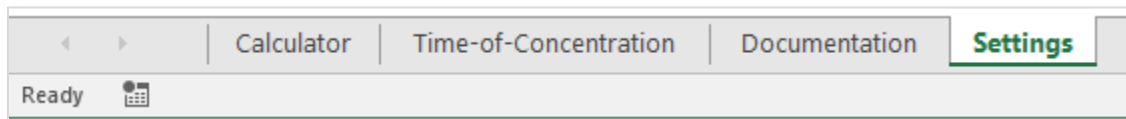


LGROW DESIGN SPREADSHEET TUTORIAL

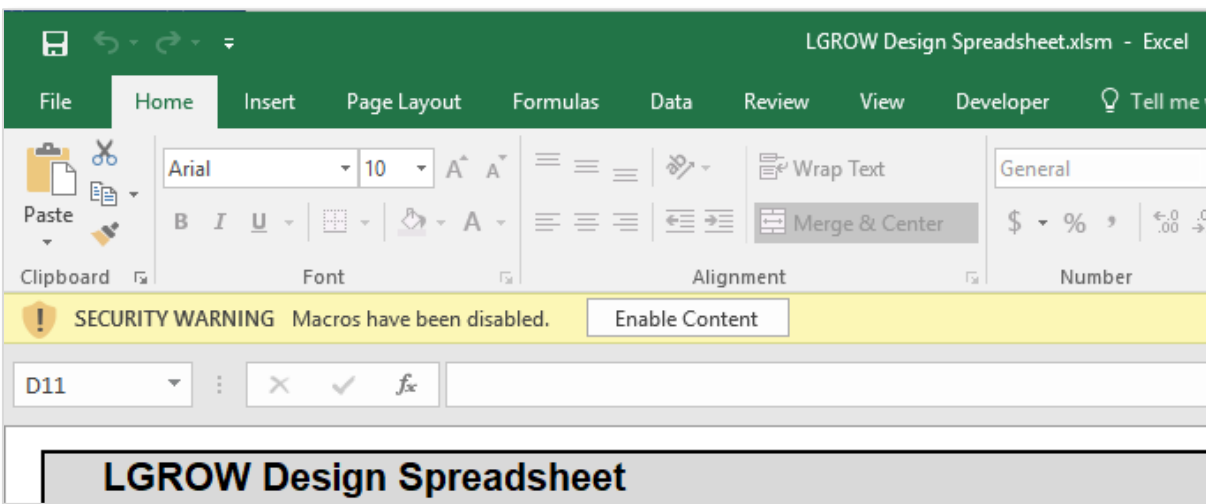
General

The LGROW Design Spreadsheet consists of four worksheets identified by tabs at the bottom of the spreadsheet (Excel workbook).

Data is input using the Calculator and Time-of-Concentration tabs. The Documentation tab provides additional supporting documentation, organized by each section of the Calculator tab. The Documentation tab can be easily accessed by clicking on the “Click here for documentation” link at the top of pertinent sections of the Calculator tab. The Settings tab is a summary of local settings selected by the county or community to manage stormwater and meet MS4 Permit requirements.



After opening the spreadsheet you will be required to enable use of a programmed macro. Look for the security warning and click “Enable Content.”



Data is entered in yellow cells. Green cells allow selection of items from pulldown menus.

A red triangle in the upper right-hand corner of a cell indicates a comment is embedded with directions or further explanation for the user.

The spreadsheet is intended for all areas contributing to a single stormwater treatment train. A site with multiple treatment trains requires one spreadsheet for each treatment train, even if they discharge to the same detention basin or outlet.



Section 1: Project Description

1. Enter project information.

1. Project Description	
Development name:	JTP Expansion
Location:	Kent County, C Township
Firm name:	ABC Consultants
Engineer:	RJH
Date:	9/1/2018
Description (catchment name):	Entire Site
Notes:	Expansion of building area and parking with the use of BMPs to mitigate increases in stormwater runoff.

Section 2: Area Summary

2. Enter total area contributing to the end of a single treatment train. (This may or may not be the total site area.)
3. The “Disturbed area” cell will automatically populate based on the area entered in Section 3 “Runoff from Disturbed Areas.” If this value is less than the “Total area” entered in Section 2, the remaining area will be shown as “Undisturbed area.”
4. Select “Yes” if this is a redeveloped site.

2. Area Summary		
	Area [ac]	% Total
Total area	1.00	
Disturbed area	1.00	100%
Undisturbed area	0.00	0%
Redevelopment?	Yes	

Section 3: Runoff from Disturbed Areas

5. Enter land use information for existing site. Select area units for each land use (square feet or acres).

3. Runoff from Disturbed Areas		Click here for documentation		
3a. Existing				
Land Use	HSG	Area	Units	SCS CN
Impervious (paved parking lot, roof, driveway, etc.)	D	0.18	acre	98
			acre	
Woods - poor			acre	
Woods - fair			acre	
Woods - good			acre	
Open spaces (grass cover) - poor			acre	
Open spaces (grass cover) - fair			acre	
Open spaces (grass cover) - good			acre	
Gravel			acre	
Dirt			acre	
			acre	
			acre	
		0.18	acre	



Enter land use information for the developed site. The total developed area must be equal to the existing area (indicated by red ovals in screen shot below). Refer to land use comments (red triangle in spreadsheet cell) for more guidance on selecting an appropriate land use/land cover. Pay attention to the following land use considerations:

- a. Select “Open spaces (grass cover) – fair” or “poor” depending on condition for disturbed pervious areas.
- b. Review the non-structural BMPs and select for use as appropriate. Selecting these will allow for a lower CN to be used as compared to disturbed pervious area.
- c. Select “BMP surface” to account for the surface area of structural BMPs, including detention basins used for flood control. Since these BMPs are sized in later sections of the spreadsheet, the values used here may initially be estimates based on conceptual design. These should be updated as appropriate in later iterations.

3. Runoff from Disturbed Areas				Click here for documentation
3a. Existing				
Land Use	HSG	Area	Units	SCS CN
Impervious (paved parking lot, roof, driveway, etc.)	D	0.18	acre	98
Open spaces (grass cover) - good	D	0.82	acre	80
			acre	
			acre	
			acre	
			acre	
			acre	
			acre	
			acre	
		1.00	acre	
3b. Developed				
Land Use	HSG	Area	Units	SCS CN
Impervious (include pervious pavement and vegetated roof)	All HSG's	0.40	acre	98
Open spaces (grass cover) - fair	D	0.30	acre	84
Minimal & no disturbance areas: Open spaces - good	D	0.10	acre	80
Plant trees (200 sqft per tree): Woods - good	D	6,400	sqft	77
BMP surface: Meadow	D	0.05	acre	78
			acre	
			acre	
			acre	
			acre	
		1.00	acre	

Note: Table 3c shows the land use calculations for pre-development conditions as defined by the channel protection standard (included in the Documentation tab). This information will be identical to existing conditions if the “Channel Protection Volume Basis” on the Settings tab shows “Pre-development = Existing Condition.”



Section 4: Channel Protection Volume

6. Check required channel protection volume. This volume is calculated using information entered in Section 3.

Note: The definition of “pre-development condition” is provided in the Settings tab.

4. Channel Protection Volume	
4a. Required Channel Protection Volume	
2-year, 24-hour runoff volume for proposed development condition [cft]	5,532
2-year, 24-hour runoff volume for pre-development condition [cft]	4,293
Minimum Required Channel Protection Volume [cft]	1,239

7. Select structural BMPs to meet the minimum required channel protection volume.

Note: For pervious pavement and vegetated roof, the “Volume Provided” is limited by the total amount of precipitation that falls on the BMP during the 2-year rainfall event.

4b. Structural BMP used to meet Channel Protection Volume					
Structural BMP	Data Columns Required	A Area of BMP [sqft]	V Available Water Storage Volume [cft]	i Design Infiltration Rate [in/hr]	Volume Provided [cft]
Vegetated Roof	A & V	2,500	625		533
					0
					0
					0
					0
					0
					0
					0
					0
Total Channel Protection Volume Provided					533
Percentage of Channel Protection Volume met by retention					43%

8. If the entire channel protection volume is unable to be met through onsite retention, the extended detention volume and release rate reported in Section 4c may be allowed.

4c. Extended Detention for Channel Protection Volume not met by Structural BMPs	
Minimum Required Extended Detention Volume [cft]	705
Maximum Allowable Extended Detention Release Rate [cfs]	0.005



Section 5: Water Quality Volume

9. White cells are automatically populated with impervious and disturbed pervious areas not receiving BMPs.
10. Enter amount of impervious roof and/or unpaved impervious surface. If none is entered, all impervious will be considered to be paved.
11. Check required water quality volume. This volume is calculated using information entered in Sections 3, 4 and 5.

Note: Directly connected impervious area is reduced by the surface area entered for pervious pavement and vegetated roof BMPs in Section 4b.

5. Water Quality Volume		Click here for documentation
Sum of directly connected impervious area [ac]	0.34	
Flat Roofs/Unpaved [ac]	0.20	
Pitched Roofs [ac]	0.14	
Paved [ac]	0.14	
Sum of directly connected disturbed pervious area [ac]	0.30	
Sandy Soils (HSG A) [ac]	0.00	
Silty Soils (HSG B) [ac]	0.00	
Clayey Soils (HSG C&D) [ac]	0.30	
Minimum Required Water Quality Volume [cft]	1,322	

Section 6: Water Quality Volume and TSS Accounting

12. Use this section to add up the water quality volume provided and calculate the TSS removal efficiency in the treatment train.
13. Select all BMPs in the treatment train and insert the water quality volume provided by each. Refer to comments (red triangle in spreadsheet cell) for more guidance on selecting the appropriate volume to report. The “Total Water Quality Volume Provided” is the sum of the listed volumes. In this example, at least 500 cft of the detention basin storage volume (to be sized in Section 8) is needed to meet the water quality volume requirements.
14. If the BMP has a published TSS removal efficiency, the yellow cell under “Value” will be grayed out and the published value will automatically populate the white cell. If a manufacturer supplied TSS removal efficiency is needed, the user must enter the value in the yellow cell. The “Treatment Train TSS Removal Efficiency” is the accumulated efficiency of all BMPs in the train.
15. Ensure that water quality volume and 80% TSS removal requirements are met.



6. Water Quality Volume and TSS Accounting [Click here for documentation](#)

BMPs Used in Treatment Train	Water Quality Volume Provided [cft]	Manufacturer Supplied TSS Removal Efficiency		TSS Removal Efficiency [%]	
		Needed?	Value [%]	BMP	Treatment Train
Catchbasin	126	No		22	22
Detention Basin (extended)	704	No		72	78
Detention Basin (dry)	500	No		49	89
Total Water Quality Volume Provided	1,330	Treatment Train TSS Removal Efficiency		89	
Water Quality Volume requirement met?	Yes	80% TSS removal met?		Yes	

Section 7: Time-of-Concentration

16. The existing and developed times-of-concentration can be entered in one of two ways. User specified values can be entered manually or the values can be computed using TR-55 methodology.

17. To enter user specified times select "User Spec." in the green pulldown menu and enter the values in the yellow cells under "User Spec."

Note: The minimum time-of-concentration used in the calculations is 0.1 hour consistent with TR-55.

18. The time of travel through the structural BMPs selected in Section 4 is shown in the Worksheet column even if "User Spec." is selected (refer to red oval in screen shot below). This time can be added manually to the user specified time.

Note: The value displayed for Developed time-of-concentration in the Worksheet column is only reflective of the structural BMP travel time if no data is entered in the Time-of-Concentration tab.

7. Time-of-Concentration

	Worksheet	User Spec.	User Spec.
Existing [hr]	0.00	0.50	0.50
Developed [hr]	0.05	0.55	0.55

19. To compute the times-of-concentration using TR-55 methodology enter the flow path details for both the existing and developed site using the Time-of-Concentration tab. Then select "Worksheet" in the green pulldown in Section 7.



Tc1. Time-of-Concentration for Existing Site

Sheet Flow						
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Manning's n	Slope [ft/ft]	Travel Time [hr]
Paved						
Gravel						
Bare soil						
Fallow						
Cultivated (< 20% residue)						
Cultivated (> 20% residue)						
Short grass						
Dense grass						
						0.00

Shallow Concentrated Flow (after 300 feet of sheet flow)						
Type	US Elevation [ft]	DS elevation [ft]	Flow Distance [ft]	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]
						0.00

Open Channels, Swales, and Pipes										
Type	US Elevation [ft]	DS elevation [ft]	Flow Distance [ft]	Area [sqft]	Wetted Perimeter [ft]	User Specified, n	Manning's n	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]
										0.00

Time of concentration [hr] **0.00**

Section 8: Flood Control Volume

20. Use the option button to select either the standard allowable discharge or an approved alternate allowable discharge.
21. If the developed peak discharge is less than or equal to the selected allowable discharge, no detention storage is required.
22. Select desired units for detention storage volume (cubic feet or acre-feet).
23. Click on the "Calculate detention storage volume" button to run macro if detention storage is required.
24. The "Minimum Required Detention Volume" is the total storage volume required in a detention basin before discharging offsite. This volume includes the extended detention volume reported in Section 4c, but it does not include BMP volumes entered in Section 4b.
25. If a single site has more than one treatment train, the detention volumes reported in the spreadsheet for each treatment train may be summed up to obtain the total flood control volume for the site.

8. Flood Control Volume (detention only) [Click here for documentation](#)

Design storm: 25-year

Developed peak discharge [cfs]: 1.86

Allowable Discharge Worksheet

Standard allowable discharge [cfs] - 0.13 [cfs/ac]: 0.13 Select

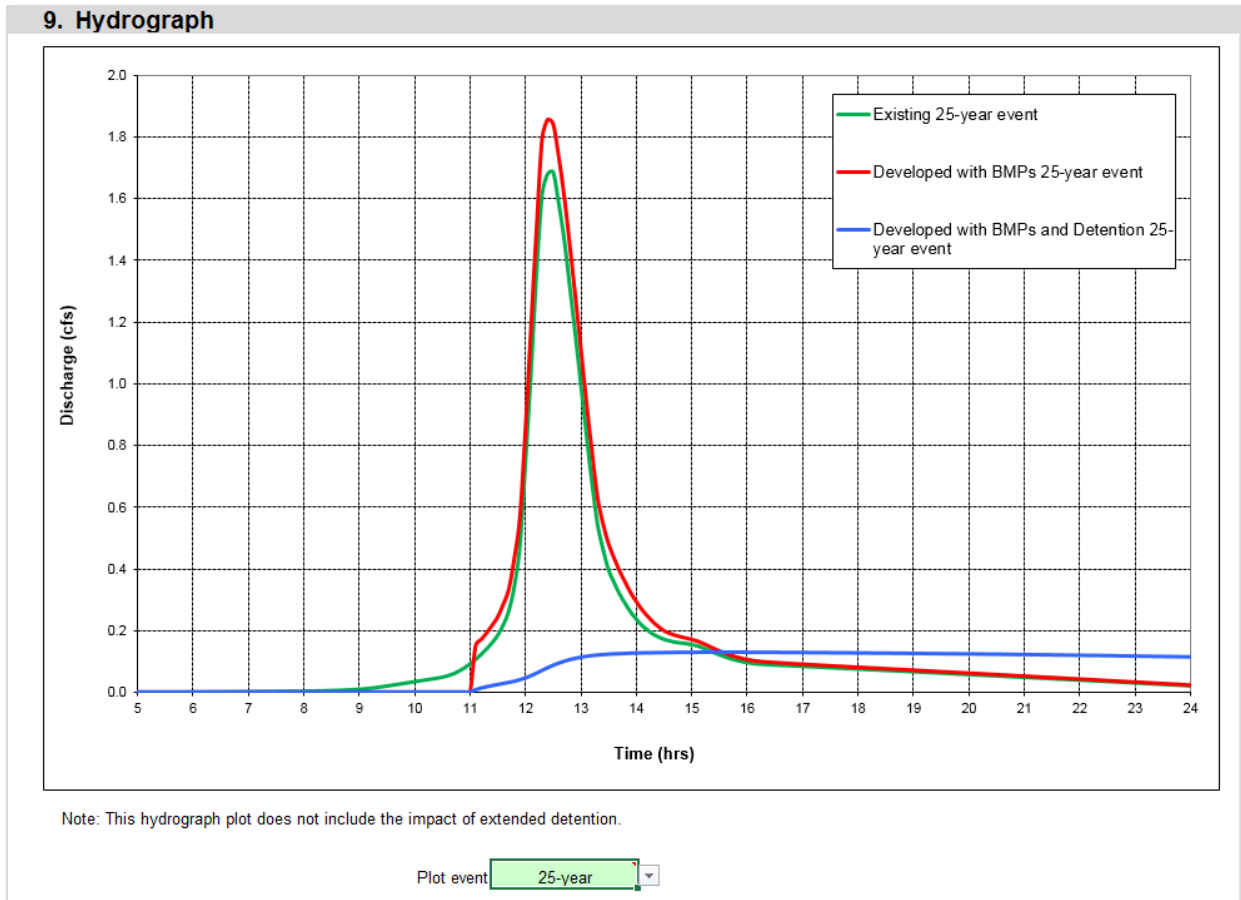
Alternate allowable discharge [cfs]:

Calculate detention storage volume

Maximum allowable discharge [cfs]	0.13
Detention storage required?	Yes
Calculated peak discharge [cfs]	0.13 Detention storage volume calculated.
Minimum Required Detention Volume	8,125 cft

Section 9: Hydrograph

26. Select the plot event to view hydrographs for existing and developed conditions.





Section 10: Results Summary

- 27. Section 10 provides a tabular summary of the results.
- 28. Select desired volume units (cubic feet or acre-feet).
- 29. Use this table to verify that the extended detention peak discharge is less than the 1-year, existing condition peak discharge. For this example, Section 4c shows the maximum allowable extended detention release rate to be 0.005 cfs, while Section 10 shows the existing condition 1-year peak discharge to be 0.53 cfs.
- 30. The “Volume retained by BMPs” row of the table also shows how the volume retained by pervious pavement and vegetated roof BMPs, which was limited to the 2-year rainfall volume in Section 4b, increases with rainfall depth for larger storms until the available water storage volume of the BMPs is reached (625 cft in this example).

10. Results Summary					
Volume units		cft			
Rainfall					
Source and distribution 24-hour, NOAA Atlas 14 at Kent County Airport, NRCS MSE4					
Rainfall frequency	1-year	2-year	10-year	25-year	100-year
Rainfall depth (inches)	2.22	2.56	3.77	4.66	6.27
Pre-development					
Pervious Curve Number	80	80	80	80	80
Average runoff [in]	0.93	1.18	2.16	2.93	4.39
Peak discharge [cfs]	0.53	0.68	1.24	1.68	2.53
Runoff volume [cft]	3,389	4,293	7,826	10,625	15,924
Existing Conditions					
Pervious Curve Number	80	80	80	80	80
Average runoff [in]	0.93	1.18	2.16	2.93	4.39
Peak discharge [cfs]	0.53	0.68	1.24	1.68	2.53
Runoff volume [cft]	3,389	4,293	7,826	10,625	15,924
Developed with BMPs					
Pervious Curve Number	81	81	81	81	81
Average runoff [in]	1.25	1.53	2.58	3.39	4.90
Peak discharge [cfs]	0.68	0.84	1.41	1.86	2.69
Runoff volume [cft]	4,526	5,532	9,333	12,266	17,732
Volume retained by BMPs [cft]	463	533	625	625	625
Volume released [cft]	4,063	4,998	8,708	11,641	17,107
Developed with BMPs and Detention					
Peak discharge [cfs]	0.07	0.08	0.11	0.13	1.81
Maximum volume detained [cft]	2,380	3,095	5,892	8,125	8,164