

APPENDIX B

STANDARD STORMWATER MANAGEMENT FACILITY CONSTRUCTION SPECIFICATIONS*

* **Editors Note:** Printed herein are the Standard Stormwater Management facility construction specifications, as adopted by ordinance number 92-18 on August 27, 1992. Amendments to the ordinance are indicated by parenthetical history notes following amended provisions. The absence of a history note indicates that the provision remains unchanged from the original ordinance. Obvious misspellings and punctuation errors have been corrected without notation. For stylistic purposes, headings and catchlines have been made uniform and the same system of capitalization, citation to state statutes, and expression of numbers in text as appears in the Code of Ordinances has been used. Additions made for clarity are indicated by brackets.

Cross References: Development standards for stormwater management, § 114-381 et seq.; floods, ch. 118.

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The [These] specifications provide minimum standards for the construction of a stormwater management facility which meet conditions as follows:

1. Facility to be constructed within the City of Eustis.
2. Facility to be turned over to the homeowner's association or to the City of Eustis for operation.
3. Facility to become a permanent part in the City of Eustis.

These specifications describe minimum acceptable standards of construction and to promote uniformity where practical. It is felt that adherence to the standards presented will benefit both the citizens of Eustis and the operators of the facility.

Stormwater management shall be in general accordance with the city's adopted planning documents including (A) Stormwater Management Master Plan, 1991, and (B) City of Eustis Comprehensive Plan.

Should any design be submitted which varies appreciably from the standards set herein or uses materials other than those recommended, it should be accompanied by appropriate supporting documentation or engineering studies.

All plans submitted for review must be in conformance with all federal, state, county, and city regulations and codes. Minimum standards will not be less than those established by recognized private and governmental agencies, unless stated otherwise in these specifications.

Plans submittal, site preparation and earthwork shall be in accordance with appendix A of these specifications. Construction specifications for transportation and water and sewer are listed in appendix A and C, respectively.

The developer and his engineers are responsible for obtaining and submitting the required design and construction permits and certification of completion from St. Johns River Water Management District, Florida Department of Transportation, Lake County Environmental Services, and other regulatory agencies with jurisdiction on the project, to the city.

SECTION 1.

STORMWATER RUNOFF STORAGE BASINS

Sec. 1.1. Description.

Stormwater runoff storage basins include retention and detention basins in a new development. The basins shall be rectangular, square, round or irregular shapes. The basins shall be designed to store stormwater runoff based on the appropriate storm events as described in art. V of chapter 114, Code of Ordinances.

Sec. 1.2. Requirements.

Stormwater runoff storage basins shall be constructed with or without overflow structures. Total runoff on-site containment is required. The bottom elevation of the basins shall be a minimum of three feet above the seasonal high water elevation for dry basins. Percolation tests for the storage basins shall be provided to the city prior to construction. All basins shall be cleared of organic matter and mud and filled with clean sand. The storage basins shall be two to eight feet deep with a maximum side slope not to exceed 1:4.

Sec. 1.3. Overflow structures.

Overflow structures of the storage basins, if required, shall be constructed of corrosion-resistant materials, such as concrete or aluminum, with skimming device. The skimming device shall be of aluminum or stainless steel construction and shall be placed at a minimum elevation of 12 inches below the top of the berm. The outfall of the overflow structure shall be underground drain pipe directed to the adjacent storm sewer, canal, lake or river approved by the city and other regulatory agencies. A typical detail of the overflow structure is shown in Drawing No. 1 at the end of this appendix [which is on file with the city engineer].

Sec. 1.4. Inlet structures.

Inlet structures to the storage basins shall be concrete flume type design with energy dissipators. The flume shall be constructed with a minimum of four-inch-thick reinforced concrete slab parallel to the finished side slope of the basins. The apron of the flume shall extend horizontally five feet toward the center of the basin. Underground drain pipe to the storage basins shall be mitered end section type design, FDOT Index 272, connected and flushed with the concrete flume. The inlet structures shall be constructed on the compacted subbase. A typical detail of the inlet structure is shown in Drawing No. 2 [at the end of this appendix] [which is on file with the city engineer].

Sec. 1.5. Berms.

The minimum width of the basin berms shall be 20 feet for easement and maintenance purposes. The berms shall be constructed with compacted clean sand or clay and free of organic materials. The berm shall not be more than two feet above the finished ground level.

Sec. 1.6. Sod, seed and mulch.

All side slopes of the storage basins shall be sodded to the horizontal levels extending two feet from the edge of the slopes. The flat bottom and top of the basins beyond the sodded areas shall be seeded and mulched. Frequent irrigation of the grassed areas is required daily for the first seven days to ensure germination and twice a week thereafter for a period of three weeks.

Sec. 1.7. Fencing.

Fencing of stormwater storage basins shall be considered under certain circumstances for safety purposes. All basins with standing water more than three months in a year shall be fenced. Dry basins with depths greater than four feet or side slopes steeper than 1:4 shall be fenced. All fences and gates shall be six feet high chain link type fencing with 12 feet wide gates for maintenance purposes.

Sec. 1.8. Operation and maintenance.

The design and construction of the storage basins shall provide the intended function of the system during storms. The assigned authorities shall provide regular maintenance of the storage basins such as mowing, cleaning of inlet and outlet structures, debris removal from the basins, flushing inlet and outlet lines and regular inspections of the inlet and outlet structures, berms and basins for leaks, erosion, etc.

SECTION 2.

DRAINAGE SWALES

Sec. 2.1. Description.

Drainage swales are mainly used for runoff conveyance rather than storage or the combinations of both. Swales are normally shallow depressions not greater than three feet in depth with mild slopes to facilitate ease of maintenance. Swales are normally constructed parallel to both sides of the road to direct runoff from the roads and convey the excess runoff to the storage basins.

Sec. 2.2. Requirements.

Swales shall be constructed to provide a top width-to-depth ratio of the cross section equal to or greater than 6:1, or side slopes equal to or greater than three feet horizontal to one foot vertical. Swale blocks shall be provided along the flow path on steep areas to reduce erosion problems. The top elevation of the swale blocks shall be a minimum of six inches below the adjacent ground level. The swales shall have a minimum grade of 0.05 percent for effective runoff conveyance.

Sec. 2.3. Inlet structures.

Runoff inlet structures from the swales to the storage basins through underground drainage pipes shall be in accordance with FDOT Index 232. The use of inlet structures on the swales is strongly discouraged due to maintenance problems. Direct flow of runoff through a continuous swale system to the storage basin spillway is highly recommended.

Sec. 2.4. Sodding.

All swales shall be sodded two feet beyond the top horizontal level to enhance stability and operation efficiency. The contractor may elect to temporarily seed and mulch the swales prior to the construction of buildings and provide permanent sodding of the swales at a later time after the building is constructed. In this case, the contractor shall exercise care and prudent judgement to restore the swale grade lines to the designed

grades in accordance with the approved plans.

SECTION 3.

STORM SEWER AND CULVERT

Sec. 3.1. Description.

Storm sewer is generally used to convey stormwater runoff from the inlet structures to the storage facility. A culvert is a flow conduit beneath and across a driveway or infrastructures. Both the storm sewer and culvert are normally large conduits to convey a large volume of runoff within a short period of time.

Sec. 3.2. Requirements.

Both the storm sewer and culvert shall be of reinforced concrete pipe (RCP) or corrugated metal pipe (CMP) and shall be a minimum of 15 inches in diameter. All storm sewers and culverts shall be designed and constructed to provide a minimum flow velocity of two feet per second and a maximum velocity of 15 feet per second. All storm sewers shall be designed for the tailwater conditions of the receiving facility, or water, and the hydraulic gradient of the drainage system is to provide a positive flow path for any storm events.

Sec. 3.3. Reinforced concrete pipe.

Reinforced concrete pipe shall be a minimum of class III, conforming to the ASTM Designation C-76. The joints shall have a continuous O-ring rubber gasket, or approved equal, which fits snugly in the annular space between the beveled surfaces of the tongue and groove ends of the pipe to form a flexible watertight joint. There shall be no exposed metal in the joint, except that allowed by ASTM and FDOT for "chair". Elliptical concrete pipe joints shall be wrapped with filter fabric extending one foot on both sides of the joint and a two-foot overlap on the top.

Sec. 3.4. Corrugated metal pipe.

Corrugated aluminum alloy pipe shall conform to the current A.A.S.H.T.O. Standard Specification M-196. Aluminum coated steel sheets for corrugated metal pipe shall conform to the current A.A.S.H.T.O. Standard Specification M-244. Metallic coated corrugated steel pipe shall conform to the current A.A.S.H.T.O. Standard Specification M-36. All corrugated metal pipe installed shall have a continuous helical lock seam or a continuous welded helical seam. Riveted seams, spot welded seams, or non-helical corrugated metal pipe are prohibited.

The ends of all corrugated metal pipe shall be recorruagated and the pipe supplied with a metal banding system. The metal band system shall have a rubber gasket, or approved equal, which shall fit snugly in the space between the recorruagated end and metal band. The band shall be a minimum of two feet in width.

All joints within six feet of a pavement shall be wrapped with typar, or approved equal. The material shall extend a minimum of three feet on both sizes of the joint and shall have a two-foot overlap on the top of the pipe. All joints shall be wrapped with filter fabric.

Sec. 3.5. Pipe slopes.

The minimum pipe slopes of the sewer shall be as follows:

Pipe Diameter (inches)	Minimum Slope	
	RCP (percent)	CMP (percent)
15	0.40	1.03
18	0.30	1.00
24	0.20	0.70
30	0.15	0.50
36	0.10	0.40
42	0.08	0.30
48	0.07	0.25
54 or larger	0.05	0.20

Sec. 3.6. Sewer manholes.

The storm sewer manholes shall be of precast concrete construction and shall have a minimum inside diameter of 48 inches.

- A) Precast reinforced manholes shall be in accordance with ASTM Designation C478, with pre-formed flexible plastic joint sealer conforming to Federal Specification SS-S-0210 (GSA-FSS).
- B) Manhole frames and covers shall be gray cast iron conforming to ASTM Designation A48, Class 30, and shall have a minimum 24 inches opening. Covers shall be marked with "Storm Sewer" signs. Frames and covers shall be fully bedded in mortar to the correct finish grade elevation, with adjustment brick courses placed below, as detailed for precast manholes. There will be no steps allowed in manholes.
- C) Manhole flow channels shall have smooth and carefully shaped bottoms, built up sides and benching constructed from concrete. Channels shall conform to the dimensions of the adjacent pipe and provide changes in size, grade and alignment evenly. A flow channel shall be formed in the invert of all inlets, manholes and junction boxes and shall extend to the spring line of the pipe.
- D) Precast manholes, inlets and junction boxes shall be in accordance with ASTM C-478. The inlet and outlet pipes shall be flushed with the inside face of the wall. Mortar bonding shall be required between pipe and structure wall.
- E) The interior surfaces of the manholes shall be protected by two coats of Koppers Bitumastic No. 300M, or approved equal. The exterior surfaces shall receive two coats of Koppers Bitumastic Black Solution, or approved equal.

Sec. 3.7. Pipe depth and protection.

The minimum cover for storm sewer shall be two feet from the top of the pipe to finish grade. The

minimum cover for culvert from the bottom roadway base to the exterior pipe is 12 inches.

Sec. 3.8. Maximum lengths of pipe.

The maximum runs of pipe between the manholes are as follows:

Pipe Size (inches)	Maximum Length (feet)
15 to 18	300
24 to 36	400
42 and larger	500

Sec. 3.9. Laying pipe.

All pipe shall be carefully laid, true to the lines and grades as shown on the plans. For pipe laid with rubber gasket joints, any deviation from true alignment or grade which would result in a displacement from the normal position of the gasket of as much as one-fourth inch, or which would produce a gap exceeding one-half inch between sections of pipe for more than one-third of the circumference of the inside of the pipe, will not be acceptable, and where such occurs, the pipe shall be relaid. No mortar, joint compound, or other filler which would tend to restrict the flexibility of the gasket joint shall be applied to the gap.

Sec. 3.10. Backfilling.

Backfilling shall progress immediately when the construction and testing of the pipe are complete. All backfill material shall be free of organic material, construction debris, concrete, and other deleterious materials. The initial backfill shall be carefully deposited on both sides of the pipe and uniformly compacted around the barrel of the pipe until sufficient fill material has been placed to provide a cover of two feet above the crown of the pipe. The backfill across the roads shall be placed and compacted to an average density of 95 percent of the maximum density value as determined by A.A.S.H.T.O. T-180.

Sec. 3.11. Culverts.

Culverts crossing the street or driveway shall be terminated with endwall or mitered end section at both ends. Drain pipe outfall to the open channel shall also be equipped with endwall or mitered end section. Endwall shall be in accordance with FDOT Index 250, 261 or 266. Mitered end section shall be in accordance with FDOT Index 273.

SECTION 4.

UNDERDRAIN SYSTEM

Sec. 4.1. Description.

An underdrain system is specifically used for extreme conditions where other means of positive drainage conveyance are exhausted. The underdrain system tends to clog and therefore requires regular inspection and cleaning. An underdrain system, if used, shall be preapproved by the city. All underdrain pipes shall have a minimum diameter of six inches.

Sec. 4.2. Requirements.

An underdrain system is to be used at existing developed areas where limited space and drainage infrastructures exist. Drainage net works for retention/detention basins and swales for new development areas are strongly discouraged. An underdrain system consists of perforated pipe wrapped with filter fabric. The wrapped pipe is embedded in filter aggregate in which stormwater runoff seeps into the pipe for storage, exfiltration and conveyance. Underdrain pipes shall be constructed at a minimum grade of 0.1 percent.

Sec. 4.3. Filter fabric.

The filter fabric shall be of strong, tough, porous nylon, polyester, polypropylene, or other fabric which completely covers and secures to the underdrain pipes and aggregate in such a way as to prevent infiltration of trench backfill material. The filter fabric shall be in accordance with FDOT Standard Specifications for Road and Bridge Construction, section 985. All filter fabric joints shall overlap a minimum of one foot.

Sec. 4.4. Filter aggregate.

Coarse aggregate shall be used as the inner layer for the filter fabric envelope. The coarse aggregate shall consist of hard, durable, clean quartz gravel of one to one-half inch in size, meeting the requirements of FDOT Standard Specifications for Road and Bridge Construction, section 901-1.4, No. 5. The coarse aggregate for the filter fabric envelope shall be constructed in accordance with FDOT Index 286, type III.

Fine aggregate shall be used as the outer layer around the filter fabric envelope. The fine aggregate shall consist of hard, durable, clean quartz sand, reasonably graded from coarse to fine, meeting the requirements of FDOT Standard Specifications for Road and Bridge Construction, section 902-2. The fine aggregate around the filter fabric envelope shall be constructed in accordance with FDOT Index 286, type III.

Sec. 4.5. Underdrain pipe.

Underdrain pipe shall be of corrugated polyethylene tubing conforming to A.A.S.H.T.O. M-252.

Sec. 4.6. Excavation trench.

The trench shall be excavated to such depth and width as required to permit the pipe to be laid to the grade desired, and to the dimensions shown in the plans.

The underdrain trench shall be constructed in a dry condition.

Sec. 4.7. Placing the filter fabric.

After the trench has been excavated, the filter fabric shall be rolled out over the trench and walked into the trench. Care shall be taken to prevent the excavated material from entering the trench after the fabric has been installed.

Sec. 4.8. Laying the pipe.

After the filter fabric has been placed in the trench, approximately six inches of coarse aggregate shall be placed in the trench. The pipe shall be bedded firmly in the filter aggregate to the correct line and grade. The upper end of the run of pipe shall terminate at a drainage structure or underdrain cleanout to prevent any filter aggregate from entering the pipe.

All lateral connections to underdrains shall be made at approved drainage structures. The maximum spacing of cleanouts or structures shall be 200 feet.

Sec. 4.9. Placing and compacting filter aggregate.

After the pipe has been laid to grade, the pipe shall be firmly held in place by mechanical means while the filter coarse aggregate is placed to a maximum height of six inches (compacted) above the top of the pipe. After the first lift is placed and compacted, the remainder of the filter coarse aggregate shall be placed. The procedures and steps of excavation, filter fabric placement, and aggregate placement and compaction shall be accomplished in a single continuous operation.

Sec. 4.10. Backfill filter fine aggregate.

After the filter coarse aggregate has been placed 12 inches above the pipe, the filter fabric shall be lapped the full width of the trench from both sides to form a filter fabric envelope. The portion of the trench outside the filter fabric envelope shall be filled with filter fine aggregate which shall be placed and tamped in layers to the existing grade.

SECTION 5.

EROSION AND SEDIMENT CONTROL

Sec. 5.1. Description.

Erosion caused by stormwater runoff on the bare ground surface during land development and construction results in transporting topsoil to the downstream as sediment. The accumulation and deposition of sediment on canal, river, lake, swale or retention/detention basins impairs flow and reduce storage volume and water quality of the receiving water. Erosion and sediment control measures shall be implemented on all land development in the city.

Sec. 5.2. Requirements.

The erosion and sediment control plans shall be submitted to the city prior to site plan approval. The control plans shall indicate existing and proposed grading, runoff flow and temporary containment, stockpiling material, temporary surface cover, siltation barriers, etc.

Sec. 5.3. Stockpiling material.

No excavated material shall be stockpiled in such a manner as to direct runoff directly off the construction site or into any adjacent water body or stormwater collection facility.

Sec. 5.4. Exposed area limitation.

The surface area of open and erodible soil exposed by clearing and grubbing operations or excavation and filling operations shall be limited to an extent that temporary measures such as mulching can be provided to stabilize the surface soil daily. Exposed and bare land surface for a period of not more than 30 days shall be stabilized with a quick growing grass species which will provide an early cover during the season in which it is planted, and will not later compete with the permanent grassing. The rate of seeding shall be 30 pounds per acre.

Sec. 5.5. Inlet protection.

Inlets and catch basins shall be protected from sediment laden stormwater runoff during construction phase by installing bailed hay or straw barriers at the entrance in accordance with FDOT Index 102.

Sec. 5.6. Temporary seeding and mulching.

Land slopes steeper than 6:1 shall additionally receive mulching of approximately two inches loose measure of mulch material cut into the soil of the seed areas to a depth of four inches.

The seeded or seeded and mulched areas shall be rolled and watered as required to assure optimum growing conditions for the establishment of a good grass cover.

Sec. 5.7. Permanent seeding and mulching.

All exposed finish surfaces after grading shall be seeded and mulched to achieve the level of protection from erosion. Finish ground slopes from 6:1 to 4:1 inclusive shall be mulched with two inches of loose mulch material cut into the soil of the seeded area to a depth of four inches.

Sec. 5.8. Permanent sodding.

All retention/detention basins and swales shall be sodded in accordance with sections 1.6 and 2.4 of this manual. Strip sod shall be placed adjacent to all curbs, walks, pavement and inlet structures.

Sec. 5.9. Turbidity barriers.

All constructions within the vicinity of receiving water, such as canal, river, lake or wetlands, shall install turbidity barriers along the shore of the receiving water. The installation of turbidity barriers shall be in accordance with FDOT Index 103.

Sec. 5.10. Standard details chain link fence.

A. Materials.

Types of fencing:

Chain link. Install seven-foot high fencing, consisting of six feet of chain link and three strands of barbwire. Specific location of fence construction shall be as shown on the plans.

Fabric. Use two-inch mesh, 9 gauge galvanized after weaving, six feet high to form a continuous chain link fabric.

Barbwire: Use 12 1/2 gauge wire with four barbs spaced approximately five inches apart, zinc-coated with a minimum coating of 0.80 ounce per square foot of surface area. Support three strands of barbwire on arms extended one foot above the fence and at a 45-degree angle.

Zinc coating. Zinc coat after fabrication all steel and iron parts using zinc grade "E" in accordance with Federal Specifications WW-C-351. Cover each square foot of actual surface with not less than 1.2 ounces of zinc coating.

Posts, frames and braces:

Chain link. Using posts and frames with the following minimum dimensions and weights:

- a. Line posts - 1.9 inches O.D., 2.72 pounds per foot, 0.145-inch wall thickness.
- b. End, corner, gate and pull posts - 2.875 inches O.D., 5.79 pounds per foot, 0.203-inch wall thickness.
- c. Top rails, bracing and gate frames - 1.66 inches O.D., 2.27 pounds per foot, 0.14-inch wall thickness.

Stretcher bars. Minimum three-sixteenths inch by three-quarters inch, and one inch less in length than the full height of fabric.

Post tops. Ornamental tops or combination tops and barbwire supporting arms with hole for purpose of top rail of a size to fit over outside of posts to exclude moisture.

Top rail couplings. Minimum six inches long.

Bottom tension wire. Use a No. 7 gauge galvanized spring coil or crimped wire.

Concrete. DOT Spec. paragraphs 345-2, 345-3, 345-4, 345-6, 345-9, 345-10, 345-11, 345-12, and 345-13, except that the word "Department" shall be taken as "Owner." Make all concrete with class 1 concrete, minimum 28-day compressive strength of 2,500 psi.

B. Installation.

Line posts - Chain link. Uniform space line posts a maximum of ten feet apart.

Pull posts - Chain link. Install pull posts as required for proper installation.

Posts - Chain link. Do not stretch fabric until concrete has cured a minimum of three days. Set posts plumb. Set all posts at least 33 inches deep into a 36-inch deep by one-foot diameter concrete foundation crowned to shed water.

Leaf gates. Gate will be six feet wide each leaf of a 12-foot overall width double leaf gate as shown on the drawings and six feet high with three strand barbed wire on top to match fence used. The gate shall be properly trussed to prevent sag using two inches O.D. minimum schedule 40 galvanized pipe. The hardware shall be of adequate design and strength to provide satisfactory operation. Gate shall be capable of being opened and closed easily by one person. Also, there shall be provided a hardware and locking system to be approved by the owner.

Corner, end, pull and gate posts. Brace all corner, end, pull and gate posts with 1.6-inch O.D. galvanized steel tubes and fittings in each direction.

Top grade. Construct the top of fence to a uniform line or grade to present an even appearance.

Top rail. Form a continuous brace from end to end and pass through line posts.

Bottom tension wire. Stretch taut between terminal posts and securely fasten to each intermediate post six inches above finished grade. Attach to fabric with galvanized hog rings every 14 inches.

Ties. Provide ties or clips of adequate strength in sufficient number for attaching the fabric to all line posts at intervals not exceeding 15 inches. Stretch fabric taut without sag and securely fasten to all posts. Provide one stretcher bar for each gate and end post and two for each corner and pull post. Top rail ties shall be on 24-inch centers.

Barbed wire. Install extension arms. Tightly stretch and secure barbed wire to each arm or post as the fence type dictates.

Grounding. Install electrical ground at locations and according to details shown on the drawings for all fencing installations where the site is served by overhead electrical service.

Clearing. Where the clearing and grubbing for the project does not include the area occupied by the fence, clearing shall be done to the limits shown on the plans. If the limits are not shown on the plans, clearing shall be done to a width of at least two feet on each side of the fence line, except that the engineer/owner may direct that valuable trees be left in place. Such clearing shall not extend beyond the right-of-way or property line.

Construction over irregular terrain and other obstructions:

1. *Clearance of bottom of fence.* The bottom of the fence shall, in general, follow the contour of the ground. The fence is detailed in the plans at approximately three inches above ground line. Over irregular ground, however, a minimum clearance of one inch length and a maximum clearance of six inches will be permitted for a length not to exceed eight feet, and for type A fence, with the barbed wire spaced midway between ground and bottom of fabric.

2. *Grading.* Where necessary to secure proper vertical alignment, and to meet the clearance requirements specified above, depressions shall be substantially filled (except where filling would obstruct proper drainage) and knolls and ridges cut down; all in such manner as to provide a substantial and permanent foundation for the fence.
3. *Use of extra-length posts.* At locations where it is impractical to adjust the ground level, the engineer/owner may require that posts of additional length be set and that the opening at the bottom be closed by additional barbed wire, stretched taut between poles, with no vertical distance between wires greater than three inches. For all such posts requiring a concrete base, the concrete shall be extended downward to the bottom of the extra-length post.

Sec. 5.11. Illustrations and drawings.

The illustrative drawings that might be required in this section are on file with the city engineer.