URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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TECHNICAL MEMORANDUM

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SUBJECT: Modeling Detention Basins

DATE: Revised February 1, 2016 (Original January 20, 2014)

The purpose of this memorandum is to document a set of equations and method to model proposed detention basins with stage-storage relationships that produce realistic draining characteristics; for use in reservoir routing programs such as HEC-HMS and HEC-1; TR-20/TR-55; HEC-RAS unsteady flow; SWMM (including PC-SWMM and XP-SWMM); ICPR, PondPack, HydroCAD, and Hydraflow. This method is appropriate for modeling proposed flood and/or stormwater quality detention basins in watershed planning studies.

Area and Volume Calculations:

Initial Surcharge Volume:

$$ISV = 0.003WQCV; \qquad A_{ISV} = \frac{ISV}{ISD}; \qquad L_{ISV} = \sqrt{A_{ISV}}; \qquad W_{ISV} = \sqrt{A_{ISV}}$$

Where *ISV* is the initial surcharge volume (ft^3), A_{ISV} is *ISV* surface area (ft^2), *ISD* is the initial surcharge depth (ft, typically 0.33 to 0.50), and L_{ISV} and W_{ISV} are the length and width of the *ISV* (ft).

Basin Floor Volume:

$$L_{floor} = L_{ISV} + \frac{H_{floor}}{S_{TC}} + H_{floor}(S_{main}); \qquad W_{floor} = W_{ISV} + \frac{H_{floor}}{R_{L:W}(S_{TC})};$$

$$A_{floor} = L_{floor}(W_{floor}); \; V_{floor} = \frac{H_{floor}}{3}\left(A_{ISV} + A_{floor} + \sqrt{A_{ISV}(A_{floor})}\right)$$

Where L_{floor} and W_{floor} (ft) are the length and width of the basin floor section at the point where the top of the basin floor section meets the toe of the basin main section, H_{floor} is the depth of the basin floor section (ft), S_{TC} is the trickle channel slope (ft/ft), S_{main} is the side slope of the basin main section (H:V; e.g., 4 if the horizontal:vertical ratio is 4:1), $R_{L:W}$ is the basin length:width ratio (e.g., 2 if the basin length is twice the basin width), A_{floor} is top area of the basin floor section (ft^2), and V_{floor} is volume of the basin floor section (ft^3).

Main Basin Volume:

$$L_{main} = L_{floor} + 2H_{main}(S_{main}); \qquad W_{main} = W_{floor} + 2H_{main}(S_{main}); \qquad A_{main} = L_{main}(W_{main});$$

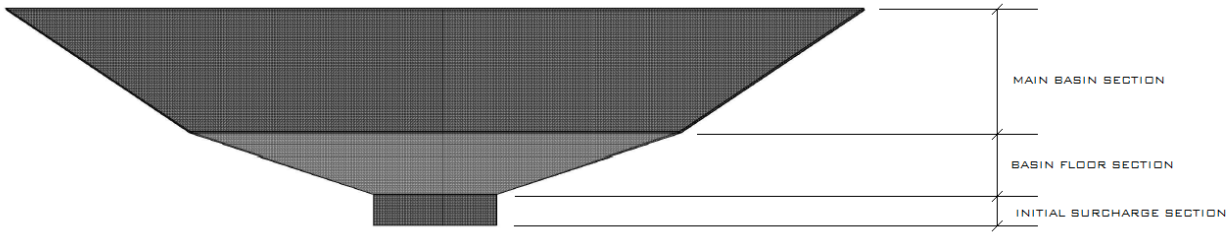
$$V_{main} = \frac{H_{main}}{3}\left(A_{main} + A_{floor} + \sqrt{A_{main}(A_{floor})}\right)$$

Where L_{main} and W_{main} (ft) are the length and width of the main basin section at the point at the top of the basin, H_{main} is the depth of the main basin section (ft), A_{main} is top area of the main basin section (ft^2), and V_{main} is volume of the main basin section (ft^3).

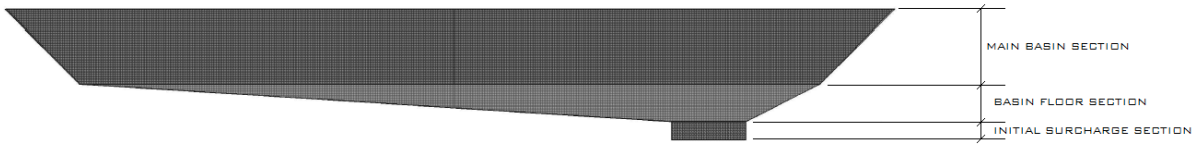
Total Basin Volume:

$$V_{total} = ISV + A_{ISV}(D_{TC}) + V_{floor} + V_{main}$$

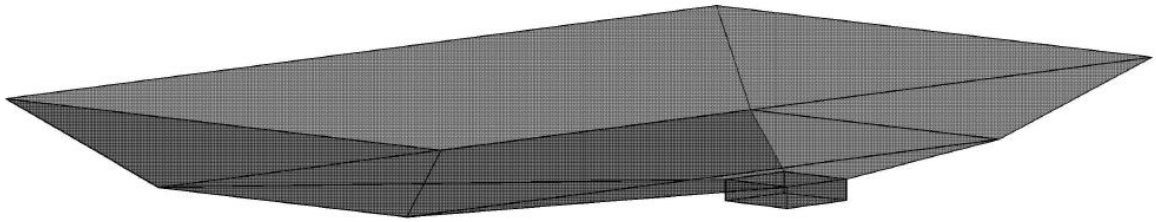
Where V_{total} is the total basin volume (ft^3) and D_{TC} is the depth of the trickle channel (ft).



Front view of detention basin model



Side view of detention basin model



Axonometric projection of detention basin model