# generate_swmm_inp

**Manual for the QGIS plugin, version 0.20**

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# Contents

# 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. An intruduction to the model itself and details about attributes used in SWMM can be found in the official manual [4].

For a new SWMM model, objects such as nodes, links and catchments can either be drawn via the graphical user interface (GUI) of SWMM or specified in a plain text file in ".inp" format (*input file*). The required data regarding sewer geometries and rivers systems are usually available as geodata (e.g. *shapefiles*). However, a direct import function for such files is not available yet in SWMM. To fix this problem, the plugin "generate_swmm_input" enables the conversion of geodata in QGIS into *input files* for SWMM. Additionally, the plugin provides a tool to import *input files* from SWMM into QGIS. This allows you to use edit layers with the aid of the large toolbox of QGIS.

This documentation explains how install the plugin and how to prepare the geodata in GIS. It 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.

## 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 [1] and can be installed from a zip file after download.

**Missing Python packages:** The plugin needs the Python packages "pandas" and "openpyxl"[1]. 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 [2] for R or packages such as "pyswmm" [3] for Python.

## 1.2 Hints for this documentation

There have been several changes of attribute names from the plugin versions 0.13 to 0.20. These changes are highlighted in <span style="color:red">**red**</span> in every section. Since version 0.19, new features from SWMM 5.2 are integrated in the plugin. Therefore new columns, tables and keywords had to be added. These features are highlighted in <span style="color:blue">**blue**</span> in every section. If you want to continue working with SWMM 5.1 the plugin can generate suitable input files if you don´t chose the keywords.

Two different types of tables will appear in the documentation. The first type shows the column names and attributes which are used in geodata and .xlsx files. Such a table will look like this:

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[1]"openpyxl" is needed to write tables in .xlsx format. Instead you could also install the packages "odf" and "odfpy" to use the .ods file format for tables.

| 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 geodata are provided for the main infrastructures:

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

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 directly convert layers from QGIS into input files. You can add further data (e.g. curves, inflows patterns, see 3.1.2) from tables to the input file. 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. Actions for the user interface:

1. Select the layers and files you want to have in your SWMM model
2. Choose a location and name for the resulting input file (".inp")

## 2.3 3_ImportInpFile

The third tool allows you to import input files into QGIS. All sections (if already implemented) of the input file will be connverted into QGIS layers (e.g. shapefiles) and tables. Actions for the user interface:

1. Choose the input file (".inp")
2. Choose the file format for geodata
3. Choose the (expected) CRS of the data in the input file
4. Optional: choose a prefix to specify the name of the resulting files. For example, if the prefix is set to "20210101", then the name of the junctions file will be "20210101_SWMM_junctions". Try to avoid any characters here, which could cause trouble with file systems (e.g. ".", "," , "/"... )
5. Select a folder to save the resulting files in. Creating and chosing a new, empty folder for the import is recommended.

# 3 Field names and column names in geodata and tables

## 3.1 Geodata

In the first versions of the plugin, the main file type for geodata are shapefiles. This limited 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 (see section 3.1.2), which refers to "Seepage Loss Rate" in the SWMM GUI.

### 3.1.1 Nodes

LAYER TYPE: point
Four types of nodes can be added to a SWMM-file: junctions, storage units, dividers or outfalls. Inflows into any kind of nodes can be are defined in the 'Inflows' table. Treatment of pollutatants is not implemented yet.

**Junctions**

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

**Storage units**

DESCRIPTION: Storage units are represented in a point layer in QGIS. Until SWMM version 5.1 the shape of a storage could be described either by a function ('FUNCTIONAL') or in a table ('TABULAR') as a storage curve. With SWMM version 5.2 storage units can have a variety of shape types (see "Type"). Different columns in the attribute table are required for different shape types[1]. Of course you can also have shape types for different storages within one storage layer

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[1]Not all columns are needed. If a column is not necessary it will be ignored. You'll need:

- When at least one "Type" is 'FUNCTIONAL': Coeff, Exponent, Constant
- When at least one "Type" is 'TABULAR': Curve
- When at least one "Type" is 'PYRAMIDAL': MajorAxis, MinorAxis, SideSlope
- When at least one "Type" is 'PARABOLIC': MajorAxis, MinorAxis, SurfHeight
- When at least one "Type" is 'CONICAL': MajorAxis, MinorAxis, SideSlope
- When at least one "Type" is 'CYLINDRICAL': MajorAxis, MinorAxis

| Name in attribute table | Data type | Name in SWMM GUI | 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', 'TABULAR', 'PYRAMIDAL','PARABOLIC','CONICAL' or 'CYLINDRICAL' |
| 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 | |
| Exponent | float | Exponent | for FUNCTIONAL curves |
| Constant | float | Constant | |
| MajorAxis | float | (Base) Major Axis Length | |
| MinorAxis | float | (Base) Minor Axis Length (Width) | |
| SideSlope | float | Side (Wall) Slope | |
| SurfHeight | float | Heigth of Axis Surface | |
| Fevap | float | Evap. Factor | |
| Psi | float | Suction Head | for seepage loss; inches or mm |
| Ksat | float | Conductivity | for seepage loss; in/h or mm/h |
| IMD | float | Initial Deficit | for seepage loss; difference between porosity and moisture content |

**Dividers**

DESCRIPTION: If the routing option (see options section) is set to 'Steady Flow' or 'Kinematic Wave', flow dividers divert inflows in a certain way, prescribed by the user with the attribute "Type". With the 'Dynamic wave' routing model, dividers are treatet as junctions.
CHANGES: "CutoffFlow" was renamed in version 0.15, before: "CutOffFlow"

| Name in attribute table | Data type | Name in SWMM GUI | 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 | 'CUTOFF', 'TABULAR', 'WEIR' or 'OVERFLOW' |
| 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**

DESCRIPTION:
CHANGES: "FixedStage" and "Curve_TS" were added in version 0.15 instead of "Data" to enable different types

of boundary conditions

| Name in attribute table | Data type | Name in SWMM GUI | 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' |
| FixedStage | float | Fixed Stage | for outfalls with FIXED type |
| Curve_TS | string | Curve Name or Series Name | for TIDAL type: the name of the tidal curve has to be matching with the name in the curves table; for TIMESERIES type: the name of the time series has to be matching with then name in the time series table |

### 3.1.2 Links

LAYER TYPE: line

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

**Conduits**

CHANGES:

<span style="color:red">"Kentry" was renamed in version 0.14, before: "Inlet"</span>
<span style="color:red">"Kexit" was renamed in version 0.14, before: "Outlet"</span>
<span style="color:red">"Kavg" was renamed in version 0.14, before: "Average"</span>

DESCRIPTION:

| Name in attribute table | Data type | Name in SWMM GUI | 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 | See SWMM manual [4] for shape types |
| Geom1 | float | | for most of the shapes this is the 'Max. Depth' |
| Geom2 | float | | |
| Geom3 | float | | |
| Geom4 | float | | |
| Barrels | float | Number of Barrels | |
| Shp_Trnsct | string | - | Transect name if "Shape" is IRREGULAR, shape curve name if "Shape" is CUSTOM or <span style="color:blue">street type name if "Shape" is STREET</span> |
| 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 | 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**

<span style="font-variant: small-caps;">Changes:</span>

"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"

<span style="font-variant: small-caps;">Description:</span>

| Name in attribute table | Data type | Name in SWMM GUI | 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 | 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 | in ft or meter |
| Width | float | Width | in ft or meter |
| InOffset | float | Inlet Offset | |
| Qcoeff | float | Discharge Coeff. | |
| FlapGate | string | Flap Gate | 'YES' or 'NO' |
| CloseTime | float | Time to Open/Close | in hours |

**Outlets**

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

| Name in attribute table | Data type | Name in SWMM GUI | 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 |

### 3.1.3 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 | 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 | Curb Length | Optional parameter needed only for buildup functions (quality) |
| SnowPack | string | Snow Pack | for snow melt analysis only |
| *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 | 'OUTLET','PERVIOUS' or 'IMPERVIOUS' |
| PctRouted | float | Percent Routed | |
| *Data for INFILTRATION[2]:* | | | |
| InfMethod | string | Infiltration Method | 'HORTON', 'MODIFIED_HORTON', 'GREEN_AMPT', 'MODIFIED_GREEN_AMPT', 'CURVE_NUMBER'; if empty then the infiltration method defined in the options table will be applied |
| MaxRate | float | Max. Infil. Rate | Maximum infiltration rate on the Horton infiltration curve in mm/h or in/h |
| MinRate | float | Min. Infil. Rate | Minimum infiltration rate on the Horton infiltration curve in mm/h or in/h |
| Decay | float | Decay constant | Decay constant for the Horton curve in 1/h |
| DryTime | float | Drying Time | Drying time (number of days it takes a fully saturated soil to dry) |
| MaxInf | float | Max. Volume | Maximum infiltration volume possible (Max. Infil. Vol.) in inches or mm; 0 if not applicable |
| SuctHead | float | Suction head | Suction head in inches or mm |
| Conductiv | float | Conductivity | Soil saturated hydraulic conductivity (in/h or mm/h) |
| InitDef | float | Initial deficit | This is the fraction of soil volume that is initially dry [0 to 1] |
| CurveNum | float | SCS curve number | see SWMM Manual [4] for details |

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[2]Not all columns are required. If a column is not necessary for the infiltration method of a subcatchment it will be ignored. You'll need at least:

- When "InfMethod" is 'HORTON' or 'MODIFIED_HORTON': MaxRate, MinRate, Decay, DryTime , MaxInf
- When "InfMethod" is 'GREEN_AMPT' or 'MODIFIED_GREEN_AMPT': SuctHead, Conductiv, InitDef
- When "InfMethod" is 'CURVE_NUMBER': CurveNum, Conductiv, DryTime

You can also have different infiltration methods for different subcatchments.

## 3.2 Tables

### 3.2.1 Options

FILE IN DEFAULT DATA: gisswmm_options.xlsx
DESCRIPTION: 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: "Option" and "Value". So far, **time steps longer than one day cannot be chosen here**, as the date format in python is in conflict with the notation in SWMM (e.g. in SWMM a time step of two days will be written as '48:00:00'. However, Python only accepts 0-23 hours)

### 3.2.2 Curves

FILE IN DEFAULT DATA: gisswmm_curves.xlsx
DESCRIPTION: Any type of curves can be imported as a table in an xlsx file. Each curve type has to be in a seperate sheet/table named with the curve type. 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. Curve types are:

- Pump1
- Pump2
- Pump3
- Pump4
- Pump5
- Weir
- Storage
- Rating
- Tidal
- Control
- Diversion
- Shape

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

FILE IN DEFAULT DATA: gisswmm_timeseries.xlsx
DESCRIPTION: Time series are saved in a .xlsx file (any sheet name). For a normal time series you only fill the columns "Name", "Date" (optional), "Time" and "Value" (See example "TS_1" below).

| Column in table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Time Series Name | |
| Type | string | - | Can be empty. If you put "rain_gage" here, the tool will try add a rain gage with the time series |
| Date | date format | Date | |
| Time | time format | Time | |
| Value | float | Value | |
| File_Name | string | - | file name for external data file; if used, keep "Date", "Time" and "Value" empty (see example TS_3 below) |
| Format | string | - | Can be empty. If Type is "rain_gage", then you have to choose one of "VOLUME", "INTENSITY" or "CUMULATIVE" |
| Description | string | - | If Type is "rain_gage", then you have to put the name of the rain gage here. Otherwise leave empty. |

Exemplary table for a rain gage and a normal time series:

| Name | Type | Date | Time | Value | File_Name | Format | Description |
|---|---|---|---|---|---|---|---|
| TS_1 | | 2021-01-02 | 01:00:00 | 0 | | | |
| TS_1 | | 2021-01-02 | 01:30:00 | 0 | | | |
| TS_1 | | 2021-01-02 | 02:00:00 | 0 | | | |
| TS_1 | | 2021-01-02 | 02:30:00 | 0,2 | | | |
| TS_1 | | 2021-01-02 | 03:00:00 | 0,3 | | | |
| ; | | | | | | | |
| TS_2 | rain_gage | 2021-01-02 | 00:00:00 | 0 | | VOLUME | RG_1 |
| TS_2 | rain_gage | 2021-01-02 | 01:00:00 | 0.1 | | VOLUME | RG_1 |
| TS_2 | rain_gage | 2021-01-02 | 02:00:00 | 0.5 | | VOLUME | RG_1 |
| TS_2 | rain_gage | 2021-01-02 | 03:00:00 | 0.6 | | VOLUME | RG_1 |
| TS_2 | rain_gage | 2021-01-02 | 04:00:00 | 0.1 | | VOLUME | RG_1 |
| TS_2 | rain_gage | 2021-01-02 | 05:00:00 | 0 | | VOLUME | RG_1 |
| ; | | | | | | | |
| TS_3 | | | | | ts_3.dat | | |

### 3.2.4 Patterns

FILE IN DEFAULT DATA: gisswmm_patterns.xlsx

DESCRIPTION: Patterns can be imported in an .xlsx file, where each pattern type is stored in a separate sheet named after the pattern type. Patterns of the same type are written in the same table. Each table consist of three columns: "Name", a Time_Stamp column and "Factor". Pattern types are:

- HOURLY, where the Time_Stamp column is called "Hour" (from 0:00 to 23:00)

- DAILY, where the Time_Stamp column is called "Day" (from Sunday to Saturday)

- MONTHLY, where the Time_Stamp column is called "Month" (from January to December)

- WEEKEND, where the Time_Stamp column is called "Hour" (from 12AM to 11PM)

For example, a table for a DAILY pattern will look like this:

| Name | Day | Factor |
|---|---|---|
| p1 | Sun | 2.0 |
| p1 | Mon | 1.6 |
| p1 | Tue | 1.4 |
| p1 | Wed | 1.8 |
| p1 | Thu | 2.5 |
| p1 | Fri | 2.0 |
| p1 | Sat | 1.8 |
| ; | | |
| p2 | Sun | 2.8 |
| p2 | Mon | 2.7 |
| ... | ... | ... |

## 3.2.5 Quality

FILE IN DEFAULT DATA: gisswmm_quality.xlsx

DESCRIPTION: Quality parameters can be imported with a .xlsx file with the four tables/sheets: 'POLLU-TANTS', 'LANDUSES', 'COVERAGES', 'LOADINGS'.

**POLLUTANTS**

| Columns in table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Name | |
| Units | string | Units | |
| RainConcentr | float | Rain Concen. | |
| GwConcentr | float | GW Concen. | |
| IiConcentr | float | I&i Concen | |
| DecayCoeff | float | Decay Coeff | |
| SnowOnly | string | Snow Only | 'YES' or 'NO' |
| CoPollutant | string | Co-Pollutant | |
| CoFraction | string | Co-Fraction | |
| DwfConcentr | float | DWF Concen | |
| InitConcetr | float | Init. Concen | |

**LANDUSES**

This sheet sets up buildup and washoff functions for different landuses. Since one landuse can have more than one pollutant with individual functions for buildup and washoff, the have defined in different rows of this sheet (see exemplary table).

| Columns in table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Land Use Name | |
| SweepingInterval | float | Interval | in days |
| SweepingFractionAvailable | float | Availability | between 0 and 1 |
| LastSwept | float | Last Swept | in days |
| Pollutant | string | - | |
| BuildupFunction | string | Function | 'NONE', 'POW', 'EXP', 'SAT' or 'EXT' |
| BuildupMax | float | Max. Buildup | kg per textitNormalizer (area or curb length) |
| BuildupRateConstant | float | Rate Constant | |
| BuildupExponent_SatConst | float | Power/Sat. Constant | |
| BuildupPerUnit | string | Normalizer | 'AREA' or 'CURB' |
| WashoffFunction | string | Function | 'NONE', 'EXP', 'RC' or 'EMC' |
| WashoffpCoefficient | float | Coefficient | |
| WashoffExponenet | float | Exponent | |
| WashoffCleaninfEfficiency | float | Cleaning Effic. | percent |
| WashoffBmpEfficiency | float | BMP Effic. | percent |

**COVERAGES**

This sheet refers to *Land Uses* in the GUI of subcatchments. As one subcatchment can have morge than one land use covering its area[3], they are defined in the quality table. Example for one subcatchment with two land use types:

| Subcatchment | Landuse | Percent |
|---|---|---|
| SC1 | LU_1 | 24.5 |
| SC1 | LU_2 | 75.5 |

**LOADINGS**

This sheet refers to *Initial Buildup* in the GUI of subcatchments. As one subcatchment can have morge than one pollutants the initial buildup is defined in the quality table. Values in the column "InitialBuildup" are mass

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[3]the tool will not check if Σ Percent > 100

per area (e.g. kg/ha or lbs/ac). Example for two subcatchments with two pollutants:

| Subcatchment | Pollutant | InitialBuildup |
|---|---|---|
| SC1 | COD | 1 |
| SC1 | TN | 0.6 |
| SC2 | COD | 0.8 |
| SC2 | TN | 0.4 |

### 3.2.6 Inflows

FILE IN DEFAULT DATA: gisswmm_inflows.xlsx

DESCRIPTION: The .xlsx file for inflows contains two tables/sheets. One is for direct inflow (sheet name: "Direct") and one is for dry weather inflow (sheet name: "Dry_Weather"). More than one constituent can have inflows to a node.

**Direct**

| Columns in table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Name | name of the Node |
| Constituent | string | Constituent | 'FLOW' or name of the pollutant |
| Baseline | float | Baseline | |
| Baseline_Pattern | string | Baseline Pattern | |
| Time_Series | string | Time Series | |
| Scale_Factor | float | Scale Factor | |
| Type | string | Type | "MASS", "CONCEN"; applies, when Constituent is not FLOW |
| Units_Factor | float | Units Factor | |

**Dry_Weather**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Name | |
| Constituent | string | Constituent | |
| Average_Value | float | Average Value | |
| Time_Pattern1 | string | | |
| Time_Pattern2 | string | Time Patterns | |
| Time_Pattern3 | string | | |
| Time_Pattern4 | string | | |

### 3.2.7 Transects

FILE IN DEFAULT DATA: gisswmm_transects.xlsx

DESCRIPTION: The .xlsx file for transects (for IRREGULAR cross-sections) contains two tables/sheets ("Data" and "XSections"):

**Data**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| TransectName | string | Name | |
| Station | float | Station | |
| Elevation | float | Elevation | |

**XSections**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| TransectName | string | Name | |
| RoughnessLeftBank | float | Left Bank | |
| RoughnessRightBank | float | Right Bank | |
| RoughnessChannel | float | Channel | |
| BankStationLeft | float | Left | |
| BankStationRight | float | Right | |
| ModifierStations | float | Stations | |
| ModifierElevations | float | Elevations | |
| ModifierMeander | float | Meander | |

### 3.2.8 Streets and Inlets

FILE IN DEFAULT DATA: gisswmm_streets.xlsx

CHANGES: "RoadWidth" was renamed in version 0.20, before: (unfortunately) "CurbWidth"

DESCRIPTION: Streets and Inlets are completely new features in SWMM version 5.2. StreetsThe .xlsx file for streets (for STREET cross-sections) contains three tables/sheets ("STREETS", "INLETS" and "INLET_USAGE"):

**STREETS**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Street Section Name | |
| RoadWidth | float | Road Width | |
| CurbHeigth | float | Curb Heigth | |
| CurbSlope | float | Curb Slope | |
| RoadRoughn | float | Road Roughness | |
| GuttDepres | float | Gutter Depression | |
| GuttWidth | float | Gutter Width | |
| Sides | int | One Sided / Two Sided | 1 or 2 |
| BackWidth | float | Backing Width | |
| BackSlope | float | Backing Slope | |
| BackRoughn | float | Backing Roughness | |

**INLETS**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Name | string | Name | |
| Type | String | Inlet Type | 'GRATE', 'CUSTOM', 'CURB', 'SLOTTED', 'DROP_GRATE', 'DROP_CURB' or 'CUSTOM' |
| Length | float | Length | |
| Width | float | Width | |
| Heigth | float | Heigth | |
| Shape | String | - | Type for GRATE, DROP_GRATE inlets; Throat Angle for CURB inlets; Curve name for CUSTOM inlets |
| OpenFract | float | Open Fraction | For GRATE inlets with GENERIC shape |
| SplashVel | float | Splash Velocity | |

**INLET_USAGE**

| Name in attribute table | Data type | Name in SWMM GUI | annotations |
|---|---|---|---|
| Conduit | string | - | Name of the conduit |
| Inlet | string | Inlet Structure | |
| CaptNode | int | Capture Node | The Name has to be matching to one node name |
| Number | float | Number of Inlets | 1 - 5 |
| PercClog | float | Percent Clogged | 0 - 100 |
| MaxFlow | float | Flow Restriction | 0 for no flow restriction |
| DeprHeigth | float | Depression Height | 0 for no local depression |
| DeprWidth | float | Depression Width | |
| Placement | string | Inlet Placement | 'AUTOMATIC', 'ON_GRADE' or 'ON_SAG' |

# Bibliography

[1]  *generate_swmm_inp*. URL: https://github.com/Jannik-Schilling/generate_swmm_inp.

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[3]  Bryant E. McDonnell et al. "PySWMM: The Python Interface to Stormwater Management Model (SWMM)". In: *Journal of Open Source Software* 5.52 (2020), p. 2292. ISSN: 2475-9066. DOI: 10.21105/joss.02292. URL: https://joss.theoj.org/papers/10.21105/joss.02292.

[4]  Lewis A. Rossmann. *Storm Water Management Modell User's Manual Version 5.1.* Technical Report EPA-600/R-14/413b. U.S. Environmental Protection Agnecy. 2015.