PIPE-R™ Reservoir System in HydroCAD® Stormwater Modeling System

HydroCAD® Stormwater Modeling is a computer aided design system that can be used to model a PIPE-R™ reservoir system as retention and detention system. HydroCAD 10.00-Built 20 has the PIPE-R™ reservoir system for all configurations and stacks incorporated. Though HydroCAD® is for modeling the hydrology and hydraulics of stormwater runoff in general, this guide only presents how to model PIPE-R™ reservoir system as a pond. For all other modeling capabilities of the HydroCAD® modeling system, which may include inflow and outflow, hydrographs and other routing details contact the developers of the model or get help from the website www.hydrocad.net.

This guide provides only specifics of the storage calculations of PIPE-R™ reservoir system using the Chamber Wizard or Prismatoid options in HydroCAD® system. Brief descriptions and the required steps in modeling PIPE-R reservoir system with either options are presented subsequent sections.

Chamber Wizard

This option provides a simply modeling approach to underground storage calculations of PIPE-R™ reservoir system. After the selection of the PIPE-R™ reservoir chamber type, the Chamber Wizard automatically applies the recommended chamber spacing, sizes, separation and perimeter widths, cover and base depths, and all other manufacturer's specifications. These specifications can also be user defined to fit the design. The Chamber Wizard has the capability to calculate approximate cost of the designed system and automatically store in the project, if prices are entered. The steps to follow in modeling the storage calculations for chamber wizard option are presented below.

1. Open an existing project or create new project and save the project in the appropriate folder on your computer
2. Create a pond by dragging the blue triangle pond icon on the left pane into the workspace on the right.
3. Double-click on the pond triangle or right-click and select the "Edit" submenu to open the "Edit Pond" dialog box.
4. In the "General" tab:
    a. Give a name to describe the pond in the "Node Name" box.
    b. On the "Pond Type" check the "Detention Pond (or other storage area)"
5. Select the "Storage" tab:
    a. Uncheck the "Use Large units" box if you are using smaller units or leave it checked if using larger units (default).
    b. Double-click anywhere in the blue colored highlighted area to open the "Select New Storage Type" dialog box.
    c. In the "Wizards" selections, double-click on the "Chamber Wizard" selection or click "OK" to open the "Chamber Wizard Field" dialog box.
    d. In the "Model" dropdown menu click on "ECS" and select the desired PIPE-R™ reservoir chamber type (Pipe-R 11W, Pipe-R 15W, Pipe-R 1890, Pipe-R 424, or Pipe-R 90).

e. Uncheck the "Use typical spacing", recommended, to input design specific spacing, stone depths, etc.; and enter user defined measurements in the following cells for "Row Spacing", "Side Stone", "End Stone", "Stone Cover", "Stone Base", "Side Slope" – enter "0", "Stone Voids" – as specified by design engineer or local regulatory agency, and "Stone Invert" elevation in feet.

f. In the "Size" dropdown menu select the number of stacks desired, between 1 and 10. The nominal height for a stack is 8.625 inches (219 mm), so the PIPE-R™ reservoir chamber height becomes the number of stack multiplied by the stack height of 8.625 inches (219 mm).

g. In the "Number of Rows" dropdown menu, enter the number of rows to fit the available site space and/or constraints.

h. In the "Chambers per Row" dropdown menu, enter the number of chambers in a row – to fit available site space and/or constraints. Maximum allowed length for a chamber is 100 feet (30.5 m).

i. For approximate install cost, enter the cost of each material and check the "Show Costs" see approximate pricing in the output.

j. Click "OK" to exit dialog box, and click "OK" again in the previous dialog box.

6. Double-click on the pond triangle or right-click and select the "Report" view the dialog box for output results.

a. "Summary" tab display the outputs for the entire system showing available storages, storage descriptions, invert elevations, and more, if outflow routing was included in the model.

b. "Wizards" tab displays the input parameters used in the pond, sizes and dimensions, material quantities and cost.

c. "Hydrograph" tab will display the routing hydrograph if included in the model.

d. "Discharge" tab displays the stage-discharge chart, if outflow conditions were included in the model.

e. "Storage" tab displays the stage-area-discharge chart.

f. "Sizing" tab displays approximate storage volume and desired peak flow as guide to establishing initial parameters for actual pond routing.

7. For inflow and outflow routing to the PIPE-R™ reservoir system follow basic HydroCAD® steps as applicable to ponds.

Prismatoid

Per the HydroCAD® Help file, this modeling option "is used to describe storage volume of a prismatoid with rectangular bottom and four equally sloped sides", which includes the PIPE-R™ reservoir system with vertical sides. It allows for a storage vault such as PIPE-R™ reservoir system to be embedded within an envelope volume with different voids assigned to each volume. It, thus, requires that the length, width and height dimensions of the enveloping volume be known prior to modeling the PIPE-R™ reservoir system. The modelling option is manual, unlike the chamber wizard, for better accuracy. The steps to follow in modeling the storage calculations for prismatoid option are presented below.

1. Open an existing project or create new project and save the project in the appropriate folder on your computer

2. Create a pond by drag the blue triangle pond icon on the left pane into the workspace on the right.

3. Double-click on the pond triangle or right-click and select the "Edit" submenu to open the "Edit Pond" dialog box.
4. In the "General" tab:
    a. Give a name to describe the pond in the "Node Name" cell.
    b. On the "Pond Type" check the "Detention Pond (or other storage area)"
5. Select the "Storage" tab:
    a. Uncheck the "Use Large units" cell if you are using smaller units or leave it checked if using larger units (default).
    b. Double-click anywhere in the blue colored highlighted area to open the "Select New Storage Type" dialog box.
    c. In the "Basic Options" selections, double-click on the "Prismatoid" selection or click "OK" to open the "Prismatoid Storage" dialog box. The "Description Box should the Prismatoid selected.
    d. Enter the "Invert Elevation", "Bottom Width", "Bottom Length", "Height", and "Side-Z" (always equal to zero for PIPE-R™ reservoir system) for the envelope volume.
    e. Enter the following parameters for the remaining cells:
        i. Nothing for "Embed Inside" because that is the aggregate envelope.
        ii. 1.00 for "Storage Multiplier"
        iii. Percent voids – actual value, say 40 or some other value for "Voids". Value should be the design voids for the aggregate.
        iv. Wall thickness is inactive for this dialog box.
    f. Click "OK" to exit the dialog box.
    g. Double-click on the next row below the Prismatoid selection on the "Edit Pond" dialog box to open the next dialog box – "Select New Storage Type" dialog box.
    h. In the "Basic Options" selections, double-click on the "Prefab Chamber" selection or click "OK" to open the "Prefab Chamber Storage" dialog box.
    i. In the "Model" dropdown menu click on "ECS" and select the desired PIPE-R™ reservoir chamber type (Pipe-R 11W, Pipe-R 15W, Pipe-R 1890, Pipe-R 424, or Pipe-R 90).
    j. In the "Size" dropdown menu select the number of stacks desired, between 1 and 10. The nominal height for a stack is 8.625 inches (219 mm), so the PIPE-R™ reservoir chamber height becomes the number of stack multiplied by the stack height of 8.625 inches (219 mm).
    k. In the "Description" cell you make changes or leave the default description.
    l. In the "Embed Inside" cell, select "Volume 1" or any other predefined Volume based on the entering in the prismatoid selection.
    m. Enter the design values for the remaining cells:
        i. "Invert Elevation" of the PIPE-R™ reservoir chamber from the plan.
        ii. "Effective Length" of the PIPE-R™ reservoir chamber type, using the default value is recommended.
        iii. "Row Adjustment" inactive cell
        iv. "Interior Voids" cell enter 100
        v. "Storage Multiplier" enter the number of chambers for the selected type in section "5-i" above.
        vi. "Number of Rows" The number chamber must be a multiple of the number rows to equal the storage multiplier.

       vii.   Click "OK" to exit the dialog box, and click "OK" again in the previous dialog box

6. Double-click on the pond triangle or right-click and select the "Report" view the dialog box for output results.
   a. "Summary" tab display the outputs for the entire system showing available storages, storage descriptions, invert elevations, and more, if outflow routing was included in the model.
   b. "Hydrograph" tab will display the routing hydrograph if included in the model.
   c. "Discharge" tab displays the stage-discharge chart, if outflow conditions were included in the model.
   d. "Storage" tab displays the stage-area-discharge chart.
   e. "Sizing" tab displays approximate storage volume and desired peak flow as guide to establishing initial parameters for actual pond routing.
7. For inflow and outflow routing to the PIPE-R™ reservoir system follow basic HydroCAD® steps as applicable to ponds.