CHAPTER A-8

SITE ENVIRONMENTAL

Revised 15 Oct 2008

INDEX

EXHIBITS

CHAPTER A-8

ENVIRONMENTAL ENGINEERING

This chapter presents general requirements for the preparation of plans, specifications, and design analysis for water supply and wastewater treatment systems.

8.1 **GENERAL**.

8.1.1 Water Supply Systems. Water supply systems include sources, pumping, treatment, storage, and distribution of water used for domestic, industrial, irrigation, and fire protection.

8.1.2 Wastewater Systems. Wastewater systems include collection, pumping, treatment, and disposal of domestic and industrial wastes.

8.2 **APPLICABLE PUBLICATIONS**.

8.2.1 Air Force Basic References.

Air Force	AFM 88-15 Air Force Manual - Criteria and Standards for Air Force Construction (Chapter 15)

8.2.2 Water Supply Treatment, Storage and Distribution Systems. (Army/Air Force)

TI 814-01	Water Supply
TI 814-03	Water Distribution
TL 1110-3-367	Trace Organic Compounds in Potable Water Supplies
TL 1110-3-465	Design and Construction of Water Meters and Appurtenances/New Army Facilities
TM 5-809-10/AFM 32-1070, Chap. 13	Seismic Design for Buildings
TM 5-810-5/AFM 88-10, Chap. 4	Plumbing
TM 5-813-1/AFM 88-10, Vol. 1	Water Supply Sources and General Considerations
TM 5-813-3/AFM 88-10, Vol. 3	Water Supply Water Treatment
TM 5-813-4/AFM 88-10, Vol. 4	Water Supply Water Storage
TM 5-813-5/AFM 88-10. Vol. 5	Water Supply, Water Distribution

Recommended Standards for WATER WORKS (Ten States' Standards) (Latest Edition)

8.2.3 Water Supply, Storage and Pumping for Fire Protection. (Army/Air Force)

ER 1110-1-260	Fire Protection Engineering Policy

MIL-HDBK-1008C	Fire Protection for Facilities Engineering, Design, and Construction
NFPA 22	Water Tanks for Private Fire Protection
TM 5-813-7/AFM 88-10, Vol. 7	Water Supply for Special Projects
TM 5-813-9	Water Supply Plumbing Stations
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24	Installation of Private Fire Service Mains

8.2.4 Wastewater Collection and Treatment Systems. (Army/Air Force)

MIL-HDBK-1005/16	Wastewater Treatment System Design Augmenting Handbook
TI 814-10	Wastewater Collection
TI 814-21	Solid Waste Incinerator
TL 1110-3-477	Alternative Sludge Dewatering Techniques for Wastewater Treatment Facilities
TM 5-814-1/AFM 88-11, Vol. 1	Sanitary and Industrial Wastewater Collection - Gravity Sewers and Appurtenances
TM 5-814-2/AFM 88-11, Vol. 2	Sanitary and Industrial Wastewater Collection Pumping Stations and Force Mains
TM 5-814-5	Sanitary Landfill
TM 5-814-7	Hazardous Waste Land Disposal/Land Treatment Facilities
TM 5-814-8	Evaluation Criteria Guide for Water Pollution Prevention, Control, and Abatement Programs

Recommended Standards for Sewage Works (Ten States Standards) (Latest Edition)

Manual of Septic Tank Practice, U.S. Department of Health, Education, and Welfare

Applicable State Criteria

American Petroleum Institute (API Publication 421) Monographs on Refinery Environmental Control-Management of Waste Discharges

8.2.5 Guide Specifications. Internet address for UFGS specifications http://www.wbdg.org/ccb/

8.3 **CODE 3 DESIGN REQUIREMENTS.**

8.3.1 Submittal. Submittal content and format shall be as described in TI 802-01, “Technical Instructions for Code 3 Design with Parametric Estimating”. Base or project specific requirements will be furnished with specific instructions to the contract or delivery order.

8.4.3 **CONCEPT (35 PERCENT) SUBMITTAL REQUIREMENT**.

8.4.1 Studies. Certain projects may be of such magnitude or significance that in order to select the best possible design the COE may require a study to be made prior to concept submittal. Where a 10 percent submittal is specifically called for, the A-E shall submit the project site plan with the building outline with supporting utilities.

8.4.2 Study Plan Submittal. The plan shall show the design approach in sufficient detail so that an evaluation by SAS, SAD and using agency together with the A-E may arrive at the most feasible scheme to prepare a concept package. This submittal shall be on full size drawing sheets printed at one-half size.

8.4.2.1 Building Service. The analysis for exterior building water service lines shall show flow, velocity and pressure drop between the water main and building, and pipe sizes. No design analysis of gravity house sewers will be required unless the sewage flow exceeds the capacity of a 6-inch [150 mm] pipe on a 0.6 percent slope. A design analysis is required for pneumatic ejectors, sewage pumps, sump pumps, and hydropneumatic systems.

8.4.2.2 Water Distribution Mains. If new water distribution mains are required, a Hardy Cross analysis may be required. This shall consist of a flow analysis of the proposed new mains using fire demands developed from criteria contained in MIL-HDBK-1008, Fire Protection for Facilities, and AFM 88-15 (Chapter 10) for Air Force projects. The flow around all loops shall be balanced by use of the Hardy Cross system of analysis or other approved means. In developed areas where the existing distribution mains appear adequate, indicate the required fire demand and verify the adequacy of the existing system by a fire-flow test at a nearby hydrant. Results of the fire-flow test shall be put on form, Exhibit A-8-1, as part of the design analysis. Frictional losses from test point to the site tie on should be included in the analysis. If the existing system is proved to be inadequate to supply the fire demand, augmentation of the system will be required. This will be documented even though it may not be part of the project. Requirements for fire-flow tests shall be forwarded through the Corp's Project Manager. Design of fire pumping stations shall be accomplished by individuals experienced in fire protection systems. The A-E shall determine for the concept design stage whether fire pump station/ground storage reservoirs are required for specific projects.

8.4.2.3 Sewage. Gravity sewage collection systems will be sized for concept design. The analysis shall show sewage flows, velocities, pipe sizes, elevations, and pipe capacities. Where new sewage collection systems are to be connected to the existing system, the existing sewage collection system will be checked downstream for five or more existing manholes to see if it is adequate for the added flow. New sewage flow will be added to the existing flow to determine the impact of the increased flow. Design analysis shall be furnished for sewage lift stations and force mains showing flows, velocities, component capacities, head requirements, detention periods, etc. Analysis shall be prepared in conformance with TM 5-814-1/AMF 88-11, Vol.1, TM 5-814-2/AMF 88-11, Vol.1, and AFM 88-15 for Air Force projects. Design analysis will be required for septic tanks and tile fields. The A-E shall determine the feasibility of a septic tank and tile field where buildings are remotely located and it is uneconomical to make normal house connections into an existing

main. Soil percolation tests will be conducted by the Corps of Engineers, or the state environmental office unless otherwise specified to be made by the A-E. Oil/water separators shall be designed in accordance with API criteria and be capable of removing free and effluent oil globules greater than 15 mg/L and provide no greater than 15 mg/L free oil concentration effluent.

8.5 **CONCEPT DESIGN DRAWINGS**.

8.5.1 Exterior Utility Layouts. Exterior utility layouts on the concept design shall be adequately detailed to show the various systems; and the design proposed shall include sufficient details to obtain adequate concept.

8.5.2 Other Requirements. Any information other than the requirements listed above which the designer considers necessary to show the intent of design.

8.6 **PRELIMINARY (OVER THE SHOULDER) SUBMITTAL REQUIREMENTS**. (See paragraph A-5, Volume 1 for submittal requirements).

8.7 **PRELIMINARY (60 PERCENT) DESIGN SUBMITTAL REQUIREMENTS**.

8.7.1 Design Analysis. The Preliminary design analysis shall include all items in the concept design analysis and any necessary revisions. In addition, the following specific items shall be included, when applicable:

8.7.1.1 Water Supply Sources.

8.7.1.1.1 Calculations indicating available supply and pressure versus required supply and pressure if revisions are required.

8.7.1.1.2 Calculations to support selection of all equipment and pipe sizes.

8.7.1.1.3 Outline specifications.

8.7.1.2 Domestic and Industrial Wastewater Treatment.

8.7.1.2.1 Average and peak loadings for individual unit processes including hydraulic gradient, biological and physical, etc.

8.7.1.2.2 Detailed descriptions of proposed unit processes including type, size, capacity, supporting data, and calculations showing the degree of treatment expected in each unit process, as well as the overall treatment efficiency.

8.7.1.2.3 Discussion of controls, instrumentations, and proposed operating sequences or methods.

8.7.1.2.4 Discussion of features for operator safety and comfort.

8.7.1.2.5 Discussion of facility layout from the standpoint of easy operation and maintenance.

8.7.1.2.6 Calculations to support selection of all equipment and pipe sizes.

8.7.1.2.7 Discussion of pollution control authority requirements and design compliance with authority requirements.

8.7.1.2.8 Outline specifications.

8.7.1.3 Water Distribution and Wastewater Collection Systems

8.7.1.3.1 Detailed hydraulic calculations for each system including the worst fire situation for the water distribution system.

8.7.1.3.2 Discussion of pipe materials and justification for the materials selected when different from the options listed in the guide specifications.

8.7.1.3.3 Outline specifications.

8.7.2 Design Drawings. The following specific items shall be submitted, when applicable.

8.7.2.1 Water Supply.

8.7.2.1.1 Detailed floor plans and sections of treatment plants and pumping stations with equipment layout, piping, and sufficient dimensions and elevations to physically locate all items of equipment, piping, etc.

8.7.2.1.2 Hydraulic profiles.

8.7.2.1.3 Pipe sizes and materials of construction.

8.7.2.2 Domestic and Industrial Water and Wastewater Treatment.

8.7.2.2.1 Hydraulic profiles.

8.7.2.2.2 Detailed floor plans and sections of structures with equipment layout, piping, and sufficient dimensions and elevations, physically locate all items of equipment, piping, etc.

8.7.2.2.3 Instrumentation and control schematics.

8.7.2.3 Water Distribution and Wastewater Collection Systems.

8.7.2.3.1 Location of valves, fire hydrants, manholes, pumping stations, laterals, meters, etc.

8.7.2.3.2 Sizes and materials of construction for new pipelines and manholes.

8.7.2.3.3 Partially completed profiles of gravity sewers, force mains, and water supply lines. Double lines are required for profile piping.

8.7.2.3.4 Invert and rim elevations for all manholes.

8.7.2.3.5 Details for connecting new lines to existing systems.

8.8 **FINAL (100 PERCENT) SUBMITTAL REQUIREMENTS**.

8.8.1 Final Design Analysis.

8.8.1.1 Final design analysis will be a refinement of concept and/or preliminary design analysis. The previous design analysis will be revised as required to reflect changes made during final design.

8.8.1.2 Design analysis will show applicable references for design assumptions not found in common reference manuals which were not listed during the previous design analysis.

8.8.1.3 Design analysis will reflect all comments from the District on the previous design analysis.

8.8.1.4 All pipe sizing computations will be included in the analysis. Piping analyses will show design flow, pipe size, friction factors, slopes, lengths, and elevations where applicable, flow quantity, and velocity in the various mains and branches. Where necessary, flow diagrams will be included in the analysis.

8.8.1.5 Determination of pump heads will be based on complete take-off friction losses and static heads. Systems head curves are required for all pumping systems.

8.8.2 Final Design Drawings.

8.8.2.1 Final plans will be a refinement and completion of concept of preliminary drawings. All comments from this office relating to preliminary or concept design shall be incorporated in the final drawings.

8.8.2.2 Where crowded conditions exist due to close proximity of other phases of the work, sufficient sections and elevations will be shown to indicate clearly the exact location of the particular item in relation to other items.

8.8.2.3 The number of elevations and details will be sufficient to allow construction and installation of the work without additional design work by the Contractor.

8.8.2.4 Where equipment connection details are shown, indicate all required valves, trim, gauges, and fittings required. Coordinate with specification requirements and make sure that valves, fittings, etc., that are specified to be furnished with each piece of equipment are included in the detail.

8.8.2.5 Final plans shall show all pipe sizes. Catwalks, ladders, platform, access panels, and doors required for operation and maintenance of equipment, valves, and accessories will be detailed on the drawings.

8.8.2.6 Performance characteristics for all items of equipment will be placed in carefully prepared equipment schedules. Equipment characteristics specified in "Note" fashion, or in random locations on the drawings are not acceptable. Equipment characteristics selected shall not be restrictive to any one manufacturer but must be competitive among at least three major manufacturers. <u>No manufacturer's trade names shall be shown on the drawings or in the specifications.</u>

8.8.2.7 Electrical characteristics, classification of NEMA type, if applicable, and except in special cases, rotative speeds will be included in equipment schedules.

8.8.2.8 Location of equipment and piping shall be completely coordinated with other features of the project; architectural, plumbing, mechanical, structural, electrical, etc.

8.8.2.9 Sanitary and industrial waste sewer drawings will have complete profiles for the entire length of run. These profiles will indicate elevations, depth of bury, and interfering utilities which may be encountered.

8.8.2.10 Complete construction details of water and sanitary sewer utilities as well as layouts will be required on the final plans. A legend shall be provided on the drawings to clearly differentiate between existing and new construction. Existing construction is generally indicated by light symbols and new construction is indicated by heavy black symbols. Existing construction data such as pipe size, elevations, valve, and fire hydrant locations, etc. pertinent to new construction will be included on the drawings.

8.8.3 Specifications.

8.8.3.1 Specifications will not be restrictive. Generally, the description will be such that at least three major manufacturers can meet the specified requirements. Do not use trade names in the specifications unless sole source authorization is requested and granted.

8.8.3.2 The subparagraphs on "Electrical Work" shall be carefully coordinated with the electrical section of the specifications. There shall be no conflicts as to which section covers starters, controls, or cost estimates for all items such as lift stations, septic tanks, oil separators, etc. The top and invert elevations of all new and existing sanitary sewer lines and manholes shall be shown on the concept plans. The A-E will be furnished standard water and sanitary details which shall be incorporated in the specifications or on the drawings. The legend in Exhibit A-8-2 shall be used in differentiating between new and existing work.

8.9 **CORRECTED FINAL DESIGN SUBMITTAL REQUIREMENTS**. All final design drawings and specifications shall have incorporated comments from the preceding reviews before the design is submitted as ready-to-advertise.

8.10 REQUIREMENTS FOR DESIGN/BUILD RFP PACKAGES. To be furnished with specific instructions to the contract or delivery order.

8.11 **TECHNICAL REQUIREMENTS**.

8.11.1 Permits.

8.11.1.1 Construction of new facilities and major extensions to existing water and wastewater systems must comply with the procedural requirements of the applicable state agency having approval authority. In most cases this is the Public Health Department for water supply and onsite wastewater treatment systems. Each state also has a department for pollution control projects involving point discharges. For this reason all designs of water and wastewater systems shall be coordinated with the appropriate agency at all stages of design. For all states review and approval of the final plans and specifications constitutes approval for construction.

8.11.1.2 The designer is required to contact the appropriate state pollution control agency and verify the procedure to follow to obtain a construction permit. In addition, where formal documents are required to be submitted, the designer will prepare all permits to a "ready for signature" condition. After review by the COE, the documents will be forwarded by the designer to the the state's EPD. Permit requirements should be ascertained by the designer at the time of the concept submittal. In South Carolina the designer shall be required to certify that the utilities have been installed in accordance with the permit.

8.11.2 Standard Systems Criteria.

8.11.2.1 Building Services:

8.11.2.1.1 Water Service Connections. The designer shall provide exterior water service connections to all new buildings from existing and/or new water distribution systems. Size building water service connections to meet the peak building demands as indicated in TM 5-810-5 (or AFM 32-1070, Section D for Air Force projects). Pressure drop between street mains and buildings shall not exceed 10 psi/100 feet [2.26 kPa/m] at these rates of flow. Provide valve or curb stop with box near connection to main.

8.11.2.1.2 Building Sewers (Sanitary). House sewers shall be of either the gravity type or the force main type as required by the building site conditions. Gravity type building sewers are preferable, if feasible, and they shall be constructed of 6-inch [150 mm] minimum size pipe on at least 0.6 percent slope. Where gravity sewage connections to street collection mains cannot be provided, provide pneumatic ejectors or sewage pumps in the building. The selection of pumps or ejectors shall be based on the economy of initial installation. No design analysis of gravity building sewers is required, but size and slopes of these lines must be shown on the plans. Duplex units shall be provided where ejectors or pumps are required. The capacity of each unit shall be sufficient to handle the peak rates of flow. Operation of the pumps shall be lead-lag for single as well as combined capability. Other design characteristics shall conform to TM 5-814-2, Sewage and Industrial Waste Pumping Stations.

8.11.2.2 Fire Protection:

8.11.2.2.1 Distribution Mains and Fire Hydrants. Provide distribution mains and fire hydrants, if not already existing in the building area, in accordance with the applicable portions of TM-5-813-1 and TM 5-813-5. The residual flow pressures at design flows shall not be less than 20 psi [138 kPa]. When practical water mains shall be installed parallel to streets and roads but not under roadway pavements if practical. The fire demand is determined by the sum of the fire flow, 50 percent of the average domestic demand rate, and any industrial demand that cannot be reduced during a fire period. See TM 5-813-1 or AFM 88-15 for Air Force projects. Provide fire hydrants in accordance with TM-5-813-5 and NFPA 24. Each building should be within 300 feet [90 m] of at least two hydrants. Fire hydrants will have gate valves on service lines.

8.11.2.2.2 Building Sprinkler Supply Mains. Sprinkler supply mains shall be at least the size required by the National Fire Protection Association. The adequacy of the existing or proposed distribution system and sprinkler lines to meet the sprinkler and hose stream demands as indicated in MIL-HDBK-1008C shall be determined by a fire-flow analysis or other approved means of analysis. Calculations shall show that the fire sprinkler demand flow and residual pressure can be provided by the available flow and residual pressure with the outside fire hydrant demand hydraulically subtracted out. If the available flow is greater than the required flow and residual pressure is greater than the design pressure then it is acceptable. If not, the existing distribution system shall be augmented to provide at least a 15-pound [7 m] residual pressure at the highest sprinkler heads in the building at design fire demands. Provide cutoff valves with boxes on the supply mains. These shall be located not less than 25 feet [8 m] nor more than 50 feet [15 m] from the face of the building which they are to serve. They may be of either the post indicator type or the rising stem and yoke type installed in a pit, as indicator valves generally in grassed areas, and use the rising stem and yoke type installed in underground pits in paved areas. Fire pumping stations

shall comply with MIL-HDBK-1008C and NFPA Codes 20 and 24, as appropriate, and shall be designed by persons experienced in design of fire protection systems.

8.11.2.3 Sewage Collection System:

8.11.2.3.1 Gravity Mains. Where more than one building is involved, use gravity type sewage collection mains. Design is to conform to the applicable requirements of TM 5-814-1 (or AFM 88-15, Chap. 11, for Air Force projects). Size gravity sewers to discharge the expected peak rate of flow. The minimum size of sewer mains (not house sewers) shall be 8 inches [200 mm]. The sewers will normally be laid on sufficient slope to provide a velocity of at least 2 feet [600 mm] per second at the average daily flow or average hourly flow rate and a minimum velocity of 2.5 - 3.5 feet per second [760 - 1066 mm/s] at peak diurnal flow rate. See TM 5-814-1 or (AFM 88-15, for Air Force projects). Locate sewage collection mains by the topography of the site to keep excavation for these lines to a minimum.

8.11.2.3.2 Force Mains and Sewage Lift Stations. Where more than one building is involved, if gravity type sewers cannot be provided, sewage pumps will be installed in a sewage lift station constructed on the lowest terrain in the vicinity. As force mains do not require any specific grade for satisfactory operation, they shall be constructed as straight, short, and shallow as possible. In this section of the United States, they are generally installed 30 inches below final grades for the area. Force mains and sewage lift stations shall conform to the applicable requirements of TM 5-814-2 (or AFM 88-15 for Air Force projects). The capacity of the lift station shall be sufficient to handle rates of sewage flow, determined in accordance with TM 5-814-1 (or AFM 88-15 for Air Force projects). Sewage pumps must be designed to meet actual head conditions of the force main provided for the lift station. The design point on the pump characteristic curve shall be determined by plotting this curve against the system head-capacity curve. The system head curve shall be obtained by combining friction head, static head, and velocity head curves. Where pumps operate in parallel or series, combined curves will be provided. Intersection of characteristic curve with system head curve shall be the design point. Major items of equipment shall be described with sufficient clarity to permit a definite selection for cost estimating purposes from manufacturers' catalog data where appropriate grinder-type pumps will be considered.

8.11.2.3.3 Septic Tank and Tile Field. Design septic tanks and tile fields in accordance with applicable State criteria. Specify prefabricated septic tanks where locally available in the required size.

8.11.2.3.4 Oil-water separators shall be provided as required by AFM 88-15, Chapter 15, Section G, paragraph 15-54, and shall be designed in accordance with API criteria, Publication 421. A grit chamber shall be designed for upstream installation of the separator where grit is prevalent in the waste.

8.11.2.4 Treatment Plants. For water and wastewater treatment plants see specific instructions to the A-E contained in Section Environmental, of Appendix A of his contract.

8.11.2.5 Seismic Provision. All projects will include appropriate provision for protection of piping, equipment, and underground utilities against damage from seismic events in accordance with TM 5-809-10 (AFM-88-3, Chapter 13).

8.11.2.6 Fire protection using AFFF systems shall comply with the requirements of MIL-HDBK 1008C. Provide a means for containing and disposing AFFF foam solution runoff.

8.12 **SUPPLEMENTAL TECHNICAL REQUIREMENTS**.

8.12.1 Water Supply.

8.12.1.1 Vertical turbine pumps larger than 5 hp [3.7 kw] shall conform to AWWA E-101 and CEGS-11212, PUMPS: WATER, VERTICAL TURBINE.

8.12.1.2 Design of water treatment plants shall conform to TM 5-813-3/AFM 88-10, Volume 3, and applicable State Public Health Department criteria for public water supplies and Recommended Standards for Water Works (Ten States' Standards).

8.12.1.3 Small isolated facilities will utilize a hydropneumatic pressure tank and, if appropriate, a ground storage reservoir. Small systems will normally be located in a protective building.

8.12.1.4 Supply and distribution piping shall comply with TM 5-813-5/AFM 88-10, Chapter 5, and AFM 88-15, Chapter 15.

8.12.1.5 Water storage designs shall comply with TM 5-813-4/AFM 88-10, Chapter 4; AFM 88-15; and AWWA D100. Specifications shall be based on current CEGS specifications, as appropriate.

8.12.1.6 In computing head losses due to friction in a distribution system, the Hazen-Williams formula as given below will be used.

h =0.002083L x (100/C)^1.85 x (gpm^1.85/d^4.8655)

8.12.1.7 Hydraulic analyses will normally be made using a value of C = 100 for the roughness coefficient; however, consideration should be given to the use of coefficients greater than 100 when specifying concrete or plastic pipe. Coefficients greater than 130 should not be used. Asbestos-cement pipe shall not be used.

8.12.1.8 Fire hydrant branches shall not be less than 6 inches [150 mm] in diameter, shall be as short in length as possible, and shall have a gate valve.

8.12.1.9 Locate water mains at least 10 feet [3050 mm] horizontally from sewers or drain lines. When required, a minimum horizontal separation of 6 feet [1830 mm] can be allowed, but the bottom of the water main must be at least 12 inches [300 mm] above the top of the sewer.

8.12.1.10 Where water mains must cross sewers they shall conform to the requirements of TM 5-813-5/AFM 88-10, Volume 5, Chapter 3.

8.12.1.11 Water mains crossing railroads shall be installed in protective casings conforming to the requirements of American Railway Engineering Association (AREA), Volume 1. Design should specify method of construction for each particular site (open cut vs. jacking).

8.12.1.12 Water mains located in airfield pavement shall conform to the requirements of TM 5-813-5/AFM 88-10, Volume 5.

8.12.1.13 Control valves shall be provided on distribution systems in accordance with TM 5-813-5/AFM 88-10, Volume 5.

8.12.1.14 Air release and vacuum relief valves shall be provided in accordance with the requirements of TM 5-813-5/AFM 88-10, Volume 5.

8.12.1.15 Fire hydrants shall be provided in accordance with the requirements of TM 5-813-5/AFM 88-10, Volume 5, Chapter 5; and NFPA 24. Hydrants should not be located closer than 25 feet [7.6 m] to a building and should be located not more than 7 feet [2130 mm] nor less than 6 feet [1830 mm] from the edge of a paved roadway surface. Residual pressures at fire hydrants should not be less than 10 psi [70 kPa] when flowing at the desired rate.

8.12.1.16 Thrust blocking shall be provided in accordance with TM 5-813-5/AFM 88-10, Volume 5, Appendix C; and current CEGS specification.

8.12.1.17 Where the base distribution system is unable to provide the quantity of water at the required residual pressure needed for sprinkler systems and hose streams, the designer will analyze the system and provide pumping equipment and, if appropriate, ground storage. A complete design analysis is required, including fire-flow test data. Pumping stations shall conform to the requirements of NFPA 20. Pumping stations for aircraft hangars will conform to the above referenced TM/AFM, Appendix I, except that fire pumps will be diesel engine driven. Provide post indicating cutoff valves in accordance with NFPA 24.

8.12.1.18 Water for domestic purposes and fire protection for special projects such as reserve centers shall be provided in accordance with the requirements of TM-813-7/AFM 88-10, Volume 7.

8.12.1.19 Service lines to new buildings shall be sized to meet peak building demands in accordance with TM 5-810-5/AFM 88-15. Pressure drop between street main and building should not exceed 10 psi/100 feet [2.26 kPa/m] at peak rate. Provide control valves in accordance with current CEGS specification.

8.12.1.20 All water mains, and storage tanks shall be effectively sterilized with chlorine solution and tested bacteriologically safe in accordance with AWWA Standards before placing them in service. See current CEGS specifications.

8.12.1.21 Storage reservoirs shall be provided with cathodic protection when required.

8.12.1.22 Hydropneumatic Pressure Systems.

8.12.1.22.1 Use at small activities where the demand is not enough to justify any other type of storage. Design the tank to meet pressure vessel requirements. Provide air compressors, safety valve, and sight glass, to show the tank air-water ratio. If the tank is less than 500 gallons [1800 Leters], a bleeder valve with a snifter valve in the well discharge pipe will be used in lieu of the air compressor.

8.12.1.22.2 Use 20 psi [138 kPa] pressure differential between high water level and low water level in the hydropneumatic tank with high water/high pressure set at the tank's one-half mark.

8.12.1.22.3 Tank Capacity. Determine the tank usable capacity when the operating pressure is between 60 and 40 psi [413 and 275 kPa]. At 60 psi [413 kPa] the tank is one-half full. First, determine the usable volume (%). Always use tank volume as 1/2 full at its highest operating pressure, i.e 60 psi [413 kPa].

$$(P1/P2 - 1)\ (100-V) = \%$$

Example.

P1 = 60 + 14.7 = 74.7 V1 @ 50%

P2 = 40 + 14.7 = 54.7

(74.7/54.7 -1) (100-50)

(1.36 - 1) x 50 = 18.3%)
Therefore 18.3% = Usable volume for this particular condition.

If the well or source can produce water (gpm) at the rate equal to the average demand (gpm) then the usable volume should be 2.5 times the average demand. Therefore, the tank capacity is Q= 2.5 X average demand.

If the produced water is less than the average demand (gpm) then the multiplier factor should be 5 or more.

8.12.1.22.4 Compressed Air. Compressed air is supplied for tank operation according to the tank capacities. Provide 2.0 CFM [1 L/s] for capacities from 500-3,000 gallons [1800-10 000 L] and each additional 3,000 gallons [10 000 L] or fraction thereof. Quantities are expressed in CFM free air at pressure equal to the high-pressure maintained within the hydropneumatic tank.

8.12.1.22.5 Controls. The controls of a hydropneumatic system shall maintain the predetermined pressures, water levels, and air-water ratio within the tank. Controls shall admit compressed air into the tank only when tank pressure at high-water level is 2 psi [13.8 kPa] below high pressure and an air volume control.

8.12.1.22.6 Provide chlorine disinfection system for water to be consumed by humans. Size to provide 1 mg/l chlorine residual when flowing at the peak 4-hour rate. Consider using hypochlorinators for intermittent pumping rates up to 200 gpm [800 L/min] or when maximum chlorine demand is less than 3 pounds per day [1.36 kg]. Chlorine gas shall be used for larger pumping rates or chlorine demands.

8.12.2 Wastewater Treatment and Disposal.

8.12.2.1 Design of onsite treatment disposal facilities shall conform to applicable criteria published by the appropriate State Public Health Department, and Manual of Septic Tank Practice by Department of Health, Education and Welfare.

8.12.2.2 Where onsite soil conditions are such that the septic tank and tile field system cannot be used, consideration will be given to use of septic tank and subsurface filter system. A composting system may be considered. Design must conform to the above referenced documents for septic tanks.

8.12.2.3 Gravity Sewers (TM 5-814-1/AFM 88-11, Vol.1).

8.12.2.3.1 Provide a minimum of 2 feet [600 mm] of cover over pipe.

8.12.2.3.2 Manholes are required at the end of laterals and at each change of direction or slope.

8.12.2.3.3 Distance between manholes shall not exceed the following:

Diameters less than 18" [500 mm]	400' [122 m]
Diameters 18" [500 mm] and greater	600' [183 m]

8.12.2.3.4 Drop connections are required at manholes when the invert of the inlet pipe is more than 18 inches [500 mm] above the manhole floor.

8.12.2.3.5 Minimum size building sewer connections shall be 6 inches [150 mm] in diameter with at least 0.6 percent grade.

8.12.2.3.6 Sewers shall be laid with sufficient slope to ensure cleansing velocities.

8.12.2.3.7 Capacity of building sewer connections, except for barracks, shall be based on fixture units. Barracks capacity shall be based on population.

8.12.2.3.8 Minimum size sewer mains between manholes shall be 8 inches [200 mm] in diameter.

8.12.2.3.9 Use Manning's formula for computing gravity flows in sewers. Use n = .014 for pipe 10 inches [250 mm] and smaller and n = .013 for pipe larger than 10 inches [250 mm].

8.12.2.3.10 Deep sewers shall be analyzed for excessive loads using the equations of TM 5-814-1, Paragraph 12.

8.12.2.3.11 Selection of pipe materials shall consider structural loads, soil conditions, and characteristics of transported wastes.

8.12.2.3.12 Design analyses are required for sizing all 8-inch [200 mm] and larger sewers.

8.12.2.4 Pumping Stations (TM 5-814-2/AFM 88-11, Volume 2; AFM 88-15, Chapter 11, Paragraph 3).

8.12.2.4.1 Force mains shall be analyzed for water hammer conditions.

8.12.2.4.2 Minimum size force mains where nonclog pumps are used is 4 inches. Smaller pipe sizes can be considered when grinder pumps are used.

8.12.2.4.3 Small lift stations will be of the wet-pit, submerged-pump type.

8.12.2.4.4 Pumping capacity will be adequate to discharge the peak flow rates when the largest pump is out of service. Each pumping unit will be of the constant speed type, and will be capable of discharging the extreme peak wastewater flow rate and shall alternate between discharges.

8.12.2.4.5 Overflows shall not be provided.

8.12.2.4.6 A complete design analysis is required.

8.12.2.4.7 Force mains shall be provided with a minimum of 30 inches [760 mm] cover.

8.12.2.4.8 Systems head curves are required for all pumping systems.

8.12.2.5 Wastewater treatment plant designs shall conform to applicable State criteria; and Recommended Standards for Sewage Works (Ten States' Standards). Designs will be based on meeting National Pollution Discharge Elimination System (NPDES) discharge permit limitations for the site.

8.12.2.6 Treatment plants for industrial wastes shall conform to AFM 88-15, Section F, and TM 5-814-8, Chapter 6. Designs will be based on meeting NPDES discharge permit limitations for the site.

8.12.2.7 Wastewaters containing oils shall be treated in accordance with the requirements of AFM 88-15, Section F. Gravity oil-water separators cast-in-place type shall be provided on aircraft and vehicular washracks, tactical equipment shops and industrial facilities for the Army prior to discharge to central sewage collection systems. Oil separator shall be designed to API standard and in accordance with ETL 1110-3-466 "Selection and Design of Oil/Water Separators at Army Facility." Where central sewage systems are nonexistent, package type oil-water separators meeting state discharge criteria are required. Oil/water separators for the Air Force shall be of the cast-in-place type. The SAS_STD CD has example design of oil separator to API standard in the DETAILS directory in DGN format. Grit separators are required to be located ahead of oil-water separators. Flow rate for washracks shall be based as follows:

Number and capacity of hose bibbs

Waste generated

Storm runoff is Q=CIA

Where Q= Runoff in cubic feet per second
C= Imperviousness factor (1 = pavement and 0.4 = soil)
I= Average rainfall intensity in inches/hour
A= Drainage area in acres. Adjacent area should be sloped away from the drainage area.

10-YEAR STORM

Design Storm	tc in minutes 5	10	15	20	25	30	35	40	45	50	55	60
2-2	6.7	5.7	4.8	4.2	3.8	3.5	3.1	2.9	2.8	2.6	2.4	2.2
2-4	7.1	6.0	5.1	4.5	4.1	3.8	3.4	3.1	3.0	2.8	2.6	2.4
2-6	7.6	6.3	5.4	4.8	4.4	4.0	3.6	3.3	3.2	3.0	2.8	2.6
2-8	8.0	6.7	5.7	5.1	4.6	4.2	3.9	3.7	3.4	3.2	3.0	2.8
3-0	8.4	7.0	6.1	5.4	4.9	4.6	4.2	3.9	3.6	3.4	3.2	3.0

Ft. Fisher, NC = 3.0
Robins AFB, GA = 2.8
Winston-Salem, NC = 2.3
Seymour Johnson, NC = 2.9

Ft. Benning, GA = 2.8
Ft. Gordon, GA = 2.6
Ft. Bragg, NC = 2.8
Dobbins AFB, GA = 2.6
Hunter AAF, GA = 3.0
Pope AFB, NC = 2.8
Savannah, GA = 3.0
Moody AFB, GA = 2.8
Charleston, SC = 3.0
Ft. Stewart, GA = 3.0
Ft. McPherson, GA = 2.6
Ft. Jackson, SC = 2.6

NOTE: It is important for the first 10 minutes of a 10-year storm be caught and run through the oil/water separator. All quantities above this amount should be diverted to the storm drain.

CHAPTER A-8

ENVIRONMENTAL ENGINEERING

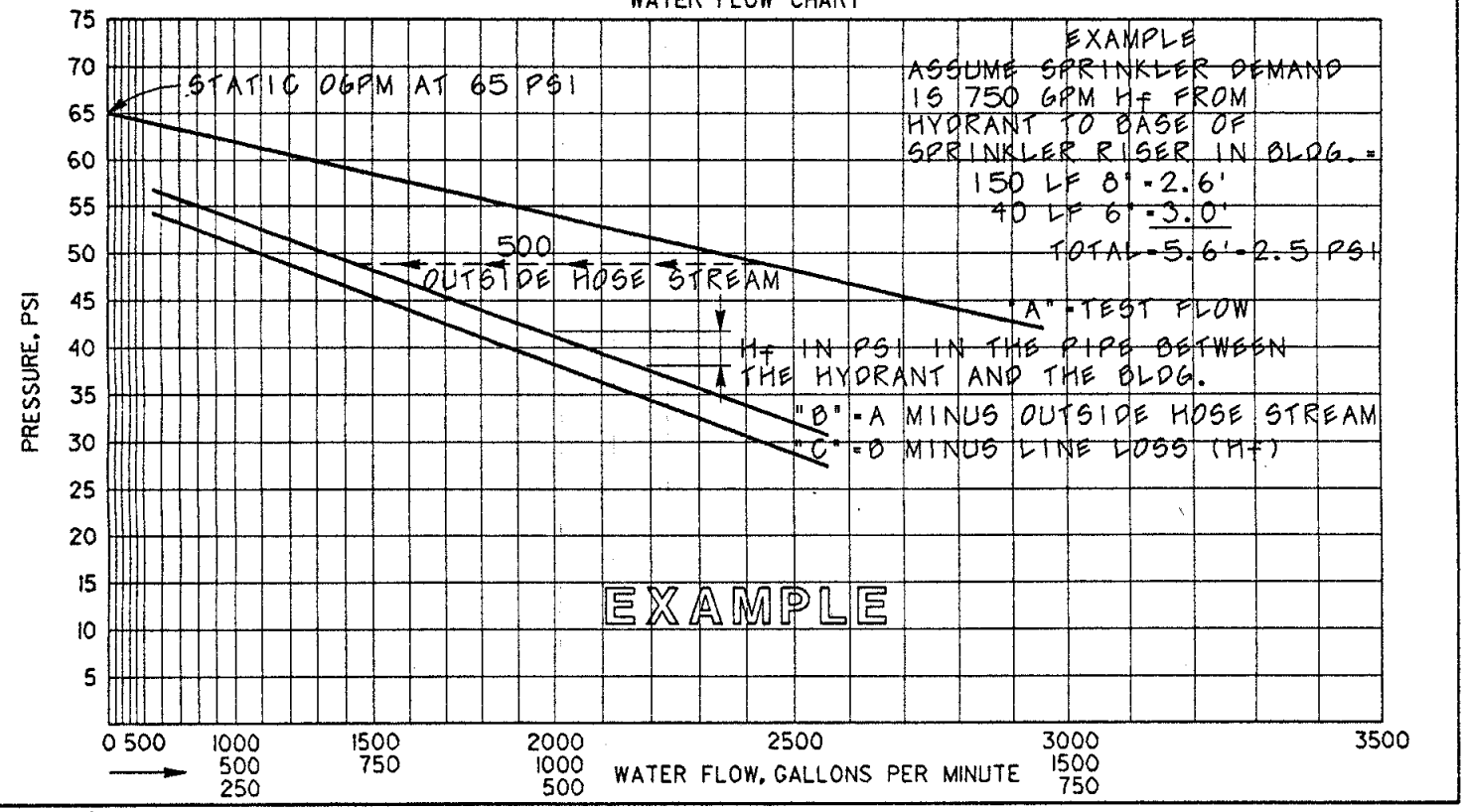
EXHIBITS

WATER FLOW TEST SUMMARY SHEET

(FORSCOM Suppl 1 to AR 420-46)

HYDRANT NUMBER	OUTLET DIAMETER (Inches)	PITOT PRESSURES (PSI)	DISCHARGE (Gallons per minute)	LOCATION	DATE
128	2.5	50	1185	RAYMOND AT 1ST ST. FORT BRAGG N.C.	15 AUG 86
				STATIC PRESSURE 65	RESIDUAL PSI 50
				TOTAL DISCHARGE DURING TEST (Gallons per minute) 1185	AVAILABLE GALLONS PER MINUTE (At 20 PSI)

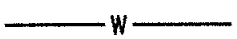
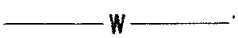
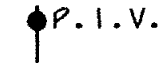
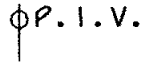
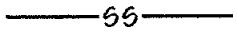
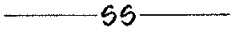
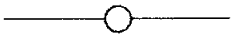
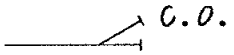
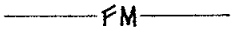
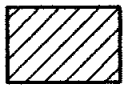
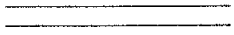
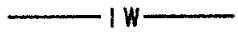
WATER FLOW CHART



FORSCOM FORM 1 JUL 77 241-R

EXHIBIT A-8-1
Page 1 of 1

STANDARD SANITARY SEWER AND WATER LEGEND

NEW	EXISTING	NAME
		WATER LINE
		VALVE
		POST INDICATOR VALVE
		FIRE HYDRANT
		SANITARY SEWER
		SANITARY MANHOLE
		CLEANOUT
		FORCE MAIN
		BUILDING
		PAVING
		INDUSTRIAL WASTE

U.S. ARMY ENGINEER DISTRICT, SAVANNAH

DESIGN ANALYSIS OF GRAVITY SANITARY SEWERS

SHEET OF
COMPUTED BY
CHECKED BY
DATE

SEWER LINE NO
PIPE "N"= 10" OR LESS
PIPE "N"= GREATER THAN 10"
(BASED ON MANNING'S FORMULA)

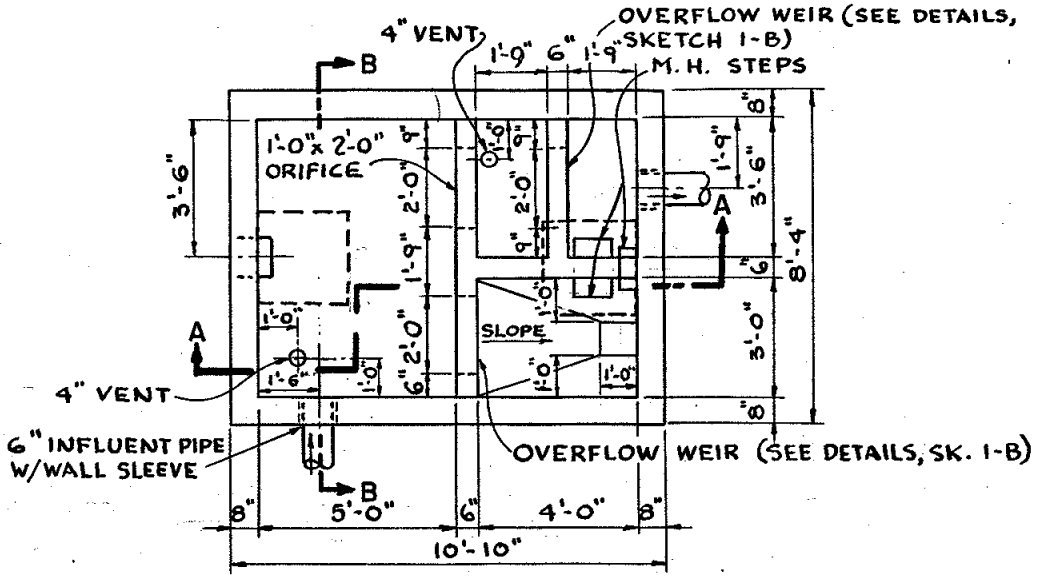
PROJECT
LOCATION
LI FY

MANHOLE NO.		EST. CONTRI-BUTING POP.	AVG. FLOW•	DAILY PEAK FLOW•	EXTREME PEAK FLOW•	PIPE SIZE (INCHES)	FLOW DEPTH AT DESIGN FLOW	VELOCITY AT DESIGN FLOW	DISTANCE BETWEEN MANHOLE (FEET)	PIPE SLOPE	INVERT ELEV. MANHOLE LISTED COL. 2	PIPE DEPTH		NOTES & REMARKS
FROM	TO											MAX.	MIN.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

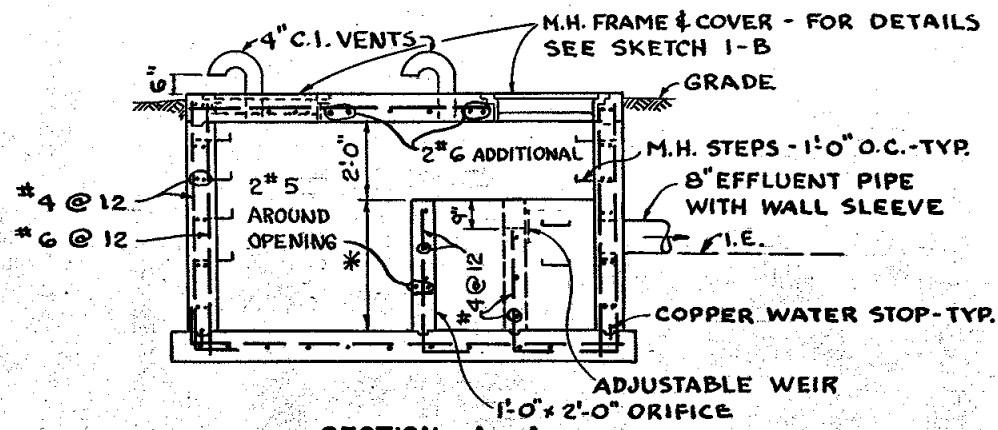
REF: A-E MANUAL APPENDIX C, SECTION 8

• A-E TO INDICATE UNITS USED (GPM, GPD, MGD)

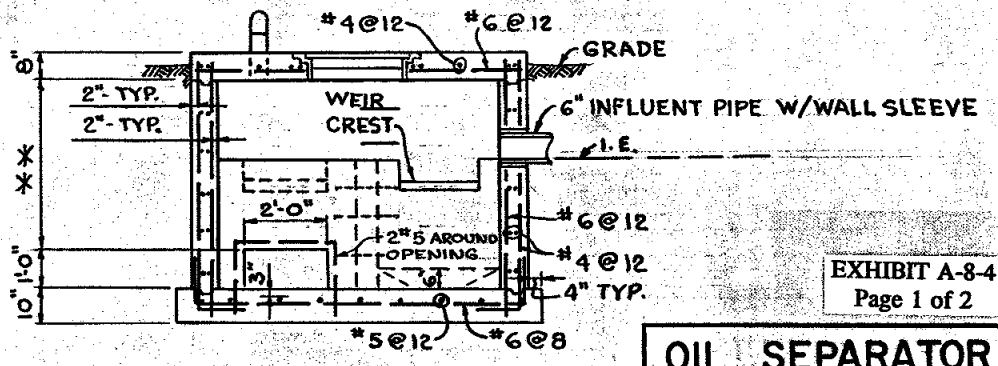
EXHIBIT A-8-3
Page 1 of 1



PLAN



SECTION A - A



SECTION B - B

* = 5'-6" FOR 1000 GAL. & 3'-3" FOR 500 GAL.
** = 6'-6" FOR 1000 GAL. & 4'-3" FOR 500 GAL.

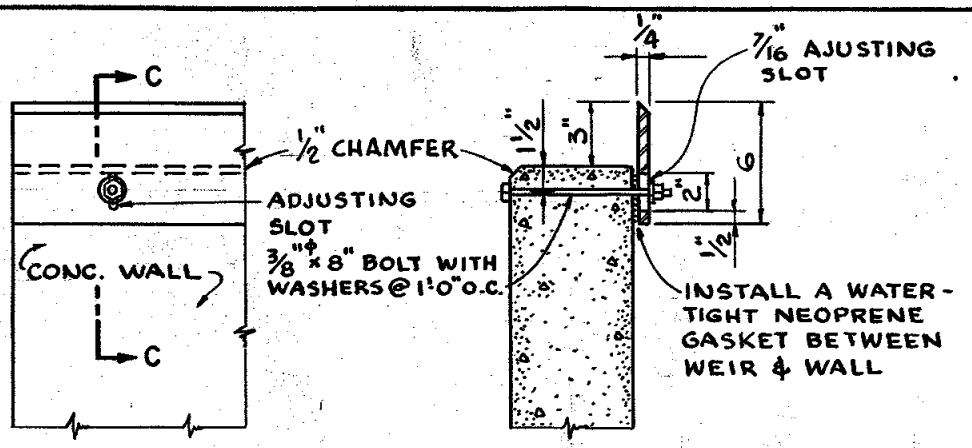
EXHIBIT A-8-4
Page 1 of 2

OIL SEPARATOR

SKETCH NO. 1-A

SCALE: $\frac{1}{4}$" = 1'-0"

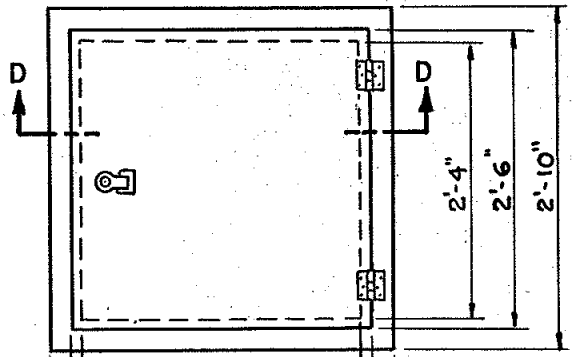
DATE _ _ _ _ _ _ _ _ _



ELEVATION SECTION C - C

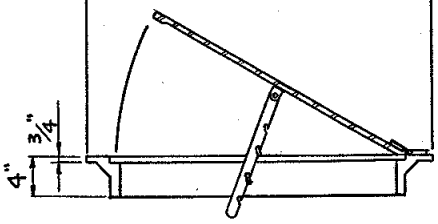
OVERFLOW WEIR DETAILS

SCALE: 1/2" = 1'-0"



PLAN

NOTE:
CAST IRON FRAME & COVER TO HAVE A COMBINED WEIGHT OF NOT MORE THAN 250 LBS.
COVER TO BE HINGED TYPE AND FURNISHED W/ADJUSTABLE RATCHET.



SECTION D - D

MANHOLE FRAME AND COVER

SCALE: 3/4" = 1'-0"

EXHIBIT A-8-4
Page 2 of 2

OIL SEPARATOR

SKETCH NO. 1-B

SCALE: AS SHOWN

DATE _ _ _ _ _ _ _ _