

5.8.0 STORM DRAIN OUTFALLS INTO OPEN CHANNELS

Storm drain outfalls into open channels shall conform to the design guidelines in Standards 508S-13 or 508S-16 through 508S-20, as appropriate for site specific conditions.

- A. **End Treatment:** As appropriate for site conditions based on engineering judgment, outfalls into natural channels shall utilize flexible armor, such as rock riprap (508S-16 through 508S-20), to allow for adjustment of the receiving channel due to normal creek erosion. Rock riprap shall be sized in accordance with ECM 1.4.6(D) and meet the requirements of Standard Specification 591S. Use of standard concrete headwalls (508S-13) and other rigid end treatments shall be limited to outfalls into non-erosive or armored channels. Where rigid end treatments are used in natural channels, the design shall account for future erosion and channel adjustment such that the structure will not become an obstruction to channel flow as adjustments occur. This may include using flexible armor to stabilize the surrounding channel banks and/or setting the structure into the bank such that future erosion will not expose the structure. For both flexible and rigid end treatments, the transition between natural channel banks and the outfall shall be smooth and stable such that erosion at the interface is minimized. The angle of intersection between the outfall flow path and the channel flow path shall not be greater than 45-degrees.
- B. **Drop Height:** The outfall drop height shall be minimized to the extent feasible and shall not exceed six feet, as measured vertically from the flowline of the outfall to the toe of the channel bank. The recommended outfall drop height is one foot to allow for potential sedimentation at the outfall. A manhole(s) may be used to limit the outfall drop height, per 508S-18. In all cases, non-erosive conveyance shall be provided from the outfall to the flowline (lowest elevation) of the receiving channel. Concentrated discharges on steep embankments, ravine slopes, or high bluffs shall be avoided.
- C. **Stabilization:** Where possible, the outfall should be located away from existing eroded banks in the most stable location available. The surrounding banks and bed shall be appropriately armored or made geotechnically stable, so as to sufficiently resist erosive forces. As outlined in Standards 508S-16 through 508S-20, armor below the outfall shall extend from the toe of the bank into the channel equal to a length ten times the pipe diameter. For channel bottom widths less than ten times the pipe diameter, armoring shall extend up the opposite bank to an elevation equal to that of the top of pipe. Flexible armor, such as rock riprap, shall be utilized for bed and bank stabilization in erodible channels. The location of the outfall, armoring, and channel stabilization must consider the location of existing infrastructure and utilities and provide adequate horizontal and vertical separation so as not to obstruct access or maintenance, nor adversely impact the infrastructure.