Summary of Updates to 2023 Drainage Manual

Chapter 3 – Storm Drain Hydrology and Hydraulics

Section 3.9.1 – Added spread analysis during MOT and additional spread language from the Turnpike Drainage Handbook.

Section 3.9.3 – Changed “associated with” to “required for” typical section approval, to match the language added to the FDM from the Turnpike Drainage Handbook.

Section 3.11 – Added requirement to provide verification of wall zones.

Section 3.12.3 – Added requirement for resilient connectors for vertical pipes.

Section 3.13.1 – Updated documentation reference to reflect the switchover to FDM 900/ Open Roads Designer

Chapter 5 – Stormwater Management

Section 5.4.1.1 – Added language from the Turnpike Supplement regarding treatment swales and base clearance.

3.8 GRADES

3.8.1 Longitudinal Gutter Grade

The minimum longitudinal gutter grade is 0.3 percent.

3.9 PAVEMENT HYDRAULICS

3.9.1 Spread Criteria

The spread criteria listed is for permanent design and temporary construction conditions. Limit the spread resulting from a rainfall intensity of 4.0 inches per hour as follows.

Table 3.5: Spread Criteria

Typical Section Condition	Design Speed (mph)	Spread Criteria*
Parking Lane or Full Width Shoulders	All	No encroachment into the lane
Left Turn Lanes	Design Speed > 45	Keep 8’ of lane clear
Right Turn Lanes	All	Keep ½ of lane clear
All Other	Design speed ≤ 45	Keep ½ of lane clear
	45 < Design Speed ≤ 55	Keep 8’ of lane clear
	Design Speed > 55	No encroachment into the lane

* The criteria in this column apply to travel, turn, or auxiliary lanes adjacent to barrier wall or curb, in normal or super-elevated sections.

In addition to the above standards, for sections with a shoulder gutter, the spread resulting from a 10-year frequency storm will not exceed one foot, three inches outside the gutter in the direction toward the front slope. This distance limits the spread width to 6 ft, to provide clearance to the face of guardrail posts. See ***Standard Plans, Index 536-001***.

Design temporary drainage, for traffic diversions and construction phases, to provide drainage where construction activities may divert or trap water, compromising the safety and efficiency of the travel lanes. Give additional attention to expected spread for areas that are: (1) flood sensitive, (2) high-speed facilities (> 55 mph posted speed), or (3) using a low side barrier wall. Bridge deck spread must be evaluated for all bridges including MOT phases.

The Bridge Development Report (BDR) must include preliminary spread calculations for the bridge deck in order to determine whether additional drainage conveyance is required. Typical drainage conveyance costs may include, but are not limited to, additional shoulder width during construction, bridge deck drains, and conveyance systems. Costs for the bridge deck drainage must be considered when comparing alternative bridge designs.

3.9.2 Trench Drain

Consider trench drains only when traditional inlets are not feasible. Do not place the trench drains in pedestrian paths unless ADA compliant grates are used. If placed adjacent to reinforced concrete barrier, provide the detail in plans showing the position of the drain relative to the barrier to avoid conflicts with the foundation.

Identify in the plans the type, the design flow of the drain, begin and end locations of the drain and the location of the outlet pipe (if the drain is not stubbed directly into a drainage structure).

Slope outlet pipes and preformed channel inverts at 0.6% or steeper toward the outlet regardless of the surface slope.

Modification for Non-Conventional Projects:
Trench drains are not allowed for the final constructed condition unless approved by the District Drainage Engineer. Trench drains are only allowed for temporary drainage.

3.9.3 Evaluation of Hydroplaning Potential

The ***FDM***, ***Section 210.2.4.2 and 211.2.3, Hydroplaning Risk Analysis*****,*** addresses policy for the analysis of hydroplaning potential when ~~associated~~ required for ~~with~~ typical section approval.

Capture accumulated runoff from driveways, side streets and ramps to limit runoff into the mainline travel lanes or other areas where the additional sheet flow could contribute to potential hydroplaning. Design the inlet to capture 100 percent of the flow.

Use the hydroplaning web-based tool and the Design Guidance: Hydroplaning Risk Analysis to perform risk analysis to evaluate hydroplaning potential of typical section options. The hydroplaning tool is available online at : https://www.fdot.gov/roadway/drainage/hydroplaning.

3.10 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

Design storm drain systems consistent with the standard construction and maintenance practices of the Department. The ***Standard Plans*** provide standard details for inlets, manholes, junction boxes, end treatments, and other miscellaneous drainage details. Specifications are provided in the ***Standard Specifications.*** In the event the ***Standard Plans*** are not suitable for a specific project need, develop a detailed design and include it in the plans; and, as appropriate, provide special provisions for inclusion with the project specifications. Consider maintenance concerns of adequate physical access for cleaning and repair in the design.

Except for gutter drain bends, provide topside access at all pipe junctions and bends. The use of junction boxes without topside access will require District Drainage Engineer approval. Consider the use of a new inlet in place of a junction box or manhole to capture roadway runoff.

Drainage structures with internal weirs must have manhole access on each side of the weir. For areas of expected frequent entry, ask FDOT Maintenance if a two-piece, three-foot diameter manhole cover is needed for maintenance access.

Modification for Non-Conventional Projects:
Delete the last sentence in the paragraph above and see the RFP for additional requirements.

desilting and/or dewatering activities.

Prior to extending any existing pipe that exhibits signs of corrosion and/or structural cracking, further evaluation is required to determine whether pipe repair or replacement is warranted to extend the service life of the rehabilitated system.

3.11 PIPES WITHIN OR ADJACENT TO RETAINED EARTH (WALLED) EMBANKMENT SECTIONS

The design requirements of this section pertain to all pipes that are within or adjacent to embankments confined by retaining walls. Avoid placing drainage pipes through retaining walls and similar structures when possible. If pipes must be placed within or adjacent to retaining walls, coordinate the design of the drainage system with the geotechnical and structural engineers.

The drawings in ***Appendix D*** detail three categories of pipes within retained earth (walled) embankments. Pipes proposed for installation within these embankments are defined as Wall Zone Pipes. For Wall Zone Pipes, provide verification of wall zones in design calculations.

The Optional Materials Tabulation Sheet must note those pipes that are deemed Wall Zone Pipes. When steel pipes are listed as an option for Wall Zone Pipes also show the minimum pipe wall thickness, meeting the requirements of ***Appendix D*** on the Optional Materials Tabulation Sheet.

Pipes used as vertical drains passing under or through retaining walls must satisfy the structural requirements of the latest edition of the American Association of State Highway and Transportation Officials ***(AASHTO) Load and Resistance Factor Design Bridge Design Specifications, (LRFD – BDS), Chapter 12***.

When incorporating existing pipes within or adjacent to retained earth embankments sections, assess the condition of the pipe—both water tightness and structural adequacy under the proposed loading—and confer with the geotechnical and structural engineers.

3.12 ADDITIONAL DESIGN CONSIDERATIONS

3.12.1 Noise Walls

Evaluate the capacity of drainage openings in noise walls and locate them horizontally and vertically to ensure that offsite stormwater inflows are accommodated without increasing offsite stormwater stages for the appropriate regulatory design events. Document the existing drainage patterns, including taking photographs along the location

3. Loss of functionality of the French drain due to its being under impervious surfaces.

4. Location of trees, utilities, and other features that may compromise the integrity of the trench envelope.

5. The cost of providing other stormwater management infrastructure in lieu of the French drain.

6. Cost of replacing the French drain in the future.

7. Potential geotechnical failures in Karst areas.

3.12.3 Resilient Connectors

All storm drain manholes and inlets may utilize resilient connectors, as specified in ***Standard Specifications 430***.

Resilient connectors are required for:

- All structures within walled embankments or connected to wall zone pipe.

- and for aAll vertical pipes.

- To accommodate movement of the bridge collection piping.

~~Use resilient connectors to accommodate movement of the bridge collection piping.~~

Do not specify or require resilient connectors for the following conditions:

- The interface angle of connection between the structure and pipe is greater than 15 degrees in either the horizontal or vertical direction.

- The structure and all connections fall outside the 1:2 roadway template control line, as per ***Standard Plans, Index 120-001***.

- The remaining beam height of the single precast unit, from the top of that segment to the existing crown of pipe chosen, is less than eight inches.

- In projects where elliptical pipes are specified on the plans.

3.12.4 Flotation

Design structures larger than 10 feet by 10 feet, and greater than 14 feet below the anticipated groundwater table to prevent flotation under design conditions. Recognize that in sandy soils, the groundwater table may increase briefly but significantly during a large rainfall event.

3.13 DOCUMENTATION

3.13.1 Tabulation Form

~~***Figure 3-2***~~***FDOT-Conduit-StormTab*** presents the required format for tabulating the results of hydrologic and hydraulic calculations for storm drain systems. ~~This figure also notes the minimum information for producing a Storm Drain Tabulation Form.~~ File a copy of the completed ~~form~~ table for permanent record as a part of the signed and sealed design documentation. You will find descriptions and examples of the form content in the ***DDG.***

Projects utilizing ***FDM 900 Series*** are required to provide ~~a report including the data shown~~the FDOT-Conduit-StormTab Flex table. ~~in ***Figure 3-2***.~~

3.13.2 Other Documentation

File other supporting calculations and design documentation, including:

1. For complex systems, a narrative describing how the storm drain system will function.
2. Hydrologic computations:
    a. Time of concentration
    b. Runoff coefficients
3. Spread and inlet capacity analysis
4. Determination of design tailwater
    a. NOAA sea level rise trend supporting documentation
5. Optional materials evaluation

a. Wall zone pipe identification

b. LRFD calculations, if applicable

6. Computation of minor energy losses and design resource for the loss coefficient assigned

7. Completed drainage map with drainage areas to each inlet identified, and structures numbered consistent with drainage computations and tabs

8. Outlet scour protection analysis, if applicable

9. Existing Pipe Inspection and Siltation Report

FLORIDA DEPARTMENT OF TRANSPORTATION
STORM DRAIN TABULATION FORM

Financial Project Identification: | County: | Network: | Prepared: | Date:
Description: | Organization: | State Road: | Checked: | Date:

LOCATION OF UPPER END			STRUCTURE NO.	TYPE OF STRUCTURE	LENGTH (ft.)	DRAINAGE AREA (Acres) C= ** C= ** C= **		SUB-TOTAL (C*A)	TIME OF CONCENTRATION (min)	TIME OF FLOW IN SECTION (min)	INTENSITY (in/hr)	TOTAL (C*A)	BASE FLOW (cfs) *	TOTAL FLOW (cfs)	MINOR LOSSES (ft.) ***	INLET ELEVATION (ft.)	HGL CLEARANCE (ft.) *	HYDRAULIC GRADIENT			NUMBER OF BARRELS *	PIPE SIZE (in.)	SLOPE (%)	ACTUAL VELOCITY (fps)		NOTES AND REMARKS
ALIGNMENT NAME			UPPER															CROWN				RISE	HYD. GRAD.			ZONE:
STATION	DISTANCE (ft.)	SIDE	LOWER			INCREMENT	TOTAL											FLOWLINE					PHYSICAL			FREQUENCY (Yrs):
																		UPPER END ELEVATION (ft.)	LOWER END ELEVATION (ft.)	FALL (ft.)		SPAN	MIN. PHYS.	PHYSICAL VELOCITY (fps)	FULL FLOW CAPACITY (cfs) *	MANNING'S "n":
																										TAILWATER EL (ft):

* Denotes optional information.
** A composite runoff coefficient may be shown in lieu of individual C-values, provided the composite C calculations are included in the drainage documentation.
*** Required if Minor Losses are included

Figure 3-2: Storm Drain Tabulation Form (FDM 300 Series Projects)

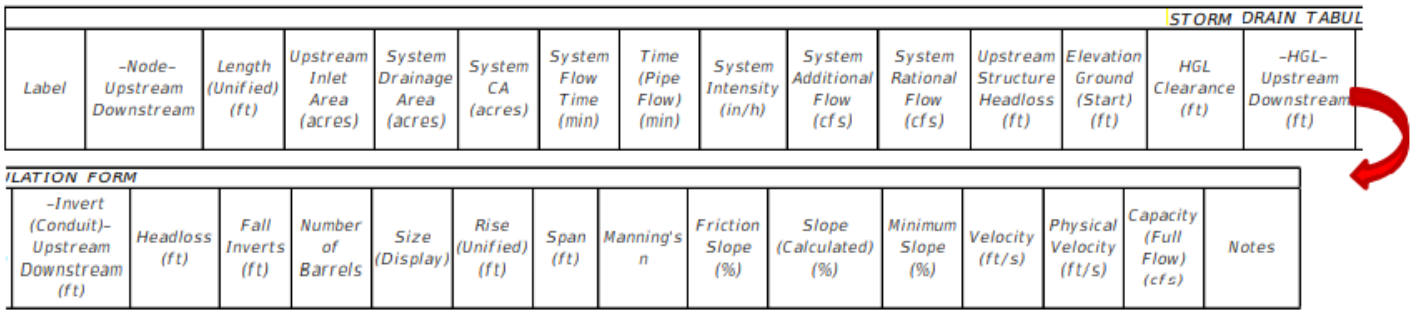

Figure 3-3: FDOT-Conduit-StormTab for projects utilizing the FDM 900 Series.

feasible within the design phase.

5.4 DESIGN STANDARDS

5.4.1 Design of Systems

5.4.1.1 General

Design stormwater management facilities to provide the necessary quantity, rate, and quality control based on the presumption that the upstream discharge meets stormwater quantity, rate, and quality criteria prior to reaching the FDOT right-of-way.

For facilities designed to be dry, or using underdrains or exfiltration systems, provide geotechnical analysis certified by the project Geotechnical Engineer.

Accommodate all offsite runoff in accordance with the Department's criteria and all regulatory agency criteria. Maintain all historical flow patterns for offsite flows. If economically prudent, the Department's wet detention facilities may accept (co-mingle) offsite discharges into them without increasing the required water quality treatment design; in such cases, avoid hydraulic impacts on upstream property owners. For co-mingling offsite discharges into the Department's dry retention facilities, consult with the District Drainage Engineer for direction on whether to co-mingle or bypass offsite inflows.

Modification for Non-Conventional Projects:
Delete the previous paragraph and see the RFP for requirements.

Stormwater pond control structures consist of ditch bottom inlets in conjunction with outfall pipes. Do not use trapezoidal weirs, shaped into the pond berm, as primary control structures except where inlets and pipes are not feasible.

Start initial pond routing at the control elevation unless otherwise required by the Water Management District permit.

No pump or any other mechanical means may control any component of a permanent stormwater system.

With facilities designed to be wet, provide a minimum permanent pool depth of six feet to minimize aquatic growth.

Adjust the tailwater elevation for coastal pond outfalls to account for sea level rise using the methodology in ***Section 3.4.1***.

While the Department does not encourage the use of pond liners, unique project conditions may necessitate their use. Consult the District Drainage Office prior to beginning design. The ***DDG Section 9.3.4.2*** provides additional pond liner design considerations.

For treatment swales, base clearance to the base clearance water elevation (BCWE) should be considered when establishing roadway grades. The BCWE for roadside treatment swales should be set at the weir elevation. A lower elevation may be used if all of the following apply:

- In-situ soils are classified as Hydrologic Soil Group A,
- Geotechnical investigation reveals there is no confining layer to impede drawdown, and
- Construction activities are limited within the treatment swale to avoid compaction and tracking of silt and muck.

For ponds, set the BCWE at the 24-hour design high water elevation. In the absence of ponds and treatment swales, set the BCWE at the Seasonal High Water Table elevation.

5.4.1.2 Watersheds with Positive Outlets

Projects discharging to offsite areas subject to reported historical flooding, up to the 100-year, 24-hour storm event, must assess the discharge requirements of ***Chapter 14-86, F.A.C***. Additionally, any Department projects discharging into drainage systems with heightened public safety risks, such as roadway drainage systems, must comply with ***Chapter 14-86, F.A.C***.

5.4.1.3 Watersheds without Positive Outlets

For projects that are located within a watershed that contributes to a depressed low area, or a lake that does not have a positive outlet such as a river or stream to provide relief (i.e., closed basin or isolated depression), a detention/retention system is required.

Design the detention/retention systems to meet the discharge requirements of ***Chapter 14-86, F.A.C***. The retention volume must recover at a rate such that one-half of the volume is available in seven days, with the total volume available in 30 days. A sufficient amount must be recovered within the time necessary to satisfy applicable water quality treatment requirements.