generate_swmm_inp

Manual for the QGIS plugin version 0.15

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1 Introduction

SWMM is an open-source model and software by the US EPA for the simulation rainfall-runoff and routing in water bodies, sewer systems and wastewater infrastructures. To set up a new SWMM model, objects such as nodes, links and catchments can either be drawn via SWMM´s graphical user interface (GUI) or specified in a plain text file in ".inp" format ("input file"). The plugin "generate_swmm_input" provides tools for the conversion of geodata in QGIS into input files for SWMM (and vice versa).

1.1 Installation

The plugin: "generate_swmm_inp" can be installed within QGIS from official QGIS plugin repository. The latest experimental version of the plugin will be available on GitHub and can be installed from a zip file after download.

Missing Python packages: The plugin needs the Python packages "pandas" and "openpyxl". If they are not already installed, the tools will raise errors, when running. To install missing packages, various instructions can be found online. Here are some examples...

- Windows:
  - until QGIS version 3.18: Open the OSGeo4W shell and run `py3_env`.
    Then run `python −m pip install openpyxl` (and likewise "pandas" if needed).
    If you have had an "advanced install" of QGIS within osgeo4w-setup, you can simply open osgeo4w-setup again, search for the packages and use the checkbox to install them.
  - for QGIS version 3.20 and later: Open the OSGeo4W shell and directly run `python −m pip install openpyxl`.
- Linux: open the terminal and install via pip: `python −m pip install openpyxl` (and likewise "pandas" if needed).

SWMM: To run the models, SWMM has to be installed. Alternatively you can use the "swmmr" package for R or packages such as "pyswmm" for Python.

1.2 Hints for this documentation

This documentation is a "work in progress". If you find any mistakes or you miss explanations for certain tools, layers, ... please write an issue on GitHub or an email to the author.
Two different types of tables will appear in the documentation. The first type shows the column names and attributes which are used in shapefiles and .xlsx files. Such a table will look like this:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
...	...	...	
...	...	...	

The second type shows examples of how tables in the .xlsx files have to be organised. Such a table will look like this:

1st col.	**2nd col.**	**3rd col.**	**4th col.**	**5th col.**
some	random	data	...	...
...	...	...	..	...

2 The tools

2.1 1_GenerateDefaultData

The first tool will give you a default data set to see the data structure needed for the export and conversion into a input file later on. You have to chose a folder, in which all data will be saved. To date shapefiles are provided for the main infrastructures:

- junctions (SWMM_junctions.shp)
- conduits (SWMM_conduits.shp)
- subcatchments (SWMM_subcatchments.shp)
- storages (SWMM_storages.shp)
- outfalls (SWMM_outfalls.shp)
- pumps (SWMM_pumps.shp)
- weirs (SWMM_weirs.shp)
- outlets (SWMM_outlets.shp)
- orifices (SWMM_orifices.shp)
- dividers (SWMM_dividers.shp)

Further data is provided in tables and can be edited there:

- curves (gisswmm_curves.xlsx)
- inflows (gisswmm_inflows.xlsx)
- options (gisswmm_options.xlsx)
- patterns (gisswmm_patterns.xlsx)
- quality (gisswmm_quality.xlsx)
- timeseries (gisswmm_timeseries.xlsx)
- transects (gisswmm_transects.xlsx)

2.2 2_GenerateSwmmInpFile

With the second tool, you can convert shapefiles and tables into input files. The default data serve as a template for your own model, because column names have to be matching in order to identify the correct information for the input file. In the user interface of the tool, select the layers you want to have in your SWMM model and a location to save the input (".inp") file.

2.3 3_ImportInpFile

3 Field names and column names in geodata and tables

3.1 Geodata

In the current version of the plugin, the main file type for geodata are shapefiles. This limits the length of the field names in the attribute to 10 characters. Hence, in some cases, the field names required for the tools differ from those used in the graphical user interface (GUI) in SWMM. For example, the rate of seepage loss into the surrounding soil of a conduit can be defined with the field "Seepage" in the conduits layer, which refers to "Seepage Loss Rate" in the SWMM GUI.

3.1.1 Subcatchments

LAYER TYPE: point / polygon
CHANGES: "InfMethod" was renamed in version 0.15, before: "kind"
DESCRIPTION: Subcatchments can either be points or polygons. Each subcatchment has to have a unique name (attribute *Name*). The required fields in the attribute table are:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
Name	string	Name	
RainGage	string	Rain Gage	the name of the rain gage
Outlet	string	Outlet	the name of the junction into which water of the subcatchment flows
Area	float	Area	Area in hectares (or other unit defined in the options table)
Imperv	float	% Imperv	
Width	float	Width	
Slope	float	% Slope	
CurbLen	float		
SnowPack			
Data for SUBAREAS:			
N_Imperv	float	N-Imperv	
N_Perv	float	N-Perv	
S_Imperv	float	Dstore-Imperv	
S_Perv	float	Dstore-Perv	
PctZero	float	% Zero-Imperv	
RouteTo	float	Subarea Routing	
PctRouted	float	Percent Routed	
Data for INFILTRATION:			
Param1	float		
Param2	float		
Param3	float		
Param4	float		
Param5	float		
InfMethod	string	Infiltration Method	'HORTON', 'MODIFIED_HORTON', 'GREEN_AMPT', 'MODIFIED_GREEN_AMPT', 'CURVE_NUMBER'

3.1.2 Nodes

LAYER TYPE: point
Four types of nodes can be added to a SWMM-file: junctions, storage units, dividers or outfalls.

Junctions

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Elevation	float	Invert El.	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Aponded	float	Ponded Area	

Inflows are defined in a table (see 'Inflows' table). Treatment of pollutatants is not implemented yet.

Storage units

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Elevation	float	Invert El.	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Type	string	Storage Curve	'FUNCTIONAL' or 'TABULAR'
Curve	string	Curve Name	for TABULAR storage curves; the names of the curves have to be matching with those in the storage curves table
Coeff	float	Coefficient	for FUNCTIONAL curves
Exponent	float	Exponent	
Constant	float	Constant	
Fevap	float	Evap. Factor	
Psi	float		
Ksat	float		
IMD	float		

Dividers

CHANGES: "CutoffFlow" was renamed in version 0.15, before: "CutOffFlow"
DESCRIPTION:

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Elevation	float	Invert El.	
DivertLink	string	Outlet Node	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Aponded	float	Ponded Area	
Type	string	Type	
CutoffFlow	float	Cutoff Flow	if Type is 'CUTOFF'
Curve	float	Curve Name	if Type is 'TABULAR'; the names of the curves have to be matching with those in the divider curves table
WeirMinFlo	float	Outlet Offset	
WeirMaxDep	float	Initial Flow	if Type is 'WEIR'
WeirCoeff	float	Maximum Flow	

Outfalls

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Elevation	float	Invert El.	
FlapGate	string	Tide Gate	'YES' or 'NO'
RouteTo	string	Route To	Subcatchment outflow ist routed onto; leave blank if not applicable
Type	string	Type	'FREE','NORMAL','FIXED','TIDAL' or 'TIMESERIES'
Data	float/string		Das muss überarbeitet werden!

3.1.3 Links

LAYER TYPE: line
Links are represented as line layers in QGIS. These can be conduits, pumps, weirs, orifices or outlets.

Conduits

CHANGES:
"Kentry" was renamed in version 0.14, before: "Inlet"
"Kexit" was renamed in version 0.14, before: "Outlet"
"Kavg" was renamed in version 0.14, before: "Average"
DESCRIPTION:

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Length	float	Length	
Roughness	float	Roughness	
InOffset	float	Inlet Offset	
OutOffset	float	Outlet Offset	
InitFlow	float	Initial Flow	
MaxFlow	float	Maximum Flow	

Data for cross sections (XSECTIONS):

Shape	string	Shape	
Geom1	float		for most of the Shapes this is the 'Max. Depth'
Geom2	float	see SWMM	
Geom3	float	Documentation	
Geom4	float		
Barrels	float	Number of Barrels	
Shp_Trnsct	string	-	Transect name for IRREGULAR cross sections or shape curve name for CUSTOM cross sections
Culvert	float	Culvert Code	
Data for LOSSES:			
Kentry	float	Entry Loss Coeff.	
Kexit	float	Entry Loss Coeff.	
Kavg	float	Avg. Loss Coeff.	
FlapGate	String	Flap Gate	can be 'YES' or 'NO'
Seepage	float	Seepage Loss Rate	

Pumps

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
PumpCurve	string	Pump Curve	has to be matching with the curve name in the pump curves table; set an asterisk ('*') here for ideal pump
Status	string	Initial Status	'ON' or 'OFF'
Startup	float	Startup Depth	
Shutoff	float	Shutoff Depth	

Weirs

CHANGES:

"CoeffCurve" was renamed in version 0.15, before: "Coeff_Curv"
"RoadWidth" was renamed in version 0.15, before: "Roadwidth"
"RoadSurf" was renamed in version 0.15, before: "Roadsurf"

DESCRIPTION:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Type	string	Type	'TRANSVERSE', 'SIDEFLOW', 'V-NOTCH', 'TRAPEZIODAL' or 'ROADWAY'
Height	float	Height	
Length	float	Length	
SideSlope	float	Side Slope	Slope (width-to-height) of TRAPEZIODAL weir side walls
CrestHeigh	float	Inlet Offset	
Qcoeff	float	Discharge Coeff.	
FlapGate	string	Flap Gate	'YES' or 'NO'
EndContrac	int	End Contractions	0, 1 or 2
EndCoeff	float	End Coeff.	For TRAPEZIODAL weirs
Surcharge	string	Can Surcharge	'YES' or 'NO'
CoeffCurve	float	Coeff. Curve	the name of the curve has to be matching to the name in the table for weir curves
RoadWidth	float	Road Width	For ROADWAY weir types
RoadSurf	float	Road Surface	

Orifices

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Type	string	Type	'SIDE' or 'BOTTOM'
Shape	string	Shape	'CIRCULAR' or 'RECT_ClOSED'
Height	float	Heigth	
Width	float		Width
InOffset	float	Inlet Offset	
Qcoeff	float	Discharge Coeff.	
FlapGate	string	Flap Gate	'YES' or 'NO'
Close Time	float		

Outlets

CHANGES: "RateCurve" was renamed in version 0.15, before: "Rate_Curve"
DESCRIPTION:

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
InOffset	float	Inlet Offset	
FlapGate	string	Flap Gate	'YES' or 'NO'
RateCurve	string	Shape	'FUNCTIONAL/DEPTH', 'TABULAR/DEPTH', 'FUNCTIONAL/HEAD' or 'TABULAR/HEAD'
Qcoeff	float	Coefficient	for FUNCTIONAL curves
Qexpon	float	Exponent	for FUNCTIONAL curves
CurveName	float	Curve Name	for TABULAR curves; has to be matching with the name in the oulet curves table

3.2 Tables

3.2.1 Options

You may want to set the options already in your input file. To do so, you simply write them in a table with two columns: key and value.

3.2.2 Curves

Any type of curves can be imported as a table in an xlsx file. Each curve type has to be in a seperate table named with the curve type. Curve types are:

- Pump1
- Pump2
- Pump3
- Pump4
- Weir
- Storage
- Rating

- Tidal
- Control
- Diversion
- Shape

Different curves oft the same type are stored in the same table by using different names. Just like in the SWMM GUI, curves always consist of three columns: Name, a x-value and a y-value. More culomns can be added (e.g. for annotations), but only the first three columns are relevant for the import into SWMM. Rows beginning with a semicolon (";") will be ignored. Example for a table of two storage curves (where "Depth" is the x-value and "Area" is the y-value) :

Name	**Depth**	**Area**	**Notes**
StC_1	0	3	this is the first storage curve
StC_1	0.5	4	
StC_1	1	4	
StC_1	1.5	5	
;			this row will be ignored
second_StC	0	10	this is the second storage curve
second_StC	1	10	
second_StC	2	11	
second_StC	3	11	
second_StC	4	12	

3.2.3 Timeseries

Name	**Type**	**Date**	**Time**	**Value**	**Format**	**Description**

3.2.4 Patterns

Patterns can be imported in an xlsx file, where each pattern type is stored in a separate table. Pattern types are

- daily
- weekly
- monthly

3.2.5 Quality

Quality parameters can be imported with a xlsx file with the four tables:

POLLUTANTS

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
Name	string	Name	
Units	string		
RainConcentr	float		
GwConcentr	float		
IiConcentr	float		
DecayCoeff	float		
SnowOnly	string		'YES' or 'NO'
CoPollutant	string		
CoFraction	string		
DwfConcentr	float		
InitConcetr	float		

LANDUSES

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Pollutant	string		
SweepingInterval			
SweepingFractionAvailable	string		
LastSwept			
BuildupFunction			
BuildupMax	float		'YES' or 'NO'
BuildupRateConstant	string		
BuildupExponent_SatConst	string		
BuildupPerUnit			
WashoffFunction			
WashoffpCoefficient			
WashoffExponenet			
WashoffCleaninfEfficiency			
WashoffBmpEfficiency			

COVERAGES

Example:

Subcatchment	Landuse	Percent

LOADINGS

Example:

Subcatchment	Pollutant	InitialBuildup

3.2.6 Inflows

Direct

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Constituent	string		
Baseline	float		
Baseline_Pattern	float		
Time_Series	float		
Scale_Factor	float		
Type	string		

Dry_Weather

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
Constituent	string		
Average_Value	float		
Time_Pattern1	float		
Time_Pattern2	float		
Time_Pattern3	float		
Time_Pattern4	float		

3.2.7 Transects