Volume 1, Chapter 7- Major Drainage

Users' Guidance:

If a UDFCD *Section* number in this chapter is **skipped**:
It was adopted as is; please refer to that Section in the **corresponding UDFCD Manual**, Volume, Chapter and *Section.*

If a UDFCD *Section* number in this chapter is **amended or a new COFC *Section* in this Chapter is added**:
It is **listed below**; please refer to it in **this document**.

If a UDFCD *Section* in this chapter is **deleted then** it was **not** adopted by the City of Fort Collins;
The deleted UDFCD *Section* number will be **identified as deleted in the text below**.

(1) Section 3.2.8 is amended to read as follows:

3.2.8 Open Channel Design

The minimum design criteria requirements listed below must be satisfied.

3.2.8.1 Natural Channels (Open Floodplain Design)

For development sites located out of the 100-year floodplain, the following open channel requirements must be met:

1. If the total flow of the channel and floodplain is confined to an incised channel and erosion can be expected to endanger adjacent structures, 100-year check structures are required to control erosion and degradation of the channel area. See Volume 2, Chapter 8, "Hydraulic Structures", of this Manual for more information. In addition, sufficient right-of-way must be reserved to install the equivalent of a trapezoidal grass-lined channel that satisfies the velocity criteria specified in Table MD-2. Extra width must be reserved where drop structures are needed, in which locations a twenty (20) foot-wide maintenance access bench must be provided along one side of the channel.

2. If the floodplain is wide and the low-flow channel represents a small portion of the floodplain area, low-flow check structures are usually required, unless it can be demonstrated that the channel will remain stable as the watershed urbanizes.

3. Consult the applicable City's Master Drainage Plan document for guidance on the design event and stable stream or waterway longitudinal slope.

4. For either of the above cases, a maintenance access trail must be provided. It should be designed according to the guidelines for grass-lined channels in Section 3.2.8.3, below.

3.2.8.2 Open Floodway Design (Natural Channel with Floodplain Encroachment)

Although floodplain preservation is preferable, when the development involves preserving the floodway while filling and building on the fringe area, the open channel

design must meet the all the requirements in listed Section 3.2.8.1 of this chapter, as well as the following requirements listed below for fill.

The fill slopes must be adequately protected against erosion with:

1. Fill slopes of four to one (4H:1V) or flatter that are vegetated in accordance with the criteria listed in the "Revegetation" chapter of this Manual (Volume 2, Chapter 12).

2. Fill slopes must be protected by rock (not broken concrete or asphalt) riprap meeting City criteria with up to two and a half to one (2.5H:1V) slopes.\

3. Retaining walls must not be not taller than three and a half (3.5) feet, with adequate foundation protection.

3.2.8.3 Grass-Lined Channel Design

The design for a grass-lined channel must meet the following criteria:

1. Side slopes must be four to one (4H:1V) or flatter.

2. Continuous maintenance access, such as with a trail, must be provided. The stabilized trail surface must be at least eight (8) feet wide with a clear width of twelve (12) feet. It must be located above the minor (2-year) event water surface elevation, but never less than two (2) feet (three feet for streams with perennial flow) above that elevation. Trail profiles need to be shown for all critical facilities such as roadway crossings, stream crossings and drop structures. All access trails shall connect to public streets. Maintenance trails need not be paved, but must be of all-weather construction such as aggregate base course, crusher fines, recycled concrete course or Aggregate Turf Reinforced Grass Pavement (RGP) described in Volume 3 of this Manual and capable of sustaining loads associated with large maintenance equipment. Paved trails are encouraged to allow for recreational use of the trails. When paved, pavement should be five (5) inches minimum thickness of concrete (not asphalt). Maximum longitudinal slope for maintenance-only trails is ten percent (10%), but less than five percent (5%) when used as multi-purpose recreational trails to meet the requirements of the *Americans with Disabilities Act*. The Utilities Executive Director may accept adjacent public local streets or parking lots as maintenance access in lieu of a trail, if he or she determines that a modification of this requirement is appropriate.

3. A low-flow or trickle channel is desirable. See Section 4.1.5 of this chapter for criteria.

4. Wetland bottom and bioengineered channels are acceptable when designed according to City wetland bottom channel criteria in Section 4.2 of this chapter.

5. The channel bottom minimum cross slope for dry bottom channels shall be one percent (1%).

6. Tributary inflow points shall be protected all the way to the low-flow channel or trickle channel to prevent erosion. Inflow facilities to wetland bottom channels shall have their inverts at least two (2) feet above the

channel bottom to allow for the deposition of sediment and shall be protected with energy dissipaters.

7. All roadway crossings of wetland bottom channels shall incorporate a minimum of a stabilized two (2) foot drop from the outlet to the bottom of the downstream channel in order to preserve hydraulic capacity as sediment deposition occurs over time in the channel.

8. All drop structures must be designed in accordance with the "Hydraulic Structures" chapter of this Manual. Underdrain and storm sewer outlets located below the stilling basin's end-sills are not acceptable. Construction plans must utilize City standard details.

9. Storm sewer outlets must be designed in accordance with the criteria in Sections 5.0, 6.0, and 7.0 of this chapter. Alternatively, conduit outlet structures, including low tailwater riprap basins design described in Section 3.0 of the "Hydraulic Structures" chapter of this Manual must be used when appropriate.

10. Grouted boulder rundowns and similar features must be designed in accordance with Section 7.0 of the "Hydraulic Structures" chapter of this Manual.

11. Grass seeding specifications provided by the City (see the "Revegetation" chapter of this Manual) are recommended unless irrigated blue grass is used. The City will not maintain irrigated blue grass..

(2) Section 3.3.3 is amended to read as follows:

3.3.3 Environmental Permitting Issues

Environmental permitting, in particular wetland permitting, must be considered in selection of the type of major drainage channel. To assist with the selection of type of channel or drainageway improvements to be used, a flow chart is presented in Figure MD-4. The flow chart contains a series of questions to be considered in light of the requirements in this Manual and the requirements of the Clean Water Act, Section 404 (dredge and fill in jurisdictional wetlands and "Waters of the United States").

Following along with the chart, the first step is to determine whether channelization is needed or desired. In many cases, a well-established natural drainageway and its associated floodplain can be preserved and protected from erosion damage. Therefore, before deciding to channelize, assess whether the value of reclaimed lands will justify the cost of channelization and whether a new channel will provide greater community and environmental benefits than the existing drainageway.

If the decision is to neither channelize nor re-channelize an existing drainageway, investigate the stability of the natural drainageway and its banks, design measures to stabilize the longitudinal grade and banks, if needed, and obtain any necessary, Section 404 permits and other approvals for these improvements.

If the decision is to channelize, then determine whether the existing natural drainageway has a perennial flow, evidence of wetland vegetation, or is a well-established ephemeral channel. This will often require the assistance of a biologist with wetland training. If any of these conditions exist, then the project is likely to be subject to individual or nationwide Section 404 permitting requirements. Regardless, it is suggested that the

designer check with the local United States Army Corps of Engineers (USACE) office early to determine which permit will be needed. Keep in mind that it is the responsibility of the proponent to comply with all applicable Federal and State laws and regulations. Approvals by the City do not supersede or waive compliance with these laws.

(3) Section 3.3.4 is amended to read as follows:

3.3.4 Maintenance

(a) All major drainage channels in urban areas will require maintenance to ensure that they are capable of conveying their design flow, such as the 100-year flow (as well as more frequently occurring flows) and to ensure that channels do not become a public nuisance and eyesore. Routine maintenance (i.e., mowing for weed control or annual or seasonal clean-outs), unscheduled maintenance (i.e., inspection and clean-out after large events) and restorative maintenance after some years of operation should be expected.

(b) Native tall grasses may require mowing three to six times a year or on a less frequent schedule, depending on the type of channel and setting. Mowing cuts down the presence of standing dead grasses and places them on the ground where decomposition can take place. Often mowing of dry-land native grasses during the growing season may not be necessary, except for weed control.

(c) A maintenance access platform with a minimum passage width of twelve (12) feet shall be provided along the entire length of all major drainageways except at drop structures, where a twenty (20) foot maintenance platform is needed

(d) When public or private drainage channels and associated facilities abut private property, it is the responsibility of the parties involved, whether they are public or private, to develop and implement a policy regarding fencing and safety.

(4) Section 4.1.1.5 is amended to read as follows:

4.1.1.5 Design Discharge Freeboard

All open channels shall be designed with a freeboard. Freeboard for major channels (defined as those with capacity in excess of one hundred (100) cfs) must be a minimum of one foot of extra depth. Freeboard for minor channels (defined as those carrying less than one hundred (100) cfs design flow) must be designed to handle a minimum of an additional 33 percent of runoff, over and above the 100-year design flow.

(5) *Table MD-2* is adopted with the following modification:

The minimum riprap Manning's-n value used to check for stability is 0.07.

(6) *Table MD-3* is adopted with the following modification:

All references to "District Maintenance Eligibility" shall be deleted.

(7) *Table MD-4* is adopted with the following modification:

All references to "District Maintenance Eligibility" shall be deleted.

(8) *Section 4.3.6* is deleted in its entirety.

(9) *Table MD-6* is adopted with the following modification:

All references to “District Maintenance Eligibility” shall be deleted.

(10) *Table MD-7* is adopted with the following modification:

All references to Type VL and Type L riprap designations shall be deleted.

(11) *Table MD-10* is adopted with the following modification:

All references to Type VL and Type L riprap designations shall be deleted.

(12) *Table MD-12* is adopted with the following modification:

All references to Type VL and Type L riprap designations shall be deleted.

(13) A new section 4.4.4.3 is added, to read as follows:

4.4.4.3 Riprap Specifications and Applicability

(a) Riprap applications must be designed by a professional engineer familiar with the design of stormwater conveyance systems and structures.

(b) The minimum mean particle size (intermediate dimension) by weight for riprap, commonly known as the $D_{50,}$ is twelve (12) inches.

(c) All riprap must be angular in shape and clean; no round shaped rocks are allowed.

(d) Riprap coloring must be specified to blend with the existing soil and environment where it will be placed in a manner that will present the smallest amount of visual contrast.

(e) Riprap shall only be used when other methods of protection or stabilization are not appropriate or possible. Riprap alternates with the exception of gabions are recommended whenever practical. Manufactured channel lining or revetment treatments such as Turf Reinforcement Mats (TRMs), erosion control matting, geotextiles, Articulating Concrete Blocks (ACBs), partially-grouted riprap, and other flexible linings are encouraged in lieu of standard riprap applications. These alternates will be considered by the City on a case-by-case basis in order to determine the most appropriate material that should be specified under particular conditions and for different applications.

(14) *Table MD-13* is adopted with the following modification:
All references to "District Maintenance Eligibility" shall be deleted.

(15) *Section 10.0* is adopted with the following modification:
All references to "Rosgen, D., 1996, "Applied River Morphology" shall be deleted.