CONJUNCTIVE USE FACILITIES FOR STORM WATER MANAGEMENT AND FLOOD CONTROL
JANUARY 21, 2020

INTRODUCTION

Conjunctive use means the use of a facility for two or more purposes. This handout addresses basins, vaults, or other storage facilities that are designed to meet both a storm water management objective and a flood control objective. Storm water management objectives include pollutant control and/or hydromodification control as defined in the *County of San Diego BMP Design Manual* (January 1, 2019). Flood control includes detention of the 100-year storm event to a protection level (release rate) determined based on site-specific conditions, such as controlling a 100-year post-project peak flow rate to the capacity of an existing downstream facility or to match the 100-year pre-project peak flow rate, as defined in the *San Diego County Hydraulic Design Manual* (September 2014). Examples of conjunctive use facilities for storm water management and flood control include (and are not limited to) facilities that provide:

- Pollutant control and detention of the 100-year storm event flow
- Pollutant control, hydromodification control, and detention of the 100-year storm event flow
- Hydromodification control and detention of the 100-year storm event flow

The design of these facilities must meet criteria presented in the BMP Design Manual for the storm water management objective(s) and design criteria presented in the Hydraulic Design Manual for flood control. While calculations for storm water management design and flood control design are typically presented separately, the design process requires coordination between the storm water management engineer and the flood control engineer because each objective provides criteria that drives the complete design of the facility. The purpose of this handout is to clarify when the required storage volumes for the various objectives can overlap versus when they are additive, and to provide guidance for detention routing analyses for flood control.

BASIN STORAGE VOLUME REQUIREMENTS

Figures 1 through 5 illustrate basin storage volume requirements for various types of conjunctive use facilities for storm water management and flood control. The following guidelines drive the basin storage volume requirements for the design of the facilities:

- Consistent with the San Diego County Hydraulic Design Manual, the storage volume for flood control shall be provided *in addition to* the storage volume provided for pollutant control. This means it shall not encompass volume below the lowest above-ground outlet of an infiltration or biofiltration basin (Figures 1, 2, and 3). The rationale for this is that the storage volume for pollutant control may be full when the flood control design event occurs and may not be available to act as effective storage volume for peak flow attenuation.
- Volume infiltrated for pollutant control and/or hydromodification control is not included as volume for flood control (Figures 1, 2, and 3).
- The storage volumes for pollutant control and hydromodification control may overlap. Usually the storage volume required for pollutant control is less than the storage volume required for hydromodification control. Therefore all of the pollutant control storage volume may be within the hydromodification control storage volume (Figures 2 and 3).

- The storage volume for flood control is measured from the lowest above-ground outlet (i.e., outlet that does not require water to pass through soil media to reach the outlet) (Figures 1, 2, 3, and 4). Exception: if a portion of the storage volume measured from the lowest above-ground outlet to another above-ground outlet takes more than 96 hours to drain, then that portion of the volume may not be counted as storage volume for flood control, and the flood control storage volume must be measured from the first above-ground outlet for which the volume above the outlet drains in less than 96 hours (Figure 5).
- The storage volume for flood control may overlap storage volume provided for hydromodification control (Figures 2, 3, 4, and 5). Exception: if a portion of the storage volume for hydromodification control takes more than 96 hours to drain, then that portion of the hydromodification control storage volume may not be counted as storage volume for flood control (Figure 5).

In Figures 1 through 5, blue text accompanied by 'FC' indicates items related to flood control storage, purple text accompanied by 'HC' indicates items related to hydromodification control storage, and green text accompanied by 'PC' indicates items related to pollutant control storage.

Figure 1 shows a facility for pollutant control and flood control detention without hydromodification control. Figure 1 illustrates the flood control storage volume being above the lowest above-ground outlet (i.e., outlet that does not require water to pass through soil media to reach the outlet).

Figure 2 shows a facility for pollutant control, hydromodification control, and flood control detention with a simple primary outflow structure consisting of a catch basin or riser without side openings. Figure 2 illustrates the flood control storage volume overlapping the portion of hydromodification control storage volume that is above the lowest above-ground outlet (i.e., outlet that does not require water to pass through soil media to reach the outlet).

Figure 3 shows a facility for pollutant control, hydromodification control, and flood control detention with a more complex primary outflow structure than that shown in Figure 2, consisting of a catch basin or riser with a side opening. Figure 3 illustrates the flood control storage volume overlapping the portion of hydromodification control storage volume that is above the lowest above-ground outlet (i.e., outlet that does not require water to pass through soil media to reach the outlet).

Figure 4 shows a facility for hydromodification control and flood control detention without pollutant control. This facility does not have an outlet that would require water to pass through soil media to reach the outlet. The low flow orifice is considered to be the lowest above-ground outlet (including when this facility is an underground vault). Figure 4 illustrates the flood control storage volume overlapping the hydromodification control storage volume. All of the hydromodification control storage volume may be encompassed within the flood control storage volume provided that the drawdown time from the crest of the primary outflow structure to the low flow outlet is less than 96 hours. See Figure 5

when the drawdown time from the crest of the primary outflow structure to the low flow outlet is greater than 96 hours.

Figure 5 shows a facility for hydromodification control and flood control detention without pollutant control similar to Figure 4, except that the drawdown time from the crest of the primary outflow structure to the low flow outlet is greater than 96 hours. When a portion of the storage volume for hydromodification control takes more than 96 hours to drain, then that portion of the hydromodification control storage volume may not be counted as storage volume for flood control. Figure 5 illustrates the flood control storage volume measured from the first above-ground outlet for which the volume above the outlet requires less than 96 hours to drain. The flood control storage volume overlaps only the portion of the hydromodification control storage volume that requires less than 96 hours to drain.

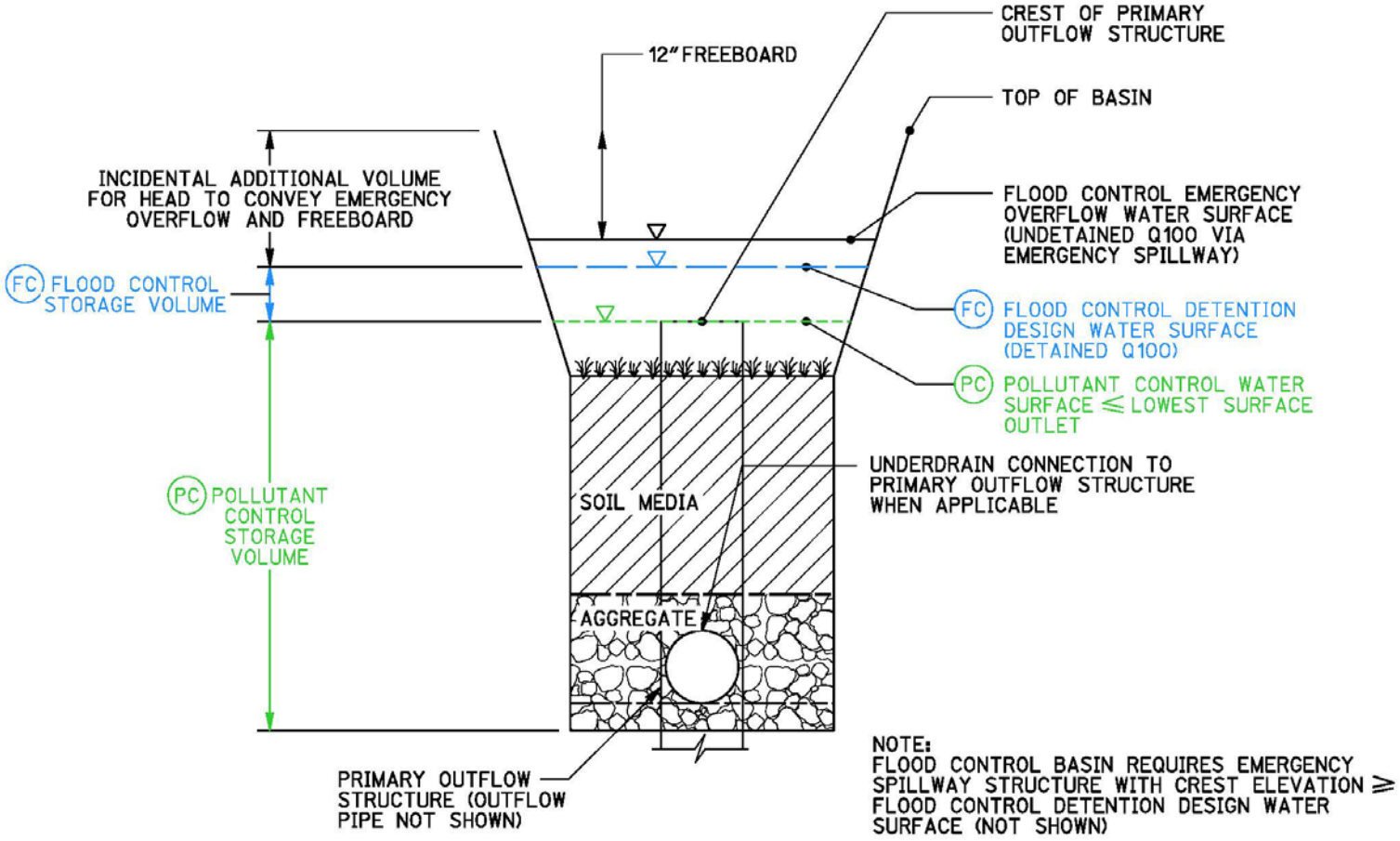

Figure 1
Conjunctive Use Facility for Storm Water Management and Flood Control:
Pollutant Control and Flood Control Detention

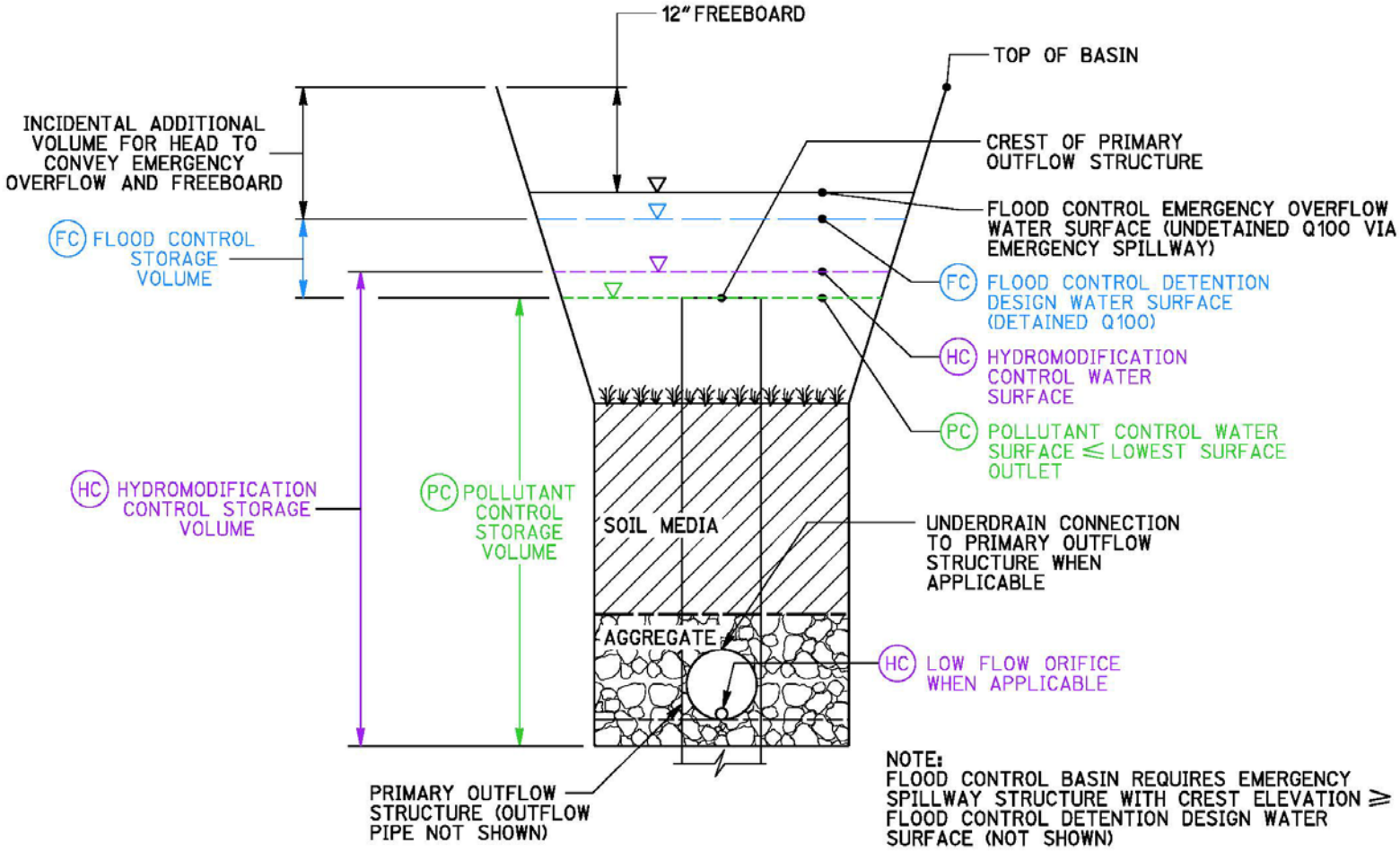

Figure 2
Conjunctive Use Facility for Storm Water Management and Flood Control:
Pollutant Control, Hydromodification Control, and Flood Control Detention; No Mid-flow Outlet

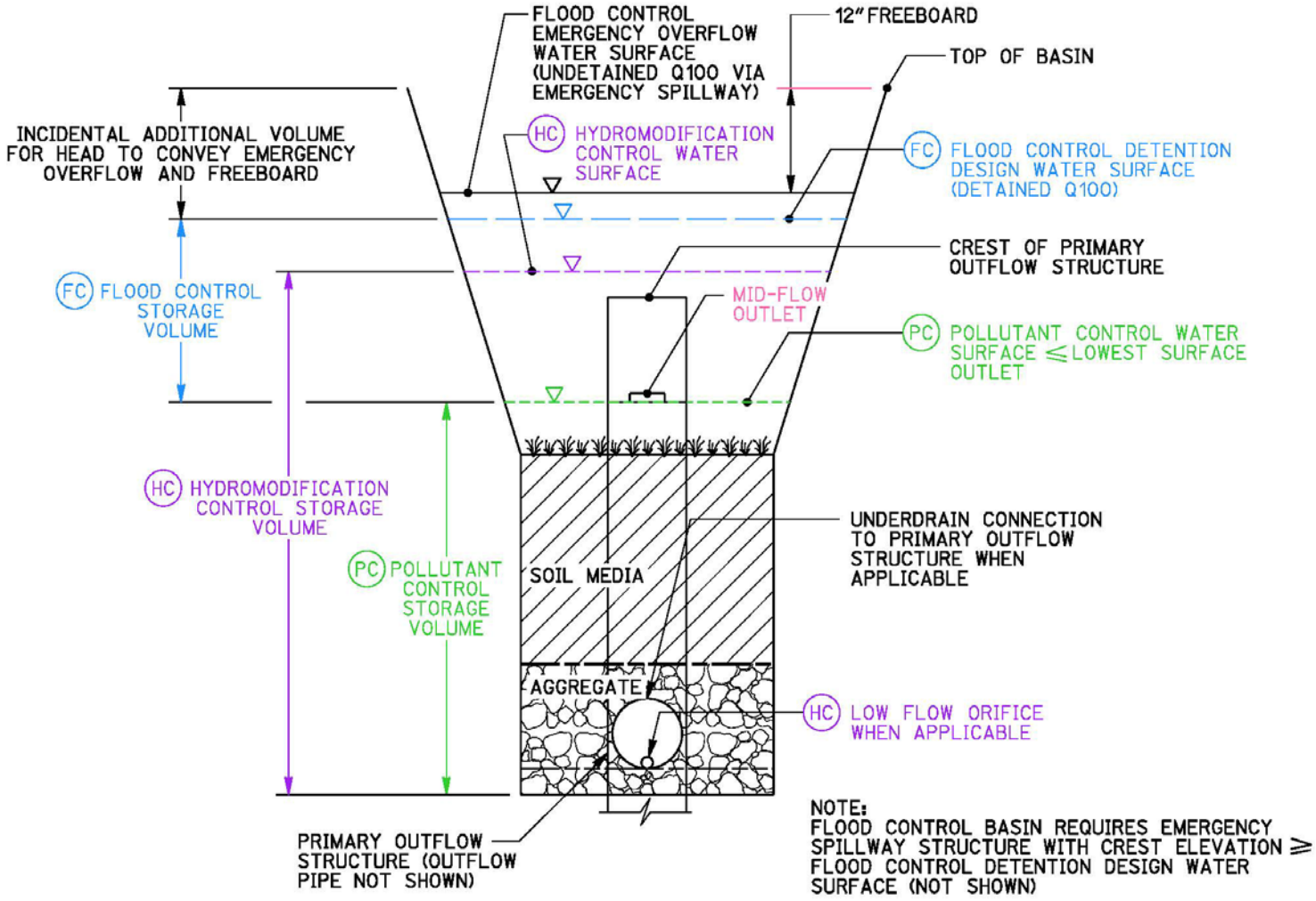

Figure 3
Conjunctive Use Facility for Storm Water Management and Flood Control:
Pollutant Control, Hydromodification Control, and Flood Control Detention; With Mid-flow Outlet

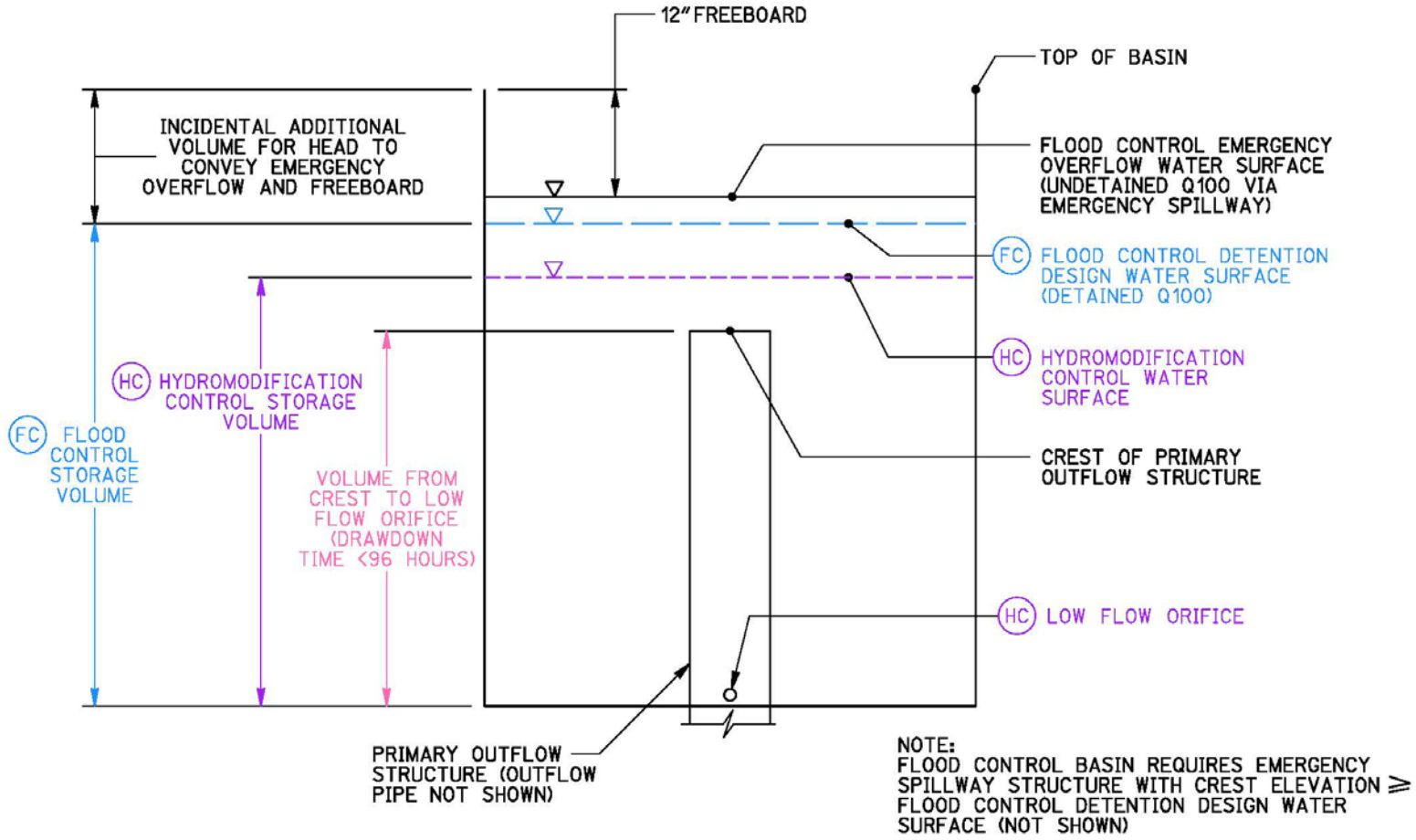

Figure 4
Conjunctive Use Facility for Storm Water Management and Flood Control:
Hydromodification Control and Flood Control Detention;
Drawdown Time from Crest of Primary Outflow Structure to Low Flow Orifice Less than 96 Hours

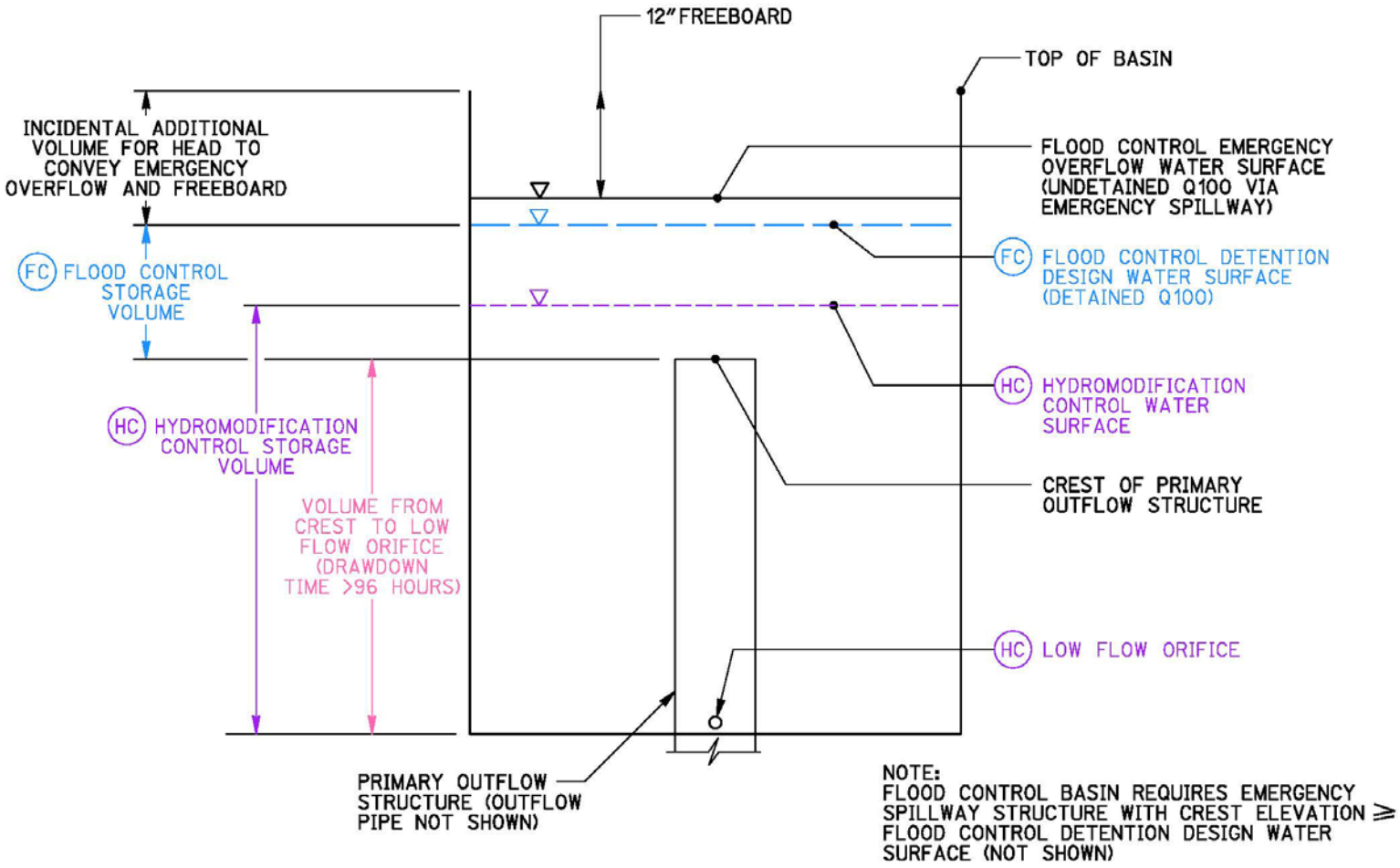

Figure 5
Conjunctive Use Facility for Storm Water Management and Flood Control:
Hydromodification Control and Flood Control Detention;
Drawdown Time from Crest of Primary Outflow Structure to Low Flow Orifice Greater than 96 Hours

DESIGN PROCESS

The design process for conjunctive use facilities starts with an assessment of the controlling design factor. For conjunctive use facilities for storm water management and flood control, the storm water management objective(s) will control the initial design. First, determine the necessary storage volume and outflow control structure to meet the storm water management objective(s) (i.e., pollutant control and/or hydromodification control) based on the requirements of the *County of San Diego BMP Design Manual* (January 2019). Then add volume above the pollutant control water surface to meet the flood control objective and provide for emergency overflow conveyance and freeboard in accordance with the *San Diego County Hydraulic Design Manual* (September 2014) by increasing the depth of the facility. If it is necessary to add outflow control to meet the flood control detention objective (i.e., if the primary outflow structure provided for pollutant control and/or hydromodification control does not incidentally provide enough outflow control to meet the flood control detention objective), see guidance below for adding outflow control. Note that the emergency overflow outlet for flood control must be provided as a separate, secondary outlet structure such as a spillway or a second riser.

Adding Outflow Control to Pollutant Control and Flood Control Facility without Hydromodification Control (See Figure 1)

Add outflow control above the pollutant control water surface. This can be accomplished by increasing the height of the primary outflow structure for pollutant control and adding an orifice opening (mid-flow outlet) on the structure above the pollutant control water surface.

Adding Outflow Control to Pollutant Control, Hydromodification Control, and Flood Control Facility (See Figures 2 and 3); or Hydromodification Control and Flood Control Facility without Pollutant Control (See Figures 4 and 5)

Add outflow control above the hydromodification control water surface. The hydromodification control water surface is the maximum water surface that occurred in the continuous simulation hydrologic model that was used to demonstrate that the design meets the hydromodification management performance standard. The hydromodification control water surface can be determined from the project-specific continuous simulation model. If BMP Sizing Factors have been used to design for hydromodification management; the hydromodification control water surface can be assumed to be 1.0-foot above the crest of the primary outflow structure for infiltration, biofiltration with partial retention, and biofiltration BMPs; or 0.143 times the height of the primary outflow structure for cistern BMPs (above the crest of the primary outflow structure).

DETENTION ROUTING ANALYSES FOR FLOOD CONTROL

To prepare the storage routing analysis for flood control, the engineer may either: (1) include stage-storage data for the entire depth of the facility from bottom to top but set the starting water surface for the analysis to the elevation of the lowest above-ground outlet, or (2) set the elevation of the lowest above-ground outlet as the datum for the “bottom” of the basin and exclude stage-storage data for elevations below the lowest above-ground outlet. Stage-discharge data must only include outflow through the lowest above-ground outlet and any other outlets above the lowest above-ground outlet. Infiltration and outflow through the underdrain must be excluded from the flood control analysis.

REFERENCES

County of San Diego. January 1, 2019. County of San Diego BMP Design Manual. https://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html

County of San Diego. September 2014. San Diego County Hydraulic Design Manual. https://www.sandiegocounty.gov/content/sdc/dpw/flood/drainage.html