# Example for using BMPs in series in the MIDS calculator

This page provides an example application of the Minimal Impact Design Standards (MIDS) calculator for several BMPs in series. Examples for individual BMPs can be found at MIDS calculator sample exercises.

The



| Watershed | Soil type (HSG) | Land Cover (acres) | | | Total (acres) |
|---|---|---|---|---|---|
| | | Turf-disturbed | Forest-undisturbed | Impervious | |
| Cistern | B | 0 | 0 | 0.08 | 0.08 |
| Tree Box | B | 0.11 | 0 | 0.07 | 0.18 |
| Basin 1 | B | 0.17 | 0 | 0.03 | 0.20 |
| Green Roof (1) | B | 0 | 0 | 0.02 | 0.02 |
| Permeable Pavers (2) | B | 0 | 0 | 0.08 | 0.08 |
| Basin 2 | B | 0.12 | 0 | 0.15 | 0.27 |
| Total: | | 0.40 | 0 | 0.43 | 0.83 |

Notes:

(1) For "Site Information", Green roof area is considered impervious area. 4" media depth. Entire watershed is a green roof (871 sf)

(2) For "site Information", Permeable pavers are considered impervious area. 2,614 sf of pavers with 870 sf of roof draining onto the pavers

Table summarizing BMPs used for this example.

Schematic used for the example of BMPs in series for the MIDS calculator. Site properties are illustrated in the table below. See Step 1.



| Watershed | BMP Description | Surface Area at Overflow (ft²) | Surface Area at Media Surface (ft²) | Surface Area at Underdrain (ft²) | Bottom surface Area (ft²) | Overflow Depth (ft) | Total Media Depth (ft) | Depth Below Underdrain (ft) |
|---|---|---|---|---|---|---|---|---|
| Cistern (1) | Harvest and re-use/Cistern | 50 | NA | NA | 50 | 1.0 | NA | NA |
| Tree Box (2) | Tree trench system/Box (w/o underdrain) | NA | 650 | NA | 650 | NA | 6.0 | NA |
| Basin 1 | Bioretention basin (w/o underdrain) | 2200 | 1282 | NA | NA | 1 | NA | NA |
| Green Roof | Green Roof | NA | 871 | NA | NA | NA | 4 inches | NA |
| Permeable Pavers (3) | Permeable Pavement | NA | NA | 2614 | 2614 | NA | NA | 1.0 |
| Basin 2 (4) | Bioretention basin (with elevated underdrain) | 1546 | 1258 | 1200 | 1118 | 1 | 3.0 | 1.3 |

Notes:

(1) Irrigates a 0.25 acre area at 1 in/week from May through September. Is offline during offseason.

(2) Media porosity - field capacity = 0.30. Median field capacity - wilting point is 0.07. 6 deciduous, small sized trees are planted in the tree boxes.

(3) For "Site Information", Permeable pavers are considered impervious area. 2,614 sf of pavers with 871 sf of roof draining onto the pavers. Media Porosity=0.48

(4) Media field capacity - wilting point = 0.15. Media porosity - field capacity = 0.35. Planting media mix = C, P content of media is less than 30 kg/mg, and no soil amendments have been added

Table summarizing inputs for the BMPs used in this example

Mississippi Watershed Management Organization (http://www.mwmo.org/) office in northeast Minneapolis contains multiple BMPs that are routed to one another before the water reaches the Mississippi River. This site contains a **cistern** that receives runoff from part of the building's roof and is used to irrigate a 0.25 acre area, a **green roof (https://stormwater.pca.state.mn.us/index.php?title=Green_roofs)**, a series of **tree boxes** that treat overflow from the cistern, **permeable pavement (https://stormwater.pca.state.mn.us/index.php?title=Permeable_pavement)**, a **bioretention** basin without an **underdrain** and a bioretention basin with an underdrain. The flow of water and location of the BMPs are displayed in the schematic. All

watershed information and BMP parameters for this site are displayed in the tables below. This example will show how to enter all of the BMPs, route them to the appropriate downstream BMP and view the results.

**Step 1**: Determine the watershed characteristics for the entire site. For this example we have a 0.8 acre site with 0.43 acres of impervious area and 0.37 acres of turf cover in B soils.

**Step 2**: Fill in the site specific information into the *Site Information* tab. This includes entering a Zip Code (55418 for this example) and the watershed information in Step 1. Zip code and impervious area must be filled in or an error message will be generated. Other fields on this screen are optional.

**Step 3**: Go to the Schematic tab and drag and drop the BMPs into the *Schematic Window*. BMPs in this example include a Harvest and re-use/Cistern, a Tree trench system/Box (w/o underdrain), a permeable pavement BMP, a green roof, a bioretention basin without an underdrain and a bioretention basin with an underdrain.

**Step 4**: Open the BMP properties for the Cistern by right clicking on the *Harvest and re-use/Cistern* icon and selecting *Edit BMP properties*, or by double clicking on the *Harvest and re-use/Cistern* icon.

**Step 5**: Determine the watershed characteristic for the cistern. For this example 0.08 acres of impervious area is draining to the cistern. Enter in the watershed information, change the name to cistern and route to the Tree trench system/Box BMP.

**Step 6**: Enter in the BMP design parameters into the *BMP parameters* tab. Harvest and re-use/Cistern requires the following entries:

- Reuse storage volume - equal to the cistern volume of 500
- Irrigation application area - 0.25 acres
- Irrigation application rate - 1 inch/week
- Irrigation start month - May
- Irrigation end month - September
- Does the system go offline during off season – Yes

**Step 7**: Close the BMP properties window for cistern by clicking OK.

**Step 8**: Open the BMP properties for the tree box by right clicking on the *Tree trench system/Box (w/o underdrain)* icon and selecting *Edit BMP properties*, or by double clicking on the *Tree trench system/Box (w/o underdrain)* icon.

**Step 9**: Determine the watershed characteristic for the tree box. The watershed parameters for the tree box include a 0.18 acre site with 0.07 acres of impervious area and 0.11 acres of pervious turf area in type B soils. Enter in the watershed information. Change the name and route the BMP to the bioretention basin without an underdrain.



Screen shot of the Site information tab for the MIDS calculator example of BMPs in series. See Step 2.



Screen shot of schematic tab for the MIDS calculator example of BMPs in series. See Step 3.
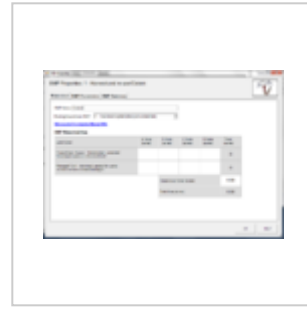
**MIDS calculator screen shots for watershed tabs for BMPs used in this example. Click on an image for enlarged view.**
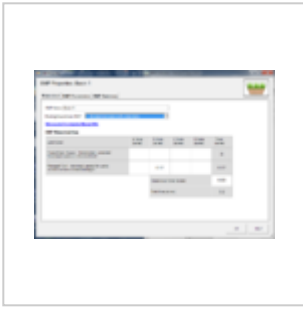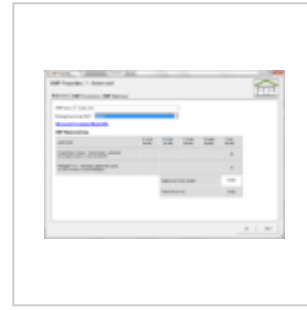


Screen shot of the watershed tab for the bioretention basin without an underdrain. See Step 17.
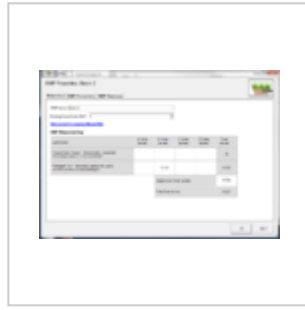


Screen shot of the watershed tab for bioretention with an underdrain. See Step 21.



Screen shot of the watershed tab for a cistern. The Harvest and Reuse/Cistern BMP must be used. See Step 5.



Screen shot of the watershed tab for a green roof. See Step 25.



Screen shot of the watershed tab for permeable pavement. See Step 13.



Screen shot of the watershed tab for a tree trench. See Step 9.

**Step 10**: Enter in the BMP design parameters into the *BMP parameters* tab. Tree trench systems require the following entries.

- Surface area at **engineered media** (https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_bioretention#Materials_specifications_-_filter_media) surface - 650 square feet
- Bottom surface area (area at media-soil interface) - 650 square feet
- Media depth - 6 feet
- Media **field capacity** minus **wilting point** - 0.07 cubic feet per cubic foot
- Media **porosity (f)** minus field capacity - 0.30 cubic feet per cubic foot
- Tree type - Deciduous
- Tree Size - Small
- Number of Trees - 6
- Underlying soil – Hydrologic Soil Group which is SM (HSG B; 0.45 in/hr) from the dropdown box
- Required **drawdown time** (hrs) - 48 from the dropdown box

**MIDS calculator screen shots for BMP Parameter tabs for BMPs used in this example. Click on an image for enlarged view.**
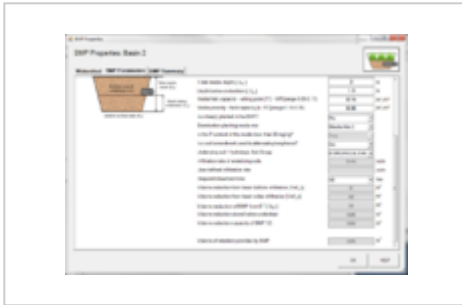
Screen shot of BMP parameters tab for a cistern. See Step 6.



Screen shot of the BMP Parameters tab for biorention with no underdrain (bioinfiltration). See Step 14.



Screen shot of BMP Parameters tab for bioretention with an underdrain (biofiltration). See Step 18.



Screen shot of BMP Parameters tab for bioretention with an underdrain (biofiltration). See Step 18.

**Step 11**: Close the BMP properties window for tree box by clicking OK.

**Step 12**: Open the BMP properties for the permeable pavement by right clicking on the *Permeable pavement* icon and selecting *Edit BMP properties*, or by double clicking on the *Permeable pavement* icon.

**Step 13**: Determine the watershed characteristic for the permeable pavement. The watershed parameters for the permeable pavement include a 0.08 acre site with all of it being impervious. Enter in the watershed information. Change the name and route the BMP to the bioretention basin without an underdrain.

**Step 14**: Enter in the BMP design parameters into the "BMP parameters" tab. Permeable pavement requires the following entries.

- Surface area at underdrain - 2614 square feet
- Bottom surface area - 2614 square feet
- The depth below the underdrain - 1 foot
- The media porosity - 0.4 cubic feet per cubic foot
- Will the soil require compaction – No
- Underlying soil – **hydrologic soil group (https://stormwater.pca.state.mn.us/index.php?title=Design_infiltration_rates)** - 6 SM (HSG B, 0.45 in/hr)
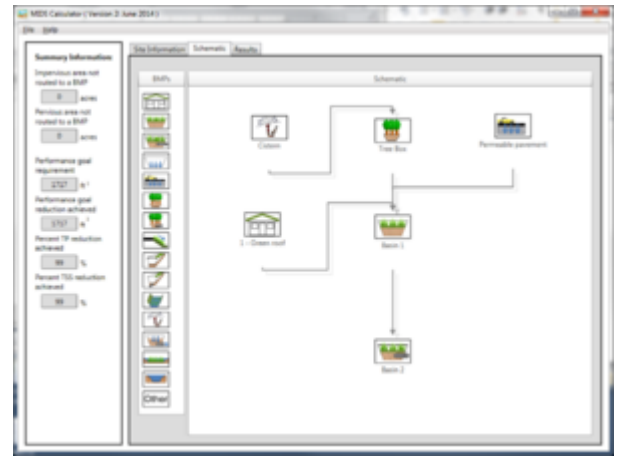- Required drawdown time - 48 hours

**Step 15**: Close the BMP properties window for permeable pavement by clicking OK.

**Step 16**: Open the BMP properties for the Basin 1 by right clicking on the *Bioretention basin (w/o an underdrain)* icon and selecting *Edit BMP properties*, or by double clicking on the *Bioretention basin (w/o an underdrain)* icon.

**Step 17**: Determine the watershed characteristic for the bioretention basin without an underdrain. The watershed parameters for Basin 1 include a 0.2 acre site with 0.03 acres of impervious area and 0.17 acres of pervious turf area in type B soils. Enter in the watershed information. Change the name and route the BMP to the bioretention basin with an underdrain.

**Step 18**: Click on the *BMP Parameters* tab and enter the BMP design parameters. Bioretention basin without an underdrain requires the following entries.



Screen shot of Schematic tab showing the routing for the BMPs used in the example.

- Overflow surface area - 2200 square feet
- Bottom surface area - 1282 square feet
- Overflow depth - 1 foot
- Underlying soil – Hydrologic Soil Group - SM (HSG B; 0.45 in/hr) from the dropdown box
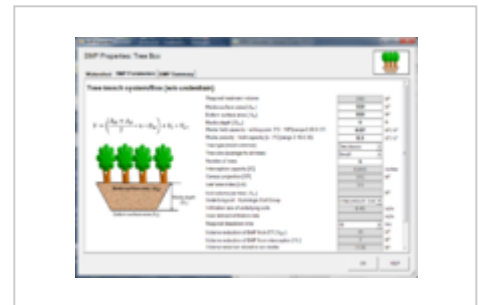- Required drawdown time (hrs) - 48 from the dropdown box

**MIDS calculator screen shots for BMP Parameter tabs for BMPs used in this example. Click on an image for enlarged view.**



Screen shot of the BMP Parameters tab for green roof. See Step 26.



Screen shot of the BMP parameters tab for permeable pavement. See Step 14.



Screen shot of the BMP parameters tab for tree box. See Step 10.



Screen shot of the BMP parameters tab for tree box. See Step 10.

**Step 19**: Close the BMP properties window for Basin 1 by clicking OK.

**Step 20**: Open the BMP properties for the Basin 2 by right clicking on the *Bioretention basin (with an underdrain)* icon and selecting *Edit BMP properties*, or by double clicking on the *Bioretention basin (with an underdrain)* icon.

**Step 21**: Determine the watershed characteristic for the bioretention basin with an underdrain. The watershed parameters for Basin 2 include a 0.27 acre site with 0.15 acres of impervious area and 0.12 acres of pervious turf area in type B soils. Enter in the watershed information and change the name.

**Step 22**: Enter in the BMP design parameters into the *BMP parameters* tab. Bioretention basin with an underdrain requires the following entries.

- Is the underdrain elevated above native soils – Yes
- Are the sides of the basin lined with an impermeable liner – No
- Is the bottom of the basin lined with an impermeable liner – No
- Surface area of overflow - 1546 square feet
- Surface area at media surface - 1250 square feet
- Surface area at underdrain -1200 square feet
- Bottom surface area (area at media-soil interface) - 1110 square feet
- Overflow depth - 1 foot
- Total media depth - 3 feet
- Depth below underdrain - 1.3 foot
- Media field capacity minus wilting point - 0.15 cubic feet per cubic foot
- Media porosity minus field capacity - 0.35 cubic feet per cubic foot
- Is a tree(s) planted in the BMP – No
- Bioretention planting media mix - Media Mix C
- Is the P content of the media less than 30 mg/kg - auto fills to "Yes" for Media Mix C
- Is a soil amendment used – No
- Underlying soil – Hydrologic Soil Group - SM (HSG B; 0.45 in/hr) from the dropdown box
- Required drawdown time (hrs) - 48 from the dropdown box

**Step 23**: Close the BMP properties window for Basin 2 by clicking OK.

**Step 24**: Open the BMP properties for the green roof by right clicking on the *Green roof* icon and selecting *Edit BMP properties*, or by double clicking on the *Green roof* icon.

**Step 25**: Determine the watershed characteristic for the green roof. The watershed parameters for the green roof include a 0.02 acre site all impervious. Enter in the watershed information. Change the name and route the green roof to Basin 1.

**Step 26**: Click on the *BMP Parameters* tab and enter in the BMP design parameters. Green roof requires two entries.

- The media depth - 4 inches
- The surface area of the green roof - 871 square feet

**Step 27**: Close the BMP properties window for the green roof. Check the routing by looking at the *Schematic tab* to make sure all of the BMPs are routed correctly.

**Step 28**: Go to the *Results tab* and review the results.

**MIDS calculator screen shots for Results tabs for this example. Click on an image for enlarged view.**
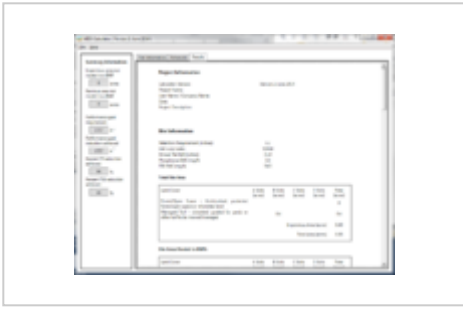
Screen shot of the Results tab for the BMP in series example. See Step 28.

Screen shot of the Results tab for the BMP in series example. See Step 28.

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Screen shot of the Results tab for the BMP in series example. See Step 28.

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