CITY OF ORANGE CITY

Design Standards & Specifications Manual

Detail Index

EFFECTIVE DATA AND FUTURE REVISIONS

This document was initiated and first draft issued on November 1, 1990, by Dyer, Riddle Mills and Precourt, Inc. Subsequent draft revisions were made by Hartman and Associates, Inc. and was issued for DRC usage on December 7, 1991. This document is officially approved by reference in the Subdivision Regulations of the City of Orange City, Florida (Ordinance No. 92- 5-2), which was adopted by the City Council on June 23, 1992. The cover shall indicate the date of any future revisions or newer editions. The document may be officially revised twice a year with effective dates occurring on November 1st and May 1st of each year perpetually thereafter as required to achieve the goals of the latest approved Land Development Regulations.

ERRORS AND OMISSIONS

This document may have errors and omissions contained within and shall not substitute for professional engineering judgment. Any individual that finds any information in this manual to be in conflict with professionally accepted standards or newly revised laws, codes, or other standards such that he/she believes that the health, safety or welfare of the public may be compromised, is encouraged to bring the error, omission, or revision to the City's attention.

All construction plans and design calculations shall be signed and sealed by an Engineer registered in the State of Florida practicing within his or her area of expertise.

OTHER IMPORTANT CITY CODES, ORDINANCES & REFERENCES

Some very important documents that one should obtain to cover the various ordinances and codes relevant to engineering design within the City include but are not limited to:

92-5-2 - Subdivision Regulations 90-3 -1 - I 00 Year Flood

90-4-3 - Wetland Ordinance 91-7-1 - Zoning Ordinance

80-2-2 - Stormwater Management and Conservation Ordinance

CITY OF ORANGE CITY

DESIGN STANDARDS MANUAL

1.0 CLEARING AND GRADING

1.1 Clearing

1.1.1 General Tree Removal Requirements

See Orange City Land Development Regulations.

1.1.2 Disposal of Material (burning/hauling)

All burning activities shall be approved by the Orange City Fire Department. See Orange City Land Development Regulations.

1.1.3 Landscape Replacement Requirements

See Orange City Land Development Regulations, Zoning Ordinance 6.5.

1.1.4 Clearing of Wetlands

Any clearing activity within a wetland of Orange City shall be in compliance with Ordinance 90-4-3.

1.2 Grading

1.2.1 Open Space (pervious) & Lot Grading

a. Residential

1. Residential areas shall be graded such that proper runoff conveyance is provided away from the habitable structures and to stormwater management facilities or to the location of the runoff prior to development. In no case shall runoff be routed such that it will adversely affect adjacent properties.

2. Residential lots shall have finish floor elevations (FFE) a minimum of one (1) foot above roadway centerlines unless adequate drainage around the finish floor can be demonstrated to the Enforcement Official or City Engineer.

3. [Ord. 90-3-1] All "habitable" FF construction shall be a minimum of 12" above the 100-year flood elevation.

4. 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.

b. Commercial/Industrial

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

2. Commercial/Industrial lots shall have finished floors (FF) above the roadway centerline unless adequate drainage around the FF can be demonstrated to the City Engineer.

3. The grading for all commercial and industrial construction shall comply with Ordinance 90-3-1.

4. Commercial/Industrial subdivisions that propose to individually sell lots to other developers shall indicate on the construction plans either: [a] 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; or [b] each individual lot shall comply in full to the Stormwater Management Ordinance (Chapter 18). If this procedure is selected, special drainage conditions may be required by the City Engineer to address drainage concerns for the overall project.

c. P.U.D. Grading

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

1.2.2 Stormwater Storage Facilities

a. Grading

The grading of private 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 1.2.2 (a)(1) gives the requirements for grading dry storage facilities. Information regarding wet detention design is given in Section 3, Stormwater Management.

b. Those facilities to be maintained by the City Public Works Department shall be graded by the standard set forth in the standards manual.

c. Fencing Requirements

Fences shall be mandatory for all facilities with slopes steeper than those values listed in Tables 1.2.2(a)(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 Section 9.3.

TABLE 1.2.2 (a)(1) Stormwater Storage Facilities Side-Slope Grading Requirements

	Retention/Detention Pond		Retention Swale
Depth Range (feet)	W/O Fence (recommended)	(Minimum Allowed)	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.

d. 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 illustrates maintenance berm requirements:

Table 1.2.2.(d)(1)

Stormwater Storage Facility	Minimum Maintenance Berm Required
with fencing	10 ft. around pond perimeter
without fencing	5 ft. around pond perimeter

1.2.3 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 1.2.3 (a)(1) gives the requirements for grading "dry" conveyance facilities. Information regarding the design of wet detention facilities is given in Section 3, Stormwater Management.

b. Public Maintained (City Public Works Department)

Those facilities to be maintained by the City Public Works Department shall be graded by the standards set forth by the Public Works Department in DRC. The tables given in 1.2.3(a) 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 Tables 1.2.3(a)(1). 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 in accordance with Section 9.3

TABLE 1.2.3 (a)(1) Stormwater Conveyance Facilities Side Slope Grading Requirements

Depth Range (feet)	Conveyance Canal or Ditch W/O Fence	Conveyance Swale W/O Fence
≤ 1'	N/A	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 1.2.2 (a)(1) and 1.2.3 (a)(1):

(1) depth is measured from top of bank to bottom

(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 4' deep

(4) "conveyance swales" are those dry, sodded areas designed to convey stormwater, slope toward a positive outfall, and be no deeper than 3 feet

(5) "dry" ditches or canals are those facilities designed to "convey" stormwater but do not qualify by definition as "conveyance swales"

(6) 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 (see Section on Suitable Fencing), 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.

(7) 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 illustrates maintenance berm requirements:

TABLE 1.2.3.(d)(1)

Ditch or Canal Width	Minimum Maintenance Berm Required
Less than 16 ft.	20 ft. one side
Greater than 16 ft.	20 ft. both sides

1.2.4 Public Roadway Sections

Public roadways shall be graded so to provide adequate drainage, safe traffic operation, and proper site distances.

a. Longitudinal slopes shall be no flatter than 0.28% with curb and gutter sections. Maximum longitudinal slopes shall be consistent with maximum algebraic differences discussed in Section 4.7.2.

b. Cross-sectional slopes through paved surfaces shall be a minimum of 2.0% or (one quarter 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 public R/W shall be a minimum of 1.0% and a maximum of 3.0%.

e. Cross sectional slopes across grassed areas within public R/W shall be a minimum of 2.0% and a maximum of 4.0%.

1.2.5 Public Parking Areas

Parking lots that serve the public of Orange City should be graded so to provide adequate drainage and safe vehicle operation. Parking service isles should be designed as a typical roadway section when possible. Transverse slopes shall be a minimum of 1.0%. Longitudinal slopes shall be a minimum of 0.5%.

2.0 EXCAVATION AND FILL

2.1 Excavation

2.1.1 Maximum Removals (T.B.D.)

2.1.2 Bedding & Backfilling (T.B.D.)

2.1.3 Excavation within Wetlands

All letters (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the St. Johns River Water Management District (SJRWMD), Florida Department of Environmental Protection (FDEP), U.S. Army Corps of Engineers (ACOE), and Environmental Protection Agency (EPA), for excavation within wetlands, shall be submitted to the Enforcement Official prior to commencing any excavation in wetland areas. In addition, all conditions of Orange City Wetland Ordinance 90-4-3 must be met.

2.1.4 Sheeting and Bracing (T.B.D.)

2.1.5 Bore and jack trenches (T.B.D.)

2.2 Fill

2.2.1 Suitability of Borrow Material (T.B.D.)

2.2.2 Fill within Wetlands

All letters (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the St. Johns River Water Management District (SJRWMD), Florida Department of Environmental Regulation (FDER), U.S. Army Corps of Engineers (ACOE), and Environmental Protection Agency (EPA), for filling activities within wetlands, shall be submitted to the Enforcement Official prior to the commencement of any filling within any wetland areas. In addition, all conditions of Orange City Wetland Ordinance 90-4-3 must be met.

2.2.3 Fill within 100-year Flood Plain

a. All fill activities within a 100-year flood plain shall be in accordance with Ordinance 90-3-1. Activities within the 100-year flood plain boundaries that contain wetlands shall also comply with Ordinance 90-4-3.
b. 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.

3.0 STORMWATER MANAGEMENT

3.1 Surface Water Management System Components

3.1.1 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. The minimum criteria to meet City Ordinance 80-2-2, Chapter XVIII, Section 26(b)(1) states "the first inch of rainfall falling on all areas caused by, or resulting from the project shall be retained on site." However, projects within SJRWMD authority will normally determine a more stringent design volume that will dictate.

a. Retention systems

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.

1. Provide retention of 1 inch of rainfall over the entire site.

2. Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event.

3. 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 18" 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 boring per pond minimum, depicting soil strata and depth to high groundwater table.

4. Minimum pond bottom width shall be five (5) feet unless approved by City Engineer.

5. See Typical Section 3.2.1(c).

6. All side slopes and top of bank of the retention pond area shall be sodded.

7. Where SJRWMD 40C-42 criteria is applicable, the City will require that proof of issuance of the necessary SJRWMD permit has been obtained prior to issuance of a Certificate of occupancy.

8. In instances where other agency criteria is applicable, the more stringent criteria dictates.

b. Wet Detention Ponds

Facilities designed to store and release pollution abatement stormwater at a controlled outflow rate.

1. Provide additional pollution abatement volume above that described in (a) above meeting the states latest code for Wet Detention. Refer to SJRWMD for details. Only projects within the SJRWMD jurisdiction will be given consideration for the use of such facilities. Sites exempt from SJRWMD permitting shall utilize retention.

2. For design criteria of wet detention systems refer to the latest edition of the Best Management Practices (BMP's) Manual issued by F.D.E.P.

3. 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 boring per pond, minimum depicting soil strata and depth to high groundwater table.

4. The wet detention pond shall be sodded from top of bank to the littoral zone or control water elevation as applicable.

c. Retention Swale Systems

Are dry, shallow, linear shaped facilities designed to retain stormwater for pollution abatement and groundwater recharge.

1. Provide retention of 1 inch of rainfall over the entire site.

2. Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event.

3. The complete retention swale area shall be sodded.

4. Retention swales shall be less than three (3) feet deep.

d. Exfiltration Systems

Definitions:

"Exfiltration System":	sub-surface system that stores pollution abatement and recharges stormwaters and percolates the stormwater into the soil.
"Public Property":	a facility or building which has as its primary purpose serving the needs of a governmental entity like the City of Orange City, Volusia County, or the State of Florida.

Exfiltration systems shall not be used in public rights-of-ways unless needed for pollution abatement and stormwater storage associated with the operation of the public right-of-way. Exfiltration systems on or for public or private property shall only be used to accomplish the pollution abatement and groundwater recharge component of the surface water management system. See Standard Detail 3.2.4. Such systems shall

conform to the following design constraints.

1. Provide retention of 1 inch of rainfall over the entire site.

2. Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event.

3. There should be a clean-out on each side of the exfiltration pipe. The clean-out should be an approved inlet or manhole.

4. The maximum distance between clean-outs is 250 feet.

5. The sedimentation pit should be at least 12 inches deep with a weep hole at least 6" in diameter filled with clean gravel and wrapped in a siltation preventing wrap.

6. The invert of the exfiltration pipe must be a minimum of 18 inches above SHWT (preferably 24 inches or more). This should be verified by providing a certified soils report indicating the SHWT.

7. There should be sufficient driving head (2 foot minimum).

8. The volume retained underground should be equivalent to that required if stored above ground. If not, a suitable form of calculation must be provided.

9. 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 systems.

10. The system shall be designed with a minimum safety factor of a least two (2).

11. Runoff filtering devices such as grass borders, filter strips, swales, sediment and grease drops are encouraged prior to the exfiltration process.

12. A filter fabric equivalent to Dupont “Typar” or Celenese “Mirafi” must be entirely wrapped around all perforated or slotted pipes.

13. A gravel envelope with a filter fabric wrap is highly recommended for all exfiltration designs (a 50% void ratio

is accepted when determining additional volume credit stored in gravel). Larger safety factors will be required for those designs that do not utilize gravel envelopes to dispense the water from the perforations to the soil media. (RESOLUTION NO. 111-02 ,03-26-02)

e. Underdrain Systems

Systems designed to filter pollution abatement stormwater through a filter medium, typically of sand.

1. Provide retention of 1 inch of rainfall over the entire site.

2. Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event.

3. Detention with filtration systems shall be used in dry ponds only. See Standard Detail 3.2.5(b).

   (a.) Minimum filter material depth is 2' cover.

   (b.) All perforated pipe must be completely wrapped with a filter fabric equivalent to Dupont "Typar" or Celenese "Mirafi".

   (c.) All filter media must be totally wrapped with a filter fabric.

   (d.) The maximum distance between clean-outs is 100 feet.

   (e.) All clean-outs must be protected by a concrete collar.

4. The system shall be designed with a minimum safety factor of at least two (2).

3.1.2 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 have been established as follows to accomplish this objective.

a. 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 Orange City the storm events used for peak discharge attenuation are:

25-year/24-hour

100-year/24-hour

1. 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 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:

   a. Soil Conservation Method (see U.S. Department of Agriculture, Soil Conservation Service "National Engineering Handbook, Section 4, Hydrology," TR-55 or TR-20 user’s manuals).

   b. Santa Barbara Urban Hydrograph Method.

   c. U.S. Army Corps of Engineers HEC-1 Computer Programs.

   d. Other hydrograph methods approved by the City Engineer.

2. 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:

a. USDA Soil Conservation Services, "Rainfall Frequency Atlas of Alabama, Florida, Georgia, and South Carolina for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 years" January 1978; Gainesville, Florida.

b. U.S. Weather Bureau Technical Paper No. 49.

c. U.S. Weather Bureau Technical Paper No. 40.

d. U.S. Department of Interior, Bureau of Reclamation, "Design of Small Dams", 2nd Edition.

e. SJRWMD Tech. Publication SJ-88-3 (May 1988).

3. Upper Soil Zone Storage and Surface Storage - In most instances, the upper soil zone storage and surface storage capacities will have an effect on the pre-development and post-development peak discharges and should be considered in these computations. Any generally accepted and well documented method may be used to develop the upper soil zone storage and surface storage values.

a. The soil zone storage at the beginning of a storm should be estimated by using reasonable and appropriate parameters to reflect drainage practices, average wet season water table elevation, the antecedent moisture condition (AMC II) and any underlying soil characteristics which would limit or prevent percolation of storm water into the entire soil column. In no case should the soil storage used in the computation exceed the difference between the maximum soil water capacity and the field capacity (i.e., gravitational water) for the soil columns above any impervious layer or seasonal ground water table.

b. Surface storage, including that available in wetlands and low lying areas, shall be considered as depression storage. Depression storage shall be analyzed for its effect on peak discharge and the time of concentration. Depression storage can also be considered in post-development of stage-storage relationships; if depression storage is considered, then both pre-development and post-development storage routing must be considered.

4. Time of Concentration: Calculations shall be performed in accordance with TR-55 methodology or other acceptable methodology as approved by the City Engineer.

5. 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 boring is required per area (minimum) depicting strata and depth to high groundwater table.

6. 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:

   a. Growth and Decay of Groundwater - Mounds in Response to Uniform Percolation, Mahdi S. Hantush, Water Resources Research Vol. 3, No. 1, 1967.

   b. Ground Mounding and Recharge Program (GRAMP) Peter Singhofen, 1983.

   c. Prickett - Lonnquist Aquifer Simulation Model/PLASM. Selected Digital Computer Techniques, Illinois Water Survey, 1971.

   d. Modflow - USGS 3-D Finite Difference Groundwater Flow Model, 1990.

b. Stormwater Volumetric Storage

Stormwater Volumetric Storage is a flood control practice designed to attenuate the additional stormwater runoff volume generated from the development of land. Stormwater systems that are designed to discharge into land-locked basins shall be sized such that pre-development flood stages do not increase for offsite areas. Land-locked basins are areas where there is no positive drainage outfall. Attenuation is to be accomplished by detention of the runoff volume from a 100 year/24 hour storm event. The detained stormwater shall be drawn down below the control elevation (such as the bottom of a pond, bottom of an exfiltration trench or a normal water level) within 14 days.

1. Methodologies: Soil Concentration Method (see U.S. Department of Agriculture, Soil Conservation Service "National Engineering Handbook, Section 4, Hydrology," TR-55 or TR-20 user’s manuals.

2. Soils Investigation: The area where stormwater volumetric flood storage is proposed will require a certified soils report, prepared by a licensed Geotechnical Engineer, to verify SHWT estimates. A soils report may also be required to verify soil permeability rate. One boring is required per area (minimum) depicting soil strata and depth to high groundwater table.

3. Credit for Stormwater Seepage: Credit for stormwater seepage will not be allowed unless accompanied by supporting documentation and the use of sound engineering judgment.

See 3.1.2.a.6 for acceptable analytical methods.

c. Floodplain Compensating Storage

This is a flood control practice of creating the same volume of flood storage to compensate for the encroachment of fill into 100-year flood plains. The goal is to prevent 100-year flood elevations from rising due to the removal of natural storage by development. Stormwater management practices such as compensating storage may be required by the City Engineer. The SJRWMD also regulates flood plain encroachment activities.

3.2 Primary Conveyance System Requirements (drainage between receiving water bodies)

Drainage easements are required for all primary conveyance facilities that are maintained by Orange 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 3.1.

3.2.1 Required Submittals

a. 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 24 inch by 36 inch sheet on a scale not to exceed 1"=200'. Listed below are the features that are to be included on the drainage map.

1. Drainage bounds, including all offsite areas draining to the proposed subdivision.

2. Sufficient topographical information with elevations to verify the location of all ridges, streams, etc. (one foot contour intervals).

3. Highwater data on existing structures upstream and downstream for the subdivision.

4. Notes indicating sources of highwater data.

5. Notes pertaining to existing standing water, area of heavy seepage, or springs.

6. Existing drainage features (ditches, roadways, ponds, etc.).

7. Subdivision layout with horizontal and vertical controls.

8. Drainage features, including location of inlets, swales, ponding areas, etc.

9. Delineation of drainage sub-areas.

10. Show retention/detention areas and ingress/egress areas for retention/detention facilities.

11. General type of soils (obtain from soil survey of Volusia County).

12. Flood hazard classification.

13. Description of current ground cover and/or land use.

b. Recent aerial photograph delineating project at no smaller scale than 1" = 400 ft.

c. Drainage Calculations

3.2.2 Canals & Ditches

a. All canals and ditches shall have a five (5) foot minimum bottom width unless approved otherwise by City Engineer.

b. All canals and ditches shall have graded side slopes conforming to the standards given in 1.2.3.

3.2.3 Culvert Connections (T.B.D.)

3.2.4 Lakes and Ponds (T.B.D.)

3.3 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 10-year return frequency.

3.3.1 Public Roadway and Pavement Drainage Systems

a. Physical standards:

1. The minimum size pipe allowed in public right-of-ways is 15" unless otherwise approved by the City Engineer.

2. All drainage pipes within public right-of-way and easements shall be reinforced concrete pipe per F.D.O.T Standard Specifications for Road and Bridge Construction (latest edition) Section 430-7, unless otherwise approved by the City Engineer.

3. Corrosive pipe materials will not be permitted within public R/W where corrosive soil environments are suspected.

4. Minimum pavement longitudinal grades and cross-sectional slopes are given in Section 1.2.4 and 1.2.5.

5. Driveway crossings shall have a minimum culvert diameter of 15".

6. Minimum cover over culverts within public right-of-ways is 18" below pavement unless acceptable loading calculations supporting a lesser depth are submitted and approved by City Engineer.

b. Hydraulic Standards:

All public roadway and paving projects must verify that secondary conveyance systems perform properly during the design storm event.

1. Stormwater calculations shall include the following:

(a) Storm sewer tabulations including, but not limited to, the following:

(b) Locations and types of structures.

(c) Types and lengths of line.

(d) Drainage sub-area tributary to each structure.

(e) Runoff coefficient per sub-area.

(f) Time of concentration to structure.

(g) Hydraulic gradient for the 10 year frequency storm event.

(h) Estimated receiving water (tailwater) elevation with sources of information, if available.

(i) Diameters of pipe.

(j) Outlet and other pipe velocities.

2. Hydraulic Grade Line Calculations - Public roadways shall be designed so that the Hydraulic Grade Line (HGL) computed through the storm sewer system shall be 1.0 foot below gutter line for arterial streets and 0.5 feet below gutter line for collector and local streets during a 10-year intensity storm event. For public roadways utilizing swale sections for drainage, the HGL shall not reach the edge of pavement during a 10-year intensity storm event.

The Hydraulic Grade Line 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.

3. 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 tolerable limits as determined by the City Engineer.

   The acceptable tolerable limits for arterial and collector roadways is defined as approximately one half of the traveled lane width. Acceptable tolerable limits for interior subdivision roadways are defined as a maximum of one (1) inch above the crown of the road.

4. Tailwater conditions for storm sewer systems shall consider the receiving facility. In the case where the detention pond is the receiving facility, the design tailwater level can be estimated from the information generated by routing through the pond the hydrograph resulting from a 10 year frequency storm of duration equal to that used in designing the pond. Then the design tailwater level can be assumed to be the 10 year pond level corresponding to the time at which peak inflow occurs from the storm sewer into the pond. In lieu of the above detailed analysis, however, a simpler design tailwater estimate can be obtained by averaging the established 25 year Design High Water elevation for the pond and the pond bottom elevation for "dry bottom" ponds or the top of the pollution abatement volume for "wet bottom" ponds.

5. Minimum & Maximum Velocities - Public roadway pipe systems shall be designed such that the minimum flushing velocity in all pipes is 2.5 feet per second (fps) for a 10-year intensity storm event when flowing full. The maximum velocity allowed within the pipe system is 10 fps and no greater than 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 3.6.

6. Inlet Interception Rates and Capacities - Maximum inlet interception rates shall be based on the Inlet Capacity Chart contained in the F.D.O.T. Drainage Manual.

3.3.2 Private Roadway and Pavement Drainage Systems

All private roadways and paving should be designed in accordance with the public standards.

3.4 Tertiary Conveyance Performance Standards

This includes minor drainage systems such as parking lots and service roads intended for public use on private property. Easements 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 10-year return frequency.

3.4.1 Parking Lot Drainage Systems

a. Sheet Flow Standards

See Section 1.2.5 and 1.2.6.

b. Pipe Flow Standards

The minimum pipe size shall be 15" between stormwater runoff inlet structures and manholes. Roof drainage, special structure drain pipes and other minor drainage structures shall be no smaller than 6" in diameter.

3.4.2 Swale Drainage

These systems must meet the performance standards for stabilization as outlined in Section 3.6. Grading shall be in accordance with Sections 1.2.2 and 1.2.3.

3.4.3 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 will be directed to the pond, inlet, or structure intended to receive the stormwater runoff in accordance with stormwater management calculations.

3.5 Erosion Protection Performance and Design Standards

3.5.1 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 3.6.3.

3.5.2 Acceptable Stabilization Practices

Acceptable stabilization practices include but are not limited to:

a. 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 3.6.2(a) 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%

1. Maximum channel velocities and slopes are given in Table 3.6.2 (a)

2. All swales are required to be completely sodded.

3. Ditches (canals) are required to have sodded side slopes from their top of bank to their normal water level (or bottom).

4. All ponds are required to have sodded side slopes from top of bank to their normal level or dry bottom.

5. Dry bottoms may be seed and mulched or grass and mulched, as an option to sodding.

b. Flumes

Flumes are required whenever concentrated storm water leaves a parking area or road or enters a stormwater management facility. A standard detail is presented in the Appendix as Detail 3.6.2(b).

c. Check Dams

Check dams may be used to dissipate the velocity of swales but must be completely sodded.

d. 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.

e. 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.

f. Splash Pads

Splash pads are required to stabilize the soil of all stormwater discharge structures with outlet velocities in excess of 2.5 Fps. Energy dissipaters may also be required in addition to splash pads in order to reduce outlet velocities from the splash pad.

3.5.3 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).

a. 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.

b. Temporary Seeding: Areas exposed by construction for 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 30 lbs./acre.

3.6 Stormwater Drainage Structure Performance & Design Standards

This section includes standards for manholes, inlets, catch basins, and control structures.

3.6.1 Acceptable Structures

All drainage structures within public right-of-way or easements shall be standard Florida Department of Transportation (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.

3.6.2 Placement & Spacing

a. Manholes: Stormwater manholes shall in no instance be spaced no further than as given in Table 3.7.2(a)

Table 3.7.2(a) Maximum Spacing for Stormwater Manholes

Pipe Size	Max. Spacing (ft.)
$\leq$ 18"	300
24"-36"	400
$\geq$ 42	500

Public drainage systems may require closer spacing subject to the review of the Public Works Department.

b. Inlets: Inlets are to be spaced so to provide adequate stormwater runoff evacuation to prevent unacceptable stormwater spreading into the traveled lanes.

1. The maximum distance for flow in a curb and gutter to the first point of removal for any roadway shall be 500'.

2. All low point (sump) location inlets shall be designed to intercept 100% of the design flow including by-pass flow from upstream inlets.

3. All intermediary inlets (not at low points) shall be designed to intercept at least 80% of the design flow.

4. 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.

3.7 General Storm Pipe Performance and Design Standards

3.7.1 Physical Design Standards

a. Material Specifications (T.B.D.)

b. Installation Requirements (T.B.D.)

c. Clearance Requirements

There shall be a minimum cover of 6" over all concrete pipes under flexible or rigid pavement. 15" minimum cover shall be maintained over all corrugated steel or aluminum pipe. Larger diameter culverts (greater than 54" in diameter) require additional cover as determined by the City Engineer. Refer to FDOT Roadway Design Standards Manual for minimum cover with respect to culvert diameter and material. Non-doweled rigid pavement shall require a minimum of 9" of compacted soil or base (98% AASHTO T-180) between the concrete and the tip of pipe.

d. Safety Precautions (child proofing)

Any storm pipe 15" 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 8" minimum spacings on center.

e. Minimum Size Requirements

1. All pipe sizes should be designed to produce a minimum flushing velocity (whenever possible) without producing velocities that cause erosion problems.

2. The minimum pipe size to be used in a public R/W or any stormwater facility to be maintained by the City shall be 18" regardless of velocity.

3. Pipe sizes in non-public R/W or that are perpetually maintained by private individuals shall be no less than 15".

4. Any pipe sizes less than those described are at the discretion of the City Engineer.

5. See also, Sections 3.3 through 3.5.

3.7.2 Hydraulic Design Standards (T.B.D.)

a. Maximum/minimum Design Velocities

All pipes should be designed to produce flushing velocities of 2.5 Fps (3.0 desirable) and shall not exceed 10 Fps. See Sections 3.3 and 3.4. All final outlet velocities must meet the requirements of Section 3.6.

b. Flow Generation Calculations

See Table 3.8.2(b)

Table 3.8.2(b) Examples of Acceptable Flow Generation Methods

Inlet spread & spacing calculations
- Rational method and Mannings equation

Hydraulic grade line computations
- Rational method and Mannings equation

Open channel pipe flow
- Mannings equation

Basin flow to inlets
- Several*

* Several methods are acceptable depending upon individual circumstances. Some examples include: Rational method, SBUH hydrograph, SCS-unit hydrograph.

3.7.3 Location and Identification (T.B.D.)4.0 ROADWAY PERFORMANCE

4.1 Right of Way (R/W) Utilization

4.1.1 Excavations with City R/W

a. 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. Bore and jacks shall be required on high traffic volume roadways. Open cuts shall conform to the detail shown as Detail 4.1.1(a).

b. Bore and Jacks: (T.B.D.)

4.1.2 Operational Safety and Recovery

4.2 Easements (T.B.D.)

4.3 Roadway Designations & Lane Requirements

4.3.1 Roadway Classifications

a. Roadways are generally designated as local, collector, or arterial as defined by the Florida Department of Transportation (See latest edition of the Green Book). The Subdivision Regulations further offers subclassifications as "principle", "major", or "minor" in order to distinguish large volume roadways serving primarily "regional" from "inner city" traffic. For design guideline purposes, the City recognizes several individual classifications based on Average Daily Traffic (ADT) volumes. These designations will be used for establishing recommended minimum design standards. Table 4.3.1 gives approximate values for A.D.T. based on Land Use. Table 4.3.0(a) gives the designations based on A.D.T.

b. Roadway designations are further divided into Residential (R) and Commercial/Industrial (C/I). Minimum design standards are adjusted to reflect the heavier design vehicle.

c. An applicant may choose to present justification for values other than those presented as minimum herein for consideration. The source of data must be well documented in such a case.

4.3.2 Roadway Width Requirements

Minimum roadway requirements are based upon the roadway designation, vehicle usage, and rural or urban section designation. A 1-foot pavement width credit may be accepted for a cul-de-sac containing a curbing with a minimum of 12" travelable surface. Table 4.3.0(a) gives minimum pavement widths for each roadway designation.

4.3.3 Roadway R/W Width Requirements

Minimum roadway R/W width requirements are given in Table 4.3.0(a) for each roadway designation.

See Section 9.4 regarding sidewalks and bike paths standards.

4.3.4 Criteria Mandating Accessory Laneage (T.B.D.)

Table 4.3.0(a) Minimum Roadway Standards For Description, Pavement Width and R/W Width

Road Designation	A.D.T. Range	Class	Minimum Road Width Rural	Minimum Road Width Urban	Minimum R/W Width Rural	Minimum /W Width Urban
Parking		CI				
Service Access(1)	0-300	R	20'	20'	60'	50'
		CI	24'	24'	60'	50'
Local	301-1,000	R	22'	22'	60'	50'
		CI	24'	24'	60'	60'
Principle Local or Minor Collector	1,001-2,000	R	24'	24'	60'	60'
		CI	24'	24'	70'	60'
Collector	2,001-5,000	R	24'	24'	80'(3)	70'(3)
		CI	28'	28'	80'	70'
Major Collector or Minor Arterial	5,001-10,000	R	36'	36'	100'	90'
		CI	36'	36'	100'	90'
Arterial	10,001 20,000	R	48'	48'	See Note(2)	See Note(2)
		CI	48'	48'		
Major Arterial	> 20,001	R	48'	48'	See Note(2)	See Note(2)
		CI	48'	48'		
One Way	Any	Any	15'	15'	50'	40'
Cul-de-sac Terminus	<400	Any	84'	84'	110'	110'

Notes

R = Residential
CI = Commercial/Industrial (Includes Multi-Family Apts)
Rural = "Rural type" sections with no curbs and swale drainage.
Urban = "Urban type" section with curbs.
(1) = Service roadways often are cul-de-sacs but are not necessarily so.
(2) = To be determined by City Engineer and/or other applicable authorities such as Volusia County, FDOT, etc.
150' R/W according to Policy 1.3.2 of Comprehensive Plan.
(3) = Collector roadways in this range are required to provide 100' R/W according to Policy 1.3.2 of Comprehensive Plan where future upgrade to Major collector is possible.

Table 4.3.0(b) Minimum Roadway Standards
For Vertical Pavement Elements and Return Radii

Road Designation	Asphalt (3)	Class	Lime-Rock	Soil Cement	Sub-Grade	All Conc.	Min. Return Radii
Public Parking	1"	CI	6"	6"	8	6"	N/A
Service	1"	R	6"	6"	8	"	30'
Access*	1-1/4"	CI	6"	6"	8	6"	35'
Local	1-1/4"	R	6"	6"	8	6"	30'
	1-1/2"	CI	8"	8"	10	7"	40'
Principle Local or Minor Collector	1-1/2"	R	8"	6"	10"	6"	35'
	2" or (2) 1-1/2+ 1"	CI	8"	8"	12"	8"	50'
Collector	1-1/2"	R	8"	8"	12"	7"	35'
	1-1/2"+ 1"	CI	8"	8"	12"	8"	Vehcl. AASHTO Req.
Major Collector or Minor Arterial	1-1/2" 1"	R	8"	8"	12"	8"	40'
	1-1/2" 1"	CI	10"	9"	12"	8"	Vehcl.
Arterial	1-1/2" 1"	R	10"	9"	12"	8"	Vehcl.
	1"+1"	CI	10"	10"	12"	9"	Vehcl.
Major Arterial	2"+1"	R	10"	10"	12"	9"	
	2"+1"	CI	10"	10"	12"	9"	Vehcl.
One Way	1-1/4"	---	Varies	Varies	Varies	Varies	Vehcl.
Cul-de-sac Terminus	Varies (1)	---	Varies	Varies	Varies	Varies	(4)

Notes

R = Residential
CI = Commercial/Industrial (Includes Multi-Family Apts)
Vehcl. = Design for appropriate vehicular use
(1) = Asphalt depth varies with intended vehicular use to be at the discretion of City Engineer
(2) = Friction course option given also.
(3) = Asphalt depth given plus friction course if required (e.g. 1-1/2" + 1")
(4) = Minimum return radii shall be 25', however, City Engineer may require larger radius for large design vehicles and/or high ADT values.

Table 4.3.1 Average Daily Traffic Estimates By Land Use

Land Use	Average*	Units
Single Family Residential	10.1	ADT/DU
Lowrise Apartment	6.6	ADT/DU
Highrise Apartment	4.2	ADT/DU
Mobile Home Park	4.8	ADT/DU
Retirement Community	3.3	ADT/DU
10 KGSF Retail Shopping	166.3	ADT/KGSFLA
50 KGSF Retail Shopping	94.7	ADT/KGSFLA
100 KGSF Retail Shopping	74.3	ADT/KGSFLA
200 KGSF Retail Shopping	58.9	ADT/KGSFLA
500 KGSF Retail Shopping	39.8	ADT/KGSFLA
Discount Retail Store	71.2	ADT/KGSD
Convenience Store (open 24 hr.)	887.1	ADT/KGSF
Restaurant - Fast Food Drive Thru	632.1	ADT/KSFGFA
Restaurant - High Turn Over Sit Down	200.9	ADT/KSFGFA
Restaurant - Quality	95.6	ADT/KSFGFA
Supermarket	12.5	ADT/KSFBA
Medical Office Building	34.2	ADT/KGSF
10 KGSF General Office	24.4	ADT/KGSF
50 KGSF General Office	16.3	ADT/KGSF
100 KGSF General Office	13.7	ADT/KGSF
Office Park	11.4	ADT/KSFGFA
Bank (Drive In)	291.1	ADT/KGSF
Bank (Walk In)	189.9	ADT/KGSF
S&L (Walk In)	61.0	ADT/KGSF
Motel	10.2	ADT/Occ.Rm.
Hotel	8.7	ADT/Room
Nursing Home	16.7	ADT/Bed
Clinic	23.8	ADT/KGSFBA
General Light Industrial	7.0	ADT/KGSF
Industrial Park	7.0	ADT/KGSFBA
Warehousing	4.9	ADT/KGSF
Manufacturing	3.8	ADT/KGSF
General Heavy Industrial	1.5	ADT/KGSF

*BASED ON NATIONAL I.T.E. STUDIES

Table 4.3.1 Average Daily Traffic Estimates By Land Use (Con't)

LEGEND

ADT	=	Average Daily Traffic
DU	=	Dwelling Unit
KGSFLA	=	1000 gross sq. ft. leasable area
KGSF	=	1000 gross sq. ft.
KSFGFA	=	1000 sq. ft. gross floor area
KGSFBA	=	1000 gross sq. ft. building area

4.4 Signing and Striping

All proposed signing and striping shall be clearly delineated on the construction plans for review by the DRC.

4.4.1 Roadway Markings

All markings shall be in accordance with the latest edition of the "Manual on Uniform Traffic Control Devices" by the U.S. DOT/FHA.

4.4.2 Signage

All signage shall be in accordance with the Latest edition of the "Manual on Uniform Traffic Control Devices" by the U.S. DOT/FHA.

4.5 Paving Standards

All thicknesses given in this section are measured as final, compacted, in place.

4.5.1 Asphalt Requirements

See Orange City Zoning Ordinance, for requirements discussing where paved surfaces are required. Minimum asphaltic surface thickness are given for each roadway classification in Table 4.3.0(b). Concrete paved sections design criteria is given in Section 4.5.4.

a. The minimum paving application tolerance is 1/4"

b. Asphaltic concrete surface courses shall be designed for the appropriate roadway classification, usage, and projected trips per day. Allowable asphaltic surfaces include: FDOT "S-I", "S-II", "S-III", Type "II" or Type "III".

c. 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 provided to the City Engineer for approval. Certification shall also be provided to the City Engineer showing that the materials comply with F.D.O.T. Standard Specifications for Road and Bridge Construction (latest edition).

d. After asphalt is placed the Contractor shall obtain from an independent testing laboratory at minimum intervals of 300 feet, core borings of the asphalt to determine:

1. Thickness and Density

2. Marshall Stability

3. Sieve Analysis of Aggregate

4. Bitumen Content of Asphalt

The tests shall be submitted to the City Engineer for approval.

4.5.2 Base Course Requirements

All public roadways are to have a compacted base. Recommended materials are limerock or soil-cement although other materials are available for consideration upon approval by the City Engineer. Certified laboratory test results for the specifications described herein shall be mandatory prior to any dedication of public right-of-way.

Minimum base course thickness are given for each roadway classification in Table 4.3.0(b).

a. All soil cement shall be primed and meet or exceed 300 psi compressive strength after 7 days (and 450 psi if required by the City Engineer after 28 days). In addition, all soil cement shall be compacted to meet or exceed 98% of the modified proctor density AASHTO T-180 and be installed on a stabilized sub-grade.

A design mix for the soil cement shall be submitted to the City Engineer prior to the placement of the base. After the base is completed, the Contractor shall obtain from an independent testing laboratory at minimum intervals of 300 feet, cores to determine cement content, moisture content, "in place" density and thickness. compression test cylinders shall also be prepared for each 300 foot of roadway. The cylinders shall be moist cured for 7 days and

tested for compressive strength. The results of all the testing shall be submitted to the City Engineer for approval.

b. All limerock shall be primed and compacted to 98% of the modified proctor density, AASHTO T-180, and be installed on a stabilized sub-grade.

Certification from a testing laboratory shall be submitted to the City Engineer indicating that the material used for the base meets the specified criteria and contains less than 1% by weight asbestos.

After the base is completed, the Contractor shall obtain from an independent testing laboratory at minimum intervals of 300 feet, cores to determine base thickness and density. The tests shall be submitted to the City Engineer for approval.

c. All bases are to extend a minimum of 6" or 12" (according to volume of traffic and vehicular usage) beyond the asphaltic surface where curbing is omitted. See Section 4.5.5 for curbing stabilization and Section 4.13.10 for typical section details.

4.5.3 Sub-grade requirements

All public 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 4.3.0(b).

a. All sub-grades shall meet or exceed 95% modified proctor density AASHTO T-180. In addition, a minimum L.B.R. of 40 will be required of all roadway sub-grades.

b. All sub-grades are to extend a minimum of 6 inches beyond the base course layer where curbing is omitted.

c. After the subgrade is complete the Contractor shall obtain from an independent testing laboratory at minimum intervals of 300 feet, density and limerock bearing ratio tests on the subgrade. The tests shall be submitted to the City Engineer for approval.

4.5.4 Concrete Paving Requirements

a. Portland concrete roadway is an acceptable alternative to asphaltic concrete on base. The requirements of Sections 4.5.2, 4.5.3 and

4.5.5, however, may still apply. Three construction options are available as follows:

1. Thickened edge (footer)/Road on Subgrade - Edge of road - shall have a poured footer at least 3" deeper than the required concrete surface width. The footer shall be at least the outer 12" of roadway lane edge.

   Substructure - concrete road surface shall be laid on subgrade conforming to Section 4.5.3 and extending at least 12" beyond edge of pavement (footer)

2. Uniform Edge (no curb)/Road On Base - Edge of road - no curbing or footer. Substructure-concrete road surface shall be laid on a subgrade conforming to Section 4.5.5 except shall extend at least 12" beyond edge of pavement.

3. Concrete curb edge/Road on subgrade:

   Edge of road - shall have curbing in accordance with Sections 4.5.5 and 14.13.10.

   Substructure - concrete road surface shall be laid on subgrade conforming to Section 4.5.3. Curbing shall be laid on subgrade conforming to Section 4.5.5.

b. Minimum concrete thicknesses are given for each roadway classification in Table 4.3.0(b).

c. All concrete shall be 3,000 psi minimum compressive strength at 28 days.

d. All bases (or sub-bases) are to extend a minimum of 12" beyond the concrete layer where curbing is omitted. See Section 4.5.5 if curbing is used.

e. Broom finish all concrete work.

f. Transverse and longitudinal joints shall be constructed to a maximum spacing of 15 feet. Transverse joints shall extend the entire width of the pavement and through the curbs. Longitudinal joints shall be required along the centerline of crowned road sections.

g. Dowels are not required when pavement is designed with unprotected corners. In pavements designed with protected corners, dowels are required across:

1. Transverse expansion joint;

2. Plain (butt) construction joints;

3. Contraction joints where panel lengths are greater than about 20 feet or where experience indicates that aggregate interlock will not provide adequate load transference;

4. First 6 to 10 contraction joints each side of expansion joint.

h. Tiebars are required across longitudinal joints in the thin interiors of thickened edge slabs (30 inch maximum spacing) may be used across longitudinal joints in uniform thickness slabs or across thickened edges of thickened-edge slabs to prevent separation or differential settlement. Not more than 4 lanes should be tied together.

i. Grooves in joints may be formed by:

1. Temporary embedment of a suitable mandrel;

2. Installation of a thin strip of premolded joint filler material;

3. Sawing the pavement after the concrete has hardened.

j. Transverse construction joints are required at end of day's paving operation of where placing of concrete is discontinued a sufficient time for concrete to set. Tiebars are required for all such transverse construction joints.

k. A crack control plan indicating both construction joints and expansion joints must be submitted to the City Engineer for review and approval. Radial joint plans are recommended for cul-de-sacs.

4.5.5 Special Stabilization

All curbing within public R/W shall be supported by a stabilized subgrade. All roadway shoulders must also be stabilized.

a. Stabilized subgrades and shoulders must be 6" minimum thickness.

b. Stabilized subgrades and shoulders must meet or exceed a L.B.R. of 40.

c. Stabilized subgrades must extend a minimum of 6" beyond curbing.

d. See details 4.13.10(a) through (c) for details of bases used with curbing.

4.6 Horizontal Geometry

4.6.1 Return Radii

Minimum return radii for public roadways should be designed based upon A.A.S.H.T.O. guidelines for the appropriate design vehicle and best engineering practice. Minimum radii are given for each roadway classification in Table 4.3.0(b).

4.6.2 Cul-de-sac

Cul-de-sac are to be provided on all public roadways that dead end and are protected by the Orange City Fire Department.

a. The maximum length of a cul-de-sac is 1000 feet (measured along center line).

b. Cul-de-sacs may not be used on streets with greater than 35 detached dwelling units.

c. Minimum R/W required is 110 feet (diameter) for urban and rural roadway sections.

d. Minimum paved radius at the terminus is 42 feet without curbing and 41 feet with curbing.

e. Cul-de-sac with islands will be permitted if a maintenance association is established. Minimum pavement width shall be determined by City Engineer.

f. No temporary cul-de-sacs shall be allowed, except in a phased development. A temporary cul-de-sac may not be constructed in a currently approved and developing phase of construction. The temporary cul-de-sac must be constructed outside of the approved phase into the future phase of development with no access allowed

adjacent to the cul-de-sac. The temporary cul-de-sac in a phased development must meet regular paving and size requirements. A temporary public easement shall also be placed over the cul-de-sac allowing public ingress and egress.

4.6.3 Maximum Curve Without Superelevation (T.B.D.)

4.6.4 Minimum Tangent Standards

Minimum tangent standards should be in accordance with latest design guidelines from AASHTO, ITE or FDOT.

a. "Broken-back" curves:

Two consecutive curves in the same direction with a short tangent causes a hazardous and unexpected arrangement. This condition should be avoided whenever possible. Roadways with tangents less than 100 feet will be prohibited for design speeds faster than 30 miles an hour unless approved by the City Engineer.

b. "Reverse" curves:

Two consecutive curves in opposite directions.

1. A sufficient length of tangent between reverse curves is mandatory for superelevation transition and should be in accordance with the latest AASHTO, ITE, or FDOT guidelines.

2. A tangent of not less than 100 feet in length shall be provided between reverse curves on all minor collector roadway designations or higher volume roadways.

4.6.5 Horizontal Obstructions Affecting Site Distance (T.B.D.)

4.6.6 Maximum Centerline Deflection Without a Circular Curve

For small deflection angles (<5 degrees), curves should be lengthened to avoid the distracting appearance of a kink. Such design should be in accordance with the best engineering practices as dictated by AASHTO or FDOT guidelines. Example guidelines for horizontal curves are given below in Table 4.6.6 for a deflection angle of two (2) degrees.

Table 4.6.6 Minimum Horizontal Curve for
2% Deflection Angle (Example Guidelines)

Road Designation	Minimum Radius
Service Access	100
Local	200
Minor Collector	400
Collector	600
Minor Arterial	800
Arterial	T.B.D.
Major Arterial	T.B.D.

4.7 Vertical Geometry

4.7.1 Vertical Curve Requirements

Refer to FDOT and ITE guidelines.

4.7.2 Maximum/minimum Slope Requirements

Refer to FDOT and AASHTO guidelines.

4.7.3 Vertical Obstructions Affecting Site Distance (T.B.D.)

4.8 Traffic Control During Construction

Refer to FDOT guidelines

4.9 Driveways and Driveway Connections to Public R/W

Refer to Orange City, FDOT and Volusia County guidelines.

4.10 Intersection Design Standards

Intersection design should be in accordance with the recommendations and requirements of the latest F.D.O.T. Manual of Uniform Minimum Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System, F.D.O.T. Roadway and Traffic Design Standards (latest edition) and F.D.O.T.

Policy and Guidelines for vehicular connections to roads on the state highway system (Latest edition).

Minimum intersection angles and offset criteria is given in Section 14-9(b)(9) of the Subdivision Regulations.

4.11 Median and Intersection Spacing

Refer to ITE and FDOT guidelines.

4.12 Signalization (T.B.D.)

4.13 Typical Sections

All construction plans submitted to the Development Review Committee (DRC) for approval shall provide with the construction plans typical sections for any of the proposed activities listed below. All sections shall specify materials used with bearing and compaction specifications required for the material as given in section 4.5 of this Manual.

4.13.0 Public Parking

See detail 4.13.0 for typical section

4.13.1 Service Access Roads

See detail 4.13.1(a) for Residential (R) typical sections

See detail 4.13.1(b) for Commercial/Industrial (C/I) typical sections

4.13.2 Local Roadways

See detail 4.13.2(a) for R typical sections

See detail 4.13.2(b) for C/I typical sections

4.13.3 Principle Local Roads (minor collectors)

See detail 4.13.3(a) for R typical sections

See detail 4.13.3(b) for C/I typical sections

4.13.4 Collector Roads

See detail 4.13.4(a) for R typical sections

See detail 4.13.4(b) for C/I typical sections

4.13.5 Major Collector Roads (minor arterials) (T.B.D.)

4.13.6 Arterial Roads (T.B.D.)

4.13.7 Major Arterial Roads (T.B.D.)

4.13.8 One Way Roads (T.B.D.)

4.13.9 Cul-de-sac roadways

See detail 4.13.9

4.13.10 Typical Sections of Curbing

a. Standard curb (FDOT Type "F"):

See detail 4.13.10(a)

b. Miami curb:

See detail 4.13.10(b)

c. Vertical curb:

See detail 4.13.10(c)

4.14 Bridges (T.B.D.)

4.15 Design and Posted Speeds

Design speed for all roadways shall be indicated on all construction plans. Posted speeds shall be determined by the DRC.

5.0 SANITARY SEWER

Refer to the City of Orange City Utilities Standard Handbook for sanitary sewer design and construction standards.

6.0 POTABLE WATER

Refer to the City of Orange City Utilities Standard Handbook for potable water design and construction standards.

7.0 FIRE PROTECTION

7.1 T.B.D.

7.1.1 Flow Rate Required for Fire Protection

All flow rates shall be in accordance with the latest N.F.P.A. Standards.

7.1.2 Residual Pressure (T.B.D.)

7.1.3 Fire Hydrant Spacing & Specifications

Fire hydrants shall be spaced no more than 500 feet apart to be measured by vehicular travel path and in accordance with the latest N.F.P.A. Standards.

7.1.4 Hydraulic Analysis

All projects that: require more than 18,000 gpd average daily water flow; over 60 dwelling units; a P.U.D. with one commercial building; or as requested by the DRC shall submit a hydraulic analysis demonstrating the ability of the water system to provide adequate fire protection while maintaining a minimum residual pressure of 20 psi. For looped water main systems a "Hardy Cross" type calculation may be required.

7.1.5 NFPA Standards

Compliance with the latest revision of the applicable NFPA Standards is mandatory for all water facilities designed or intended to provide fire protection service.

8.0 OTHER UTILITIES

A City preconstruction meeting may be held at the City to discuss coordination of utilities within public right-of-ways. The City shall be informed of all existing and proposed utilities within a right-of-way 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 Council.

8.1 Gas

Florida Public Utilities

8.2 Cable

Cablevision

8.3 Electric

Florida Power Corporation

8.4 Telephone

United Telephone
Southern Bell

9.0 SPECIFIC SITE DESIGN REQUIREMENTS

9.1 Dumpster Pads & Solid Waste Generation

See Orange City Land Development Regulations, for information stating when dumpster and pad are required for a site.

9.1.1 Solid Waste Generation Rates

When specific information regarding anticipated waste generation volumes is not available, the City will estimate the amount of solid waste provided by Table 9.1.1.

Table 9.1.1 Estimates of Anticipated Solid Waste Generation for Various Land Uses

Description	lb/day	CY/Day
Residential	2.3 lb/dayperson	243 lb/CY
Commercial/Retail	1.0 lb/day/100 sq.ft.	243 lb/CY
Office	1.0 lb/day/100 sq.ft.	243 lb/CY
Warehouse	0.75 lb/day/100 sq.ft.	243 lb/CY
Hospital	8.0 lb/day/bed	700 lb/CY
Hotel	2.0 lb/day/room	540 lb/CY
Industrial		
Domestic	25 lb/day/100 sq.ft.	1,080 lb/CY
Process	(not available)	(not available)
Schools & Public	2.1 lb/day/100 sq.ft.	243 lb/CY

Table 9.1.1 Estimates of Anticipated Solid Waste Generation for Various Land Uses (Con't)

Description	lb/day	CY/Day
Institutions*		
R.V. Park	12 lb/unit/day	---
Lodging	12 lb/unit/day	---
Recreation Center	3 lb/day/100 sq.ft.	---
Conference Center	5 lb/day/100 sq.ft.	---
Restaurants	2.0 lb/seat/day	216 lb/CY
Residential	7.0 lb/D.U./day	243 lb/CY
(Timeshare)		

*Number of students estimated as 1/5 of population.

9.1.2 Hazardous Wastes

Any development that generates hazardous wastes shall identify the type of waste and location of waste generation, storage, and disposal. Copies of all FDER permits shall be submitted to the Development Coordinator as part of the construction plan review process.

9.2 Parking Spaces

See Zoning Ordinance

9.3 Fencing

9.3.1 Standard restricted access situations

A 6 foot high chain link fence per F.D.O.T. Roadway and Traffic Design Standards (latest edition) index no. 452.

9.3.2. Extreme restricted access situations

A 6 foot high chain link fence with barbed wire per F.D.O.T. Roadway and Traffic Design Standards (Latest edition) index no. 452.

9.4 Sidewalks & Bike Paths

9.4.1 Sidewalk Standards

a. Sidewalks are required on all new developments.

b. Minimum sidewalk width shall be 4 feet.

c. Minimum construction standards: All sidewalks shall be constructed of 4" thick Portland concrete (2,500 psi).

d. Sidewalk widths may be required to be greater than 5 feet when large pedestrian volumes are anticipated.

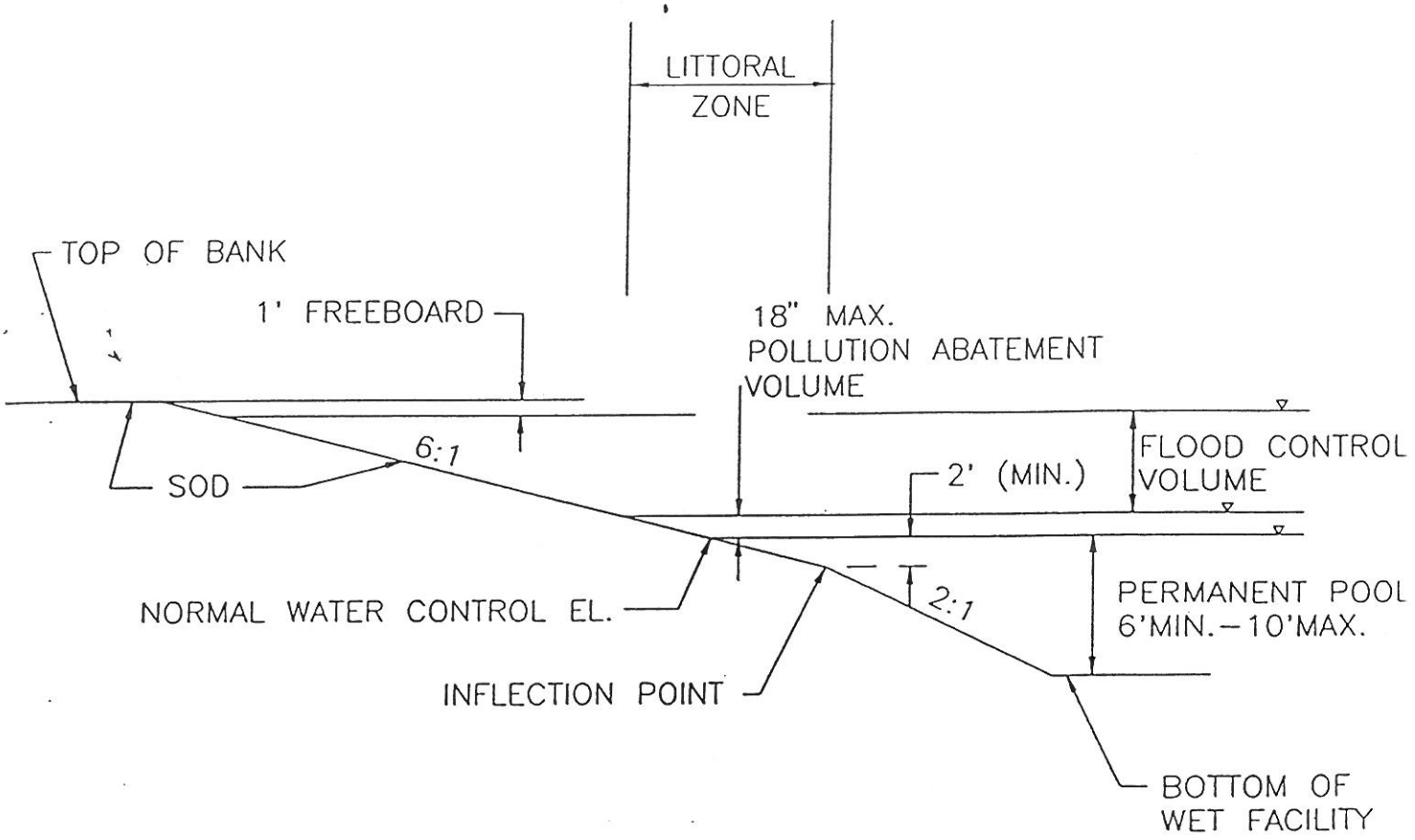
e. expansion joints and crack control joints: T.B.D.

f. Sidewalks shall incorporate pedestrian cross-access at intersection as shown in detail.

9.4.2 Bike paths and Bike Trails (T.B.D.)

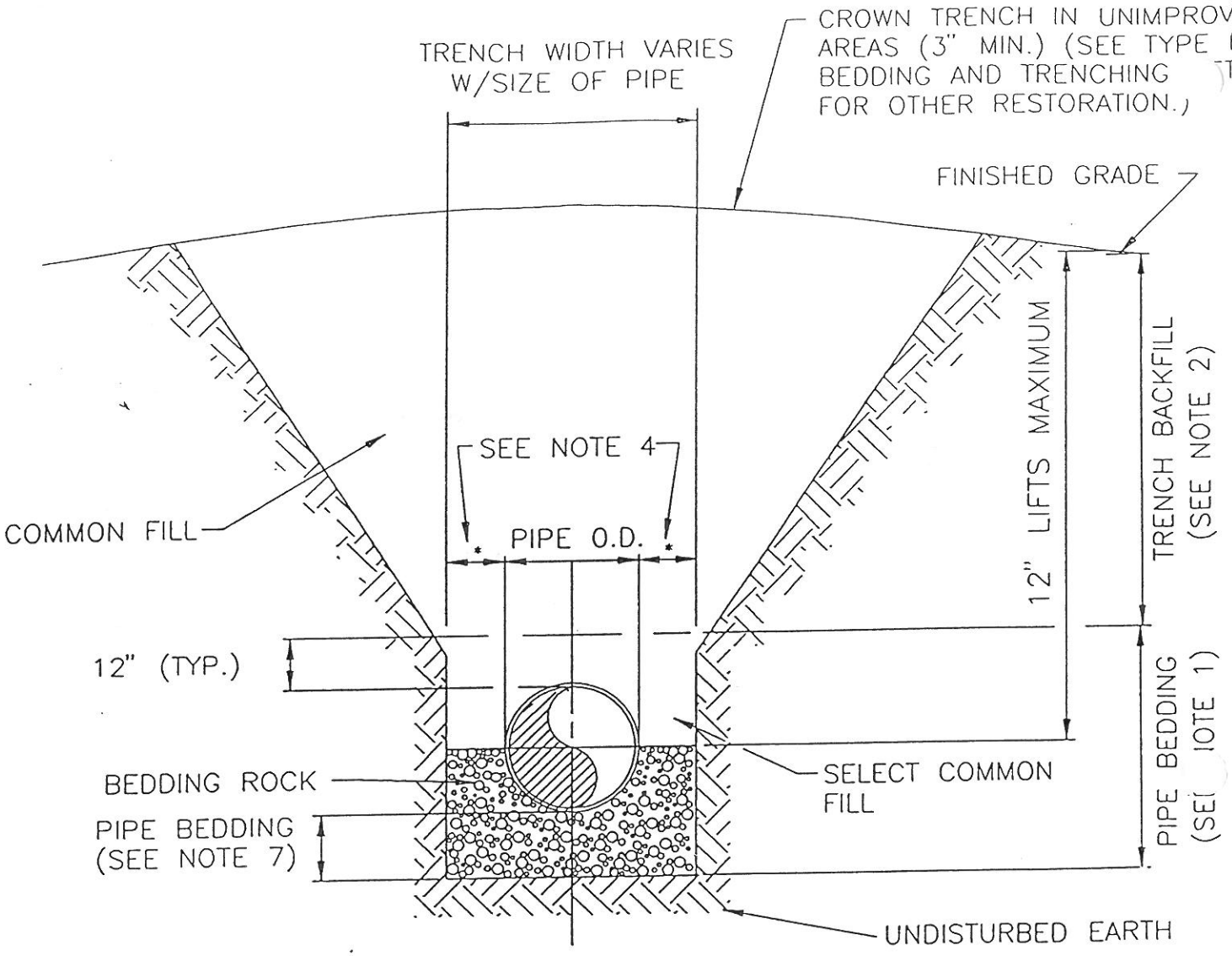
9.5 Handicap Considerations

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).



DETAIL 1.2.3(b)(8)
TYPICAL WET BOTTOM FACILITY
INFLECTION POINT & GRADING DETAIL

2



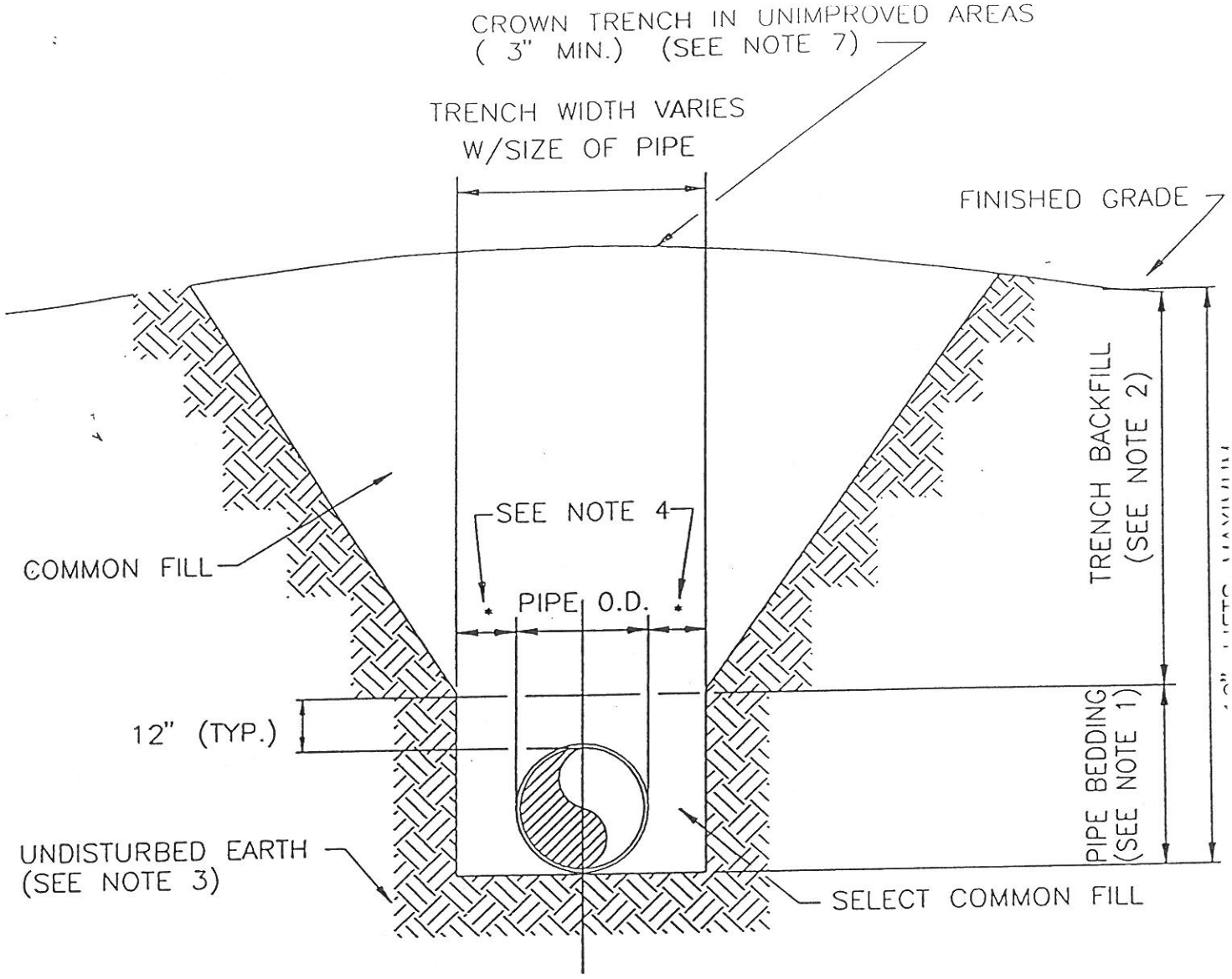
NOTES:

1. PIPE BEDDING, SELECT COMMON FILL COMPACTED TO 95% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
2. TRENCH BACKFILL, COMMON FILL COMPACTED TO 95% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
3. USE OF TYPE A BEDDING TO BE DETERMINED IN THE FIELD.
4. (*): 10" MAX. FOR PIPE DIAMETER LESS THAN 24", 12" MAX. FOR PIPE DIAMETER LESS THAN 42", AND 24" MAX. FOR RIPE DIAMETER 42" AND OVER.
5. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION.
6. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF FLOW.
7. DEPTH FOR REMOVAL OF UNSUITABLE MATERIAL SHALL GOVERN DEPTH OF BEDDING ROCK BELOW THE PIPE. CITY SHALL DETERMINE IN THE FIELD REQUIRED REMOVAL OF UNSUITABLE MATERIAL TO REACH SUITABLE FOUNDATION.
8. ALL GRAVITY SEWERS SHALL UTILIZE CLASS A BEDDING. BEDDING DEPTH 4" MIN. FOR PIPE 15" DIAMETER & LESS; 6" MIN. FOR PIPE 16" AND LA[illegible]EF

DETAIL 2.1.2(a)

TYPE 'A' BEDDING AND TRENCHING DETAIL

EFF. DATE 12/12
12003



NOTES:

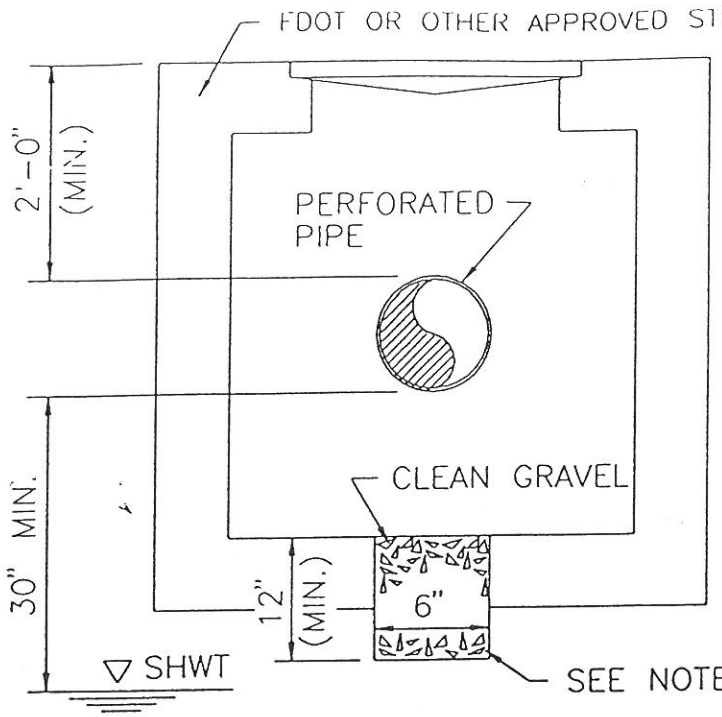
1. PIPE BEDDING SELECT COMMON FILL (6" LAYERS) COMPACTED TO 98% MAXIMUN DENSITY AS PER AASHTO T-180.
2. TRENCH BACKFILL - COMMON FILL (12" LAYERS) COMPACTED TO 95% MAXIMU DENSITY AS PER ASSHTO T-180.
3. 4" MIN. FOR PIPE 15" DIAMETER & LESS: 6" MIN. FOR PIPE 16" AND LARGER.
4. (*): 10" MAX. FOR PIPE DIAMETER LESS THAN 24"; 12" MAX. FOR PIPE DIAMETER LESS THAN 42" AND 24" FOR PIPE DIAMETER 42" AND OVER.
5. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION.
6. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF FLOW.

DETAIL 2.1.2(b)

TYPE 'B' BEDDING AND TRENCHING DETAIL

EFF. DATE 12/12/

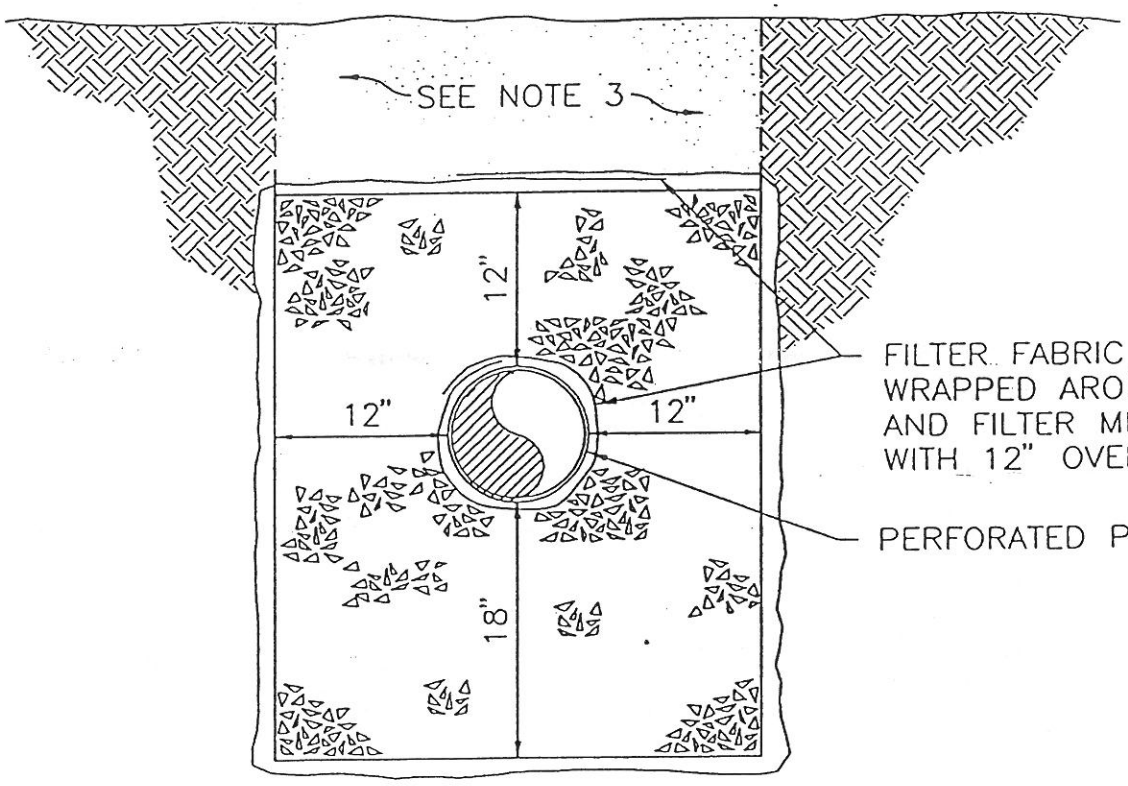
12003C



NOTES:

1. SEDIMENTATION PIT SHALL BE AT LEAST 12" DEEP W/ WEEP HOLE 6" DIAMETER FILLED W/ CLEAN GRAVEL & WRAPPED IN A SILTATION PREVENTION WRAP.
2. MAXIMUM DISTANCE BETWEEN CLEAN-OUTS IS 300 FT.
3. BACK FILL W/ CLEAN SAND FREE OF CLAY, SILT, LIMEROCK AND OTHER FINES & COMPACT TO 96% OF MAX. DENSITY AS DETERMINED BY ASTM D-1557.
4. CLEANOUT STRUCTURE REQUIRED ON EACH SIDE OF PIPE.

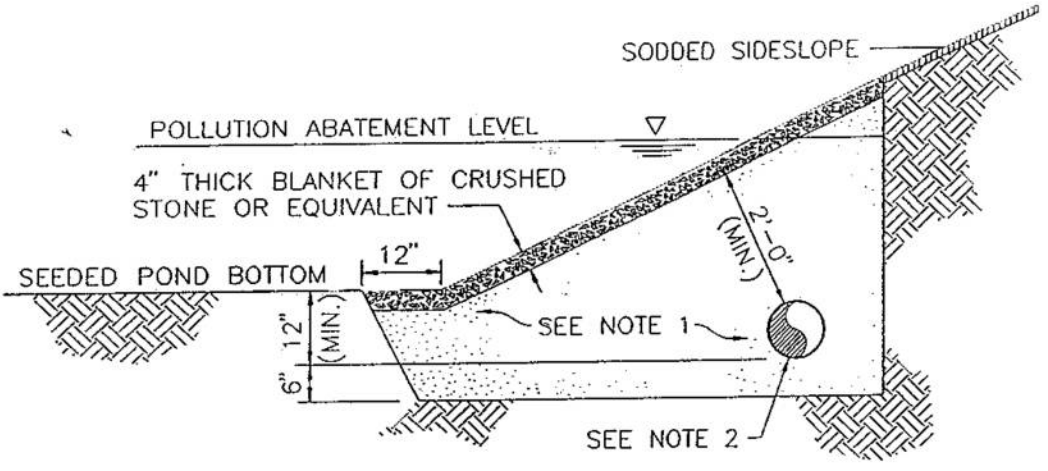
SECTION THROUGH TYP. INFILTRATION CLEANOUT STRUCTURE
(APPLICABLE TO CATCH BASINS, INLETS OR MANHOLES)



SECTION THROUGH PIPE & GRAVEL ENVELOPE

DETAIL 3.2.4
EXFILTRATION SYSTEM SECTIONS DETAIL

EFF. DATE 12/12/9(
12003C1



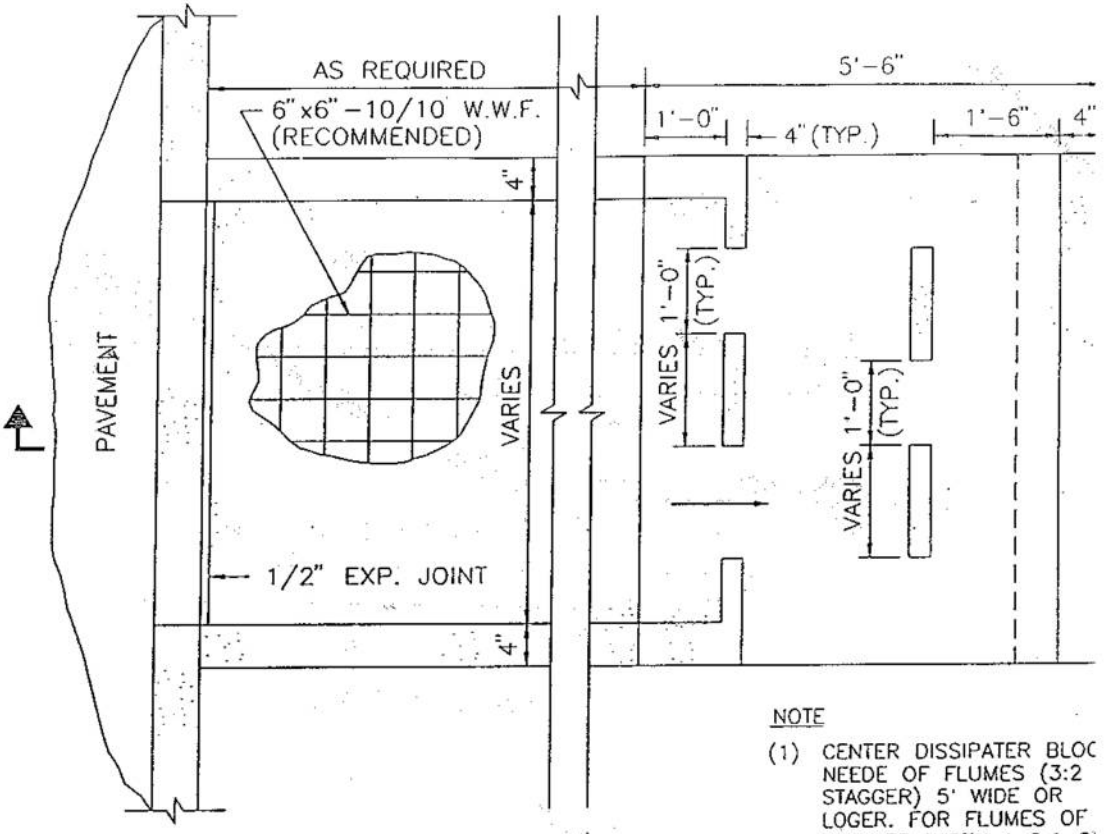
DRY BOTTOM POND CONDITION

NOTE:
1. FILTER MAT. W/ PERIMETER TOTALLY WRAPPED W/ FILTER FABRIC.
2. PERFORATED COLLECTOR PIPE WRAPPED W/ FILTER FABRIC.
3. FILTER MATERIAL SHALL BE CLEAN QUARTZ SAND (FDOT 902-4).

DETAIL 3:2.5(B)

DETENTION W/ FILTRATION UNDERDRAIN

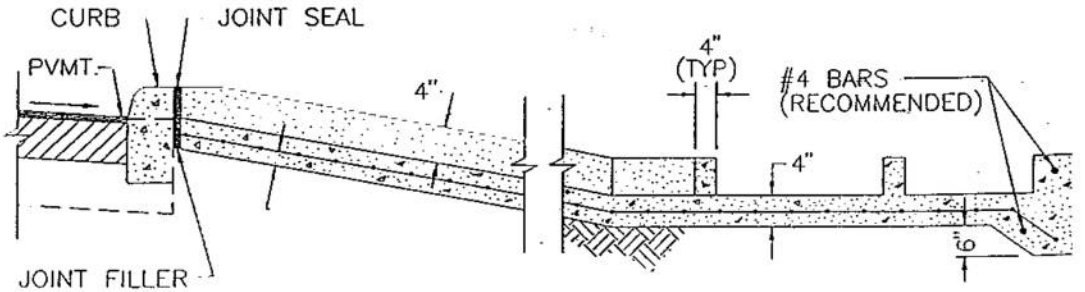
EFF. DATE 12/
120(



PLAN

NOTE

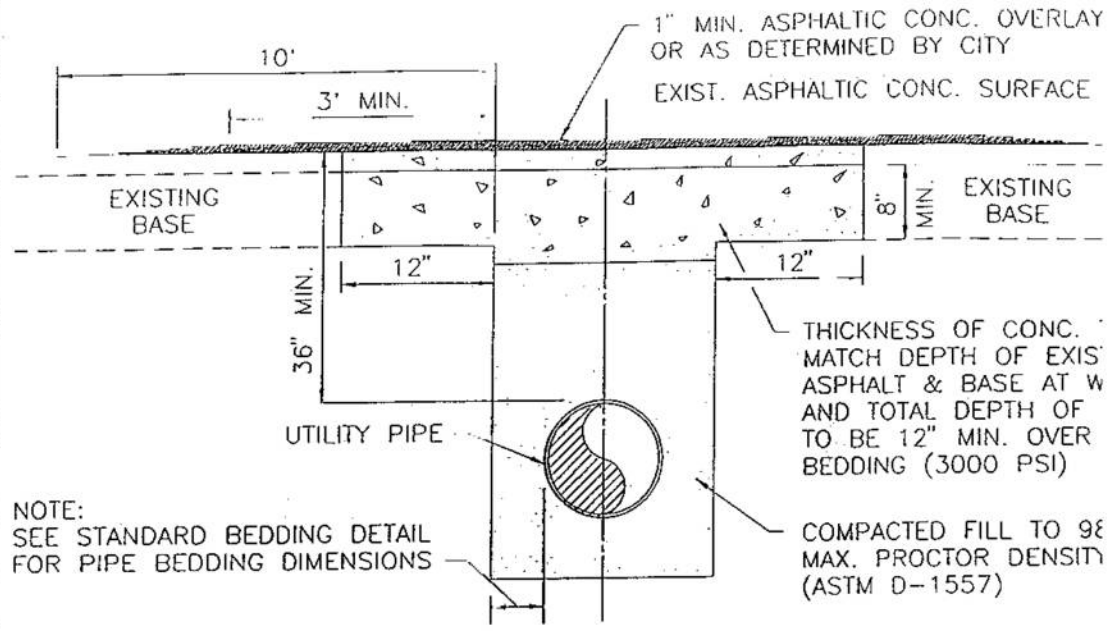
(1) CENTER DISSIPATER BLOC
NEEDE OF FLUMES (3:2
STAGGER) 5' WIDE OR
LOGER. FOR FLUMES OF
SMALLER WIDTH A 2:1 O
1:1 STAGGER MAY BE
APPROPRIATE.



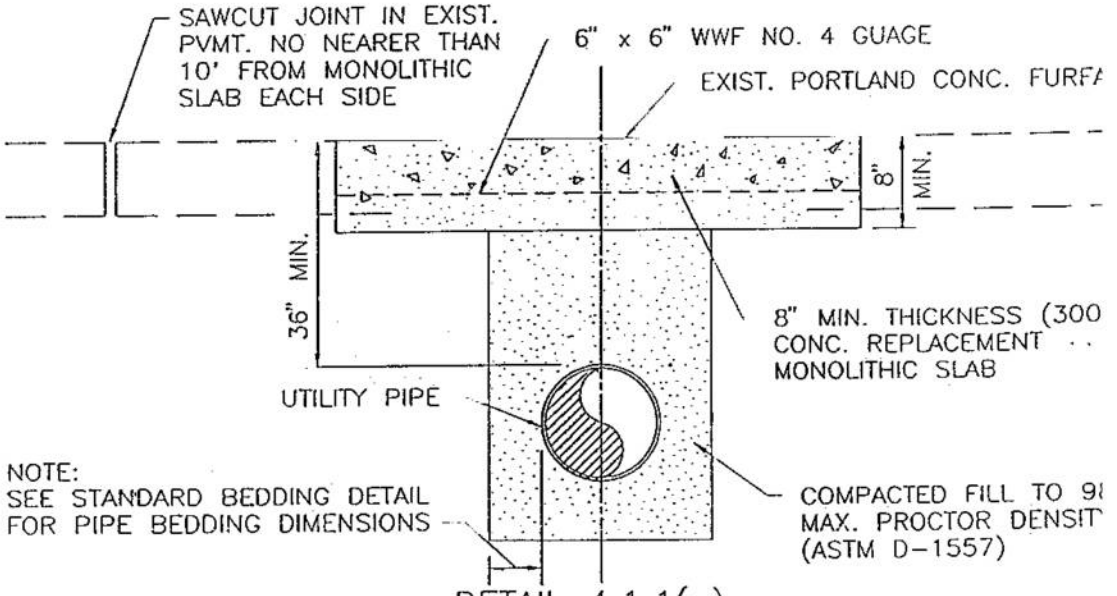
SECTION

DETAIL 3.6.2(b)
CONCRETE FLUME W/ ENERGY DISSIPATOR

EFF. DATE 12/12/
REV. DATE 7/ 3/
120030



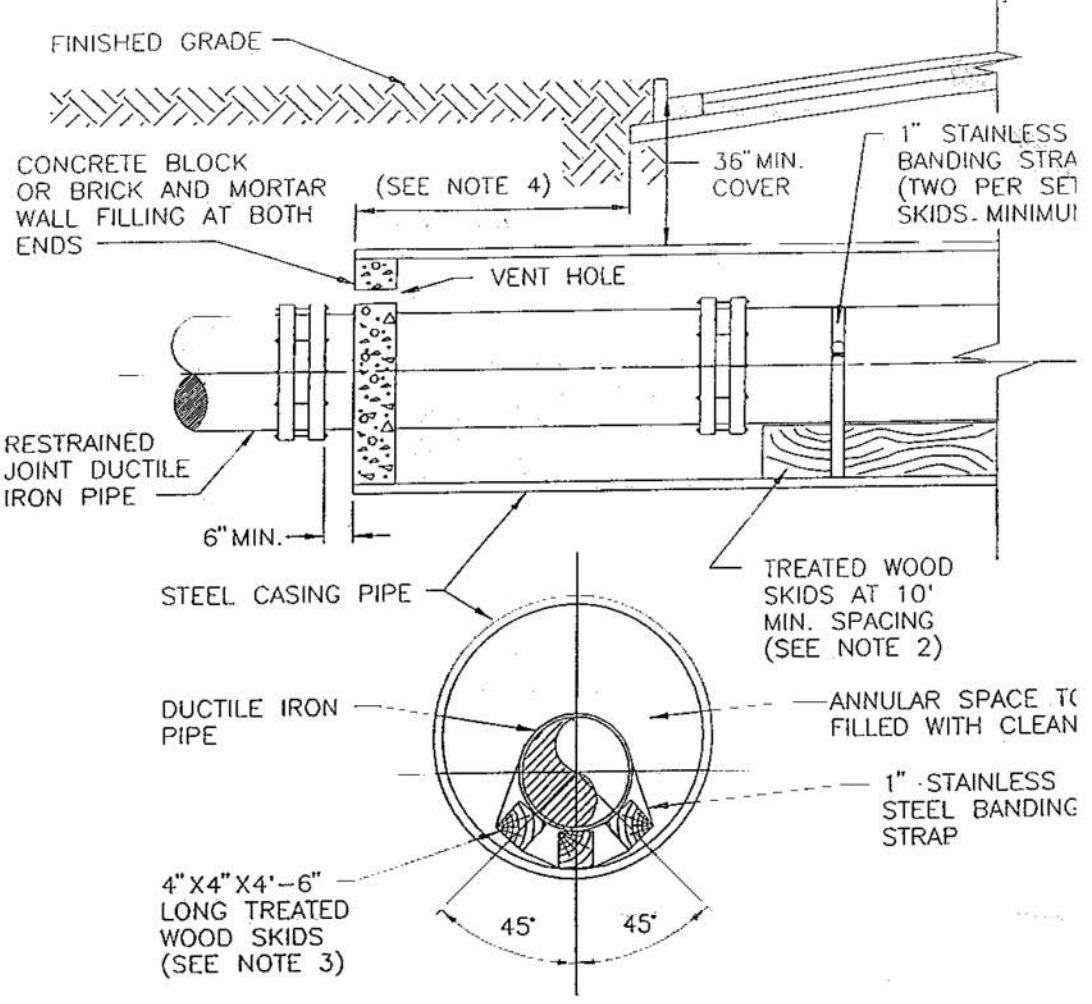
TYPICAL OPEN CUT IN ASPHALTIC-CONCRETE SURFACED ROADWAY



DETAIL 4.1.1(a)

TYPICAL OPEN CUT IN ASPHALTIC-PORTLAND SURFACED ROADWAY

EFF. DATE 12/
12(

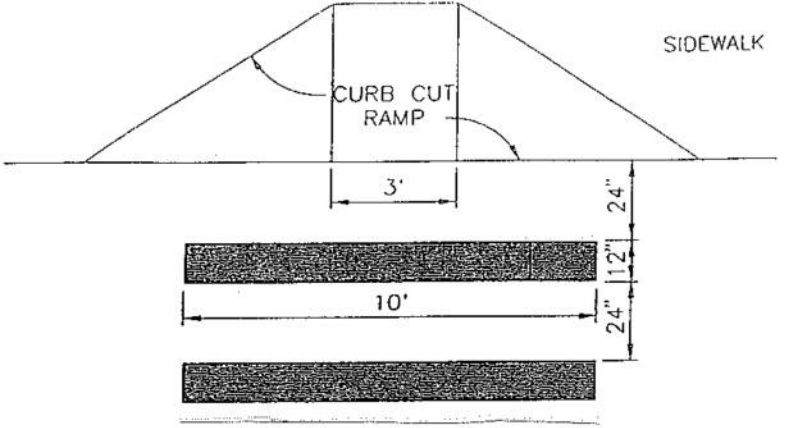


NOTES:

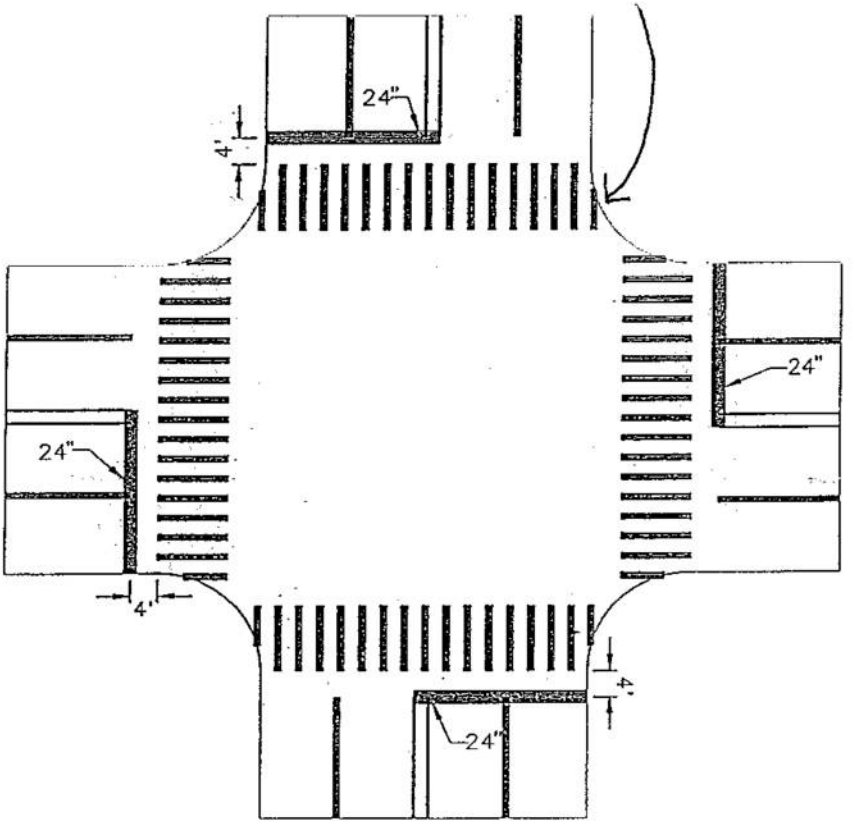
1. WHEN CONSTRUCTION IS WITHIN FDOT JURISDICTION, ADDITIONAL REQUIREMENTS OF THE UTILITY ACCOMODATION GUIDE SHALL BE MET.
2. CASING SPACER, IF APPROVED BY ENGINEER, MAY BE SUBSTITUTED IN LIEU OF WOOD SKIDS AND BANDING STRAP.
3. LARGER SKIDS SHALL BE REQUIRED FOR PIPE GREATER THAN 24" DIAMETE
4. WHERE PRACTICAL, CASING SHALL EXTEND 10' BEYOND EDGE OF PAVEMENT AND SHALL NOT BE LESS THAN 6' BEYOND EDGE OF PAVEMENT IN ANY CA THE ENGINEER MAY REQUIRE LONGER CASING FOR DEEPER BORES.

DETAIL 4.1.1(b)
BORING AND JACKING DETAIL

EFF. DATE 12/
120

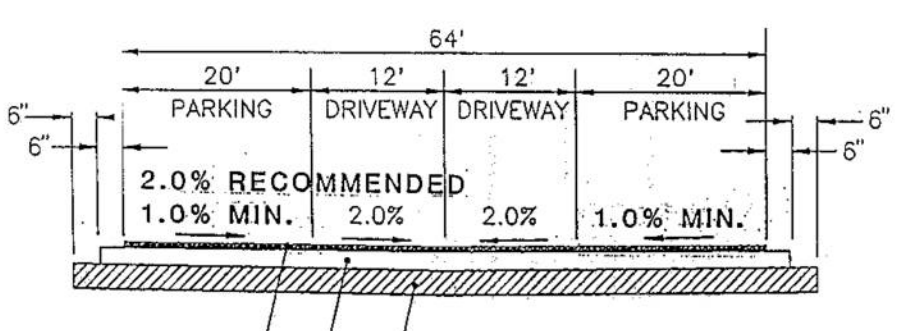


Contrasting Color and Texture



DETAIL 4.4.1(a)
INTERSECTION STRIPING

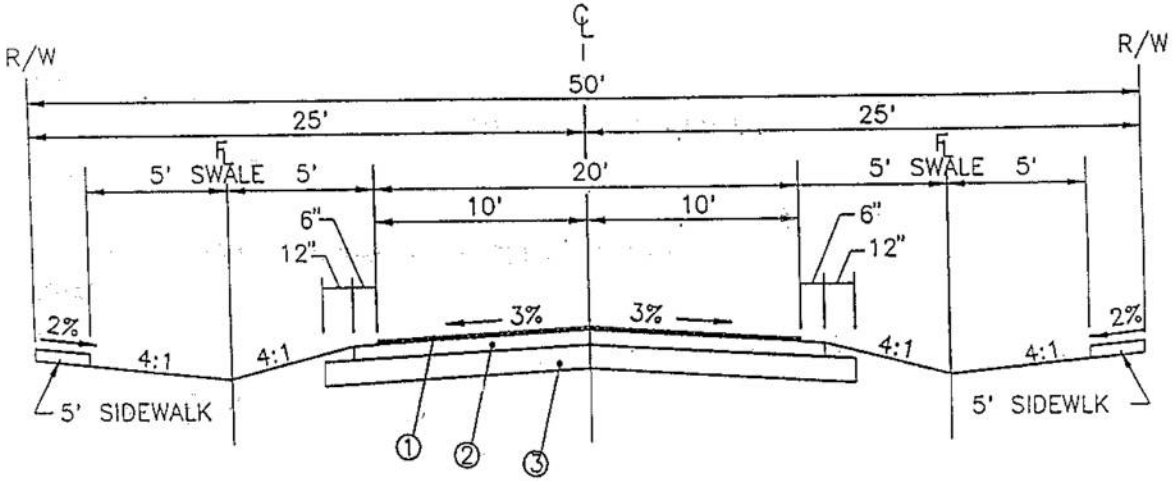
EFF. DATE
1200



① 1-1/4" ASPHALTIC CONC. PAVEMENT
② 6" BASE
③ 12" SUB-BASE

DETAIL 4.13.0

PUBLIC PARKING PAVING SECTION DETAIL



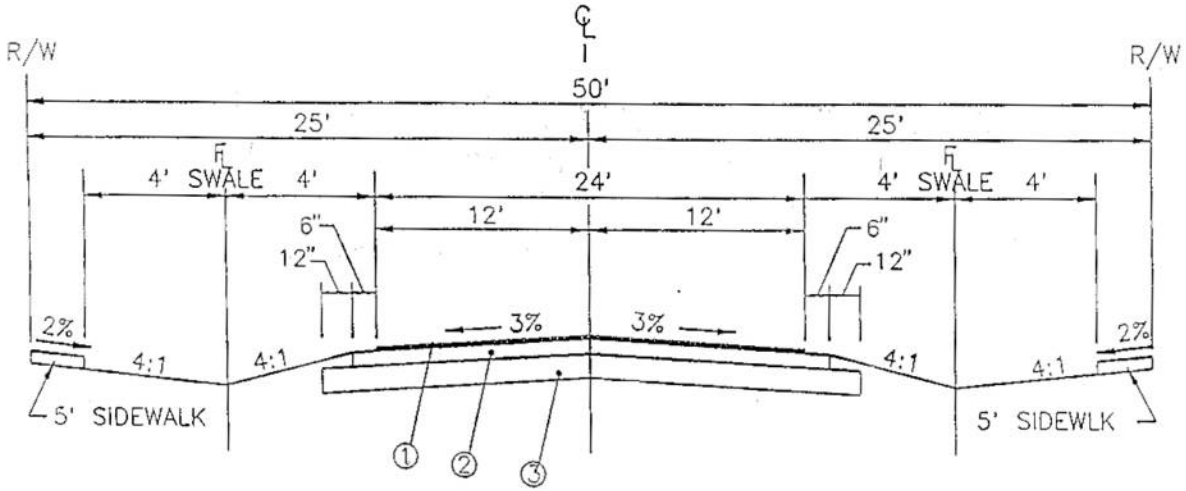
① 1-1/4" ASPHALTIC CONC. PAVEMENT
② 6" BASE
③ 8" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.1(a)

TYPICAL SERVICE ACCESS ROADWAY SECTION – RESIDENTIAL



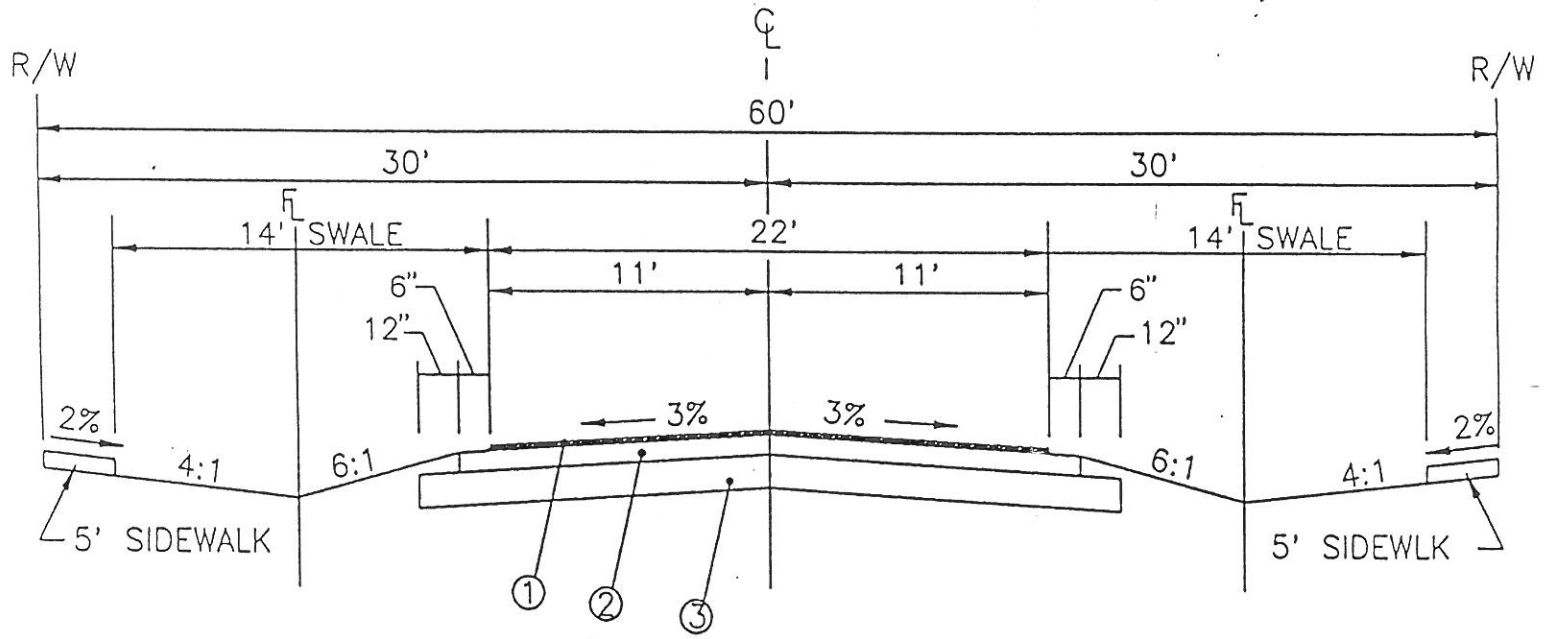
① 1-1/4" ASPHALTIC CONC. PAVEMENT
② 6" BASE
③ 8" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.1(b)

TYPICAL SERVICE ACCESS ROADWAY SECTION - COMMERCIAL/INDUSTRIAL



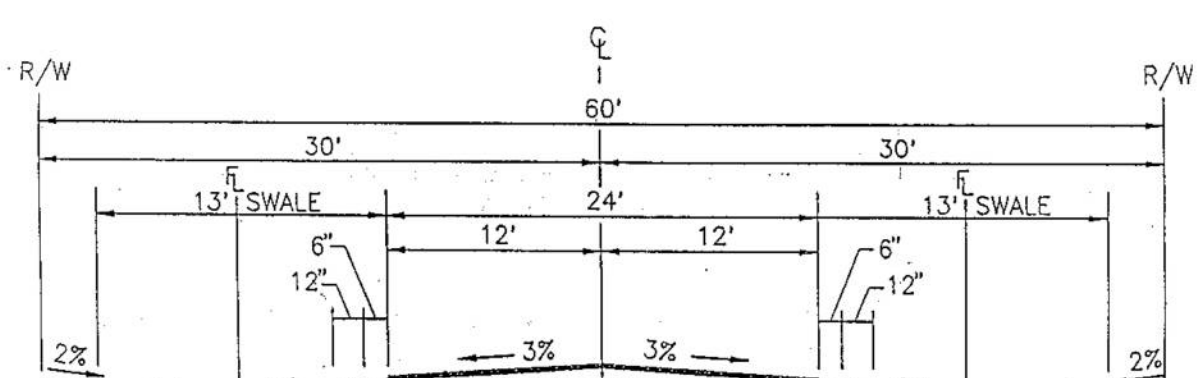
① 1-1/4" ASPHALTIC CONC. PAVEMENT
② 6" BASE
③ 8" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.2(a)

TYPICAL LOCAL ROADWAY SECTION-- RESIDENTIAL



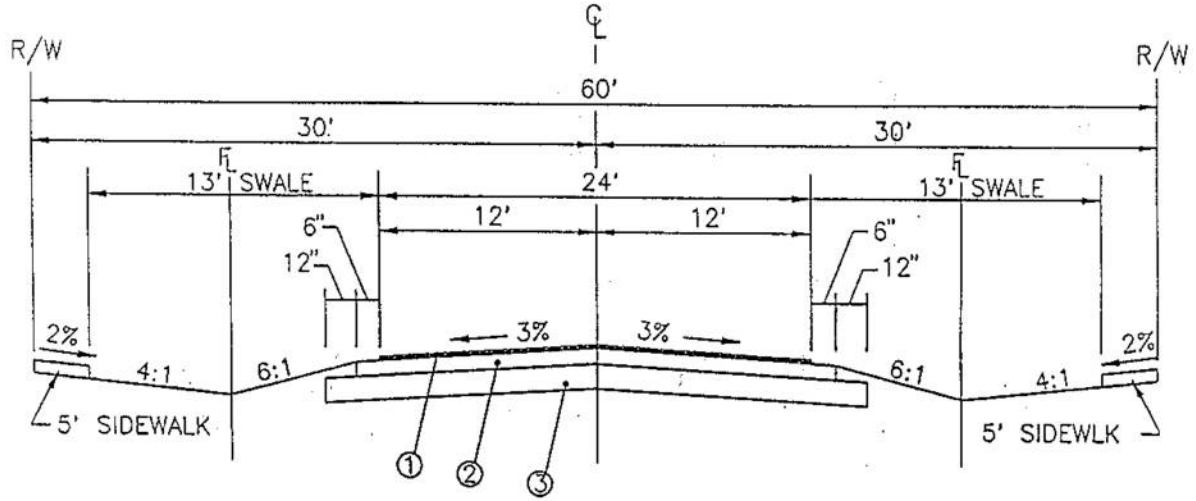
① 1-1/2" ASPHALTIC CONC. PAVEMENT
② 8" BASE
③ 12" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.2(b)

TYPICAL LOCAL ROADWAY SECTION – COMMERCIAL/INDUSTRIAL



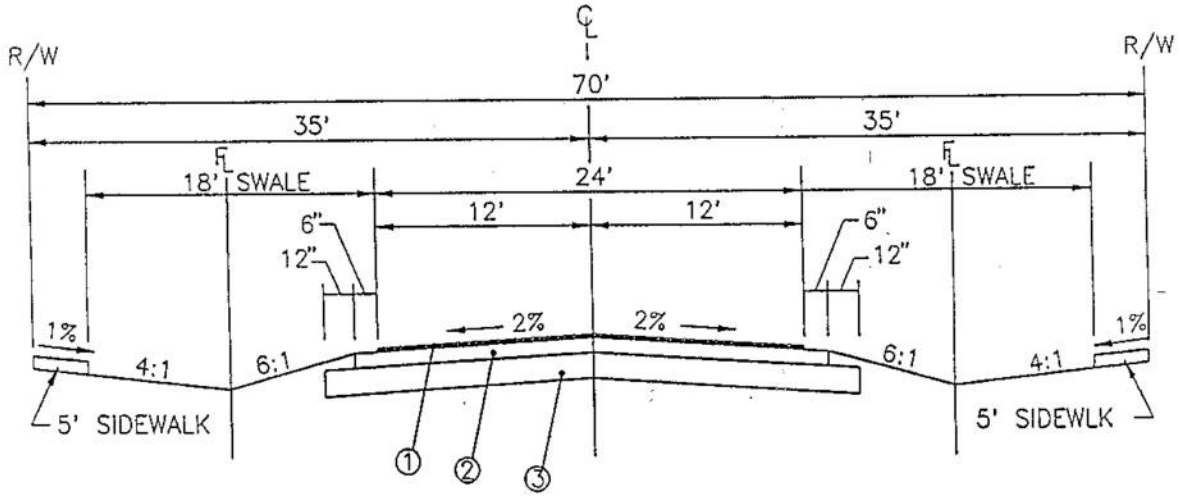
① 1-1/2" ASPHALTIC CONC. PAVEMENT
② 8" BASE
③ 10" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.3(a)

TYPICAL PRINCIPAL LOCAL ROADWAY SECTION - RESIDENTIAL



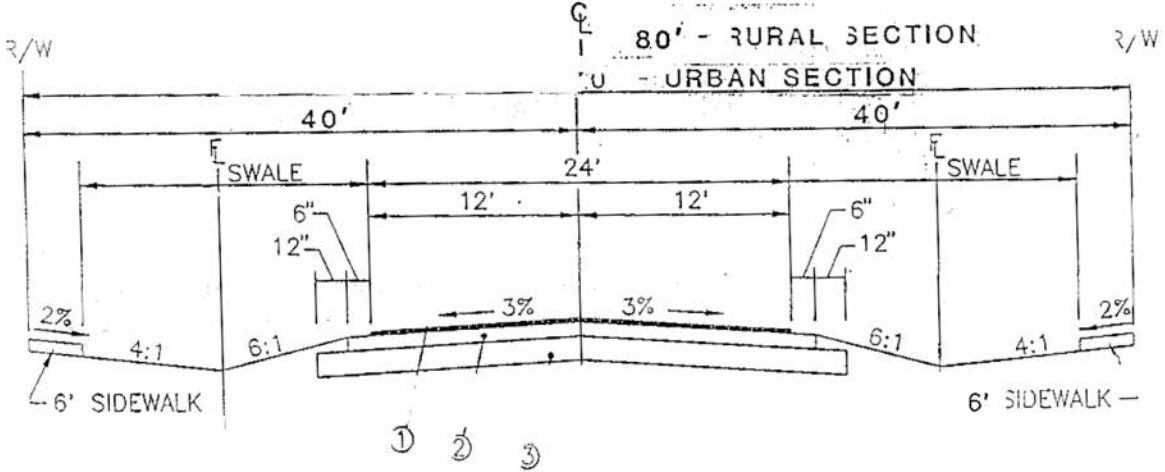
① 2" OR 1-1/2" ASPHALT W/ 1" FRICTION COURSE
② 8" BASE
③ 12" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.3(b)

TYPICAL PRINCIPAL LOCAL ROADWAY SECTION – COMMERCIAL/INDUSTRIAL



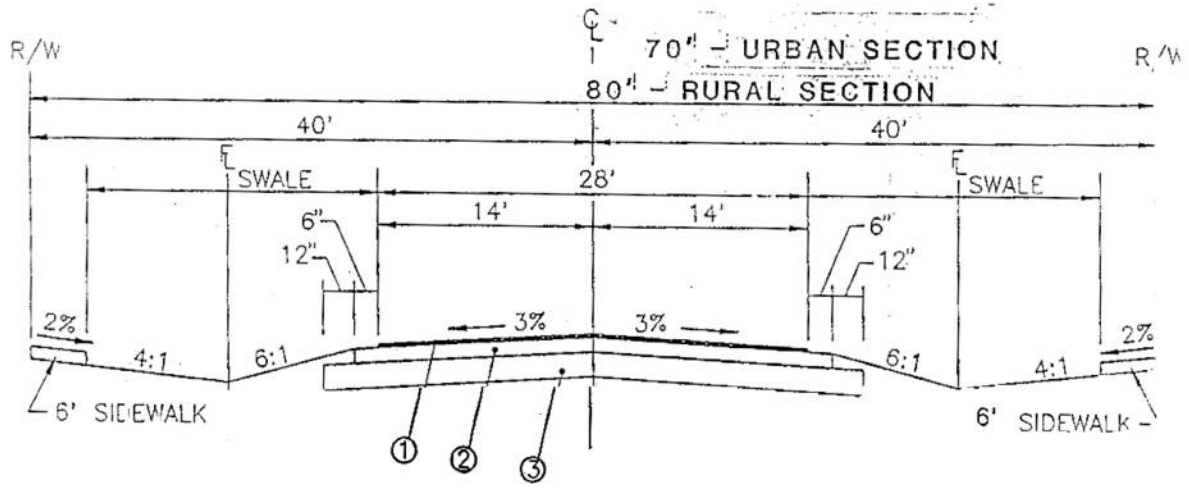
① 1-1/2" ASPHALTIC CONC. PAVEMENT
② 8" BASE
③ 12" SUB-BASE

NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.4(a)
TYPICAL COLLECTOR ROADWAY SECTION - RESIDENTIAL

EFF. DATE 12/12/8
REVISED 11/11/9
12003C1



① 1–1/2" ASPHALTIC CONC. PAVEMENT
② 8" BASE
③ 12" SUB–BASE

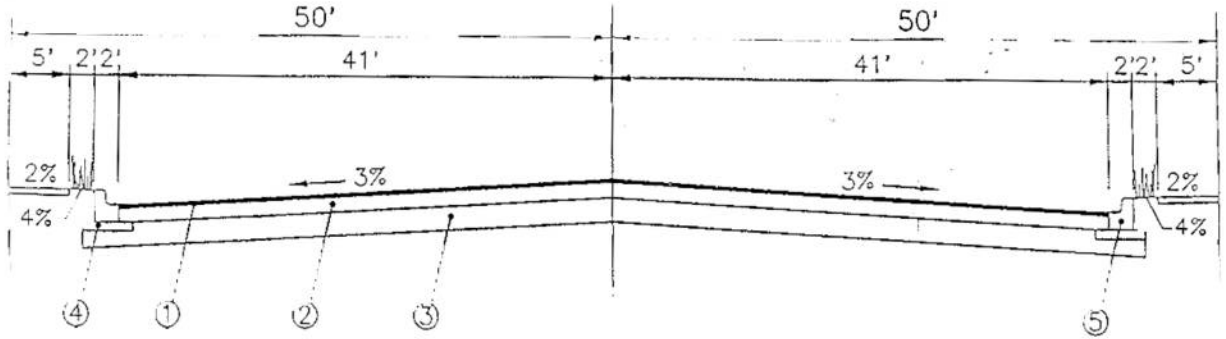
NOTES

1. FOR SECTION W/ CURBING SEE DETAIL 4.13.10

DETAIL 4.13.4(b)

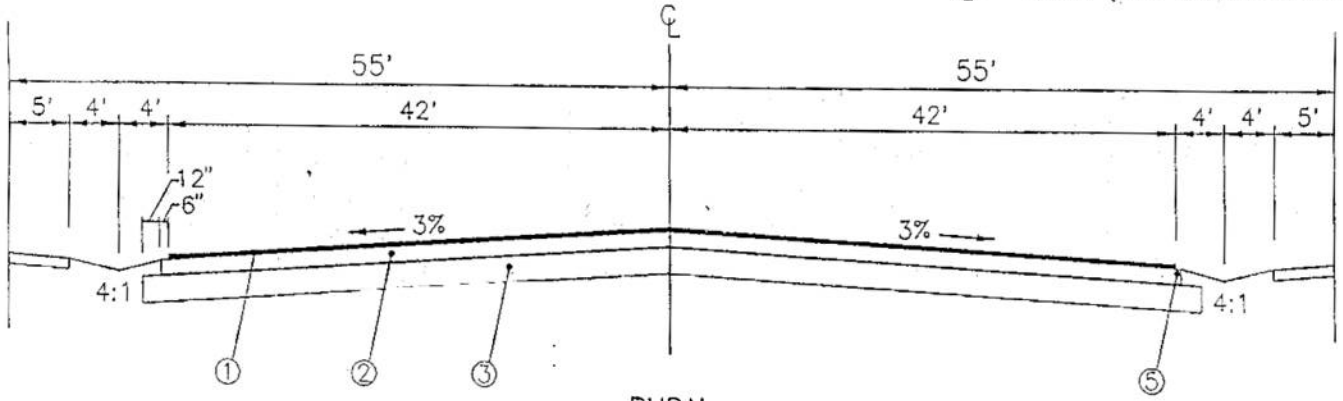
TYPICAL COLLECTOR ROADWAY SECTION – COMMERCIAL/INDUSTRIAL

EFF. DATE 12/12/90
REVISED 11/11/92
12003C15



URBAN

① ASPHALTIC CONC. PAVEMENT
② BASE
③ SUB-BASE
④ STABILIZED SUBGRADE
⑤ CURB (SEE DETAIL 4.13.10)

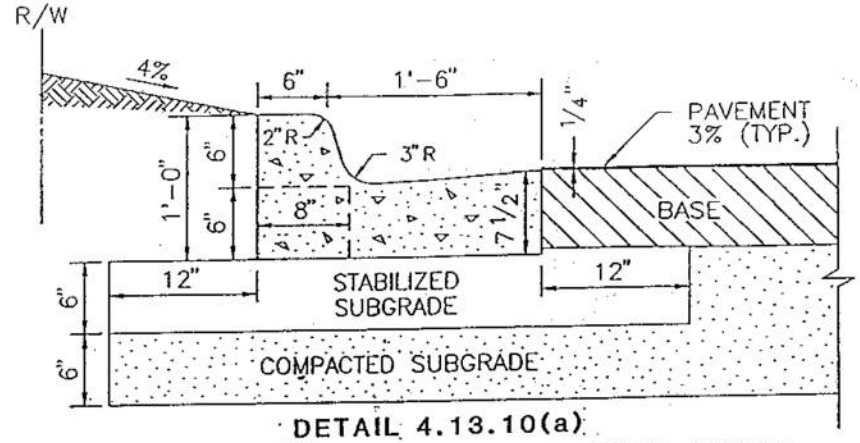


RURAL

① ASPHALTIC CONC. PAVEMENT
② BASE
③ STABILIZED SUB-GRADE

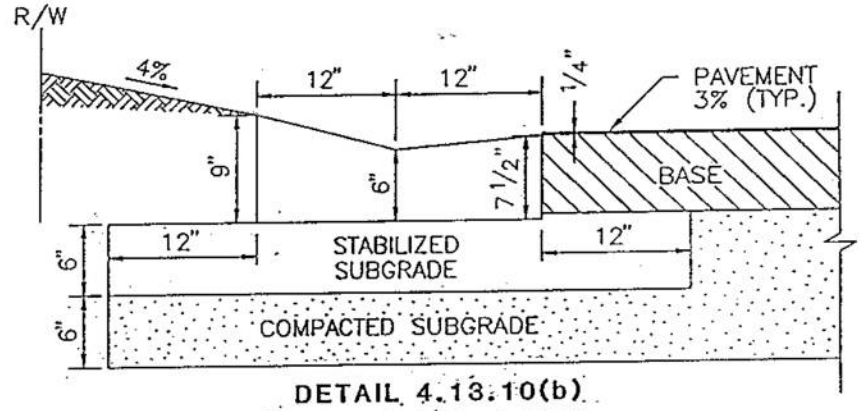
DETAIL 4.13.9
CUL-DE-SAC ROADWAY SECTIONS DETAIL

EFF. DATE 12/12/90
12003C14



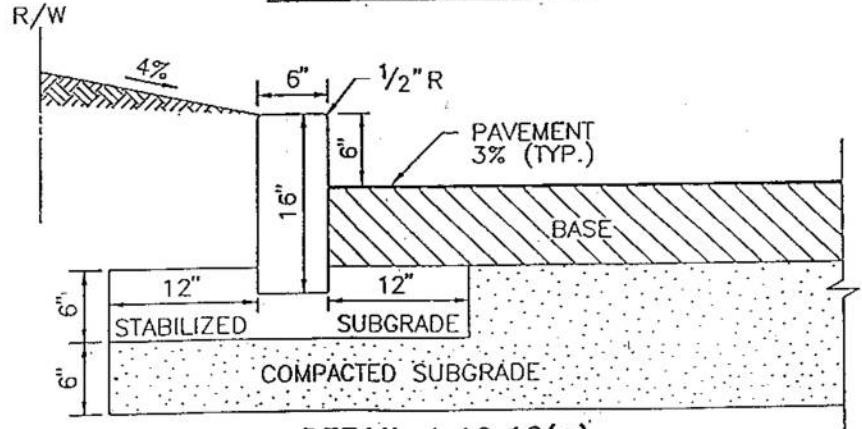
DETAIL 4.13.10(a)

FDOT TYPE 'F' CURB AND GUTTER DETAIL



DETAIL 4.13.10(b)

MIAMI CURB DETAIL

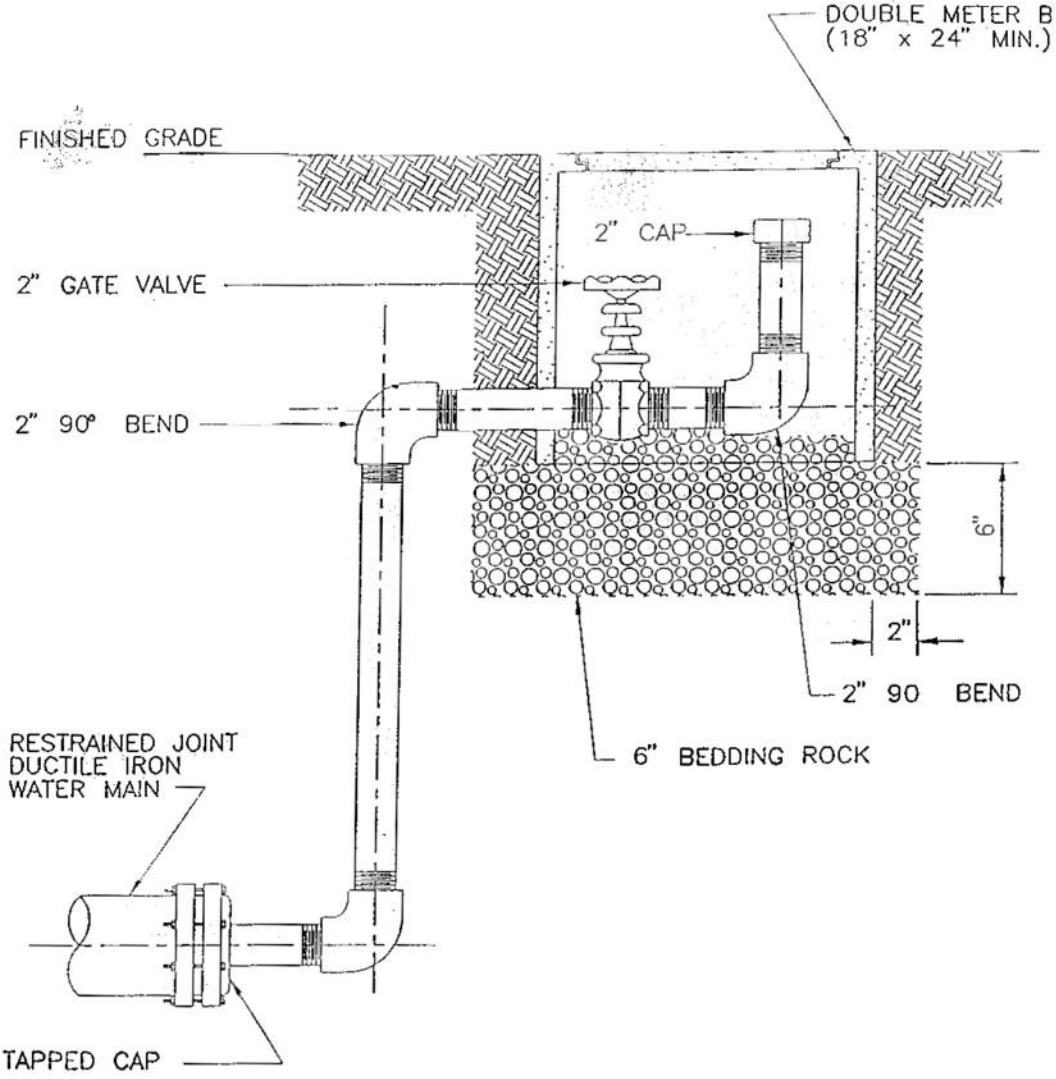


DETAIL 4.13.10(c)

VERTICAL CURB DETAIL

EFF. DATE 12/12

1200



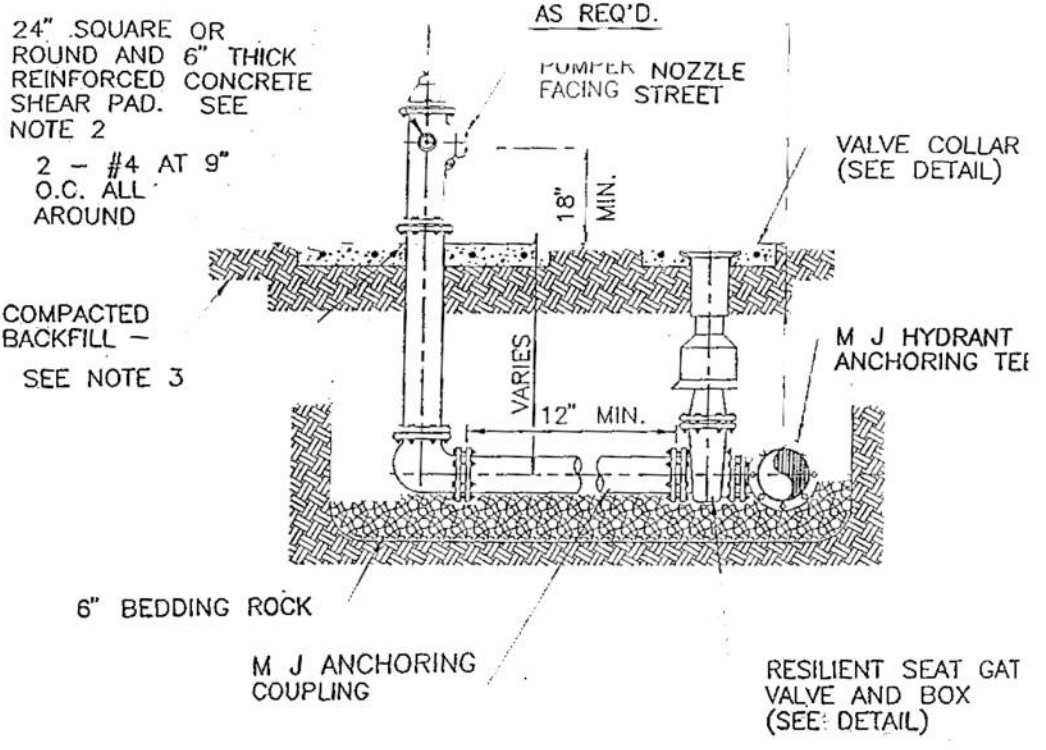
NOTES:

1. ALL 2" PIPE AND FITTINGS SHALL BE SCHEDULE 40 GALVANIZED STEEL OR BRASS WITH THREADED (NPT) JOINTS.

DETAIL 6.2.1 (a)
BLOWOFF VALVE DETAIL

HYDRANT OPERATING

NUT HOSE NOZZLE

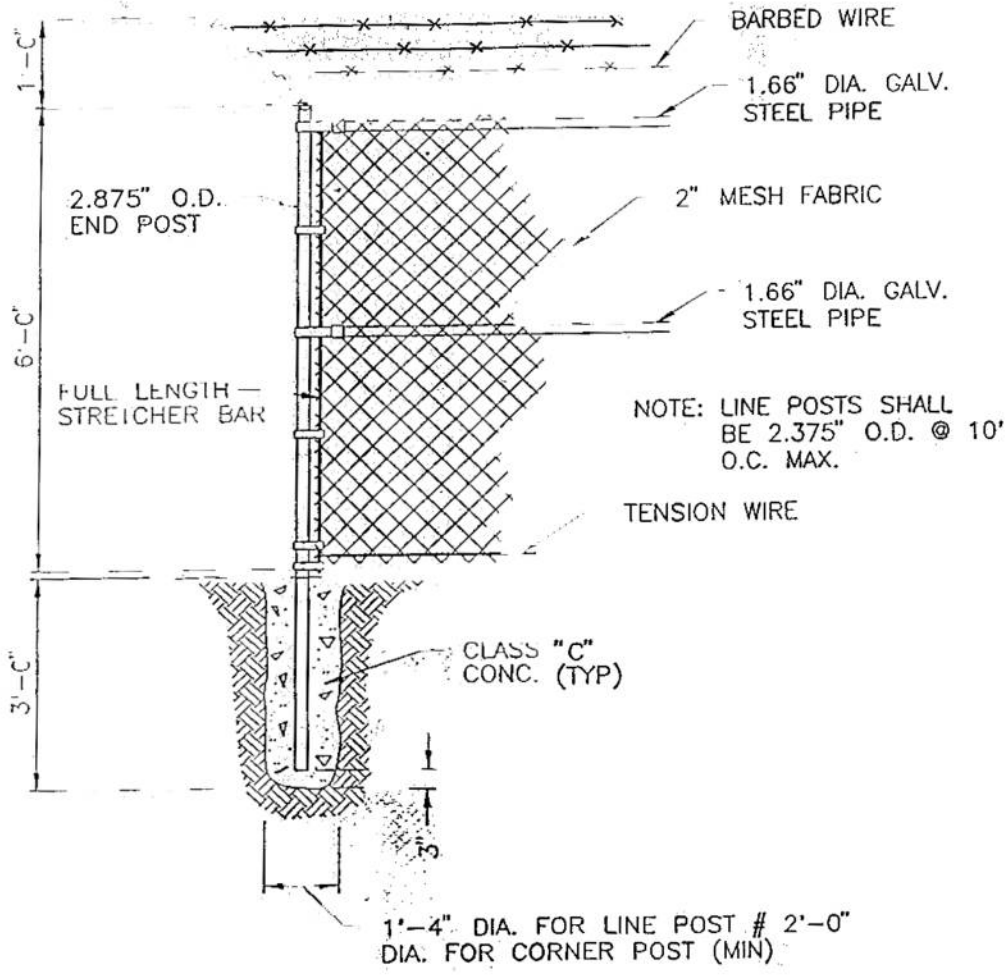


NOTES:

1. FIRE HYDRANT SHALL BE SUPPLIED WITHOUT A WEEP HOLE, OR WITH A PERMANENTLY PLUGGED WEEP HOLE.
2. THE DEVELOPER MAY INSTALL THE SHEAR PAD RECESSED UP TO 4 INCHES BELOW FINISHED GRADE AND SOD THE RECESSED SECTION.
3. CLEARANCE BETWEEN BOTTOM OF BOLTS AND TOP OF SHEAR PAD SHALL BE A 6" MINIMUM.

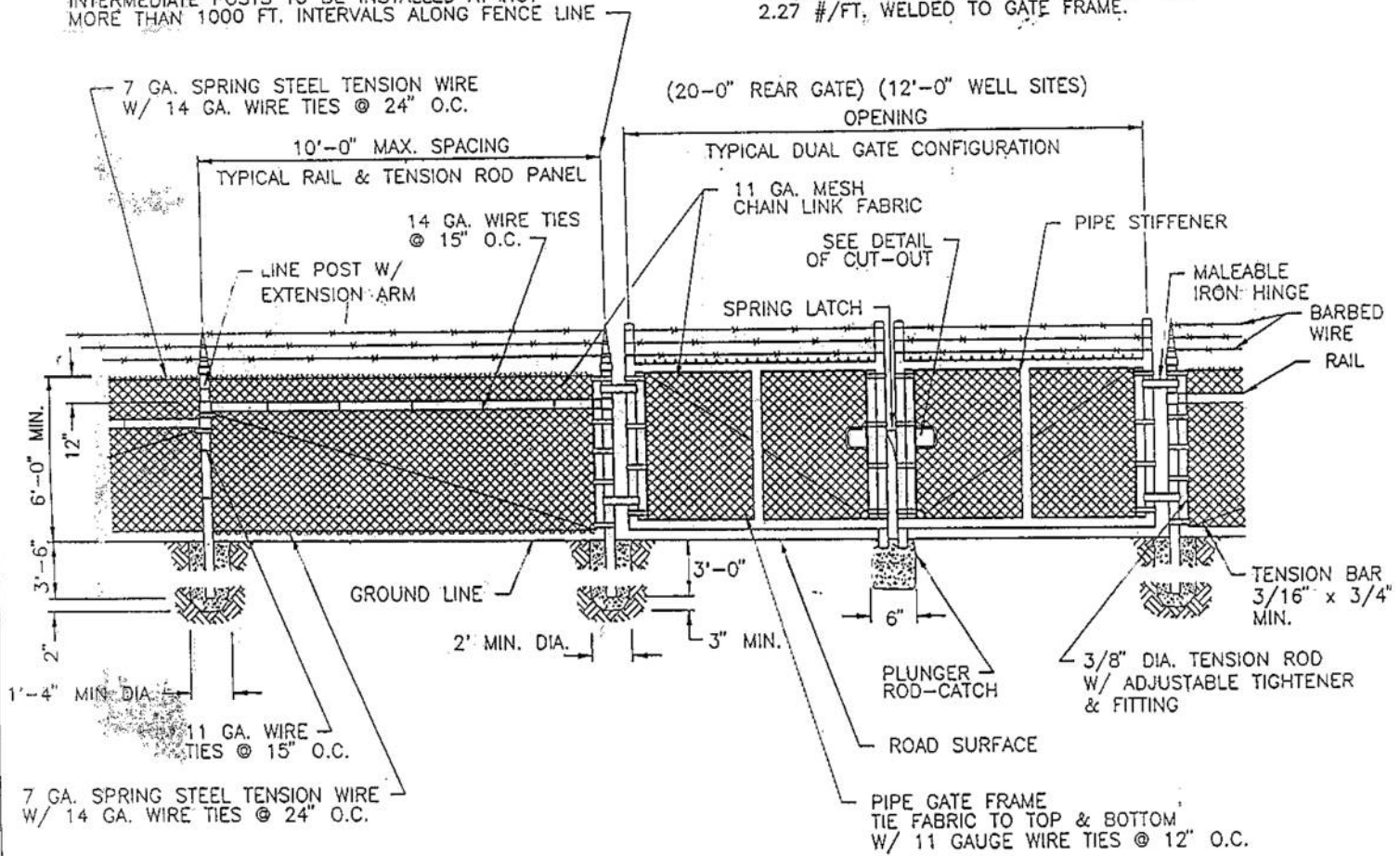
DETAIL 7.1.3
FIRE HYDRANT ASSEMBLY DETAIL

EFF. DATE 12/1



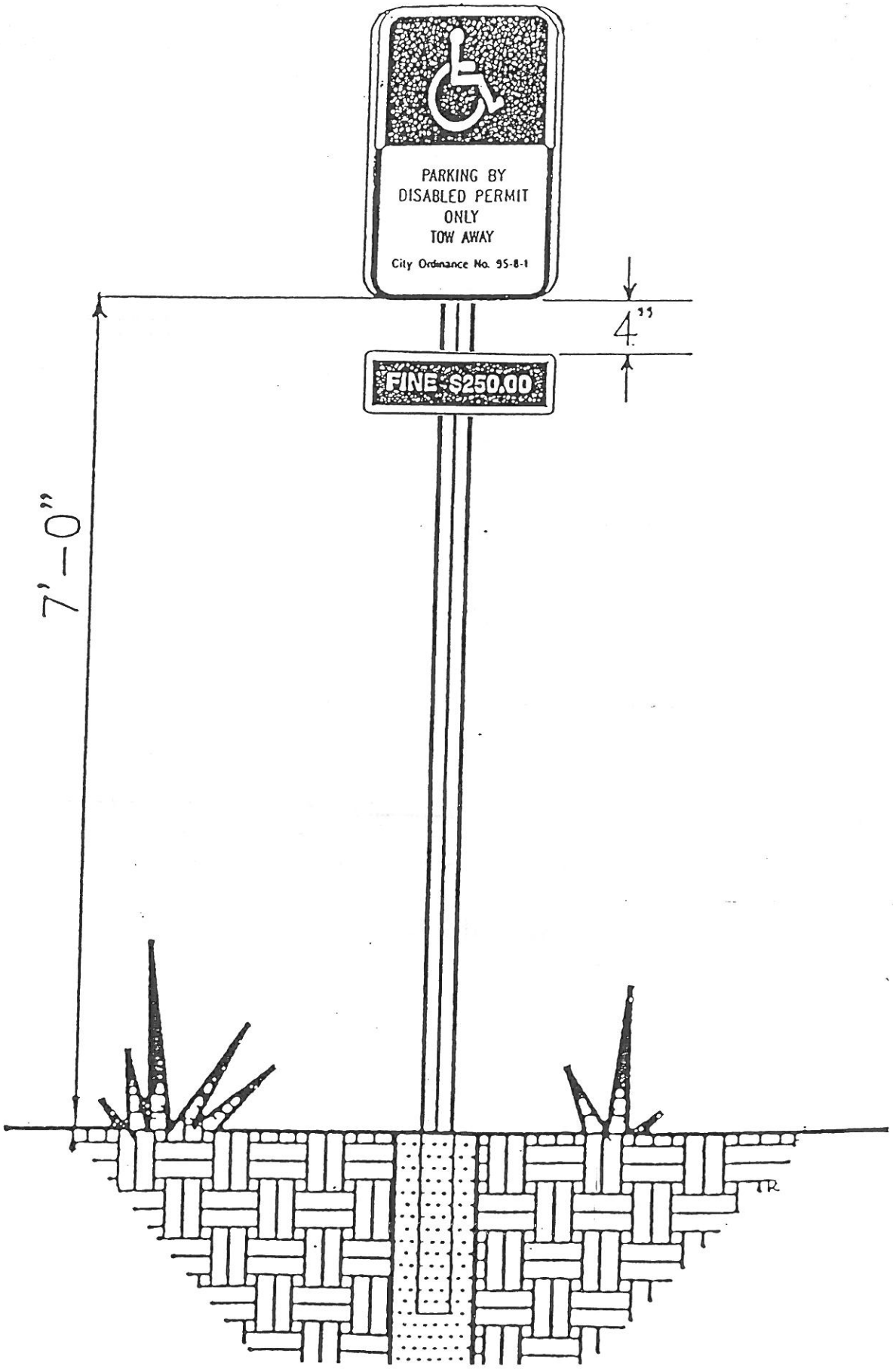
DETAIL 9.3.2 (a)

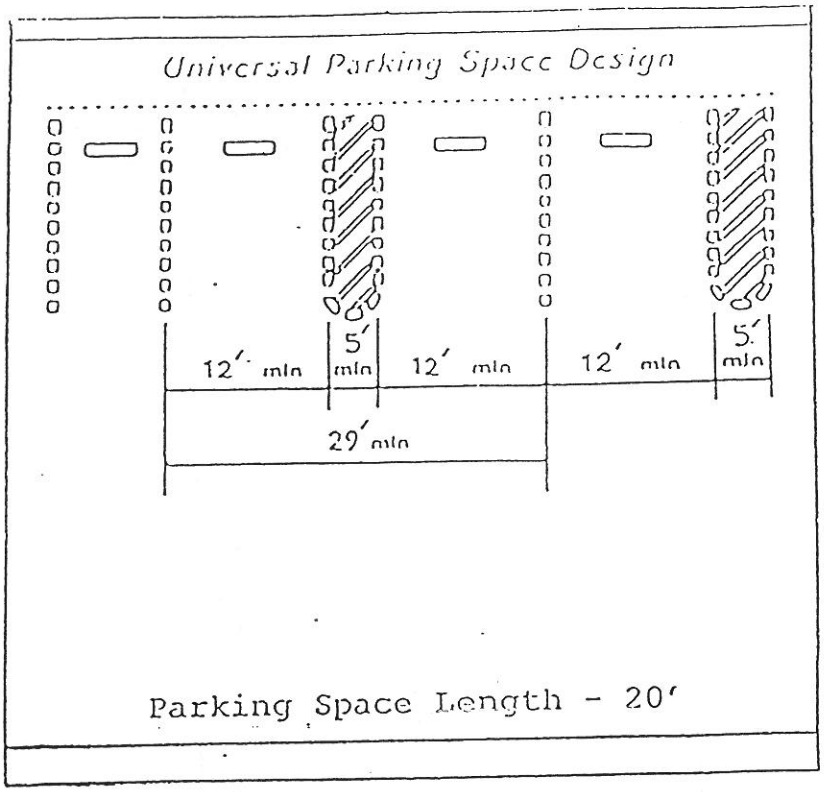
BARBED WIRE TOPPED CHAIN LINK FENCE DETAIL



DETAIL 9.3.2 (b)
DOUBLE SWING GATE DETAIL

1991
12003C08


PARKING BY
DISABLED PERMIT
ONLY
TOW AWAY
City Ordinance No. 95-8-1
4"
FINE $250.00
7'-0"



HANDICAPPED PARKING DESIGN