

CALAMBA WATER DISTRICT

Lakeview Subd., Halang, Calamba City

SCOPE OF WORKS AND SPECIFICATIONS

Installation of Water Distribution System

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Acronyms

ACI	American Concrete Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CI	Cast Iron
EPDM	Ethylene propylene diene Monomer
GI	Galvanized Iron
IR	Inspection Request
ISO	International Organization for Standardization
NPT	National Pipe Thread
NSF	National Sanitation Foundation
PNS	Philippine National Standards
uPVC	Unplasticized Polyvinyl Chloride

SCOPE OF WORKS

A. EARTHWORKS

- A.1. Removal of Existing Pavement: All concrete pavement surfaces to be removed shall be scored with concrete sawing equipment; provided, that any Portland cement concrete base under asphaltic mix surface will not be required to be scored by sawing. Asphaltic concrete pavement shall be removed to clean straight lines.

The width and length of the pavement area required to be removed for the installation of valves; valve chambers shall not exceed the maximum linear dimensions of such structures by more than 0.30 meters on each side.

Concrete sidewalks, curbs and gutter required to be removed shall be cut to the nearest score marks.

- A.2. Excavation: Excavation for pipelines shall be open-cut trenches. Excavate trenches with even bottoms, uniform width and vertical sides. The bottom of the trench, including any shoring shall have a minimum and maximum width shown in table of Typical Trench Detail drawing (SD-1). The maximum amount of open trench permitted at any one time and in one location shall be 300 meters, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater.

When excavating in rock or shale, dig trench 10 – 15 cm below the desired pipe bottom and backfill with compacted sand to proper grade.

- A.3. Disposal of excess Excavated Material: Remove and dispose all excess excavated material in manner approved by Engineer.
- A.4. Excavation in Lawn Areas: The sod shall be carefully removed and stockpiled to preserve it for replacement. Excavated material from the trench may be placed on the lawn provided a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of back filling and testing of the pipeline, the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition.
- A.5. Excavation in Vicinity of Trees: Except where trees are shown on the drawing to be removed, trees shall be protected from injury during construction operations and no tree is to be removed without written permission from Engineer. Trees shall be supported during excavation.

B. PIPE LAYING

- B.1. Installation: Install pipes, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials and all other appurtenances as shown and as required to provide a complete and workable installation. Where pipe supports details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically shown. At all times when the work of installing pipes is not in progress, all openings into the pipe and the ends of the pipe in trenches shall be kept tightly closed to permit entrance of animals and foreign materials.
- B.2. Laying of Pipes into Trench: Trenches shall be in a reasonably dry condition when the pipe is laid. The pipe sections shall be laid to the line and grade when shown and they shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B.3. Connections to Existing Water Mains: Preassemble fittings, valves etc., as far as possible and have all necessary tools and equipment on-site before shutting off the existing main. Pour concrete thrust blocks, if required, to the new line and allow curing for at least eight days before the pipe is put under pressure.
- B.4. Thrust Blocking: Concrete thrust blocks, anchor blocks or welded joints shall be provided at all junctions, changes in directions exceeding 11½° or where otherwise shown. Concrete should have a compressive

strength of at least 140 kg/cm², 28 days after pouring. This can be accomplished by mixing the following proportions:

- One part Portland cement
- 2½ parts clean sand (do not use beach sand)
- Five parts crushed stone (1 – 3 cm)
- Enough water to make a workable mix

C. BACKFILL/RESTORATION

- C.1. A newly laid pipe shall be backfilled at least 150mm (6in) above the top of the pipe at the end of each day with selected material obtained from the excavation. Materials used for backfill shall be selected, free from grass, roots, brush or other vegetation, or rocks having maximum dimensions larger than 150mm (6 in). If in opinion of the Engineer, said material is unsuitable for backfill purposes, borrow material having the sand equivalent value of not less than twenty (20) (ASTM – D2419) shall be used for this portion of the trench backfill. Selected material shall first be brought up to mid – diameter of the pipe and compacted; then the remainder of the backfill to 150mm (6in) above the pipe maybe placed and compacted. Such material shall be compacted to ninety five percent (95%) of max. density where the trench is located under proposed structures and ninety percent (90%) of max. density elsewhere. Compaction shall be obtained by tamping it not more than 150mm (6in) layers or by using excess water and passing a concrete vibrator between the pipe and the side of the trench. Obtain and complete (IR) inspection request form prior to backfilling; the works may proceed upon approval of the Supervising Engineer. Remainder of the trench shall be backfilled not later than the following day.

Barricades and warning lights satisfactory to the Engineer shall be provided and maintain for all in which case of heavy steel plates, adequately braced bridges or other type of crossing capable of supporting vehicular traffic shall be furnished.

- C.2. Concrete pavement shall be replaced with the same kind or better material in conformance with the latest specifications, rules and regulation, and subject to the inspection and approval of the agency having jurisdiction.

D. HYDROTESTING/DISINFECTION

- D.1. Prior to permanent resurfacing after the trench is backfilled, but with joints exposed, all pipes, slowly with water and has been completely filled; it shall be allowed to stand under a slight pressure for a minimum of 48 hours. The test pressure shall be 100 psi and leakage shall not be less than 0.0777 li per mm per kilometer of length per hour.

All new domestic water mains or extensions to existing systems, or valve section of such extension or any replacement in the existing water system shall be disinfected with chlorine. Disinfections shall be completed not more than 3 days prior to placing the pipeline into service unless otherwise approved by the Engineer and care shall be taken to prevent recontamination of the pipeline.

MATERIAL SPECIFICATIONS

A. PIPES AND FITTINGS

A.1. Unplasticized Polyvinyl Chloride (uPVC)

A.1.1. Pipes and fittings shall conform to the requirements of AWWA C900, ISO 1452 or PNS 65 or the latest revision or its equivalent and shall be pressure Class 150 (Series 8) with machine installed Integral Fixed seal. The seal should be polypropylene (PP) with flexible EDPM Rubber homogenously bonded to stiff piping

A.1.2. PVC Pipes and fittings shall be made from clean, blue-pigmented, virgin, NSF approved Class 12454-A or 12454-B PVC compound conforming to the requirements of ASTM D1784.

A.1.3. All pipes shall be furnished in lengths of 6 meters.

Table 1. uPVC Pipe Dimensions

Nominal Pipe Size, in	2	3	4	6	8	10	12
Nominal Diameter, mm	50	75	100	150	200	250	300
Outside Diameter, mm							
Min	63	90	110	160	225	280	315
max	63.3	90.3	110.4	160.5	225.7	280.9	316.0
Wall Thickness, mm							
min	3.6	5.2	6.6	9.5	13.4	16.6	18.7
max	4.16	5.92	7.13	10.32	14.39	17.80	20.00

A.2. Galvanized Iron (GI)

A.2.1. Pipes shall conform to the requirements of the ASTM A53/A53M (Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless) or the latest revision or its equivalent and shall be Schedule 40.

Pipe fittings shall conform to the requirements of ASME/ANSI B16.3 (Malleable Iron Threaded Fittings Class 150 and 300) and shall be Class 150.

A.2.2. The pipe shall be practically straight and both ends of the pipe shall be at right angle to the axis of the pipe. The inside and outside surfaces of the pipe shall be free from injurious defects. Unless otherwise specified, the length of the pipe shall be 6 meters. The tolerance shall be plus 6 meters without negative tolerance. Pipes shall be clearly marked with Trademark, Nominal Size, Length and Class of Pipe.

A.2.3. The pipe and fitting threads shall be made according to “American Standard Pipe Taper Thread (NPT) with taper angle equal to 1°47’.

A.2.4. Pipes and fittings shall be coated with zinc, both inside and outside surfaces, in accordance to ASTM A153/A153M-05 (Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware)

Table 2. GI Pipe and Fitting Dimensions

Nominal Pipe Size, in	½	¾	1	1¼	1½	2	3	4
Nominal Diameter, mm	15	20	25	32	40	50	75	100
<i>Pipes</i>								
Outside Diameter, mm	21.3	26.7	33.4	42.2	48.3	60.3	88.9	114.3
Wall Thickness, mm	2.8	2.9	3.4	3.6	3.7	3.9	5.49	6.02
Tolerance								
outside diameter,	±0.397	±0.397	±0.397	±0.397	±0.397	±1%	±1%	±1%

Nominal Pipe Size, in	½	¾	1	1¼	1½	2	3	4
Nominal Diameter, mm	15	20	25	32	40	50	75	100
wall thickness	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%
Weight per meter, kg	1.27-1.34	1.68-1.78	2.50-2.62	3.38-3.55	3.75-4.23	5.00-5.43	10.3-11.3	14.5-16.1
<i>Fittings</i>								
90° Elbow								
Length	28.45	33.27	38.10	44.45	46.74	57.15	78.23	96.27
Weight, kg	0.11	0.18	0.29	0.43	0.56	0.79	2.34	4
45° Elbow								
Length	22.35	24.89	28.45	32.77	36.32	42.67	55.12	66.29
Weight, kg	0.07	0.10	0.15	0.38	0.52	0.77	2.11	3.46
St. Elbow								
Length, ME	40.89	48.01	54.10	61.98	67.82	83.06	114.55	114.27
Length, FE	28.45	33.02	38.10	44.45	49.28	57.15	78.23	96.27
Weight, kg	0.11	0.18	0.29	0.49	0.66	1.06	2.99	4.94
Tee								
Length	28.45	33.27	38.10	44.45	49.28	57.15	78.23	96.27
Weight, kg	0.16	0.25	0.41	0.59	0.78	1.19	3.22	5.12
Cross Tee								
Length	28.45	33.27	38.10	44.45	49.28	57.15	78.23	96.27
Weight, kg	0.20	0.29	0.44	0.72	0.86	1.33	3.7	6.76
Coupling								
Length	34.04	38.61	42.42	49.02	54.61	64.26	80.77	93.73
Weight, kg	0.09	0.13	0.22	0.34	0.45	0.66	1.5	2.56
Union Patente								
Length	43.69	51.31	55.63	57.40	62.74	69.85	89.92	97.79
Weight, kg	0.21	0.26	0.41	0.54	0.74	1.09	2.47	4.31
Thickness, mm	2.54	3.05	3.30	3.56	3.81	4.32	5.84	6.60
Tolerance								
Dimension, CF, mm	±1.50	±1.50	±1.80	±1.80	±2.00	±2.00	±2.50	±3.00
Thickness	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%

Notes: (1) All dimensions are in millimeters except where otherwise shown.

(2) Center-to-Face dimensions apply to elbows, tees & crosses

(3) Face-to-Face dimensions apply to couplings, unions, etc.

(4) ME – Male End, FE – Female End, CF – Center-to-Face

A.3. Cast Iron (CI)

A.3.1. Cast iron pipe shall conform to the requirements of AWWA C106 (Cast Iron Pipe Centrifugally Cast in Metal Molds for Water or other Liquids) or AWWA C108 (Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water or other Liquids) and shall be Class 100 or Class 150 where shown in the Drawing; or ISO Recommendation R-13 (Cast Iron Pipes, Special Castings and Cast Iron Parts for Pressure Main Lines) and shall be Class LA, however, the hydrostatic test pressure shall be 2.45MPa (355 psi) for all sizes.

A.3.2. Pipe shall be furnished with bell and spigot ends with rubber “push-on” joints, flange joints, or flexible coupling.

- A.3.3. The pipe shall be lined with cement mortar in accordance with the requirements of AWWA C104 (American Standard for Cement-Mortar Lining for Cast-Iron Pipe and Ductile-Iron Pipe and Fittings for Water)
- A.3.4. Cast iron fitting shall conform to the requirements of AWWA C110 (American Standard for Cast Iron and Ductile Iron Fittings, 2-in through 48-in., for Water and Other Liquids) or ISO R13 (Cast Iron Pipes, Special Casting and Cast Iron Parts for Pressure Mainlines).
- A.3.5. Fittings are manufactured of ductile iron grade 70-50-05 (minimum tensile strength: 70,000psi; minimum yield strength: 50,000; minimum elongation: 5%) as specified in AWWA C110 or C153.
- A.3.6. Fittings shall be furnished with mechanical or flanged joints.
 - A.3.6.1 Mechanical Joints: All mechanical joint fittings will be Bell and Bell unless otherwise specified. Mechanical joint fittings shall be rated for 350 psi working pressure for sizes 4-in – 24-in.
 - A.3.6.2 Flanges: All flanges are plain without projections and are furnished smooth or with shallow serrations. The flanges shall conform to ISO 7005 – 2. Flanged fittings shall be rated for 250 psi working pressure for sizes 4-in – 64-in.
 - A.3.6.3 Bolts, Studs and Nuts: Bolts are hex head machine bolts with regular or heavy hex nuts as specified. Studs with one hex nut each are required for tapped flanges. Bolts, studs and nuts are low-carbon steel per ASTM A307 Grade B; threads are ANSI B1.1 Coarse Thread Series, Class 2A external and Class 2B internal. Recommended studs are the same length as corresponding bolt length with "tap end" threaded approximately the same length as flange thickness.
- A.3.7. All fittings shall be epoxy coated internally and externally in accordance to AWWA C116 (Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service).

B. VALVES

- B.1. Air Release and Air/Vacuum Valves
 - B.1.1. Air release and air/vacuum valves shall conform to the requirements of AWWA C512 (Air Release, Air/Vacuum and Combination Air Valves for Waterworks Service) or the latest revision or its equivalent.
 - B.1.2. The body shall be single body type with National Pipe Threaded (NPT) inlet and outlet configurations.
 - B.1.3. Epoxy lining and coatings for valves shall conform to AWWA C550 (Protective Epoxy Interior Coatings for Valves and Hydrants).
- B.2. Check Valves
 - B.2.1. Check valves shall be resilient seated conforming to AWWA C508 (Swing-check Valves for Waterworks Service 2-in through 24-in (50-mm through 600-mm) NPS) or the latest revision or its equivalent.
 - B.2.2. The valve shall be designed for a minimum water working pressure of 1.0MPa (150psi).
 - B.2.3. The valve body and cover shall be cast in Ductile Iron and coated with a thermally applied polymeric coating.
 - B.2.4. The disc shall be encapsulated in EPDM rubber.
 - B.2.5. The check valve shall be designed so that the disc and body seat may be easily removed without removing the valve from the line.
 - B.2.6. The check valve shall be flanged type conforming to ISO 7005 – 2.

B.3. Gate Valves

Cast Iron (CI)

- B.3.1. All valves shall conform to the AWWA Specifications C509 (Standard for Resilient Seated Gate Valves) or the latest revision or its equivalent. Component parts are constructed of heavy, rugged proportions for extra strength to withstand pipe strain and possible shifting in underground service. Gate valves shall be designed for minimum water working pressure of 1.0 MPa (150 psi).
- B.3.2. The gate valve shall be flanged and mechanical joint. Flanges and drilling shall conform to ISO 7005 – 2.
- B.3.3. All resilient gate valves have a full bore with same nominal diameter as the pipeline. The full bore ensures minimum pressure loss, as the valve does not cause any reduction in the flow path, other great advantages are that the full bore allows drilling and facilitates pipe pigging to ensure high quality potable water.
- B.3.4. The ductile iron core is fully vulcanized with EPDM rubber internally and externally. No iron parts are exposed to the medium and the excellent rubber vulcanization prevents creeping corrosion underneath the rubber.
- B.3.5. The fixed integral wedge nut reduces the number of moveable valve parts and risk of malfunction.
- B.3.6. The valve shall be encapsulated and shall be non-rising stem with a minimum two “O” ring seals (at least one above the stem collar).
- B.3.7. The valve shall have 50mm (2 in) square operating nut with cast arrow showing direction in which the nut is to be turned open the valve.
- B.3.8. The body and cover bolts and nuts shall meet specifications of ASTM A-307 (rust proofed).
- B.3.9. All valve casting to be shot blasted prior to epoxy coating. Epoxy coating shall conform to AWWA C550 (Protective Epoxy Interior Coatings for Valves and Hydrants) specifications. Body and bonnet are coated internally and externally. Layer thickness shall be 250-400 microns on flat and pressurized parts and 150-300 microns on convex outer edge.

Table 3. CI Gate Valve Dimensions

Nominal Pipe Size, in	2	3	4	6	8	10	12
Nominal Diameter, mm	50	75	100	150	200	250	300
Length (Face to Face), mm	178 – 180	203 – 205	221 – 229	267 – 268	292 – 295	330 – 335	356 – 365
Height (above CL), mm	241 – 326	297 – 378	334 – 430	443 – 549	544 – 646	627 – 750	785 – 835
Weight, kg	13 – 18	20 – 23	26 – 33	51 – 53	75 – 83	125 – 133	174 – 193

Brass

- B.3.10. Brass valves shall be full port, screwed-in bonnet and non-rising stem.
- B.3.11. The valve body, bonnet and solid wedge disc shall be brass conforming to ASTM B584 Alloy C84400-1996 or the latest revision or its equivalent. The minimum pressure rating shall be 125psi saturated steam pressure and 200psi non-shock water, oil or gas.
- B.3.12. The valve shall be threaded end conforming to ASME B1.20.1 (NPT)

Table 4. Brass Gate Valve Dimensions

Nominal Pipe Size, in	½	¾	1	1¼	1 ½	2
Nominal Diameter, mm	15	20	25	32	40	50
Length, mm	35 – 43	39 – 45	43 – 54	48 – 61	54 – 63	58 – 72
Height, mm	71 – 72	77 – 84	88 – 98	103 – 116	114 – 125	134 – 153

Handwheel Diameter, mm	54 – 55	54 – 55	60 – 61	72 – 77	72 – 77	80 – 83
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C. FIRE HYDRANTS

- C.1.1. Fire hydrants heads shall be cast iron body conforming to the requirements of AWWA C503 (Wet-Barrel Fire Hydrants) or the latest revision or its equivalent, with bronze working parts.
- C.1.2. Fire hydrants shall be designed for a minimum pressure of 1.0MPa (150 psi) and have a 100mm (4-in) flanged inlet and two (2) 63mm (2½-in) fire hose outlet.
- C.1.3. The outlets shall have National Standard Hose Threads with hose caps and chains.
- C.1.4. The stem shall be provided with at least two (2) O-rings.
- C.1.5. Hydrant valves shall open counter clockwise.
- C.1.6. Breakable piece and extension elbow shall be provided.
- C.1.7. Epoxy lining and coatings for valves shall conform to AWWA C550 (Protective Epoxy Interior Coatings for Valves and Hydrants).

D. STRAINER

- D.1.1. The strainer should be designed for minimum weight and pressure loss.
- D.1.2. The screen shall be made of perforated stainless steel plate and shaped to give maximum rigidity against the flow stream forces.
- D.1.3. The effective straining area shall be at least double that of the meter main case inlets.
- D.1.4. An access cover plate shall be provided.
- D.1.5. Strainers shall be furnished with dual round-type flanged connections which are faced and drilled. Bolt circle, length and diameters shall be compatible with meter connection dimensions in conformance to ISO 7005 – 2. Sufficient flange bolts; nuts and gaskets shall be furnished.
- D.1.6. The housing and cover shall be cast iron. Raised letters indicating the flow direction will be clearly visible.
- D.1.7. Casing bolts, nuts, screws and washers shall be made of a copper alloy containing not less than 57 percent copper or stainless steel.

E. MANHOLE FRAME AND COVER

- E.1.1. The manhole frame and cover shall be round manufactured from cast iron or ductile iron conforming to ASTM A-126, Class B or ASTM A-536-80, Class 400 respectively.
- E.1.2. The frame depth shall not exceed 200mm and four (4) bolt holes shall be provided for anchoring purposes.
- E.1.3. The cover shall be 575mm – 625mm in diameter. The face of the cover shall include the name and/or logo of Calamba Water District. The name/logo shall be cast into the cover during manufacture.
- E.1.4. The cover shall be connected to the frame with a hinged. A locking mechanism shall be included to prevent unauthorized access.
- E.1.5. The cover shall be one-man operable and shall be designed for a maximum highway loading.

F. RANDOM TESTING

- F.1. For every size, two (2) sample pipes representing each lot of one hundred (100) pieces or less shall be tested for compliance with this specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

G. CERTIFICATION

- G.1. The manufacturer shall furnish a sworn statement that the inspection and metallurgical and pressure tests have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification shall be submitted to Calamba Water District.