

DIVISION 100 - PLANNING

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SECTION 101 - GENERAL

All proposed work shown in the Plans submitted to the Manager for approval shall be designed according to these Standards unless otherwise directed by the Manager.

The Manager may grant exception to the Standards to permit reasonable utilization of engineering judgment while at the same time securing substantial conformance with the objectives of these Standards.

SECTION 102 - MAINS

102.01 LOCATION.

Mains, other than those installed in easements or rights-of-ways, shall be located in the paved street area at the respective distances from the face of curb as listed below unless otherwise required to clear obstructions or as determined by the Manager:

<u>Island</u>	<u>Feet</u>
Hawaii, Kauai	5
Maui, Oahu	10

For Oahu Only: Mains shall be located 3 feet minimum clear from curbs, curb ramps or edge of gutters and shall also be aligned to provide 3 feet clearance between edges of valve boxes or manholes and curbs, curb ramps or gutters.

Within easements and rights-of-way, mains shall be accessible at all times clear of any parking stalls and above ground structures and located as determined by the Manager.

In case of extra wide streets, the Manager may require that two parallel, interconnected mains be installed, one on each side of the street. Sizes and other details in such cases shall be as approved by the Manager.

On side hill streets, the main shall, where possible, be located on the cut side of the centerline of the street. Where practicable, mains shall be located on the high side of super-elevated curves.

Unless otherwise specified by the Manager, where mains are to be installed in vicinity of trees, provide 8 feet minimum clearance to the outermost edge of the trunk of the trees or concrete jacket the main and provide 5 feet minimum clearance to the outermost edge of the trunk of the tree. Install root barrier around trees. *(For Hawaii and Oahu only: Provide 3 feet minimum clearance from the spread of the tree where practicable.)*

Where practicable, mains shall be located out of street parking areas and in one lane of the road to minimize traffic disruptions.

Mains and concrete thrust blocks shall be located 3 feet minimum clear from street monuments and temporary benchmarks.

Guardrail post locations are to be kept to a minimum clear distance of 18 inches to any 2-1/2-inch or smaller water lines and meter boxes. No post driving will be allowed when post is to be installed closer than 3 feet from 3-inch and larger water mains.

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No gas, petroleum, sewer main, nonpotable water main, electric or telephone duct or other utility line shall be installed in the same trench with potable water mains.

For stub-outs, mains shall be located to provide adequate room for future extension and clearance to existing and proposed utilities.

For cross-country mains and mains located in inaccessible areas, as approved by the Manager, mains shall be concrete jacketed. Grouted riprap paving with adequate concrete keys and weepholes shall be constructed.

Minimum horizontal and vertical clearances between water mains and other utilities except sanitary sewers are listed in Table 100-1. Minimum clearances shall be measured between outer edges or diameters of the utilities. Wherever possible, water mains shall be installed at a higher elevation than sewer mains. Refer to Section 102.06 - JACKETS and Table 100-5 for criteria for use of concrete jackets with sanitary sewers. Whenever concrete jackets are involved, clearances shall be total clear distance between the concrete jacket and utility concerned. The water main shall be concrete jacketed when determined necessary by the Manager.

Utilize perpendicular crossings with other ducts and utilities where practicable.

Table 100-1 - Water Main Clearances			
Island	Utility Diameter (Inches)	Clearances	
		Horizontal (Feet)	Vertical (Inches)
Hawaii	All Sizes	8	18 ^a
Kauai	All Sizes	8	18 ^b
Maui, Oahu	< 16	3	6 ^b
	≥16	3 ^c	12 ^b

- a - Provided other utility mains are concrete jacketed.
- b - For trenchless installation work (micro-tunneling, directional drilling, pipe ramming/jacking of new utilities such as electrical duct lines, sewer lines, drain lines) crossing or paralleling existing water mains, provide 3 feet vertical clearances to existing mains.
- c - For Oahu only: 5 feet clear to water mains 16-inches and larger.

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The utility owner or Contractor shall make the necessary adjustments to meet the minimum clearances to the water mains prior to construction at no cost to the Department should the existing water mains and appurtenances be found closer to the proposed utility line after probing work. The Manager may require additional clearances based on the size of the utilities, the location and size of water mains, bends, fittings and concrete blocks, the existing soil and ground conditions and the type of installation work.

102.02 PIPELINE EASEMENTS.

Water pipeline easements shall be granted to the Department for all water mains to be conveyed to the Department which are located within private properties and roadways that will not be dedicated to the City/County. Easements are also required in the interim for roadways that are temporarily privately owned until improved and dedicated to the City/County at a later date. The minimum width of easements shall be as listed in Table 100-2.

For Oahu Only: Upon completion of the project, the developer shall provide the Department with a certificate from a licensed civil engineer specializing in geotechnical engineering certifying that the road prism along the easements has been constructed in accordance to City and County Roads Standards for pipelines to be located in private properties and roadways.

Table 100-2 - MINIMUM EASEMENT WIDTH REQUIRED (FEET)				
Island	Pipelines 12-Inch Diameter or Smaller	Pipelines 16-Inch Diameter or Larger	Roadway Areas	Fire Hydrants, Water Meters, and Other Appurtenances Outside of Roadways or Right-of-Ways
All Islands	15	20	Full Width of the right-of-way and/or pavement, whichever is wider	10 feet wide and 5 feet beyond such facilities*

* Size of easement shall be determined by the Manager.

- Note:*
1. *For Maui Only: The required easement documents will be executed and submitted to the Department and recorded prior to approval of the construction plans.*
 2. *For Hawaii Only: Provide 10-foot wide minimum all weather road as approved.*
 3. *For Oahu Only: Provide 12-foot wide minimum all weather road as approved.*

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102.03 COVER.

Invert grades of water mains shall provide minimum cover as specified in Table 100-3 and also to assure proper clearance between top of valves and bottom of manhole covers or valve box covers as provided in the section on Main Valves. Minimum cover shall be maintained after any road improvement work including cold planing and resurfacing.

Table 100-3 - COVER FOR WATER MAINS (FEET)							
Island	Minimum Cover for Pipe Diameter Indicated ^a						Maximum ^b For All Mains
	Smaller Than 4- Inch	4-Inch	6-Inch	8-Inch	12-Inch	Larger Than 12- Inch	
Oahu	1.5	2.5	3.0	3.0	3.0	3.0	8
Hawaii	1.5	2.0	2.0	2.0	2.5	3.0	5
Kauai	3.0	3.0	3.0	3.0	3.0	3.0	8
Maui	N/A	2.5	3.0	3.0	3.0	3.0	5

- a - Minimum cover for mains and laterals to be installed in State rights-of-way shall be 3 feet.
- b - Over maximum cover requires Manager's approval and concrete jacketing of pipe.

102.04 DIAMETER.

Diameter of water main shall be designed to deliver water in adequate quantities and pressures for domestic use under peak consumption conditions and fire fighting in accordance with these Standards.

Standard water main diameters shall be 2½ (except Hawaii and Maui), 3 (Kauai only), 4, 6, 8, 12, 16, 18 (except Oahu), 20, 24, 30, 36 and 42-inches.

For Kauai Only: The minimum water main diameter shall be 6-inches. The water main diameter may be reduced after the last fire hydrant. Mains less than 6-inches in diameter shall be Ductile Iron Cl. 52, PVC C900 Cl. 150 or 200, brass pipe or copper tubing.

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102.05 TYPE, CLASS.

Types and classes of mains are as shown in Table 100-4.

Table 100-4 - TYPES AND CLASSES OF MAINS				
Island	Ductile Iron Cl. 52	Concrete Cylinder Cl. 150 Or 250	Cl. 150 or 200 PVC C900	Cl. 150 PVC C905
Hawaii	1,10	NA	NA	NA
Kauai	1,8	NA	7	NA
Maui	1,4,8	3,4	NA	NA
Oahu	1,4,9	4,5	2,4	4,6

- 1 - Mains 4-inch through 42-inch in diameter.
 - 2 - Mains 4-inch through 12-inch in diameter (Cl. 150 = DR 18, Cl. 200 = DR 14).
 - 3 - Mains 30-inch in diameter or larger.
 - 4 - See Division 500 for external corrosion control requirements as applicable to the project. *(For Maui Only: Applicable to main sizes of 24-inch and larger).*
 - 5 - Mains 16-inch through 42-inch in diameter. Class 250 straight pipes only. Class 150 is not allowed.
 - 6 - Mains 16-inch through 30-inch in diameter with DR of 18.
 - 7 - Mains 4-inch through 8-inch in diameter.
 - 8 - Polyethylene wrap mains and fittings, 8 mils minimum total thickness.
 - 9 - Polyethylene wrap mains and fittings, double wrap, 16 mils minimum total thickness.
 - 10 - Polyethylene wrap mains and fittings with invert elevations of 5 feet and below.
- NA - Not Allowed.

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Joints shall be push-on joint, mechanical joint or flange joint unless otherwise allowed. In all cases, the Manager reserves the right to specify the type of pipe, joint, or class of pipe to be used. The class of water mains shall be determined by the maximum pressure to be expected in the line. The class of pipe and test pressure shall be as shown on the plans. Provide a minimum of 2 feet clearance between edges of glands or bolts of adjacent fittings.

Where water mains are attached to or suspended from a bridge, pier, or other structures subject to vibration, mechanical joint or push-on joint shall be used. Sleeves shall be installed at the midpoint of bridge spans with one inch spacing or as called for on the plans between pipes. Adequate support and bracing shall be provided to prevent lateral movement. If the water line is cathodically protected or set up for future cathodic protection, it shall be electrically isolated from the bridge, pier, or other structures.

When non-metallic pipe or lateral is used, installation of toning wire or toning tape shall be required and as specified on the plans.

When connecting to existing mains, like materials shall be used to replace the existing mains unless otherwise specified.

102.06 JACKETS.

Wherever the main crosses under a streambed, large structure or utility larger than 16-inch diameter constituting a potential hazard to the main or where the main location is considered inaccessible by the Manager, the main shall be jacketed with reinforced DWS 2500 concrete. Necessary measures shall be taken to protect the stream embankment from erosion at the points of crossing. For cross-country mains and mains located in inaccessible areas, as approved by the Manager, mains shall be concrete jacketed. Grouted riprap paving with adequate concrete keys shall be constructed on steeper slopes. Additional valves may be required before and after streambed or structure crossing and jacketed mains where practicable.

Plastic and existing asbestos cement pipes shall not be jacketed. Ductile iron or concrete cylinder pipe and fittings shall be used for the portion to be jacketed.

Whenever a water main crosses over or under a sewer line, the sewer line will be concrete jacketed as listed in Table 100-5. Standard concrete jacket details for sewer lines as specified by the Department of Public Works Standards shall be followed.

Table 100-5 - CONCRETE JACKET REQUIREMENTS FOR SEWER MAINS		
Island	Water Main Under Sewer Main	Water Main Above Sewer Main
Hawaii	a	c
Kauai, Maui, Oahu	a	b

- a - 5 L.F. of reinforced concrete jacket on both sides of crossing
- b - 3 L.F. of reinforced concrete jacket on both sides of crossing (when water line is less than 18 inches above sewer line)
- c - 5 L.F. of reinforced concrete jacket on both sides of crossing (when water line is within 6 feet of pressurized sewer line or within 18 inches of gravity sewer line)

For Maui only: Whenever a water main crosses over or under a buried electrical, telephone, or cable line, the electrical line shall be jacketed. The length of jacket required for the electrical, telephone, or cable line shall be as specified for sewer lines in Table 100-5. Standard concrete jacket details for sewer lines as specified by the Department of Public Works Standards shall be followed.

102.07 DEFLECTION PER JOINT.

Deflection in laying ductile iron mechanical joint and push-on joint pipes and concrete cylinder pipes shall not exceed that shown in Table 100-6, Table 100-7 and Table 100-8. Maximum permissible deflection for laying plastic pipes varies with the type of plastic pipe being used.

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Table 100-6 - MAXIMUM PERMISSIBLE DEFLECTION FOR LAYING MECHANICAL JOINT PIPE					
Nom. Pipe Diameter (Inches)	Deflection Per Joint (Degrees)	Maximum Deflection With Pipe Length Of: (Inches)		Minimum Radius of Curve With Pipe Length Of: (Feet)	
		18 Ft.	20 Ft.	18 Ft.	20 Ft.
4	8° 18'	31	34	125	140
6	7° 07'	27	30	145	160
8	5° 21'	20	22	195	220
12	5° 21'	20	22	195	220
16	3° 35'	13.5	15	285	320
18	3° 00'	11	12	340	380
20	3° 00'	11	12.5	340	380
24	2° 23'	9	10	450	500
30	2° 23'	9	10	450	500
36	2° 05'	8	9	500	550
42	2° 00'	7.5	8	510	570

For Oahu only: The maximum permissible deflection per joint for laying pipes shall be 50 percent of the deflection per joint in Table above to facilitate repair and/or replacement of pipes. Avoid installation of pipe with deflections on a radius. Periodic bends are recommended where practicable.

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Table 100-7 - MAXIMUM PERMISSIBLE DEFLECTION FOR LAYING PUSH ON JOINT PIPE					
Nom. Pipe Diameter (Inches)	Deflection Per Joint (Degrees)	Maximum Deflection With Pipe Length Of: (Inches)		Minimum Radius of Curve With Pipe Length Of: (Feet)	
		18 Ft.	20 Ft.	18 Ft.	20 Ft.
4	5° 00'	19	21	205	230
6	5° 00'	19	21	205	230
8	5° 00'	19	21	205	230
12	5° 00'	19	21	205	230
16	3° 00'	15	17	340	380
18	3° 00'	11	12	340	380
20	3° 00'	11	12	340	380
24	3° 00'	11	12	340	380
30	3° 00'	11	12	340	380
36	3° 00'	11	12	340	380
42	2° 00'	7.5	8	510	570

Maximum permissible deflection taken from AWWA C600. Maximum deflection angle may be larger than shown above for main 16-inch and larger. Consult pipe manufacturer.

For Oahu only: The maximum permissible deflection per joint for laying pipes shall be 50 percent of the deflection per joint in Table above to facilitate repair and/or replacement of pipes. Avoid installation of pipe with deflections on a radius. Periodic bends are recommended where practicable.

Table 100-8 - *MAXIMUM PERMISSIBLE DEFLECTION FOR LAYING CONCRETE CYLINDER PIPE					
Nom. Pipe Diameter (Inches)	Deflection Per Joint (Degrees)	Maximum Deflection With Pipe Length of: (Inches)		Minimum Radius of Curve With Pipe Length Of: (Feet)	
		16 Ft.	32 Ft.	16 Ft.	32 Ft.
16	2° 24'	8.0	16.0	382	764
18	2° 07'	7.1	14.2	400	800
20	1° 55'	6.4	12.8	474	948
24	2° 10'	7.3	14.5	423	846
30	1° 46'	5.9	11.8	519	1038
36	1° 29'	5.0	10.0	625	1250
42	1° 17'	4.3	8.6	724	1448

*The maximum deflection may be exceeded for pipes and fittings with beveled ends.

For Oahu only: The maximum permissible deflection per joint for laying pipes shall be 50 percent of the deflection per joint in Table above to facilitate repair and/or replacement of pipes. Avoid installation of pipe with deflections on a radius. Periodic bends are recommended where practicable.

102.08 STREET ENDS.

At the end of a street which may be extended in the future, the water main shall, whenever possible, extend at least 5 feet beyond the end of the paving. Install valve and concrete beam with reverse bell pipe at stub-outs for future extension, where practicable. Where a proposed main extension would result in a dead-end, the condition shall, whenever possible, be corrected by the installation of water line circuits or interconnections as may be required by the Department to provide a two-way feed to the services. For developments with 100 or more subdivided lots, provide a second feed to the subdivision’s water system unless otherwise approved by the Manager. Cleanouts with pipe markers or valve boxes, blowoffs, and air relief valve assemblies shall be installed as required for proper operation and maintenance of the main.

On dead-end streets, permission may be granted for laying mains 6-inch or smaller beyond the last fire hydrant where both of the following conditions are met:

1. Due to a natural barrier, the street will never be extended; and

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2. Due to topography or street arrangement, it is the Manager's opinion that it is impractical to require a connection between the mains at the end of the dead-end street and some other main in order to complete a good gridiron.

A properly sized distribution main when directed by the Manager shall be installed parallel to a 16-inch or larger transmission main to avoid connecting laterals to the transmission main.

102.09 CORROSION PROTECTION.

In locations below an elevation of 4 feet, or where water or especially corrosive soils, including those contaminated with petroleum products, are encountered or where other unfavorable conditions may subject the pipe to serious corrosion, the Manager may specify the type of pipe to be used. Under such circumstances, corrosion protection for the pipe, fittings, and appurtenances may be required by the Manager. The materials and methods to be used for corrosion protection shall be specified on the plans or by special provisions or as directed by the Manager.

To ascertain whether unfavorable soil conditions exist, the Manager may request that soil boring samples at approximately the invert of the pipe be taken, analyzed, and submitted as part of the project.

For Maui and Oahu Only: Where corrosion protection is required, it shall be installed for all buried metallic pipes, fittings and appurtenances. Soil resistivity tests are required in all cases. The types of corrosion protection will be determined by the soil resistivity. If concrete-coated pipe is to be used, soil samples must be obtained and soil analysis (pH, chlorides, and sulfates) shall be performed in addition to the soil resistivity. The test results shall be submitted as part of the project design. See Division 500 of the Water System Standards for the appropriate corrosion protection as applicable to the project. The corrosion protection design shall be approved by the Manager.

SECTION 103 - MAIN VALVES

103.01 LOCATION, TYPE, WORKING PRESSURE.

Main valves shall be installed along the water main so that the maximum distance between valves shall not exceed the spacing listed in Table 100-9.

Table 100-9 - MAXIMUM DISTANCE BETWEEN MAIN VALVES (FEET)		
Residential, Agricultural	Transmission Mains	All Others Districts
750	2,000 ^a	500 ^{b,c}

a - For Maui only: For mains 16-inch diameter or larger or as determined by the Manager, otherwise 1,000 feet.

b - Or as determined by the Manager.

c - For mains that provide a one-way feed to subdivisions with more than 100 lots as determined by the Manager.

At all branches or intersections of mains, lines in each direction shall be valved, unless otherwise approved by the Manager. At street intersections, valves shall, wherever practicable, be located in "clusters" about the points of intersection of water mains.

Where a new main is connected to an existing main, valves on both the new and the existing main shall be installed as required above. Where it is impractical to shut off the "live" main for connection, a tapping sleeve with tapping valve shall be installed.

Wherever valves are to be installed, the pipe invert slope shall not exceed six percent. Valves shall be located so there will be a minimum clearance of 6 inches from the top of the valve stem to the underside of the valve box frame and cover or a 24 inch clearance from the top of the valve stem to the underside of the manhole slab. Valve markers and concrete slabs around the valve box frames and covers shall be installed for valves in unpaved and undeveloped areas.

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Types of main valves for the various pipe sizes are listed in Table 100-10.

Table 100-10 - TYPES AND SIZE OF MAIN VALVES			
Island	Gate Valves	Bevel Geared	Butterfly
Maui	5 ^a	NA	6
Kauai, Oahu	1	2 ^b	2
Hawaii	3	NA	4

- 1 - 12-inch and smaller
- 2 - 16-inch and larger
- 3 - 8-inch and smaller
- 4 - Larger than 8-inch
- 5 - 16-inch and smaller (subject to pressure)
- 6 - 18-inch and larger
- NA - Not Allowed

- a - For 16-inch mains with working pressure of 100 psi or greater, use butterfly valves.
- b - *For Oahu Only: Install bevel-gear gate valves with bypass at key locations including, but not limited to, facilities, intersections (cluster valve locations) and every 6,000 feet spacing for long continuous transmission mains. The Manager may specify the type of valve to be used for transmission mains.*

The classes of valves, which are listed in Table 100-11, denote the maximum pressure expected in the line and shall be shown on the plans.

Table 100-11 - CLASSES OF VALVES					
	Main Valves			Tapping Valves	
Island	150	200	250	150	200
Kauai, Oahu, Maui	a	a	a	a	a
Hawaii	NA	b	a	NA	a

- a - Allowed, depending upon the maximum pressure expected in the main.
- b - Allowed for gate valves only, depending upon the maximum pressure expected in the main.
- NA - Not Allowed

103.02 MANHOLES AND VALVE BOXES.

Valve boxes shall be installed over all gate valves and air relief valves up to one-inch size except where manholes are called for by the Manager.

For Kauai and Hawaii Only: Valve Boxes only are required unless otherwise specified.

For Maui and Oahu Only: Manholes in lieu of valve boxes are required for the following conditions:

1. *For Maui Only: Whenever depth from the finish grade of the pavement or ground to the top of the stem of valve exceeds 4 feet.*
2. *For Oahu Only: Whenever depth from the finish grade of the pavement or ground to the pipe invert exceeds the maximum depth as listed in Table 100-12.*
3. Key mainline valves including, but not limited to, cluster valve locations, valves in high traffic areas and valves serving a one-way feed.
4. Valves to reservoirs, boosters, wells.
5. *For Oahu only: For air relief valves up to 3/4-inch size off mains 16-inches and smaller where ground water is encountered.*
6. Butterfly valves and bevel geared gate valves.
7. Valves submerged in seawater, in corrosive soils (areas with soil corrosion rating of 1 as defined in Division 500 or as determined by the Manager) or in petroleum saturated areas.

Table 100-12 - FOR OAHU ONLY: MAXIMUM DEPTH OF PIPE INVERT FOR VALVE BOX INSTALLATION	
Size of Main (Inches)	Finish Pavement/ Grade to Invert (Feet)
4	6.5
6	7.0
8	7.5
12	8.5

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Where manholes are required, the type and situations requiring them are listed in Table 100-13.

Table 100-13 - TYPES OF MANHOLES REQUIRED FOR GIVEN SITUATION							
	Situation						
Island	1	2	3	4	5	6	7
Hawaii, Kauai	NA	NA	NA	NA	NA	NA	NA
Maui	A	NA	NA	D	NA	F	C
Oahu	A	B	C	D	E	NA	NA

Situation

1 - *For Maui only: For butterfly valves 12-inches and larger.*

For Oahu only: For bevel geared gate valves and butterfly valves 16-inches and larger. (Air relief valves are installed with bevel geared gate valves or butterfly valves 16-inches and larger.)

2 - For 12-inch gate valves and air relief valves on 16-inch mains.

3 - For 8-inch gate valves and smaller, air relief valves on mains 12-inch and smaller.

4 - For single or two 2-inch air relief valves offset from mains 20-inch and larger.

5 - For tapping valves.

6 - For air relief valves on mains 18-inch and smaller.

7 - Optional for single only air relief valve on mains 20-inch and larger.

Type of Manhole

A - Type A or A-1 Manhole

B - Type B Manhole

C - Type C Manhole

D - Type D Manhole

E - Type E Manhole

F - Type F Manhole

NA - Not Applicable

A 24 inch minimum clearance shall be provided between top of valve and bottom of manhole top slab. Pedestal anchorage straps for valves shall be installed in manholes for all PVC pipes.

SECTION 104 - APPURTENANCES

104.01 HYDRANTS.

A. Spacing. Hydrants shall be spaced as listed in Table 100-19 and located in accordance with these Standards.

B. Location. Hydrants shall be located to be fully accessible, and in such manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. Hydrants shall be located as follows:

1. When located at street intersections, hydrants shall be 7 feet from P.C. or P.T. of curb returns or edge of any driveway apron or as directed by the Manager.
2. Hydrants shall be located in front of a boundary line between lots.
3. Hydrants shall not be installed on curves, except as approved by the Manager. On side hills, hydrants shall be located on the cut side.
4. Where practicable, hydrants shall be placed alternately on each side of the street.
5. On streets having an appreciable grade and in cases where the hydrant is to be installed with a 1/4 (90°) bend (see Standard Details), the hydrant shall be installed downhill from the connection to the main and the hydrant valve location (*For Hawaii only: The hydrant shall be installed uphill from the connection.*)
6. *For Oahu only: On streets without curbs, protect hydrants with curb guards. Curb guard shall be 3 feet minimum clear from the edge of road pavement. Install guard posts and concrete pads, if there is inadequate room to install a hydrant curb guard clear of paved roadway.*
7. *For Kauai, Hawaii and Maui: On street without curbs, concrete pads shall be installed around the fire hydrants. Fire hydrant pads shall be flush with the finish grade.*
8. The minimum clearance between fire hydrants and utility poles, or light standards, property lines or any walls or obstructions shall be 3 feet. (*For Kauai only: 2 feet minimum clearance from property lines and walls.*) (*For Maui only: 2 feet minimum clearance from property lines and walls; 10 feet minimum clearance from utility poles, light standards and similar obstructions.*) (*For Hawaii only: 3 feet 6 inches minimum clearance from property lines and walls; 10 feet minimum clearance from utility poles, light standards and fixtures taller than the fire hydrant.*)

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9. Fire hydrant valve and valve box or manhole shall be installed clear of the concrete curb and gutter. Fire hydrant valve shall be installed at a higher elevation than the hydrant where practicable and shall be installed downstream of traffic in relation to the hydrant where possible.
10. Fire hydrant shall be located to provide 3 feet minimum clear pathway for wheelchairs from the outside diameter, outlet or any protruding portion of the hydrant to the edge of accessible route.

The hydrant connection using an elbow as shown on the Standard Details shall depend on the space available between main and hydrant. Where the fire hydrant lateral is crossing wide streets along major thoroughfares, additional valve may be required 8 feet from the fire hydrant as directed by the Manager.

C. Depth. Lengths of hydrant buries shall be measured from the face of the flange to the center line of the 6-inch intake pipe.

D. Outlets.

1. The height of the centerline of the 4½-inch streamer nozzle shall be set above the curb or finish grade at a height of 22 ± 2 inches.
2. Direction of the 4½-inch outlet shall not exceed 15 degrees from the perpendicular to the road.
3. Outlet threads shall conform to National Fire Protection Association's "Standard for Screw Threads and Gaskets for Fire Hose Couplings".

104.02 SERVICE LATERALS AND CONNECTIONS.

A. Location. Service laterals and connections shall be constructed in accordance with the Standard Details as part of the project. Where practicable, laterals shall not be located adjacent to electric and telephone lines leading into the property to be served.

The ball stop at the beginning of the branch of the service lateral serving two or more meter sites shall be located in front of the boundary line between lots clear of driveway apron or flare. The ball stop shall be on a prolongation of this boundary line.

Where the street is of unusual width or where it is not permissible to connect laterals directly to the main, the Manager may require the installation of service mains in the sidewalk area parallel to the main. This installation should not be confused with a parallel main in the paved area. The Manager may permit connection of service laterals to fire hydrant laterals or laterals to 3-inch and larger meters with an isolation valve installed after the service lateral connection prior to the fire hydrant or meter.

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B. Cover. Laterals shall have a minimum cover of 18 inches (3 feet in State DOT rights-of-way) or as specified elsewhere in these Standards.

C. Diameter. Diameters of service laterals and connections are identified by a code numbering system (see Standard Details). Appropriate codes shall be indicated on the Construction Plans.

D. Type of Lateral and Connection. Laterals and connection shall be of copper pipe with appropriate valves, stops and fittings as described in DIVISION 200 - MATERIALS, and as shown in the Standard Details. In special cases, subject to special design, 2-½-inch copper or larger ductile iron laterals and connections may be installed.

E. Connection to Main. Laterals shall be connected to the various types of mains as shown in the Standard Details and as specified in Table 100-14, subject to the following conditions:

1. The connection to the main shall be by a ball corp with Mueller (tapered) threads tapped into the main. Main shall not be tapped closer than 36 inches (*18 inches for Hawaii*) center to center.
2. Laterals shall not be connected to 16-inch or larger mains unless specifically permitted by the Manager.
3. Direct taps into plastic pipe or existing AC pipe shall not be permitted.
4. Where the size of the ball corporation is larger than allowed in Table 100-14, service saddle or double hub tee with boss (tapped with Mueller threads) as listed in Table 100-15, shall be installed to receive the ball corp. Only one tap per double hub tee will be permitted.
5. See Division 500 for the required corrosion protection and electrical isolation requirements as applicable to the project (*not applicable for Hawaii and Kauai*). (*For Hawaii Only: Install dielectric unions between new copper service laterals and existing or new dissimilar metal pipes and fittings.*) (*For Oahu only: Install 3 feet (minimum) of plastic lateral (PE tubing) after meter.*)
6. Where laterals are allowed to take off from the end of mains, the caps shall be tapped with standard pipe threads with maximum permissible tap as recommended by the manufacturer (*not applicable for Hawaii*).
7. Service lateral connections shall not be made at locations within easements that have no established accessible public roadways.

Table 100-14 - MAXIMUM ALLOWABLE DIRECT TAPS INTO DUCTILE IRON MAIN	
Main Size	Largest Tap Size
4"	1"
6"	1 ¼" (For Oahu Only: 1")
8"	1 ½"
10"	1 ½"
12"	2"

Table 100-15 - SERVICE SADDLES OR BOSSED TEES FOR TAPS IN MAINS			
Island	Service Saddle		Double Hub Tee With Boss
	Single Strap	Double Strap	
Hawaii, Kauai	a	b	c
Maui	NA	d	c
Oahu	NA	e	f

- a - Allowed for taps up to and including 1-inch.
- b - Allowed for taps 1 ½-inch to 2-inch on mains 4-inch to 12-inch diameter.
- c - Allowed.
- d - Allowed for taps for 1-inch to 2-inches.
- e - Allowed for taps to existing PVC only.
- f - Required for all PVC pipes.
- NA - Not allowed.

104.03 METER BOXES.

Meter boxes shall be installed in public right-of-way areas clear of driveway aprons or flares and curb ramps or as directed by the Manager and as shown in the Standard Details for each lot at each service connection. *(For Maui only: One-inch and smaller meters shall be installed in public right-of-way and meters larger than one-inch in manholes shall be installed within private property with easements.)* The type of meter boxes to be used, spacing, dimensions, and other details shall be as shown in the Standard Details. *(For Oahu and Maui only: install concrete pads for meter boxes installed in dirt or unimproved areas.)*

104.04 THRUST BLOCKS AND BEAMS.

All fittings such as tees, plugs, caps, bends, offsets, reducers, and valves, as well as all other pipeline appurtenances which are subject to unbalanced thrust, shall be properly braced with thrust blocks of reinforced DWS 2500 concrete. At all top vertical bends, blocks shall be reinforced. Due to the various types and sizes of vertical bends and field conditions, the size, dimensions and reinforcing for the blocks will vary. The design engineer shall be responsible for the design and details of all concrete thrust blocks. *(For Oahu only: The Department will furnish the design and details of all concrete thrust blocks for projects awarded by the Manager.)*

Wherever connection to existing mains is to be made, the design of the thrust block shall include structural steel struts in connection with reinforced concrete thrust blocks as shown in the Standard Details. Concrete thrust beams shall be constructed at the valves of all branch lines and dead-end lines that are to be extended in the future. The thrust beams shall be constructed in conjunction with a reversed bell pipe when installed at valves and shall be in accordance with the Standard Details. In instances where the valves are secured by means of metal strap and concrete, the thrust beam may be eliminated. Thrust beams may also be required at flanged by bell adaptors.

104.05 RIPRAP OVER TRENCH.

In unpaved areas, riprap shall be constructed over water main trenches wherever the slope and condition of the ground warrant such construction. The design of the riprap shall be furnished by the engineer who prepared the plans and shall be as shown on the plans. Whether shown on the plans or not, the Manager may require riprap wherever ground conditions warrant such construction.

104.06 AIR RELIEF VALVES/COMBINATION AIR VALVES.

Air relief valves/combination air valves or combination of two ARVs shall be installed at high points in the main or as otherwise required by the Manager. Required sizes of ARVs shall be as shown in Table 100-16:

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Table 100-16 - REQUIRED SIZES AND NUMBER OF AIR RELIEF VALVES		
Main Size	ARV	Number of ARV
16-inch mains and smaller	¾-inch (<i>Oahu and Maui only</i>)	One
18-inch mains and smaller	1-inch (<i>Hawaii and Kauai only</i>)	One
18-inch mains	1-inch (<i>Maui Only</i>)	One
20-inch to 30-inch mains	2-inches	One
36-inch mains and larger	2-inches or as directed by the Manager	2

At dead-end streets, where water main terminates at a high point, ARV shall be installed at the end of the line. The working pressure shall be designated on the plans where ARVs are required. For continuous uphill grades, ARVs shall be installed at a maximum of 2,000 feet apart. Install ARVs on level runs of main at zero percent slope.

Where ARVs are located below the high water line or flood level, waterproofed manholes and vertical check valves shall be installed to prevent any backflow of the ground water into the water system.

104.07 BLOWOFF LINES.

Where required by the Manager, blowoff lines shall be installed. The blowoff lines will normally be required on long transmission mains to provide a means for flushing out the line. The blowoff line shall be installed in such a manner and at such location as to preclude backflow.

104.08 CLEANOUTS.

A. Permanent Cleanouts. A permanent cleanout shall be installed at the terminal point of all dead-end lines except where a fire hydrant is installed (*for Hawaii only, cleanouts are required regardless of fire hydrant installation*). Size of cleanout shall be as shown in the Standard Details. (*For Oahu only: Install valve boxes for permanent cleanouts.*)

B. Temporary Cleanouts. A temporary cleanout shall be installed to facilitate disinfecting and flushing of any part of the water system. Size of temporary cleanout for disinfection and flushing shall be as shown in the Standard Details.

SECTION 105 - STRUCTURES

105.01 GENERAL.

All proposed work shown on plans submitted to the Manager for approval shall be designed according to these Standards unless directed otherwise by the Manager. All work shall comply to all applicable federal, state and county rules and regulation.

105.02 APPROVAL.

Approval of plans by the Manager is based solely on the adequacy of the water supply. Approval shall also be based on the type of structure: prestressed, reinforced concrete, steel, masonry, or wood, etc., as designated on the plans. Soil stability, structural stability, and drainage design shall be the responsibility of the engineer who prepared the plans.

105.03 DRAINAGE SYSTEM.

Site shall be drained of excess water, including overflow and washout from reservoirs, and shall be discharged into the County's storm drain system or an approved drywell or receiving system. Where a County storm drain system is not available, the drainage may traverse other properties, provided perpetual drainage and or flowage easements are obtained from the property owners affected by the drainage water.

105.04 ACCESS ROAD.

Provide a paved access road with the following parameters:

1. Minimum width of pavement 12-feet (*10-feet minimum for Hawaii only*).
2. Maximum grade of 20%.
3. Asphalt concrete pavement on grades up to 12%. Install concrete headers at edges of AC pavement.
4. Reinforced concrete pavement on grades in excess of 12%.
5. Where vehicle must stop to open gates: 10% Maximum grade.

105.05 ACCESS ROAD GATE.

On access roads not enclosed with fences, provide a gate approved by the Manager to prevent unauthorized vehicles from entering the road. Provide means for attaching padlock which will be furnished by the Department.

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105.06 LANDSCAPING.

The plans for water facility sites shall include provisions for landscaping, planting, irrigation system, and maintenance. Landscaping shall follow xeriscaping principles. All landscaping shall minimize the use of and impact on the potable water supply.

105.07 ACOUSTICAL REQUIREMENTS.

The station shall be acoustically designed in compliance with all Land Use Ordinance (LUO), OSHA and State Department of Health requirements.

105.08 PERIMETER FENCE.

Provide a 6-foot high fence around perimeter of property and gate for driveway and security devices as specified by the Department.

105.09 DRAINAGE EASEMENTS.

When water from the site is discharged over properties other than public streams or storm drains, the plans shall indicate a drainage easement and flowage easement up to a natural waterway or drainage system to be granted to the Department.

The Department shall be held free and clear of all damages, liabilities and/or litigations arising from:

1. Discharge of water from the reservoir and deep well drainage system.
2. Surface runoff from the water facility sites.
3. Design and sizing of drainage system and/or structures outside the Department's property.
4. Maintenance of downstream waterway and/or conduits outside the property of the Department.

In the event future developments are affected by the downstream waterways and/or conduits, the waterways and/or conduits shall be modified, adjusted, or relocated by the landowner at no cost to the Department. All such plans shall be submitted to the Manager for review.

For projects constructed by the Department, drainage and flowage easements will be obtained by the Department and included on the plans.

All such drainage systems shall conform to applicable drainage standards.

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105.10 RESERVOIRS.

A. Size. Size of reservoir shall be designed to store sufficient water to insure a reliable supply of water, maintain adequate pressures and an economical water system. Unless otherwise approved, standard sizes shall be 0.10 MG, 0.20 MG, 0.25 MG, 0.30 MG, 0.50 MG, and 1.0 MG; thereafter, sizes shall be in multiples of 0.50 MG.

When there are two or more reservoirs or pumps serving the same service zone, the design shall be made on the basis of combined protection provided by all facilities available.

B. Type. Reservoir shall be reinforced concrete, prestressed concrete, or post-tensioned concrete, or as specified by the Department.

C. Influent-Effluent Line. Where practicable, the influent-effluent lines shall enter the reservoir through the access road. Where the influent-effluent line traverses rough country or otherwise be inaccessible to maintenance vehicles, a pipeline maintenance road shall be constructed.

D. Washout Line. Washout line shall be provided to empty the reservoir within 12 hours. Where washout flows are not allowed into drainage way, a pump connection shall be provided instead of an outfall.

E. Overflow Line. Overflow line shall be provided for each reservoir to prevent damage to the reservoir and allow proper discharge of water due to malfunction of controls. A reservoir's designated elevation shall be the overflow elevation.

Provide flap valve at the end of the overflow line. *(For Maui only: Stainless steel screen may be used in lieu of a flap valve with the approval of the Manager.)*

F. Washdown Connection. Washdown connection shall be provided to enable hosing the reservoir for cleaning. Connection is required at:

1. Reservoir site on the source side of the shutoff valve to the reservoir.
2. Exception - Washdown connection is not required when an emergency pumping connection is installed at the reservoir site where hose connection may be made for the water source.

G. Instrument Pressure Line. Provide a one-inch copper line from the reservoir side of washout valve to the pressure recording instruments.

H. Sampling Line. Provide a copper sampling line with a hand valve control and spigot. Outlet shall be installed as specified on the plan.

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I. Perimeter Road. Provide a perimeter road around the reservoir with a minimum 10-foot width measured outwards from edge of footing to edge of road. Finish grade of road shall be at 2 inches minimum below the top of the footing and sloped to drain away from the reservoir.

J. Access to Reservoir. If access roads are to be constructed for the exclusive use of the Department, fee simple title shall be provided.

If access to the reservoir is through private roads which will be used by others and the Department, right-of-entry and access easements for use by the Department shall be provided. The Department will not be responsible for the maintenance of the roadway beyond the necessary repairs caused by its operations.

K. Blowoff Lines. A blowoff line shall be installed on reservoir effluent line to drain the reservoir to an approved drainage system. The size of the blowoff line shall be capable of draining the reservoir in 12 hours.

L. Chlorination Line. Provide a PVC line with all plastic ball valve suitable for injection of chlorine into the reservoir. Injection point and valve shall be installed as specified on the plan.

M. Painting. All exterior reservoir surfaces shall be painted. *For Maui, Hawaii and Kauai: All interior reservoir wall, columns, and floor surfaces shall be painted as specified in these standards.*

N. Floor Cement Topping. *For Oahu and Kauai Only. All reservoirs floor shall have a cement topping as shown on the plans and as specified in this Standards.*

O. Exterior and Interior Ladders. Exterior and interior ladders shall conform to OSHA requirements.

105.11 CORROSION PROTECTION.

Corrosion protection shall be provided for buried pipelines as specified in Division 500 of the Water System Standards as applicable to the project. Steel reservoirs and submerged metallic structures in concrete reservoirs shall have corrosion protection, such as adequate coatings, etc. The corrosion protection design shall be approved by the Manager.

SECTION 106 - MECHANICAL AND ELECTRICAL

106.01 GENERAL.

Booster pump stations shall be equipped with a minimum of two pumping units, one of which shall be a standby unit equal in capacity to the largest of the main pumping units.

106.02 PUMPS.

Pumps shall be of the horizontal centrifugal, submersible or vertical turbine type. Pumps should be rated at or near the maximum efficiency for that pump to deliver water. Line shaft deep well turbine pumps shall be water lubricated. Petroleum based lubricated lineshaft pumps will not be permitted.

106.03 MOTORS.

Motors shall conform to the latest Standards of NEMA and shall have ample capacity to operate the pumps under all head conditions without overloading. Motor shall have a service factor of 1.15.

106.04 INSTRUMENTATION.

Indicating and recording instruments and appurtenances shall be provided for suction and discharge pressures, flow rates, water level in wells, reservoir levels, watt hour meter, ammeter, volt meter, power factor and any other important station parameters.

106.05 CHLORINATORS.

Source pump stations shall be equipped with a minimum of two chlorinators, one of which shall be a standby unit equal in capacity to the largest of the main chlorinators. Chlorinators and chlorinator rooms shall be in conformance with the latest fire code and OSHA requirements.

106.06 SHUTOFF VALVES.

Shutoff valves shall be installed to allow for maintenance and repair of equipment without disruption of service.

106.07 FLOW METERS.

Flow meters shall be installed at all pump stations and at locations required by the Manager.

SECTION 107 - BACKFLOW PREVENTION ASSEMBLY

107.01 GENERAL.

The authority for enforcing the Department's cross-connection control and backflow prevention program is derived under the Department's "Rules and Regulations." This program shall be further guided and enforced by any or all applicable Federal laws, State statutes or regulations and local County Ordinances or Codes. All backflow prevention assemblies shall be approved in accordance with the University of Southern California's Foundation for Cross-Connection Control and Hydraulic Research.

For Oahu only: All backflow prevention assemblies that vent to atmosphere, which are located within a Flood Hazard District, as delineated on the Flood Boundary and Floodway Maps, and Flood Insurance Rate Maps, shall be at least one foot above the regulatory flood elevation. If these backflow prevention assemblies cannot be located at least one foot above the regulatory flood elevation, the Manager must approve any alternatives installations.

107.02 REQUIREMENTS FOR NON-SPECIFIED FACILITIES.

The facilities and the backflow prevention requirements specified under Section 107.03 - REQUIREMENTS FOR BACKFLOW PROTECTION have been listed for the consumer's convenience. For facilities that are not listed, the same requirements for a similar specified facility shall be followed. Should a similar specified facility not be listed, the Department shall determine the required backflow prevention assembly.

107.03 REQUIREMENTS FOR BACKFLOW PREVENTION.

The specific requirements for cross connection and backflow prevention installation as specified in Division 300, Section 305 - BACKFLOW PREVENTION ASSEMBLIES are as follows:

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Table 100-17 - BACKFLOW PREVENTION REQUIREMENTS			
Facility	Backflow Prevention Assembly		
	Pressure Vacuum Breaker (Includes Spill-Resistant Pressure Vacuum Breaker)	Double Check Valve Assembly	Air Gap or Reduced Pressure Principle Backflow Preventer
Aircraft, Airport Facilities and Missile Plants			X
Agricultural Activities			X
Automotive Plants			X
Auxiliary Water Systems (Private Wells, Sewage Effluent, Used Waters, Reclaimed Waters (Regardless of Classification), Industrial Fluid Systems)			X
Beverage Bottling Plants			X
Buildings - (Hotels, Apartments, Commercial, Industrial, Public and Private Buildings) and Warehouses			X
Canneries, Packing Houses and Reduction Plants			X
Car Wash Facilities			X
Chemical Plants - Manufacturing, Processing, Compounding or Treatment			X
Chemically Contaminated Water System - Premises where chemicals used as additives with water in processes.			X
Civil Works - Federal, State, City, County and District Yards; Docks and Facilities; Military Camps, Posts, Stations, Public Buildings, and Facilities			X
Construction Activities			X
Dairies and Cold Storage Plants			X
Dual/Nonpotable Water Systems			X

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Table 100-17 - BACKFLOW PREVENTION REQUIREMENTS (cont.)			
Facility	Backflow Prevention Assembly		
	Pressure Vacuum Breaker (Includes Spill-Resistant Pressure Vacuum Breaker)	Double Check Valve Assembly	Air Gap or Reduced Pressure Principle Backflow Preventer
<p>Fire Systems</p> <p>CASE I. No chemical added to system or no auxiliary source involved.</p> <p>CASE II. A system containing antifreeze, rust or corrosion inhibitors fire retardants, or other chemicals utilizing auxiliary source</p> <p>CASE III. A system with a fire department connection to the system riser.</p> <p>1 - Minimum requirement is a single check valve if fire protection system is not connected to a DC meter. <i>(For Maui only: Minimum requirement is a double check Detector Assembly.)</i></p>		<p>X¹</p> <p><i>X (For Hawaii Only)</i></p>	<p><i>X (For Kauai Only)</i></p> <p>X</p>
Golf Courses			X
Medical Buildings, Hospitals, Animal Hospitals, Animal Clinics, Sanitariums, Dental Clinics, Morgues, Mortuaries, Autopsy Facilities, Nursing and Convalescent Homes			X

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Table 100-17 - BACKFLOW PREVENTION REQUIREMENTS (cont.)			
Facility	Backflow Prevention Assembly		
	Pressure Vacuum Breaker (Includes Spill-Resistant Pressure Vacuum Breaker)	Double Check Valve Assembly	Air Gap or Reduced Pressure Principle Backflow Preventer
<p>Irrigation Systems - Premises having separate systems (i.e., Parks, Playgrounds, Cemeteries, Golf Courses, Schools, Estates, Ranches, etc.)</p> <p>CASE I. No fertilizer or chemical added to system</p> <p><i>For Kauai Only: RPs only</i></p> <p>CASE II. Irrigation system equipped with pumps, injectors, pressurized tanks or vessels used for adding pesticides or other chemicals into the system; irrigation systems subject to contamination from submerged inlets, auxiliary water supplies, ponds, and other sources of contaminated waters.</p> <p><i>2 - For Kauai Only: RPs only; For Maui Only: Air gaps only</i></p>	<p><i>X (Excluding Hawaii)</i></p>	<p>X</p>	<p><i>X (For Maui Only)</i></p> <p>X²</p>
Laundries and Dye Works			X
Metal Manufacturing, Cleaning, Processing, Fabricating, and Plating Plants			X
Motion Picture Studios and Film Laboratories			X
<p>Multi-family Master Metered Developments (PDH's, Clusters)</p> <p>3 - Property must not be in an area that uses nonpotable or reclaimed water as an auxiliary source.</p>		<p>X³ <i>(For Oahu Only)</i></p>	X

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Table 100-17 - BACKFLOW PREVENTION REQUIREMENTS (cont.)			
Facility	Backflow Prevention Assembly		
	Pressure Vacuum Breaker (Includes Spill-Resistant Pressure Vacuum Breaker)	Double Check Valve Assembly	Air Gap or Reduced Pressure Principle Backflow Preventer
Multiple Services - Interconnected			X
Oil and Gas Production, Storage or Transmission Properties			X
Paper and Paper Products Plants			X
Power Plants			X
Radioactive Materials or Substances - Plants or Handling Facilities			X
Restricted, Classified or Other Closed Facilities			X
Rubber Plants - Natural and Synthetic			X
Sand and Gravel Plants and Quarries			X
Schools and Colleges			X
Separate Pressure Water Systems Utilizing Booster Pumps or Separate Storage Facilities			X
Shopping Centers and Other Multi-Tenant Buildings			X
Swimming Pools			X
Wastewater Facilities			X
Water Front Facilities and Industries			X

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SECTION 108 - WELL DRILLING

108.01 GENERAL.

In order to comply with the requirements of the State Water Code, Chapter 177, HRS, titled, "Ground Water Use", Chapter 178, HRS, titled, "Wells, Generally", and the Department's requirements on well locations, yield, size and spacing, the developer's engineer shall consult the Manager prior to proceeding with detailed plans and specifications.

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SECTION 109 - LANDSCAPING AND IRRIGATION

109.01 GENERAL.

All Departments' facilities such as reservoirs, pump stations, well sites, etc., shall be landscaped with an irrigation system as specified by the Manager. All landscaping shall utilize xeriscaping principles by specifying plants that will thrive in the natural environment of the project location. All landscaping and irrigation shall make efficient use of water.

SECTION 110 - PLANNED DEVELOPMENTS

110.01 INTRODUCTION.

Unless otherwise approved by the Manager, all planned developments with private water systems shall have master domestic water meters with backflow devices and fire meters. All developments are subject to backflow prevention and cross connection requirements. These guidelines have been developed to assist consulting engineers or developers of cluster or planned development type of projects in the design of water system requiring approval of the Manager. While these criteria are not intended to readily adapt to each situation, the engineer's ultimate aim should be directed toward providing an adequate water system for both domestic and fire fighting purposes. However, all plans showing water systems shall be subject to review and approval by the Manager.

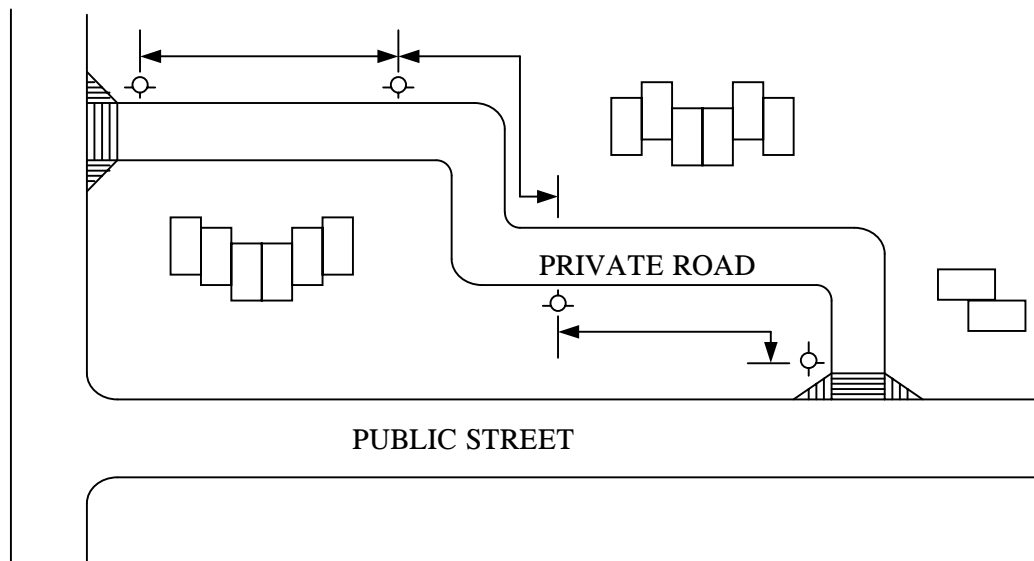
The water system for the development shall meet the requirements of these Standards and as further clarified by these guidelines.

110.02 PLANS.

To facilitate review and approval, all plans submitted shall comply with Section 112 - CONSTRUCTION PLANS of these Standards.

110.03 FIRE HYDRANTS.

A. Spacing. Where a development has master water meters on its perimeter, and where no Department's water mains go through the private property, the Developer shall be responsible for providing adequate fire protection within the development. The on-site fire protection improvements shall be verified and coordinated with the nearest County Fire Department.

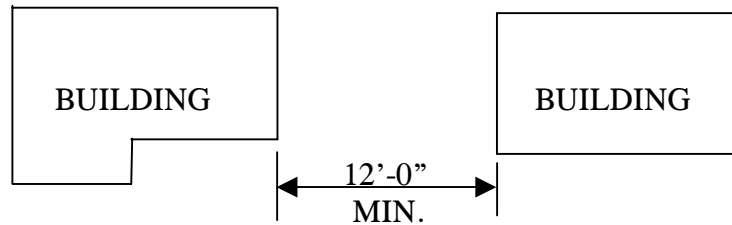


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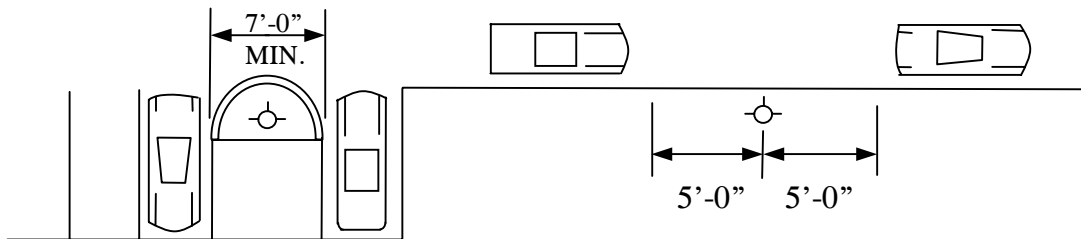
Maximum spacing of fire hydrants for the various types of communities is listed in Table 100-19. Fire hydrant spacing is measured along the roadway and not straight-line, point-to-point or across the lot.

B. Accessibility. Unless otherwise noted, accessibility to fire hydrants shall be as follows:

1. Minimum width of driveways to hydrant shall be 15 feet unobstructed. Driveways shall be paved.
2. Maximum grade to hydrant, 20% .
3. Minimum radius of edge of pavement or curbs for driveways and roadways, 35 feet.
4. Minimum vertical clearance, 14 feet above pavement.
5. Minimum horizontal distance between buildings for access, 12 ft.



6. For parallel parking, 5 feet (*10 feet for Maui*) on each side. For perpendicular parking, dimension of curb guard as shown.



7. Minimum distance of hydrant to wall or building shall be 3 feet for the hydrant operating wrench clearance.
8. Setback of hydrant behind guardrail shall be a minimum of 5 feet clear.
9. Maximum distance of hydrant shall be 8 feet from the curb or pavement.

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110.04 WATER MAINS.

A. Unpaved Areas. In looped main where pipe goes through unpaved areas, the line shall be accessible for maintenance purposes with a valve on each end.

B. Paved Traveled Areas. Mains should be installed in paved traveled area to roadways. Avoid parking areas as much as possible.

C. Off Roadways. Where main is installed off the roadways of the development, a pipeline maintenance access road shall be provided.

110.05 DRAINAGE.

Area drainage to accommodate water from broken mains or hydrants shall provide for maximum flow from broken main or hydrant. Flow of 1500 gallons per minute is minimum expected flow.

110.06 FIRE FLOW.

Fire flow requirements shall be as noted in Section 111.03 - FIRE FLOWS, DURATION AND HYDRANT SPACING of these Standards.

110.07 SECOND FEED.

For developments with 100 or more subdivided lots, provide a second feed to the subdivision's water system unless otherwise approved by the Manager.

SECTION 111 - WATER REQUIREMENTS

111.01 GENERAL.

These standards of planning are not intended to limit the initiative and resourcefulness of the engineer in developing water system plans but they shall be viewed as the minimum limits in design criteria. The water system shall be designed to meet the needs of the community for a reasonable number of years in the future.

111.02 DOMESTIC CONSUMPTION GUIDELINE.

The guidelines for water consumption which should provide an adequate water system are listed in Table 100-18. These guidelines may be revised by the Manager based on variable factors that influence water consumption rates.

111.03 FIRE FLOWS, DURATION AND HYDRANT SPACING.

The fire flows considered as the minimum by the Department are shown on Table 100-19 subject to the following considerations:

1. For residential areas, required fire flow will depend on the character and congestion of buildings.
2. For business, industry, and shopping centers the required flow depends on the bulk, congestion, fire resistance and contents of buildings.

Additional for Maui only: Supplemental to the above, fire hydrants and necessary pipelines and appurtenances may be required by the Department as deemed necessary for adequate fire protection for structures in any land use or zoning district. The Standard of the Insurance Services office's Guide for Determination of Required Fire Flow shall be used as a guide in designing mains for fire flow requirements.

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111.04 SYSTEM CAPACITY.

The capacity of the distribution system shall deliver the maximum daily demand simultaneously with the required fire flow.

The distribution system shall also deliver the peak hour flow (without fire flow).

For Maui Only: For surface water systems, the demand shall not exceed 80% of the average daily inflow from the source.

111.05 DEMAND FACTORS.

Table 100-20 lists the demand factors.

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Table 100-18 - DOMESTIC CONSUMPTION GUIDELINES				
AVERAGE DAILY DEMAND*				
ZONING DESIGNATION	HAWAII	KAUAI	MAUI	OAHU
RESIDENTIAL:				
Single Family or Duplex	400 gals/unit	500 gals/unit	600 gals/unit or 3000 gals/acre	500 gals/unit or 2500 gals/acre
Multi-Family Low Rise	400 gals/unit	350 gals/unit	560 gals/unit or 5000 gals/acre	400 gals/unit or 4000 gals/acre
Multi-Family High Rise	400 gals/unit	350 gals/unit	560 gals/unit	300 gals/unit
COMMERCIAL:				
Commercial Only	3000 gals/acre	3000 gals/acre	6000 gals/acre	3000 gals/acre
Commercial/Industrial Mix	--	5000 gals/acre	140 gals/1000 sq. ft.	100 gals/1000 sq. ft.
Commercial/Residential Mix	--	3000 gals/acre	140 gals/1000 sq. ft.	120 gals/1000 sq. ft.
RESORT (To include hotel for Maui only)	400 gals/unit (1)	350 gals/unit	350 gals/unit or 17000 gals/acre	350 gals/unit or 4000 gals/acre
LIGHT INDUSTRY:	4000 gals/acre	4000 gals/acre	6000 gals/acre	4000 gals/acre
SCHOOLS, PARKS:	4000 gals/acre or 60 gals/student	4000 gals/acre or 60 gals/student	1700 gals/acre or 60 gals/student	4000 gals/acre or 60 gals/student
AGRICULTURE:		2,500 gals/acre	5000 gals/acre	4000 gals/acre

* - Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption use shall govern the design unless specified otherwise.

(1) - Subject to special review and control by the Manager.

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Table 100-19 - FIRE FLOW REQUIREMENTS

LAND USE	FLOW (GPM)/DURATION (HRS)/FIRE HYDRANT SPACING (FT.)			
	HAWAII	KAUAI	MAUI	OAHU
Agriculture	500/0.5/600 (1)	250/1/500	500/2/500	1000/0.5/700
Rural			1000/2/500	
Single Family	(2)	(4)	1000/2/350	1000/1/350
Duplex	1500/1/300	(4)	1250/2/350	1000/1/350
PUD Townhouse and Low Rise Apartments	1500/1/300	(4)	(5)	1500/1/250
Schools, Neighborhood Businesses, Small Shopping Centers, Hotels (except Maui), and High Rise Apartments	2000/2/300	2000/2/350	2000/2/250	2000/2/250
Light Industry, Downtown Business, Large Shopping Center, and Hospitals	2,000/2/300	3000/3/350	2000/2/250	4000/3/250
Heavy Industry, Hotels	2,000/2/300	3000/3/350	2,500/2/ 250	(3)

(1) - Applies to one acre lot size or less

(2) - 10,000 sq. ft. or larger lot size = 500/2/600; Less than 10,000 sq. ft. lot size = 1000/1/600

(3) - Subject to special review and control by Manager

(4) - R-2 = 500/1/500 R-4 = 750/2/500

R-6 = 1000/2/500 R-10 = 1250/2/350

RR-20 = 2000/2/350

(5) - A-1 = 1500/2/250 A-2 = 2000/2/250

Note:

1. On dead end streets, the last F.H. shall be located at one half the spacing distance for F.H.s from the last house/unit (frontage property line or to the driveway/access for the property).
2. Spacing of fire hydrant shall be measured along the roadway.

Table 100-20 - DEMAND FACTORS		
Island	Maximum Daily Demand	Peak Hour
Hawaii	1.5 x Average Day	5.0 x Average Day
Kauai, Maui, Oahu	1.5 x Average Day	3.0 x Average Day

111.06 PIPELINE SIZING.

Pipelines shall be sized to meet the following requirements:

1. Maximum daily flow plus fire flow with a residual pressure of 20 psi at critical fire hydrant.
2. Peak hour flow with a minimum residual pressure of 40 psi.
3. In determining the carrying capacity of the mains, the "C"* values to be applied are shown in Table 100-21.

Table 100-21 - "C"* FACTORS	
Pipe Diameter (In.)	"C"
4", 6"	100
8", 12"	110
16", 20"	120
24" and Larger	130

* Not for metallic non-cement lined pipe.

4. Maximum velocity in distribution main (without fire flow) is 6 feet per second.
5. *For Maui Only: In addition, the maximum velocity in mains shall apply as follows:*
 - a. *Distribution mains - 10 feet per second with fire flow at max day domestic flow.*
 - b. *Transmission mains without water services or fire flow - 20 feet per second.*
 - c. *Fire lines - 13 feet per second.*

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6. *For Hawaii Only: Maximum velocity in distribution mains with fire flow shall be 10 feet per second.*
7. Unless specified otherwise, maximum static or pumping pressure, whichever is greater, shall not exceed 125 psi.
8. *For Oahu Only: Minimum diameter of influent-effluent line from booster pump to reservoir shall be 12-inches.*

111.07 RESERVOIR CAPACITY.

Reservoir shall be sized as follows:

1. Meet maximum day consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.
2. Meet maximum day rate plus fire flow for duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.
3. Minimum size reservoir shall be 0.1 MG. Reservoir size shall be as specified in Section 105.10 - RESERVOIR, Subsection A - Size.

Where there are two or more reservoirs serving the same system, the design shall be made on the basis of combined protection provided by all facilities available.

111.08 TOTAL PUMP CAPACITY.

The total pump capacity for each site shall be based on the criteria that yields the maximum pumpage. The criteria for each island is as shown on Table 100-22.

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Table 100-22 - TOTAL PUMP CAPACITY CRITERIA	
Island	Total Pump Capacity Criteria At Each Site
Hawaii	2
Kauai	5 ^a
Maui	1, 3, 4 ^a
Oahu	1, 3 ^a , 4 ^a

a - The largest pumping unit shall be considered out of service (standby).

Criteria

1. Meet maximum day demand with an operating time of 16 hours simultaneously with maximum fire flow required independent of the reservoir. The standby unit may be used to determine the total flow required.
2. Meet average day demand with an operating time of 16 hours or meet maximum day demand with an operating time of 24 hours with larger pump unit on standby and not contributing to flow requirements.
3. Maximum day demand during the duration of fire plus fire demand less 3/4 of reservoir storage.
4. Meet maximum day demand with an operating time of 16 hours.
5. Meet maximum day demand with an operating time of 24 hours.

SECTION 112 - CONSTRUCTION PLANS

112.01 GENERAL.

All proposed work shown on plans submitted to the Manager for approval shall be designed according to these Standards.

All construction plans shall be prepared, signed, and stamped by professional engineers, licensed under the State of Hawaii, to the extent of his professional qualifications under the laws of the State.

In matters of engineering judgment, the Manager's decision will be final.

Approval of plans by the Manager is based solely on the adequacy of the water system. Approval shall also be based on the Water System facilities and appurtenances. In the event a design change material is contemplated, thereafter, and if the project is not under construction within a period of one year (*for Oahu only: two years*), the plans shall be resubmitted to the Department for review, re-approval and changes, as it deems proper because of changed conditions or revision of Standards. All other features of the water system such as lines, grades, slope stability, fittings, etc., and other features of improvements shall be the responsibility of the engineer who prepared the plans. Drainage within water facility site, and other features of the improvements shall also be the responsibility of the engineer who prepared the plan.

112.02 PLANS.

Unless otherwise approved by the Manager the construction plans, insofar as the water system is concerned, shall be of polyester tracing film (4 mil thick mylar sheets) (*for Oahu only: xerographic vellum*), matte on both sides, and shall show the following on standard size sheet or sheets, measuring 24" x 36" overall (*for Kauai only: 22" x 36" overall*) with no exceptions. Drawings and title sheets shall be in ink or photo mylars ("sticky-backs are not acceptable"). (*For Oahu only: Minimum lettering size shall be 1/8-inch.*)

The construction plans submitted for approval shall include the following minimum requirements.

1. Name of project or subdivision, name of engineer with engineer's signature and stamp affixed thereon, appropriate approval signature blocks and location map of project.
2. North arrow, graphic scale, tax map key.

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3. The proposed project, type of development such as single family, clusters, high-rise, commercial, industrial, one-lot development, utility improvements and others, number of units and living stories. Complete with both plan and profile, and its inter-relationship with street lines, lot lines, curb grades, sewers and drains, electrical, gas, cable, communication lines, both existing and proposed conditions, as well as any other features natural or artificial necessary for a complete understanding of the water system design.
4. Plan views drawn to a scale of one inch equals 40 feet or one inch equals 20 feet. Profile views drawn to a vertical scale of one inch equals 4 feet or larger to USGS datum. Plan and profile shall be drawn on the same sheet where practicable, with profile stationing running from left to right.
5. Main location and size, to include profile view of main and meter connection and all material call outs.
6. The designation, including alignment, width and area, of all easements for parts of the water system which will not be in street areas to be dedicated to the public.
7. A general layout map with an appropriate scale showing the locations of lot, lot numbers, access to property (show ingress and egress), rights-of-way, easements, roadways, property pins, and streets within the project and its near vicinity together with existing and proposed utilities and its appurtenances. Show phasing of water system construction as applicable.
8. A small key location inset or vicinity map showing the proposed project in relationship to streets and water mains in the area.
9. Applicable Water Notes to include test pressure for water main.
10. Building, streets, and lot layouts. Plans shall show location of access to property, all existing conditions, and existing fire hydrant locations with numbers. All utilities shall be labeled as existing or new. All street names shall be labeled as existing or proposed new City, State, Federal, Private or Private City Maintained roadways.
11. Lettering size shall be readable when reduced 50 percent.
12. The Manager's signature block shall be shown on the construction plans as follows:
 - a. *For Maui and Hawaii: Title sheet only.*
 - b. *For Kauai: Title sheet and all applicable interior water related sheets.*

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- c. For Oahu: Title sheet for subdivisions or new water facilities projects (wells, booster stations and reservoirs) only. Provide signature block for Manager's designated official for water notes sheet, detail sheets and all other appropriate sheets where work is to be done near or along the water system. Signature blocks for City projects may not be required and shall be verified with the latest requirements of the City Department of Planning and Permitting.*
13. Easement lines on plan and profile. Provide dimensions and area of the easement to be granted to the applicable Department or Water Board (Hawaii).
14. Applicable details only if they deviate from the latest water system standard details.
15. Plan and profile shall provide the following:
 - a. Existing and new main locations and sizes including meter connections and utilities. Existing waterlines and utilities must be in light or hidden lines and new utilities must be in solid or thicker lines for distinction.
 - b. All material call-outs including bends and fittings with concrete blocks or beams, as required, and valves with station numbers.
 - c. Show existing and new finish grade lines, valves, 3-inch and larger meter and fire hydrant pipe inverts on profile views.
16. For existing and new water services:
 - a. Locations of all new and existing water meter boxes within the project limits serving the specified lot(s) that are affected by the project and indicate meter numbers on plans. (The meter numbers are located on top of or underneath the meter dial cover) Laterals from meter box to existing or new main.
 - b. Size of existing and new laterals and meters and provide Flow Requirements that include existing and additional fixture units (FU), gallons per minute (GPM), gallons per day (GPD) and the Department's estimate of applicable charges. *(For Oahu only: All information shall be shown on the construction plans.)*
 - c. Existing and/or new approved backflow preventers after domestic meters, after property valves but prior to any tees and branches.
 - d. For new 3-inch and larger meter connections, provide plan and profile views of lateral from main to property or backflow preventers.

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- e. Laterals to be cut and plugged at main; meters, valve boxes, manholes and meter box frames and covers to be removed and salvaged.
- f. The installation, chlorination and testing of the water main and facilities after the meter(s) shall not be the responsibility of the Department.

When submitting for approval, four sets (six sets for new facilities) of construction plans and specifications along with a transmittal letter (indicating what is being submitted and person to contact with phone numbers) shall be submitted. *(For Oahu Only: Initial submittals shall be coordinated with the City and County of Honolulu, Department of Planning and Permitting.)*

112.03 MISCELLANEOUS SUBMITTALS.

For Oahu Only: Submit the following as applicable to the new onsite or offsite water system improvements:

1. One set of fire flow calculations for plans showing new on-site fire hydrant installations off an existing or new detector check or FM meter. Fire flow calculations shall be for the most critical fire hydrant and shall meet the minimum requirements in Section 111.03 - FIRE FLOWS, DURATION AND HYDRANT SPACING and Table 100-19.
2. Two sets of soils report showing the soil resistivity test results and rating for new waterlines exceeding 500 linear feet of new pipes only. The report shall include recommendations and calculations for the corrosion design and type of anodes to be used. Plans shall include applicable corrosion designs.
3. Two sets of soils or geotechnical survey report, drainage report, and structural calculations for new structures and facilities to be dedicated to the Department.
4. Six sets of project specifications and special provisions for new reservoirs, booster stations, wells and other structures.
5. Copy of latest approved master plan. The size and layout of water mains shall be in accordance with the approved master plans for new subdivisions.
6. For new subdivisions, transmission mains, reservoirs, wells, booster stations and other larger water system improvements, submit a preliminary cost estimate for construction of all water systems prior to approval of plans.

112.04 SUBMITTALS PRIOR TO CONSTRUCTION.

For Oahu only: The Department's Maintenance Unit – Engineering, Construction Section shall be notified in writing one week prior to commencing work on the water systems. For improvements that require work on the water systems and inspection from the Department, four (4) sets of approved construction plans and specifications shall also be submitted to the Department one week prior to commencing work. Specifications are required for new structures and facilities only. All notifications must be in writing and shall include information on the Contractor's, contact person's name and phone numbers and approximate date, the work on the water systems will begin.

112.05 SUBMITTALS DURING CONSTRUCTION.

Six sets of shop drawings reviewed, stamped and signed by the design engineer shall be submitted to the Department for review and approval prior to construction and/or fabrication of materials. See Division 200 - MATERIALS and Division 300 - CONSTRUCTION for other submittals required during construction.

112.06 AS-BUILT CONSTRUCTION PLANS.

Upon completion of construction of a project, as-built construction plans and tracings shall be submitted to the Department. Tracings shall be as specified in Section 112.02 - PLANS.

1. The Licensed Professional Engineer shall make all necessary corrections on the tracings to reflect all construction changes, alterations and/or deletions, other than formal approved revisions already shown on the construction plans. Additional tracings of any working or shop drawings approved by the Manager shall also be included for filing.
2. All corrections shall be in permanent-type red ink darkened with permanent black ink (approximately one-part black to five-part red).
- 3a. The word "AS BUILT" shall be labeled on the title sheet and certified by the Licensed Professional Engineer as to accuracy.

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AS-BUILT TRACINGS

Certified By: _____ Date: _____
Engineer

Approved By: _____ Date: _____
Manager

Label "AS-BUILT" on all sheets in the margin space left of the sheet number.

- 3b. In lieu of 3a, the words "RECORD DRAWING" shall be labeled on the title sheet and certified by the Contractor as to accuracy. The Licensed Professional Engineer shall formally submit the tracing.

RECORD DRAWING TRACINGS

Certified By: _____ Date: _____
Contractor
(Include name and company)

Submitted By: _____ Date: _____
Design Engineer

Approved By: _____ Date: _____
Manager

Label "RECORD DRAWINGS" on all sheets in the margin space left of the sheet number. All signatures and dates shall be in permanent black ink.

4. Tracings for filing must be of good quality and not subject to flaking, rubbing, or scraping off. Tracings for filing must also not exhibit or be subject to discoloration or distortion.
5. No "paste ons", especially for title blocks, water notes and engineer's stamp will be accepted.
6. All tracings and shop drawings shall bear the stamp or seal and the signature of the Licensed Professional Engineer in permanent black ink.

SECTION 113 - WATER MASTER PLAN

113.01 GENERAL.

A water master plan is defined as a plan describing the development of any property including all of the proposed water system improvements necessary to provide adequate water service to the development. All proposed work shown on the water master plan submitted to the Manager for approval shall be designed according to these Standards.

In matters of engineering judgment, the Manager's decision will be final.

Approval of plans by the Manager does not constitute a water commitment. Water commitment for the project shall be in accordance with the Department's Rules and Regulations.

113.02 PLANS.

The water master plan, insofar as the water system is concerned, shall show the following:

1. Name of project or subdivision, name of engineer, tax map key, location and acreage.
2. Type of development and number of units.
3. Access to property.
4. Elevations and contours of property based on mean sea level.
5. Building, street, and lot layout.
6. Estimated water demand in gallons per day.
7. Development and construction schedules.
8. Proposed water facilities.
9. Supporting calculations showing adequacy of water facilities during interim and ultimate development.

113.03 DEVELOPMENT BY PHASES.

If development of the project is to be done in phases over a period of time and the Standards are revised, or if there are changes in the type or layout of development proposed, the master plans shall be revised accordingly and resubmitted for review and approval by the Manager.