CITY OF MIRAMAR ENGINEERING STANDARDS for PUBLIC WORKS & UTILITIES SYSTEMS

Office of Operational Services

October 1998

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FOR
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SECTION 1

MIRAMAR PUBLIC WORKS AND UTILITIES SYSTEMS

1.1 PURPOSE

The City of Miramar Office of Operational Services (hereinafter sometimes referred to as CMOOS) was formed to plan for Public Works and Utilities and to establish management of the roads; capital improvement projects; the storm water system; the water treatment facilities; the transmission and distribution systems; the wastewater treatment facility and reclaimed/reuse water production; and the collection and transmission systems within the City of Miramar Service Area in order to accomplish the following goals:

A. To plan for and better accommodate public facilities users.

B. To delineate user procedures.

C. To provide a mechanism allowing utility service commitment for major capacity requests.

D. To establish a reserve capacity fee for unused utility services.

E. To delineate user service policies.

F. To establish minimum technical specifications and standards for approval of public facility construction; water, and wastewater facilities and reclaimed/reuse water production, transmission, collection, and distribution and service systems to be constructed within the City of Miramar Service Area.

1.2 DUTIES OF THE OFFICE OF OPERATIONAL SERVICES

CMOOS is authorized and empowered:

A. To adopt such rules and regulations as the City may deem necessary in transacting its business based on recommendations from the City Engineer.

B. To construct, acquire, improve, maintain and operate public works facilities, roads, water or wastewater systems within the City Service Area and the environs thereof, and to acquire by gift, purchase, grant-in-aid of planning, construction, reconstruction or financing, franchises, public works, water or wastewater systems or portions thereof, land, rights or interests of any nature whatsoever in land or water rights connected therewith, and any of the property, real, personal, and tangible or intangible, necessary for such public facilities.

C. To operate and maintain such public works, roads, water or wastewater system or facilities for its own use and for the use and benefit of the inhabitants and of persons, firms, corporations, political subdivisions or other public agencies or parties located within the City Service Area or the environs thereto, who shall use the facilities and services of such system or facilities and to enter into contracts for the supply and distribution or receiving of water with any such persons, firms, corporation, municipalities, special districts, political subdivisions or other public agencies or parties.

D. To employ and to enter into agreements or contracts with consultants, advisors, engineers, attorneys or fiscal, financial, or other experts for the planning, preparation, supervision, operation and financing of such public works, water or wastewater system or facilities, or any part thereof, upon such terms and conditions as to compensation and otherwise as CMOOS shall deem desirable and proper.

E. To fix and collect fees, rentals or other charges (hereinafter sometimes referred to as "revenues") determined on an equitable basis for the use of CMOOS water and/or wastewater facilities and services.

1.3 DEFINITIONS

Except where specific definitions are used within a specific section, the following terms, phrases, words, and their derivation shall have the meaning given herein when consistent

with the context. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.

A. AASHTO - American Association of State Highway and Transportation Officials. Any reference to AASHTO standards shall be taken to mean the most recently published revision unless otherwise specified.

B. ANSI - American National Standards Institute. Any reference to ANSI standards shall be taken to mean the most recently published revision unless otherwise specified.

C. APPLICANT/BUILDER - The person, firm or corporation engaged in developing or improving real estate for use or occupancy. All conditions that apply to the Builder also apply to the Builder's Contractors and the Contractor's Sub-contractors.

D. ASTM - American Society for Testing Materials. Any reference to ASTM standards shall be taken to mean the most recently published revision unless otherwise specified.

E. AWWA - American Water Works Association. Any reference to AWWA Standards shall be taken to mean the most recently published revision unless otherwise specified.

F. BCHD - Broward County Health Department

G. BCTED - Broward County Traffic Engineering Division

H. BUILDER - Used interchangeably with the word Developer, means the person, firm, or corporation engaged in developing or improving real estate for use or occupancy.

I. BUILDER'S ENGINEER - An engineer or engineering firm registered with the State of Florida Department of Professional Regulation retained by the Builder to provide professional engineering services for a project.

J. CITY - The City Commission of Miramar and/or its designated representative(s).

K. CFM – Construction & Facilities Management Department

L. CMOOS - City of Miramar Office of Operational Services

M. CODE - City of Miramar Code of Ordinances

N. CONTRACTOR - The person, firm, or corporation with whom the contract for work has been made by the Owner, the Builder, the Utility Owner, or the City.

O. COUNTY - Broward County

P. DEP - Department of Environmental Protection, State of Florida

Q. DI - Ductile Iron

R. DIPRA - Ductile Iron Pipe Research Association.

S. EPGMD – Environmental Protection & Growth Management Department , Broward County

T. DRAWINGS - Engineering drawings prepared by a registered Professional Engineer of the State of Florida to show the proposed construction.

U. ENGINEER - An engineer or engineering firm registered with the State of Florida Department of Professional Regulation.

V. FDOT - Florida Department of Transportation.

W. GEOTECHNICAL/SOILS ENGINEER - means a Registered Florida Engineer who provides services related to terrain evaluation and site selection, subsurface exploration and sampling, determination of soil and rock properties, foundation engineering, settlement and seepage analysis, design of earth and earth retaining structures, the design of subsurface drainage systems and the improvement of soil properties and foundation conditions, and testing and evaluation of construction materials.

X. HD – Health Department

Y. MUTCD - MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES - The United States Department of Transportation Manual on Traffic Control Devices, latest edition.

Z. NEMA - National Electrical Manufacturers Association. Any reference to NEMA Standards will be taken to mean the most recently published revision unless otherwise specified.

AA. NSF - National Sanitation Foundation. Any reference to NSF Standards shall be taken to mean the most recently published revision unless otherwise specified.

AA. OSHA - The Federal Occupational Safety and Health Administration.

BB. OWNER - The person, firm, corporation or governmental unit holding right of possession of the real estate upon which construction is to take place.

CC. PLANS - Drawings as defined herein above.

DD. PPFA - Plastic Pipe and Fitting Association. Any reference to PPFA Standards shall be taken to mean the most recently published revision, unless otherwise specified.

EE. ROADWAY - Paved area within public right-of-way.

FF. R/W - Right(s)-of-way

GG. SBDD - South Broward Drainage District.

HH. SFWMD - South Florida Water Management District.

II. STANDARD DRAWINGS - Detailed drawings in these Standards related to water and wastewater main materials and installation.

JJ. STANDARD SPECIFICATIONS - The Department of Transportation, State of Florida, Standard Specification for Road and Bridge Construction, latest edition.

KK. STANDARDS - City of Miramar Engineering Standards for Public Works and Utilities Systems (this document).

LL. SUBCONTRACTOR – The person, firm, or corporation in privity with the Contractor.

MM. SURVEYOR - Person licensed in Florida under Chapter 472 of the Florida State Statutes to practice land surveying in the State of Florida (similar to "Engineer").

NN. TRAFFIC CONTROL AND SAFE PRACTICES MANUAL - The State of Florida Department of Transportation Manual on Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operation, latest edition.

OO. UTILITY ACCOMMODATION GUIDE - The State of Florida Department of Transportation (FDOT) Utility Accommodation Guide, latest edition.

PP. DIRECTOR - The Director of Construction & Facilities Management department.

QQ. UTILITY SERVICE AREA - The water and wastewater service area defined by the City.

RR. WATER MAINS - Water transmission mains, distribution mains, pipes, fittings, valves, hydrants, services, meters and miscellaneous related appurtenances.

SS. RECLAIMED/REUSE WATER MAINS – Reclaimed/reuse water transmission and distribution mains, pipe, fittings, service, meters and miscellaneous related appurtenances.

TT. WASTEWATER MAINS - Wastewater gravity sewers, force mains, pump stations, fittings, valves, service laterals, and miscellaneous related appurtenances.

UU. WORK - The labor, materials, equipment, supplies, services and other items necessary for the execution, completion and fulfillment of the contract.

1.4 CRITERIA OF REVIEW

No public works, water, wastewater or reclaimed/reuse water facility or associated transmission and distribution lines may be constructed in the City of Miramar Service Area without obtaining prior CMOOS approval. CMOOS evaluates applications for approval to construct facilities or associated lines based upon the following criteria:

A. Compliance with the procedures and technical specifications of CMOOS, as contained within these Standards.
B. Compliance with City zoning regulations where applicable.
C. Compliance with the Comprehensive Plan as amended.
D. Compliance with City Land Development Code and Code of Ordinances.
E. No application for approval shall be granted which fails to comply with the above criteria.

1.5 GENERAL INFORMATION

A. The information set forth in this document is intended to provide minimum standards for approving design and construction of public works (roadways, sidewalks, storm drainage, and street lighting), and utilities (water, wastewater and reclaimed/reuse facilities, transmission, collection and distribution systems).
B. It shall be the responsibility of the applicant or his engineer to secure proper existing information, and prepare drawings (including plan and profile sheets) in accordance with these minimum standards. It remains the right of the applicant to exceed these minimum standards.
C. Construction drawings shall contain CMOOS approved plan and profile sheets (stamped and signed approved) showing all facilities, utilities, and storm drains. No changes shall be made on pre-approved drawings without prior approval of the

CMOOS. No construction whatsoever shall begin prior to plan approval and issuance of a construction permit(s) by CMOOS.

D. Construction drawings submitted to CMOOS are to be the latest revision. Contractor must have a CMOOS approved set of Drawings and Specifications on the project site. This set will be the only official reference set for construction.

E. Contractor shall use Appendix "A" for selecting pre-approved equipment and material suppliers acceptable to CMOOS.

F. The contractor shall furnish a minimum of three (3) copies of all shop drawings or catalog cuts to CMOOS for approval prior to construction, for all equipment and materials to be incorporated in a project.

1.6 PLANS AND SPECIFICATIONS

A. All submitted plans shall be standard size sheet twenty-four (24) inches by thirty-six (36) inches with title block. Graphic scale(s) shall be provided on each sheet and all lettering shall be one-eighth (1/8) inch or larger to permit photographic reproduction and reduction. Submittal of specifications will only be required when special facilities outside the scope of these Standards are proposed. All plan and profile sheets and the title page of submitted specifications must be signed, sealed and dated by a Professional Engineer registered in the State of Florida for each discipline involved in the project.

B. Whenever possible, the entire potable water, wastewater, and reclaimed/reuse water systems shall be shown on a single master plan. The master plan shall indicate the general locations of all mains, manholes, valves, hydrants, services and service laterals with respect to the proposed development improvements and the existing potable water, wastewater, and reclaimed/reuse water systems. Main sizes shall be indicated on the master plan. A master paving and drainage plan will also show existing, proposed and future roadways, as well as finished grades,

including all stormwater inlets, catch basins, outfalls and drainage watershed areas.

C. All gravity sewers on-site and off-site, all storm sewers on-site and off-site, all wastewater force mains, and off-site potable water or reclaimed/reuse water mains shall be drawn in plan and profile. On-site potable water or reclaimed/reuse water mains may be shown in plan view only, except in specific locations where conflicts may occur. Those locations will require pot-holing for survey elevations and size verification on existing underground lines. All storm sewers conveyance mains and finish pavement grades shall also be shown on the plan and profile sheets.

Whenever possible, on-site potable water, wastewater, reclaimed/reuse water systems, and storm water collection shall be shown on the same plans sheet. As a minimum, the plan and profile drawings shall include the following information.

1. General information such as north arrow, name of firm with address and phone number, names of designer and approving engineer, revision block with dates, graphic scale(s), and sheet number and/or drawing number.
2. Profile with elevations at one hundred (100) foot intervals, or more frequently if required by good design practice. Profile sheets will be required for all gravity sanitary sewers and shall include all separation clearances, points of conflict, and any special protection required.
3. Development layout with horizontal and vertical controls.
4. All conflicts with other utility and drainage systems.
5. All manhole locations, with invert and rim elevations, for all manholes within or outside of paved areas.
6. Pipe data including size, lengths, material, slopes, roughness coefficient, direction of flow (on plans).
7. Size, type, and locations of fittings, valves, hydrants, air release/vacuum relief valves, and other related appurtenances.

8. Limits of pipe deflection. Generally, not more than one-half (½) of manufacturer's allowable deflection for each pipe size.
9. Limits of special interior or exterior pipe coatings, wrappings, or cathodic protection.
10. Limits of special bedding requirements.
11. Pipe restraint requirements.
12. Details of connection to existing systems.
13. Location(s) and general layout of wastewater pumping stations.
14. Construction notes regarding cover, horizontal and vertical control, special construction requirements, and references to standard and special details.
15. Location and size of all relevant structures.

D. The plans shall include all applicable Standard Drawings as shown in these Standards. Special details shall be prepared by the Builder's Engineer for aerial and underwater crossings of rivers, streams, canals and ditches. Other special details shall be prepared by the Builder's Engineer as required.

E. The master plan shall be prepared at a scale not-to-exceed one (1) inch to one hundred (100) feet. Plan and profile sheets shall not exceed a scale of one (1) inch to forty (40) feet. Special details shall be of sufficiently large scale to show pertinent construction information (1/2" = 1′-0").

1.7 ADMINISTRATIVE PROCEDURES

A. This section covers all roads, drainage, water, wastewater and reuse improvements that are to be constructed in the City of Miramar. These improvements shall be designed, reviewed, constructed and accepted in accordance with the criteria established herein.

B. Design of roads, storm sewers, potable water, wastewater, and reclaimed/reuse water improvements shall be in compliance with the design standards and the

specifications outlined in these Standards. Plans will be reviewed and approved by the CMOOS Construction & Facilities Management (CFM) Department as part of the site plan review process. The review process consists of the following steps:

1. Site plan review application/plans/fee submittal.
2. Application/plans review by CMOOS CFM Department.
3. Comments returned to Engineer.
4. Final plan submittal (including return of drawings relined by City Staff) and payment of CMOOS CFM Department fees.
5. CMOOS executes HD, EPGMD, DEP applications.

C. The City Engineer or his designee shall periodically inspect all construction subject to these standards and specifications. These inspections shall include, at a minimum, substantial and final completion inspections.

Non-compliance with approved plans or specifications or evidence of faulty materials or workmanship shall be called to the attention of the Engineer Contractor and if not corrected in an expeditious manner, all work on the project will be suspended and/or Certificate of Occupancy withheld. After all required improvements have been installed, the Developer shall have his Engineer submit certification to the City that the improvements have been constructed substantially according to the City approved plans and specifications and, clearly note all deviations. Laboratory tests may be required when appropriate.

D. A surety bond shall be posted by the Developer and executed by a bonding company authorized to do business in the State of Florida, and whose rating is satisfactory to the City, payable to the City in the amount of one hundred twenty-five (125%) percent of the actual bid from the Contractor for the construction cost of all required roads, storm sewers, water, wastewater and reclaimed/reuse water improvements to be owned and maintained by the City. Upon completion of construction and commencing on the date of acceptance by the City Commission, a maintenance bond in the amount of twenty-five (25%) percent of the actual cost

for the public improvements of construction intended to be owned and maintained by the City shall be posted for a one (1) year period. The materials, workmanship and structural integrity of roads, storm sewers, water, wastewater systems, reclaimed/reuse water systems and miscellaneous related facilities, (excluding mechanical equipment for a one (1) year period) shall commence on the date of the acceptance by the City. The manufacturer's warranty will be acceptable for mechanical equipment. As an alternative to the provision of a surety bond, the Developer may provide a Letter of Credit in the same amount acceptable to the City.

E. After successful completion of all roads, storm sewers, potable water, wastewater, and/or reclaimed/reuse water improvements, and after receipt of the required documents, the Developer's Engineer will provide a Certificate of Completion verifying the satisfactory construction of all improvements on the approved construction plan and provide all HD, EPGMD, DEP, SBDD and BCTED required acceptance certifications. The required documents shall include Record Drawings, final release of lien, applicable operation and maintenance manuals and final construction cost information based on actual construction costs. After the one (1) year warranty period and verification by the City of satisfactory performance of all potable water, wastewater, and wastewater reuse improvements, the City will issue the "Approval for Maintenance", thereby releasing the Builder from further responsibilities.

F. The Builder's Engineer shall submit a certified set of Mylar Record Drawings (as-builts) to the City with his Certificate of Completion for the improvements. In addition, plans shall be submitted in a digital format in AutoCAD 2000 or better. The Digital File shall be compatible with the City's layering system. The drawings coordinate datum shall refer to North American Horizontal Datum (NAD) 1983, transverse Mercator projection. The Builder's Engineer shall be responsible for recording information on the approved plans concurrently with construction

progress. Record Drawings submitted to the City as part of the project acceptance shall comply with the following requirements:

1. Drawings shall be legibly marked to record actual construction.
2. Drawings shall show actual location of all underground and above ground water and wastewater piping and related appurtenances. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface improvements. Drawings shall also show actual installed pipe material, class, etc. Profile sheets shall be updated to include all field measurements and elevations taken during construction.
3. Drawings shall clearly show all field changes of dimension and detail including changes made by field order or by change order.
4. Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.
5. Location of all manholes, hydrants, tees, reducers, crosses, valves, and valve boxes shall be shown. All tees, reducers, crosses, and valves shall be referenced from at least two (2) and preferably three (3) permanent points such as building corners and roadway intersections.
6. Dimensions between all manholes shall be field verified and shown. The rim, inverts and grade elevations of all manholes shall be shown.

Each sheet of the plans shall be signed, sealed and dated by the Developer's Surveyor as being "As-Builts" or "Record Drawings". Construction plans simply stamped "As-Builts" or "Record Drawings" and lacking in above requirements will not be accepted, and will be returned to the Developer's Engineer. The Certificate of Occupancy will not be issued until correct "Record Drawings" have been submitted, approved, and accepted by CMOOS.

G. Maintenance Bond – Upon completion of construction, the Developer is required to post a bond valued at twenty-five (25%) percent of the construction cost of the project for a one (1) year period, commencing on the date of acceptance by the City Commission.

1.8 LIST OF MATERIALS AND APPROVED MANUFACTURERS

A list of Materials and Approved Manufacturers for the various products specified in these Standards is included in Appendix "A." It is the intent of the City to review and update Appendix "A" as appropriate to ensure efficient operation of the services and facilities under the jurisdiction of these Standards. For this purpose, the City shall evaluate technical submittals from interested manufacturers or suppliers at least once every three (3) years.

1.9 PERSON TO CONTACT

The key person to contact concerning these Standards is:

City Engineer
City of Miramar
2200 Civic Center Place
Miramar, Florida 33025
(954) 602-3320

1.10 REGULATORY PERMITS

All permits required from any federal, state and local government entity having jurisdiction over the facilities proposed to be installed shall be obtained by the applicant. Any application which fails to meet the requirements of all federal, state and local governing bodies will be deemed incomplete by CMOOS. No work will be allowed without first obtaining a CMOOS Engineering Construction Permit.

SECTION 2

GENERAL CONSTRUCTION REQUIREMENTS

2.01 GENERAL

A. This Section sets forth the general requirements for construction and installation of roads, storm sewer, water, wastewater and wastewater reuse utility facilities.

2.02 GRADES, SURVEY LINES, AND PROTECTION OF MONUMENTS

A. Grades: All work shall be constructed in accordance with the lines and grades shown on the plans. The full responsibility for keeping alignment and grade shall rest upon the Builder.

Bench marks and base line control points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Builder shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. The Builder shall remove any obstructions placed contrary to this provision.

B. Surveys: The Builder shall furnish and maintain, at his own expense, stakes and other such materials, and give such assistance, including qualified helpers, for setting reference marks to the satisfaction of the City and the Engineer. The Builder shall check such reference marks by such means as he may deem necessary and, before using this, shall call the City's attention to any inaccuracies. The Builder shall, at his own expense, establish all working or construction lines and grades as required from the reference marks, and shall be solely responsible for the accuracy thereof. The Builder shall, however, be subject to the check and review of the City.

C. Monument Preservation: Property corners and survey monuments shall be preserved using care not to disturb or destroy them. If a property corner or survey monument is disturbed or destroyed during construction, whether by accident, careless work, or required to be disturbed or destroyed by the construction work, said property corner or survey monument shall be restored by a professional land surveyor registered in the State of Florida. All costs for this work shall be paid for by the Developer. Once restored, the professional land surveyor and builder shal notify the City, in writing, of the completion of the restoration work.

2.03 UTILITY COORDINATION

A. Location of Utilities: Prior to proceeding with trench excavation, the Developer shall contact all utility companies, that serve the area for aid in locating their underground services. It shall be the Developer's responsibility to contact utility companies at least three (3) normal working days before starting construction (Sunshine One-call for utility locations). The Developer shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground utilities may be determined.

The Utility Owner will endeavor to accurately locate and mark its utility. This action does not relieve the Contractor or its Sub-contractors from taking all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, the Builder shall immediately notify the responsible official of the organization operating the interrupted utility. The Developer shall lend all possible assistance in restoring services and shall assume all cost, charges, or claims connected with the interruption and repair of such services.

B. Deviations Occasioned by Structures or Utilities: Wherever obstructions are encountered during the progress of the Work and interfere to such an extent that

an alteration in the Plans is required, the City shall have the authority to order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation or reconstruction of the obstructions. Where storm sewer, gas, water, sewer, reclaimed/reuse water, telephone, electrical, hot water, steam or other existing utilities are an impediment to the vertical or horizontal alignment of the proposed pipe line, the City shall approve a change in grade or alignment or shall direct the Builder to arrange with the owners of the utilities for their removal. If a change in line or grade of a gravity sewer is necessary, the City will require the addition of any manholes needed to maintain the integrity of the sewer system.

C. Test Pits: Test pits for the purpose of locating underground pipeline, utilities, or structures in advance of the construction shall be excavated and backfilled by the Builder. A utility permit is required from CMOOS CFM Department prior to initiating any test pit construction. All appropriate utility companies shall be notified forty-eight (48) hours in advance of any test pit investigation. Test pits shall be backfilled immediately after their purpose has been fulfilled and maintained in a manner satisfactory to the City. The costs for such test pits shall be borne by the Builder.

2.04 MAINTENANCE OF TRAFFIC AND CLOSING OF STREETS

A. The Builder shall carry on the work in a manner which will cause a minimum of interruption to traffic. A maintenance of Traffic Plan in accordance with the latest edition of the FDOT's "Roadway and Traffic Standards, Index 600 Series" shall be submitted to the City and the responsible authorities for review, comments and approval. Where traffic must cross open trenches, the Builder shall provide suitable bridges at street intersections and driveways. The Developer shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic in accordance with MUTCD. Prior to closing of any

streets the Builder shall notify when applicable the BCTED and obtain the approval of responsible authorities and the CMOOS CFM Department.

Unless permission to close a street is received in writing from the proper authority (City, County, FDOT, etc.), all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Builder's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the CMOOS CFM Department.

Detours around construction will be subject to the approval of the authority having jurisdiction and the City. Where detours are permitted, the Builder shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured the Builder shall expedite construction operations. Periods when traffic is being detoured will be strictly controlled by the City.

It shall be the sole responsibility of the Builder to take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection may be provided for traffic while work is in progress. The Builder shall be fully responsible for damage or injuries whether or not police protection has been provided.

2.05 PROTECTION OF PUBLIC AND PROPERTY

A. Barricades, Guards and Safety Provisions: The Builder shall be solely responsible for adhering to the rules and regulations of OSHA and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, temporary fencing, construction signs, lights and guards as required shall be placed and maintained by the Builder at his expense during the progress of the work and until it is safe for traffic to use the roads and

streets. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when visibility is poor. All signs and barricades shall be in accordance with the most recent edition of the "Manual on Uniform Traffic Control Devices" and the "Traffic Control and Safe Practices Manual."

B. Protection of Utility Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures including drains, sewers, manholes, hydrants, valves, valve covers, power poles and other miscellaneous utility structures encountered in the progress of the work shall be furnished by the Builder at his expense. Any such structures which may have been disturbed shall be restored immediately upon completion of the work.

C. Open Excavation: All open excavations shall be adequately safeguarded by providing temporary barricades, temporary fencing, caution signs, lights and other means to prevent accidents to persons and damage to property. The Builder shall, at his own expense, provide suitable and safe bridges with handrailings and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required. The length of an open trench will be controlled by the particular surrounding conditions, but shall be limited to three hundred (300) feet unless otherwise approved by the City. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the City may require special construction procedures such as limiting the length of open trench, fencing, prohibiting excavated material in the street and requiring that the trench shall not remain open overnight. The Builder shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment or other obstacles which could be dangerous to the public shall be well lighted at night.

D. Excavation Site Safety: Whenever an excavation site or trench is left unattended by the Contractor or when an area is not within one hundred (100) feet of observation by the contractor, the excavation site or trench shall be filled and/or, at the City's discretion, protected by other means to prevent accidental or

unauthorized entry. Such protection shall include barricades and other protection devices requested by the Engineer or City, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the Contractor of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.

E. Protection of Trees and Shrubs: All trees and shrubs not shown to be removed on the Plans shall be protected by the Builder at his expense. No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Builder or his employees shall be replaced by him with new stock of similar size and age at the sole expense of the Builder.

F. Protection of Lawn Areas: Lawn areas shall be left in as good or better condition as before starting of the work. Where sod is to be removed it shall be carefully restored with new sod of the same type.

G. Restoration of Fences: Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Builder and shall be left in as good or better condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used shall be subject to the approval of the City.

H. Protection Against Siltation and Bank Erosion: The Builder shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches, and reduce or eliminate the tracking of sediment out of the public R/W or streets. A stabilized construction entrance shall be constructed at any point where traffic will be entering or leaving a construction site, to or from a public R/W, street, alley, sidewalk, or parking area. The Builder shall provide for the interception and retention of all sediment (silt) from construction sites in order to prevent any silt from leaving the construction area. Filter barriers or silt fences shall be employed in this regard. Filter barriers composed of burlap or standard weight synthetic fabric stapled to wooden stakes shall be used in ditch lines, around drop inlets,

and at temporary sites where construction changes the earth contour and water run-off pattern. Filter barriers shall be used where flows not exceeding one (1) cubic foot per second are expected. Silt fences shall be employed where sheet or overland flows are expected. Filter barriers and silt fences shall be constructed according to the guidelines set forth in the SBDD manual. The Developer, at his own expense, shall check the installed sediment and erosion devices after every rain event and shall remove any siltation deposits, and restore the site to the original grade and the devices to proper working conditions.

2.06 ACCESS TO THE PUBLIC SERVICES

A. Neither the materials excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to public services. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing streets, sidewalks and driveways. Excavated material suitable for backfilling shall be stockpiled separately on the site. No material shall be placed closer than two (2) feet from the edge of an excavation or as set forth in applicable OSHA standards. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Natural water courses shall not be obstructed or polluted. Surplus material and excavated material unsuitable for backfilling shall be transported and disposed of off the site in permitted disposal areas obtained by the Builder.

2.07 PUBLIC NUISANCE

A. The Builder shall not create a public nuisance including but not limited to encroachment on adjacent lands, flooding of adjacent lands, or excessive noise or dust. The Builder shall eliminate noise to as great an extent as practicable at all times.

2.08 CONSTRUCTION HOURS

A. No work shall be done between the hours of 6:00 p.m. and 7:00 a.m., or on Saturdays and Sundays unless the proper and efficient prosecution of the work requires operations during the night or weekend (per City Code Section 10-114). Written request to the City Engineer for doing the work shall be submitted a minimum forty-eight (48) hours before starting such work. In the event inspections are required, the Contractor will be responsible for all costs for engineering inspection overtime.

2.09 CONSTRUCTION IN EASEMENTS AND RIGHTS-OF-WAY

A. Construction Easements: In easements across private property, the Builder shall confine all operations within the easement area and shall be responsible and liable for all damage outside of the easement area. Trees, fences, shrubbery or other types of surface improvements located in easements will require protection during construction. Precautions shall be taken by adequate sheeting or other approved methods to prevent any cave-in or subsidence beyond the easement limits or damage to improvements within the easement. In general, the easement area is intended to provide reasonable access and working area for efficient operation by the Builder. Where easement space for efficient operation is not provided, the Builder shall be responsible for organizing operations to perform within the restrictions shown on the plans.

B. Construction in FDOT R/W: The Builder shall strictly adhere to the requirements of the FDOT where construction work is in a R/W under the jurisdiction of the State of Florida, including obtaining FDOT permits, and shall take care to avoid any unreasonable traffic conflicts due to the work in road R/W.

C. Construction in Broward County R/W: The Builder shall strictly adhere to the requirements of the County where construction work is in a R/W under the jurisdiction of the State of Florida, including obtaining County permits, and shall take care to avoid any unreasonable traffic conflicts due to the work in road R/W.

D. Construction in City of Miramar R/W: Work shall be governed by the City regulations as amended.

2.10 SUSPENSION OF WORK DUE TO WEATHER

A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. During suspension of the work from any cause, the work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise.

2.11 USE OF CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or other classification, must show approval of either United States Environmental Protection Agency (USEPA) or United States Department of Agriculture (USDA). Use of all such chemicals and disposal of residues shall be in strict conformance with label instructions.

2.12 COOPERATION WITH OTHER BUILDERS AND FORCES

A. During construction progress, it may be necessary for other contractors and persons employed by the City to work in or about the site. The City reserves the right to put such other contractors to work and to afford such access to the construction site and at such times as the City deems proper. The Builder shall not impede or interfere with the work of such other contractors and shall cooperate with the other contractor(s) for proper prosecution of the work.

2.13 SUB-SURFACE EXPLORATION

A. The Builder shall make such sub-surface explorations as the Builder believes necessary to perform the Work.

2.14 CLEANING

A. During Construction: During construction the Builder shall, at all times, keep the construction site and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the City, such material, debris, or rubbish constitutes a nuisance or is objectionable.

B. Final Cleaning: At the conclusion of the work, all tools, temporary structures and materials belonging to the Builder shall be promptly removed. The Developer shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances and restore the site to the pre-construction condition or better.

2.15 SALVAGE

A. Any existing City owned equipment or material, including, but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction may be designated as salvage by the City, and if so, shall be carefully removed from the site and delivered to a storage area designated by the City.

2.16 SHOP DRAWINGS AND SAMPLES

A. Prior to construction and prior to issuance of a City engineering permit, the Builder shall submit not less than three (3) copies of the shop drawings (signed by the Builder's Engineer) to the CMOOS CFM Department. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable review of the information as required. The Builder shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified in these Standards.

2.17 CLEARING AND GRUBBING

A. The Builder shall clear and grub all of the area within the limits of construction as shown on the Plans and approved by the CMOOS CFM Department prior to the beginning of any work. All site work shall conform to the applicable site clearing ordinance, landscaping, and tree ordinances of the City.

B. Clearing: The surface of the ground for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish and all other objectionable obstructions resting on or protruding through the surface of the ground. However, trees and shrubs shall be preserved as specified in Section 2.05.E. Plantings, shrubbery, trees, utility poles or structures subject to damage resulting from the excavation shall be transplanted, relocated, braced,

shored, or otherwise protected and preserved unless otherwise directed by the Owner. Clearing operations shall be conducted so as to prevent damage to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others.

C. Grubbing: Grubbing shall consist of the complete removal of all stumps, roots larger than one and one-half (1½) inches in diameter, matted roots, brush, timber, logs and any other organic or metallic debris not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of eighteen (18) inches below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

D. Stripping: In areas so designated, top soil shall be stripped and stockpiled. Topsoil so stockpiled shall be protected until it is placed as specified. Any topsoil remaining after all work is in place shall be legally disposed of by the Contractor.

2.18 EXCAVATION, BACKFILL, COMPACTION AND GRADING

A. All such work shall be performed by the Builder concurrently with the work specified in Sections 4 through 8 of these Standards. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfill, fill, compaction, grading and slope protection required to complete the work and restore the site as shown on the plans and specified herein. The work shall include, but not necessarily be limited to pump stations, manholes, inlets, vaults, conduit, pipe, roadways and paving, all backfilling, fill and required borrow; grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing and water handling.

B. The Contractor shall examine the site and undertake sub-surface investigations including soil borings before commencing the work. The City will not be responsible for presumed or existing soil conditions in the work area.

C. Contractor shall locate existing utilities in the areas of the work. If utilities are to remain in place, the Contractor shall provide adequate means of protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, the Contractor shall consult the owner of such piping or utility immediately for directions. Payment for damage and repair to such piping or utilities is the Contractor's responsibility. (Refer to Section 2.03 for utility coordination requirements.) The City shall not be responsible for uncharted or incorrectly charted water and wastewater mains or other utilities. It is the Builder's responsibility to ensure that such facilities exist at the presumed point prior to commencing construction.

D. Materials for use as bedding and backfill, whether in-situ or borrow, shall be as described under this section. The Builder shall, upon request by the City, make an appropriate sample of this material available for testing by the City or its designated representative.

1. Materials for structural fill shall be bedding rock or select common fill as specified herein or other suitable material as approved by the City.
2. Common fill shall consist of mineral soil and be substantially free of clay, organic material, loam, wood, trash and other objectionable material which may be compressible or which cannot be compacted properly. Common fill shall not contain stones larger than six (6) inches in any dimension, or asphalt, broken concrete, masonry, rubble, or other similar materials; and, backfill material placed within one (1) foot of utility lines shall not contain any stones or rocks larger than two (2) inches in diameter. It shall have physical properties such that it can be readily spread and compacted during filling. Additionally, common fill shall be no more than twelve (12%) percent by weight finer than the No. 200 mesh sieve unless finer material is approved for use in a specific location by the City.

   Material falling within the above specifications encountered during the excavation may be stored in segregated stockpiles for reuse. All material

which, in the opinion of the City, is not suitable for reuse, shall be spoiled as specified herein for disposal of unsuitable materials.

3. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than one and one-half (1½) inches in largest dimension, and shall be no more than five (5%) percent by weight finer than the No. 200 mesh sieve.

4. Bedding rock shall be three-sixteenths (3/16) inch to three-quarter (3/4) inch washed and graded stone (FDOT #67). This stone shall be graded so that ninety to one hundred (90% - 100%) percent will pass a three quarter (3/4) inch screen and ninety-five to one hundred (95% - 100%) percent will be retained on a No. 8 screen. No stones larger than one (1) inch in any dimension shall be acceptable.

E. Sheeting and Bracing in Excavations: All sheeting and shoring of excavations will be in accordance with OSHA and the Florida Trench Safety Act. Sheeting and bracing will be used to support the sides of excavations, to prevent excessive trench widths, any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect against injury to persons, erosions, cave-ins, damage to property, adjacent structures, existing piping and/or foundation material from disturbance, undermining or other damage, the Contractor shall construct, brace and maintain sheeting and bracing. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

For trench sheeting for pipes, no sheeting is to be withdrawn if driven below mid-diameter of any pipe and no wood sheeting shall be cut off at a level lower than one (1) foot above the top pipe unless otherwise directed by the City. If during the progress of the work, the City decides that additional wood sheeting should be left in place, it may direct the Builder to do so. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given by the City for an alternate method of removal. All sheeting and bracing not left in

place shall be carefully removed in such a manner so as not to endanger the integrity of other structures, utilities, existing piping or property. Unless otherwise approved or indicated on the drawings or in the specifications, all sheeting and bracing shall be removed after completion of the substructure. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools specially adapted to that purpose, by watering or otherwise as may be directed.

The right of the City to order sheeting and bracing left in place shall not be construed as creating any obligation on its part to issue such orders and its failure to exercise its right to do so shall not relieve the Builder from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Builder to leave in place sufficient sheeting and bracing to prevent any caving in or moving of the ground.

The Builder shall construct the cofferdams and sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems it desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting, bracing and cofferdams shall be adequate to withstand all pressures to which the structure will be subjected. Pumping, bracing and other work within the cofferdam shall be done in a manner to avoid disturbing any construction already performed. Any movement or bulging which may occur shall be corrected by the Builder at his own expense so as to provide the necessary clearances and dimensions.

F. Dewatering, Drainage and Flotation: The Builder shall excavate, construct and place all pipelines, concrete work, fill, and bedding rock, in-the-dry, or in accordance with an alternate construction plan approved by the City Engineer. When constructing in the dry, the Contractor shall not make the final twenty-four

(24) inches of excavation until the water level is a minimum of one (1) foot below proposed bottom of excavation. For the purpose of these Standards, “in-the-dry” is defined to be within two (2%) percent of the optimum moisture content of the soil. The City reserves the right to ask the Contractor to demonstrate that the water level is a minimum of one (1) foot below the proposed bottom of excavation before allowing the construction to proceed.

Discharge water shall be clear with no visible soil particles. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with or cause injury to public health, to public or private property, to the work completed or in progress, to the surface of the streets or waterways (or cause any interference with the use of the same by the public), nor interfere with normal drainage of the area in which the work is being performed, create a public nuisance, or cause ponding. The dewatering operation shall comply with the requirements of appropriate regulatory agencies. Additionally, where private property will be involved, advance permission shall be obtained by the Contractor.

The Builder shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavation; i.e., all necessary dewatering pumps, under-drains, well-point systems, and other means for removing water from trenches and other parts of the work. The Builder shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

Dewatering shall at all times be conducted in such a manner so as to preserve the natural undisturbed bearing capacity of the subgrade soils at the proposed bottom of the excavation.

It is expected that wellpoints will be required for pre-drainage of the soils prior to final excavation for some of the deeper in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged. Wellpoints shall be surrounded by suitable filter sand and negligible fines shall be removed by pumping. The Contractor shall submit to the City, for review and comments, a plan for dewatering systems prior to commencing work prepared by a Geotechnical/Soils Engineer.

The Builder shall furnish all materials and equipment, and perform all work required to install and maintain the drainage systems for handling groundwater and surface water encountered during construction of structures, pipelines and compacted fills.

The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, or other contaminants in order to prevent adverse effects on groundwater or receiving water quality; and shall be responsible for all contamination resulting from his operation or those of his subcontractors.

During backfilling and construction, water levels shall be measured in observation wells located as directed by the City. Continuous pumping will be required as long as water levels are required to be below natural levels.

G. Excavation: Excavation consists of removal, storage and disposal of material encountered and shall provide adequate working space and clearances for the work to be performed and for installation and removal of concrete form when establishing required grade elevations and in accordance with the notes shown in the plans. Excavation shall be made to such dimensions as will give suitable room for bracing and supporting, for pumping and draining, or other purposes. Authorized earth excavation includes removal and disposal of pavements and

other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation. Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and subgrade elevations without specific direction of the City. Unauthorized excavation, as well as remedial work directed by the City shall be at the Builder's expense. Such remedial work shall be performed as directed by the City.

If requested by the City, when excavation has reached required subgrade elevations, a Geotechnical/Soils Engineer shall make an inspection of conditions. If the subgrade is unsuitable, the Builder shall carry the excavation deeper and replace excavated material with select common fill or bedding rock, as directed by the City.

If the Builder excavates below grade, through error or for his own convenience or through failure to properly dewater the excavation or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the City to excavate below grade and refill the excavation using select common fill or bedding rock.

Slope sides of excavations shall comply with local codes and ordinances, and with OSHA requirements. The Builder shall shore and brace where sloping is not possible due to space restrictions or the stability of the material excavated. Sides and slopes shall be maintained in a safe condition until completion of backfilling.

The Contractor shall stockpile suitable excavated materials at a location approved by the City until required for backfill or fill. When needed in the work, material shall be located and graded at the direction of a Geotechnical/Soils Engineer.

Stockpiles shall be placed and graded for proper drainage. All soil materials shall be located away from the edge of excavations. All surplus and/or unsuitable excavated material shall be legally disposed of by the Builder. Any permits required for the hauling and disposing of this material shall be obtained by the Builder prior to commencing hauling operations.

1. Excavation for Structures: All such excavations shall conform to the elevations and dimensions shown on the drawing within a tolerance of plus or minus one-tenth (± .10) feet and extending a sufficient distance from the footings and foundations to permit placing and removing formwork, installation of services and other construction, inspection or as shown on the drawings. In excavating for footings and foundations, care shall be exercised not to disturb the bottom of the excavation. Bottoms shall be trimmed to required lines and grades to leave a solid base to receive concrete.
2. Trench Excavation: Excavation for all trenches required for the installation of utility pipes shall be made in accordance with the drawings and to the depths indicated on the drawings, and in such a manner and to such widths as will give suitable room for laying the pipe within the trenches, for bracing and supporting, and for pumping and drainage facilities (if applicable). The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. Three hundred (300′) feet shall be the maximum length of open trench on any line under construction. Pipe trenches shall be excavated to a width, within the limits of the top of the pipe and the trench bottom so as to provide a clearance on each side of the pipe barrel, measured to the face of the excavation, or sheeting if used, of not less than eight (8) inches nor more than eighteen (18) inches except for pipe over twenty-four (24) inches in nominal size, this maximum eighteen (18) inches clearance may be increased to twenty-four (24) inches. All pipe trenches shall be excavated

to a level six (6) inches below the outside bottom of the proposed pipe barrel unless otherwise directed by the City. Properly sloped or shored per OSHA requirements and job site conditions, and Trench Safety Act.

Trench Stabilization: No claims for extras, or additional payment will be considered for cost incurred in the stabilization of trench bottoms, which are rendered soft or unsuitable as a result of construction methods, such as improper or inadequate sheeting, dewatering or other causes. In no event shall pipe be installed when such conditions exist and the Contractor shall correct such conditions so as to provide proper bedding or foundations of crushed rock or gravel for the proposed installation at no additional cost to the City.

The bottom of the excavations shall be firm and dry, unless approved otherwise, and in all respects acceptable to the City. Excavation shall not exceed normal trench width as specified in the Standard Drawings. Any excavation which exceeds the normal trench width shall require special backfill requirements as determined by the City.

In the case of "wet" installation, where the bottom of trench is located in the limestone zone, the trench shall be over-excavated to allow for the placement of pipeline bedding material. No less than six (6) inches of bedding material shall be placed in these trench areas. In those cases where the bottom of the trench is located in the natural sand zone, placing the pipe directly on the natural sand layer is allowed.

In the case of "dry" installation, where the bottom of trench is located in the limestone zone, the trench shall be over-excavated to allow for the placement of no less than six (6) inches of pipeline bedding material. The bedding material may be well-graded sand or bedding material as set forth

in Sec. 2-18.D.4. In those cases where the bottom of trench is located in the natural sand zone, tamping of the sandy trench bottom to promote uniform pipe bearing conditions prior to pipe placement shall be performed by the Contractor.

Excavation for appurtenances shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, or sheeting if used, of not less than twelve (12) inches for precast structures and carried to an elevation two (2) feet lower than the proposed outside bottom of the structure to provide space for the backfill material. Materials removed from the trenches shall be stored and disposed of in such a manner that they will not interfere unduly with traffic on public streets and sidewalks, and they shall not be placed on private property without the private property owner's written consent. In congested areas, such materials as cannot be stored adjacent to the trench or used immediately as backfill, if acceptable, shall be removed to convenient places of storage.

All excess material suitable for use as backfill shall be hauled to and used in areas where not enough suitable material is available from the excavation.

Suitable material in excess of backfill requirements and material unsuitable for backfill shall become the property of the Contractor and shall be removed from the work and disposed of by the Contractor at his expense.

Where pipes are to be laid in bedding rock (Trench Type A, Figure 100), select common fill, or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the

material remaining in the bottom of the trench is no more than slightly disturbed.

Where the pipes are to be laid directly on the trench bottom, the lower part of the trenches shall not be excavated to grade by machinery. The last of the material being excavated shall be done manually in such a manner that will give a shaped bottom, true to grade, so that the pipes can be evenly supported on undisturbed material, as specified in the Standard Drawings. Bell holes shall be made as required.

3. Additional Excavation and Backfill

Where organic material, such as roots, muck, peat, silt, or other vegetable matter, or other material which, in the opinion of the City, will result in the unsatisfactory foundation conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of thirty-six (36) inches below the outside bottom of the pipe or to a greater depths as directed by the City and removed form the site. Sheeting shall be installed if necessary to maintain pipe trenches within the limits identified by the City. The resulting excavation shall be backfilled with pea-rock to allow for the placement of thirty-six (36) inch of pipeline bedding material. Trench over-excavation shall be terminated if the natural limestone is encountered. In the case of a "wet" installation, bedding material shall be placed for bedding/foundation material. In the case of a "dry" installation, well-graded sand shall be placed for bedding/foundation material.

Over-excavation (more than thirty-six (36) inches below the pipe) shall be performed only when ordered by the City. Over-excavation shall be considered as incidental items of the construction and the Work shall be done at the Contractor's expense.

H. Bedding and Backfill: Material placed in fill areas under and around structures and pipelines shall be deposited within the lines and to the grades shown on the plans or as directed by the City, making due allowance for settlement of the material. Fill shall be placed only on properly prepared surfaces which have been inspected and approved by the City. If sufficient select common or common fill material is not available from excavation on site, the Contractor shall provide suitable borrow fill as may be required. The additional material shall be installed as specified herein.

Backfilling of utility trenches will not be allowed until the work has been inspected by the City's representative and he indicates that backfilling may proceed. Any work which is covered up or concealed without the knowledge and consent of the City may be required to be uncovered or exposed at no cost to City.

Fill shall be brought up in substantially level lifts with a maximum loose measure of twelve (12) inch thickness starting in the deepest portion of the fill. The entire surface of the work shall be maintained free from ruts and in such condition that construction equipment can readily travel over any section.

Fill shall be placed and spread in layers by a backhoe or other approved method, unless otherwise specified. Prior to the process of placing and spreading, all materials not meeting those specified under Section 2.18.D. shall be removed from the fill areas. The Builder shall assign a sufficient number of men to this work to insure satisfactory compliance with these requirements.

If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layer, it shall be loosened by harrowing or by another approved method before the succeeding layer is placed.

All fill materials shall be placed and compacted "in-the-dry". The Builder shall dewater excavated areas as required to perform the work and in such manner as to preserve the undisturbed state of the natural inorganic soils.

Prior to filling, the ground surface shall be prepared by removing vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials. The Builder shall plow strip or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal so that fill material will bond with the existing surface. When the existing ground surface has a density less than that specified under Section 2.18.I. for the particular area classification, the Builder shall break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to the required depth and percentage of maximum density.

Before compaction, material shall be moistened or aerated as necessary to provide the optimum moisture content. Material which is too wet shall be spread on the fill area and permitted to dry, assisted by harrowing if necessary, until the moisture content is reduced to allowable limits. If added moisture is required, water shall be applied by sprinkler tanks or other sprinkler systems which will insure uniform distribution of the water over the area to be treated, and give complete and accurate control of the amount of water to be used. If too much water is added, the area shall be permitted to dry before compaction is continued. The Builder shall supply all hose, piping, valves, sprinklers, pumps, sprinkler tanks, hauling equipment, and all other materials and equipment necessary to place water in the fill in the manner specified. The Builder shall compact each layer to the required percentage of maximum dry density or relative dry density in accordance with Section 2.18.I. Backfill or fill material shall not be placed on surfaces that are muddy.

1. Bedding and Backfill for Structures: Bedding rock shall be used for bedding under all structures as indicated on the Standard Drawings. The

Builder shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed. Structural fill shall be used as backfill against the exterior walls of the structures. Fill shall be compacted sufficiently in accordance with Section 2.18.I of these Standards. If compaction is by rolling or ramming, material shall be wetted down as required.

Backfilling shall be carried up evenly on all walls of an individual structure. No backfill shall be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength.

In locations where pipes pass through building walls, the Builder shall take precautions to consolidate the fill up to an elevation of at least one (1) foot above the top of the pipes. Structural fill shall be placed in level layers not exceeding twelve (12) inches in depth.

The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the plans. No soft spots or uncompacted areas will be allowed in the work.

Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.

2. Bedding and Backfill for Pipes: Bedding for pipes shall be as shown on the plans and detailed on the Standard Drawings. The Builder shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed.

Backfilling over and around pipes shall begin as soon as practicable after the pipes have been laid, jointed and inspected. All backfilling shall be prosecuted expeditiously and as detailed on the Standard Drawings.

Any space remaining between the pipes and sides of the trench shall be carefully backfilled and spread by hand or an approved mechanical device and thoroughly compacted with a tamper as fast as placed, up to a level of one (1) foot above the top of the pipes. The filling shall be carried up evenly on both sides. Compaction shall be in accordance with the Standard Drawings and Section 2.18.I.

Select backfill material containing no stone or rocks larger than one and one-half (1-1/2) inches shall be placed in six (6) inch layers and thoroughly tamped to a depth of twelve (12) inches over the top of the pipe. Particular attention and care shall be exercised in obtaining thorough support for the branch of all service connection fittings. Care shall be taken to preserve the alignment and gradient of the installed pipe.

After selected backfill has been placed to a depth of twelve inches over the pipe, backfill shall proceed to a depth of thirty-six (36) inches or more over the pipe by placing the backfill material in nine (9) inch layers and thoroughly compacting with mechanical vibrations. Backfill in this portion of the work shall be compacted to one hundred (100%) percent of maximum density of the material as hereinafter defined.

An alternate method of backfilling shall be used when laying pipe underwater or when otherwise directed by the Owner. The alternate method of backfilling shall differ from the previously mentioned specification only in that the backfill material used around the pipe and to

a level one (1) foot above the top of the pipe barrel shall be Bedding rock (FDOT #67); e.g., 3/16 to 3/4".

I. Compaction: The Builder shall control soil compaction during construction to provide the percentage of maximum density specified. The Builder shall provide the City with copies of all soils testing reports, prepared by a Geotechnical/Soils Engineer, demonstrating compliance with these Standards.

When the existing trench bottom has a density less than that specified under Section 2.18.I.1., the Builder shall break up the trench bottom surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

1. Percentage of Maximum Density Requirements
   a. Fill or undisturbed soil from the bottom of the pipe trench to one (1) foot above the pipe shall be densified to a minimum density of ninety-eight (98%) percent of the maximum dry density as determined by AASHTO T-180.
   b. Backfill from one (1) foot above utility pipes to grade shall be densified to a minimum density of ninety-eight (98%) percent of the maximum dry density as determined by AASHTO T-180.
   c. Fill, under and around structures and to the extent of the excavation, shall be densified to a minimum density of ninety-eight (98%) percent of the maximum dry density as determined by AASHTO T-180.

2. Compaction Tests: One (1) compaction test location shall be required for each three hundred (300) linear feet of pipe and for every one hundred (100) square feet of backfill around structures as a minimum. The City may determine that more compaction tests are required to certify the

installation depending on field conditions. The locations of compaction tests within the trench shall be in conformance with the following schedule:

a. One (1) test at the spring line of the pipe.

b. At least one (1) test for each twelve (12) inch layer of backfill within the pipe bedding zone for pipes twenty-four (24) inches and larger.

c. One (1) test at an elevation of one (1) foot above the top of the pipe.

d. One (1) test for each two (2) feet of backfill placed from one (1) foot above the top of the pipe to finished grade elevation.

If testing reports and inspection of the fill which has been placed is below specified density, then the Builder shall provide additional compaction and testing prior to commencing further construction.

J. Grading: All areas within the limits of construction, including transition areas, shall be uniformly graded to produce a smooth uniform surface. Areas adjacent to structures or paved surfaces shall be graded to drain away from structures and pavement. Ponding shall be prevented. After grading, the area shall be compacted to the specified depth and percentage of maximum density. No grading shall be done in areas where there are existing pipelines that may be uncovered or damaged until such lines have been relocated.

The top surfaces of the backfill shall be restored to the original or planned conditions or better. Trenches shall be carefully examined upon the completion of backfilling and surface irregularities that are dangerous or obstructive to traffic are to be removed. Paved sections shall conform in grade with adjacent areas and shall be of at least equal quality. Design mixes for flexible pavements shall be subject to approval by the Owner and conform to Department of Transportation

State of Florida rules and regulations and. standards and/or other government agencies. All damaged or undermined areas of existing pavement, not previously removed, shall be removed and restored to original condition or in the specified manner.

Equipment or traffic shall not travel over loose rock fragments, or other hard material, lying on sections of pavement which are not to be removed. For traffic control and safety barricades may be required. Removal, replacement and restoration of areas of pavement shall be as indicated on drawings.

K. Maintenance: The Builder shall protect newly graded areas from traffic and erosion and keep them free of trash and debris. The Builder shall repair and reestablish grades in settled, eroded and rutted areas. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the Builder shall scarify the surface and reshape and compact it to the required density prior to further construction.

L. Inspection and Quality Assurance: The Builder shall examine the areas and conditions under which excavating, filling and grading are to be performed, and not proceed with the work until unsatisfactory conditions have been corrected. The Builder shall examine the existing grade prior to the commencement of work and report to the City if the elevations of existing grades vary from the elevations shown on the plans.

All work shall be performed in compliance with applicable requirements of governing authorities having jurisdiction. The Builder, at his expense, shall engage soil testing and inspection services for quality control testing during earthwork operations. The testing and inspection service shall be subject to the approval of the City.

Quality control testing shall be performed during construction to ensure compliance with these Standards. The Builder shall allow the testing service to inspect and approve fill materials, and fill layers before further construction is performed. The Builder shall give copies of all test results in a report form to the CMOOS CFM Department to demonstrate compliance with the compaction requirements stipulated in these Standards.

SECTION 3
MATERIALS

3.01 GENERAL

This section includes the material standards and installation requirements for pipes, fittings, valves and appurtenances, as applicable to wastewater, water and reclaimed/reuse installations. The data included herein are to be used as the standards for approved materials indicated under specific facility installations as set forth in other sections. A listing of materials and approved manufacturers can be found in Appendix "A."

Materials referred to by brand name in this Section and Appendix "A" of these Standards represent specific requirements of CMOOS. If desired, requests for substitutions of specified materials shall be made in writing to CMOOS prior to construction. Determination of the equality of substitute materials will be at the sole discretion of CMOOS. All equipment and materials to be installed shall be new and unused.

When a standard is specified by a reference (i.e., AWWA, ANSI, ASTM, etc.), it refers to the latest edition thereof.

Required specialty items not included under this Section shall be high quality and consistent with approved standards of the industry for the approved materials indicated under specific facility installations, as set forth in other sections.

3.02 PIPES AND FITTINGS

A. General: All pipe, pipe fittings and specials intended for conveying raw water, potable water, or reclaimed/reuse water shall be designed for a minimum working pressure of 150 psi.

All pipes and fittings for water, wastewater, and reclaimed/reuse irrigation service shall be clearly marked with the name or trademark of the manufacturer, the batch number, the location of the plant and the strength designation, as applicable.

B. Ductile Iron (DI), Steel, Pre-stressed Concrete, & Asbestos-Cement:

1. Ductile Iron: DI pipe shall conform to ANSI/AWWA Standard C151/A21.51 latest revision, with a minimum wall thickness of Class 51 for ten (10) inch and above, and Class 52 for four (4) inch thru eight (8) inch, unless heavier class is required for design conditions.

2. Fittings: DI pipe fittings shall conform to ANSI A21.10 or A21.53 and have a 25 psi minimum pressure rating for fittings through twelve (12) inches, and a 150 psi pressure rating for sizes fourteen (14) inches and larger. Coatings for fittings four (4) inches and larger shall be as set forth under "Coatings and Linings" specification below.

3. When directed by the City, steel pipe six (6) inches and above, and fittings, shall be designed in accordance with AWWA Standard C200 latest revision. If coal tar epoxy is to be used as a protective coating; it shall conform to AWWA Standard C203 protective coating; and it shall conform to AWWA Standard C210 latest revision, unless otherwise directed by the City.

4. Pre-stressed concrete water pipe and fittings, limited in size to twenty-four (24) inches and above, shall be of the steel cylinder type, pre-stressed type II cement and shall conform to AWWA Standard C301 latest revision, unless otherwise directed by the City.

5. Asbestos cement pipe shall not be permitted on new construction. All taps and repairs to existing asbestos cement pipe will be subject to approval by the City as to methods and materials used.

6. Joints:

   a. "Push-On" and mechanical type joints shall be in accordance with ANSI/AWWA Standard A21-11/C111. Gaskets shall be Neoprene rubber compression type.

   b. Restrained joint ductile iron pipe shall be TR-FLEX as manufactured by US Pipe or Flex Ring as manufactured by American, or Clow Superlock, or McWane Thrustlock.

   c. Mechanical joints shall be made up using annealed high strength ductile iron bolts and rubber gaskets having either plain or duct tape as recommended by the manufacturer. All mechanical joint pipes shall be laid and jointed in full conformance with manufacturer's recommendations, which shall be submitted to the Engineer for review and approval before work is begun. Torque wrenches sat as specified in AWWA Standard C111 latest revision, shall be used; or spanner type wrenches may be used with the permission of the City.

      Push-on joints shall be made in strict, complete compliance with the manufacturer's recommendations. Lubricant, if required, shall be an inert, non-toxic, water-soluble compound incapable of harboring, supporting, or culturing bacterial life per manufacturer's recommendations.

   d. If pipe with flexible type joint is required, it shall be of the boltless type, with a joint deflection of up to fifteen (15)

degrees, and shall be specifically designed for flexible joint use for crossing rivers, streams and lakes.

e. Flanged connections shall be in accordance with ANSI B16.1, one hundred twenty-five (125) pound and shall have full faced type rubber gaskets one-eighth (1/8) inch thick. Bolts and nuts shall be Grade B conforming to the ASTM A307, for carbon steel machine bolts and nuts and tap bolts.

f. Restraining Devices – Joint restraining devices for DI mechanical joint pipe and fittings shall be EBAA Iron, Inc., Megalug Series 1100, or approved equal.

Joint restraining devices for push joint DI pipe and fittings shall be EBAA Iron, Inc., Series 1700, or approved equal. Joint restraining devices for push joint PVC pipe and mechanical joint. DI fitting shall be EBAA Iron, Inc., Megalug Retainers Series 2000 PV, or approved equal joint restraining devices for push joint PVC pipe and PVC or DI push joint fitting shall be EBAA Iron, Inc., Series 1600, or 2800, or approved equal.

Bolts and nuts shall be 60-4210 DI or Alloy Steel or 300 Series Stainless Steel, T-Head type with hexagonal nuts.

g. Special fittings and joints shall be considered for specific installation subject to the approval of the City.

h. Joints for pre-stressed concrete pipe shall be of rubber gasket compression type conforming to AWWA Standard C301.

i. Joints for steel pipe shall be designed in accordance with AWWA Standard C200.

j. Joints for PVC pressure pipe shall be bell and spigot push-on rubber gasket type only. No solvent weld or threaded joints will be permitted.

7. Coatings and Linings:

a. DI pipe and fittings for underground service shall receive an exterior bituminous coating of coal tar varnish or asphalt base paint, 1.0 mil film thickness in accordance with ANSI/AWWA A21.51/C151.

b. Exposed DI pipe and fittings for service shall receive a factory applied exterior coating of a universal rust-inhibitive primer, 2.0 mils dry film thickness. This coating shall be followed by field painting of an intermediate and final field coat of Alkyd applied in accordance with the paint manufacturer's recommendations. Final color shall be blue for potable water, green for raw wastewater and purple for reclaimed/reuse water, unless otherwise approved by CMOOS.

c. DI pipe and fittings for wastewater service shall receive a factory applied interior coating with a minimum dry thickness of sixty (60) mils in accordance with ANSI/ASTM D1248.

1. Modified DuPont Fusabond Polyethylene with a minimum dry thickness of sixty (60) mils for DI pipe wastewater force mains.

d. DI pipe and fittings for water and reclaimed/reuse service shall receive an exterior coating as specified above under Sections 3.02.B.7.a. or 3.02.B.7.b. of these Standards, and the interior pipe wall shall be cement mortar lined and bituminous sealed in accordance with ANSI A21.4/AWWA C104.

e. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

f. Special Exterior Protection for Corrosion: Extra protection shall be provided for underground DI pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement, as specified in AWWA C105 through the area of concern. The soil test evaluation to determine the necessity for extra projection in suspect areas shall be set forth in ANSI A21.5. Additionally, where other existing utilities are known to be cathodically protected, Di pipe crossing said utility shall be protected for a distance of twenty (20) feet to each side; and, when installed parallel to and within ten (10) feet of same, protection shall also be provided.

C. Polyvinyl Chloride (PVC):

1. Potable water, wastewater force main, effluent reuse, and irrigation pipe in sizes four (4) inches thru ten (10) inches shall be manufactured from clean virgin Type I, Grade I rigid,

unplasticized polyvinyl chloride resin (Class 12454-A or Class 12454-B material) conforming to ASTM D1784. Potable water, wastewater force mains, and reuse pipe shall have the National Sanitation Foundation (NSF) seal, shall conform to AWWA C900, and shall conform with the outside diameter of cast iron pipe and have a dimension ration (D) of not more than eighteen (18). The PVC pipe shall have integral bell push on type joints conforming to ASTM D3139. Pipe used for reuse and irrigation mains shall be purple (Pantone 522C), blue for potable water mains, and green for wastewater. Ultraviolet degradation or sun-bleached pipe will be cause for rejection.

2. Connections for pipe two (2) inches in diameter and larger shall be of the rubber-compression-ring type. Pipe shall be extruded with integral thickened bell walls without increase in DR. Rubber ring gaskets shall consist of synthetic compounds meeting the requirements of ASTM D1869, and suitable for the designated service. Smaller connections shall by solvent cemented joints.
3. Gravity wastewater PVC pipes and fittings shall be manufactured from polyvinyl chloride resin conforming to ASTM D1784. Pipes and fittings of this material shall conform to ASTM D3034 and F679, "Standard Specifications for Type PSM Polyvinyl Chloride Sewer Pipe and Fittings." All pipes and fittings shall have a Standard Dimension Ratio (SDR) of not more than thirty-five (35). PVC fittings shall be of monolithic construction and of the type specified by the manufacturer. No solvent welds will be permitted.
4. PVC pipe for gravity sewers shall be furnished at a maximum of twenty (20) feet lengths, with integrally formed bell joints.
5. All PVC pipe and accessories less than two (2) inches in diameter shall be Schedule 80 and shall be of rigid normal impact polyvinyl

chloride. The pipe and accessories shall conform to ASTM D1785 and current standard. All materials shall be furnished complete to perform the work, including solvent cement, etc.

6. Connections: Connection of PVC gravity sewer lines to manholes shall be made by using an EPDM (Ethylene Propylene Diene Monomer) manhole adapter connecting piece cast into the manhole with stainless steel hardware. The connection shall provide flexibility and a watertight connection at the structure.

D. Service Pipe:

1. Water Service Pipe: All potable water service lines shall be one (1) inch, one and one-half (1½) inch or two (2) inch copper tubing K type, conforming to ANSI/NSF Standard 61 and meets or exceeds USEPA lead and copper rule (56FR2460), June 1991; or high density polyethylene water service tubing. Joints for copper tubing shall be of the compression type utilizing a totally confined grip seal and coupling nut. Other type joints may be considered for specific installations upon submission of specifications and approved by the City.

2. Service Pipe Casing: All services that are constructed under existing paving, or beneath areas that will be paved in the future, shall be placed inside a three (3) inch diameter casing. The casing material may be black iron, galvanized steel, or Schedule 80 PVC. The casing shall extend from the water main to a point three (3) feet beyond the edge of the existing or future pavement line. Following placement of the service pipe, both ends of the casing shall be sealed with a Portland cement grout, or approved equal material.

3. Wastewater Service Lateral: All wastewater service laterals shall be PVC and have a minimum diameter of six (6) inches and shall conform to ASTM D3034, SDR 35.

E. Bore and Jack:

1. Pipe Material:

a. Steel casings shall conform to the requirements of ASTM A139 (straight seam pipe only) Grade "B" with a minimum yield of 35,000 psi. The casing pipes shall have the minimum nominal diameter and wall thickness (in inches) as shown on the following table:

Carrier Pipe Diameter	Minimum Casing Diameter	Minimum Casing Wall Thickness
4	16	0.250
6	18	0.250
8	20	0.250
10	24	0.250
12	30	0.312
16	30	0.312
20	36	0.375
24	42	0.500
30	48	0.500
36	54	0.500
42	60	0.500

b. Field and shop welds of the casing pipes shall conform with the American Welding Society (AWS) standard specifications. Field welds shall be complete penetration, single-bevel-groove type joints. Welds shall be airtight and continuous over the entire circumference of the pipe and shall not increase the outside pipe diameter by more than three quarter (3/4) inch.

c. The carrier pipes shall be minimum thickness Class 52 DI pipe with restrained joints. DI pipe shall comply with the specification outlined herein.

d. The carrier pipes shall be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the stainless steel carriers with Teflon skids or "The Booster" Casing Spacer being on center and restrained. All nuts and bolts shall be high strength, low alloy meeting AWWA C111. Runners shall be made of a high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction. Spacers shall be installed six (6) feet, six (6) inches or less, on center.

F. Pressure Pipe Restraints:

1. Pressure pipe fittings and other items requiring restraint shall be braced with manufactured pipe joint restraints or other mechanical restraining assemblies. All PVC shall be restrained to prevent movement of lines under pressure at bends, tees, caps, valves, hydrants, etc., shall be restrained by mechanical restraining assemblies. All DI pipe requiring restraint shall use restrained

joints or mechanical restraining devices (i.e., MegaLug or approved equal). Use of thrust blocks for pressure pipe shall not be allowed.

2. Restrained Joints: Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints manufactured by the pipe and fitting manufacturer, and the joints shall be capable of withstanding withdrawal for line pressures of 150 psi. Only approved mechanical joint DI pipe retainer glands shall be permitted in lieu of pipe manufacturer's restrained joint pipe. Any restrained joints that allow for elongation upon pressurization will not be allowed in those locations where the pipe comes out of the ground.

   The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of the fittings and changes in direction necessary to develop adequate resisting friction with the soil. The required lengths of restrained joint DI pipe shall be determined by the Engineer and shown in a tabular form and shown as a "Restrained Pipe Table." All calculations shall be based on the method outlined in the publication entitled, "Thrust Restraint Design for Ductile Iron Pipe," latest edition, published by Ductile Iron Pipe Research Association, Birmingham, AL 35244 or the "A Design Guide for Restrained PVC Pipelines," latest edition, as published by UNI-BELL.

   Whenever two (2), forty-five (45) degree bends are used in place of a ninety (90) degree bend, the minimum restrained joints

required for the forty-five (45) degree bends is that of a ninety (90) degree bend where located midway between the two (2), forty-five (45) degree bends, or that for an individual forty-five (45) degree bend, whichever is greater.

3. Mechanical Restraining Devices: These types of devices may be substituted for the restrained "locked-type" joints manufactured by the DI pipe and fitting manufacturer. The number of joints to be restrained shall be based on the "Restrained Pipe Table" in the Drawings.

   Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of DI conforming to ASTM A536. Restraining devices shall be of DI heat treated to a minimum hardness of 370 Brinell Hardness Number (BHN). Dimensions of the gland shall be such that the gland can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/A21.53. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

G. Special Items:

1. Expansion Joints: Pipe expansion joints shall be suitable for the applicable service with a minimum 150 psi working pressure.
2. Flanged Coupling Adapters: Units shall be compatible with ANSI B16.1, one hundred twenty-five (125) pound flanges.
3. Cast Iron Sleeves and Wall Pipes: Units shall have integral annular ring water-stops, and also conform to other requirements for cast iron fittings specified in this Section. Sleeves and wall pipes to have laying length and ends required for proper installation.
4. Tapping Saddles: Units shall be fabricated of DI and suitable for either wet or dry installation. The sealing gasket shall be the "O-Ring" type suitable for the applicable service. The outlet flange shall be ANSI B16.1, one hundred twenty-five (125) pound standard. Tie straps and bolts shall be of corrosion resistant allow steel.
5. Tapping Sleeves and Valves: Tapping sleeves shall be of the mechanical-joint type or fabricated steel type sleeves for pressure connections four (4) inches and larger. All pressure connections to asbestos cement pipe and all "size on size" taps shall utilize mechanical-joint sleeves.
    a. Mechanical-Joint Sleeves: Sleeves shall be cast of gray-iron or DI and have an outlet flange with the dimensions of the Class 125 flanges as shown in ANSI B16.1 properly recessed for tapping valve. All end and side gaskets shall be totally confined. The throat section of tapping sleeves through twelve (12) inch size shall conform to MSS-SP60. Test plug shall be provided on the outlet throat. Glands shall be gray-iron or DI. Gaskets shall be vulcanized

natural or synthetic rubber. Bolts and nuts shall comply with ANSI/AWWA C111/A.21.11. Sleeves shall be capable of withstanding a 200 psi working pressure.

b. Steel Tapping Sleeve: Sleeves shall be fabricated of minimum three-eighth (3/8) inch carbon steel meeting ASTM A285, Grade C. Outlet flanges shall meet AWWA C207, Class D, ANSI one hundred fifty (150) pound drilling and be properly recessed for the tapping valve, in accordance with MSS Standard S.P. 60. Gaskets shall be neoprene "O" ring type with some type of gasket restraint incorporated in the sleeve. Test plug shall be provided on the outlet throat. Bolts and nuts shall be high strength, low alloy steel to ANSI/AWWA C111/A21.11. Gaskets shall be vulcanized natural or synthetic rubber. Sleeves shall have a manufacturer-applied, fusion-bonded epoxy coating with a minimum twelve (12) mil thickness.

c. Minimum Tap Sizes for Water Transmission Lines:

12-inch thru 16-inch	Minimum 6-inch Tap
18-inch thru 30-inch	Minimum 8-inch Tap
36-inch	10-inch Tap
42-inch and larger	12-inch Tap

d. Tapping valves 4-inch and larger shall comply with AWWA Standard C509 latest revision and shall have the following design standards plus the valve port shall be free and full to allow clutter passage without interference.

e. All valves are to be iron body, bronze mounted, non-rising stem, opening left (counter clockwise). Non-geared valves shall be furnished with "O" ring packing (two "O" rings).

The operating mechanism shall be for buried service with a two (2) inch spare-operating nut.

f. The disc mechanism shall be designed so that the seating pressure is applied equally at four (4) separate contact points near the outer edge of each disc or in the case of fully revolving disc valves, this shall be accomplished by two (2) flat rectangular contact strips producing an equivalent effect, the upper contact strip shall be faced with stainless steel.

g. Valves sixteen (16) inches and larger shall be furnished with bevel gears and by-pass valves. Bevel geared valves shall have roller, tracks and scrapers.

h. The type of end connection shall be determined by the type of pipe used.

i. Tapping valves four (4) inch thru twelve (12) inch shall have a maximum working pressure of 200 psi and be tested at 400 psi. Valves sixteen (16) inch thru forty-eight (48) inch shall have a maximum working pressure of 150 psi and be tested at 300 psi.

j. All wet taps need to be approved by the City. Size on size taps shall only be permitted where approved by the City.

k. Wet taps on AC pipe will not be permitted.

6. Service Saddles: Saddles for DI pipe shall be double band, fusion-bonded, epoxy coated DI, anchored by a minimum four (4) stainless steel bolts pattern on a DI saddle body. Service saddles for PVC pipe shall have a double band sized exactly to the pipe outside diameter. Sealing gaskets shall be "O" ring type suitable for the applicable service, confined in a retaining groove, and straps shall be corrosion resistant alloy steel. The City may require

a stainless steel band and fusion epoxy or nylon coated DI body with stainless steel hardware in areas designated as corrosive.

7. Polyethylene Encasement: Encasement shall have a minimum thickness of eight (8) mils and comply with the applicable provisions of ANSI/AWWA C105/A21.5, "Polyethylene Encasement for Gray and Ductile Iron Piping for Water and Other Liquids."

3.03 VALVES

A. General: The valve type, size, rating, flow direction arrow if applicable, and manufacturer shall be clearly marked on each unit. Valves shall open left (counterclockwise), with an arrow cast in the metal of the two (2) inch operating nuts indicating the direction of opening.

B. Gate Valves (GV):

1. All gate valves shall be resilient seat gate valves and shall be manufactured to meet or exceed the requirements of AWWA C509. The valve body, bonnet, and bonnet cover shall be DI and comply with ASTM A536. The valves shall be non-rising stem with the stem made of manganese bronze as specified in AWWA C509. Two (2) stem seals shall be provided and shall be "O-Ring" type. The stem must be independent of the gate. Valve disc shall be contoured to assure uniform seating. The resilient sealing mechanism shall provide zero leakage at the system working pressure when installed with the line flow in either direction. All ferrous surfaces inside and outside shall have a fusion-bonded epoxy coating. The valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve. The type of end connection shall be determination by the type of pipe

used. Resilient Seat Valves shall have maximum working pressure of 200 psi and be tested at 400 psi between disc seat ring and body seating surface. Seat ring seals shall be replaceable and made from internally reinforced molded natural rubber (ASTM D2000). Seat ring shall be attached to disc with stainless steel screws.

2. Underground Service: Valves shall be DI body, bronze mounted, conforming to AWWA C509, resilient seat, non-rising stem type, bolted bonnet, mechanical joint, and shall be equipped with two (2) inch square cast iron wrench nuts.
3. Above Ground Service: Valves shall be DI body, bronze mounted gate valves, bolted bonnet, flanged, conforming to C509, resilient seat, with the exception that the valves shall be outside screw and yoke (OS&Y), rising stem type. Valves shall have cast iron handwheels or chain operators with galvanized steel chains, as required.
4. Tapping Valves: Valves shall conform to the specifications set forth under Sections 3.03.B.1. and 3.03.B.2., for the applicable service conditions. Additionally, units shall be compatible with the connecting sleeve or saddle and specially designed for wet tapping installation operations.
5. Valves less than two (2) inches: Valves shall be bronze, wedge disc, 150 psi minimum working pressure, equipped with cast iron operating nut only.
6. Actuators: Valves sixteen (16) inches and larger shall be equipped with approved gearing actuators with sealed enclosures for buried or submerged service, and shall be furnished by the valve manufacturer. Position indicators shall be furnished as required.
7. Horizontal Installation: Valves sixteen (16) inches in diameter or larger, to be installed horizontally, shall be additionally equipped

as specified under the applicable section of AWWA C508 as follows:

a. Installations in vertical pipe with a horizontal stem shall be fitted with approved slides, tracks and shoes to assist the travel of the gate assembly.

b. Installations in horizontal pipe with a horizontal stem shall be equipped with approved rollers, tracks and scrapers to assist the travel of the gate assembly and to clear the track of obstructions.

C. Check Valves (CV):

1. General Service: Valves shall be iron body, bronze mounted, stainless steel hinge pin, outside lever and spring operated, single disc swing non-slam type, and equipped with removable inspection covers and shall meet the requirements of AWWA C508. The ends shall be one hundred twenty-five (125) pound ANSI B16.1 flanges. Seating surface to be bronze metal-to-metal and may be integral or a separate ring fastened securely to the disc. Check valves two (2) inch thru twelve (12) inch shall have minimum working pressure of 175 psi. Check valves sixteen (16) inch thru twenty-four (24) inch shall have minimum working pressure of 150 psi. The units shall permit a full flow area equal to that of the connecting pipe. Valves shall be constructed to allow the disc and body seat to be easily removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight. If pump shutoff exceeds seventy-seven (77) feet, then an air-cushioned assembly shall be installed. All exposed

nuts, bolts, washers and springs on buried and on above ground outdoor service valves shall be 316 Stainless Steel.

2. Valves smaller than two (2) inches: Valves shall be bronze body and disc, swing check type, with removable inspection covers, and rated 150 psi minimum working pressure.

D. Plug Valves (PV):

The City of Miramar no longer uses plug valves. All installations where a plug valve might be used will require installation of a resilient seat gate valve.

E. Butterfly Valves (BFV):

Valves shall be cast or ductile iron body that conforms to ASTM A126, Class B. All retaining segments and adjusting devices shall be of corrosion resistant material. The valve shall be fitted with a 360 degree 18-8 stainless steel seat offset from the shaft and mechanically retained in the body or on the disc of the valve. Mechanical retention shall not be affected by the mating flange. The valve disc shall be cast iron or ductile iron. The valve disc or valve body shall be fitted with a resilient seat of synthetic rubber as set forth in AWWA C504 for Rubber Seated Valves Class 150B, retained with an 18-8 stainless steel clamp ring and stainless bolting. The resilient seat shall be designed with a cross-section providing 360 degree mechanical retention against pulling out from between the retaining ring and disc. Retaining ring cap screws shall pass through the rubber seat.

The valve disc shall be rigidly attached to the shaft with keys to absolutely eliminate relative motion between the disc and shafting. The shaft keys

shall be made of heat-treated 410 or 416 stainless steel to prevent brinelling of the shaft keys in service. The keys shall be held in position with 18-8 stainless nuts.

The valve shaft shall be turned, ground and polished, constructed of 18-8 stainless steel, and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. Valve shafts shall be offset from the disc and body seats so that the shafting does not intersect the disc or body seats. Valve shafts three (3) inch and smaller shall be one (1) piece through shafts with factory set thruster to center the disc in the seat. Valve shafts larger than three (3) inch shall be stub shafts, each rigidly keyed to the disc and provided with an adjustable thruster to move the disc and shaft assembly positively in either direction to center the disc in the seat of the valve. Shaft seal shall be designed for the use of standard split V-type packing for standard "O" ring seals or for a pull down packing.

The operating mechanism shall be for buried service with a two (2) inch square-operating nut.

The valves shall be of either a short or long body type, with the valve class, shaft size and other special requirements selected in accordance with the specific design, and shall comply with the provisions of AWWA C504, "Rubber Seated Butterfly Valves". The operating mechanism shall be designed so that the valve disc is held rigid when in any position.

Valve operation shall be by approved gear actuators, with sealed enclosures for buried or submerged service. Position indicators shall be furnished, as required.

Valve operators for valves twenty-four (24) inch and smaller shall be traveling nut or worm gear type fully field adjustable stops so the operator does not have to be disassembled for valve seat adjustment. Valves larger than twenty-four (24) inch shall be equipped with worm gear operators per ANSI/AWWA Standard C504 latest revision. Valves shall open left or counter clockwise.

Units shall be equipped with actuating nuts, cast iron handwheels or chain operators, with galvanized steel chains, as appropriate for the installation. All exposed nuts, bolts, springs, and washers on buried and on above ground outdoor service valves shall be 316 stainless steel. Appurtenances shall be furnished by the valve manufacturer.

F. Ball Valves:

Ball valves shall conform to ANSI/AWWA Standard C507 latest revision for 150 psi pressure classes. The valve body shall be cast iron or ductile iron. The valve and operating mechanism shall be designed so that the plug is held rigid when in any position to prevent chatter or vibration. The valves shall be of the double seat type with either corrosion resistant metal or rubber seats. Shaft seal shall be designed for the use of standard V-type packing; for "O" ring seals. The operating mechanism shall be of the leverage or traveling nut type, which will impart a variable plug rotation speed with constant input speed, so that approximately eighty (80) % of the flow will be cut off in the first fifty (50%) percent of the operator stroke, and maximum leverage will be applied to and shall be provided with a totally enclosed grease packed, submersible type six (6) eared operating mechanism suitable for buried service. The operating shaft shall

be furnished with a standard two (2) inch square-operating nut. Valves shall open left or counter clockwise.

PVC ball valves shall be provided, as required, for chemical service installations, and shall be full port area and sufficiently large to accommodate a cleaning pig.

G. Corporation Stops and Curb Stops:

Units shall be five-eighth (5/8) inch, one (1) inch, one and one-half (1½) inch, or two (2) inch brass, equipped with connections compatible with the connecting service pipe type, threaded in accordance with AWWA C800 and C901. Curb stops shall be sized to match the meter size and conform to AWWA C800 and C901. Fittings shall be brass, cast and machined in accordance with AWWA C800 and C901, with compatible polyethylene tubing connections.

1. Curb Stops:

Curb Stops shall be of the Ball Valve type. These valves shall be of cast red brass containing copper, tin, lead, and zinc. The ball shall be Teflon coated brass and shall be held in position by and seal off against seats of Buna N rubber that are held securely in place with epoxy adhesive.

Valves shall be watertight against flow in either direction. The waterways shall be no smaller than the normal size of the valve and shall be smooth, with no abrupt changes in size to create resistance to flow. The stem that turns the ball shall exert no other

force on it except to open or close the ball and shall be held securely in place by means of a bronze ring. The minimum diameter of the stem at the point of attachment to the valve body shall be as follows:

Valve Size	Minimum Diameter
¾-inch	11/16-inch
1-inch	11/16-inch
1¼-inch	7/8-inch
1½-inch	7/8-inch
2-inch	1-inch

The seal around the stem shall consist of two (2) "O" rings. Each valve shall have a substantial T-head for the operation of opening and closing with a 90 degree turn of a standard slotted wrench. The stops or lugs for controlling the motion of the T-head shall be enclosed and properly positioned to line up the waterways through the ball with the water passage through the valve body.

The end connections shall be Pack Joint (compression type) connections for copper, plastic, or iron pipe. The valve shall be available in sizes three-quarter (3/4) inch thru two (2) inch. The valve shall turn easily and shall be an approved equal to Ball Valve Curb Stops manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana.

2. Corporation Stops:

Corporation stops shall be manufactured of brass alloy in accordance with ASTM Specification B62 latest revision. These corporation stops shall be of the ball valve type.

Inlet thread shall be AWWA NPT in all sizes in accordance with AWWA Standard C800 latest revision. Outlet connections shall have a compression type fitting as specified in Section C, Part 1.

H. Backflow Preventers: The assembly shall be of the type approved by CMOOS based on the type of service, and shall comply with the applicable provisions of AWWA Standards and City regulations.

I. Combination Air Release/Air & Vacuum Valves:

1. Wastewater Service Automatic Air Release Valve: The valve body and cover shall be DI construction, ASTM A536, and epoxy coated, and all internal parts shall be of 300 Series Stainless Steel. The venting orifice shall be one (1) inch in diameter and the seating material shall be of Viton.
   a. Combination Air Valves shall be of the single housing style that combines the operating features of both an Air/Vacuum and Air Release Valve.
   b. The Air/Vacuum portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allows air to re-enter the pipeline when the internal pressure of the pipeline approaches a negative

value due to column separation, draining of the pipeline, power outage, pipeline break, etc.

c. The Air Release portion shall automatically release small pockets of air from the pipeline while the pipeline is in operation and under pressure.

d. The Combination Air Valve shall have two (2) inch NPT inlet and outlet connections and a three-thirty-seconds (3/32) inch diameter orifice for a maximum working pressure of 150 psi. The sizing of the valve may be varied based upon an analysis of the application.

e. The materials of construction shall be: Body, Cover and Baffle of DI: Float and all other trim shall be of stainless steel with the exception of the seat and adjustable Orifice Button.

1. Valves shall be Val-Matic Model #202C, or GA Industries Model #945, or approved equal.

J. Special Items:

1. Water Meters: Five-eighth (5/8) inch thru one and one-half (1½) inch meters shall be AWWA approved Sealed Register Displacement Type Meters. The water meters that are two (2) inches and larger meters shall be AWWA approved Turbo-Meters or Compound Meters. Meters that are six (6) inches and larger must be equipped with a strainer. All meters shall be equipped with "remote read" components. All meters delivered shall have factory seals, and a manufacturer's serial number die stamped or molded upon the meter body.

a. With regard to testing, test ports shall be provided downstream of meters three (3) inches and larger.

b. Displacement meters shall be evaluated on an individual basis taking into account operating and performance characteristics along with general quality of manufacture, machining, and workmanship.

c. Turbine Meters shall be two (2) inches and larger and shall be provided with a strainer upstream of the meter. All meters furnished shall be manufactured in the Continental United States and shall conform with ANSI/AWWA Standard C701-88.

d. Main cases for all sizes shall be cast Water Works bronze. Size, model and direction of flow shall be cast, in raised characters, on both sides of the main cases.

e. The measuring chamber shall be of unitized construction (i.e. complete with measuring element, calibration device and register in one assembly). The measuring chamber shall be capable of operating within above listed accuracy limits without recalibration when transferred from one (1) main case to another of similar size. The measuring element shall be mounted on a horizontal stationary shaft with sleeve beaming and be essentially weightless in water.

f. The register shall be permanently hermetically sealed; all registers of similar size and registration to have a standard ratio gear reduction so as to permit interchangeability. The measuring chamber is removed from the main case. Sweep hand reading and odometer wheel details will conform to American Water Works Standard C701, as latest revised.

g. The register must be of the straight reading type and have a test dial. It shall read in U.S. gallons and be capable of direct visual reading both at the meter and by remote reading external to the meter. All reduction gearing shall be contained in a permanently hermetically sealed, tamper-proof enclosure made of a corrosion resistant material. The register is to be secured to the upper main case by means of an internal locking device so that the register cannot be removed by the utility customer.

h. Register output data format for automatic meter reading shall be 7-bit ASCII (American Standard Code for Information Interchange) digital, plus an even parity bit. The first character is ASCII 'R' followed by a four (4) digit meter reading (most significant digit first), followed by an eight (8) digit meter ID number. Data is to be positive true. The register's ASCII digital output is to be capable of interfacing directly to an automatic meter reading transponder to transmit data via telephone or radio waves to a central location.

i. All reduction gearing shall be enclosed in the permanently hermetically sealed register. The drive magnet shall be located in the measuring element, and the follower magnet shall be located inside the permanently hermetically sealed register. An intermediate magnetically active material shall be required to distribute the magnetic flux uniformly to the follower magnet, thereby improving the service life of the register's rotating component.

j. All meters three (3) inches and larger shall be supplied with strainers. The six (6) inch, eight (8) inch and ten (10) inch

size meters shall have external strainers as part of the meter package. Strainers shall have cover plate for inspection and removal of debris from the bronze screen without disturbing the pipeline.

k. ANSI/AWWA Standard C700 latest revision and the following options provided under this standard. Meters main casing shall be all bronze, split case type magnetically driven with mutating discs or oscillating pistons. Registers shall be straight reading hermetically sealed, and read in U.S. gallons. The register housing may be either bronze or suitable synthetic polymer materials. All other ESTERNAL parts of the meter shall be bronze including, but not limited to, the maincase and bottom and/or top. Displacement meters one (1) inch and smaller are to be furnished without coupling nuts; one and one-half (1½) inch meters are to be furnished with flanged ends.

l. Guarantees for materials and workmanship of all meters for a period of not less than one (1) year from date of delivery. A minimum ten (10) year factory warranty shall be provided to cover all defects in the register.

m. Nuts for all meters shall be brass, bronze, or stainless steel.

n. All water meters shall be manufactured by Invensys Metering Systems – North American Water, Inc. No substitute shall be accepted and must be NSF 61 compliant.

2. Meter Valves:

a. Meter valves shall be of bronze construction in accordance with ASTM Specification B62 latest revision.

b. Meter valves shall be closed bottom design and resilient "O" ring sealed against external leakage at the top. Shut-off shall be affected by a resilient pressure actuated at so positioned in the plug as to completely enclose the flow way in the closed position. Meter valves for meter sizes one (1) inch and under shall be equipped with a meter-coupling nut on the outlet sides with locking wings.

c. Meter valves for one and one-half (1½) inch and two (2) inch meters shall have flanged connections on the outlet sides. Meter valves over two (2) inches will be considered on an individual basis for the particular installation involved.

d. Meter valves two (2) inches or less shall be ball type.

e. Valves should be placed before the meter box.

3. Floor Stands: Units shall be cast iron, equipped with convenient grease fittings for all lubrication points, and suitable for the applicable operation. Stem guides shall be cast iron and adjustable with bronze bushings.

4. Valve Boxes: Units shall be adjustable, cast iron, minimum interior diameter of five (5) inches with covers cast with the applicable inscription in legible lettering on the top: "SEWER", "REUSE", "WATER". Boxes shall be suitable for the applicable surface loading and valve size. Sewer and force main covers shall be painted green, effluent water shall be painted purple and potable water shall be painted blue. A white raised reflective marker shall be used to identify water valve box location, a green raised reflective marker shall be used to identify a force main valve, a

purple raised reflective marker shall be used to identify a re-use water main.

Valve boxes shall be of the heavy duty, traffic bearing cast iron, adjustable screw type with a drop cover. The valve box assembly shall consist of a bottom section, top section and locking type cover which is cast from gray iron, formulated to ASTM A48, latest revision, Class 30 minimum and shall be free from blowholes, shrinkage or other imperfections not true to pattern. The shaft size shall be five and one-quarter (5¼) inch and the adjustable length shall be from eighteen (18) inches to twenty-four (24) inches. The wall thickness shall be a nominal three-sixteenths (3/16) inch (plus or minus one-sixteenth (1/16) inch). The weight of the assembly shall be sixty-one (61) pounds (plus or minus two (2) pounds), with the cover weight being a minimum of twelve (12) pounds.

The name of the manufacturer and foundry of origin shall be cast into each of the components of the assembly in legible form. The assembly shall be suitable for highway traffic wheel loads of 16,000 pounds and shall withstand a proof load test of 25,000 pounds without failure or permanent deflection, as per Federal Specification RR-F-621-C, latest revision. The valve box shall be cast, machined, assembled, and packaged within the United States and shall fully comply with the "Buy American" provisions of Public Law 102-240, enacted December 18, 1991. Valve boxes shall be manufactured by Opelika Foundry Company, Opelika, Alabama; Tyler Pipe Division, Tyler, Texas; or approved equal.

5. Meter Boxes: Meter boxes shall be fiberglass polymer concrete as manufactured by CDR units of a size comparable with the meter.

All reinforced meter box lids and covers shall meet the requirements for incidental Traffic H-10 loading as established by AASHTO and be of concrete/polymer and fiber as manufactured by CDR Systems Model LCDRMTS 1118-12 Box Assembly or approved equal.

Meter boxes and covers shall meet the requirements of Section A-8 of ASTM C857 on minimum structural design loading for underground precast utility structures. Meter boxes and covers shall meet ASTM D570 standards for water absorption.

All boxes with covers shall not exceed the maximum weight indicated below:

Box & Cover Dimensions	Maximum Weight
11-inch x 15-inch	45 lbs.
15-inch x 17-inch	45 lbs.
13-inch x 24-inch	52 lbs.
17-inch x 30-inch	71 lbs.
24-inch x 36-inch	100 lbs.

No meter boxes shall be located in pavement, concrete driveways, or swale drainage areas.

No permanent structures shall be allowed within four (4) feet of the meter box.

6. Service Boxes: Service boxes for reuse connections shall be heavy duty plastic with a traffic bearing jam lock cover. Boxes shall be purple (Pantone 522C) in color.

3.04 INSTALLATION

A. Potable Water, Wastewater Force Main and Reclaimed/Reuse Water Pipe:

1. Piping, fittings, valves and appurtenances shall be installed in accordance with these Standards, including the attached "Standard Detail Drawings," all applicable AWWA standards, and with the manufacturer's recommendations for the applicable service.
2. All types of pipe shall be handled in such a manner that will prevent damage to the pipe or coating. Accidental damage to the pipe or coating shall be repaired to the satisfaction of the City or be removed from the job site. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all rock points and to provide uniform support along the full length. When being transported, the pipe shall be supported at all times in a manner which willnto permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the City, is damaged beyond repair by the Contractor shall be removed from the site of the work and replaced with another unit. Joint gaskets shall be stored in a clean, dark, dry location until immediately before use. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

Lines shall be laid straight, and depth of cover shall be maintained uniform with respect to finish grade whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the drawings, batter boards with string line or a laser beam paralleling design grade shall be used by the Contractor to assure conformance to required grade. No abrupt changes in direction or grade will be allowed. Any pipe found defective shall be immediately removed and replaced with sound pipe. Restrained joins shall be used for all bends, tees, plugs, and other fittings. The joins of all pipeline shall be made absolutely tight. The particular joint used, shall be approved by the City prior to installation.

Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and re-laid. At all times when the pipe laying is in progress, the open ends of the pipe shall be closed by a water-tight plug or by other means approved by the City to ensure absolute cleanliness inside the pipe.

3. Water mains that are laid in the vicinity of pipe lines designated to carry raw wastewater, reclaimed/reuse or wastewater effluent shall meet the requirements outlined in Section 6.03.E.
4. Piping shall be installed along a straight line and grade between fittings, manholes, or other defined points, unless definite lines of the alignment, deflection, or grade change have been established. Modification to the approved alignment or grade during construction shall receive prior approval from CMOOS, and all resulting design considerations shall be resolved by the Builder.

5. Materials shall be cleaned and maintained clean, with all coatings protected from damage. The interior of the pipe shall be free of dirt and debris, and when work is not in progress, all open ends shall be plugged. Also, materials for potable water systems including taps, repairs, etc., shall be disinfected in compliance with AWWA C651.

6. Pipe, valves, fittings, or other items shall be inspected prior to installation, and any items showing a fracture or other defect shall be rejected. Additionally, any pipe or fitting which has received a severe blow that may have caused an incipient fracture, even though not visible, shall also be rejected. However, DI pipe showing an end crack, with no fracture indicated beyond that visible, may be salvaged by cutting off the damaged section twelve (12) inches past, providing the remaining pipe is sound.

7. The Contractor shall prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water and specifications outlined in Section 2.18 shall apply.

8. Pipe shall be laid to the lines and grades shown on the plans. The Contractor shall provide line and grade stakes at one hundred (100) foot maximum spacing and at all line and/or grade change locations. The Contractor shall provide temporary bench marks at maximum one thousand (1,000) foot intervals. The minimum top of pipe depth shall be three (3) feet below finished grade surface or three (3) feet below the edge of the pavement of the road surface, whichever is greater. Gravity Sanitary Sewer shall have a minimum top of pipe depth of four (4) feet below finish grade.

9. Long radius curves, either horizontal or vertical, may be laid with standard pipe deflections at the joints. The maximum deflections at pipe joints and laying radius for the various pipe lengths shall not be greater than one-half (½) the maximum deflection recommended by the pipe manufacturer.

10. Underground piping shall not be driven to grade by striking it with an unyielding object. When the pipe has been properly bedded, enough compacted backfill shall be placed to hold the utility in correct alignment. If necessary, precaution shall be taken to prevent flotation.

11. The installation of casing pipe underneath existing roadways shall be by the method of boring and jacking and shall meet the requirements outlined in Section 3.04.D.

12. Jointing shall be by an approved method and shall not require undue force to accomplish full satisfactory seating and assembly. Connections at structures shall be cut accurately and worked into place without forcing and shall align with the connecting point. Flanged joints shall be made up tight, but with care taken to prevent undue strain upon equipment or other items. Suitable flange filler rings shall be installed where required to provide suitable joints. The installation shall be permanently watertight, with no visible leakage at joints or connections with structures. Any joint that does not remain completely seated and/or watertight shall be rejected.

13. Underground pressure piping systems shall be thoroughly restrained at fittings, valves, and plugs, as set forth in Section 3.02.F. Pipe joints shall be restrained on each side of the fitting for a continuous discharge in accordance with DIPRA, “Thrust Restraint Design for Ductile Iron Pipe”.

14. Requirements for bedding and backfill for the pipes are outlined in Section 2.18.

15. Exposed systems shall be supported as necessary to hold the piping and appurtenances in a firm, substantial manner to the required lines and grades indicated, with no undue piping stresses transmitted to equipment or other items. Piping within buildings shall be adequately supported from floors, walls, ceilings, or beams. Supports from the floor shall be by suitable saddle stands or piers. Piping along walls shall be supported by satisfactory wall brackets, or saddles, or by wall brackets with adjustable hanger rods. For piping supported from the ceiling, approved rod hangers of a type capable of screw adjustment after erection of the piping shall be used. Pipe above ground outside of buildings shall be supported on concrete supports.

16. Proper provision for pipe expansion or contraction shall be provided by installation of expansion joints or other suitable methods. Additionally, flexible connections shall be provided to expedite equipment or piping system removal.

17. Subaqueous pipe laying may be permitted where conditions make it impractical to lay pipe "in the dry," provided the Builder submits his plans for laying pipe underwater to CMOOS and obtains advance approval thereof.

18. Ductile Iron Pipe: Installation shall be performed in accordance with the applicable provisions of AWWA C600. The opening cut in the pipe wall for installation of tapping saddles and sleeves shall be made by a special tapping machine designed for this specific service. All pipe cutting shall be accomplished by power operated abrasive wheel, saw cutters, or other methods approved by the pipe

manufacturer. Where required, polyethylene encasement shall be installed as set forth previously in this Section.

19. Polyvinyl Chloride Pipe (PVC): ALL PVC pipe shall be installed in accordance with the Standards set forth in the UNI-BELL "Handbook of PVC Pipe Design and Construction," unless such standards conflict with the Standards, in which case these Standards shall apply. Lubrication and/or solvent used for pipe and fitting joints shall be non-toxic (NSF approved for potable water). After joining, solvent type joints shall not be disturbed for five (5) minutes and shall not have internal pressure applied for twenty-four (24) hours, or as recommended by the pipe manufacturer.

20. Testing of piping systems shall be performed by the Builder in accordance with the specifications set forth under the Standard for the applicable service. These testing procedures shall be in accordance with AWWA standards. Prior to testing, all piping shall be thoroughly cleaned and flushed with clean water to clear the lines of all foreign matter. This work shall be done with care to avoid damage to any inside coating.

21. Disinfecting of all potable water shall be accomplished by the Builder following approved pressure testing. Unless alternate procedures are set forth under the applicable service standard, disinfecting procedures shall be in accordance with AWWA C651 and as required by the appropriate local approval agency.

22. All connections to existing pressure pipes shall be made by the Contractor only after the connection, procedure and work schedule have been reviewed and approved by the City a minimum of five (5) working days prior to scheduling the connection(s). The Contractor shall outline the following:

a. Points of connection, fittings to be used, and method of flushing and disinfecting, if applicable.
b. Estimated construction time for the connection(s).

The City shall review the submittal within three (3) working days after receiving it and inform the Contractor regarding approval or denial of the request. If the request is rejected by the City, the Contractor shall resubmit the request by modifying it in a manner acceptable to the City.

All connections shall only be made on the agreed upon date and time. If the Contractor does not initiate and complete the connection work in the agreed upon manner, the Contractor shall be required to reschedule the connection by following the procedure outlined above. The Contractor shall not operate any valves in the City's system.

During the construction, sufficient length of main shall be exposed to allow for the installation of the tapping sleeve and valve and the operation of the tapping machinery. The main shall be supported on concrete pedestals or bedding rock at sufficient intervals to properly carry its own weight, plus the weight of the tapping sleeve and machinery. Any damage to the pipe due to improper or insufficient supports shall be repaired at the Contractor's expense.

The inside of the tapping sleeve and valve, the outside of the main, and the tapping machine shall be cleaned and swabbed, or sprayed with ten (10%) percent liquid chlorine prior to beginning installation for water system pressure connections.

After the tapping sleeve has been mounted on the pipe, the tapping valve shall be bolted to the outlet flange, making a pressure tight connection. Prior to beginning the tapping operation, the sleeve and valve shall be pressure tested at 150 psi to ensure that no leakage will occur.

For pressure connections twelve (12) inches in diameter or less, the minimum diameter cut shall be one-half (½) inch less than the nominal diameter of the pipe to be attached. For pipes fourteen (14) inches thru twenty (20) inches in diameter, the minimum diameter shall be one and one-half (1½) inches less; for larger taps, the allowable minimum diameter shall be two (2) to three (3) inches less than the nominal diameter of the pipe being attached. After the tapping procedure is complete, the Contractor shall submit the pipe coupon to the City.

For pressure connections to wastewater force mains, the tapping valve shall be placed horizontally. After the tapping procedure is complete, a gate valve shall be attached to the tapping valve. The tapping valve shall be left in the open position prior to backfilling.

Adequate restrained joint fittings shall be provided to prevent movement of the installation when test pressure is applied. The pipe restraints shall meet the requirements of Section 3.02.F.

23. Excavation Site Safety: Whenever an excavation site or trench is left unattended by the Contractor or when an area is not within one hundred (100) feet of observation by the Contractor, the excavation

site or trench shall be filled and/or, at the City's discretion, protected by other means to prevent accidental or unauthorized entry. Such protection shall include barricades and other protection devices requested by the Engineer or City, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the Contractor of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.

B. Gravity Sewers

1. The Contractor shall set temporary bench marks at a maximum of five hundred (500) foot intervals. The Contractor shall constantly check line and grade of the pipe. In the event line and grade do not meet specified limits described hereinafter, the work shall be immediately stopped, the City notified, and the cause remedied before proceeding with the work.
2. All pipe shall be inspected, handled and installed as specified under Section 3.04.A.
3. Laying of gravity sewer pipe shall be accomplished to line and grade in the trench only after it had been dewatered and the tranch has been prepared in accordance with Section 2.18. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surface. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipes shall be laid to conform to the line and grade shown on the plans.

The gravity sewer pipe, unless otherwise approved by the City, shall be laid upgrade from the point of connection on the existing gravity sewer or from a designated starting point. The gravity sewer pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress, the open end of the pipe shall be kept tightly closed with an approved temporary plug.

4. All PVC pipe shall be installed in accordance with the Standards set forth in the UNIBELL "Handbook of PVC Pipe Design and Construction."
5. Laying of DI pipe shall conform to the specifications outlined in AWWA C600.
6. All applicable provisions of Section 2.18 shall apply with regards to trench excavation, dewatering, bedding material, backfill, compaction, fill and grading.
7. The Contractor shall hand-grade bedding to proper grade ahead of the pipe laying operation. Bedding shall provide a firm, unyielding support along the entire pipe length. If, without direction from the City, the trench has been excavated below the required depth for pipe bedding material placement, the Contractor shall fill the excess depth with pipe bedding material to the proper grade. The Contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.
8. The Contractor shall provide bedding material in accordance with the Standard Drawings.
9. Gravity sewer that are laid in the vicinity of pipe lines designated to carry potable water shall meet the requirements set forth in Sections 3.04.A.3. and 6.03.E.

C. Manholes and Pre-cast Structures

1. Base sections shall be placed on bedding rock conforming to the requirements outlines in Section 2.18.H.1. The bedding rock shall be firmly tamped and made smooth and level to assure uniform contact and support of the pre-cast element in accordance with Section 2.18.I.
2. The cast-in-place basis shall be utilized only when specifically approved by the City. Unless otherwise specified, cast-in-place basis shall be at least eight (8) inches in thickness and shall extend at least six (6) inches radially outside of the outside dimension of the structure. Reinforcement and connection to the riser sections shall be designed by the Builder's Engineer and submitted to the City for approval.
3. A pre-cast base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and making sure that all entering pipes can be inserted on proper grade. Pre-cast manhole and pump station sections shall be handled by lift rings or non-penetrating lift holes. Such holes shall be filled with non-shrink grout after installation of the structure. The first pre-cast section shall be placed and carefully adjusted to true grade and alignment. All inlet pipes shall be properly installed so as to form an integral watertight unit. The sections shall be uniformly supported by the base structure, and shall not bear directly on any of the pipes.

   Pre-cast sections shall be placed and aligned to provide a vertical alignment w.r.t. to a plumb line not exceeding a one-quarter (¼)

inch maximum tolerance per five (5) feet of depth. The completed manhole shall be rigid, true to dimensions, and watertight.

4. The excavation and backfilling shall conform to the requirements outlined in Section 2.18.
5. Castings for manholes shall be fully bedded in mortar with adjustment brick courses placed between the frame and manhole. Bricks shall be a minimum two (2) and a mzximum of four (4) courses. Mortar shall conform to ASTM C270, type M, and the bricks shall be clay and conform to ASTM C216, grade SW, and have the dimensions of three and one-half (3½) inches wide by eight (8) inches long and two and one-quarter (2¼) inches high.

   The top of the manhole castings that are located in pavement, shouldered areas, and sidewalks shall be flush with the finished grade. The top of manhole castings that are located outside these areas shall be placed two (2) inches above the finished grade.

   Slabs, if used, shall terminate at such elevations as will permit laying up a minimum of two (2) courses of clay brick under the manhole frame to make allowance for future street grade adjustments.

   Pre-cast manhole cones, if used, shall terminate at such elevations as will permit laying up a minimum of two (2) courses and maximum of three (3) courses of clay brick under the manhole frame to make allowance for future street adjustment.

6. Manhole flow channels shall be as shown on the Standard Drawings, with smooth and carefully shaped bottoms, built up sides and benching constructed using cement and brick with no voids. Channels shall conform to the dimension of the adjacent pipe and provide changes in size, grade and alignment evenly. Cement shall be Portland Cement Type II only.

7. Special care shall be taken to see that the openings through which pipes enter the structure are provided with watertight connections. For DI and PVC pipe, connections shall conform with ASTM C923. Drop manhole connections shall conform in all respects to details shown on the Standard Drawings.

8. All newly constructed manhole and pump stations shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection.

D. Bore and Jack:

1. General: Applicable provisions of Sections 4 through 8 shall apply concurrently with these Standards. Boring and jacking operations shall be performed within the R/W and/or easements shown on the plans, and in accordance with the requirements specified herein.

   a. All casing pipe to be installed may be inspected at the site of manufacture for compliance with these specifications by an independent laboratory selected and paid for by the City. The manufacturer's cooperation shall be required in these inspections. All casing pipe shall be subjected to a careful inspection prior to being installed. If the pipe fails to meet the specifications, it shall be removed and replaced with a

satisfactory replacement at no additional expense to the City.

b. Pipe Handling: Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe shall not be dropped. All pipe shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe or coatings shall be repaired to the satisfaction of the City.

c. Work Coordination: It shall be the Builder's responsibility to perform the boring and jacking work in strict conformity with the requirements of the agency in whose right-of-way or easement the work is being performed. Where boring and jacking is required, the casing pipe shall only be installed by accepted standard boring and jacking methods and in accordance with the State of Florida Department of Transportation's Utility Accommodation Guide, Exhibit H, Jacking and Boring Supplement, latest revision. Any special requirements of the agency such as insurance, flagman, etc., shall be strictly adhered to during the performance of work. The special requirements shall be performed by the Builder at no additional cost to the City.

d. Dewatering through the casing during construction shall not be permitted. All dewatering methods shall be approved by the City before construction work begins.

e. Excavation adjacent to the roads shall be performed in a manner to adequately support the roads. Bracing, shoring, sheeting, or other supports shall be installed as needed. The Builder shall install suitable reaction blocks for the jacks as required. Jacking operations shall be continuous and

precautions shall be taken to avoid interruptions which might cause the casting to "freeze" in place. Upon completion of jacking operations, the reaction blocks, braces, and all other associated construction materials shall be completely removed from the site.

f. Correct line and grade shall be carefully maintained. Earth within the casing shall not be removed too close to the cutting edge in order to prevent the formation of voids outside the casing. If voids are formed, they shall be satisfactorily filled with grout by pumping.

g. The sections of steel casing shall be field-welded in accordance with the applicable portions of AWWA C206 and ASTM D7.0 for field-welded pipe joints. The Builder shall wire brush the welded joints and paint with Interol Quick-Drying Primer 626 by Koppers Company or approved equal. After completion of jacking, the Builder shall clear the interior of the casing of all excess material.

Boring and jacking materials shall conform with the State of Florida Department of Transportation's Utility Accommodation Guide, Exhibit H, Jacking and Boring Supplement, latest revision, and be in accordance with but not limited to the following:

Material:	Welded Steel Pipe, ASTM A139, Grade B
Size & Thickness:	Refer to the Table in Section 3.E.1.a.
Coatings:	Two (2) coats inside and out, Koppers Bitumastic No. 50 or equal, applied in strict accordance with manufacturer's instructions.
Pipe Ends:	Beveled for field welding
Material Certificate:	Affidavit of Compliance certifying pipe complies with ASTM A139, Grade B
Blocking:	Stainless steel casing spacers with polymer runners
Casing Pipe Ends:	Masonry bulkheads as shown on the plans, or other sealing systems on new Installations, subject to City's approval.

Boring and jacking installation work shall be installed in accordance with standard practice and above specified Florida Department of Transportation's Utility Accommodation Guide. The work shall be in accordance with and not limited to the following:

Contractors Equipment:	Shall be compatible with subsoil conditions encountered. The Owner may order the Contractor to change his boring equipment if he considers it so non-compatible, and if, in his opinion, the change is necessary to safeguard the public and to protect public or private property.
Soil Stabilization:	Unstable soil shall be stabilized ahead and around casing pipe by chemical grout injection and/or other acceptable methods.
Jacking:	Installation of the casing pipe shall be a continuous operation until completed. It shall be done from one end of crossing to the other without horizontal deflection or settlement of ground, surface facilities or structures.

Boring:	Excavated materials shall be removed as jacking proceeds without causing voids behind casing pipe.
Grade Control:	Casing lead pipe grade check at least every four feet or whenever directed. A jack shall be used at the head end to control grade as required.
Alignment:	Alignment shall be controlled by guide rails set in the jacking pit.
Casing Pipe:	Lengths shall be circumferentially welded in conformance with AWWA C206. After welding, the joint area inside and out shall be cleaned and given two (2) coats of Kippers Bitumastic No. 50 or equal after priming.
Carrier Pipe:	Jacked or cable-pulled, providing no tensile force is exerted on any pipeline joints.

E. Valves:

1. General: Valves shall be carefully inspected, opened wide, and then tightly closed, and all the various nuts and bolts thereon shall be tested for tightness. Special care shall be taken to prevent joint materials, stones or other substances from becoming lodged in the valve seat. Valves, unless otherwise required, shall be set with their stems vertically above the center line of the pipe. Any valve that does not operate correctly shall be adjusted to operate properly or removed and replaced.
2. Buried valves shall be installed vertically where depth of cover permits. Where depth of cover does not permit, a valve designed for horizontal installation shall be used. Extension stems shall be provided on all buried valves up to a point not deeper than one (1)

boot below the final grade. Extension stems within valve boxes, shall include approved insert stem guides

3. Valve boxes shall be carefully centered over the operating nuts of underground valves to permit a valve wrench to be easily fitted to the nut. The tops of valve boxes shall be set to the required grade. The valve box shall not transmit surface loads directly to either the pipe or valve. Care shall be taken to prevent earth and other material from entering the valve boxes. A concrete support collar shall be provided for the valve box with a brass identification tag with valve size, number type, depth top, type of valve (water/sewer).

4. Where floor stands and/or extension stems are required, for exposed valves, adjustable wall brackets and extension stems shall be furnished. Generally, brackets shall not be more than six (6) feet apart, with floor stands and guides set so that the stems shall run smoothly and in true alignment. Stands and guides shall be firmly anchored to the concrete.

5. After installation, all valves shall be subjected to the field test for piping as outlined in Sections 4 through 8 of these Standards. Should any defects in materials or workmanship appear during these tests, the Contractor shall correct such defects to the satisfaction of the City.

3.05 COLOR/COATINGS

A. Color Coding

All above ground and below ground pipes and fittings, Polyvinyl Chlorid (PVC) pipe and fitting, metallic and non-metallic marking tapes, valve boxes, air release valve covers, and any other marking device, shall be

color coded in accordance with the Utility Location and Coordination Council Uniform Color Code, which is as follows:

Red	Electrical power line, cable, conduit, and lighting cable
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Orange	Communication, telephone, alarm, or signal lines, cable, or conduit
Blue	Water
Green	Sewer and drain lines (except storm drain lines)
Purple	Treated effluent/reclaimed/reuse water

1. Services of all valve boxes and air release valve vault covers shall be painted with appropriate color of paint, corresponding to the type of service (i.e., blue for water, green for sanitary sewer, purple for reclaimed/reuse/irrigation).

SECTION 4

WATER DISTRIBUTION SYSTEMS

4.01 GENERAL

A. The installation and testing of all new water mains shall be done in accordance with the latest revision of AWWA Standard C600, and the additional requirements of these specifications.

This section sets forth the general requirements for design and installation of water distribution systems for potable water service. Pipe used in water distribution or irrigation systems shall be either polyvinyl chloride (PVC), or ductile iron (DI) pipe as specified in Section 3 of these Standards. Note: PVC is allowed for portable water only on pipes of 4" or smaller in diameter.

The Contractor shall be responsible for all materials furnished and storage of the same until the date of substantial completion. The Contractor shall replace, at the Contractor's expense, all material found to be damaged or defective in handling or storage. The Contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified in these Standards as it relates to water and irrigation systems. All pipe delivered to the project site for installation is subject to random testing for compliance with the designated specifications.

4.02 DESIGN STANDARDS

A. Required Reference: The Builder shall comply with the design and installation requirements as established by the BCHD, DEP, DPEP, and additional specific requirements stated in these Standards. The criteria set forth in the most recent edition of "Recommended Standards for Water Works (Ten States Standards)"

and Insurance Services Office should be used as a design guide, if not in conflict with State, County or other regulatory agency requirements.

B. Water mains shall be located in dedicated R/W or utility easements. When installed in R/W, water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All water mains located outside of dedicated R/W shall require a minimum twenty (20) foot wide utility easement or as required by CMOOS CFM Department. Additional easement widths shall be provided when the pipe size or depth of cover, in both cases, so dictate. If a water main is located in a strip of land that is abutting, adjoining, and contiguous with a road R/W, a minimum ten (10) foot wide easement shall be provided. No water mains shall be placed under retention ponds or drainage ditches, tennis courts, or structures. In general, water mains shall not be located along side or rear lot lines. Placement of a water main along a side lot line may be allowed on a case-by-case basis if such a water main configuration results in efficient placement and utilization of the water distribution system.

C. System Design:

1. Normal Flow Demands: Flow demands for design shall be calculated on the basis of the ultimate development as known or projected. The average daily flow for domestic use shall be calculated at the minimum rate of 325 gpd per ERC. Flow demands for commercial, industrial, or other special developments shall be established using City Code Section 21-195.

2. Peak Flow Demands: Maximum daily flow shall be determined by applying a peak factor of two and one-half (2.5) to the average daily flow calculated above. Peak hour flow shall be determined by applying a peak factor of four (4.0) to the average daily flow calculated above.

3. Fire Flow: Minimum system requirements for fire flow rates, duration (time) for total flow, as related to the total ultimate maximum-day demand, shall be designed in conformance with the "Insurance Services Office Fire Suppression Rating Schedule", 1974. All fire flow rates and fire protection systems shall also be in complete conformance with

applicable local and state fire code regulations. Minimum fire flow rates required for maximum-day demands shall be based on population, density, and/or other hazardous features of the proposed construction, as specifically required. These minimum rates shall be 750 gpm for residential developments and 1,000 gpm for commercial/industrial developments. Where fire flow requirements exceed the anticipated available fire flow from the central water system, an on-site fire protection system or other fire department-approved mitigation measures shall be utilized. The developer may also be required to make improvements to the central water system to boost its fire flow capability.

4. Fire Hydrant Location: Spacing for hydrants located within low density areas shall in no case exceed five hundred (500) feet (measured along the roadway) and shall be connected to eight (8) inch diameter water mains, which are of satisfactory loop design. Connection to dead-end stubs are acceptable, providing said stub water main is not less than six (6) inches in diameter and approved by CMOOS CFM Department. Hydrants located in commercial, industrial or other high density areas shall be spaced no further than three hundred (300) feet apart (measured along the roadway), and shall connect to looped water mains eight (8) inches in diameter or larger if required by the design flow demand. Exact locations of fire hydrants will be in complete conformance with local and state fire code regulations. Privately owned hydrants will not be allowed. Fire hydrants shall be placed not less than five (5) feet, nor more than ten (10) feet from the face of the curb.

5. Hydraulic Modeling: The minimum design for water distribution systems shall provide for at least one hundred (100%) percent of the combined maximum day demand rate with the required fire flow for said rate or peak hourly flows, whichever is greater. The allowable minimum service pressure under said design condition shall be not less than thirty-five (35) pounds per square inch (psi). However, minimum service pressure under

maximum daily flow alone shall no be less than 50 psi, unless approved by CMOOS. The Developer's Engineer shall submit signed, sealed and dated design calculations with the Drawings for all water distribution projects. The calculations shall show that the water distribution mains will have sufficient hydraulic capacity to transport peak hourly flows and the combination of maximum daily flows and fire flows while meeting a minimum pressure of not less than 20 psi. Head losses through meters and backflow devices shall also be included in the calculations. Design computations shall be by the Cybernet or approved alternate methods, as dictated by the system configuration. The developer may be required to make improvements to the central water system to maintain minimum standards throughout the system.

6. Valve Locations: Valves shall be provided for all branch connections, main ends, fire hydrant stubs or other locations, as required to provide an operable, easily maintained and repairable water distribution system. Valves are to be placed so that the maximum allowable length of water main required to be shut-down for repair work shall be five hundred (500) feet in commercial, industrial or high density residential districts, or eight hundred (800) feet in other areas.
7. All water main distribution systems shall be designed to reduce dead-end mains and provide a loop for new and existing mains.

4.03 STANDARD REQUIREMENTS

A. Approved Pipe, Fittings and Valves: All PVC pipe of nominal diameter of four (4) inches and smaller shall be manufactured in accordance with AWWA C-900. The PVC pipe shall have a minimum working pressure rating of 150 psi and shall have a dimension ratio of eighteen (18). The pipe shall be the same outside diameter as DI pipe.

All DI pipe of nominal diameter of four (4) inches through thirty-six (36) inches shall conform to ANSI/AWWA A21.51/C-151. The types tabulated below, within the size range indicated and for the applicable service, are approved for water distribution system construction:

Pipe and Fittings	Size Range (Inches)
▪ DI Pipe & Fittings	6 inches and larger
▪ Polyvinyl Chloride	4 inches and smaller
▪ Polyethylene Pipe	Service Connections Only
▪ Resilient Seated Gate Valves (GV)	No Limit
▪ Butterfly Valves (BFV)	Greater than 24 inches (only under the directions from the City)
▪ Corporation Stops and Angle Curb Valve	Service Connections Only

1. The minimum size water mains shall be six (6) inches, and shall only be permitted in cul-de-sac areas with a maximum length of six hundred (600) feet. In cul-de-sac areas only, six (6) inch looped connection may be allowed to prevent dead ends. As a minimum, six (6) inch looped systems shall be required in low density residential projects. Where looping of water mains is not practical, minimum eight (8) inch water mains shall be required, unless detailed calculations are submitted to substantiate the sufficiency of a six (6) inch water main. In commercial, industrial, and high density residential areas, larger size water mains shall be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure of 20 psi.
2. Joints: PVC pipe shall have integral bell push on type joints conforming to ASTM D3139. Joints for DI pipe and fitting joints shall be push-on or mechanical joints conforming to ANSI/AWWA A21.11/C-111. Where

called for by CMOOS restrained or flanged joints will be required. Restrained joints shall meet the requirements of Section 4.02.F of these Standards. Flanged joints shall conform to ANSI B16.1, 125 lb.

3. Fittings: All fittings shall be mechanical joint DI conforming to ANSI/AWWA A21.10/C-110, with a 250 psi minimum pressure rating for fittings through twelve (12) inches and a 150 psi pressure rating for sizes sixteen (16) inches and larger.

4. Coatings and Linings: Interior and exterior coatings for DI pipe shall conform to the requirements outlined in Section 3.02.B.4. of these Standards.

B. Fire Hydrants:

1. All Fire Hydrants shall comply with AWWA C-502, "Dry Barrel Fire Hydrants"; and shall be equipped with a minimum of one (1) pumper outlet nozzle four and one-half (4½) inches in diameter and two (2) hose nozzles two and one-half (2½) inches in diameter, all having National Standard hose threads. Units shall be traffic type with breakable safety clips, or flange, and stem, with safety coupling located below barrel break line to preclude valve opening. Fire hydrant shall be of ample length for depth of burial. Outlet nozzles shall be on the same plane with minimum distance of eighteen (18) inches and no greater than twenty-four (24) inches from the center of the nozzles to ground line. The valve shall be compression type, opening against the pressure and closing with the line pressure, with five and one-quarter (5¼) inches minimum valve opening and mechanical joint shoe inlet connection to be six (6) inches minimum. Fire hydrants shall be equipped with "O-Ring" packing.

All iron parts of the hydrant both inside and outside shall be painted, in accordance with AWWA C-502. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish. They shall be covered with two (2) coats. The outside of the hydrant above the

finished ground shall be painted with two (2) coats of reflective type yellow paint and glass beads in accordance with N.F.P.A. #291.

Hydrants shall be furnished with a sealed oil or grease reservoir located in the bonnet so that all threaded and bearing surfaces are automatically lubricated when the hydrant is operated. The hydrant will be designed for disassembly by use of a short disassembly wrench or the hydrant shoe having integral cast tieback lugs on the main valve to permit the main valve assembly and valve seat to be removed without digging earth or disassembling the hydrant barrel.

The pentagonal operating nuts and the cap nuts shall be one and one-half (1½) inch point to flat. Drain valve outlets shall be plugged or omitted. The hydrants shall open counter-clockwise and the direction of opening shall be cast on top. The bury length measured from the bottom of the connecting pipe to the ground line at the hydrant, shall be three (3) feet and six (6) inches bury. (Minimum)

Color coding of hydrants shall be indicated by the gallons per minute flow. All fire hydrants shall be painted yellow (Rust-O-Leum #944 safety yellow or approved equal) and color coded as follows:

Class Flow Color of Bonnets and Caps
(As described in City Code Section 9-83)

A.	1,500 gpm or greater	Blue
B.	1,000 gpm – 1,500 gpm	Green
C.	500 – 1,000 gpm	Orange
D.	Less than 500 gpm	Red

2. Hydrants shall be installed plumb and in true alignment with the connection pipes to the water main. They shall be secured with restraining assemblies. The gravel or crushed stone for the drain sump, followed by backfilling, shall be carefully placed and compacted. Installation shall be as shown on "Fire Hydrant Assembly Detail", see Figure 200. Final field location of all hydrants shall be approved by the CMOOS. All hydrants shall be located no less than five (5) feet and no more than ten (10) feet from the edge of pavement of the adjacent roadway, and no less than five (5) feet from any physical feature which may obstruct access or view of any hydrant unless otherwise approved by CMOOS. Guard posts (see standard detail) around fire hydrants are required when hydrants are placed within five (5) feet of all driveways, turn radius, or parking areas. Raised reflective pavement marker in blue shall be used to identify the fire hydrant location. The placement of the reflector to be at the centerline of the outside roadway lane unless otherwise directed by the Fire Marshal.
3. An approved water supply capable of supplying the fire flow shall be provided to all premises upon which facilities, buildings, or portions of buildings are hereafter constructed or moved into the jurisdiction of the City. The supply mains shall be of adequate size and have properly arranged connections to the arterial mains which shall extend throughout the systems and have numerous connections to the secondary feeders that

supply the minor distribution. All distribution systems shall be designed to reduce dead-end mains and provide a loop for new and existing mains.

C. Dead Ends: In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins whenever practical, as determined by the City. The maximum length of the dead-end mains shall be five hundred (500) feet. Where dead-end mains occur, they shall be provided with a fire hydrant or blow-off for flushing purposes. Flushing devices shall be sized to provide flows which will provide a velocity of at least two an one-half (2½) feet per second in the water main being flushed. No flushing device shall be connected to any sewer.

D. Valves: Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located at not more than five hundred (500) foot intervals in commercial, industrial and high density residential areas, and at not more than eight hundred (800) foot intervals in all other areas. Appropriate valving shall also be provided at all areas where water mains intersect to ensure effective isolation of water lines for repair, maintenance or future extension. The acceptable valves, installation methods, and other specialty items are identified in Section 3 of these Standards.

E. Joint Restraining: Pressure piping fittings and other items requiring restraint, shall be braced with restraining assemblies, as specified under Section 3 of these Standards. Said restraining devices shall be designed for the maximum pressure condition (testing).

F. Pipe Depth and Protection: The standard minimum cover for water distribution systems shall be three (3) feet from the top of the pipe to finish grade. Should this design not be feasible, alternatives shall be reviewed for acceptance. Additional protection for the pipe may be required.

G. Separation of Water Mains and Sewers: Water mains that are installed in the vicinity of pipe lines designated to carry raw wastewater, reclaimed/reuse, or

wastewater effluent shall meet the horizontal and vertical separations specified herein.

1. Horizontal Separation: Minimum horizontal clear distance between pipe barrels shall be as follows: Water mains shall be located at least ten (10) feet horizontally from pipes carrying raw wastewater, and five (5) feet horizontally from pipes carrying reclaimed/reuse water. A minimum three-feet horizontal clearance shall be maintained between new water main installations and any other utilities.
2. Vertical Separation: Water mains shall be designed and laid to provide a separation of at least eighteen (18) inches between the bottom of the water main and the top of the sewer. Water mains shall be installed above sewers. Adequate structural support for both the water main and sewers shall be provided to prevent excessive deflection of joints and settling. Where the minimum eighteen (18) inches of separation cannot be achieved, the water mains shall be constructed of DI pipe and the length shall be a minimum of ten (10) feet on each side of the crossing. The sewer shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the water main. The sewer pipe shall be AWWA C-900, or equivalent.

H. Surface Water Crossings

1. Aerial Crossings: Structural supports shall be provided for all joints in pipes utilized for aerial crossings and shall be designed to prevent overturning and settlement. Expansion joints shall be provided between the aerial and buried sections of pipe. The impact of flood waters and debris shall be considered and the bottom of the pipe shall be placed no lower than one (1) foot above the 100-year flood elevation.

   Restrained mechanical joint DI pipe, minimum Class 52, shall be used for all aerial crossings. The above-ground pipe shall be painted as specified in

Section 3.02.B.4.b. for above-ground water mains. Underground pipe shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An automatic air release valve shall be installed at the high point of the crossing. Appropriate guards shall be installed at both ends of the crossing to prevent pipe access to the public.

It shall be the responsibility of the Developer to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Developer shall meet all requirements of the agencies who own or have jurisdiction over such structures.

2. Underwater Crossings: A minimum of one (1) foot thick concrete slab shall be placed three and one-half (3½) feet above the main. The pipe material shall meet appropriate AWWA Standards for use in submerged conditions. Valves and ARV's shall be provided at both end of the water crossings so that the section can be easily isolated for testing or repair. No isolation valves shall be located in the SFWMD or SBDD canal right-of-way. The valves shall be easily accessible, and not subject to flooding. Both valves shall be provided in a manhole or valve vault. It shall be the responsibility of the Developer to obtain all applicable regulatory permits, including dredge and fill permits.

I. Pipe Bedding: Special care shall be exercised in design and installation to provide adequate bedding for the type of pipe used taking into consideration trench width and depth, superimposed loadings above grade, and the material below trench grade. Pipe loading capabilities shall be computed in accordance with established design criteria and special support bedding or facilities shall be provided as required.

J. Connections at Structures: Where pipes are to extend into or through structures, flexible joints shall be provided at the wall face.

K. Special Exterior Protection for Corrosion: Extra protection shall be provided for underground DI pipe and fittings within areas of severely corrosive conditions. This shall be accomplished by the installation of polyethylene encasement as specified in AWWA C-105 through the area of concern. The soil-test evaluation to determine the necessity for extra protection in suspect areas shall be as set forth in ANSI A21.5. Additionally, where other existing utilities are known to be cathodically protected, DI pipe crossing said utility shall be protected for a distance of twenty (20) feet to each side, and when installed parallel to and within ten (10) feet of the said utility, protection shall also be provided.

L. Air Venting and Blow-Offs: Methods for air release shall be provided where the water main profile is such that air pockets or entrapment could occur resulting in flow blockage. Air venting capabilities shall be provided for distribution mains by appropriately placing automatic air release valves or blowoffs. At critical points on major mains, automatic air release assemblies shall be installed. All dead-end water mains, temporary or permanent, shall be equipped with a manually operated blow-off at the terminus.

M. Service Connections:

1. All service lines shall be three-quarter (¾) inch, one (1) inch, one and one-half (1½) inch or two (2) inch copper or polyethylene tubing conforming to AWWA C-800 and C-901.

2. Connections to water mains (other than DI), of four (4) inches and larger, shall be made by the drilling of the appropriate size hole and the installation of service saddles. Where water services greater than twelve (12) inches are required, dual services shall be provided. Services to smaller size mains shall be accomplished by in-line fittings. A corporation stop shall be placed at the saddle or fitting with the service line extended perpendicular to said line. Installation shall be as shown on the "Water Service Connection Detail."

3. No water main or service lateral shall parallel adjoining lots, run between neighboring property lines, or come through the rear of the property's lot line in order to provide utility service.
4. Corporation stops shall be one (1) inch, one and one-half (1½) inch or two (2) inch brass, equipped with connections compatible with the service line. Angle curb valve shall be sized to match the meter size and conform to AWWA C-800.
5. Fittings shall be brass, cast and machined in accordance with specifications in AWWA C-800, compatible with polyethylene tubing.
6. Service saddles shall be for service line taps and conform with the requirements outlined in Section 3.02.F.6. of these Standards.
7. When the service line is laid in the prepared trench, special care shall be taken to insure that minimum radius is maintained on service lines and that undue pressure is not exerted on the service line by rocks or other material protruding through the bedding material.
8. The interior of the service line shall be thoroughly cleaned of all foreign matter before being lowered into the trench. Compression joints and couplings shall be assembled in strict accordance with the manufacturer's recommendations. Particular care should be taken to keep foreign materials from interfering with proper joint assembly. The mating surfaces of the compression joint should be wiped clean. The tubing should then be inserted into the compression fitting and made tight according to the manufacturer's recommendations.
9. The maximum deflection of any service line shall not exceed fifty (50%) percent maximum deflection recommended by the tubing manufacturer. The service line shall terminate in an approved meter box or vault located within the public right-of-way or easement, adjacent to the property being served. The meter box or vault shall have a traffic type cover in areas where it is exposed to vehicular traffic.

10. The minimum depth of cover over the service line at street crossing shall be twenty-four (24) inch unless otherwise directed by the City. On installations where no street crossing is necessary, the minimum depth of cover shall be 18-inch unless special problems are encountered.

N. Water Metering: All water service connections shall be metered. In general, the method of metering will follow the guidelines listed below. However, the Developer's Engineer must obtain approval before finalizing the design of the metering system. No trees or shrubs to be planted within four (4) feet of the water meter.

1. Single Family, Duplex, and Multi-Family Subdivisions with Public R/W: Each unit shall be individually metered. Single and double services shall be installed at the property lines as indicated by the Standard Drawings.
2. Single Family and Duplex Subdivisions with Private Streets: Individual meters may be permitted in accordance with Section N.1. if the private streets are designed to City standards and easements are dedicated over the entire private street common areas. In addition, sufficient area must be available to locate water mains, services, and meters. If the above criteria cannot be met, the subdivision shall be metered pursuant to Section N.4.
3. Commercial, Industrial, and Institutional Projects without Fire Lines: In general, each building shall be individually metered. Meter(s) shall be located in the public R/W at the property line. All meters three (3) inches and larger shall be located in a meter vault.
4. Commercial, Industrial, Institutional, Multi-Family with Private Streets, Apartments, and Condominium Projects with Fire Lines and automatic fire sprinkler systems. In general, all such projects shall require installation of a fire line double detector check valve. Where on-site fire systems contain less than seventy-five (75) feet of water main, a dual system (separate domestic and fire lines) may be considered. Dual systems shall require

installation of a detector check or double detector check as determined by the City.

5. Shopping Centers: In general, shopping centers shall require installation of a fire line double detector check valve assembly.

6. Meter Installation: All meters will be installed by the City after payment of applicable fees and charges. All meters less than two (2) inches in size will be installed underground in an approved meter box. For single family lots, when facing the lot, meters shall be installed on the right side for odd numbered lots and on the left side for even numbered lots. Installation of meters under sidewalks or pavement shall not be permitted. Meters two (2) inches and larger shall be installed above ground. In general, meters larger than two (2) inches shall be located in a meter easement located adjacent to the public R/W.

7. Meter Sizing: The size of all meters shall be determined by CMOOS. The Developer's Engineer shall provide sufficient information on estimated peak flows and low flows as well as fixture counts so that a meter size can be determined.

O. Backflow Prevention: The Backflow Preventor is designed for two purposes:

1. To detect leakage or unauthorized use of water from fire or automatic sprinkler systems.

2. To protect the potable water system from contamination by the fire system.

The mainline assembly consists of a double check valve assembly. The bypass consists of an approved double check valve assembly, shut-off valves, test cocks and a meter with a sealed register.

Internal working parts are to be readily accessible for repair, removal or replacement without removal of the valve from the pipeline. The mainline assembly opens up to allow full flow of water to the user.

Backflow prevention double check valve with low flow bypass meter must meet Underwriter's Laboratories and Factory Mutual approvals.

Backflow prevention double check valve shall be designed and manufactured in accordance with AWWA Standard C506 latest revision and shall have the following design standards:

a. Backflow preventor shall be of the double check valve type. The assembly shall have two spring-loaded independently operating property valves mounted in a common body, two gate valves and four test cocks and shall be designed for installation in a normal hot water flow attitude.
b. The test cock arrangement will be such that each check valve can be tested without removal of the assembly from the line.
c. The check valves shall be designed to open under normal flow conditions at a pressure differential not less than one (1) PSI at each check valve. The check valves will be designed to close when the downstream pressure is greater than the supply pressure.
d. The assembly shall be manufactured of corrosion resistant materials.
e. The assembly shall have all internal parts accessible and removable for repair without removing the assembly from the line.
f. Detector check valves three (3) inches thru ten (10) inches shall have maximum working pressure of 175 PSI and be tested at 350 PSI.

g. The detection meter or device on the low flow bypass line shall contain the same type of double check valve assembly, shutoff valves, test cock fittings and piping of bronze or stainless steel materials. Meter size okay manufacturer's requirements shall meet displacement water meter standard per Section 2.08, Part C.

h. Backflow prevention double check valve with detector bypass shall be tested by a certified testing technician prior to acceptance by Broward County.

In order to protect the public water supply system from contamination due to cross-connections, the Developer shall install backflow prevention assemblies where there is the potential of a non-potable substance coming into contact with the public water system in accordance with City Code, Article VIII. Cross Connection Control. Some of the common systems requiring backflow prevention are residential multifamily, commercial and industrial projects, all projects with fire sprinkler and standpipe systems, projects with extensive on-site water systems, and irrigation systems.

All multifamily, commercial and industrial projects shall provide backflow prevention in accordance with City Code, Article VIII. Cross Connection Control. CMOOS will determine the degree of hazard and require the appropriate backflow assembly.

All backflow prevention assemblies are to be located directly following the water meter on the Developer’s property, installed above ground to facilitate maintenance and testing. It shall be the Developer’s responsibility to pay for, install and maintain all backflow prevention assemblies. Additional requirements, if any, are contained in the City's cross connection control ordinance.

P. Identification Tape and Locating Wire: Identification tape and fourteen (14) gauge multi-strand copper locating wire shall be installed directly above the alignment and directly on top of all PVC pipe to insure that the alignment and depth of pipe can be determined in the future. The fourteen (14) gauge multi-strand wire shall be laid clear of valves and tested for continuity at all pressure tests. The wire shall be brought up to the surface and a minimum of four (4) feet of excess wire shall be coiled at each valve.

A blue identification tape shall be installed over the centerline of the pipe, at eighteen (18) inches below finished grade, and shall be the detectable type. The identification tape shall be laid continuously without gaps between ends over all installed piping, and shall have the words "Caution, Water Line Buried Below", or equivalent, printed continuously along its length.

4.04 INSTALLATION

A. All water mains, valves and appurtenances shall be installed in accordance with Sections 3 and 4 of these Standards.

4.05 TESTING

A. The Builder shall perform hydrostatic testing of all water distribution systems, as set forth in the following, and shall conduct said tests in the presence of representatives from the CMOOS CFM Department or other authorized agencies, with two (2) days advance notice provided. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints and valves including all service lines to the angle curb valve. Air testing of pressure pipe will not be permitted under any circumstance. The Contractor shall furnish all necessary equipment and material, make all taps, and furnish all closure pieces in the pipe as required.

1. Piping and appurtenances to be tested shall be within sections between valves, unless alternate methods have received prior approval. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided as may be required. Flushing shall be at full flow conditions and at a flow rate of at least two and one-half (2½) feet per second. The Contrator shall provide calculations and information to prove that the required velocity can be achieved or provide a method for pigging the main.
2. Hydrostatic testing shall be performed at 150 psi for a period of not less than two (2) hours. If during the test the integrity of the tested line is in question, the City may require a six (6) hour pressure test. Testing shall be in accordance with the applicable provisions as set forth in Section 4 of AWWA C-600. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for the Contractor's informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.

   The procedure for conducting the test will be that each section of pipe to be tested will be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. Once the pump has raised the line pressure to 150 psi or greater, and the pressure test has commenced, there shall be no re-pumping of the line for the duration of the pressure test. To accomplish this, taps shall be made and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of this pressure test, all such items shall be

removed and replaced by the Contractor with sound material and the test repeated until satisfactory results are obtained. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in lineal feet (maximum length 2,000 feet for calculation).

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch gauge, (minimum 150 psi). Pressure loss during test shall not exceed 5 psi.

3. The testing procedure shall include the continued application of the specified pressure to the test system, for the two (2) hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container. Should the test fail, necessary repairs shall be accomplished by the Contractor and the test repeated until it is within the established limits. The Contractor shall furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required water distribution system testing and perform necessary repairs.

4.06 DISINFECTION

A. Following pressure testing, the Contractor shall disinfect all sections of the water distribution system, including service lines, and receive approval thereof from the appropriate agencies, prior to placing in service. In addition, any part of the City's water system which has direct contact with finished water and has been out of service for repair, alteration, or replacement shall be disinfected. Two (2) days advance notice shall be provided to CMOOS before disinfecting procedures start. The disinfection shall be accomplished in accordance with the applicable provisions of AWWA C-651, "Disinfecting Water Mains", and all appropriate approval agencies.

B. Sections of pipe to be disinfected shall first be flushed (full diameter) to remove any solids or contaminated material that may have become lodged in the pipe. All taps required for chlorination or flushing purposes, or for the temporary or permanent release of air shall be provided for by the Contractor as a part of the construction of water mains. All such taps shall be sealed to the satisfaction of the City.

Before being placed into service, all new mains and repaired portions of or extensions to existing mains shall be chlorinated so that the initial chlorine residual is not less than 50 mg/L, and a chlorine residual of not less than 25 mg/L remains in the water after twenty-four (24) hours in the pipe. Chlorine may be applied as a liquid chlorine (gas-water mixture), or a mixture of water and high-test calcium hypochlorite. The Contractor shall assume the responsibility for safe handling of chlorine, and shall meet the requirements of OSHA and other regulatory agencies for the safe handling of chlorine.

The preferred point of application of the chlorinating agent shall be at the beginning of the pipe line extension or any valved section of it, and through a

corporation stop inserted in the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipe line extension. Alternate points of applications may be used when approved by the City.

Maximum distance between sampling points shall be as follows:

Transmission Mains:	Every 1,500 ft.
Distribution Mains:	Every 1,000 ft.
Isolated Mains:	Less than 1,000 ft: 2 sample points
	Greater than 1,000 ft: 3 sample points

The Developer/Contractor shall be solely responsible for the cost of collecting and processing the bacteriological samples.

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows, upon test, the chlorine measurement not in excess of that normally carried in the system. After flushing, water samples shall be collected on two (2) successive days from the treated piping systems, as directed by the City, and shall show acceptable bacteriological results. All bacteriological testing shall be the responsibility of the Developer or Contractor, and must be performed by a laboratory certified by the State of Florida. In addition, proper chain of custody procedures must be followed, and samples shall only be collected by certified

personnel in the presence of City personnel. Copies of testing results and all related correspondence with the HRS and DEP shall be submitted to the City.

Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Developer/Contractor until satisfactory results are obtained. Mains shall not be placed into domestic service until the necessary bacteriological samples have been approved by the applicable regulatory agencies.

SECTION 5

SANITARY GRAVITY SEWERS

5.01 GENERAL

This section includes general technical criteria for the design and installation of sanitary gravity wastewater systems.

5.02 DESIGN STANDARDS

A. Required Reference: The Contractor shall comply with the applicable requirements as established by the DPEP. Additionally, the criteria set forth in the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)", may generally be used as a design guide, if not in conflict with these Standards or with State, County or other regulatory agency requirements.

B. Gravity sewers shall be located in dedicated R/W or utility easements. Whenever possible, sewers shall be located under the centerline of pavement in dedicated R/W. All sewers located outside of dedicated R/W shall require a minimum twenty (20) foot easement. If a gravity sewer is located coincident with a road R/W, a minimum ten (10) foot utility easement shall be provided. Additional easement widths shall be provided when the pipe size or depth of cover, in both cases, so dictate. No gravity sewers shall be placed under retention ponds or drainage ditches, tennis courts or other structures. Gravity sewers shall not be located along side or rear lot lines.

C. System Design:

1. Average Design Flows: The sewer system design shall be based on full ultimate development as known or projected. The average daily flow (ADF) from domestic units shall be calculated at the minimum rate of one hundred (100) gallons per capita per day. One ERC shall be equal to the

rate of three hundred (300) gallons per day. Flow requirements from commercial, industrial, institutional, or other special development areas shall be established using City Code Section 21-195.

2. Peak Design Flows: Gravity sewers shall be designed on the basis of ultimate development maximum rates of flow, which will be the product of selected peak factors times the cumulative ADF for the subject portion. In general, the following peak factors shall be applicable for the range of average daily flow rates indicated (million gallons per day - MGD), unless larger values are required for specific conditions or prior approval is received for modification thereof.

Population in Thousands Flow Range, MGD-ADF	Hourly Peak Factor
0.000 to 0.100	4.0
0.100 to 0.250	3.5
0.250 to 1.000	3.0
1.000 to 4.000	2.5

Note: Special analysis shall be made for flows beyond 4.000 MGD-ADF or peak factors less than two and one-half (2.5).

3. Sewer Size Computation: Sanitary sewers shall be sized to provide ample capacity for the required ultimate population/development peak flow rates. The minimum allowable size for any sewer, other than service connections, shall be eight (8) inches in diameter. All sewers shall be designed at slopes providing minimum velocities of not less than two (2) feet per second when flowing full or half-full. Said computation shall be based on Manning's Equation, using a roughness coefficient ("n") of 0.12 for PVC pipe and 0.013 for other pipe material, unless justifiably approved otherwise. In general, the following minimum slopes shall be maintained:

Sewer Diameter (Inches)	Minimum Slope (Feet per 100 Feet)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24 and larger	0.08

4. Design Considerations:

   a. Sewers shall be installed with straight alignment and grade between manholes, with manhole spacing not-to-exceed four hundred (400) feet. However, special provisions may be considered.

   b. All sanitary sewers shall initiate and terminate at manholes.

   c. Invert of downsteam pipe shall be two-hundredths (0.02) foot lower than invert of upstream pipe.

   d. Sewers of different sizes shall always join at manholes with no size conversions between manholes. Where different sizes join, the pipes shall be placed at elevations where the top of the down stream pipe is one-tenth (0.1) foot lower than the lowest top of pipe elevation. If the entrance pipe elevation exceeds two (2) feet above the effluent sewer, drop manhole connections shall be provided.

   e. Flow direction changes in excess of ninety (90) degrees shall not be included in sewer alignments without special consideration. When directional changes exceeding forty-five (45) degrees occur,

an extra flow line elevation drop one-tenth (0.1) foot across manholes shall be provided.

f. Where design velocities greater than ten (10) feet per second are calculated, a larger diameter pipe shall be selected so the design velocity will be less than ten (10) fps at maximum flow.

g. The minimum cover over gravity sewers shall be no less than four (4) feet calculated from the finished grade.

h. All sewer extensions for future connections shall terminate at a manhole.

i. Main drain and backwash systems for pools and spas, and storm drain systems shall not connect to the gravity system.

j. The Engineer of Record shall submit signed, sealed and dated design calculations with the Drawings for all sewer projects. Calculations shall show that sewers will have sufficient hydraulic capacity to transport all design flows.

5.03 STANDARD REQUIREMENTS

A. Approved Gravity Pipes, Service Laterals, and Fittings:

PVC pipe ranging in diameter from four (4) to fifteeen (15) inches shall meet the requirements for ASTM D3034, SDR 35. PVC pipe with a diameter eighteen (18) inches and greater shall meet ASTM F679, SDR 35. All gravity mains buried deeper than ten (10) feet shall be SDR 26. The joints shall be integral bell elastometric gasket joints manufactured in accordance with ASTM D3212. Unless otherwise specified, wye branches shall be provided in the gravity sewer main for service lateral connections. Wyes shall be six (6) inch inside diameters unless otherwise approved by CMOOS. All fittings shall be the same material as the pipe.

All ductile iron pipe, fittings, and specials conveying or transmitting raw sewage shall be designed for a minimum working pressure of 150 P.S.I. Ductile Iron Pipe shall conform to ANSI/AWWA Standard C151/A21.51 latest revision, "Ductile Iron Pipe centrifugally cast in metal molds or sand-lined molds" with wall thickness Class 50 for 8-inch and above, Class 52 for four (4) inch and six (6) inch, unless otherwise directed by the Owner.

Ductile Iron Pipe shall be lined with polyethylene or coated with the manufacturer's coating system. In either case, the Engineer's review and approval is required for either alternative prior to construction. Cement mortared linings are not appropriate for this application.

P.V.C. non-pressure pipe shall conform to ASTM D3034 latest revision (SDR 35). Ultra Violet degradation or sun-bleached pipe will not be accepted.

Fittings:

P.V.C. fittings shall be of monolithic construction and of the type specified by the manufacturer. No solvent welds will be permitted.

Joints:

Joints for P.V.C. non-pressure pipe shall be bell and spigot push on rubber gasket type only. No solvent weld or threaded joints will be permitted.

The pipe manufacturer shall furnish evidence in the form of affidavits, certified laboratory reports and other data as may be required that the material being used in the manufacture of the seal or gasket is in strict accordance with the material supplier's recommendations.

The jointing of the pipe shall be done in strict accordance with the pipe manufacturer's instructions and shall be done entirely in the trench unless otherwise directed by the Owner.

B. Sanitary Sewer Manholes:

1. Manholes shall be precast concrete as detailed herein. Alternate manhole materials and designs shall receive prior approval. The minimum inside diameter of manholes shall be forty-eight (48) inches for sewer sizes to twenty-four (24) inches in diameter or less. For sewers larger than twenty-four (24) inches, the minimum inside diameter shall be sixty (60) inches. A minimum access cover diameter of twenty-four (24) inches shall be provided. Installation of manholes shall be as shown on the "Gravity Sewer Detail."
2. Precast reinforced manholes shall be in accordance with ASTM Designation C478, with preformed flexible plastic joint sealer conforming to Federal Specification SS-S-0021 (GSA-FSS).
3. Precast manholes shall be constructed with a precast monolithic base structure as shown on the Standard Drawing #300. The minimum thickness shall be eight (8) inches.
4. Manhole frames and covers shall be US Foundry model 420-C and shall be gray cast iron conforming to ASTM Designation A48, Class 30. Castings shall be true to pattern in form and dimensions and free from pouring faults and other defects which would impair their strength, or otherwise make them unfit for service intended. The seating surfaces between frames and covers shall be machined to fit true. No plugging or filling will be allowed. Lifting or pick holes shall be provided.

   Casting patterns shall conform to those shown or indicated on the Standard Drawing #302. Covers shall have no perforations and shall be marked with the words "CITY OF MIRAMAR SANITARY." Frames and covers shall

be fully bedded in mortar to the correct finish grade elevation, with adjustment brick courses placed below, for precast manholes. Frames shall be suitable for the future addition of cast iron rings for upward adjustment of top elevation. All manhole frames and covers shall be traffic bearing to meet AASHTO H-20 loadings.

5. Manholes shall be supplied and installed with inflow protection inserts. The insert body shall be made of acrylonitrile-butadiene-styrene (ABS) high-impact, high-grade LS material specifications under ASTM D-256 method A, D-638, D-790, D-785 method A and D-635, as manufactured by Borg-Warner Grade LS Cycoloac, or equal. The insert gasket shall be made of closed-cell neoprene. The insert shall be equipped with a two and one-half (2½) cm one (1) inch woven nylon strap for removing the insert, fastened to the body with stainless steel rivets or other fastener, and the strap shall be able to withstand five hundred (500) pounds test load without separating from the insert. The insert shall be tested to support a minimum of a five hundred (500) pounds deadload without damage or collapsing into the manhole. Insert shall be Rain Guard model LF-VHS as manufactured by L.F. Manufacturing, or approved equal.
6. Manhole flow channels shall be smooth with carefully shaped semi-circular bottoms, built up sides and benching constructed from concrete. Channels shall conform to the dimension of the adjacent pipe and provide changes in size, grade and alignment evenly. Flow directional changes of greater than ninety (90) degrees shall not be included in sewer alignments without special consideration. When directional changes exceeding forty-five (45) degrees occur, an additional flow line elevation drop of one-tenth (0.1) foot across manholes shall be provided. Benching shall be provided which shall have a minimum slope of two (2) inches per foot.
7. All wet wells shall be protected internally from deterioration by either of the following methods:

a. Interior of wet well and valve box shall be lined with the Thoroc Concrete Protection System consisting of a one-half (1/2) inch layer of Thoroc SP15 Spray Mortar, one component, Microsilica-enhanced, fiber reinforced wet spray mortar followed by sixty (60) mils of Thoroc Sewer Guard HBS 100 Epoxy Liner, high-build, moisture-intensive, chemical resistant epoxy coating. The surface of the concrete shall be brush blasted and inspected prior to the application of the mortar and prior to the application of the epoxy. The coating system application shall be performed by a manufacturer approved applicator.

b. An alternate method of internal protection for the wet well and valve box requires furnishing and installing all labor, materials, equipment, and incidentals to provide a minimum two (2) mm (.079 inches) High Density Polyethylene (HDPE) thermo-plastic liner.

The HDPE liner rehabilitation system shall be designed to protect the interior surface of the existing structure's wall, corbel, top slab, and access area from acid attack, abrasion, and impact; to provide a backpressure resistant barrier to groundwater inflow; and to add structural integrity to the existing structure. The bench and invert in manholes and the floor and fillets in lift stations/wet wells need not be lined.

Unless included as part of the wet well manufacturing process (the preferred method), attachment of the liner to the interior of the structure is accomplished by embedding the liner into concrete poured into the annular space between the existing surface and the formwork supporting the liner. If the Contractor intends to secure the liner in the field, the pump station wet well shall be

manufactured with an inside diameter not less than eight (8) feet, six (6) inches, so that a minimum finished inside dimension of eight (8) feet may be maintained. The annular void shall be poured with new concrete to mechanically anchor the line in approximately three (3) inches of concrete all around.

The underside of flat top slabs not exposed to a high level of hydraulic backpressure, or turbulence, requires attachment of non-studded flat sheet liner by means of mechanical fasteners, or other approved method. If mechanical fasteners are used, the fasteners must by sealed either by covering the fastener with a welded liner patch or with thermo-plastic excruciate.

The Contractor shall forward for approval, a submittal package that includes the scope of the work; the installation instructions of the liner system; the thermowelding specifications of the liner manufacturer; and a copy of the welders' certification issued by the manufacturer of the liner.

The HDPE liner shall be free of pores, pinholes, voids, and foreign bodies. All anchoring studs shall be manufactured during the extrusion process in one piece with the sheet. Welding of the studs to the sheet is not permitted. The same manufacturer shall manufacture the studded liner, non-studded flat sheet liner, welding rod, profile strips, cap strips, and polyester backed transition wrap from the same resins.

The liner shall be Sure Grip HDPE* as manufactured by Alois Gruber (AGRU) GmbH, or approved equal.

Liner shall be manufactured of virgin materials by an ISO 9001 (or equal) certified manufacturer of thermo-plastic liners.

The characteristic values of the HDPE liner material shall be as follows:

Property	Test Method	Unit	Std. Value
Density	ASTM D 792-86	g/cm^3	0.945
Melt Flow Index	ASTM D 1238-86	g/10 min	190/5
Heat Reversion	ASTM D 1637-83	%	<2
Yield Stress	ASTM D 638-89	PSI	$\geq$ 2,320
Elongation of Yield	ASTM D 638-89	%	$\geq$ 12
Elongation of Break	ASTM D 638-89	%	$\geq$ 200
Fire Classification	UL-94		V2
Pull-out Resistance	SKZ Test Directives	t/ft^2	3
Max. Working Temp		F.	140 Degrees

Studded HDPE liner sheets used for underground structure rehabilitation shall have a minimum design thickness of two (2) mm (.079 inches) and have a minimum of thirty-nine (39) wedge shaped anchoring studs per square foot of liner. Minimum stud height shall be no less than thirteen (13) mm.

Installed HDPE liner shall be repairable at any time during the life of the system.

Transitions from dissimilar materials, such as PVC pipe to HDPE liner, shall be accomplished using a polyester backed HDPE liner transition wrap and an approved bonding material.

The concrete used to anchor the liner shall be a minimum four thousand (4000) psi @ twenty-eight (28) days plasticized (eight (8) to ten (10) inch slump) pump mix design. Concrete shall be poured or pumped in place and vibrated to eliminate voids.

The forming system used to support the liner during the concrete pour shall be capable of bracing the liner against hydraulic forces that would result from the pouring and vibrating of concrete into the void between the liner's embeds and the existing wall.

The utilization of a moisture tolerant epoxy based mortar at one-eighth (1/8) inch minimum thickness onto the bench, or other concrete surfaces that are not protected by the liner, is required.

8. The interior surfaces of all manholes shall be protected by the application of two (2) coats of epoxy, Cooper Black No. 775 by M.A. Bruder & Sons, Inc., or approved equal. The first coat shall be red and the second coat black. Each coating shall have a minimum dry film thickness of eight (8) mils. Exterior surfaces shall receive one (1) coat of Cooper Black No. 775 by M.A. Bruder & Sons, Inc., or approved equal with a minimum dry film thickness of eight (8) mils. Surface preparation and paint application shall comply with the manufacturer's recommendations.
9. Where additional pipe connections or modification of existing factory-made openings are required on new or existing precast concrete manholes, all cutting relative thereto shall be performed only by a power driven abrasive wheel or saw. It is specifically noted that such connections to existing manholes shall be made watertight with neoprene boot specifications.
10. An outside drop pipe shall be provided for a sewer entering a manhole where its invert elevation is twenty-four (24) inches or more above the

manhole invert. Drop connections, where required, shall be cast monolithically with the manhole elements. Where the difference in elevation between the incoming sewer and the manhole invert is less than twenty-four (24) inches, the manhole invert shall be filleted to prevent solids deposition.

11. Concrete for manholes shall be Type II, 4,000 psi at twenty-eight (28) days. Barrel, top and base sections shall have tongue and groove joints. All jointing material shall be cold adhesive preformed gaskets, conforming to FDOT Article 942-2.

12. Manhole sections shall be cured by an approved method for at least twenty-eight (28) days prior to painting.

13. Minimum height of base sections shall be three (3) feet above the top of base slab.

14. Manhole sections shall be joined with a mastic compound or a round compression ring of neoprene material set in annular spaces cast into the spigot end of a bell spigot type joint. The mastic compound or ring shall be uniformly compressed between the positioned sections so as to form a watertight joint.

    a. After the sections are assembled, the remaining space in the joint shall be pointed up and filled with a dense cement mortar and finished so as to make a smooth, continuous surface inside and outside the wall sections.

15. Deep manholes (seven (7) feet or deeper - Please refer to Section 10, details 5 and 6) may substitute an eight (8) inch precast reinforced concrete slab on the top in lieu of the cone section. Slabs shall have a twenty-four (24) inch diameter access hole centered in the slab. Slabs, if used, shall terminate at such elevations as will permit laying up a minimum of two (2) courses of clay brick under the manhole frame to make allowance for future street grade adjustments.

16. Precast manhole cones, if used, shall terminate at such elevations as will permit laying up a minimum of two (2) courses and maximum of (3) courses of clay brick under the manhole frame to make allowance for future street adjustment.

17. Brick for manhole construction shall be dense, hard burned, common clay brick conforming to ASTM C62 latest revision, except that brick absorption shall be between five (5) and twenty-five (25) grams of water absorbed in one minute by dried brick, set flat face down, in one-eighth (1/8) inch of water. All brick shall be thoroughly wet before laying up and shall be laid with a shove joint in full mortar beds and shall be thoroughly slushed up with mortar at every course.

18. Where shown on the drawings, the contractor shall place opening for future extensions. The openings shall be closed with a plug as specified by the City. Two coats of protective material, Kopper's 300M or approved equal, shall be applied to the entire inside and outside surfaces of the manhole at the job site. This material shall be applied in accordance with the manufacturer's specifications. The coats shall have contrasting colors so as to be easily verified.

19. The lid and frame shall be cast of close ground grey iron conforming to ASTM A48 latest revision, and shall be of uniform quality, free of blow holes, porosity, cracks and other obvious visual defects. The combined weight of the frame and lid shall not be less than five hundred twenty-five (525) pounds, and the lid shall weight a minimum of one hundred sixty (160) pounds. The seating surfaces between frames and covers shall be machined to fit true. No plugging or filling will be allowed. Casting patterns shall conform to those designated by the Owner shall have the words “Sanitary Sewer” and the City’s logo or name cast in all manhole covers. Castings shall be cleaned. Pick type lifting holes will be cast into lids, but shall not go clear through the lid. Manhole lid adapters of up to 2-inches are allowed.

20. When a manhole is in a low lying area or when, in the opinion of the City, an unusual condition exists, a sealed locking type lid may be required. Installation of this type lid will be carried out as directed by the City.

21. All concrete used in manhole construction shall use Type II cement.

22. Manhole adapter couplings shall be required at all manhole connections when using P.V.C. pipe.

23. Portland cement mortar will not provide a water-tight bond to PVC or ductile iron pipe. Therefore, resilient connector manhole inserts with stainless steel band shall be installed on all new constructed manholes. The connection piece shall be an EPDM (Ethylene Propylene Diene Monomer) manhole adapter connecting piece, cast into the manhole, with stainless steel hardware. The connection shall provide flexibility and a watertight connection at the structure.

C. Pipe Bedding: Special care shall be exercised in design and installation to provide adequate bedding for the type of pipe used, taking into consideration trench width and depth, superimposed loadings above-grade and the material below trench grade. Pipe loading capabilities shall be computed in accordance with established design criteria and special supporting bedding or facilities shall be provided as required.

D. Service Connections: Installation shall be as shown on "Service Lateral Details" including the wye branches installed in the sewer main at the point of connection; and the service pipe and required fittings extended to the property line, perpendicular to said line, terminating with stoppered ends or fittings and cleanouts, as indicated. P.V.C. clean-outs shall have a screw type access plug. The minimum service pipe size shall be six (6) inches in diameter and not more than fifty (50) feet in length for single or double connections. Service laterals shall not be allowed to discharge into sanitary manholes. A case-by-case exception to this requirement may be allowed if the lateral discharges at the same elevation as the manhole invert. Service laterals shall have a minimum slope of one-eighth (1/8) inch per foot. Locations shall be adequately marked by EMS Sanitary

Marker #1253 (Green) - to be installed at clean out for electric locating or by an alternate method approved by CMOOS.

Clean-outs shall be provided and brought to final grade at the property or easement line for all sewer laterals. As a general rule, cleanouts shall not be located or installed in pavements or driveways. Where there is no choice but to locate clean-outs in driveways, traffic bearing protective covers shall be provided. One (1) six (6) inch diameter clean out shall be installed for each service connection.

No wastewater service lateral shall parallel adjoining lots, run between neighboring property lines, or come through the rear of the property's lot line in order to provide utility service, unless otherwise approved by CMOOS.

E. Protection of Water Systems: The horizontal separation between sanitary sewers and existing or proposed water mains shall not be less than ten (10) feet. Unless sewer pipes cross below water mains with a vertical separation of eighteen (18) inches between the bottom of the water pipe and the top of the sewer, special protection shall be provided for a minimum distance of ten (10) feet on each side of the water main.

5.04 INSTALLATION

A. All gravity sewer pipe, manholes and appurtenances shall be installed in accordance with Section 3 of these Standards.

5.05 TESTING

A. The Contractor shall perform testing of all sanitary gravity sewers, as set forth in the following, and shall conduct said tests in the presence of representatives from CMOOS with two (2) days advance notice provided.

B. The installed sewers shall be "lamped" between manholes or other structures in order to ascertain that they are clear and to correct alignment. The concentricity of the lamp image received shall be such that the diameter of said image shall have no vertical reduction from that of the pipe inside diameter, and not more than twenty (20%) percent horizontal reduction. Each manhole or other appurtenance to the system shall be of the specified size and form, be water tight, neatly and substantially constructed, with the top set permanently to exact position and grade. All repairs shown necessary by the inspection are to be made; broken or cracked pipe replaced; all deposits removed and the sewers left true to line and grade entirely clean and ready for use.

C. Sanitary sewers to be tested shall be within sections as previously approved. Testing shall not proceed until all facilities are complete in place and concrete-cured. All piping shall be thoroughly cleaned prior to testing to clear the lines of all foreign matter.

D. Leakage testing shall be conducted in accordance with the procedure for "Recommended Practice For Low Pressure Air Testing of Installed Sewer Pipe" as established by the UNI-BELL PVC Pipe Association. Passing this test shall be presumed to establish leakage test limits of fifty (50) gallons per day per inch diameter per mile of sewer.

E. Should the test fail, necessary repairs shall be accomplished by the Builder and the test repeated until the results are within the established limits. The Builder shall furnish the necessary labor, water and all other items required to conduct the required testing and shall perform the necessary system repairs required to comply with the specified test.

F. Maximum ring deflection of PVC pipe under load shall be limited to five (5%) percent of the vertical internal pipe diameter.

G. The installed sewers shall undergo television inspection at two (2) times. The first shall be prior to final acceptance by CMOOS and the other shall be just prior to the one (1) year of CMOOS acceptance. The television inspections shall be performed in accordance with The National Association of Sewer Service Companies "Recommended Specifications For Sewer Collection System Rehabilitation." Videotapes and inspection logs shall be provided to CMOOS for each inspection. If either inspection reveals cracked, broken or defective pipe or pipe misalignment resulting in vertical sags in excess of one (1) inch, the Builder shall be required to repair or replace the pipeline. Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to CMOOS for approval. Pressure grouting shall not be considered an acceptable method of repair. The results of all testing shall be provided to the City in legible form by the Builder.

H. Infiltration/Ex-filtration Gravity Sewer Main Line: The allowable limits of infiltration or ex-filtration for the entire system, or any portion thereof, shall not exceed a rate of one hundred (100) gallons per inch of inside pipe diameter per mile of pipe per twenty-four (24) hours. No additional allowance will be made for house service lines. The allowable limits of infiltration or ex-filtration of manholes shall not exceed a rate of four (4) gallons per manhole per twenty-four (24) hours.

Any part or all of the system may be tested for infiltration or ex-filtration, as directed by the Owner. Prior to testing for infiltration, the system shall be pumped out so that normal infiltration conditions exist at the time of testing. The amounts of infiltration or ex-filtration shall be determined by pumping into or out of calibrated drums or by other methods approved by the Owner.

The ex-filtration test will be conducted by filling the portion of the system being tested with water to a level equal to the lowest part of the manhole frame.

Tests shall be conducted on portions of the system not exceeding three (3) manhole runs or maximum of one thousand two hundred (1200) feet whichever is greater unless otherwise directed by the Owner. Tests shall be run continuously for two (2) hours.

Where infiltration or ex-filtration exceed the allowable limits specified herein, the defective pipe, joints, or other fault construction shall be located and repaired by the Contractor. If the defective portions cannot be located, the Contractor shall remove and reconstruct as much of the work as is necessary in order to conform to the specified allowable limits.

The Contractor, at no expense to the owner, shall provide all labor, equipment and materials and shall conduct all testing required, under the direction of the Owner.

I. Infiltration/Ex-filtration Gravity Sewer Laterals: Infiltration and ex-filtration testing (two (2) feet of Head for infiltration; zero (0) head for ex-filtration) of service connection lines shall be done in conjunction with the testing of the lateral and/or main line sewer. No additional leakage allowance will be made for service lines.

Infiltration testing of service lines will not be permitted unless a minimum two (2) feet static head of ground water exists over the shallow end of the service line at cleanout.

J. The results of all testing shall be provided to the City in legible form by the Builder.

SECTION 6

WASTEWATER FORCE MAINS

6.01 GENERAL

This Section includes the general requirements for design and installation of force main systems servicing wastewater pumping stations.

6.02 DESIGN STANDARDS

A. Required Reference: The Contractor shall comply with the applicable design and installation requirements as established by the FDEP and the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)."

B. System Design: Force main systems shall be of adequate size to efficiently transmit the total ultimate peak operational flows applied by the connected sewage pumping station(s) to the effluent point. Consideration should be given to possible future connecting pumping stations and this probability shall be reviewed by the CMOOS representatives. Capacity computations shall be coordinated with the proposed pumping system(s) along with any future flow requirements, if applicable. Force main flow velocity shall not be less than two and one-half (2.5) feet per second or more than ten (10) feet per second.

1. Average Design Flows: The force main system design shall be based on full ultimate development as known or projected. The average daily flow (ADF) from domestic units shall be calculated at the minimum rate of one hundred (100) gallons per capita per day. One (1) ERC shall be equal to the rate of three hundred (300) gallons per day. Flow requirements from commercial, industrial, institutional, or other special development areas shall be established using City Cods Section 21-195.

2. Peak Design Flow: The peak design flow rate shall conform to the requirements outlined in Broward County's "Consulting Engineer's Guide

for a Wastewater Collection/Transmission System Construction License System".

3. At design pumping rates, a scour velocity of a least two and one-half (2.5) feet per second should be maintained at all times. The maximum velocity at design pumping rates should not exceed ten (10) feet per second. The minimum force main diameter shall be six (6) inches.
4. Friction losses through force mains shall be based on the Hazen-Williams formula. In the use of the Hazen-Williams formula, the values for "C" shall be one hundred (100) for new DI pipe and one hundred twenty (120) for new PVC pipe.
5. Force mains shall not terminate into a gravity sewer line, or gravity sewer manhole.
6. Design Calculations: The Developer's Engineer shall submit signed, sealed and dated design calculations for all wastewater force main projects. The calculations shall show that the force main will have sufficient hydraulic capacity to transport and clean the pipeline for all design flows. The developer may be required to make improvements to the City's collections system to maintain capacity downstream of the development.
7. Hydraulic Model: WaterCad Hydraulic modeling or approved equal of wastewater system shall be run to demonstrate capacity of force main system and results provided to the City for review and acceptance. Model runs are to include all lift stations with all (both) pumps operating as well as only the most remote lift station operating with a single pump. (See Section 7.02 C.)

C. Operational Cost Considerations: In addition to initial capital expenditure, long term pumping station operational costs shall also receive consideration when sizing force mains. Should a pipe size option be available within the design limits, the cost of sewage pumps and motors, force main system and pump operating

power (computed for design average daily flow rate for ten (10) years at existing electricity cost), shall be compared to like amounts for the alternate designs. The final force main size selection shall be directed towards the system with the least long range capital and operational cost. Said cost analysis shall be subject to review.

D. Location: Force mains shall be located in dedicated rights-of-way or utility easements. When installed in rights-of-way, force mains shall maintain a consistent alignment with respect to the centerline of the road. All force mains located outside of dedicated rights-of-way shall require a minimum twenty (20) foot easement.

6.03 STANDARD REQUIREMENTS

A. Approved Pipe, Fittings and Valves: Pipe used for force main systems shall be DI pipe. All pipe, pipe fittings, pipe restraining systems, and specials intended for conveying or transmitting service of raw sewage shall be designed for a minimum working pressure of 150 PSI.

All DI pipe shall conform to ANSI/AWWA A21.51/C-151. The DI pipe shall be a minimum thickness Class 52 for four (4) inch and six (6) inch pipe, and Class 51 for eight (8) inch and above, unless a higher class pipe is specifically required by CMOOS. The types tabulated below within the size range indicated and for the applicable service are approved for wastewater force main construction.

Pipe and Fittings	Size Range (inches)
Ductile Iron Pipe & Fittings*	4 and greater

Ductile iron pipe shall be lined with polyethylene or coated with the manufacturer's coating system. In either case, the Engineer's review and approval is required for either alternative prior to construction. Cement mortared linings are not appropriate for this application.

(*) Interior coating or lining requirements shall receive special consideration in regard to operational conditions.

Cast iron and ductile iron fittings shall conform to ANSI/AWWA Standard C110 A21.10 latest revision. Fittings four (4) inches and larger shall be coated as set forth above for ductile iron pipe.

Valves	Size Range
Gate Valves	No Limit

B. Joints: Joints for DI pipe and fittings shall be push-on or mechanical type joints conforming to ANSI/AWWA A21.11/C-111, unless otherwise required by CMOOS. Flanged joints, if required, shall conform to ANSI B16.1-125 lb. Joints for bell and spigot ductile iron pipe and fittings shall conform to ANSI/AWWA Standard C111/A21.11 latest revision. Mechanical joint or push on joint shall be rubber gasket compressions. Special fittings and restrained joints shall be considered for specific installation subject to the approval of the Owner. No solvent weld or threaded joints will be permitted.

Flanges on flanged ductile iron pipe for above ground application shall conform to ANSIIAWWA Standard C110/A21.10.

C. Joint Restraining: Pressure piping fittings and other items requiring restraint, shall be braced with restraining assemblies. Said restraining devices shall conform to Sections 3.02 and 4.03.E. of these Standards, and shall be designed for the maximum pressure condition (testing).

D. Pipe Depth and Protection: The standard minimum cover for wastewater force main systems shall be three (3) feet from the top of the pipe to finished grade. Additionally, approved utility crossing signs shall be placed on the pipe alignment at each side of the canal, etc.

E. Separation of Water Mains and Sewers: Wastewater force mains that are installed in the vicinity of pipe lines designated to carry potable water shall meet the horizontal and vertical separations specified herein.

1. Horizontal Separation: Under normal conditions wastewater force mains shall be located at least ten (10) feet horizontally from pipes carrying potable water and five (5) feet horizontally from reuse pipe, whenever possible. The distance shall be measured from the inside edge of pipe to inside edge of pipe. When local conditions prevent a horizontal separation of ten (10) feet, a wastewater force main may be laid closer to a pipe carrying potable water provided that the bottom of the water main is at least eighteen (18) inches above the top of the wastewater force main, and the water main is laid in a separate trench or on an undisturbed earth shelf.

2. Vertical Separation: Wastewater force mains shall be laid to provide a separation of at least eighteen (18) inches between the top of the wastewater main and the bottom of the water main and/or reuse main.

3. Crossing of Water Mains and Sewers: Wastewater force mains shall be installed below water mains whenever they cross. A vertical separation of at least eighteen (18) inches shall be maintained between the top of the force main and the bottom of the water main as noted above. Adequate structural support for both the water main and wastewater force main shall be provided to prevent excessive deflection of joints and settling. Both mains shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the other main.

F. Connections at Structures: Where pipes are to extend into or through structures, flexible joints shall be provided within one (1) foot from the wall face.

G. Special Exterior Protection for Corrosion: Extra protection shall be provided for underground DI pipe and fittings within areas with severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement as specified in AWWA C-105 through the area of concern. The soil-test evaluation to determine the necessity for extra protection in suspect areas shall be as set forth in ANSI A21.5. Additionally, where other existing utilities are known to be cathodically protected, DI pipe crossing said utility shall be protected from a distance of twenty (20) feet to each side, and when installed parallel to and within ten (10) feet of the said utility, protection shall also be provided.

H. Air Venting: Where the force main profile is such that air pockets or entrapment could occur, provisions for automatic air release shall be provided. The air release valves shall conform to the requirements outlined in Section 4.03.I. of these Standards. Automatic air release assemblies shall be installed where venting is required, on all major force mains, and at critical points on lesser mains. Air release valve assemblies shall be provided at profile break points on major force mains, such as tops of hills, etc., where free flow will occur during operation or after pumping stops. Air release valves shall be suitably housed in a properly vented underground chamber. Installation shall be as shown on "air release valve detail" (See Figure 108 or Figure 109).

I. Valves: Gate valves as specified in Section 3.03 B of these Standards shall be used on all wastewater force mains. Valve boxes shall be in accordance with the requirements set forth under Section 3.03 J of these specifications.

J. Valve Locations: Valves shall be installed on all subsidiary force mains at the point of connection to the major main, in order to isolate said pipeline for maintenance. Where force mains are to be extended, valves shall be placed at the future connection point to preclude line shut-down at the time of extension. At future connection branches or ends, the valves shall be restrained by methods other than thrust blocking in order to facilitate said connection without system shut-down. On straight runs of force mains, valve spacing shall not exceed two

thousand (2,000) feet. Materials and allowable tap sizes on existing force mains shall conform with the requirements of Section 3.03 herein.

K. Branch Connections: Where the receiving force main liquid transmission sectional area is less than four (4) times that of the subsidiary main, connections shall be through wye fittings. Tee fitting connections are acceptable within the allowable range (receiving main sectional area more than four (4) times that of the branch) with tapping sleeves recommended for receiving mains twenty-four (24) inches and larger.

L. Alignment Direction Change: When changes in the direction of alignment are required, fitting angles shall not exceed forty-five (45) degrees, unless specific design considerations dictate otherwise. For example, at a ninety (90) degree turn, two (2) forty-five (45) degree bends will be used in place of one (1) ninety (90) degree bend.

M. Pigging Connections: Should force mains appear to be susceptible to sedimentation clogging, as created by depressed crossings or extended low flow (velocity) periods, suitable pigging connections shall be provided at the lift station and along the force main. Said pigging connection, such as plugged wye or tee fittings with resilient seated gate valves, shall be located to facilitate (launching and retrieving) the subject maintenance operation.

N. Identification Tape and Locating Wire: Identification tape and fourteen (14) gauge multi-strand locating wire shall be installed over all PVC pipe. The fourteen (14) gauge copper wire is placed directly on top of all PVC pipe. The tape is installed over the centerline of the pipe, at eighteen (18) inches below finished grade, and shall be the detectable type. The fourteen (14) gauge multi-strand wire shall be laid clear of valves and tested for continuity at all pressure tests. The identification tape shall be laid continuously without gaps between ends over all installed piping, and shall have the words "Caution, Wastewater Force Main Buried Below" printed continuously along its length.

6.04 INSTALLATION

A. All force mains, valves and appurtenances shall be installed in accordance with Sections 2 and 3 of these Standards.

6.05 TESTING

A. The Builder shall perform hydrostatic testing of all wastewater force mains, as set forth in the following, and shall conduct said tests in the presence of representatives from CMOOS and/or other authorized agencies with two (2) days advance notice provided.

B. Piping and appurtenances to be tested shall be within sections between valves or adequate plugs, all with prior approval. Testing shall not proceed until restraining devices have been installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section with additional release cocks provided if required.

C. Hydrostatic testing shall be performed at 150 psi. The testing procedure shall continue for an uninterrupted period of not less than two (2) hours. Testing shall be in accordance with the applicable provisions as set forth in Section 4 of AWWA C-600. The allowable rate of leakage for piping shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in linear feet (maximum length is 2,000 feet for calculation)

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch, gauge min 150 psi. Pressure loss during test shall not exceed 5 psi.

D. The testing procedure shall include continuous application of the specified pressure to the test system, for the two (2) hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

Upon completion of the hydrostatic testing, all force main piping shall be flushed with a sufficient amount of clear water to displace test water. If the discharged water shows evidence of excessive mud, sand or other deposits, the Owner may direct the Contractor to continue flushing, or to clean the entire force main system by other approved methods to insure the removal of such deposits.

E. Should the test fail, necessary repairs shall be accomplished by the Contractor and the test repeated until it is within the established limits. The Contractor shall furnish the necessary labor, water, pumps, gauges and all other items required to conduct the required sanitary sewage force main testing, and shall perform the necessary system repairs required to comply with the specified hydrostatic test.

F. Surface Water Crossings

1. Aerial Crossings: Structural supports shall be provided for all joints in pipes utilized for aerial crossings, and shall be designed to prevent overturning and settlement. Expansion joints shall be provided between the aerial and buried sections of pipe. The impact of flood waters and debris shall be considered and the bottom of the pipe shall be placed no lower than one (1) foot above the 100-year flood elevation.

Restrained mechanical joint DI pipe, minimum Class 52, shall be used for all aerial crossings. The above-ground pipe shall be painted as specified in Section 3.05 of these Standards for above-ground water mains. Valves

located on the underground pipe shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An automatic air release relief valve shall be installed at the high point of the crossing. Appropriate guards shall be installed at both ends of the crossing to prevent pipe access to the public.

It shall be the responsibility of the Contractor to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Contractor shall meet all requirements of the agencies who own or have jurisdiction over such structures.

2. Underwater Crossings: The pipe material shall meet appropriate Standards for use in submerged conditions. Valves shall be provided at both ends of each crossing so that the section can be easily isolated for testing or repair. The valves shall be easily accessible. It shall be the responsibility of the Contractor to obtain all applicable regulatory permits, including dredge and fill permits.

SECTION 7

WASTEWATER PUMPING STATIONS

7.01 GENERAL

A. This section includes the general requirements for the design criteria and installation of wastewater pumping stations discharging less than three thousand (3,000) gallons per minute (gpm). All such pump stations shall be submersible duplex or triplex type pump stations. All design calculations and plans for wastewater pumping stations shall be signed, sealed and dated by a professional engineer registered in the State of Florida. Only approved pumps and equipment listed in Appendix "A" shall be allowed.

B. The work included under this specification consists of a guide for the design of lift stations and pump stations to be owned and operated by the City of Miramar Utilities. A wastewater pumping station will be comprised of eight (8) major elements:

1. Wet well and submersible pumps
2. A covered valve pit
3. Control panel
4. Parking area
5. Pipe line
6. Concrete pad/slab
7. Fence
8. One (1) inch water service

A drawing shall be required showing lift station location, roads, paved service truck parking area, control location, pipe layout, force main route, easements, and fencing.

C. These specifications apply for normal domestic sewage where the sewage temperature will not exceed one hundred fifteen (115) degrees Fahrenheit.

7.02 DESIGN STANDARDS

A. Required Reference: The Developer shall comply with the applicable requirements established by the DPEP. Additionally, the criteria provided in the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)", may generally be utilized as design guidelines, if not in conflict with State, County or other regulatory agency requirements.

B. Design Flows: Wastewater Pumping Stations shall be designed for the total ultimate development flow from all contributory areas. Calculations shall be required showing influent flow rate, wet well storage capacity, pump static and dynamic head conditions, and pump cycle time. Said contributions shall include the immediate gravity system, subsidiary sources, and known or projected future development within the designated station service area. The maximum required pumping capability shall be as set forth in Section 5 herein.

In general, no more than one (1) lift station per quarter section (160 acres) shall be allowed.

If a proposed wastewater pumping station is within three hundred (300) feet of an existing water body, a Soil Engineer's Report with recommendation for wet well construction shall be provided.

C. Pump Selection:

1. For pumping stations with a maximum flow demand of one thousand five hundred (1,500) gpm or less, a minimum of two (2) pumping units shall be provided. Where the peak design flow exceeds one thousand five hundred (1,500) gpm, three (3) or more units shall be included in the facility. In all cases, stand-by pumping capability shall be provided, such that if any one (1) pump is out of service, an alternate unit is available at equal or greater

capacity. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors.

2. The selected sewage pump system shall have the minimum capability of pumping the design peak flow (at the maximum computed system total dynamic head (TDH) requirements) with the largest pumping unit out of service.

3. Head-Capacity curves shall be prepared for the proposed pumping system in order to determine the various operational conditions. Hydraulic computations shall be in accordance with good engineering practice with pipe friction loss calculated by the Hazen-Williams formula using standard friction factors based on the material utilized. However, it shall not be greater than "C=120" unless the justification for higher values are approved. Pump curves for the proposed pump shall be included with head-capacity curves for CMOOS review. WaterCad Hydraulic Modeling shall be run and results provided to the City for review and acceptance. The system head-capacity analysis shall provide the following and be subject to review:

   a. WaterCad Hydraulic Modeling of wastewater pump stations shall be run to demonstrate the pumping capacity and results shall be provided to the City for review and acceptance.

   b. System operation under peak flow conditions with all pumps pumping. Should the receiving force main system be interconnected all pumps at all pumping stations shall also be pumping.

   c. Pumping capability with one (1) pump running at every station on the interconnect force main, all units operating in parallel, and other combinations, if applicable.

   d. This station only with only one (1) pump running.

D. Design Calculations: The Developer's Engineer shall submit signed, sealed and dated design calculations for all wastewater pump stations. Calculations shall include head versus capacity curves with copies of certified published manufacturer's pump curves, hydraulic analysis of the force main system, operating cycle calculations with wet well sizing, and buoyancy calculations.

E. Wet Well Design: The wet well structure shall provide a capacity between operational water levels sufficient to allow a minimum of fifteen (15) minutes between successive starts of the pumps under the following condition: influent rate of one-half (1/2) the maximum one (1) pump capacity and, one (1) pump running at said maximum. The wet well bottom shall be a minimum of five (5) feet below the lowest invert. Low water levels shall provide a minimum of one (1) foot of liquid above the top of the pump motor to preclude pump inlet vortexing, air-binding, or other design considerations. Operational maximum water levels shall not exceed the invert elevation of the influent pipe.

In general, the normal operational water level shall provide a positive suction head for the sewage pumps. Operational maximum or high water levels shall not exceed the invert elevation of the lower influent pipe. No interior ladders shall be permitted in the wet well.

Buoyancy calculations verifying that adequate provisions have been made to prevent wet well flotation shall be submitted to CMOOS. These calculations shall assume that the wet well is empty and the minimum factor of safety with respect to flotation is 1.2.

F. Ventilation: Wet wells for submersible installations or others without free access shall be ventilated with not less than one (1) four (4) inch diameter open vent pipe. A four (4) inch odor control line may be required. Top elevation shall be above the 100-year flood elevation.

G. Water System: The wastewater pump stations shall be provided with a water system with adequate capacity and pressure for station washdown and other

requirements. The station water system shall be completely separated from the potable water supply by means of a reduced pressure backflow preventer or other CMOOS approved system.

H. Emergency Operation: All pump stations shall be provided with an emergency pumpout connection and an emergency power receptacle as specified herein. Pump stations with pumping capacity of 1,500 gpm and greater shall be provided with onsite emergency power generation.

I. Site: Wastewater pumping station parcels shall be minimum thirty feet by thirty feet (30 x 30) and shall not be located within one hundred (100) feet of the top of the bank of any water body. Pumping stations shall be installed on/off the R/W, readily accessible sites, and shall have adequate area provided for operation and maintenance of the facility. The site shall be readily accessible by maintenance vehicles during all weather conditions. The wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by a 100-year flood event. The wastewater pumping stations should remain fully operational and accessible during 100-year flood events. Regulations of the City, County Health Department, State and Federal agencies shall be considered.

The pump station sites shall be sized and dedicated parcels shall also be required around the site as delineated on the "Pump Station Site Plan" in the Standard Drawings. The Developer shall dedicate the pump station site free of encumbrances by warranty deed or plat to the City. All pump station sites shall be fenced and sodded with Floratam and/or landscaped.

J. General: A site plan must be provided indicating the following:

1. The station must be referenced to the nearest street.
2. Adequate access.
3. Auxiliary power plug or the generator location and automatic power transfer switch.

4. The power pole location.
5. The water meter with backflow prevention and hose bib location.
6. The pumping station site plan must indicate what landscaping the developer will provide.
7. Pump and pump station specifications and performance data must be provided. This should include:
    a. An operator's manual.
    b. A layout block diagram showing location of different components attached to the control panel.
    c. The performance curves for the pump submitted must show that it will operate generally in the center part of the curve and not approach either upper or lower extreme.
    d. An electrical schematic and wiring diagram including a parts schedule containing information on type, model and rating of components.
    e. Motor controls should include backspin motor protection.
8. Emergency alarm system circuitry must be installed.
9. All wiring must be copper.
10. All outside enclosures must be NEMA 4X Stainless Steel, unless otherwise specified.
11. A lock out/pump down switch is to be provided at the wet well. This function has to be interrelated with the main auto/off/manual MCC switch.
12. A light pole with light to illuminate the wet well and the control panel is required. Light shall be equipped with photocell for automatic on/off. The circuit shall include an on/off switch to disable the photocell.
13. All required telemetry conduits shall be installed for telemetry construction.

7.03 GENERAL REQUIREMENTS

A. Piping Systems:

1. Connections at Structures: Where pipes are to extend into or through structures from the exterior, flexible connections (mechanical or push-on type joints) shall be provided within one (1) foot of the exterior wall face.
2. Wall Pipes or Sleeves: For pipes passing through structural walls, wall pipes shall be installed where the location is below the surface of the ground or at any point where water levels will exceed the installed pipe elevation. Sleeves with watertight caulking shall be suitable at other locations.
3. Piping Flexibility: In order to provide for expansion and contraction or to expedite installation and maintenance, flexible connections (flanged coupling adapters, expansion joints, couplings, etc.) shall be provided.
4. Debris Cage: Each influent pipe entering the lift station wet well shall be equipped with a stainless steel or fiberglass debris cage. The cage shall be constructed to facilitate ease of removal and cleaning. (Cage is shown in Figure 305.1, labeled as S.S. Trash basket.)

B. Valves:

1. Check Valves: Check valves shall be swing type and shall meet the requirements of AWWA C-500 and Section 3.03.C. of these Standards. Check valves shall be spring and lever type.

C. Pressure Sensor: Gauges and transmitters shall be provided on each wastewater pump discharge pipe down stream of the check valve and gate valve, as well as other locations where pressure sensing is desirable. Each pressure gauge shall be a direct-mounted, annular-sealed stainless steel sensing element, and liquid-filled, with a two (2) inch dial and furnished with a clear glass crystal window, and a one-quarter (¼) inch shut-off valve. All gauges shall be weatherproofed. The dial face shall be white finished aluminum with jet black graduations and figures. The

dial face shall indicate the units of pressure measured in psi, with a zero (0) to sixty (60) psi range.

D. Emergency Pump Connections: Connections shall be provided for emergency auxiliary pumping, and shall be coupled to the discharge main through a fitting with valving as required for making a dead hook-up. The connection pipe shall be DI of suitable size, but in no case less than four (4) inches in diameter. Above fifteen (15) hp., pipe shall be six (6) inches minimum.

E. Surge Control: Surge control valves, or other approved systems shall be provided for all wastewater pumping stations where hydraulic conditions indicate the necessity.

F. Wastewater Pumps and Motors:

1. General: The wastewater pumping units shall be capable of handling raw, unscreened wastewater and shall be capable of passing a sphere of at least three (3) inches in diameter. Pumps shall be electric motor-driven and of a proven design that has been in sewage service under similar conditions for at least five (5) years. The pumps shall provide the required peak design performance requirements, and be suitable for operation within the total hydraulic range of operation without frequent change of impeller.

2. Submersible Pumps: The pump design shall provide easy removal and replacement for inspection or maintenance purposes without bolts or other fastenings to be removed. Slide rails to be dual pole. The units shall be non-clog, mechanical seal, submersible sewage pumps.

3. Shaft: The pump shaft shall be of Series 300 or 400 Stainless Steel. The shaft and bearings shall be adequately designed to meet the maximum torque required for start-up or operating conditions and minimize vibration and shaft deflection. As a minimum, the pump shaft shall rotate on two (2) permanently lubricated bearings. The upper bearing shall be a single row ball bearing. The lower ball bearing shall be a two (2) row angular contact ball bearing, if required, to minimize vibration and provide maximum bearing life.

4. Impeller: The impeller shall be constructed of gray cast iron, ASTM A-48, Class 30. Each pump shall be provided with a replaceable metallic wear ring system to maintain pump efficiency. As a minimum, one (1) stationary wear ring provided in the pump volute or one (1) rotating wear ring provide on the pump impeller shall be required. In addition, a two (2) part system is acceptable.

5. Mechanical Seal: Each pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two (2) separate lapped face seals, each consisting of one (1) stationary and one (1) tungsten carbide ring. Each pair shall be held in contact by a separate spring so that the outside pressure assists spring compression in preventing the seal faces from opening. The compression spring shall be protected against exposure to the wastewater. Silicone carbide may be used in place of tungsten carbide for the lower seal. The pumped liquid shall be sealed from the oil reservoir by one (1) face seal and the oil reservoir from the air-filled motor chamber by the other face seal. The seals shall require neither maintenance nor adjustment, and shall be easily replaced. Conventional double mechanical seals with a single spring between the rotating faces requiring constant differential pressure to effect sealing and subject to openings and penetration by pumping forces shall not be considered equal to the tandem seal specified and required.

6. Guides: A sliding bracket shall be an integral part of the pump casing and shall have a machined connecting flange to connect with the cast iron discharge connection. All guide rails shall be Flygt compatible. A stainless steel plate shall be placed and leveled on epoxy grout before the bracket shall be bolted to the floor of the wet well with stainless steel anchor bolts and so designed as to receive the pump discharge flange without the need of any bolts or nuts. Sealing of the pumps to the discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided by no less than two (2) Type

316 seamless tubular stainless steel guides which will press it tightly against the discharge connection. No portion of the pump shall bear directly on the floor of the wet well and no rotary motion of the pump shall be required for sealing. Sealing at the discharge connection by means of a diaphragm or similar method of sealing shall not be accepted as an equal to a metal to metal contact of the pump discharge and mating discharge connection specified and required. If it is necessary to meet the above specification, approved pump manufacturers shall provide a sliding guide bracket adapter. The design shall be such that the pumps shall be automatically connected to the discharge piping when lowered into place on the discharge connection. The pumps shall be easily removable for inspection or service, and shall require no bolts, nuts, or fastenings to be removed for this purpose. There shall be no need for personnel to enter the wet well. Each pump shall be fitted with a Type 304 Stainless Steel, three-quarter (¾) inch lifting chain of adequate strength. A one-quarter (¼) inch stainless steel cable, air craft rating, shall be provided between the cable holder and the lifting chain.

7. Pump Motors: All motors shall be built in accordance with the latest NEMA, IEEE, ANSI, and AFBMA Standards where applicable. Pump motors shall be housed in an air-filled, water-tight casing and shall have Class F insulated windings which shall be moisture resistant. Motors shall be NEMA Design B, rated one hundred fifty-five (155) degrees Celsius maximum. Pump motors shall have cooling characteristics suitable to permit continuous operation in totally, partially, or non-submerged conditions. The pump shall be capable of running continuously in a non-submerged condition under full load without damage, for extended periods. The motor shall be capable of a minimum of ten (10) starts per hour. Before final acceptance and if required by CMOOS, a field running test demonstrating this ability with twenty-four (24) hours of continuous operation under the above conditions shall be performed for all pumps

being supplied. Motors of twenty-five (25) h.p. and below shall be 230/460 volt, 3-phase, and motors greater than twenty-five (25) h.p. shall be 460 volt, 3-phase. All pump motors shall be designed with a 1.15 service factor and shall not be less than five (5) h.p. unless approved. Pumps shall be capable of meeting all pump curve conditions without exceeding the motor's rated h.p.

Two (2) or more normally closed heat sensing miniature switches connected in series and embedded within the motor windings shall be provided. In addition, the motor shall incorporate one (1) motor sensing device. These protective devices shall be wired into the pump controls in such a way that if excessive temperature or moisture is detected, the pump will shut down. These devices shall be self-resetting.

Cables shall be designed specifically for submersible pump applications and shall be properly sealed. A type CGB water-tight connector with a neoprene gland shall be furnished with each pump to seal the cable entry at the control panel. The pump cable entry seal design shall preclude specific torque requirements to insure a water-tight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by washers. The washers shall have a close tolerance fit against the cable outside diameter and the entry inside diameter, and they shall be compressed by the entry body containing a strain relief function separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board which shall isolate the motor interior from foreign material gaining access through the pump top. Secondary sealing systems utilizing epoxy potting compounds may be used. When this type of sealing system is used, the manufacturers shall supply a cable cap as part of the spare parts for each

pump. All cables shall be continuous without splices from the motor to the control panel. The junction chamber containing the terminal board shall be perfectly leak proof.

G. Pump Control Panel:

1. The control panel shall respond to liquid level bubbler to automatically start and stop pumps, a float and an alarm at high wet well levels. The control panel shall operate all electrical submersible pumps at the power characteristics stipulated. The control function shall provide for the operation of the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, the lag pump shall automatically start to handle this increased flow. As the flow decreases, the pumps shall be cutoff at the specified elevation. The pumps shall alternate positions as lead pump at the end of each cycle. A failure of the alternator shall not disable the pumping system. The alternator shall include a safe, convenient method of manual alternation and have provisions to prevent automatic alternation without disturbing any wiring. Should the “pump on” regulator fail, the float system shall keep the station in operation and provide a visual indication of the regulator failure.

   The control panel shall consist of main circuit breakers and generator breaker with mechanical interlock, a Meltric 200-amp Model 3 PHW #3799043 emergency power receptacle, a circuit breaker and magnetic starter for each pump motor, and fifteen (15) amp, 120-volt circuit breakers as required. All pump control operations shall be accomplished by a bubbler liquid level control system with all control components mounted in one (1) common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. A bubbler liquid level control system shall

continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps. Dual compressors shall be provided to furnish a redundant level of reliability for the liquid level control system.

Pump controls shall be designed to provide pump off elevation at a minimum of one (1) foot above the top of the pump motor. The lead pump on, lag pump on and high level alarms shall be below the lowest inlet invert so that the gravity system is not used for storage at any time. The lag pump elevation (in a duplex station) shall be above the high-level alarm elevation for the bubbler. The high-level float elevation shall be above the lag pump elevation and below the influent invert.

2. Panel Construction: The panel shall be housed in a NEMA 4X, Type 304, 14 gauge stainless steel enclosure with thirty (30) percent extra mounting space for additional equipment. The enclosure shall have provisions for padlocking the door and a dead front inner door unit for mounting controls. All exterior hardware and hinges shall be stainless steel. In addition, there shall be affixed to the interior side of the exterior door both a nameplate and a ten (10) inch by twelve (12) inch pocket for log sheet storage. The nameplate is to be removable for replacement in the event a pump upgrade is performed. The nameplate shall contain the following information: voltage, phase, rated horsepower, speed, date manufactured, pump and control panel manufacturer's name, address and telephone number, pump data, including impeller data, operating point and head, KW, and amps at the operating point and at least two (2) other points on the pump curve.

3. Power Supply and Main Disconnect: The power supply to the control panel shall be either 240-volt, 3-phase, 4-wire or 480-volt, 3-phase, 4-wire. Minimum service shall be one hundred (100) amp. Single phase power shall not be accepted. Nonfusible stainless steel safety service main disconnects shall be installed at all stations. In all 240-volt systems,

disconnects should be installed between the meter and the panel, and on all 480-volt systems disconnect should be installed ahead of the meter. LED power available indicators shall be supplied on all legs.

4. Circuit Breakers:
   a. Main Breakers: The panel shall have an inter-lock system between the normal power main breaker and the emergency breaker to ensure only one (1) breaker in the "on" position at a time. Both breakers shall be equal in size.
   b. Circuit Breakers: All circuit breakers shall be heavy-duty molded-case breakers. The handle on the circuit breakers shall be operational through the inner door.
5. Motor Circuit Protectors: Each pump shall be protected by a three (3) pole motor circuit protector. The motor circuit protector shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free from the handle so that the contacts cannot be held closed against a short circuit and abnormal currents which cause the motor circuit breaker to trip. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the normal "on" and "off" positions. All latch surfaces shall be ground and polished. All poles shall be so constructed so that they open, close, and trip simultaneously. The motor circuit protector must be completely enclosed in a high-strength glass polyester-molded case. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. A manual push-to-trip button shall be provided for manual exercising of the trip mechanism. Each pole of these motor circuit protector's shall provide instantaneous short circuit protection by means of an adjustable magnetic-only element.
6. Motor Starter and Selector Switches: The panel shall contain two (2) motor starters. The motor starter shall be across the line magnetic starter

with individual overload protection on each lower leg with reset installed through the inner door unit. Selector switches shall be installed on the face of the inner door unit. Selector switch shall be a heavy-duty oil-tight "Hand-Off-Automatic" three (3) position switch to control the operation mode of each pump motor starter.

7. Lights and Alarms:
   a. Indicator Lights: Heavy-duty oil-tight indicator lights as shown on the Standard Drawings shall be installed on the face of the inner door unit.
   b. Alarm Light: A vapor-proof red light and horn shall be mounted on a separate pole adjacent to the control panel. In addition, there shall be an alarm silence push-button on the inner door and a silence relay which will silence the horn and automatically reset when these signals are restored to normal. The push-button shall be heavy duty oil tight. The red globe shall be the screw-on type.
8. Emergency Power Receptacle: The control panel shall have an external mounted generator receptacle, namely, a Meltric one hundred (100) amp Model 3 PHW #3799043, receptacle that shall face toward the gate.
9. Additional Requirements:
   a. All power wires shall be THW or THWN seventy-five (75) degree Celsius insulated stranded copper conductors and shall be appropriately sized for the given load application. All control circuit wire shall be type THW, stranded wire type. All wiring within the enclosure shall be neatly routed by the use of slotted wiring duct with snap-on type covers. Wiring on the rear of the inner door shall be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage, with each end of the conductor marked as indicated below:

WIRE NO	COLOR	DESCRIPTION
1	Black	120 Volt Hot
2	White	120 Volt Common Ground
3	Green	Ground
4	Green	Dedicated Ground
5	Orange	Service Key Switch
6	Orange	Service Key Switch – Common
7	Brown	Bubbler Failure
8	Brown	Bubbler Failure – Common
9	Brown	Wetwell High Level Alarm
10	Brown	Wetwell High Level Alarm - Common
11	Brown	Wetwell & Valve Vault Intrusion
12	Brown	Wetwell & Valve Vault Intrusion – Common
13	Purple	Phase Failure
14	Purple	Phase Failure
15	Purple	Control Circuit Failure
16	Purple	Control Circuit Failure
17	Gray	Pump Station Disable/Enable Control from RTU
18	Gray	Pump Station Disable/Enable Control from RTU – Common
19	Gray	Pump Station Disabled Report
20	Gray	Pump Station Disabled Report
21	Orange	Control/Phase Failure
22	Orange	Control/Phase Failure - Common
23	Yellow	Pump 1 On
24	Blue	Pump 2 On

25	Red	Pump 3 On
26	White	Pumps On – Common
27	Yellow	Pump 1 Failure
28	Yellow	Pump 1 Failure – Common
29	Yellow	HOA 1 Not in Auto Position
30	Yellow	HOA 1 Not in Auto Position - Common
31	Blue	Pump 2 Failure
32	Blue	Pump 2 Failure - Common
33	Blue	HOA 2 not in Auto Position
34	Blue	HOA 2 not in Auto Position - Common
35	Red	Pump 3 Failure
36	Red	Pump 3 Failure – Common
37	Red	HOA 3 not in Auto Position
38	Red	HOA 3 not in Auto Position - Common
39	Twst Pr	Force Main Pressure (+) (4-20 ma Twisted Pair)
40	Twst Pr	Force Main Pressure (-) (4-20 ma Twisted Pair)
41	Gray	Alarm Silence from RTU
42	Gray	Alarm Silence from RTU – Common
43	Orange	Drywell Flooding
44	Orange	Drywell Flooding – Common
45	Orange	Sump Pump 1 On
46	Orange	Sump Pump On – Common
47	Red	12VDC (+) From RTU
48	Black	12VDC (-) From RTU
49	Twst Pr	Water Main Pressure (+) (4-20 ma Twisted Pair)
50	Twst Pr	Water Main Pressure (-) (4-20 ma Twisted

		Pair)
51	Twst Pr	Water System Pressure (+) (4-20 ma Twisted Pair)
52	Twst Pr	Water System Pressure (-) (4-20 ma Twisted Pair)
53	Twst Pr	Wetwell Level (+) (4-20 ma Twisted Pair)
54	Twst Pr	Wetwell Level (-) (4-20 ma Twisted Pair)
55	Twst Pr	Discharge Flow (+) (4-20 ma Twisted Pair)
56	Twst Pr	Discharge Flow (-) (4-20 ma Twisted Pair)

b. Terminal points of all terminal strips shall be permanently identified. All terminal numbers and identifying nomenclature shall correspond to and be shown on the electrical diagrams. All wiring shall be permanently shown on the electrical drawings.

c. All circuit breakers, control switches, indicator pilot lights, and other control devices shall be identified with permanently affixed legend plates and lamicoid-type engraved nameplates.

d. A surge protector shall be included and wired to protect motors and control equipment from lightning-induced line surges. All surge protectors shall be United Laboratories (UL) approved and installed per the respective power company's requirements and manufacturer's specifications. Surge protectors shall be attached to the main disconnects.

e. Elapsed time meters shall be 115-volt not-reset type and shall totalize pump running time in hours and tenths of hours to 99999.9 hours.

f. On the face of the inner door unit, there shall be installed a fifteen (15) amp, 120-volt, duplex convenience receptacle. It shall be

provided with it's own single pole, fifteen (15) amp circuit breaker for protection. Ground fault interrupt type shall be required.

g. Control terminal blocks shall be of the clamp screw type, rated for 600-volts. Amperage rating shall accommodate the control circuit amperage. An additional thirty (30) space terminal strip shall be installed in the cabinet for future use, with RTU equipment.

h. There shall be a control power transformer with a minimum size of 500VA to provide 120VA power for: coils for starters, 15A duplex receptacle, indicator pilot lights, alarm horn, alarm light, pump alternator, elapsed time meters, etc. The secondary side shall have one (1) leg fused and the other grounded. This control power transformer is required only on 480-volt control panels. The signal required by the float switches and relays shall be 24VAC. This shall be provided by a 24VAC control power transformer properly sized with a fused secondary.

10. All panels shall use JIC standard wiring numbers.

11. Wire shall be color coded according to voltage:

Black - 480/240

Red - 120 volt control power

Yellow- low voltage AC

Blue - low voltage DC, except where noted

7.04 TYPE OF PUMPING STATION CONSTRUCTION

Wastewater pumping stations of the submersible type are suitable where the peak design flow rate does not exceed three thousand (3,000) gpm or the pump motor size is fifty (50) h.p. or less. Said installation shall include the removable pump units. Aluminum access frame and cover, stainless steel pipe pump guide bars, pump discharge connection, and other necessary appurtenances. Individual discharge pipes shall extend from each pump to an accessible drained pit, in which the plug or gate and check valves shall be installed.

7.05 REQUIRED SUBMITTALS

A. The Builder shall provide to CMOOS in triplicate the following information regarding the wastewater pumping equipment:

1. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
2. Descriptive literature, bulletins, and/or catalogs of the equipment.
3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves based on actual shop tests of similar units which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, submergence, and horsepower. A certified shop test will be required for pumps greater than fifty (50) h.p. Curves shall be submitted on eight and one-half (8½) inch by eleven (11) inch sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to maximum manufacturer recommended pump capacity. Catalog sheets showing a family of curves will not be acceptable. A system head curve should also be platted on the pump curves.
4. Complete layouts, wiring diagrams, elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the pump control system. Suitable outline drawings shall be furnished for approval before proceeding with the manufacture of any equipment. Standard preprinted sheets or drawings simply marked to indicate applicability will not be accepted.
5. A drawing showing the layout of the pump control panel shall be furnished. The layout shall indicate and completely identify all devices mounted on the door and in the panel.
6. The weight of each pump.

7. Complete motor data shall be submitted including:
    a. Nameplate identification.
    b. No-load current.
    c. Full-load current.
    d. Full-load efficiency.
    e. Locked-rotor current.
    f. High potential test data.
    g. Bearing inspection report.

7.06 TOOLS AND SPARE PARTS

A. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

B. Spare parts shall be properly packaged and labeled for easy identification without opening the packaging and suitably protected for long term storage under humid conditions. The manufacturer shall furnish the following spare parts for each pump supplied:
    1. One (1) upper bearing.
    2. One (1) lower bearing.
    3. One (1) set of upper and lower shaft seals.
    4. One (1) set of "O-Rings" or gaskets required for replacement of bearings and seals.
    5. One (1) impeller wear ring.
    6. One (1) shaft sleeve, if applicable.
    7. One (1) cable cap, if applicable.
    8. The electrical spare parts:
        a. Digital Control Corporation...Duplex Controller Model # 11928
        b. Triplex Controller Model # 1196

7.07 DETAILS

Pump station details shall be as set forth in these Standards.

7.08 INSTALLATION AND TESTING

A. The pump station pumps, controls, electrical system, piping, valves and associated appurtenances shall be installed in accordance with Sections 3, 5, and 6 of these Standards.

B. A factory representative knowledgeable in pump operation and maintenance shall inspect and supervise a test run at the pumping station. A minimum of one (1) working day shall be provided for the inspections. Additional time made necessary by faulty or incomplete work or equipment malfunctions shall be provided as necessary to meet the requirements in these Standards at no additional cost to the City. A minimum of forty-eight (48) hours written notice shall be given to the City to witness the test(s). Upon satisfactory completion of the test run, the factory representative shall issue the required manufacturer's certificate.

The test run shall demonstrate that all items of these Standards have been met by the equipment as installed and shall include, but not be limited to, the following confirmation tests:

1. That all units have been properly installed.
2. That the units operate without overheating or overloading any parts, and without objectionable vibration.
3. That there are no mechanical defects in any of the parts.
4. That the pumps can deliver the specified pressure and quantity.
5. That the pumps are capable of pumping the specified material.
6. That the pump controls perform satisfactorily.

C. Warranty and Service:

1. Warranty: The products shall be guaranteed to be free from defects in material and workmanship under normal use and service for a period of eighteen (18) months after conveyance to the City.
2. Service: Service shall be available for in situ repair of the products. Manufacturer's repair personnel shall be based in Florida to insure a reasonable response time of not more than two (2) working days.
3. Critical Service: In the event that both pumps fail and are out of service, response time will be no more than four (4) hours.

SECTION 8

REUSE/RECLAIMED WATER AND IRRIGATION DISTRIBUTION SYSTEMS

8.01 GENERAL

A. This Section sets forth the general requirements for design and installation of effluent reuse and irrigation distribution systems. CMOOS shall determine, prior to plan preparation, if the system is to be sized for effluent reuse/reclaimed water or irrigation. Pipe used in effluent reuse and irrigation systems shall be either polyvinyl chloride (PVC), or ductile iron (DI) pipe as specified in Section 3 of these Standards.

The Contractor shall be responsible for all materials furnished and storage of same until the date of substantial completion. The Contractor shall replace, at the Contractor's expense, all material found to be damaged or defective in handling or storage. The Contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified in these Standards as it relates to effluent reuse and irrigation systems. All pipe delivered to the project site for installation is subject to random testing for compliance with the designated specifications.

8.02 DESIGN STANDARDS

A. Required Reference: The Builder shall comply with the design and installation requirements as established by the FDEP and additional specific requirements stated in these Standards.

B. System Design:

1. Normal Flow Demands: The distribution system shall supply effluent reuse/reclaimed water or irrigation water for irrigation. Irrigation demands shall be determined using the method described in these Standards.

2. System Size Computation: The minimum design for reuse/reclaimed water and irrigation distribution systems shall provide for at least one hundred (100%) percent of the normal flow demand. The allowable minimum system pressure under said design condition shall not be less than thirty (30) pounds per square inch (psi). Design computation shall be by the WaterCad procedure, or other applicable methods, as dictated by the system configuration. These computations with electronic data files and a key map are to be supplied to the City for review. Design flows and method of computation shall be subject to review and approval. These calculations shall be signed, sealed and dated by a professional engineer registered in the State of Florida.

3. Valve Locations: Valves shall be provided for all branch connections, main ends, or other locations, as required to provide an operable, easily maintained and repairable distribution system. Valves are to be placed so that the maximum allowable length of reuse or irrigation main required to be shut-down for repair work shall be five hundred (500) feet in commercial, industrial, or high density residential districts, or one thousand (1,000) feet in other areas.

C. Location: The reuse mains shall be located in dedicated R/W or utility easements. When installed in R/W, reuse mains shall maintain a consistent alignment with respect to the centerline of the road. All reuse mains located outside of dedicated R/W shall require a minimum twenty (20) foot wide easement. If a reuse main is located in an area abutting a road R/W, a minimum ten (10) foot easement shall be provided. Additional easement widths shall be provided when the pipe size or depth of cover so dictates. No reuse mains shall be placed under retention ponds or drainage ditches, tennis courts, or other structures. Placement of a reuse/reclaimed water or irrigation main along side or rear lot line may be allowed on a case-by-case basis if such a main configuration results in efficient placement and utilization of the distribution system.

8.03 STANDARD REQUIREMENTS

A. Approved Pipe, Fittings and Valves: All PVC pipe of nominal diameter of four (4) inches and smaller shall be manufactured in accordance with AWWA C-900. All PVC pipe shall meet the requirements of Section 3.02.C. of these Standards. The PVC pipe shall have a minimum working pressure rating of one hundred fifty (150) psi and shall have a dimension ratio of eighteen (18). The pipe shall be the same outside diameter as DI pipe. The DI pipe of nominal diameter of four (4) inches through thirty-six (36) inches shall conform to ANSI/AWWA A21.51/C-151. A minimum of thickness Class 52 shall be supplied for all sizes of pipe unless specifically required by CMOOS. The types tabulated below, within the size range indicated and for the applicable service, are approved for reclaimed water reuse distribution system construction:

Pipe and Fittings	Size Range (Inches)
Ductile Iron Pipe & Fittings - Cement Mortar Lined	No Limit
Polyvinyl Chloride Pipe & Ductile Iron Fittings	Less than 4
PVC Pipe (Schedule 80) and PVC Fittings with Special CMOOS Approval	Service connections only
Polyethylene Plastic Tubing with Brass Fittings	Service connection
Gate Valves	No limit
Corporation Stops and Curb Stops	Service connections only

1. Joints: PVC pipe shall have integral bell push on type joints conforming to ASTM D3139. Joints for DI pipe and fitting joints shall be push-on or mechanical joints conforming to ANSI/AWWA A21.11/C-111. Where called for by CMOOS restrained or flanged joints will be required.

Restrained joints shall meet the requirements of Section 3.02.F. of these Standards. Flanged joints shall conform to ANSI B16.1, 125 lb.

2. Fittings: All fittings shall be mechanical joint DI or gray iron conforming to ANSI/AWWA A21.10/C-110, two hundred fifty (250) psi minimum pressure rating.

3. Coatings and Linings: Interior and exterior coatings for DI pipe shall conform to the requirements outlined in Section 3.02.B.7. of these Standards.

B. Joint Restraining: Pressure piping fittings and other items requiring restraint, shall be braced with restraining assemblies, as specified under Section 3 of these Standards. Said restraining devices shall be designed for the maximum pressure condition (one hundred fifty (150) psi minimum test pressure).

C. Pipe Depth and Protection: The standard minimum cover for reclaimed water reuse distribution systems shall be three (3) feet from the top of the pipe to finish grade. Should this design not be feasible, alternatives shall be reviewed for acceptance.

D. Pipe Bedding: Special care shall be exercised in design and installation to provide adequate bedding for the type of pipe used, taking into consideration trench width and depth, superimposed loadings above grade and the material below trench grade. Pipe loading capabilities shall be computed in accordance with established design criteria and special supporting bedding or facilities shall be provided as required.

E. Connections at Structures: Where pipes are to extend into or through structures, flexible joints shall be provided within eight (8) inches of the wall face.

F. Special Exterior Protection for Corrosion: Extra protection shall be provided for underground DI pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement, as specified in AWWA C-105, through the area of concern. The soil-test evaluation to determine the necessity for extra protection in suspect areas shall be as set forth in ANSI A21.5. Additionally, where other existing utilities are known to be

cathodically protected, DI pipe crossing said utility shall be protected for a distance of twenty (20) feet to each side, and when installed parallel to and within ten (10) feet, protection shall also be provided.

G. Air Venting and Blow-Offs: Where the reuse main profile is such that air pockets or entrapment could occur, methods for air release shall be provided. Air venting capabilities shall be provided for distribution mains by appropriately placing automatic air release valves, blow-offs, or other manual devices. At critical points on major mains, automatic air release assemblies shall be installed. All dead-end reuse mains, temporary or permanent, shall be equipped with a manually operated blow-off at the terminus.

H. Service Connections: All service lines shall be one (1) inch, one and one-half (1½) inch or two (2) inch purple PVC conforming to the specifications in PPFA and ASTM D-1785 or polyethylene tubing in accordance with AWWA C-800. Connections to reclaimed water reuse mains (other than DI), of four (4) inches and larger, shall be made by the drilling of the appropriate size hole and the installation of service saddles. Services to smaller size mains shall be accomplished by in-line fittings. A corporation stop shall be placed at the saddle or fitting, with the service line extended perpendicular to said line. Services shall consist of hose bibs. Hose bibs shall be located in below grade jam-lock services boxes which shall be clearly labeled as not of potable water quality. No service lateral shall parallel adjoining lots, run between neighboring property lines or come through the rear of the property's lot line in order to provide utility service, unless otherwise approved by CMOOS.

I. Identification Tape and Locating Wire: Purple identification tape and fourteen (14) gauge multi-strand locating wire shall be installed over all PVC reuse mains. The fourteen (14) gauge copper wire is placed directly on top of all PVC pipe. The tape is installed over the centerline of the pipe, eighteen (18) inches below finished grade, and shall be the detectable type. The fourteen (14) gauge multi-strand wire shall be laid clear of valves and tested for continuity at all pressure tests. The identification tape shall be laid continuously without gaps between ends

over all installed piping, and shall have the words "Caution, Reuse Main Buried Below" printed continuously along its length.

J. Separation of Reuse Mains from Water Mains and Sewers: Reuse mains that are installed in the vicinity of pipe lines designated to carry potable water and raw wastewater shall meet the horizontal and vertical separations specified herein.

1. Horizontal Separation: Under normal conditions reuse mains shall be located at least five (5) feet horizontally from pipes carrying potable water and raw wastewater. The clear distance shall be measured from the outside edge of pipe to outside edge of pipe. When local conditions prevent a horizontal separation of five (5) feet, a water main may be laid closer to a pipe carrying reclaimed water provided that the bottom of the water main is at least eighteen (18) inches above the top of the reclaimed/reuse pipe and the water main is laid in a separate trench.

2. Vertical Separation: Under normal conditions reuse mains shall be laid to provide a separation of at least eighteen (18) inches between the bottom of the water main and the top of the reuse or irrigation main. When construction conditions prevent a vertical separation of eighteen (18) inches as described herein above, the reclaimed water pipe shall be constructed of DI pipe with mechanical joints.

3. Crossing of Water Mains and Sewers: Reuse mains shall be installed above sewers and below water mains whenever they cross. A vertical separation of at least eighteen (18) inches shall be maintained between the top of the sewer and the bottom of the reuse main and between the top at the reuse main and the bottom of the water main. Adequate structural support for both the reuse or irrigation main and sewers shall be provided to prevent excessive deflection of joints and settling. The reuse main shall be constructed of DI pipe and the length shall be a minimum of eighteen (18) feet. The water and/or sewer shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the reuse or irrigation main.

K. Surface Water Crossings

1. Aerial Crossings: Structural supports shall be provided for all joints in pipes utilized for aerial crossings and shall be designed to prevent overturning and settlement. Expansion joints shall be provided between the aerial and buried sections of pipe. The impact of flood waters and debris shall be considered and the bottom of the pipe shall be placed no lower than one (1) foot above the 100-year flood elevation.

   Restrained mechanical joint DI pipe, minimum Class 52, shall be used for all aerial crossings. The above ground pipe shall be painted purple as specified in Section 3.02.B.7.b. of these Standards for above ground reuse mains. Underground pipe shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An automatic air release valve shall be installed at the high point of the crossing. Appropriate guards shall be installed at both ends of the crossing to prevent pipe access to the public. Sign shall be posted on the guard to read, "Caution – No Trespassing, City of Miramar."

   It shall be the responsibility of the Developer to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Developer shall meet all requirements of the agencies which own or have jurisdiction over such structures.

2. Underwater Crossings: A minimum of four (4) foot wide by six (6) inch thick precast concrete slab shall be provided a minimum of three and one-half (3½) feet above the pipe. The pipe material shall meet appropriate AWWA Standards for use in submerged conditions. Valves shall be provided at both ends of the water crossings so that the section can be easily isolated for testing or repair. The valves shall be easily accessible

and not subject to flooding. Each valve shall be provided in a manhole or valve vault. It shall be the responsibility of the Developer to obtain all applicable regulatory permits including dredge and fill permits. No isolation valve will be allowed in the SFWMD or SBDD R/W.

8.04 INSTALLATION

A. All reuse or irrigation mains, valves and appurtenances shall be installed in accordance with Sections 2 and 3 of these Standards.

8.05 TESTING

A. The Builder shall perform hydrostatic testing of all reuse and irrigation distribution systems, as set forth in the following, and shall conduct said tests in the presence of representatives from CMOOS or other authorized agencies, with two (2) days advance notice provided. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints and valves including all service lines to the curb stops. Air testing of pressure pipe will not be permitted under any circumstance. The Contractor shall furnish all necessary equipment and material, make all taps, and furnish all closure pieces in the pipe as required.

1. Piping and appurtenances to be tested shall be within sections between valves, unless alternate methods have received prior approval. Testing shall not proceed until restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required. Flushing shall be at full flow conditions and at least two and one-half (2½) feet per second flow rate.

2. Hydrostatic testing shall be performed at one hundred fifty (150) psi pressure, for a period of not less than two (2) hours. If during the test the integrity of the tested line is in question, the City may require a six (6) hour pressure test. Testing shall be in accordance with the applicable provisions as set forth in Section 4 of AWWA C-600. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for the Contractor's informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.

   The procedure for conducting the test will be that each section of pipe to be tested will be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered as a result of this pressure test, all such items shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory results are obtained. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in linear feet (maximum of two thousand (2,000) feet for calculation)

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch gauge, (minimum one hundred fifty (150) psi) Pressure loss during test shall not exceed five (5) psi.

3. The testing procedure shall include the continued application of the specified pressure to the test system for the two (2) hour period by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container. Should the test fail, necessary repairs shall be accomplished by the Contractor, and the test repeated until it is within the established limits. The Contractor shall furnish the necessary labor, water, pumps, gauges and all other items required to conduct the required water distribution system testing and perform necessary repairs.

SECTION 9

CLEARING AND GRADING

9.01 CLEARING

A. General Tree Removal Requirements

Landscaping requirements and tree conservation are addressed in Chapter 9 of the City's Land Development Code.

B. Disposal of Material (burning/hauling)

All burning activities shall be approved by the City's Fire Department and DPEP.

C. Landscape Replacement Requirements

See City's Land Development Code, Chapter 9.

D. Clearing of Wetlands

Any clearing activity within a wetland of the City of Miramar shall be in compliance with the City's Land Development Code and SFWMD.

9.02 GRADING

A. Open Space (pervious) & Lot Grading

1. Residential

a. Residential areas shall be graded such that proper runoff conveyance is provided away from the habitable structures and to stormwater management facilities. In no case shall runoff be routed such that it will adversely effect adjacent properties. Side and back lot swales shall have a slope of six-tenths (0.6%) percent minimum. Final grade elevations shall be provided by a Florida registered land surveyor retained by the builder prior to each lot receiving a Certificate of Occupancy and shall be within one-tenth (0.10) feet of proposed grades as shown on the approved engineering plans.

b. Residential lots shall have finish floor elevations (FFE) a minimum of eighteen (18) inches above roadway centerlines.

c. All "habitable" FFE construction shall be a minimum of twelve (12) inches above the 100-year flood elevation.

d. Residential subdivisions that propose to individually sell lots to other developers must provide adequate assurance that future lot grading and impervious surface will be in conformance with an approved master grading and drainage plan. This master lot-grading and drainage plan must identify which lots (or portions thereof) drain to the inlets, structures, or ponds in accordance with the approved drainage calculations for the master stormwater facilities.

2. Commercial/Industrial

a. Commercial and Industrial areas shall be graded such that proper runoff conveyance is provided away from all building structures and to stormwater management facilities.

b. Commercial/Industrial lots shall have finished floors above the roadway centerline unless adequate drainage around the finished floor can be demonstrated to the City Engineer.

c. Commercial/Industrial subdivisions that propose to individually sell lots to other developers shall indicate on the construction plans that future lot grading and impervious surface will be in conformance with an overall master lot-grading and drainage plan identifying which lots (or portions thereof) drain to the inlets, structures, or ponds indicated in the approved drainage calculations for the master stormwater facilities.

3. Planned Unit Development (P.U.D.) Grading

All P.U.D. grading shall comply with standards set forth in Sections (a) and (b) above.

B. Stormwater Storage Facilities

1. Grading

The grading of stormwater storage facilities shall be performed in such a manner as to provide side slopes that are easily stabilized; perpetually maintainable; reasonably safe to the public health; and aesthetically pleasing in keeping with the adjacent land uses so as not to detract from the overall property value or objectives of the adjacent land uses. The minimum side slopes required for grading ponds is dependent upon whether the pond is designed to have a normally dry bottom or a wet bottom. Table 9-1 gives the requirements for grading dry storage facilities. Information regarding wet detention design is given in Section 11, Stormwater Management, of these Standards.

2. Those facilities to be maintained by the City's Public Works Division shall be graded by the standard set forth in these Standards.

3. Fencing Requirements

Fences shall be mandatory for all facilities with slopes steeper than those values listed in Table 9-1. In addition, fencing may also be required on specific facilities regardless of slope if the opinion of the Enforcement Official or City Engineer, that fence is necessary to protect the health, safety or general welfare of the public in accordance with Table 9-3 of these Standards.

TABLE 9.1 Stormwater Storage

Facilities Side-Slope Grading Requirements

Depth Range (feet)	Retention/Detention Pond W/O Fence (recommended)	Retention/Detention Pond (Minimum Allowed)	Retention Swale W/O Fence
≤ 1'	4:1	3:1	3:1
< 3'	4:1	4:1	4:1
3 to 4	4:1	4:1	4:1
4 to 6	5:1	4:1	N/A
> 6'	6:1	4:1	N/A

Slopes steeper than what is indicated above shall require fencing. The maximum allowable side slopes of fenced retention/detention ponds and swales shall be 2:1.

4. Maintenance Requirements

A maintenance berm shall be mandatory for all facilities. A maintenance berm is a level unobstructed strip of land surrounding the stormwater facility to provide easy access around a stormwater facility for maintenance personnel and equipment. The following Table 9-2 illustrates maintenance berm requirements:

TABLE 9-2

Minimum Maintenance

Stormwater Storage Facility	Berm Required
With fencing	10 ft. around pond perimeter
without fencing	5 ft. around pond perimeter

9.03 STORMWATER CONVEYANCE FACILITIES

A. Privately Maintained Facilities

The grading of private stormwater conveyance facilities shall be performed in such a manner as to provide side slopes that are easily stabilized; perpetually maintainable; reasonably safe to the public health; and aesthetically pleasing in keeping with the adjacent land uses so as not to detract from the overall property value or objectives of the adjacent land uses. The minimum side slopes required for grading conveyance facilities is dependent upon whether the facility is designed to have a normally dry bottom or a wet bottom. Table 9-3 gives the requirements for grading "dry" conveyance facilities. Information regarding the design of wet detention facilities is given in Section 11, Stormwater Management.

B. Publicly Maintained (City's Public Works Division)

Those facilities to be maintained by the City's Public Works Division shall be graded by the standards set forth by the CMOOS. Table 9-3 shall be used as a minimum guide.

C. Fencing Requirements

Fences shall be mandatory for all facilities with slopes steeper than those values listed in Table 9-3. In addition, fencing may also be required on specific facilities regardless of slope if in the opinion of the Enforcement Official or City Engineer, that fence is necessary to protect the health, safety or general welfare of the public.

TABLE 9-3 Stormwater Conveyance

Facilities Side Slope Grading Requirements

Depth Range (feet)	Conveyance Canal or Ditch W/O Fence	Conveyance Swale W/O Fence
≤ 1'	≤ 1'	2:1
<3'	4:1	3:1
3 to 4	4:1	N/A
4 to 6	4:1	N/A
>6'	4:1	N/A

Slopes steeper than what is indicated above shall require fencing. The maximum side slope of a fenced conveyance canal or ditch shall be 2:1.

Notes for Tables 9-1 and 9-3:

1. Depth is measured from top of bank to bottom of ditch or retention pond.
2. Side slopes are measured as horizontal to vertical ratio (H:V).
3. "Retention swale" are those manmade swales designed to retain water; have a dry bottom with vegetation suitable for stabilization, surface water treatment, and nutrient uptake; and be less than four (4) feet deep.
4. "Conveyance swales" are those dry, sodded areas designed to convey stormwater, slope toward a positive outfall, and be no deeper than three (3) feet.
5. Side slopes steeper than 2:1 shall be considered in a case by case basis for retention ponds, ditches, and canals providing that: a suitable fence is placed to prevent public access to the facility, and; that the side slopes be stabilized with a material other than sodding such as concrete, stone, brick, rip rap, fabric-form or other suitable material approved by City Engineer.

6. Swale type facilities are not intended to be fenced. Canal or ditch type facilities may be required to be fenced.

D. Maintenance requirements

A maintenance berm shall be mandatory for all facilities with the exception of a swale. A maintenance berm is a level unobstructed strip of land surrounding the stormwater facility to provide easy access around a stormwater facility for maintenance personnel and equipment. The following Table 9-4 illustrates maintenance berm requirements:

TABLE 9-4

Ditch or Canal Width	Minimum Maintenance Berm Required
Less than 16 ft.	20 ft. one side
Greater than 16 ft.	20 ft. both sides

9.04 ROADWAY SECTIONS

All roadways shall be graded so to provide adequate drainage, safe traffic operation, and proper site distances.

A. Longitudinal slopes shall be no flatter than three-tenths (0.3%) percent with curb and gutter sections. Maximum longitudinal slopes shall be consistent with maximum algebraic differences discussed in Section 12.6.2. of these Standards.

B. Cross-sectional slopes through paved surfaces shall be a minimum of two (2%) percent or one-quarter (¼) inch per foot.

C. Cross-sectional slopes through non-paved surfaces shall be sufficient to promote adequate drainage and prevent erosion.

D. Cross sectional slopes across sidewalks within R/W shall be a minimum of one-quarter (¼) inch per foot.

E. Cross sectional slopes across grassed areas within R/W shall conform with FDOT's "Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways."

9.05 PUBLIC PARKING AREAS

Parking lots that serve the public of the City should be graded so to provide adequate drainage and safe vehicle operation. Transverse slopes shall be a minimum of one (1%) percent. Longitudinal slopes shall be a minimum of one-half (½%) percent. The parking service isle may be designed with an inverted crown cross section.

SECTION 10

EXCAVATION AND FILL

10.01 EXCAVATION

A. Engineering Construction

No land development activity including clearing and grubbing; and filling or excavation work shall commence without first obtaining engineering plan approval, and an engineering site work permit.

B. Engineering Excavation

No excavation shall commence without first obtaining engineering plan approval of the excavation activity, and an engineering site work permit.

C. Mining, Quarrying, or Excavation

An annually renewable engineering permit issued in accordance with the regulations of City's Land Development Code, Section 516, shall not be transferable and shall be obtained prior to commencing any resource extraction activity pursuant to this code.

D. Excavation Within Wetlands

All letters (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the SFWMD, SBDD, EPGMD and the U.S. Army Corps of Engineers (ACOE), for excavation within wetlands, shall be submitted to the CMOOS prior to commencing any excavation in wetland areas.

10.02 FILL

A. Fill Within Wetlands

All letters (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the SFWMD, SBDD, EPGMD, and ACOE, for filling activities within wetlands, shall be submitted to the CMOOS prior to the commencement of any filling within any wetland areas.

B. Fill Within 100-Year Flood Plain

1. All fill activities within a 100-year flood plain shall provide for compensating storage within the same 100-year flood plain.
2. The City Engineer may request a 100-year flood study for a project within a suspected 100-year flood plain with no established 100-year flood elevation.

SECTION 11

STORMWATER MANAGEMENT

11.01 Surface Water Management System Components

A. Stormwater Management

All stormwater drainage systems shall be designed in accordance with the requirements of the SBDD's publication entitled "Stormwater Management Regulations, Standards, Procedures", latest edition, the SFWMD's permit manual "Management and Storage of Surface Waters", latest edition and the City's Land Development Code.

B. Stormwater Pollution Abatement and Groundwater Recharge

A direct result of development is the alteration of natural pervious ground surfaces with the addition of pavement and building impervious surface. A source of stormwater pollution is introduced with the development of land associated with impervious surfaces, as well as a lowering of the groundwater table underneath the impervious surfaces. It becomes important to lessen or abate the amount of pollutants being discharged from a developed site, as well as recharge and maintain groundwater table levels. Performance criteria have been established as follows to accomplish these two main objectives.

1. Retention systems

Retention systems are facilities designed to percolate, evaporate, or transpirate stormwater for pollution abatement and groundwater recharge. If the pond bottom intercepts the water table, then the process is typically not valid.

a. Provide retention of one (1) inch of rainfall over the entire site.

b. Provide the capacity for the specified treatment volume of stormwater within seventy-two (72) hours following a storm event.

c. The pond bottom should be a minimal of two (2) feet above the estimated Seasonal High Water Table (SHWT) but in no circumstances will less than eighteen (18) inches be allowed. A certified soils report, prepared by a licensed Geotechnical Engineer, shall be required to verify SHWT and may be required to verify soil permeability rate. One (1) boring per pond minimum, depicting soil strata and depth to high groundwater table.

d. Minimum pond bottom width shall be five (5) feet unless approved by City Engineer.

e. All side slopes and top of bank of the retention pond area shall be sodded.

f. Where SFWMD 40E-6 criteria is applicable, the City will require that proof of issuance of the necessary SFWMD permit has been obtained prior to issuance of a Certificate of Occupancy. In addition, a SBDD permit will also be required.

g. In instances where other agency criteria is applicable, the more stringent criteria dictates.

2. Wet Detention Ponds

Facilities designed to store and release pollution abatement stormwater at a controlled outflow rate.

a. Provide additional pollution abatement volume above that described in (a) above meeting the states latest code for Wet Detention. Refer to SFWMD for details. Only projects within the SFWMD jurisdiction will be given consideration for the use of such facilities. Sites exempt from SFWMD permitting shall utilize retention.

b. For design criteria of wet detention systems refer to the latest edition of the “Best Management Practices Manual” issued by DEP.

c. A certified soil prepared by a Licensed Geotechnical Engineer report shall be required to verify SHWT and may be required to verify soil permeability rate. One (1) boring per pond, minimum depicting soil strata and depth to high groundwater table.

d. The wet detention pond shall be sodded from top of bank to the littoral zone or control water elevation as applicable.

3. Retention Swale Systems

Are dry, shallow, linear shaped facilities designed to retain stormwater for pollution abatement and groundwater recharge.

a. Provide retention of one (1) inch of rainfall over the entire site.

b. Provide the capacity for the specified treatment volume of stormwater within seventy-two (72) hours following a storm event.

c. The complete retention swale area shall be sodded.

d. Retention swales shall be less than three (3) feet deep.

4. Exfiltration Systems

Sub-surface systems that store pollution abatement and recharge stormwaters and percolate the stormwater into the soil. Exfiltration system can be used in public R/W or for any public facility as approved by the CMOOS CFM Department. Exfiltration systems may be used to accomplish the pollution abatement and groundwater recharge component of the surface water management system. Such systems shall conform to the following design constraints.

a. Provide retention of one (1) inch of rainfall over the entire site.

b. Provide the capacity for the specified treatment volume of stormwater within seventy-two (72) hours following a storm event.

c. There shall be a clean-out on each end of the exfiltration pipe. The clean-out shall be an approved inlet or manhole.

d. A pollution retardant baffle shall be required within the structure at each end of an exfiltration pipe.

e. The maximum distance between clean-outs is three hundred (300) feet.

f. The invert of the exfiltration pipe must be a minimum of eighteen (18) inches above Seasonal High Water Table (SHWT) (preferably twenty-four (24) inches or more). This should be verified by providing a certified soils report indicating the SHWT.

g. The volume retained underground should be equivalent to that required if stored above ground. If not, a suitable form of calculation must be provided.

h. The soil-permeability value, "K", must be indicative of the native soil. A certified soils report prepared by a licensed Geotechnical Engineer, will be required for all exfiltration system.

i. The system shall be designed with a minimum safety factor of at least two (2).

j. Runoff filtering devices such as grass borders, filter strips, swales, sediment and grease drops are encouraged prior to the exfiltration process.

k. A filter fabric equivalent to Dupont "Typar" or Celenese "Mirafi" must be entirely wrapped around all perforated or slotted pipes.

l. A gravel envelope with a filter fabric wrap is highly recommended for all exfiltration designs (a fifty (50%) percent void ratio is accepted when determining additional volume credit stored in gravel).

5. Underdrain Systems

Systems designed to filter pollution abatement stormwater through a filter medium, typically of sand.

a. Provide retention of one (1) inch of rainfall over the entire site.

b. Provide the capacity for the specified treatment volume of stormwater within seventy-two (72) hours following a storm event.

c. Detention with filtration systems shall be used in dry ponds only.

1. Minimum filter material depth is two (2) foot cover.
2. All perforated pipe must be completely wrapped with a filter fabric equivalent to Dupont "Typar" or Celenese "Mirafi".
3. All filter media must be totally wrapped with a filter fabric.
4. The maximum distance between clean-outs is one hundred (100) feet.
5. All clean-outs must be protected by a concrete collar.

d. The system shall be designed with a minimum safety factor of at least two (2).

C. Flood Management

A direct result of development is the alteration of natural pervious ground surfaces with the addition of pavement and building impervious surface. Additional stormwater runoff rates and volumes are introduced with the development of land associated with impervious surfaces. It becomes important to attenuate stormwater discharge rates and volumes after development to those rates and volumes that existed prior to development so as to not cause adverse drainage impacts to adjacent properties, public conveyance systems, and the community in general. Performance criteria has been established as follows to accomplish this objective.

1. Stormwater Peak Discharge Attenuation

A flood control practice designed to attenuate (lessen the impact of) the additional stormwater runoff discharge rate generated from the development of the land. The peak flow rate leaving a developed site shall not be larger than that leaving the site prior to the development. The goal is to ensure that downstream lands are not adversely impacted from upstream development during large storm events. In the City, the storm events used for peak discharge attenuation are:

25-year/24-hour

100-year/24-hour

a. Methodologies - Peak discharge computations should consider the duration, frequency, and intensity of rainfall, the antecedent moisture conditions, upper soil zone and surface storage, time of concentration, tailwater conditions, changes in land use or land cover, and any other changes in topographic and hydrologic characteristics. Large systems should be divided into subbasins, according to artificial or natural drainage divides to allow for more accurate hydrologic simulations. Examples of accepted methodologies for computation of runoff are as follows:

b. Rainfall Intensity In determining peak discharge rates, intensity of rainfall values shall be obtained through a statistical analysis of historical long term rainfall data or from sources or methods generally accepted as good engineering practice.

Examples of acceptable sources include:

1. SFWMD, Volume 4.
2. SBDD Public Facilities Report.
3. SBDD Stormwater Management Manual.

c. Upper Soil Zone Storage and Surface Storage – See SFWMD, Volume 4.

d. Time of Concentration: Calculations shall be performed in accordance with TR-55 methodology or other acceptable methodology as approved by the City Engineer. An initial time of concentration of ten (10) minutes must be used. Time of

concentration of more than fifteen (15) minutes must be justified by engineering calculations.

e. Soils Investigation: The area where stormwater flood attenuation is proposed will require a certified soils report (prepared by a licensed Geotechnical Engineer), to verify the estimated SHWT determination and may be required to verify soil permeability rate. One (1) boring is required per area (minimum) depicting strata and depth to high groundwater table.

f. Credit for stormwater seepage: Credit for stormwater seepage during the storm will not be allowed unless accompanied by supporting documentation that models the drawdown and the use of sound engineering judgment.

Accepted methods of calculating soil stormwater seepage capacity:

1. See SFWMD, Volume 4.

11.02 Primary Conveyance System Requirements (drainage between receiving water bodies)

Drainage easements are required for all primary conveyance facilities that are maintained by the City or that serve the public but are maintained by a private individual or association. All such facilities shall be designed for the minimum design hypothetical storm events which have been established in Section 11.1. of these Standards.

A. Required Submittals

1. Drainage Map

The Project Engineer shall include in the construction plans a master drainage map showing all existing and proposed features. The map is to be prepared on a twenty-four (24) inch by thirty-six (36) inch sheet on a scale

not smaller than one (1) inch = two hundred (200) feet. Listed below are the features that are to be included on the drainage map.

a. Drainage boundaries, including all offsite areas draining to the proposed subdivision.

b. Sufficient topographical information with elevations to verify the location of all ridges, streams, etc. (one (1) foot contour intervals).

c. Highwater data on existing structures upstream and downstream for the subdivision.

d. Notes indicating sources of highwater data.

e. Notes pertaining to existing standing water, area of heavy seepage, or springs.

f. Existing drainage features (ditches, roadways, ponds, etc.).

g. Subdivision layout with horizontal and vertical controls.

h. Drainage features, including location of inlets, swales, ponding areas, etc.

i. Delineation of drainage sub-areas.

j. Show retention/detention areas and ingress/egress areas for retention/detention facilities.

k. General type of soils (obtain from soil survey of Broward County).

l. Flood hazard classification.

m. Description of current ground cover and/or land use.

2. Recent aerial photograph delineating project at no smaller scale than one (1) inch = four hundred (400) feet.

3. Drainage Calculations

B. Canals & Ditches

1. All canals and ditches shall have a minimum bottom width as specified in SBDD Stormwater Management Manual.

2. All canals and ditches shall have graded side slopes conforming to the standards given in the City Land Development Code.

11.03 Secondary Conveyance Performance Standards

(Public roadways, private roadways, and drainage connections to receiving water bodies.) The required design storm event for such facilities shall utilize a three (3) year return frequency, using FDOT rainfall curve for Zone 10 – three (3) year rainfall data. Easements may be required for all such facilities so the City may maintain or repair any facilities so the City may maintain or repair any facilities affecting the general health or welfare of the public.

A. Roadway and Pavement Drainage Systems

1. Physical standards:

a. The minimum size pipe allowed in City's R/W or Private land development is fifteen (15) inches unless otherwise approved by the City Engineer.

b. All drainage pipes in City's R/W shall be reinforced concrete pipe (RCP) per FDOT "Standard Specifications for Road and Bridge Construction" (latest edition) Sections 430 and 449. Private land developments may request, subject to approval, the use of High Density Polyethylene Pipe (HDPE) or Polypropylene Pipe (PP) per FDOT "Standard Specifications for Road and Bridge Construction" (latest edition) Sections 430 and 948, and ASTM D2321, with the exception of outfalls and interconnect pipes which shall be RCP. In order to ensure proper installation of HDPE/PP pipes, the developer must submit a commitment letter to provide full-time Construction Engineering & Inspection (CEI) services during installation of the HDPE/PP pipes, and submit engineer inspection reports to City. The following criteria must be met for HDPE and PP:

Material	Class	Size	Min. Cover	Installed depth*
HDPE	Class II	15" – 24"	36"	< 6'
PP	HP**	15" – 36"	36"	< 7'

*Bottom of pipe. Trench must be dry during installation.
**HP = High Performance polypropylene as manufactured by Advance Drainage Systems, Inc.

c. Minimum pavement longitudinal grades and cross-sectional slopes are given in Section 9.2.4. and 9.2.5. of these Standards.

d. Driveway crossings shall have a minimum culvert diameter of fifteen (15) inches with end sections as approved by the CMOOS CFM Department.

e. Minimum cover over culverts within R/W is thirty-six (36) inches below pavement unless acceptable loading calculations supporting a lesser depth are submitted and approved by City Engineer.

f. There shall be no catch basins or manholes located within driveways or driveway aprons connecting to the roadway.

2. Hydraulic Standards:

All roadway and paving projects must verify that secondary conveyance systems perform properly during the design storm event.

a. Stormwater calculations shall include the following:

Storm sewer tabulations including, but not limited to, the following:

1. Locations and types of structures.
2. Types, diameter lengths, and slop of pipe(s), and flow volumes.
3. Drainage sub-area tributary to each structure.
4. Runoff co-efficient per sub-area.
5. Time of concentration to structure.
6. Hydraulic gradient for the three (3) year frequency storm event.

7. Estimated receiving water (tailwater) elevation with sources of information, if available.
8. Outlet and other pipe velocities.

b. Hydraulic Grade Line Calculations - All roadways shall be designed so that the Hydraulic Grade Line (HGL) computed through the storm sewer system shall be one (1) foot below gutter line for arterial streets and one-half (½) foot below gutter line for collector and local streets during a three (3) year intensity storm event. For roadways utilizing swale sections for drainage, the HGL shall not reach the edge of pavement during a three (3) year intensity storm event.

The HGL for the storm sewer system shall be computed taking into consideration the design tailwater on the system and the energy losses associated with entrance into and exit from the system; friction through the system; and turbulence in the individual manholes/catch basins/ junctions within the system.

The energy losses associated with the turbulence in the individual manholes are minor for an open channel or gravity storm sewer system and can typically be overcome by adjusting (increasing) the upstream pipe invert elevations in a manhole by a small amount. However, the energy losses associated with turbulence in the individual manholes can be significant for a pressure or surcharged storm sewer system and must be accounted for in establishing a reasonable hydraulic gradient line.

c. Stormwater Spread Into Traveled Lane - Inlets shall be spaced at all low points, intersections and along continuous grades so as to prevent the spread of water from exceeding six (6) feet for arterial

and collector roadways. Acceptable tolerable limits for interior subdivision roadways are defined as one-half (½) of the traveled lane width.

d. Tailwater conditions for storm sewer systems shall consider the receiving facility and shall be in accordance with SFWMD and SBDD requirements.

e. Minimum & Maximum Velocities - Public roadway pipe systems shall be designed such that the minimum flushing velocity in all pipes is three (3) feet per second (fps) for a three (3) year intensity storm event when flowing full. The maximum velocity allowed within the pipe system is fifteen (15) fps and no greater than six (6) fps exiting the system, provided that sufficient energy dissipation is included in the design. Outlet and exit velocities shall be reduced to the performance standards specified in Section 11.6. of these Standards.

f. Inlet Interception Rates and Capacities - Maximum inlet interception rates shall be based on the Inlet Capacity Chart contained in the FDOT Drainage Manual.

B. Private Roadway and Pavement Drainage Systems

All private roadways and paving should be designed in accordance with these Standards.

11.04 Tertiary Conveyance Performance Standards

This includes minor drainage systems such as parking lots and service roads intended for public use on private property. Easements for service roads are required for all such facilities so that the City may maintain or repair any facility affecting the general health or welfare of the public. The design storm event is a three (3) year return frequency.

A. Parking Lot Drainage Systems

1. Sheet Flow Standards

   See Section 9.2.5. of these Standards.

2. Pipe Flow Standards

   The pipe between stormwater runoff inlet structures and manholes shall be a minimum of fifteen (15) inches in diameter; and shall be reinforced concrete pipe per FDOT "Standard Specifications for Road and Bridge Construction" (latest edition) Section 430-7, unless otherwise approved by the City Engineer. Roof drainage, special structure drain pipes and other minor drainage structures shall be no smaller than six (6) inches in diameter.

B. Swale Drainage

These systems must meet the performance standards for stabilization as outlined in Section 11.6. of these Standards. Grading shall be in accordance with Sections 9.2.2. and 9.2.3. of these Standards.

C. Roof Drainage

All roof drainage outlets shall be shown on the construction plans. The plans must give evidence that stormwater runoff from the building structure shall be connected to the pond, inlet, or structure intended to receive the stormwater runoff in accordance with stormwater management calculations.

11.05 Erosion Protection Performance and Design Standards

A. Performance Design Standards

Erosion protection and earth stabilization is mandatory for all sites. The velocities generated by stormwater runoff shall not erode, washout, or otherwise affect the intended performance of the drainage system during the design storm event of the facility. Erosion and sediment control shall also be enforced during construction as specified in Section 11.5.3. of these Standards.

B. Acceptable Stabilization Practices

Acceptable stabilization practices include but are not limited to:

1. Sodding/paving

The method of ground stabilization will be selected based upon the anticipated design storm velocity of the facility or the steepness of slope.

Table 11-1

Maximum Channel Velocity/Slopes

Stabilization Practice	Velocity	Slope
Seed/Grass & Mulched	0-2 Fps	<2.0%
Sodded	2-4 Fps	2.0-5.0%
Paved or Fixed	>4 Fps	>5.0%

a. Maximum channel velocities and slopes are given in Section 11.6.2 (a).

b. All swales are required to be completely sodded.

c. Ditches (canals) are required to have sodded side slopes from their top of bank to their normal water level (or bottom).

d. All ponds are required to have sodded side slopes from top of bank to their normal level or dry bottom.

e. Dry bottoms may be seed and mulched or grass and mulched, as an option to sodding.

2. Flumes

Flumes are required whenever concentrated storm water leaves a parking area or road or enters a stormwater management facility.

3. Culvert End-Treatments

All culverts discharging to a stormwater management facility shall have end treatment. These structures are to prevent undermining of the pipe, and providing a readily maintainable entrance/exit for stormwater flow, free from vegetative overgrowth. Standard FDOT concrete headwalls and mitered end sections are acceptable. Pour in-place collars may also be acceptable on smaller diameter pipe. Child-proofing bars must be placed at both ends of the culvert in accordance with FDOT Standards.

4. Energy Dissipaters

Whenever stormwater is discharged from a pipe, flume, or other conveyance channel at a velocity sufficient to cause erosion, energy dissipation devices shall be employed.

5. Splash Pads

Splash pads are required to stabilize the soil of all stormwater discharge structures with outlet velocities in excess of two and one-half (2½) fps. Energy dissipaters may also be required in addition to splash pads in order to reduce outlet velocities from the splash pad.

C. Erosion & Sediment Control During Construction

Erosion and sediment shall be controlled during construction. This includes the prevention of both wind erosion and water erosion (turbidity).

1. Inlet Protection: All inlets and catch basins shall be protected from sediment laden storm runoff until completion of all construction operations that contribute sediment to the inlet.
2. Temporary Seeding: Areas exposed by construction for thirty (30) days or more shall be seeded with a quick growing grass species, appropriate for that season, that will not compete with permanent grassing, and be applied at a rate of thirty (30) lbs./acre.

11.06 Stormwater Drainage Structure Performance & Design Standards

This section includes standards for manholes, inlets, catch basins, control structures, headwalls, and end walls.

A. Acceptable Structures

All drainage structures within public R/W or easements shall be standard FDOT inlets, manholes and junction box types unless special requirements require a unique structure design. Such instances will be reviewed on a case-by-case basis.

Discharge outfall systems shall be protected with an appropriately designed headwall or end wall as detailed on FDOT standards.

B. Placement & Spacing

1. Manholes: Stormwater manholes shall in no instance be spaced no further than as given in Table 11-2.

Table 11-2

Maximum Spacing for Stormwater Manholes

Pipe Size	Max. Spacing (ft.)
≤ 18"	500
24"-36"	500
≥ 42	500

Public drainage systems may require closer spacing subject to the review of the CMPWUD.

2. Inlets: Inlets are to be spaced so to provide adequate stormwater runoff evacuation to prevent unacceptable stormwater spreading into the traveled lanes as stated in Section 11.3.1.b.3. of these Standards.

   a. The maximum distance for flow in a curb and gutter to the first point of removal for any roadway shall be five hundred (500) feet.

   b. All low point (sump) location inlets shall be designed to intercept one hundred (100%) percent of the design flow including by-pass flow from upstream inlets.

   c. All intermediary inlets (not at low points) shall be designed to intercept at least eighty (80%) percent of the design flow.

   d. All roadway inlet structures and ditch bottom inlets within the R/W that are subject to vehicular collision shall be set flush with finished grade. This is not meant to preclude the installation of weir-type control structures, but to limit fixed protruding concrete structures from serving as hazards to motorists.

11.07 General Storm Pipe Performance and Design Standards

A. Physical Design Standards

1. Clearance Requirements

There shall be a minimum cover of thirty-six (36) inches over all concrete pipes under flexible or rigid pavement. Larger diameter culverts (greater than fifty-four (54) inches in diameter) require additional cover as determined by the City Engineer.

2. Safety Precautions (child proofing)

Any storm pipe fifteen (15) inches and above in diameter and discharging to a public facility, shall have secured bars to prevent children from accessing the pipe system. These bars are to be set at eight (8) inches minimum spacings on center.

3. Minimum Size Requirements

a. All pipe sizes should be designed to produce a minimum flushing velocity (whenever possible) without producing velocities that cause erosional problems.

b. The minimum pipe size to be used in a R/W or any stormwater facility to be maintained by the City shall be fifteen (15) inches regardless of velocity.

c. Any pipe sizes less than those described are at the discretion of the City Engineer.

4. Easement

A minimum twenty (20) foot drainage/maintenance easement dedicated to the City or SBDD centered over stormwater mains will be required as part of the development review process.

B. Hydraulic Design Standards

1. Maximum/minimum Design Velocities

All pipes should be designed to produce flushing velocities of two and one-half (2½) fps (three (3) desirable) and shall not exceed ten (10) fps. All final outlet velocities must meet the requirements of Section 11.6. of these Standards.

SECTION 12

ROADWAY PERFORMANCE

12.01 RIGHT-OF-WAY (R/W) UTILIZATION

A. Subdivision Design Standards

The entire right of way within public and private roadways shall be demucked prior to any roadway construction. Roadway Standards shall conform to the requirements of the City's Land Development Code (LDC) "Subdivision Design Standards" listed in Section 802, City's Complete Streets Manual and City's "Transportation Element" listed in "Comprehensive Plan – Goals, Objectives and Policies", as adopted by the City Commission. All parts of the Transportation Element shall be followed except FDOT's 2002 Quality/Level of Service (LOS) Handbook listed in the City's Comprehensive Plan. Latest versions of these standards should be utilized when designing any improvements within road right-of-way.

B. Excavations within City R/W

1. Open cuts: open cuts on paved streets within City R/W may be permitted on streets functioning as "local" service roadways. Any roadways functioning as "collector" or higher will be considered on a case by case basis. Non intrusive methods such as directional bore, jack and bore operations shall be required on high traffic volume roadways. Open cuts shall conform to standard drawings shown in Figures 403 and 404 in Section 15 of these Standards.

12.02 ROADWAY DESIGNATIONS & LANE REQUIREMENTS

A. Roadway Functional Classifications

1. Roadways as it applies to City's street network are generally classified Arterial Highways, Collectors and Local roads as defined by AASHTO Green Book and FDOT Standards. The arterial highways generally provide direct service between Cities that generate and attract a large proportion of the relatively longer trips. Arterials include expressways without full control of

access, US numbered routes and principal state routes. Roads of the intermediate functional category (collectors) serve small Cities directly connecting them to the arterial network. Collectors include minor state routes, major county roads, and major urban and suburban streets.Roads of this category collect traffic from the local roads serving residential neighborhoods, individual farms and other rural land uses or distribute traffic to these local roads from the arterials. Local roads include minor county roads, minor urban and suburban subdivision streets, and graded or unimproved roads.

B. Roadway Design

Designs for highway and street projects shall be based on established design controls for the various elements of the project such as width of roadway, side slopes, horizontal and vertical alignment, drainage considerations and intersecting roads. Selection of the appropriate criteria and standards is influenced by traffic volume and composition, capacity and levels of service, functional classification, terrain features, roadside developments, environmental considerations and other individual characteristics. Inverted crown roadways shall not be permitted on public or private streets. This limitation shall not apply to private parking lots or private driveways within multi-family development.

New Roadways~~s~~ Design

Designers shall determine if the proposed improvements will satisfy future needs by comparing the forecast directional hourly volumes with the traffic handling capacity of an improved facility. Project traffic forecasts and capacity of the roadway shall be used to determine the number of through lanes, length of auxiliary lanes, signalization timings, right of way requirements, etc., so that the facility will operate at an acceptable level of service through the design year.

Design (for new construction or reconstruction projects) shall be based on project traffic for the projected design year, and shall be 20 years after the project is

opened to traffic. The Design Hourly Volume (DHV) shall be determined through the use of the FDOT's standard "K" factors, as provided by the FDOT Transportation Statistics Office and can be found in FDOT's Project Traffic Forecasting Handbook. Recommended design period (service life) shall be 12-20 years. Use recommended thicknesses per AASHTO guidelines or FDOT Pavement Design Manual, or as specified in Section 12.03 and Table 12.1(a) of these standards, whichever is more stringent.

Lane Width Requirements

Minimum lane width requirements are based upon the roadway designation, vehicle usage, and rural or urban section designation. Table 12.1 gives minimum lane widths for each roadway designation. For cul-de-sac, for the minimum radius and lane width, refer to Engineering Standards Figure Number 502.

C. Roadway R/W Width Requirements

Minimum roadway R/W width requirements are given in Table 12.1 for each roadway designation. For design of "Pedestrian, Bicycle and Public Transit Facilities" within the City's roadways, utilize City's Complete Streets ~~Policies~~ and Manual, for guidance.

Table 12.1 Minimum Roadway Standards For Lane Width, R/W Width, Bike Lane Width, Sidewalk Width and Curb Radii

Road Designation	Class	Lane Width	R/W Width (Private/Public)	Bike Lane Width (4)	Side Walk Width (5)	Min. Curb Radii (6)
Arterial	--	11’	(2)	4’-7’	6’	35’ (with arterial) 30’ (with collector) 30’ (with local)
Collector	--	11'	(3)	4’-7’	5’	30’ (with arterial) 30’ (with collector) 30’ (with local)
Service Access (1)	R	11'	50'	4’-7’	4’	30’
	CI	12'	50'	4’-7’	4’	30’
	TH	11'	44'	4’-7’	4’	--
	AC	11’	--	4’-7’	4’	--
Local	R	11'	50'	4’-7’	4’	30’ (with arterial) 30’ (with collector) 25’ (with local)
	CI	12'	50'	4’-7’	4’	

Legend and Notes

CI = Commercial/Industrial
TH = Townhomes
AC = Apts and Condos
R = Residential
(1) = Service roadways often are cul-de-sacs but are not necessarily so. Sidewalks can be replaced with a shared use path combining the sidewalk and bike lane
(2) = To be determined by City Engineer and/or other applicable authorities such as Broward County, FDOT, etc. For City Arterial (6 ultimate traffic lanes) = 106' Minimum R/W (source: Land Development Code, Table 802-1)
(3) = For 4 lane Collector, minimum required R/W = 80’. For 2 lane Collector, minimum required R/W = 60’.
(4) = When a parking lane is present, a 3’ buffer shall be included between the parking lane and bicycle lane.
(5) = Both sides of the street.
(6) = Source: Broward County Municode Sec 5-195. - Site Plan requirements. Column shows minimum curb radii,

however, City Engineer may require larger radius for large design vehicles and/or high ADT values.

D. Capacity and Level of Service (LOS)

In order to determine the roadway and intersection capacity, utilize Chapter 2 (Design Contols and Criteria) of the AASHTO publication A Policy on Geometric Design of Highways and Streets and applicable sections of the Transportation Research Board publication Highway Capacity Manual. They contain the necessary guidelines and calculation guides to determine the number and configurations of lanes required and the resulting levels of service. As illustrated in these publications; the gradients, roadside developments, number, spacing and types of crossings and intersections, traffic volumes, and signalization patterns all greatly influence capacity and level of service. Those factors, in addition to the roadway functional classification, have a direct influence on the design speed to be adopted at the preliminary design level. Design of signalized intersections should ensure an adequate LOS through the design year of the facility, especially when right of way acquisition is being considered.

The capacity of an at-grade arterial or collector is primarily controlled by its ability to move traffic through signalized intersections, rather than the mid-block through lane capacity. The operational analysis methods in the Highway Capacity Manual shall be used for design of signalized intersections. The designer must provide information or assumptions on basic intersection geometrics, lane utilization, movement-specific traffic volumes, etc. The primary output of the operational analysis method is LOS and delay at a signalized intersection; however, this method can be used to determine geometric requirements, signal timing or service flow volumes.

Include analysis for both project buildout phase and 20 years beyond existing base year. Following are the LOS requirements for public roads and intersections.

1. All *public and private roads* within the City of Miramar; including local, County, State, and Federal roads; shall be required to operate at LOS D or better on a peak hour basis. This is consistent with FDOT and Broward County procedures, who use the LOS "D" (or better) standard as the roadway concurrency standard. Use the two-way peak hour volumes instead of the directional peak hour volumes to be consistent with FDOT and Broward County. Use the Generalized Peak Hour Two-Way Volumes and criteria listed in the FDOT "2013 Quality/Level of Service Handbook".
2. *Intersection* analyses need to be conducted for existing conditions, future conditions without the project, and future conditions with the proposed project in place. The length of queues will be documented at the intersections and the project driveways. Level of Service "D" or better is acceptable. Level of Service "E" or worse would require mitigation measures to improve the intersection's operation.

12.03 PAVING STANDARDS

All thicknesses given in this section are measured as final, compacted, in place.

A. Asphalt Requirements

Minimum asphaltic surface thickness are given for each roadway classification in Table 12.1 (a).

1. The maximum paving application tolerance is one quarter (¼) inch. Ponding of water shall not be acceptable.
2. Asphaltic concrete surface courses shall be designed for the appropriate roadway classification, usage, and projected trips per day. Allowable asphaltic surfaces include: FDOT S1 and Type SIII.
3. Prior to placement of asphalt a design mix for the asphalt including gradation of all material, content of mix, Marshall Stability and laboratory density shall be approved by the Engineer of Record (EOR). EOR provides certification to the City Engineer showing that the materials

comply with FDOT Standard Specifications for Road and Bridge Construction (latest edition).

4. After asphalt is placed, the Contractor shall obtain from an independent testing laboratory at minimum intervals of three hundred (300) feet, core borings of the asphalt to determine:
   a. Thickness and Density
   b. Marshall Stability
   c. Sieve Analysis of Aggregate
   d. Bitumen Content of Asphalt

   The tests shall be submitted to the City Engineer for approval.

Table 12.1(a) Minimum Roadway Standards For Vertical Pavement Elements

Road Designation	Asphalt	Lime-rock	Sub-grade
Public Roadway	2”	12”	12”
Private Roadway/ Parking	1.5”	8”	12”

B. Base Course Requirements

All roadways are to have a compacted base. Recommended materials are limerock unless otherwise approved by the City Engineer.

Minimum base course thickness are given for each roadway classification in Table 12.1(a).

1. The base material shall be of uniform quality throughout, substantially free from vegetable matter, shale, lumps and clay balls, and shall have a Limerock Bearing Ratio value of not less than one hundred (100).

2. All limerock shall be primed and compacted to ninety-eight (98%) percent of the modified proctor density, AASHTO T-180, and be installed on a

stabilized sub-grade. In addition, a minimum LBR of one hundred (100) is required.

Certification from a testing laboratory shall be submitted to the City Engineer indicating that the material used for the base meets the specified criteria.

After the base is completed, the Contractor shall obtain from an independent testing laboratory at minimum longitudinal intervals of three hundred (300) feet, for density. The tests shall be submitted to the City Engineer for approval.

C. Sub-grade requirements

All roadways are required to have a compacted sub-grade to support the base course. If the in place soil cannot meet or exceed the limerock bearing ratio specifications listed below, the entire subgrade must be stabilized to do so. Minimum sub-grade thicknesses are given for each roadway classification in Table 12.1(a).

1. All sub-grades shall meet or exceed ninety-eight (98%) percent modified proctor density AASHTO T-180. In addition, a minimum L.B.R. of forty (40) will be required of all roadway sub-grades.
2. All sub-grades are to extend a minimum of six (6) inches beyond the base course layer where curbing is omitted.
3. After the subgrade is complete the Contractor shall obtain from an independent testing laboratory at minimum longitudinal intervals of three hundred (300) feet, density and limerock bearing ratio tests on the subgrade. The tests shall be submitted to the City Engineer for approval.

D. Concrete Paving Requirements

1. Portland concrete roadway is an acceptable alternative to asphaltic concrete on base. Get approval from City Engineer prior to

commencement of design. Cement Concrete Pavements shall meet FDOT standards and specifications.

2. Engineer of Record shall determine minimum thicknesses required for concrete pavements.
3. All concrete shall be three thousand (3,000) psi minimum compressive strength at twenty-eight (28) days.
4. All bases (or sub-bases) are to extend a minimum of twelve (12) inches beyond the concrete layer where curbing is omitted.

E. Special Stabilization

All curbing within public R/W shall be supported by a stabilized subgrade. All roadway shoulders must also be stabilized.

1. Stabilized subgrades and shoulders must be twelve (12) inches minimum thickness.
2. Stabilized subgrades and shoulders must meet or exceed a LBR of eighty (80).
3. Stabilized subgrades must extend a minimum of six (6) inches beyond curbing.
4. See Figure 405 of these Standards for details of subgrade/curb application details.

F. Inspection and Approval

1. Ponding of water is not acceptable on the pavement surface.

12.04 HORIZONTAL GEOMETRY

A. Turning Radii

Minimum turning radii for roadways shall be determined based upon AASHTO guidelines for the appropriate design vehicle and best engineering practice.

B. Cul-de-sac

Cul-de-sacs are to be provided on all roadways that dead end and exceeds the length per LDC 802.4.9.

1. The maximum length of a cul-de-sac is measured along center line. See LDC 802.4.9.
2. For minimum R/W width and radii refer to Figure 502.
3. Sidewalks are not required around cul-de-sac.
4. Cul-de-sac with islands may be permitted. Minimum pavement width shall be determined per Figure #502.
5. No temporary cul-de-sacs shall be allowed, except in a phased development.

C. Minimum Tangent Standards

Minimum tangent standards (aka superelevation transitions) shall be in accordance with latest design guidelines from AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

D. Maximum Centerline Deflection Without Horizontal Curves shall be per AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

E. Determination of Length of Horizontal Curves shall be per AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

F. Maximum Curvature of Horizontal Curve (for Rural and Urban Environments) shall be per AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

12.05 VERTICAL GEOMETRY

A. Vertical Curve Requirements

Refer to AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

B. Maximum/minimum Slope Requirements

Refer to AASHTO's publication ***A Policy on Geometric Design of Highways and Streets*** or FDOT.

12.06 TRAFFIC CONTROL DURING CONSTRUCTION

Refer to applicable sections of FDOT Design Standards (Index 600 Series), FDOT Standard Specifications for Road and Bridge Construction, Broward County land development code (Section 3-6. Construction) and requirements set forth by Broward Highway Construction and Engineering Division (BHCED). In addition, the following item shall be made available to the City.

A. Whenever work inside public right of way is in progress, a set of plans for the project bearing the approval stamp, the Permit issued by the Highway Construction and Engineering Division, and the MOT plans approved by the Traffic Engineering Division, shall all be onsite whenever work is in progress. In the event that any one of these items is not so located, work shall not be allowed to begin or, if already begun, shall be halted.

B. For construction within private developments, traffic control plans has to be approved by the City of Miramar Construction and Facilities Management Department.

12.07 DRIVEWAYS, DRIVEWAY CONNECTIONS, MEDIAN & INTERSECTION SPACING WITHIN PUBLIC R/W

Refer to Section 804 of the City's Land Development Code, Broward County land development code (Sections 5, 6, 9) and FDOT Plans Preparation Manual Volume 1. On FDOT facilities, ***Access Management Rule*** standards ***14-97.003(3)*** shall be applied to regulate the location of driveway connections and median openings for any roadways within the City of Miramar based on the Roadway Classification.

Refer to Section 802.3 through 802.4.3 of the City's Land Development Code, for criteria related to Minimum median and intersection spacing, intersection design, intersection angles and street jogs at intersection.

12.08 INTERSECTION DESIGN STANDARDS

Intersection design should be in accordance with the recommendations and requirements of the latest FDOT ***Florida Intersection Design Guide***, ***Manual of Uniform Minimum Standards for Design, Construction And Maintenance For Streets & Highways (aka Florida Greenbook"),*** FDOT ***Traffic Design Standards*** and FDOT ***Manual on Uniform Traffic Studies*** (MUTS) and the ***Manual on Uniform Traffic Control Devices*** (MUTCD), as it relates to justification studies for signals and roundabouts. Applicable sections of the ***Highway Capacity Manual*** (HCM) and related capacity analysis software shall be used to determine geometric design with the appropriate design vehicle types and templates specified in AASHTO's publication ***A Policy on Geometric Design of Highways and Streets.*** Applicable sections of FDOT ***Plans Preparation Manual (PPM).*** Intersection designs, especially in urban areas shall include details showing utilility accommodation details. Engineering concept plans and drawings shall include intersection details.

12.09 SIGHT DISTANCE STANDARDS

Refer to applicable sections of the City's Land Development Code (LDC Section 804.8), AASHTO's publication ***A Policy on Geometric Design of Highways and Streets.*** Applicable sections of FDOT ***Plans Preparation Manual (PPM)*** and FDOT ***Design Standards.*** Utilize the most stringent criteria from these codes. For sight distance at intersections, no above ground structures or landscaping shall be allowed within the clear sight line from the minor road, as defined under FDOT Standard Index number 546.

12.10 LANDSCAPING REQUIREMENTS

Refer to applicable sections of the City's Land Development Code, for criteria related to Master Roadway Landscaping Plan Standards per the City's Department of Community and Economic Development.

12.11 TYPICAL SECTIONS

All roadway construction plans submitted to the Construction & Facilities Management department for approval shall provide with the construction plans, typical sections for any of the proposed activities listed below. Typical sections shall be submitted for review and approval by the City, prior to providing detailed plans. Typical sections shall include the location and limits of such features as lanes, medians, shoulders, curbs, sidewalks, bicycle lanes, barriers, railings, landscaping, lighting etc. Accommodate complete streets elements such as bike lane, pedestrian enhancements, sidewalks and transit facilities. Typical sections for all projects shall also include the following data:

A. Design speed

B. Cross Slopes

1. Cross slopes of roadway pavement, shoulder surfaces, sidewalks and bridge decks.
2. Median and outer slopes shall be shown by percentage, vertical to horizontal.
3. Either feathering details or notes (or both) shall be shown when resurfacing without milling in urban curb and gutter sections is specified or when milling depth is less than the overlay thickness.
4. When cross slope correction is necessary, special milling and layering details showing the method of correction shall be shown in the plans.

C. Profile grade point shall be labeled.

D. Pavement construction shall be described in a clear, precise manner by indicating the LBR requirement and the thickness of the subgrade stabilization, subbase or base, as well as thickness for structural course, friction course and shoulder pavement. All sections shall specify materials used with bearing and compaction specifications required for the material as given in Section 12.04 of these Standards.

E. Pavement structure information shall be obtained from the approved pavement design and shall be described in the order of construction, i.e., starting with bottom layer and ending with friction course.

F. Sidewalk and bicycle lane locations and widths.

G. Include sod width and specify type of sod.

H. Curb and gutter location and type (show applicable Type per Drawing #405, not the dimension).

I. Limits of clearing and grubbing.

J. Right-of-ways line.

K. Template dimensions:

For widening projects, the existing pavement width shall be shown as a +/- dimension, and the base widening width shall be shown with an asterisk.

NOTE: For typical sections with varying dimensions, the dimensions shall be clearly indicated on the plan-profile sheets.

L. Standard notes for typical sections.

M. Shoulder treatment shall be identified where applicable

12.12 DESIGN & POSTED SPEEDS

Design speed for all roadways shall be indicated on all construction plans. To set design speeds refer to Florida Green Book, "***Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways***" (Table 3 – 1 Recommended Minimum Design Speed (MPH)). The design speed shall not be less than the expected posted or legal speed limit. A design speed 5 mph to 10 mph greater than the posted speed limit will compensate for a slight overrunning of the speed limit by some drivers. Any speed studies conducted independently on any City facilities for the purpose of establishing posted speeds shall be done in accordance with FDOT standards listed under the FDOT Manual on Uniform Traffic Studies (MUTS).

12.13 ROADWAY PLANS

All new roadway construction plans must include paving, grading and drainage along with landscaping, irrigation, lighting, signals and signing-pavement marking plans. Plans shall meet the requirements of City of Miramar Community and Economic Development Department and City's Land Development Codes. Street lights design and installation shall be in accordance with Florida Power and Light Company's standards.

12.14 SIGNING AND PAVEMENT MARKINGS

All proposed signing and striping shall be clearly delineated on the construction plans for review by the City Engineer or designee.

A. Pavement Markings

To determine the appropriate pavement markings as it relates to the jurisdiction of the roadway and onsite driveways and parking areas, designer shall consider applicable sections of the following standards, latest editions of the "Manual on Uniform Traffic Control Devices (MUTCD)" (Source: U.S. DOT/FHA), FDOT Design Standards, FDOT Standard Specifications for Road and Bridge Construction, FDOT Traffic Engineering Manual (Chapter 4) and Broward County "Traffic Engineering Standards and Specifications". All pavement markings installed on public and private roadways shall be thermoplastic, except parking stalls which may be painted. Painted pavement markings shall follow Section 710 of the FDOT Standard Specifications for Road and Bridge Construction.

B. Signage

To determine the appropriate signage as it relates to the jurisdiction of the roadway and site, designer shall consider applicable sections of the following standards, latest editions of the "Manual on Uniform Traffic Control Devices (MUTCD)" (Source: U.S. DOT/FHA), FDOT Design Standards, FDOT Standard Specifications for Road and Bridge Construction, FDOT Traffic Engineering Manual (Chapter 2) and Broward County "Traffic Engineering Standards and Specifications".

In addition, Designer shall follow the sign regulations adopted by the City Commission, listed under Chapter 10 (Signs) Sec.1001 through Sec.1012 of the City of Miramar Land Development Code.

12.15 ADDRESSING PROCEDURES (NEW DEVELOPMENTS)

All streets shall be numbered in accordance with a numbering system approved by the U.S. Post Office and Community and Economic Development department director. All streets shall have a sign displaying the street number. Street signs shall have reflective type lettering meeting Broward County standards.

For a residential sub-division, developer's Engineer shall assign standardized naming convention to the private residential streets based on coordination with the designated local post office official. Deliver to the City Engineer, a stamped approved Mylar. For subdivisions, approved street names shall be provided on the final plat. Street names shall be submitted and approved prior to final plat processing. As a minimum the standardized naming system shall:

A. Minimize future street name and addressing conflicts. Duplicate street names are prohibited.
B. Names of similar pronunciation and/or spelling shall be prohibited (e.g.: Briar Lane, Brier Lane)
C. No street shall have more than one name.
D. No Street name shall contain the words North, South, East, or West, or any combination thereof, within the street name. All named streets that extend from incorporated areas into unincorporated areas shall retain the same name.
E. Streets that have a definite north-south directional course shall be designated as "Avenue"
F. Streets that have a definite east-west directional course shall be designated as "Street"
G. Streets that do not have a definite directional course shall be designated as "Drive", "Trail", "Way, or "Lane".

H. A dead end street or cul-de-sac less than 1000 feet in length, when not an extension of an existing street or a continuation of a proposed street, shall be called a "Court".

I. A Street that has its ingress and egress on the same street shall be designated a "Loop".

J. A street that circles back upon itself shall be designated as a "Circle".

K. Street names which are not readily capable of pronunciation or which would be distasteful to a reasonable person are prohibited.

L. Provide a database for City records and enhanced 911 services.

M. Expedite property identification by emergency services.

N. Comply with the addressing guidelines published by US Postal Service Publication 28.

12.16 HANDICAP (ADA) CONSIDERATIONS

ADA (Americans with Disabilities Act) requirements shall be met in areas subject to pedestrian traffic and they shall comply with the latest "ADA Standards for Accessible Design" under Section 810 (Transportation Facilities) published by the Deparment of Justice, FDOT Plans Preparation Manual and FDOT design standards. Specifically the design and construction shall address the following areas:

- Bus Boarding and Alighting Areas.
- Bus Shelter accessibile route to boarding, alighting areas.
- Handicap Parking Spaces: surface lots and parking garages.
- At intersections: ADA compliant designs for
    - Pedestrian curb ramps widths and slopes.
    - All sidewalks, ramps and landings shall a maximum cross slope of 0.02. All ramp slopes shall be 1:12 maximum.
    - Sidewalks slopes.
    - Crosswalk surface texture/material is subject to approval be the City Engineer. Approval is critical, since replacing flexible pavement with rigid patterned pavement within the limits of a crosswalk where the abutting pavement is to remain flexible pavement will likely result in pavement

joint problems and adverse impacts to rideability. This type treatment is therefore not permitted.

- Alignment of crosswalks with curb ramps
- Horizontal clearances to obstructions located within sidewalks, such as poles and sign posts.
- Location of pedestrian signal push buttons

Detectable Warnings – Public Roadways and Intersections

- Install detectable warnings on newly constructed and/or existing concrete or asphalt walking surfaces (sidewalk curb ramps, sidewalks, shared use paths, etc.) constructed in accordance with the Design Standards, Index No. 304 and ADA Standards for Transportation Facilities, Section 705.
- Detectable warnings in ramps, shall extend the full width of the ramp and to a depth of 2'. They shall be constructed in accordance with FDOT Standard Index 304 and specifications Section 527.
- Detectable warnings shall be required on sidewalks and shared use paths at:
    - Intersecting roads,
    - Median Crossings greater than or equal to 6' in width,
    - Railroad Crossings,
    - Signalized driveways.
    - Detectable Warnings -Color and contrast: Use safety yellow, brick red or black colored detectable warnings on concrete walking surfaces. Use safety yellow colored detectable warnings on asphalt walking surfaces. Use reflectance values as listed in FDOT specifications 527-2.3.
- Detectable warnings shall be installed per procedures listed in FDOT specifications 527-3.1.
- Detectable warnings shall not be installed over grade breaks.
- Use detectable warnings listed on the FDOT's Approved Product List (APL).

SECTION 13

OTHER UTILITIES

A utility permit must be obtained prior to construction of any utility within the public R/W or utility easement.

A City preconstruction meeting may be held at the City to discuss coordination of utilities within public R/W or dedicated public utility easement. The City shall be informed of all existing and proposed utilities within a R/W prior to construction, and notified at least two (2) days in advance of being installed. Secondary utilities shall be buried. Primary utilities shall be placed at the discretion of City Commission.

13.01 All work in the public R/W must be completed by the franchise holder or a licensed contractor. This licensed contractor must obtain a permit with the City and provide proof of insurance naming the City as additional insured.

13.02 ELECTRIC

Florida Power & Light Corporation (FPL)

13.03 GAS

City Gas Company

13.04 TELECOMMUNICATIONS R/W (See Code Chapter 23, Article IV, entitled "Communication for Permitting R/W" requirements). Florida State registered telecommunication firms need to follow the City's right-of-way ordinance, Chapter 23, Article IV, Placement and Maintenance of Facilities for Communications Services in Rights-of-Ways. The first step is to register with the City as a Communications Services provider, or Pass Through provider. If not a registered telecommunication firm with the State, then the company need to follow the City's Telecommunications section of the Land Development code

SECTION 14

SPECIFIC SITE DESIGN REQUIREMENTS

14.1 OFF STREET PARKING STANDARDS

See Section 808 of the City's Land Development Code.

14.2 FENCING

A. Fencing

A six (6) foot high chain link fence per FDOT Roadway and Traffic Design Standards (latest edition) Index No. 452. See Figure 306. Also, follow City's LDC.

14.3 SIDEWALKS & BIKE PATHS

A. Sidewalk Standards

1. Sidewalks are required on all new developments.
2. Minimum sidewalk width shall be four (4) feet for local streets, five (5) feet for collector, and six (6) feet for arterial streets.
3. Minimum construction standards: All sidewalks shall be constructed of four (4) inches thick Portland concrete (three thousand (3,000) psi) and six (6) inches thick at driveways.
4. Sidewalk widths may be required to be greater than five (5) feet when large pedestrian volumes are anticipated.
5. Sidewalks shall incorporate pedestrian cross-access at intersection as shown in Figure 409.

B. Pedestrian/Bicycle Path Standard

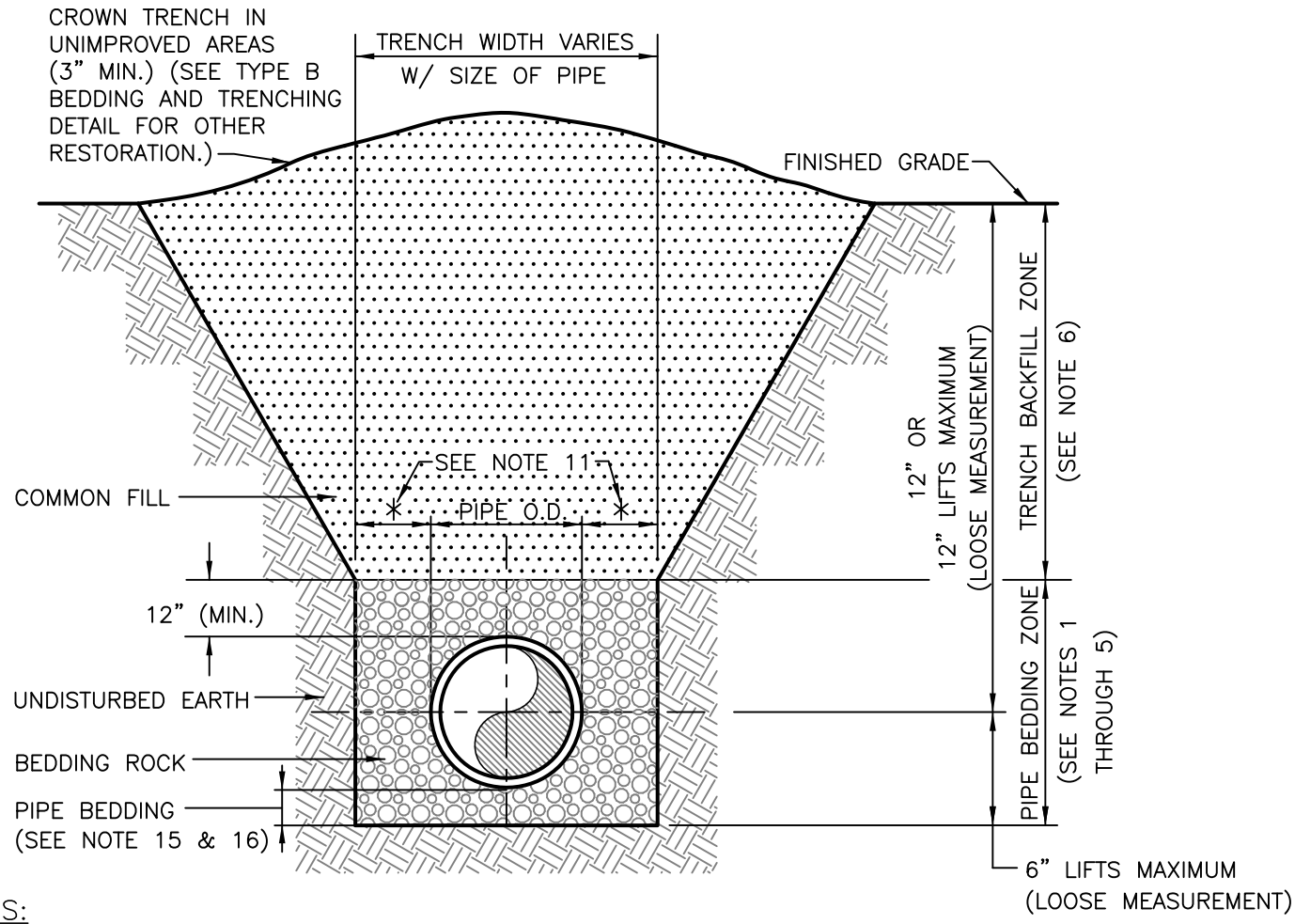
A pedestrian/bicycle path which is a minimum of six (6) feet wide and constructed within an adjacent easement may be used in lieu of the required sidewalk on that side of the R/W.

Also, see Section 12 of this Manual.

14.4 HANDICAP CONSIDERATIONS

All provisions for handicap parking and access shall be in accordance with Chapter 553 Florida Statutes "accessibility by handicap persons" and the latest edition of "Accessibility Requirements Manual" by the Department of Community Affairs Florida Board of Building Codes and Standards and in accordance with American Disabilities Act (ADA). Also, see Section 12 of this Manual.

SECTION 15
Standard Drawings



NOTES:

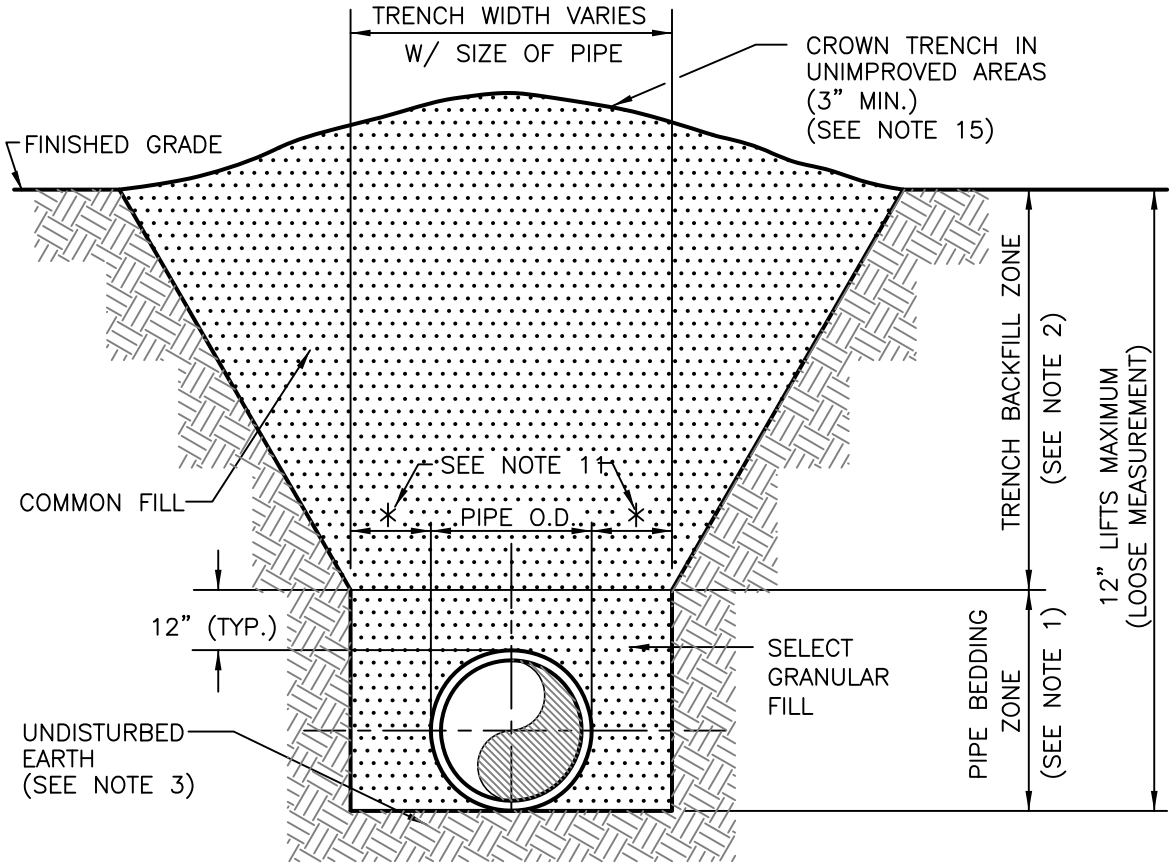
1. PIPE BEDDING: SELECT BEDDING ROCK TAMPED IN PLACE.
2. GRADE AND SHAPE PIPE BED TO EVENLY SUPPORT PIPE AT THE PROPER LINE AND GRADE, WITH FULL CONTACT UNDER THE BOTTOM OF THE PIPE.
3. INSTALL PIPE AND SYSTEM COMPONENTS.
4. PLACE BEDDING SIMULTANEOUSLY ON BOTH SIDES OF THE PIPE. CORRECT ANY PIPE DISPLACEMENTS BEFORE PROCEEDING.
5. IN THE PIPE BEDDING ZONE, PLACE BEDDING IN LIFTS NOT GREATER THAN 6" THICKNESS TO 12" MINIMUM ABOVE THE TOP OF THE PIPE.
6. IN THE TRENCH BACKFILL ZONE, PLACE COMMON FILL IN LIFTS NOT GREATER THAN 12" THICKNESS AND COMPACT TO 98% OF MAXIMUM DENSITY PER AASHTO T-180 TO THE BOTTOM OF THE SUBGRADE OR THE TOP OF TRENCH IN UNIMPROVED AREAS.
7. USE TYPE A BEDDING TO BE DETERMINED IN THE FIELD AS DIRECTED BY THE CITY OF MIRAMAR.
8. IF REQUIRED IN THE CONTRACT DOCUMENTS OR IF APPROVED BY THE CITY OR ITS REPRESENTATIVE, FLOWABLE MORTAR OR CONTROLLED LOW STRENGTH MATERIAL MAY BE USED IN LIEU OF OTHER BEDDING MATERIAL TYPES.
9. SECURE PIPE AGAINST DISPLACEMENT OR FLOTATION BEFORE PLACING FLOWABLE MORTAR OR CONCRETE ENCASEMENT.
10. CONCRETE ENCASEMENT: INSTALL WHERE SHOWN IN THE PLANS.
11. (*): 18" MAXIMUM FOR PIPE DIAMETER LESS THAN 24", AND 24" MAXIMUM FOR PIPE DIAMETER 24" AND LARGER.
12. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION. UNLESS OTHERWISE APPROVED BY THE CITY.
13. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF THE FLOW.
14. REFER TO SECTION 2.18-E OF THE MANUAL FOR SHEETING AND BRACING IN EXCAVATIONS.
15. GRAVITY SEWERS SHALL UTILIZE TYPE A BEDDING. BEDDING DEPTH SHALL BE 4" MINIMUM FOR PIPE DIAMETER LESS THAN 15", AND 6" MINIMUM FOR PIPE DIAMETER 18" AND LARGER.
16. DEPTH FOR REMOVAL OF UNSUITABLE MATERIAL SHALL GOVERN DEPTH OF BEDDING ROCK BELOW THE PIPE. CITY OF MIRAMAR SHALL DETERMINE IN THE FIELD REQUIRED REMOVAL OF UNSUITABLE MATERIAL TO REACH SUITABLE FOUNDATION.
17. UNSUITABLE MATERIAL INCLUDES ORGANIC MATERIAL, BEDROCK, LIMEROCK FILL, BOULDERS, ETC.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
10/02	Revised note #8 add note #10	L.L.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYPE A BEDDING AND TRENCHING DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 100



NOTES:

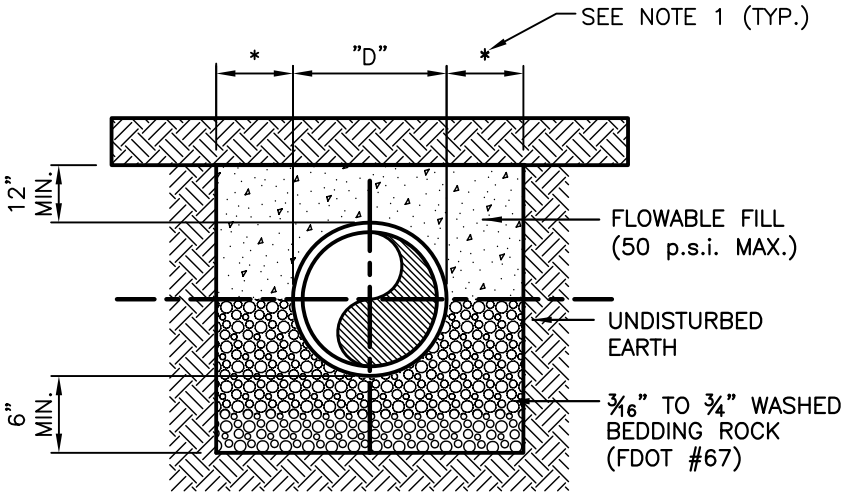
1. PIPE BEDDING: SELECT GRANULAR FILL COMPACTED TO 98% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
2. TRENCH BACKFILL: COMMON FILL IN 12" MAX. LIFTS COMPACTED TO 98% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
3. PIPE BEDDING UTILIZING SELECT COMMON FILL OR BEDDING ROCK IN ACCORDANCE WITH TYPE "A" BEDDING AND TRENCHING DETAIL MAY BE REQUIRED AS DIRECTED BY THE CITY OF MIRAMAR.
4. GRADE AND SHAPE PIPE BED TO EVENLY SUPPORT PIPE AT THE PROPER LINE AND GRADE, WITH FULL CONTACT UNDER THE BOTTOM OF THE PIPE.
5. INSTALL PIPE AND SYSTEM COMPONENTS.
6. PLACE BEDDING SIMULTANEOUSLY ON BOTH SIDES OF THE PIPE. CORRECT ANY PIPE DISPLACEMENTS BEFORE PROCEEDING.
7. IN THE TRENCH BACKFILL ZONE, PLACE BEDDING IN LIFTS NOT GREATER THAN 12" THICKNESS AND COMPACT TO 98% OF MAXIMUM DENSITY PER AASHTO T-180 TO THE BOTTOM OF THE SUBGRADE OR THE TOP OF TRENCH IN UNIMPROVED AREAS.
8. IF REQUIRED IN THE CONTRACT DOCUMENTS OR IF APPROVED BY THE CITY OR ITS REPRESENTATIVE, FLOWABLE MORTAR OR CONTROLLED LOW STRENGTH MATERIAL MAY BE USED IN LIEU OF OTHER BEDDING MATERIAL TYPES.
9. SECURE PIPE AGAINST DISPLACEMENT OR FLOTATION BEFORE PLACING FLOWABLE MORTAR OR CONCRETE ENCASEMENT.
10. CONCRETE ENCASEMENT: INSTALL WHERE SHOWN IN THE PLANS.
11. (*): 18" MAXIMUM FOR PIPE DIAMETER LESS THAN 24", AND 24" MAXIMUM FOR PIPE DIAMETER 24" AND LARGER.
12. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION. UNLESS OTHERWISE APPROVED BY THE CITY.
13. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF THE FLOW.
14. REFER TO SECTION 2.18-E OF THE MANUAL FOR SHEETING AND BRACING IN EXCAVATIONS.
15. FINAL RESTORATION IN IMPROVED AREAS SHALL BE IN COMPLIANCE WITH THE CITY OF MIRAMAR. SURFACE RESTORATION WITHIN CITY OR COUNTY RIGHT-OF-WAY SHALL COMPLY WITH THE APPLICABLE REGULATIONS.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
10/02	Replace common fill w/ granular fill	L.L.

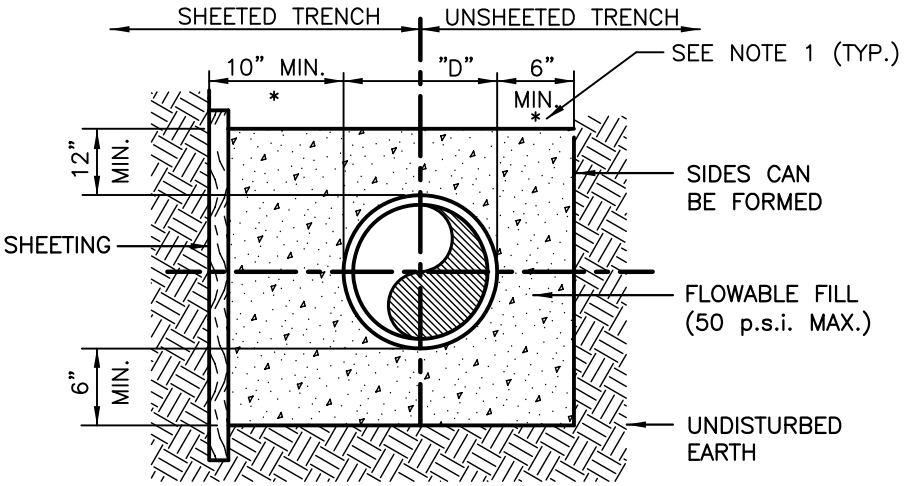
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYPE B BEDDING AND TRENCHING DETAIL

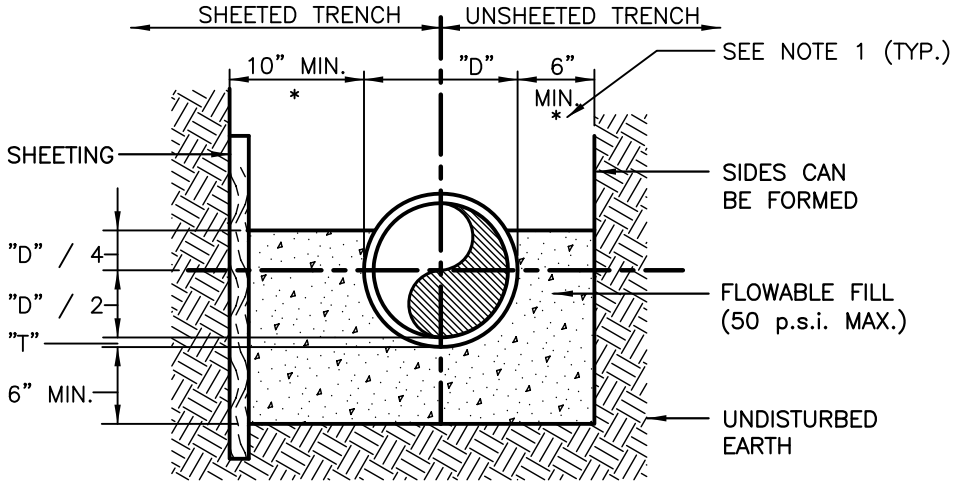
Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 101



CONCRETE ARCH



FULL ENCASEMENT



CRADLE OR HALF ENCASEMENT

NOTES:

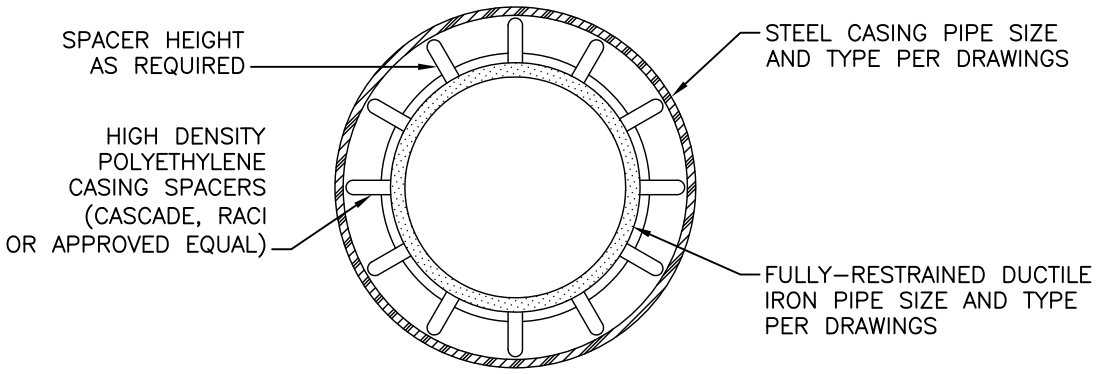
1. (*): 15" MAX. FOR PIPE DIAMETER LESS THAN 24", AND 24" MAX. FOR PIPE DIAMETER 24" AND OVER.
2. "D" REFERS TO THE DIAMETER OF THE PIPE.
3. "T" REFERS TO THE THICKNESS OF THE PIPE.
4. USE OF CONCRETE ARCH HALF ENCASEMENT OR FULL ENCASEMENT TO BE DETERMINED IN THE FIELD AS DIRECTED BY THE CITY OF MIRAMAR.

Date	Revisions	Appr. By
03/04	Concrete Arch – Bedding Rock from 4" to 6"	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

CONCRETE ARCH AND ENCASEMENT DETAILS

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 102



CASING SPACERS – END VIEW

NOTES:

1. WHEN CONSTRUCTION IS WITHIN FDOT JURISDICTION, ADDITIONAL REQUIREMENTS OF THE UTILITY ACCOMODATION MANUAL SHALL BE MET.

2. CASING SHALL BE OF SUFFICIENT LENGTH TO EXTEND UNDER ALL PAVEMENTS AND IN NO CASE SHALL THE END OF THE CASING BE CLOSER THAN EIGHT (8) FEET FROM THE PAVEMENT EDGE INCLUDING PAVED SHOULDERS PLUS ADDITIONAL LENGTH AS NECESSARY TO EXTEND TO THE EXCAVATED SLOPES OF THE JACKING AND RECEIVING PITS.

3. CONTRACTOR SHALL MAINTAIN A MINIMUM OF A 2:1 SLOPE (ANY STEEPER AND PIT MUST BE SHEETED AND SHORED) BEGINNING EIGHT (8) FEET FROM EDGE OF PAVEMENT.

4. CASING SPACERS SHALL BE USED TO INSTALL CARRIER PIPE INSIDE THE ENCASEMENT/CASING PIPE AND TO PROVIDE SUPPORT AROUND THE PERIPHERY OF THE PIPE SHOULD THE PIPE TWIST AS IT IS PUSHED THROUGH THE CASING.

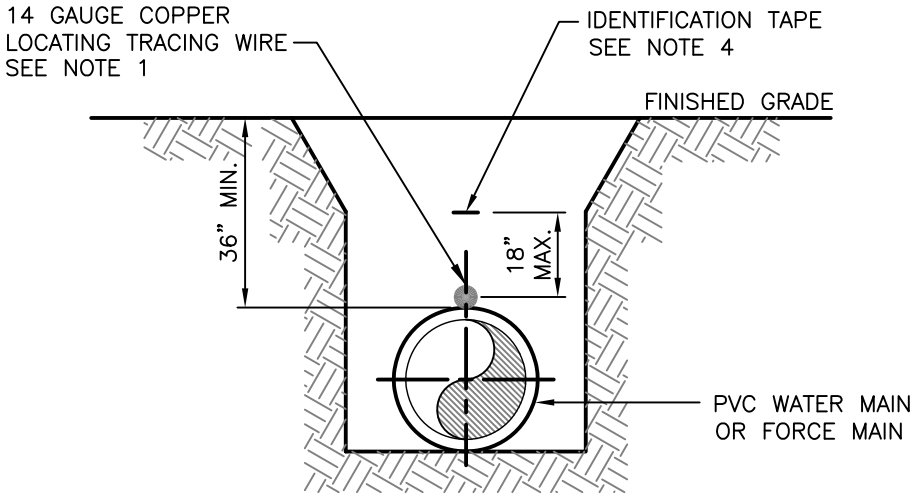
5. THE MAXIMUM SPAN SHOULD BE 6 ½ FEET TO PREVENT SAGGING OF THE CARRIER PIPE. THE SPAN BETWEEN SPACERS SHOULD RESULT IN CONSERVATIVE LONG TERM SAFETY FACTOR PROVIDED TOTAL LOAD PER SPACER DOES NOT EXCEED THE MAXIMUM LOAD FOR PIPE FULL OF LIQUID PER SPACER LISTED IN THE LITERATURE. SPACERS SHALL HAVE MINIMUM HEIGHT THAT CLEARS THE PIPE BELL OR AS OTHERWISE INDICATED ON DRAWINGS. SPACER SHALL BE INSTALLED ACCORDING TO MANUFACTURERS RECOMMENDATIONS.

6. RESTRAINED JOINTS NOT SHOWN FOR CLARITY.

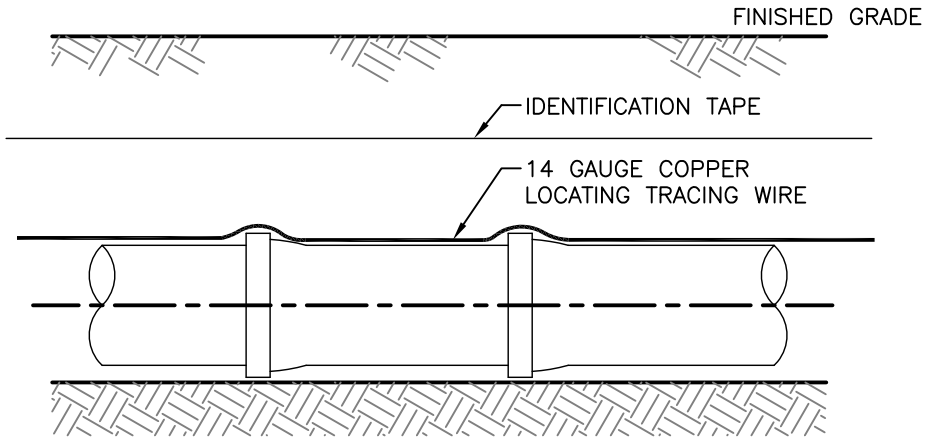
7. IF THE CASING SPACER MANUFACTURER'S RECOMMENDED CASING SPACING IS MORE STRINGENT THAT THE SPACING SHOWN ABOVE, THEN THE MANUFACTURER'S RECOMMENDED SPACING SHALL BE USED.

8. THE ENDS OF THE CASING SHALL BE SEALED USING CONCRETE BLOCK OR BRICK AND MORTAR WALL FILLING OR PWM MODEL 1 WA WRAP AROUND END SEAL MADE OF ⅛" THICKNESS RUBBER AND STAINLESS STEEL BANDS OR DESIGN ENGINEER APPROVED EQUAL.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			BORING AND JACKING DETAIL			
03/04	General Revision	K.H.G.				
Date	Revisions	Appr. by	Issue Date: July 1998	Scale: N.T.S.	Sheet#: 2 of 2	Fig.#: 103



SECTION



PROFILE

NOTES:

1. PVC PIPE SHALL REQUIRE INSULATED METALLIC LOCATING TRACING WIRE (14 GAUGE COPPER) CAPABLE OF DETECTION BY A CABLE LOCATOR AND SHALL BE BURIED DIRECTLY ON TOP OF THE PIPE AT CENTERLINE.

2. LOCATING WIRE SHALL TERMINATE AT THE TOP OF EACH VALVE BOX AND BE CAPABLE OF EXTENDING 12" ABOVE TOP OF BOX IN SUCH A MANNER SO AS NOT TO INTERFERE WITH VALVE OPERATION.

3. USE PLASTIC CLIPS AS NECESSARY TO HOLD WIRE DIRECTLY ON THE TOP OF THE PIPE.

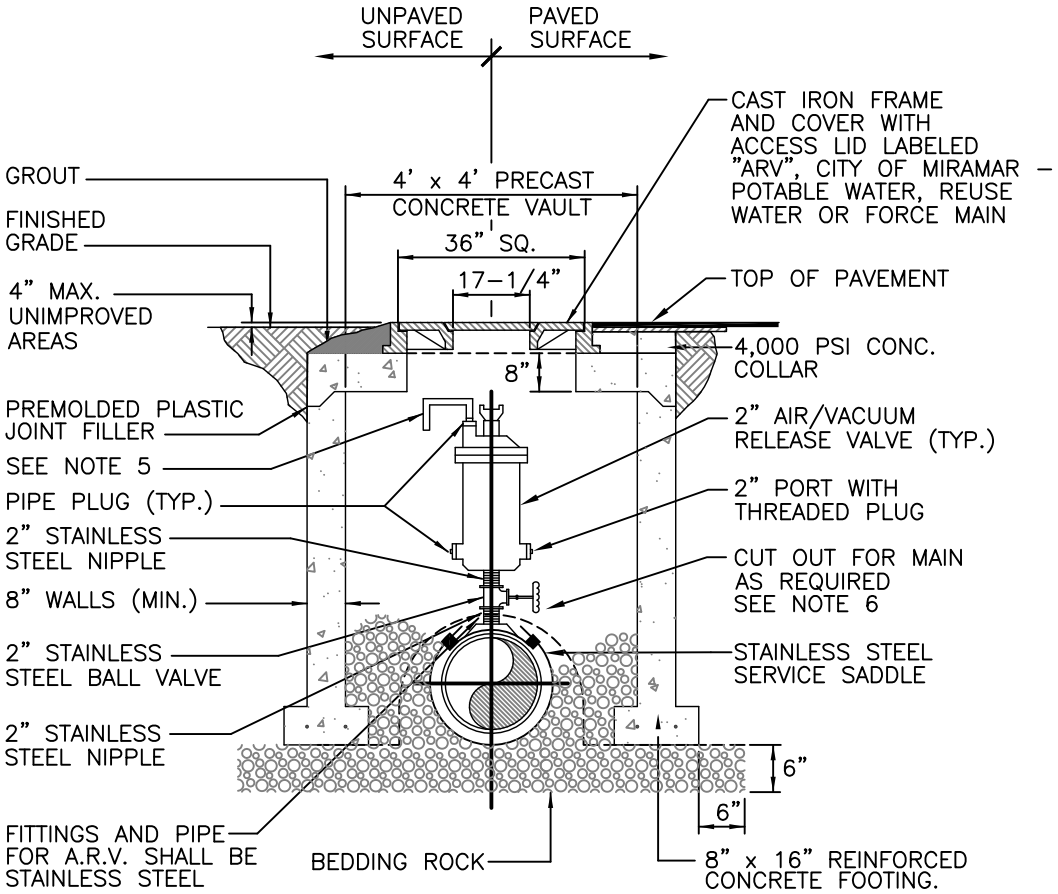
4. DETECTABLE IDENTIFICATION TAPE SHALL BE INSTALLED DIRECTLY OVER CENTERLINE OF ALL PIPE AT 18–INCHES ABOVE THE TOP OF THE PIPE. SEE "ENGINEERING STANDARDS," SECTIONS 4.03–P, 6.03–N AND 8.03–I FOR FURTHER DETAILS.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
12/01	Revised note #4	L.L.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

PVC PIPE LOCATING WIRE AND IDENTIFICATION TAPE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 104



NOTES:

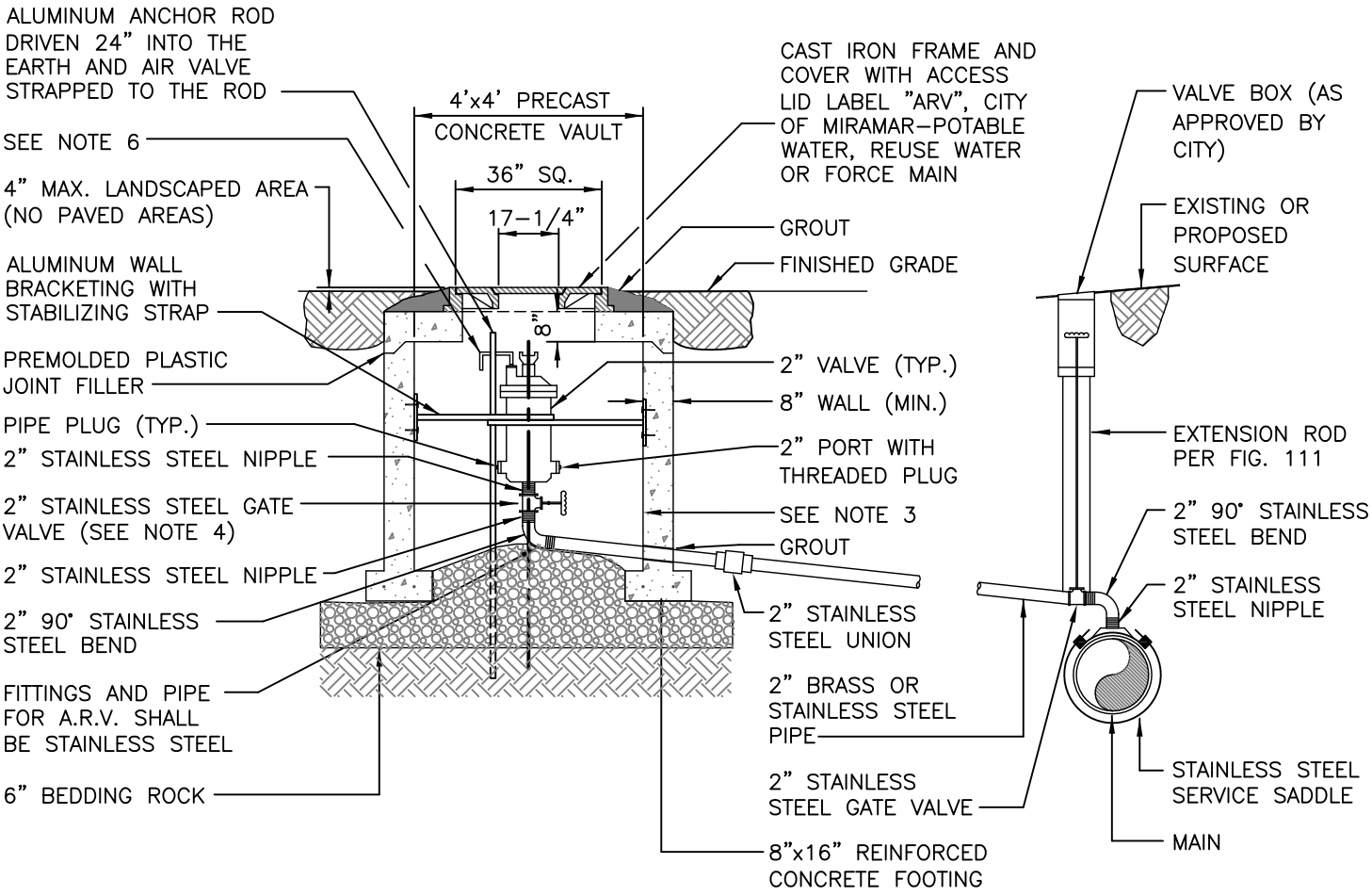
1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE, CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY PRIOR TO INSTALLATION.
2. THE BOTTOM OF THE PRECAST VAULT SHALL BE PLACED AT THE SAME ELEVATION AS THE BOTTOM OF THE PIPE.
3. ARV VAULT WALLS TO BE COATED INSIDE AND OUTSIDE WITH 16 MIL. THK. APPROVED ASPHALTIC COATING.
4. LIFT HOLES ARE TO BE SEALED WITH MORTAR INSIDE AND OUTSIDE AFTER INSTALLATION. ALL OPENINGS SHALL BE SEALED WITH WATERPROOF, EXPANDING GROUT.
5. WASTEWATER VALVES TO BE EQUIPPED WITH THREADED VENT PIPE THAT DIRECTS VENT DOWNWARD.
6. VAULT SHALL NOT REST ON PIPE. ALLOW 9" MIN. SEPARATION.
7. WHEN USED ON A FORCE MAIN ALL FITTINGS SHALL BE STAINLESS STEEL.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
09/02	Change material to stainless steel	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

AIR RELEASE VALVE DETAIL

Issue Date: Sept. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 108



NOTES:

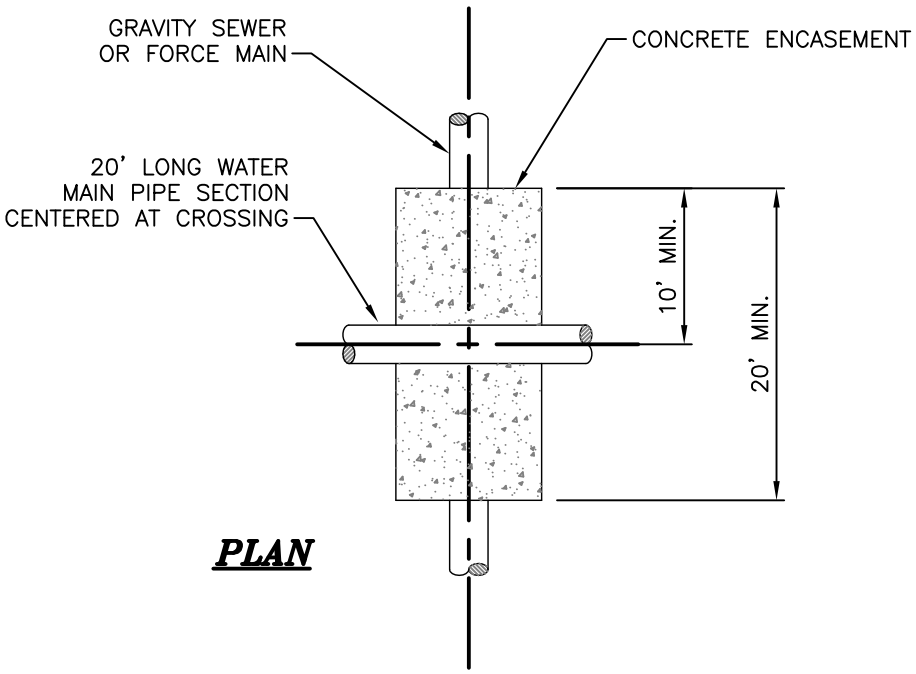
1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE, CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 4.0 FEET.
3. ARV VAULT WALLS TO BE COATED INSIDE AND OUTSIDE WITH 16 MIL. THICK APPROVED COATING.
4. VALVE SHALL BE SUPPORTED TO VAULT WALL.
5. LIFT HOLES ARE TO BE SEALED WITH MORTAR INSIDE AND OUTSIDE AFTER INSTALLATION. ALL OPENINGS SHALL BE SEALED WITH WATERPROOF, EXPANDING GROUT.
6. VALVES TO BE EQUIPPED WITH THREADED VENT PIPE THAT DIRECTS VENT DOWNWARD.

03/04	General Revision	K.H.G.
12/01	General Revision	L.L.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

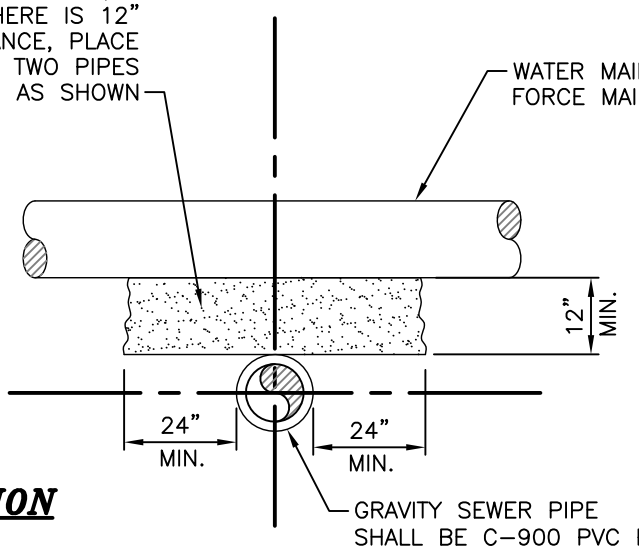
OFFSET AIR RELEASE VALVE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 108.1



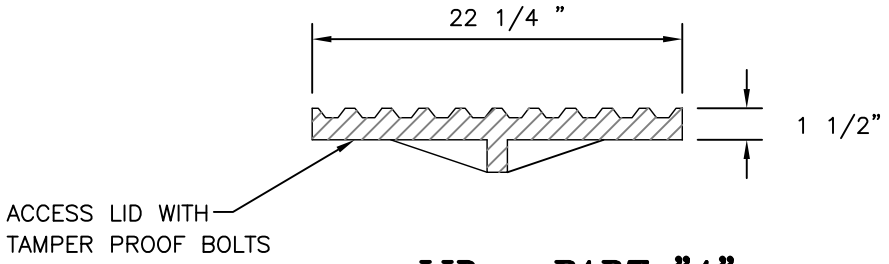
PLAN

WHEN A PIPELINE CROSSES OVER (OR UNDER) ANOTHER PIPE AND THERE IS 12" OR LESS VERTICAL CLEARANCE, PLACE FLOWABLE FILL BETWEEN THE TWO PIPES AS SHOWN

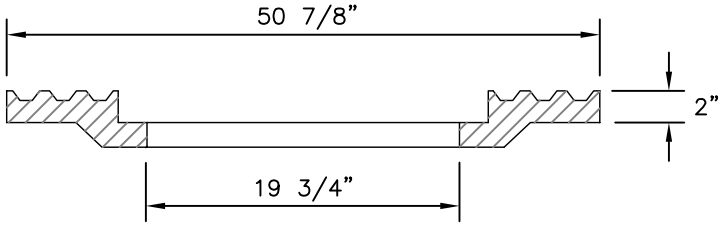


SECTION

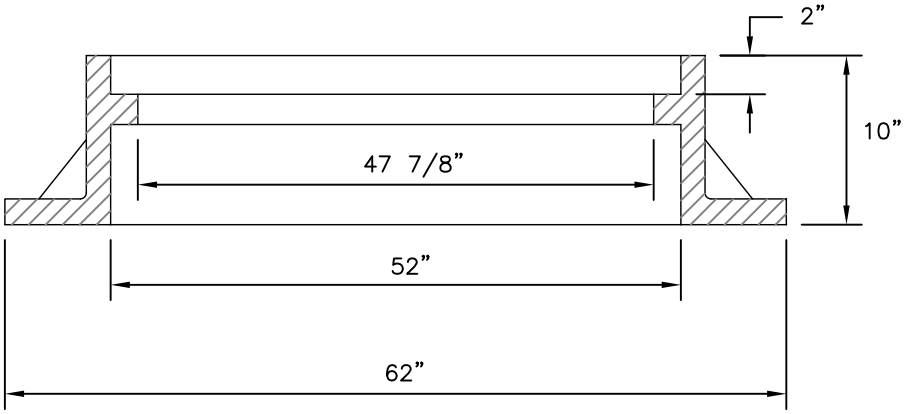
			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			FLOWABLE FILL BEDDING BETWEEN CROSSING PIPES
08/05	Revise note	B.V.	
Date	Revisions	Appr. by	Issue Date: MAR. 2004 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 109



LID – PART "A"



LID – PART "B"



FRAME

NOTES:

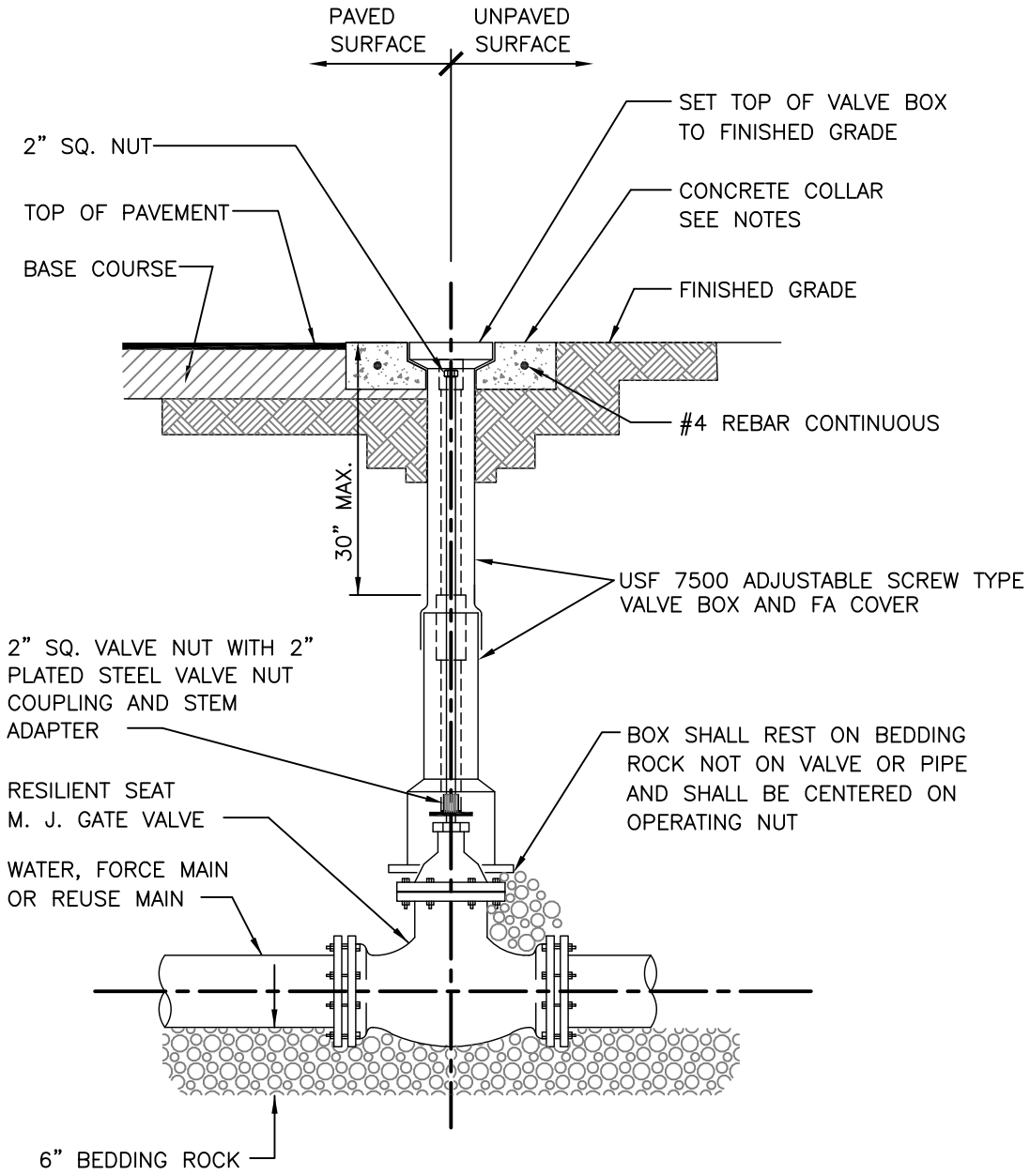
1. ALL BEARING SURFACES TO BE MACHINED.
2. MINIMUM WEIGHT 1480 LBS.
3. U.S.F. 1341–AHM, TYPE C OR APPROVED EQUAL.
4. LID TO BE LABELED "ARV – CITY OF MIRAMAR – POTABLE WATER";
   "ARV – CITY OF MIRAMAR – REUSE WATER"; OR
   "ARV – CITY OF MIRAMAR – FORCE MAIN".

Date	Revisions	Appr. by
03/04	Revised note #4	K.H.G.
10/02	Revised note #3	K.H.G.
12/01	Added note #4	L.L.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

AIR RELEASE VAULT ACCESS COVER

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 110



NOTES:

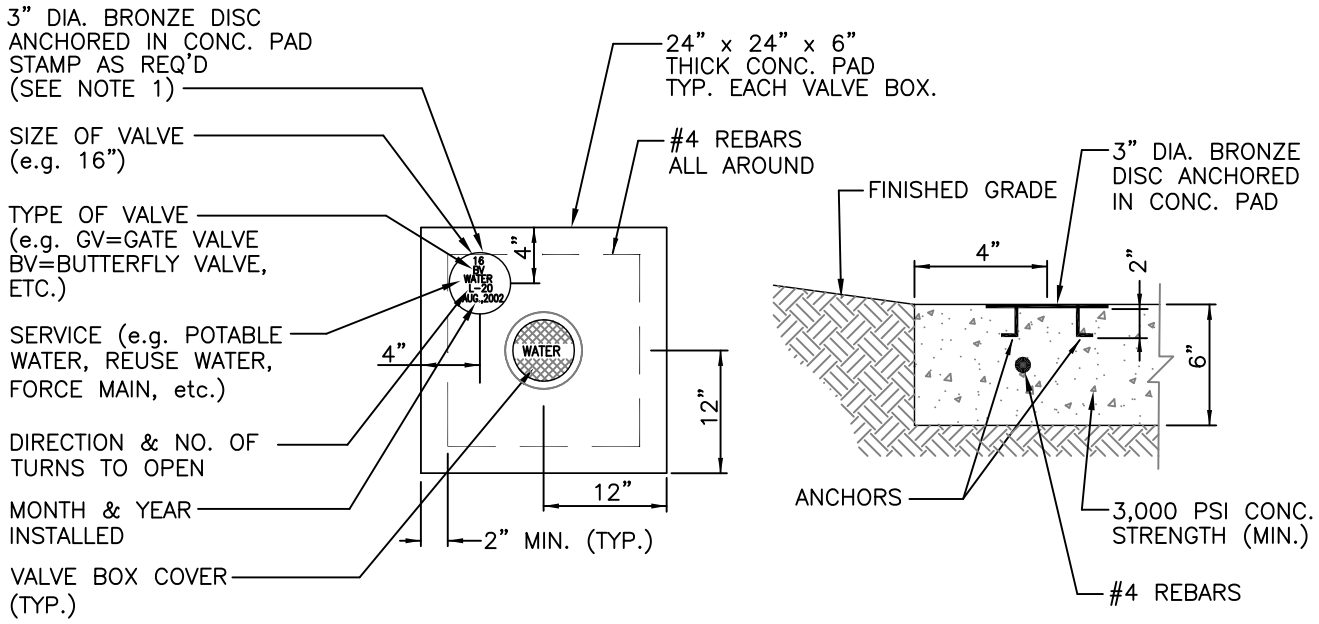
1. VALVE COLLAR SHALL BE 24"X24"X6" (MIN.) CONCRETE COLLAR PER FIG. 113.
2. WHEN WATER VALVE IS NOT LOCATED IN PAVEMENT, PLACE A WHITE PAVEMENT REFLECTOR MARKER IN THE DRIVE LANE, ADJACENT TO THE VALVE.
3. VALVE BOX COVER SHALL BE PAINTED BLUE WITH THE DESIGNATION "WATER"; GREEN WITH THE DESIGNATION "SEWER"; PURPLE WITH THE DESIGNATION "REUSE".

09/07	General Revision	B.V.
03/04	General Revision	K.H.G.
07/03	Added note #3	K.H.G.
10/02	Revision to figure text & paved surface	L.L.
Date	Revisions	Appr. by

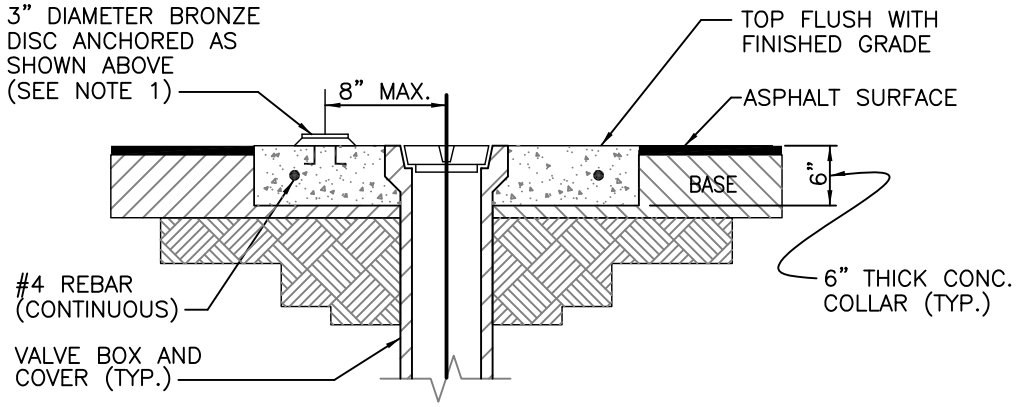
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

GATE VALVE AND VALVE BOX DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 111



UNIMPROVED CONDITION



ALTERNATIVE FOR PAVED SURFACE

NOTES:

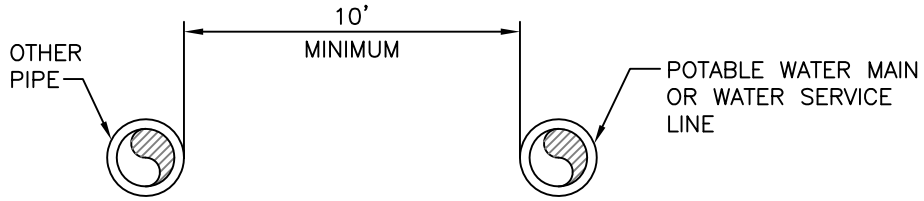
1. BRONZE IDENTIFICATION DISC SHALL BE REQUIRED FOR ALL VALVES, AND SHALL INDICATE: SIZE OF VALVE, TYPE OF VALVE, SERVICE, DIRECTION AND NUMBER OF TURNS TO OPEN, AND DATE INSTALLED.

Date	Revisions	Appr. by
03/04	General text revisions	K.H.G.
09/02	General text revisions	K.H.G.
12/01	Addition to bronze disc	L.L.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

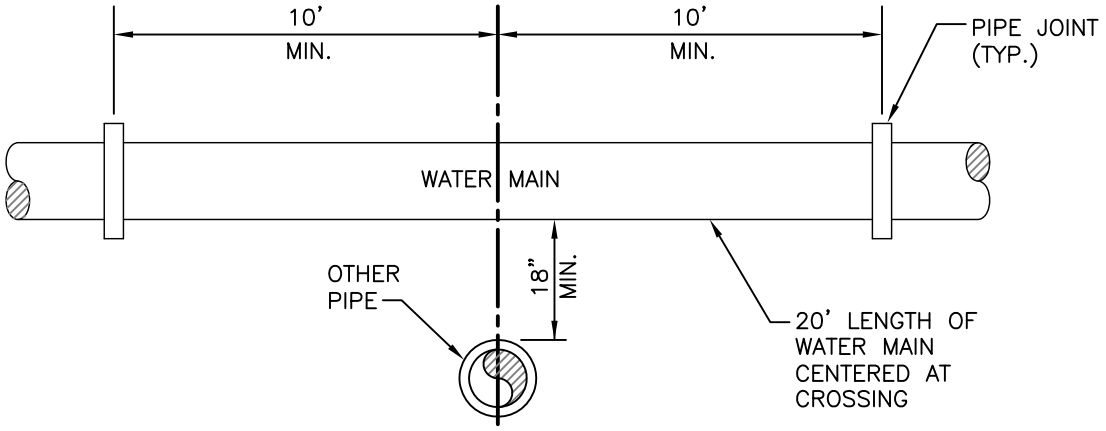
VALVE BOX CONCRETE COLLAR DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 113



PLAN

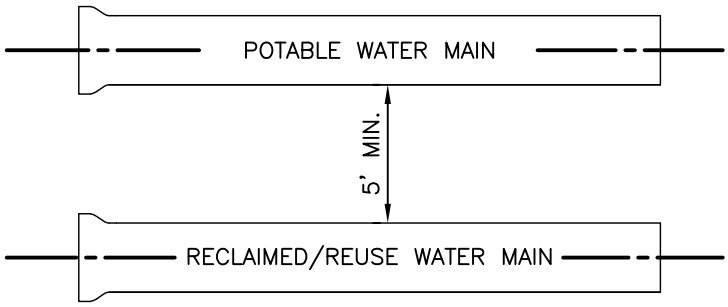
HORIZONTAL SEPARATION 10 FEET OR GREATER



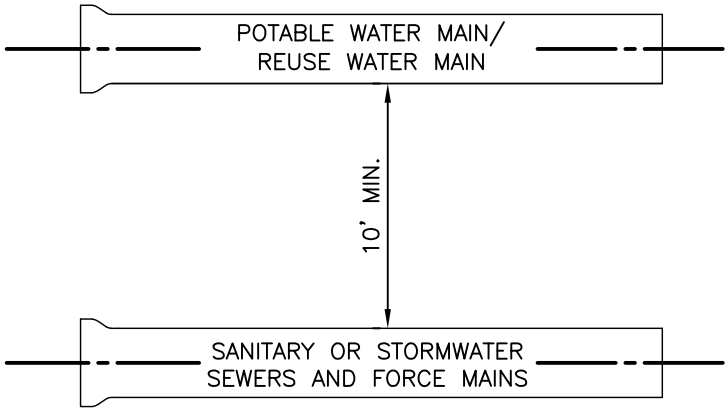
SECTION

VERTICAL CLEARANCE AT CROSSING 18 INCHES
OR GREATER

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			DETAILS FOR PROTECTION OF POTABLE WATER SUPPLY			
Date	Revisions	Appr. by	Issue Date: AUG. 2003	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 114

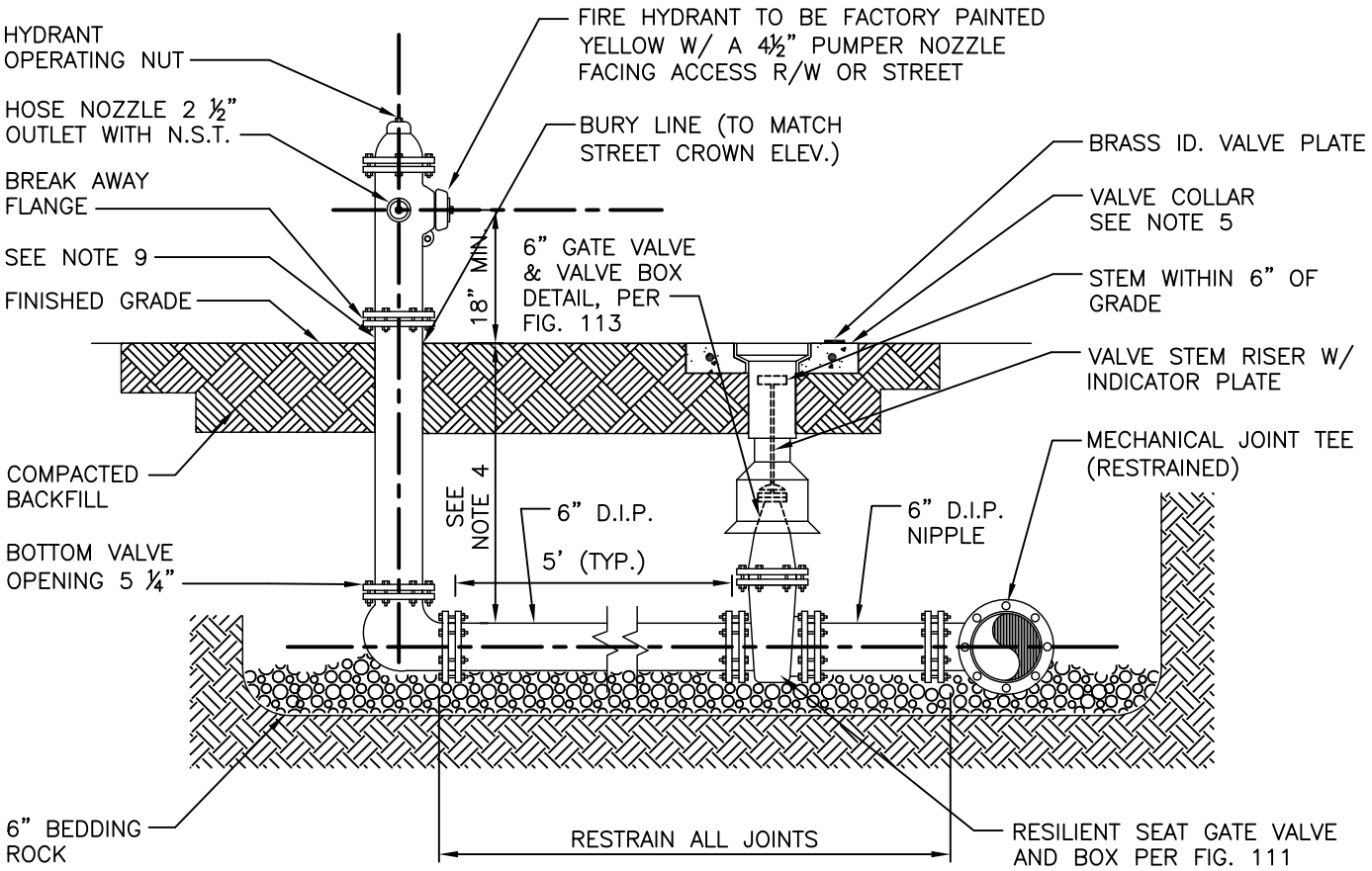


A MINIMUM 5' CLEAR HORIZONTAL SEPARATION SHALL BE MAINTAINED BETWEEN RECLAIMED/REUSE WATER MAINS AND POTABLE WATER MAINS.



A MINIMUM 10' CLEAR HORIZONTAL SEPARATION SHALL BE MAINTAINED BETWEEN POTABLE WATER MAINS/REUSE WATER MAINS AND SANITARY OR STORMWATER SEWERS AND FORCE MAINS.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			MIN. HORZ. SEPARATION REQUIREMENTS FOR POTABLE WATER, RECLAIMED, STORMWATER & SEWER LINES			
Date	Revisions	Appr. by	Issue Date: Aug. 2003	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 114.1



NOTES:

1. PIPE SHALL BE DUCTILE IRON CLASS 52. DIP SPOOL PIECES TO BE CLASS 350.
2. ALL PIPES AND FITTINGS SHALL BE RESTRAINED MECHANICAL JOINT, MATERIAL TO BE DUCTILE IRON.
3. HYDRANT VALVES SHALL BE INSTALLED AS CLOSE TO WATER MAIN AS POSSIBLE.
4. DEPTH OF COVER TO TOP OF UNDERGROUND PIPING: 30" MINIMUM TYPICAL; 36" MINIMUM UNDER DRIVING SURFACES.
5. VALVE COLLAR SHALL BE 24"x24"x6" CONCRETE COLLAR W/ 1–#4 BAR (CONT.) PER FIG. 113.
6. NO HYDRANT SHOULD BE LOCATED CLOSER THAN 5' TO A TYPE "D" CURB OR 7' TO A VALLEY GUTTER.
7. GUARD POSTS (PER FIG. 201) AROUND FIRE HYDRANTS ARE REQUIRED WHEN HYDRANTS ARE PLACED WITH IN 6 FEET OF ALL ROADWAYS, DRIVEWAYS, TURN RADIUS, OR PARKING AREA.
8. A BLUE REFLECTIVE PAVEMENT MARKER SHALL BE PROVIDED IN THE CENTER OF THE NEAREST LANE OF ROAD PAVEMENT ADJACENT TO ALL FIRE HYDRANT LOCATIONS.
9. CLEARANCE BETWEEN BOTTOM OF BOLTS AND GRADE SHALL BE 6" MINIMUM.

CONTRACTOR SHALL COLOR CODE THE TOP OF EACH HYDRANT INDICATED BY THE GALLONS PER MINUTE OF FLOW. THE BODY OF ALL FIRE HYDRANT SHALL BE PAINTED YELLOW (RUST–OLEUM #944 SAFETY YELLOW, O.A.E. WITH A 40 MIL DFT.) AND THE TOP COLOR CODED AS FOLLOWS:

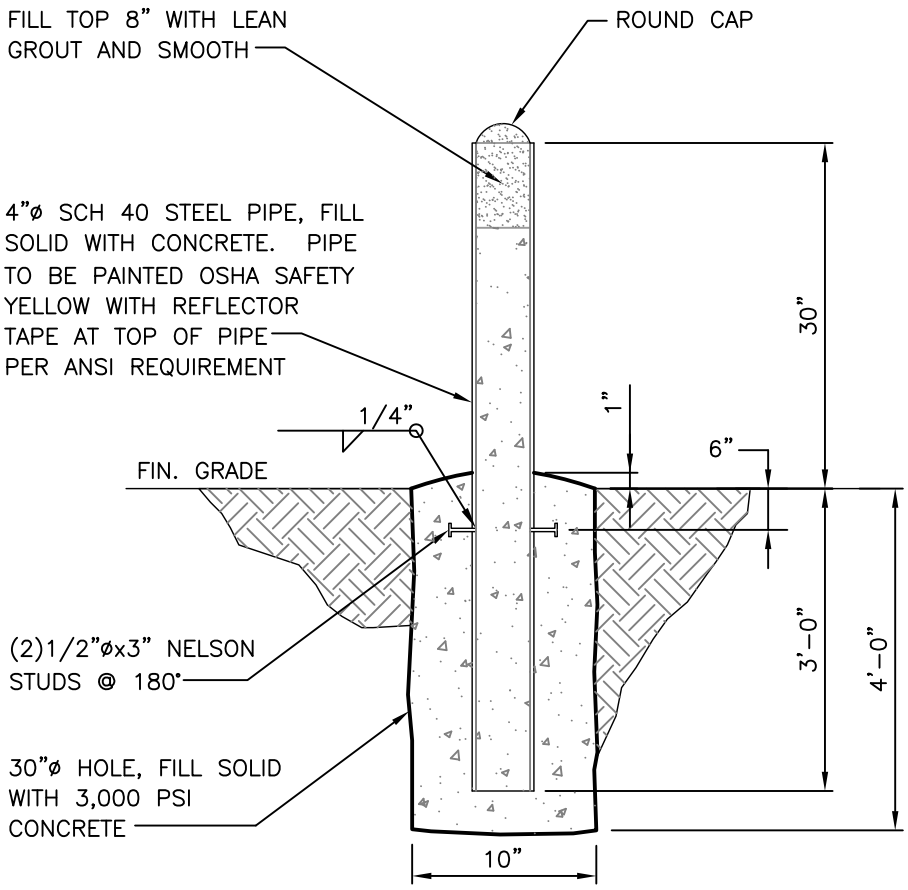
FLOW	COLOR OF BONNETS & CAPS
1,500 GPM OR GREATER	BLUE
1,000 GPM OR GREATER	GREEN
500–1,000 GPM	ORANGE
LESS THAN 500 GPM	RED

09/07	General Revision per F.D.	B.J.V.
03/04	General Revision	K.H.G.
07/03	General Revision	K.H.G.
07/02	Misc. Revisions by Fire Department	M.M.
Date	Revisions	Appr. by

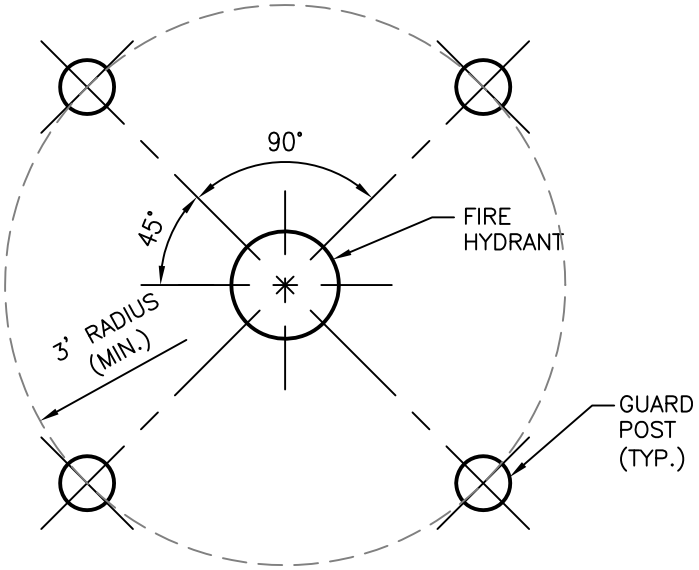
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

FIRE HYDRANT ASSEMBLY DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 200

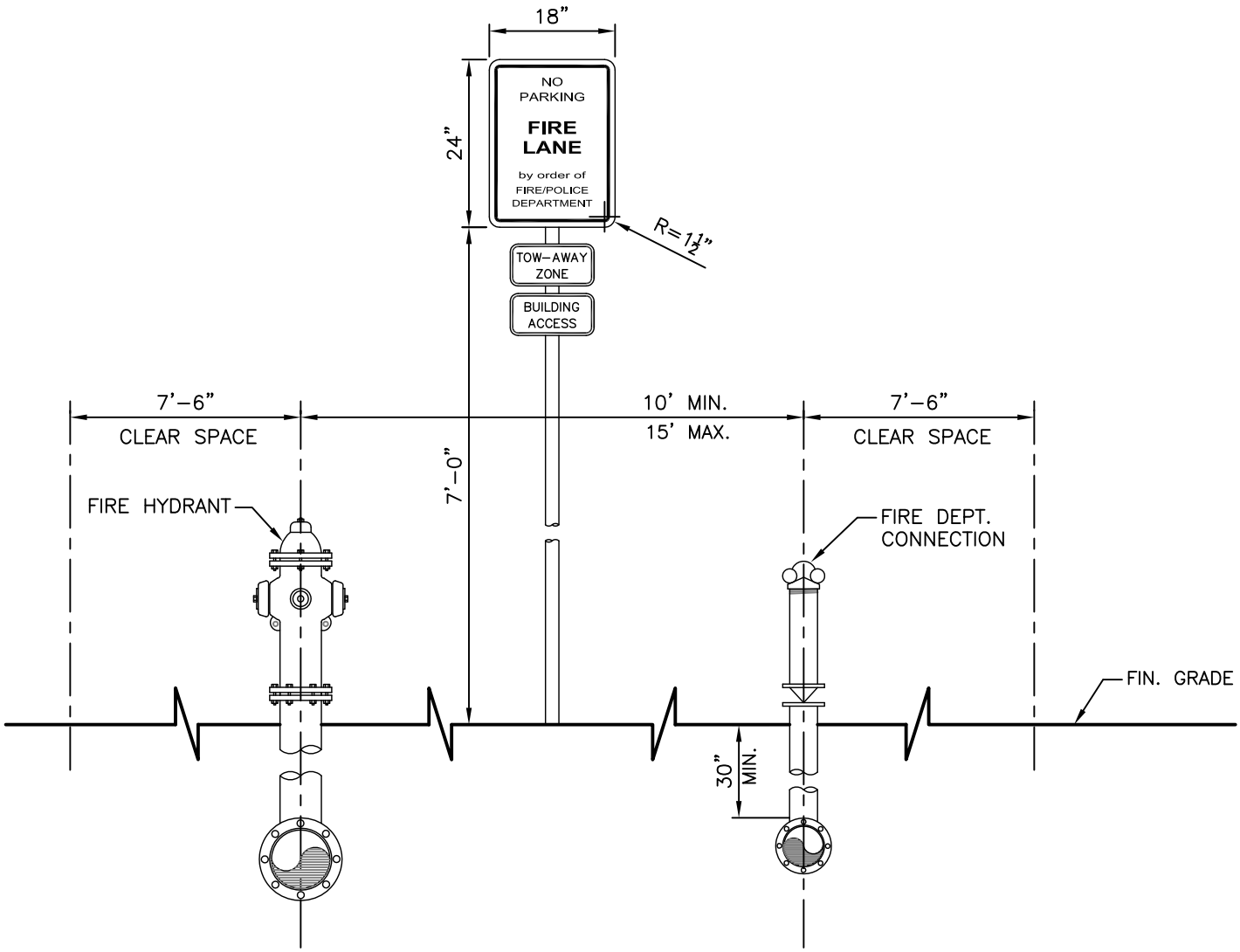


SECTION



PLAN VIEW

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			GUARD POST DETAIL
10/02	Add plan view by Fire Department	M.M.	
Date	Revisions	Appr. by	Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 201



NOTE: FIRE HYDRANT AND FDC SHALL BE ON THE SAME PLANE

NOTES:

FIRE LANE SIGN:

1. SIGNS SHALL HAVE A WHITE REFLECTORIZED BACKGROUND WITH RED OPAQUE LEGEND AND BORDER.
2. "FIRE LANE" LETTERS SHALL BE 1¼" AND ALL OTHER LETTERS SHALL BE 1" SERIES "C".
3. SIGNS SHALL BE MOUNTED ON POST AT LOCATIONS DEPICTED ON SITE PLAN AT A MAXIMUM HEIGHT OF 7'–0" FROM THE FINISHED GRADE TO THE BOTTOM PART OF THE SIGN.

TOW–AWAY ZONE SIGN AND BUILDING ADDRESS SIGN:

1. SIGNS SHALL BE A MINIMUM OF 6"x12" WHITE BACKGROUND WITH RED LETTERS MINIMUM LETTER SIZE TO BE ONE INCH.

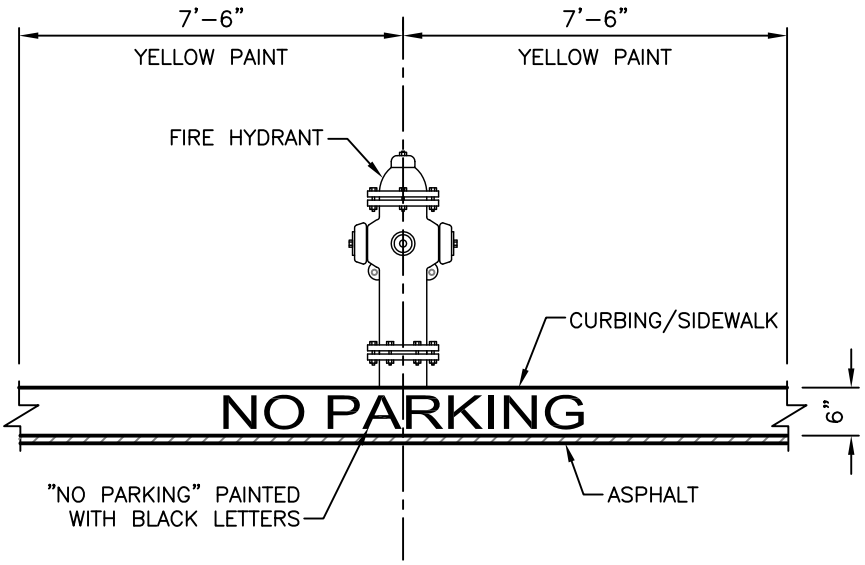
09/07	Removed guard posts	B.V.
07/02	Detail added by Fire Dept.	M.M.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

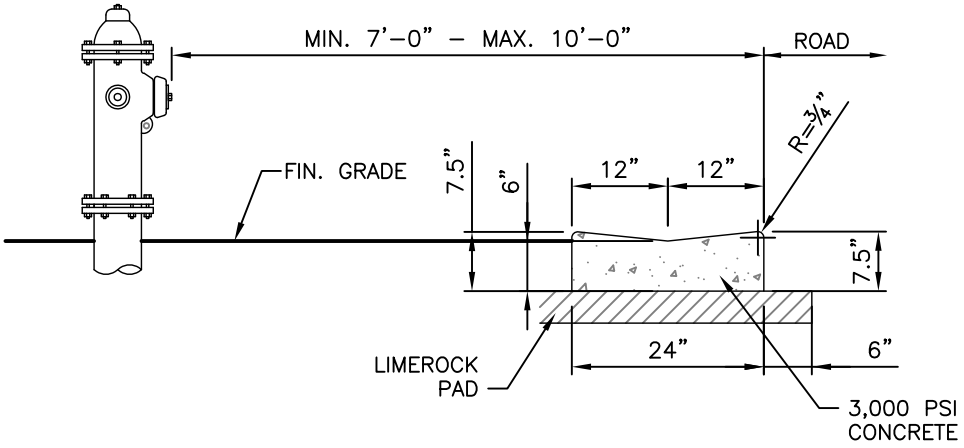
FIRE HYDRANT–FIRE DEPT. CONNECTION LOCATION DETAIL

Issue Date: May 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 202

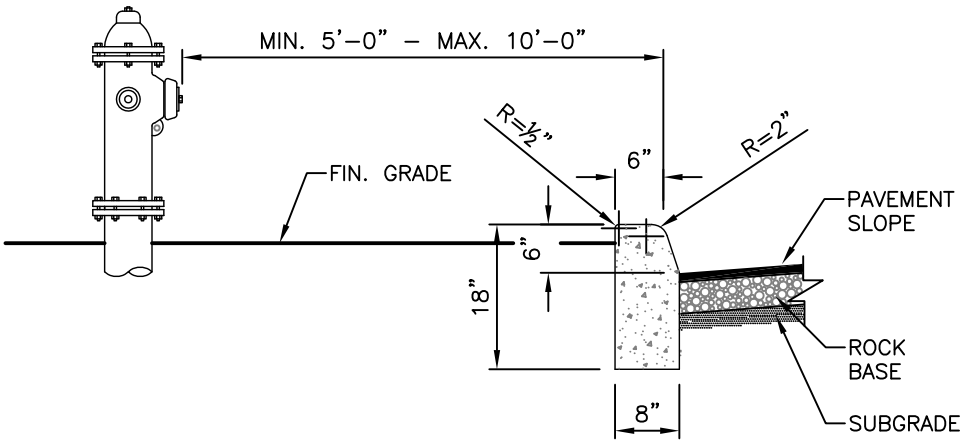
TYPICAL CURB MARKING AT HYDRANT LOCATIONS



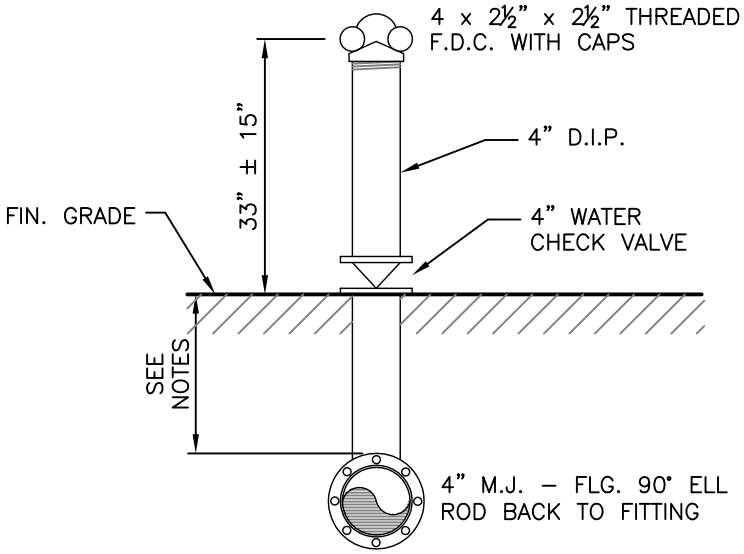
VALLEY GUTTER



TYPE "D" CURB



			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			STANDARD FIRE HYDRANT PLACEMENT DETAIL
07/02	Detail added by Fire Dept.	M.M.	
Date	Revisions	Appr. by	Issue Date: May 2002 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 203



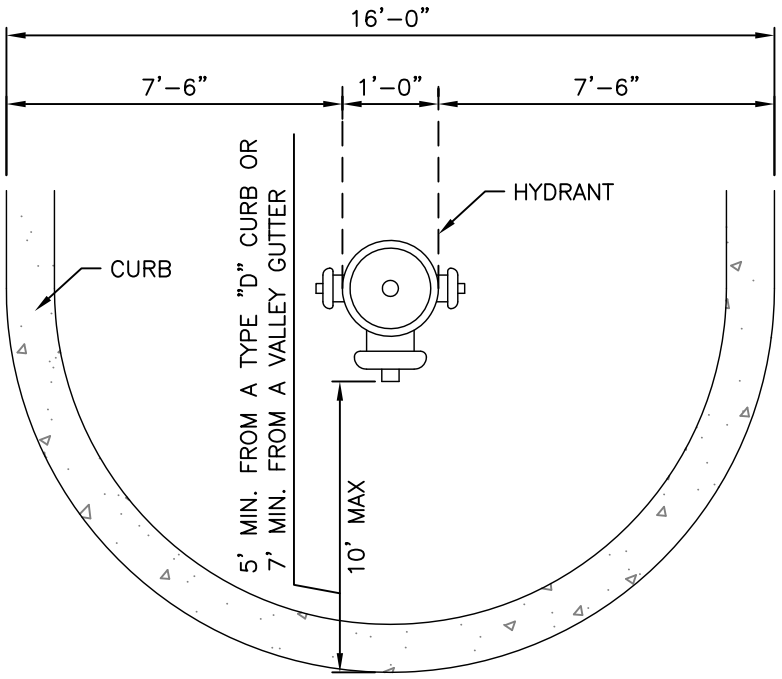
THERE SHALL BE NO SHUT OFF VALVE IN THE FIRE DEPARMENT CONNECTION.
NFPA 24 2–6.3

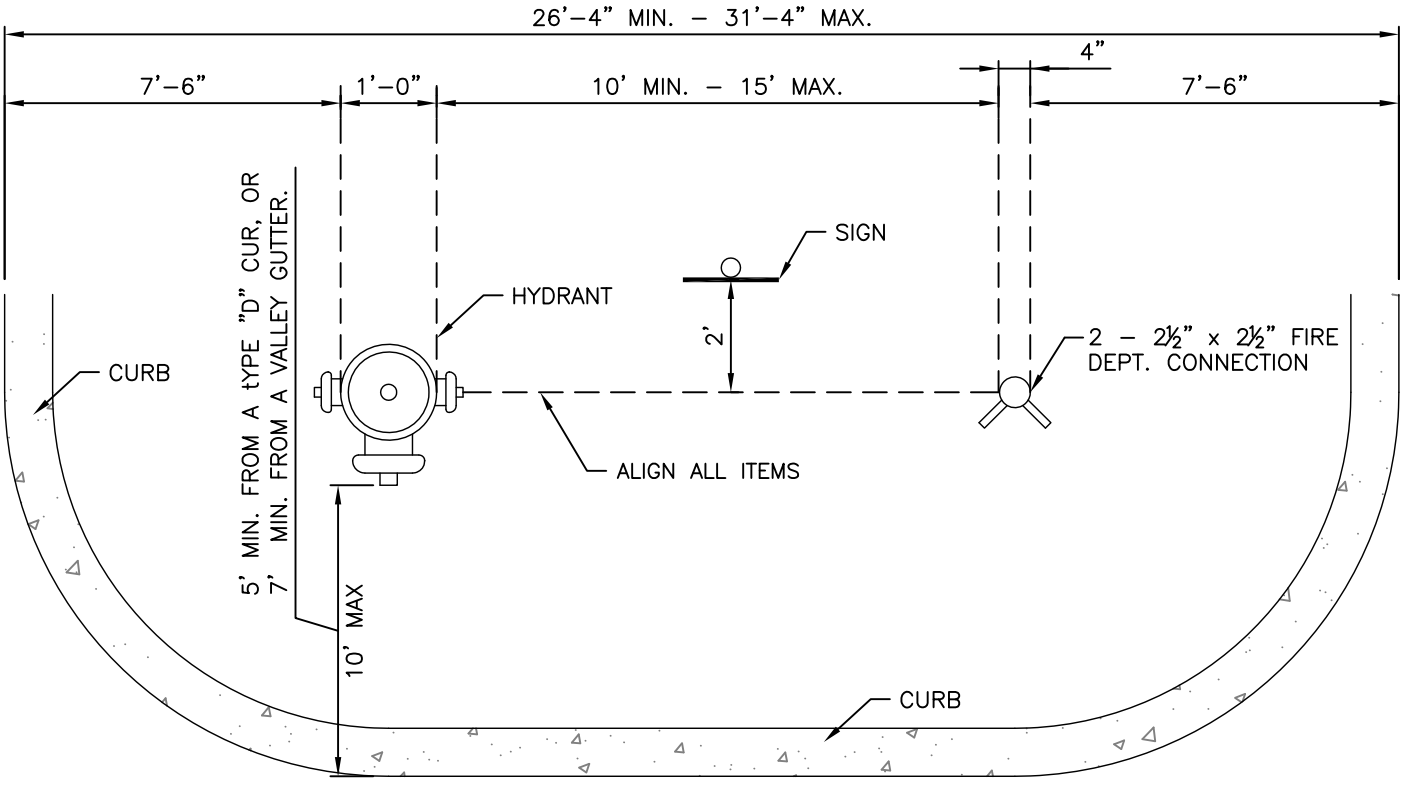
NOTES:

1. DEPTH OF COVER TO TOP OF PVC UNDERGROUND PIPING SHALL BE NOT LESS THAN 36" MINIMUM.

2. DEPTH OF COVER TO TOP OF DIP UNDERGROUND PIPING SHALL BE NOT LESS THAN 30" MINIMUM.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			STANDARD FIRE DEPARTMENT CONNECTION DETAIL
07/02	Detail added by Fire Dept.	M.M.	
Date	Revisions	Appr. by	Issue Date: May 2002 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 204



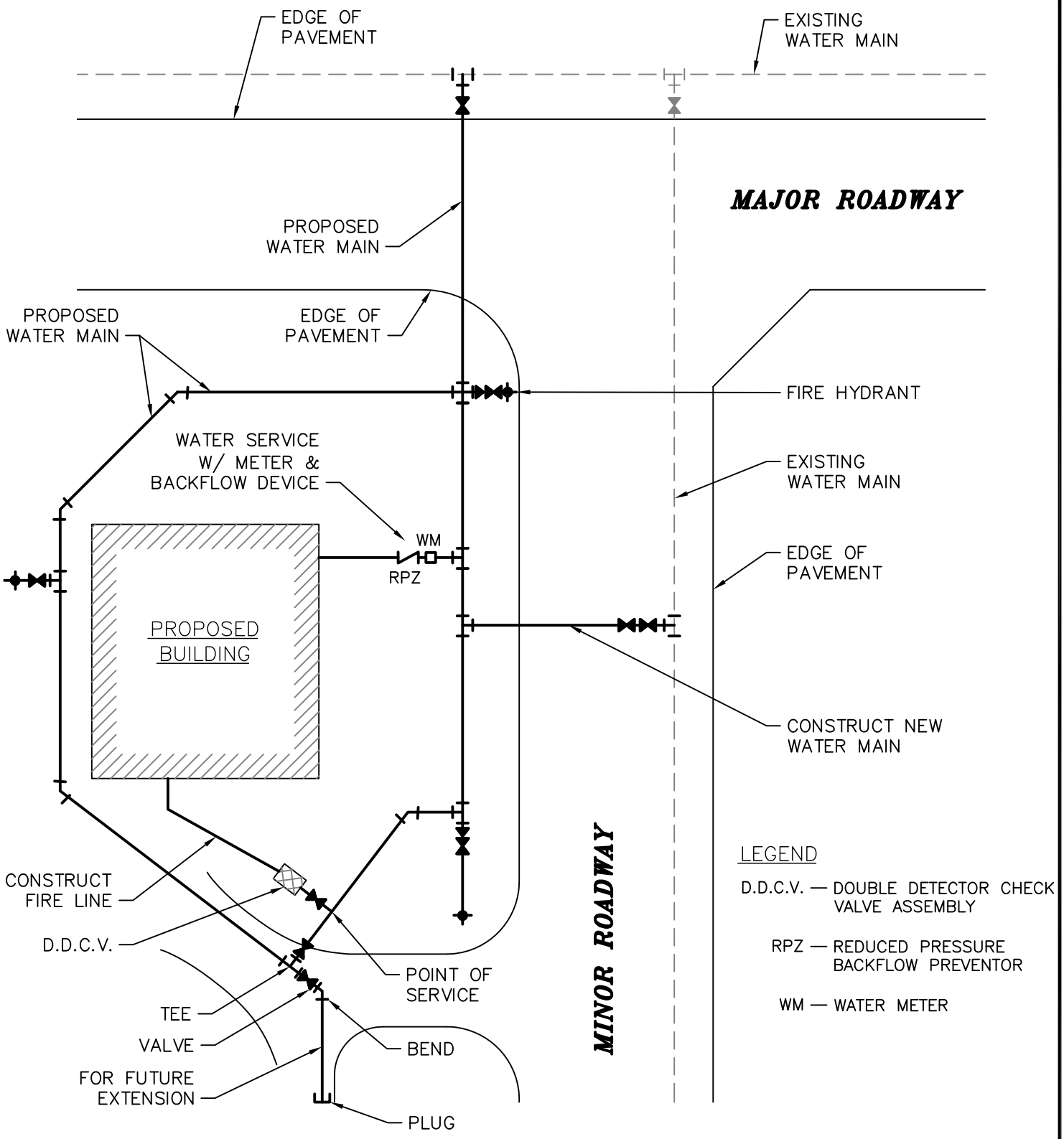


09/07	General Revision per Fire Dept.	B.V.
07/02	Detail added by Fire Dept.	M.M.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYP. FIRE HYDRANT/FIRE DEPT. CONNECTION ISLAND DETAIL (PLAN VIEW)

Issue Date: May 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 205

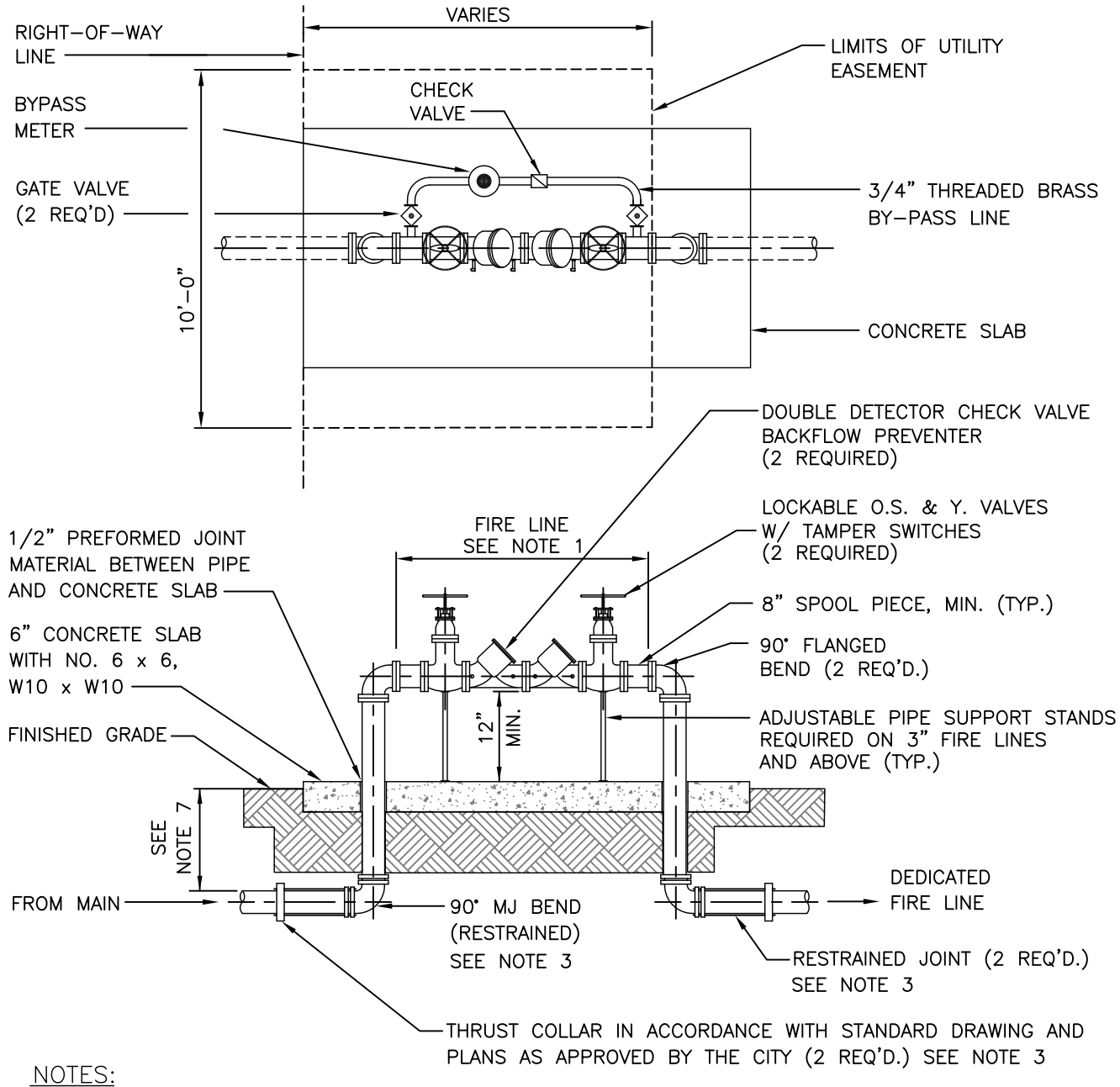


07/02	Detail added by Fire Dept.	M.M.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

LOOPED WATER MAIN SYSTEM

Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 206



NOTES:

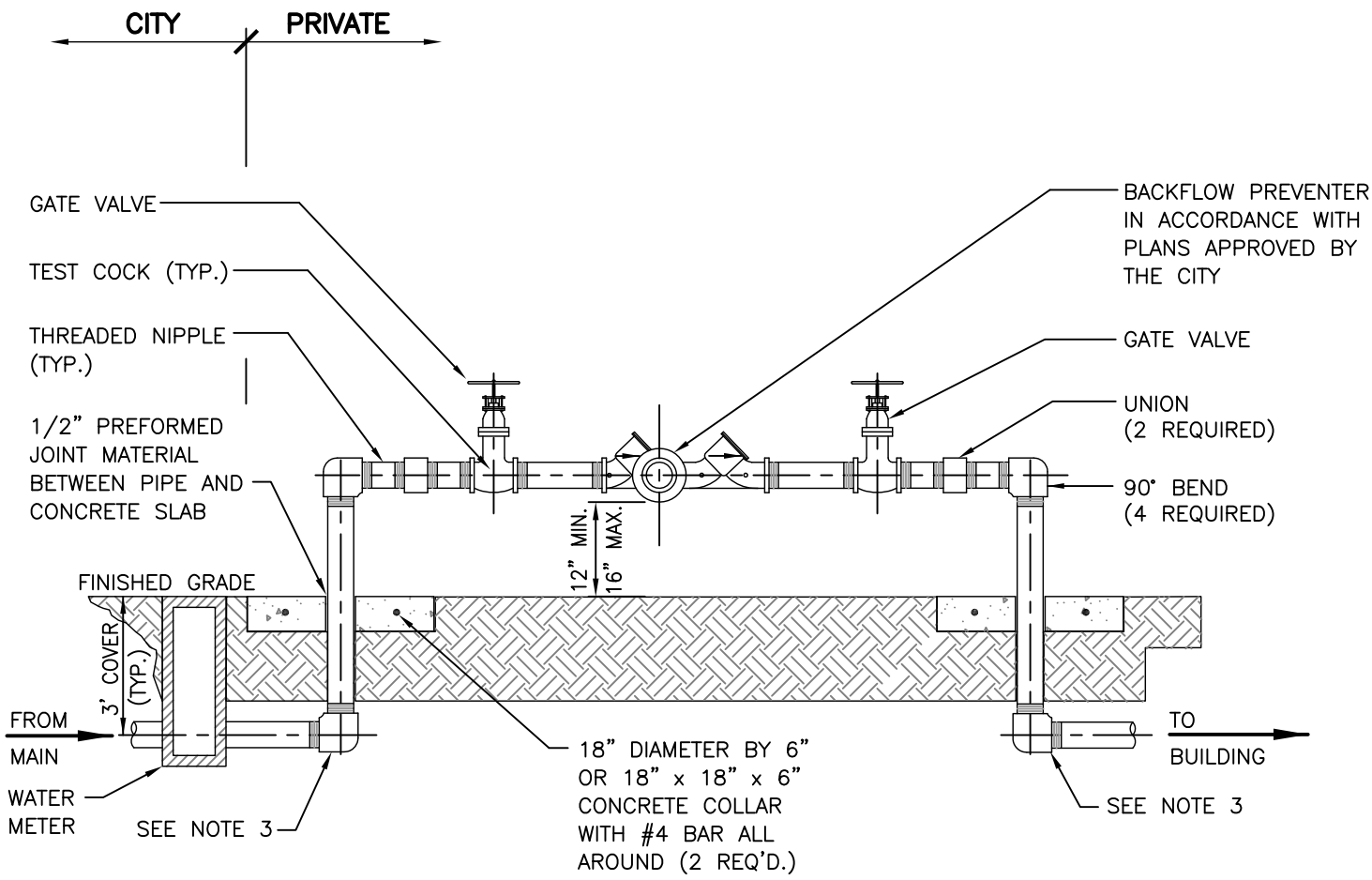
1. ALL PIPE AND FITTINGS 2" AND SMALLER SHALL BE THREADED BRASS.
2. ALL PIPE FITTINGS 4" DIA. AND LARGER SHALL BE CEMENT-LINED DUCTILE IRON WITH FLANGED FITTINGS FOR ABOVEGROUND USE. MECHANICAL JOINT FITTINGS SHALL BE USED UNDERGROUND.
3. MEGALUGS, OR APPROVED EQUAL, CAN BE USED IN PLACE OF RESTRAINED JOINTS ON ALL UNDERGROUND PIPING.
4. PAINT ALL ABOVEGROUND DUCTILE PIPING, FITTINGS AND VALVES.
5. BACKFLOW PREVENTOR CONTROL VALVES SHALL BE MONITORED BY AN ELECTRONIC TAMPER SWITCH CONNECTED TO A CENTRAL ALARM SERVICE.
6. DEPTH OF COVER TO TOP OF UNDERGROUND PIPING:
   - 30" MINIMUM (TYP.)
   - 36" MINIMUM UNDER DRIVING SURFACES

Date	Revisions	Appr. by
09/07	Removed note	B.V.
07/02	Added note 7 by Fire Dept.	M.M.
07/02	Added notes 5 & 6	B.V.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

FIRE LINE-DOUBLE DETECTOR CHECK VALVE ASSEMBLY DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 207



NOTES:

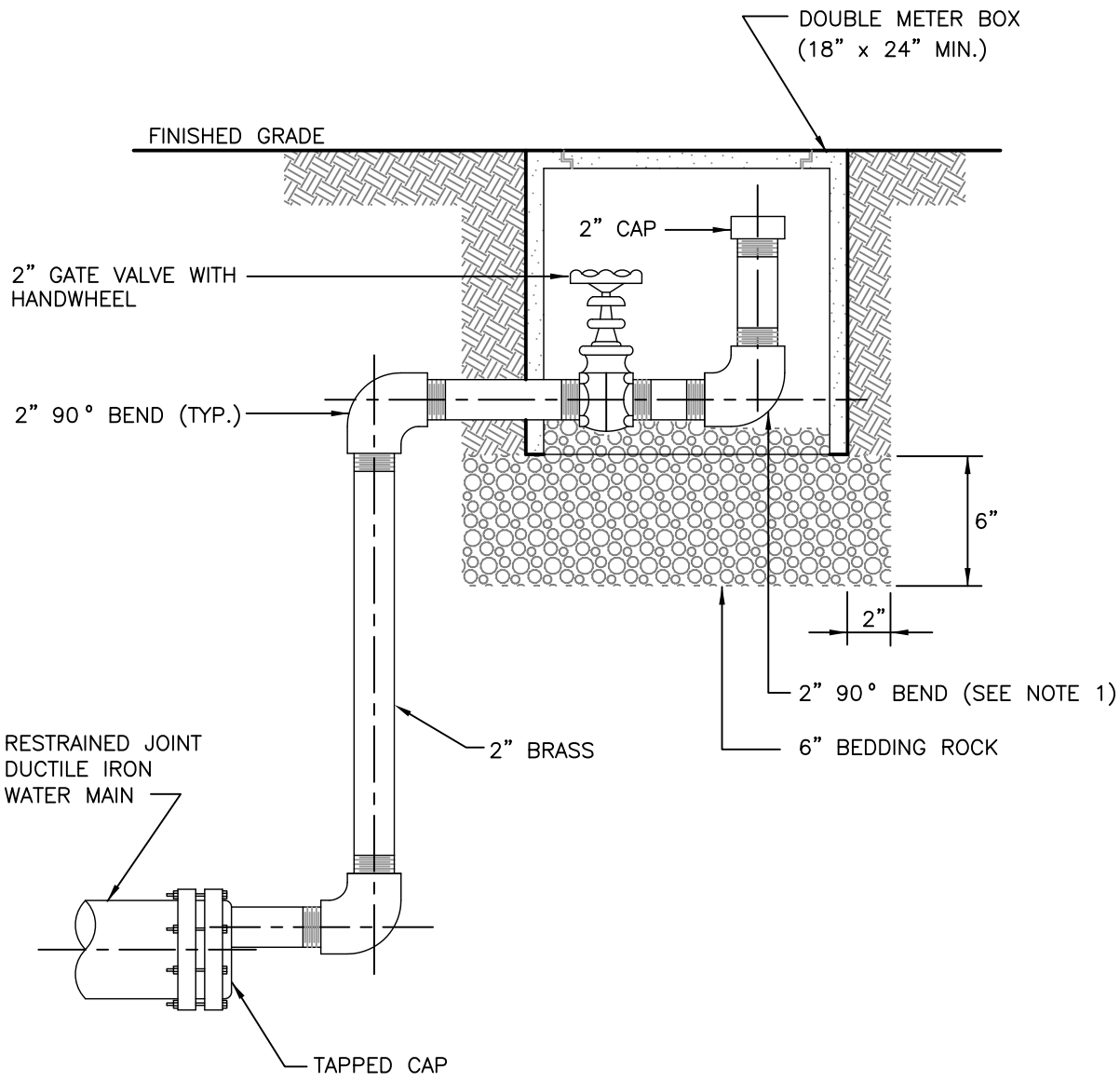
1. ALL PIPE AND FITTINGS 2" AND SMALLER SHALL BE THREADED BRASS. ALL 3" PIPE TO BE GALVANIZED STEEL.
2. ALL PIPE FITTINGS 4" AND LARGER SHALL BE CEMENT–LINED DUCTILE IRON WITH FLANGED FITTINGS FOR ABOVEGROUND USE. MECHANICAL JOINT FITTINGS SHALL BE USED UNDERGROUND WITH RESTRAINED JOINTS AND THRUST COLLARS.
3. APPROVED RESTRAINED ALL JOINTS ON UNDERGROUND DUCTILE IRON PIPING 4" AND LARGER.
4. ALL ABOVEGROUND DUCTILE PIPING, FITTINGS AND VALVES SHALL BE PAINTED RUST–OLEUM BLUE OR APPROVED EQUAL.

03/04	General Revision	K.H.G.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

REDUCED PRESSURE BACKFLOW PREVENTER

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 208



NOTES:

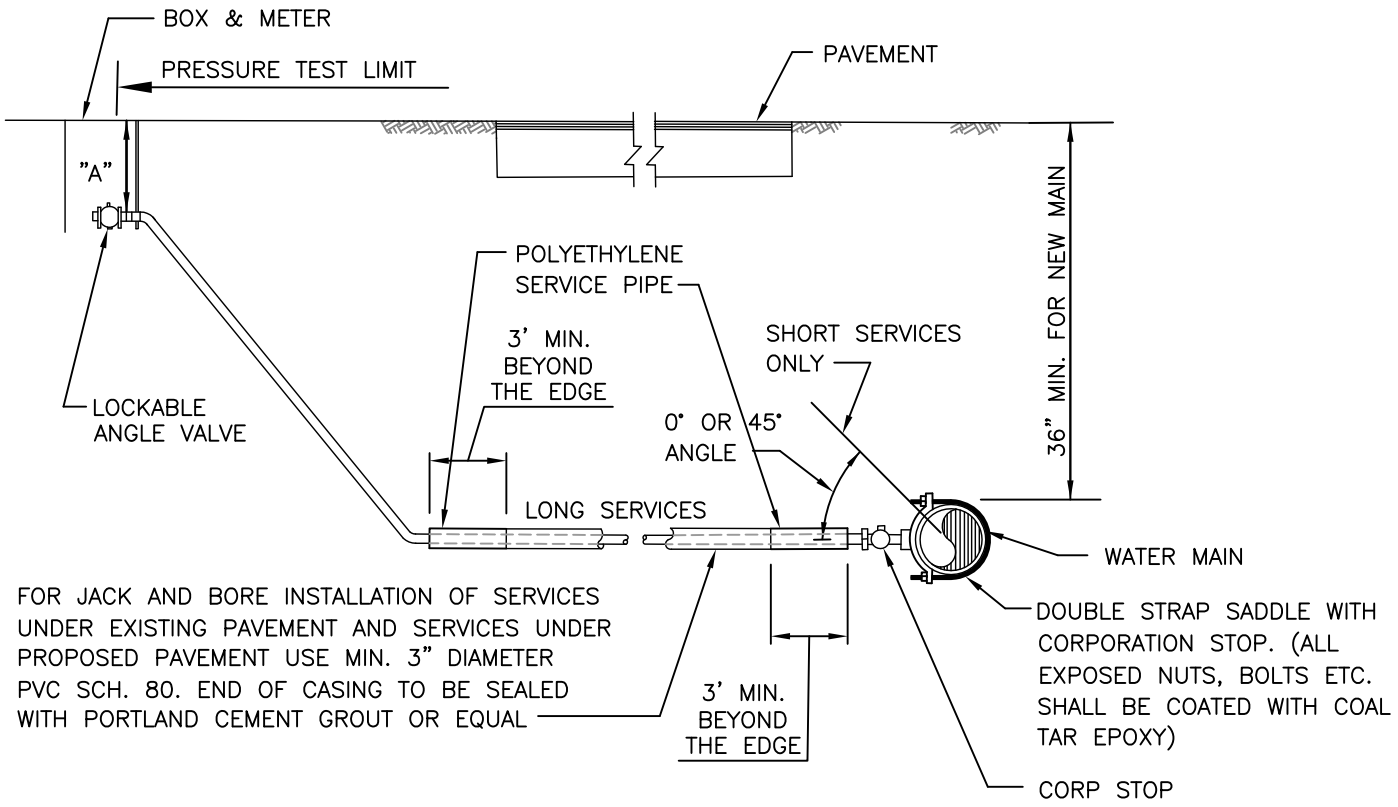
1. ALL 2" PIPE AND FITTINGS SHALL BE DUCTILE IRON PIPE THREADED (NPT) JOINTS. BEND SHALL BE ROTATED APPROXIMATELY 20° FROM VERTICAL.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
07/02	Replace stainless steel/brass w/ DIP &	B.V.
	misc. revisions	

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

BLOW OFF VALVE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 209



NOTES:

1. SUCCESSIVE TAPS INTO THE WATER MAIN SHALL BE SPACED A MINIMUM OF 18" APART. TAPS SPACED BETWEEN 18" TO 48" SHALL BE OFFSET TO EACH SIDE OF THE MAIN.

2. METER BOX SHALL BE SET TO CONFORM TO FINISHED GRADE ADJACENT TO PROPERTY LINE. METER SHALL NOT BE PLACED IN SIDEWALK OR DRIVEWAY AREAS. SERVICE LINES SHALL NOT BE PLACED UNDER DRIVEWAYS.

3. ALL 5/8" & 1" METERS REQUIRE A LOCKABLE ANGLE CURB VALVE (ANGLE BALL VALVE: 3/4" VALVE FOR 5/8" METER, 1" VALVE FOR 1" METER AND 1 1/2" VALVE FOR 1 1/2" METER), YOKE AND INTEGRAL CHECK VALVE.

4. A DUAL CHECK VALVE OR OTHER BACKFLOW PREVENTION DEVICE REQUIRED ON ALL SERVICES BEHIND METER.

5. DIMENSION "A" = 7" (5/8" METER)
   = 8" (1" METER)
   = 8" (1 1/2" METER)
   = 12" (2" METER)

6. MAXIMUM SERVICE LENGTH IS 100' TO METER.

7. BEDDING (MIN. 4") AND COVER (MIN. 4") OVER SERVICE LINE OR CASING SHALL CONSIST OF FINE GRANULAR MATERIAL. UNSUITABLE IN-SITU MATERIALS SUCH AS MUCK, DEBRIS AND LARGER ROCKS SHALL BE REMOVED WITH 3/4" MAXIMUM SIZE.

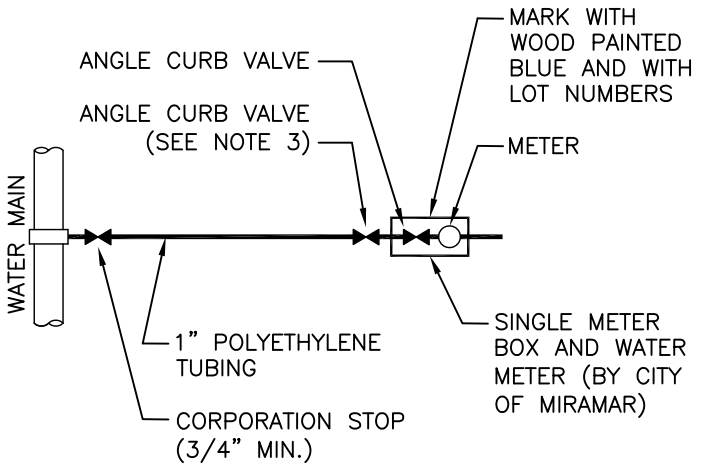
8. USE MIN. 3" DIAMETER PVC SCH. 80 CASING FOR ALL LONG SERVICES UNDER EXISTING OR PROPOSED ROADWAY. END OF CASING TO EXTEND MIN. 3 FEET FROM EDGE OF PAVEMENT AND IS TO BE SEALED WITH CEMENT.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
07/02	Misc. revisions	B.V.

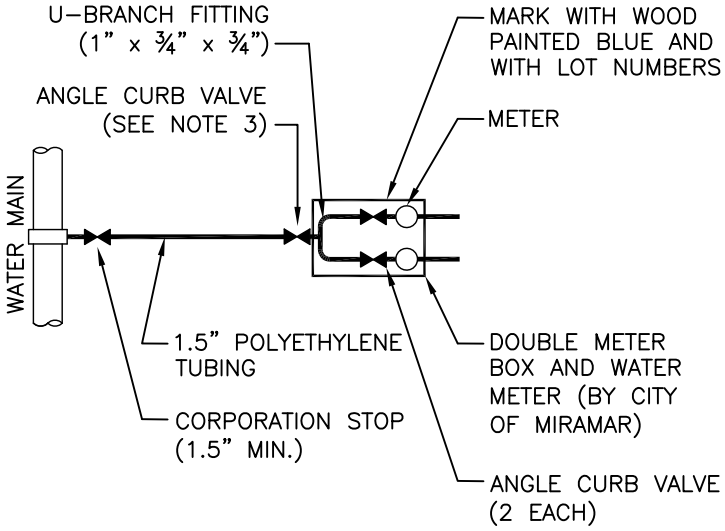
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYPICAL SERVICE CONNECTION FOR 5/8", 1", 1 1/2", OR 2" METER

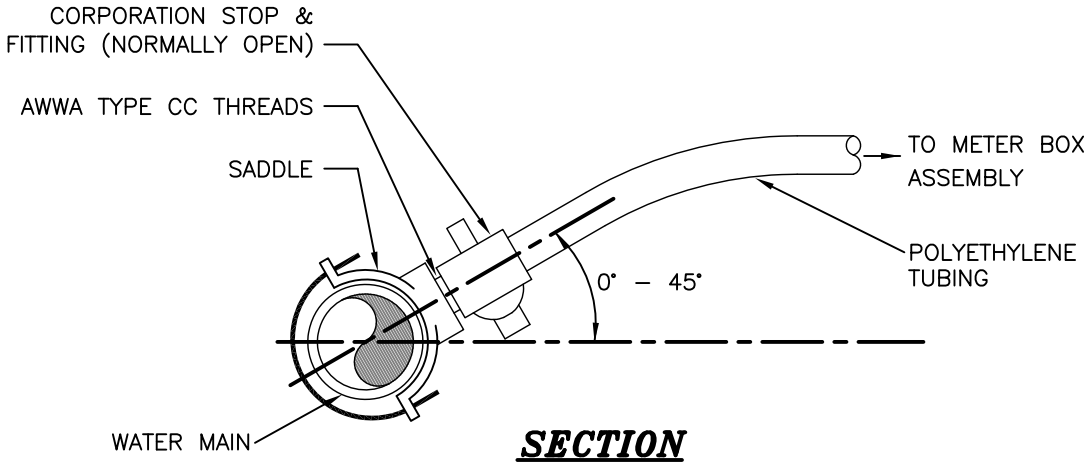
Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 210



SINGLE SERVICE



DOUBLE SERVICE



SECTION

NOTES:

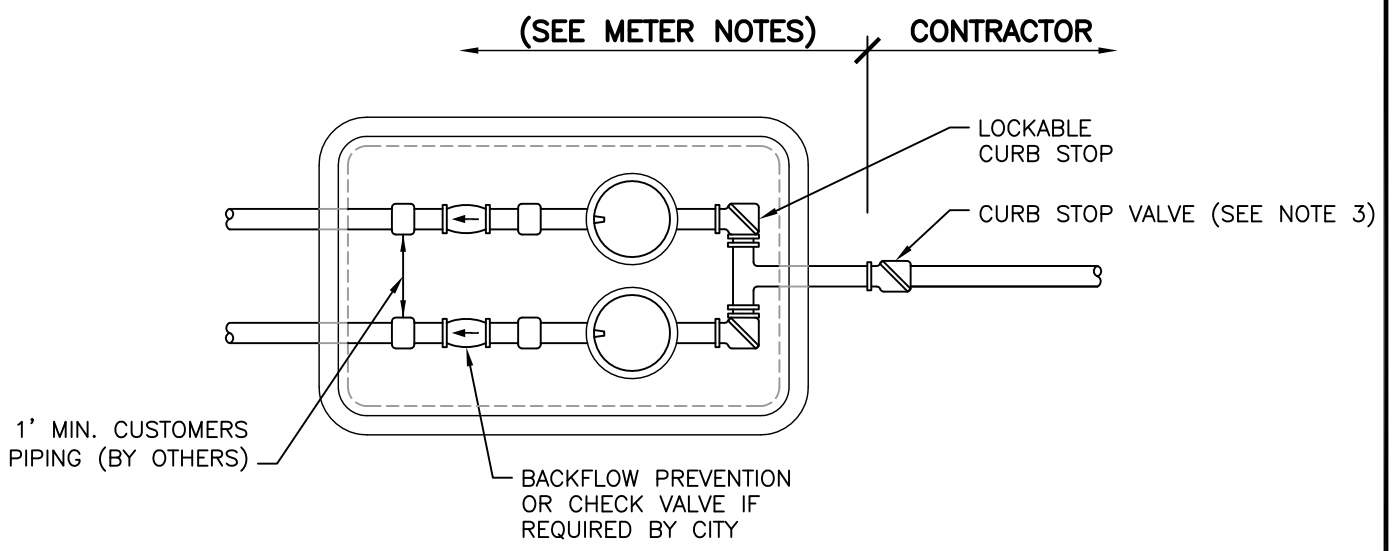
1. ALL FITTINGS SHALL BE BRASS WITH COMPRESSION/PACK JOINT TYPE CONNECTIONS.
2. NO SERVICE LINE SHALL TERMINATE UNDER A DRIVEWAY.
3. EACH SERVICE SHALL TERMINATE AT AN ANGLE CURB VALVE, FORD METER BOX KV43-341W-NL; 1.5"X1" FOR DOUBLE SERVICE AND 1"X1" FOR SINGLE SERVICE OR APPROVED EQUAL.
4. INSTALL MIN. 3" DIA. PVC SCH. 80 CASING FOR ALL LONG SERVICES UNDER EXISTING OR PROPOSED ROADWAY. END OF CASING TO EXTEND MINIMUM 3-FEET FROM EDGE OF PAVEMENT AND IS TO BE SEALED WITH PORTLAND CEMENT GROUT, OR APPROVED EQUAL.

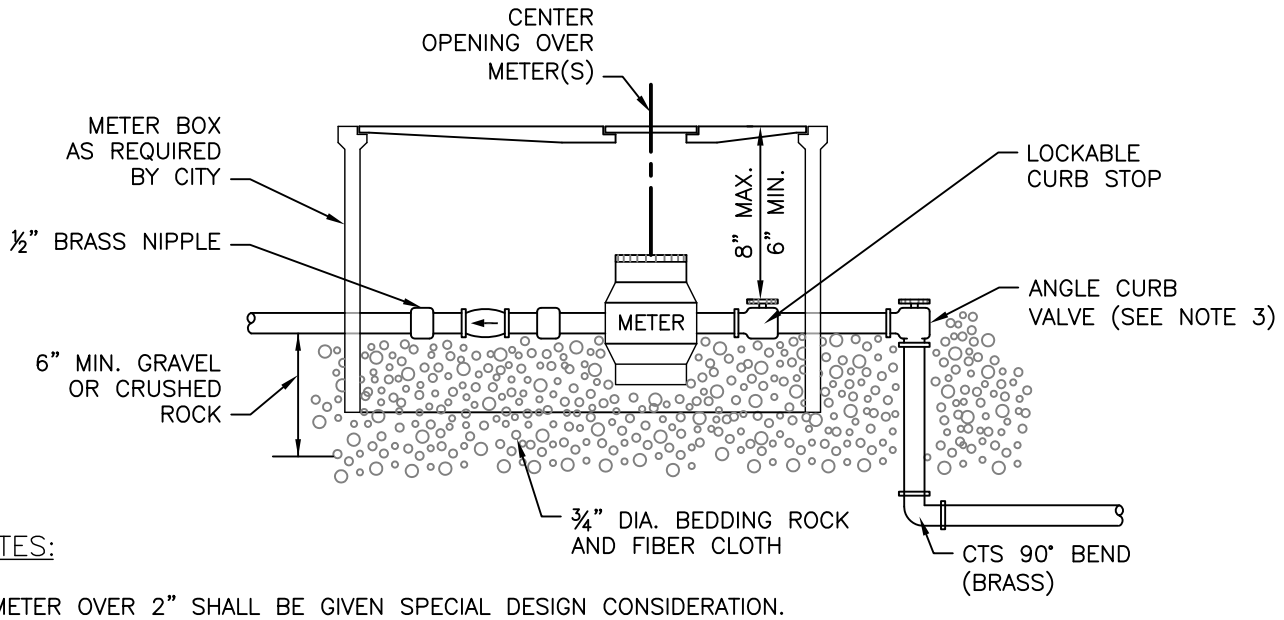
Date	Revisions	Appr. by
08/15	General revisions	W.G.
03/04	General revisions	K.H.G.
07/02	Misc. revisions	B.V.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

WATER SERVICE CONNECTION DETAILS

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 211





NOTES:

1. METER OVER 2" SHALL BE GIVEN SPECIAL DESIGN CONSIDERATION.

2. METERS SHALL BE PURCHASED AND INSTALLED BY THE CONTRACTOR (SEE METER NOTES).

3. EACH SERVICE SHALL TERMINATE AT AN ANGLE CURB VALVE, FORD METER BOX KV43–341W–NL; 1.5"X1" FOR DOUBLE SERVICE AND 1"X1" FOR SINGLE SERVICE, OR APPROVED EQUAL. CURB STOP SHALL NOT BE INSTALLED BELOW 12" FROM FINISHED GRADE.

4. METER BOXES TO BE SET IN GRASS AREAS.

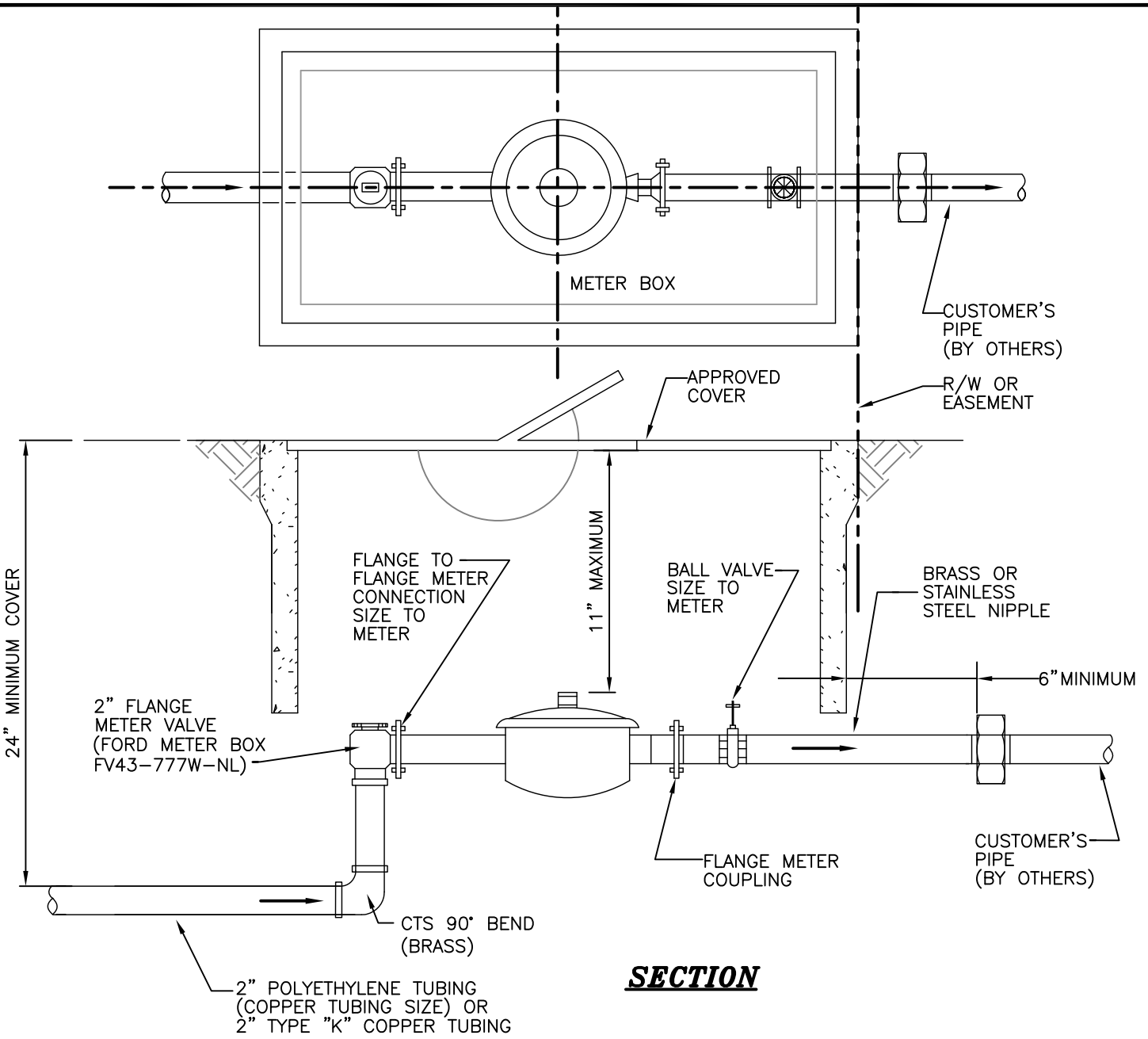
5. METER BOX SHALL BE PURCHASED BY CONTRACTOR.

Date	Revisions	Appr. by
08/15	General Revision	W.G.
03/04	General Revision	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

METER BOX DETAIL U.S. FOUNDRY NO. 7630

Issue Date: May 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 212



SECTION

NOTES:

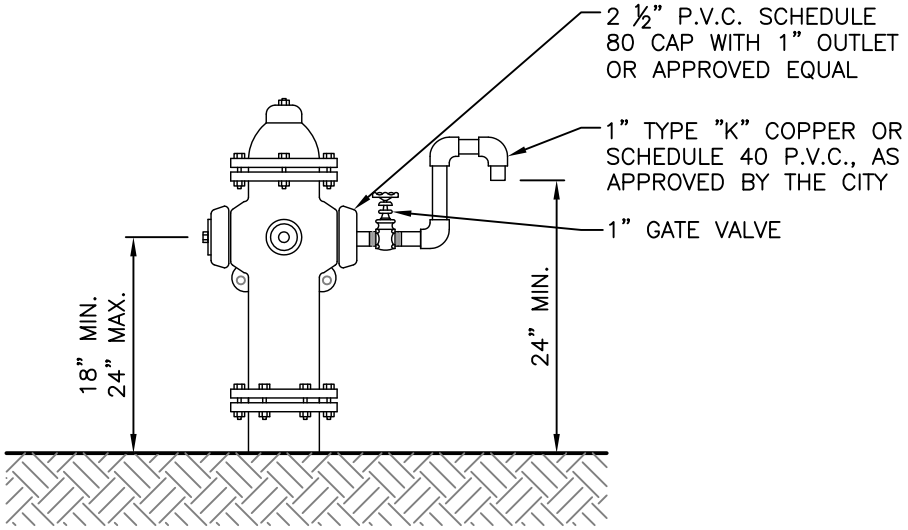
1. ALL STRUCTURES IN R/W TO BE TRAFFIC BEARING TYPE.
2. R/W OR EASEMENT LINE IS THE CUSTOMERS SIDE OF METER BOX.
3. CITY OF MIRAMAR RESPONSIBILITY ENDS AT THE CUSTOMERS SIDE OF BALL VALVE.
4. CURVE IN SERVICE LINE SHALL BE AS CLOSE TO METER BOX AS PRACTICAL AND MINIMUM RADIUS SHALL BE 21" FOR 2" TUBING.
5. METERS SHALL BE PURCHASED AND INSTALLED BY THE CONTRACTOR (SEE METER NOTES).
6. ALL BACKFLOW PREVENTION DEVICES PER LOCAL BUILDING CODE AND SUPPLIED BY CUSTOMER.

Date	Revisions	Appr. by
08/15	General Revision	W.G.

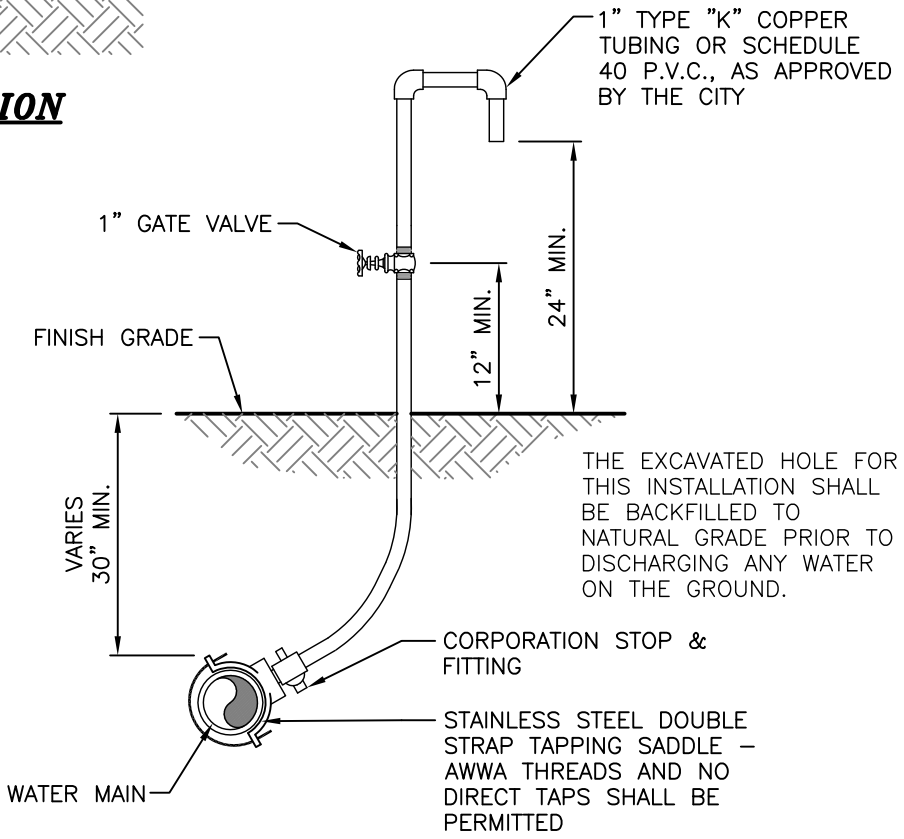
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

METER INSTALLATION FOR 1 ½" OR 2" METERS

Issue Date: Jan. 2000	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 213



HYDRANT CONNECTION



MAIN CONNECTION

NOTES:

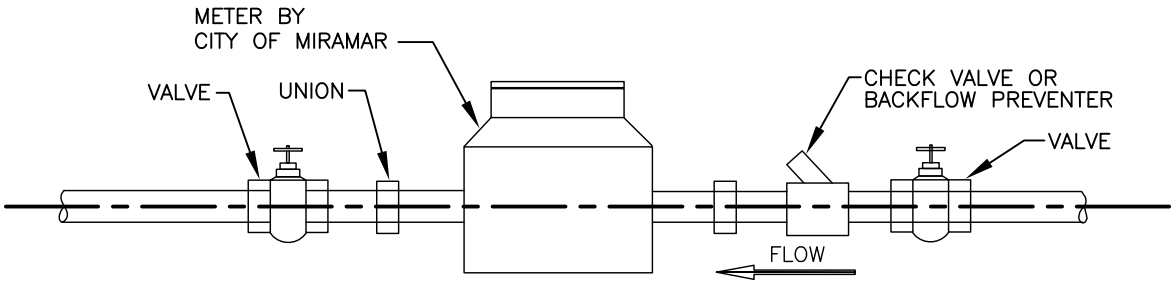
1. SAMPLING POINTS SHALL BE LOCATED AND LATER REMOVED AS REQUIRED BY CITY OF MIRAMAR.
2. CORPORATION STOP SHALL BE REMOVED AND SADDLE PLUGGED WITH A BRASS FITTING.
3. SAMPLING POINTS MAY BE PLACED AT THE ENDS OF WATER SERVICES BEFORE THE METERS AND ON BLOW OFFS FOR TERMINAL WATER MAINS, WHERE SERVICES AND BLOW OFFS ARE REQUIRED BY THE PLANS.
4. WHERE COPPER TUBING IS USED A CORPORATION STOP SHALL BE INSTALLED WITH A LENGTH OF COPPER TUBING EXTENDING ABOVE THE GROUND. THE TUBING SHALL BE INSTALLED WITH A 180° BEND AND A VALVE.
5. UPON COMPLETION OF SAMPLING, REMOVE COPPER TUBING AND INSTALL SCREW–IN BRASS PLUG AT CORPORATION STOP.

Date	Revisions	Appr. by
03/04	General revisions	K.H.G.

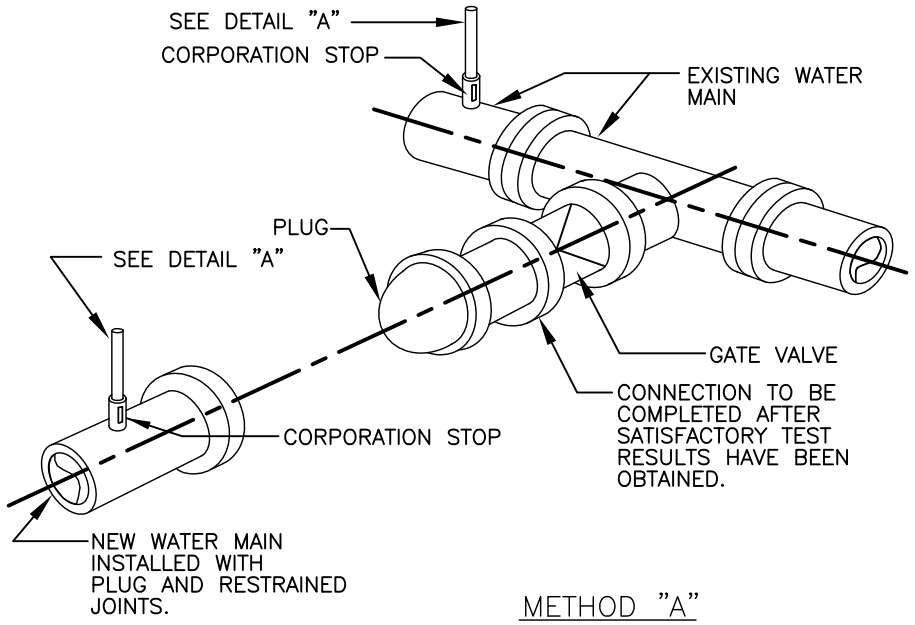
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

SAMPLING POINT DETAIL

Issue Date: Jan. 2000	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 214



DETAIL "A"



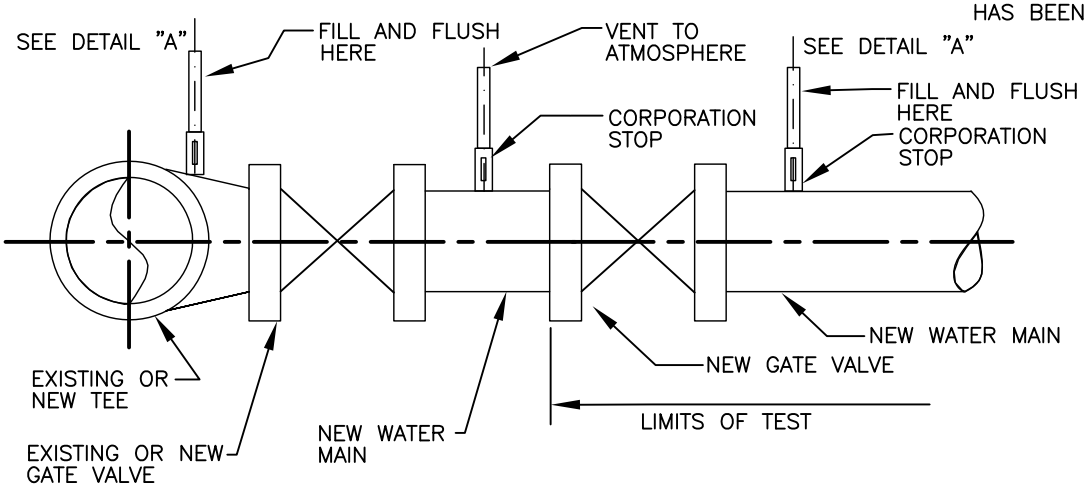
NOTES:

1. REMOVE TEMPORARY CONNECTION AT CORPORATION STOP ON EXISTING MAIN AFTER FILLING AND FLUSHING OF NEW LINE.
2. DO NOT REMOVE TEMPORARY CONNECTION AT CORPORATION STOP ON NEW MAIN UNTIL ALL TESTING HAS BEEN COMPLETED.

METHOD "A"

NOTE:

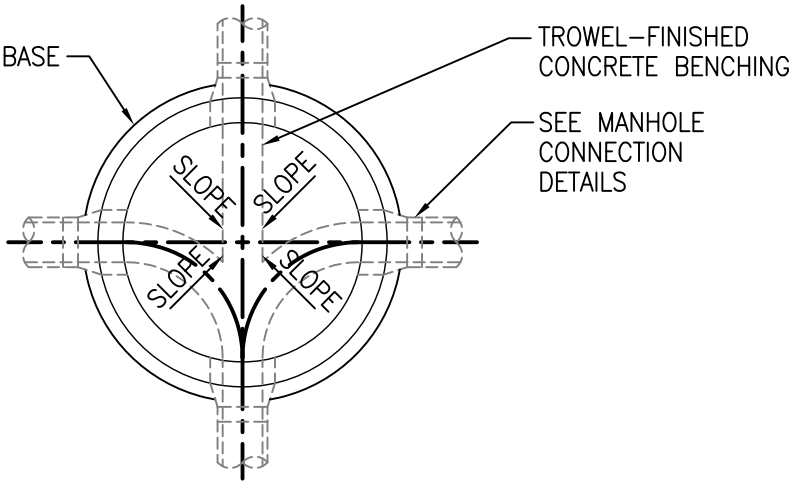
1. REMOVE TEMPORARY CONNECTION AT CORPORATION STOPS ON NEW MAIN AFTER FILLING AND FLUSHING HAS BEEN COMPLETED.



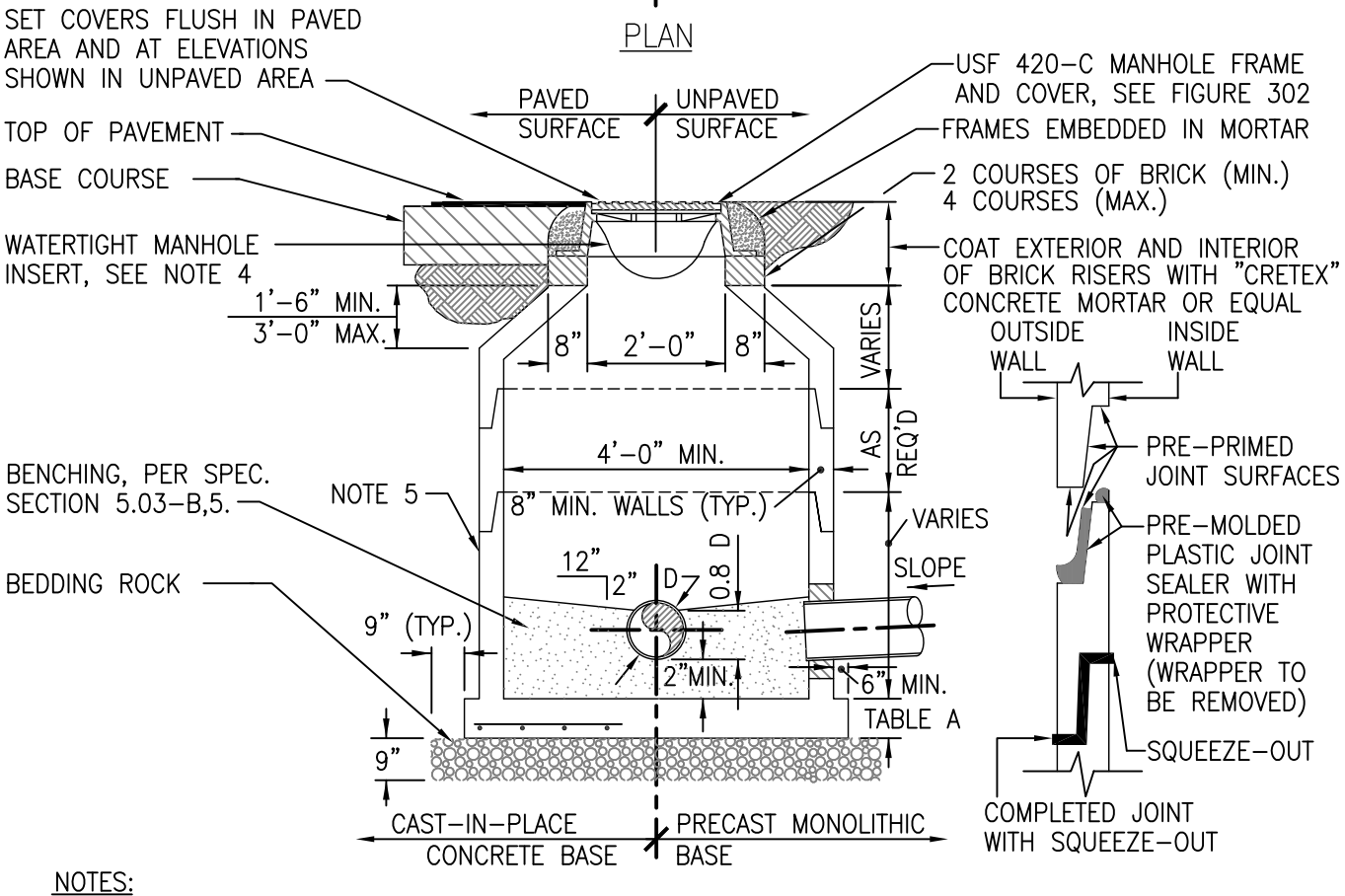
METHOD "B"

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			FILL AND FLUSHING CONNECTION DETAIL			
Date	Revisions	Appr. by	Issue Date: Jan. 2000	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 215

TABLE A	
M.H. I.D.	BASE THICKNESS
LESS THAN 13'	8"
13' OR MORE	12"



PLAN



NOTES:

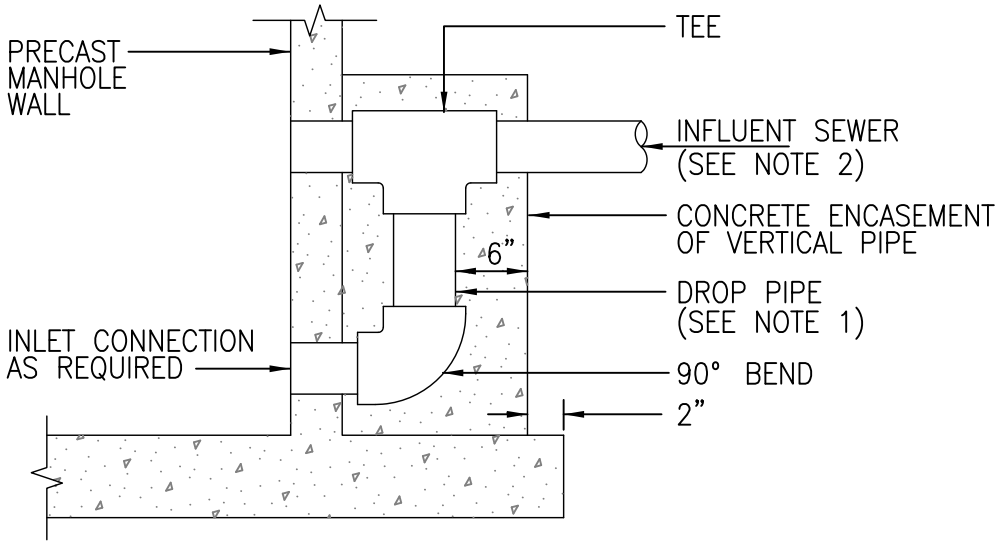
1. MANHOLE SHOWN IS FOR SEWER SIZE 8" THRU 24".
2. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT OF INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAILS.
3. APPROVED ECCENTRIC CONE DESIGN MAY BE USED AS AN ALTERNATIVE.
4. SEWERGUARD INSERT REQUIRED TO PREVENT INFLOW.
5. INTERIOR AND EXTERIOR COATING: EXTERIOR COATING SHALL BE COOPER BLACK NO. 775 EPOXY TAR COATING. INTERIOR COATING SHALL BE COOPER RED NO. 775 EPOXY TAR COATING WITH A SECOND COAT OF COOPER BLACK NO. 775 WITHIN 48 HOURS OF FIRST COAT.
6. ALL CONCRETE SHALL BE MADE WITH PORTLAND CEMENT TYPE II.

Date	Revisions	Appr. by
03/04	General Revision	K.H.G.
07/02	Revised Note #5, Add Note #6	B.V.
11/00	Misc. Revisions	K.H.G.

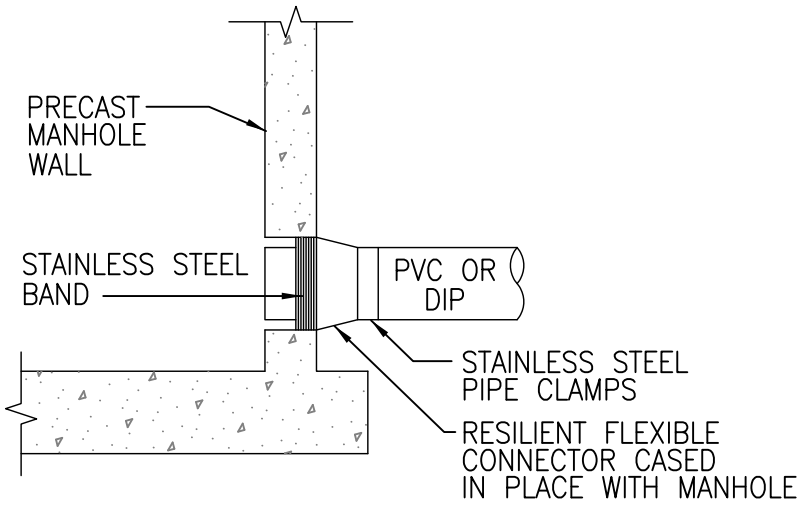
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

PRECAST MANHOLE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 300



STANDARD DROP DETAIL

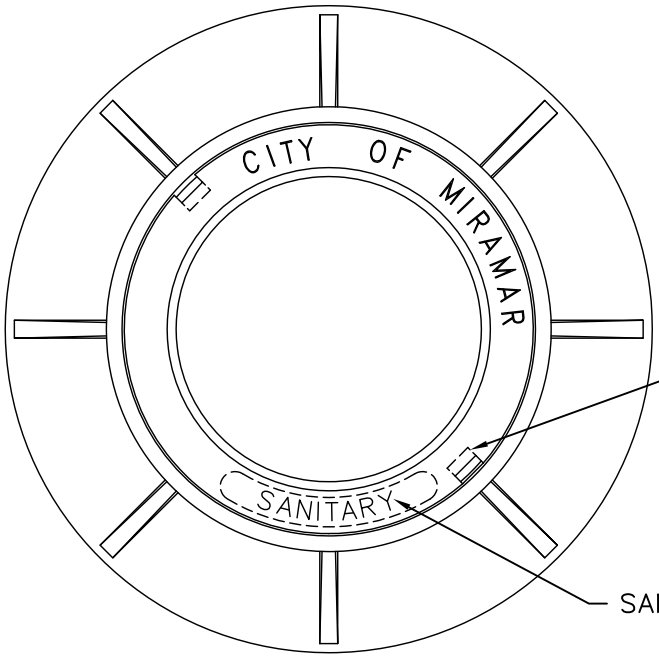


STANDARD PRECAST MANHOLE PIPE CONNECTION

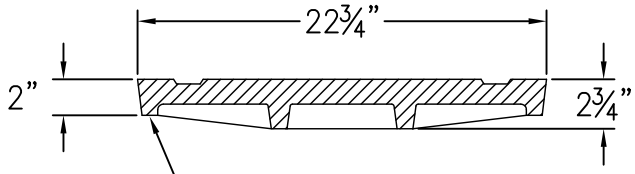
NOTES:

1. DROP PIPE AND FITTINGS SHALL BE OF EQUAL SIZE AND MATERIAL AS THE INFLUENT SEWER.
2. AN OUTSIDE DROP CONNECTION SHALL BE REQUIRED FOR ALL INFLUENT WHICH HAVE AN INVERT 2' OR MORE ABOVE THE MANHOLE INVERT.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			MANHOLE–TO–PIPE CONNECTION DETAILS
03/04	General Revision	K.H.G.	
Date	Revisions	Appr. by	Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 301

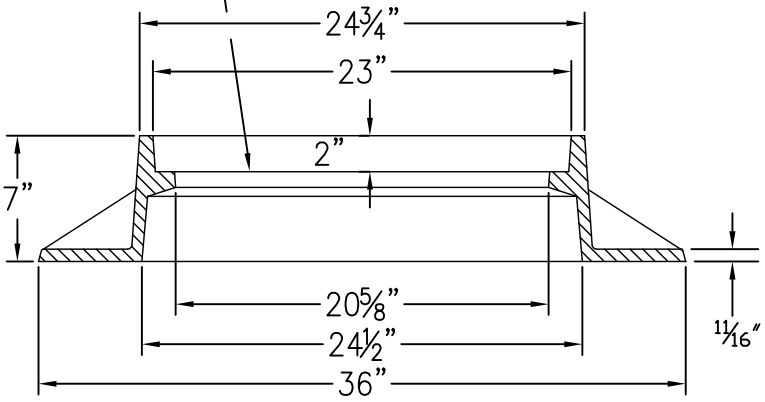


PLAN



MACHINED SURFACES

COVER



ELEVATION

RING

NOTES:

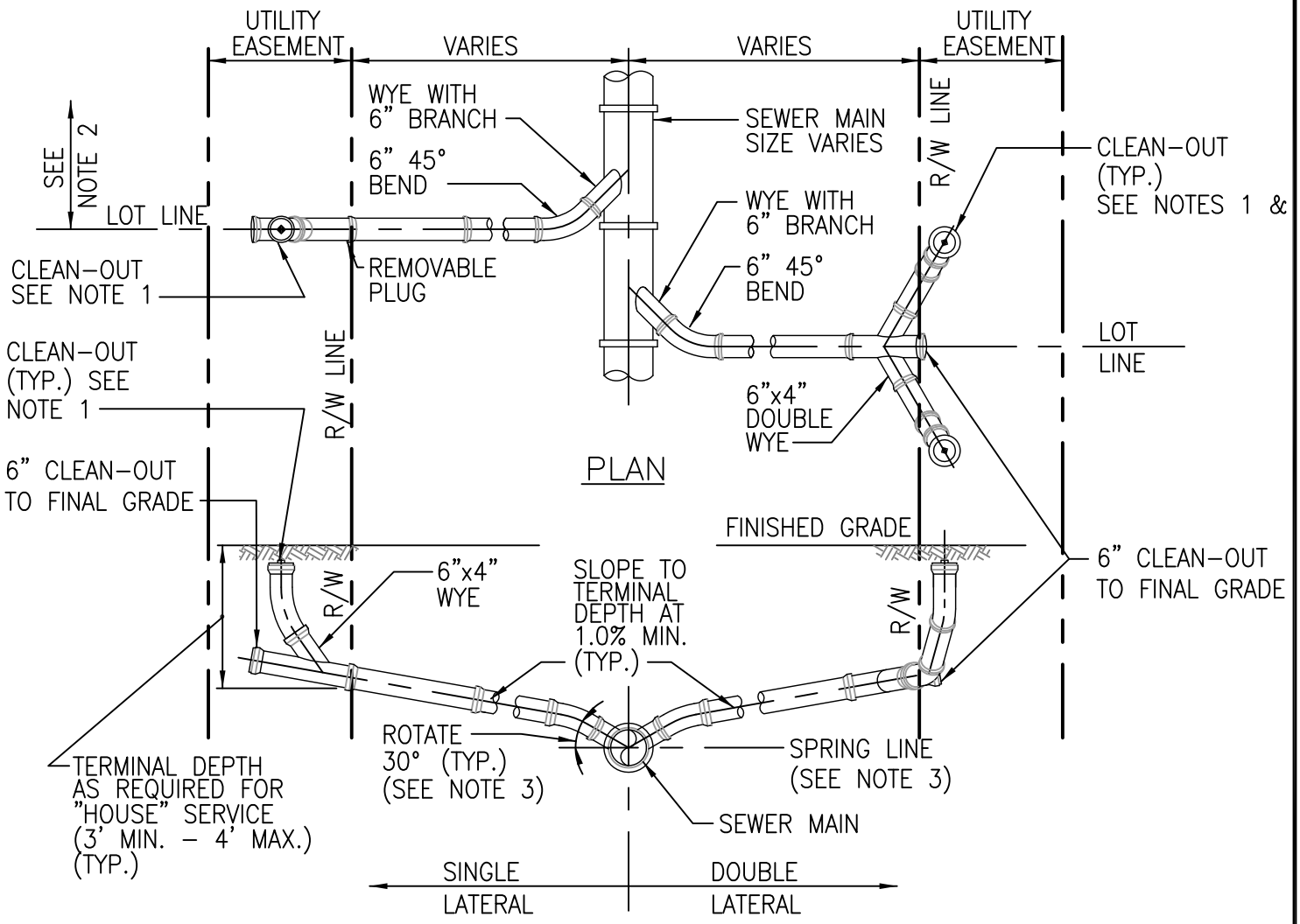
1– MATERIAL: ASTM A48 CLASS 30B GRAY IRON.
2– COVER WT: 160 LBS. APP.
3– RING WT: 240 LBS. APP.

03/04	Deleted City of Miramar Logo	K.H.G.
07/02	Replaced w/ USF 420 Ring & Cover	K.H.G.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

SANITARY/STORM MANHOLE COVER

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 302



PROFILE

NOTES:

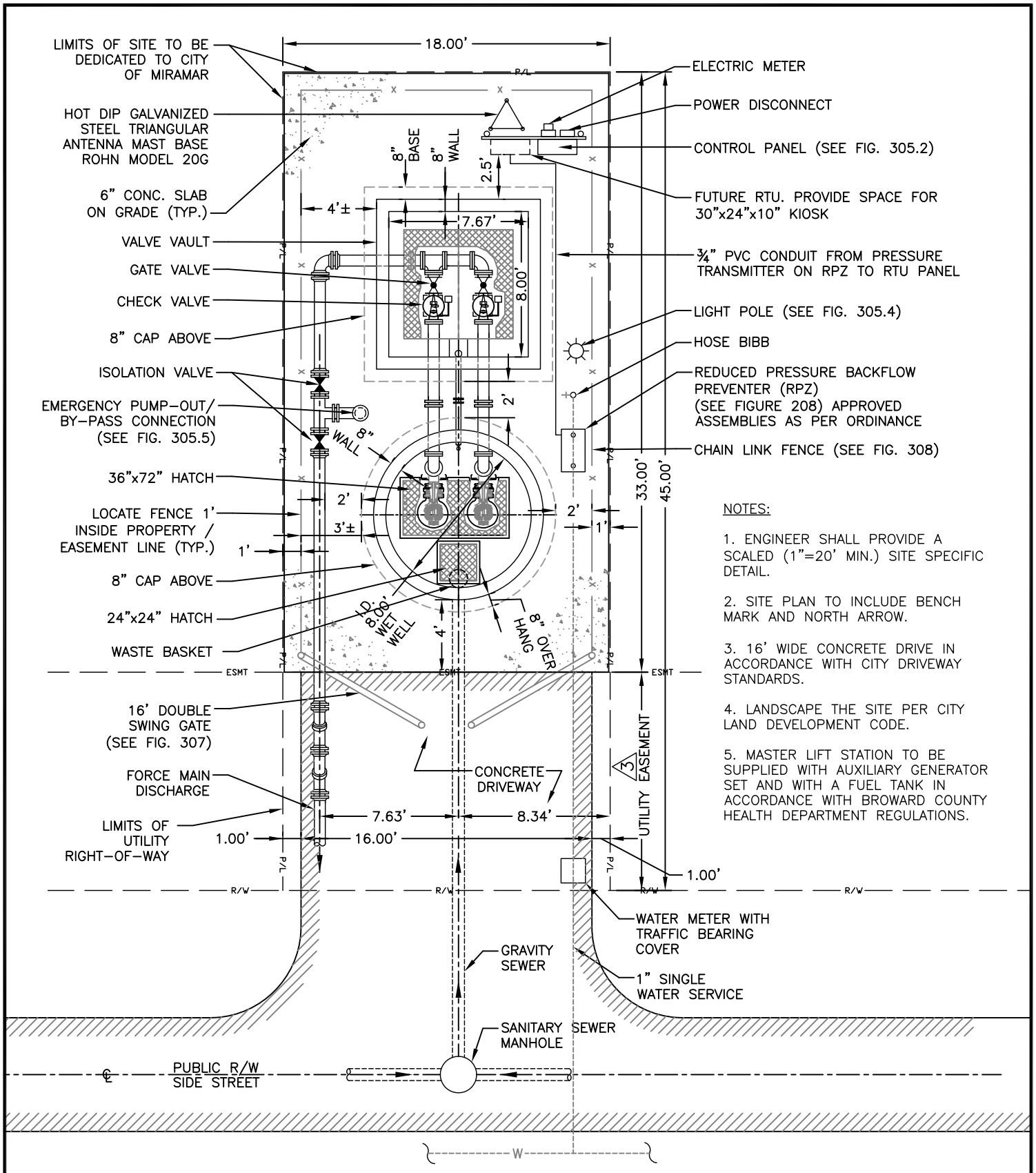
1. CLEAN–OUT SHALL BE INSTALLED BY THE BUILDER IN ACCORDANCE WITH STANDARD PLUMBING CODE.
2. LOCATE SINGLE LATERAL AS CLOSE TO LOT LINE AS POSSIBLE, 25' MAXIMUM.
3. INVERT OF SERVICE LATERAL SHALL NOT ENTER SEWER MAIN BELOW SPRING LINE.
4. SERVICE LATERALS SHALL HAVE A MINIMUM 18" OF COVER BETWEEN R/W TIE–IN AND BUILDING.
5. ROTATE BENDS AS REQUIRED TO ALLIGN SERVICE BRANCH WITH THE SERVICE PIPE.
6. CLEANOUT SHALL BE LOCATED IN A UTILITY EASEMENT. IF UTILITY EASEMENT DOES NOT EXIST, CLEANOUT SHALL BE LOCATED AT THE RIGHT–OF–WAY LINE.

Date	Revisions	Appr. by
09/07	Added Note 6	B.V.
06/05	Revised clean out to final grade	B.V.
03/04	Added Utility Easement	K.H.G.
07/02	Revised Notes	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

SANITARY SERVICE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 303



NOTES:

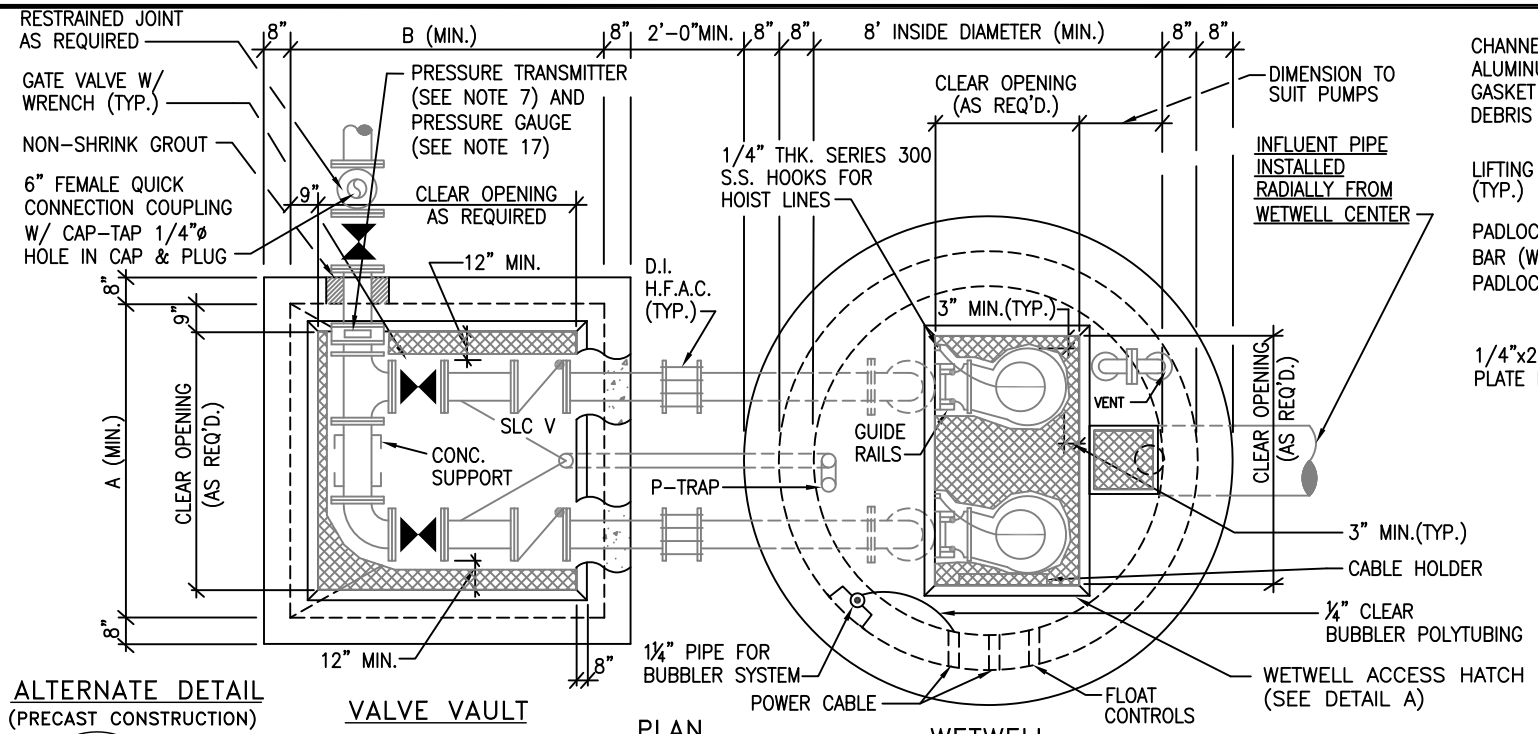
1. ENGINEER SHALL PROVIDE A SCALED (1"=20' MIN.) SITE SPECIFIC DETAIL.
2. SITE PLAN TO INCLUDE BENCH MARK AND NORTH ARROW.
3. 16' WIDE CONCRETE DRIVE IN ACCORDANCE WITH CITY DRIVEWAY STANDARDS.
4. LANDSCAPE THE SITE PER CITY LAND DEVELOPMENT CODE.
5. MASTER LIFT STATION TO BE SUPPLIED WITH AUXILIARY GENERATOR SET AND WITH A FUEL TANK IN ACCORDANCE WITH BROWARD COUNTY HEALTH DEPARTMENT REGULATIONS.

Date	Revisions	Appr. by
03/04	Misc. Revisions	K.H.G.
06/03	3 Misc. Revisions	K.H.G.
07/02	Misc. Revisions	K.H.G.
11/00	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

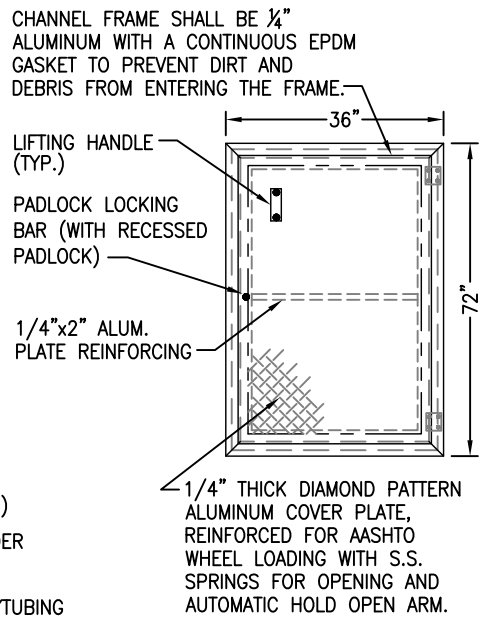
WASTEWATER PUMP STATION ALTERNATIVE PLAN 2

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 305C



NOTE

CUT OFF LIFTING HOOKS BELOW SLABS AND GROUT HOLES FLUSH.



DETAIL A
WETWELL ACCESS HATCH
N.T.S.

NUMBER OF PUMPS	
PUMP MANUFACTURE	
PUMP MODEL NUMBER	
IMPELLER NUMBER	
TYPE OF DRIVE	
DESIGN CAPACITY PER PUMP	(GPM)
TOTAL DYNAMIC HEAD	(FEET)
PUMP CYCLE TIME	(MIN.)
SHUT-OFF HEAD	(FEET)
DESIGN SPEED	(PRM)
MIN. HORSEPOWER PER PUMP	(HP)
VOLTS	
PHASE POWER	
MAX. SIZE SOLIDS	(INCHES)
PUMP DISCHARGE SIZE	(INCHES)
DIAMETER RISER PIPE	(INCHES)
DIAMETER PIPE AFTER RISER	(INCHES)
DIAMETER WETWELL (I.D.)	(FEET)
TOP OF WETWELL ELEVATION	(FEET)
100-YR FLOOD ELEVATION	(FEET)
BOTTOM OF WETWELL ELEVATION	(FEET)
INFLUENT PIPE ELEVATION	(FEET)
HIGH LEVEL ALARM FLOAT ELEVATION	(FEET)
LAG PUMP ON ELEVATION	(FEET)
HIGH LEVEL ALARM ON ELEVATION	(FEET)
LEAD PUMP ON ELEVATION	(FEET)
PUMPS OFF ELEVATION AT 1 FEET ABOVE PUMP MOTOR	(FEET)
LOW LEVEL ALARM ON ELEVATION	(FEET)
MINIMUM WATER ELEVATION	(FEET)
TOP OF PUMP ELEVATION	(FEET)

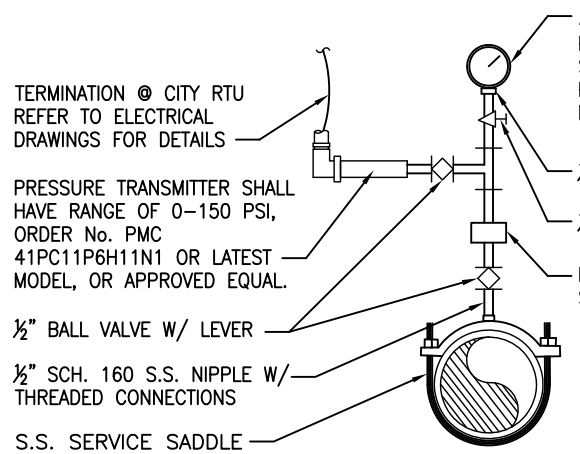
1 / 305.2

Force Main Pipe Size	2 PUMPS A	2 PUMPS B
4"	7'	7'
6"	7'	7'
8"	7'	7'
10"	7'	7'

2 / 305.2

NOTES:

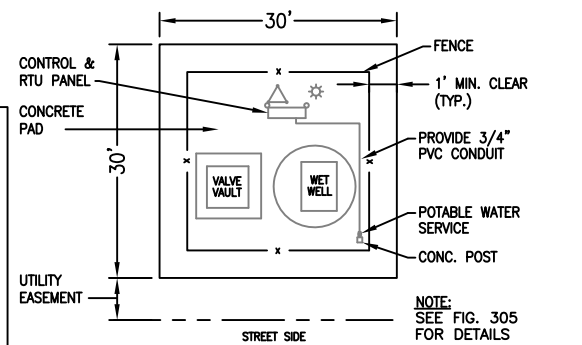
1. SERIES 300 STAINLESS STEEL SHALL BE USED IN THE WETWELL AND VALVE VAULT AND CONTROL PANEL STRUCTURE AND MOUNTING, FOR FLANGE, BOLTS, BRACKETS, GUIDE RAILS AND OTHER HARDWARE.
2. EXTERIOR COATING SHALL BE COOPER BLACK NO. 775 EPOXY TAR COATING THE FIRST COAT SHALL BE RED AND THINNED AND THE TOP COAT(S) SHALL BE BLACK. TOTAL DRY FILM THICKNESS SHALL BE 18 MILS MIN. CURE TIME: 12 TO 24 HOURS. APPLICATION BY SPRAY OR BRUSH (ROLLERS NOT ACCEPTED) TOUCH UP DISTUBED AREAS IN FIELD.
3. INTERIOR OF WET WELL AND VALVE BOX SHALL BE LINED WITH THE THOROC CONC. PROTECTION SYSTEM CONSISTING OF A 1/2" LAYER OF THOROC SP15 SPRAY MORTAR, ONE-COMPONENT, MICRO-SILICA ENHANCED,FIBER-REINFORCED WET SPRAY MORTAR FOLLOWED BY 60MILS OF THOROC SEWER GUARD HBS 100 EPOXY LINER, HIGH-BUILD, MOISTURE-INSENSITIVE, CHEMICAL RESISTANT EPOXY COATING. THE SURFACE OF THE CONCRETE SHALL BE BRUSH BLASTED AND INSPECTEDPRIOR TO THE APPLICATION OF THE EPOXY. THE COATING SYSTEM APPLICATION SHALLBE PERFORMED BY A MANUFACTURER APPROVED APPLICATOR.
4. THE CONTRACTOR SHALL FURNISH MASTER SERIES 0464 PADLOCKS WITH TWO (2) KEYS FOR FENCE GATES, CONTROL PANEL, RTU, INTERFACE PANEL, ACCESS HATCHES, AND DISCONNECT SWITCH.
5. ALL CONCRETE SHALL BE TYPE II CEMENT.
6. WETWELL SHALL BE CONSTRUCTED OF 8'-0" MIN. LARGE SECTIONS OF REINFORCED CONCRETE PIPE, IN ACCORDANCE WITH ASTM C-478, WALL THICKNESS, ASTM C-76, WALL 'B'. WHENEVER POSSIBLE, NO OPENING SHALL BE WITHIN 12" OF THE END OF ANY SECTION.
7. THE WATER AND FORCEMAIN PRESSURE TRANSMITTER SHALL BE ENDRESS HAUSER ORDER #PMC 41-PC11P6H1INI OR LATEST MODEL OPERATING BETWEEN 0-150 PSI OR APPROVED EQUAL. THE PRESSURE TRANSMITTER SHALL BE INSTALLED ON A SADDLED WITH 1/2" COCKSTOP. THE LEVEL TRANSMITTER SHALL BE ENDRESS HAUSER ORDER #PMC131-A22FIQ4H OPERATING BETWEEN 0-15 PSI. POWER AND SIGNAL WIRING SHALL BE SUPPLIED FROM THE CONTROL PANEL AND TO THE RTU VIA A 3/4 INCH CONDUIT AND APPROPRIATE WIRING PER CODE.
8. SEE PUMPING STATION DATA TABLES FOR DATA ON SPECIFIC ELEVATIONS AND DIAMETERS.
9. DISTANCE BETWEEN PUMPS SHALL BE SET BY MANUFACTURER'S RECOMMENDATIONS OR THE DISTANCE BETWEEN DISCHARGE PIPING, WHICHEVER IS GREATER.
10. DISCHARGE PIPE FROM THE WETWELL TO THE VALVE VAULT SHALL BE PARALLEL TO EACH OTHER.
11. ALARMS TO NON-LATCHING. ALARMS TO CLEAR AUTOMATICALLY AFTER ALARM CONDITION TERMINATED.
12. DURING INSTALLATION, THE CONTRACTOR SHALL MAINTAIN THE GROUND WATER ELEVATION BELOW THE BOTTOM OF THE WETWELL UNTIL FULLY BACKFILLED AND COMPACTED TO AVOID FLOATATION.
13. THE CONTRACTOR SHALL LOCATE THE SERVICE ENTRANCE STRUCTURE WHERE ACCESS TO THE CONTROL PANEL, METER, AND RTU ARE NOT LOCATED OVER THE WETWELL.
14. FOR 240V. OR 480V., SERVICE, GENERATOR RECEPTACLE SHALL BE MELTRIC 100 AMP 3 PHASE #37-99043.
15. ELECTRICAL CONTACTS FOR RTU TO INCLUDE PHASE AND CONTROL CIRCUIT FAILURE; HIGH LEVEL ALARM; BUBBLER FAILURE ALARM; WETWELL, VALVE VAULT AND RTU INTRUSION; HOA SWITCH, NOT IN AUTO POSITION; PUMP FAILURE; PUMP STARTS; PUMP RUN TIME; STATION DISABLE, CONTROL AND REPORT; FORCE MAIN AND WATER LINE PRESSURE; CURRENT LEVELS AND SERVICE KEY ACTIVATED INDICATOR.
16. WATER AND FORCEMAIN PRESSURE TRANSMITTERS ARE TO BE PROTECTED BY AN EDCO COMPLEX DEVICE MODEL #SS64-036-1 OR APPROVED EQUAL.
17. THE PRESSURED GAUGE SHALL BE A HIGH QUALITY OIL FILLED TYPE INSTALLED ON A SADDLE WITH 1/2" COCKSTOP.
18. 1 1/4" 316 STAINLESS STEEL PIPE CAPPED BOTH END (SEALED) WATER TIGHT INSTALLED 12" ABOVE END OF PIPE. TOP CAP TO BE THREADED TO FIT 1/4" FITTING FOR BUBBLER TUBE. PIPE TO BE SECURED TO WET WELL WALL WITH STAINLESS STEEL BRACKETS. BOTTOM OF PIPE TO BE 12" ABOVE BOTTOM OF WET WELL.
19. CONTRACTOR MUST PROVIDE 3/4" CONDUIT FROM WATER SERVICE TO CONTROL PANEL.



DETAIL B
PRESSURE TRANSMITTER AND PRESSURE GAUGE
N.T.S.

ABBREVIATIONS

ABS	ACRYLONITILE BUTADIENE STYRENE
CLR	CLEAR; CLEARANCE
DI	DUCTILE IRON
HFAC	HARNESSED FLANGED ADAPTER COUPLING
SLCV	SPRING & LEVER CHECK VALVE (M&H CO.)
GV	GATE VALVE
PVC	POLYVINYL CHLORIDE
SS	STAINLESS STEEL



TYPICAL SITE LAYOUT
N.T.S.

Date	Revisions	Appr. by
03/04	Misc. Revisions	K.H.G.
05/03	Water Level From Pump	K.H.G.
10/02	Misc. Revisions	KHG/BV

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

WASTEWATER PUMP STATION

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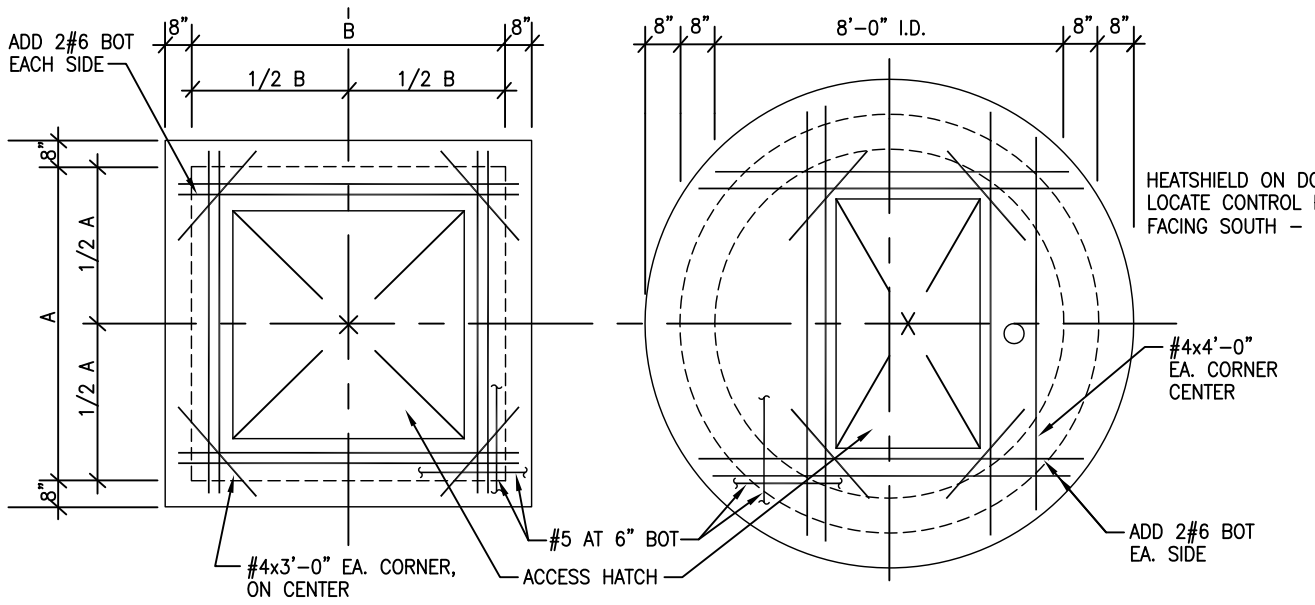
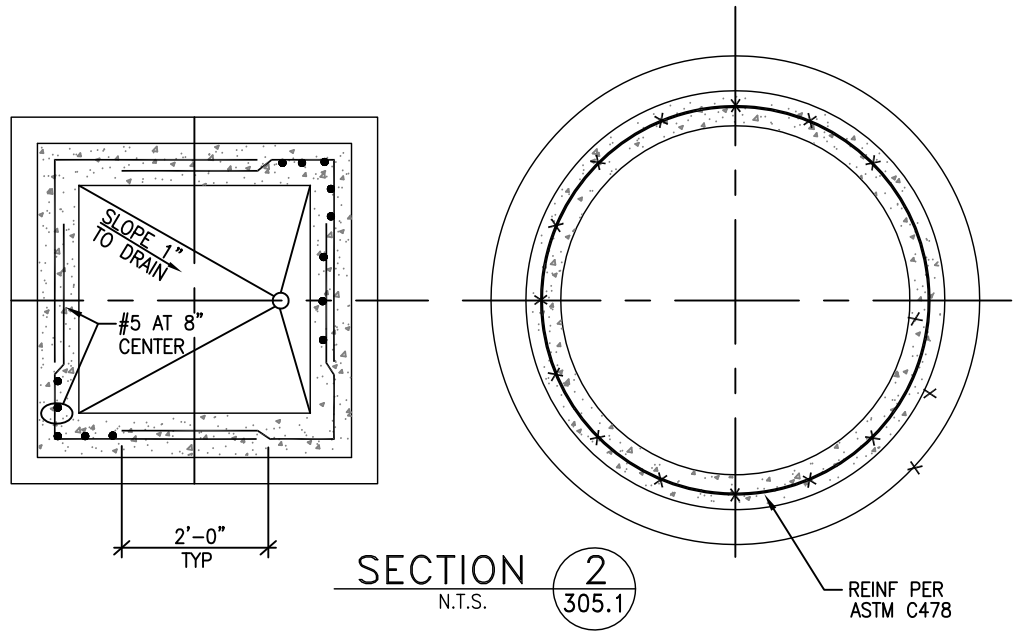
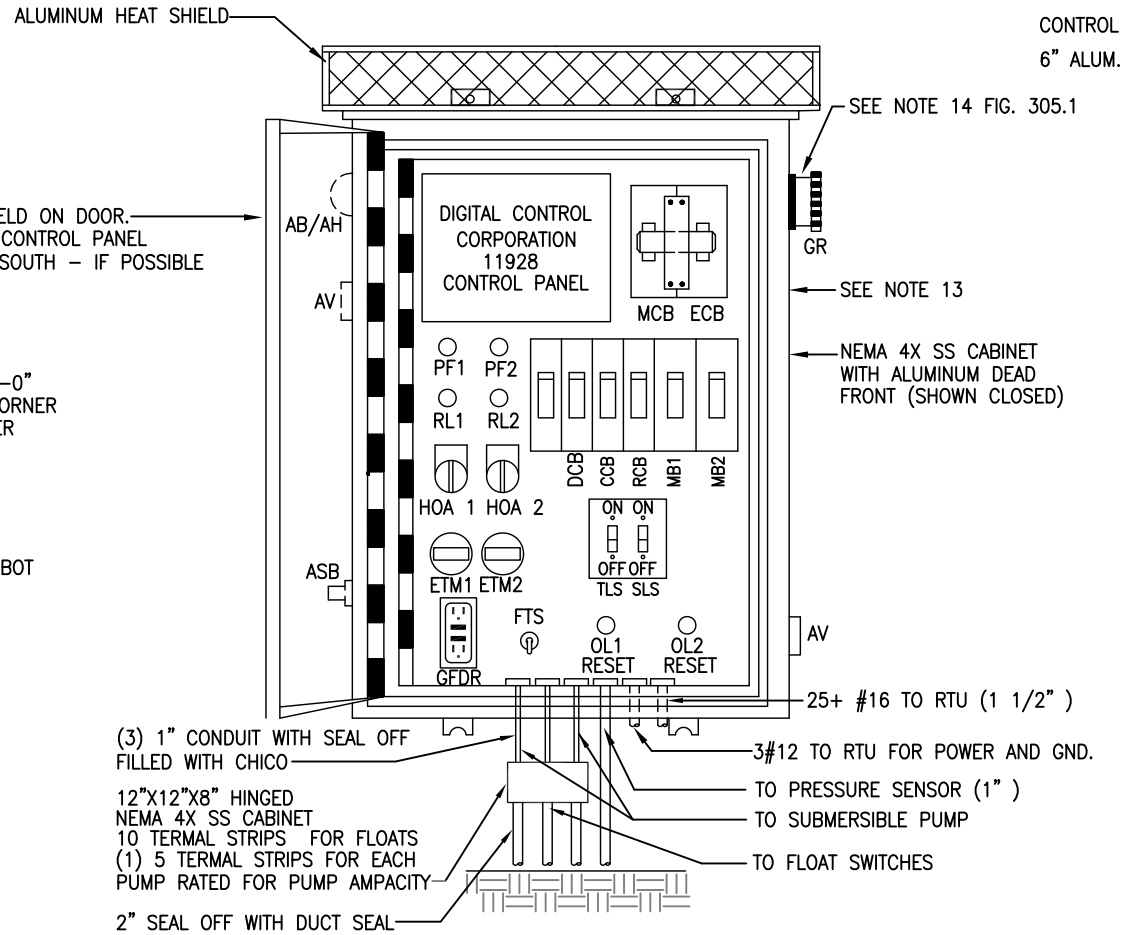


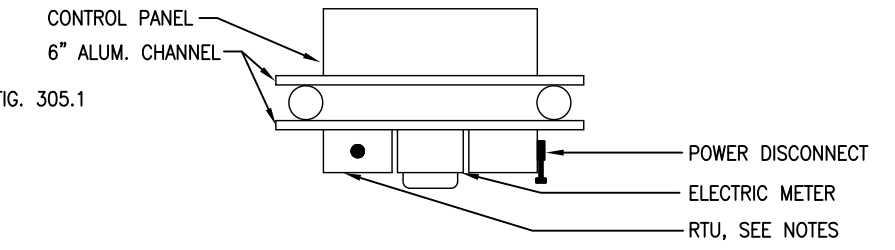
SECTION 1 (305.1)
N.T.S.



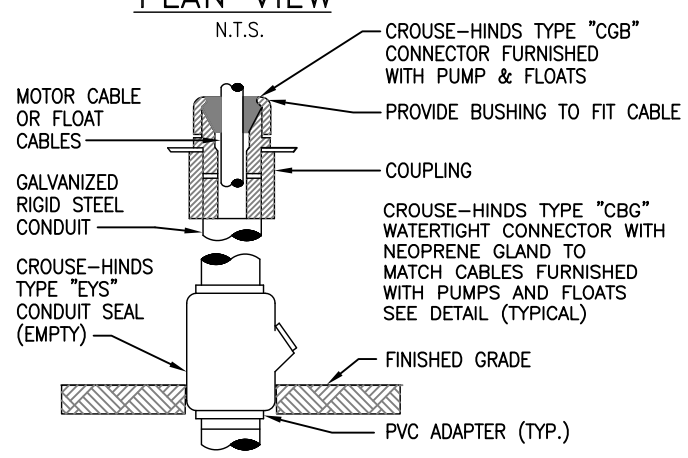
SECTION 2 (305.1)
N.T.S.



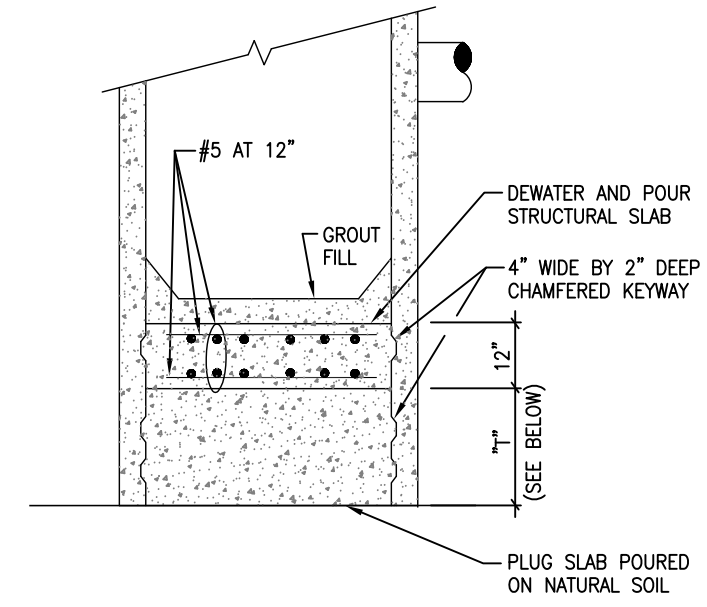
SERVICE ENTRANCE AND INTERFACE BOX



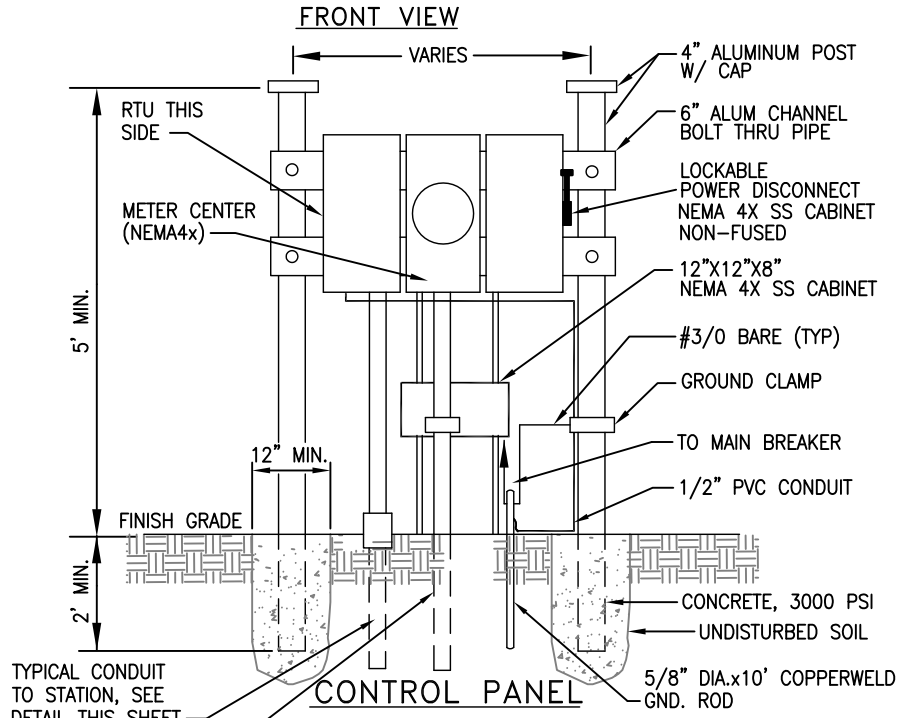
CONTROL PANEL PLAN VIEW
N.T.S.



CONDUIT CONNECTION DETAIL
N.T.S.



OPTIONAL BASE SLAB CONSTRUCTION
N.T.S.



CONTROL PANEL FRONT ELEVATION

8'-0" I.D. PUMP STATION				
DEPTH OF P.S.	0' TO 12'	13' TO 18'	19' TO 22'	23' TO 26'
PLUG SLAB "T"	12"	24"	30"	36"

DEPTH OF P.S. REFERS TO TOP OF PUMP STATION SLABS TO STRUCTURAL SLAB BOTTOM OF WETWELL

CAST IN PLACE CONCRETE

ALL MATERIAL AND METHODS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH ACI-350R AND ACI-318 REQUIREMENTS. CONCRETE: 28-DAY COMPREHENSIVE STRENGTH-4000 PSI, CEMENT-TYPE II AIR-ENTRAINING WATER REDUCING ADMIXTURES-PER SPECIFICATIONS.

PRE-CAST CONCRETE

MATERIALS AND METHODS OF CONSTRUCTION SHALL BE PER SPECIFICATIONS. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR PRE-CAST ELEMENTS FOR ENGINEER'S REVIEW.

REINFORCEMENT

REINFORCEMENT SHALL CONFORM TO ASTM A615-GRADE 60 REQUIREMENTS. ALL ACCESSORIES SHALL BE IN CONFORMANCE WITH ACI-315 REQUIREMENTS. THE CONTRACTOR SHALL PREPARE DETAILED PLACEMENT DRAWINGS AND SCHEDULES IN CONFORMANCE WITH ACI-315 REQUIREMENTS, FOR ENGINEER'S REVIEW.

FOUNDATION DEWATERING/FLOATATION

FOUNDATION DEWATERING SHALL BE MAINTAINED UNTIL FOUNDATION EXCAVATION IS TOTALLY BACKFILLED. CONTRACTOR SHALL PROTECT THE STUCTURE AGAINST FLOATATION, UNTIL THE STRUCTURE IS PUT INTO SERVICE.

REQUIRED SPARE PARTS

A. ONE (1) SET OF ALL SPECIAL TOOLS REQUIRED FOR NORMAL OPERATION AND MAINTENANCE SHALL BE PROVIDED. ALL SUCH TOOLS SHALL BE FURNISHED IN A SUITABLE STEEL TOOL CHEST COMPLETE WITH LOCK AND DUPLICATE KEYS.

B. SPARE PARTS SHALL BE PROPERLY PACKAGED AND LABELED FOR EASY IDENTIFICATION WITHOUT OPENING THE PACKAGING AND SUITABLY PROTECTED FOR LONG TERM STORAGE UNDER HUMID CONDITIONS. THE MANUFACTURER SHALL FURNISH THE FOLLOWING SPARE PARTS FOR EACH PUMP SUPPLIED:

1. ONE (1) UPPER BEARING.
2. ONE (1) LOWER BEARING.
3. ONE (1) SET OF UPPER AND LOWER SHAFT SEALS.
4. ONE (1) SET OF "O-RINGS" OR GASKETS REQUIRED FOR REPLACEMENT OF BEARINGS AND SEALS.
5. ONE (1) IMPELLER WEAR RING.
6. ONE (1) SHAFT SLEEVE, IF APPLICABLE.
7. ONE (1) CABLE CAP, IF APPLICABLE.
8. ONE (1) INFLUENT DEBRIS CAGE.

C. THE ELECTRICAL SPARE PARTS - DIGITAL CONTROL CORPORATION.

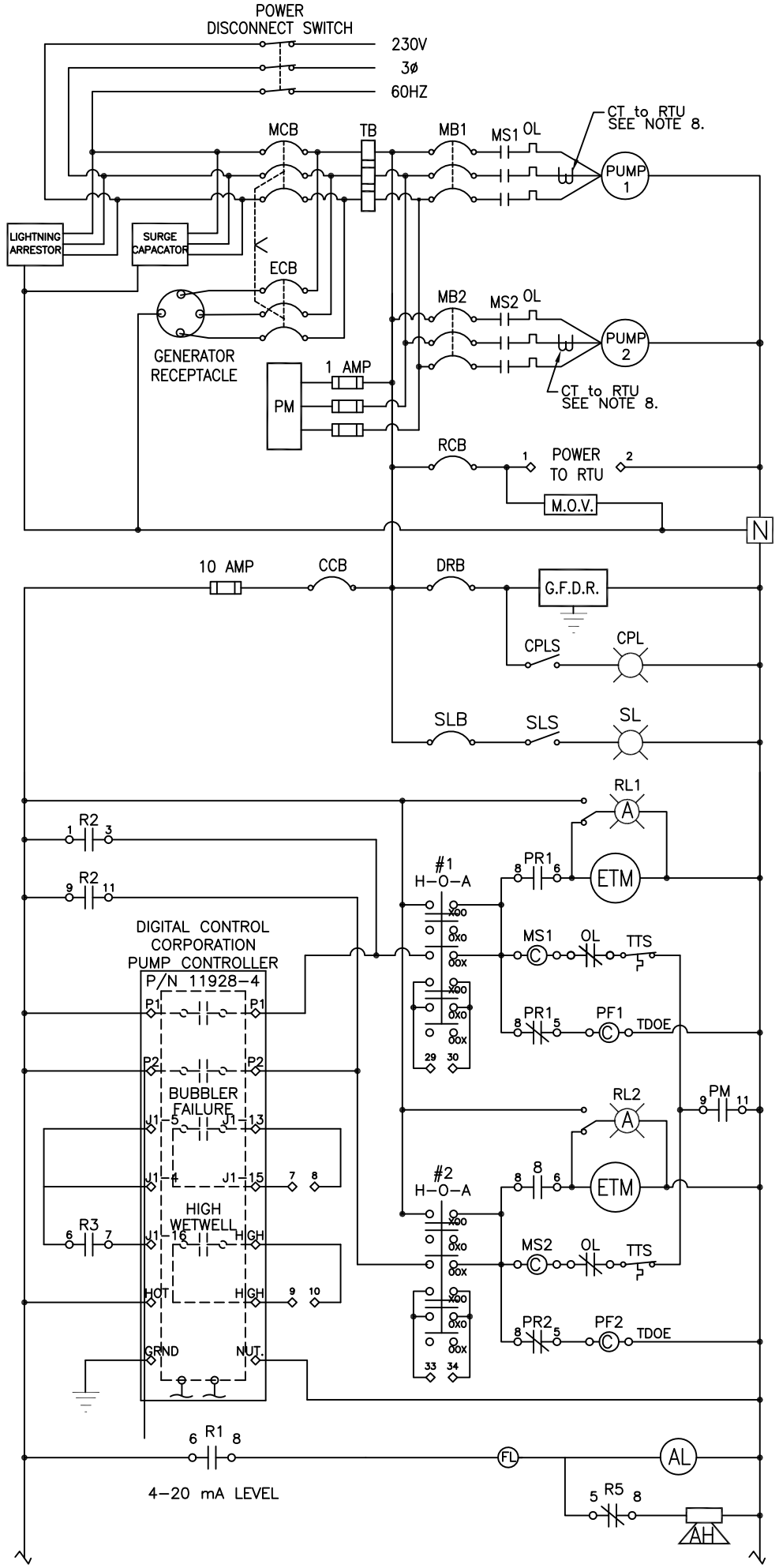
DUPLEX CONTROLLER MODEL #11928
TRIPLEX CONTROLLER MODEL #11967

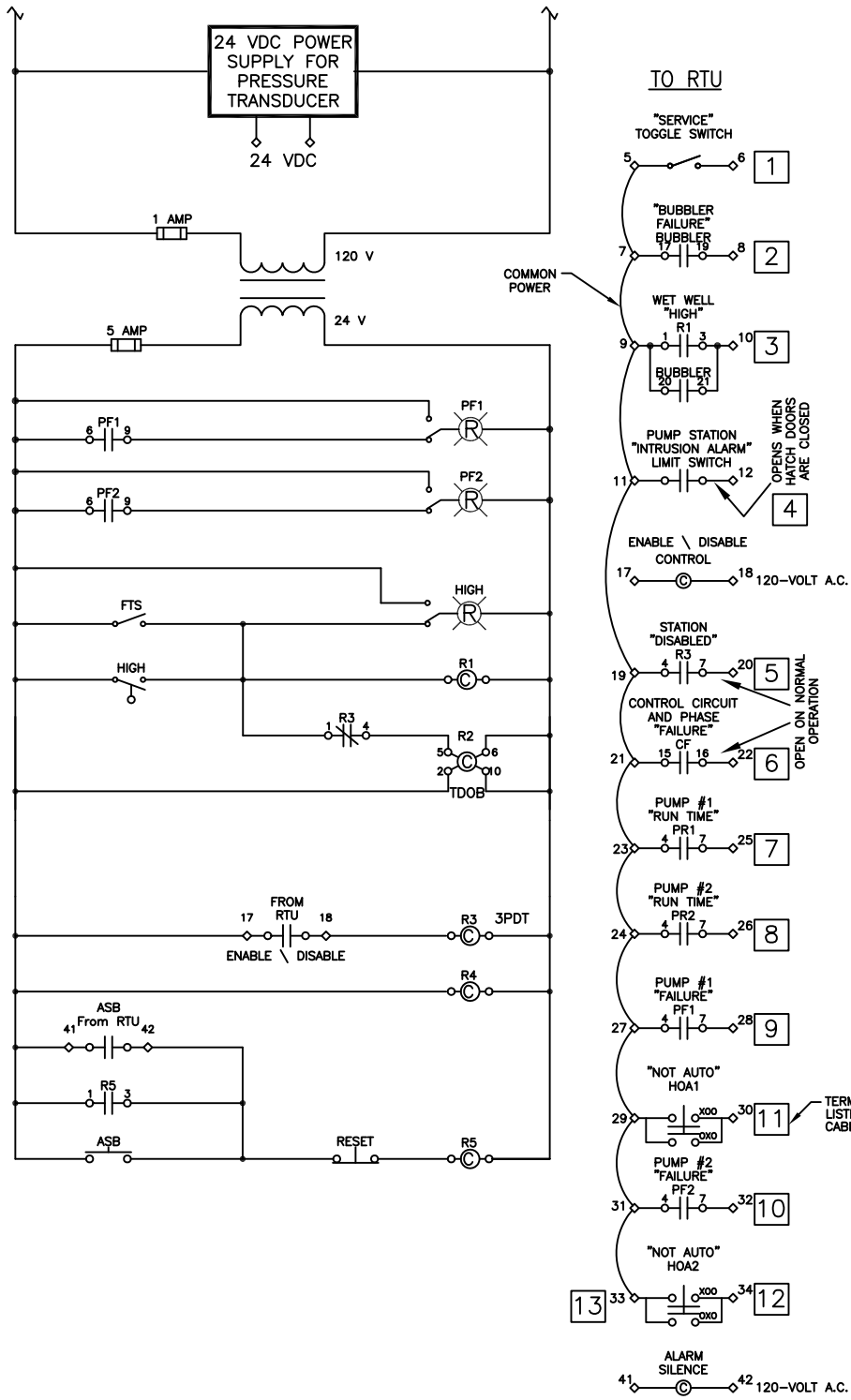
Date	Revisions	Appr. by
03/04	Revised Optional Base Slab Const. And	
	Added Notes On Required Spare Parts	K.H.G.

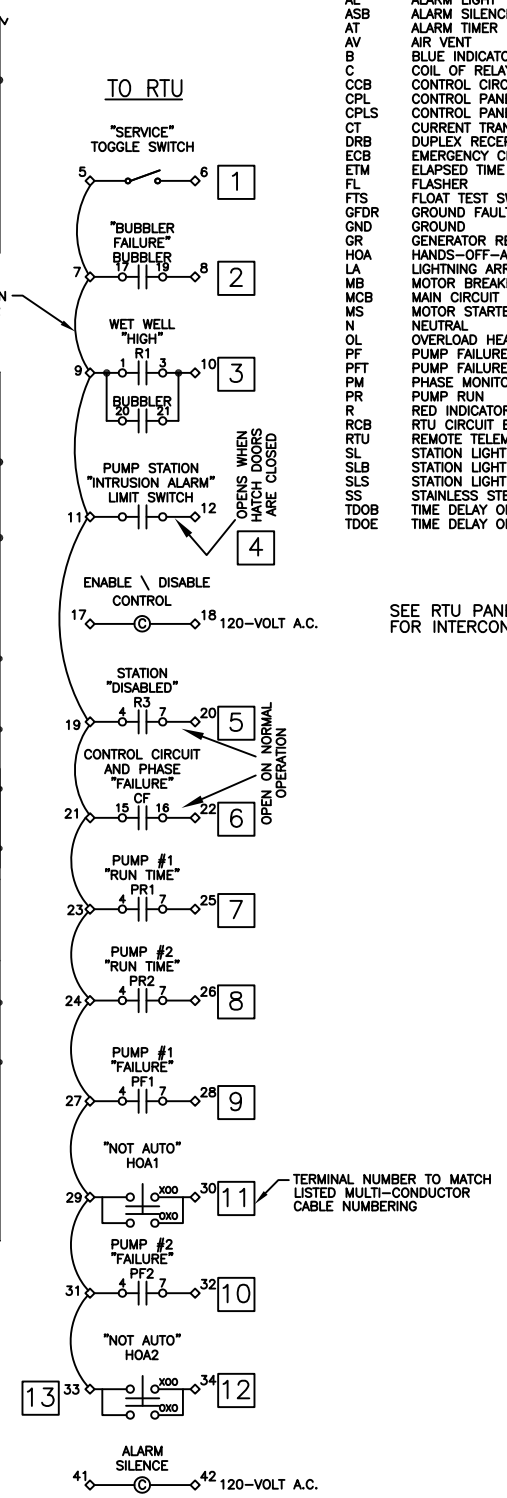
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

WASTEWATER PUMP STATION

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 2 of 3 | Fig.#: 305.2





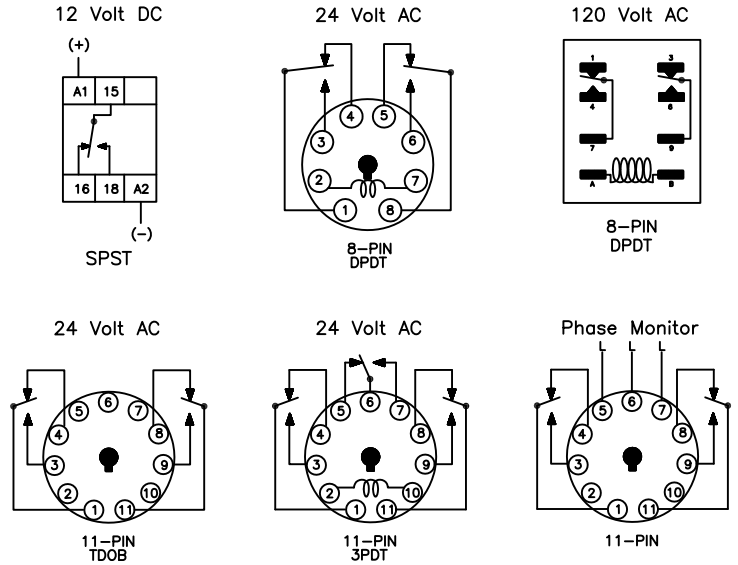


CITY OF MIRAMAR STANDARD CONTROL PANEL ABBREVIATIONS

A	AMBER INDICATOR LIGHT (PUSH TO TEST)
AH	ALARM HORN/ALARM BELL
AL	ALARM LIGHT
ASB	ALARM SILENCE BUTTON
AT	ALARM TIMER
AV	AIR VENT
B	BLUE INDICATOR LIGHT (PUSH TO TEST)
C	COIL OF RELAY
CCB	CONTROL CIRCUIT BREAKER
CPL	CONTROL PANEL LIGHT
CPLS	CONTROL PANEL LIGHT SWITCH
CT	CURRENT TRANSDUCER
DRB	DUPLEX RECEPTACLE BREAKER
ECB	EMERGENCY CIRCUIT BREAKER
ETM	ELAPSED TIME METER
FL	FLASHER
FTS	FLOAT TEST SWITCH
GFDR	GROUND FAULT DUPLEX RECEPTACLE
GND	GROUND
GR	GENERATOR RECEPTACLE
HOA	HANDS-OFF-AUTOMATIC SELECTOR SWITCH
LA	LIGHTNING ARRESTOR (GE #9L15ECC001)
MB	MOTOR BREAKER
MCB	MAIN CIRCUIT BREAKER
MS	MOTOR STARTER
N	NEUTRAL
OL	OVERLOAD HEATERS
PF	PUMP FAILURE
PFT	PUMP FAILURE TIMER
PM	PHASE MONITOR
PR	PUMP RUN
R	RED INDICATOR LIGHT (PUSH TO TEST)
RCB	RTU CIRCUIT BREAKER
RTU	REMOTE TELEMETRY UNIT
SL	STATION LIGHT
SLB	STATION LIGHT BREAKER
SLS	STATION LIGHT SWITCH
SS	STAINLESS STEEL
TDOB	TIME DELAY ON BREAK
TDOE	TIME DELAY ON ENERGIZE

SEE RTU PANEL LAYOUT DWG ON FIG. 305.6 FOR INTERCONNECTION WIRING

STANDARD RELAYS



RELAY SCHEDULE

RELAY	COIL VOLTAGE	TYPE	MODEL
CF	12 V DC	SPDT – TDOE	Crouzet B-AR-U-12D or Crouzet B-LR-U-12D
R1	24 VAC	DPDT	Crouzet RPT-2C8-24A
R2	24 VAC	DPDT – TDOB	Crouzet T-CR2-U-110A
R3	24 VAC	3PDT	Crouzet RPT-3C11-24A
R4	24 VAC	DPDT	Crouzet RPT-3C11-24A
R5	24 VAC	DPDT	Crouzet RPT-2C8-24A
PM	TO SUIT	DPDT – 11 PIN	Diversified SLA-230-ASA
MS1	120	3PDT	TO SUIT PUMP
MS2	120	3PDT	TO SUIT PUMP

NOTES:

1. 12 Volt Time Delay Relays shall be DIN rail mount type, Crouzet model B-AR-U-12D, or B-LR-U-12D, or approved equal.
2. 24 VAC Relays shall be 8-pin (DPDT), or 11-pin (3PDT), general purpose, Octal-type, plug-in mounting, Crouzet model RPT-2C8-24A, or RPT-3C11-24A, or approved equal.
3. 24 VAC Time-Delay-On-Break Relays shall be 11-pin (DPDT), Octal-type, plug-in mounting, on-break timing mode, adjustable from .05 sec (max.) to 30 min. (min.). Relays shall be Crouzet model T-CR2-U-110A (adjusted for 24VAC operations), or approved equal.
4. 120 VAC Relays shall be 8-blade (DPDT), or 11-blade (3PDT), general purpose with square-base, relay-type mounting. Relay shall be Crouzet model RKT-2C-110A, or RKT-3C-110A, or approved equal.
5. 120 VAC Time Delay relays shall be 8-blade (DPDT) square-base, relay-type mounting, on-make timing mode, adjustable from 0.5 sec. (max.) to 30 min. (min.), Relay shall be Crouzet model RTM, or approved equal.
6. Service switch shall be a SPST toggle switch. Label switch in control panel "SERVICE SWITCH".
7. Phase Monitor shall be 11-pin, DPDT, Octal-type, plug-in mounting. Relay shall be Crouzet model L-WRA2-xxxA, with coil appropriately sized for application, or approved equal.
8. Current transducer shall be a Mitchell # 9QA2002

ALL RELAY CONTACTS ARE SHOWN IN THE DE-ENERGIZED STATE

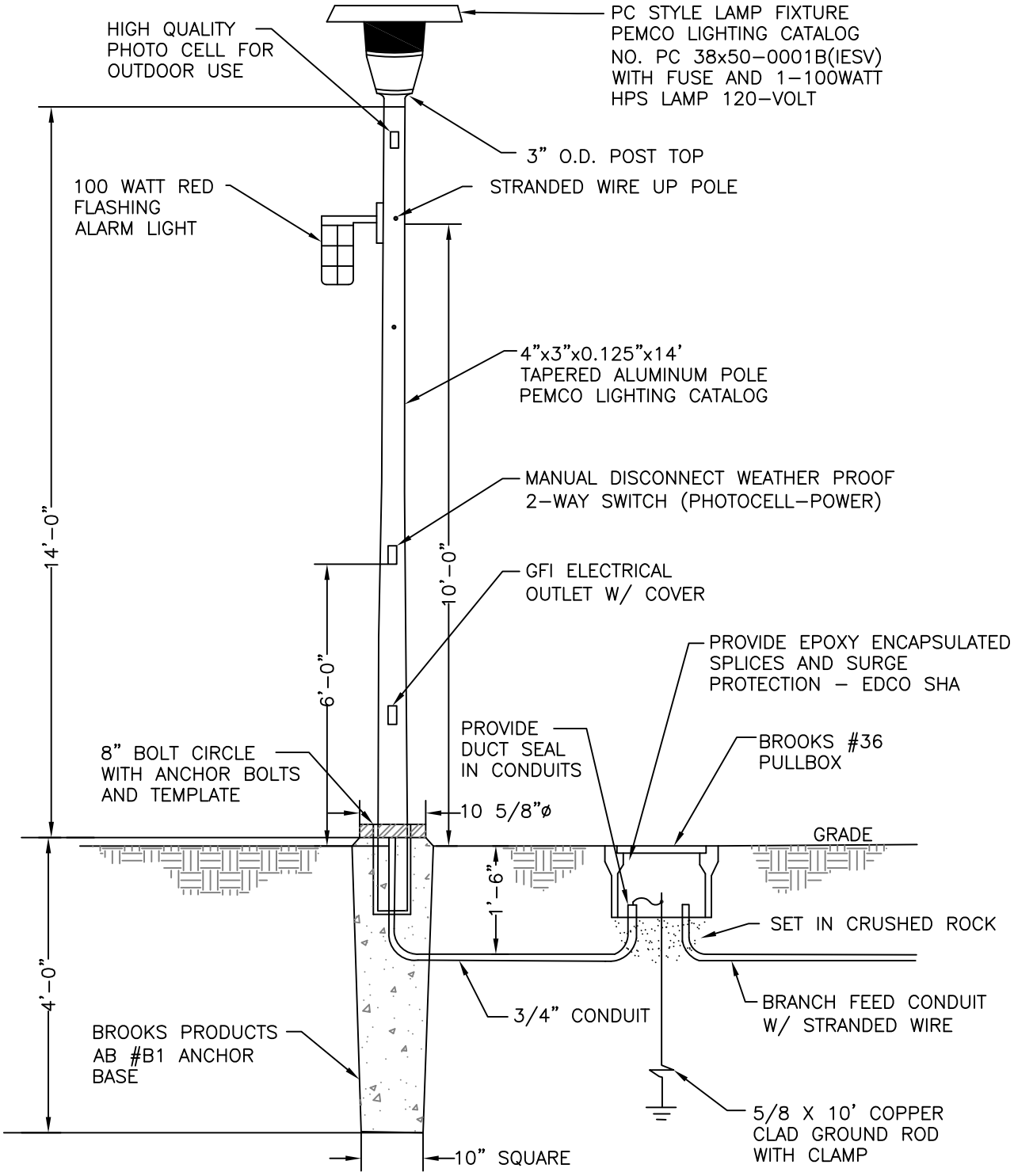
ELECTRICAL DIAGRAM
(TYPICAL)

Date	Revisions	Appr. by
10/02	Misc. Revisions	K.H.G.
11/00	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

WASTEWATER PUMP STATION

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 3 of 3 | Fig.#: 305.3

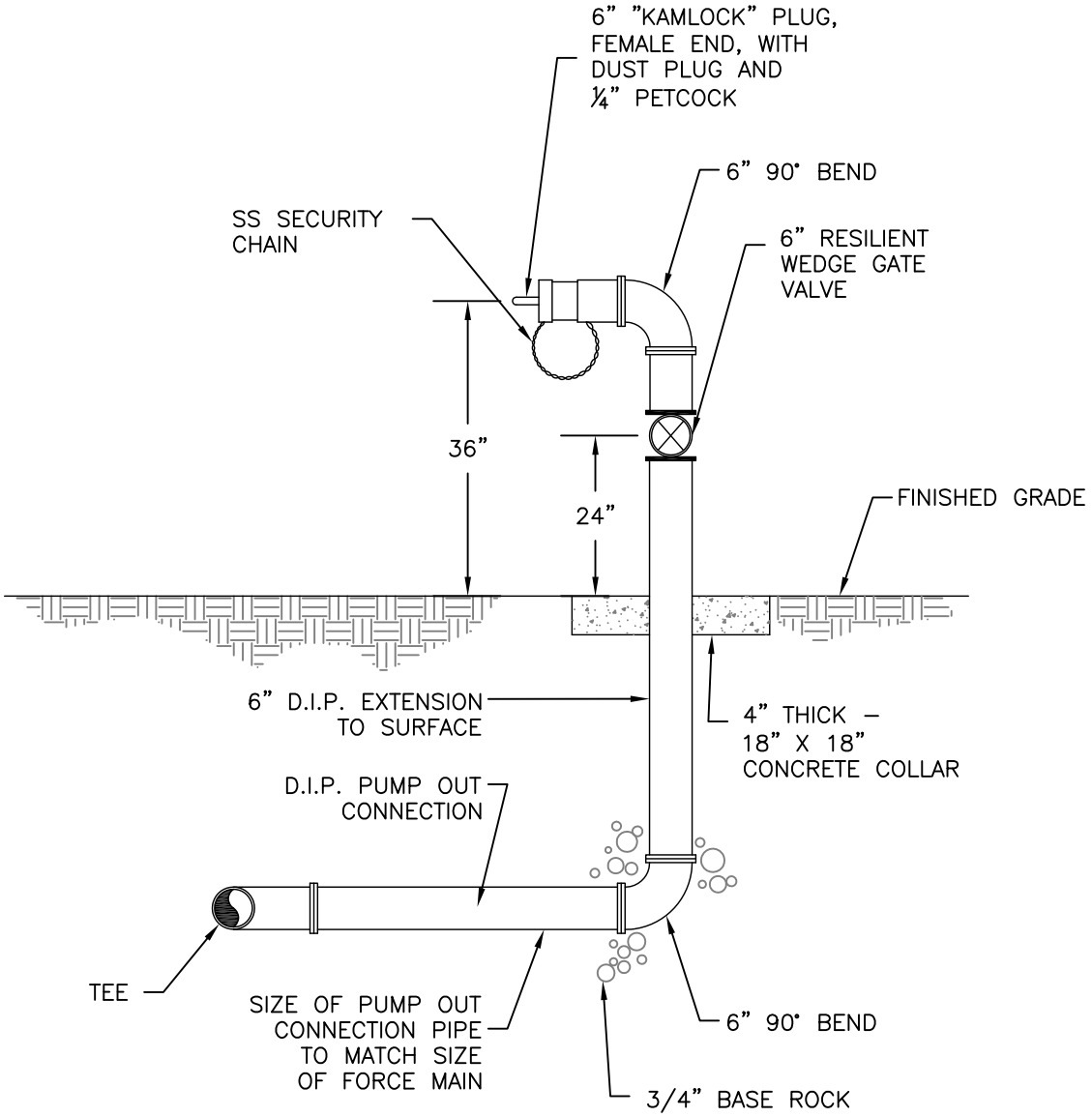


07/02	Misc. Revisions	K.H.G.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

POST LIGHT DETAIL

Issue Date: Nov. 2000	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 305.4

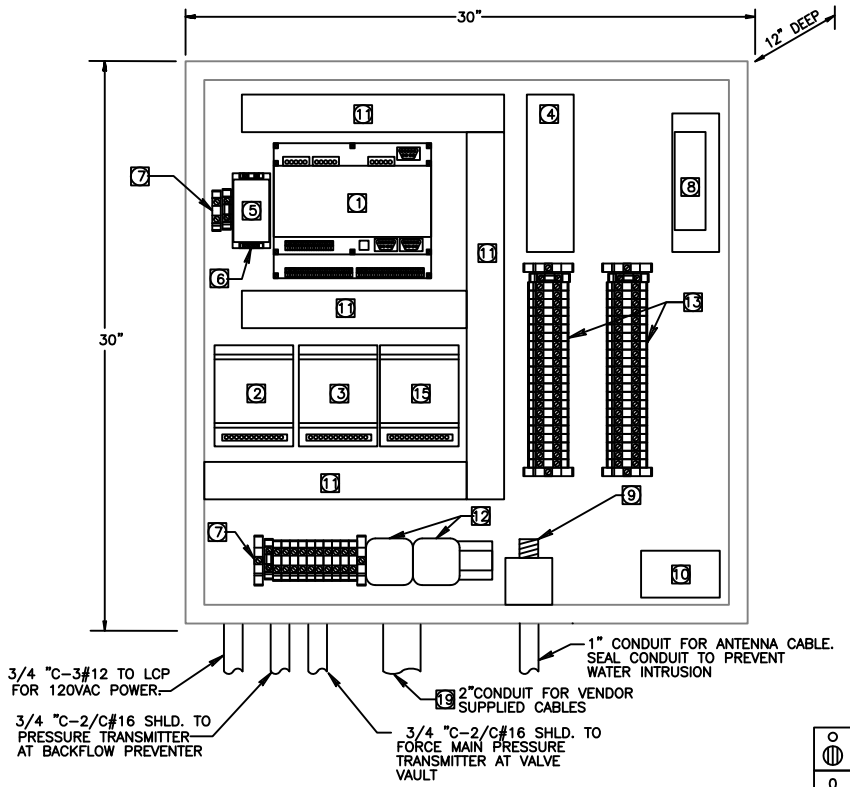


Date	Revisions	Appr. by
06/03	Changed To 6" Pipe	K.H.G.
10/02	Misc. Revisions	K.H.G.
11/00	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

WASTEWATER PUMP – OUT/ BY–PASS CONNECTION

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 305.5



LIFT STATION RTU PANEL – INTERIOR

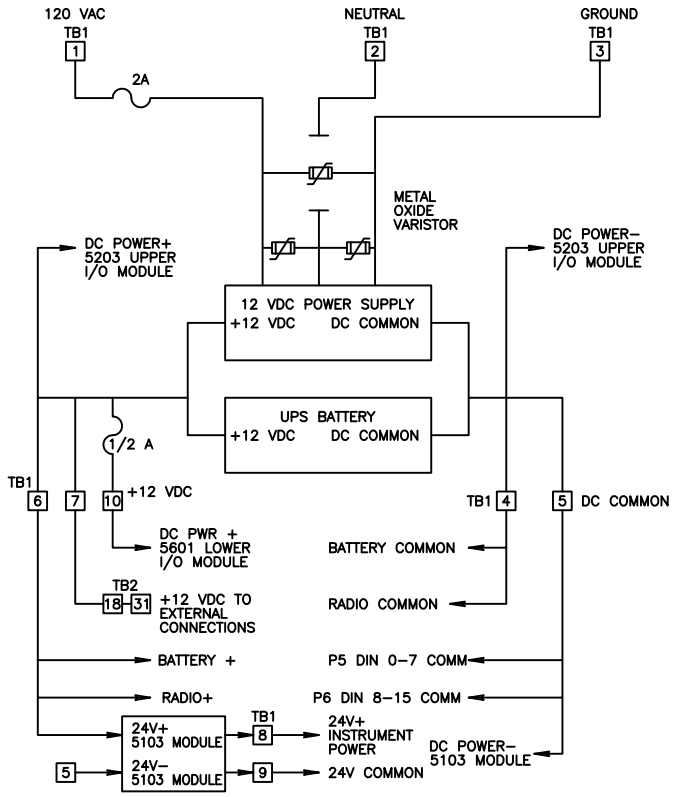
(PANEL DOOR NOT SHOWN FOR CLARITY)
(NEMA-4X, WHITE PAINTED ALUMINUM 12 GAUGE PANEL WITH LOCKABLE DOOR HANDLE)

GENERAL NOTES:

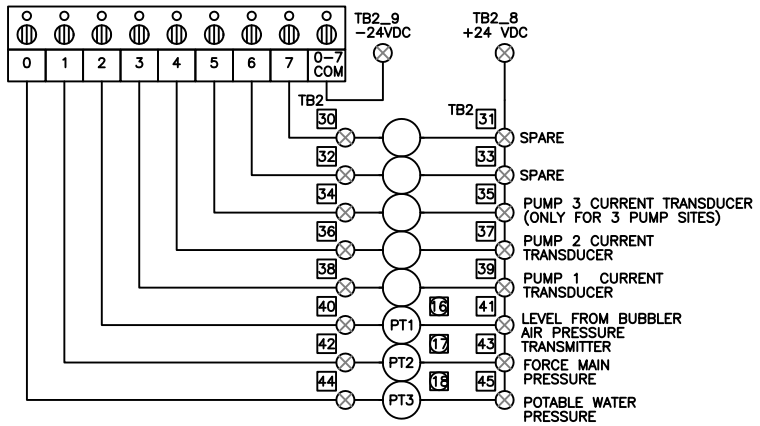
1. ALL CABINETS SHALL BE FABRICATED OF ALUMINUM WELDED CONSTRUCTION, WEATHERPROOF AS SHOWN, WITH NEOPRENE GASKETS.
2. WATER AND FORCE MAIN PRESSURE TRANSMITTERS SHALL BE PROTECTED BY LIGHTNING SURGE ARRESTORS, AS MANUFACTURED BY EDCO MODEL No.: SS64-036-1, OR EQUAL.
3. ALL ANALOG DEVICES LOCATED OUTSIDE OF THE RTU PANEL SHALL BE CONNECTED TO LIGHTNING SURGE ARRESTORS.

NOTES:

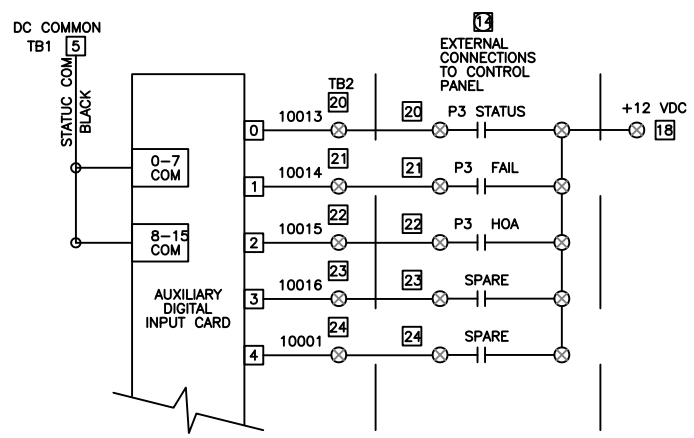
1. SCADAPACK PLC AS SUPPLIED BY ENGINEER SERVICE CORPORATION, P.O. BOX 23511, JACKSONVILLE, FL 32241. (TEL): 904-268-0482, (FAX): 904-268-3490.
2. CONTROL MICROSYSTEMS 5103 POWER SUPPLY
3. CONTROL MICROSYSTEMS 5403 8-CHANNEL D/I REQUIRED FOR 3 PUMP SITES
4. MDS-9810 SPREAD SPECTRUM TRANSCEIVER
5. OMRON 12 VDC POWER SUPPLY FOR PLC
6. (3) MOV'S (LIGHTNING SURGE ARRESTOR)
7. TERMINAL STRIP TB1
8. COOLING FAN
9. POLYPHASER IS50B-LN-C2 SURGE PROTECTOR FOR THE ANTENNA.
10. YUASA UPS BATTERY
11. 2" WIDE WIREWAY
12. RELAYS
13. TERMINAL STRIP TB2
14. CONTACTS LOCATED IN PUMP LOCAL CONTROL PANEL.
15. AUXILIARY DISCRETE I/O CARD (FOR THOSE STATIONS EQUIPPED WITH THREE PUMPS ONLY).
16. WATER PRESSURE TRANSMITTER LOCATED AT THE BACKFLOW PREVENTER, AS MANUFACTURED BY ENDRESS & HAUSER PART #: PMC-41-PC11P6H11N1
17. FORCE MAIN PRESSURE TRANSMITTER LOCATED ON FORCE MAIN IN VALVE VAULT.
18. LEVEL TRANSMITTER LOCATED ON BUBBLER AIR LINE IN LOCAL CONTROL PANEL, AS MANUFACTURE BY ENDRESS & HAUSER PART #:PCM-131-A22F1Q4H.
19. RTU SUPPLIER TO PROVIDE 100 FT. OF (4)-2/C#16 SHLD. (600V INSULATION) CABLE AND 20 FT. OF 25 CONDUCTOR #16 THHN CABLE. PROVIDE AN EXTRA 12 CONDUCTOR #14 THHN CABLE FOR THOSE SITES WITH 3 PUMPS. CABLE SHALL HAVE NUMBERED WIRES, AS MANUFACTURED BY BELDEN, OR EQUAL.



RTU POWER DISTRIBUTION

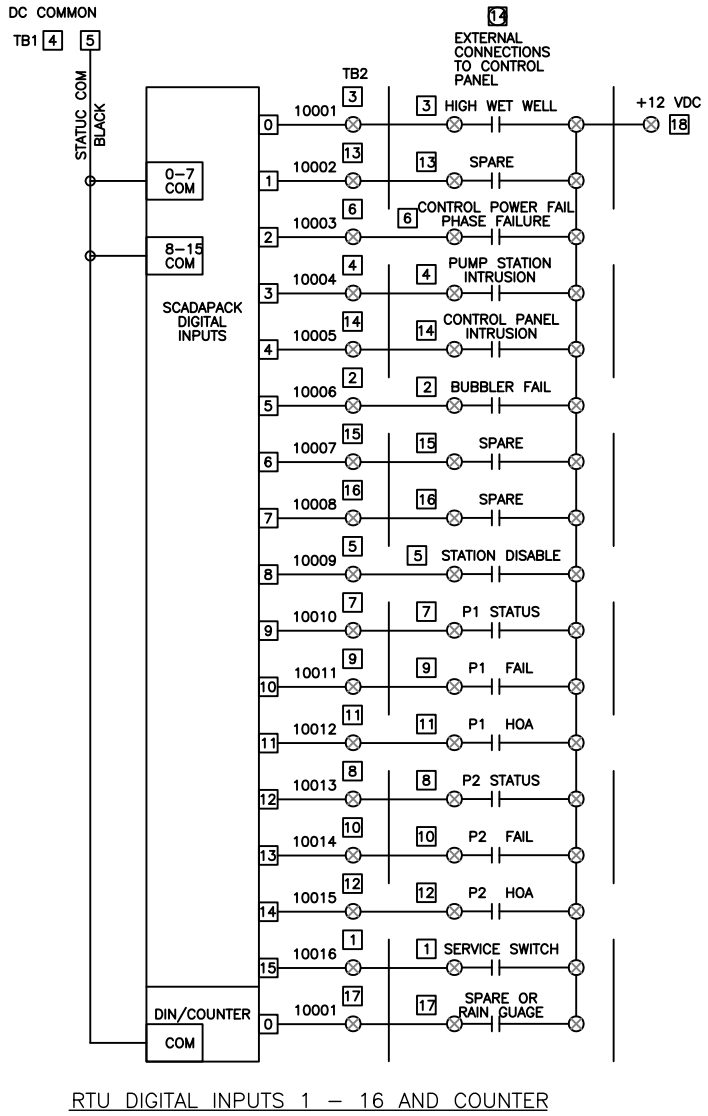


RTU ANALOG INPUTS 0 – 7

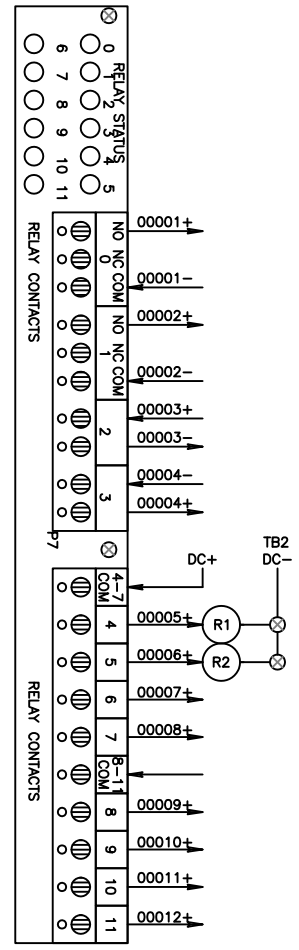


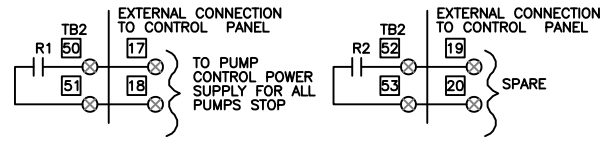
RTU AUXILIARY DIGITAL INPUTS 1 – 16

(ONLY FOR 3 PUMP SITES)

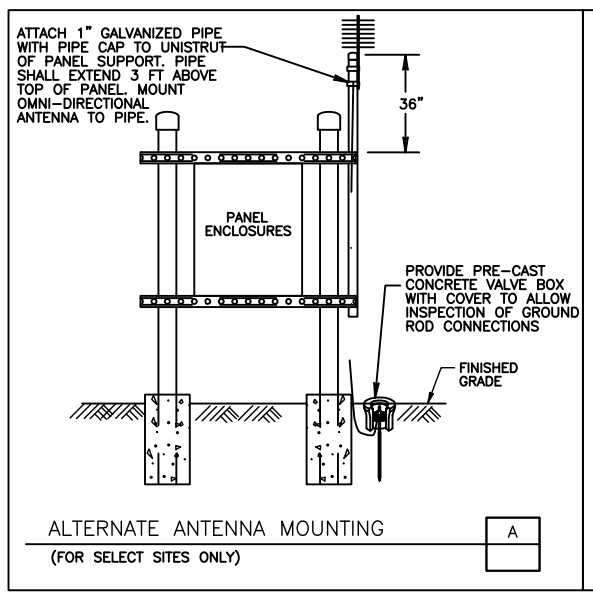


RTU DIGITAL INPUTS 1 – 16 AND COUNTER



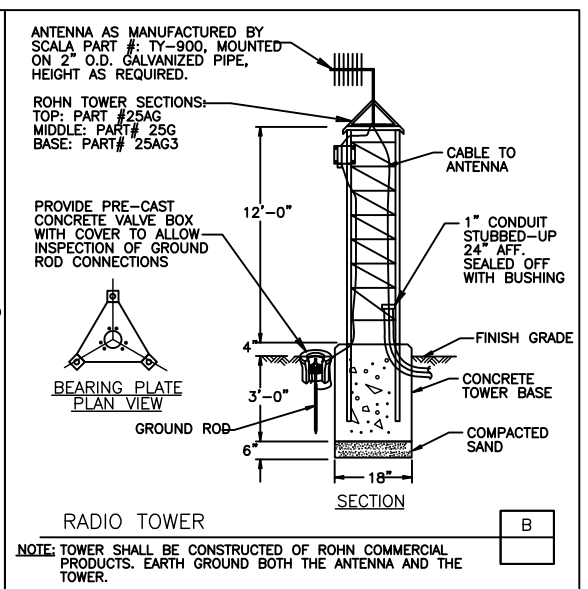


RTU DIGITAL OUTPUTS 1 – 12



ALTERNATE ANTENNA MOUNTING (A)

(FOR SELECT SITES ONLY)



RADIO TOWER (B)

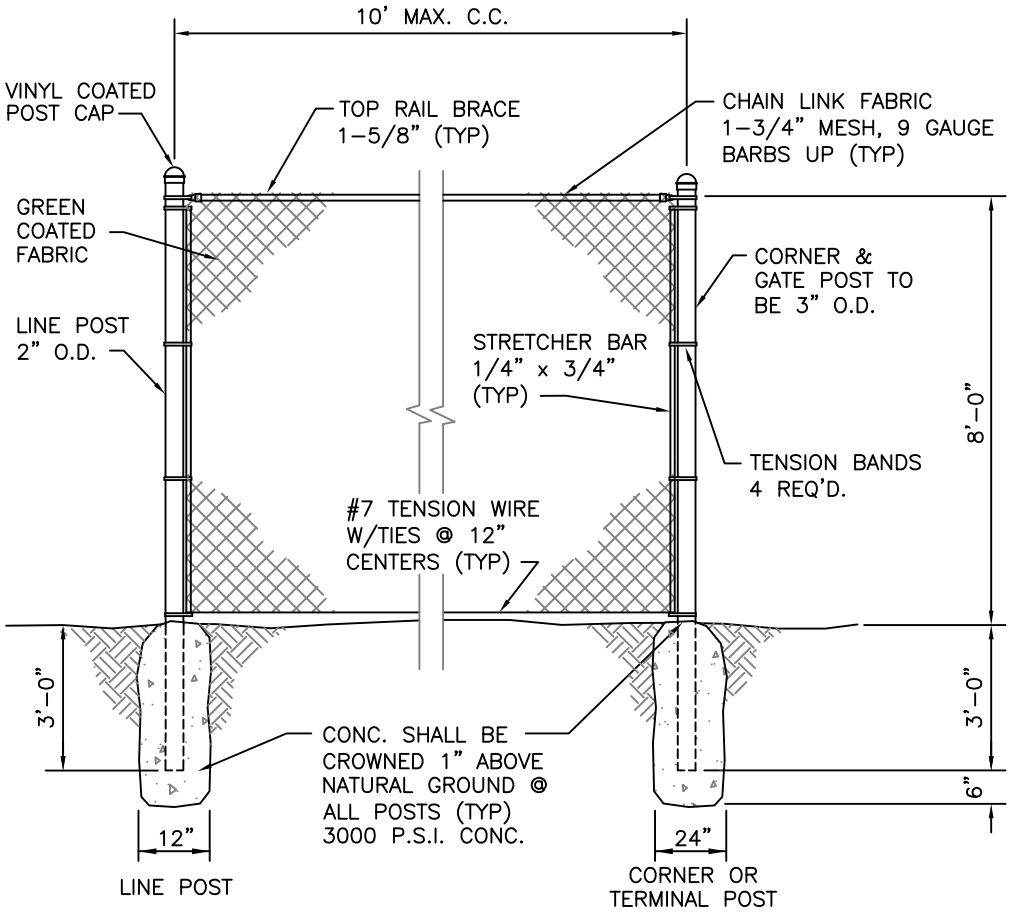
NOTE: TOWER SHALL BE CONSTRUCTED OF ROHN COMMERCIAL PRODUCTS. EARTH GROUND BOTH THE ANTENNA AND THE TOWER.

Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

RTU PANEL LAYOUT

Issue Date: Nov. 2000	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 305.6



FENCE NOTES:

1. CHAIN LINK FABRIC SHALL BE 1 3/4"" MESH (TWISTED & BARBED). WIRE SHALL BE 9 GAUGE GALVANIZED. BARBS ARE TO BE INSTALLED UPWARD.

2. CORNER AND GATE POSTS SHALL BE GALVANIZED STEEL PIPE 3" NOMINAL DIA., SCHEDULE 40, EMBEDDED 3' INTO THE GROUND.

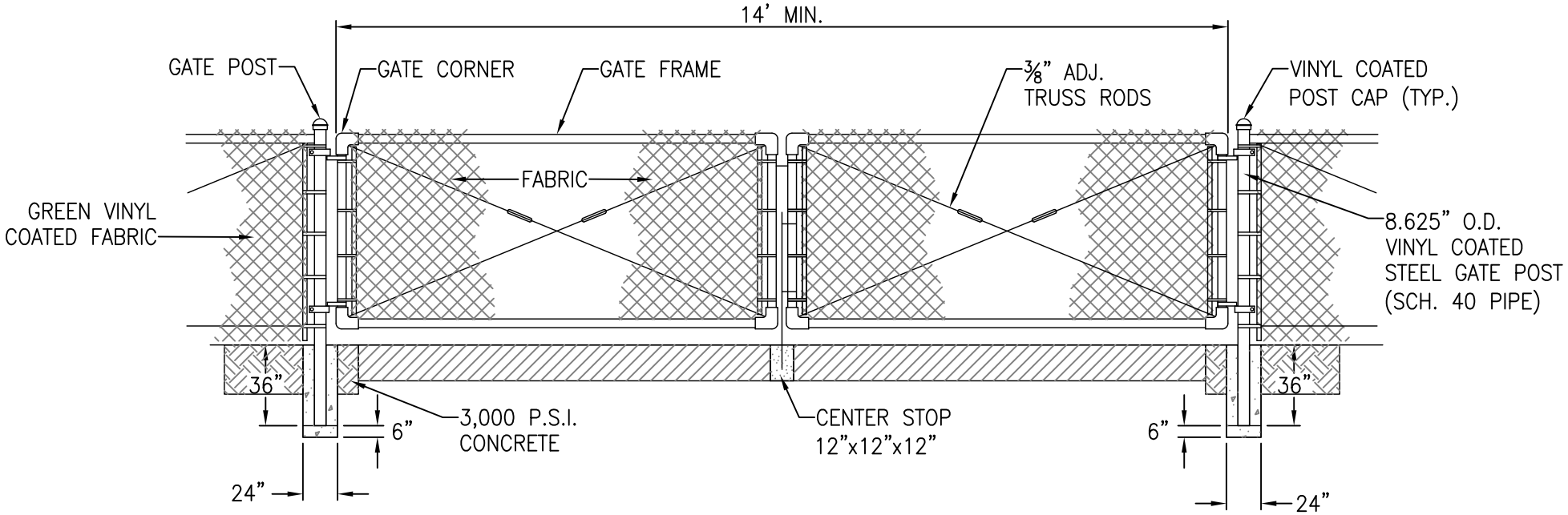
3. LINE POSTS SHALL BE GALVANIZED STEEL PIPE 2" NOMINAL DIA., SCHEDULE 40, EMBEDDED 3' INTO GROUND. SPACING SHALL BE 10' MAX. CENTER TO CENTER.

4. TOP RAIL SHALL BE GALVANIZED STEEL PIPE 1 5/8" NOMINAL DIA., SCHEDULE 40.

5. TENSION WIRE SHALL BE NO. 7 GAUGE GALVANIZED STEEL.

6. TIE WIRE AND HOG RINGS SHALL BE NO. 9 GAUGE GALVANIZED STEEL.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			CHAIN LINK FENCE DETAIL			
Date	Revisions	Appr. by	Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 306

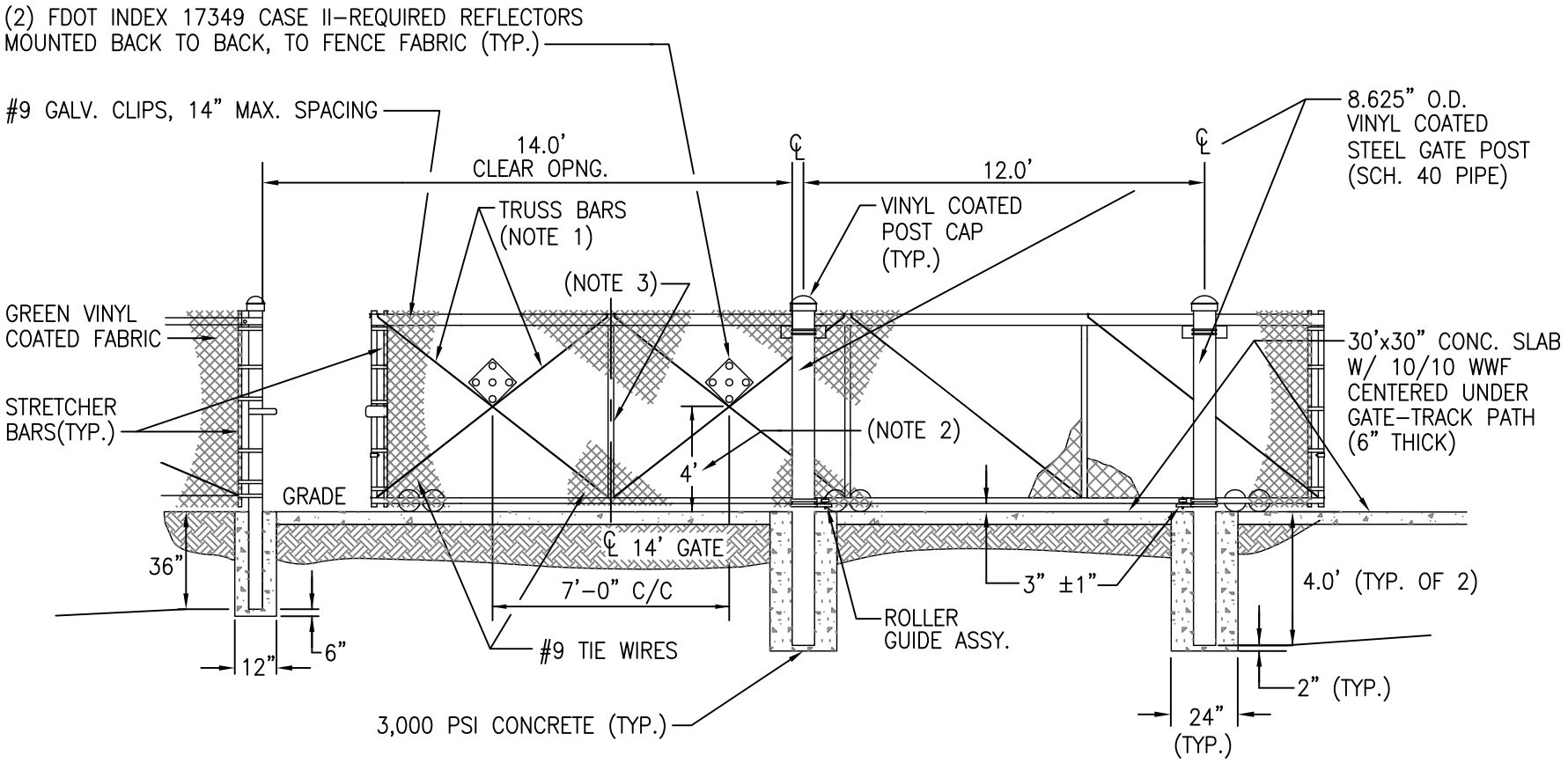


Date	Revisions	Appr. By
11/05	Chage Footing from 12" to 24" Wide	H.E.T.
10/02	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

DOUBLE SWING GATE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 307



NOTES:

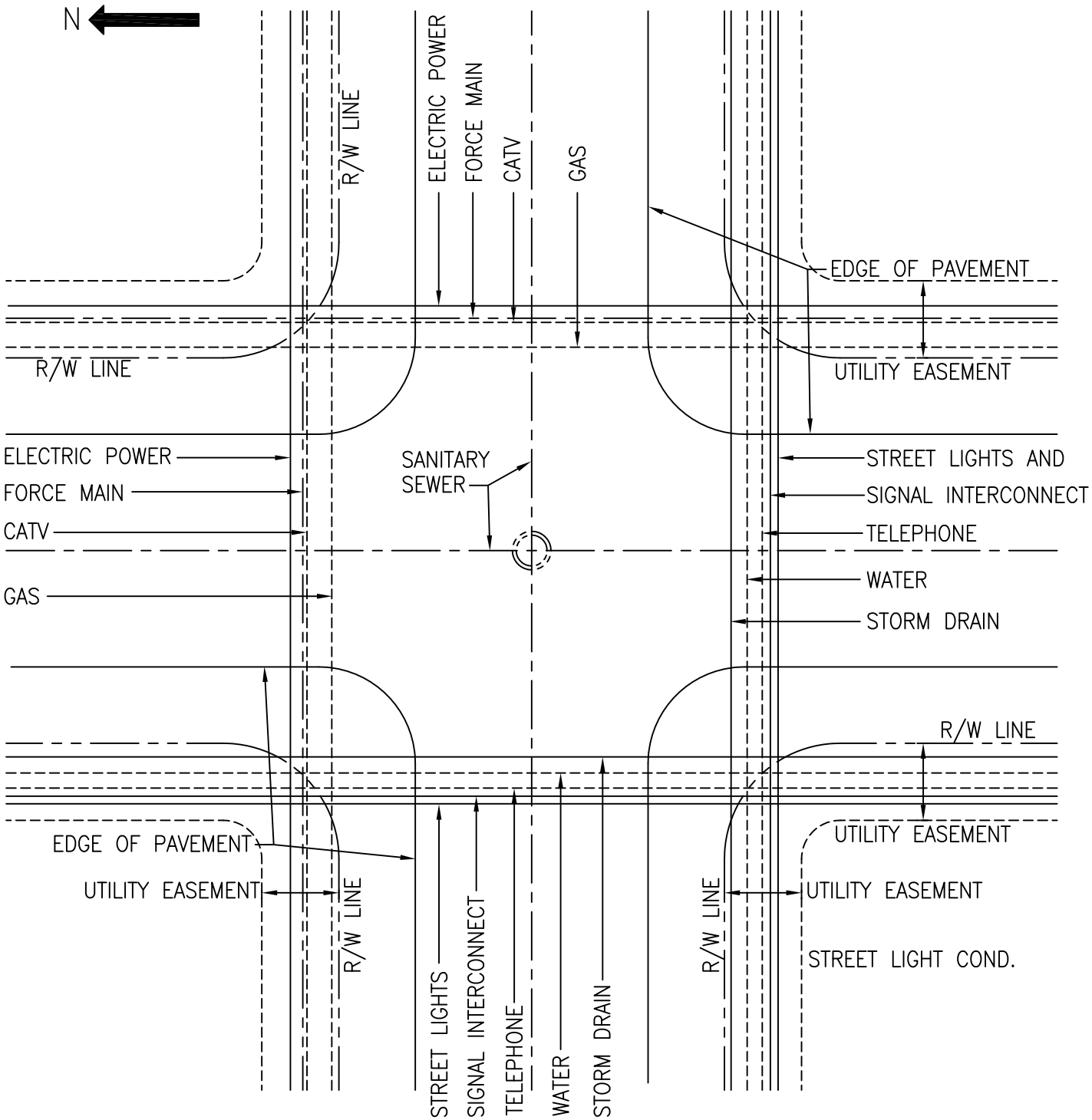
1. TRUSS BARS ARE REQUIRED FOR EACH GATE SECTION AND THE FIRST SPAN ON EACH SIDE OF A CORNER POST ONLY.
2. CONTRACTOR TO MAKE MINIMAL ADJUSTMENT TO INSURE TOP OF REFLECTOR SIGN CLEARS GATE TOP RAIL AND TRACK WHEN GATE IS OPENED.
3. INTERMEDIATE SUPPORTS, 8'–0" O.C. MAX. (TYP.)
4. REFER TO "ENGINEERING STANDARDS" SECTION 7.03–H FOR FENCING.

Date	Revisions	Appr. By
10/02	Misc. Revisions	K.H.G.

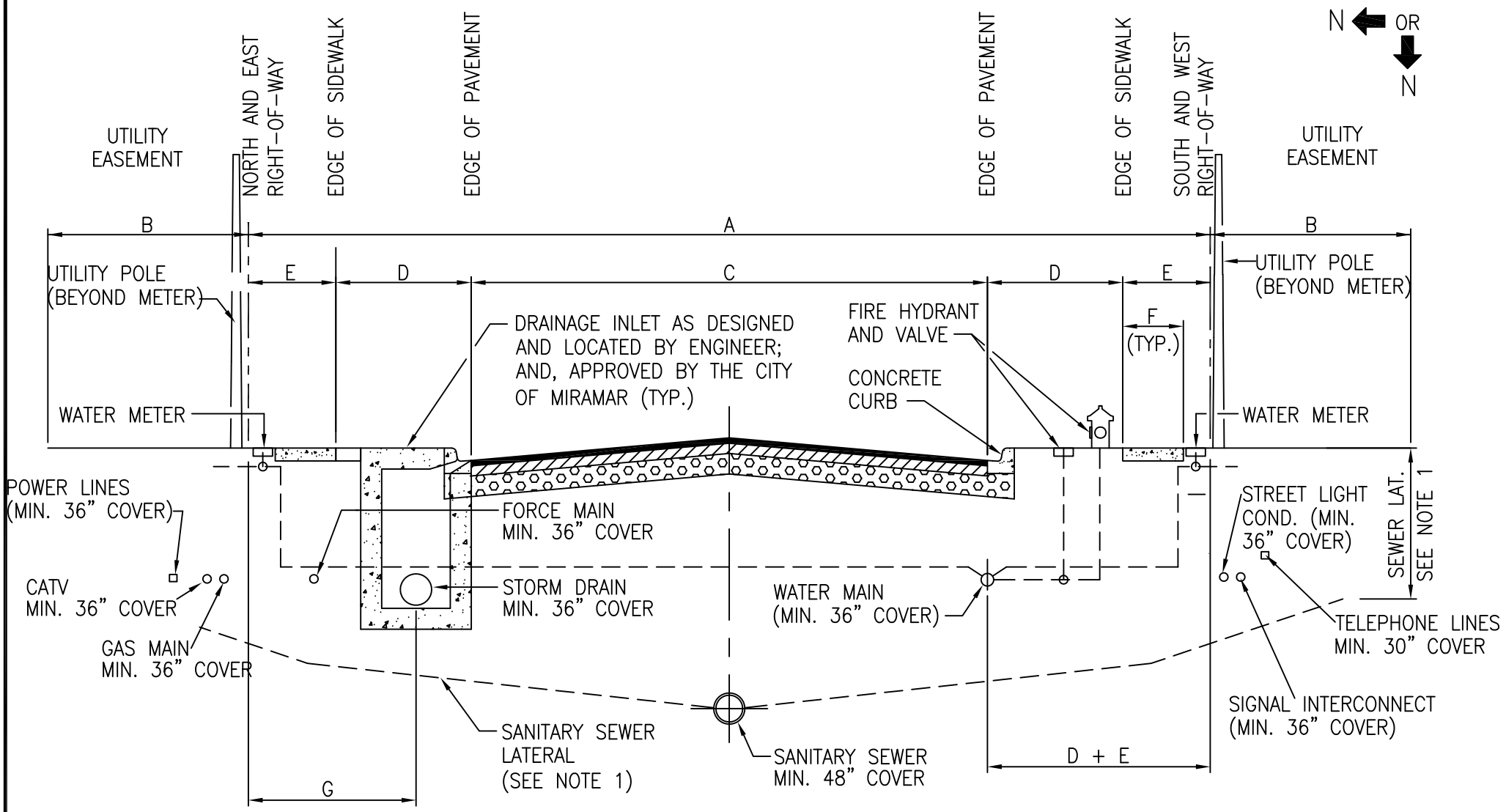
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

CANTILEVER GATE DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 308



			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			ROADWAY DETAILS TYPICAL ROADWAY PLAN–UTILITY PLACEMENT IN 50–FT. AND 60–FT. RIGHT–OF–WAY			
Date	Revisions	Appr. by	Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 400



NOTE:

1. 30" MIN. COVER FOR D.I.P.; 36" MIN. COVER FOR ALL OTHER MATERIALS.

* AS DETERMINED BY CITY.

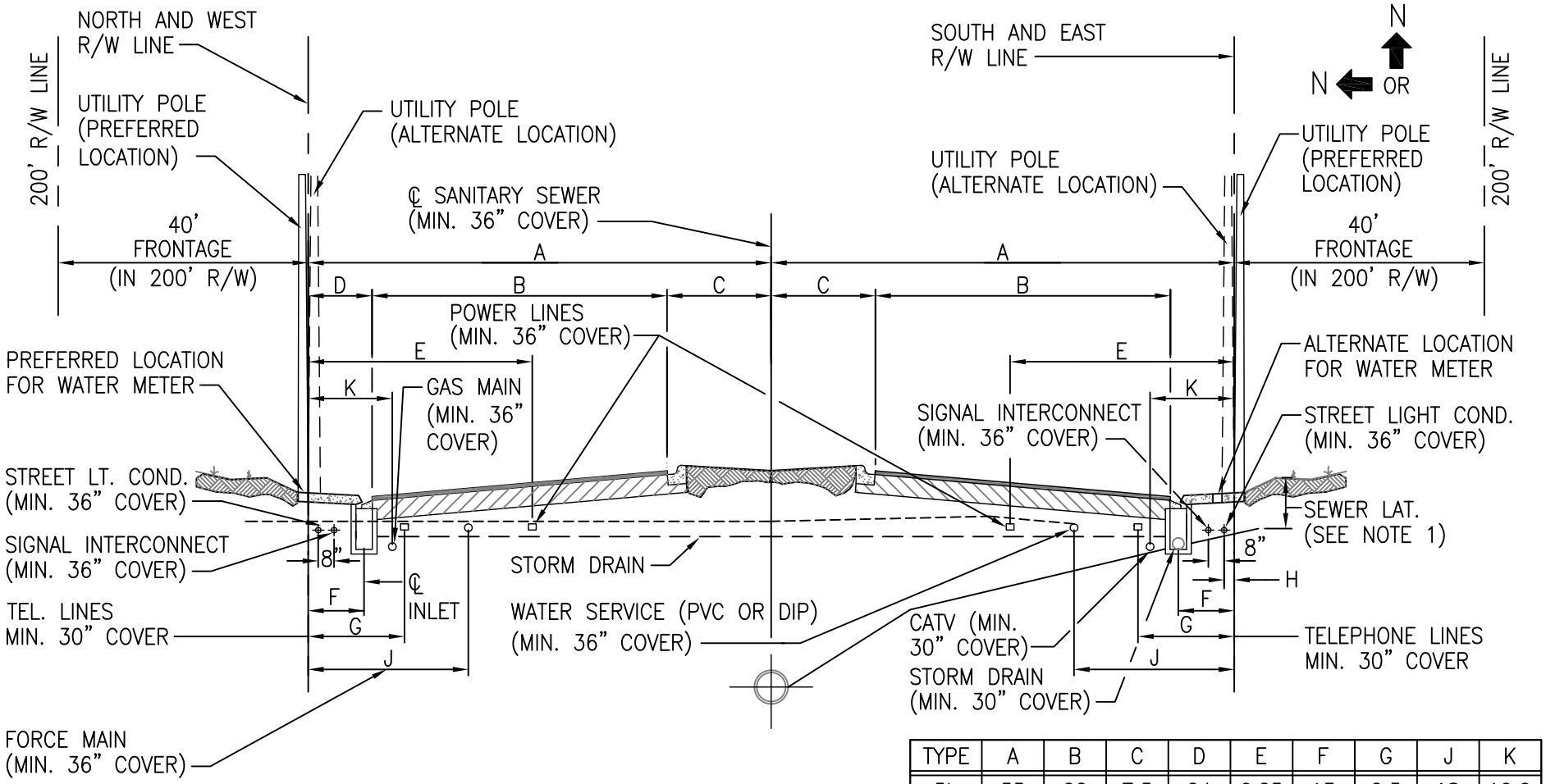
RESIDENTIAL USAGE	A	B	C	D	E	F	G
ARTERIAL	60'	*	28'	9'	7'	5'	11'
SINGLE FAMILY	50'	*	24'	7'	6'	4'	7'
TOWNHOMES	44'	*	20'	6'	6'	4'	6'

Date	Revisions	Appr. By
03/04	Revised Notes	K.H.G.
10/02	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS – TYPICAL ROADWAY SECTION UNDERGROUND UTILITIES IN 50-FT, AND 60-FT. RIGHT-OF-WAY

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 401



TYPE	A	B	C	D	E	F	G	J	K
5L	55	22	7.5	24	6.25	13	2.5	18	10.0
5L	40	26	8.0	29	6.75	14	2.5	19	11.0
4LD	40	24	8.0	26	6.75	14	2.5	19	11.0
4LD	47	27	9.0	30	7.75	15	2.5	20	12.0
6LD	50	34	8.0	26	6.75	14	2.5	19	11.0
6LD	53	37	8.0	28	6.75	14	2.5	19	11.0
6LD	55	37	8.0	28	6.75	14	2.5	19	11.0
6LD	60	38	10.0	31	8.75	16	3.5	21	13.0
6LD+P	60	38	10.0	31	8.75	16	3.5	21	13.0

NOTES:

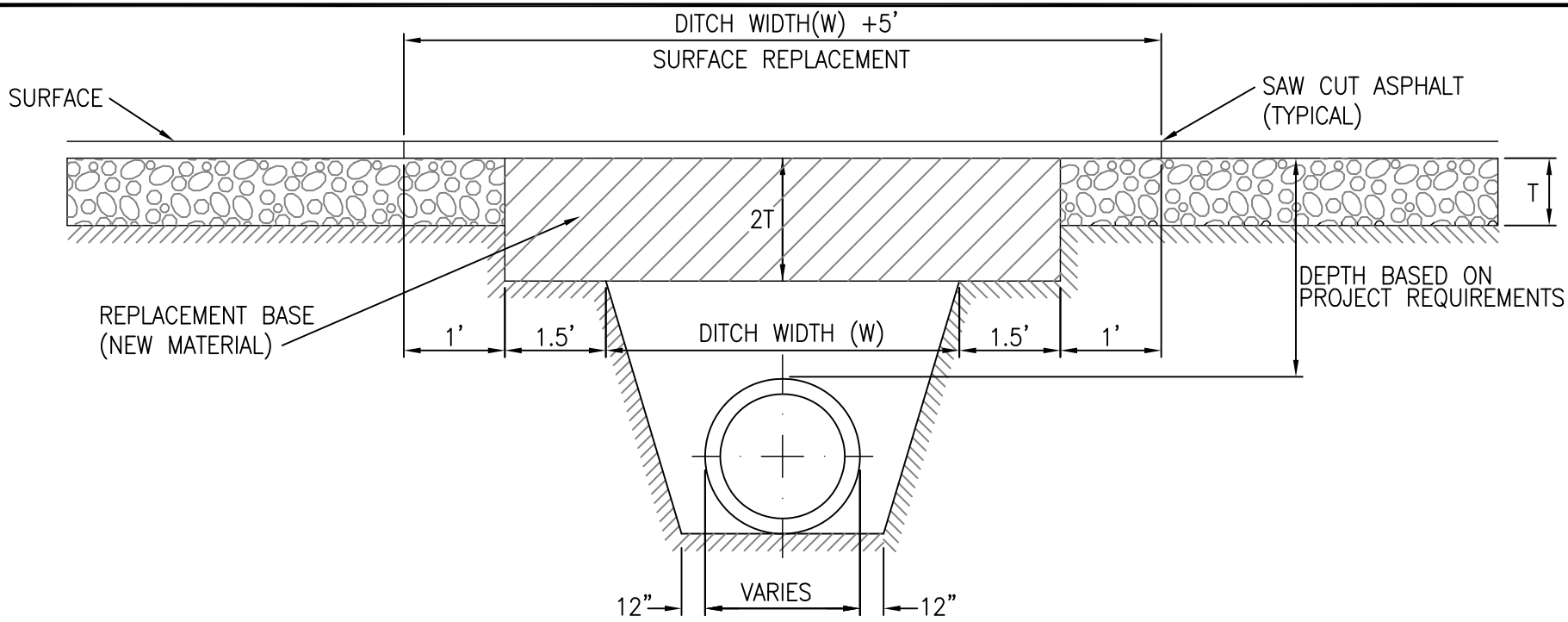
1. 30" MIN. COVER FOR D.I.P. 36" MIN. COVER FOR ALL OTHER MATERIALS.

03/04	Revised Notes	K.H.G.
Date	Revisions	Appr. By

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS – TYPICAL ROADWAY SECTION UNDERGROUND UTILITIES IN 70-FT, TO 200-FT. RIGHT-OF-WAY

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 402



GENERAL NOTES

1. REPLACED BASE MATERIAL OVER DITCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE, MINIMUM 16", MAXIMUM 24".
2. BASE MATERIAL SHALL BE PLACED IN 6" MAXIMUM (LOOSE MEASUREMENT) LAYERS AND EACH LAYER THOROUGHLY ROLLED OR TAMPED TO 98% OF MAXIMUM DENSITY, PER AASHTO T-180.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL SHALL BE CONSISTENT WITH THE SURROUNDING SURFACE MATERIAL.
5. BASE MATERIAL SHALL HAVE A MINIMUM LIMEROCK BEARING RATIO (LBR) OF 100 AND A MINIMUM CARBONATE CONTENT OF 70% (60% FOR LOCAL STREETS).
6. IF THE DITCH IS FILLED TEMPORARILY, IT SHALL COVERED WITH A 2" THICK ASPHALTIC CONCRETE PATCH TO KEEP THE FILL MATERIAL FROM RAVELING, UNTIL REPLACED WITH A PERMANENT PAVEMENT PATCH.
7. RESTORATION MUST BE RECTANGLE IN SHAPE WITH A UNIFORM WIDTH ACROSS A FULL LANE.
8. DETERMINE DEPTH AND COMPOSITIION OF EXISTING PAVEMENT PRIOR TO CONDUCTING WORK.

Date	Revisions	Appr. By
09/15	General revisions	S.Z.
10/02	Revised Note #1	L.L.

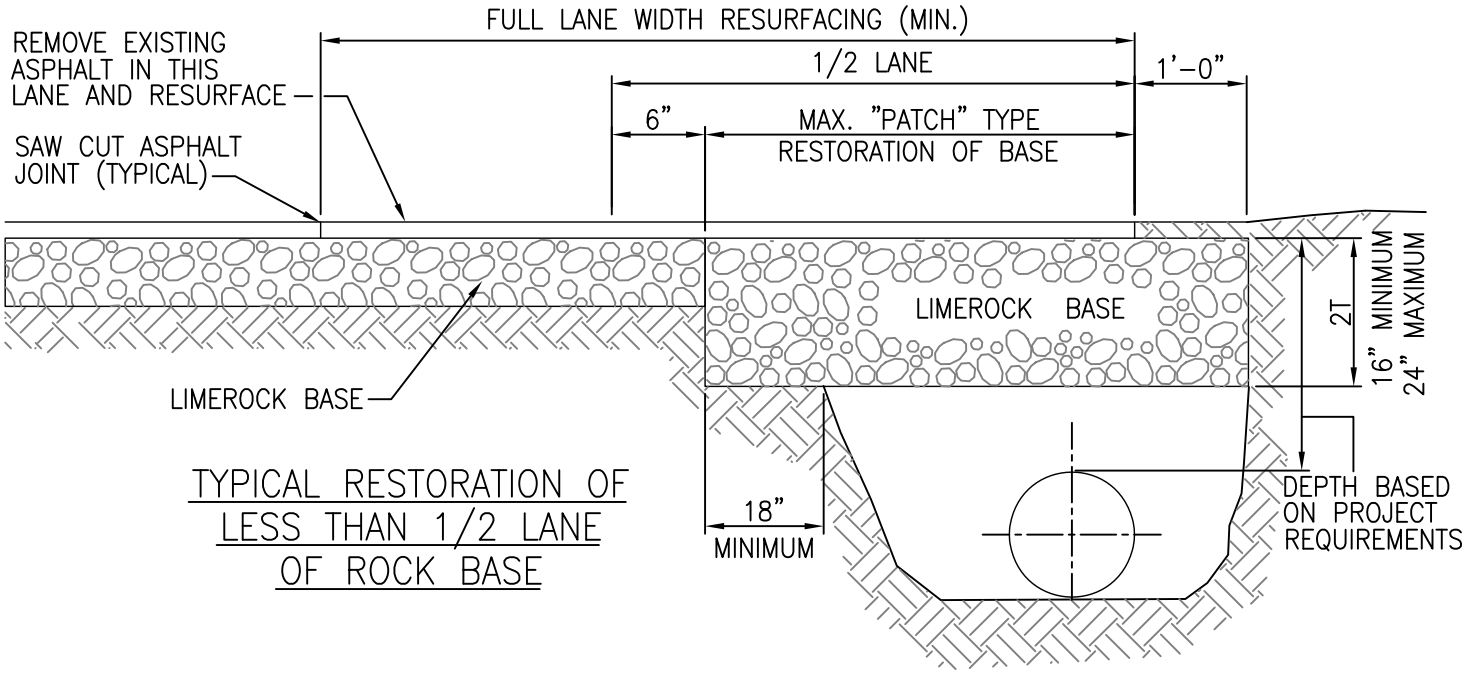
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
ROADWAY CUT RESTORATION FOR UTILITY CROSSING

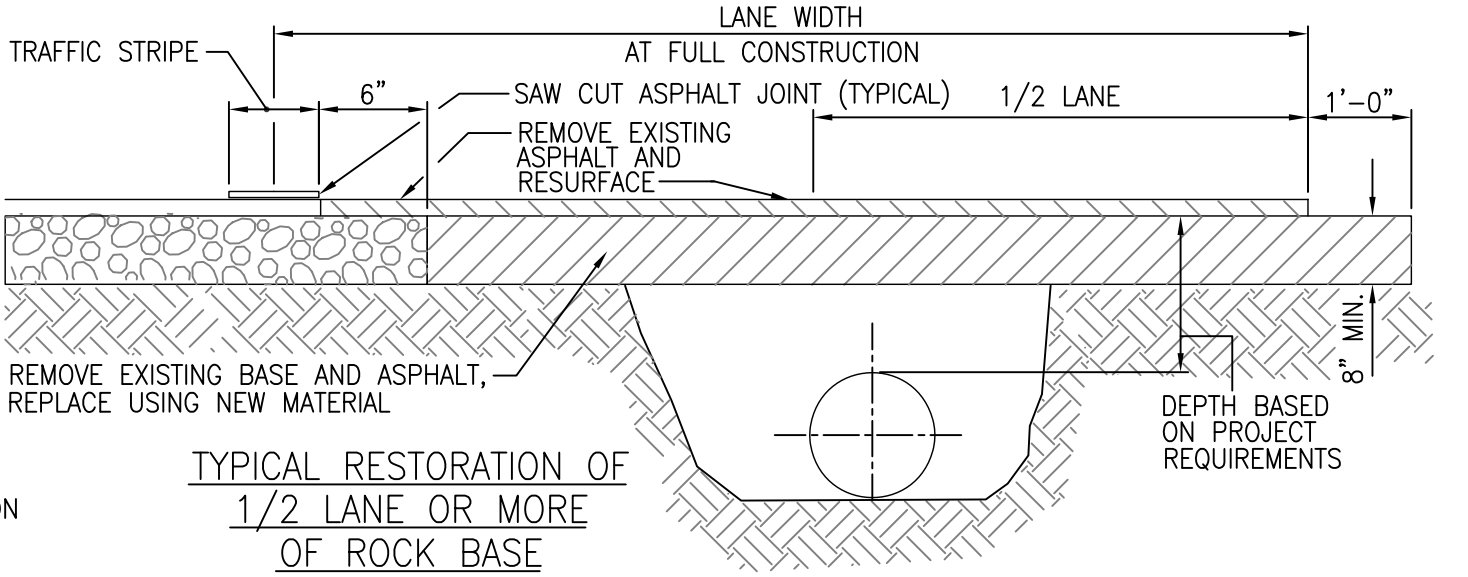
Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 403

NOTES:

1. BASE MATERIAL SHALL HAVE A MINIMUM LBR OF 100 AND A MINIMUM CARBONATE CONTENT OF 70% (60% FOR LOCAL STREETS).
2. BASE SHALL BE PLACED IN 6" MAXIMUM THICKNESS LAYERS WITH EACH LAYER COMPACTED AS REQUIRED AND TESTED PRIOR TO THE PLACEMENT OF THE SUCCEEDING LAYERS.
3. SUBGRADE MATERIAL SHALL BE GRANULAR AND ANGULAR, AND SHALL HAVE A MINIMUM LBR OF 40.
4. BACKFILL SHALL BE PLACED AND COMPACTED IN 8" LAYERS, BUT TESTING WILL BEGIN 12" ABOVE THE INSTALLED FACILITY. PRIOR TO THE PLACEMENT OF THE SUCCEEDING LAYERS.
5. ALL EDGES OF EXISTING ASPHALT PAVEMENT WHERE RESURFACING WILL ABUT, SHALL BE SAW CUT IN STRAIGHT LINES PARALLEL TO OR PERPENDICULAR TO ROADWAY, PRIOR TO THE RESURFACING.
6. RESURACING MATERIAL SHALL BE CONSISTENT WITH SURROUNDING SURFACE AND SHALL BE APPLIED A MIN. OF 1" AND A MAX. OF 2" IN THICKNESS.
7. DETERMINE DEPTH AND COMPOSITION OF EXISTING PAVEMENT PRIOR TO CONDUCTING WORK



TYPICAL RESTORATION OF LESS THAN 1/2 LANE OF ROCK BASE



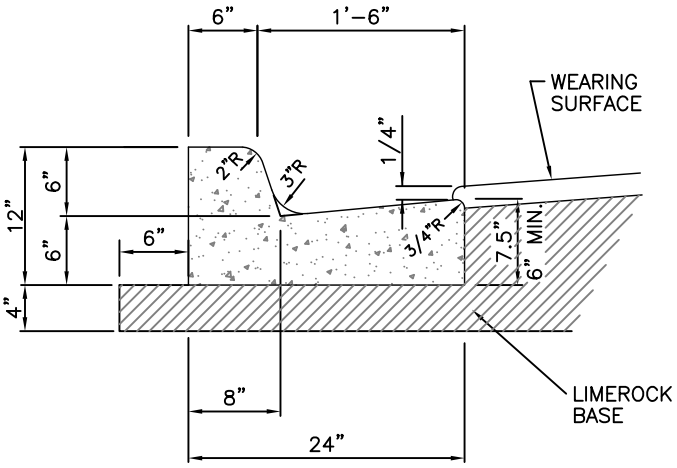
TYPICAL RESTORATION OF 1/2 LANE OR MORE OF ROCK BASE

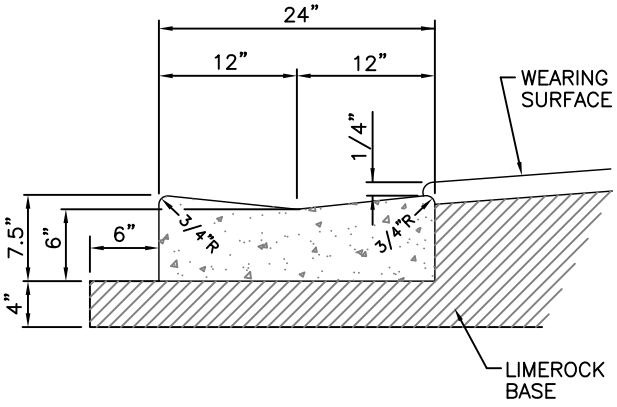
Date	Revisions	Appr. By
09/15	General revisions	S.Z.
10/02	Revised Limerock Base's Thickness	L.L.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
ROADWAY CUT RESTORATION FOR PARALLEL UTILITY CROSSING

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 404



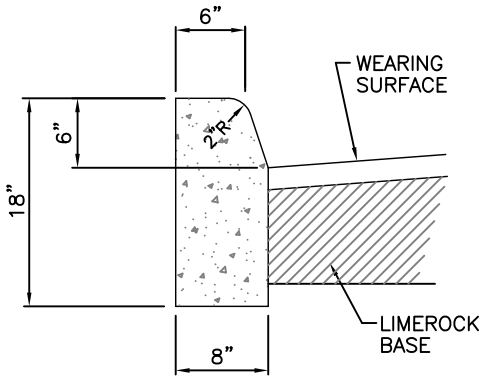


VALLEY GUTTER

NOTE:

1. WHEN USED ON HIGH SIDE OF ROADWAYS, CROSS SLOPE OF THE GUTTER SHALL MATCH THE CROSS SLOPE OF THE ADJACENT PAVEMENT AND THE THICKNESS OF THE LIP SHALL BE 6".
2. SAWCUTS REQUIRED AT 10' CENTERS.

TYPE 'F' CURB & GUTTER DETAIL



TYPE 'D' CURB

NOTES:

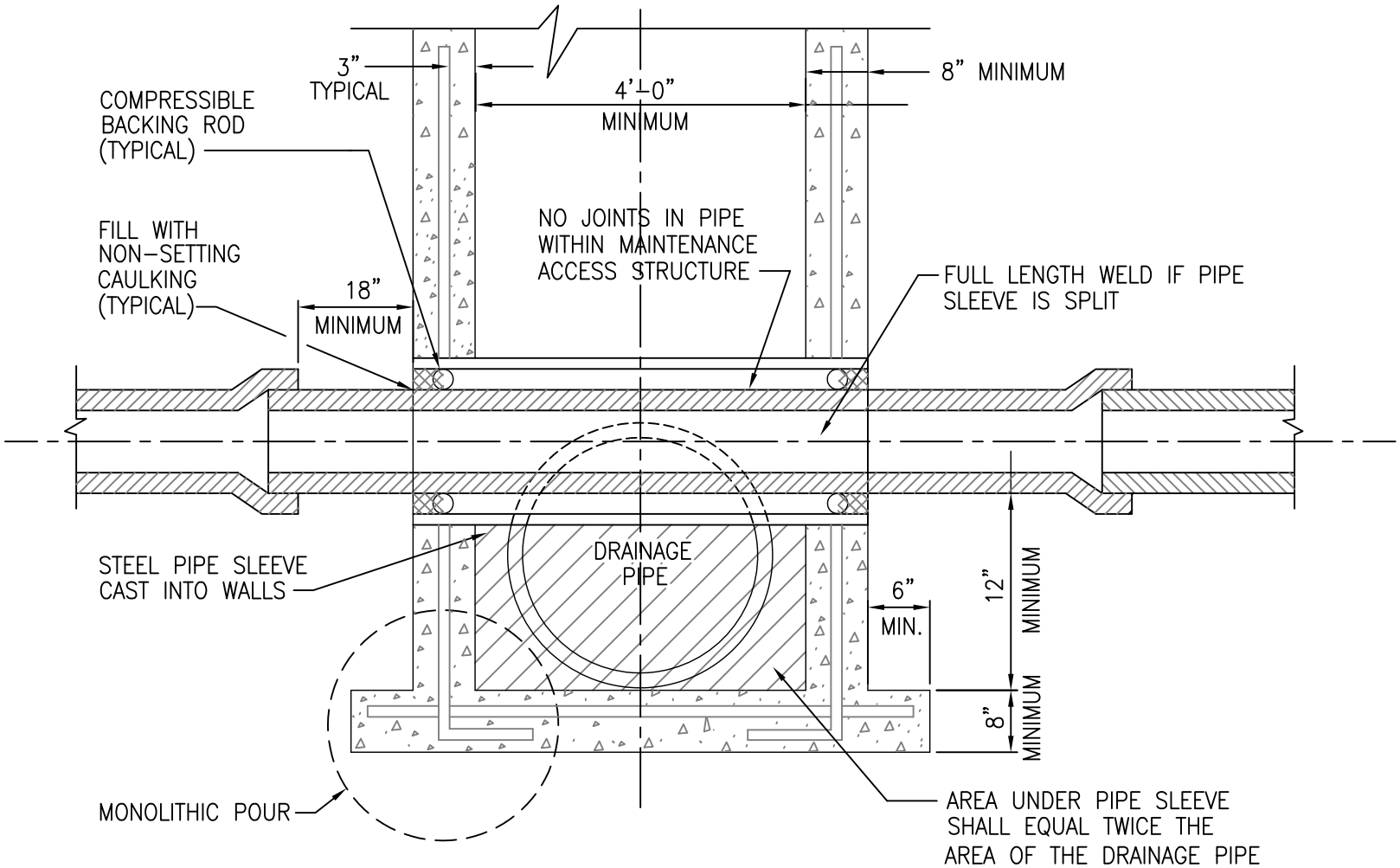
1. ROADWAY SUBGRADE SHALL IN ALL CASES EXTEND BELOW CURBING.
2. SAWCUTS AT 10' CENTERS SHALL BE MADE WITHIN 24 HOURS OF CONCRETE PLACEMENT.
3. FOR USE ADJACENT TO CONCRETE PAVEMENT, EXPANSION JOINT, PREFORMED JOINT FILLER AND JOINT SEAL ARE REQUIRED BETWEEN CURB AND CONCRETE PAVEMENT.

09/15	General revisions	S.Z.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
CURB AND GUTTER DETAILS

Issue Date: Sept. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 405



NOTES:

1. POTABLE WATER PIPE SHALL NOT PASS THROUGH OR CONTACT SANITARY SEWER MAINTENANCE ACCESS STRUCTURE.

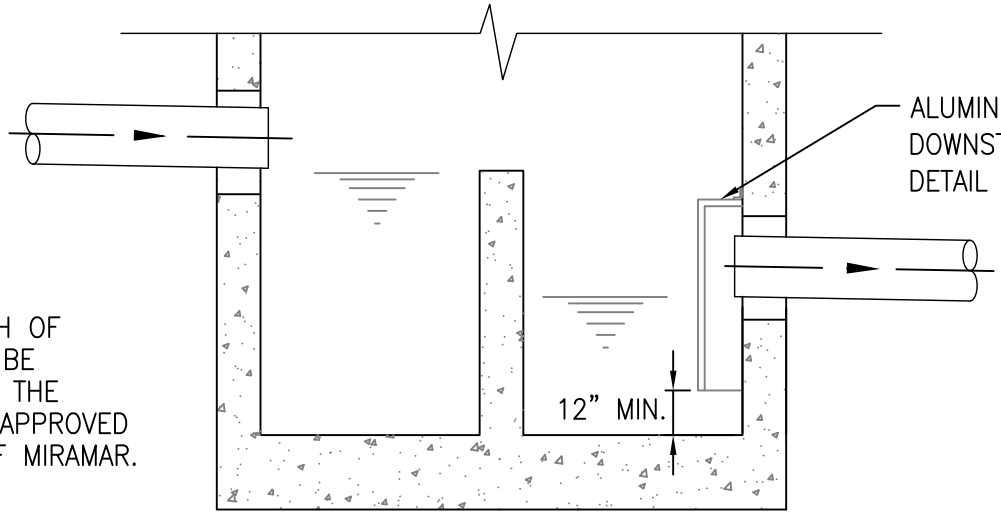
09/02	Revisions	K.H.G.
Date	Revisions	Appr. By

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
CONFLICT ACCESS MAINTENANCE STRUCTURE

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 406

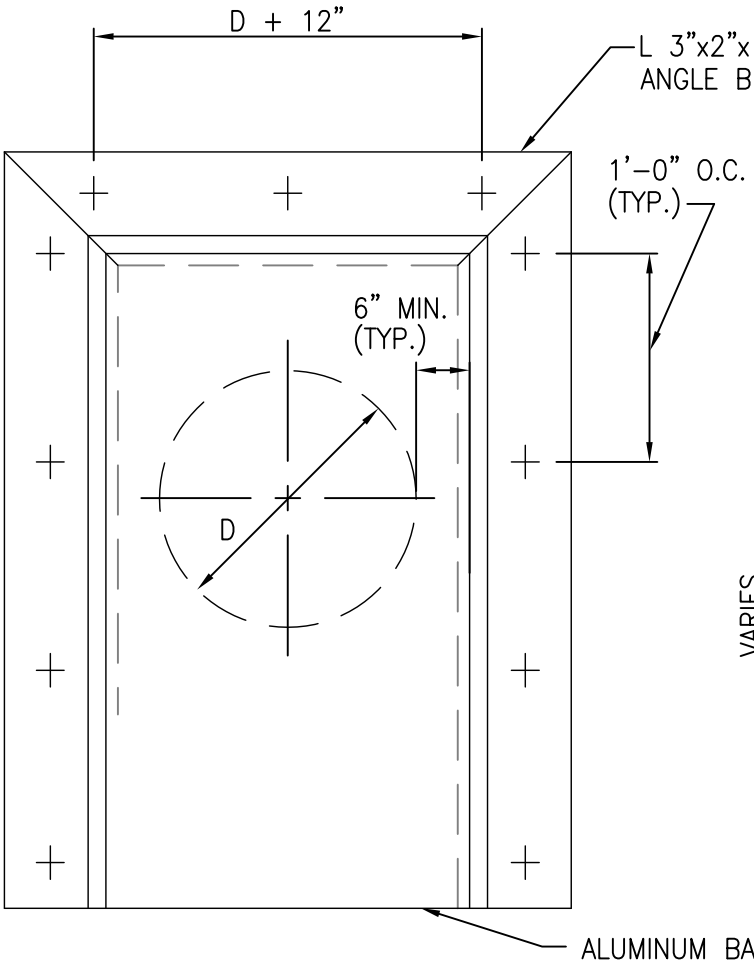
TOP OF STRUCTURE: MANHOLE OR HATCH ACCESS W/ H-20 LOADING.



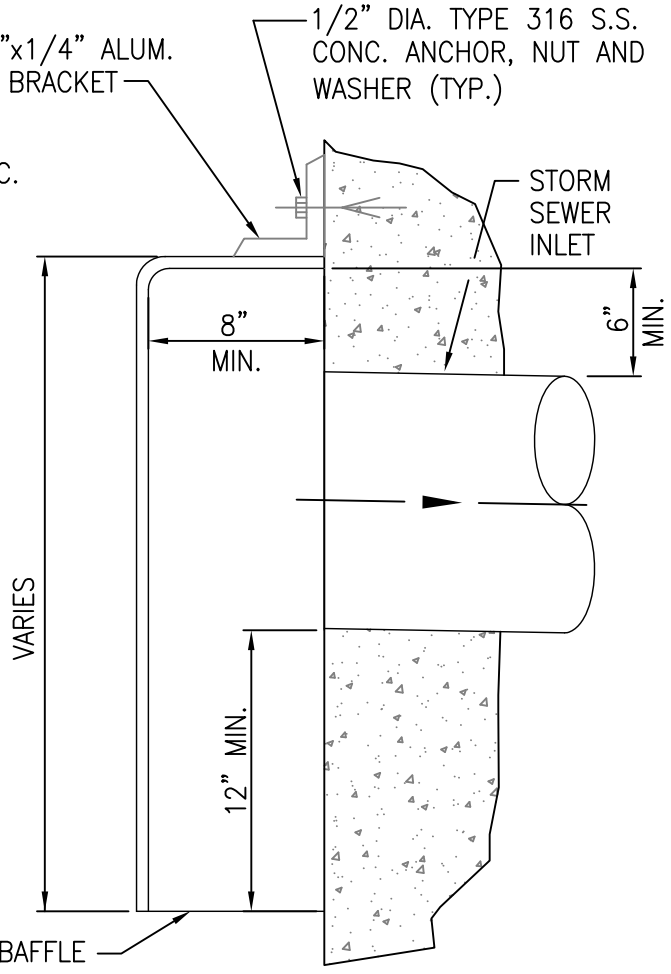
NOTE:

SIZE AND DEPTH OF STRUCTURE TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY OF MIRAMAR.

BELOW-GRADE CONTROL STRUCTURE

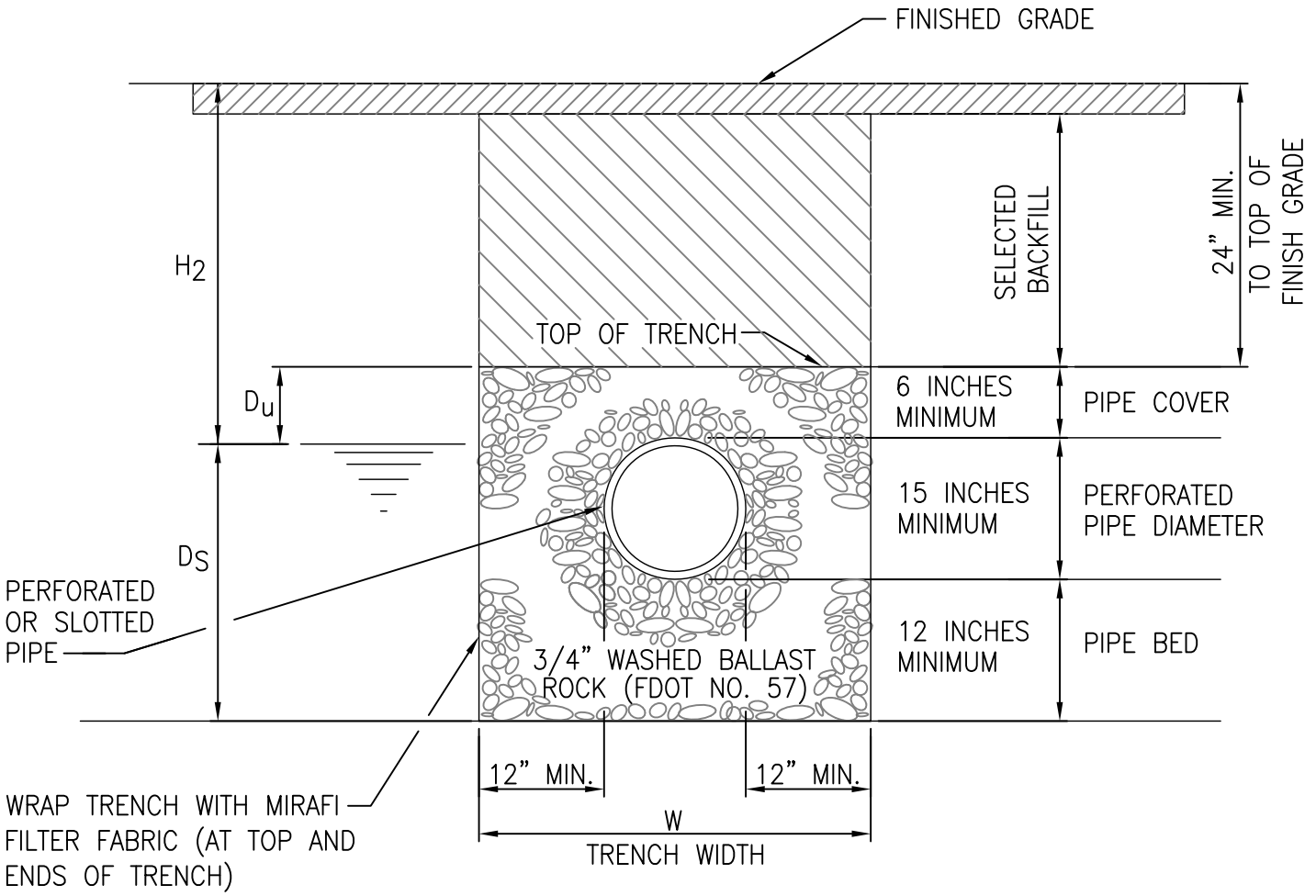


ELEVATION



SECTION

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT			
			CONTROL STRUCTURE WITH POLLUTION RETARDANT BAFFLE			
Date	Revisions	Appr. by	Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 407



$$L = \frac{V}{K(H_2W + 2H_2D - D_u^2 + 2H_2D_S) + (1.39\times10^{-4})WD_u}$$

L= LENGTH OF TRENCH REQUIRED (FEET)

V= VOLUME TREATED (ACRE–INCH)

W= TRENCH WIDTH (FEET)

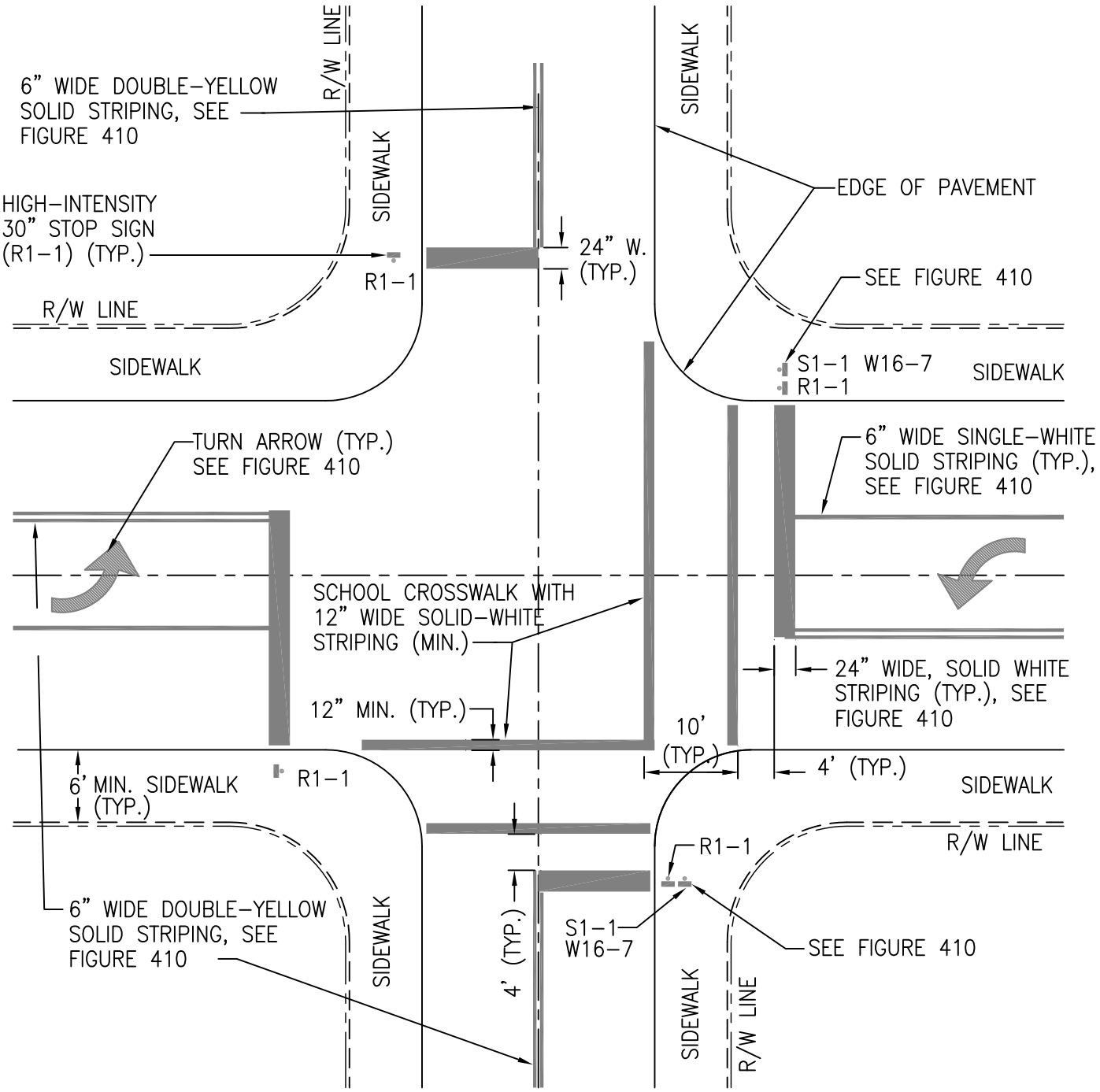
K= HYDRAULIC CONDUCTIVITY (CFS/FT –FT. HEAD)

H_2= DEPTH TO WATER TABLE (FEET)

D_u= NON–SATURATED TRENCH DEPTH (FEET)

D_S= SATURATED TRENCH DEPTH (FEET)

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			FRENCH DRAIN DETAIL (TYPICAL EXFILTRATION TRENCH)
09/02	Misc. Revisions	K.H.G.	
Date	Revisions	Appr. by	Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 408



GENERAL NOTES:

1. ALL PAVEMENT MARKINGS AND SIGNING SHALL BE IN ACCORDANCE WITH THE "MANUAL ON UNIFORM CONTROL DEVICES FOR STREET AND HIGHWAYS," UNLESS SPECIFIED OTHERWISE.
2. SEE FIGURE 410 FOR ADDITIONAL SIGNAGE, MARKING AND CROSSWALK DETAILS.

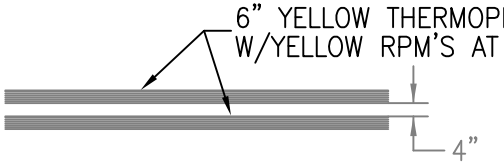
Date	Revisions	Appr. by
09/15	Misc. Revisions	S.Z.
10/02	Misc. Revisions	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
PAVEMENT SIGNING AND MARKING DETAIL

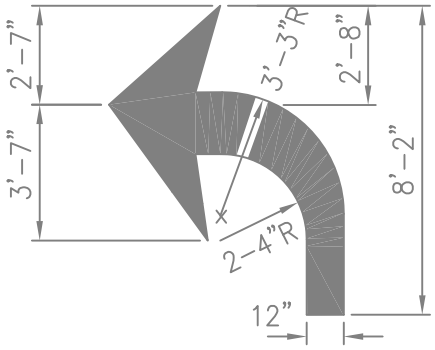
Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 409

6" SINGLE WHITE



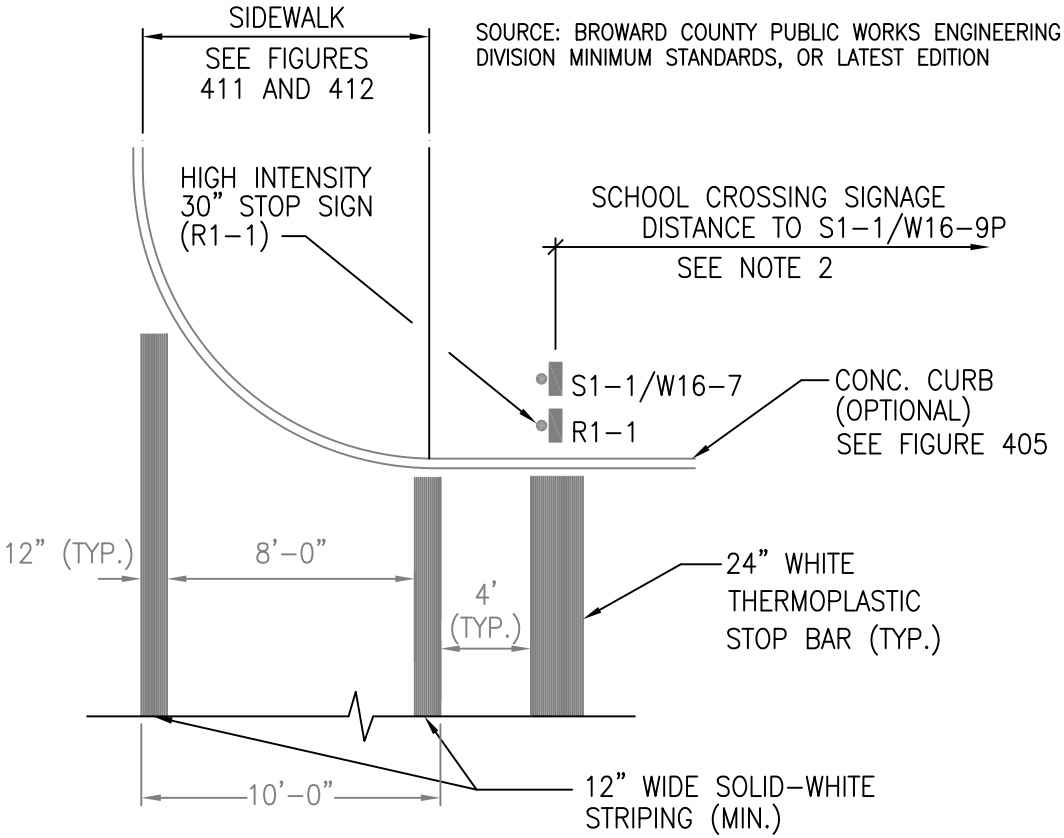
6" DOUBLE YELLOW

STRIPING DETAIL



DIMENSIONS ARE ±1".
16 s.f.

TURN ARROW



SOURCE: BROWARD COUNTY PUBLIC WORKS ENGINEERING DIVISION MINIMUM STANDARDS, OR LATEST EDITION

STOP SIGN, STOP BAR,
AND SCHOOL CROSSING DETAIL

GENERAL NOTES:

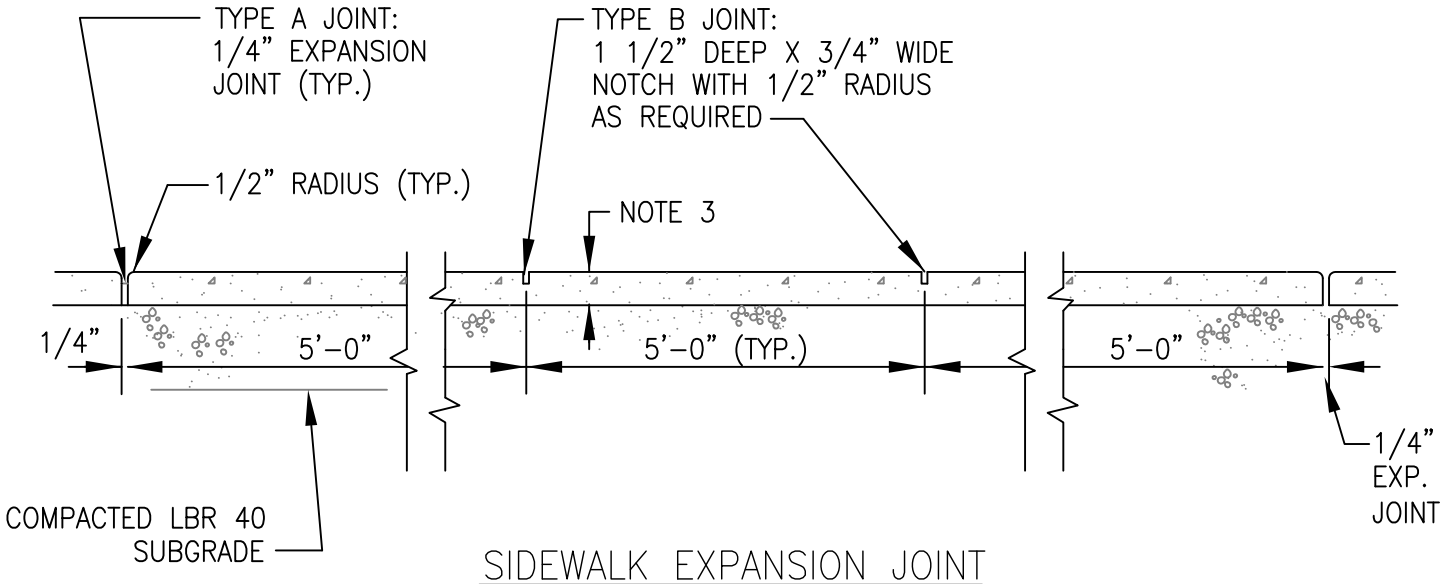
1. ALL PAVEMENT MARKINGS AND SIGNING SHALL BE IN ACCORDANCE WITH THE "MANUAL ON UNIFORM CONTROL DEVICES FOR STREET AND HIGHWAYS," UNLESS SPECIFIED OTHERWISE.
2. ADVANCED SCHOOL CROSSING SIGNAGE S1-1 TO BE PLACED AT THE FOLLOWING DISTANCE FROM STOP BAR: LESS THAN 25 MPH =200' 26-35 MPH = 250' 36-45 MPH = 300'; 46-55 MPH = 325'.

Date	Revisions	Appr. By
09/15	Misc. Revisions	S.Z.
10/02	Revisions	K.H.G.

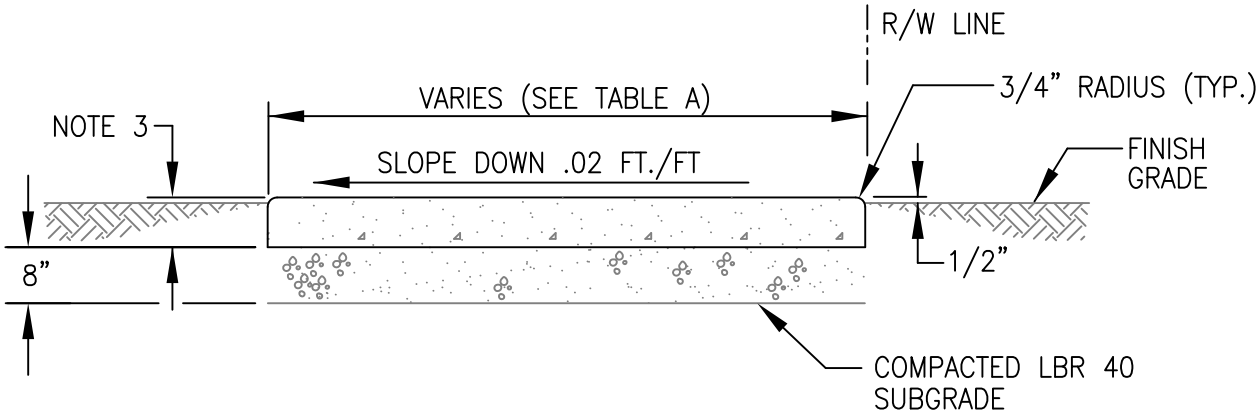
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ROADWAY DETAILS
PAVEMENT SIGNING AND MARKING-TYPICAL SCHOOL CROSSING APPLICATIONS

Issue Date: July 1998 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 410



SIDEWALK EXPANSION JOINT
LONGITUDINAL SECTION



SIDEWALK SECTION

TABLE A – SIDEWALK WIDTH	
WIDTH	ROADWAY APPLICATION
4'	LOCAL STREET ACCESSES
5'	TWO–LANE COLLECTOR
5'	FOUR–LANE COLLECTOR
6'	ARTERIAL ROADWAYS

SIDEWALK JOINTS	
TYPE	LOCATION
"A"	P.C. P.T. OF CURVES
"B"	5'–0" CENTER TO CENTER ON SIDEWALKS

NOTES:

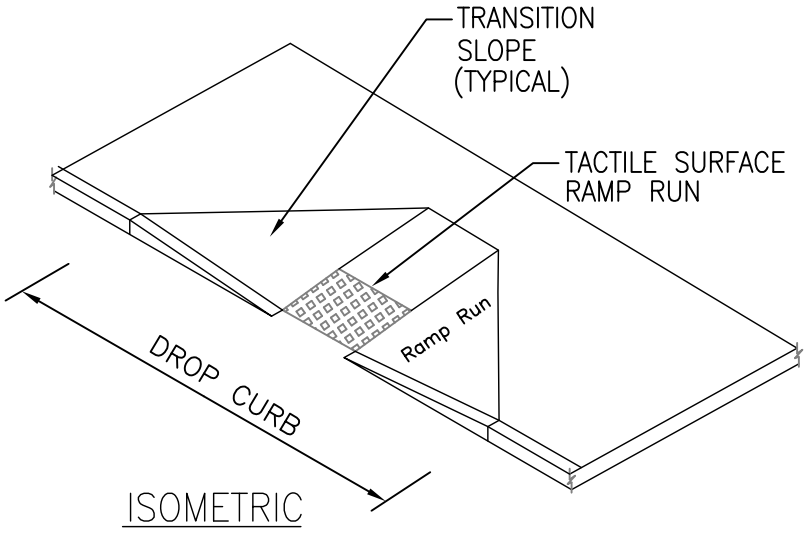
1. CONCRETE TO BE CLASS 1, 3,000 P.S.I.
2. USE OF FIBER REINFORCED CEMENT IS PROHIBITED
3. 4" THK. MIN. (TYP.); 6" THK. AT DRIVEWAYS, EXTENDED TWO–FEET BEYOND DRIVEWAYS, ON BOTH SIDES.
4. SIDEWALK SLOPES SHALL MEET THE REQUIREMENTS OF THE AMERICAN WITH DISABILITIES ACT.
5. CONSTRUCT EXPANSION JOINTS AT SPACINGS SHOWN ABOVE; AT POINT OF CURVATURE; AT ADJOINING STRUCTURES; AT THE END OF DAYS WORK; AND WHERE NEW SIDEWALK MEETS EXISTING SIDEWALK.
6. SIDEWALK SHALL BE PLACED PREFERABLY AT THE RIGHT OF WAY LINE AS FAR AS PRACTICAL FROM THE TRAVEL LANES.

Date	Revisions	Appr. by
09/15	General Revisions	S.Z.
03/04	General Revisions	K.H.G.
10/02	Misc. Revisions	K.H.G.

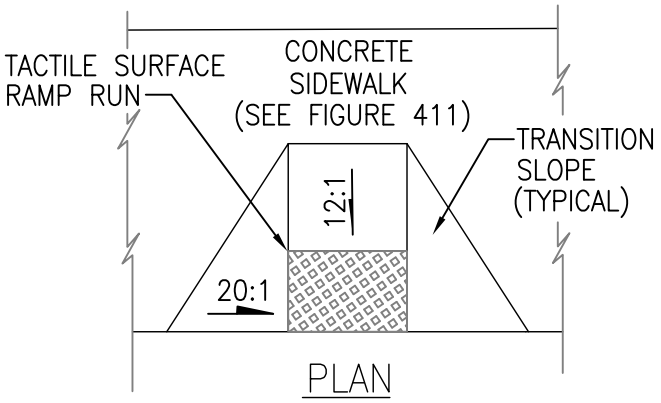
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYPICAL SIDEWALK DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 411



ISOMETRIC



PLAN

GENERAL NOTES

1. PEDESTRIAN PATHWAYS WITH RUNNING SLOPES STEEPER THAN 20:1 ARE CONSIDERED RAMPS. RAMP RUNNING SLOPES SHALL NOT EXCEED 12:1. RAMP CROSS SLOPES SHALL NOT EXCEED 0.02.

2. CURBED FACILITIES WITH SIDEWALKS AND THOSE WITHOUT SIDEWALKS ARE TO HAVE CURB CUT RAMPS CONSTRUCTED AT ALL STREET INTERSECTIONS AND AT TURNOUTS THAT HAVE CURBED RETURNS. PARTIAL CURB RETURNS SHALL EXTEND TO THE LIMIT PRESCRIBED BY INDEX No. 515 TO ACCOMMODATE CURB CUT RAMPS. RAMPS CONSTRUCTED AT LOCATIONS WITHOUT SIDEWALKS SHALL HAVE A LANDING CONSTRUCTED AT THE TOP OF EACH RAMP.

3. THE LOCATION AND ORIENTATION OF CURB CUT RAMPS SHALL BE DETERMINED BY THE CIVIL ENGINEER.

4. IF A CURB CUT RAMP IS LOCATED WHERE PEDESTRIANS MUST WALK ACROSS THE RAMP, THEN THE WALK SHALL HAVE TRANSITION SLOPES TO THE RAMP; THE MAXIMUM SLOPE OF THE TRANSITIONS SHALL BE 12:1. CURB CUT RAMPS WITH RETURNED CURBS MAY BE USED WHERE PEDESTRIANS WOULD NOT NORMALLY WALK ACROSS THE RAMP.

5. CURB RAMPS SHALL BE CONSTRUCTED IN ACCORDANCE WITH FDOT INDEX 304. RAMPS RUNS SHALL HAVE A DETECTABLE WARNING TACTILE SURFACE EXTENDING THE FULL WIDTH OF THE RAMP AND 24" FROM THE BACK OF CURB. DETECTABLE WARNING SURFACES SHALL BE CONSTRUCTED IN ACCORDANCE WITH FDOT SPECIFICATION 527 (LATEST EDITION) AND BE LISTED ON THE FDOT QUALIFIED PRODUCTS LIST IN ACCORDANCE WITH 527–2.4.

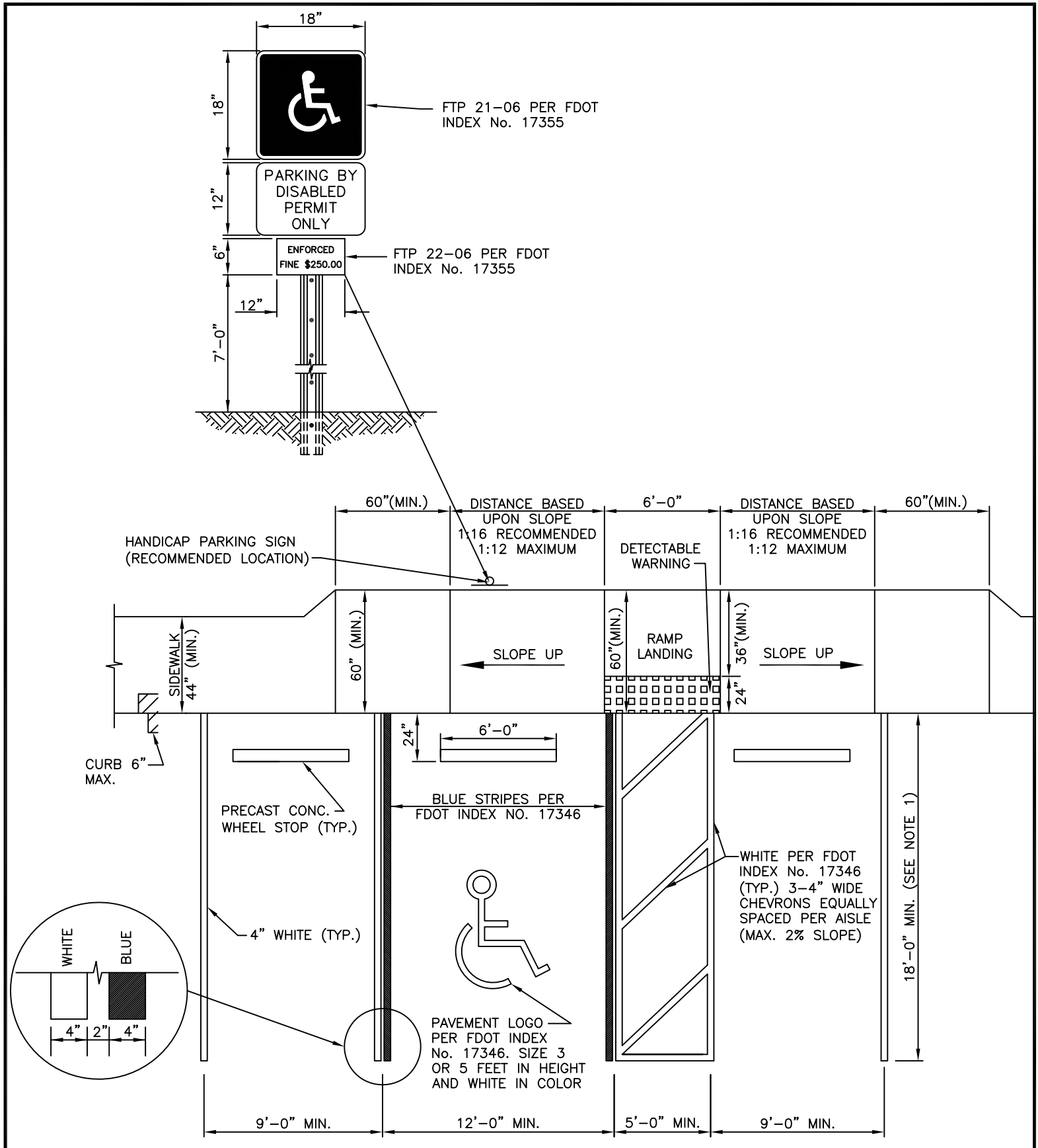
6. WHERE A CURB CUT RAMP IS CONSTRUCTED WITHIN EXISTING CURB, CURB AND GUTTER AND/OR SIDEWALK, THE EXISTING CURB OR CURB AND GUTTER SHALL BE REMOVED TO THE NEAREST JOINT BEYOND THE DROP CURB OR TO THE EXTENT THAT NO REMAINING SECTION OF CURB OR CURB AND GUTTER IS LESS THAN 5' LONG. THE EXISTING SIDEWALK SHALL BE REMOVED TO THE NEAREST JOINT BEYOND THE TRANSITION SLOPE OR WALK AROUND OR THE EXTENT THAT NO REMAINING SECTION OF SIDEWALK IS LESS THAN 5' LONG.

Date	Revisions	Appr. by
09/15	Misc. Revisions	S.Z.
06/09	Revised Note #5	B.J.V.
03/04	Deleted Note #7	K.H.G.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

SIDEWALK RAMP DETAIL

Issue Date: July 1998	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 412



NOTE 1: FOR ANGLED PARKING AT 45° = 19'1" AND AT 60° = 20'1". REFER TO FDOT INDEX 17346

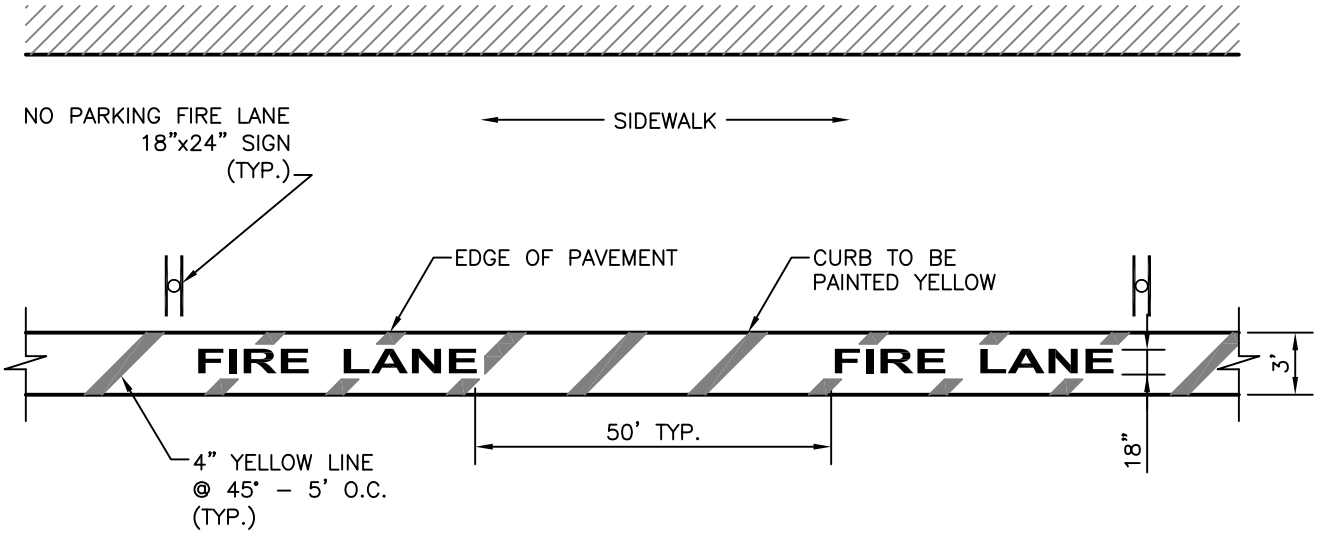
Date	Revisions	Appr. by
12/15	Misc. Revisions	S.Z.
09/15	Misc. Revisions	S.Z.
09/04	Revised Parking Width & Stripe Width	S.N.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

TYPICAL HANDICAP PARKING DETAIL

Issue Date: Mar. 2001	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 413

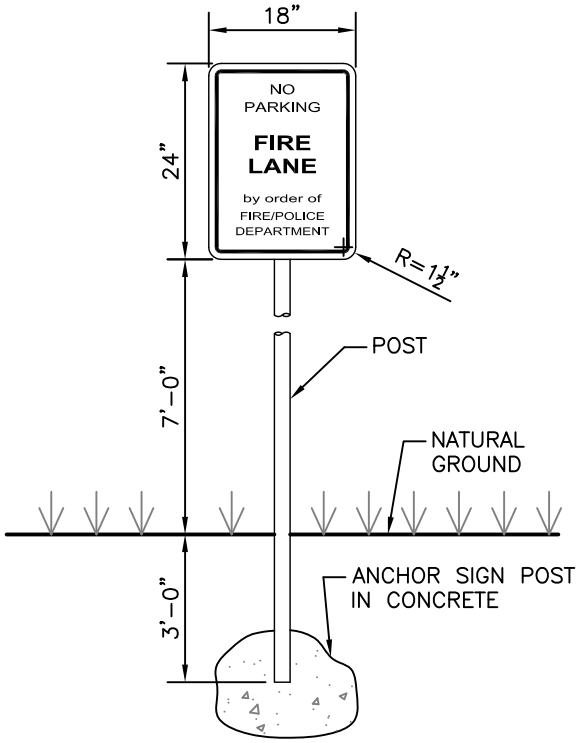
BUILDING



NOTES:

1. ALL PAVEMENT MARKING SHALL BE OF THERMOPLASTIC PAINT.

FIRE LANE STRIPING DETAIL



SIGN DETAIL

NOTES:

1. "NO PARKING FIRE LANE BY ORDER OF FIRE/POLICE DEPARTMENT" SIGN AT MAX 75' O.C. SIGN TO BE 18"x24" W/ RED LETTERS ON WHITE BACKGROUND.

2. SIGN TO BE POSTED 7' ABOVE FINISHED GRADE. ON B.C.T.E.D. STANDARD POST.

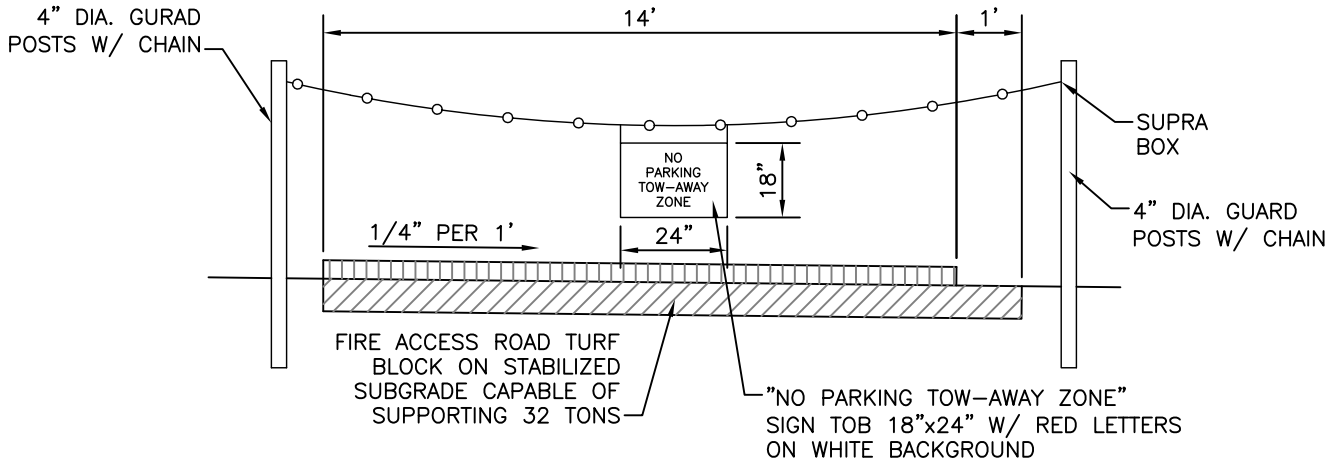
05/02	Detail Added By Fire Department	M.M.
Date	Revisions	Appr. by

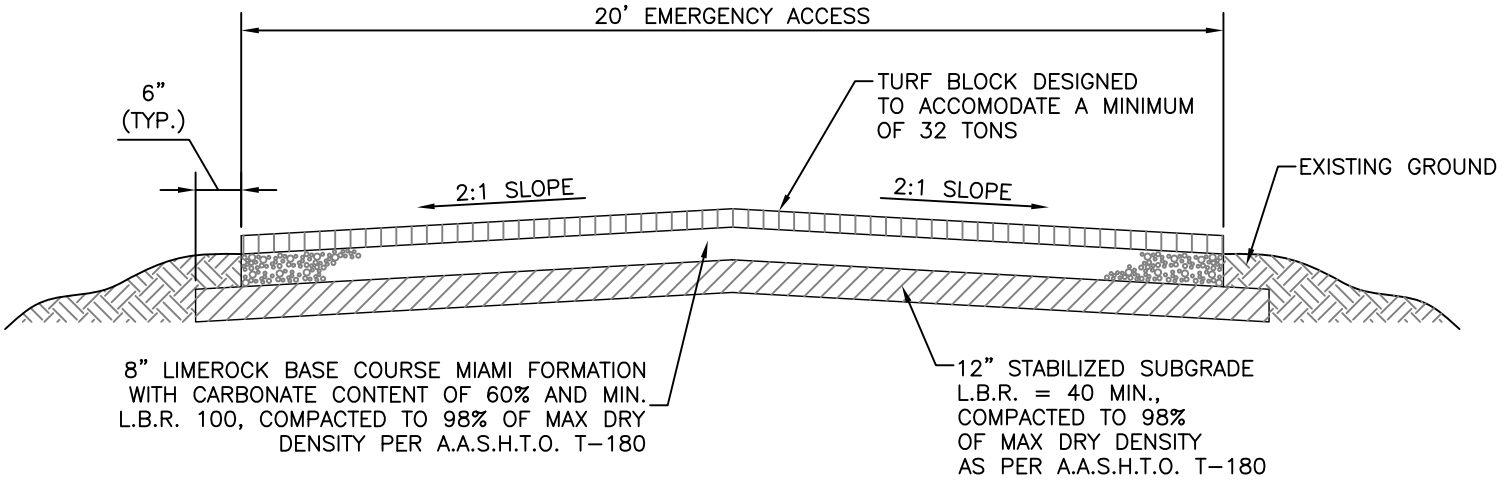
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

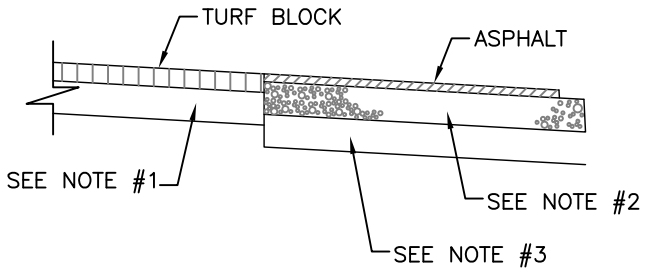
FIRE LANE DETAIL

Issue Date: May 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 500

EMERGENCY FIRE ACCESS ROAD DETAIL







CONNECTION TO ROADWAY

NOTES:

1. 12" STABILIZED SUBGRADE MIN. LBR 40 COMPACTED TO 98% A.A.S.H.T.O. T-180 CAPABLE OF SUPPORTING 32 TONS.

2. THE BASE COURSE SHALL BE LIMEROCK (70% CALCIUM), 8" THICK COMPACTED IN ACCORDANCE WITH A.A.S.H.T.O. SPECIFICATION T-180 TO 98% DENSITY.

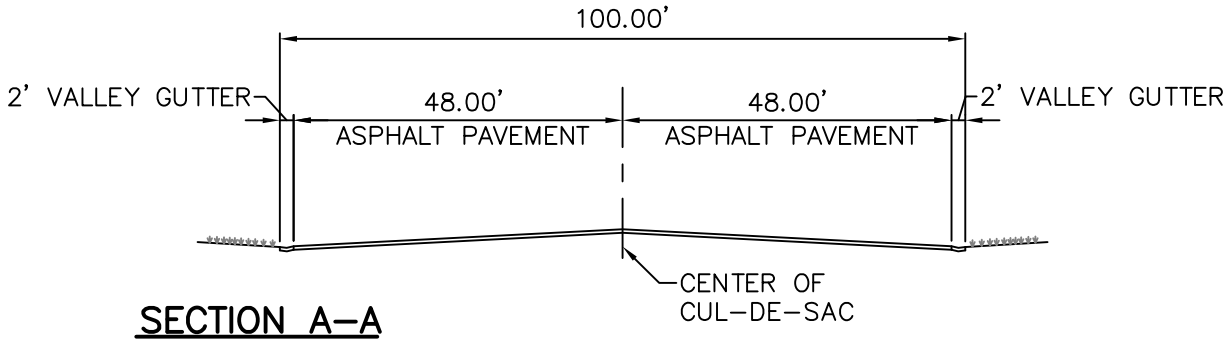
3. ALL ORGANIC AND YIELDING MATERIAL WITHIN THE LIMITS SHOWN SHALL BE REMOVED AND REPLACED WITH CLEAN FILL, THE SUBBASE SHALL EXTEND 12" BELOW THE BASE COURSE, SHALL HAVE A MINIMUM DRY DENSITY OF 115 PCF AND SHALL BE COMPACTED TO 98% OF MAXIMUM DRY DENSITY PER A.A.S.H.T.O. SPECIFICATION T-180, METHOD "C". MINIMUM LBR TO BE 40.

Date	Revisions	Appr. by
05/02	Detail Added By Fire Department	M.M.

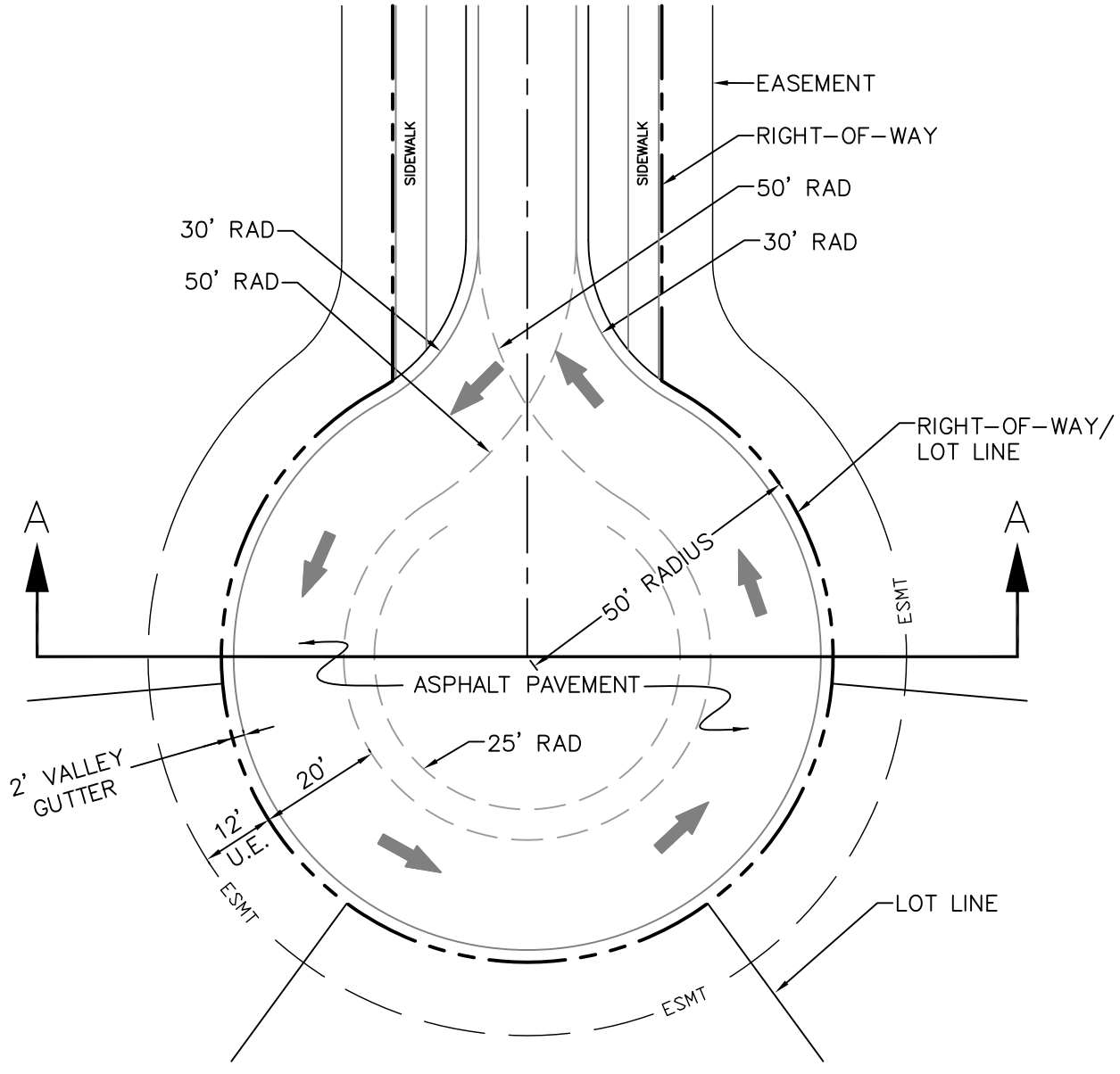
CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

EMERGENCY ACCESS ROADWAY DETAIL

Issue Date: May 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 501



SECTION A–A



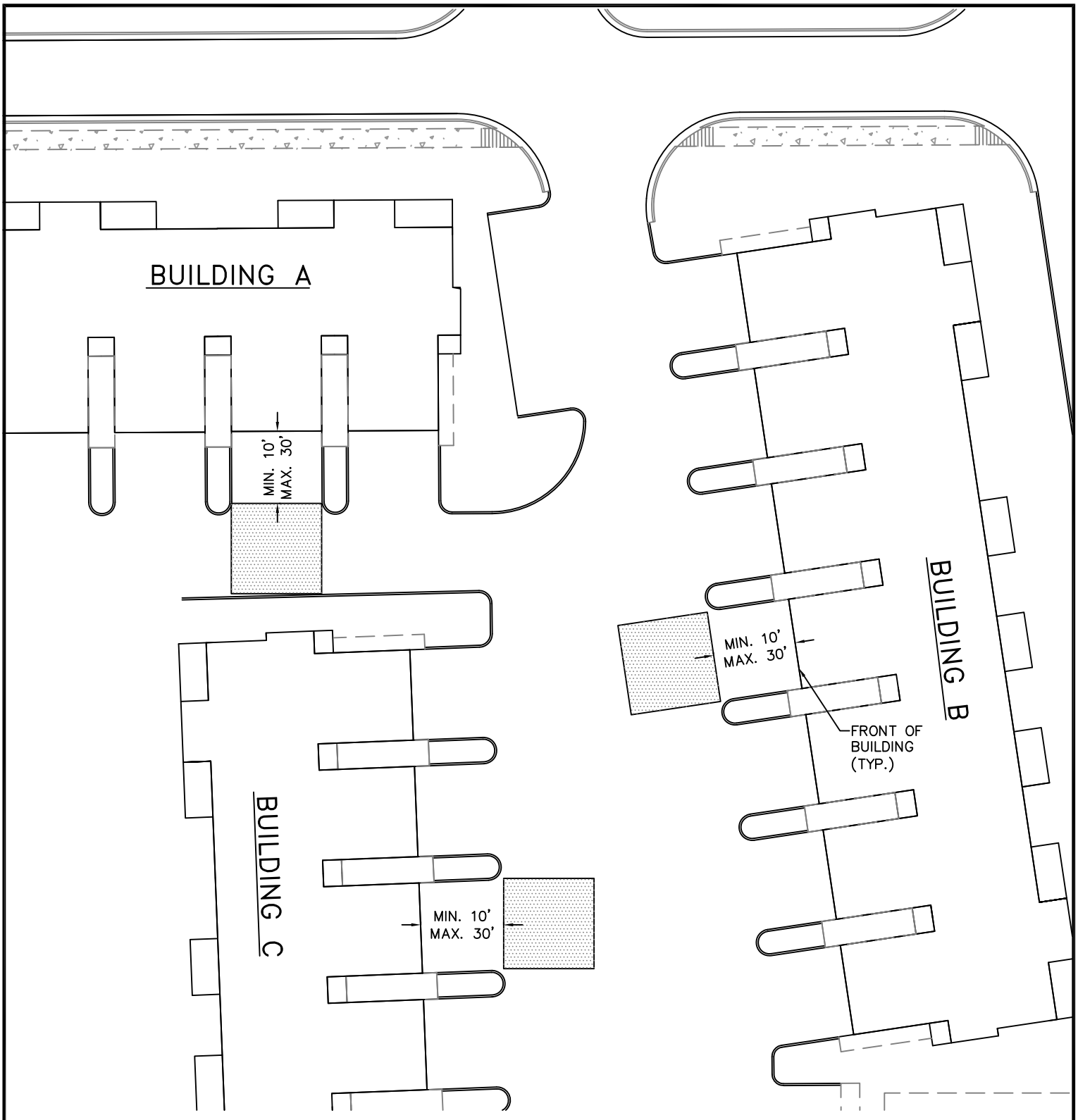
PLAN

03/04	General Revision	
10/02	Detail Added By Fire Department	M.M.
Date	Revisions	Appr. by

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

CUL-DE-SAC DETAIL

Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 502



LEGEND

24" x 24" LADDERING AREA. CONSTRUCTED TO SUPPORT 32 TONS.

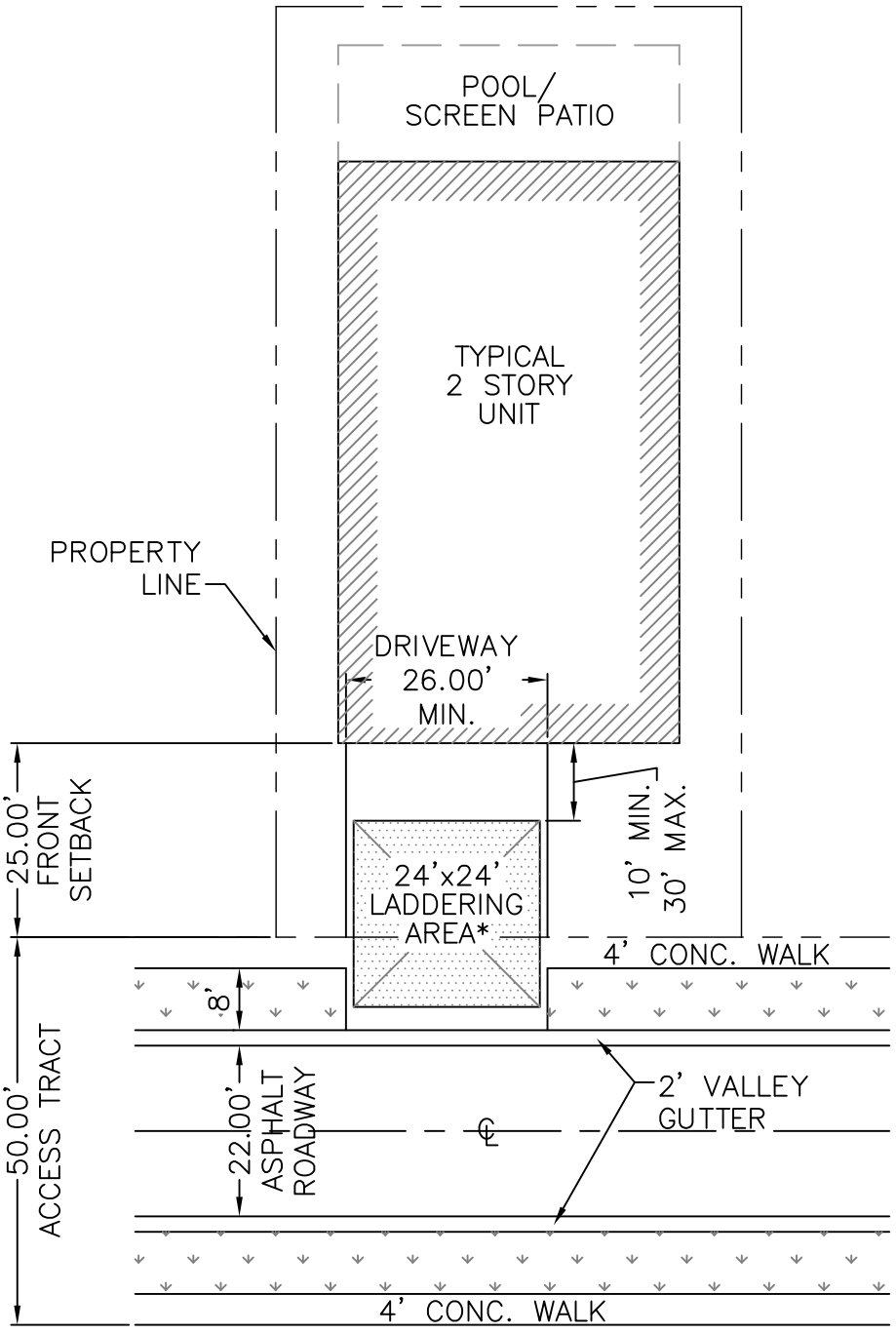
Date	Revisions	Appr. by
10/02	Detail Added By Fire Department	M.M.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

LADDERING AREAS DETAIL

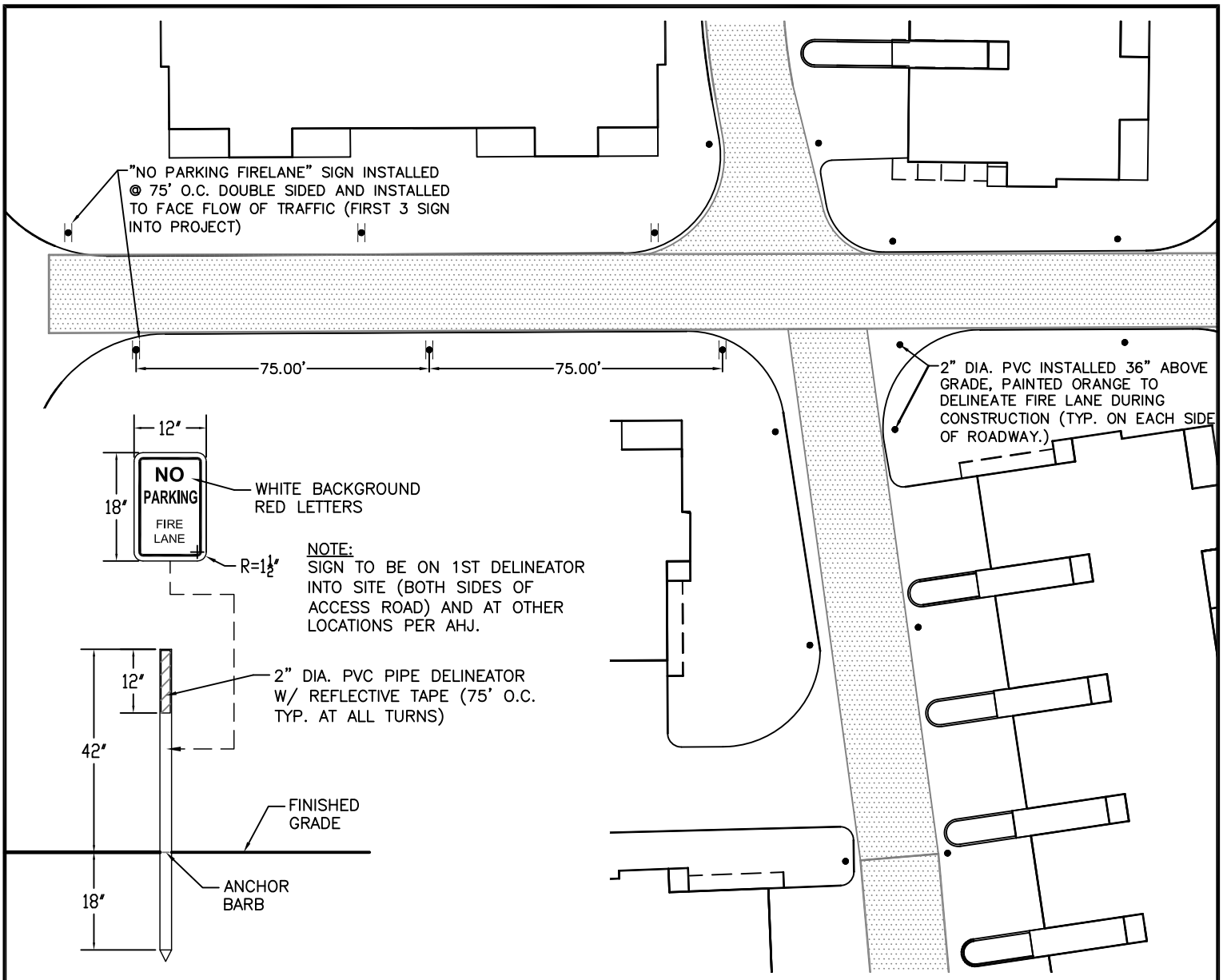
Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 503

LADDERING DETAILS FOR SINGLE FAMILY HOUSING AREAS REQUIRED FOR ALL BUILDINGS GREATER THAN ONE STORY



*CONSTRUCTED TO SUPPORT A 32 TON VEHICLE.

			CITY OF MIRAMAR OFFICE OF OPERATIONAL SERVICES CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT
			LADDERING DETAILS FOR SINGLE FAMILY HOUSING AREAS
10/02	Detail Added By Fire Department	M.M.	
Date	Revisions	Appr. by	Issue Date: Oct. 2002 | Scale: N.T.S. | Sheet#: 1 of 1 | Fig.#: 504



NOTES:

1. ACCESS ROADWAYS TO HAVE AN ALL WEATHER DRIVING SURFACE OF NOT LESS THAN 20FT (6M) OF UNOBSTRUCTED WIDTH, TO WITHSTAND THE LIVE LOADS OF FIRE APPARATUS AND HAVING A MINIMUM OF 13FT. 6IN. (4M) OF VERTICAL CLEARANCE. DEAD–END FIRE DEPARTMENT ACCESS ROADS SHALL BE PROVIDED WITH APPROVED PROVISIONS FOR THE TURNING AROUND OF FIRE DEPARTMENT APPARATUS.

2. THE REQUIRED WIDTH OF ACCESS ROADWAYS SHALL NOT BE OBSTRUCTED IN ANY MANNER, INCLUDING OBSTRUCTION BY PARKED VEHICLES. "NO PARKING" SIGNS OR OTHER APPROPRIATE NOTICES, OR BOTH, PROHIBITING OBSTRUCTION SHALL BE PERMITTED TO BE REQUIRED AND SHALL BE MAINTAINED.

LEGEND

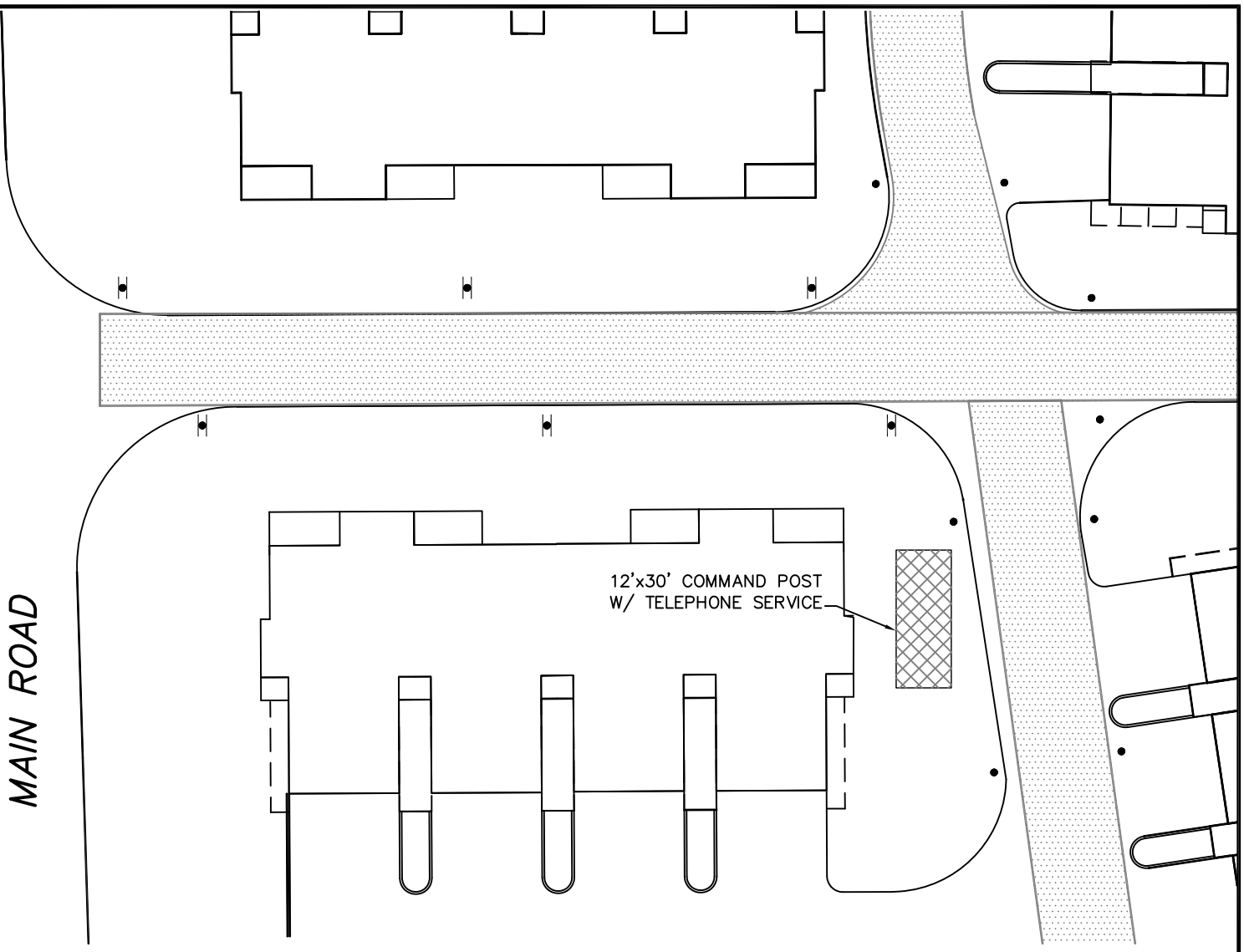
- ● PVC DELINEATOR
- ●| PVC DELINEATOR WITH SIGNS FACING FLOW OF TRAFFIC
- ▭ 20' WIDE FIRE LANE DURING CONSTRUCTION

Date	Revisions	Appr. by
10/02	Detail Added By Fire Department	M.M.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

ACCESS ROAD DURING CONSTRUCTION DETAIL

Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 505



NOTES:

1. A SUITABLE LOCATION AT THE SITE SHALL BE DESIGNATED AS A COMMAND POST AND PROVIDED WITH PLANS, EMERGENCY INFORMATION, KEYS, COMMUNICATION, AND EQUIPMENT, AS NEEDED. THE PERSON IN CHARGE OF FIRE PROTECTION SHALL RESPOND TO THE LOCATION COMMAND POST WHENEVER FIRE OCCURS.

2. THERE SHALL BE READILY AVAILABLE PUBLIC FIRE ALARM BOX NEAR THE PREMISES, TELEPHONE SERVICE TO THE RESPONDING FIRE DEPARTMENT, OR EQUIVALENT FACILITIES. INSTRUCTIONS SHALL BE ISSUED FOR THE IMMEDIATE NOTIFICATION OF THE FIRE DEPARTMENT IN CASE OF FIRE. WHERE TELEPHONE SERVICE IS EMPLOYED, THE LOCAL FIRE DEPARTMENT NUMBER AND SITE ADDRESS SHALL BE CONSPICUOUSLY POSTED NEAR EACH TELEPHONE.

LEGEND

- ● PVC DELINEATOR
- |● PVC DELINEATOR WITH SIGNS FACING FLOW OF TRAFFIC
- ▨ 20' WIDE FIRE LANE DURING CONSTRUCTION

Date	Revisions	Appr. by
10/02	Detail Added By Fire Department	M.M.

CITY OF MIRAMAR
OFFICE OF OPERATIONAL SERVICES
CONSTRUCTION & FACILITIES MANAGEMENT DEPARTMENT

COMMAND POST LOCATION DETAIL

Issue Date: Oct. 2002	Scale: N.T.S.	Sheet#: 1 of 1	Fig.#: 506

Appendix

APPENDIX A

LIST OF MATERIALS AND APPROVED MANUFACTURERS

1. WATER MAIN MATERIALS

EQUIPMENT	MANUFACTURER	MODEL NO./DESCRIPTION
Air Release Valves	1. Empire 2. Valmatic 3. Apco	1. 920 2. VM-38 3. 200
Backflow Preventers	1. Wilkins 2. FEBCO 3. Watts	1. 975XL 2. 825Y 3. 009 M2
Casing Spacers	1. Cascade 2. PSI	1. CCS – 12” Width Min. 2. C12G-2
Cast Couplings	1. Dresser Manufacturing 2. Clos Corporation 3. Baker Coupling Co., Inc.	
Corporation Stops	1. Ford Metal Box Co. 2. A.Y. McDonald Mfg. Co. 3. Mueller Co. 4. Hays/Lee Brass Co.	1. F-1000, FB-1100 2. 4701-T 3. H-15008, H-15013 4. 5200DF, 4400DF
Telephone Read Meters	1. Sensus Technologies	
Meter Boxes	Supplied by City	
Curb Stops	1. Ford Meter Box Co. 2. A.Y. McDonald Mfg. Co. 3. Mueller Co. 4. Hays/Lee Brass Co.	1. Single Service: KV43-341W-NL 1”x1” Double Svc./Branch: KV43-341W-NL 1.5’x1” 2. Single Service: 6100 MTW Double Svc./Branch: 4604N/3795-T 3. Single Service: H-14350 Double Svc./Branch: H-14265/H-15363 4. Single Service: 4317-1DF Double Svc./Branch 25013/5591DF

1. WATER MAIN MATERIALS (Cont.)

Expansion Joints	1. Mercer 2. Metraflex 3. EBAA Iron	
Fire Hydrants	1. Mueller Co. 2. American Cast Iron Pipe	1. Super Centurian 200 2. B 84 B-6”
Fittings	1. U.S. Pipe and Foundry 2. American Cast Iron Pipe 3. Tyler Pipe	
Flanged Adapter Couplings	1. Dresser Manufacturing 2. Clow Valve Co. 3. Baker Coupling Co., Inc.	
Gate Valves Resilient Seated Only	1. U.S. Pipe and Foundry	1. Metroseal 250
PAINTING: AERIAL PIPING, FITTINGS & VALVES		
Field Primer	1. Porter/Int’l 2. Koppers 3. Tnemec 4. Glidden	1. 284 U-Primer 2. Pug Primer 3. 37-77 Chem-Prime 4. Alkyd Metal Primer
Finish (Exterior)	1. Porter/Int’l 2. Koppers 3. Tnemec 4. Glidden	1. 2410 Alkyd Gloss 2. Glamortex 501 Enamel 3. Tnemec-Gloss 4. Alkyd Ind. Enamel
Pipe (DI)	1. American 2. McWane 3. U.S. Pipe & Foundry 4. Griffin	Pressure Class 150 minimum, cement lined
Polythylene Tubing	1. Endot Ind. (Yardley) 2. Orangeburg 3. Contube	
Restrained Joints	1. EBAA Iron Inc.	1. Megalug

1. WATER MAIN MATERIALS (Cont.)

Service Saddles	1. Ford Meter Box Co. 2. JCM Industries 3. Mueller Co. 4. Baker Coupling Co.	1. FC-202 2. 402 3. Series 10500 4. Shur Seal-O
Tapping Sleeves, Fabricated Steel	1. JCM Industries 2. Baker Coupling Co. 3. Ford Meter Box Co. 4. Mueller Co.	1. 412 2. 428 3. FTSC 4. H-624
Tapping Sleeves, M.J.	1. U.S. Pipe & Foundry 2. Mueller Co. 3. Typer Pipe 4. Clow Corp. 5. American Cast Iron Pipe	1. T-9 2. H-615 3. S-149 4. F-5205 5. A-D
Tapping Valves	1. American Cast Iron Pipe 2. U.S. Pipe & Foundry 3. Clow Corp 4. Mueller Co.	1. No. 865 2. Metroseal 250 3. F-5093 4. H-687
Valve Boxes	1. Tyler Pipe 2. Opelika Foundry	
Vault Frame & Cover for Air Release Valves	1. U.S. Foundry	1. USF 7665

2. WASTEWATER MAIN MATERIALS

EQUIPMENT	MANUFACTURER	MODEL NO./DESCRIPTION
Air Release Valves	1. Empire 2. Apco 3. Val-matic	2” inlet & outlet minimum
Casing Spacers	1. Cascade 2. PSI	1. CCS-12” Wideth Min. 2. C12G-2
Cast Couplings	1. Dresser Manufacturing 2. Clow Corporation 3. Baker Coupling Co., Inc.	Not Applicable

2. WASTEWATER MAIN MATERIALS (Cont.)

Check Valves (4" & Larger)	1. APCO 2. M&H Co. 3. Golden Anderson	
Expansion Joints	1. Mercer 2. Metraflex 3. EBAA Iron	
Fittings	1. U.S. Pipe & Foundry 2. American Cast Iron Pipe 3. Tyler Pipe	
Flanged Adaptor Couplings	1. Dresser Manufacturing 2. Clow Corporation 3. Baker Coupling Co., Inc.	
Manhole Frame & Cover	1. U.S. Foundry	1. 420C
Manhole Jointing Material	1. K.T. Snyder Co., Inc. 2. Conseal	1. Ram-Nek 2. CS102
Manhole Surface Coatings	1. Koppers 2. Press-Seal	1. Bitumastic 300M 2. EZ-Wrap – Plastic or Rubber
PAINTING: AERIAL PIPING, FITTINGS & VALVES		
Field Primer	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 284 U-Primer 2. Pug Primer 3. 37-77 Chem-Prime 4. Alkyd Metal Primer
Finish (Exterior)	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 2410 Alkyd Glass 2. Glamortex 501 Enamel 3. Tnemec-Gloss 4. Alkyd Ind. Enamel
Pipe (DI)	1. American 2. McWane 3. U.S. Pipe & Foundry 4. Griffin	Pressure Class 350 minimum, w/interior coating as specified
Pipe (PVC) Force Main	1. Certainteed Corp. 2. J0M Manufacturing	C900/C905, DR 18 minimum

2. WASTEWATER MAIN MATERIALS (Cont.)

Pipe (PVC) Gravity	1. Certainteed Corp. 2. J-M Manufacturing	SCR 35 minimum
Plug Valves	1. Val-Matic 2. Dezurik 3. Clow	1. 5800,5900 2. Series 100 3. F-5370, F-5365
Restrained Joints	1. EBAA Iron Inc. 2. American Cast Iron Pipe 3. U.S. Pipe & Foundry	1. Megalug 2. Flex Ring 3. TR Flex
Tapping Sleeves, Fabricated Steel	1. JCM Industries 2. Baker Coupling Co., Inc. 3. Ford Meter Box Co. 4. Mueller Co.	1. 412 2. 428 3. FTSC 4. H-624
Tapping Sleeve, MJ	1. U.S. Pipe & Foundry 2. Mueller Co. 3. Tyler Pipe 4. American Cast Iron Pipe	1. T-9 2. H-615 3. S-149 4. A-D
Tapping Valves	1. U.S. Pipe & Foundry	1. Metroseal 250
Valve Boxes	1. Tyler Pipe 2. Opelika Foundry	
Valve Frame & Cover for Air Release/Vacuum Relief Valves	1. U.S. Pipe & Foundry	1. USF 7665

3. WASTEWATER PUMP STATION MATERIALS

EQUIPMENT	MANUFACTURER	MODEL NO./DESCRIPTION
Generator Circuit Breaker	1. Square D	
Generator Systems	1. Caterpillar 2. Onan (Cummins)	
Motor Automatic Megger	1. Automeg	

3. WASTEWATER PUMP STATION MATERIALS (Cont.)

Pressure Sensors	1. Red Valve 2. Fluid Isolation Technology, Series 40, FF-4000, SE-4200	
Submersible Pumps	1. Flygt	
Wetwell Access Frames & Covers	1. Halliday Products, Inc. 2. Bilco Co. 3. U.S. Foundry TPD	
Control Panels (CP)	1. Sta-Con, Inc. 2. Quality Control, Inc.	
Alarm Horn (AH)	1. Edwards 2. Wheelock	1. 870-N5 2. 31T-115-R
Alarm Light (AL)	1. American Electric 2. Red Dot	1. F32552 2. 886 B
Control Circuit Breaker	1. Square D	1. QOU120
Control Circuit Transformers	1. Square D	1. EO-18
Duplex Receptacle/GFI (DR)	1. Square D 2. Hubbel	1. GFSR-115-IC 2. GF-5262I
Elapsed Time Meter (ETM)	1. Engler 2. Hecon	1. AC-200-10NG7 2. T0621134
Emergency Circuit Breaker (ECB)	1. Square D	
Enclosure	1. Hoffman 2. Tanco	
Fuses (F)	1. Bussmann 2. Gould-Shawmut	
Flasher (FL)	1. Sta-Con, Inc. 2. SSAC	1. 008-24-13SP 2. FS-126
Air Bubbler System	1. Digital Control Corporation	1. P/N 11928-3 2. P/N 11928-4
Generator Receptacle (GR) 230V, 100A, 3P, 4W	1. Meltric	1. 3PHW #37-99043

3. WASTEWATER PUMP STATION MATERIALS (Cont.)

Hand-Auto-Off-Selector (HOA)	1. Square D	1. 9001-SKS
Horn Silence Button (HSS	1. Square D	1. 9001-SKR-1U
Main Circuit Breaker (MCB)	1. Square D	
Main Circuit Transformer (MCT)	1. Square D	1. 500SW43F
Moisture & Temperature Failure Light (MT)	1. Dialco 2. Littelfuse	1. 930407X
Motor Circuit Breaker (MB)	1. Square D	
Motor Starter (MS)	1. Square D	1. D-8536
Overload Heater (OL)	1. Square D	
Phase Monitor (PM)	1. Diversified (11 pin)	
Pilot Light (PL)	1. Dialco 2. Littelfuse	1. 803-1710 2. 930407X
Pump Automatic Alternator (PAA)	1. Diversified	1. ARA-120-ACA
Relay (R)	1. Potter Brumfield 2. Eagle Signal	1. KRPA-11AN 2. 22 Series
Resistor (RE) 5 watt, 2500 ohm	1. Rockwood	
Run Indicator (RL)	1. Dialco 2. Littelfuse	1. 803-1710 2. 930407X
Surge Protector (LA)	1. GE 2. EDCO	
Terminal Strip (TS)	1. Marathon 2. Square D	1. Series 200 2. 9070-GR6
Pressure Switch	1. Honeywell	1. Vapor state #L-408B-1099-2

4. Stormwater Drainage Pipe

EQUIPMENT	MANUFACTURER	MODEL NO./DESCRIPTION
Reinforced Conrete Pipe (RCP)	1. US Precast 2. Rinker	n/a
High Density Polyethelyne Pipe (HDPE)	1. Advance Drainage System (ADS)	1. NT-12 (Class II)
Pol;ypropylene Pipe (PP)	2. Advance Drainage System (ADS)	2. High Performance (HP)