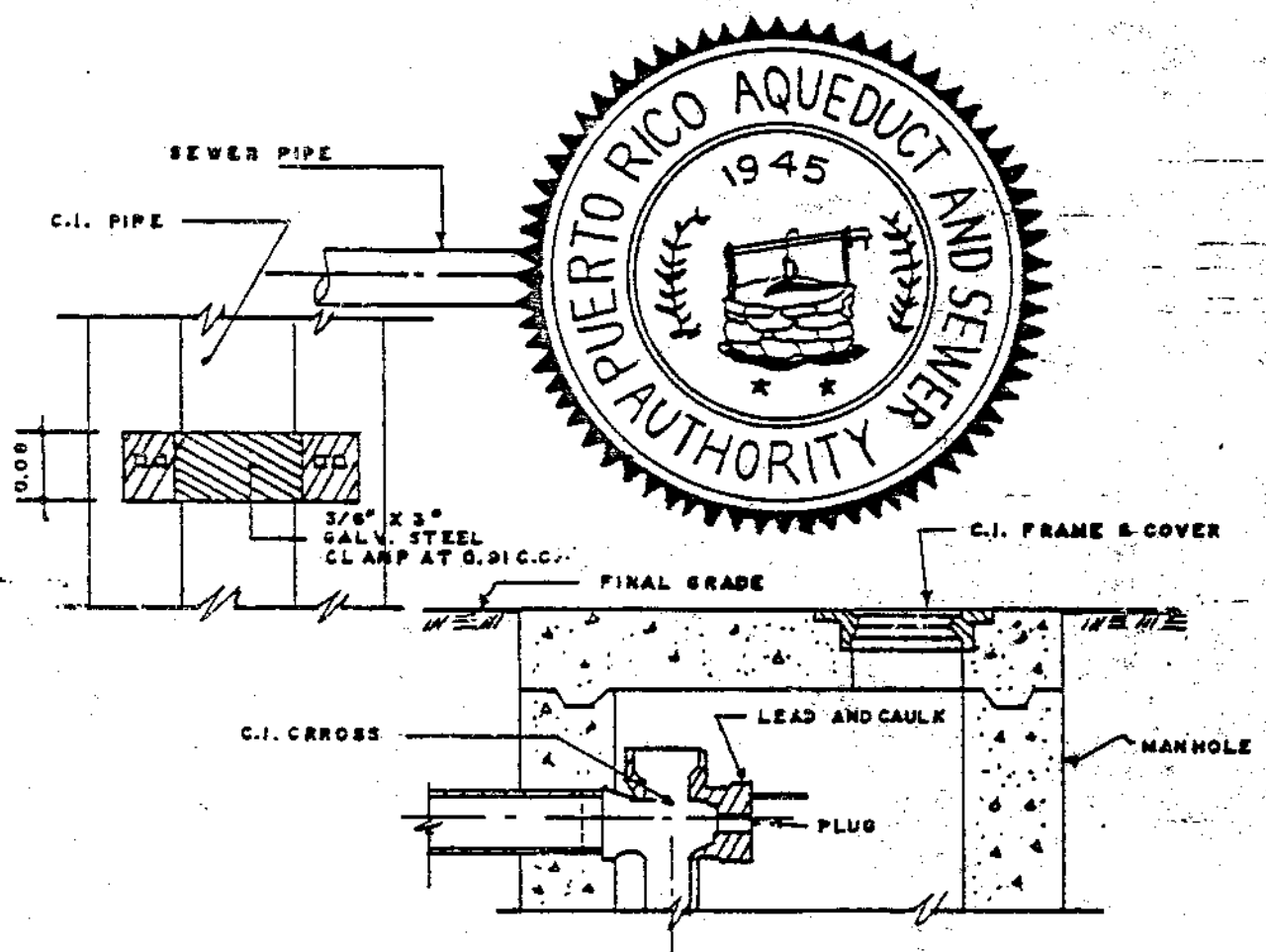


RULES AND REGULATIONS FOR THE DESIGN STANDARDS



PUERTO RICO AQUEDUCT AND SEWER AUTHORITY

From [unclear]

No. 3149
Date: September 13, 1984 10:20
Approved: Carlos S. Quirós *A-4*
Secretary of State

RESOLUTION NUMBER 1127

By: *Luis La Pedraza*
Sewer Authority
Assistant Secretary of State

WHEREAS: The Puerto Rico Aqueduct and Sewer Authority was created in order to provide and help provide the inhabitants of Puerto Rico an adequate water and sanitary sewer service and any other service or incidental facilities concerning to the same (22 L.P.R.A., Section 144);

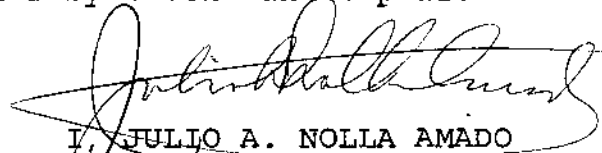
WHEREAS: The Puerto Rico Aqueduct and Sewer Authority is empowered to promulgate rules and regulations concerning the use and conservation of water, the disposal of waste waters, the care, conservation and protection of the facilities used or to be used for the supply, distribution, consumption or use of water and disposal of waste waters in order to comply with the purposes for which the Puerto Rico Aqueduct and Sewer Authority was created (32 L.P.R.A., Section 152);

WHEREAS: In the year 1974 the Rules and Regulations for Designing were approved, which actually regulates the designing for Sanitary Sewer Systems and the Water Supply Systems;

WHEREAS: A committee was appointed to perform a revision to such rules and regulations and to adapt them for today's technical and professional needs;

WHEREAS: After having complied with all the law requirements including public hearings and submitted to the Executive Director, Eng. Carlos A. Mulero, who approved the same;

NOW, THEREFORE BE IT RESOLVED: By this Governing Board and in compliance with Law Number 163 of May 3rd., 1949 to RATIFY THE APPROVAL OF THE RULES AND REGULATIONS FOR DESIGNING, which shall be in effect as soon as it is complied by filing the same at the Department of State. The Rules and Regulations for Designing in force are hereby revoke and repeal.



I, JULIO A. NOLLA AMADO
Secretary of the Governing Board
of the Puerto Rico Aqueduct and
Sewer Authority, DO HEREBY CERTIFY,
the above is a true and exact copy
of the Resolution approved by the
Board during their meeting held on
June 26, 1984.



No. 3149
Date: September 13, 1984. L.D. 20
Approved: Carlos S. Quirós A-14
Secretary of State

*** I N T R O D U C T I O N ***

By: *Lucrecia S. ...*
in its desire
Assistant Secretary of State

The Puerto Rico Aqueduct and Sewer Authority to offer a better service to its customers and to lessen its operation and maintenance problems, prepared what at the time entitled "House Connection Standards" and considered this as its first attempt to prepare a manual that in the future would be called "Operation Manual and Design Standards". This "House Connection Rules" advised that from time to time, when new ideas, new methods appear, the necessary revisions should be made.

By the year 1957, its name was changed to "Design Standard Manual", and in 1974, the Authority was compelled to revise its standards. Now, the Authority, recognizes that due to the new water quality standards, new programs, raising costs of equipment, chemical products, operation and maintenance programs, must deal with the revision of its design standards aiming at the uniformity of its structures, services, operation and maintenance programs, etc.

In addition the Authority for its revision, held public hearings, consulted customers, updated safety requirements, incorporating them into the "Rules of Design Standards".

Today I am very pleased to submit to you the Rules that will govern the Design of Aqueduct and Sewer Systems in Puerto Rico and that will come into effect today.

Com ...

To all entities both governmental and private, fellow engineers, businessmen and to all that in one way or another assisted us in preparing this rules of design standards, our gratitude.

Carlos A. Mulero
CARLOS A. MULERO
EXECUTIVE DIRECTOR

December 19, 1983

*MAR
CAM*

F O R E W O R D

The purpose of this Rules of Design Standards is to establish the needed requirements and the proper procedure for the development and approval of design projects for Sanitary Sewer Systems and/or Water Supply Systems. These Standards are not expected to cover each and everyone of the submitted cases, and they may be subjected to particular conditions.

made Cam

TABLE OF CONTENT

We understand that both the table of content or index constitute an essential part of the norms, but considering of valuable assistance to the fellow designer that they be part of the corresponding chapter, only the chapter's title and number is included in this Table of Content.

Chapter I	REQUIREMENTS FOR THE PRESENTATION OF PROJECT PLANS
Chapter II	GENERAL NORMS FOR THE DESIGN OF AQUEDUCT SYSTEMS
Chapter III	WATER FILTER PLANTS
Chapter III-A	CLEAR WATER PUMPING STATIONS
Chapter IV	GENERAL STANDARDS FOR THE DESIGN OF SANITARY SEWERS
Chapter V	SEWAGE PUMPING STATION
Chapter VI	WASTEWATER TREATMENT PLANT
Chapter VII	GUIDES FOR DESIGN AND REVISION OF ELECTRICAL PLANS
Chapter VIII	SAFETY REGULATIONS
Chapter IX	WATER SUPPLY NORMS FOR APARTEMENT'S BUILDINGS AND CONDOMINIUMS
Chapter X	RULES AND REGULATIONS FOR THE SUPPLY OF WATER AND SEWER SERVICE, PUERTO RICO AQUEDUCT AND SEWER AUTHORITY 1976.
Chapter XI	ACT FOR THE CONSERVATION, DEVELOPMENT AND USE OF THE WATER RESOURCES OF P.R. LAW #136, JUNE 3, 1976
Chapter XII	TYPICAL DETAILS

*mano
C/O*

CHAPTER I

REQUIREMENTS FOR THE SUBMITTAL OF PLANS

This chapter comprises the requirements applicable to the submittal of plans, from the Preliminary Consultation to the Final Plans for each type of project, including Trailer Houses.

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.01	Types of Projects	I-1
1.02	Preliminary Consultation	I-1
1.03	Preliminary Plans	I-1
1.04	Final Plans	I-2
1.05	Trailer Housing	I-5
1.06		

*Mary
Blom*

CHAPTER I

REQUIREMENTS FOR THE PRESENTATION OF PLANS

1.01 Types of Projects

- 1.01.01 Private and public urbanizations, simple lot divisions, urban renewal projects, and any other public housing project where water and/or sewer facilities are provided to be connected to the systems of the Authority or to be transferred to it for its operation.
- 1.01.02 Apartment, condominiums or office buildings with more than three units and trailer houses.
- 1.01.03 Hotels, hospitals, medical centers, industrial buildings, institutional buildings, commercial, educational, recreational, sports centers, gasoline station.
- 1.01.04 Any other project not included in the above clauses, which requires a water connection 4" in diameter or larger.

1.02 Preliminary Consultation

Prior to submitting the preliminary plans, a written consultation is required from the proposer or designer, regarding water and sewer facilities available in the area where the project is to be located, with evidence of the submittal of the project plans to the Planning Board, Permit and Regulations Administration, and/or other agencies (E.Q.B., U.S. Army Corps of Engineers, Department of Natural Resources, Health Department, and Transportation and Public Works Authority). The consultation also shall include a site plan and a general description of the project.

1.03 Preliminary Plans

After obtaining the approval of the permits and requirements aforementioned and submitting evidence of such approvals, the proposer shall submit two (2) advance copies of the proposed project plans, including the information specified in Sections 1.04.01 to 1.04.06 for revision and recommendations by the Authority.

1.04 Final Plans

- 1.04.01 Once the recommendations and approval by the Authority regarding the preliminary plans are obtained and incorporated, the project planner shall submit two (2) copies for revision and final approval, then two (2) copies, (one in Mylar (0.005) for the Authority and one in sepia to be returned to the project planner, after the approval seal of the Authority is stamped) and six (6) copies of the final plans of the project. Copy of these documents shall be forwarded to the Permits and Regulations Administration.
- 1.04.02 The horizontal projections shall indicate the following; project site, topography, project limits, adjacent property owners, north, scale, elevation contours at intervals no greater than one (1) meter, road and nearest kilometric marker, streets and other nearby accesses, bench marks within the project limits, referred to one of the U.S. Coast and Geodetic survey and clearly identified in the plans. All dimensions and contours, except pipe sizes and fittings, pump suction and discharge, valves and other accessories related with piping will be indicated in the metric system and in parenthesis its equivalent in the English system.
- 1.04.03 Horizontal projections indicating the proposed water distribution system and sewer system. In cases of lot divisions or urbanization; numbered lots must be indicated, as well as existing and proposed roads or access. Also, the various elements and details of the water and sewer systems to be installed in the project.
- 1.04.04 Longitudinal profiles showing the elevations of the roads, streets, as well as the existing and proposed sewers related with the project, survey points, partial distances between manholes, station points, slopes and dimension of the sewers. The manholes shall have the same numbers, invert and top elevations as shown on the site plans. Also all existing sanitary and storm sewers, aqueduct,

gas or any other piping, cable or structure that would cross the water or sewer piping of the proposed project. Aqueduct projects shall include hydraulic profiles of the piping between pumping stations and distribution tank and between tanks and points of maximum or minimum pressure in the distribution system.

In sanitary sewer projects where pumping stations are included, it will be required to show the hydraulic gradient of the system including velocity.

- 1.04.05 Submit detailed plans, including typical details related to the proposed project, according to the norms of the Authority, as well as special works, such as, overflows, crossings of ramparts, streams, tunnels, siphons, house connections, culverts, channels, sewers of non-circular sections etc.
- 1.04.06 In case of works that must be installed in private property, the necessary right of way to be adquired and transferred to the Authority, must be indicated.

The land to be transferred, by the Developer, to the Authority, must be transferred at no cost and with a notarized non-return clause and proof of the Owner's agreement. Right-of-way along the property limits of adjacent lots shall not be permitted and shall be accessible to permit maintenance. For right of way width refer to Section 1.04.15.

- 1.04.07 The plans must include a minimum space of 5" high and 6" long over the title on the lower right hand corner of each sheet for the seal of approval of the Authority. Full name and address of the owner must appear on the first sheet of the plans.
- 1.04.08 Each project plans must have a conventional symbols' legend or code.
- 1.04.09 All plans submitted for approval must be prepared and signed by an engineer duly authorized to practice the profession in Puerto Rico including full name, address, and license number.

- 1.04.10 The minimum scales for the plan shall be 1:1000; for profiles H= 1:1000, V= 1:1000; for street or road transverse sections 1:1000 except typical sections indicating paving details that will be 1:50. For special details an adequate scale shall be used.
- 1.04.11 On projects for every kind of building, a site plan of the project must be submitted indicating its use, number of floors, housing, offices, rooms, beds, students etc. Also, building sections and soil test results must be indicated.
- 1.04.12 Isometric plans or water and plumbing installations of the buildings comprised in the project must be submitted.
- 1.04.13 Plans for urbanizations shall include a scaled sheet showing all structures comprised in both aqueduct or sewer projects.
- 1.04.14 The lots for the location of structures, such as pumping stations and distribution tanks that are part of the project, must be indicated in the plans, including compass bearings and length of property lines, area, name of existing adjacent property owners, topography, existing and proposed ways of communication, nearest kilometric marker, existing and proposed access, etc. The lot shall be large enough to allow easy access to the structures, providing paved concrete walks around them, no less than two (2) meters wide. Every lot for pumping stations shall be concrete paved. Restriction to adjacent properties will be required, such as setback around the structures where no other structure will be built. The setback for sewage pumping stations will be 15 meters. For wastewater treatment plants see Chapter 6 Section 6.02. The access road shall be no less than four (4) meters wide with one (1) meter wide shoulder on each side.
- 1.04.15 The necessary rights-of-way for the installation of water pipes or sewers on private property will be indicated on the plans, having a width as follows:
- a) three (3) meters for water pipes up to or twelve (12) inches diameter.
 - b) four (4) meters for water pipes up to or 18" diameter.

*MANE
G.A.M.*

- c) for water pipes twenty (20) inches to sixty six (66) inches in diameter, the width shall be six (6) meters.
- d) three (3) meter wide for sewer pipes up to twenty-four (24) inches diameter,
- e) for sewer with a larger diameter the Authority will determine the width of the right of way, and
- f) four meter wide for common right of ways of up to twelve (12) inches for water pipe and sewers up to twenty-four (24) inches in diameter.

1.04.16 For the project final approval a report must be submitted including the stratigraphical profiles and localization of the soil test and recommendation of the foundation of the structures. Stratigraphical profile of this soil test must be shown in the project plans. The report should be certified by a Soil Engineer. The Authority may require additional tests, such as:

- a) compaction tests to determine settling,
- b) triaxial tests to establish resistance to cutting or digging,
- c) test trench to verify construction methods,
- d) pumping test to determine the coefficient of permeability to use in the design of the drainage system,
- e) seismic refraction test, jointly with the borings, to obtain geological information data.
- f) establish the number, depth and spacing of the borings. In the case of treatment plants, the dimensions and depth of the structure should be considered.

1.05 Trailer Housing

1.05.01 Trailer housing is a recent type of development and sufficient experience is not yet available to establish design standards. Requirements approved by the Authority shall be applied.

Handwritten signature/initials

- a- Summer trailer housing
- b- Residential trailer housing

1.05.02 Up to this date the only regulation pursuant to Trailer Houses has been established by the Planning Board in its Resolution No. J.P. 229. This Resolution aims to promote projects of this type in an orderly and planned manner for the enjoyment of these facilities under healthfulness, comfortable and safety conditions. Said Resolution entails the following criteria:

Definition of Trailer Houses' Recreational Projects

Will be understood as trailer houses' recreational project, that which comprises a lot with minimum facilities, oriented toward the local tourism, to provide two or more parking spaces for compact housing units, with all or part of the ordinary facilities of a house, permanently assembled over a chassis that can be towed by another vehicle, or can move on its own it does not exclude the combination of trailer houses with cottages and/or tents for short term stays, in trailer houses' projects.

Location

- 1- Projects within or adjacent to an area of environmental, natural and cultural importance will need the endorsement of the Department of Natural Resources.
- 2- The minimum drinking water infrastructure with adequate capacity according to the rules of the Puerto Rico Aqueduct and Sewer Authority must exist. If there are no sanitary facilities, central septic tanks or any other system will be used.
- 3- Its location will be at:
 - a) 30 meters measured from the exterior river bed of every river, channel and brook.
 - b) 200 meters measured from P.R.A.S.A.'s acquisition limit on every reservoir for the supply of drinking water.

*MAR
COM*

- 4- Projects proposed to be on lands adjacent to residential areas, urbanizations, rural communities, etc., must observe a buffer zone planted with trees, free of every activity, of 20 meters.

Special Controls

- 1- The segregation or division into lots or spaces for trailer houses in recreational projects will not be allowed.
- 2- The trailer houses will no be allowed to be used as permanent housing units.

1.05.03 In compliance, with the Planning Board's Resolution No. 229 this Authority states that:

- 1- Only one connection of size corresponding to the number of trailer houses at a rate of 200 gallons per day per trailer house, will be allowed.
- 2- Only one connection to be discharged into a tank or cistern will be allowed and the distribution will be at the owner, or administrator's expenses.
- 3- There will be no segretation, nor installation of individual connections.
- 4- The distribution system to be used will be designed by a qualified, licensed engineer and it will have to be approved by the Aqueduct and Sewer Authority.

*MANA
CAM*

1.06.02 The particular attention of the Designer is directed to the fact that the water and wastewater facilities and all appurtenances shall be designed and constructed to withstand, in addition to normally occurring stresses, the stress resulting from earthquake and hurricane forces.

All designs shall comply with applicable requirements of the Building Regulations of the Puerto Rico Planning Board and of the Uniform Building Code, latest editions.

1.06.03 The designer shall submit the design data and design calculations of the Process, Structural, Electrical, Mechanical, Architectural or any other matter deemed necessary for the revision and approval of plans submitted to this Authority.

*MADE
COM*

CHAPTER II

GENERAL STANDARDS FOR THE DESIGN OF AQUEDUCT SYSTEM

This chapter includes the daily consumption for different uses such as domestic, industrial, commercial, etc., both urban and rural. Norms for buildings requiring tanks and pumping systems to satisfy the minimum water pressure required, factors to be considered in the design for maximum hourly demand and for 25 years future demand. Water sources of supply are regulated for quality and quantity. General conditions are established for the pumping of raw water and clear water in the distribution system, type and capacity of pumps, and general norms for distribution systems.

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
2.01	Domestic Consumption	II-1
2.02	Other Uses	II-1
2.03	Additional Requirements	II-2
2.04	General Norms for Rural Aqueduct Design	II-3
2.05	Pumping Stations	II-4
2.06	Reserve Tanks	II-11
2.07	Distribution Systems	II-12

*MARCELO
CAM*

CHAPTER II

GENERAL STANDARDS FOR DESIGN OF AQUEDUCT SYSTEMS

2.01 Domestic Use

- 2.01.01 Private housing projects - 1514 liters (400 gallons) per day per housing unit.
- 2.01.02 Public housing projects, renewal projects and other public-communal projects-1135 liters (300 gallons) per day per housing unit.
- 2.01.03 Rural housing projects - 946 liters (250 gallons) per day per housing unit.

2.02 Other Uses

- 2.02.01 Light Industry (Consumption for personal use only). Shall be determined based on 1325 liters (350 gallons) of water daily per 93.0 square meters (1000 square feet) of floor space or 37,850 liters (10,000 gallons) daily per each "cuerda" of land assigned for construction of industrial buildings.
- 2.02.02 Heavy Industry. (Consumption includes human needs and industrial process). The consumption for human need will be the same as in the preceding clause. The owner or the sponsor of the project shall submit the necessary information on the quantities of water to be used for the industrial process.
- 2.02.03 Commercial Buildings

The consumption will be determined based on 1135 liters (300 gallons) daily per each 93.0 square meters (1000 square feet) of floor space or 26300 liters (7000 gallons) daily per "cuerda" of land assigned for construction of commercial buildings.
- 2.02.04 Office Buildings

Will be computed based on 1,135 liters (300 gallons) daily per each 93.0 square meter (1000 square feet) of floor space.

*MANE
COM*

2.02.05. Apartment and Condominium Buildings.
1515 liters (400 gallons) daily per apartment.

2.02.06. Hotels (with all services and facilities) - 2650
liters (700 gallons) per room per day

Deductions for Services or Facilities not provided

Laundry -----378 liters (100 gallons) per
room per day

Beach -----378 liters (100 gallons) per
room per day

Food Service -----378 liters (100 gallons) per
room per day

Swimming pool -----189 liters (50 gallons) per
room per day

2.02.07. Hospitals and Medical Centers.
1325 liters (350 gallons) per bed per day.

2.02.08. Schools.
114 liters (30 gallons) per student per day.

2.03 Additional Requirements

In those cases where water services can not be provided by gravity, to the buildings mentioned on clauses 2.02.04 and 2.02.07, the following additional requirements must be considered:

2.03.01. A tank must be provided for water storage with a minimum capacity equivalent to half the daily average total consumption of the building, plus an adequate reserve, that in no case shall be less than 11,560 liters (300 gallons) to used in case of fire. The fire protection system should be designed in accordance with the regulations of the Planning Board, the Administration of Permits and Regulations and the Fire Department.

2.03.02. The water service connection must be sized to fill the water storage tank in eight (8) hours.

2.03.03. A pump system must be used, with a capacity equal to the maximum instant consumption of the building, but never less than 11340 liters per second (50 gallons per minute). At least two (2) units shall be provided with capacity to supply maximum instant

*MANE
COM*

consumption each one, which will function alternately or simultaneously if necessary.

In apartment buildings, hospitals, or other institutions that provide emergency services, an emergency power generating plant, will be provided, with capacity to run one of the pumps.

- 2.03.04 The minimum residual pressure, at the top floor level, shall not be less than 1.05 kgs/square cen. (15 lbs/sq. inch.).
- 2.03.05 For apartment buildings and condominiums see Chapter IX.
- 2.04 General Standards for Rural Aqueduct Systems Design Guide.
 - 2.04.01 Average domestic water consumption shall be determined based on 190 liters (50 gallons) per capita. Population shall be computed based on five (5) persons per family or living unit. The average domestic consumption will be estimated based on 190 liters (50 gallons) daily per person, plus 114 liters (30 gallons) per student, if schools exist. If industrial developments, urbanizations, public housing or a possibility of them exist, their consumption must be considered in addition to the rural system consumption and computed according to the norms of the Authority.
 - 2.04.02 The rural aqueducts systems shall be designed with capacity to supply the estimated demand in the next twenty five (25) years, considering a population growth of 25% the actual population, thus the daily future consumption shall be computed by multiplying the actual daily consumption by 1.25. Hourly future maximum demand to be determined by multiplying future demand by 2.25. To calculate the loss due to friction in cast iron pipe use coefficient C-100.
 - 2.04.03 The minimum capacity of the source of supply should be sufficient to provide the demand for the next twenty five (25) years. If not possible the project should include the study of sources to be used in the future.
 - 2.04.04 The water to be used should be chemical and bacteriological satisfactory for human consumption.

*MAR 21
CALM*

When chlorine treatment alone does not guarantee this condition, additional treatment and chemical use should be considered.

- 2.04.05 The dams for rural aqueduct systems, and when so permitted by the supply source, should be small dams, approximately 1.5 meters high to facilitate the water intake and storage for a period of time. The dams shall be constructed of reinforced concrete and preferably on rock ground. At the intake structure, two (2) racks should be installed, one at the intake made of steel rods 1.27 centimeter (1/2 inch) in diameter and spaced 5.08 to 10.2 centimeter (1/2 to 2 inches) and another in the interior made of wire mesh gauge number 10, spaced about one centimeter (3/8 inch). A gate, not less than 41 centimeters (16 inch) diameter, shall be provided for drainage and cleaning.

2.05 Pump Stations

- 2.05.01 When not technically possible or economically feasible to provide a gravity water supply system and/or distribution system, a pumping system as included in clauses 2.05.02 and 2.05.03 will be provided.
- Selected pumps should be of the minimum size necessary to supply the daily future flow operating sixteen (16) hours daily and most convenient with regard to efficiency. Two (2) units of equal capacity should be provided, maintaining one in reserve for emergencies and/or maintenance facilities.
- All pumping stations shall be provided with pressure gauges to measure pump suction and discharge pressure and automatic graphic pressure recorder of seven (7) days duration. They must be protected by a 1.83 m. (6 feet) high galvanized chain link fence with 3 strands of barbed wire on top, along the property line of the lot with a four (4) meters gate. See Fig. No. 1.
- A paved road for access to the pumping stations, not less than four (4) meters wide with one meter shoulders at each side. In case of concrete pavement, construction joints 5.49 meters (18 feet) apart should be provided.

Handwritten:
MAD
QAM

Final grading of the access road will have a minimum elevation of 0.60 meters above maximum flood level. All pumping equipment should at least be duplicated for emergencies, except in particular cases of small projects using a deep well as a supply source. To estimate losses due to friction a coefficient of $C = 100$ must be used.

2.05.02 Distribution Pump Stations

Distribution pumping stations must have concrete houses of adequate size. The possibility of eliminating the pump house should be considered, subject to previous consultation and approval of the Authority. The space inside the house should permit the easy arrangement and installation of the equipment and accessories so that operation and maintenance can be accomplished with comfort. To facilitate the removal of vertical type pumps for replacing or to repair, a one square meter opening should be provided, above each pump, with a watertight lid with hinges and lock. In case of horizontal pumps with motors larger than 15 H.P., an I beam with hoist, must be provided. An automatic starting generator, should be provided for emergencies in case of electric power failure.

2.05.03 Raw Water Pumping Stations

The raw water intake pumping stations shall consist of a catch basin with a minimum capacity equal to eight (8) hours daily average consumption which will be supplied from a river, stream, or a deep well, etc. Means of measuring the flow should be provided. Pumps and electrical controls up to 30 H.P. can be installed outdoors and for those over 40 H.P. a control house should be built. When installed outdoors the control box shall be watertight (NEMA III) and a Diesel driven generator for emergencies shall be provided, with adequate delay relay to operate automatically in case of electric power failure. An automatic transfer switch shall be provided. Generators shall be housed in a concrete structure. The structures and equipment shall be arranged according to typical details of the Authority.

*MADE
C.A.M.*

When the water supply is a river, stream, etc., the catch basin shall be design to include bar screens, weir, drains, and intake dam. In this case a filtering plant is required according to requirements of the Authority depending on each particular case. In this type of installation two pumps well type, will be required, each with a capacity equal to the maximum filtering flow of the plant in 24 hours. See Fig. No. 29 and 29A.

The maximum yield of the well should be 1.67 times greater than the flow to be provided. Concrete housing for the chlorination equipment and electric power generator, shall be provided. The well shall be constructed as follows:

- a. Should be tested for plumbness and alignment. Any deviation or bend which might affect the installation or operation of the pump, should constitute basis for rejection.
- b. The diameter of the final casing shall depend on the flow required, but never less than 10 inches.
- c. The final casing pipe thickness will be determined by the Authority, depending on the diameter and the depth of the well, but shall not be less than 0.23 inches thick.
- d. New smooth type steel pipe shall be used for the casing and not less than 15.3 meters (50 feet) deep and seal with cement mortar to eliminate possible contamination of the water.
- e. The contractor shall submit to the Authority a tabulation of the well, as constructed, indicating the depth of the different formations penetrated, the pipe installed, the grouting depths, water static levels, water veins founded and any other information that might be usefull to the project history.
- f. The contractor shall perform a 48 hours yield test after well construction, supervised by personnel of the Authority. All equipment needed for the test, including the pump, shall be furnished by the contractor.

*MAKE
CLAM*

A suction well must be provided with a minimum water reserve of eight (8) hours, based on the average pump capacity and the connection sized for the capacity of the pit for 24 hours.

2.05.05 Centrifugal Pumps

Every booster pump for water supply purposes must be a centrifugal type pump (horizontal or vertical, simple or multiple stage, turbine well type or with submergible motor), and determined according to the specifications of flow and head on each case.

When pumps of the vertical barrel type are used, they should have the suction and discharge flanges at the same elevation.

In general, these pumps will be bronze fitted, body will be gray iron with a high percentage of steel. The housing impeller wearing and lubrication rings will be of bronze, the shaft shall be of stainless steel (304N) and mounted in adequate ball bearing when required. The pump will be provided with blow off valves, cooling interconnections packing box glands or mechanical seals as required by the Authority.

The horizontal pumps will be driven by electric motors, by means of direct or flexible coupling, mounted on a common base of cast iron or welded steel, subject to the approval of the Authority. When the coupling is flexible, a coupling guard will be provided.

The motor will be horizontal or vertical according to the type and speed of the pumps. They will be induction type, with class B insulation, three phase, 60 cycles and 230 to 460 volts. The Authority has the option, in cases of synchronous motors larger than 150 H.P., to authorize voltage of 4160 volts. The motors and their installation shall meet all the latest requirements of the National Electric Code and the P.R. Electric Power Authority.

When designing the electrical system, consideration should be given to use the most economic power rates.

Pumping equipment electrical control panel shall consist of the following accessories:

- a) Automatic type, general circuit breaker of adequate capacity for the total load to be connected.
- b) Control for each unit with its magnetic starter, according to the capacity of the motor, preceded by the automatic circuit breaker. For motors larger than 40 H.P. the starter will be of the reduced voltage autotransformer type, with overload protection.
- c) Relays for protection against power failure, drop in voltage or phase failure, reversal or unbalance, should be provided connected to the input buss bars of the control panel and electrically protected by a current limiting fuse block at the input of the equipment (C.L.F.). Spare fuses should be provided for emergency use. This device should normally maintain a couple of contacts closed.
- d) An electrical control system by means of an exposed, concealed, pneumatic, radio or electric signal device that would be sensitive to the variations of water level in the tank or system, should be provided, to operate automatically the pumping units, using electrodes at the pump suction sump pit to prevent pumping while dry. In case of booster pumps installed in the pipe line a time retarder switch, shall be provided due to the electrodes short margin of operation.
- e) Every pump shall be provided with an autographic pressure recorder of seven (7) days duration of a well known and accepted make, electrically operated and will be connected to the system by valves, snubbers and flexible coupling at the pump suction and discharge ends.

Each pump shall be provided with adequate gate valves and flexible couplings in the suction and at the discharge of the same. In addition a pressure sustaining and check valve will be installed at the discharge, prior to the gate valve. All this accessories of adequate size in accordance with the pumping capacity and the velocity recommended in the design. All these fittings & connection shall be flanged connections.

All check valves shall be of the silent type, or any other combined type for pumps of large capacity, as determine by the Authority. See Fig. No. 23 and 24.

- f) Other necessary accessories, such as selector switch for manual or automatic operation or for circuit breaker interruptor.

2.05.06 Turbine Type Pumps for Deep Wells

Turbine or centrifugal vertical type pumps for deep wells shall folow the requirements and recommendations of the National Association of Vertical Turbine Pumps Manufactures and the Standards of the Hydraulic Institute with the following conditions:

- a) The motor will be open drip-proof weather protected NEMA I of a hollow shaft for a maximum speed of 1750 r.p.m., 3 phase, 60 cycles 230 to 460 volts and couple directly to the base of the pump discharge.
- b) The discharge columns shall be of oil lubrication type, and no larger than 3.05 meters (10 feet) and of adequate diameter, according to the capacity and conditions of the system. Total length of the column and the diameter of its components shall be indicated in the plans.
- c) The pumping element must be of the multiple type with scroll cases made of cast iron, properly enamaled or other equivalent material, bronze closed type impellers, and stainless steel column. Provided with the corresponding suction pipe of adequate size and galvanized conical screen.

In addition, the necessary equipment to determine the pumping level at any desired moment and an automatic switch for low level.

The pump discharge shall be provided with a flexible rubber gasket coupling, check valve, a gate valve, a flow control valve, smooth nosed sampling tap, a pressure releif valve according to the pumping pressure gauge at the discharge end of the pump and an air release valve of adequate capacity before the check

WAP/
CCM

valve or at the base of the pump.

In addition, in the pump discharge line, after the check valve and before the "T" cleanout a turbine or venturi type meter to measure the flow across the pump shall be installed according to manufacturer instructions. See Fig. No. 23.

A chlorination system shall be installed consisting of hyperchlorinator and solution tank for pump capacities up to 350 g.p.m. and a gas chlorinator of adequate capacity for pumping stations with pump capacities greater than 350 g.p.m., with all necessary equipment.

All electrical equipment and material shall conform to the existing norms and regulations of the National Electric Code and to the Puerto Rico Electric Power Authority.

2.06 Reserve Tanks

2.06.01 Capacity

- a) The capacity of the tanks or deposits for reserve for rural systems will be estimated using the following formula:

$$V = N (250) + (250 \times 60 \times 4)$$

where V = Volume or capacity of the tank in gallons.

N = Number of families

- b) For urban systems the capacity will be estimated by the following formula:

$$V = N (400) + (250 \times 60 \times 4)$$

where V = Volume or capacity of the tank in gallons.

N = Number of families

2.06.02 General Tank Requirements

- a) The location of the tank should be such that produces uniform pressures in the distribution system. In case that the topography does not

permit the construction of the tank on the ground, the construction of an elevated tank will be permitted. Where, due to special conditions, the construction of a concrete elevated tank would be too costly, the construction of reserve tank made of steel or other acceptable material will be permitted.

These tanks must be cathodically protected. However, the construction of such tanks will not be permitted at coastal areas, where the same would be exposed to the effects of sodium nitrates. Prefabricated pre-stress concrete tanks will be accepted subject to previous approval of the Authority.

- b) The elevation of the bottom of the tank should be such that maintains, at the highest point of the system, the minimum pressure required as specified in clause 2.06.01.
- c) Emergency overflow piping connected to a natural trench or to a storm sewer, shall be provided. Internal overflow pipe should be of the same or greater diameter as the diameter of the inlet pipe. On the outside of the structure the overflow pipe diameter should be the same used in the hydraulic gradient calculations. Cast iron or ductile cast iron pipe shall be used for exposed pipe lines.
- d) A plot will be provided according to the size of the tank, leaving a 3 meter strip around its perimeter. In urban areas the plots shall be concrete paved with paved access and of an area that will permit the addition of another tank.
- e) The minimum distance from the perimeter of the base of the elevated tank to the nearest structure will be the same as the height at the top of the tank plus 3 meters.
- f) An automatic control to prevent spills and an overflow shall be provided.

*MARCO
C.A.M.*

2.07 Distribution System

2.07.01 Minimum Pressure Required

The minimum pressure required in the distribution system will be 2.1 kg/sq. cm (30 lbs/sq inch) at the level of the sidewalk curb at the highest point of the system, based on the design maximum hourly consumption.

2.07.02 Capacity of Main Piping

The main piping shall be design to carry from the reserve or storage tanks to the distribution system, a minimum of 2.25 times the average normal consumption plus the reserve for fire or average consumption plus 60,000 GPD (4 hours fire reserve) whichever is greater. The maximum velocity permitted in piping systems flowing by gravity will be 1.22 meters/second (4 feet/second) and in forced mains 2.44 meters/second (8 feet/second).

2.07.03 Pipe Types

Piping for main lines and distribution systems, except in cases approved by the Authority, will be of cast iron or Ductile iron 150 type, with cement lining, P.V.C. or reinforced concrete.

a) Cast Iron and Ductile Iron Pipe

The cast iron pipe, pit cast, size 30" or larger will adjust to specifications ANSI A-21.2 The cast iron pipes centrifugally cast in molds, will meet specifications ANSI A-21.6 (AWWA C-106) or ANSI A-21.8 (AWWA C-108).

In addition the ends of the mechanical joints shall conform to specification ANSI A-21.11 (AWWA C-111). Pipes of 2" diameter will adjust to specification CIPRA 8-57.

Ductile iron pipe shall conform to specification A-21-51 (AWWA C-151) and ANSI A-21-51A (AWWA C-151a). Specifications in force, latest revision, shall be applied.

Handwritten signature/initials

1. Accessories

Accessories with bell and spigot ends in sizes 4" to 12" shall conform to specification ANSI 21.10 (AWWA C-110) and in sizes larger than 12" to specification AWWA C-100. All 90° curves shall conform to AWWA C-100.

All accessories with mechanical joint ends in sizes 4" to 12" shall conform to specification ANSI 21.10 (AWWA C-110), ANSI A-21.11 (AWWA C-111), CIPRA 2.54, 3.5 and 6.54.

Accessories with flanged ends shall conform to specification ANSI B-16.1, class 125.

2. Connections and Coupling Materials

Pipes and accessories in sizes 6" or larger will have push-on mechanical joints.

In crossings under river bed; permanent structures which obstruct their easy removal and replacement, or in installations on road bridges, the use of mechanical joint pipe and accessories shall be required.

3. Pressure Connections

In pipe and accessories with pressure connections the joints shall conform to specification ANSI A21.11 (AWWA C-111). The gasket and the lubricant for the joints shall conform to specification ANSI A21.11.

4. Mechanical Joints

Dimensional and material requirements for pipe ends, pipe caps, screws, lock nuts, joints shall conform with specification ANSI A21.11 (AWWA C-111).

5. Concrete Pipe

Reinforced concrete pipe shall conform to specification AWWA C-300. Prestressed concrete pipe shall meet requirements of specification

*MADE
QAM*

AWWA C-301 of latest revision. Both will be designed for the following minimum conditions.

Pressure Calibration....10.5kg./cm² (150 lbs/sq. inch).
Soil Cover.....1.83 meters (6 feet)
Hydraulic Ram.....40% x Pressure Calibration
Accidental Load.....ASSHO H-20

To all concrete pipe, a bituminous layer shall be applied, to seal the interior surface according to specification ANSI A21.4.

The use of concrete pipe will be subject to the approval of the Authority.

All accesories shall be subject to the same requirements as the concrete pipe and the same type of cement should be used.

All joints and coupling material will be subject to the approval of the Authority.

2.07.04 Piping Installation

In General water piping will be installed in streets and roads, avoiding private areas leading to rights-of-way. Installing them at the most convenient side of the public roads, at a depth of not less than 0.75 meters (measured from ground surface to the upper part of the pipe) and a minimum distance of 1.50 meters to the side-walk curb.

On roads with no sidewalk curb or concrete gutter, the 1.50 meter limit can be reduce to 1.00 meter from the edge of the shoulder, subject to the approval of the Authority.

In all installations where plastic pipe is used a detectable metal or plastic tape shall be placed above all the length of the pipe to permit locating the pipe.

a. Crossings

Water mains crossing sewers, above or under or running at a distance less than 1.52 meters

*MANE
C.A.M.*

(5.0 feet) shall be laid above the sewer providing a vertical distance of 0.30 meters (1 foot) between the outside of the water main and the outside of the sewer. When crossing at a distance less than 0.30 meter (one foot), or even greater, a concrete foundation shall be provided to the water main to prevent transmitting its weight to the sewer pipe. See Fig. No 43.

b. Parallel Installations

Water mains shall be laid at least 3.05 meters (10 feet) horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. This distance may be less if the water main is installed in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 0.46 meters (18 inches) above the top of the sewer, subject to the approval of the Authority. See Fig. No. 43. No crossing or contact between a water pipe and a sanitary or storm sewer manhole will be permitted.

2.07.05 Accessories

In the distribution system the following accessories shall be provided:

- a. Valves to isolate the circuits which divide the distribution system. Each circuit shall include four (4) blocks of houses. Valves shall adjust to the specifications of the American Water Works Association (AWWA C-500 71, latest revision) and will be for at least a working pressure of 150 pounds. Valves will open to the left.
- b. Drainage valves will be installed in the lower places of the distribution system. The diameter of the drainage valves and piping shall not be less than 4 inches and sufficient to drain the water that flows to the drainage area in a maximum time of two (2) hours. Drainage sizes shall not be less than one half (1/2) the diameter in piping up to 8" diameter and one third (1/3) in piping up to 24" diameter. In piping of larger than 36" diameter, the size of the drainage shall be one fourth (1/4) the diameter of the pipe.

*WAP
CAM*

- c. Dead ends in the pipe systems will not be permitted. At the ends, after the last house connection, a tapped plug or cap shall be placed. In cases where probability of future development exist, a valve shall be installed before the plug or cap. See Fig. No. 8 and 9.
- d. Fire hydrants shall be Puerto Rico type according with the design adopted by the Authority. See Fig. No. 20.

Each fire hydrant shall be provided with an auxiliary valve and a four (4) inch diameter pipe connection when the diameter of the piping to be connected is 4"; and 6" diameter connection when the main is 6" or larger in diameter. The fire hydrants will be located preferably close to street intersections at a distance not less than four (4) meters (13 feet) from the corner of the sidewalks and in such a way that will not interfere with the driveways and yards of residences.

Shall be connected to the piping of larger diameter in the vicinity of the hydrant location. In straight lengthes the maximum spacing between hydrants shall be 150 meters. In curved spaces the maximum distance shall be the same, measured on a line parallel to the center line of the street or road. Hydrants shall be located in the planting strip between curb and sidewalk. If no planting strip exists it shall be located at not less than one meter from the property line. See Fig. 20.

2.07.06 House Connections

The water service will be provided by house connections or water taps from the distribution mains according to the following:

- a. Water service connections will be at least 1/2" in diameter, located in the front and at the center of each plot, its end will be at 0.25 meters (10 inches) from the sidewalk finished surface and will consist of a corporation cock, flexible type "K" copper piping, adapter, straight line jokes provided with a stopcock that permits the installation of a lock and cast iron meter box, all in accordance with the specification and requirements of the Authority. (See Fig. No. 11 and 12. Instead of the straight line joke and the cast iron box, a meter jokebox of a model and specifications accepted by the Authority, may be installed.

*MARCO
CANA*

The box will be installed in the planting strip, 0.15 meters (6 inches) from the exterior edge of the sidewalk (facing the street) and 0.15 meter (6 inches) thick concrete slab as shown of Figure No. 12. Copper piping from the meter box to a length of 0.30 meters (1 foot) inside the property limit, passing under the sidewalk provided with a brass stop valve. The Authority will determine and approve the adequate size of the house connection and the meter according to the water service to be provided on each case.

- b. The following table shows the maximum size house connections allowed in centrifugal cast iron, Class 150. Larger connections than the specified in this, will be done with type F-4339 Double Strap Service Clamp from James B. Clow & Sons, Inc., or approved equal.

Piping Size (inches)	4	6	8	10	12	16	20	24
Water Connection Size (inches)	3/4	1	1	1-1/2	2	2	4	4

In 2" diameter, connections will be done using one strap only.

- c. Water connections to service piping larger than 2" diameter will be made with tapping valve and sleeve of the type approved by the Authority. In out of service piping the water connection will be made with a tee and gate valve of the type and class approved by the Authority.
- d. The installation of 2" or larger water meters will include special fittings such as nipples, valves.

*MARCO
CLAW*

corporation cocks, concrete meter box, cast iron lid to protect meter as indicated in typical detailed figures #13 and 14.

2.07.07 Other Dispositions

In special cases in which the project includes other units not covered by this norms, such as dikes, filtration plants, intake lines, etc., the Authority should be consulted in relation to the norms to be used in the design.

2.07.08 Concrete Painting

The interior walls of the pumping stations will be painted in beige color. The exterior walls will be painted ceiling blue. Special paint for concrete of a quality accepted by the Authority will be used. A primer coat and two coats of paint shall be applied.

Handwritten signature

CHAPTER III

WATER FILTER PLANTS

In this chapter before covering standards related to the title subject, we had covered other areas included in the design of a water supply system, since they are considered exceedingly necessary as an approach to a Water Filter Plant design such as:

- a) Supply sources
- b) Collection and transportation works

Referring to supply sources we have tried, in the case of surface water, to include; hydrological information, flow, safe yield, description of the watershed, etc., and in the case of underground sources, its advantages, the geological formation through which the source is to be developed, a summary of the exploration, etc., the Engineer would notice that these phases precede the standards for treatment that begins in Section 3.10, page III-27, which, to the best of our knowledge, covers a wide range in the field of surface water treatment, and future designs shall be evaluated by these Design standards.

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
3.01	Water Filter Plants	III-1
3.02	Design General Considerations	III-5
3.03	Sources Development	III-9
3.03.02	Surface Water	III-10

MAR 20 1961

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
3.04	Ground Water	III-12
3.05	Location	III-14
3.06	Test and Record	III-14
3.07	Well Construction	III-16
3.08	Aquifer Types and Construction Methods Special Condition	III-21
3.09	Well Pumps, Discharge Piping and Appurtenances	III-24
3.10	Treatment	III-27
3.11	Filtration	III-34
3.12	Rapid Rate Pressure Filters	III-41
3.13	Disinfection	III-42
3.14	Aeration	III-44
3.15	Iron and Manganese Control	III-47
3.16	Fluoridation	III-50
3.17	Taste and Odor Control	III-52
3.18	Waste Handling and Disposal	III-53
3.19	Chemicals Application	III-58
3.20	Facilities Design	III-59
3.21	Operator Safety	III-66
3.22	Acids	III-67

*MARC
CLAM*

CHAPTER III

WATER FILTER PLANTS

- 3.01 A system for supplying or providing water consist of the following basic parts:
- a- Sources of water supply
 - b- Structures for its collection and transportation from the source to the treatment works
 - c- Water treatment structures
 - d- Distribution system

The water supplied should meet two basic conditions:

- a- Should be free of risks or dangers to the health or life of the consumers.
- b- Should consider all costs and the system should be operated at a reasonable cost.

At times this conditions may be conflicting, but both factors must be taken in consideration. To satisfy the first, the water should be free of pathogenic micro-organisms, substances that are health toxic or noxious, which is an essential and indispensable condition. To fulfil the second, the water characteristics must be such that do not cause any damage to the distribution system, the industries or the domestic economy, and can be obtained without having to incur in an exceptionally expensive treatment process, consuming great quantities of electric power.

3.01.01 General

All permits necessary for the location of the plant should be obtained from all agencies such as the Planning Board, Health Department, the U.S. Army Corps of Engineers, Enviromental Quality Board, Department of Permits and Regulations, Department of Natural Resources and others; before applying for approval to the Aqueduct and Sewer Authority.

*MARCO
CALAM*

Permits for construction, for waste discharge, for crossing of water courses, etc. must be required from the pertinent federal, state, or local agencies.

Preliminary plans and the engineer's report should be submitted for review prior to the preparation of final plans.

No approval for construction can be issued until final, complete, detailed plans and specifications have been submitted to the Authority and found to be satisfactory. The documents submitted for formal approval shall include at least

- a- a summary of the basis of design,
- b- operation requirements, where applicable,
- c- general layout,
- d- detail plans,
- e- specifications,
- f- cost estimates

3.01.02 Sources of Water Supply

The Engineer's report shall describe the proposed source or sources of water supply to be developed, the reasons for their selection, and provide the following information:

A- Surface Water Sources

Including:

- a- hydrological data, stream flow and weather records,
- b- safe yield, including all factors that may affect it,
- c- maximum flood level, together with approval for safety features of the spillway and dam from the appropriate authorities,

*MAAD
CLAM*

- d- description of the watershed, noting any existing or potential sources of contamination which may affect water quality.
- e- summarized quality of the raw water with special reference to fluctuations in quality, changing meteorological conditions, etc.

B- Ground Water Sources

Including:

- a- sites considered,
- b- selected site advantages,
- c- elevations with respect to surroundings,
- d- probable character of formations through which the source is to be developed,
- e- geologic conditions affecting the site,
- f- summary of source exploration, test well depth, and methods of construction; placement of liners or screen; test pumping rates and their duration; water levels and specific yield; water quality,
- g- sources of possible contamination such as sewers and sewerage facilities, landfills, waste disposal wells, etc.

3.01.03 Proposed Treatment Processes

Summarize and establish the adequacy of proposed processes and unit parameters for the treatment of the specific water under consideration. Alternative methods of water treatment and chemical use should be considered as a means of reducing waste handling and disposal problems. Pilot studies may be required.

*MAN
C. Am*

3.01.04 Waste Disposal

Discuss the various wastes from the water treatment plant, their volume, proposed treatment and points of discharge, considering Public Federal, Law 95-217 Rev.

3.01.05 Automation

Provide supporting data justifying automatic equipment, including the servicing and operator training. Manual override must be provided for any automatic controls.

3.01.06 Project Sites

Including:

- a) discussion of the various sites considered and advantages of the recommended ones,
- b) the proximity of residences, industries, and other establishments.
- c) any potential source of pollution that may influence the quality of the supply or interfere with the effective operation of the water works system, such as sewage absorption systems, septic tanks, privies, cesspools, sink holes, sanitary landfills, refuse and garbage dumps, etc.
- d) plant location
 1. the plant should be located as near as possible to present and future developments to be service,
 2. with easy access
 3. plot of sufficient area available for expansion and addition of facilities.

3.01.07 Influent and Effluent Quality

The characteristics of the influent shall be determined the modes and degree of treatment to be applied and should be based on the standards for water quality.

*MANA
COM*

3.02 General Design Considerations

3.02.01 General

The design of a water supply system or treatment process comprises a broad area. Application of this part is dependent upon the type of system or process involved.

3.02.02 Plant Layout

The design shall consider

- a) functional aspects of the plant layout,
- b) provisions for future plant expansions,
- c) provisions for expansion of the plant waste treatment and disposal facilities,
- d) access roads,
- e) site grading,
- f) site drainage,
- g) walks,
- h) driveways,
- i) chemical delivery

3.02.03 Building Layout

Design shall provide for

- a) adequate ventilation,
- b) adequate lighting
- c) mechanical ventilation, if necessary,
- d) adequate drainage,
- e) dehumidification equipment, if necessary,
- f) accessibility of equipment for operation, serving, and removal,

*MANE
CLAM*

- g) flexibility of operation,
- h) operator safety,
- i) convenience of operation
- j) chemical storage and feed equipment in a separate room to reduce hazards and dust problems.

3.02.04 Location of Structures

The appropriate regulating authority must be consulted regarding any structure which may impede normal or flood stream flows because of its location.

3.02.05 Electrical Controls

Main switch gear electrical controls shall be located above ground level.

3.02.06 Stand-by Power

Standby power may be required by the Authority so that the plant operations may continue during power outage.

3.02.07 Shop Space and Storage

Adequate facilities for shop space and storage should be include, consistent with the designed facilities.

3.02.08 Laboratory Equipment

Laboratory facilities and equipment shall be compatible with the raw water source, intended use of the treatment plant and the complexity of the treatment process involved.

3.02.09 Testing Equipment

Testing equipment provided shall be adequate for the purpose intended and recognized procedures must be utilized

3.02.10 Physical Facilities

Adequate ventilation, adequate lighting,

*MANAGE
CLAN*

sufficient bench space, storage room, laboratory sink, and auxiliary facilities shall be provided. Air conditioning may be necessary.

3.02.11 Monitoring Equipment

Water treatment plants with a capacity of 1.89 mld (0.5 mgd) or more should be provided with continuous monitoring equipment (including recorders) to monitor water being discharged to the distribution system as follows:

- a) plants treating surface water and plants using lime for softening should have the capability to monitor and record turbidity and free chlorine residual,
- b) plants treating ground water using iron removal and/or ion exchange softening should be capable of monitoring and recording free chlorine residual.

3.02.12 Sample Taps

Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each operation of treatment. Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads and shall not be of the mixing type, and shall not have a screen, aerator, or other such appurtenance.

3.02.13 Facility Water Supply

Water supply service line for the facility and the plant finished water sample tap shall be supplied from a source of finished water at a point where all chemicals have been thoroughly mixed.

3.02.14 Wall sleeves

To facilitate future uses whenever pipes pass through walls of concrete structures, consideration

Handwritten signature

shall be given to providing extra wall sleeves built into the structure.

3.02.15 Piping Color Code

To facilitate identification of piping in plants and pumping stations it is recommended that the following color scheme be used:

Water Lines

Raw	Olive green
Settled or Clarified	Aqua Blue
Finished or Potable	Dark Blue

Chemical Lines

Alum	Orange
Ammonia	White
Carbon Slurry	Red
Chlorine (Gas or Solution)	Yellow
Fluoride	Light Yellow with Red Band
Lime Slurry	Light Green
Potassium Permanganate	Violet
Sulfur Dioxide	Light Green with Yellow Band

Waste Lines

Backwash Waste	Light Brown
Sludge	Dark Brown
Sewer (Sanitary, Other)	Dark Gray

Other

Compressed Air	Dark Green
Gas	Black
Other Lines	Light Gray

In cases where two colors do not have sufficient contrast to easily differentiate between them, a six-inch band of contrasting color should be painted on one of the pipes at approximately 76 cm. (30 inches) intervals.

*MANE
CLAM*

The name of the gas or liquid should also be painted on the pipe. In some cases it may be advantageous to paint arrows indicating the direction of flow.

3.02.16 Disinfection

All pipes, tanks, wells, and equipment that can convey or store potable water shall be disinfected in accordance with AWWA procedures. The procedure shall be outlined in the plans and specifications, including the disinfectant dosage, contact time, and method of testing the results of the procedure.

3.02.17 Manuals and Parts Lists

A part list and parts order form, and an operation and maintenance manuals shall be supplied to all water works as part of every unit installed in the facility.

3.02.18 Operation Instruction

Provisions shall be made for operator instruction at the start-up of a plant or a pumping station.

3.02.19 Other Considerations

Consideration must be given to the design requirements of other federal state and local agencies for items such as special designs for the handicapped, plumbing and electrical codes, etc.

3.03 Source Development

3.03.01 General

In selecting the source of water to be developed, the designing engineer must prove to the satisfaction of the Authority that an adequate quantity of water will be available, and that the water which is to be delivered to the consumers will meet the current requirements of the authorities with respect to microbiological, physical, chemical and radiological qualities. Each water supply should take its water from the best available source which is economically reasonable and technically possible.

*MAP
Cam*

3.03.02 Surface Water

A surface water source includes all tributary streams and drainage basins, natural lakes and artificial reservoirs or impoundments above the point of water supply intake.

3.03.03 Quantity

The quantity of water at the source shall

- a) be adequate to meet the projected water demand of the service area as determined by calculations based on the extreme drought of record,
- b) provide a reasonable surplus for anticipated growth,
- c) be adequate to compensate for all losses such as silting, evaporation, seepage, etc.

3.03.04 Quality

A sanitary survey and study shall be made of all the factors, both natural and man made, which will affect the quality. Such survey and study shall include but not be limited to:

- a) determined possible future uses of impoundments and reservoirs,
- b) determined the degree of control of watershed,
- c) assessing the degree of hazard to the supply by accidental spillage of materials that may be toxic harmful or detrimental to treatment process
- d) obtaining samples over a sufficient period of time to assess the microbiological, physical, chemical and radiological characteristics of the water,
- e) assessing the capability of the proposed treatment process to reduce contaminants to applicable standards.

3.03.05 Structures

1. Design of Intake Structures shall provide for:
 - a) withdrawal of water from more than one level if quality varies with depth,

*MAPS
CLAM*

- b) separate facilities for release of less desirable water held in storage,
- c) inspection manholes every 300 meters for pipe sizes large enough to permit visual inspection,
- d) occasional cleaning of the inlet line,
- e) adequate protection against rupture,
- f) parts located above the bottom of the stream, lake, or impoundment, but at a sufficient depths to be kept submerged at low water levels,
- g) where shore wells are not provided, a diversion device capable of keeping large quantities of fish or debris from entering an intake structure.

2. Shore Wells

Shall:

- a) have motors and electrical controls located above grade, and protected from flooding as required by the Authority,
- b) be accessible,
- c) be designed to prevent flotation,
- d) be equipped with removable or traveling screens before the pump suction well,
- e) provide for application of chlorine or other chemicals in the raw water transmission main if necessary for quality control,
- f) have intake valves and provisions for back-flushing or cleaning by a mechanical device and testing for leaks, where practical,
- g) provide for withstanding surges where necessary.

*Can
map*

3. An Upground Reservoir

Is a facility into which water is pumped during periods of good quality and high stream flow for future release to treatment facilities. Upground reservoirs shall be constructed to assure that:

- a) the water quality is protected, by controlling the runoff into the reservoir, .
- b) dikes are protected against wind action and erosion and structurally sound,
- c) intake structures and devices meet requirements of Section 3.03.05,
- d) influent flow point is separated from the point of withdrawal,
- e) provide separate pipes for influent to and effluent from the reservoir.

3.04 Ground Water

A ground water source includes all water obtained from dug, drilled, bored wells, and infiltration lines.

3.04.01 Quantity

The total developed ground water source capacity shall equal or exceed the design maximum future day demand with the largest producing well out of service. A minimum of two (2) sources of ground water shall be developed.

3.04.02 Auxiliary Power

- a) When power failure would result in interruption of the minimum essential service sufficient power shall be provided to meet average day demand by means of:
 1. connection to at least two independent power sources, or
 2. portable or in-place auxiliary power.

*MARIE
Cam*

- b) When automatic pre-lubrication of pump bearings is necessary, and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a by-pass, with valve, around the automatic control.

3.04.03 Microbiological Quality

- a) Disinfection of every new, modified or re-conditioned ground water source;
 - 1. should be provided after completion of work if a period of time, to be determined by the Authority, elapses prior to test pumping or placement of permanent pumping equipment, and
 - 2. shall be provided after placement of permanent pumping equipment.
- b) After disinfection, one or more water samples shall be submitted to a laboratory satisfactory to the Authority for microbiological analysis and results submitted to the Authority before the well is placed into service.

3.04.04 Physical and Chemical Quality

- a) Every new, modified or reconditioned ground water source shall be examined for applicable physical and chemical characteristics by tests of a representative sample in a laboratory approved by the Authority with the results submitted to the Authority.
- b) Samples shall be collected at the conclusion of the test pumping procedure and examined as soon as practical or at the earliest opportunity in the required period of time.
- c) The Authority may require field determination of physical and chemical constituents or special sampling procedure.

3.04.05 Radiological Quality

Every new, modified or recondition ground water source shall be examined for radiological activity

QAM
man

as required by the Authority by tests of a representative sample in an approved laboratory, with results reported to the Authority.

3.05 Location

3.05.01 Well Location

The Authority and other pertinent agencies shall be consulted prior to design and construction regarding a proposed well location since its location may be affected by potential sources of contaminations and other ground water developments.

3.05.02 Continued Protection

Continued protection of the well site from potential sources of contamination shall be provided either through ownership, zoning, easements, leasing, righth-of-way or other means acceptable to the Authority. Fencing of the site will be required by the Authority.

3.06 Testing and Records

3.06.01 Yield and Drawdown Tests

- a) Yield and drawdown tests shall be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump.
- b) The test methods should be clearly indicated in the specifications.
- c) Shall have a test pump capacity, at maximum anticipated drawdown, at least 1.5 times the quantity anticipated.
- d) Provide for a continuous pumping test for at least 48 hours or until stabilized drawdown has continued for at least six hours when test pumped at 1.5 times the design pumping rate.
- e) Shall provide the following information:
 1. test pump capacity-head characteristics,

*MARCO
CORP*