually runs off into the Babocomari and San Pedro River.

Storm drains and a detention basin adequately protect the runway watershed from flooding. Drainage from the Huachuca wash is channeled under the westend of the primary runway, and drainage from Greely Hall, down Arizona Street, is diverted and drained to the east of the airfield.

5.6.1 Limitations of the Storm Drainage System. The Fort does not have any hydrologic or hydraulic studies substantiating the flood boundary lines shown on the maps mentioned above. Although there is no recorded flood history on the Installation, no mobilization activities should encroach on the flood plains shown on the maps.

5.7 ELECTRICAL SYSTEMS. The primary power for the Fort is obtained from the Tucson Electric Power Company (TEP) 138/46/14 KV Substation, located 800 feet west of Greely Hall. Power is delivered from TEP's Vail Substation via a 54 mile long 138 KV transmission line. Back-up power is available from TEP's South-end Substation near Nogales, AZ, via a 70 mile long 46 KV transmission line and a 46/14 KV transformer that has recently been installed at the TEP substation. The power capacities available to the Fort are shown in *Table 5-4*.

Table 5-4
Electrical Capacity

FACILITY	AVAILABLE CAPACITY AT FORT	PRESENT LOAD	KVA ESTIMATED 1993 LOAD	1993 % LOAD'G
138 KV line	124,000 KVA	18,898 KVA	24,000	19%
46 KV line *	25,000 KVA	18,898 KVA	24,000	96%
138/14 KV XFMR	42,000 KVA	18,898 KVA	24,000	57%
46/14 KV * XFMR	28,000 KVA	18,898 KVA	24,000	86%

* available stand-by power via 46 KV transmission line from south-loop

5.7.1 14KV Switching Station. The existing station is double ended. One half is served from TEP Bus "A", while the other half is served from TEP Bus "B". A normally open bus tie circuit breaker can transfer one half of the switching station to the other in case of a failure on TEP Bus "A" or "B". Since both TEP buses A & B are served by an independent breaker, the double-ended scheme

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is considered very reliable in the industry. Unfortunately, the switching station is blocked by other facilities, thus constraining the expansion of buses.

5.7.2 14KV Distribution. The Fort is presently served by six (6) distribution circuits. Each circuit emerges from the switching station with 500 MCM underground cable. Some distance from the station each circuit converts to an overhead pole line, consisting of 336 MCM aluminum mains. The peak and emergency loads of the existing circuits are shown in *Table 5-5*.

Under the "Roads an Utilities Upgrade" project, currently being completed, the existing 14KV switching station is expanded to provide six additional 14KV distribution circuits. A follow-on projects will include two additional 14 KV feeders. The addition to the switching station will accommodate sixteen feeders.

Table 5-5
Peak Loads and Emergency Loads - Existing Circuits

Circuit No	Capacity in Amps	Peak Load in Amps	Emergency Load in Amps	% Capacity at Emergency	Notes
AF-1	270	212	234 (Cir BF-1)	87	
AF-2	270	169	413 (Cir BF-2)	153	Most loads will be transferred to new switching station addition
AF-3	270	95	212 (Cir BF-3)	79	
BF-1	270	22	234 (Cir AF-1)	87	
BF-2	270	244	413 (Cir AF-2)	153	Approx. 100 AMPS load will be transferred to new switching station addition
BF-3	270	117	212 (Cir AF-3)	79	Most loads will be transferred to new switching station addition
Total		**859**			

The overloads at AF-2 and BF-2 can be completely mitigated by opening disconnecting switches by closing tie switches and transferring loads to adjacent circuits.

5.7.3 Reliability of Power Source/Supply. Out of ten power outages during the last seven years, five were of long duration and considered extremely disruptive to the Fort. The reliability of the Fort's electrical system was markedly improved through the addition of the new 14KV switching station in 1987, the installation of a "TEP" 46/14 KV transformer in April 1991, and the

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16 recent replacements of the exterior busduct, which connects the TEP 138/14KV power transformer to TEP 14KV switchgear.

5.7.4 Back-Up Power Supply to the Fort. The power supply to the Fort depends on the reliabilities and capacities of TEP's transmission lines to Fort Huachuca substation and transformers. The worst condition occurs when the 138KV line from the Vail substation to the Fort or the 138/46/14KV 42 MVA transformer at Fort Huachuca substation fail. In both cases the Fort's power supply depends entirely on the TEP 46 KV line from Nogales, AZ, to Fort Huachuca, the 46/14KV 28 MVA transformer, and the standby electric generating units listed in *Table 5-6*. During peacetime the total peakload of the Fort can be carried by this back-up supply from Nogales until 1993. At that time the 46KV line capability of 25MVA is reached.

Table 5-6[9]
Standby Generating Units

Model	Location	Capacity	
Caterpillar	Greely Hall	455	KW
Caterpillar	Greely Hall	455	KW
Hanco	Greely Hall	125	KW
Onan	Greely Hall	28	KW
Continental	Engineers Yard	150	KW
Hanco	Control Tower LAA	125	KW
Kohler	Transmitter Bldg LAA	15	KW
Hanco	Hospital	440	KW
Onan	Hospital	220	KW
Mil Std	Com Ctr Greely Hall		
Onan	Range 12 Target Range	15	KW
	Old Post Exchange	125	KW
Kohler	Riley Barracks	40	KW
Onan	MARS Station	85	KW
Kohler	Transmitter Reservoir Hill		
Hanco	EOC Bldg 3122	50	KW
Hanco	MP Station	30	KW
Hanco	East Range, Bldg 15680	30	KW
Stewart & Stevenson	Fire Sta #1, Bldg 22336	60	KW
Lima	Intel School, BDS Bldg	6.5	KW
Mil Std	Lights & Ops Bldg LAA	100	KW
Onan	Commissary	33	KW
Kohler	Radar Transmitter LAA	20	KW
Onan	V. O. R. LAA	30	KW
Hanco	Ground Slope LAA	20	KW

[9] Source: DEH Fort Huachuca, Electrical Division

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Table 5-6 (continued)

Hanco	Localizer LAA	20	KW
Hanco	GCA/Tower LAA	20	KW
Total		2,697.5	KW
Rounded		**2,700**	**KW**

To back-up loads at the Fort the following three options are available:

1. Install relaying and controls to initiate shedding of "non-critical" loads until the load at the Fort does not exceed 25MVA.

2. Request TEP to reconductor 40 miles of the 46KV transmission line from 2/0 copper to 336 MCM ACSR and install additional capacitors to partially compensate for voltage drops.

3. Bring in a 69KV transmission line from the Sulphur Springs Valley Electric Cooperative (SSVEC). With a 28 MVA 69/14KV transformer at its terminal near the existing switching station, the back-up capability to the Fort would be increased to 53MVA, 25MVA from TEP and 28MVA from SSVEC.

The first option should not be too costly, especially if there are circuits available with non-critical loads that can be entirely dropped at the Fort's switching station. If these circuits are not available, expensive remote controls and switches will have to be installed to drop non-essential building loads or feeder sections. The second option is expensive. TEP would probably have to spend close to $1,000,000 to upgrade the 46KV line. Besides, even when the 46KV line is upgraded, in year 2000 the Fort's peak load may exceed the TEP 46/14KV transformer capacity of 28MVA at Fort Huachuca substation. If load shedding is not applied, another $500,000 expenditure is needed by TEP to increase the 46/14KV transformer capacity at the above substation. The cost for reconductoring the 46 KV transmission line and upgrading the 46/14 KV, 28 MVA transformer will be passed on to the Fort. TEP will only carry the maintenance cost for both above items and the costs for upgrading the main 138 KV service to the Fort, when needed. The third option is very expensive and is as high as $2,200,000 in 1993 dollars. In addition, the cost of energy from SSVEC electricity will be approximately 40% to 50% higher than from TEP.

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Table 5 – 7

Electrical Power History

Month	1988				1989				1990			
	Peak Power Demand		Power	Total Energy	Peak Power Demand		Power	Total Energy	Peak Power Demand		Power	Total Energy
	MVA	KW	Factor	Consumed (MWH)	MVA	KW	Factor	Consumed (MWH)	MVA	KW	Factor	Consumed (MWH)
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*
Jan	14.957	12,945.00	0.87	6,770.10	15.454	13,955.00	0.90	7,671.00	15.191	13,825.00	0.91	6,780.00
Feb	14.585	12,760.00	0.87	6,594.60	15.405	14,046.00	0.91	6,917.70	15.247	14,018.00	0.92	6,805.50
Mar	14.993	13,128.00	0.88	6,143.10	15.452	14,098.00	0.91	6,516.30	14.814	13,678.00	0.92	6,465.30
Apr	15.219	13,268.00	0.87	6,388.50	18.170	16,524.00	0.91	7,688.40	15.244	13,994.00	0.92	7,841.10
May	17.177	14,922.00	0.87	6,751.50	19.425	17,444.00	0.90	7,627.80	17.982	16,211.00	0.90	7,417.50
Jun	19.773	16,736.00	0.85	7,601.40	20.438	17,934.00	0.88	8,027.40	20.336	18,581.00	0.91	8,604.30
Jul	18.926	16,488.00	0.87	7,974.30	21.130	18,383.00	0.87	9,068.70	20.334	18,898.00	0.93	8,725.80
Aug	18.652	16,332.00	0.88	8,036.70	18.904	16,719.00	0.88	8,423.10	17.836	16,682.00	0.94	7,995.90
Sep	18.782	16,515.00	0.88	7,298.10	18.516	16,918.00	0.91	8,286.00	19.234	17,859.00	0.93	8,572.80
Oct	17.820	15,954.00	0.90	7,412.40	17.818	16,248.00	0.91	7,479.85	16.840	15,932.00	0.95	7,188.00
Nov	14.661	13,289.00	0.91	6,376.50	15.249	13,886.00	0.91	6,450.00	14.666	13,934.00	0.95	7,153.50
Dec	15.067	13,669.00	0.91	6,490.80	14.921	13,609.00	0.91	7,604.40	14.365	13,634.00	0.95	7,002.30
Total		176,006.00		83,838.00		189,764.00		91,760.65		187,246.00		90,552.00
Average/Mo	16.718	14,667.17	0.88	6,986.50	17.573	15,813.67	0.90	7,646.72	16.841	15,603.83	0.93	7,546.00
Average 3 High Mos	19.160	16,579.67		7,870.80	20.331	17,920.33		8,592.60	19.551	18,446.00		8,634.30
Average 3 Low Mos	14.734	12,944.33		6,336.80	15.260	13,816.67		6,628.00	14.615	13,712.33		6,683.60

Average 3 month – (high 3 year MVA demand) = 19.681 Per capita demand = 19,681 KVA/11,530 EF = 1.71 KVA/EF

MVA = Mega Volt Amps KW = Kilowatts PF = Power Factor MVA = KW/PF x 1000

Sample: MVA = 12,646/.8649 x 1000 = 14.621 EF = 11,530

Note: All consumption and demand data shown are provided by Fort Huachuca DEH

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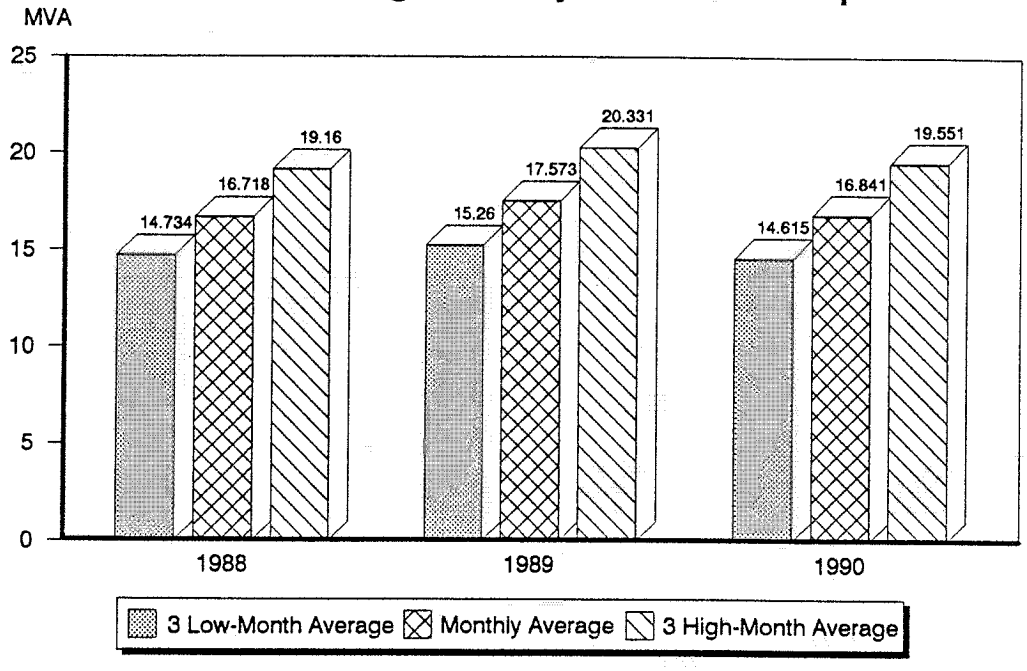
5.7.5 Limitations and Capabilities of the Electrical System. The power consumption and the demand on the system for the last three years is shown in *Table 5-7 Electrical Power History* and *Figure 5-7*. The three month high average load for 1988-1990 is recorded as 19,681 KVA which establishes a load of 1.71 KVA per 1990 effective population of 11,530 (19,681 KVA/11,530 EP = 1.71 KVA).

Figure 5-7

1988-1990 Average Monthly Power Consumption



To determine the weakest link in the electrical system regarding the effective population of 23,436 on M+4, the capacities of the following three systems must be examined.

1. TEP 138/46/14 KV XFMR, 42,000 KVA

$$EP = \frac{\text{Available KVA}}{\text{Per Capita Peak Demand}} = \frac{42{,}000 \text{ KVA}}{1{,}71 \text{ KVA/EP}} = 24{,}561 > 23{,}436 \text{ projected EP}$$

2. TEP 46 KV line, 25,000 KVA + 2,300 KVA Standby Generators

$$EP = \frac{\text{Available KVA}}{\text{Per Capita Peak Demand}} = \frac{25{,}000 \text{ KVA} + 2{,}700 \text{ KVA}}{1.71 \text{ KVA/EP}} = 16{,}199 < 23{,}436 \text{ projected EP}$$

3. Distribution circuits AF-1, AF-2, AF-3, BF-1, BF-2 and BF-3, each 270 Amps

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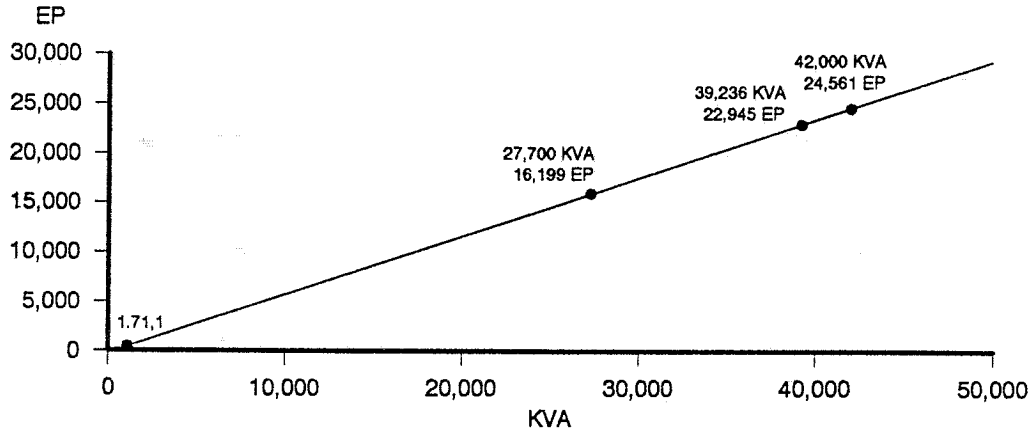
$$EP = \frac{\text{Available KVA}}{\text{Per Capita Peak Demand}} = \frac{6(270 \times 1.73 \times 14)}{1.71 \text{ KVA/EP}} = 22{,}945 < 23{,}436 \text{ projected EP}$$

Based on the above calculation and as shown in *Figure 5-8*, the 46 KV line with 25,000 KVA capacity is the weakest link in the system supporting only 16,199 EP which is 7,237 EP less than the projected 23,436 EP (23,436 - 16,199 = 7,237). It must be emphasized that this shortfall will only occur if the power supply of the 138/46/14 KV, 42,000 KVA, substation is suddenly interrupted.

Figure 5-8

Existing Electrical System Capacity Relative to Effective Population



1 EP = 1.71 KVA
Critical KVA 27,300 39,236 42,000
Critical EP 15,964 22,945 24,561

5.8 TELEPHONE AND COMMUNICATIONS

5.8.1 General. Communications capabilities at Fort Huachuca include: telephone system, high frequency radio, fire alarm, intrusion detection systems, secure voice system, telecommunication center (record traffic) outside plant facilities, and if required commercial radio. The telephone system is owned by the Government, except for Mountain Bell ownership of trunk connections and lines for Sierra Vista, WATS and Foreign Exchange circuits to Tucson and Phoenix.

5.8.2 Communication Resources Available.[10] The communication resources are divided into six categories described in the following subsections.

5.8.2.1 Non-Secure Voice System. The two administrative switchboards consist of the Dial Central Office (DCO) located in Building 22324, and the

[10] Source: Fort Huachuca Mobilization Plan, prepared by DPTM, March 1991

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Digital Branch Exchange (DBX) located in Greely Hall, Bldg 61801, Room 1028. Each switchboard has a 4,000 line capacity. The 4,000 lines at the DCO are 80% filled, leaving a residual of 800 lines, and the 4,000 lines at Greely Hall have with 99% almost reached their capacity.

The switchboards have eight operator positions and are open 24 hours each day. Of the 72 in/out commercial trunk lines, 10 are operator assisted. There are nine foreign exchange tie lines to Tucson, AZ, and three to Phoenix, AZ. The SPRINT system includes 25 two-way lines.

The AUTOVON/DCTN lines for precedence only communication is located at Apache Junction, AZ, and for routine communication at Socorro, NM. The system's 72 in/out lines can be used with various degrees of priority.

No Federal Telephone Service (FTS) is available on the Installation, but the Defence Communication Agency (DCA) provides 12 additional Defense Communications Telecommunications Network (DCTN) circuits to bring the Government Owned System (GOS) to P.03. No additional requirements are anticipated.

The special purpose non-secure voice includes 200 lines for the Command Control Network, and 100 lines for the Emergency Fire and Rescue System.

The communication system supports the tenant activities on the Fort. The local operating procedures are listed in the Post telephone book.

5.8.2.2 Secure Voice System. The "safe, crypto type" Secure Telephone Unit (STU) System includes STU Models-II and III. The system operates 24 hours per day. STU II is located in Greely Hall and Riley Barracks. STU III units have been distributed to agencies throughout the Installation.

5.8.2.3 Record Traffic. The electronically-transmitted narrative, card, magnetic tape and facsimile message system is a 24-hour operation and located in Greely Hall. The standard remote terminal (SRT) equipment functions as an automated facility with a Mode I circuit that is homed from Norton Automated Switching Center. The system operates with different security levels and procedures for delivery/receipt of message traffic and is in accordance with AR 105-31 Message Preparation and TM 11-490 -2.

5.8.2.4 Commercial Radio. The commercial radio net is a 24-hour operation providing communication for the following activities: Facilities Engineer and Fire Department, Provost Marshal, Raymond W. Bliss Hospital, USAG, FH EOC, Transportation Household Good Inspection Branch, Logistic Division USAISC, and Commanding General Integrated FM Mobile Radio System.

Access to the system, with the exception of the Commanding General, is made through contact with EOC and obtaining telephone patch of intercom connect.

5.8.2.5 Installation High Frequency (HF) Radio. The Army Military Affiliate Radio System (MARS) is located in Building 90551. The types of emission are voice and radio. The transmit power output range from 20 watts to 3 kilowatts, and the frequency range is from 3.0 to 30 megahertz. Most of the station's equipment is newly installed. Normal operating hours are 1430Z-2200Z, Monday through Friday.

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Requirement for HF radio is in support of the following contingency plans/mission: DA Continuity Operations Plan (COOP), HF Emergency Radio Net; Fort Huachuca General War Plan(s); CDRFORSCOM/USINCARRED; Sixth US Army General War Plan; USAISC Basic Plan; MARS; Sixth US Army Military Assistance to Civil Authorities Plan; and FORSCOM Military Assistance to Civil Authorities Plan.

5.8.2.6 Outside Plant Capabilities. The following barracks buildings including the required terminals, cables and feeders are identified as support during mobilization: Building 82002; 82007; 82008; 82027; 820028; 84020; 85009; 85008; 85007; 84021; 85027; 82028; and 85003.

5.8.3 Limitations of Telephone Communications. There is no communication support required that is not currently available from existing capabilities of the USAISC Activity-Fort Huachuca.[11]

5.9 HEATING, COOLING, AND FUELS

5.9.1 Fuel and Energy Sources. Natural gas is the primary fuel for all heating and cooking functions on the Installation and is supplied by Southwest Gas Company through two high pressure mains (400 psi) owned by the El Paso Natural Gas Company. One main parallels Whitside Road to pressure regulating and metering station north of the cold storage area, and the other parallels Highway 90 to a regulating metering station located at Brainard Road and Carter Street. Both mains originate from a single branch line with branches from the pipeline along Interstate 10, 28 miles to the north, and which ties into the two 400 psi mains inside the north corner of the Reservation.

5.9.2 Distribution. Beginning at the metering stations, gas is distributed throughout the Installation in a government-owned pipe system, consisting of 4-inch mains along the principal thoroughfares and branching off with smaller pipe sizes to individual buildings. Operating pressure is 45 psi, with reducing stations at several points for the purpose of balancing flows, especially in loops.

5.9.3 Heating Plants. The majority of buildings on the Installation have individual heating plants. One central heating serves several buildings in the campus area, and the expanded campus will also be served by a central plant.

Major gas consuming facilities include: Bldg 22528 shop, Bldg 45001 hospital, Bldg 51001 barracks, Bldg 51005 Riley Barracks, Bldg 52004 mess, Bldg 52107 mess, Bldg 52204 barracks, Bldg 61801 Greely Hall, Bldg 72908 maintenance shop, and Bldg 90201 laundry.

5.9.4 Fuel Availability and Consumption. According to the Southwest Gas Company gas supply can increase two to three fold over and above current

[11] Source: Fort Huachuca Mobilization Plan, prepared by DPTM, March 1991

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consumption. The analysis of the heating system is dependent upon the present and projected heating space and not on a per capita basis. Conservation measures recommend a consumption of 80 BTU/per square foot.

The total energy consumption of natural gas for 1989 was 4,872,298 CCF or 502,334 MBTU and for 1990 5,903,839 CCF or 608,685 MBTU. The use of propane gas for 1989 was 36,973 gallons or 3,531 MBTU.

5.9.5 Fuel Alternatives. Fort Huachuca is in an ideal geographical location to obtain a significant portion of its heating requirements from solar energy. However, installing a complex solar plant on short notice to meet potential mobilization requirements for heating is difficult to achieve. Individual low pressure gas systems (LPG) may be better suited to respond to rapid expansion requirements.

5.9.6 Limitations on Fuel and Energy Sources. Limitations on gas supply do not exist at this time. According to the Southwest Gas Company, a two to three fold increase above the current demand can be met.

5.10 SOLID WASTE

5.10.1 Collection and Disposal. Solid waste generated by the Fort is collected under contract with Huachuca City and disposed in a landfill area outside the Installation. Approximately 120 tons of waste per day can be handled by the landfill which has a total capacity of 430,000 refuse tons. The landfill is jointly owned by the State and the private sector and serves a population of 40,000. At that rate of use and according to community planners, the landfill will reach its capacity in three years. In the meantime, the planners look for a new site in the Whetstone area, approximately five miles north of Huachuca City. The Fort has the option to reach an agreement with the responsible agencies to use the new site or develop a site on the Installation.

The Installation purchased space for 108,360 refuse tons in this landfill area. One third of that capacity was used up in 1988.

5.10.2 Limitations of Solid Waste Disposal. For all intents and purposes the existing landfill site has reached its capacity. This means that the City of Sierra Vista must find a new site in the near future which can also be used by the Fort. It is expected that the new landfill area can absorb the additional refuse generated during mobilization. Until the new site is established and proper use agreements are ratified, the refuse disposal remains critical.

5.11 INDUSTRIAL AND HAZARDOUS WASTE. As any modern community will, Fort Huachuca generates hazardous waste materials including cleaning compounds and solvents, fuels and lubricants, paints and chemicals, batteries and heavy metals in various forms, pesticides and other poisons, and various contaminated liquids and soils. In accordance with the requirements of the Arizona Department of Environmental Quality, Fort Huachuca monitors all hazardous waste generating activities and records the data obtained according to Standard Industrial Classification (SIC) and Department of Transportation (DOT) classification codes. Records include sources of waste generation,

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disposal, and, for materials disposed off-post, the names, locations and identification numbers of receiving facilities and transporters. This material is transmitted yearly[12] to the Arizona Department of Environmental Quality.

Concurrent with increasing on-post activities during mobilization, it seems reasonable to assume that there will be a corresponding but temporary increase in the amount of industrial and hazardous waste currently generated. The methods of disposal and compliance with regulation will be the same as during peacetime.

5.12 SUMMARY OF UTILITY SYSTEMS AND WASTE DISPOSAL

5.12.1 General. The water distribution system, the sewage treatment system, and the electrical source supply system can present limitations to the greatest expansion on M+4. All other systems will have greater than adequate capacity.

5.12.2 Water System. Water supply and storage will not be limitations. The 5.76 MGD pumping capability to the supply system exceeds the 3.29 MGD projected demand, and the 4.95 MG storage capacity is more than twice the 2.34 MGD domestic demand. In a severe case, such as extinguishing two simultaneous hangar fires at LAA, a distribution limitation in form of a water pressure drop to less than 20 PSI can occur.

5.12.3 Sanitary Sewer System. On M+4, the time of greatest expansion, the treatment plant reaches capacity. Plant capacity becomes critical as soon as 70 GPCD inflow is exceeded, and at 100 GPCD only 17,435 EP can be sustained which is a shortfall of 6,001 EP (23,436 - 17,435 = 6,001 EP). Plans are underway to increase the capacity and must be implemented to avoid a crisis situation.

5.12.4 Storm Drainage. There is no recorded flood history on the Installation, neither is there a flood plain study. The hundred year flood plains recorded on the existing conditions maps represent relatively small areas along the Cantonment periphery, away from potential encroachment by mobilization activities.

5.12.5 Electrical System. The electrical system may present a limitation on mobilization expansion, if the incoming 138 KV from the 46 KV power line, which has a record of breakdowns, were to fail. The 25,000 KVA available from the 46 KV line will not meet full service power requirements on M+4. Measures to reduce power requirements below 25,000 KVA include installing relays and controls to initiate shredding of "non-critical" loads.

5.12.6 Communications. There is no communication support required that is not currently available form existing capabilities of the US Army Information System Command, Fort Huachuca.

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[12] See Arizona Department of Environmental Quality Generator Annual Hazard Waste Report for 1990, Identification and Certification.

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5.12.7 Heating and Cooling Fuels. There will be no limitation imposed by gas supply. According to Southwest Gas Company, a two to three fold increase above current demand can be met.

5.12.8 Solid Waste Disposal. The off-post landfill, belonging to the adjacent communities and used by the Fort, is reaching its capacity. This presents a disposal limitation to the Fort as well as to the communities until a new site is in operation in the near future.

5.12.9 Industrial and Hazardous Waste. Industrial and hazardous wastes are disposed off by three commercial means and it is reasonable to expect this capability to continue during mobilization. The disposal methods and compliance with regulations employed in peacetime will not change for mobilization.

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