

WATERWORKS MANUAL

MINIMUM STANDARDS FOR WATER SYSTEMS



**Manual and Revisions Adopted by
BOARD OF SUPERVISORS**

**COUNTY OF VENTURA
PUBLIC WORKS AGENCY**

FOREWORD

PURPOSE: The Ventura County Waterworks Manual establishes uniform policies and procedures for the design and construction of water supply facilities within County rights-of-way and on projects subject to approval by the County.

It was not the intent at the time of adoption of this Manual, or the intent at this time, that any standard of conduct or duty toward the public shall be created or imposed by the publication of this Manual. The Manual is not a textbook or a substitute for engineering knowledge, experience or judgment. The methods and procedures contained herein shall be reviewed by the engineer using them to see that they are applicable to the project on which he is working. Where not considered applicable, the engineer shall request a variance from the standards as provided in the Manual.

COUNTY OF VENTURA

GUIDE TO ENGINEERS, DEVELOPERS AND CONTRACTORS

The following publications have been adopted by the County for regulating the design and construction of public improvements constructed by developers; work performed under County or Flood Control District permits; land grading; water systems; and sanitary sewer systems:

1. Ventura County Road Standards (RdStd)
2. Ventura County Water Works Manual and Sewerage Manual (VCWWM & VCSM).
3. Standard Specifications for Public Works Construction (SSPWC).
4. Standard Land Development Specifications (SLDS) which adopt, supplement and modify SSPWC.
5. Ventura County Water Works Districts Nos. 1, 16, 17, and 19; Ventura County Service Areas 3, 4, 14, 29 and 30; and Lake Sherwood Community Services District Rules and Regulations (R&R).
6. Standard Plans for Public Works Construction (SPPWC).
7. State Standard Plans from CALTRANS (SSP).
8. Land Development Manual.
9. Standard cover sheets for grading.
10. Individual project plans and specifications (P&S).

The scope of each publication is contained within that publication. The publications should be used as follows:

Engineers - Use RdStd, VCWWM and VCSM (also R&R in Districts listed in 5 above) as the general requirements for design. Do not assume contractors have copies of these publications so don't make references to plates or formulas from these documents in the P&S. Material in SLDS, SSPWC, SPPWC, and SSP may be referred to in the P&S as contractors may be assumed to have copies of these publications.

NOTE: The Ventura County Standard Designs are no longer being published and should not be used as a reference. Use SPPWC in their place. Where SPPWC does not contain an appropriate design, SSP may be used.

Developers and Contractors - Use SLDS (which adopts and modifies SSPWC); SPPWC and SSP where specified in the P&S; Grading Cover Sheet and P&S.

FUTURE AMENDMENTS TO THIS MANUAL

Amendments to this manual may be issued from time to time.

Users of this publication may contact the Agency to determine the latest revision date. See the "Revision" pages herein that list the latest date for each page.

To ascertain the current purchase price and postage charge for the manual or to purchase an updated edition, contact the Agency at the address shown below. Individual pages may also be purchased at the standard price for Xerox copies.

Agency: Public Works Agency
Engineering Services Department
County Surveyor's Public Counter
800 South Victoria Avenue
Ventura, California 93009-1670

Location: The County Surveyor's Public Counter is at the Ventura County Government Center, Hall of Administration, Third floor, at the top of the escalator from the main entrance atrium.

Phone: (805) 654-2068

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WATERWORKS MANUAL REVISIONS

From time to time, revisions of this Manual may become necessary. When revisions are made and approved, they will be issued to staff holders of this Manual and sold to others. Each time a revision is made, the revision index sheet will be reissued showing the date of the currently active pages in the book. Revision "0" indicates the date the Manual was first adopted by the Board of Supervisors; or in the case of the plates, the latest adoption or revision date of that plate.

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1 GENERAL PROVISIONS

1.1 SCOPE & APPLICABILITY

1.1.1 APPLICABLE FACILITIES

This Waterworks Manual, adopted by the Board of Supervisors, establishes the minimum acceptable standards for the design and construction of additions or changes to water supply facilities in Ventura County. These standards apply to any facilities or system in the County that meets any one or more of the following conditions:

- a. Are or will be in County (or County governed special district) owned or controlled rights-of-way.
- b. Serves, or plans to serve, water to any land development project which is subject to the approval of the County Board of Supervisors or the County Planning Commission.
- c. Provides fire protection service in the Ventura County Fire Protection District.

1.1.2 ADDITIONS EFFECTING EXISTING SYSTEMS

When expanding an existing system, the additions to the system shall meet the standards provided herein without reducing the supply, flow, or storage presently available to the existing system unless such reduction does not reduce these items below the requirement for the whole system based on these standards.

1.2 ENFORCEMENT

1.2.1 ENFORCING OFFICIAL

When the provisions of this Waterworks Manual are not complied with, enforcement shall be by the withholding of building permits, encroachment permits and approval of land development, as follows:

- a. By the Director of Public Works, when construction in county-owned or controlled rights-of-way is involved.
- b. By the Director of Public Works, by the Director of Environmental Health, by the Planning Director, or by the Building Official as determined by the Board of Supervisor's delegation of duties, when land development projects controlled by the County are involved.
- c. By the County Fire Chief, when fire protection is involved.

1.2.2 LAND DEVELOPMENT & BUILDING PERMITS

Land developers and applicants for building permits shall furnish evidence of compliance with these standards. Evidence shall include a "will serve" letter from the water purveyor, and a certification from the purveyor's engineer that the standards have been complied with for any required additions to the system without adversely affecting the present customers of the system.

1.2.3 DEVIATIONS

Deviation from the standards set by this Manual can be made only on approval of the Board of Supervisors except where the Board delegates that authority as indicated herein. Requests for deviations must be submitted in writing, together with supporting justification and technical documentation, to the enforcing agency who will transmit them to the Board with their recommendation. Designs should not be made nor construction started where a deviation is needed without first obtaining approval of the deviation.

1.2.4 APPEALS

Decisions of the enforcing agency heads may be appealed to the Board of Supervisors. Appeals shall be in writing and be accompanied by supporting technical and other evidence. A copy of the appeal with all attachments shall also be sent to the enforcing agency.

1.3 DEFINITIONS

1.3.1 ENGINEER:

The Director of Public Works of the County, acting, either directly or through authorized employees, such employees acting within the scope of the particular duties delegated to them.

1.3.2 WATER PURVEYORS:

A public utility, a mutual water company, a governmental body, or other entity, owning and operating a water system and holding a valid permit to purvey water from the state or county health department. Also, the owner of a planned development or a trailer park served by its own well and holding a valid permit. In the case of a public utility, it must also hold a valid "certificate of convenience and necessity" from the California Public Utilities Commission.

1.3.3 PURVEYOR'S ENGINEER:

An engineer, registered in the State of California, employed by purveyor.

1.3.4 TRAILER PARK:

A facility for parking trailers, motor homes, campers and similar vehicles which are used as temporary living quarters. Such vehicles must have wheels, be currently licensed as vehicles, and be of such a size that they can legally operate on roads and highways without special permit. Such facility may also include common use buildings such as restrooms, bathhouses, and personal laundry facilities.

This term includes recreational vehicle parks.

1.3.5 MOBILE HOME PARK:

A facility for locating portable living quarters including trailers and other vehicles where the facility does not meet all of the requirements of 1.3.4. The facility may also include common use buildings.

2 WATER SUPPLY DESIGN REQUIREMENTS

2.1 INTENT OF REQUIREMENTS

2.1.1 QUANTITY

The quantity of water delivered to the distribution system from all sources must be sufficient to supply adequately, dependably and safely the total requirements of all system consumers (including fire hydrants) during periods of maximum consumption.

The distribution system must be capable of adequately delivering this water supply to all the customers. Storage facilities must provide for minimum sanitary and fire fighting requirements during periods when wells and pumps are being repaired. Storage must also accumulate water during off-peak demand periods for use during peak demand periods.

2.1.2 APPLICABILITY

All new water supply systems and all additions to existing water supply systems shall meet the requirements of the California Waterworks Standards as set forth in California Code of Regulations Title 22, Division 4, with the addition of fire flows and fire storage, as set forth herein, and with the provisions of this Manual.

2.1.3 CALIFORNIA WATERWORKS STANDARDS

It is intended that the supply, storage and peak flow requirements of these standards for domestic water usage be identical to those prescribed by the California Waterworks Standards. Water for fire protection specified herein is in addition to water for domestic usage.

2.1.4 GOOD ENGINEERING PRACTICE

Systems designed to marginally meet the minimum requirements of these standards may, in many cases, have insufficient storage, pumping facilities, sources of supply and looping mains to provide the level of service and reliability considered to be good engineering and operating practice by the waterworks industry.

This is particularly true of the standards specified in § 2.8 on system reliability. Such section was a compromise between keeping initial construction costs to a minimum and the need for continuous fire and domestic water supply. In drafting such, consideration was given to the low probability of a major fire occurring simultaneously with unusual conditions in the water system.

In systems designed to marginally meet the minimum standards, the quantity of water available during accidental or planned out-of-service conditions for key system components will supply fire flow at a reduced rate and for a shorter duration and domestic usage would have to be curtailed within the first day of the outage to the minimum needed for cooking and sanitation. The notification and enforcement necessary to make such restrictions work will need to be well planned in advance by the water purveyor.

Systems with many pressure zones, a number of isolated service areas, high fire flow requirements relative to domestic use or other special conditions particularly require facilities meeting more than minimum standards; however, final determination of level of service is left to the judgment of the purveyor and the purveyor's engineers.

2.1.5 UNITS OF MEASUREMENT

2.1.5.1 US UNITS Conventional US units of measurement are used in this Manual.

2.1.5.2 SI UNITS System International or SI (Metric) units equivalents are included in this Manual and shown in *italics*. The general County Public Works Agency policy is to make "Hard" conversion to metric units, i.e., rounding SI units to new rational standards. However, as the waterworks industry is not yet converted to SI units, the equivalents shown in this Manual are "Soft" conversions, i.e., rounding of SI units only to normal measurement tolerances.

2.1.5.3 SYMBOLS FOR UNITS & CONVERSIONS

US UNITS		FACTOR US TO SI (METRIC)	SI (METRIC) UNITS	
SYMBOL	NAME		SYMBOL	NAME
Ft.	Feet	0.3048	<i>m</i>	<i>meters</i>
In.	Inches	25.4	<i>mm</i>	<i>millimeters</i>
SqFt	Square Feet	0.092903	<i>m²</i>	<i>square meters</i>
Ac.	Acres (43,560 SqFt)	0.4046856	<i>ha</i>	<i>hectares (10,000 m²)</i>
CuFt	Cubic Feet	0.028317	<i>m³</i>	<i>cubic meters</i>
Gal.	Gallons	3.78541	<i>L</i>	<i>Liters</i>
		0.00378541	<i>m³</i>	<i>cubic meters</i>
GPM	Gallons per minute	0.2271	<i>m³/h</i>	<i>Cubic meters per hour</i>
		0.06309	<i>L/s</i>	<i>Liters per second</i>
		3.78541	<i>L/m</i>	<i>Liters per minute</i>
GPD	Gallons per day	0.00378541	<i>m³/d</i>	<i>Cubic meters per day</i>
MGD	Million Gallons/day	3785.41	<i>m³/d</i>	<i>Cubic meters per day</i>
PSI(G)	Pounds per square inch	6.89476	<i>kPa</i>	<i>kilo Pascals</i>
Ft Head	Feet of water head	2.9877	<i>kPa</i>	<i>kilo Pascals</i>
		0.3048	<i>m</i>	<i>meters</i>
Atm	Atmospheric pressure=14.7 psi	101.35	<i>kPa</i>	<i>kilo Pascals</i>
	=33.9 Ft of Water	10.33	<i>m</i>	<i>meters of water</i>
FPS	Feet per second	0.3048	<i>m/S</i>	<i>meters per second</i>
SF	Safety Factor	1	<i>SF</i>	<i>Safety Factor</i>

To change an value in SI units to U.S. units, divide the number of SI units by the conversion factor from the table above.

2.2 SYMBOLS

The following symbols are used repeatedly in the Manual. Other lesser used symbols are defined where used.

- D** Duration of required peak flow (minimum), in hours. See § 2.3.2.
- F** Fire flow rate, in GPM (m^3/h). See § 2.3.3.
- M** Multiplier for peak hour domestic flow rate. See § 2.3.1.
- N** Number of equivalent residential services in system or portion of system tributary to facility being designed. See § 2.3.4.
- P** Peak flow demand rate, in GPM (m^3/h) See § 2.5.2..
- P_E** Peak flow demand rate during emergency conditions allowing reduced flow, in GPM (m^3/h). See § 2.8.2
- Q_M** Quantity of water supply (minimum required), in GPD (m^3/d). See § 2.4.2.
- Q_o** Quantity of water used on maximum day (average), from the California Waterworks Standards, Charts 1 or 2, in GPM (m^3/h). See also § 2.3.5.
- Q₁** Quantity of water supply actually available to system, in GPM (m^3/h). Where water supply is dependant on pumps without automatic control, **Q₁**, shall be reduced by the capacity of the largest pump.
- T** Maximum average monthly air temperature, **T_F** in degrees Fahrenheit (**T_C** in degrees Celsius), 50° (10°C) min., 80° (27°C) max. See **Plates 3 & 3A**.
- V_M** Volume of storage (minimum required for minimum Q_M), in Gal. (m^3). See § 2.7.2.
- V_o** Volume of storage quantity from California Waterworks Standards Charts 3 or 4, in Gal. (m^3). See also § 2.3.5.
- V₁** Volume of storage actually available in system, in gal. (m^3).
- V_E** Volume of storage required as a minimum to provide for emergency conditions, in Gal. (m^3). See § 2.8.3.

2.3 NUMERICAL VALUES OF VARIABLES AND CONSTANTS

2.3.1 PEAK HOUR FLOW MULTIPLIER - "M"

M = $10.56 / N^{0.333}$, where "N" is less than 500

M = 1.33, where "N" is 500 or greater

2.3.2 REQUIRED DURATION OF PEAK FLOW - "D"

D = 2 hours when "N" is less than 100

D = 3 hours when "N" is from 100 to 250

D = 4 hours when "N" is greater than 250

D = 4 hours for commercial areas and industrial areas

2.3.3 FIRE FLOW - "F"

2.3.3.1 RESIDENTIAL AREAS:

"F" shall be determined for each individual case by the Fire Chief; however, in no case shall "F" be less than 1000 GPM ($227 \text{ m}^3/\text{h}$). Residential areas shall include one, two and three family residential lots, mobile home parks and up to two acres (0.81 ha) of isolated commercial use when included in a predominantly residential area.

2.3.3.2 COMMERCIAL AREAS:

"F" shall be determined for each individual case by the Fire Chief; however, in no case shall "F" be less than 1,250 GPM ($284 \text{ m}^3/\text{h}$). Commercial areas shall include all commercial uses (except as noted under residential area), hotels, apartments, multiple residential buildings with over three families per lot, dormitories, all types of schools, and colleges.

2.3.3.3 INDUSTRIAL AREAS:

"F" shall be determined for each individual case by the Fire Chief; however, in no case shall "F" be less than 1,500 GPM ($341 \text{ m}^3/\text{h}$).

2.3.3.4 TRAILER PARKS:

F = 500 GPM ($114 \text{ m}^3/\text{h}$).

"F" for recreation buildings in trailer parks shall be determined for each individual case by the Fire Chief.

2.3.3.5 ISOLATED RESIDENTIAL

F = 500 GPM ($114 \text{ m}^3/\text{h}$) at the building site.

The Fire Chief may modify this requirement when, in his opinion, equivalent protection is provided by other means.

Isolated residential shall mean a single, one-family dwelling on a parcel of land of 5 acres (2 ha) or more in size where no building is closer than 100 feet (30 m) to the nearest building on any adjacent parcel.

2.3.3.6 DEVIATIONS

The Fire Chief is authorized to deviate from the requirements contained in § 2.3.3.1 for any of the following:

- a. Existing residential lots that are within a portion of a water purveyor's current system's area and the full fire flow requirements cannot be met without excessive system modification.
- b. Parcel maps, with four or less parcels, when the water purveyor certifies the system cannot provide the full fire flow, but can provide a minimum fire flow of 500 GPM ($114 \text{ m}^3/\text{h}$) with a residual pressure of at least 20 PSI (140 kPa), and where equivalent protection is provided by installation of a residential fire sprinkler system in each building on parcels within the parcel map.
- c. Parcel maps with four or less parcels, each 20 acres (8 ha) or more in size, where the water purveyor certifies that the system cannot provide the required fire flow or where there is no water purveyor, and where equivalent fire protection is provided by installation of automatic fire sprinklers in all buildings to be built within the parcel map area, and where adequate water to operate such sprinkler system is provided by any combination of on-site storage, well supplies or connections to a purveyor's system.

2.3.4 NUMBER OF SERVICES - "N"

2.3.4.1 RESIDENTIAL AREAS:

Each single family home or lot and each mobile home space of 3000 SqFt (280 m^2) or more shall be counted as one service.

Each unit of an apartment, duplex or triplex building and each mobile home space under 3000 SqFt (280 m^2) shall be counted as one-half service.

2.3.4.2 COMMERCIAL AND INDUSTRIAL AREAS:

Each acre (0.4 ha) (including storage and parking area) shall be counted as a minimum of five services.

2.3.4.3 AGRICULTURAL AREAS:

Each acre (0.4 ha) of land shall be counted as two services. This may be modified by enforcing authority for storage and peak flow computation when system rules provide for scheduling irrigation on a rotational basis.

2.3.4.4 TRAILER PARKS:

Each trailer or trailer space shall be counted as one-third service.

2.3.5 California Waterworks Standards - "Q₀" & "V₀"

The following table gives value approximately equal to those from charts 1 through 4 of the California Waterworks Standards for N≥5. See the California Waterworks Standards to confirm values.

U.S UNITS = T _F in °F, Q ₀ in GPM, V ₀ in Gal		
N	Q ₀ METERED	Q ₀ UNMETERED
<20	$(3.28+0.8N-1.09/N)(0.025T_F-0.45)$	$(2.03+0.9N-0.76/N)(0.05T_F-1.5)$
20-500	$N(0.025T_F-0.45)$	$N(0.05T_F-1.5)$
>500	$N(0.025T_F-0.45)$	$N(0.05T_F-1.5)$
N	V ₀ METERED	V ₀ UNMETERED
<20	$1000(3.02+0.54N-1.58/N)(0.034T_F-0.7)$	$1000(3.82+0.67N-1.37/N)(0.05T_F-1.5)$
20-500	$1000(11+0.3N-50/N)(0.034T_F-0.7)$	$1000(20+0.33N-120/N)(0.05T_F-1.5)$
>500	$320N(0.034T_F-0.7)$	$1000(16+0.36N-100/N)(0.05T_F-1.5)$
METRIC (SI) UNITS = T _C in °C; Q ₀ in m ³ /h; V ₀ in m ³		
N	Q ₀ METERED	Q ₀ UNMETERED
<20	$(0.745+0.182N-0.248/N)(0.045T_C+0.35)$	$(0.461+0.204N-0.173/N)(0.09T_C+0.1)$
20-500	$0.227N(0.045T_C+0.35)$	$0.227N(0.09T_C+0.1)$
>500	$0.227N(0.045T_C+0.35)$	$0.227N(0.09T_C+0.1)$
N	V ₀ METERED	V ₀ UNMETERED
<20	$(11.4+2.04N-6/N)(0.0611T_C+0.39)$	$(14.4+2.54N-5.2/N)(0.09T_C+0.1)$
20-500	$(41.6+1.14N-190/N)(0.0611T_C+0.39)$	$(75.7+1.25N-455/N)(0.09T_C+0.1)$
>500	$1.21N(0.0611T_C+0.39)$	$(60.6+1.36N-380/N)(0.09T_C+0.1)$
See Plate 3 for values of T _F and Plate 3A for Values of T _F & T _C .		

2.4 MINIMUM SUPPLY

2.4.1 GENERAL

2.4.1.1 The minimum daily supply of water to the system, Q_1 , shall equal or exceed the value for **TOTAL Q_M** given by the formula in § 2.4.2.

2.4.1.2 Where industries using large quantities of water are included in the service area, their requirements must be considered separately and added to the requirements computed by the formulas in § 2.4.2.

2.4.1.3 Wells and firm surface stream diversions are the only sources of water supply to be considered in this section. See also § 2.12.

2.4.1.4 Water from systems operated by the Casitas Municipal Water District, the Calleguas Municipal Water District, or the United Water Conservation District will be considered firm supplies to the extent determined by the respective district.

2.4.2 FORMULAS FOR MINIMUM SUPPLY

$$Q_M = Q_D + Q_F$$

$$Q_D = C_1 S Q_0 \quad (\text{Domestic})$$

System	$V_1 > V_0$	S
Metered or Unmetered	Yes	1
Metered	No	2.5 - 1.5 (V_2 / V_0)
Unmetered	No	2 - (V_1 / V_0)

$$Q_F = C_1 \left[\frac{F * D}{2 C_2} + \frac{F (V_M - V_1)}{V_M} \right] \quad (\text{Fire when } V_1 < V_M)$$

$$Q_F = C_1 \left[\frac{F * D}{2 C_2} \right] \quad (\text{Fire when } V_1 \geq V_M)$$

C₁ Constant to change flow units to daily flow rate.
(U.S.Units: 1,440 for GPM.) (SI Units: 60 for m^3/h)

C₂ Constant to change duration in hours to conform with flow units.
(U.S.Units: 60 for GPM.) (SI Units: 1 for m^3/h .)

The first term inside the brackets provides for recovery of storage in 5 days following a maximum fire flow for required duration. The second term provides for additional required supply for fire flow in systems with storage less than V_M .

2.5 PEAK DEMAND RATE

2.5.1 GENERAL

2.5.1.1 The distribution system must be capable of delivering water at the rate determined by the formulas in § 2.5.2. Minimum sizes for individual pipelines shall be computed for flow given by the formulas using "N" for the portion of the system served by the pipeline.

2.5.1.2 In determining peak flow required by system, use highest value of "F" required in system.

2.5.1.3 Fire flows equal or less than the following quantities shall be capable of being obtained from any one fire hydrant in any area of that type.

<u>TYPE AREA</u>	<u>GPM</u>	<u>m³/h</u>
Residential	1000	227
Commercial	1250	284
Industrial	1500	341
Trailer parks	500	114

Fire flows required in excess of the quantities shown above shall be capable of being obtained from any adjacent group of hydrants whose number shall be the minimum required to deliver the required fire flow at the rate per hydrant shown above.

2.5.1.4 Mains and laterals serving a fire hydrant shall be at least 6" (150 mm) in diameter.

2.5.2 FORMULAS FOR PEAK HOUR FLOW RATES

P equals the larger of the values given by formula P_A or P_B below:

$$P_A = (M Q_0 / 2) + F$$

$$P_B = M Q_0$$

2.6 PRESSURE

2.6.1 MINIMUM

A minimum of 20 PSI (138 kPa) residual pressure shall be maintained in the mains at all locations in the distribution system during required periods of flow at peak demand rate. The maximum static pressure shall not exceed 150 PSI (1034 kPa).

2.6.2 NORMAL

Water distribution systems shall be designed to maintain normal operating pressures of not less than 25 PSI (138 kPa) nor more than 125 PSI (862 kPa) at the service connection. Variations in pressures under normal operations shall not exceed 50% of the average operating pressure. The average operating pressure shall be determined by computing the arithmetical average of at least 24 consecutive hourly pressure readings.

2.6.3 MATERIALS DESIGN

All pipe, valves, fittings and appurtenances shall be designed for a minimum working pressure of 150 PSI (1034 kPa) unless a higher working pressure is called for in this Manual or any referenced specification or actual conditions require a high working pressure.

2.7 STORAGE

2.7.1 GENERAL

2.7.1.1 Storage units include surface reservoirs and tanks and elevated tanks. Aquifer storage and storage in pipelines shall not be taken into consideration in meeting storage requirements.

2.7.1.2 Size of storage units shall be computed from the lowest withdrawal level to the overflow level.

2.7.1.3 The storage in the system, V_1 , shall equal or exceed the value of V_M given by formula in § 2.7.2 unless additional supply is available as provided in § 2.4.

2.7.2 FORMULA FOR STORAGE CAPACITY

$$V_M = V_0 + V_F$$

$$V_F = C_2 F D \quad (\text{Fire})$$

C_2 Constant to change duration in hours to conform with flow units.
(U.S.Units: 60 for GPM.) (SI Units: 1 for m^3/h)

2.8 SYSTEM RELIABILITY

2.8.1 REQUIREMENTS

A water system, and each of its components, shall be designed to insure reliability of service. Systems, or portions thereof, which rely on pumps to provide flow to the system are vulnerable to utility interruptions, mechanical breakdown and maintenance downtime. To insure reasonable reliability of such systems, the system shall be designed to provide the peak flow rate " P_E " specified in §2.8.2 and the total water volume of " V_{E1} " or " V_{E2} " specified in § 2.8.3 during the period when any one of the following is occurring.

2.8.1.1 **Power Interruption.** A one hour interruption of electric power to all system pumps. Provide for P_E & V_{E1} .

2.8.1.2 **Pump Out of Service** A four day "out of service" condition of any one pump in the system at one time. Provide for P_E & V_{E2} .

2.8.1.3 **Source Interruption** Where water source is one of those listed in § 2.4.1.4, temporary suspension of service as provided by the rules of the district supplying water. Provide for P_E & V_{E2} .

2.8.2 PEAK FLOW RATES DURING EMERGENCY PERIODS

P_E equals the larger of P_{EF} or P_{ED} in formulas below:

$$P_{EF} = (M Q_0 / 4) + 0.75 F$$

$$P_{ED} = M Q_0 / 2$$

2.8.3 TOTAL VOLUME REQUIREMENTS DURING EMERGENCY PERIODS

Formulas for emergency water volumes:

$$V_{E1} = C_2 PE$$

$$V_{E2} = V_0 + 0.75 C_2 F$$

C_2 Constant to change duration in hours to conform with flow units.
(U.S.Units: 60 for GPM.) (SI Units: 1 for m^3/h)

2.8.4 REQUIRED DURATION DURING EMERGENCY PERIODS

Peak flow requirements of § 2.8.2 are rates of flow which must be sustained for a period of one hour during a power outage and the two to four hour period **D** of § 2.3.2 during longer emergency situations.

Total volume requirements are the total amount of water to be served:

- (1) during the one hour emergency and,
- (2) during the one to four day type emergency periods.

The facilities provided for normal operations may provide for emergency situations but in most cases will require augmentation by extra facilities. To meet the emergency requirements, the total system facilities remaining in operation during emergency periods must include two or more of the following together with larger diameter pipe to reduce friction losses in some cases:

- a. Water stored at an elevation which will provide service by gravity.
- b. Duplex booster pump installations (for § 2.8.1.2).
- c. Wells or low level storage utilizing pumps with two sources of power (gas fueled emergency generators + electric powered emergency generators, or electric powered emergency generators + hydrocarbon fueled emergency generators) and automatic power source transfer (for § 2.8.1.1).
- d. Wells (with pumps) not required to meet the basic supply requirements (for § 2.8.1.2 and § 2.8.1.3).
- e. Water stored at an elevation that does not provide gravity service can be combined with above (for § 2.8.1.2 and §2.8.1.3).
- f. Emergency standby connection to another water system (for § 2.8.1.2 and § 2.8.1.3).

2.9 SURGE CONTROL

Water systems shall be designed to avoid excessive surges (water hammer). Where there is the possibility of excessive surges, the design shall incorporate such devices as pump control valves, slow opening check valves or surge tanks to minimize surges.

2.10 BLOW-OFFS

Permanent blow-offs shall be installed at the end of each dead-end water main where stagnant conditions are likely to develop. They shall be designed to provide a minimum flushing velocity of 2 ½feet per second ($0.76 m/S$) in the main.

2.11 WATER MAIN VALVE LOCATIONS

Sufficient valves shall be provided on water systems to minimize inconvenience and sanitary hazards during repairs. In general, valves on water mains of 12 inches (305 mm) or less should be located such that water main lengths of not more than 1,000 feet (305 m) can be isolated by valve closures.

2.12 CRITERIA FOR DEMONSTRATING A LONG TERM DOMESTIC GROUNDWATER SUPPLY

2.12.1 GENERAL

Various County ordinances and regulations require a demonstration that the proposed domestic water supply for development is likely to be adequate for the expected useful life of structures or 60 years (the Long term \equiv). When the proposed domestic water supply for a development is to be provided by a water supply system having fewer than five service connections and is to be drawn from wells, the following criteria and procedures shall be used to demonstrate that the supply is Long term. \equiv In connection with the issuance of a permit to operate a state small water system pursuant to Section 64211 of Title 22 of the California Code of Regulations, the following criteria and procedures shall be used in addition to all other applicable state and local regulations for the purposes of demonstrating the sufficiency of the system's water supply when that supply is to be provided exclusively by wells. In any case, only potable groundwater shall be considered for the purpose of the demonstration.

2.12.2 CATEGORIES

A domestic groundwater supply is divided into three categories, Category 1, Category 2 and Category 3. These three categories cover all potential wells in the County.

2.12.2.1 Category 1 wells are those wells located in areas of the County where the Public Works Agency determines that the sustained yield of water wells may not be adequate to meet minimum County standards, or where existing area data is insufficient to assess groundwater availability and site specific work to demonstrate availability of a long term domestic (potable) groundwater supply is necessary. This usually occurs in outlying bedrock areas, near the edge of overdrafted groundwater basins, or where data regarding groundwater availability is insufficient.

2.12.2.2 Category 2 wells are those wells located in known or suspected areas of groundwater overdraft or where the quantity of water may not be adequate to supply the total domestic (potable) requirements of all projected consumers in the area, and in either case, where adequate data is available to directly assess whether the groundwater supply is sufficient to meet the long term requirements of all projected consumers for domestic (potable) water.

2.12.2.3 Category 3 wells are those wells located in areas of the County where the presence of a groundwater supply sufficient to meet the long term requirements of all projected consumers is documented by substantial data and overdraft of the basin is not known to exist.

2.12.3 CATEGORY 1 WELL TEST

To demonstrate that a Category 1 well is likely to be adequate for the long term, the applicant shall complete a well pump and recovery test (well test) of the proposed water supply well that meets the following requirements:

2.12.3.1 Well Test Procedures - The following procedures shall apply to the well test.

- (1) The well test shall be performed under the immediate supervision of a California Licensed Water Well or Pump Contractor, or a California Registered Civil Engineer or Geologist.
- (2) The County may inspect a well test in-progress at any time to observe testing methods and results. The County may also measure the water level in the test well prior to or within 15 days after the testing has been completed to verify the static water level.
- (3) The well test shall not be initiated until the well has been idle for a period of at least 72 hours and the water level has become static.
- (4) The Water Resources Division of the Public Works Agency shall be notified by the person who will supervise and certify the testing at least 48 hours prior to initiation of the well test. Call (805) 654-2024. Prior notification is needed to insure that the testing is properly conducted so that retesting is not necessary, and so the County will have an opportunity to observe portions of the test.
- (5) Use of the current County test form to record test results is required.
- (6) If the pump breaks suction at any time during the pumping period, the test shall be stopped and restarted after the well has again reached a static level.
- (7) The recovery portion of the well test shall begin immediately upon completion of the pump test. Measurements of the water levels shall be recorded during the time they are returning to static level. The well test may be terminated prior to the required recovery period, if the groundwater level returns to the original static water level before the full recovery period has elapsed.
- (8) Test results shall be submitted to the County Water Resources Division of the Public Works Agency on the current Water Well Pump and Recovery Test recording form, along with any other pertinent information.
- (9) The depth of water in a well shall be determined by electrical sounder, airline or digitized sounding equipment. Tapes and acoustical sounding equipment are not acceptable.
- (10) The well test shall be conducted in accordance with Table 1, below.

2.12.3.1 Well Test Procedures - (Continued)

- (11) Except as otherwise provided in § 2.12.3.1(12) and § 2.12.3.1(13), the level of use listed in the first column of Table 1 that is applicable to any given well shall be determined by computing the total number of persons to be served by that well. The total number of persons to be served by a well shall be determined as follows:
- (a) Identify every separate structure having a water requirement that is to be served by the well. Structures are separate from each other if they do not share a common roof. A structure has a water requirement if it contains at least one water closet (commode) plus at least one faucet. The division of what would normally be a single structure into separate structures for the purposes of avoiding a water requirement (e.g., by placing the water closet in one structure and the faucet in the other) is not allowed.
 - (b) Determine the number of bedrooms (as defined in Policy 7.3 of the County Environmental Health Division) for each of the identified structures.
 - (c) Using Table 1, determine the number of persons associated with each of the identified structures.
 - (d) Again using Table 1, determine the total number of persons to be served by the well. Examples are: a well serving two identified structures, one with three bedrooms and the other with two bedrooms, would serve seven persons; a well serving one identified structure with five bedrooms would serve six persons.
- (12) When the development is residential and the number of structures to be served by a well cannot be determined (e.g., when the development is a subdivision intended to create residential lots for sale as vacant land) the level of use shall be deemed to be three bedrooms (or four persons) for each lot served by the well.
- (13) When the development is industrial or commercial, the Public Works Agency shall determine on a case-by-case basis the appropriate level of use to be assumed for the well test. If that level of use is equivalent to one of the levels listed on Table 1, the well test specified for that level on Table 1 shall be conducted. If that level is higher than the highest level on Table 1, the Public Works Agency shall also determine on a case-by-case basis the maximum number of hours the well test is to be conducted and the minimum number of gallons that the well must produce during the test.
- (14) The output of two or more wells serving the same development may be combined for the purposes of the well test provided the following requirements are met:
- (a) A minimum flow of 5 GPM ($1.14 \text{ m}^3/\text{h}$) shall be maintained for each well for the entire time it is pumped; and
 - (b) The wells are either all tested concurrently or they are each separated from any other well by at least 500 feet (150 m).

2.12.3.1 Well Test Procedures - (Continued)

- (15) The minimum number of gallons (m^3) specified in the last column of Table 1 is based upon the assumption that each person will require 100 gpd ($0.378 m^3/d$) and each legal lot on which the structure or structures are located may require an additional 2,678 gpd ($10.14 m^3/d$) for outside use. The gpd required for personal use is multiplied by a safety factor of 4.

For example (U. S. Units): the total required gpd for a two bedroom residence (3 persons) plus a one bedroom second dwelling unit (2 persons) located on a single lot would be 4678 gpd (5 persons x 100 gpd x 4(SF) + 2678 = 4678) In Table 1, the next to last column lists the total required gpd for various levels of use, and the last column lists that total rounded up to the nearest 100 gallons.

For example(S. I. Units): the total required gpd for a two bedroom residence (3 persons) plus a one bedroom second dwelling unit (2 persons) located on a single lot would be $17.71 m^3/d$ (5 persons x $0.378 m^3/d$ x 4(SF) + $10.14 m^3/d$ = 17.71). In Table 1, the next to last column lists the total required m^3/d for various levels of use, and the last column lists that total rounded up to the nearest $0.1 m^3$.

- (16) When a well to which Table 1 applies is to serve more than 8 persons, the last two columns of the table shall be adjusted in accordance with methodology specified in § 2.12.3.1(15), above.

2.12.3.2 Well Test Pass-or-Fail Criteria - The following criteria shall be used to evaluate the well test.

- (1) The well must produce the applicable minimum number of gallons specified in the last column of Table 1 within a maximum of 24 consecutive pumping hours. A minimum flow of 5 GPM ($1.14 m^3/h$) shall be maintained for the entire time the well is pumped. A well that fails to meet the applicable minimum flow requirement at any time during the well test will not pass even if it produces the applicable minimum number of gallons (m^3) within 24 hours.
- (2) During the last hour of pumping, the water level in the well must remain static.
- (3) A well, after 24 hours of rest, must fully recover to the before test water level. Instrumentation error will be considered in evaluating recovery.

2.12.3.2 Well Test Pass-or-Fail Criteria - (Continued)

Table 1 (U.S. Units)

Level of Use	gpd per bdrm.	gpd with (SF)=4	gpd for Land	Total gpd	Pump Test min. gallons
1 bedroom = 2 persons	200	800	2678	3478	3500
2 bedrooms = 3 persons	300	1200	2678	3878	3900
3 bedrooms = 4 persons	400	1600	2678	4278	4300
4 bedrooms = 5 persons	500	2000	2678	4678	4700
5 bedrooms = 6 persons	600	2400	2678	5078	5100
6 bedrooms = 7 persons	700	2800	2678	5478	5500
7 bedrooms = 8 persons	800	3200	2678	5878	5900

Table 1 (SI Units)

Level of Use	m ³ /d per bdrm.	m ³ /d with (SF)=4	m ³ /d for Land	Total m ³ /d	Pump Test min. m ³
1 bedroom = 2 persons	0.76	3.03	10.14	13.17	13.2
2 bedrooms = 3 persons	1.14	4.54	10.14	14.68	14.7
3 bedrooms = 4 persons	1.51	6.06	10.14	16.20	16.2
4 bedrooms = 5 persons	1.89	7.57	10.14	17.71	17.8
5 bedrooms = 6 persons	2.27	9.08	10.14	19.22	19.3
6 bedrooms = 7 persons	2.65	10.60	10.14	20.74	20.8
7 bedrooms = 8 persons	3.03	12.11	10.14	22.25	22.3

2.12.4 CATEGORY 2 GROUNDWATER SUPPLY STUDY AND REPORT

To demonstrate that a Category 2 well is likely to be adequate for the long term, the applicant shall provide a study and report that meets the following requirements.

2.12.4.1 Study Site Category 2 study sites are generally near the outside boundary of known or suspected overdrafted groundwater basins, where hydrologic data is adequate to evaluate the historic and future rate of groundwater level decline and future water availability.

2.12.4.2 Study and Report Procedure The Category 2 study and report must be conducted and certified by a California Registered Civil Engineer or Geologist possessing adequate experience to perform the required work using the following general procedures and data:

- (1) Collect existing data concerning the immediate area surrounding the site to be studied, including:
 - (a) Historic groundwater levels.
 - (b) Historic water quality data.
 - (c) Available well logs.
 - (d) Base of the fresh water and aquifer delineation maps.
 - (e) Historic groundwater extractions and previous land use data.
 - (f) Projected land use from the current County General Plan.
 - (g) Other pertinent data.
- (2) Evaluate data in the immediate site area.
 - (a) Determine historic rate of groundwater level rise or decline in the proposed water supply aquifer(s).
 - (b) Evaluate historic groundwater quality data from the proposed water supply aquifer(s) and determine suitability for domestic use.
 - (c) Use the current base-of-fresh-water map, aquifer delineation map, and area well logs to determine vertical extent of groundwater supplies.
 - (d) Use the historic groundwater extraction data, or land use data to develop estimates of historic groundwater extraction amounts.
 - (e) Estimate future extractions using projected land use data obtained from the County General Plan (see § 2.12.4.2(2)(d)).
 - (f) Estimate the future average rate of groundwater level rise or decline at the water supply well location from previous data.
- (3) Report Conclusions.
 - (a) Project groundwater quality through a 60-year period starting at proposed initiation of groundwater use, and determine whether it will meet current County Environmental Health Division regulations for potable water supplies. The determination must be affirmative in order for the well to pass. Include all assumptions used to reach conclusions.
 - (b) Project water level change throughout the 60-year period and determine whether remaining groundwater storage will be adequate for the intended use at the end of this period. The determination must be affirmative in order for the well to pass.
 - (c) The report shall be signed and certified by the California Registered Civil Engineer or Geologist who performed the study.

2.12.5 CATEGORY 3 WELL QUALIFICATIONS

A domestic water supply provided by a qualified Category 3 well is presumed to be adequate for the long term. To qualify a well as a Category 3 well, the applicant shall demonstrate that the well is located in a Category 3 area. If there is any uncertainty as to whether the well is located in a Category 3 area, the well shall be deemed to be either a Category 1 or Category 2 well, as appropriate. A Category 3 area is an area where the presence of a groundwater supply sufficient to meet the domestic water requirements of all projected consumers for the next 60 years has been documented to the satisfaction of the Public Works Agency by substantial data, and where there is no known overdraft of the basin.

3 MATERIALS

3.1 GENERAL REQUIREMENTS

Materials shall be chosen for their strength, durability and ease of repair and maintenance, with due consideration for dead and live loads, beam strength, resistance to corrosion and internal pressure.

3.2 STANDARD LAND DEVELOPMENT SPECIFICATIONS

All materials for which specifications are provided by the Ventura County SLDS shall meet those specifications. Where reference is made to SLDS and the SLDS does not contain the referenced number, refer to the same section number in the SSPWC as provided in § 0 of SLDS. Reference to a section number, such as 287-10, includes all sections with numbers containing 287-10 in their number.

3.3 ALTERNATE MATERIALS

The provisions of this Manual are not intended to prevent the use of any material or method of construction not specifically prescribed by this Manual if such alternate has been submitted to and has been approved by both the Engineer and Purveyor's Engineer.

The Engineer may approve such alternate if such alternate is found to be suitable for the purpose intended and at least the equivalent of that prescribed in this Manual in quality, strength, sanitation, durability, safety, and effectiveness.

The Engineer may require submission of a sample of such alternate material, together with a technical report which includes design data, report of physical and chemical analysis, and details of laboratory tests which have been performed by testing laboratories or standard groups (UL, AWWA, ASTM, ASA, etc.)

3.4 TRANSMISSION AND DISTRIBUTION WATER PIPE

The following types of pipe are approved for use for water mains and services three inches (*76 mm*) or more in nominal diameter.

3.4.1 ASBESTOS CEMENT Pipe shall comply with **SLDS § 207-7.**

3.4.2 CAST IRON AND DUCTILE IRON PIPE shall comply with **SLDS § 207-9.**

3.4.3 STEEL PRESSURE PIPE shall comply with **SLDS § 207-10.**

3.4.4 CONCRETE CYLINDER PIPE shall comply with **SLDS § 207-4** and **SLDS § 451.**

3.4.5 REINFORCED CONCRETE PRESSURE PIPE shall comply with **SLDS § 207-5.**

3.4.6 POLYVINYL CHLORIDE (PVC) PIPE shall comply with **SLDS § 207-17.**

3.5 PIPE LINE APPURTENANCES

The following materials are approved for use as appurtenances on water systems.

3.5.1 WATER SERVICE CONNECTIONS shall comply with **SLDS § 451-1.**

3.5.2 VALVES AND APPURTENANCES shall comply with **SLDS § 451-2.**

3.5.3 FIRE HYDRANTS shall comply with **SLDS § 451-3.**

Fire hydrant types shall be selected as follows:

FIRE FLOW REQUIRED §2.3.3	SLDS § 451-3 TYPE
Less than 1250 GPM (<i>284 m³/h</i>)	A
1250 GPM (<i>284 m³/h</i>) to 3000 GPM (<i>682 m³/h</i>)	B
Greater than 3000 GPM (<i>682 m³/h</i>)	C

3.5.4 PIPE FITTINGS shall comply with **SLDS §451-4.**

3.5.5 PIPE FLANGES, COUPLINGS AND ADAPTERS shall comply with **SLDS § 451-5.**

4 INSTALLATION AND CONSTRUCTION

Installation and construction shall comply with **SLDS § 306** and sections referenced therein and with any permit requirements of agencies in whose rights-of-ways installation is made.

5 STORAGE FACILITIES

5.1 DESIGN

Steel tanks, standpipes, reservoirs, and elevated tanks for water storage shall comply with "AWWA D100" or "API. Standards" and with the foundation and seismic requirements of the building code.

5.2 REPAIRING

Inspection and repairing of steel tanks, standpipes, reservoirs, and elevated tanks for water storage shall comply with "AWWA D101".

5.3 PAINTING

Painting and repainting of steel tanks, standpipes, reservoirs, and elevated tanks for water storage shall comply with "AWWA D102" and the environmental requirements contained in State and Federal laws.

6 PUMPS

Deep-well vertical turbine and submersible pumps shall comply with "AWWA E101".

7 ELECTRIC MOTORS

Electric motors shall comply with "American Standard for Rotating Electrical Machinery, ASA C50", complete series.

WATER-SEWER SEPARATION REQUIREMENTS

CALIFORNIA CODE OF REGULATIONS §64630. Water Main Installation.

- (a) Water mains shall be installed below the frost line or shall otherwise be protected to prevent freezing.
- (b) Water mains shall not have less than 30 inches (0.75 meters) of cover over the top of the pipe except where necessary to avoid underground obstructions or rocky conditions.
- (c) Water mains shall be installed at least:
 - (1) Ten feet (3 meters) horizontally from and 1 foot (0.3 meters) higher than sanitary sewers located parallel to the main.
 - (2) One foot (0.3 meters) higher than sanitary sewers crossing the main.
 - (3) Ten feet (3 meters), and preferably 25 feet (7.5 meters), horizontally from sewage leach fields, cesspools, seepage pits and septic tanks.
- (d) Separation distances specified in (c) shall be measured from the nearest edges of the facilities.
- (e) Where the requirements of (c) and (d) cannot be met due to topography, inadequate right-of-way or easements or conflicts with other provisions of these regulations, lesser separation is permissible if:
 - (1) The water main and the sewer are located as far apart as feasible within the conditions listed above.
 - (2) The water main and the sewer are not installed within the same trench.
 - (3) The water main is appropriately constructed to prevent contamination of the water in the main by sewer leakage.
- (f) Water mains shall be disinfected according to AWWA Standard C601-81 before being placed in service.
- (g) Installation of water mains near the following sources of potential contamination shall be subject to written approval by the Department on a case-by-case basis:
 - (1) Storage ponds or land disposal sites for waste water or industrial process water containing toxic materials or pathogenic organisms.
 - (2) Solid waste disposal sites.
 - (3) Facilities such as storage tanks and pipelines where malfunction of the facility would subject the water in the main to toxic or pathogenic contamination.

NOTE: Authority cited: Sections 208 and 4010.1 (h), Health and Safety Code. Reference: Sections 4010.1(h), 4012, 4013 and 4019, Health and Safety Code.

The following pages (dated 4/5/83) from the California Department of Health Services give the current (04/16/01) criteria for the Separation of Water Mains and Sanitary Sewers.

DEPARTMENT OF HEALTH SERVICES

1744 P STREET
SACRAMENTO, CA 95814CRITERIA FOR THE SEPARATION
OF WATER MAINS AND SANITARY SEWERSA. PUBLIC HEALTH CONSIDERATIONS

Waterborne disease outbreaks attributed to the entry of sewage-contaminated groundwater into the distribution systems of public water supplies continue to be a problem in the United States. A community with its buried water mains in close proximity to sanitary sewers is vulnerable to waterborne disease outbreaks.

Sanitary sewers frequently leak and saturate the surrounding soil with sewage. This is caused primarily by structural failure of the sewer line, improperly constructed joints, and subsidence or upheaval of the soil encasing the conduit. A serious public health hazard exists when the water mains are depressurized and no pressure or negative pressures occur. The hazard is further compounded when, in the course of installing or repairing a water main, existing sewer lines are broken. Sewage spills into the excavation and, hence, enters into the water main itself. Additionally, if a water main fails in close proximity to a sewer line, the resultant failure may disturb the bedding of the sewer line and cause it to fail. In the event of an earthquake or man-made disaster, simultaneous failure of both conduits often occurs.

The water supplier is responsible for the quality of the water delivered to consumers and must take all practical steps to minimize the hazard of sewage contamination to the public water supply. Protection of the quality of the water in the public water system is best achieved by the barrier provided by the physical separation of the water mains and sewer lines.

This document sets forth the construction criteria for the installation of water mains and sewer lines to prevent contamination of the public water supplies from nearby sanitary sewers.

B. BASIC SEPARATION STANDARDS

The "California Waterworks Standards" sets forth the minimum separation requirements for water mains and sewer lines. These Standards, contained in Section 64630, Title 22, California Administrative Code, specify:

- (c) (1) Parallel Construction: The horizontal distance between pressure water mains and sewer lines shall be at least 10 feet.
- (2) Perpendicular Construction (Crossing): Pressure water mains shall be at least one foot above sanitary sewer lines where these lines must cross.

- (d) Separation distances specified in (c) shall be measured from the nearest edges of the facilities.
- (e) (2) Common Trench: Water mains and sewer lines must not be installed in the same trench.

When water mains and sanitary sewers are not adequately separated, the potential for contamination of the water supply increases. Therefore, when adequate physical separation cannot be attained an increase in the factor of safety should be provided by increasing the structural integrity of both the pipe materials and joints.

C. EXCEPTIONS TO BASIC SEPARATION STANDARDS

Local conditions, such as available space, limited slope, existing structures, etc., may create a situation where there is no alternative but to install water mains or sewer lines at a distance less than that required by the Basic Separation Standards. In such cases, alternative construction criteria as specified in Section E should be followed, subject to the special provisions in Section D.

Water mains and sewers of 24 inches diameter or greater may create special hazards because of the large volumes of flow. Therefore, installations of water mains and sewer lines 24 inches diameter or larger should be reviewed and approved by the health agency prior to construction.

D. SPECIAL PROVISIONS

1. The Basic Separation Standards are applicable under normal conditions for sewage collection lines and water distribution mains. More stringent requirements may be necessary if conditions, such as, high groundwater exist.
2. Sewer lines shall not be installed within 25 feet horizontally of a low head (5 psi or less pressure) water main.
3. New water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less.
4. In the installation of water mains or sewer lines, measures should be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipeline.
5. Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit, such as a septic sewage which produces corrosive hydrogen sulfide.

6. Sewer Force Mains

- a. Sewer force mains shall not be installed within ten feet (Horizontally) of a water main.
- b. When a sewer force main must cross a water line, the crossing should be as close as practical to the perpendicular. The sewer force main should be at least one foot below the water line.
- c. When a new sewer force main crosses under an existing water main, all portions of the sewer force main within ten feet (horizontally) of the water main shall be enclosed in a continuous sleeve.
- d. When a new water main crosses over an existing sewer force main, the water main shall be constructed of pipe materials with a minimum rated working pressure of 200 psi or equivalent pressure rating.

E. ALTERNATE CRITERIA FOR CONSTRUCTION

The construction criteria for sewer lines or water mains where the Basic Separation Standards cannot be attained are shown in Figures 1 and 2. There are two situations encountered:

Case 1 -- New sewer line -- new or existing water main.

Case 2 -- New water main -- existing sewer line.

For Case 1, the alternate construction criteria apply to the sewer line.

For Case 2, the alternate construction criteria may apply to either or both the water main and sewer line.

The construction criteria should apply to the house laterals that cross above a pressure water main but not to those house laterals that cross below a pressure water main.

Case 1: New Sewer Being Installed (Figures 1 and 2)

Zone Special Construction Required for Sewer

- A Sewer lines parallel to water mains shall not be permitted in this zone without approval from the responsible health agency and water supplier.
- B A sewer line placed parallel to a water line shall be constructed of:
1. Extra strength vitrified clay pipe with compression joints.
 2. Class 4000, Type II, asbestos-cement pipe with rubber gasket joints.
 3. Plastic sewer pipe with rubber ring joints (per ASTM D3034) or equivalent.
 4. Cast or ductile iron pipe with compression joints.
 5. Reinforced concrete pressure pipe with compression joints (per AWWA C302-74).
- C A sewer line crossing a water main shall be constructed of:
1. Ductile iron pipe with hot dip bituminous coating and mechanical joints.
 2. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered over the pipe being crossed.
 3. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered over the pipe being crossed.
 4. Any sewer pipe within a continuous sleeve.
- D A Sewer line crossing a water main shall be constructed of:
1. A continuous section of ductile iron pipe with hot dip bituminous coating.
 2. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered on the pipe being crossed.
 3. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered on the pipe being crossed.
 4. Any sewer pipe within a continuous sleeve.
 5. Any sewer pipe separated by a ten-foot by ten-foot, four-inch-thick reinforced concrete slab.

Case 2: New Water Mains Being Installed (Figures 1 and 2)

Zone

- A No water mains parallel to sewers shall be constructed without approval from the health agency.
- B If the sewer paralleling the water main does not meet the Case 1, Zone B, requirements, the water main shall be constructed of:
1. Ductile iron pipe with hot dip bituminous coating.
 2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 3. Class 200, Type II, asbestos-cement pressure pipe.
 4. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 5. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).
- C If the sewer crossing the water main does not meet the Case 1, Zone C, requirements, the water main shall have no joints in Zone C and be constructed of:
1. Ductile iron pipe with hot dip bituminous coating.
 2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 3. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 4. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).
- D If the sewer crossing the water main does not meet the requirements for Zone D, Case 1, the water main shall have no joints within four feet from either side of the sewer and shall be constructed of:
1. Ductile iron pipe with hot dip bituminous coating.
 2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 3. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 4. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).

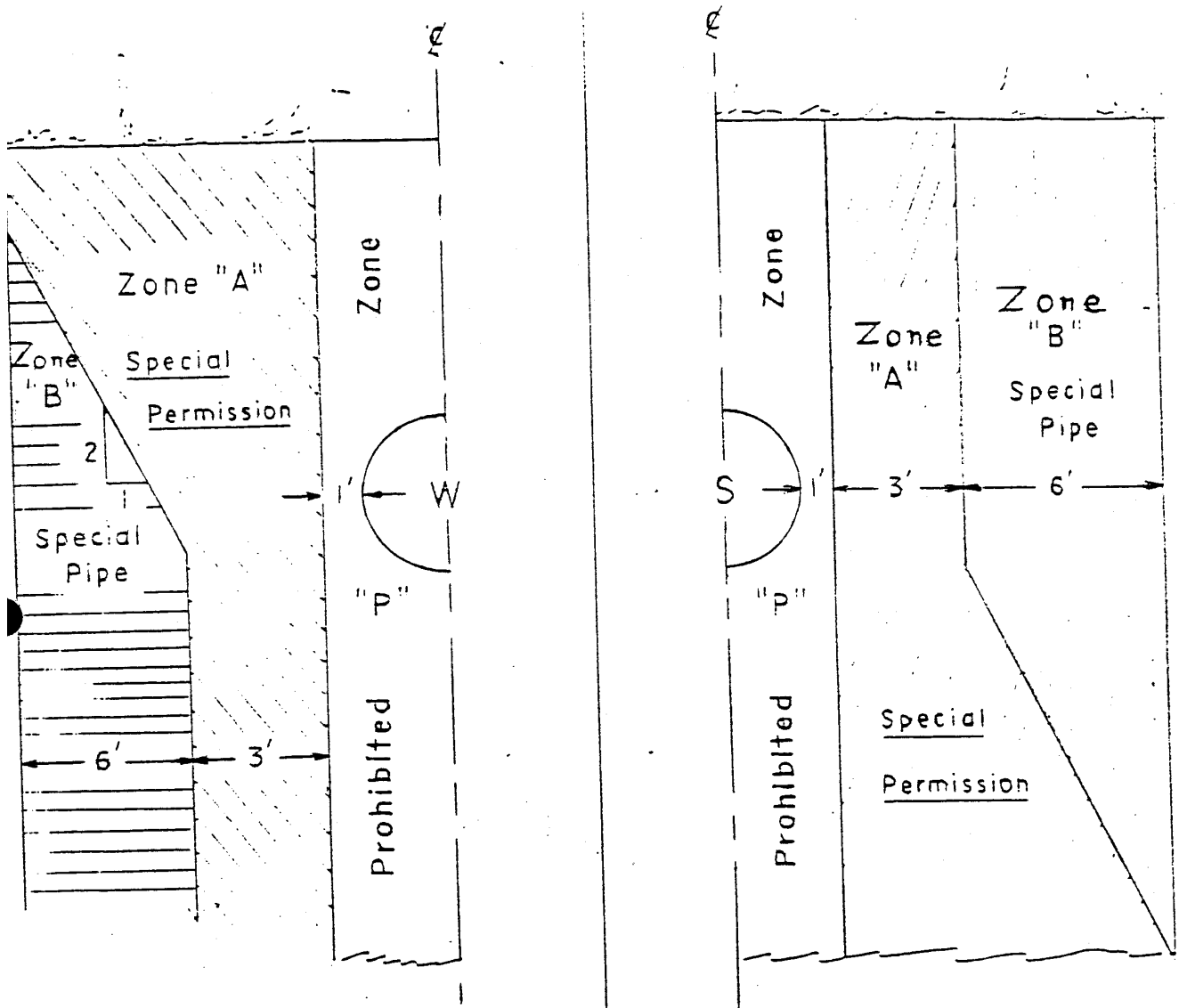
NOTES AND DEFINITIONS:

1. HEALTH AGENCY -- The Department of Health Services. For those water systems supplying fewer than 200 service connections, the local health officer shall act for the Department of Health Services.
2. WATER SUPPLIER -- "Person operating a public water system" or "Supplier of water" means any person who owns or operates a public water system.
3. LOW HEAD WATER MAIN -- Any water main which has a pressure of five psi or less at any time at any point in the main.
4. Dimensions are from outside of water main to outside of sewer line or manhole.
5. COMPRESSION JOINT -- A push-on joint that seals by means of the compression of a rubber ring or gasket between the pipe and a bell or coupling.
6. MECHANICAL JOINTS -- Bolted joints.
7. RATED WORKING WATER PRESSURE OR PRESSURE CLASS -- A pipe classification system based upon internal working pressure of the fluid in the pipe, type or pipe material, and the thickness of the pipe wall.
8. FUSED JOINT -- The jointing of sections of pipe using thermal or chemical bonding processes.
9. SLEEVE -- A protective tube of steel with a wall thickness of not less than one-fourth inch into which a pipe is inserted.
10. GROUND WATER -- Subsurface water found in the saturation zone.
11. HOUSE LATERAL -- A sewer connecting the building drain and the main sewer line.

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Figure 1

PARALLEL CONSTRUCTION

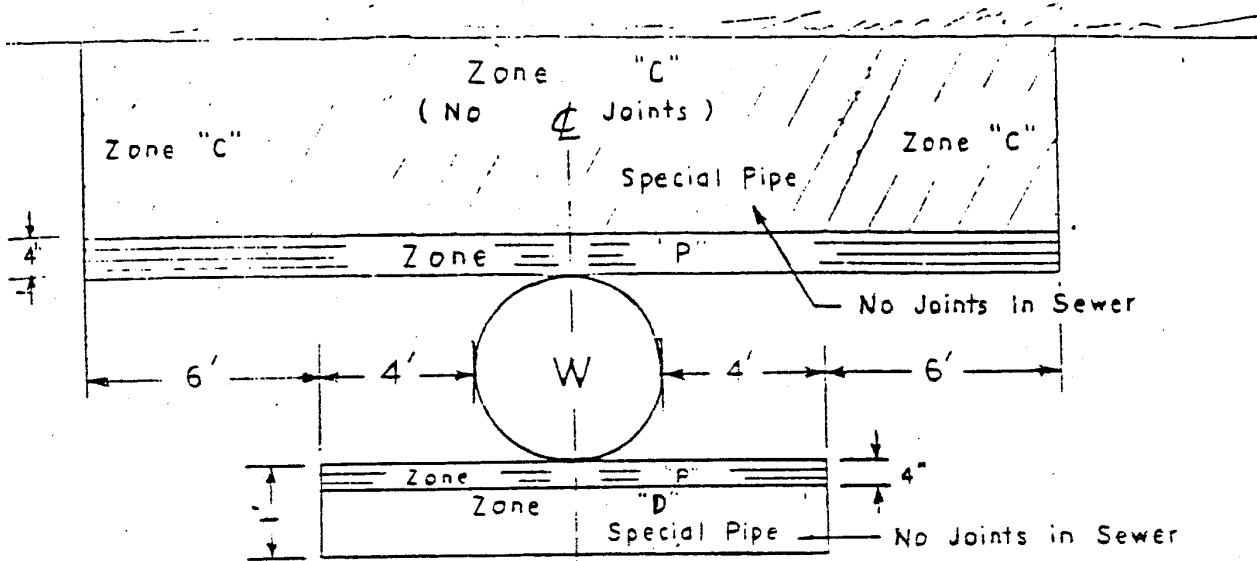


CASE 1
NEW SEWER

CASE 2
NEW WATER MAIN

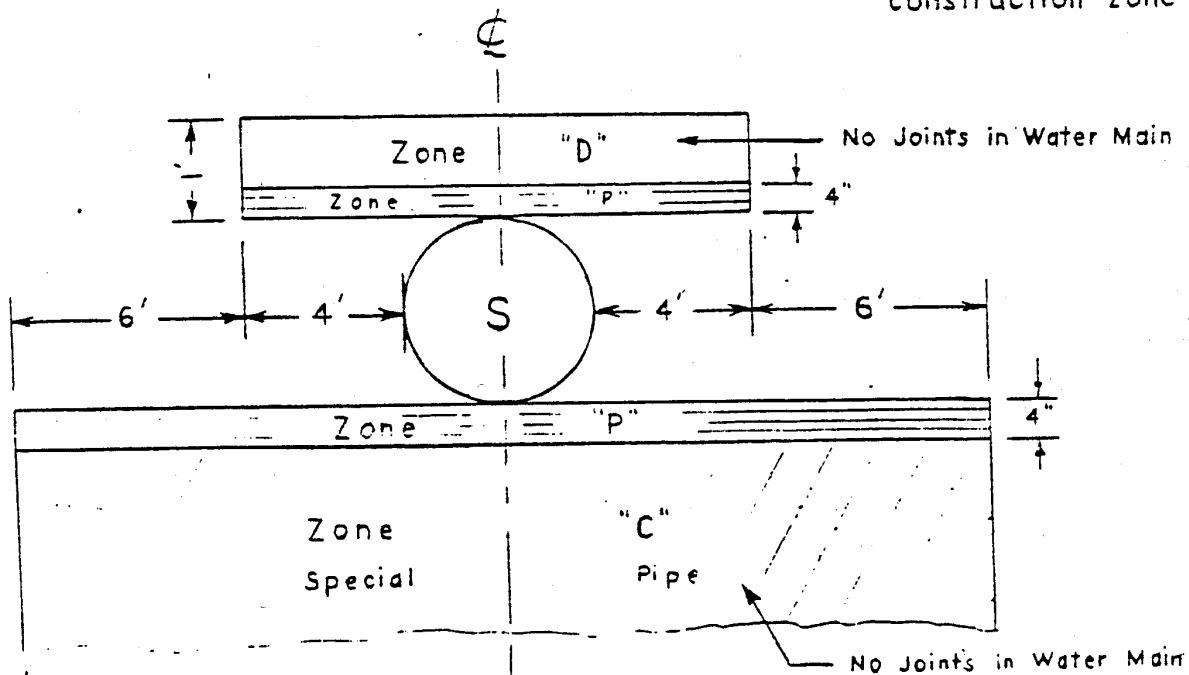
Note: Zones identical on either side of center lines.
Zones "P" is a prohibited zone, Section 64630 (e) (2)
California Administrative Code, Title 22

Figure 2 CROSSINGS



CASE 1
NEW SEWER

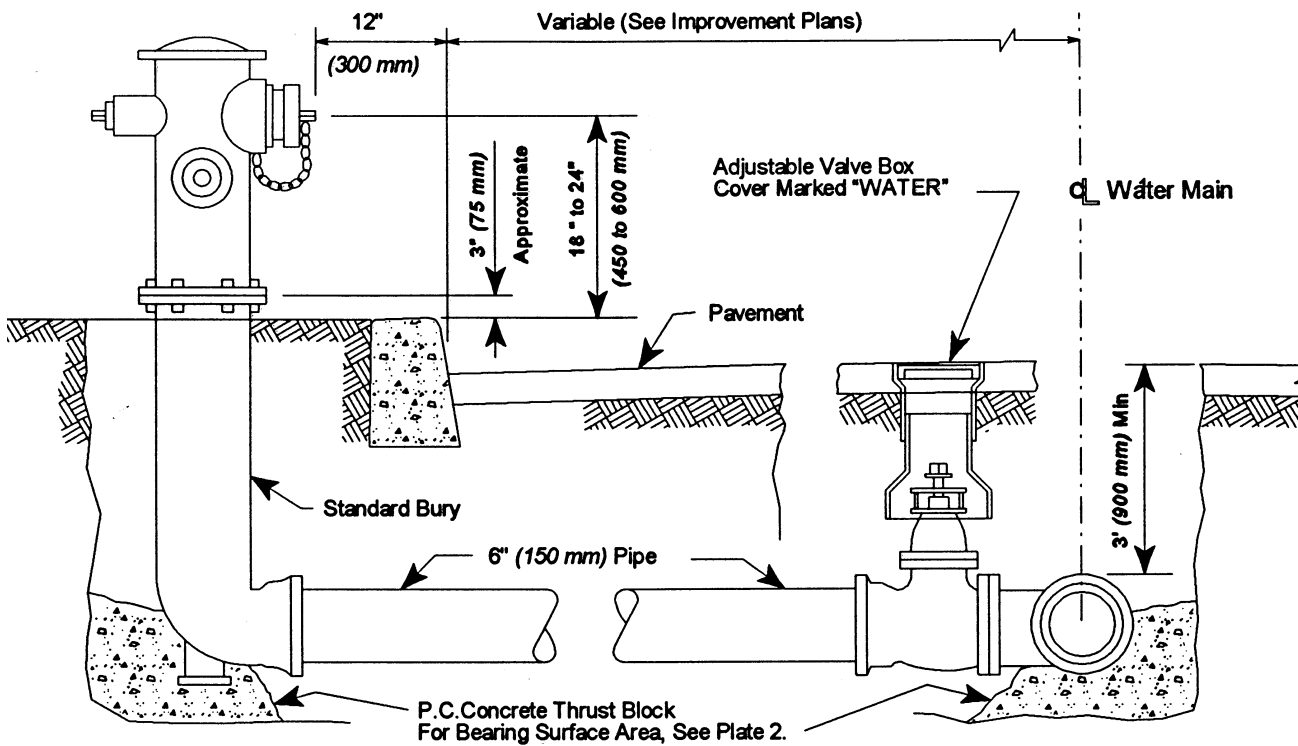
Note: "P" is a prohibited construction zone



CASE 2
NEW WATER MAIN

WATERWORKS MANUAL PLATE NO. 1

FIRE HYDRANT INSTALLATION



NOTES

1. All materials and installation shall conform to the applicable sections of the Ventura County Waterworks Manual.
2. When installation is in roads without curbs, (Road Standards Plate B-7), fire hydrants shall be located within the road right of way, three feet clear of the property line. An eight foot wide clear, level access to the fire hydrant across the roadside ditch shall be provided by the installation of a properly sized culvert and fill. A driveway adjacent to the fire hydrant may be used to provide the required access.
3. Fire hydrants shall not be closer than three feet from driveways, street trees, lighting standards, signs, or other obstructions.
4. See Road Standards Plate D-10 for sidewalk widening where sidewalk is adjacent to curb.
5. No coupling is required where the distance between the valve and the bury is less than four feet.

**WATERWORKS MANUAL PLATE NO. 2
THRUST BLOCK REQUIREMENTS**

TABLE I									
THRUST AT FITTINGS IN POUNDS (N) AT 100 PSI (690 kPa) WATER PRESSURE									
PIPE		TEES		BENDS					
SIZE INCHES (mm)	CLASS PSI (kPa)	LBS	N	90°		45°		22½°	
				LBS	N	LBS	N	LBS	N
4 (100)	100 (690)	1,720	(7,650)	2,440	(10,860)	1,320	(5,870)	660	(2,940)
	150 (1035)	1,850	(8,230)	2,610	(11,610)	1,420	(6,320)	720	(3,200)
	200 (1380)	1,850	(8,230)	2,610	(11,610)	1,420	(6,320)	720	(3,200)
6 (150)	100 (690)	3,560	(15,840)	5,030	(22,380)	2,720	(12,100)	1,380	(6,140)
	150 (1035)	3,800	(16,910)	5,370	(23,900)	2,910	(12,950)	1,470	(6,540)
	200 (1380)	3,800	(16,910)	5,370	(23,900)	2,910	(12,950)	1,470	(6,540)
8 (200)	100 (690)	6,140	(27,320)	8,680	(38,630)	4,700	(20,910)	2,380	(10,590)
	150 (1035)	6,580	(29,280)	9,300	(41,380)	5,040	(22,430)	2,550	(11,350)
	200 (1380)	6,580	(29,280)	9,300	(41,380)	5,040	(22,430)	2,550	(11,350)
10 (250)	100 (690)	9,380	(41,740)	13,270	(59,050)	7,190	(32,000)	3,640	(16,200)
	150 (1035)	10,750	(47,840)	15,200	(67,640)	8,240	(36,670)	4,170	(18,560)
	200 (1380)	10,750	(47,840)	15,200	(67,640)	8,240	(36,670)	4,170	(18,560)
12 (300)	100 (690)	13,330	(59,320)	18,860	(83,930)	10,240	(45,570)	5,170	(23,010)
	150 (1035)	15,310	(68,130)	21,640	(96,300)	11,720	(52,150)	5,940	(26,430)
	200 (1380)	15,310	(68,130)	21,640	(96,300)	11,720	(52,150)	5,940	(26,430)
14 (350)	100 (690)	17,930	(79,790)	25,360	(112,850)	13,740	(61,140)	6,960	(30,970)
	150 (1035)	20,770	(92,430)	29,360	(130,650)	15,910	(70,800)	8,060	(35,870)
	200 (1380)	20,770	(92,430)	29,360	(130,650)	17,880	(79,570)	8,060	(35,870)
16 (400)	100 (690)	32,210	(143,330)	32,820	(146,050)	17,880	(79,570)	9,000	(40,050)
	150 (1035)	26,880	(119,620)	38,010	(169,140)	20,590	(91,630)	10,430	(46,410)
	200 (1380)	26,880	(119,620)	38,010	(169,140)	20,590	(91,630)	10,430	(46,410)

TABLE II		
SOIL TYPE	SAFE BEARING LOAD I	
	Lbs/Ft²	(Pa)
Soft Clay	500	(24,000)
Sand	1000	(48,000)
Sand & Gravel	1500	(72,000)
Sand & Gravel Cemented with Clay	2000	(96,000)
Shale	5000	(239,000)

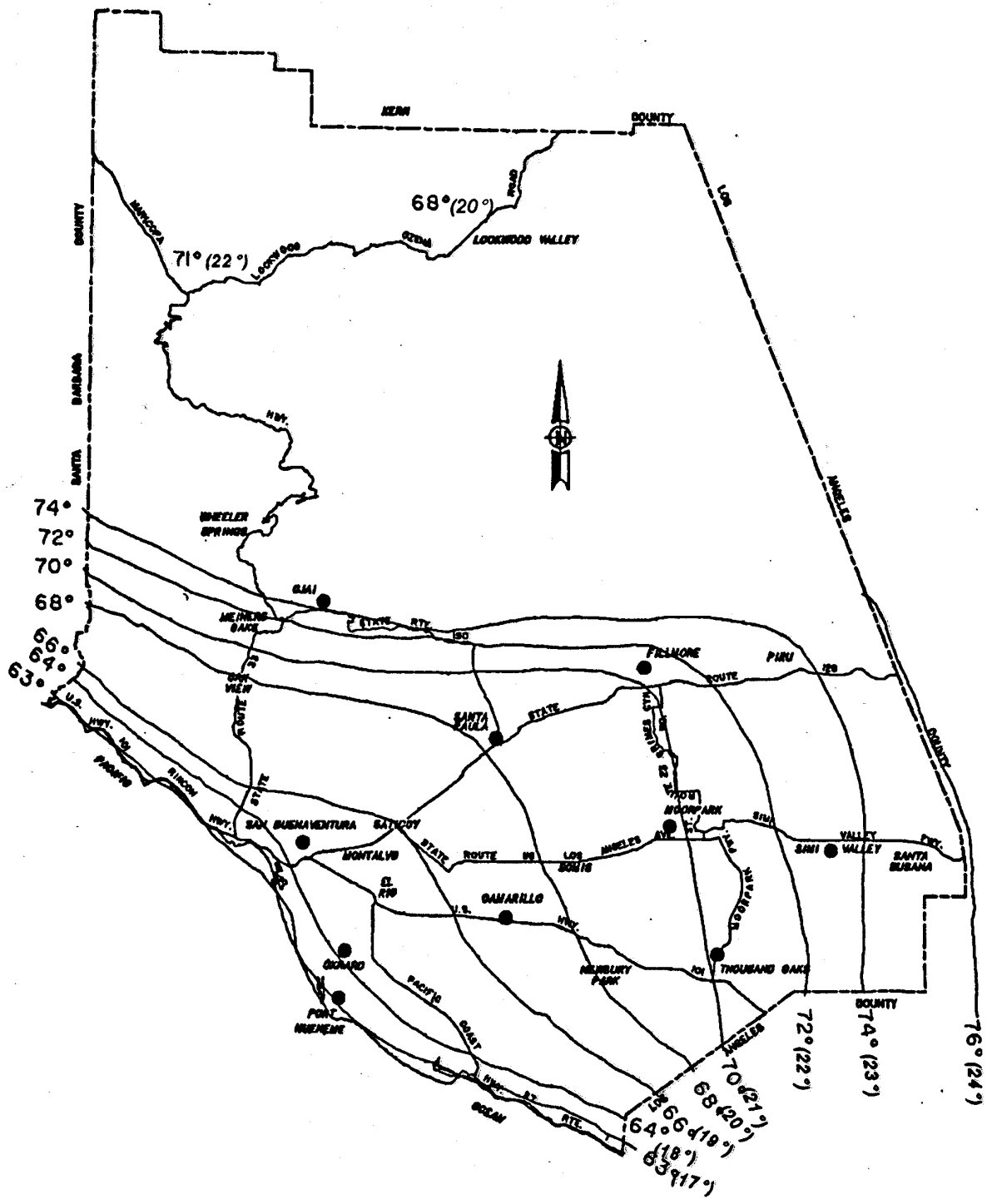
When soil analysis is available, use actual bearing capacity of soil.

EXAMPLE

Given: Determine thrust block area for 90° bend for 8" Class 150 (1035) pipe in sand.

Design: Pressure = 150 + 50 (test pressure) = 200 PSI (1035+345=1380 kPa).
 From Table I, thrust = 9300 LBS (41,380 N) for 100 PSI (690 kPa).
 For 200 psi (1380 kPa) thrust = 18,600 LBS (82,760 N).
 From Table II, safe bearing pressure for sand is 1000 PSF (48 kPa).
 Area required = 18,600/1000 = 18.6 SF (82,760/48,000 = 1.72 m²)

**WATERWORKS MANUAL - PLATE NO. 3
MAXIMUM MONTHLY AVERAGE TEMPERATURE °F (°C)**



- SOURCES:**
1. Climatological Data, Annual Summary, 1978, NOAA (For Oxnard & Ojai).
 2. Climatology of Ventura County, Ventura County Farm & Home Advisor (Other Areas).

WATERWORKS MANUAL - PLATE 3A
MAXIMUM AVERAGE MONTHLY AIR TEMPERATURES
AT SELECTED VENTURA COUNTY LOCATIONS

Location	Ref.	Maximum Average Monthly Temperature	
		°F	°C
Camarillo	2	67	19
Fillmore	2	70	21
Lockwood Valley	2	68	20
Moorpark	2	70	21
Newbury Park	2	68	20
Oak View	2	68	20
Ojai	1	74	23
Oxnard	1	65	18
Ozena	2	71	22
Piru	2	74	23
Point Mugu	2	63	17
Port Hueneme	2	64	18
Rincon	2	64	18
Santa Paula	2	68	20
Saticoy	2	66	19
Simi	2	73	23
Simi Hills	2	75	24
Somis	2	68	20
Thousand Oaks	2	71	22
Ventura	2	64	18
Not listed above	-	From Plate 3	(°F-32)/1.8

References:

1. Climatological Data Annual Summary, 1978, National Oceanic and Atmospheric Administration. Data for departures from normal were algebraically subtracted from monthly data to get long-term mean and the month with the highest value used.
2. Climatology of Ventura County, Ventura County Farm and Home Advisor. Used where data did not appear in Reference 1. Maps showing isotherms for July Maximums and July Minimums were used and the data averaged & rounded up.