



**STANDARD SPECIFICATIONS**  
**For**  
**PIPELINE CONSTRUCTION**

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CAYMAN WATER COMPANY LTD  
STANDARD SPECIFICATIONS FOR  
PIPELINE CONSTRUCTION

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## **General Requirements**

### **1. Project Description**

1.1. General: A brief description of the work is stated in the Invitation to Bid. To determine the full scope of the project or any particular part of the project, coordinate the applicable information in the several parts of these Contract Documents.

### **2. Sequence of Operations**

#### **2.1. Coordination**

2.1.1. Contractors shall cooperate in the coordination of their separate activities in a manner that will provide the least interference with the Owner's operations and other contractors and utility companies working in the area, and in the interfacing and connection of the separate elements of the overall project work.

2.1.2. The Contractor shall maintain traffic flow throughout the project unless previous arrangements have been approved by the Royal Cayman Islands Police (RCIP). The Contractor shall maintain access to businesses and private residences at all times.

2.1.3. All Contractors working on this site are subject to this requirement for cooperation, and all shall abide by the Engineer's decision in resolving project coordination problems without additional cost to the Owner.

2.1.4. All pipelines shall be tested and put into service in segments so that interruption of service is kept to a minimum. The Contractor shall meet with the Owner and Engineer within 2 weeks after award of contract with his proposed project work schedule so that it can be discussed and finalized.

#### **2.2. Shutdown of Existing Operations or Utilities**

2.2.1. Continuous operation of the Owner's existing water distribution system is of critical importance.

2.2.2. For tie-in to existing services or utilities, or for other work that require the temporary shutdown of any existing operations or utilities shall be planned in detail

with appropriate scheduling of the work and coordinated with the Owner or Engineer. The approved schedule for shutdown or restart shall be indicated on the Contractor's Progress Schedule, and advance notice shall be given in order that the Owner or Engineer may witness the shutdown, tie-in, and startup.

2.2.3. All materials and equipment (including emergency equipment) necessary to expedite the tie-in shall be on hand prior to the shutdown of existing services or utilities.

### 2.3. Operation of Existing System Prohibited

At no time undertake to close off any lines or open valves or take any other action which would affect the operation of the existing system, except as specifically required by the Drawings and Specifications and after approval is granted by the Owner. Request approval 5 working days in advance of the time that interruption of the existing system is required.

### 2.4 Scheduling

2.4.1. Plan the work and carry it out with minimum interference to the operation of the existing facilities. Prior to starting the work, confer with the Engineer and Owner's representative to develop an approved work schedule which will permit the facilities to function normally as practical. It may be necessary to do certain parts of the construction work outside normal working hours in order to avoid undesirable conditions. The Contractor shall do this work at such times, and at no additional cost to the Owner. Do not make connections between existing work and new work until necessary inspection and tests have been completed on the new work and it is found to conform in all respects to the requirements of the Contract Documents.

2.4.2. Work on existing structures and facilities shall be performed on a schedule and in a manner that will permit the existing facility to operate continuously.

### 2.5. Progress of Pipeline Construction

2.5.1. The work shall proceed in a systematic manner so that a minimum of inconvenience will result to the public in the course of construction. It is, therefore, necessary to confine operations to as small a length of work area per crew as is practical. Normally, the trenching equipment shall not be farther than 400 feet ahead of each pipe-laying crew or such distance as necessary to provide maximum safety. Backfill the trench so no section of properly laid pipe is left open longer than is absolutely necessary. The safety conditions of open excavations shall be the Contractor's responsibility. Completely backfill and clean up after each section of pipe has been inspected and approved.

2.5.2. Clean up construction debris, excess excavation, excess materials, and completely restore fences, mailboxes, ditches, culverts, signposts, and similar items immediately following the final backfilling.

## 2.6. Work to be Performed by Owner or other Contractors

During the construction period for this project, the Owner (either with his own forces or under a separate contract) may be performing work that will require the cooperation of Contractors in scheduling and coordination to avoid conflicts.

## 3. Site Conditions

### 3.1. Submittals

3.1.1. The Contractor shall submit the following information as applicable to the coordination activities:

3.1.1.1. Subsurface information and utilities including records of logs of borings or test holes made by the Contractor, results of exploratory excavations made to verify locations and nature, shape, dimensions etc., of existing utilities and facilities, records of maintenance performed on existing facilities and copies of utility company authorizations.

3.1.1.2. Field Relocation: Clearly show proposed relocation of new or existing facilities, or related work affected by the relocation on a clean copy of the Project Drawings and submit prior to performing relocation.

3.1.1.3. Easements: Copy of any easements and other agreements obtained from utilities and property owners as required to carry out the work.

3.1.1.4. Connecting Work: Proposed methods of connecting new work to existing facilities, where not shown or specified.

### 3.2. Site Investigation and Representation

3.2.1. The Contractor acknowledges that he has satisfied himself as to the nature and location of the work, the general and local conditions, particularly those bearing upon availability of transportation, access to the site, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather,

ground water elevations or similar physical conditions at the site, the conformation and conditions of the ground, the conformation and conditions of the soils, the character of equipment and facilities needed preliminary to and during the prosecution of the work, and all other matters which can in any way affect the work or the cost thereof under this Contract.

3.2.2. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from his inspection of the site and from reviewing any available records or exploratory work furnished by the Owner or included in these Documents. Failure by the contractor to acquaint himself with the physical conditions of the site and all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work.

3.2.3. The Contractor warrants that as a result of examination and investigation of all the aforesaid data, the Contractor can perform the work in a good and workmanlike manner and to the satisfaction of the Owner. The Owner assumes no responsibility for any representations made by any of its officers or agents urging or prior to the execution of this Contract, unless (1) such representations are expressly stated in the Contract, and (2) the Contract expressly provides that the responsibility therefore is assumed by the Owner.

### 3.3. Information on site Conditions

3.3.1. General: Any information obtained by the Engineer regarding site conditions, subsurface information, groundwater elevations, existing construction of site facilities as applicable, and similar data will be available for inspection at the office of the Engineer upon request. Such information is offered as supplementary information only. Neither the Engineer nor the Owner assumes any responsibility for the completeness or interpretation of such supplementary information.

### 3.4. Subsurface Investigation

3.4.1. No test holes or boring have been made by the Owner; however, any information the Owner may have concerning subsurface conditions will be made available to the Contractor upon request.

3.4.2. The Contractor shall examine the site and may make arrangements with the Owner to conduct his own subsurface investigation.

### 3.5. Differing Subsurface Conditions

3.5.1. In the event subsurface or latent physical conditions are found materially different from those indicated in these Documents, and differing materially from those ordinarily encountered and generally recognized as inherent in the character of work covered in these Contract Documents, the Contractor shall promptly, and before such conditions are disturbed, notify the Engineer in writing of such changed conditions.

3.5.2. The Engineer will investigate such conditions promptly and following this investigation, the Contractor shall proceed with the work, unless otherwise instructed by the Engineer. If the Engineer finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for performing the work, the Engineer will recommend to the Owner the amount of adjustment in cost and time he considers reasonable. The Owner will make the final decision on all Variation Orders to the Contract regarding any adjustment in cost or time for completion.

### 3.6. Underground Utilities

Utilities and structures, adjacent to or encountered in the work, known by the Owner and Engineer are shown on the drawings. The best information however will be provided by the appropriate utility and the Owner and Engineer do not assume responsibility for the accuracy or completeness of any third party underground utility information.

### 3.7. Contractors Responsibility for Utility Properties and Service

3.7.1. Where the Contractor's operations could cause damage or inconvenience to telephone, television, power, oil, gas, water, sewer, or irrigation systems, the Contractor shall make arrangements necessary for the protection of these utilities and services. Replace existing utilities removed or damaged during construction, unless otherwise provided for in these Specifications.

3.7.2. Notify all utility offices which are affected by the construction operation at least 48 hours in advance. Under no circumstances expose any utility without first obtaining permission from the appropriate agency. Once permission has been granted, locate,



expose, and provide temporary support for all existing underground utilities.

3.7.3. Protect all power poles from damage at no cost to the Owner. If interfering power poles, telephone poles, guy wires, or anchors are encountered, notify the Engineer and the appropriate utility company at least 48 hours in advance of construction operations to permit the necessary arrangements for protection or relocation of the interfering structures.

3.7.4. The Contractor shall be solely and directly responsible to the Owner and operators of such properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.

3.7.5. Neither the Owner nor its officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

3.7.6. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, promptly notify the proper authority. Cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair. In no case shall interruption of any water or utility service be allowed to exist outside working hours unless prior approval is granted.

3.7.7. In the event that the Contractor encounters interference from the Owners existing water service lines, while trenching, he may by prior approval of the Owner and affected consumer, cut the service, dig through, and restore the service with similar and equal materials at the Contractors expense.

3.7.8. Drainage culverts or wells which are removed or fouled by the Contractor, shall be repaired or replaced in kind at the expense of the Contractor

3.7.9. The Contractor shall replace, at his own expense, all existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents or ordered by the Engineer.

### 3.8. Major utilities:

Notify the following applicable utilities if conflicts or emergencies arise during the work:  
The following is a list of the companies which may have utilities in the area. The Owner and Engineer recommend that the Contractor verify all pertinent information on existing services with each utility company.

Water Authority Cayman: Box 1104 GT, 13-G Red Gate Road, Grand Cayman.  
Contact : Tom Hill  
ph (345) 949-6352 after hours (345)916-1000

Caribbean Utilities Company Ltd: Box 38 GT, North Sound Rd, Grand Cayman.  
Contact: Cindy Savage, Electrical Engineer  
ph (345)949-5200 or (345)949-5300

Cable & Wireless Cayman Ltd: Box 293 GT, Anderson Square, Grand Cayman.  
Contact: ph

Government Public Works Department: Box 505 GT, North Sound Road, Grand Cayman.  
Contact: Peter Ogden, Engineer Major Projects. ph (345) 949-7800

Royal Cayman Islands Police: Central Police Station, Georgetown. Contact Sergeant Elliott  
ph (345) 946-6254.

### 3.9. Interfering structures

3.9.1. Take necessary precautions to prevent damage to existing structures whether on the surface, above ground, or underground. An attempt has been made to show major structures on the Drawings. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented simply as a guide to avoid known possible difficulties.

3.9.2. Protect underground and above ground existing structures from damage, whether or not they lie within the limits of the easements obtained by the Owner. Where such existing fences, gates, barns, sheds, buildings, or any other structure Just be removed in order to properly carry out the construction, or are damaged during construction, restore to their original condition to the satisfaction of the property owner involved a the Contractor's own expense. Notify the Engineer of any damaged underground structure, and make repairs or replacements before backfilling.

3.9.3. Without additional compensation, but with the approval of the property owner, the Contractor may remove and replace in a condition as good as or better than original, such small miscellaneous structures as fences, mailboxes, and signposts that interfere with the Contractor's operations.

### 3.10. Field Relocation

During the progress of construction, it is expected that minor relocations of the work will be necessary. Such relocations shall be made only by direction of the Engineer. If existing structures are encountered which prevent the construction, and which are not properly shown on the Drawings, notify the Engineer before continuing with the construction in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor shall fail to so notify the Engineer when an existing structure is encountered and shall proceed with the construction despite this interference, he shall do so at his own risk.

### 3.11. Monuments and Markers

3.11.1. Preserve and protect survey monuments and markers throughout construction. If damage occurs or removal becomes necessary, immediately notify the Engineer and restore monument or marker to original condition.

3.11.2. Preserve private and public monuments that are found. If monument must be removed, replace at original location using a registered land surveyor. Notify Owner when monuments are encountered.

### 3.12. Easements

Under the Water Production and Supply (1979) Law, and the Cayman Water Company 1990 license under that said Law the Owner has the power, with seven days notice, to enter on premises other than buildings for the purpose of installing, improving or maintaining any works (defined as "wells, desalination plants, pipes, tanks, ponds, reservoirs, pumping stations, valves, hydrants, buildings, machinery, metering devices and other apparatus used in a water system"), but the Owner does not thereby acquire any right over any land other than for the purpose of supply in accordance with it's license.

### 3.13. Project Meetings

The Owner will schedule regular progress meetings at least monthly to review work progress, schedules and other matters needing discussion and resolution.

### 3.14. Abbreviations

3.14.1. This section lists the construction industry organizations, professional and technical associations, societies and institutes, and Governments agencies issuing, promoting, or enforcing standards to which references may be made in these Specifications, along with abbreviations commonly used for those references. Also included are certain general requirements for the use of industry standards specified, and for application of the standards in quality control.

3.14.2. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall conform to or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.

3.14.3. Where specified, products or workmanship shall conform to the additional prescriptive of performance requirements included within the Specifications to establish a higher or more stringent standard of quality than that required by the referenced standard.

3.14.4. Where the specific date of issue of the standard is not included with the reference to the standard, the most recent edition including all amendments published and available shall apply.

3.14.5. Where two or more standards are specified to establish quality, the product and workmanship shall conform to or surpass the requirements of both.

3.14.6. In case of conflicts between standards, the more stringent shall apply.

3.14.7. Where both a standard and a brand name are specified for a product in the Specifications, the proprietary product named shall conform to or surpass the requirements of the specified reference standard. The listing of a trade name in the Specifications shall not be construed as warranting that such product conforms to the respective reference standard.

3.14.8. Copies of applicable referenced standards have not been bound in these Specifications. Where copies of standards are needed by the Contractor for

superintendence and quality control of the work, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the jobsite, available to the Contractor's personnel, subcontractors, Owner and Engineer.

3.14.9. The following is a list of construction industry organizations and government agencies to which references may be made in the Specifications with abbreviations used.

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacture's Association
CI	Cayman Islands
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
CUC	Caribbean Utilities Company
CWC	Cayman Water Company
FM	Factory Mutual
Fed. Spec.	Federal Specifications
FS	Federal Specifications
HI	Hydraulic Institute
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
ISA	Instrument Society of America
JIC	Joint Industry Conferences of Hydraulic Manufactures
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufactures Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

OSHA	Occupational Safety and Health Act (US Federal and State)
PWD	Public Works Department (CI Government)
RCIP	Royal Cayman Islands Police
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SSBC	Southern Standard Building Code
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.
WAC	Water Authority- Cayman
WA	Water Authority

#### **4. Temporary Construction Utilities and Facilities**

- 4.1. Temporary Water: The Contractor will need to discuss the requirements for water during the construction period with the Owner and Engineer. If location allows, the Contractor will be established as a regular consumer for the duration of the works.
- 4.2. Water For Testing: The Owner and Engineer will approve the source of water required for testing equipment prior to acceptance of the work. The Owner shall be informed at least 72 hours before testing. If the Contractor is a consumer of the Owner at the construction site, he will be credited accordingly for water used in testing. If water must be imported, this will be coordinated by the Contractor with the approval of the Engineer, and billed to the Owner direct from the supplier of the water.
- 4.3. Electric Power: The Contractor must make his own arrangements for electricity. Temporary electrical power installations shall meet construction and safety requirements of Caribbean Utilities Company and other governing agencies.
- 4.4. Safety Requirements: The Contractor must comply with all relevant local Laws and Regulations.
- 4.5. Sanitary Facilities: The Contractor will be responsible for the provision of any sanitary facilities required under local Law, Regulation, employment contract or other agreement

## 4.6. Storage of Material

4.6.1. Materials shall be so stored as to ensure the preservation at their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without the written permission of the owner or lessee.

4.6.2. Delicate instruments and materials subject to vandalism shall be placed under locked cover and, if necessary, provided with temperature control as recommended by the manufacturer.

## 5. Safety and Protection

### 5.1. Examination of Existing Facilities

5.1.1. Before the commencement of work, the Contractor and Engineer shall make a thorough examination of all existing buildings, structures, and other improvements in the vicinity of the work, as applicable, which might be damaged by construction operations. Periodic examinations shall be made jointly by the Contractor, Engineer, Owner and affected property owners. Scope of examination shall include cracks in structures, settlement, leakage, and similar conditions.

5.1.2. Records of all observations shall be prepared by the Contractor and all copies shall be signed by the Owner and Contractor. Photographs and videos made by the Contractor shall be signed as above and one copy of the every document, photograph, and video tape shall be provided to the Engineer. These records, photographs, and videos are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of the Contractor's operations, and are for the protection of the adjacent property owners, the Contractor, the Owner, and CWC.

### 5.2 Safety Requirements

5.2.1. The Contractor, as part of his safety program, shall maintain at his site-office or other well-known place at the jobsite, safety equipment applicable to the work as prescribed by the governing safety authorities, all articles necessary for giving first-aid to the injured, and shall establish the procedure for the immediate removal to a hospital or a doctor's care of any person who may be injured on the jobsite.

5.2.2. The Contractor shall do all work necessary to protect the general public from hazards, including, but not limited to, surface irregularities or unramped grade changes in pedestrian sidewalk or walkway, and trenches or excavations in roadway. Barricades, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the work.

5.2.3. The performance of all work and all completed construction, particularly with respect to ladders, platforms, structure openings, scaffolding, shoring, lagging, machinery guards and the like, shall be in accordance with the applicable governing safety authorities.

5.2.4. During construction, the Contractor shall, construct and at all times maintain satisfactory and substantial temporary chain link fencing, solid fencing, railing, barricades or steel plates, as applicable, at all openings, obstructions, or other hazards in streets, sidewalks, floors, roofs, and walkways. All such barriers shall have adequate warning lights as necessary, or required, for safety.

### 5.3. Accident Reports

5.3.1. In the event of any serious accident, resulting in death or hospitalization ( outpatient included ) the incident shall immediately be reported to the Engineer in writing. Such report shall include the accounts of eyewitnesses.

### 5.4. Ensured Access by Officials

Authorized representatives of the Owner, Engineer or Government agencies shall be permitted access to the construction site at all times without prior notice.

### 5.5. Traffic Maintenance and Safety

5.5.1. Comply with all rules and regulations of the CI Government PWD and RCIP regarding closing or restricting the use of public streets or highways. No public or private road shall be closed, except by express permission of the Owner. Two-way traffic is to be maintained at all times. Conduct the work so as to assure the least possible obstruction to traffic and normal commercial pursuits. Protect all obstructions within traveled roadways by installing approved signs, barricades, and lights where necessary for the safety of the public. The convenience of the general public and residents adjacent to the project, and the protection of persons and property are of



prime importance and shall be provided for in an adequate and satisfactory manner.

5.5.2. Where traffic will pass over trenches after they are backfilled and before they are paved, the top of the trench shall be maintained in a condition that will allow normal vehicular traffic to pass over. Temporary access driveways must be provided where required. Cleanup operations shall follow immediately behind backfilling and the worksite shall be kept in an orderly condition at all time.

5.5.3. When flagmen and guards are required by regulation or when deemed necessary for safety, they shall be furnished with approved orange wearing apparel and other regulation traffic-control devices.

5.5.4. Warning Signs shall be erected in accordance with the United Kingdom Department of Transportation booklet, "Traffic Warning Signs for Roads Works". A copy of which may be consulted at the PWD.

## 5.6. Traffic Control

All traffic control shall meet requirements of the Royal Cayman Islands Police (RCIP) and CI Government PWD, and shall be approved in advance in agreement between RCIP, FWD and the Contractor.

5.6.1. Prior to starting work the Contractor shall submit traffic flow plans to the Engineer, PWD and RCIP for review and approval. The plans shall show the following:

- a. Sequences of construction affecting the carriageways
- b. Time required for each phase of work
- c. Provisions for decking over excavations, phasing of operations or a combination of these two methods to provide necessary access.
- d. Signing, barricading and striping to provide passage for pedestrians and number and width of vehicular lanes over and adjacent to trenches and other excavations.

5.6.2. Furnish signs, equipment, and barricades as required by the United Kingdom Transportation Booklet in sufficient quantity to safeguard the public and the work.

## 5.7. Protection of Property

5.7.1. Contractor shall employ such means and methods necessary to adequately protect public property and Property of the Owner from damage. In the event of damage to such property, immediately restore the property to a condition equal to its original condition to the satisfaction of the Engineer and owner of said property and bear all costs thereof.

5.7.2. Protect cultivated trees and crops and other items located adjacent to the proposed work. Notify property owners affected by the construction at least 48 hours in advance of beginning construction. During construction operations, construct and maintain facilities to enable pedestrian access by all property owners to their property at all times. No person shall be cut off from vehicular access to residence or place of business for a period exceeding 8 hours, unless the Contractor has made special arrangements with the affected persons.

5.7.3. Provide access at all times for livestock through farm areas. No portion of farmlands in which livestock are pastured shall be cut off from ready access by the farm animals.

5.7.4. Protect from damage all trees outside the limits of the work and trees within the limits of the work which are specifically designated to remain undisturbed. No trees except those specifically designated by these Specifications or in the project drawings shall be removed without the approval of the Engineer. Dispose of trees in a legal manner off the jobsite.

## 5.8. Fire Prevention and Protection:

The Contractor shall work in a safe and diligent manner to avoid fires. To achieve that end the Contractor shall comply with any local Fire Prevention Laws or Regulations.

## 5.9. Environmental Controls

5.9.1. General: The Contractor in executing the work shall maintain affected areas within and outside project boundaries free from environmental pollution that would be in violation of CI Government Public Health Department Regulations or other accepted standards. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes and other debris from entering sewers, pump stations, storm drains or other sewer structures. Maintain original site drainage wherever possible.

5.9.2. Water Pollution Control: Comply with laws, rules and regulations of the agencies of the CI Government Environmental Health Department and Water Authority-Cayman

governing the pollution of lakes, wetlands, bays and coastal waters from the dumping of refuse, rubbish or debris.

**5.9.3. Dewatering Procedures:** The Contractor shall construct, maintain and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protect works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from various parts of the work. Maintain the foundations and parts of the work free from water. Where excavation extends below the water table, dewater in a manner that will prevent loss of fines from the foundation. Maintain stability of the slopes and bottom of the excavation and perform construction operations in the dry. Use screened wells or equivalent methods for dewatering. Control seepage along the bottom of sumps from which the water shall be pumped and properly discharged.

**5.9.4. Waste Materials Disposal:** The Contractor shall make his own arrangements for the disposal of waste materials. Provide watertight conveyance for liquids, semi liquids, or saturated solids that tend to bleed during transport. Maintain work areas and affected properties free from accumulations of waste, debris, and rubbish caused by construction operations. Remove excavated materials from the site. Cleaning and disposal shall comply with CI Governments regulations and pollution control laws. Do not burn or bury rubbish or waste materials on site. Disposal of wastes into wetlands, canals, bays, or coastal waters is prohibited. Provide acceptable containers for the collection and disposal of waste materials, debris and rubbish.

**5.9.5. Air Pollution:** Minimize air pollution likely to occur from construction operations by wetting down bare soils during windy periods, requiring proper emission control devices on construction vehicles and equipment and by shutting down motorized equipment when not in use. Do not burn trash.

## **6. Preservation Restoration and Cleanup**

### **6.1. Site Restoration and Cleanup**

**6.1.1.** At all times during the work, keep the premises clean and orderly, and upon completion of the work, repair all damage caused by equipment and leave the project free of rubbish or excess materials of any kind.

**6.1.2.** Stockpile excavated materials in a manner that will cause the least damage to

adjacent lawns, grassed areas, gardens, shrubbery, or fences, regardless of whether these are on private property, or on local rights-of-way. Remove all excavated materials from grassed and planted areas, and leave these surfaces in a condition equivalent to or better than their original condition. Replace topsoil areas as specified in Section Finish Grading and Grassing, raked and graded to conform to their original contours.

6.1.3. All existing drainage ditches and culverts shall be reopened and graded and natural drainage restored. Restore culverts broken or damaged to their original condition and location.

6.1.4. Upon completion of pipe laying and backfilling operations, hand-rake and drag all former grassed and planted areas, leaving all disturbed areas free from rocks, gravel, clay, or any other foreign material and ready, in all respects, for seeding. The finished surface shall conform to the original surface, and shall be free-draining and free from holes, ruts, rough spots, or other surface features detrimental to a seeded area.

## 6.2. Tree Removal

The Contractor shall comply with applicable Cayman Law covering tree removal. No tree shall be removed without the contractor giving proper consideration to relocation. No trees shall be removed without the express approval of the Engineer, and the Engineer must be satisfied that relocation is not required. Removed trees will be disposed of off the worksite by the Contractor. Trees designated to remain and shown on the Drawings shall be protected from all construction. No materials shall be stockpiled within 5 feet of the trunks of these trees, no grade shall be disturbed, and equipment shall stay clear of those limits. The contractor shall comply with applicable ordinances on tree removal.

## 6.3. Reseeding and Fertilizing

Originally seeded areas outside dedicated rights-of-way or easements shall be fertilized and reseeded with first-quality seed or planted with new sod as approved by the property owner. All ground preparation, reseeded, and sodding shall be done in accordance with the best accepted practices for lawn planting. The Contractor shall be responsible for obtaining a satisfactory grass turf to the property owner.

## 6.4. Finishing of Site, Borrow, and Storage Areas

Upon completion of the project, all areas used by the Contractor shall be properly cleared of all temporary structures, rubbish, and waste materials and properly graded to drain and blend in with the abutting property. Areas used for the deposit of waste materials shall be finished to properly drain and blend with the surrounding terrain. Excess, unused construction material shall also be completely removed by the contractor.

## 6.5. Removal of Rock from Finished Surfaces

Remove and dispose of all loose rock and boulders larger than 2-inch diameter occurring on the finished surfaces as a result of the construction operations.

#### **6.6. Street Cleanup during Construction**

Thoroughly clean all spilled dirt, gravel, or other foreign material caused by the construction operations from all streets and roads at the conclusion of each day's operation.

#### **6.7. Dust Minimization**

The Contractor shall make all practical efforts to minimize dust during construction. This will include, but is not limited to, brushing excess spoils from the traffic path and occasionally watering down the area.

### **7. Submittals During Construction**

#### **7.1. General**

7.1.1. Requirements in this section are in addition to any specific requirements for submittals specified in other sections of these specifications. Individual sections shall take precedence in the event of a conflict with this section.

7.1.2. Submittals to the Cayman Water Company shall be addressed to:

Resident Engineer  
Cayman Water Company  
P.O. Box 1114 GT  
Grand Cayman, Cayman Islands  
British West Indies

7.1.3. Submitted data shall be fully sufficient in detail for determination of compliance with the Contract Documents.

7.1.4. Review, acceptance, or approval of substitutions, schedules, shop drawings, lists of materials, and procedures submitted or requested by the Contractor shall not add to the contract amount, and additional costs which may result there from shall be solely the obligation of the Contractor.

7.1.5. The Owner is not precluded, by virtue of review, acceptance, or approval, from

obtaining a credit for construction savings resulting from allowed concessions in the work or materials therefore.

7.1.6. It shall not be the responsibility of the Owner to provide engineering or other services to protect the Contractor from additional costs accruing from such approvals.

7.1.7. No equipment or material for which listings, drawings, or descriptive material is required shall be installed until the Engineer has on hand copies of such approved lists and the appropriately stamped final shop drawings.

7.1.8. The review of drawings by the Engineer will be limited to general design requirements only, and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein.

7.1.9. Make required submittals promptly to the applicable Government Department or authority as required by law. Submit to the Engineer and Owner a copy of letters relative to the contract including notifications, reports, certifications, and the like that: are submitted directly to a governing agency.

7.1.10. Schedules:

a. The Contractor shall be required to prepare and submit to the Engineer before the start of construction an Overall Project Schedule comprised of construction operations covering all of the work to be done in connection with the project.

b. The Overall Project Schedule shall be of sufficient detail and shall indicate the minimum of individual work activities of the Project. A work activity is defined as an activity for which manpower is required and must be performed before the project is considered complete.

c. The Overall Project Schedule shall indicate the sequence of work and the time of starting and completion. It shall include but not be limited to the following items as they pertain to the project;

1. Shop drawing
2. Materials and Equipment order, delivery and installation.
3. Performance tests and supervisory activities.
4. Backfilling, grading, reinstatement, etc.
5. Subcontractor's items of work.

- 6. Final cleaning
- 7. Allowance for inclement weather.

7.1.10.1. Submit three copies of the Overall Project Schedule and each subsequent revision.

7.1.11. Progress Reports: At least once each month on a date mutually agreed upon by the Owner and Engineer, a jobsite meeting will be held at which time the schedule will be reviewed and updated. In updating the schedule, progress will be reviewed;

- a. To identify those activities started and completed during the previous period.
- b. For remaining duration, from the date of update, required to complete each activity started but not completed.
- c. For review of remaining durations for selected activities not yet started.

## 7.2. Samples, Test Specimens and Shop Drawings

7.2.1. Shop drawings as defined herein, consist of all drawings, diagrams, illustrations, schedules, and other data which are specifically prepared by or for the Contractor to illustrate some portion of the work; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a manufacturer and submitted by the Contractor to illustrate material or equipment for distinct portions of the work.

7.2.2. The Contractor shall submit, six (6) copies, to the Engineer for his review, such shop drawings, electrical diagrams, and catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment) required for the construction. Shop drawings shall be submitted in sufficient time to allow the Engineer not less than 20 regular working days for examining the shop drawings.

7.2.3. These shop drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the Contract Drawings and Specifications.

7.2.4. Unless otherwise approved by the Engineer, shop drawings shall be submitted only by the Contractor, who shall indicate by a signed stamp on the shop drawings, or other approved means, that he (the Contractor) has checked and approved the shop drawings, and that the work shown is in accordance with Contract requirements and has been checked for dimensions and relationship with work of all other trades involved. The practice of submitting incomplete or unchecked shop drawings for the Engineer to correct or finish will not be acceptable, and shop drawings which, in the opinion of the Engineer, clearly indicate that they have not been checked by the Contractor will be considered as not complying with the intent of the Contract Documents and will be returned to the Contractor for resubmission in the proper form.

7.2.5. When the shop drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the shop drawing may be rejected and one set will be returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit the shop drawings in the same manner and quantity as specified for the original submittal, unless otherwise directed by the Engineer. If changes are made by the Contractor (in addition to those requested by the Engineer) on the resubmitted shop drawings, such changes shall be clearly explained in a transmittal letter accompanying the resubmitted shop drawings.

7.2.6. The review of such shop drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the shop drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop drawings.

7.2.7. The Contractor agrees that shop drawing submittals processed by the Engineer do not become Contract Documents and are not Variation Orders; that the purpose of the shop drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his work and to permit the Engineer to monitor the Contractor's progress and understanding of the design.

### 7.3. Certificate of Compliance

The Contractor shall issue the Owner and Engineer with a certificate of Compliance. The Certificate of Compliance is a statement from the Contractor that all material and equipment used is in compliance with a recognized standard code. At the Engineer's discretion, he may request that the Contractor provide component or material specific Certificates of Compliance which the Contractor must obtain from his supplier or the manufacturer.



7.3.1. The Engineer reserves the right to refuse and object to the use of materials based on the Certificate of Compliance. This does not reduce the rights of the Owner to object to other substandard material or work.

#### 7.4. Construction Photographs

7.4.1. The Contractor shall provide color videos or photographs showing the preconstruction site, and the post construction site. All videos and photographs shall be taken by a professional photographer. The photographer shall be equipped to take interior/exterior videos and photographs.

7.4.2. Videos shall be in the 1/2 inch VHS format and the film shall be 4 inches by 5 inches in size. Videos and photographs shall indicate on the beginning or front of each cassette or print the date, job title and brief description of the video or photograph and location where the video or photograph was taken. Copies of the video cassette and 3-inch by 5-inch glossy prints of each exposure together with the negatives shall be delivered to the Engineer.

#### 7.5. Record Drawings

Each month or as otherwise agreed, submit to the Engineer a current listing and description of each change incorporated into the work since the preceding submittal. Engineer will prepare a set of record drawings for the project which will include the changes made in materials, equipment, locations, and dimensions of the work.

### 8. Payment

8.1. General: Payment for the work in this section will be included as part of the lump sum bid or applicable unit prices stated in the Proposal.

## SECTION A

# Trench Excavation & Backfill

## 1. GENERAL

### 1.1. Work Included

This section covers the work necessary for the trench excavation and backfill, complete.

#### 1.1.1. Trench Excavation

Excavation is unclassified. Complete all excavation regardless of the type of materials encountered. The Contractor shall make his own estimate of the kind and extent of the various materials which will be encountered in the excavation

### 1.2. Related Work Specified

Elsewhere Cayman Islands Government Public Works Department, Specifications for Surface Reinstatement.

### 1.3. Type of Backfill

The right is reserved to modify the use, location, and quantities of the various types of backfill during the construction as the Engineer considers to be the best interest of the Owner. Payment shall be based on the class of backfill installed. During construction, the Engineer will designate the type of backfill to be used in each location throughout the project.

#### 1.3.1. Class A Backfill

In general, Class A backfill will be used throughout the project except where Class D backfill is specified. It is intended that all surfaces for which Class A backfill is specified shall be returned to equal or better condition than that existing prior to construction. Surfaces shall not settle or rut due to normal weathering or vehicular traffic that can be expected for each area.

#### 1.3.2. Class D Backfill

1.3.2.1. Class D backfill will, generally, be limited to paved streets, driveways, and parking lots where final surfacing replacement will be made shortly after backfilling and subsequent trench settlement must be held to a minimum.

1.3.2.2. Class D backfill shall also be used under all culverts, water, gas, irrigation, and sewer lines, buried telephone, power and television cable, and any other miscellaneous buried pipelines or cables that cross the excavated trench. This work should be done at no cost to Owner.

## SECTION A

1.3.3. Concrete Backfill will be used where, in the opinion of the Engineer, there is insufficient cover over the pipe for proper cover and protection. It is also required when the water main crossing is 18 inches above or below a sewer line.

## 2. Materials

### 2.1. Foundation Stabilization

Foundation stabilization material shall be 1-inch minus crushed rock or gravel, well graded from course to fine with no more than 20 percent of fines passing No. 200 sieve, free from organic materials.

### 2.2. Suitable Backfilling Material

Material suitable for backfill in a properly de-watered trench shall consist of any of the following:

2.2.1. Well-graded course granular materials with maximum particle size not exceeding 3 inches; sands, silty-sands or clayey-sands. Soils having more than 35% of its weight passing a No. 200 sieve shall not be used for backfill. The majority of fine sand common in the project area is suitable for backfill. Excavated material may be used if it meets the above criteria.

### 2.2.2. Concrete for trench backfill

Conform to ASTM C 94, Alternate 3. Proportion to obtain a 28-day compressive strength of 2,500 pounds per square inch. Use a minimum of five sacks of cement per cubic yard of concrete.

### 2.3. Imported Topsoil

Imported topsoil shall be suitable sandy loam from an approved source, which possesses friability and a high degree of fertility. It shall be free of high salts content, clods, roots, gravel, and other inert material. It shall be free of quack grass, horsetail, and other noxious vegetation and seed. Should such regenerative material be present in the soil, the Contractor shall remove, at his expense, all such growth, both surface and root, which may appear in the imported topsoil within 1 year following acceptance of the job in a manner satisfactory to the Owner.

### 2.4. Water for Trench Backfill

The Contractor shall make all arrangements for a source of water and bear all costs for the delivery of the water to the trench site. See paragraph TEMPORARY WATER in section GENERAL REQUIREMENTS.

### 2.5. Compaction equipment

Compaction equipment shall be of suitable type and adequate to obtain the amount of compaction specified. Compaction equipment shall be operated in strict accordance with the manufacturer's instructions and recommendations and shall be maintained in such condition that it will deliver the manufacturer's rated compactive effort.

## SECTION A

### 3. Workmanship

#### 3.1. Preparation of Right-of-Way

3.1.1. Where clearing or partial clearing of the right-of-way is necessary, complete clearing prior to the start of trenching. Cut trees and brush as near to the surface of the ground as practicable, remove all stumps, and pile for disposal. Do not permit excavated materials to cover brush or trees prior to disposal.

3.1.2. Do not remove existing trees or tree limbs over 2 inches in diameter on public property unless they are within 10 feet of the pipe centerline, without permission from the Engineer. Protect from damage, unless otherwise marked by the Engineer, all trees, shrubs, or plants within the limits of the public rights-of-way. Those that interfere with trenching may be removed intact with their root system. Ball the root system of the trees, shrubs, or plants, bind in burlap, heel into the stockpiled topsoil from the trench excavations, and keep watered as required. Upon completion of the pipe laying and backfilling of the trench, replant the trees, shrubs, or plants in their original location. The Contractor shall record the location of any plant prior to its removal. Should any tree, shrub, or plant that has been disturbed as a result of its removal, or otherwise damage by the Contractor, die within 6 months from the time that it was disturbed or damaged, it shall be replaced in kind and size by the Contractor at his expense.

#### 3.2. Disposal of cleared material

3.2.1. The Contractor shall bear all costs of disposing of trees, stumps, brush, roots, limbs, and other waste materials from the clearing operation. Material shall be disposed of in such a manner as to meet all requirements of local regulations regarding health, safety, and public welfare. Nonflammable material, and flammable material shall be disposed of the construction site in an approved location at the Contractor's expense.

#### 3.3. Obstructions

3.3.1. This item refers to obstructions which may be removed and do not require replacement. Remove obstructions within the trench area or adjacent thereto such as tree roots, stumps, abandoned piling, or buildings and concrete structures, logs, and debris of all types without additional compensation. The Engineer may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment changes can be made within the easement or right-of-way without adversely affecting the intended function of the facility. The Contractor shall pay all additional costs or credit the Owner for any savings resulting from such alignment changes.

3.3.2. Dispose of obstructions removed from the excavation in accordance with Paragraph DISPOSAL OF CLEARED MATERIAL.

## SECTION A

### 3.4. Removal and Replacement of Topsoil

3.4.1. Where trenches crosses lawns, garden areas, pasturelands, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil for a depth of 12 inches for the full width of the trench to be excavated. Stockpile this topsoil to one side of the right-of-way and do not mix with the remaining excavated material. Replace the topsoil in the top 12 inches of the backfilled trench.

3.4.2. In lieu of stockpiling and replacing the topsoil, imported topsoil may be substituted in the top 12 inches.

3.4.3. Maintain the finished grade of the topsoil level with the area adjacent to the trench until final acceptance by the Engineer. Repair damage to adjacent topsoil caused by work operations. Remove all rock, gravel, clay, and any other foreign materials from the surface re-grade, and add topsoil as required.

### 3.5. Pavement, Kerb and Sidewalk Removal

Cut all bituminous and concrete pavements, regardless of the thickness, and all kerbs and sidewalks, prior to excavation of the trenches with an approved pavement saw, hydro-hammer, or approved pavement cutter. Pavement and concrete materials removed shall be hauled from the site and not used for trench backfill.

### 3.6. Trench Width

3.6.1. Minimum width of unsheeted trenches in which pipe is to be laid shall be 12 inches greater than the nominal diameter of the pipe. Sheet piling requirements shall be independent of trench widths.

3.6.2. The maximum width at the top of the trench will be limited to 18 inches or 24 inches as shown on the project drawings and section Details.

3.6.3. Confine trench widths to dedicated rights-of-way or construction easements, unless special written agreements have been made with the affected property owner.

### 3.7. Grade

Excavate the trench to the lines and grades shown or as established by the Engineer with proper allowance for pipe thickness and for pipe base or special bedding when required. If the trench is excavated below the required grade, correct any part of the trench excavated below the grade at no additional cost to the Owner, with material of the type specified for pipe base in Sections DUCTILE IRON PIPE, PVC BELL & SPIGOT WATER PIPE AND DUCTILE OR CAST IRON FITTINGS. Place the base material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade.

## SECTION A

### 3.8. Shoring, Sheet piling, and Bracing of Trenches

Sheet and brace the trench when necessary to prevent caving during excavation in unstable material, or to protect adjacent structures property, workmen, and the public. Increase trench widths accordingly by the thickness of the sheet piling. Maintain sheet piling in place until the pipe has been placed and backfilled at the pipe zone. Shoring and sheet piling shall be removed, as the backfilling is done, in a manner that will not damage the pipe or permit voids in the backfill. All sheet piling, shoring, and bracing of trenches shall conform to the safety requirements of the local public agency having jurisdiction. The most stringent of these requirements shall apply.

### 3.9. Location of Excavated Material

During trench excavation, place the excavated material only within the construction easement, right-of-way, or approved working area. Do not obstruct any private or public traveled roadways or streets. Conform to all local codes governing the safe loading of all trenches with excavated material.

### 3.10. Removal of Water

#### 3.10.1. Dewatering and Drainage

3.10.1.1. At all times during construction the Contractor shall keep excavations free from standing water.

3.10.1.2. Well point systems, shallow wells, dual well point systems and/or other dewatering equipment shall be used as necessary to ensure adequate dewatering of excavations.

3.10.1.3. The dewatering system shall take into consideration both the construction procedures and the depth of the excavation relative to the ground water level. The Contractor is solely responsible for the design, installation and operation of dewatering systems and their safety and conformity with all applicable local codes and regulations.

3.10.1.4. Water pumped from the excavation shall be discharged to prevent re-entry into the excavation being dewatered. Water containing silt in suspension or any contaminants shall not be pumped into pipelines, the ocean or any extension thereof including sounds, bays, canals, ponds, swamps or marshes. The method of disposing of water pumped from the excavation shall be reviewed by the Engineer prior to actual disposal.

3.10.1.5. Operation of the dewatering system shall be continued until the construction is carried above the natural groundwater level and the trench backfilled to prevent flotation.

## SECTION A

### 3.11. Foundation Stabilization

When in the opinion of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, excavate below the flow line of the pipe, as directed by the engineer. Backfill the trench to the specified pipe grade with foundation stabilization material specified hereinbefore. Place foundation stabilization material over the full width of the trench and compact in layers not exceeding 6 inches deep to the required grade.

### 3.12. Pipe Base and Pipe Zone backfill

Pipe base and pipe zone backfill are included in specification for pipe.

### 3.13. Trench backfill above Pipe Zone

When backfill is placed mechanically, push the backfill material onto the slope of the backfill previously placed and allow to slide down into the trench. Do not push backfill into the trench in such a way as to permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Under no circumstances allow sharp, heavy pieces of material to drop directly onto the pipe or the taped material around the pipe. Do not use backfill material of consolidated masses larger than 1/2 cubic foot.

#### 3.13.1. Class A Backfill

Backfill the trench above the pipe zone with excavated trench materials with a maximum size of 3 inches and free from organic material. Place in 12-inch layers and compact each layer by means of mechanical tampers or vibratory compactors to a minimum of 95 percent of maximum density as determined by ASTM D 1557. Backfill to the required surface grade, and compact so that no settlement will occur. Maintain the surface of the backfilled trench level with the existing grade until the entire project is accepted by the Owner. Any subsequent settlement of the finished surface during the warranty period shall be considered a result of improper or insufficient compaction and shall be promptly repaired by the Contractor at no cost to the Owner.

#### 3.13.2. Class D Backfill

Backfill the trench above the pipe zone with approved granular backfill material in lifts not exceeding 8-inch loose depth and compact each lift to a minimum of 95 percent of maximum density as determined by ASTM D 1557, with mechanical vibrating or impact tampers.

3.13.2.2. Maintain the surface of the backfilled trench level with the existing grade. Place base material as specified in Section SURFACE REINSTATEMENT until pavement reinstatement is complete and the entire project is accepted by the Owner.

3.13.2.3. Any subsequent settlement of the finished surfacing during the warranty period shall be considered to be a result of improper or insufficient compaction and shall be promptly repaired by the Contractor at no cost to the Owner.

## SECTION A

### 3.13.3. Concrete Backfill

Place concrete backfill in such a manner that no dirt or foreign material becomes mixed with the concrete. Minimum thickness of concrete protection shall be 6 inches on the top and sides of the pipe. Concrete shall have sufficient time to reach initial set before any additional backfill material is placed in the trench. Place pipe base in all trenches requiring concrete backfill.

3.13.4. Class A and D backfill shall be tested for compaction on an average of every 1,500 feet or once for each extension whichever is shorter as directed by the Engineer. Failure of any one test will require additional testing as directed by the Engineer.

### 3.13.5. Road Base

Road Base material above trench backfill material is included in section SURFACE REINSTATEMENT.

## 3.14. Maintenance of Trench Backfill

3.14.1. Maintain the backfilled trench surface until the following operations have been completed and approved by the Engineer :

- I. Construction of Manholes and Appurtenances
  - II. Valves, Valve Boxes, and Hydrants Installed
  - III. Testing and Sterilization
  - IV. Cleanup and Restoration of All Physical Features
  - V. Utilities Restored to Their Original Condition or Better
  - VI. And, in general, all Work Required with the Exception of Repaving

3.14.2. This maintenance shall include, but not be limited to, the addition of crushed rock backfill material to keep the surface of backfilled trenches reasonably smooth, free from ruts and potholes, and suitable for normal traffic flow.

3.14.3. No additional payment will be made for the maintenance of the trench backfill prior to completion of the work outlined above.

3.14.4. No pavement replacement shall be undertaken until all items outlined above have been completed and approved by the Engineer.

3.14.5. Maintenance of backfilled trenches is considered as incidental to this item of work and payment for such maintenance will be considered as included in payment for backfill.

## 3.15. Disposal of Excess Excavated Material

Dispose of all excess excavated materials. Make arrangements for the disposal and bear all costs or retain any profit incidental to such disposal.



## SECTION A

### 3.16. Drainage Culverts

3.16.1. All culverts shall be protected from damage or restored to equivalent condition, if damaged, at no Cost to the Owner.

3.16.2. Replace culverts to the lines and grades established by the Engineer. Do not replace culverts until the proposed pipeline is installed and the backfill of the trench has been completed to the sub-grade of the culvert.

### 3.17. Drainage ditch restoration

Undercrossings of minor drainage ditches not covered in a special section shall be backfilled so that the upper 1 foot of material in the ditch between ditch banks is topsoil, loam, or clay. Compact this material for the full ditch width to a minimum of 95 percent of maximum density as determined by ASTM D 1557. The Contractor shall correct any ditch leakage occurring as a result of his operations at no cost to the Owner

### 3.18. Settlement

Any settlement noted in backfill, fill, or in structures built over the backfill or fill within the 1-year warranty period in accordance with the General Conditions will be considered to be caused by improper compaction methods and shall be corrected at no cost to the Owner. Structures, or paved surfaces damaged by settlement shall be restored to their original condition by the Contractor at no cost to the Owner.

## 4. Payment

### 4.1. General

Payment for the work specified in this section will be made at the unit prices stated in the proposal and shall be included under the following items;

4.1.1. Class A backfill: A minimum of Class A backfill shall be provided for all excavations. Payment for all excavation and Class A backfill shall be made is part of the unit prices for installing pipe and appurtenances.

4.1.2. Class D backfill: Payment for the additional effort required for providing Class D backfill in lieu of Class A backfill will be included in the surface repair items included in the Contractor's Proposal.

4.1.3. Concrete backfill: Payment for this item will be based on the price per cubic yard as stated in the Proposal. Payment will be in addition to the linear foot payment for trench excavation and backfill.

4.1.4. Foundation stabilization: It is not anticipated that foundation stabilization will be required for the pipelines in this project. If small unstable areas are encountered totaling less than 2 percent of the total length of pipeline in the project that can be stabilized by over-excavating and replacing not more than 18 inches

#### **SECTION A**

depth of unstable pipe foundation material, the Contractor shall stabilize the foundation at no cost to the Owner. If the total length of the unstable material exceeds 2 percent of pipeline length or if more than 18 inches over excavation is required, payment for foundation stabilization shall be made on the basis of time and materials at unit prices established by Contract Variation Order. The need for foundation stabilization shall be determined by the Engineer. Payment will not be made for stabilization work not authorized by the Engineer.

- 4.1.5. Imported backfill: It is not anticipated that imported backfill will be required for this project. The Contractor shall replace unsuitable backfill with imported suitable backfill material at no expense to the Owner if required for up to 2 percent of the total length of pipeline in the project. If imported backfill is required for more than 2 percent of the pipeline length, payment will be made on the basis of time and materials at unit prices established by Contract Variation Order. No payment will be made for imported backfill not authorized by the Engineer.

## SECTION B

### **PVC Bell-And-Spigot Water Pipe**

#### **1. Scope**

##### **1.1. Work Included**

This section covers the work necessary for furnishing and installing the PVC bell-and-spigot water pipe including pipe base material and pipe zone backfill material complete.

##### **1.2. Related Work Specified Elsewhere**

Section A TRENCH EXCAVATION AND BACKFILL  
Standard AWWA C601

#### **2. Materials**

##### **2.1. Pipe Material**

The rigid PVC pipe used in municipal water main distribution system shall meet the requirements of ASTM D-2241 or equal, as approved by the Engineer and specified on the drawings.

##### **2.2. Qualification for Potable Water Service**

The pipe shall bear the seal of approval (or NSF mark) of the National Sanitation Foundation Testing Laboratory, Inc., or other similarly accredited testing agency which has qualified the pipe for potable water service.

##### **2.3. Design Requirements**

**2.3.1. Impact strength:** Each length of pipe shall be designed to meet the test requirements as specified under Paragraph IMPACT RESISTANCE

**2.3.2. Class Pipe:** Pipe Shall be Class 160 meeting SDR 26.

##### **2.4. Pipe Ends**

**2.4.1. Joints for PVC pressure pipe** shall be bell-and-spigot push-on joint. Pipe joints for pressure service shall be provided with thrust restraint designed for the test pressures specified. Thrust restraint shall be provided by concrete thrust blocks as shown in the Details of the Project drawings. Thrust tie-rod attachments relying on clamp friction with the barrel of the pipe to restrain thrust are unacceptable anchoring of thrust ties with devices employing set screws is not acceptable.

##### **2.5. Detail Requirements**

**2.5.1. PR160 SDR 26**

## SECTION B

### 2.5.1.1. Pipe and fitting test requirements at the plant:

Conditions of specimens prior to test at 23 plus or minus 2 degrees C (73.4 plus or minus 36 degrees F) and 50 plus or minus 5 percent relative humidity for not less than 40 hours in accordance with procedure of ASTM D618, Conditioning Plastics and Electrical Insulating materials for testing.

### 2.5.1.2. Hydrostatic Routine Test of Couplings: Each coupling shall be tested to 200 psi for a minimum dwell of 5 seconds

### 2.5.1.3. Impact Resistance: Using mix test specimens per shift, conduct tests in accordance with ASTM D 256.

## 2.6. Pipe and Fitting Marking at the Plant

2.6.1. Standard random lengths: Each standard and random length of pipe shall be clearly marked on the outside surface with the manufacturer's name with the appropriate designation code (eg, PVC 1120), SDR, nominal size, pressure classification, date, and shift of manufacture.

2.6.2. Couplings: All component parts of each coupling shall be clearly marked for use with the pipe which they are intended. Each coupling shall also be marked with the letter T to indicate that it has been hydrostatically tested.

2.6.3. Special marking: If factory inspection is made by the Owner or his authorized inspector, each pipe and each coupling may receive an additional special marking of no more than three letters as required by the Owner's inspector.

2.6.4. Preparation at the plant for shipment: All pipe and couplings shall, unless otherwise specified, be prepared for standard commercial shipment.

### 2.6.5. Pipe Lengths

2.6.5.1. Pipe shall be produced in standard and random lengths. At Least 85 percent of the total footage of pipe of any class and size shall be furnished in standard lengths. The remaining 15 percent may be in random length.

2.6.5.2. Standard laying lengths shall be 20 feet plus or minus 1 inch for all sizes.

2.6.5.3. Random lengths shall not be less than 10 feet long.

2.6.6. Sockets and couplings: The integral socket bell of the PVC pipe or the separate coupling for use with the same size and class as that of the pipe shall be furnished with each length of pipe.

## SECTION B

### 2.7. Rubber Rings

Rubber rings shall conform to requirements of the latest edition of ASTM D 1869 or ASTM F477

### 2.8. Pipe Fittings

Unless otherwise shown or specified, fittings shall be PVC of the same class and rating as the pipe. Fitting joints shall be as required for the pipe being connected. Transition fittings necessary for proper connection shall be the standard of, and provided by the manufacturer of the fitting.

#### 2.8.1. Fittings for PVC PR 160 SDR26 Pipe

SDR26 pipe fittings shall be PVC produced in compliance with ASTM-D2241-80.

### 2.9. Service Saddles

Connections and fittings for Customer Service Connections are specified in section SERVICE CONNECTIONS.

### 2.10. Joint Lubricant

The joint lubricant shall have been tested and approved for potable water service. No lubricant shall be used that will harbor bacteria or damage the rings.

### 2.11. Concrete for Thrust Blocking

Concrete shall have a minimum compressive strength of 2,500 psi at 28 days. The use of high-early cement will be required to allow hydrostatic testing 5 days following the installation of the thrust blocking.

### 2.12. Pipe Base Material

2.12.1. Loose trench side material may be selected by the Engineer for use as pipe base when such material is free from stones larger than 1/2 inch in size, organic materials, foreign matter, large dirt clods and is suitable for hand grading to evenly support the entire length of the pipe barrel.

2.12.2. Imported pipe base material shall be used where trench side material is determined by the Engineer to be unsuitable for proper support of the pipe barrel. Such imported pipe base material shall be clean angular sand with a uniform gradation from 1/2-inch maximum to fine sand in size. The imported base shall be 4 inches in depth below the pipe barrel, and extend to the full width of the trench bottom.

### 2.13. Pipe Zone Material

2.13.1. Loose trench side material may be selected by the Engineer for backfilling the pipe zone when such material is free from stone larger than 1/2 inch in size, organic materials, foreign matter, large dirt clods, and is suitable for hand placement and compaction around the pipe to evenly support the sides and protect the top of the

## SECTION B

pipe.

2.13.2. Where trench side material is determined by the Engineer to be unsuitable for backfilling in the pipe zone, imported pipe zone material shall be used. The imported pipe zone material shall be clean angular sand with a uniform gradation from 1/2-inch maximum to fine sand in size. The pipe zone shall extend from the pipe base to a point not less than inches above the top outside surface of the pipe barrel for the full width of the trench.

2.14. Backfill Above the Pipe Zone: Specified under Section TRENCH EXCAVATION AND BACKFILL.

### 3. Workmanship

#### 3.1. Manufacture of Pipe

3.1.1. Surfaces: The inside and the outside surface of each length of pipe shall be free from nicks, scratches, and other surface defects and blemishes. The pipe shall be homogeneous throughout, free of any bubbles, voids, or inclusions.

3.1.2. Joint areas: The jointing areas of the barrel of each length of pipe shall be free from dents and gouges.

#### 3.2. Inspection at the Plant

3.2.1. Inspection by the Owner or his representative shall not relieve the responsibility to furnish material performing in all respects to the requirements of this Specification.

3.2.2. If plant inspection is requested by the Owner, the manufacturer shall notify the Owner in advance of the date, time, and place of testing of the pipe, in order that the Owner may be represented at the test.

3.2.3. The Owner's inspector shall have free access to those parts of the manufacturer's plant that are involved in work performed under this Specification. The manufacturer shall afford the inspector, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this Specification.

#### 3.3. Pipe Unloading at the Site and Handling

3.3.1. Inspect each shipment of pipe and fittings and make provisions for a timely replacement of any damaged material. Unload by hand or use canvas slings to avoid scratching the pipe do not slide or drag PVC pipe over an abrasive surface. Pipe with deep scratches shall be replaced with new pipe and removed from the site. The Engineer may clearly mark any defective pipe stored by Contractor.

3.3.2. Stack pipe no higher than 5 feet and provide support for the pipe barrel to prevent bending of the pipe. Pipe stockpiled for more than 10 days shall be covered to protect it from the sun's rays. Provide for air circulation through the stockpile.

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3.3.3. Store rubber rings in a cool, dark place out of the direct rays of the sun.

3.3.4. Each pipe and fitting shall be carefully inspected before exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. Clean ends of pipe thoroughly. Remove any foreign matter and dirt from inside of pipe and keep clean during and after laying. Use proper implements, tools, and facilities for protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

### 3.4. Distribution Pipe Along the Trench

Distribute pipe by hand. Do not drop or drag pipe. Distribute sufficient pipe for 1 day's work, and place with bell end in the direction of pipe laying. Prevent dirt and contaminants from entering the pipe.

### 3.5. Preparation of Trench

3.5.1. The trench bottom shall be smooth and free from stones larger than 1/2 inch, and large dirt clods.

3.5.2. Pipe bed material shall be placed and graded by hand to provide uniform support to the entire length of the pipe. Stabilize the pipe bed material with not less than one pass with an adequate vibratory compactor. Re-grade and re-compact as necessary to provide full length bearing for the pipe.

### 3.6. Assembling the Pipe

Pipe may be preassembled alongside of the trench, then lowered into the trench position in long sections. Closely follow the manufacturer's recommended procedure for cleaning, setting the ring, lubricating the spigot end of pipe, and assembling.

### 3.7. Making Special Joints

Follow manufacturer's recommended procedure, and use on the recommended tools for cutting and beveling.

### 3.8. Service Connections

Service connections are of the size, type, and at the locations shown on the project drawings. Service connections installed after the installation of the pipe shall be installed in accordance with the manufacturer's instructions. Approved tools and particular caution are required to keep drilling fines and scrap from entering the pipe. Saddles bushings, etc., required for tapping-in service connections are specified in section WATER SERVICE CONNECTIONS.

### 3.9. Placing Pipe in Trench

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Pipe that is assembled prior to placing in the trench shall be carefully fed by hand (or with properly designed power equipment) on the pipe bed. Provide pockets in the pipe bed material to accommodate bell ends and eliminate a concentration of load at these points.

### 3.10. Preventing Trench Water From Entering Pipe

When pipe laying is not in progress, close the open ends of pipe with a watertight plug and allow no water or other objectionable materials to enter the pipe.

### 3.11. Thrust Blocking and Anchors

#### 3.11.1. Thrust blocks are required at the following locations:

- A. At tees, bends, and crosses
- B. At pipe reducers
- C. At dead-end stops
- D. At valves where thrust develops when closed

#### 3.11.2. Anchors are required at the following locations:

- A. At valves in the line 3-inch or larger as shown on steep slopes in the line at hydrant run-outs.

#### 3.11.3. Concrete for thrust blocks and anchors shall be a dry mix so the concrete may be easily shaped into the desired form. The concrete shall be poured between the fitting and the undisturbed bearing wall of the trench.

#### 3.11.4. The size of thrust blocking and anchors shall be as shown on the Drawings. Precast thrust will have lifting handles for easy removal at a later date.

### 3.12. Hydrostatic Testing the Installed Pipe

The Contractor shall provide all equipment, air relief valves, fittings, make arrangements for water if necessary, and perform the leakage tests. The Contractor shall notify the Engineer in advance of the testing in sufficient time to allow the Engineer to witness all tests. The test pressure for all pipework is 150 PSI

#### 3.12.1. Initial testing of sections of the pipe during construction

3.12.1.1. Prior to testing, backfill with the pipe zone material and compact with vibrator-compactor, along the pipe, except at the joints and fittings which are to be left exposed during the test. The partial backfilling shall be accomplished in a manner as specified under Paragraph BACKFILLING THE PIPE ZONE.

3.12.1.2. Thrust blocking must attain sufficient strength to withstand the thrust pressure of the pipe before testing. If high-early cement is used, the test may be performed 5 days after pouring the thrust blocks. If the testing indicated a failure due to insufficient thrust blocking, such



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blocking shall be replaced with new blocking as necessary to, properly withstand the pipe thrust. All facilities required for subsequent tests after the first test, including water, shall be at the Contractor's sole expense.

3.12.1.3. Air relief valves shall be installed at high points in the section of pipe being tested.

### 3.12.2. Test Equipment

- 1 Hydraulic force pump
- 2 Suitable graduated containers
- 3 Pressure gauges
- 4 Hose and suction pipe as required

### 3.12.3. Test Procedure

Water shall be used as the hydrostatic test fluid. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system. Purge air pockets by opening vents service connections and blow off points while the piping system is filling. All parts of the piping system shall be subject to the test pressure. The hydrostatic test pressure shall be continuously maintained for 2 hours and such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. Any visible leakage shall be corrected at the Contractor's sole expense.

### 3.12.4. Allowable Leakage

Some leakage is permissible from buried water pressure pipelines. Consequently, the hydrostatic testing of these pipelines must be conducted as follows:

1. Where any section of piping is provided with concrete thrust blocking, do not make the pressure test until at least 5 days have elapsed after the thrust blocking is installed. If high early concrete is used the time may be reduced to 2 days.
2. Expel the air from the piping system prior to testing and apply the test pressure by means of a hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the test for 2 hours. Reopen the isolation valve only as necessary to restore the test pressure. The pump suction seal be in a barrel or similar device or metered so that the amount of water required maintain the test pressure may be measured accurately. This measurement represents the leakage. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula :

$$L = [ SD(P) ]^{1/2} / 133,200$$

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with        L = Allowable leakage, in gallons per hour  
              S = Length of pipe tested in feet  
              D = Nominal diameter of pipe in inches  
              P = Test pressure in PSI

3. The Contractor shall correct any leakage greater than the allowance determined in this formula at the Contractor's Sole expense.

3.12.5. Test records shall be made of each piping system installation test which include the date of test, description and identification of piping tested, test fluid, test pressure, any leaks visible, repairs, and allowable leakage measured.

### 3.13. Backfilling the Pipe Zone

3.13.1. The pipe zone shall be considered to include the full width of the excavated trench from the bottom of the trench to a level. 12 inches above the top outside surface of the pipe barrel.

3.13.2. Following the Engineer's acceptance of the initial pipe testing results, the remaining pipe zone shall be backfilled. The material shall be carefully placed around the pipe and "walked in" or hand-tamped and hand-bladed with a shovel to completely support the pipe barrel in lifts not to exceed 6 inches with both sides of the pipe being backfilled at the same time.

3.13.3. When the hand-tamped lifts of backfill cover the pipe, the remainder of the pipe zone material shall be backfilled in two lifts: each lift shall be compacted with a suitable type vibrator compactor. If the Engineer determines that the pipe zone material requires jetting or the addition of water to achieve proper consolidation for the backfill for pipe support, the Contractor shall provide such corrective measures as are required.

### 3.14. Backfilling Above The Pipe Zone

Backfilling above the pipe zone is specified under Section  
TRENCH EXCAVATION AND BACKFILL.

### 3.15. Final Testing of Installed Pipe

3.15.1. Following the complete backfilling of the trenches, a final hydrostatic test shall be made of the total work completed.

3.15.2. The equipment, test procedure, and allowable leakage shall be as specified in Paragraph Initial Testing of Sections of the Pipe During Construction.

### 3.16. Sterilization

Pipelines intended to carry potable water shall be sterilized before placing in service. Sterilizing procedures shall conform to AWWA C601 as hereinafter modified or expanded.

3.16.1. Flushing: Before sterilizing, flush all foreign matter from the pipeline. Provide

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hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties. Flushing velocities shall be at least 2.5 fps. For large diameter pipe or where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipeline in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

### 3.16.2. Sterilizing Mixture

3.16.2.1. Sterilizing mixture shall be a chlorine water solution having a free chlorine residual of 40-50 ppm. The sterilizing mixture shall be prepared by injecting a calcium or sodium hypochlorite and water mixture into the pipe at a measured rate while fresh water is allowed to flow into the pipeline at a measured rate so that the combined mixture of fresh water and chlorine solution or gas is of the specified strength.

3.16.2.2. If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a 1 percent solution of (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1 percent solution. The following proportions of hypochlorite to water will be required.

<u>Product</u>	<u>Quantity</u>	<u>Water</u>
Calcium Hypochlorite (1) (65-10 percent Cl)	1 lb.	1.5 gal.
Sodium Hypochlorite (2) (5.25 percent Cl)	1 gal.	4.25 gal.

(1) Comparable to commercial products known as HTH, Perchloron and Pittchlor.

(2) Known as liquid laundry bleach, Clorox, Purex, etc.

3.16.3. Point of application: Inject the chlorine mixture into the pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of the pipeline. Water from the existing system or other approved source shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be in such a proportion to the rate of water entering the pipe that the combined mixture shall contain 40-50 ppm of free available chlorine. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check valves if necessary.

### 3.16.4. Retention Period

3.16.4.1. Treated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. With proper flushing and the specified solution strength, 24 hours is adequate. At the end of the

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24-hour period, the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.

- 3.16.4.2. Operate all valves, hydrants, and other appurtenances during sterilization to assure that the sterilizing mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the treated water.
- 3.16.4.3. Do not place concentrated quantities of commercial sterilizers in the line before it is filled with water.
- 3.16.4.4. After chlorination, flush the water from the line until the water through the line has equal chlorine residual to the permanent source of supply.
- 3.16.4.5. Disposal of sterilizing water: Dispose of sterilizing water in an acceptable manner that will protect the public and publicly used receiving waters from harmful or toxic concentrations of chlorine. The Contractor shall present in writing, the method of disposal and submit to the CI Government Environmental Health Dept. and the Engineer for approval. Do not allow disinfecting water to flow into ponds, bays, canals, coastal waters, swamps, or marshes. Dilute disinfecting water adequately and do not dispose of any concentration of disinfecting water above 2.5 PPM.

## 4. Payment

### 4.1. General

- 4.1.1. The measurement for payment will be the field measured centerline length of the pipe and fittings in place within the limits shown.
- 4.1.2. Payment for furnishing and installing pipe fittings will be made at the unit price stated in the proposal. This payment shall constitute full compensation for all work required for furnishing and installing the pipe fittings, complete.
- 4.1.3. Weights of fittings for payment purposes shall be Handbook Weights, *i.e.*, excluding joint accessories. Cast Iron fitting weights shall be as listed in the appropriate tables of the fitting manufacture with physical verification by weighing the fitting if deemed necessary by the engineer, owner or contractor

## SECTION C

### Valves

#### 1. Scope

##### 1.1. Work Included

This section covers the work necessary for furnishing and installing the large and special valves, complete.

##### 1.2. Submittals

Submittals shall be made as required in the section GENERAL CONDITIONS. The Contractor shall supply information as specified in this section and any other information the Engineer requests in order to determine the suitability of the proposed valve.

#### 2. Materials

##### 2.1. General

2.1.1. All valves shall be complete with all necessary extension stems, worm and gear operators nuts, and wrenches which are required for the proper completion of the work included under this section.

2.1.2. Renewable parts including discs, packing and seats shall be of types recommended by the valve manufacturer for the intended service.

2.1.3. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

2.1.4. For the purpose of designating the type and grade of a valve desired, a manufacturer's name and list or figure number is given in the following specifications. Valves of equal quality by another manufacturer will be considered in accordance with the Specifications.

##### 2.2. Design Features

2.2.1. Brass and bronze components of valves and appurtenances which have surfaces in contact with treated water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.

2.2.2. Approved alloys are of the following ASTM designations;

1. B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UN:3 No. C90300 or C94700), B164, B194, and B127.

2. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.

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2.2.3. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.2.4. All valve operators shall open by turning counterclockwise. Worm and gear operators used on manually operated valves shall be of the totally enclosed design, so proportioned as to permit operation of the valve under full operating head with maximum pull of 40 pounds on the hand-wheel or crank. The valve operators shall be of the self locking type to prevent the disc or plug from creeping. Self locking worm gears shall be a one-piece design of gear bronze material, accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished.

### 2.3. Gate Valves Less Than 2-Inches

Gate valves less than 2 inches shall be all-bronze with screwed bonnet and ends, single solid wedge gate, and non-rising stem. Valves shall be rated 125-pound SWP, 200-pound WOG, and shall be Walworth Company Figure 4; Crane Co. Cat. No. 438; or equal.

#### 2.3.1. Gate Valves

2.3.1.1. Gate valves 2 inches and larger for buried water service shall be iron body, bronze mounted valves with mechanical joint ends, double disc gate, non-rising stem, o-ring sealed stuffing box, and 2 inch wrench nut conforming to AWWA C500. Valves shall be rated 150-pound WOG minimum, and shall be American Valve and Hydrant Company No. 55; Ludlow-Rensselaer Valve Division of Patterson Industries, Inc., List AWWA; or equal.

2.3.1.2. All interior areas of the cast iron shall be provided with a two-part thermosetting epoxy protective coating and shall function as a physical, chemical, and electrical barrier between the base metal to which it is applied and the surroundings. The coating shall be nontoxic and shall not impart taste to the water. The coating must be formulated from materials deemed acceptable per the U.S. Food and Drug Administration Document Title 21 of the U.S. Federal Regulations on Food Additives, section 121.2514 entitled, "Resins and polymeric Coatings" Further, the coating shall have a satin finish and be suitable for field over-coating and touchup without sanding or special surface preparation of application of heat in excess of room temperature. The coating shall have a successful record of performance in valves, pipe or other applied, equipment for a minimum of 3 years.

2.3.1.3. Exterior areas of the valve shall have two coats of asphalt varnish which shall conform to the requirements of Federal Specification TT-V-51 Asphalt Varnish, or equal.

## SECTION C

### 2.4. Air Release Valves (ARV)

1. The air release valve shall be constructed to permit the escape of large volumes of air when the line is being filled with water. In addition the valve shall act to release smaller amounts of accumulated air under normal operating conditions, and additionally function so that air may reenter the line to break any vacuum caused by the water leaving rapidly. The valves shall be designed to operate under working pressures of 150 psi to 225 psi and shall be tested at a pressure not less than 300 psi.
2. The ARV shall be in the sizes shown on the project drawings and shall be manufactured by APCO, series 140 or equal. Inlets shall be iron pipe thread.

### 2.5. Butterfly Valves

Butterfly valves shall comply in all respect with the physical and performance requirements of AWWA C504-74, short body type. All valves shall be Class 150B. Valve body shall have mechanical joint ends meeting the requirement of ANSI 21.11 Valve shafts may consist of a one-piece unit extending completely through the valve disc, or may be of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs. If of "stub shaft" construction, each stub shaft shall be inserted into the valve disc hubs for a distance of at least 1-1/2 shaft diameters. All valve shafts shall be 18-8 stainless steel Type 304 or 316. Shaft seals shall be o-ring sealed. Manufacturer shall provide an affidavit of compliance to provisions hereinbefore and of the standard. Valve disc shall be of ductile iron conforming to ASTM A 536, Grade 65-15-12 and have a resilient rubber seat ring. The rubber seats may be applied to the body or disc and the mating seat surface shall be stainless steel conforming to ASTM A 276, Grad Type 304 or 316. Butterfly valves shall be Kennedy BFV 80 or Mueller B3211.

### 2.6. Buried Manual Operations

Operators shall comply with AWWA C504 with an extension to ground level and a 2-inch square operating nut Operators shall be fully gasketed and grease-packed to withstand an external water pressure of 10 psi. Operators shall have adjustable mechanical stop limiting devices to prevent over-travel of the disc. Operators shall be capable of developing torques listed in Table I of AWWA C504 for Class 150B.

### 2.7. Valve Boxes

Valve boxes shall be provided for all operators and shall consist of the top section, including the cover and the extension section. The top section shall be cast iron with an overall length of 15 inches, or as approved. Inside diameter of the barrel shall be 6-1/4 inches. Top section shall be pattern 804-A and cover pattern 806 with word WATER cast in the top. The extension stem shall be PVC water well casing with an outside diameter of 6 inches. Provide concrete pad and valve identification disc, as shown. Valve boxes shall be Mueller H-10364 or approved equal.

### 2.8. Extension stems for Valve Operations

- 2.8.1. Where the depth of the operating nut is more than 3 feet, operating extensions shall be provided to bring the operating nut to a point 18 inches below the surface of the ground or pavement. The extension stem shall be constructed of steel.

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2.8.2. Joint materials for mechanical joint or push-on joint, for cast iron pipe shall conform to AWWA C111. Joint materials for joining valves to asbestos-cement pipe shall conform to AWWA C603. Joint materials for flanged joints shall consist of 1/8-inch thick, full-face, one-piece, cloth-inserted, rubber gaskets conforming to section 7 of AWWA C207. Bolts and nuts shall conform to Section 8 of AWWA C207.

### 2.9. Bolts, Gaskets, Gland, Nuts

Bolts, gaskets, glands, nuts, and miscellaneous accessories required to install all special valves are to be furnished. Bolts for flanged connections shall be galvanized steel with American Standard regular unfinished square or hex heads. Nuts shall be galvanized steel with American Standard regular hexagonal dimensions. Gaskets for flanged connections shall be 1/8-inch thick rubber. Gaskets shall extend from the inside diameter of the flange to at least the inside edge of the bolt holes or they may extend beyond the bolt circle. Jointing materials for mechanical joints shall conform to ANSI A21.11.

### 2.10. Air Release Valve Enclosures

Enclosures for air release or combination air release valves shall be furnished and installed for each air valve as shown on the Drawings. Enclosures shall be Davis 0-112 Traffic Type, or equal.

### 2.11. Marker Posts

Marker posts shall be as specified by the Engineer and placed on all valves and appurtenances

### 2.12. Water service Taps

Materials for water service taps, are to be as specified in the section SERVICE CONNECTIONS

## 3. Workmanship

### 3.1. General

Before installation, carefully clean valves of all foreign material, adjust stuffing boxes, and inspect Valves in OPEN and CLOSED positions. Install valves in accordance with the applicable portions of these Specifications. Unless otherwise indicated, install valves with the stem vertical. Mount horizontal valves in such a manner that adequate clearance is provided for operation. Installation practices shall conform to manufacturer's recommendations.

### 3.2. Testing

Valves will be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The contractor will be held responsible for any damage caused by the testing.



SECTION C

**4. Payment**

**4.1. General**

Payment for the work in this section will be included in the unit price as stated in the proposal.

## SECTION D

### **Ductile Iron Pipe and Ductile or Cast Iron Fitting**

#### **1. Scope**

##### **1.1. Work Included**

This section covers the work necessary for furnishing and installing the ductile iron pipe and cast or ductile iron fittings, complete.

##### **1.2. Related Work Specified Elsewhere**

Section A      Trench Excavation and Backfill  
Standard      AWWA C601

#### **2. Materials**

##### **2.1. Ductile Iron Pipe**

All ductile iron pipe and cast or ductile iron fittings shall be in accordance with ANSI A21.4.

##### **2.2. Joints**

2.2.1. Pipe joints shall be push-on joints, except where specifically shown or detailed otherwise.

2.2.2. Fitting joints shall be mechanical joint ends, except where specifically shown or detailed otherwise.

##### **2.3. Push-On and Mechanical Joint Pipe**

Ductile iron pipe shall be centrifugally cast of 60-42-10 iron and shall conform to ANSI/AWWA C151/A21.51 for mechanical properties and ANSI/AWWA C150/A21.50 for design. The pipe shall be cement-mortar lined and seal coated in accordance with ANSI A21.4. All buried ductile iron pipe shall be a minimum Class 50. All exposed ductile iron pipe shall be a minimum Class 53.

##### **2.4. Gaskets**

The rubber-ring gaskets shall be suitable for the specified pipe sizes and pressure and shall conform to applicable parts of the latest U.S. Federal Specification WW-P-421, and shall be furnished by the pipe manufacturer.

##### **2.5. Lubricants**

A nontoxic vegetable soap lubricant shall be supplied with the pipe in sufficient quantities for installing the pipe.

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### 2.6. Mechanical Joint Fittings

Mechanical joint ductile or cast iron fitting shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 and shall be of a class at least equal to that of the adjacent pipe. Fitting shall be minimum thickness Class 250. Mortar lining and seal coat for fittings shall be same thickness specified for pipe.

### 2.7. Restrained Joint Pipe

2.7.1. Restrained boltless pipe and fittings, where specified or shown on the Drawings, shall be ductile iron conforming to the types as noted herein. Where restrained joints are shown, any of the types specified herein may be used; cast iron pipe will not be allowed where restrained joints are required. Retainer glands with mechanical joints will not be allowed.

2.7.2. Restrained "push-on" pipe shall be: American Cast Iron Pipe "Lok-Fast" or Clow Corp. "Super Lock," for all pipe sizes; U.S. Pipe "Lok-Tyte" for pipe sizes 14 inches and larger; or equal.

2.7.3. Restrained boltless "ball-joint" pipe shall be: Flex-Lok as manufactured by American Cast Iron Pipe Company, or Usiflex as manufactured by U.S. Pipe and Foundry Company or approved equal, minimum thickness Class 54.

### 2.8. Selected Trench Excavated Material for Pipe Base and For Pipe Zone

Selected trench excavated material shall conform to the requirements for suitable backfill material defined in Section A. TRENCH EXCAVATION AND BACKFILL.

### 2.9. Imported Pipe Zone Material

Imported pipe zone material shall be equivalent to Paragraph SUITABLE BACKFILL MATERIAL as defined in Section A. TRENCH EXCAVATION AND BACKFILL.

## 3. Workmanship

### 3.1. Preparation of Trench

3.1.1. Grade: Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and for pipe base when specified or indicated. Before laying each section of the pipe, check the grade and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

3.1.2. Bell (Joint) Holes: At the location of each joint, dig bell joint holes of ample dimensions in the bottom of the trench and at the sides where necessary to permit the joint to be made properly and to permit easy visual inspection of the entire joint.

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- 3.1.3. Removal of Water: Provide and maintain ample means and devices at all times to keep trench excavation dry and remove and dispose of all water entering the trench excavation during the process of pipe laying.

### 3.2. Laying

- 3.2.1. Distributing Pipe: Distribute material on the job from the cars, trucks, or storage yard no faster than can be used to good advantage. In general, distribute no more than 1 week's supply of material in advance of the laying.

- 3.2.2. Handling Material: Handle the pipe so as to prevent injury to the coating and lining. Provide and use proper implements, tools, and facilities for the safe and proper prosecution of the work. Lower all pipe, fittings, and appurtenances into the trench piece by piece, by means of a crane, slings, or other suitable tools or equipment, in such a manner as to prevent damage to the pipeline materials and protective coatings and linings. Do not drop or dump pipeline materials into the trench.

### 3.2.3. Cleaning Pipe and Fittings

- 3.2.3.1. Remove all lumps, blisters, and excess coal-tar coating from the bell-and-spigot ends of each pipe. Wire brush the outside of the spigot and the inside of the bell and wipe clean, dry, and free from oil and grease before the pipe is laid.

- 3.2.3.2. Wipe the ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of all dirt, grease, and foreign matter.

- 3.2.4. Exterior Protection for Buried Pipe: Buried ductile iron piping shall be wrapped with polyethylene bagging, 8 thousands of an inch minimum thickness, manufactured in accordance with the latest edition of ASTM D 1248, Type I, Class C, Grade E1 and installed in accordance with, AWWA C105 and the manufacturer's recommendations.

### 3.2.5. Placing of Pipe in the Trench:

- 3.2.5.1. Do not allow foreign material to enter the pipe while it is being placed in the trench.

- 3.2.5.2. After the first length of pipe is installed in the trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement.

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### 3.2.6. Number of Pipes laid Before Jointing

3.2.6.1. Mechanical Joint and Push-On Joint Pipe: Connect mechanical joint pipe and push-on joint pipe as hereinafter specified as soon as they are placed in the trench.

### 3.2.7. Cutting Pipe

3.2.7.1. Ductile Iron Pipe: cut pipe with milling type cutter or saw. Do not flame cut.

3.2.7.2. Dressing cut Ends: Dress cut end of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket. Dress cut ends of push-on joint pipe by beveling, as recommended by the manufacturer.

3.2.8. Bell End to Face Direction of Laying: Unless otherwise directed, lay pipe with bell end facing in the direction of the laying. For lines on an appreciable slope, face bells upgrade at the discretion of the Engineer.

3.2.9. Permissible Deflection of Joints: Wherever it is necessary to deflect pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed 75 percent of the manufacturer's recommended limit.

3.2.10. Alignment: Pipelines intended to be straight shall not deviate from the straight line at any joint in excess of 4 inches. The pipe elevation as shown on the Drawings shall not be changed (plus or minus 2 inches) without authorization from the Engineer.

3.2.11. Unsuitable Conditions for Laying Pipe: Do not lay pipe in water or when, in the opinion of the Engineer, trench conditions are unsuitable.

### 3.3. Joining Push-On Joint Pipe and Mechanical Joint Fitting

3.3.1. Lay and join pipe with push-on type joints in strict accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for the installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

## SECTION D

3.3.2. Mechanical joint fittings vary slightly with different manufacturers. Install the particular fittings furnished in accordance with the manufacturer's recommendations. In general, the procedure shall be as hereinafter specified. Clean the ends of the fittings of all dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which slip the gland and gasket on the plain end. If necessary, lubricate the pipe to facilitate sliding the gasket in place. Then guide the end of the pipe into the bell of the pipe previously laid. Locate the spigot centrally in the bell, place gasket in position, and insert the bolts in the holes.

3.3.3. Torque ranges to be applied to bolts and wrench lengths which should produce the required torque when applied by the average man should be as follows:

<u>Diameter of Bolt (in.)</u>	<u>Torque Range (Foot-Pounds)</u>	<u>Wrench Length (in.)</u>
5/8	40-60	8
3/4	60-90	10
1	70-100	12
1-1/4	90-120	14

3.3.4. When tightening bolts, bring the gland up toward the flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Tighten all nuts progressively a little at a time. Do not over stress bolts to compensate for poor alignment. If effective sealing is not attained at the maximum torque, disassemble the joint and reassemble after cleaning.

### 3.4. Definition of Pipe Zone

The pipe zone shall include the full width of the trench from the bottom of the pipe to a point 6 inches above the top of the pipe barrel.

### 3.5. Selected Trench Excavated Material for Pipe Ease

If, in the Engineer's opinion, the trench excavation has material suitable for pipe base, grade the bottom of the trench by hand with a uniform bedding of selected trench excavated material to a minimum of 2 inches in thickness not to exceed a maximum of 4 inches in thickness, placed and leveled to grade in advance of the pipe laying. If the trench is over-excavated, rebuild the over-excavated section of the trench with compacted trench pipe base material at no additional cost to the Owner.

### 3.6. Selected Trench Excavated Material for Pipe Zone:

3.6.1. After the pipe is in place and ready for backfilling, place selected trench excavated material at approximately the same rate on each side of the pipe such that the elevation of the backfill on each side of the pipe is approximately equal at all times. Compact the backfill by tamping in 6-inch lifts to the horizontal centerline of the pipe. Each layer shall be compacted to approximately 95 percent of its maximum density. For backfilling under a roadway the Section Surface Reinstatement should be followed with densities as determined by AASHTO T 99,

## SECTION D

and as required by Cayman Islands Government Public Works Department. Particular attention shall be given to the backfilling and tamping procedures to assure that no unfilled or uncompacted areas occur beneath the pipe.

**A.** The remainder of the backfill in the pipe zone shall be placed without compacting by layers. After backfilling to the top of the pipe zone, compact the native material to approximately 95 percent of its maximum density. For backfilling under a roadway the Section Surface Reinstatement should be followed with densities as determined by AASHTO T 99, and as required by Cayman Islands Government Public Works Department.

**B.** In all areas requiring Cayman Islands Government highway crossings, the Contractor shall have onsite an approved, by the Engineer, Soils Testing Lab capable of operating a density gauge to verify the soil densities. This shall be done at the Contractor's expense.

### 3.7. Imported Pipe Base and Pipe Zone Material

**3.7.1.** When, in the opinion of the Engineer, insufficient or unsuitable material exists from trench excavation for selected trench excavated material, import and place imported pipe base and pipe zone material. The imported granular material shall be placed and compacted in the same manner specified for selected trench excavated material. Extra payment for placing imported backfill material in the pipe zone will be made only when the Engineer has directed that the material be provided and placed.

**A** Imported granular material shall be used for the full depth of the pipe zone when required by the Engineer. This material shall be placed, in a manner approved by the Engineer, simultaneously on both sides of pipe in lifts not to exceed 6 inches. Each lift shall be compacted to approximately 85 percent of its maximum density. For backfilling under a roadway the section Surface Reinstatement should be followed with densities as determined by AASHTO T 99, and as required by Cayman Islands Government Public Works Department. Particular attention shall be given to the backfilling and tamping procedures to assure that no unfilled or uncompacted areas occur beneath the pipe.

**B** In all areas requiring Cayman Islands Government highway crossings, the Contractor shall have onsite an approved, by the Engineer, Soils Testing Lab capable of operating a density gauge to verify the soil densities. This shall be done at the Contractor's expense.

### 3.8. Hydrostatic Tests

**3.8.1.** Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Engineer. The Engineer will monitor the tests.

SECTION D

3.8.2. Furnish the following equipment and materials for the tests:

<u>Amount</u>	<u>Description</u>
2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
1	Suitable hose and suction pipe as required

3.8.3. Conduct the tests after the trench has been backfilled or partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Engineer. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 7 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

3.8.4. Conduct the pressure test in the following manner, unless otherwise approved by the Engineer: After the trench has been backfilled or partially backfilled as hereinbefore specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 150 pounds per square inch.

3.8.4.1. Duration: The duration of each pressure test shall be 4 hours, unless otherwise directed by the Engineer.

3.8.4.2. Procedure: Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Apply and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.

3.8.4.3. Leakage: Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{5,500}$$

In the above formula:

- L = Allowable leakage, in gallons per hour
- N = Number of joints in the length of pipe tested
- D = Nominal diameter of pipe, in inches
- P = Average test pressure during the leakage test, in pounds per square inch



SECTION D

3.8.4.4. Correction of Excessive Leakage: Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

3.9. Sterilization

Pipelines intended to carry potable water should be sterilized before placing in service. Sterilization procedures shall conform to AWWA C601 as hereinafter modified or expanded and the requirements of any governing agency having jurisdiction.

3.9.1. Flushing: Before sterilizing, flush all foreign matter from the pipeline. Provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties. Flushing velocities shall be at least 2.5 fps. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipeline in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

3.9.2. Sterilizing Mixture

3.9.2.1. Sterilizing mixture shall be a chlorine-water solution having a free chlorine residual of 20 to 30 ppm. The sterilizing mixture shall be prepared by injection: a calcium or sodium hypochlorite and water mixture into the pipeline at a measured rate while fresh water is allowed to flow through the pipeline at a measured rate so that the chlorine-water solution is of the specified strength.

3.9.2.2. If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1 percent solution. The following proportions of hypochlorite to water will be required:

<u>Product</u>	<u>Quantity of Water</u>
Calcium Hypochlorite (1) 1 lb. (65-70 percent Cl)	7.5 gal.
Sodium Hypochlorite (2) 1 gal. (5.25 percent Cl)	4.25 gal.

(1) Comparable to commercial products: known as HTH, Perchloron, and Pittchlor.

(2) Known as liquid laundry bleach, Clorox, Purex, etc.

## SECTION D

### 3.9.3. Point of Application:

Inject the chlorine mixture into the pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of the pipeline. Water from the existing system or other approved source shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 20 to 30 ppm of free available chlorine. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check valves if necessary.

### 3.9.4. Retention Period

3.9.4.1. Treated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria with proper flushing and the specified solution strength, 24 hours is adequate. At the end of the 24-hour period, the sterilizing mixture shall have a strength of at least 5 ppm of chlorine.

3.9.4.2. Operate all valves, hydrants, and other appurtenances during sterilization to assure that the sterilizing mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the treated water.

3.9.4.3. Do not place concentrated quantities of commercial sterilizers in the line before it is filled with water.

3.9.4.4. After chlorination, flush the water from the line until the water through the line has equal chlorine residual to the permanent source of supply.

### 3.9.5. Disposal of Sterilizing Water

Dispose of sterilizing water in an approved manner. Do not allow sterilizing water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

## 4. Payment

### 4.1. Pipe

4.1.1. Payment for furnishing, installing, and testing the ductile iron pipe and installing pipe zone and pipe base material will be made at the Unit Price per linear foot stated in the Proposal.

4.1.2. Backfill shall be included in the Unit Price if so designated in the Proposal.

## SECTION D

4.1.3. The measurement for payment will be the field measured centerline length of the pipe, in place, within the limits shown, as approved by the Engineer.

### 4.2. Fittings

4.2.1. Payment for furnishing and installing cast iron fittings will be made at the Unit Price per pound stated in the Proposal. This payment shall constitute full compensation for all work required for furnishing and installing the cast iron fittings, complete.

4.2.2. Weights of fitting for payment purposes shall be Handbook Weights, i.e., excluding joint accessories. Fitting weights shall be as listed in the appropriate tables of AWWA C110. Weights of special fittings not listed in AWWA C110 and fittings which are nonstandard shall be determined by physically weighing the fittings with joint accessories removed.

### 4.3. Polywrap

Payment for furnishing and installing polyethylene bagging will be made at the unit Price per linear foot as stated in the Proposal.

## SECTION E

### Fire Hydrants

#### 1. Scope

- 1.1. Work Included: This section covers the work necessary for furnishing and installing the fire hydrants, complete.
- 1.2. Related Work Specified Elsewhere  
Section D: Ductile Iron Pipe and Fittings

#### 2. Materials

##### 2.1. Low Pressure Hydrants

All low pressure hydrants shall be an assembly consisting of ductile iron and high density polyethylene components as shown in standard detail section of these specifications. The Hydrant shall be said to begin after the tee on the water main.

##### 2.2. Ductile Iron

All ductile iron pipe and cast or ductile iron fittings shall be cement-mortar lined in accordance with ANSI A21.4.

##### 2.3. Gravel for Drainage

Gravel for drainage shall be washed 3/4 inch drainage gravel and shall be free of organic matter, sand, loam, clay, and other small particles.

##### 2.4. Concrete for Thrust Blocking

A mix not leaner than 1 part cement, 2-1/2 parts sand, 5 parts coarse aggregate, and just enough water to make a workable mix. Engineer shall approve quality of materials prior to their use.

##### 2.5. Thrust Ties

All thrust ties shall be fabricated from 3/4 inch reinforcing bar or approved equal.

#### 3. Workmanship

##### 3.1. General

Installation shall conform to specifications outlined herein and as detailed in standard Detail No.1 shown in the Drawing section of these specifications.

##### 3.2. Assembly of Hydrant

The components of the hydrant shall be assembled in such a manner as is practical. The Contractor shall be responsible for the proper alignment and anchoring of each hydrant. Assembly shall follow the guidelines in Section D: Cast Iron Pipe and Fittings.

## SECTION E

### 3.3. Location and position

- 3.3.1. Locate as shown so as to provide complete accessibility and minimize possibility of damage from vehicles or injury to pedestrians. Improperly located hydrants shall be disconnected and relocated at the Contractors expense.
- 3.3.2. When placed behind the kerb, set the hydrant so that no portion of the hose connections will overhang the kerb.
- 3.3.3. Set hydrants so that the centerline of the discharge tee is between 18 and 24 inches above grade.

### 3.5. Excavation:

Do not carry below sub-base grade. Refill overexcavated areas with gravel, and hand tamp to provide firm foundation, at no cost to Owner.

### 3.6. Installation of Hydrants

Place hydrant on prepared sub-base and make preparations for support prior to thrust blocking as shown in standard detail

### 3.7. Gravel for Drainage

Place gravel around base and hydrant bottom in accordance with standard detail.

### 3.8. Concrete Thrust Blocking

Place after hydrant is blocked and secured in its final position and hydrant is joined to the mains. Concrete thrust block shall have a minimum of 3 square feet of bearing area against undisturbed earth.

## 4. Payment

### 4.1. General

Payment will be made for each fire hydrant furnished and installed at the unit price stated in the Contractor's Proposal. Payment for the fire hydrants shall constitute full compensation for all work and materials beginning at the tee in the main.

SECTION E

## SECTION F

### Pipe Boring and Jacking for Road Undercrossings

#### 1. Scope

##### 1.1. Work Included

The work in this section includes, but is not limited to the following:

- A. Boring, Jacking and Tunneling
- B. Casing, Pipe Material and Installation

##### 1.2. Related Work Specified Elsewhere

Section A Trench Excavation and Backfill

##### 1.3. General Construction Requirements

1.3.1. All materials and methods of installation for crossings by boring and jacking or by tunneling shall be subject to the Engineers approval and in accordance with the Drawings, Specifications, and the requirements of the permit issued by the controlling agency of the facility being crossed. The cost of abiding by the provisions of the permit shall be considered incidental to the contract.

1.3.2. The contractor shall give officials of the controlling agency adequate notice of the anticipated time and duration of the crossing construction.

1.3.3. All necessary permits for the undercrossing will be obtained by the Owner, using appropriate documentation provided by the contractor.

#### 2. Materials

##### 2.1. Steel Casing Pipe

Steel casing pipe shall be ASTM A139, Grade A pipe of a diameter equal to or greater than 12 inches and a smooth steel pipe, minimum thickness of 1/4 inch, according to ASTM A 53. Final determinations of size and strength of casing pipe shall be made by the Contractor. The pipe shall be large enough to facilitate carrier pipe installation and strong enough to withstand installation without damage. Joints shall be welded.

##### 2.2. Concrete

ASTM C 94, Alternate 2. Proportion and mix to produce a minimum compressive strength of at least 2,500 psi at 28 days. Maximum size of aggregate 1-1/2 inch, slump between 2 and 4 inches.

##### 2.3. Stainless Steel Bands

One-half-inch wide by 0.020-inch thick, 304 stainless steel bands, or equal.

## SECTION F

### 2.4. Pipe Supports

2.4.1. All timbers shall be rough-sawn, pressure-treated southern yellow pine No.2 Grade or better.

2.4.2. Pressure treatment shall conform to Standard C18 of the American Wood Preservers Association Manual of Recommended Practice. The preservative material shall be creosote, and the minimum net retention shall be 12 pounds per cubic foot. Pressure treatment shall be the full-cell process. Creosote-treated timbers shall be completely dry before using.

### 3. Workmanship

#### 3.1. Casing Installation

3.1.1. Bored installations shall have a hole diameter which shall not exceed the OD of the casing pipe, as specified elsewhere by more than 3/4 inch. Where unstable soil conditions are found to exist, boring operations shall be conducted in such manner as not to be detrimental to the facility being crossed. If excessive voids or too large a bored hole results, or if it is necessary to abandon a bored hole, prompt remedial measures shall be taken by the Contractor, subject to review by the Engineer and approval of the controlling agency of the facility being crossed.

3.1.2. Once boring and jacking operations are started, the work shall be continuous until completed in order to guard against the "freezing" of the casing due to settlement and compaction of surrounding soil.

#### 3.2. Carrier Pipe Installation

3.2.1. The entire length of casing shall be complete before any carrier pipe is placed therein. Carrier pipe materials and installation shall conform to the requirements specified elsewhere except as hereafter indicated or as required by the controlling agency permit.

3.2.2. The carrier may be pushed or pulled (depending upon piping material, joint type, and method of pipe support) into the casing as pipe lengths are assembled. The carrier shall be with timber cradle under barrel of pipe. Pipe bells shall not touch casing. The proposed method of carrier pipe installation shall be approved by the Engineer prior to starting the crossing.

#### 3.3. Seals and Vents

At each end of each casing, provide seals for the annular space between the casing and carrier pipes. Seals shall be concrete or concrete and brick with a minimum thickness of 8 inches. Vents, if any, shall be as shown on the Drawings and/or required by the permit.



SECTION F

**4. General**

Payment for the work in this section will be included as part of the lump sum bid for each crossing in the Proposal. Payment for furnishing and installing the carrier pipe from the beginning to end of casing shall be included in this Lump Sum Item.

## SECTION G

### Surface Reinstatement

#### 1. Scope

##### 1.1. Work Included

This section covers; the work necessary to replace all pavement, kerbs, sidewalks, rock surfacing, drainage facilities, and other street features damaged either directly or indirectly by the operations incidental to the construction of the water system, complete.

##### 1.2. Related Work Specified Elsewhere

Section A Trench Excavation and Backfill

##### 1.2.1. Standard Specifications

Where the term "Standard Specifications" is used, such reference shall mean the current edition, including all supplements, of the Cayman Islands Government Public Works Department Standard Specifications for Asphaltic Concrete Pavement. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications. For work on public highways, in case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements of the Standard Specifications shall prevail.

##### 1.3. Submittals

1.3.1. Samples: Prior to the delivery of specified aggregate to the site, the Contractor shall submit samples of the material for the Engineer's approval. Samples shall be typical of materials to be furnished from the proposed source and in conformance with the specified requirements.

##### 1.3.2. Certificates

1.3.2.1. Prior to the delivery of asphalt materials and paving mixes to the site, the Contractor shall submit certificates of compliance of such materials with these Specifications.

1.3.2.2. Where laboratory testing is necessary or specified herein, the Contractor shall employ an independent testing laboratory to conduct such tests and submit certificates of the test results to ensure Specification conformance.

1.3.2.3. The costs for submittals shall be included in the price(s) quoted for the work under this section.

1.4. The maximum allowable length of trench requiring reinstatement is 5000 feet.

## SECTION G

### 2. Materials

#### 2.1. Base Course

The materials used in the construction of the road base shall be marl meeting the requirements of the Standard Specifications. The marl shall consist of uniform quality, clean marl free of clots or other objectionable matter. Submit a sample of the material along with certificates of test result to the Engineer for examination and approval 10 days prior to delivery of any of the material.

#### 2.2. Prime Coat

Asphalt to be used for prime coat shall be asphalt emulsion Type AE 200H, or liquid asphalt RC-70 or RC-250 conforming to the Standard Specifications or as approved by the Engineer.

#### 2.3. Chip and Spray

Asphalt material and cover stone shall conform to the requirements of the Standard Specifications of the CI Government FWD. The grade of asphalt and aggregate size shall be as per the Standard Specifications.

#### 2.4. Asphalt Concrete

Asphalt concrete for paving the designated area shall be Type AC 20 hot-plant mix and shall conform to the requirements of the Standard Specifications. Portions of the referenced specification that are obviously not applicable for the type of work to be done shall be disregarded.

#### 2.5. Job Mix Formula

Ten days prior to the start of asphalt concrete production, the Contractor shall submit to the Engineer, for approval, a complete job mix formula for the material intended for use on the project. No asphalt concrete paving shall be done without approval of a job mix formula.

#### 2.6. Concrete

2.6.1. Concrete for Kerbs, sidewalks, pavement, and miscellaneous construction shall conform to ASTM C94, Alternate 3, and shall have a design mix proportioned for 3000 pounds per square inch compressive strength at 28 days. The concrete mix shall contain no less than 5-1/2 sacks of cement per cubic yard.

2.6.2. Concrete forms for kerbs and sidewalks shall be either 2-inch dimensioned lumber, plywood, or metal forms. Forms on the face of the kerb shall have no horizontal form joints within 7 inches of the top of the kerb.

## SECTION G

2.6.3. Curing Compound: Commercial grade conforming to ASTM C309, Type I

2.6.4. Reinforcing steel: Conform to ASTM A615, Grade 40.

### 2.7. Pavement Markings

All pavement markings shall be replaced as required by the CI Government PWD. paint type, colors and road reflectors shall be as required by PWD.

## 3. Workmanship

### 3.1. Construction Procedure

3.1.1. Backfill: All backfill beneath bases for paved surfaces, kerbs and sidewalks shall be Class D.

### 3.1.2. Removal of Pavement, Sidewalk, Curbs and Gutters

Removal of all pavement, sidewalks, kerbs, and gutters shall conform to Section A: TRENCH EXCAVATION AND BACKFILL and payment for removal shall be included in that section.

### 3.1.3. Street Maintenance

Maintain all trenches as specified under section A: TRENCH EXCAVATION AND BACKFILL.

### 3.2. Subgrade

1. Bring the trench to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for the base course and pavement. Trim existing pavement to a straight line to remove any pavement which has been damaged or which is broken and unsound to provide a smooth, sound edge for joining the new pavement.
2. Roll subgrade with an approved roller until the top 12 inches is compacted to 95 percent maximum density as determined by ASTM D1557. Remove all soft or otherwise unsuitable material disclosed by the rolling and replace with suitable material from the excavation as directed. Fill holes and depressions, which develop under the roller, to the required grade and cross sections with material from the excavation. The finished subgrade shall be within a tolerance of plus or minus 0.08 of a foot of the grade and cross section required, and shall be smooth and free from irregularities and at the specified density. The subgrade shall be considered to extend over the full width of the base course.
3. All underground work contemplated in the area of the subgrade, shall be completed and properly backfilled before subgrade work is started.
4. The Contractor shall protect the prepared subgrade until the base is placed.

## SECTION G

5. Compaction testing will be as required under the Section TRENCH EXCAVATION AND BACKFILL.

### 3.3. Base Course Construction

1. Place sufficient base course on the subgrade to obtain a thickness of 8 inches minimum after compaction. Place for the full width of the trench and process as required to provide a smooth surface without segregation.
2. Compact the base course to 98 percent of the maximum density in accordance with ASTM C1557. Accomplish supplementary compaction where required with approved mechanical vibrating or impact tampers.
3. Compaction testing will be required as under TRENCH EXCAVATION AND BACKFILL
4. except one test will be required for each extension.

### 3.4. Asphalt Concrete Pavement Replacement

#### 3.4.1. Prime Coat

The prime coat shall be applied to the base course in conformance with the Standard Specifications at a rate of 0.30 gallon per square yard of surface area and to the edges of the existing pavement.

#### 3.4.2. Asphalt Concrete Pavement:

1. Place the asphalt concrete over the base course of existing pavement in a single or multiple lift, to a depth of not less than 12 inches or to the depth of the adjacent pavement, whichever is greater. Place asphalt concrete after the prime coat has set. If the thickness is greater than 6 inches, place the surfacing in two lifts, spread and level the asphalt concrete with hand tools or by the use of a mechanical spreader, depending upon the area to be paved. Bring the asphalt to the proper grade and compact by rolling or the use of hand tampers where rolling is impossible or impractical.
2. Roll with power rollers capable of providing compression of 200 to 300 pounds per linear inch. Begin the rolling from the outside edge of the replacement progressing toward the existing surfacing, lapping the existing surface at least 1/2 the width of the roller. If the existing surfacing bounds both edges of the replacement, begin rolling at the edges of the replacement, lapping the existing surface at least 1/2 the width of the roller and progress toward the center of the replacement area. Overlap each preceding track by at least 1/2 the width of the roller and make sufficient passes over the entire area to remove all roller marks and produce a smooth surface.
3. The finished surface shall be flush with the existing surface and shall conform with the grade and crown of the adjacent pavement.

## SECTION G

4. Immediately after the new paving is compacted, all joints between the new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies.

### 3.5. Chip and Spray Pavement Reinstatement

All existing chip and spray surfaces will be reinstated with triple application chip and spray. The first two layers above the compacted base course shall each consist of a layer of bitumen (RC250) material spread at a rate of 0.35 gallon per square yard at a temperature of 150 - 180 F. and 1/2 inch chips uniform spread over the bitumen. The third layer shall consist of the bitumen layer as stated above and 3/8 inch chips. All chips will be single sized, washed crushed rock aggregate and will be dry and clean at the time of application. Chips will be spread at a rate to produce a uniformly closed surface for each layer. The finished surface should be slightly proud of the original pavement to allow for displacement of loose chips during curing. The engineer may reject surfaces finished too high above the existing pavement.

### 3.6. Weather Conditions

Asphalt shall not be applied to wet material. Asphalt shall not be applied during rainfall or any imminent storm that might adversely affect construction.

### 3.7. Protection of Structures

3.7.1. Provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, kerbs, gutters, posts, guard fences, road signs, and any other structures from splashing oil and asphalt from the paving operations. Remove any oil, asphalt, dirt, or any other undesirable matter that may come upon these structures by reason of the paving operations.

3.7.2. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are within the area to be surfaced, the resurfacing shall be level with the top of the existing finished elevation of these facilities. If it is evident that these facilities are not in accordance with the proposed finished surface, notify the Engineer to have the proper authority contacted in order to have the facility altered before proceeding with the resurfacing around the obstruction. Consider any delays experienced from such obstructions as incidental to the paving operation. No additional payment will be made. Protect all covers during asphalt application.

### 3.8. Excess Materials

Dispose of all excess materials. Make arrangements for the disposal and bear all costs or retain any profit incidental to such disposal.

### 3.9. Contractor's Responsibility

## SECTION G

Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the sub-base or base materials. The Contractor shall promptly repair all pavement deficiencies noted during the warranty period at no additional cost to the Owner.

### 3.10. Dressing of Shoulders

In addition to the preparation of the surfaced roadway, blade the entire width of the graded roadway between the outside edges of the shoulders until it presents a neat and uniform appearance. Open up all culverts under the roadway or under side roads within the right-of-way or ditches obstructed by the Contractor's operations, and remove all debris therefrom and disposal of as directed by the Engineer.

### 3.11. Sidewalk and Kerbs

3.11.1. Replace concrete sidewalks and kerbs to the same section width, depth, line, and grade as that removed or damaged. Cut ends of existing kerb to a vertical plane. Prior to replacing the sections, properly backfill and compact the trench to prevent subsequent settlement.

3.11.2. Cut ends of existing kerbs to a vertical plane. Construct forms to match existing. Place concrete and finish exposed surfaces similar to adjacent kerb.

3.11.3. Replace concrete sidewalks between scored joints and make replacement in a manner that will avoid a patched appearance. Provide a stabilized sub-grade for the sidewalk.

### 3.12. Asphalt Driveways and Walks

Replace asphalt driveways and walks in accordance with the ASPHALT CONCRETE PAVEMENT REPLACEMENT in this section.

### 3.13. Storm Sewers, Sanitary Sewers, Culverts, And Catch Basins

3.13.1. All storm sewers, sanitary (including laterals) catch basins, or culverts that are removed because of interference with the new construction shall be removed so as to do the least possible damage to the pipe or basin. Dispose of culvert pipe that is in too poor condition for replacement because of age, physical condition, or other reasons install, as approved by the Engineer, suitable pipe.

3.13.2. Replace culvert headwalls of all types to a condition at least equivalent to the original shape or form.

3.13.3. Maintain catch basins in their original locations and reconnect to the drainage system in a manner equal to the original. If the existing catch basins are damaged beyond repair by the operations, construct new basins of similar size, cross section, and design as the original at no expense to the Owner.

## SECTION G

### 4. Warranty

The Warranty Period shall be 52 weeks following the initial acceptance and use of the reinstated surfaces by third parties.

### 5. Payment

#### 5.1. General

Payment for the work under this section shall be based on the appropriate unit prices stated in the Contractor's Proposal. Payment shall be considered full compensation for furnishing all labor, materials, and equipment to complete the work as specified under this section.

#### 5.2. Kerbs, Culverts, storm Sewers, Sanitary Sewers, Catch Basins and Sidewalk

Payment for restoration of Kerbs, culverts, storm sewers, sanitary sewers, catch basins and sidewalks existing on the date the Contractor submits his Proposal, shall be based on the Lump Sum Price in the Contractor's Proposal.

#### 5.3. Dressing of Shoulder's and Driveways

Payment for furnishing and installing prepared sub-grade, limerock, complete, with additional cost for providing Class D backfill shall be based on the unit Prices; as stated in the Proposal.

#### 5.4. Restoration of Paved Surfaces

Payment for furnishings and installing prepared subgrade, limerock base and 2-inch thick asphaltic concrete surface complete with additional cost for providing Class D backfill shall be based on the unit Prices as stated in the Proposal special requirements for pavement restoration are included hereinafter.

5.4.1. All paved surfaces will be acceptance tested in compliance with section 330-10 of the Standard Specifications

#### 5.5. Replacement of Flexible Pavement

Payment for furnishing and installing prepared subgrade, limerock base, concrete backfill and 2-inch thick asphaltic concrete surface, complete, with additional cost for providing Class D backfill shall be based on the unit Prices as stated in the Proposal. Special requirements for pavement restoration are included hereinafter.

5.5.1. All Flexible Pavement will be acceptance tested in compliance with section 330-10 of the Standard Specifications



## SECTION H

### Finish Grading and Grassing

#### 1. Scope

##### 1.1. Work Included

This section covers the work necessary for the finish grading, grass establishment, and tree and shrubbery replacement, complete, including furnishing and delivery of material, seeding, and maintenance of grass.

1.2. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

#### 2. Materials

##### 2.1. Topsoil

Any topsoil that is required will have to be imported by Contractor at no cost to Owner.

##### 2.2. Fertilizer

2.2.1. Commercial Fertilizer: A complete plant food containing 12 percent nitrogen, 8 percent available phosphoric acid, and 8 percent potash, conforming to applicable local fertilizer laws, uniform in composition, dry, free-flowing, and delivered in original, unopened containers bearing manufacturer's guaranteed analysis.

##### 2.3. Mulch

2.3.1. Dry Mulch: straw or hay, consisting of oat, rye, or wheat straw or pangola, peanut, coastal Bermuda or Bahia grass hay. Only undeteriorated mulch which can readily be cut into the soil shall be used.

##### 2.4. Seed

##### 2.4.1. General

2.4.1.1. Unless other types of seed are called for in the Drawings or special provisions, permanent type grass seed shall be a mixture of 20 parts of Bermuda seed and 80 parts of Argentine Bahia seed. Quick growing type grass. Seed shall be a species which shall provide an early ground cover during the particular season when planting is done and will not later compete with permanent grass. The separate types of seed used shall be thoroughly dry-mixed immediately before sowing. Seed which has become wet shall not be used.

## SECTION H

2.4.1.2. The Argentine seed shall be an equal mixture of hulled and unhulled seed. The Pensacola Bahia seed shall be scarified seed, having a minimum active germination of 40 percent and a total germination of 85 percent. All seed shall meet the requirements of state Department of Agriculture and Consumer Services and all applicable laws, and shall be approved by the Engineer before being sown.

### 2.5. Quick-Growing Type Grass Seed

Millet or winter rye as required for the time of year applied.

### 2.6. Sprigs

2.6.1. Unless a particular type of sprig is called for in the Drawings or special provisions, the sprigs used shall be either Bermuda, St. Augustine, or Centipede.

2.6.2. Sprigs shall be harvested with approved implements, in such manner that at least 3 inches of root system shall be lifted intact.

2.6.3. The sprigs shall be of suitable size and character and shall be live, fresh, healthy, and uninjured, at the time of planting.

### 2.7. Sods

2.7.1. Types - Unless a particular type of sod is called for, sod may be of either centipede or bahia grass, at the Contractor's option. It shall be well matted with roots. Where sodding will adjoin or be in sufficiently close proximity to private lawns, other types of sod may be used if desired by the affected property owners and approved by the Engineer.

2.7.2. Dimensions-The sod shall be taken up in commercial-size rectangles, preferably 12 inches by 24 inches or larger, except where 6"-inch strip sodding is called for.

### 2.8. Trees and Shrubs

Unless otherwise specified for on the Drawings, trees and shrubbery are to be replaced as found in the field.

### 2.9. Inspections, Tests, and Sample

Notify Engineer of source for sod and/or sprigs and await approval before delivering.

## SECTION H

### 3. Workmanship

#### 3.1. Easement Restoration

Within easements, the Contractor shall level grade the entire width. The easement shall be grassed by fertilizing, mulching, seeding, rolling and watering until a healthy growth is achieved, if it was originally grassed.

#### 3.2. Grass Restoration Along Public Right-of-Way

3.2.1. All grassed areas along road shoulders and other areas within or outside of public rights-of-way damaged by the Contractor's operations shall be finished, graded and grassed. Grassing shall consist of fertilizing, mulching, seeding, rolling and watering until a healthy growth is achieved.

3.2.2. The Contractor may sprig or sod in lieu of seeding, if approved by the Engineer.

#### 3.3. Delivery, Handling and Storage

#### 3.4. Construction Methods

##### 3.4.1. Topsoil and Finish Grading

3.4.1.1. Spread topsoil over the prepared rough grade using a rubber-tired tractor with grader blade or equivalent not weighing more than 3 1/2 tons. A minimum of 6 inches of topsoil is required

3.4.1.2. Thoroughly mix the applied topsoil to a depth of 8 inches by running a rototiller over the entire area in two directions at right angles.

3.4.1.3. Rake the top-soiled area to a uniform grade so that all areas drain, as indicated on the grading plan.

3.4.1.4. Lightly compact with a cultipacker before planting grass.

3.4.1.5. Remove all trash and stones exceeding 2 inches in diameter from area to a depth of 2 inches prior to preparation and planting grass.

##### 3.4.2. Fertilizing

Apply commercial fertilizer at the rate of 20 pounds per 1,000 square feet distributing uniformly with a mechanical spreader.

##### 3.4.3. Seeding

## SECTION H

3.4.3.1. Time of Seeding: Conduct seeding under favorable weather conditions during seasons which are normal for such work as determined by locally accepted practice.

3.4.3.2. Seeding: Sow grassed areas evenly with a mechanical, spreader at rate of 100 pounds per acre, roll with cultipacker to cover seed, and water with fine spray. Method of seeding may be varied at discretion of Contractor on his own responsibility to establish a smooth, uniformly grassed area.

3.4.3.3. Quick-Growing Type Grass Seed: Shall be thoroughly mixed with permanent seed and applied at a rate of 30 pounds per acre.

### 3.4.4. Sodding

Before sod is laid, correct soft spots and inequalities in grade of prepared bed. Lay so that no voids occur and tamp or roll, brush or rake screened topsoil with no lumps or stones larger than 3/4 inch over sodded area, water sod thoroughly. Complete sod surface true to finished grade, even and firm. Fasten sod on slopes steeper than 1:2, by wooden pins about 6 inches long driven through sod into soil until flush with top of sod at sufficient intervals to hold sod.

### 3.4.5. Sprigging

Sprigging shall be "row sprigging" unless otherwise approved by the Engineer. Sprig within all areas as called for on the Drawings.

3.4.5.1. Dig furrows at minimum of 12 inches on centers and open to a depth of not less than 4 inches. Open furrows at right angles to direction of slopes or as otherwise directed to prevent water erosion.

3.4.5.2. Cover sprigs with soil as soon as possible but not later than 30 minutes after placing in furrows. Level and roll by approved mechanical or hand methods to an even surface and to established grade.

### 3.4.6. Mulching

When mulching is called for, approximately 2 inches, loose thickness, of the mulch material shall be applied uniformly over the seeded area, and the mulch material cut into the soil with the equipment specified, so as to produce a loose mulched thickness of three to four inches. Care shall be exercised that the materials are not cut too deeply into the soil. When green mulch is used the green mulch shall be incorporated into the soil not later than two days after being cut, and no artificial watering of the mulch shall be done before it is applied.

### 3.4.7. Rolling

Immediately after completion of the seeding, the entire grassed or mulched area shall be rolled thoroughly with the equipment specified. At least two trips over the entire area will be required.

## SECTION H

### 3.4.8. Watering

The seed areas shall be watered so as to provide optimum growth conditions for the establishment of the grass. In no case, however, shall the period of maintaining such moisture be less than 2 weeks after planting.

### 3.4.9. Trees and Shrubs:

The Contractor is to take all precautions necessary for the protection of trees and shrubbery. However, when trees and/or shrubbery are damaged or destroyed in order to construct the pipeline, they shall be replaced as directed by the Engineer with equivalent of or better quality trees and/or shrubbery. The Contractor shall meet with the Engineer prior to construction and discuss the pipeline route and discuss at the time which tree and shrubs can be saved.

## 3.5. Maintenance

### 3.5.1. Maintenance Period

Begin maintenance immediately after each portion of lawn is planted and continue until grass is established and shows growth.

### 3.5.2. Maintenance Operations

Water, to keep surface soil moist. Repair washed out areas by filling with topsoil, liming, fertilizing, and seeding. Replace mulch on banks when washed or blown away. Repair fence, mow to 2 inches after grass reaches 3-1/2 inches in height. And mow frequently enough to keep grass from exceeding 3-1/2 inches. Weed by local spot application of selective herbicide only after first planting season when grass is established.

### 3.5.3. Guarantee

All sodding and sprigging shall be guaranteed by the Contractor to be in a vigorous growing condition.

## 4. Payment

### 4.1. General

Payment for the work specified herein shall be based on the Unit Prices stated in the Contractor's Proposal. This payment shall constitute full compensation for the works specified and as shown.

## SECTION I

### Water Service Connections

#### 1. General

##### 1.1. Work Included

1. This section covers the work necessary for the service connections, complete, within the limits shown.
2. The work includes trench excavation and backfill, furnishing and installing service saddles, corporation stops or valves, service connection tubing, fittings, and appurtenance within the design limits, testing flushing, and other incidental work as required for complete installation.
3. It is estimated that the total number of connections of any size may vary from the estimated quantities.
4. Trench excavation and backfill and carriageway reinstatement are included under section TRENCH EXCAVATION & BACKFILL and section SURFACE REINSTATEMENT.

#### 2. Products

##### 2.1. Excavation

Excavation shall conform to the requirements of Section TRENCH EXCAVATION & BACKFILL.

##### 2.2. Backfill

Select material excavated from the trench may be used for trench backfill and pipe zone. Select material shall conform to the requirements of the sections PVC BELL-AND-SPIGOT WATER PIPE, and TRENCH EXCAVATION AND BACKFILL.

##### 2.3. Service Connection Size

The location and size or type of the service Connection will be shown. The meter will be installed by others.

##### 2.4. Service Saddles

Service saddles shall be:

- 1) CAL AM Manufacturing, CLAMP IT PVC tapping saddles with TAP IT hot/wet tapping tee; or equal. Service saddles shall be adequate for use with Class 160 PVC pressure pipe
- 2) Mueller tap and neoprene gaskets and shall be Smith Blair Inc., Style 315 or 317; or equal.

## SECTION I

### 2.5. Tapping Materials

The Contractor shall provide the necessary tapping machines and tools for making the connections, and he shall furnish the miscellaneous materials required for making the taps, such as cutting oil and similar materials.

### 2.6. Corporation Stops

Corporation stops for 3/4-inch and 1-inch polyethylene service lines shall have AWWA thread inlet and compression connection for CTS PE plastic pipe outlet and shall be Mueller H-15008, Hays Manufacturing Company, or equal.

### 2.7. Curb stops

Curb stops for 3/4-inch and 1-inch polyethylene service lines shall have compression connection for CTS PE plastic pipe inlet, and meter nut outlet, and shall be Mueller H-15155, Hays Manufacturing Company or equal.

### 2.8. Miscellaneous Fittings

Miscellaneous fittings, including reducers and adaptors shall be Aqua Systems, Harco; or equal.

### 2.9. Polyethylene Plastic Pipe

Polyethylene plastic pipe shall be manufactured from ultra high molecular weight, high-density polyethylene in accordance with AWWA C901. The pipe shall have a working pressure of 160 PSI and a standard dimension ratio of 7.

## 3. Execution

### 3.1. Trench Excavation

Conform to the requirements of section TRENCH EXCAVATION AND BACKFILL. Place only select backfill material in the pipe zone as specified above. Pipe zone shall extend for the full width of the trench on each side of the tubing, and a minimum of 10 inches above the top of the tube. Minimum cover of service connection tubing shall be 16-inches. Backfill the remainder of the trench with excavated material as specified above.

### 3.2. Connection to Main

3.2.1. Clear exterior of main of dirt and other foreign matter that may impair the quality of the completed connection. Then place service saddle at the desired location and clamp tight. Do not place service saddle within 1 foot of pipe joint or another saddle.

3.2.2. Taps shall be made in the pipe by experienced workmen using tools in good repair with the proper adaptors for the size main being tapped.

## SECTION I

### 3.3. Preparation of Trench

Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe bedding. Bedding, as specified in Section TRENCH EXCAVATION AND BACKFILL, will be required at all locations where the trench bottom is not uniform and smooth or where it presents rocks or projections that might, in the opinion of the Engineer, be detrimental to the service connection pipe. The trench bottom shall form a continuous and uniform bearing support for the pipe. Provide and maintain ample means to remove water entering the trench during the laying operation to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill around the pipe zone. Do not lay pipe in water.

### 3.4. Polyethylene Plastic Pipe

Install polyethylene plastic pipe in accordance with the manufacturer's recommendations.

### 3.5. Hydrostatic Test and Leakage

Test service connections and service connecting pipe by either testing in conjunction with the main at the test pressure required for the main, or by testing at the normal hydrostatic main pressure after the main has been completely installed. and tested. Inspect visually for leaks and repair any leaks before backfilling. If the service connection pipe is tested separately, duration of the test shall be at least 15 minutes. If the service connection pipe is tested in conjunction with the main, duration of the test shall be the same as the main.

### 3.6. Disinfection

Make connection to the main pipeline and disinfect service connections at the same time as the main pipeline. Disinfection shall be as specified in section PIPING-GENERAL.

### 3.7. Surface Reinstatement

Surface reinstatement will be done according to section SURFACE REINSTATEMENT.

## 4. Payment

### 4.1. Trench Excavation and Backfill

The work required under this item will be included in the unit price for the service connection. No differentiation will be made for trench depth.

### 4.2. Service Connection Pipe and Fittings

Payment for the service connection pipe will be made at the respective price(s) per connection stated in the Contractor's Bill of Quantities for the service connection of the various types and sizes. This payment shall constitute full compensation for the service pipe and appurtenances as specified.

### 4.3. Surface Reinstatement

Payment for surface reinstatement will be as specified in the section SURFACE REINSTATEMENT.



## SECTION J

# Water Service Mains and Other Buried Utilities

## 1. Scope

### 1.1. Works Included

The works in this section includes, but is not limited to the following:

- A. Cross Connections
- B. Design of Sewer in Relation to Water Mains
  - 1. Distance of Separation of Systems
  - 2. Crossings
- C. Material Color Coding/ Detection Tape Type for Buried Utilities
- D. As-Built Drawing Submittal Following to Construction

## 2. Cross Connections

2.1. There Shall be no Physical Connections between the Potable Water Supply System and the Sewer, or Appurtenance thereto which would permit the passage of any water or polluted water into the potable supply. No potable water shall pass through or come in contact with any part of the sewer system including sewer manholes. This also applies to "grey water" or treated waste water system effluent which is sometimes used for irrigation purposes.

## 3. Design of Sewer in Relation to Water Main

### 3.1. Distance of Separation of Systems

3.1.1. Sewers Systems (force mains as well as gravity), (raw and treated) shall be laid at least 6 feet Total Separation from any existing or proposed water main. The minimum horizontal separation shall be 2 feet. This distance shall be measured from side of water pipe to side of the sewer pipe. In cases where it is not possible or practical to maintain a total of 6 feet in separation, Prior to construction CW will review and may allow changes. It is the responsibility of the contractor to notify CW in a timely manner of the need for such a request for change.

3.1.2. The water main must remain in a separate trench from the sewer system at all times.

## SECTION J

### 3.2. Crossings

3.2.1. Sewers (force mains as well as gravity), (raw and treated) shall be laid at least 18 inches vertically from any existing or proposed water main. This distance shall be measured from bottom of water pipe to top of the sewer pipe. The crossing shall be arranged such that the sewer joints will be equidistant and as far as possible from a water main pipe joint. In cases where it is not possible or practical to maintain an 18 inch vertical separation, the sewer pipe shall be cased in a carrier pipe. The proposed method of carrier pipe installation shall be approved by the Engineer prior to starting the crossing. Where a sewer line crosses under an existing water main, adequate structural support shall be provided for the water main to maintain line and grade.

3.2.2. The water main must remain in a separate trench from the sewer main at all times.

### 3.4. Material Color Coding/ Detection Tape Type for Buried Utilities

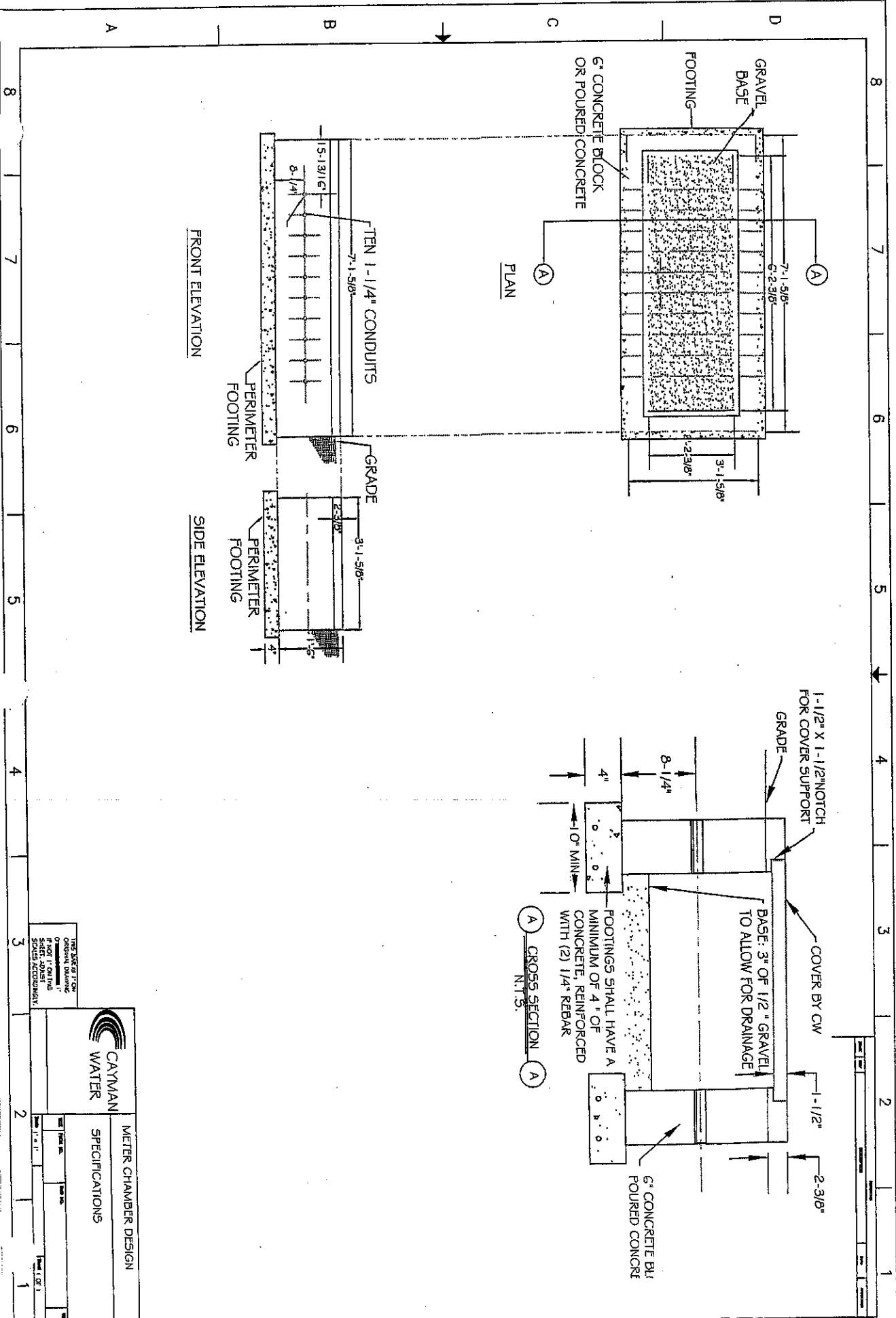
3.4.1. It is recommended that the sewer pipe be differing in color than the existing or proposed water main. Water mains shall be blue or white in color. Water Service Branch-offs from the main shall be black or blue colored HDPE tubing. It is recommended that force main sewer or treated sewer water be piping in green colored pipe or differ from the above stated potable water pipe colors.

3.4.2. Detection tape which includes the words "POTABLE WATER" or "WATER" shall not be used on top of sewer lines (raw or treated). Tape which is blue in color shall not be used for Detection tape of sewer lines (raw or treated effluent.)

### 3.5. As-Built Drawing Submittal Following to Construction

3.5.1. As-built drawing of the location of a new buried utility shall be submitted to CW following construction.

3.5.2. These drawings shall be submitted in .DWG format.

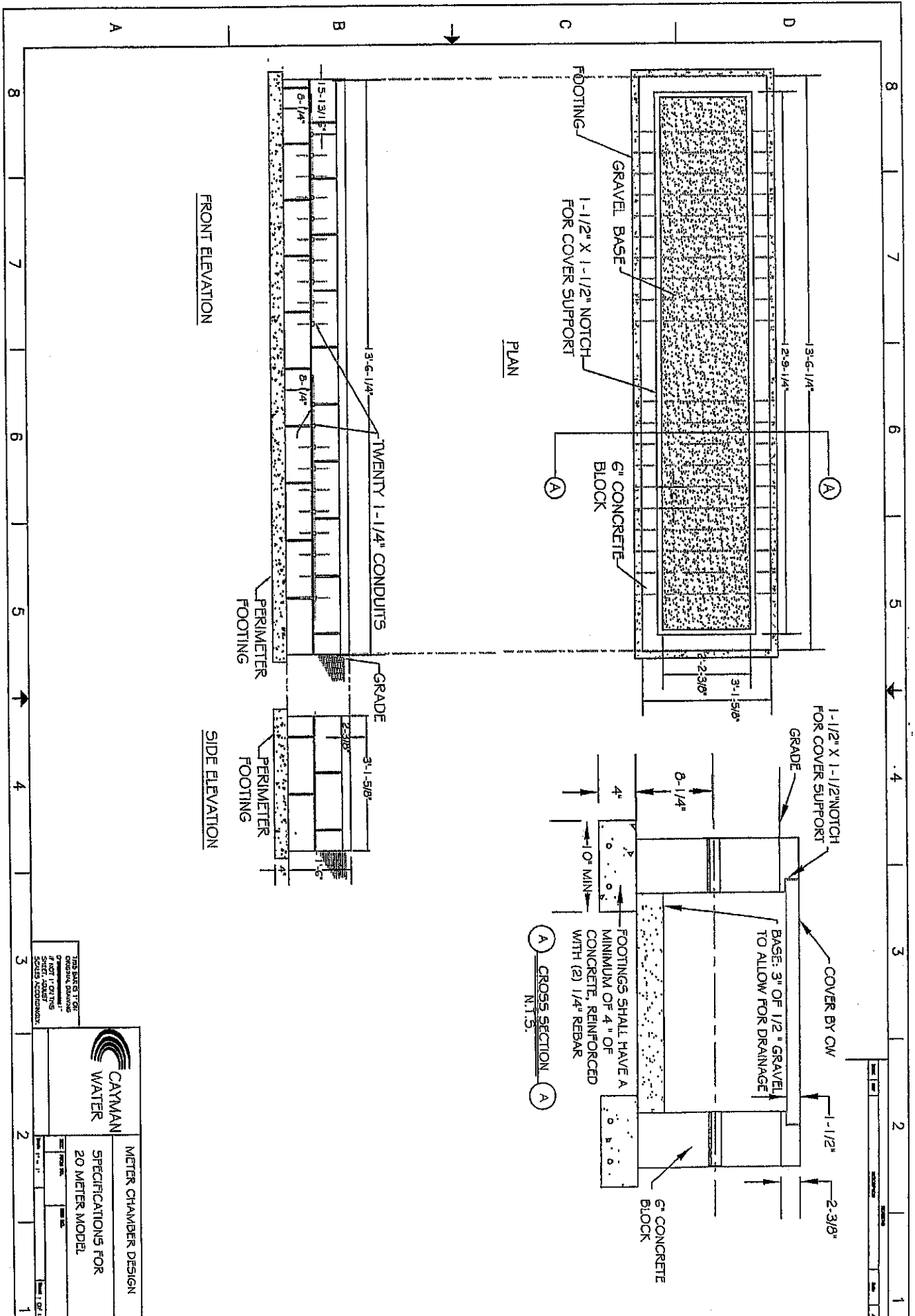


THIS SCALE IS FOR ORIGINAL DRAWING ONLY. FOR ALL OTHER SIZES, ADJUST SCALES ACCORDINGLY.



METER CHAMBER DESIGN  
SPECIFICATIONS

DATE	BY	CHKD BY	APP'D BY



PLAN

FRONT ELEVATION

SIDE ELEVATION

CROSS SECTION  
N.T.S.

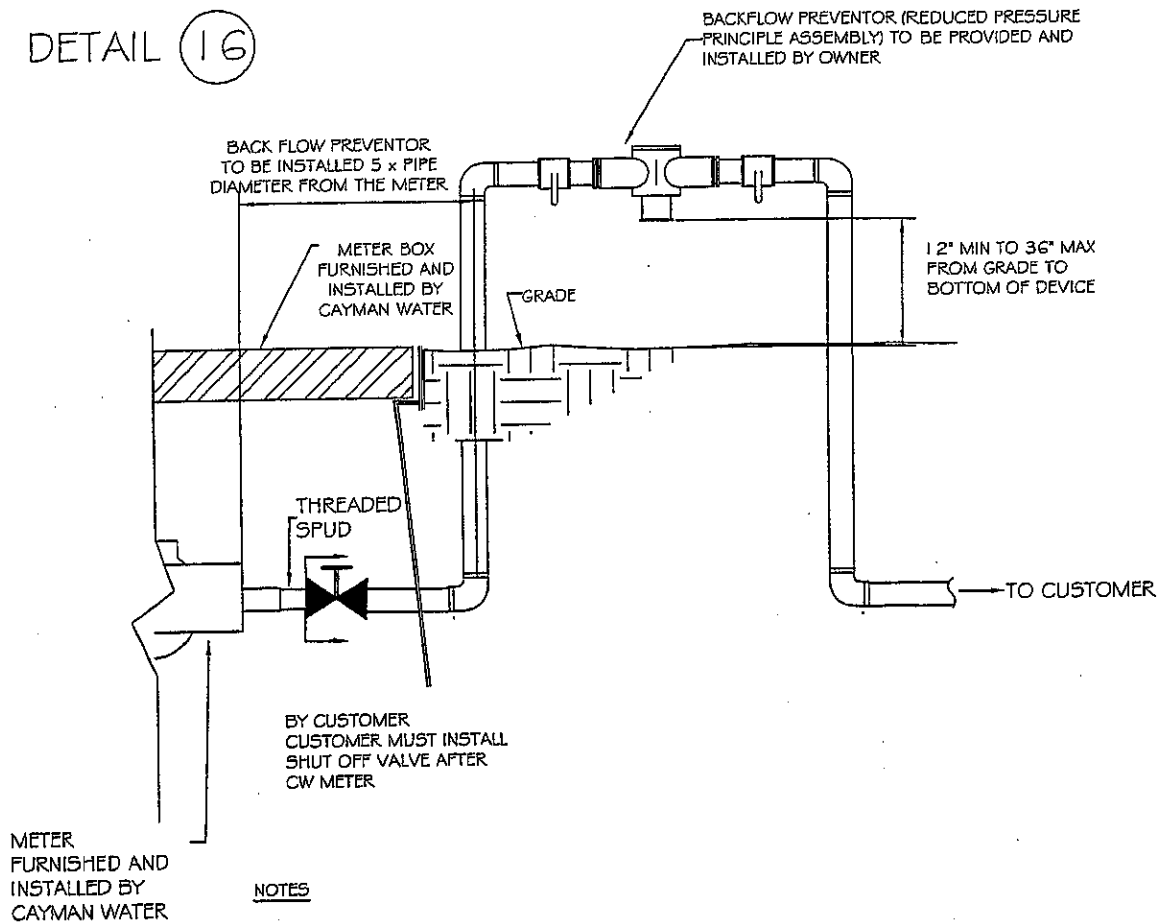
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METER CHAMBER DESIGN  
SPECIFICATIONS FOR  
20 METER MODEL

DATE	10/1/01
BY	J.M.
CHECKED	J.M.
SCALE	1" = 1'-0"

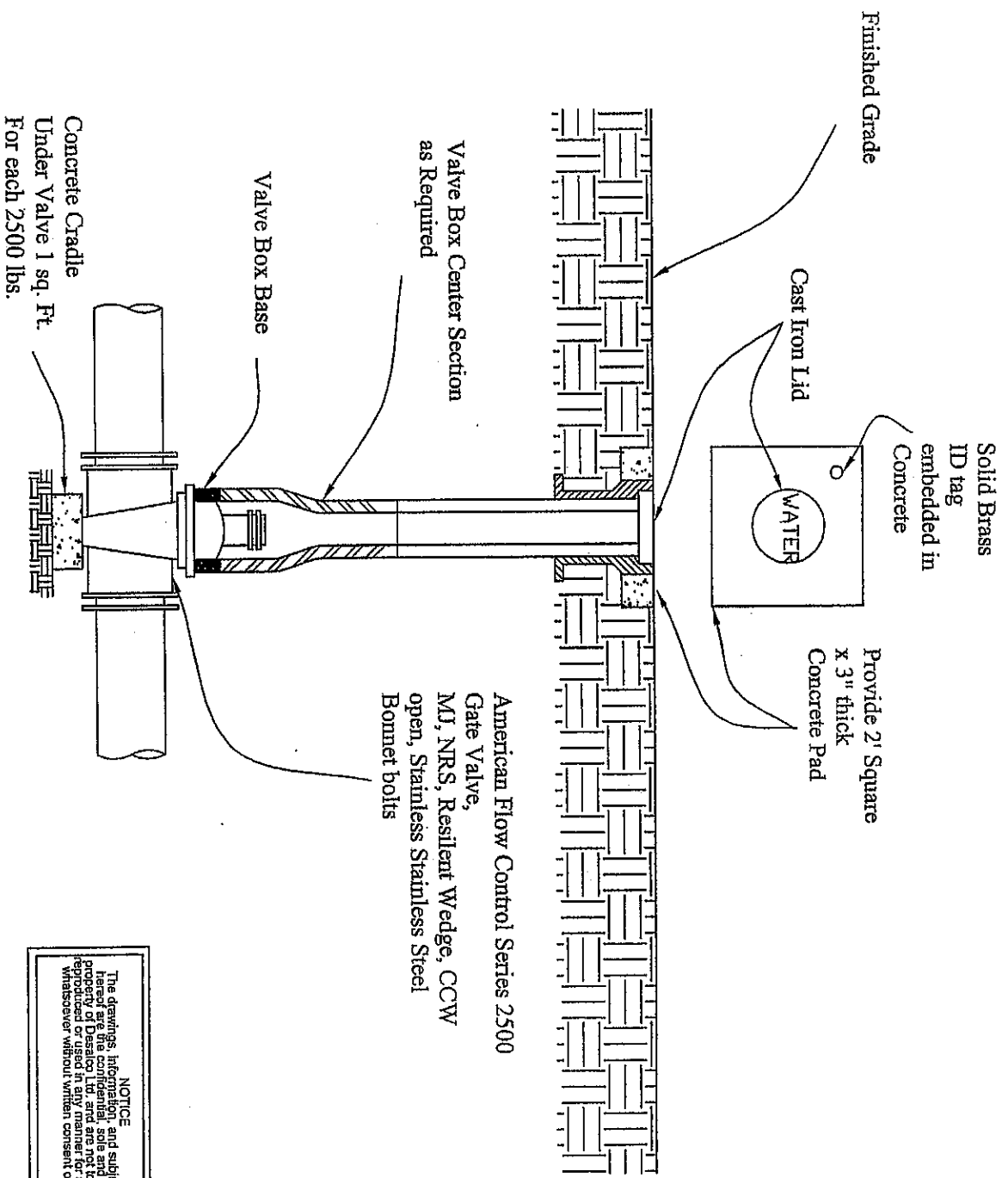
DETAIL 16



NOTES

1. A BACKFLOW PREVENTOR SHALL BE INSTALLED FOR SERVICE CONNECTIONS OF TWO (2) INCHES AND GREATER AND/OR FOR CONNECTIONS SERVICING BUILDINGS OF 5 STORIES AND GREATER OR AS DIRECTED BY CW
2. THE BACKFLOW PREVENTOR TYPE SHALL BE THE REDUCED PRESSURE PRINCIPLE ASSEMBLY MANUFACTURED BY ONE OF THE FOLLOWING OR EQUIVALENT; AMES CO, FEBCO, WATTS REGULATOR CO.
3. BACKFLOW PREVENTORS MUST HAVE AT LEAST THE SAME CROSS-SECTIONAL AREA AS THE WATER METER.
4. THE BACKFLOW PREVENTOR SHALL BE INSTALLED ON THE OWNERS PROPERTY AS CLOSE AS PRACTICAL TO THE SERVICE CONNECTION.
5. THERE SHALL BE NO OULET, TEE, TAP OR CONNECTION OF ANY SORT BETWEEN THE WATER METER AND THE BACKFLOW DEVICE.
6. THE DEVICE SHALL BE INSTALLED A MINIMUM OF 12" AND NO MORE THAN 36" ABOVE GRADE (MEASURED FROM THE BOTTOM OF THE DEVICE) WITH A MINIMUM OF 12" OF SIDE CLEARANCE
7. THE DEVICE SHALL BE INSTALLED IN THE HORIZONTAL POSITION AND IN A LOCATION IN WHICH NO PORTION OF THE ASSMBLY CAN BECOME SUBMERGED IN ANY SUBSTANCE UNDER ANY CIRCUMSTANCE. PIT AND/OR BELOW GRADE INSTALLATION ARE PROHIBITED
8. THE DEVICE SHALL BE INSTALLED SO THAT IS READILY ACCESSIBLE FOR MAINTENANCE AND TESTING
9. OWNERSHIP, TESTING AND MAINTENANCE OF THE ASSEMBLY SHALL BE THE RESPONSIBILITY OF THE PROPERTY OWNER.
10. TESTING OF BACKFLOW PREVENTION ASSEMBLIES SHALL BE MADE BY A CERTIFIED BACKFLOW PREVENTION ASSEMBLY TESTER APPROVED BY CAYMAN WATER. SUCH TESTS SHALL BE CONDUCTED UPON INSTALLATION AND ANNUALLY THERE AFTER

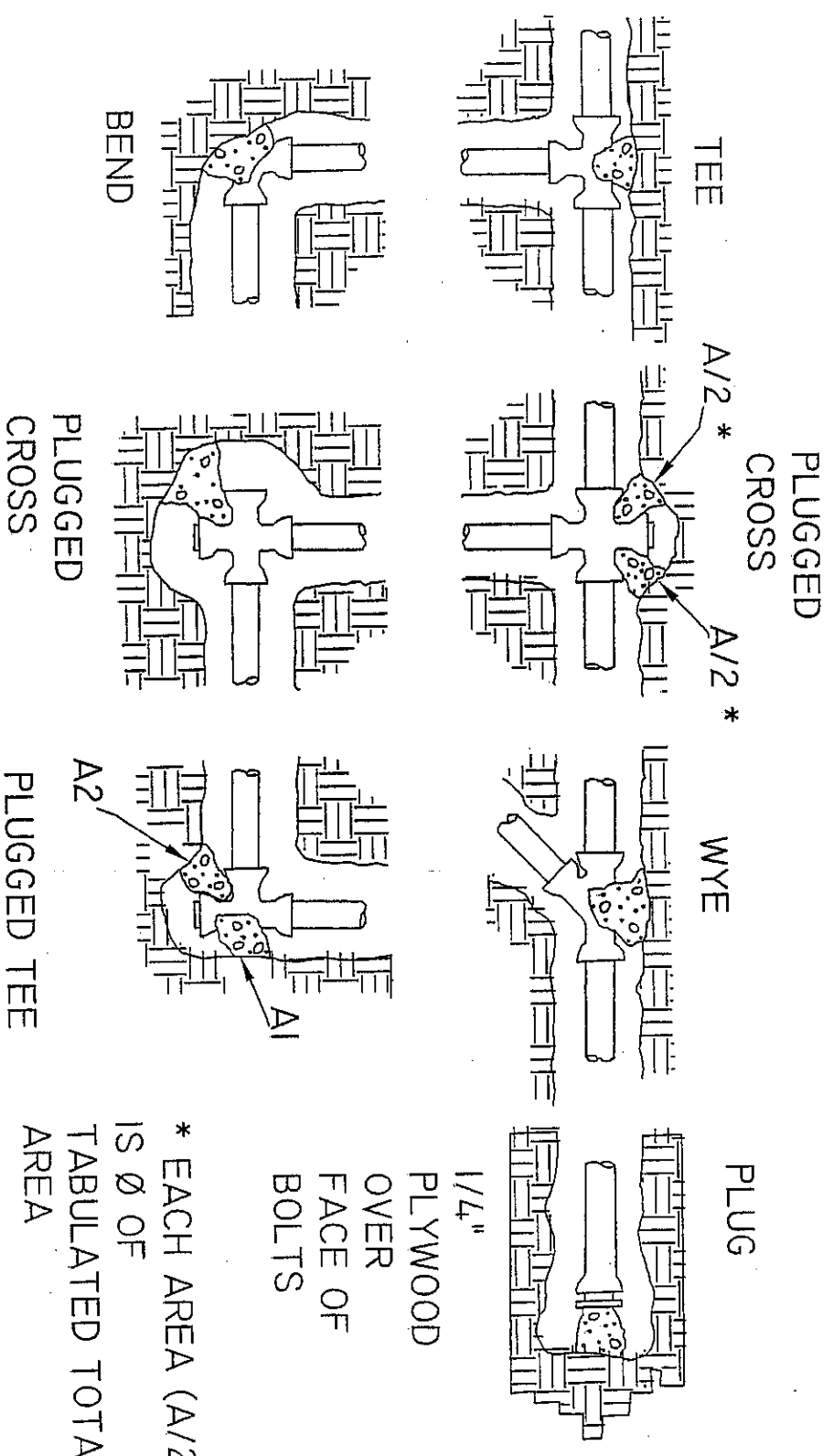
BACKFLOW PREVENTION FOR WATER SERVICE INSTALLATION FOR 2" AND LARGER CONNECTIONS



# TYPICAL UNDERGROUND GATE VALVE

**NOTICE**  
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Project: Cayman Water Company Distribution Standards	
Title: Typical Underground Gate Valve	
Desalco Ltd.	Drawn: BS
1st.	Date: 24 October 2003
Sheet	Scale
1 OF 1	N/A
	Drawing Number
	BS-DIST0002
	Revision
	01



# THRUST BLOCK DETAIL PLAN

NTS

1/4"  
PLYWOOD  
OVER  
FACE OF  
BOLTS

\* EACH AREA (A/2)  
IS Ø OF  
TABULATED TOTAL  
AREA

# THRUST BLOCK NOTES AND DETAILS

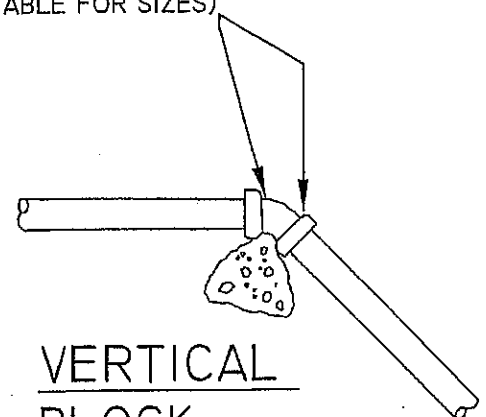
- I. KEEP CONCRETE CLEAR OF JOINTS AND JOINT ACCESSORIES
2. CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH
3. REQUIRED VOLUMES OR BEARING AREAS AT FITTINGS SHALL BE AS INDICATED BELOW, ADJUSTED, IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING STRESS(ES) STATED IN THE SPECIFICATIONS.
4. THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 PSIG AND THE WEIGHT OF CONCRETE= 4050 LBS/CU YD. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES , USE THE FOLLOWING EQUATION:  
VOLUME=(TEST PRESSURE/150) X (TABLE VALUE)
5. BEARING AREAS FOR HORIZONTAL BEND THRUST BLOCKS ARE BASED ON TEST PRESSURE OF 150 PSIG AND AN ALLOWABLE SOIL BEARING STRESS OF 1000 LBS/SQ. FT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, MULTIPLY TABLE VALUES BY THE FACTOR (P'/S'<sub>a</sub>) WHERE: P'= ACTUAL TEST PRESSURE, PSIG S'<sub>a</sub>= ACTUAL OR BEARING PRESSURE, PSF
6. THRUST BLOCKS FOR VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS SHALL BE THE SAME AS FOR HORIZONTAL BENDS.
7. BEARING AREAS, VOLUMES, AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER THIS STANDARD.
8. BEARING AREA OF THRUST BLOCK SHALL NOT BE LESS THAN 1.0 SQ. FT. BEARING AREA SHALL HAVE EQUAL HEIGHT AND WIDTH.
9. VERTICAL BENDS THAT REQUIRE A THRUST BLOCK VOLUME EXCEEDING 5 CUBIC YARDS REQUIRE SPECIAL BLOCKING DETAILS. SEE PLANS FOR VOLUMES SHOWN TO LEFT OF SOLID LINE IN TABLE.
10. ALLOWABLE SOIL BEARING STRESS IS 1000 LBS/ SQ. FT.
- II. ASSUME PIPELINE MATERIAL IS DUCTILE IRON OR PVC.

BEARING AREA OF THRUST BLOCKS IN SQ. FT. (HORIZONTAL BENDS)					
FITTING SIZE (IN)	TEE, WYE PLUG, OR CAP	90° BEND PLUGGED CROSS	BEND ANGLE		
			45°	22 1/2°	11 1/4°
3	1.5	2.2	1.2	1.0	1.0
4	2.7	3.8	2.1	1.1	1.0
6	5.6	7.9	4.3	2.2	1.1
8	9.6	13.6	7.4	3.8	1.9
10	14.5	20.5	11.1	5.7	2.8
12	(20.5)	29.0	15.7	8.0	4.0

VOLUME OF THRUST BLOCK IN CUBIC YARDS (VERTICAL BENDS)			
FITTING SIZE (IN)	BEND ANGLE		
	45°	22 1/2°	11 1/4°
4	1.1	0.4	0.2
6	2.7	1.0	0.4
8	4.0	1.5	0.6
10	6.0	2.3	0.9
12	8.5	3.2	1.3

FOR FITTING SIZE  
12" AND LESS,  
GALVANIZED ROD  
SIZE TO BE #6  
EMBEDMENT 30"

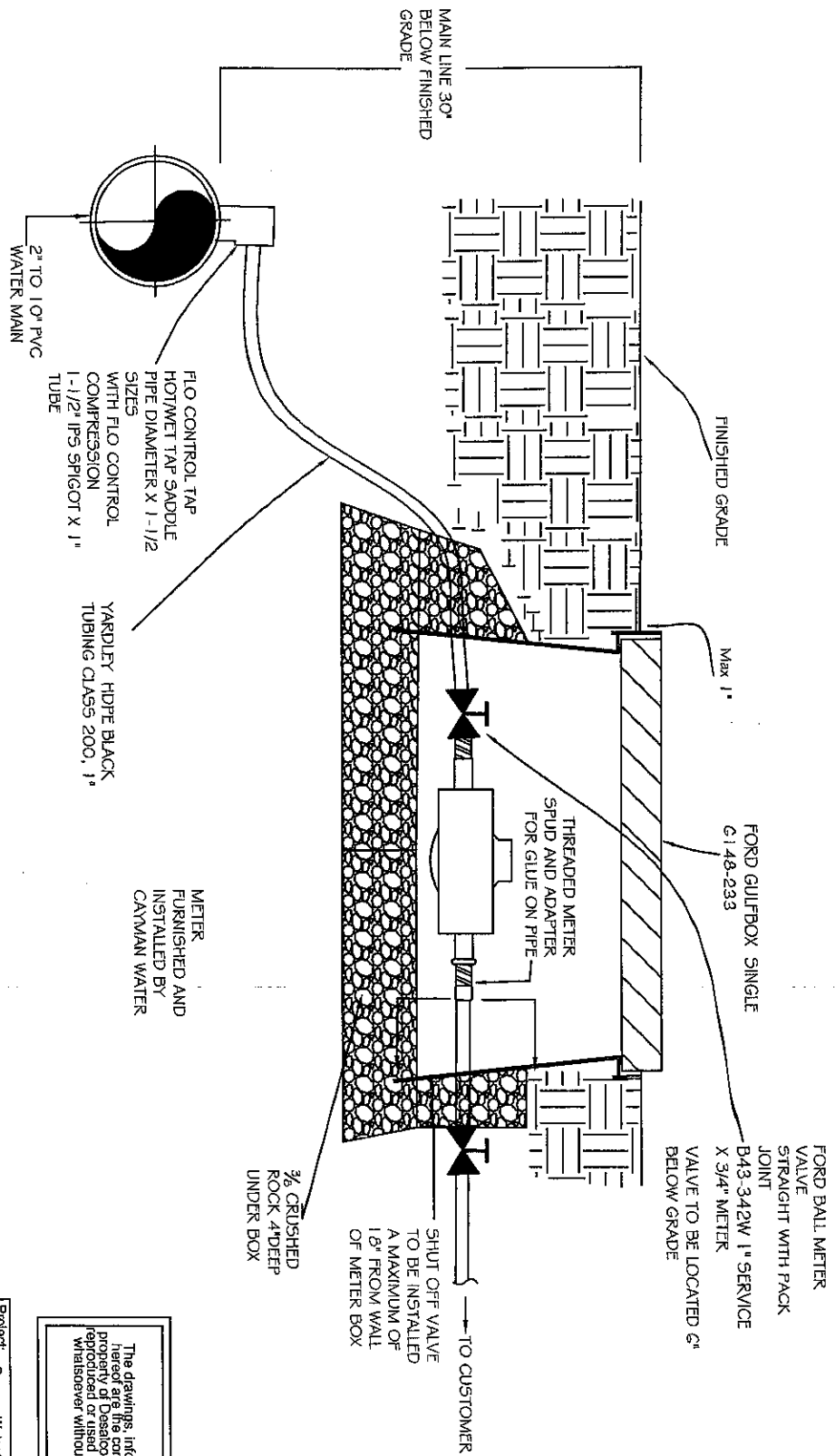
GALVANIZED RODS OVER FITTING  
AND EMBEDDED IN CONCRETE (SEE  
TABLE FOR SIZES)



**VERTICAL  
BLOCK  
PROFILE**

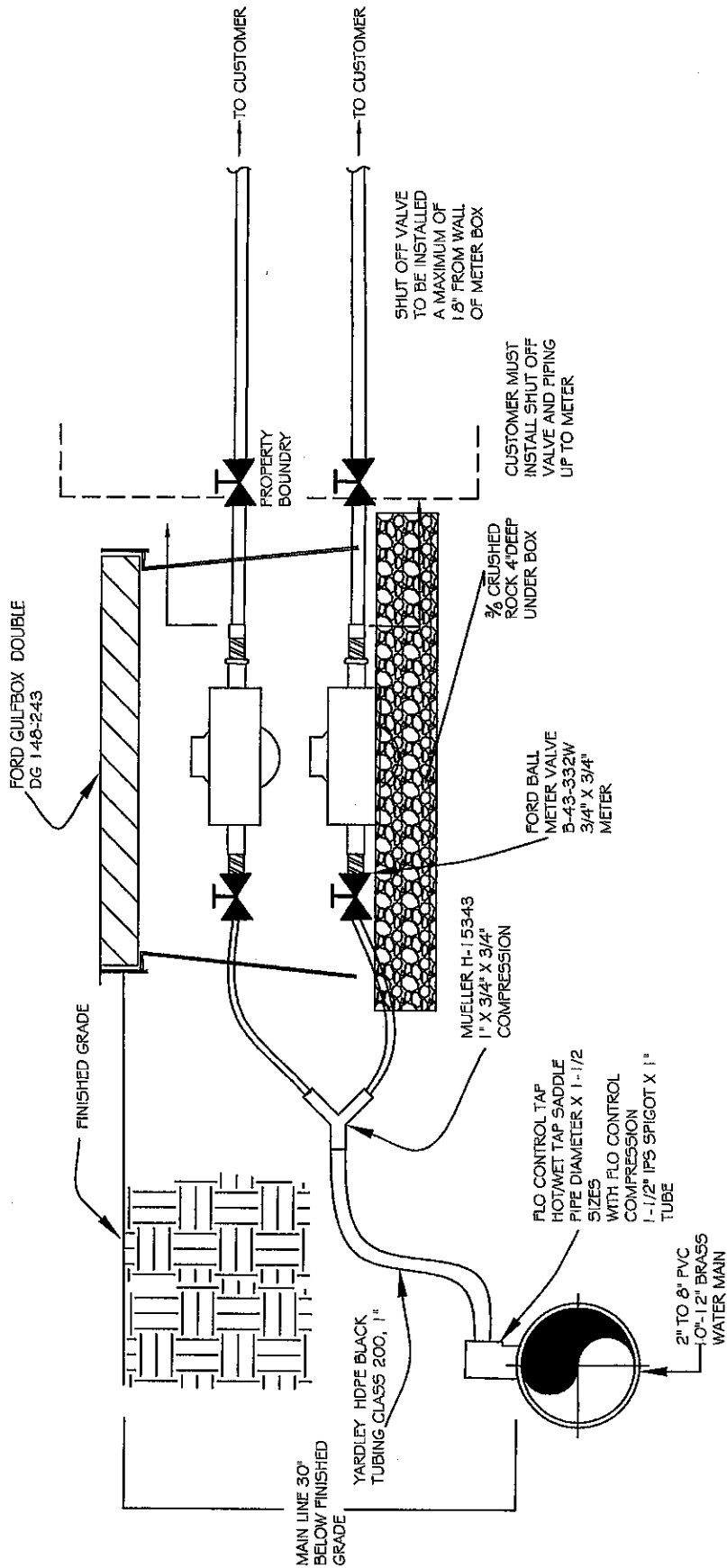


# (S-1), WATER SERVICE INSTALLATION FOR SINGLE RESIDENCE



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Project: Cayman Water Company Distribution Standards	
Title: (S-1) SINGLE RESIDENT SERVICE CONNECTION	
Desalco Ltd.	Drawn: HR
Date: 1 December 2006	Scale: N/A
Sheet: 1 OF 1	Drawing Number: HR-DIST0015
Revision: 01	



## S-2) WATER SERVICE INSTALLATION FOR TWO RESIDENTIAL PROPERTIES

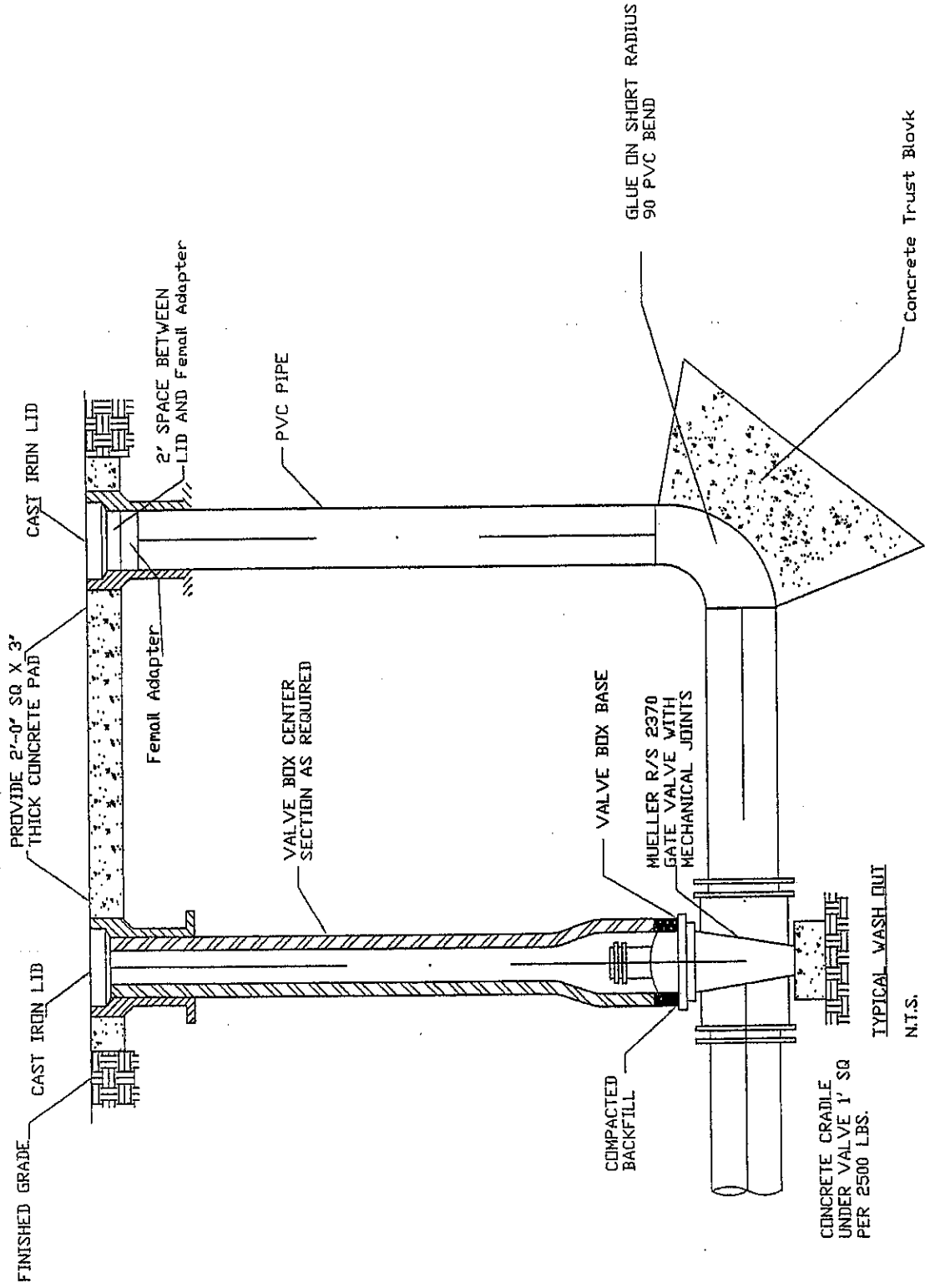
Project: Cayman Water Company Distribution Standards		Title: (S-2) SERVICE CONNECTION	
Drawn: HR	Date: 1 December 2006	Sheet: 1	Scale: N/A
DesalCo Ltd.	Revision: 01	Drawing Number: BS-DIST155-2	
A Cayman Island Company		A Cayman Island Company	
Drawn: BS	Date: 24 October 2003	Sheet: 1	Scale: N/A
DesalCo Ltd.	Revision: 01	Drawing Number: BS-DIST155-2	
A Cayman Island Company		A Cayman Island Company	

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# TYPICAL WASH OUT

DETAIL 2



FINISHED GRADE

CAST IRON LID

PROVIDE 2'-0" SQ X 3" THICK CONCRETE PAD

CAST IRON LID

2' SPACE BETWEEN LID AND Female Adapter

Female Adapter

PVC PIPE

VALVE BOX CENTER SECTION AS REQUIRED

COMPACTED BACKFILL

VALVE BOX BASE

MUELLER R/S 2370 GATE VALVE WITH MECHANICAL JOINTS

GLUE ON SHORT RADIUS 90 PVC BEND

CONCRETE CRADLE UNDER VALVE 1' SQ PER 2500 LBS.

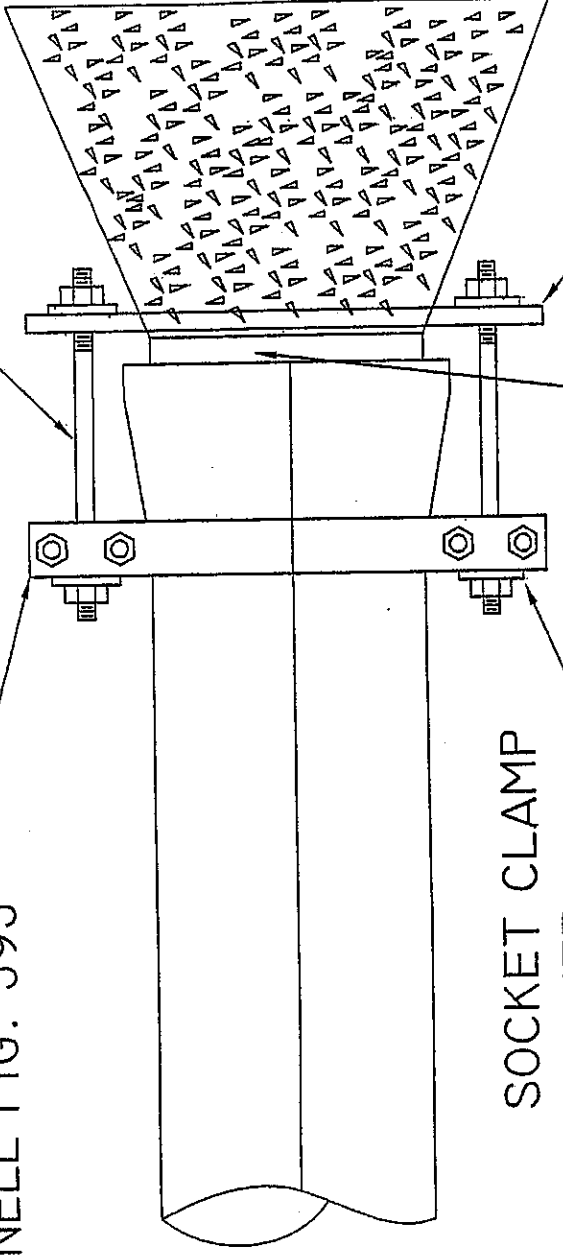
TYPICAL WASH OUT

N.T.S.

Concrete Trust Block

ROD, SIZE AS  
SPECIFIED,  
TYP

SOCKET CLAMP  
GRINNELL FIG. 595



CONCRETE TRUSS  
BLOCK

ANCHOR STRAP  
GRINNELL FIG.  
592

PLUG

SOCKET CLAMP  
WASHER  
GRINNELL  
NO. 594, TYP

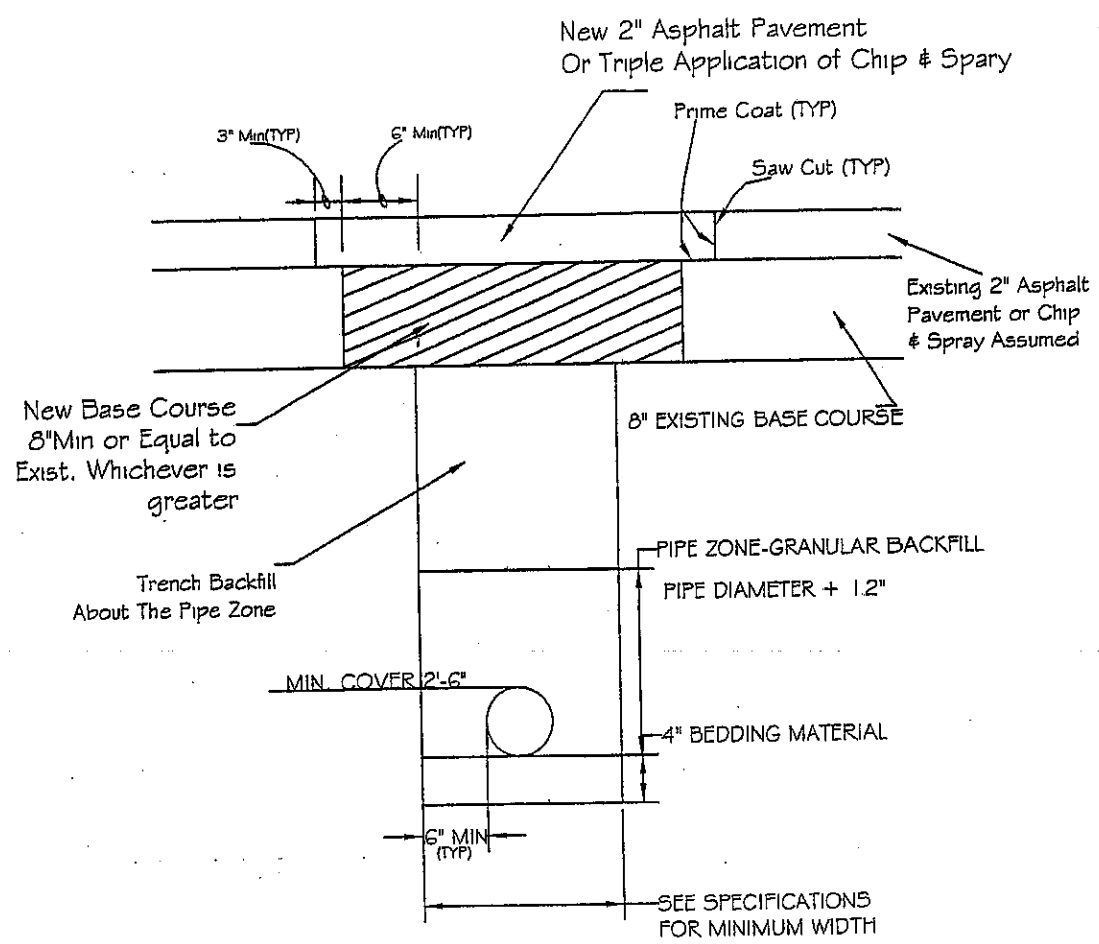
# END PLUG ANCHOR

NTS

Project: Cayman Water Company Distribution Standards		Title: (S-2) SERVICE CONNECTION	
DesaiCo Ltd.	Drawn: BS	Date: 24 October 2003	Revision
1 Of 1	Scale	Drawing Number	01
A Cayman Islands Company	N/A	BS-DIST155-2	

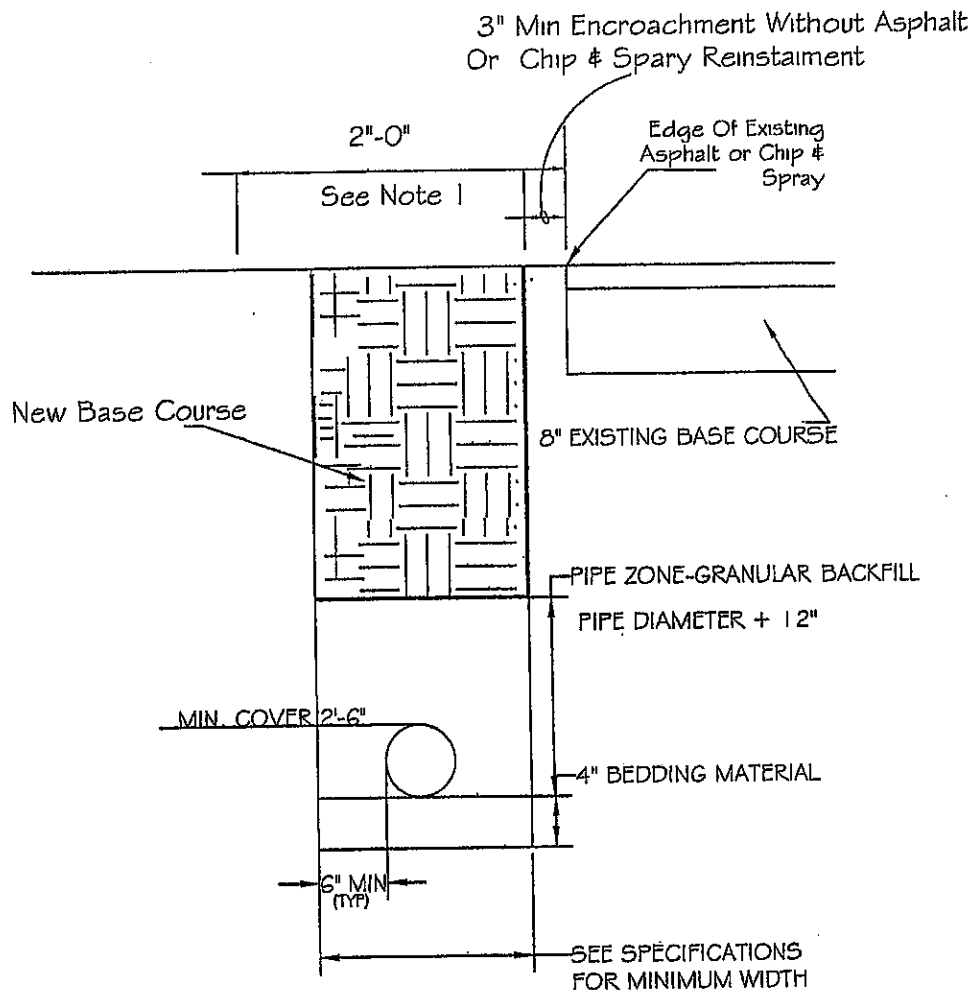
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# DETAIL 6



TRENCH AND REINSTATEMENT SECTION FOR TRENCH  
LOCATED TOTALLY WITHIN EXISTING PAVEMENT

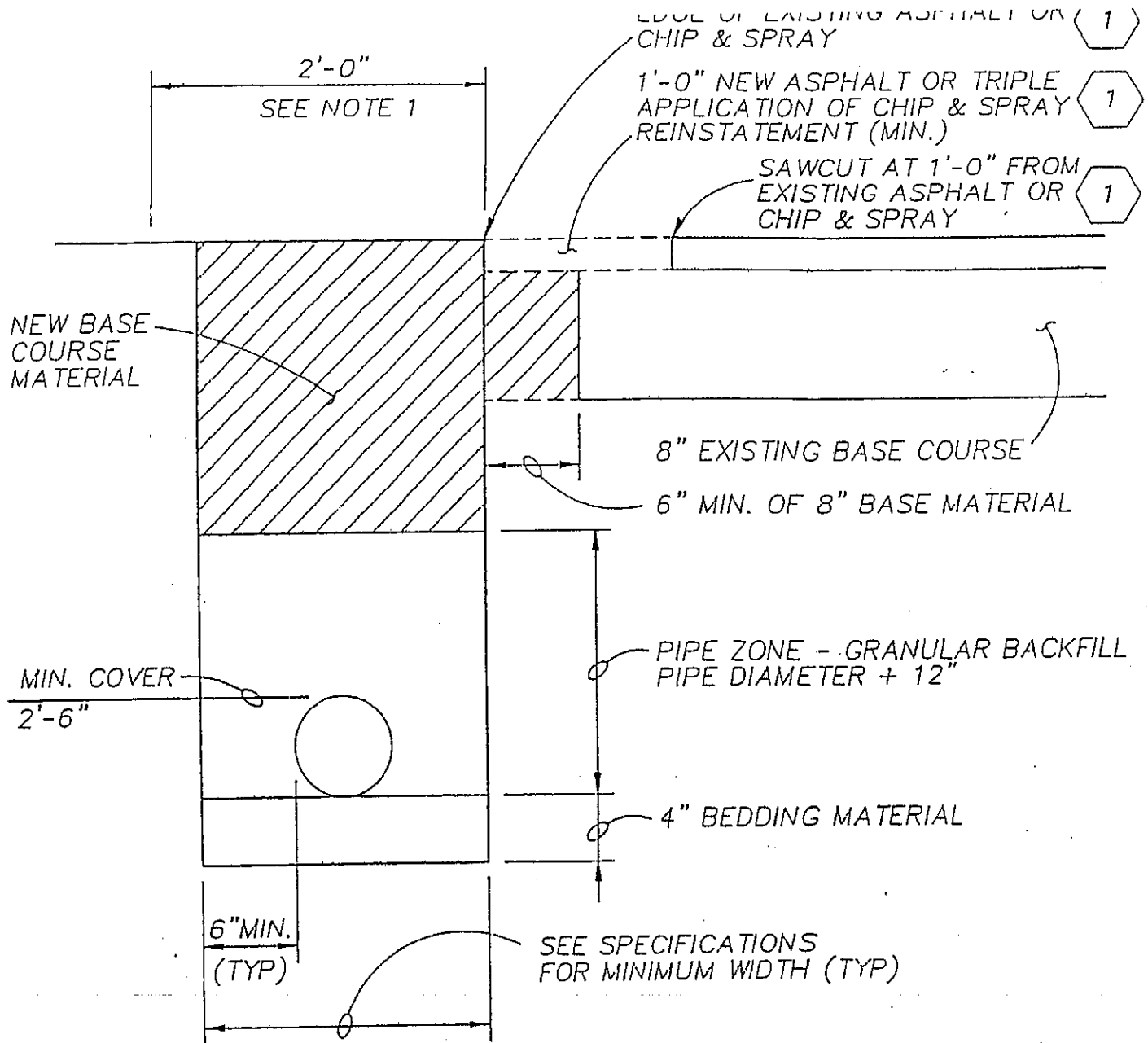
# DETAIL 7



- 1) If Trench is within 2'-0" of edge of pavement all backfill above pipe zone shall be roadway base material
- 2) Minimum encroachment on existing edge of pavement not requiring reinstatement shall be 3-inches
- 3) Encroachment of edge of trench on roadway less than 3- inches will require a reinstatement width of 1.0-feet See detail 8
- 4) For pipe size larger than 6" diameter use 2'-0" trench

TRENCH AND REINSTATEMENT SECTION FOR TRENCH

LOCATED ALONG EDGE OF PAVIMENT



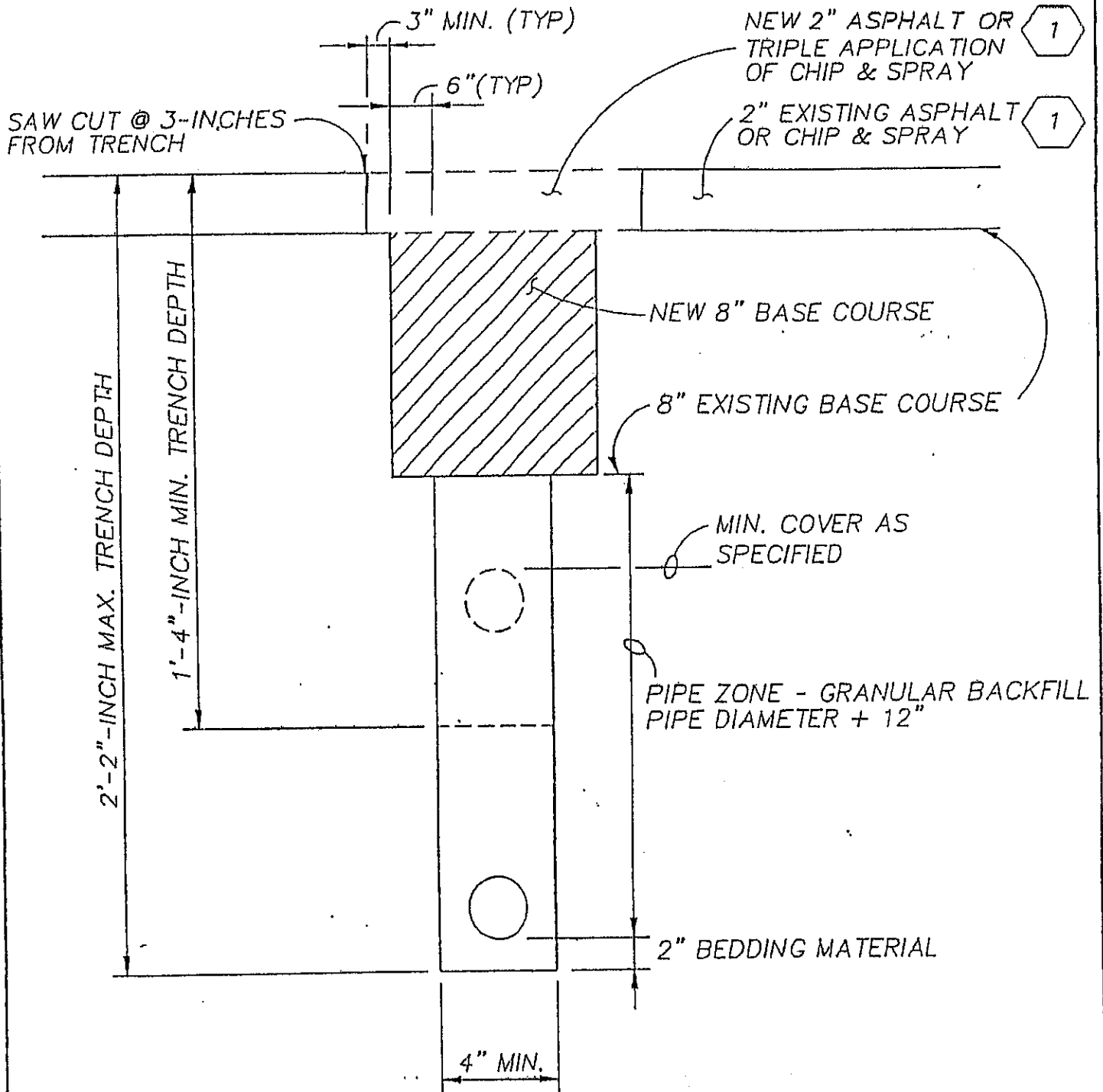
NOTES:

- 1) IF TRENCH IS WITHIN 2'-0" OF EDGE OF PAVEMENT ALL BACKFILL ABOVE PIPE ZONE SHALL BE ROADWAY BASE MATERIAL.
- 2) ENCROACHMENT OF EDGE OF TRENCH ON ROADWAY LESS THAN 3-INCHES WILL REQUIRE A REINSTATEMENT WIDTH OF 1.0- FEET.
- 3) FOR PIPE SIZE LARGER THAN 6" DIAMETER, USE 2'-0" TRENCH.

TRENCH AND REINSTATEMENT SECTION FOR TRENCH ENCROACHMENT ON EDGE OF PAVEMENT

N.T.S.

8



SERVICE CONNECTION TRENCH AND REINSTATEMENT FOR 2-INCH AND LESS CROSSING CARRIAGE WAY

N.T.S.



CI MANHOLE RING & COVER  
W/ MIN OF 6-3/4" DIA HOLES  
SYMMETRICALLY PLACED

GALVS 90° STREET ELBOW  
W/ INSECT SCREEN

FINISH GRADE  
SLOPE (TYP)

GROUT

LIMIT OF PAVEMENT

T-HANDLE  
GUIDE-DOUBLE  
NUTTED EYE  
BOLT & GALV  
ANGLE BRACKET

COMPACTED  
BACKFILL ALL  
AROUND CONC PIP

COMBINATION AIR  
RELEASE VALVE

GALV T-HANDLE,  
LENGTH AS REQD

BRASS PIPE

BRASS 90° BEND

3" MIN

ANGLE VALVE

12"x12"x4" CONC  
BLOCK

B & S CONC  
PIPE

MIN 8", CUT CONC  
PIPE AS REQD

1/3 CY GRAVEL  
BACKFILL

BRASS PIPE LENGTH  
AS REQD

CORPORATION STOP

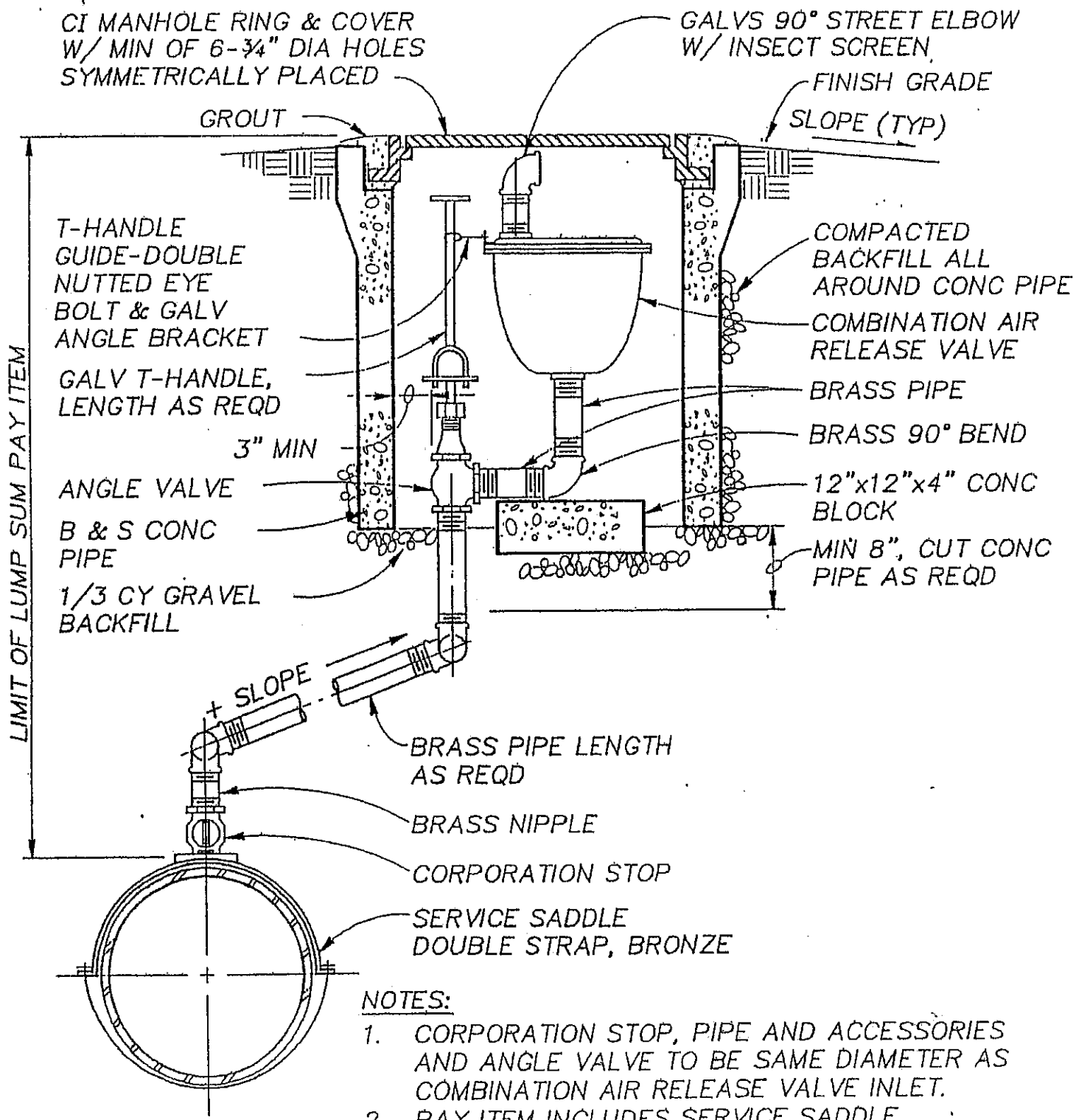
SERVICE SADDLE  
DOUBLE STRAP, BRONZE

NOTES:

1. CORPORATION STOP, PIPE AND ACCESSORIES AND ANGLE VALVE TO BE SAME DIAMETER AS COMBINATION AIR RELEASE VALVE INLET.
2. PAY ITEM INCLUDES SERVICE SADDLE.

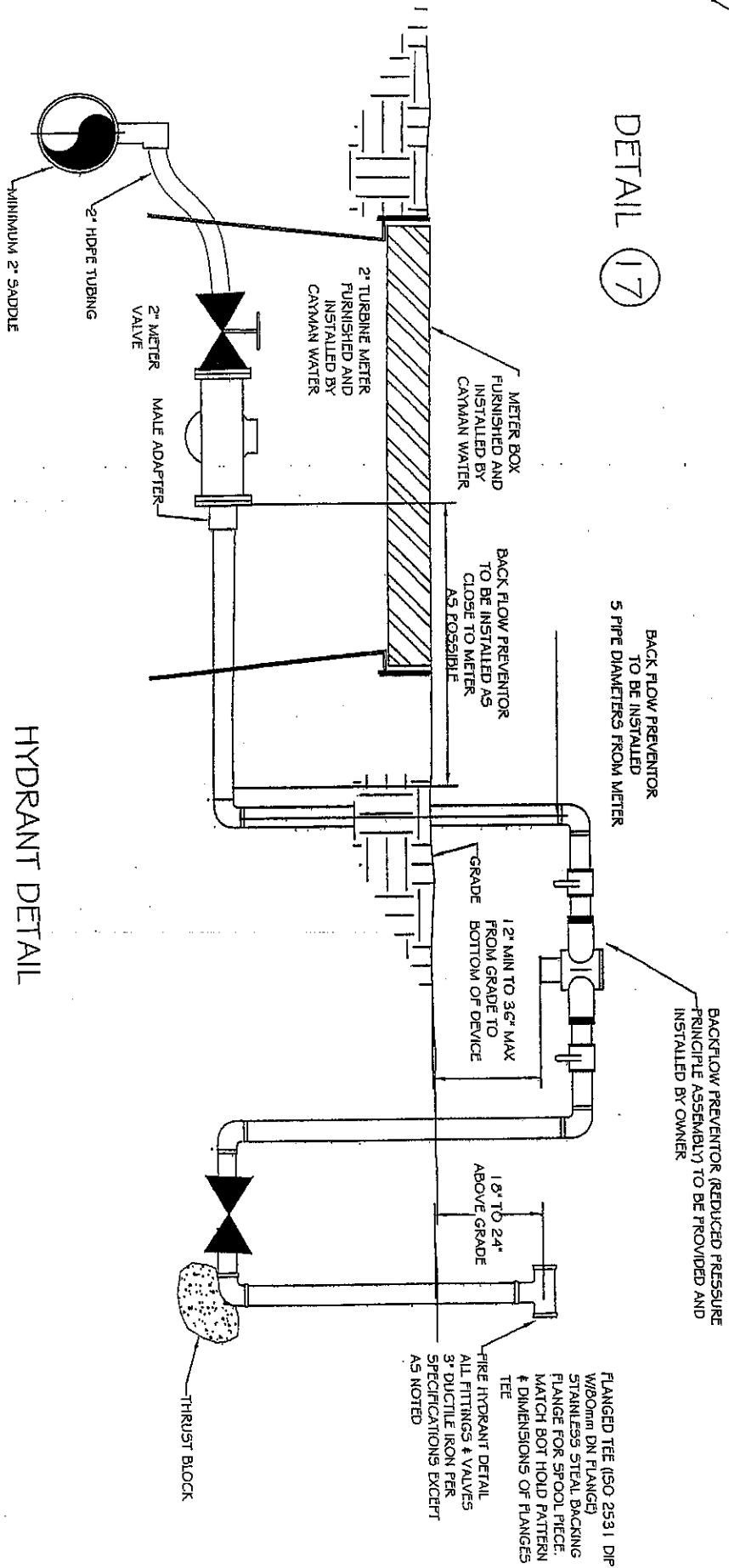
TYPE 'A' COMBINATION AIR  
RELEASE VALVE ASSEMBLY

NTS (UP TO AND INCLUDING 2")



TYPE 'B' COMBINATION AIR  
RELEASE VALVE ASSEMBLY  
NTS (UP TO AND INCLUDING 2")

DETAIL 17



HYDRANT DETAIL

N.T.S.

NOTES

- PAYMENT FOR FIRE HYDRANTS SHALL INCLUDE TEE AT MAIN, THRUST BLOCKS & OTHER MATERIALS SHOWN ABOVE INSTALLED COMPLETE.



