

SECTION 91 WATER DISTRIBUTION SYSTEM

91.1 GENERAL

The construction of all waterworks and appurtenances shall be in accordance with these specifications. Trenching and backfilling components are in a separate Section in this manual **or refer to the appropriate Municipalities Standards.**

Water mains shall refer to the supply, installation, testing, and cleaning of pipe and bedding in accordance with these specifications.

No persons, other than Aquatera employees, are to operate Aquatera water valves or other Aquatera appurtenances for any reason.

91.2 MATERIALS

91.2.1 PIPE

Poly Vinyl Chloride (PVC) type CIOD (Cast Iron Outside Diameter) pipe meeting the specifications of AWWA C-900-89 (100 - 300 mm), AWWA C-905 (350 - 600 mm) and CAN3-B137.3-M86 latest version thereof.

The pipe must be CSA approved with a pressure rating of 1035 kPa (class 150).

Dimension Ratio (SDR) shall be 18.

Jointing shall be Gasketed bell-end, Gaskets shall conform to ASTM D1869, latest version thereof.

For horizontal directional drilling TerraBrute PVC pipe is approved for use.

91.2.2 FITTINGS

a) PVC

PVC Injection Moulded Gasketed Fittings meeting the specifications of Can/CSA-B137.2-M89 and AWWA C-907-91, latest version thereof. (Fittings of 200 mm or less).

Fittings shall be CSA approved with a pressure rating of 1035 kPa (class 150).

Dimension Ratio (DR) shall be 18. Colour coded blue.

PVC reducers and fabricated fittings are not allowed.

b) Cast Iron

Will only be allowed if the fitting is not readily available in injection moulded PVC. (Fittings greater than 200 mm).

Conforming to AWWA C110.71 Class 1725 kPa.

Jointed with push-on rubber rings. PVC reducers shall not be allowed.

Cathodic Protection shall be required.

91.2.3 TRANSITION COUPLINGS

Transition couplings to connect dissimilar pipe materials are to be robar style, or approved equivalent.

The transition coupling shall have sleeves and end plates made of ductile iron conforming to ASTM A536. Bolts, nuts and washers shall be stainless steel type 304. Gaskets shall be made of vulcanized rubber conforming to the latest issue of ASTM D2000. The corrosion protective coating shall be applied to the sleeves and end plates and shall be factory coated with 3M scotchkote 206N or equal in accordance with AWWA C-213, coatings in contact with potable water. All coated elements shall carry a label identifying the name of the coating applicator. The couplings shall be packaged and delivered as a complete unit (c/w sleeve, gaskets, end plates, nuts, bolts and washers).

91.2.4 VALVES

Cast Iron body and bronze mounted with grade of bronze used to be completely resistant to de-zincification by water have a pH of 9.0

Resilient seat gate valve type conforming to AWWA C-509.

Operating pressure shall be 1,200 kPa.

Push-on rubber ring connectors.

Non-rising stems, type 304 stainless steel.

O-ring stem seals

50 mm type 304 stainless steel operating nut. All exterior nuts, bolts, and washers shall be type 304 stainless steel. All bolts and nuts shall have hexagonal heads.

Valves shall open in a counter clockwise direction.

Those portions of valves in contact with potable water shall be coated with 3M scotchkote 206N or approved equal in accordance with AWWA C213, coatings. All coated elements shall carry a label identifying the name of the coating and the coating applicator.

Internal and External portions of valves shall be coated with epoxy coating.

91.2.5 VALVE BOXES

Cast iron body, two section, bituminous coated.

Norwood Foundry type or equivalent adjustable to 3.0 metre bury.

Comes with extension spindle and 50mm flange nut and cap and shall have a 2 inch top nut installed.

Must be of sufficient length to provide adjustments of 300mm in up or down direction.

Extensions shall be cast iron suitable for use with valve boxes installed.

91.2.6 HYDRANTS

Conforming to AWWA C502.80 - Fire hydrants for ordinary waterworks service.

The following manufactures are approved for use in Aquatera's operating area:

1. McAvity (Clow Canada)
2. Mueller
3. Canada Valve

Hydrants to be supplied with a minimum of one 300mm lower barrel extension. The combined length of the lower barrel and the 300mm extension shall allow at least 2.9 metres depth of bury for the watermain.

For hydrants with a depth of bury in excess of 4.3m an inline chamber shall be used with the depth of the valve not to exceed 3.0m.

150 mm inlet connection with compression type push-on rubber ring joint to suit the watermain pipe.

Hydrants shall be supplied with break-away type ground level flanges.

Hydrants shall have two 63.5 mm hose nozzles threaded to conform to the Alberta Mutual Aid Thread Standard of 8 threads per 25.4 mm and open in a counter clockwise direction.

Hydrants shall also have a single 100mm pumper nozzle with an integral Stortz coupling and nozzle cover conforming to CSA CAN4-S543-M84 threaded to conform to the Alberta Mutual Aid Thread Standard of 8 threads per 25.4 mm and open in a counter clockwise direction. All nozzle caps and operating nuts shall be pentagonal in shape. Hydrants on public property are to be painted Hi-Vis Yellow. Hi-Vis Yellow shall conform to General Paint Self-Prime Gloss Urethane Enamel Rust Resistant Formula, 16-242 Hi-Visible Yellow.

All hydrants are to have bolt down tops.

Nozzle covers are to be painted the same colour as the hydrant barrel. Hydrants on private property are to be painted red.

Hydrants shall be equipped with a threaded drain which shall not be plugged unless so directed by Aquatera in consideration of the water table.

All flange nuts and bolts shall be stainless type 304 steel with hexagonal heads conforming to ASTM standards. Bolts and nuts shall be the size and length recommended by the valve and flange manufacturer.

A 2 mil. filter fabric shall be required at the top of the sump. The sump shall be constructed with washed crushed gravel meeting the following specifications:

Sieve Size	% Passing
25,000	100
12,500	40 - 65
5,000	25 - 45
2,000	10 - 30
400	7 - 15
80	0 - 5

91.2.7 BEDDING

a) Sand

Sand bedding shall have an even gradation falling within the following limits:

Sieve Size (CGSB Spec)	Allowable Passing (percent)
5,000	100
2,000	70 to 95
400	30 to 65
160	10 to 25
80	2 to 10

b) Granular (B1)

Granular bedding shall have an even gradation falling within the following limits:

Sieve Size (CGSB Spec)	Allowable Passing (percent)
20,000	95 to 100
12,500	75 to 95
5,000	40 to 60
2,000	25 to 45
400	10 to 25
80	2 to 10

c) Select Native

Shall be well graded soil selected by the Contractor from the excavated trench material. It shall contain no particles larger than 32mm in its largest dimension. It shall contain no frozen soil, roots or other objectionable material in quantities that might cause pipe damage, excessive settlement or inadequate compaction. The moisture content shall be such as to allow proper placing and compaction.

d) Concrete

Shall be 25 MPa concrete ASTM Type 50, slump 25-75mm, air 3%.

91.2.8 HYDRANT MARKERS

Hydrant markers shall be Briteside Series 10.3.1 in diamond grade yellow minimum 3" wide or an equivalent approved in writing by Aquatera.

91.2.9 THRUST BLOCKING

Thrust blocking shall be done with 25 MPa ASTM Type 50 sulphate resistant concrete only. The dimensions of the thrust blocking shall be as shown in the Typical Detail Drawings.

91.2.10 CATHODIC PROTECTION

Ground Bed, Test station and access chamber, as shown in Typical Detail Drawings or an equivalent approved by Aquatera.

91.2.11 WARNING TAPE

Underground warning tape shall be installed above all water mains, water services and other buried water lines of any type.

Material shall be Brady Detectable Identoline Warning Tape, or an approved equivalent,

consisting of B-721 metal detectable polyester with a 4.5 mils minimum thickness and 50 mm width. For water lines the color shall be safety precaution blue with black lettering on one side only, repeated continuously with "Caution Buried Water Line Below".

Warning tape for raw water lines shall be the same as above.

91.3 INSTALLATION

91.3.1 PIPE

a) Placement

- i) All pipe laying and connecting shall be in strict accordance with the manufacturer's recommended practice unless otherwise specified by Aquatera.

Pipe shall be laid at the depth and location shown in the Detailed Engineering Drawings or as specified by the Engineer.

- ii) The Contractor shall remove all water from the trench prior to and during the installation of water mains and appurtenances.

All foreign material shall be kept out of the pipe before, during and after installation. When pipe laying is not in progress the pipe shall be temporarily plugged to prevent entry of water or other foreign material.

- iii) It is the Contractor's responsibility to locate and protect all other structures, buried or above ground, in the vicinity of the work.

b) Stubs

Stubs extending past the valve and terminating with a plug shall be a minimum of 6 m in length.

c) Open Cut Installation

Refers to the installation of pipe in an open trench.

d) Augered Installation

Augered Installation refers to the installation of pipe into a cased or uncased tunnel or hole. Refer to Auger Specifications for detailed installation procedures.

91.3.2 FITTINGS

Fittings shall be installed in the watermain at the required location. Pipe shall be cut and the joints made to provide a watertight pipeline. All fittings shall have thrust blocking installed.

91.3.3 TRANSITION COUPLINGS

Transition Couplings shall be installed at all locations where the water pipes are of dissimilar materials. Any portion of the protective coating which is damaged before or while being put into service shall be repaired with the appropriate repair kit recommended by the coating manufacturer. All transition couplings shall be wrapped with "Denso" tape.

The use of transition couplings will not be permitted when connecting PVC pipe sections, where PVC couplings are manufactured for this purpose.

91.3.4 VALVES

Valves shall be installed in the watermain at the required location. Pipes shall be cut and the joints made to produce a water-tight pipeline. Concrete thrust blocks shall be constructed at all valves. All valves are to be wrapped with Denso Tape.

91.3.5 VALVE BOXES

Valve boxes shall be installed centered and plumb over the wrench nut of the gate valve, and shall be supported in a manner such that strain or shock cannot be transmitted to the valve. The valve box cover shall be set 5 to 15 mm below flush with the existing pavement or ground surface unless otherwise approved by Aquatera. The rock disk nut shall not be more than 600 mm below finished grade. **Rock disks shall be bolted onto the operating rod.** Valve boxes shall be sliding type.

91.3.6 HYDRANTS

a) Placement

Hydrants shall be installed in the designated locations at the required elevations. All hydrants shall stand plumb with the hose nozzles parallel to the street centreline and the pumper nozzle at right angles to and facing the street. Concrete thrust blocks shall be constructed at hydrants.

b) Sump

A coarse gravel sump the width of the trench, from the back of the trench to 450 mm in front of the hydrant and 600 mm deep shall be placed around the hydrant after the pouring and placement of thrust block and base. Top of the sump to be 150 mm above the hydrant drain holes and covered with a 2 mil filter fabric to prevent intrusion of clay or silt into the gravel. The hydrant drain shall be clear of obstructions. Where the water table is above the bottom of the hydrant or where in the opinion of Aquatera the soil will not allow for satisfactory drainage, the hydrant drain shall be plugged and the sump will not be required.

91.3.7 HYDRANT MARKERS

Hydrant markers shall be installed on all hydrants as identified on the detailed engineering drawings or where directed by Aquatera.

91.3.8 BEDDING

a) Placement

The bedding shall be shaped so as to provide a uniform and continuous support for the pipe and fittings. Proper allowance shall be made for bells and couplings such that the coupling does not bear directly on the bedding or support the weight of the pipe.

Bedding shall refer to and include all soil or concrete material placed from the bottom of the trench to 300 mm above the pipe. Concrete bedding shall be placed only to the springline of the pipe.

No Bedding shall be laid in water or on frozen ground or in any conditions considered unsuitable by Aquatera.

Unless otherwise specified bedding shall be placed by hand up to 300 mm above the crown of the pipe. This material shall be well tamped with hand tools along both sides of the pipe and compacted to 97% Standard Proctor Density unless otherwise specified.

b) Alternative Material

Where granular bedding is specified, an approved sand may be used with approval of Aquatera provided the pipe diameter is less than 375 mm and the pipe has water tight joints.

c) Classes

Specifications for the various classes of bedding are illustrated in the Typical Detail Drawing. Unless otherwise approved, B1 Bedding shall be used.

91.3.9 WARNING TAPE

Warning tape shall be installed at the top of the pipe zone (300 mm above the pipe) and centered over the utility intended for identification. The tape shall be installed with the printed side up and run continuously along the length of the intended utility. Tape shall be installed on the main piping and all appurtenant laterals, including blow offs, air releases, fire hydrants and services. For service lines tape shall extend to the property line.

Warning tape shall be wrapped around valves, hydrants, blow offs and other appurtenances. Tape for services shall overlap tape for mains by 300mm. End of rolls or other breaks in the tape shall be suitably overlapped or joined to provide a continuous length of detectable tape for locating.

91.3.10 THRUST BLOCKING

Concrete thrust blocking shall be provided at valves, tees, wyes, bends, caps and plugs, and where changes in pipe diameter occur at reducers and fittings. It shall be placed between undisturbed soil and the fittings, and the area of thrust block bearing shall be as shown on the Typical Detail Drawings. The fitting shall be wrapped in a plastic bond breaker so that the concrete is not in direct contact with the fitting. The blocking shall be placed so that the pipe at fitting joints and the bolts at flanged joints will be accessible for

repairs. Thrust blocking will be considered part of the installation of valves, fittings and hydrants.

91.3.11 TIE-IN TO EXISTING WATERMAIN

The work under this item shall consist of removing existing plugs or fittings and making the connections as required to the existing pipe or fitting and shall include all trenching, bedding, laying and jointing of pipe, backfilling and clean-up, and other items necessary to complete the work as specified including all necessary adapters and fittings. All connections to existing pipelines shall be made with Ring-tite joints in accordance to manufacturer's recommendations. Should a transition coupling be required to connect pipes of dissimilar materials it shall be Robar style or equivalent.

91.3.12 CUT-IN TO EXISTING WATERMAIN

The work under this item shall consist of cutting into existing pipes in order to install fittings to make the connections as required and shall include all trenching, bedding, laying and jointing of pipe, backfilling and clean-up, and other items necessary to complete the work as specified including all necessary adapters and fittings.

91.3.13 RELOCATION OF EXISTING WATER MAIN

Relocation of an existing water main shall be carried out in accordance with the Material Specifications, installation of Waterworks Specifications, and all other relevant Specifications and Detailed Engineering Drawings.

An existing waterline shall only be relocated in the event that the pipe being laid comes within 500 mm of intersecting the existing pipe. Relocation shall only be carried out with the express approval of Aquatera. It shall be the Contractor's responsibility to obtain approval from the authority maintaining the existing pipe prior to relocation. Unless otherwise directed by Aquatera an existing waterline shall be relocated below the new crossing line with a minimum separation of 500 mm between the two pipes.

The bedding for the pipe passing below shall be class B-1 with compacted granular material or non-shrinkable fill completely filling the void between the two pipes. The bedding between the two crossing pipes shall be firmly compacted to a density of 97% Standard Proctor Density.

91.3.14 CATHODIC PROTECTION

Cathodic protection shall be placed on all buried metallic pipe, fittings or appurtenances unless a geotechnical report recommends otherwise. Cathodic Protection is required on hydrants and valves. Installation shall be as per Typical Detail Drawings.

91.3.15 CROSSING OTHER PIPELINES OR UTILITIES

Where the watermain being installed must cross another pipeline or utility the void between the two lines shall be completely filled with granular or sand material compacted to 97% Standard Proctor Density. Under normal conditions, watermains shall cross above sewers with a sufficient vertical separation to allow for proper bedding and structural support of the water and sewer mains.

Where the watermain and the existing pipe or utility cross within 500mm of each other, the watermain shall be lowered to cross under the existing pipe or utility such that a clearance of 500mm is obtained between the two. The void between the two lines and the excavated portion of the crossed pipe or utility shall be filled with approved granular material; hand placed and compacted to 97% Standard Proctor Density or non-shrinkable fill. There shall be no connections or joints in the watermain being laid within 1000mm of the pipeline crossing.

91.3.16 DISINFECTION AND CLEANING

At the Contractor's expense and before placing into service all potable water mains, fittings and appurtenances shall be thoroughly cleaned and disinfected. Methods used must be approved by Aquatera and Alberta Environmental Protection. Where a line is plugged and cannot be flushed through an existing hydrant, a 50 mm **blow off** is to be installed within 1 m of the plug or fabricated into the plug itself. This **blow off** is to be removed once the line is extended into future development phase. If the water main is to remain a dead end by design, the **blow off** shall remain in place permanently.

All temporary injection points used as part of the disinfection process shall be stainless steel service saddles, Robar 2606 series or equivalent. Upon completion of the disinfection process and approval by Aquatera Utilities, the corporation stop shall be turned to the off position and the copper service line cut and crimped approximately 150mm from the main.

For the complete disinfection and bacteriological testing requirements, refer to Section 91.4.3 (b) (iii).

91.4 TESTING REQUIREMENTS OF THE CONTRACTOR

91.4.1 PRE-INSTALLATION

- a) Materials: The Contractor shall provide copies of sieve analysis of bedding material.
- b) Systems: None required.

91.4.2 INSTALLATION

- a) Materials: None required.
- b) Systems: None required.

91.4.3 POST-INSTALLATION

- a) Materials: None required.

b) Systems:

i) Hydrostatic and Leakage Tests

All water mains shall be tested in accordance with AWWA C605-99, PVC Water Main Testing, or the latest revision thereof.

Aquatera shall be notified at least 2 business days prior to testing so they may operate the boundary valve to facilitate the filling of the pipelines to be tested.

Each section of pipeline shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to Aquatera. The pump, pipe connection, taps, gauges and all other materials and labour shall be furnished by the Contractor.

During the filling of the pipe and before applying the specified test pressure, all air shall be expelled from the pipeline. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and after completion of tests the taps shall be killed, unless otherwise specified. The test shall be made in sections containing no more than 100 joints or as directed by the Engineer. Hydrostatic test pressure shall be 1035 kPa (150 psi) or 1.5 times the normal operating pressure based upon the elevation of the lowest point in the main and corrected to elevation of the test gauge, for a period of two hours. For P.V.C. pipe, the overall leakage for the section of line tested shall not exceed the rate of leakage specified in the Table below. The Contractor shall in the presence of the Engineer, examine the entire pipe and repair leakage as required to the satisfaction of the Engineer. The hydrostatic test shall be repeated until the results are satisfactory to Aquatera.

TABLE: Maximum Allowable Leakage (L/100 Joints/Hour) For PVC Pipe

	Test Pressure								kPa
	345	515	690	860	1035	1380	1550	1724	
Pipe Dia.	50	75	100	125	150	200	225	250	psi
100 mm (4")	1.46	1.77	2.00	2.28	2.46	2.90	3.07	3.28	
150 mm (6")	2.17	2.65	3.07	3.43	3.76	4.34	4.60	4.82	
200 mm (8")	2.90	3.54	4.09	4.57	5.02	5.79	6.14	6.46	
250 mm (10")	3.62	4.42	5.12	5.71	6.27	7.34	7.67	8.10	
300 mm (12")	4.34	5.30	6.14	6.86	7.52	8.69	9.20	9.70	
350 (14") mm	5.07	6.19	7.16	8.00	8.77	10.13	10.74		

400 (16") mm	5.79	7.07	8.19	9.14	10.03	11.58	12.27	
450 (18") mm	6.51	7.96	9.21	10.28	11.28	13.03	13.80	

Allowable leakage calculation is based upon the following formula:

$$\text{PVC pipe } L = ND(P^{0.5})/128,320$$

- L - allowable leakage in litres per hour
- N - number of joints
- D - nominal diameter (mm)
- P - test pressure (kPa) (1.0 psi = 6.9 kPa)

ii) Hydrant Flow Tests (Development Agreement Requirement)

Prior to issuance of the Construction Completion Certificate, tests of designated hydrants shall be conducted by Aquatera, at the request of the Contractor, to verify that the flows and pressures identified in the design calculations are being provided in the field. The Engineer shall co-ordinate testing with Aquatera Utilities Technical Services Department (780)538-0348 a minimum of 2 business days in advance of the desired test date. Results of the testing shall be compiled and submitted to Aquatera with a comparison of the actual flows and design flows for the same hydrant. Where the actual flows do not meet the minimum fire and service requirements all hydrants in the project must be tested and the Developer must advise the corrective actions he shall be taking to provide the necessary service level. The location and extent of initial testing shall be as required by Aquatera. As a minimum the hydrant with the lowest design flow shall be tested for each water zone.

iii) Chlorine Residual and Bacterial Testing

All the watermains shall be disinfected in accordance with the latest version of AWWA Specification C651-99.

Aquatera shall be notified at least 2 business days prior to testing so they may witness the residual chlorine test and the sampling for the bacteriological test.

Minimum residual chlorine after 24 hours shall be 10 mg/L.

After final flushing, following the primary disinfection period, and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. At least one set of samples shall be collected from each 366m of the new main, plus one set from the end of the line and one set from each branch. All samples shall be tested for bacteriological quality in accordance with the Standard Methods for the Examination of Water and Wastewater and shall show the absence of coliform organisms and include a standard heterotrophic plate count. Samples for bacteriological analysis shall be collected from blow-offs or service taps. Sampling from hydrants shall be avoided. Bacterial Test results and the disinfection records are to be submitted to Aquatera Utilities Department for review and approval. Upon

approval, Aquatera will place new water lines into service by opening the boundary valves. Bacteriological tests must be undertaken at an approved provincial laboratory.

iv) Disinfection and Bacteriological Test Reporting Procedures

Forms are provided in the back of this section for reporting results obtained from the Primary Disinfection Period and Chlorine Residual and Bacteriological Sampling. These reports are to be completed in full and submitted to Aquatera along with other test results, prior to construction completion. The report for the Primary Disinfection Period must have a sketch showing the test area, the chlorine application point, chlorine sampling points, the disinfection method employed and initial and 24 hour residual concentrations of total chlorine. The Chlorine Residual and Bacteriological Sampling Report for Environmental Operations shall include a sketch showing the test area, bacteriological sampling locations, total and free chlorine residuals and the results from bacteriological samples which must accompany the report. These reports shall be certified, stamped and signed by a Professional Engineer licensed to practice by APEGGA.

v) Flushing and Dechlorination

After the applicable retention period is over, heavily chlorinated water should not remain in prolonged contact with the pipe and should be flushed from the line as soon as possible to prevent damage to the pipe itself. Flushing of the line should continue until chlorine measurements show that the water leaving the main is no higher than that which is generally prevailing in the distribution system or is at an acceptable level for domestic use.

Discharge of heavily chlorinated water shall be neutralised by chemicals and apparatus suitable for that purpose. If approved by Aquatera, the chlorinated water may be discharged directly into the sanitary sewer.

vi) Any failed bacteriological tests may require re-disinfection of the failed section as per the procedures as stated from above (iii) to (v).

91.5 PAYMENT

91.5.1 PIPE

Payment for water mains, system testing and disinfection shall be paid as one item at the unit prices per lineal metre shown in the Tender Form for the various types of bedding and pipe sizes indicated. Such payment will be full compensation for all materials, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

The length of the main shall be taken as the assembled length of pipe installed.

91.5.2 FITTINGS

Payment for the supply of all materials and the installation of all fittings, including thrust blocking, will be the unit price for each shown in the Tender Form. Such payment will be full compensation for all materials, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

91.5.3 TRANSITION COUPLINGS

Transition Couplings shall be considered part of the connections to existing systems and there shall be no additional payment for Transition Couplings.

91.5.4 VALVES

Payment for the supply of all materials and the installation of all valves will be the unit price for each shown in the Tender Form. Such payment will be full compensation for all materials, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

91.5.5 VALVE BOXES

Valve Boxes shall be considered part of the installation of valves and there shall be no additional payment for valve boxes.

91.5.6 HYDRANTS

Payment for the supply of all materials and the installation of all hydrants will be the unit price for each shown in the Tender Form. Such payment will be full compensation for all materials, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

91.5.7 WARNING TAPE

There shall be no additional payment for warning tape. Warning tape shall be considered incidental to Watermain installation.

91.5.8 THRUST BLOCKING

Thrust and Anchor blocking shall be considered part of the installation of valves, fittings, and hydrants and there shall be no additional payment for thrust blocking.

91.5.9 CONNECTIONS TO EXISTING SYSTEMS

Payment for connections to existing system will be at the unit price per tie shown in the Tender Form. Such payment will be full compensation for all materials, fittings, adapters, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

91.5.10 RELOCATION OF EXISTING WATERLINE

Payment for relocating an existing waterline shall be at the Lump Sum rate quoted in the Tender. Such payment will be full compensation for all materials, fittings, adapters, labour, equipment, supervision and all incidentals necessary to complete the work to these specifications.

91.5.11 WATERMAIN CROSSING OTHER UTILITIES

There shall be no additional payment for crossing other buried pipelines or utilities beyond the normal payment made for Watermain installation.

91.5.12 CATHODIC PROTECTION

There shall be no additional payment for cathodic protection. Cathodic protection shall be considered incidental to Watermain installation.

91.5.13 DISINFECTION AND CLEANING

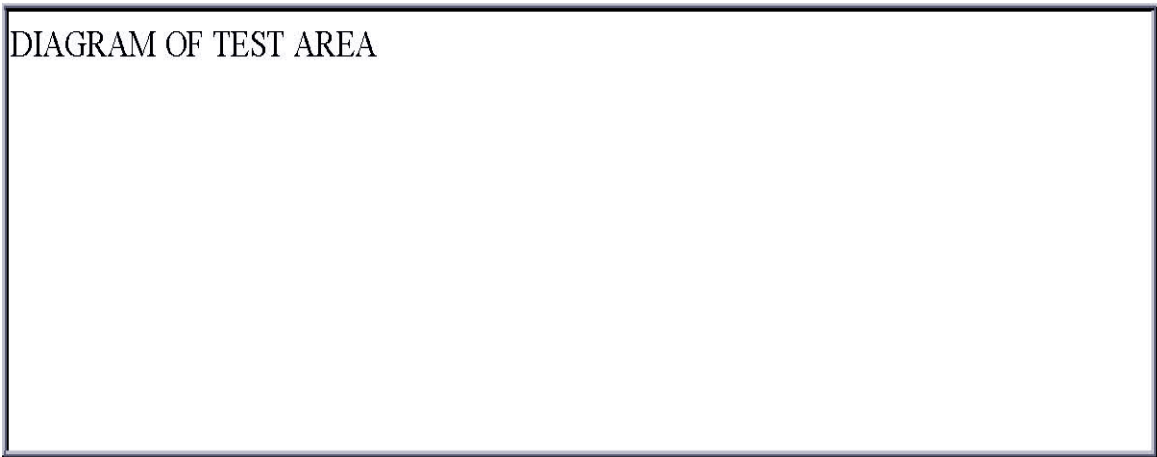
There shall be no additional payment for disinfection and cleaning. It is considered incidental to Watermain installation.

91.5.14 TESTING REQUIREMENTS OF THE CONTRACTOR

There shall be no additional payment for testing required by the Contractor. It is considered incidental to Watermain installation.

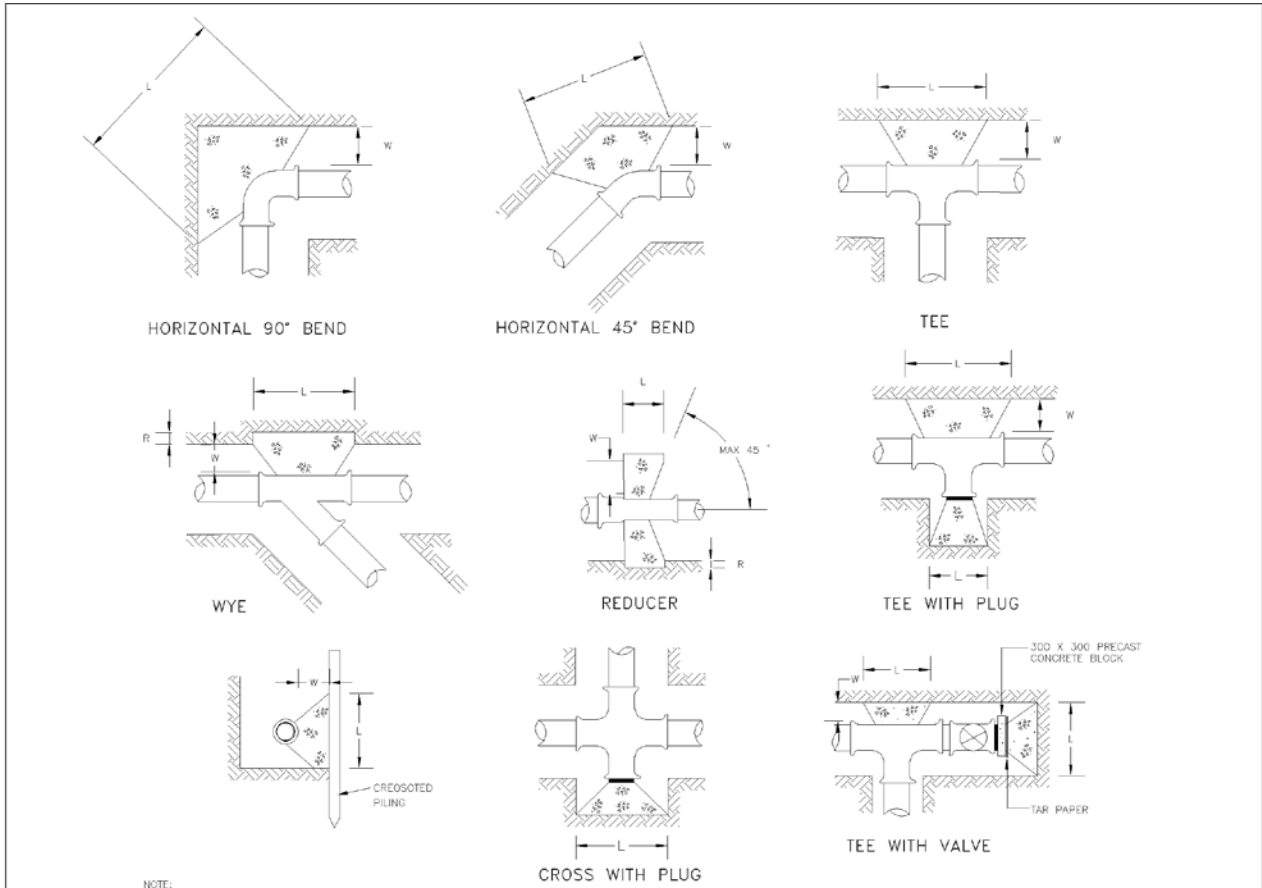
**CHLORINE RESIDUAL AND BACTERIAL SAMPLING REPORT
FOR ENVIRONMENTAL OPERATIONS**

DEVELOPER: _____ SUBDIVISION: _____
 CONSULTANT: _____ DATE: _____
 CONTRACTOR: _____ PUMP LOCATION: _____
 LOCATION: _____



NOTE: _____

LOCATION	TEST DATE	TOTAL CL ₂ (mg/L)	FREE CL ₂ (mg/L)	TOTAL (cFu/100 ml)	STANDARD PLATE COUNT (CFu/ml)
1)					
2)					
3)					
4)					
5)					
6)					

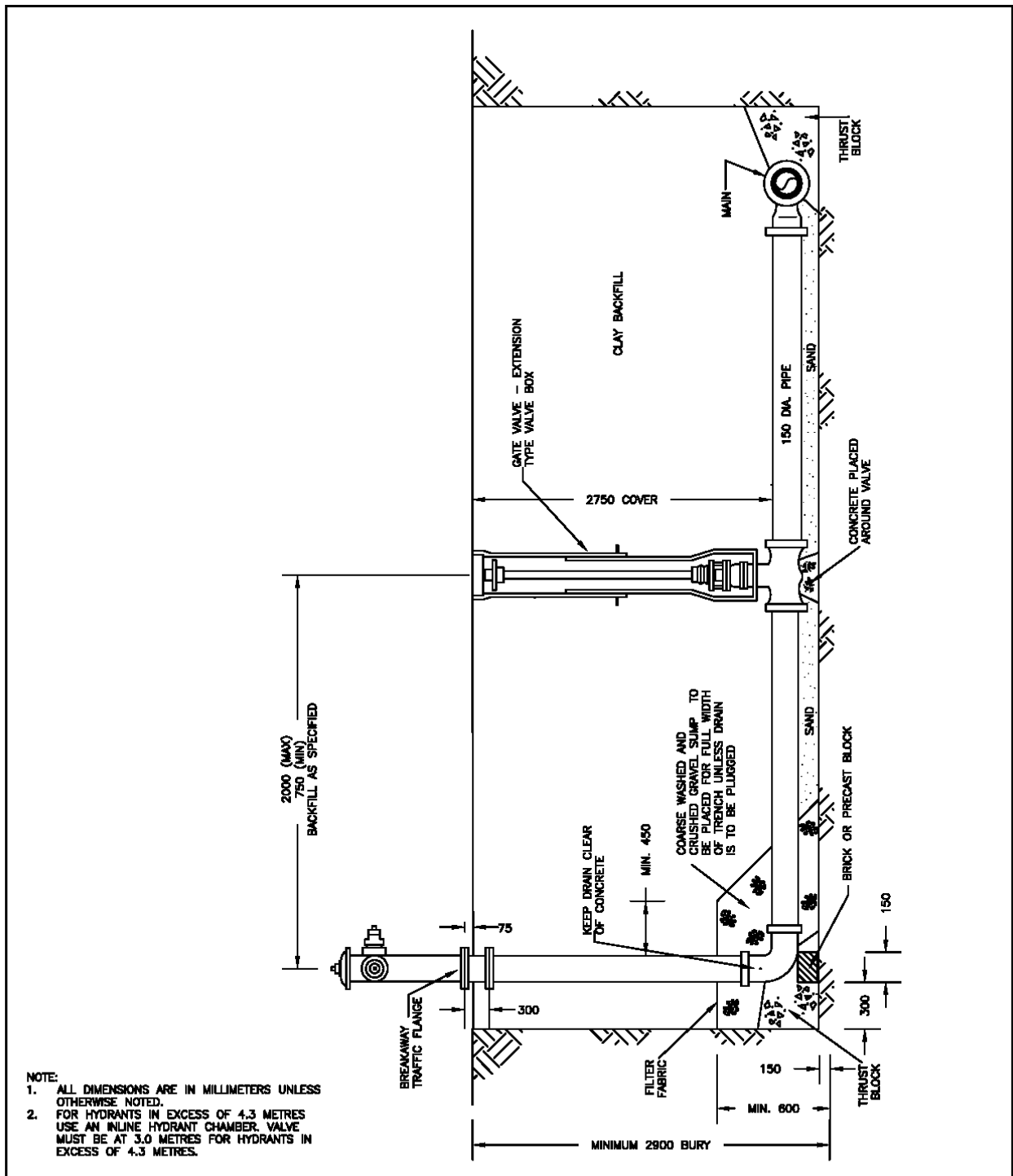


NOTE:
1. WHERE GROUND CANNOT BE EXCAVATED TO FREE STANDING UNDISTURBED SOIL, A SMALL PLANK SHEET PILING SHALL BE DRIVEN TO PROVIDE UNDISTURBED THRUST AREA. THE PILING IS TO BE DRIVEN PRIOR TO EXCAVATING FOR THRUST BLOCK. THE PILING SHOULD BE USED ONLY BELOW THE PERMANENT WATER TABLE.

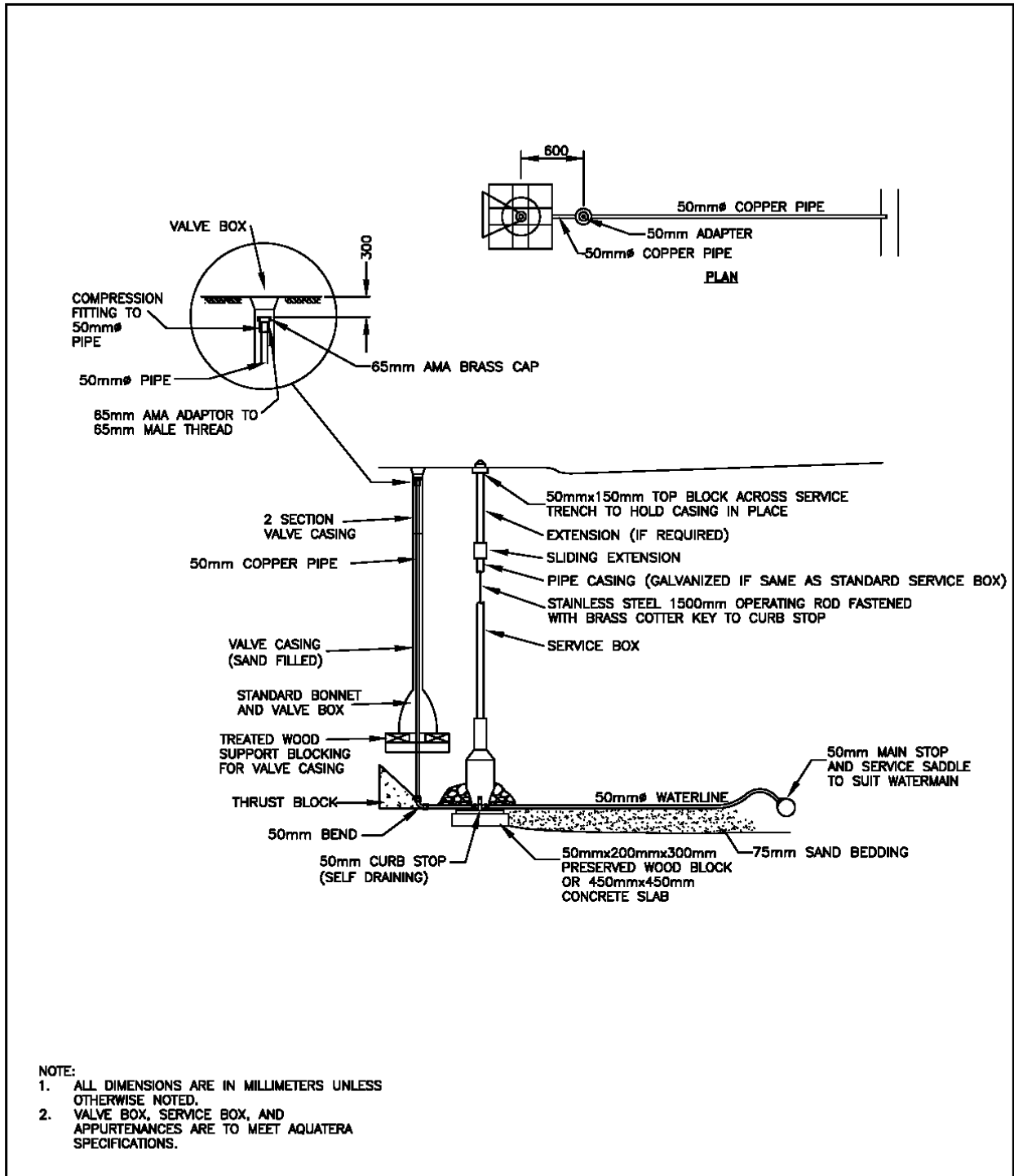
MINIMUM THRUST AREAS FOR FITTINGS AT 10.35 kPa PRESSURE AND FOR SOILS WITH MINIMUM BEARING OF 9765 kg/m ² OR 95 kPa (NOT TO BE USED FOR SOFT CLAY, MUCK, PEAT, ETC.)											
TYPE OF FITTING	FITTING SIZE	OUTSIDE OF FITTING TO BEARING FACE	RECESS IN TRENCH WALL	LENGTH	HEIGHT	TYPE OF FITTING	FITTING SIZE	OUTSIDE OF FITTING TO BEARING FACE	RECESS IN TRENCH WALL	LENGTH	HEIGHT
	D	W	R	L	H		D	W	R	L	H
90° BEND	150	300		900	450	CROSS	150	300		600	450
	200	350		1050	600		200	350		825	600
	250	375		1445	750		250	375		975	825
	300	400		1650	900		300	400		1200	900
45° BEND	150	300		450	450	45° WYE	150	300	300	450	450
	200	350		600	600		200	350	400	600	600
	250	375		750	750		250	375	500	825	825
	300	400		900	900		300	400	600	900	900
22 1/2° BEND	150	300		450	230	REDUCER *	150	300	150	450	450
	200	350		600	300		200	350	200	600	600
	250	375		825	450		250	375	250	825	825
	300	400		900	450		300	400	300	900	900
TEE	150	300		600	450	CAPS AND PLUGS (IF NOT BOLTED)	150	300		450	450
	200	350		825	600		200	350		600	600
	250	375		975	825		250	375		825	825
	300	400		1200	900		300	400		900	900


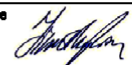
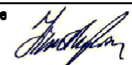
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. DIMENSIONS APPLY TO THE LARGER DIAMETER END OF FITTING.

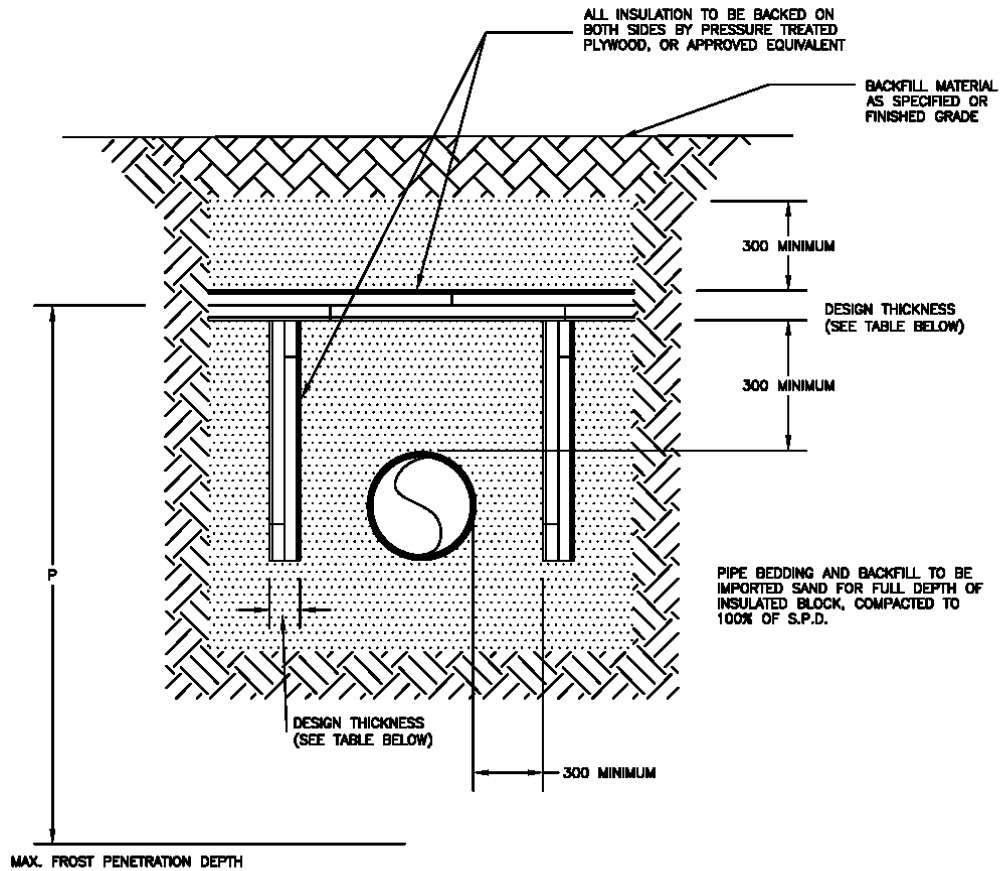
Revisions			 Permit Number P09242	THRUST BLOCK DETAILS			Standard Detail 91-01
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature		
				Checked by Norman Kyle, P.L.(Eng.)			
				Drawn by B. Shervey	Scale N.T.S.	Date 11/02/04	File Number C10069



Revisions				HYDRANT CONNECTION		Standard Detail 91-02
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature 	
			Permit Number P09242	Checked by Norman Kyle, P.L.(Eng.)	Scale N.T.S.	Date 11/02/04
				Drawn by B. Sharvey		



Revisions				BLOW-OFF VALVE		Standard Detail 91-03
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature 	
			Checked by Norman Kyle, P.L.(Eng.)		Scale N.T.S.	Date 11/01/31 File Number C10071
			Permit Number P08242		Drawn by B. Sharvey	

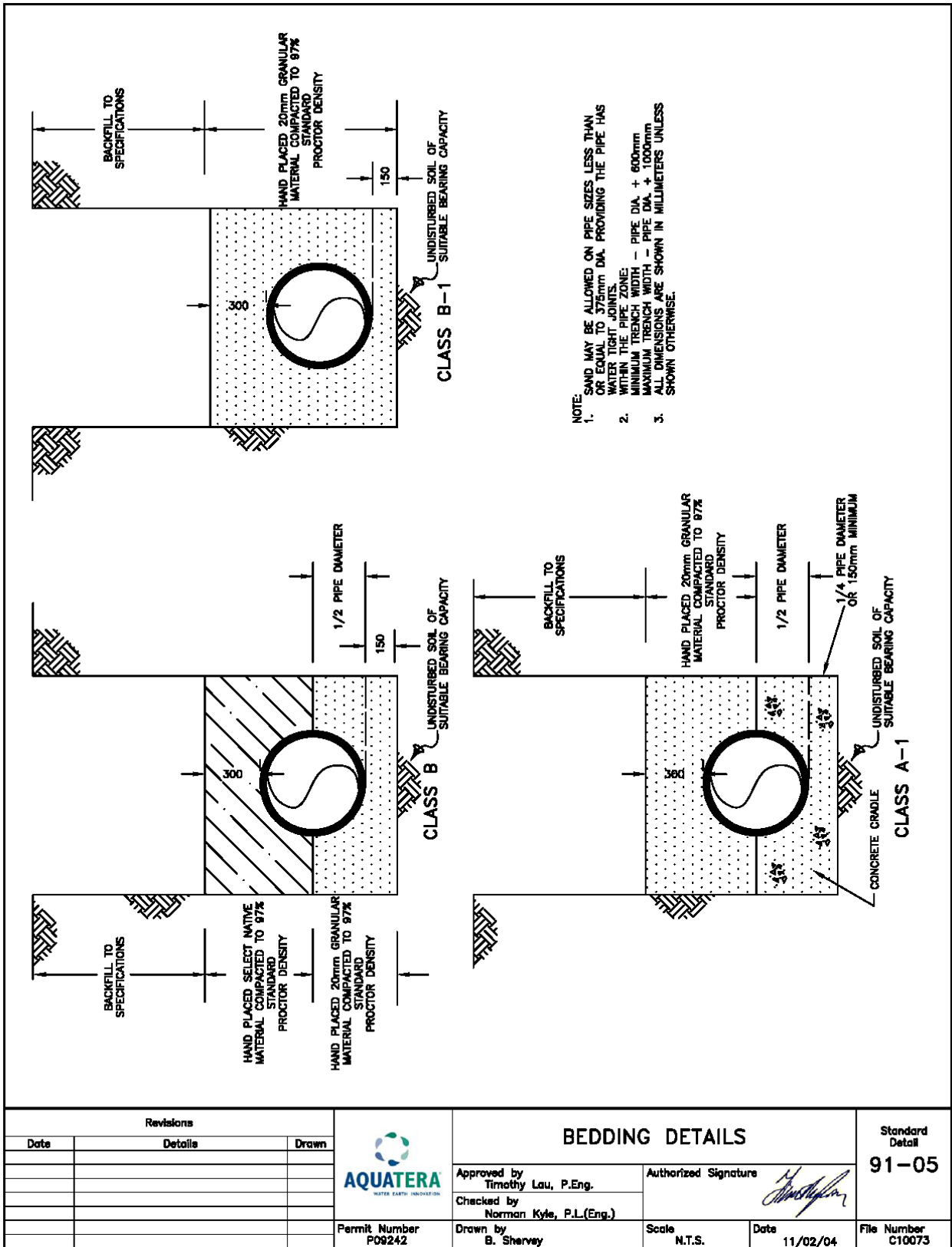


MINIMUM THICKNESS GUIDE			
SANDY SOIL		CLAY SOIL	
P	THICKNESS	P	THICKNESS
1600	100		
2100	150	1500	175
2400	200	2400	225

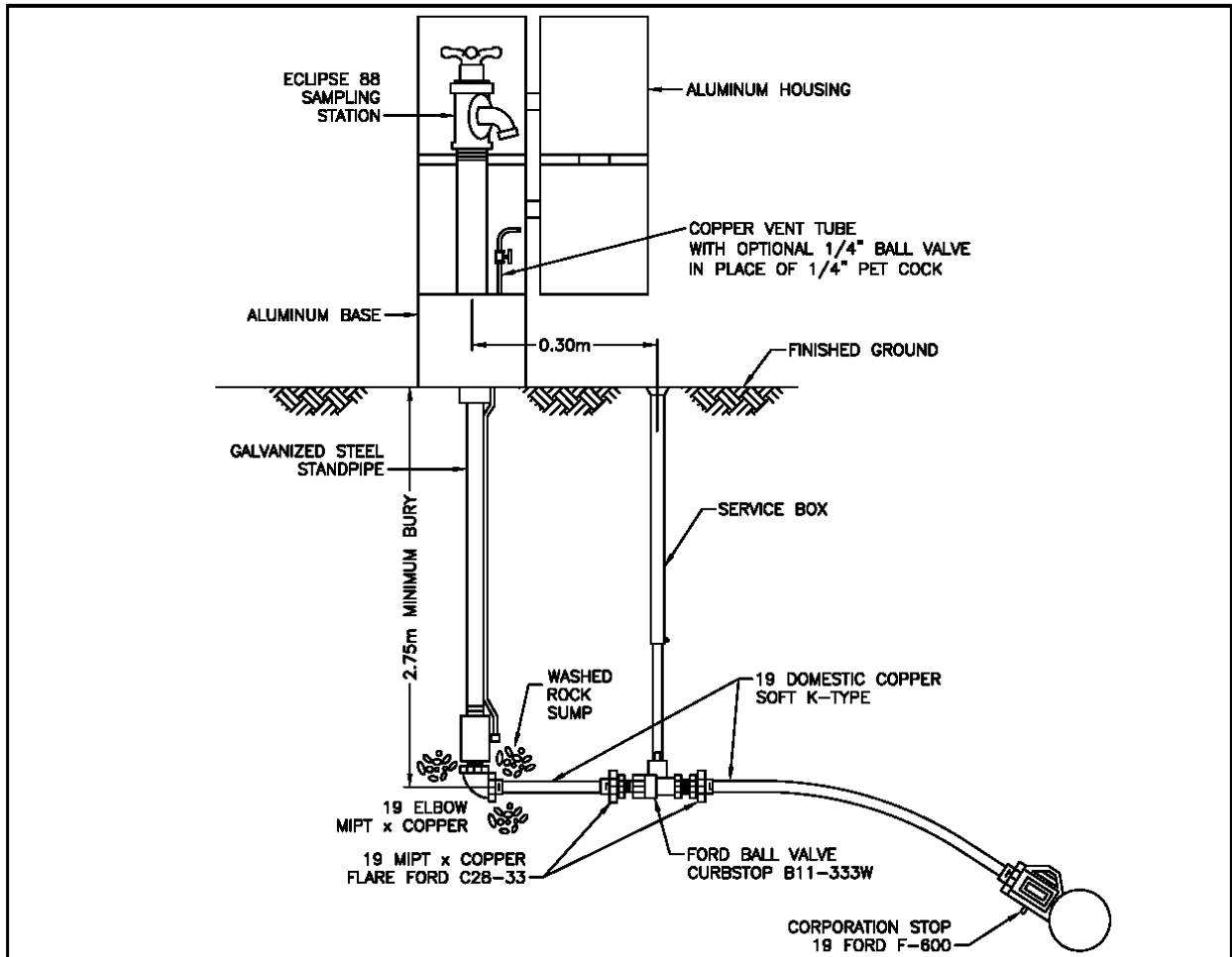
"R" VALUE IS 5 PER 25mm

- NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
 2. INSULATION TO BE MINIMUM 100mm THICKNESS.
 3. BACKFILLING TO BE DONE CAREFULLY TO PREVENT BREAKING OR CRUSHING THE INSULATION. CRUSHED SHEETS SHALL BE REMOVED AND REPLACED.

Revisions				PIPE INSULATION DETAIL		Standard Detail 91-04
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature 	
			Permit Number P08242	Checked by Norman Kyle, P.L.(Eng.)	Scale N.T.S.	Date 11/02/04
				Drawn by B. Sharvey		

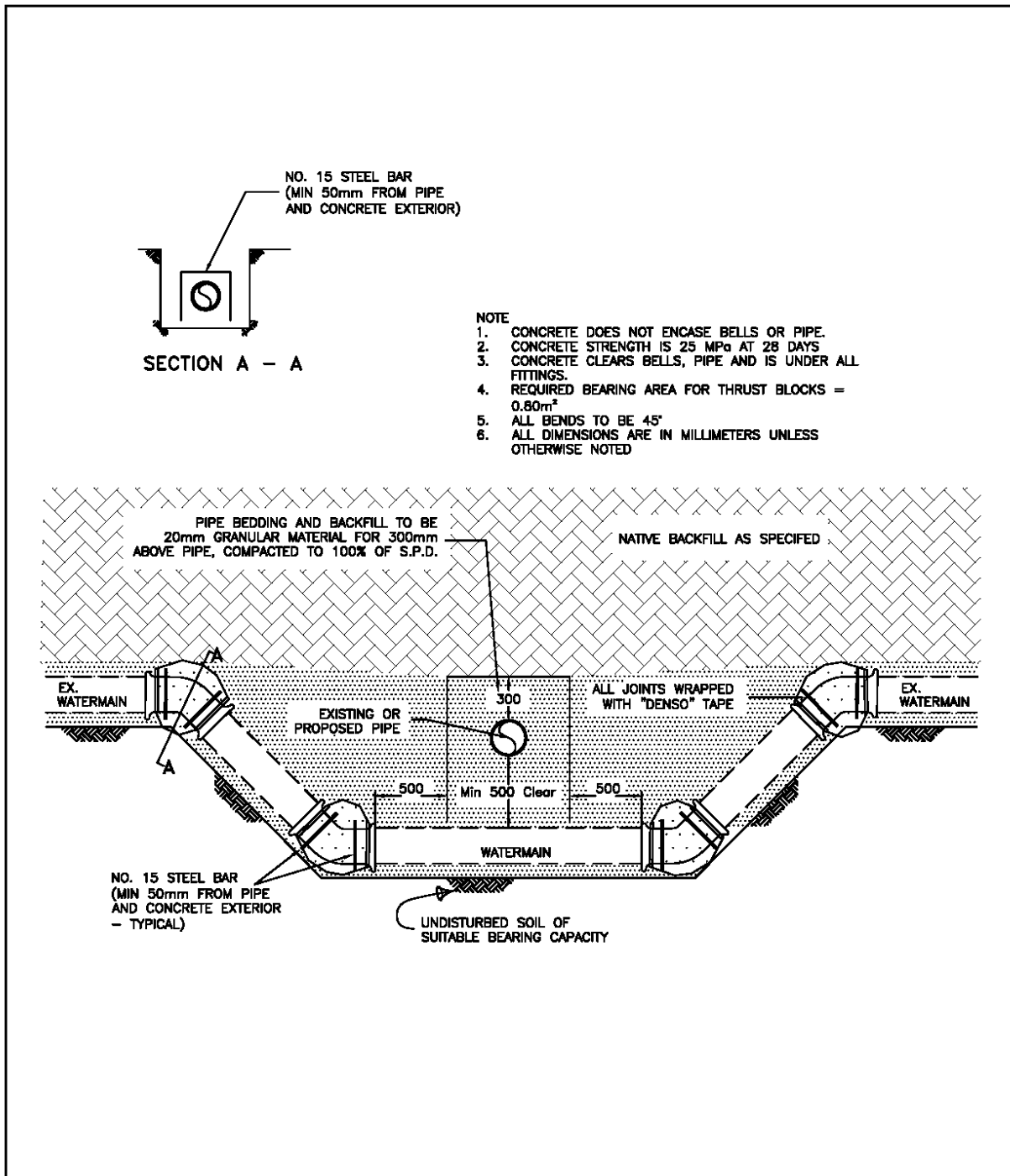



Revisions				BEDDING DETAILS		Standard Detail 91-05
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature <i>[Signature]</i>	
			Permit Number P09242	Checked by Norman Kyle, P.L.(Eng.)	Scale N.T.S.	File Number C10073
				Drawn by B. Shervey		



- NOTE:**
1. SAMPLING STATIONS SHALL BE 2.75M BURY, WITH A 19MM FIP INLET, AND A (19.0MM HOSE OR UNTHREADED) NOZZLE.
 2. ALL STATIONS SHALL BE ENCLOSED IN A LOCKABLE, NONREMOVABLE, ALUMINUM-CAST HOUSING.
 3. WHEN OPENED, THE STATION SHALL REQUIRE NO KEY FOR OPERATION, AND THE WATER WILL FLOW IN AN ALL BRASS WATERWAY.
 4. ALL WORKING PARTS WILL ALSO BE OF BRASS AND BE REMOVABLE FROM ABOVE GROUND WITH NO DIGGING. EXTERIOR PIPING SHALL BE GALVANIZED STEEL (BRASS PIPE ALSO AVAILABLE).
 5. A COPPER VENT TUBE WILL ENABLE EACH STATION TO BE PUMPED FREE OF STANDING WATER TO PREVENT FREEZING AND TO MINIMIZE BACTERIA GROWTH.
 6. ECLIPSE NO. 88 SAMPLING STATION SHALL BE MANUFACTURED BY KUPFERLE FOUNDRY, ST. LOUIS, MO 63102.
 7. CONTRACTOR TO PROVIDE AN AQUATERA LOCK, OBTAINED FROM AQUATERA.
 8. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Revisions				WATER SAMPLING STATION DETAIL		Standard Detail 91-07
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature 	
				Checked by Norman Kyle, P.L.(Eng.)		File Number C10075
				Permit Number P08242		



Revisions				WATERMAIN CROSSING DETAIL		Standard Detail 91-08
Date	Details	Drawn		Approved by Timothy Lau, P.Eng.	Authorized Signature <i>Timothy Lau</i>	
			Permit Number P09242	Checked by Norman Kyle, P.L.(Eng.)	Scale N.T.S.	Date 11/02/04
				Drawn by B. Shervey		

Adopted: December 2007

Revised June 2011