CHAPTER 13.0 HYDRAULIC STRUCTURES

13.1 Introduction

Hydraulic structures include both grade control structures and pipe/culvert outfalls and rundowns. Grade control structures are used in open channels to reduce velocities and erosion potential. Outfalls and rundowns convey runoff from pipes and culverts into streams and open channels. The design criteria and considerations for hydraulic structures used in the County shall follow those provided in the *Hydraulic Structures* chapter of the MHFD Manual.

13.2 Supplemental Guidance

This section provides brief summaries of the circumstances that may require hydraulic structures and what hydraulic structures/design criteria may be required. This information is only intended to guide the engineer towards applicable design criteria and considerations and shall not be considered formal guidance from the County.

13.2.1 Grade Control Structures

Grade control structures are used in open channels to reduce velocities and erosion potential, for example, when grass swale velocities exceed those listed in Table 12-1. Grade control structures include the basic categories of grouted stepped boulder (GSB), sculpted concrete (SC) and vertical. The MHFD Manual includes a “simplified” design procedure and a “detailed” design procedure. In most cases, the design of grass swale and roadside ditch grade control structures can be performed using the “simplified” design approach with GSB or SC. Grade control structures in major drainageways will require a site-specific evaluation.

In all cases, GSB and SC are the preferred types of grade control structures. Vertical structures should only be considered where drop heights are lower than 2 feet and the use of GSB or SC is not practical.

13.2.2 Outfalls and Rundowns

All storm drain and culvert outlets are required to have proper end treatments and erosion control/energy dissipation structures. End treatments include flared-end sections or headwalls and wingwalls. Flared-end sections are generally most appropriate for pipes and culverts 36 inches diameter or less and may require a toe wall to prevent undercutting.

Table 13-1 includes several types of erosion control and energy dissipation structures and the conditions that typically warrant their application.

Table 13-1. Erosion control and energy dissipation structure types

Type	Typical application and considerations
Riprap Apron	• Conduit velocity < 15 ft/s • Discharge parallel to channel flow
Low Tailwater Basin	• Conduit velocity < 15 ft/s • Discharge perpendicular to channel flow • Low tailwater conditions (i.e., Tw < 1/3 conduit height)
Grouted Boulder "Rundown"	• Discharge into large streams/rivers, wetland channels • Outlet invert > 2 feet above tailwater elevation
Impact Basin (concrete)	• Conduit velocity > 15 ft/s • Low tailwater conditions

13.2.3 Rundowns

Rundowns convey channelized runoff from a pipe or paved area down a slope to an open channel or detention facility. Rundowns are strongly discouraged due to their high failure rate and maintenance requirements. Alternative options that should be evaluated include lowering the pipe invert or using level spreaders (from paved areas). If a rundown is required, grouted boulders are preferred over rip-rap or soil rip-rap.

13.3 Submittal Requirements

Submittal requirements for hydraulic structures will vary depending on the type and application and will generally include at the least the following:

- Discharge rates
- Flow velocities
- Hydraulic/erosion/energy dissipation calculations
- Explanation for selecting type of hydraulic structure