

## CHAPTER 9.0 STORM DRAINS

### 9.1 Introduction

This chapter provides design criteria and procedures for all storm drains within the County public right-of-way or easements. Storm drains provide subsurface conveyance of runoff where surface drainage is not adequate or possible. Storm drains must be sized to carry the portion of runoff that cannot be conveyed on the surface, as dictated by the available capacity in streets and roadside swales during minor and major storm events.

#### **Rural Areas**

Storm drains are not preferred in rural areas due to higher construction and maintenance costs compared to open swales. Swales also provide additional benefits such as runoff reduction and pollutant removal. Projects that propose to include storm drains in rural areas should be discussed with the County Engineer prior to development of submittal documents.

Note: culverts are not considered storm drains in this context

### 9.2 Pipe Sizes and Materials

All storm drains within the County public right-of-way or easements shall be a minimum of 15 inches diameter (or the hydraulic equivalent if other than circular) and reinforced concrete pipe (RCP) of Class 3 or greater.

### 9.3 Manholes

Manholes are required at all pipe junctions (including laterals servicing inlets), as well as changes in pipe size, alignment, elevation, or slope. A minimum diameter of 4 feet is required for all manholes. Larger diameters may be required for larger pipes, when pipe alignment is not straight, or when multiple pipes share a manhole. Maximum spacing between manholes shall be no more than 400 feet, and the County may require manholes at spacing as close as 200 feet for pipes larger than 24" diameter depending on maintenance requirements and access. The design engineer should consult with the County Engineer on manhole spacing prior to developing submittal documents.

### 9.4 Storm Drain Outlets

Storm drain outlets shall have a headwall/wingwall or flared end section and appropriate erosion protection such as riprap aprons or low tailwater basins. Refer to the *Hydraulic Structures* chapter of the MHFD Manual for design criteria and considerations.

## 9.5 Storm Drain Cover

Cover depth and material shall be based on pipe manufacturer recommendations or, when traffic loadings are present, the American Association of State Highway and Transportation Officials (AASHTO) HS-20 loadings, whichever is more stringent. The minimum cover for any storm drain shall be 12 inches above the pipe crown.

## 9.6 Hydraulic Design

Storm drains shall be designed to convey the minor storm at 80% or less of full pipe capacity (without surcharging). A minimum velocity of 2 ft/sec for the minor storm is required to limit the accumulation of debris and sediment and the maximum velocity in the storm drain shall not exceed 20 ft/sec. The Manning's  $n$  values used for hydraulic calculations should be 0.013 or per manufacturer's recommendations. The energy grade line (EGL) shall be calculated as part of the hydraulic design and must account for pipe friction losses and pipe form losses. Total hydraulic losses must include friction, expansion, contraction, bend, and junction losses following the methods outlined in the *Streets, Inlets and Storm Drains* chapter of the MHFD Manual. The EGL shall be 6 inches or more below the manhole lid elevation or flowline elevation at the inlet for the major storm event.

*Table 9-1. Allowable values for storm drain design parameters*

Design Parameter	Allowable Value
Pipe size	Minimum 15 inches diameter (in public ROW or easement)
Pipe material	RCP Class 3 or greater (in public ROW or easement)
Manhole diameter	Minimum 4 feet
Manhole spacing	Maximum 400 feet
Storm drain cover	Minimum 12 inches above pipe crown
Flow depth	≤ 80% of pipe full-flow capacity for minor storm
Velocity	Minimum 2 ft/sec; maximum 20 ft/sec
Manning's $n$	0.013, or manufacturer's recommendation
EGL	≥ 6 inches below manhole lid elevation or flowline elevation at the inlet for major storm event

## 9.7 Design Procedures

The design of storm drain systems shall be performed in accordance with procedures outlined in the *Streets, Inlets and Storm Drains* chapter of the MHFD Manual. These procedures can be implemented using spreadsheets and/or other software (e.g., StormCAD, AutoDesk SSA, etc.) specifically designed for pipe hydraulic calculations.

The MHFD's UD-Sewer program is no longer supported by MHFD, however the County may still accept UD-Sewer results as long as the program is still operable with a current version of Microsoft Excel.

## 9.8 Submittal Requirements

Drainage Reports shall include the following information (at a minimum) to document storm drain design:

- Plans shall show location, size and ownership of all storm drains,
- Summary tables including pipe size, pipe capacity, flowrates, velocities, and HGL and EGL elevations,
- Profiles showing ground, HGL and EGL elevations,
- Schematics showing pipe network used in modeling software (if applicable), and
- Print outs of modeling software inputs and outputs.