



Section 7
DETENTION/RETENTION

DETENTION/RETENTION

As part of a total system of urban stormwater management, detention and retention facilities are man-made storage measures intended to mitigate the negative impacts of urbanization, which include:

- Increased peak flow rates.
- Loss of natural depression storage.
- Reduction of infiltration capacity in a drainage basin.
- Reduction of natural vegetation.
- Increased pollutant load in surface runoff.

This section presents the methods associated with the planning, analysis and design of detention and retention facilities. The guidelines herein are intended to achieve the following goals:

- I. Design of detention/retention facilities that satisfy the ordinance provisions of the City;
2. Design of detention/retention facilities that are amenities and, where possible, incorporate multiple-use concepts; and
3. Design of facilities that will not jeopardize the quality of surface water or groundwater resources.

7.1 LIMITATIONS ON USE OF DETENTION/RETENTION FACILITIES

The requirements for a development to provide storage of excess runoff by detention or retention facilities shall not be waived.

In general, storage facilities are to be located so they can intercept the flow from the entire development area. The objective is to provide storage for excess runoff with a minimum number of detention/retention facilities located at optimum points within a developed area. Whenever possible, the facilities shall be designed for multiple uses, such as parks or other recreational facilities, to offset the cost of open space and to encourage improved maintenance.

7.1.1 Regional Detention/Retention Facilities

Regional detention/retention facilities are large storage sites within a drainage basin provided to control excess runoff and to achieve the most cost-effective drainage system. Advantages of this type of facility include the following:

- The siting and design of regional storage facilities are normally incorporated as part of an overall drainage master plan.
- Operation and maintenance costs are reduced.
- Regional facilities are more effective and reliable because they are planned, designed and maintained as part of a total drainage system.

7.2 DESIGN CRITERIA

7.2.1 Criteria for Detention/Retention Facilities

FOR PROJECTS IN WHICH DOWNSTREAM FACILITIES DO NOT EXIST:

Preliminary/Entitlement Studies: For preliminary approval, the volume associated with the difference between pre-project and post-project volume of the 2-year, 24-hour and 10-year, 24-hour storm durations shall be added together. This volume shall be utilized for the preliminary volume required in the detention/retention facility, in addition to 1 foot of freeboard.

Final Engineering Permits: For final engineering and permit approval, detention/retention facilities must meet the Riverside County Interim Criteria for Sizing Increased Runoff Detention Facilities. This criteria requires that basins mitigate increased runoff for the 2-year, 5-year, and 10-year, 1-hour, 3-hour, 6-hour and 24-hour storm durations. Flow rates in the post-project condition must not exceed pre-project levels.

Basins must provide an overflow/emergency outlet sized for the peak 100-year, 1-hour flow rate, and provide a conveyance for these emergency flows that protect adjacent buildings/residences (see Appendix C of the LID BMP Design Manual for additional basin sizing criteria).

Pumps may be utilized for facilities without positive drainage so long as it meets the aforementioned criteria, and is approved by the City Engineer.

FOR PROJECTS WITH EXISTING DOWNSTREAM STORM DRAIN FACILITIES:

The capacity of the existing downstream facility must be determined. If the facility cannot accept the fully developed 100-year flow rate from the project site, increased runoff mitigation shall be provided in accordance with the requirements for the existing downstream facilities. All projects are required to validate and demonstrate that existing downstream facilities have the capacity to intercept the design flows discharging from the site. If no existing studies exist or can be located for the downstream facilities, calculations for the total tributary area to the facility must be prepared to demonstrate feasibility.

Geometry: Basic requirements regarding facility shape, side slopes, depth and bottom configuration are provided below.

- **Shape:** As a general rule, curvilinear, irregularly shaped facilities will have the most natural character. A wide range of shapes can be considered and utilized to integrate the detention facility with the surrounding site development.
- **Side Slopes:** Where grass is intended to be established, side slopes shall not be

steeper than 4 horizontal to 1 vertical. Where slopes abut the street right-of-way, the minimum slope shall be 4 horizontal to 1 vertical regardless of surface treatment.

- **Depth and Bottom Configuration:** With respect to grading, deep facilities should be avoided, if possible. For facilities in excess of eight feet deep, consideration should be given to the use of flatter side slopes or the provision of intermediate benches along the side slopes.

The bottom shall be designed to drain to a low flow channel for a detention facility.

Drain Time: The design of all detention/retention facilities shall be such that the stored runoff shall be discharged completely from the facility within 72 hours of the storm event.

Lining/Surface Treatment: As a general rule, grass and plant species used for landscape development and revegetation should be native to Riverside County.

The use of inert materials is appropriate for stabilization and erosion control where steep slopes are unavoidable, along channels, at points of inflow, at the outlet control structure and any other location where flowing water may threaten stability. Inert materials for erosion control include:

- Loose rock riprap with a specific, engineered gradation.
- Loose or grouted boulders (minimum dimension 18 inches or larger).
- River stone.

Low Flow Channels: A low flow channel is required in the bottom of a detention basin to provide positive routing of drainage to the primary outlet structure. An example of a rectangular concrete low flow channel is provided in Figure 10.2. The channel shall have a 0.5 percent maximum longitudinal slope.

Inlet and Outlet Structures: The design of an inlet structure shall be such that inflow is directed into the facility in a non-erosive manner and without adverse impacts to the retention facility or to upstream areas.

Outlet structures are classified as: 1) primary outlet structures that provide hydraulic control for the specific design event(s), and 2) emergency spillways that provide safe routes, typically via surface overflow, for storm events in excess of the design frequency or in the case of debris blockage or malfunction of the primary outlet structure.

The minimum allowable pipe size for primary outlet structures shall be 18 inches in diameter.

If the capacity of an outlet pipe must be further reduced, an orifice plate may be installed, as shown on Figure 10.3(a). The orifice plate may be constructed of heavy,

galvanized steel and attached with tamper-proof bolts or by forming a smaller diameter opening in the concrete headwall at the outlet structure.

Energy Dissipation at Outlet: Adequate energy dissipation measures shall be provided at the downstream end of primary outlet structures. Such measures shall be designed to control local scour at the pipe outlet and to reduce velocities to pre-development conditions prior to exiting onto downstream properties.

Emergency Spillways: Emergency spillways are normally surface overflow weirs, channels, or combinations thereof, provided for the safe overflow and routing of floodwaters under unusual circumstances.

Consideration must be given to the layout of the emergency spillway so that excess flow is routed in the same manner and direction as would have occurred under pre-development or historic conditions. Emergency spillways must be designed to convey the unattenuated 100-year peak discharge at non-erosive velocities.

Additional criteria for basin design shall utilize the Appendix C – Basin Design Criteria of the Riverside County LID BMP Design Handbook.

7.2.2 Criteria for Special Detention/Retention Methods

Special methods for stormwater detention/retention include, roadway embankment storage and storage in parking lots and greenbelt areas.

The use of underground storage facilities, for detention/retention of excess runoff is permitted, subject to review and approval by the City Engineer.

Since the following methods often result in facilities near buildings, it should be emphasized that the pad elevations adjacent these structures shall be a minimum of one foot above the 100-year water surface of the detention/retention facility at the maximum point over the overflow spillway/outlet.

Conveyance Storage: During the period that channels and floodplains are filling with runoff, the stormwater is being stored in transient form. This type of storage is known as conveyance storage. Construction of low velocity channels with large cross sectional areas assists in the accomplishment of such storage. Conveyance storage systems are usually feasible only on large projects, and require detailed dynamic modeling for analysis.

Embankment design shall be consistent with the Riverside County Flood Control and Water Conservation District Hydraulic Design Manual.

7.3 MULTIPLE-USE CONCEPTS

Flood control functions and other uses in detention/retention facilities are generally compatible. Rationale for multiple-use facilities includes decreased facility maintenance costs and an increased community acceptance. Combining flood storage with recreation use or other community facilities on a single site decreases total costs for land acquisition and site

development. The development of detention/retention facilities as parks or urban green space increases the acceptance by area residents and encourages better overall maintenance.

7.3.1 Potential Uses

Appropriate uses for detention/retention facilities include active and passive recreation and urban green space. Uses in addition to flood control should address specific community needs and be clearly identified before the facility is designed.

Active Recreation: Active recreation includes a wide range of activities that involves some type of physical movement. This type of recreational activity - both individual and group - generally requires larger areas than passive recreation uses. Because of their size, regional detention/retention facilities can provide more opportunities for group sports with large space requirements.

Passive Recreation: Passive recreation generally involves individuals or small groups and a minimal amount of physical activity. Typically, passive recreation does not require large open space and is, therefore, appropriate for both large and small detention/retention facilities.

Urban Green Space: Urban green space provides a visual resource within the community. As urbanization continues, the value of green space will increase. Green space provides visual breaks from the urban environment, acts as a filter to clean air and can reduce erosion from wind and rain. Landscape materials in a detention/retention facility should respond to the recessed nature of the land form, the scale of the facility and the occurrence of frequent flooding.

The use of native and non-native species for landscape planting is highly recommended. The following basic zones should be considered in the landscape design for a detention/retention facility.

- **Channels:** Planting in these areas should be limited to grasses, groundcovers and low growing shrubs, with preference given to vegetation with flexible branching and resilient growth habits.
- **Basin Areas:** There may be inundation and standing water in basin areas at some time during the year. Choice of plant materials should reflect these conditions. Trees, shrubs and grasses can be planted judiciously in these areas.
- **Elevated Areas:** These areas may be occasionally inundated. The choice of plant material will depend on the use assigned to the area. Trees, shrubs and grasses can be planted and more easily maintained in areas of higher ground elevation.

7.4 WATERQUALITY

Urban runoff is distinguished from undeveloped area runoff in two principal ways: it occurs at greater discharge rates and volumes, and it contains varying but commonly higher concentrations of toxic substances, bacteria, and dissolved organic matter. Detention/Retention facilities can play a significant role in mitigating the pollution problems associated with urban runoff.

Projects are required to adhere to the National Pollution Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for the Santa Ana River Watershed. A guidance document has been developed for preparation of Water Quality Management Plans within the Santa Ana Region, and is located here: <https://rcwatershed.org/watersheds/middle-santa-ana-river-watershed/#83-350-exhibits-1612321337> . A Design Handbook for Low Impact Development Best Management Practices was developed by Riverside County Flood Control and Water conservation district (located here: <https://rcwatershed.org/watersheds/middle-santa-ana-river-watershed/#83-438-lid-bmp-design-handbook>) to help in the design and implementation of Low Impact Development principles.

7.5 FLOOD ROUTING

Characteristically, the storage of a reservoir is closely related to its outflow rate. In reservoir routing methods, the storage-discharge relation is used for repeatedly solving the continuity equation; each solution is a step delineating the outflow hydrograph.

Basin routing analyses shall be performed per the Riverside County Flood Control and Water Conservation District Hydraulic Design Manual.