DEPARTMENT OF THE ARMY TECHNICAL MANUAL **TM 5-813-1**

DEPARTMENT OF THE AIR FORCE MANUAL **AFM 88-10, Chapter 1**

WATER SUPPLY

GENERAL CONSIDERATIONS

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

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WATER SUPPLY, GENERAL CONSIDERATIONS

TM 5-813-1/AFM 88-10, Chap. 1, 15 July 1965, is changed as follows:

1. Remove old pages and insert new pages as indicated below.

Remove pages	Insert pages
1 and 2	1 and 2
7 and 8	7 and 8
9 and 10	9 and 10

2. An asterisk appears before each line of text that is changed.

3. Below is a list of revised or added pages in the 15 July 1965 issue of TM 5-813-1/AFM 88-10, Chap. 1, with Change 1:

Page	Issue in effect	Superseded
2	C 1	(Basic)
8	C 1	(Basic)
9	C 1	(Basic)

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AIR FORCE MANUAL
No. 88-10, Chapter 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
Washington, D.C., 15 July 1965

WATER SUPPLY, GENERAL CONSIDERATIONS

* This manual superseded TM 5-813-1, 2 July 1958, previously designated as Corps of Engineers Manual EM 1110-345-220, and AFM 88-10, Chapter 1, 2 July 1958.

1. PURPOSE AND SCOPE. This manual prescribes the procedures to be followed in determining the water requirements for Army and Air Force installations and for special projects. It is applicable to all elements planning or performing military construction.

2. GENERAL. This manual describes general design procedures, application of design capacity factors, per capita water allowances, selection of materials, and the relation between domestic and fire-flow demands. It also explains terms relating to water-supply requirements and facilities. Established and accepted engineering practice will be followed in the absence of specific instructions for special conditions, problems, and details. Deviation from the following standards and criteria may be necessary in certain special cases. All proposed deviations will be presented, through appropriate Army or Air Force service channels, to the * USAF (PREE) Washington DC for approval.

3. DESIGN PROCEDURE. Planning for the development of the water-supply system for any project will proceed simultaneously with the planning for other facilities to insure proper coordination. The final design of the distribution system must of necessity await the final site plan and the completion of field surveys to obtain necessary topography. The development of ground water supplies, the design of surface water-supply works and filtration plants, and the design of water-distribution systems with storage facilities are regarded as highly specialized, requiring the attention of engineers experienced in this type of work.

4. SELECTION OF MATERIALS AND EQUIPMENT. Materials will be selected with consideration of the degree of permanence and the expected life of the project. Current policies of the Department of the Army and Headquarters, U. S. Air Force, with respect to the use of critical materials will be observed in the planning and construction of any water-supply works. To avoid delays in securing delivery of equipment, every effort will be made to utilize types of equipment that can be supplied by several manufacturers. The ability of equipment manufacturers to make delivery within the time required must be carefully investigated prior to making commitment for the purchase of mechanical equipment. As a general rule other types of equipment will be placed in competition with patented equipment peculiar to one manufacturer. Equipment of experimental nature and equipment that has not been proved by actual usage will * not be used unless specifically approved by the Office of the Chief of * Engineers or the Headquarters, U. S. Air Force.

5. DEFINITIONS. For the purpose of clarification, the following definitions are established for all manuals relating to water supply.

Water Works. All construction for the collection, transportation, pumping treatment, storage, and distribution of water.

Supply Works. Dams, impounding reservoirs, intake structures, pumping stations, wells, and all other construction for the development of a source of water supply.

Supply Line. The pipeline from the source of supply to the treatment works or to the distribution system.

Treatment Works. Filtration plant, reservoirs, and all other construction required for the treatment of a water supply.

Distribution System. The pipeline throughout the building areas including hydrants, valves, and other appurtenances used to supply water for domestic and firefighting purposes.

Feeder Mains. The principal pipelines of the distribution system.

Distribution Mains. The pipelines that comprise the distribution system.

Service Lines. Small pipelines connecting buildings to distribution mains.

Effective Population. This includes military personnel and their dependents and civilians and their dependents living on the station or in adjacent Wherry housing or similar projects, supplied by station utilities. The authorized population also includes the nonresident civilian employees. In general, nonresidents are allowed 50 gallons per day compared to 150 gallons per day for residents. Therefore, an effective-population figure can be obtained by adding one-third of the figure for nonresidents to the figure for residents. The use of this effective-population figure will simplify all subsequent calculations.

Capacity Factor. The mathematical value, varying inversely with the magnitude of the population, which is applied to the effective-population figure to provide for reasonable increases in population, variations in

water demands, and uncertainties as to actual water-supply requirements, and for unusual peak demands, the magnitude of which cannot be accurately estimated in advance.

Design Population. The population figure obtained by multiplying the effective population figure by the proper capacity factor.

Required Daily Demand. The total daily water-supply requirement is obtained by multiplying the design population by the per capita domestic water allowances, and adding to this quantity any special industrial, aircraft-wash, irrigation, air-conditioning, or other demands. Other demands include the amount necessary to replenish, in 48 hours, the storage required for fire protection and normal operation. Where the supply is from wells, the quantity available in 48 hours of continuous operation of the wells will be used in calculating the total supply available for replenishing storage and maintaining fire and domestic demands and industrial requirements that cannot be curtailed.

Peak Domestic Demand. The peak domestic demand is assumed to be 2.5 times the daily average domestic requirements.

Fire Flow. The amount of water in gallons per minute required at a specific residual pressure at the site of the fire for a specific period of time.

Fire Demand. The amount of water in gallons per minute required during specified fire period. The fire demand is determined by the sum of the fire flow, fifty percent (50%) of the average domestic demand rate, and any industrial or other demand that cannot be reduced during a fire period. The residual pressure is specified for either the fire flow or essential industrial demand, whichever is the higher. Fire demand will include quantities required for automatic sprinkler operation, in addition to direct hydrant fire-flow demand as appropriate, when sprinklers are served directly by the water-supply system.

Rated Capacity. The rated capacity of a filter or pumping unit is the amount of water which can be passed through the unit when operating under design conditions.

6. DOMESTIC WATER REQUIREMENTS. The per capita allowances given in table I on the following page will be used in determining the

domestic water requirements (par. 9b). These allowances do not include special industrial, aircraft-wash, air-conditioning, irrigation demands, or extra water demands at desert stations. Allowances for nonresidents will be one-third that allowed for residents.

Table I

Per Capita Domestic Water Allowances for Air Force and Army Projects (Gallons Per Day)†

Type of project	Permanent construction	Field training camps
USAF Bases and SAGE Support Facilities	150‡	--
Armored Divisions	150	75
Camps and Forts	150§	50
Prisoner-of-War and Internment Camps	--	50§
Hospital Units¶	150	100
Hotels#	70	--
Depot, Industrial, Plant, and Similar Projects	50 gallons per employee per 8-hour shift; 150 gallons for resident personnel.	

Note: For Aircraft Control and Warning Stations, National Guard Stations, Guided Missile Stations, and similar projects, special instructions will be issued. (See TM 5-813-7 (EM 1110-345-229) or AFM 88-10, Chap. 7.)

† The allowances set forth above include water used for laundries to serve the resident personnel, washing vehicles, limited watering of planted and grassed areas, and similar uses. The allowances do not include special industrial or irrigation uses.

‡ An allowance of 150 gallons will also be used for USAF semi-permanent construction.

§ For populations under 300, 50 gallons will be used for base camps and 25 gallons will be used for branch camps.

¶ Includes hotels and similar facilities converted to hospital use.

Includes similar facilities converted for troop housing.

7. RELATION BETWEEN DOMESTIC AND FIRE-FLOW DEMANDS. The requirements of each system must be analyzed to determine whether the capacities are fixed by the domestic requirements or by the fire demands or by a combination of both. Where fire-flow demands are relatively high, or required for long durations, and population and related domestic and/or industrial demand relatively low, the total required capacity will be determined by the prevailing fire demand. In some exceptional cases this may warrant consideration of water systems for fire purposes, separate in part or in whole from normal potable water systems. However, separate systems should be avoided if at all feasible.

8. CAPACITY OF WATER-SUPPLY SYSTEM. a. Initial Design Capacity. Except where special water demands exist, the initial capacity of the water-supply system will be based on the "effective population" multiplied by the following capacity factors.

Effective population	Capacity factor
5,000 and less	1.50
10,000	1.25
20,000	1.15
30,000	1.10
40,000	1.05
50,000 and over	1.00

Capacity factors determined by arithmetical interpolation will be used for intermediate project population figures. Capacity factors will be applied to the supply works, supply lines, treatment works, principal feeder mains, and storage reservoirs. The capacity factor will be used in planning water supplies for all projects including general hospitals and internment and prisoner-of-war camps, unless future expansion is improbable. The capacity factor will not be applied in determining distribution-main sizes to serve areas that are fully developed and are not susceptible to further expansion. Capacity factors will not be used for hotels and similar structures that are acquired or rented for hospital and troop housing. Capacity factors will not be applied to fire flows, irrigation requirements, or industrial demands.

b. Use of Capacity Factor. The proper capacity factor as given above is multiplied by the "effective population" to obtain the design population. The design of all elements of the system, except as noted above,

should be based on the design population. The capacity factor provides for reasonable increases in population, variations in water demands, and uncertainties as to actual water-supply requirements for projects of the same type and for unusual peak demands, the magnitude of which cannot be accurately estimated in advance.

c. Special Design Capacity. Where special demands for water exist, such as large fire demands, irrigation, industrial processes, cooling water, and similar purposes, consideration will be given to these special demands in determining the capacity of the water-supply facilities. (See par. 5, Required Daily Demand, par. 6, and note † of table I.)

d. Expansion of Existing Systems. Where existing systems are adequate to supply actual existing demands plus the expansion proposed without inclusion of capacity factor, no additional facilities will be provided except necessary extension of water mains. In designing extensions, consideration will be given to planned future development in adjoining areas so that mains will be properly sized to serve future areas. Where existing facilities are not adequate to supply actual total requirements and new construction is necessary, the capacity factor will be applied to the proposed total population and the expanded facilities will be planned accordingly.

9. UTILIZATION OF WARTIME CONSTRUCTION. a. General. At many posts constructed during wartime, it is possible that certain emergency materials that will eventually require replacement were used in the water-supply systems. Wood storage tanks, wood-stave and thin-wall steel water mains, temporary-type buildings at pumping stations and water-treatment plants, and wood covers on reinforced-concrete storage reservoirs fall into this category. If such posts are selected for permanent retention, the less permanent facilities in the water-supply system will normally be continued in service at the permanent post until maintenance and repair costs show that this action is no longer economically justified. When this condition develops, replacement of the facilities will be made using permanent-type materials in accordance with current criteria.

b. Domestic Water Allowance. In the design of water-supply systems, the number of gallons indicated in table I will be used for per capita allowances in determining the requirements of the systems. However, where a camp having emergency construction is selected for a

permanent post, the per capita allowance for a permanent post will be used in connection with the authorized population to determine the overall adequacy of the water-supply facilities.

10. UNDERGROUND SPRINKLER SYSTEMS FOR IRRIGATION.

a. General. In arid and semiarid regions (average annual rainfall less than 25 inches), dryland grasses and vegetative cover, when properly managed, can be maintained without irrigation to control erosion and, to a limited extent, dust. However, where native vegetative cover is unsightly or otherwise objectionable, underground sprinkler systems may be considered, subject to the availability of water.

b. Sprinkler Installations. Underground sprinkler systems (fixed, pop-up, rotary pop-up heads, and quick-coupling-valve systems) will normally be considered desirable only in arid and semiarid regions. Underground sprinkler installations in areas of favorable rainfall will be considered only under extraordinary circumstances. Specific authorization will be required from the Major Command Civil Engineer for Air
* Force projects and from HQDA (DAEN-MCE-U) WASH DC 20314, for Army projects,
* for all proposed
installations prior to inclusion in design instructions. Each project proposed will include complete justification, detailed plans of connection to source of water, estimated cost, and a statement as to the adequacy of the water supply to support the irrigation system.

Both permanent and temporary structures which have or will have lawn areas will be provided with adequate outlets for irrigation and watering of turf. Lawn irrigation provisions for all facilities such as family quarters and temporary structures in all regions will be limited to hose bibbs on the outside of buildings and risers for hose connections. The use of underground systems will be limited as follows:

(1) For Air Force projects - areas adjacent to hospitals, chapels, clubs, and headquarters and administration buildings.

(2) For Army projects - areas adjacent to hospitals, chapels, clubs, headquarters and administration buildings, athletic fields, parade grounds, EM barracks, BOQ's, and other improved vegetative plantings which require frequent recurring irrigation to maintain satisfactory growth.

c. Backflow Prevention. Backflow preventing devices such as vacuum breakers or an air gap will be provided for all irrigation systems connected to potable water systems. Single or multiple check valves will not be used. Installation of backflow preventers will be in accordance with the National Plumbing Code. Cross connections between potable water systems and nonpotable water systems will not be permitted.

d. Use of Sewage Treatment Plant Effluent. (1) Conditions for use. Sewage treatment plant effluent may be used for irrigation only where water is in short supply and the need for vegetative ground cover is acute. Only secondary treatment effluent having a minimum measurable chlorine residual of 0.5 mg/l after a 30-minute contact period will be used. The sprinkler system will be physically separated from any distribution systems using potable water and the pipe so marked that it will be distinguishable from potable water distribution systems. A detailed plan will be provided showing the location of the sprinkler system using sewage treatment plant effluent in relation to the potable water distribution system, buildings, or other pertinent facilities. Provisions will be made either for locking the system or for removing the valve handle so that only authorized personnel can turn the system on or off.

(2) Approval. Plans for proposed sprinkler system projects using sewage plant effluent will be reviewed by the engineer and surgeon at CONUS Army level and the Air Force major command as appropriate. Final approval of such projects for Army construction will be made only after review by the Office of the Chief of Engineers and Office of The Surgeon General, Department of the Army. Final approval of Air Force projects will be made by the Director of Civil Engineering (AF/PREE), and The Surgeon General (AF/SG), Headquarters, USAF. Requests for prior approval of irrigation systems using sewage plant
* effluent will be submitted to HQDA (DAEN-MCE-U) WASH DC 20314, or to
* HQ USAF/PREE) as appropriate and will be accompanied by justification covering the following items:

(a) Description of the area to be irrigated (acreage, terrain), reasons irrigation is required, and general possibility of human contact.

(b) Factors precluding use of potable water such as economy, scarcity of supply, remoteness of source, and critical water

shortages. Sufficient data shall be given to permit evaluation.

(c) Economic feasibility of construction of the facilities using sewage plant effluent.

(d) Estimated cost and description of proposed irrigation system including amounts of pipe required and types of heads to be used (fixed, pop-up, rotary pop-up, quick coupling).

(e) Estimated cost of modification to sewage treatment plant, pumps, pipeline from plant to sprinkler system, labor, and other expenses required to make the nonpotable irrigation system operable.

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APPENDIX I

REFERENCES

1.	TM 5-813-2 (EM 1110-345-221) or AFM 88-10, Chap. 2.	Water Sources.
2.	TM 5-813-3 (EM 1110-345-222) or AFM 88-10, Chap. 3.	Water Treatment.
3.	TM 5-813-4 (EM 1110-345-223) or AFM 88-10, Chap. 4.	Water Storage.
4.	TM 5-813-5 (EM 1110-345-224) or AFM 88-10, Chap. 5.	Water Distribution Systems.
5.	TM 5-813-6 (EM 1110-345-228) or AFM 88-10, Chap. 6.	Water Supply for Fire Protection.
6.	TM 5-813-7 (EM 1110-345-229) or AFM 88-10, Chap. 7.	Water Supply for Special Projects.

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