



# OpenFlows™ CulvertMaster®

## Culvert Hydraulic Analysis and Design

Bentley's OpenFlows CulvertMaster is an extremely powerful yet easy-to-use calculator product that helps engineers design new culverts and analyze existing culvert hydraulics. It can also be used to analyze everything from single-barrel crossings to complex embankment cross-drain systems, with different shapes and sizes, special tailwater considerations, and roadway overtopping. The analysis even considers watershed data, culvert characteristics, and weir geometry.

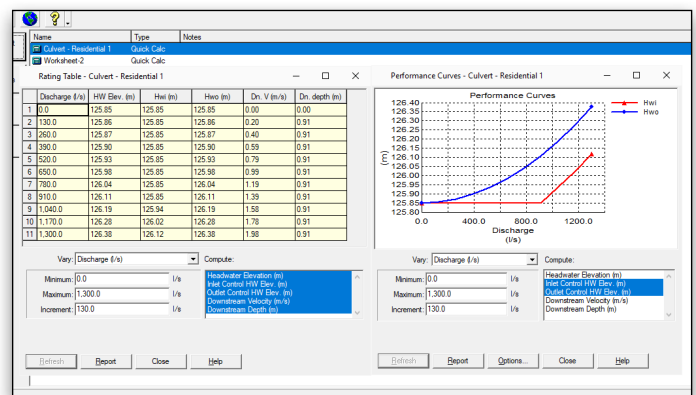
### As Easy as ABC

Data entry and manipulation is flexible and straightforward. Users of OpenFlows CulvertMaster can simply enter data in clearly labeled fields with full context-sensitive assistance and the ability to click to calculate. Design and analysis models can be navigated quickly, using tabbed dialog worksheets to edit watershed data, tailwater conditions, profile information, and more. With OpenFlows CulvertMaster, engineers can conveniently organize all the designs and analyses for the same project within a single file.

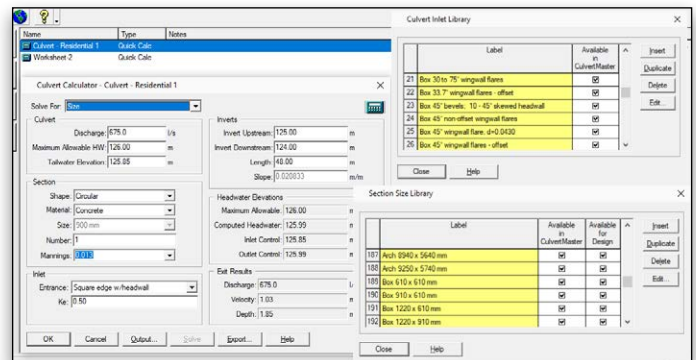
### Comprehensive Analysis and Design

OpenFlows CulvertMaster offers three flexible simulation types that engineers can use for all phases of their projects:

- **Quick Culvert Calculator** – for simple culverts with known characteristics. This simulation type allows users to plug in the data they know and solve for what they need. Its worksheet-style dialog requires a minimal amount of descriptive input information to solve for discharge, headwater elevation, or culvert size.
- **Culvert Analyzer** – for more complex systems with multiple barrels, different shapes and sizes, special tailwater considerations, and roadway overtopping. Engineers typically use this simulation type to verify the hydraulic performance of existing culverts, analyze complex situations such as main-stream culverts working in combination with relief culverts in overbank areas, perform road overtopping analysis of existing culverts or new designs, or supplement existing culvert structures to correct inadequate capacities resulting from urbanizing watersheds or undersized cross-drain conditions.
- **Culvert Designer** – allows engineers to compare several proposed options, incorporate these design trials into complex hydraulic analyses, and evaluate the results. In this design mode, engineers can create individual culvert trials and solve for the size of a culvert of a specified shape, material, and roughness to pass the design discharge under design elevation headwater conditions. Additionally, engineers can specify discharge for a specific culvert under design headwater elevation for a specific culvert under design discharge conditions.



Engineering libraries let users specify common parameters that can be shared across projects.



With OpenFlows CulvertMaster, users can easily generate reports, calculate rating tables, and plot performance curves.

### Hydraulics and Hydrology

OpenFlows CulvertMaster computations use the widely accepted US Federal Highway Administration's Hydraulic Design of Highway Culverts (HDS-5) methodologies, allowing users to solve for whatever hydraulic variables they don't know, such as culvert size, peak discharge, and headwater elevation.

Flow calculations handle pressure and varied flow situations such as backwater and drawdown curves. Design discharge can be calculated using either the Rational or SCS peak discharge method. Rainfall information is calculated using rainfall tables, equations, or the National Weather Services' Hydro-35 data. OpenFlows CulvertMaster also plots Intensity-Duration-Frequency (IDF) curves from rainfall data. Users can reuse this data for all projects in that region.

## System Requirements

### Platform Pre-requirements

OpenFlows CulvertMaster runs without platform restrictions as a stand-alone application

### Processor

As per minimum operating system requirements

### Memory

As per minimum operating system requirements

### Operating System

Microsoft Windows 10, Windows 10 x 64, Windows 8, Windows 8 x 64, Windows 7, Windows 7 x 64

Note: Windows 7 operating system is supported only with its service pack (SP1) installed

**Find out about Bentley at: [www.bentley.com](http://www.bentley.com)**

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# OpenFlows CulvertMaster At-A-Glance

## Interface, Editing, and Model Management

- Built-in interactive tutorials
- Worksheet list for convenient display of project content
- Project setup wizard
- Engineering libraries (materials, section sizes, and culvert inlets)
- Rainfall data specified using a rainfall table or a rainfall equation
- Global engineering units management
- Support for ProjectWise®

## Hydraulics

- HDS-5 methodology
- Pressure or partial (free surface) flow conditions
- Gradually varied flow algorithm
- Flow profile methods: drawdown and backwater analysis
- Culvert section shapes: box, circular, arch, horizontal and vertical ellipse

- Outlet channel sections: rectangular, triangular, trapezoidal and irregular shapes
- Roadway or broad-crested weir (to check overtopping conditions)

## Hydrology

- Watershed area calculation: calculation of total area and weighted runoff coefficient, based on an unlimited number of watershed sub-areas and corresponding runoff coefficients
- Peak flow method: Rational Method, SCS Graphical Peak Method, user-defined peak flow rate
- Rainfall data input: Intensity-Duration-Frequency (IDF) equations, IDF tables, Hydro-35

## Results Presentation

- Summarized and detailed reports of inputs and outputs
- Rating tables
- Performance curves (single or multiple elements)