



12d International Innovation Awards



12d[®] International Conference

2016

Joshua Allison, Michael Bozikis & Arvind Chovatia

Drainage Control/Sewer Control

WINNER: OVERALL



Name:	Joshua Allison & Michael Bozikis
Position:	Design Engineers
Company:	SMEC
Name Project:	Drainage Control
Client:	NA
Name:	Joshua Allison & Michael Bozikis
Position:	Design Engineers
Company:	SMEC
Name Project:	Sewer Control
Client:	NA

Category:

- ☐ Design & Visualisation
- ☐ Survey & Construction
- ☒ Drainage, Sewer, Utilities & Rivers
- ☒ Customisation
- ☐ 12d Synergy

Category:

- ☐ Design & Visualisation
- ☐ Survey & Construction
- ☒ Drainage, Sewer, Utilities & Rivers
- ☒ Customisation
- ☐ 12d Synergy



Local People. Global Experience.



12d International Innovation Awards

Description of Project:

Drainage Control is a central hub for creating/ editing/outputting drainage networks. The panel houses all of our drainage network customisations and macros in one solitary place which aid designers to work more efficiently. The macro was developed to improve increase the transparency of how a network is created.

Benefits of the macro include:

- Greater transparency for the entire network (viewing bulk amounts of network data)
- It allows someone to easily check multiple features of the network
- The ability to automatically run quality assurance tests on the network to ensure that it complies with authority standards.
- Standardising outputs and reducing drafting.
- Detailed quantities
- Allowing new property branch types and rotations to be applied.

Description of problem faced / task undertaken:

There were several problem faced when creating a macro of this magnitude, including;

- Generating over 5000 lines of code
- Implement header files to help handle the size of code.
- Tying in custom setup files including drainage.4d, custom ppf's, names.4d, as well as conforming to naming conventions.
- Handling validation issues across the entire macro.

How the problem was solved:

The macro creates a central hub to house the most frequently used 12d functions as well as our own custom macros.

The features of the macro include:

- A button to create new drainage network with our desired attributes.
- A place to view/modify a network settings that are commonly changed.
- A shortcut to create new drainage string on the chosen network including a feature which avoid string name duplication.
- A shortcut to create catchment string which correspond to the chosen network. Including an automatic colour rotation which allow designers to rotate through colours to ensure no catchments of the same colour are touch.
- A shortcut to create attribute polygons which are used to add information when outputting long sections and quantities.
- A shortcut to the string edit command
- A t
- A one stop shop for all sewer network outputs including:
 - Drainage Plan
 - Long Sections (attributes added including crushed rock hatching)
 - Quantities (pipe & pit attributes including crushed rock, depth ranges, pipe class, etc.)

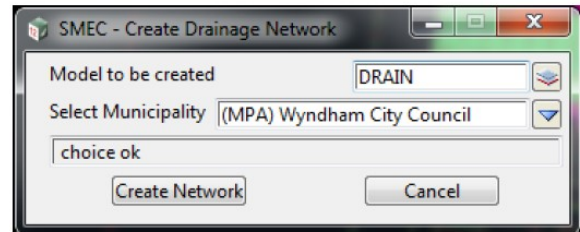
12d International Innovation Awards

Drainage

Drainage Control

Create New

- The “Create New” button allows you to create a new drainage network model.
- The model selected must not exist.
- The model must have the prefix DRAIN (e.g. DRAIN2, DRAIN st2, DRAIN Future)
- Select the relevant municipality for your project.
 - If your municipality is not on the list please contact Josh Allison for it to be created.



Creating a new network model through this panel will create:

- Create the new model
- Apply all drainage network attributes for a given municipality including (but not limited too):
 - “time of concentration” & “runoff coefficient” values
 - Appropriate rainfall file
 - Grade file, drop file
 - Default pit group
 - Creates catchment models and catchment file

Edit

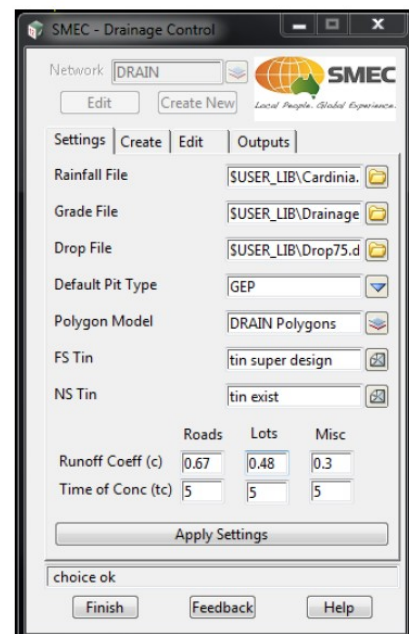
- When an existing DRAIN model is selected click “Edit” to modify/create/output the network.
- The attributes specific to the selected model will be loaded in the panel.

Settings Tab

- The commonly modified network attributes are displayed on this tab
- Click the “Apply Settings” button to activate any changes

Road Catchments

- As per the SMEC setup “Catchment 1” is for roads. If the network was created outside of this panel the **“default - % impervious” for catchment 1 should be 100%**. This means the **“time of concentration”** is set via **“Impervious Tc (minor)”**, and the **“coefficient of runoff”** is set via **“Global - Impv C (minor)”**. This setup is not flexible as when 2 different road coefficients are required across a network there is no way set a specific catchment with a different value.
- When a network is setup with this panel. The **“default - % impervious” for “Catchment 1” will be set to 0%**. This means the **“time of concentration”** will be set by **“Pervious – Tc (minor)”** and the **“coefficient of runoff”** is set via **“Pervious – C (Minor)”**. This will allow for greater flexibility in the future.
- Under the setting tab the “Roads” catchment values will be determined by the default percent impervious for Catchment 1. The tc and c values will be set accordingly.





12d International Innovation Awards

Create Tab

- This tab allows for strings to be created for the chosen network.

Drainage – Create String

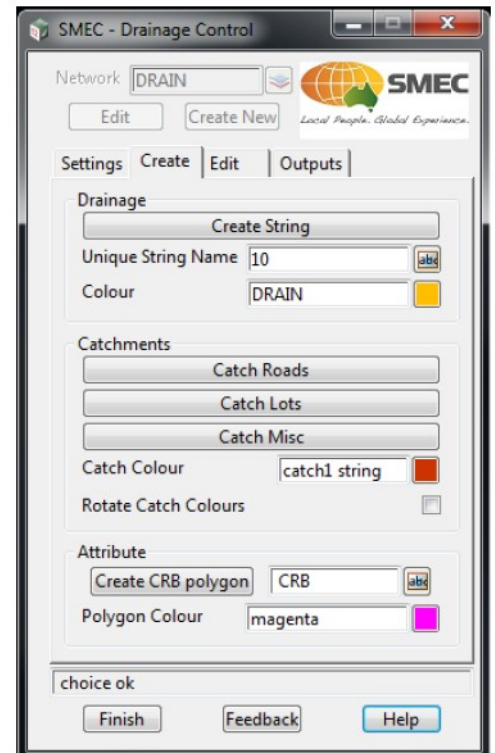
- Clicking the “Create String” button will create a drainage string on the network model. The string will take the name of whatever is in the “Unique String Name Box” and will be coloured according to the “Colour Box”. If a string of that name already exists on the model then an error is flagged and the message box will show “String name exist, please use a unique name”.

Catchment Strings

- These 3 buttons will allow you to create catchment strings on the appropriate model for the selected network. The string will take the colour of the “Catch Colour Box” and will have the line type of “CATCHMENT CLOCKWISE”.
- If “Rotate Catch Colours” is ticked, the colour box will cycle through to a new “catch string colour” every time a new catchment is created.

Attribute String

- This button will create a string on the networks attribute model and will take the name provided in the “input box”.
- When outputting, any part of the network within the attribute polygon will be labelled. The primary example of this is a polygon for “crushed rock backfill”. Drawing polygons on this model allow the user to separate different portions of a network based on the name of the polygon. Often times these polygons can overlap, when the network is quantified using the Output tab, the network is partitioned into these polygons allowing a pit/pipe to have multiple “attributes” such as “Stage 3” or “CRB” or “Class 4”. “CRB” is a special name which will hatch the correct area on the Long Section when plotted.





12d International Innovation Awards

Edit Tab

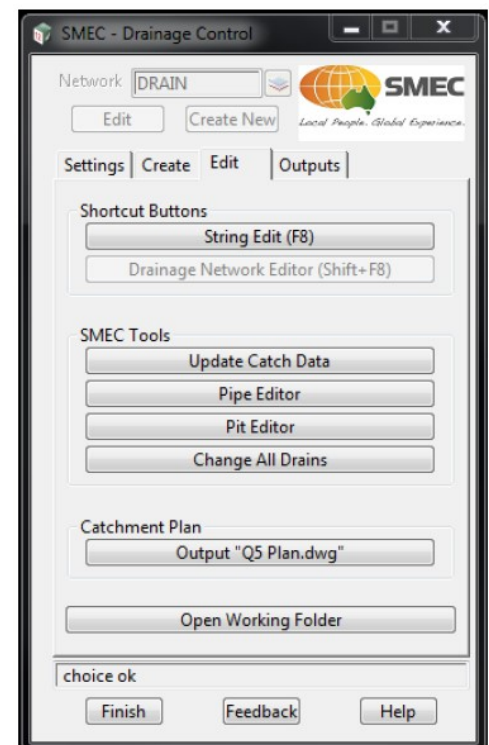
Shortcut Buttons

- String Edit (F8) – Opens the “String Edit” panel.
- Drainage Network Editor (Shift + F8) – Opens the Drainage Network Editor. (Coming Soon)

SMEC Tools

Update Catch Data

- This button will clean/create a model called “CATCH data”
- The “coefficient of runoff” and “time of concentration” for each catchment will be shown below the Catchment name label and will be based on the last storm analysis.

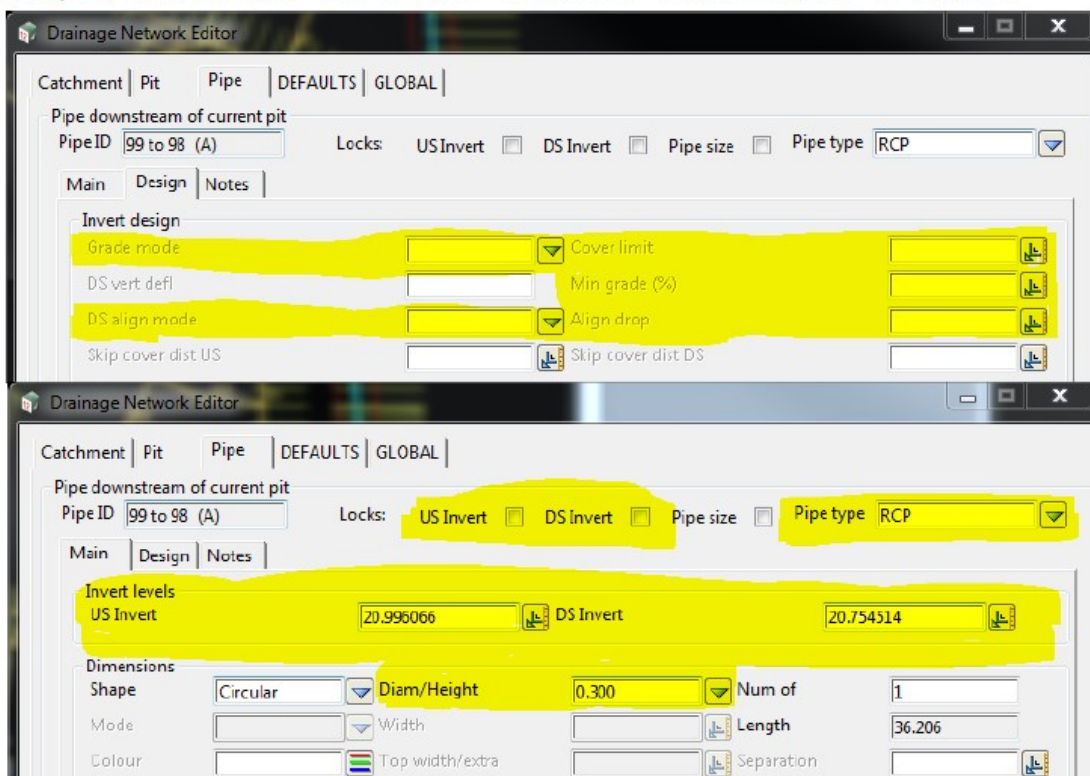


SMEC Pipe Sizing

	Name	Diameter	Type	Q I/s	Qfull	Q%	Cover Mode	Ex.Cover	Min. Cover	Ex.Grade	Min. Grade	Align Mode	Align Drop	Invert DS	Lock DS	Invert US	Lock US
1	2 to 1	1050	RCP	1282	3178	40%		-0.461	-1.000	1.353	1.353			19.000	<input checked="" type="checkbox"/>	19.200	<input checked="" type="checkbox"/>
2	3 to 2	1050	RCP	977	1058	92%	Grade from DS	0.852	0.500	0.150	0.150	CL-CL Drop	0.000	19.500	<input checked="" type="checkbox"/>	19.749	<input type="checkbox"/>
3	4 to 3	1050	RCP	960	1058	91%	Grade from DS	1.433	0.500	0.150	0.150		0.000	19.749	<input type="checkbox"/>	19.789	<input type="checkbox"/>
4	5 to 4	750	RCP	443	557	80%	Grade from DS	1.454		0.250	0.250		0.000	20.089	<input type="checkbox"/>	20.107	<input type="checkbox"/>
5	6 to 5	375	RCP	96	269	36%		1.040		2.346				20.482	<input type="checkbox"/>	21.203	<input type="checkbox"/>
6	7 to 6	300	RCP	63	64	99%		1.049		0.433				21.278	<input type="checkbox"/>	21.405	<input type="checkbox"/>
7	8 to 7	300	RCP	55	64	86%		0.958		0.433				21.435	<input type="checkbox"/>	21.534	<input type="checkbox"/>
8	9 to 8	300	RCP	15	68	22%		0.900		0.490				21.584	<input type="checkbox"/>	21.840	<input type="checkbox"/>
9	10 to 43	525	RCP	144	343	42%		0.900		0.637			0.000	22.079	<input type="checkbox"/>	22.234	<input type="checkbox"/>
10	11 to 10	525	RCP	145	195	75%		0.900		0.205			0.000	22.234	<input type="checkbox"/>	22.263	<input type="checkbox"/>
11	12 to 11	450	RCP	142	160	89%		0.982		0.314			0.000	22.338	<input type="checkbox"/>	22.438	<input type="checkbox"/>
12	13 to 12	375	RCP	122	146	84%		0.944		0.697				22.513	<input type="checkbox"/>	22.656	<input type="checkbox"/>
13	14 to 13	300	RCP	47	89	53%		0.925		0.843				22.731	<input type="checkbox"/>	22.917	<input type="checkbox"/>
14	15 to 14	300	RCP	37	69	53%		0.952		0.514				22.967	<input type="checkbox"/>	23.253	<input type="checkbox"/>
15	16 to 15	300	RCP	37	64	58%		0.925		0.433				23.303	<input type="checkbox"/>	23.341	<input type="checkbox"/>
16	17 to 16	300	RCP	14	68	20%		0.900		0.490				23.391	<input type="checkbox"/>	23.629	<input type="checkbox"/>
17	18 to 37	600	RCP	236	660	36%		1.194		1.155			0.000	20.465	<input type="checkbox"/>	20.827	<input type="checkbox"/>
18	19 to 18	600	RCP	237	255	93%		1.127		0.172			0.000	20.827	<input type="checkbox"/>	20.909	<input type="checkbox"/>
19	20 to 19	600	RCP	221	255	87%		1.065		0.172			0.000	20.909	<input type="checkbox"/>	20.925	<input type="checkbox"/>
20	21 to 20	600	RCP	215	255	85%		0.962		0.172			0.000	20.925	<input type="checkbox"/>	20.961	<input type="checkbox"/>
21	22 to 21	600	RCP	219	255	86%		0.900		0.172			0.000	20.961	<input type="checkbox"/>	21.056	<input type="checkbox"/>
22	23 to 22	525	RCP	207	255	81%		0.916		0.351			0.000	21.131	<input type="checkbox"/>	21.394	<input type="checkbox"/>
23	24 to 23	450	RCP	118	180	66%		0.900		0.399				21.469	<input type="checkbox"/>	21.549	<input type="checkbox"/>

12d International Innovation Awards

- This button opens the “Drainage Pit Sizing” panel (above).
 - The panel loads the details of every pipe in the network.
 - The 11 editable columns in the panel are populated with the attributes relative to the inputs in the drainage network editor (highlighted below).
 - This panel allows for bulk changes to be quickly made to a network. It aids the designer to see all design features including locked levels, specified drops, grades, and other overrides.
 - Any changes will not be implemented until the “Apply changes” button is pressed. This button will apply the new attributes, set pit details, regrade the network, run the storm analysis (based on the last run storm event) and update the catchment labels and data.
 - When the panel loads for the first time (or after the “apply changes” is pushed) the Q values (3 columns) are loaded with the storm data. If the “Min. Grade” or “Diameter” columns are changed for a row the “Qfull” & “Q%” will be updated to reflect the new grade or diameter.
- If “Min. Grade” is changed the Q values will assume that the pipe is going to be graded at this minimum grade. This may not be the case depending on how the network is setup.
 - If the diameter is changed, the Q values will utilise the “Min. Grade” box if it has a value, or utilise the “Ex.Grade” value if “Min. Grade” is blank.




12d International Innovation Awards

SMEC Pit Sizing

- This button opens the “Drainage Pit Sizing” panel
- The panel loads the details of every pit in the network.
- The pits name, type, width, length, standard drawing reference and remarks can be entered manually into the panel. (standard drawing & remarks will be output in the pit schedule)
- The proposed width and length columns are calculated by looking at the sizes of the pipe coming in and out of the pit.
- Pit size calculations:
 - Width - currently the largest incoming diameter and approximates a reasonable size.
 - Length – currently takes the outgoing diameter and estimates a size.
 - **These current calculations do not take into account the angle that the pipe come in/out on or which sides the pipe come in/out. Therefore all proposed pit sizes are only an estimate and should be thoroughly checked and not assumed to be correct.**
- To utilise all proposed sizes the “copy over proposed dimensions” will replace all values in the width and length columns. Note – these sizes will not be applied until the “Apply Changes” button is pressed.
- Once all changes have been made the “Apply Change” button will set the pits with the new attributes and will run “Set Pit Details”.
- Pits will be coloured according to their type (Right):
 - All other pit types = Drain

MH Type	Colour
SEP	dark red
GEP	Purple 200
JP	Blue 140
GP	cyan
DSEP	Green 84
DGEP	yellow

SMEC - Drainage Pit Sizing

 **SMEC**
Local People. Global Experience.

Name	Type	Width	Length	Prop Wid	Prop Len	In dia.	In dia.	In dia.	Out dia.	Depth	Std dwg	Remarks
1	ExPit	1350	1050	1050	900	675	0	0	0	2.071		CONNECT TO EXISTING PIT
2	SEP	1050	900	1050	1050	675	300	0	675	2.217	GAA013	
3	SEP	1050	900	900	1050	600	450	0	675	2.783	GAA013	
4	SEP	1050	900	900	900	600	375	0	600	2.247	GAA013	
5	SEP	900	1500	900	900	600	375	0	600	3.522	GAA013	
6	SEP	900	1500	900	900	600	0	0	600	3.662	GAA013	
7	JP	900	900	900	900	600	300	0	600	3.550	GAA014	
8	GP	900	900	750	900	450	0	0	600	3.322	GAA014	
9	SEP	600	900	600	900	300	0	0	450	1.705	GAA013	
10	SEP	600	900	600	900	0	0	0	300	3.096	GAA013	
11	JP	600	900	600	900	300	0	0	300	1.268	GAA014	
12	JP	600	900	600	900	225	0	0	300	0.996	GAA014	
13	JP	900	900	600	900	225	225	0	225	1.276	GAA014	
14	JP	600	600	600	900	0	0	0	225	0.855	GAA014	
15	JP	600	900	600	900	0	0	0	225	0.849	GAA014	
16	SEP	600	900	750	900	450	0	0	450	2.584	GAA013	
17	SEP	600	900	750	900	450	300	0	450	2.108	GAA013	
18	ENDPIPE	0	0	600	900	0	0	0	450	2.033		BLANK END OF PIPE WITH MARINE GRADE PLYWOOD
19	SEP	600	900	600	900	0	0	0	300	1.393	GAA013	
20	SEP	600	900	600	900	300	300	0	375	1.646	GAA013	
21	JP	600	900	600	900	300	0	0	300	1.685	GAA014	
22	GP	600	600	600	900	0	0	0	300	0.868	GAA014	TEMPORARY PIT WITH 600x600

Drainage data added!

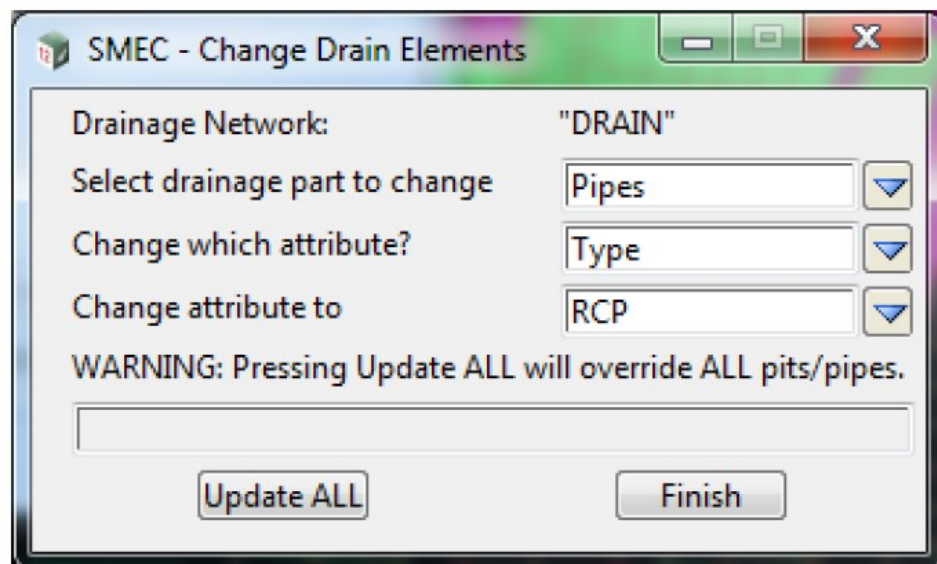
Apply Changes Copy over proposed dimensions Finish



12d International Innovation Awards

Change All Drains

- This button opens the “Change Drain Elements” panel.
- This panel enables you to change a pit or pipe attribute over the whole network.
- This panel is extremely powerful. For example you can change the pipe size of the whole network to one size, and therefore you will lose any previous drainage sizing.
- Using the panel is fairly self-explanatory.



Catchment Plan

Output “Q5 Plan.dwg”

- Creates the view “Catch5” if it doesn’t exist or removes all models if it does.
- Adds the networks appropriate catchment models (lots, roads, misc, fill, labels), Title and Title all (if they exist).
- Runs the Drainage Catchment PPF and adds the output to the view.
- The Catchment fill model is clean and then repopulated appropriately.
- The “Q5 Plan.dwg” is output. The models output are the appropriate CATCH fill, CATCH labels and Drainage Catchment Plan. (Title and Title All are not output as the Base/Comp drawings should be referenced in after the data is copied into the drawing template.



12d International Innovation Awards

Outputs Tab

Input

Data

- This will initially default to the model of the chosen network.
- However if only part of a network is required to be output the other widgets can be utilised.
- Note: please only select data from one drainage network.

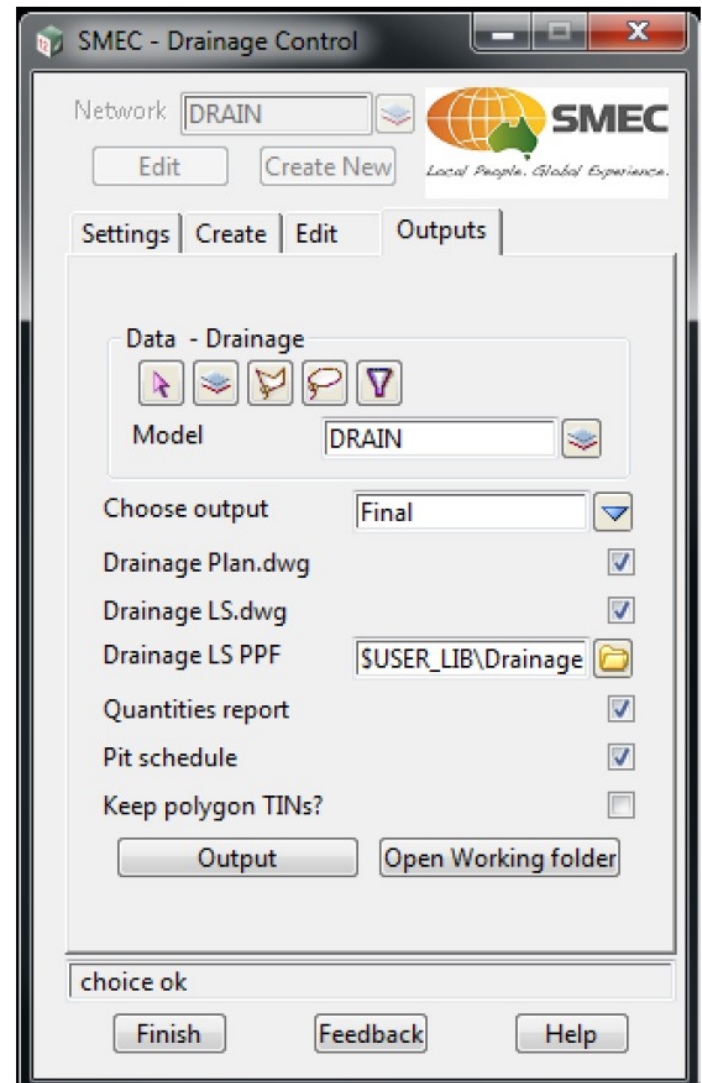
Output

Drainage Plan

- If ticked the "Drain_Base.drainplanppf" will be run on the selected data.
- DrainBase.dwg will be output to the working folder

Drainage Long Sections

- If ticked the long sections will be output as per the PPF specified.
- The crushed rock areas will be hatched on the output.
- Where the polygons cut the drainage string a chainage will be output.



Quantities

- If ticked a quantities report (Drainage_Quantities.csv) will be output into the working folder with the following information:
 - Pit Quantities: Type, Size, Depth Range.
 - Pipe Quantities: Size, Type, Backfill, Depth Range, Length.
- The quantities will be broken into areas where the network's "Attribute" Polygons are used.

Pit Schedule

- If ticked a pit schedule (Drainage_Pit_Schedule.csv) will be output to the working folder

Keep polygon TINs

- If this is ticked, the "Attribute" Polygon TINs will not be deleted after outputting the data.



12d International Innovation Awards

Description of Project:

Sewer Control is a central hub for creating/ editing/outputting sewer networks. The panel houses all of our sewer network customisations and macros in one solitary place which aid designers to work more efficiently. The macro was developed to improve increase the transparency of how a network is created.

Benefits of the macro include:

- Greater transparency for the entire network (viewing bulk amounts of network data)
- It allows someone to easily check multiple features of the network
- The ability to automatically run quality assurance tests on the network to ensure that it complies with authority standards.
- Standardising outputs and reducing drafting.
- Detailed quantities
- Allowing new property branch types and rotations to be applied.

Description of problem faced / task undertaken:

There were several problem faced when creating a macro of this magnitude, including;

- Generating over 4000 lines of code
- Implement header files to help handle the size of code.
- Tying in custom setup files including drainage.4d, custom ppf's, names.4d, as well as conforming to naming conventions.
- Handling validation issues across the entire macro.

How the problem was solved:

The macro creates a central hub to house the most frequently used 12d functions as well as our own custom macros.

The features of the macro include:

- A button to create new sewer network with our desired attributes.
- A place to view/modify a network settings that are commonly changed.
- A shortcut to create new sewer string on the chosen network including a feature which avoid string name duplication.
- A shortcut to create attribute polygons which are used to add information when outputting long sections and quantities
- A shortcut to the string edit command
- A tool to analyse the sewers properties against specific authority requirements (drops, minimum capacity, minimum grade, maximum capacity, maximum grades, grade changes, etc.) and provide a formatted XML output.
- A tool to manage house connection, including:
 - Modification of names, adopted levels & lengths.
 - Allow for property branches to be rotated as required.
 - Allow for new connection types.
 - Creation of house connection strings for visualisation and clash detection.
 - A tool to check house connections against authority standards (branch rise, covers, safety requirement, boundary traps, etc.).
 - A tool to automatically adjust connection levels to match acceptable branch rises.
- A one stop shop for all sewer network outputs including:
 - Sewer Plan (including detailed connection attributes and rotated connections)
 - Long Sections
 - Quantities (pipe & pit attributes including crushed rock, depth ranges, pipe class, etc.)



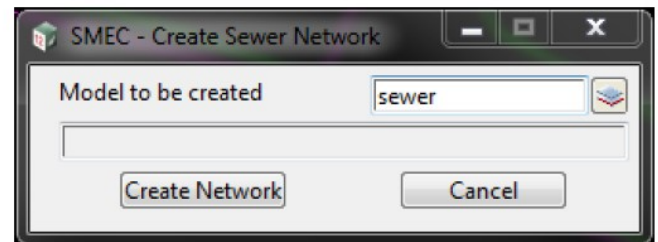
12d International Innovation Awards

Sewer

Sewer Control

Create New

- The “Create New” button allows you to create a new sewer network model.
- Creating a new network model through this panel will create the new model and apply all sewer network attributes

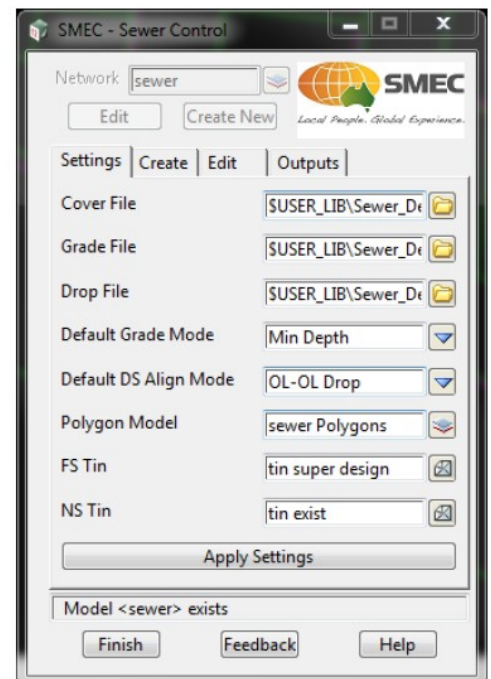


Edit

- When an existing sewer model is selected click “Edit” to modify/create/output the network.
- The attributes specific to the selected model will be loaded in the settings panel.

Settings Tab

- The commonly modified network attributes are displayed on this tab
- Click the “Apply Settings” button to activate any changes



Create Tab

- This tab allows for strings to be created for the chosen network.

Sewer – Create String

Edit Tab

Shortcut Buttons

- String Edit (F8) – Opens the “String Edit” panel.
- Drainage Network Editor (Shift + F8) – Opens the Drainage Network Editor. (Coming Soon)



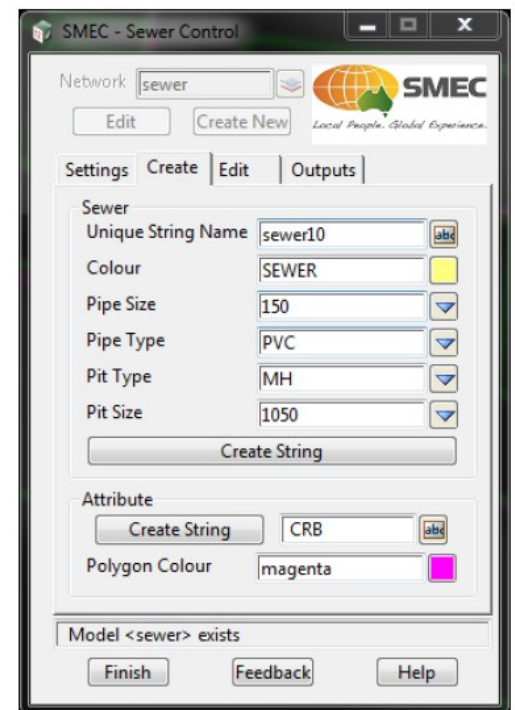
12d International Innovation Awards

Sewer – Create String

- Clicking the “Create String” button will create a sewer string on the network model. The string will take the name of whatever is in the “Unique String Name Box” and will be coloured according to the “Colour Box”. If a string of that name already exists on the model then an error is flagged and the message box will show “String name exist, please use a unique name”. The string will also take the pipe size, pipe type, pit type and pit size as per the provided boxes.

Attribute String

- This button will create a string on the networks attribute model (see settings tab) and will take the name provided in the “input box”.
- When outputting, any part of the network within the attribute polygon will be labelled. The primary example of this is a polygon for “crushed rock backfill”. Drawing polygons on this model allow the user to separate different portions of a network based on the name of the polygon. Often times these polygons can overlap, when the network is quantified using the Output tab, the network is partitioned into these polygons allowing a pit/pipe to have multiple “attributes” such as “Stage 3” or “CRB”.





12d International Innovation Awards

SMEC Tools

Sewer Analysis

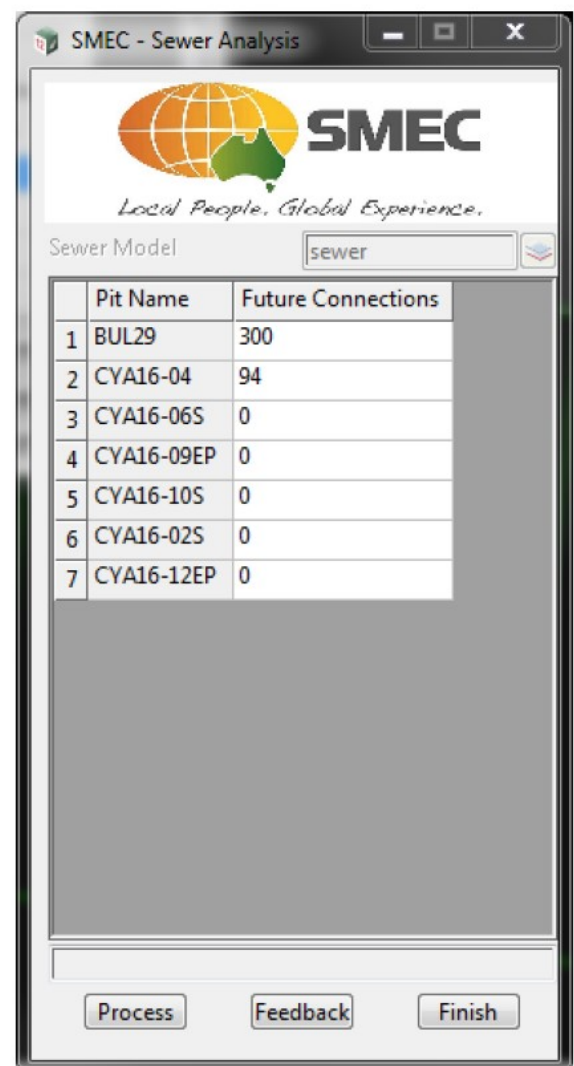
- This tool details key features of the sewer network and allows the designer to quickly analyse the network against authority standards. The macro counts the number of lot connections flowing in all pipes, runs a PPF which outputs some data onto the “sewer data” model. A spread sheet is also created which shows all the data for a selected sewer model and provides some calculations to test against design standards.

Inputs

- Pit Name: Shows the most upstream pits (no incoming pipes).
- Future Connections: This is where the number of future lots upstream can be added to the network. The value entered must be an integer. (The pit is then assigned with the attribute “future lots”). This allows the calculations to use the correct number of lots flowing through the pipe.

Output

- The macro now calculates the number of lots that travel through all pipes in the network and provides each pipe with a “total lots” attribute.
- The “Sewer_Data.drainplanppf” from the User Library





12d International Innovation Awards

is now run. This outputs information for the network onto the “sewer data” model. The information includes the pipe diameter, grade, total number of lots and downstream drop.

- A spreadsheet is now created and opened showing all relevant information about the sewer network (Sewer_Analysis.xml). The spreadsheet will provide automatic calculations and will format the data with reference to the sewer design standards.
- Pits: shows the name, type, diameter (if relevant), and depth off all pits.
- Pipes:
 - Type, size, grade, no lots, drop, and cover (the downstream pit type, pipe size, pipe grade, and deflection between the pipes is output with the columns hidden).
 - The minimum cover check, Dia/grade/lot no check and drop check is completed against the industry standard and if requirements are not met the cell is highlighted and the error is explained.

Property Branches

This tool allows the designer to manage property branches (house connections) once they have been created on the sewer network.

A grid box is created to detail all relevant attributes required to make an informed decision when setting property branch details.

The panel allows you to:

- Modification of names, adopted levels & lengths.
- Allow for property branches to be rotated as required.
- Allow for new connection types.
- Creation of house connection strings for visualisation and clash detection.
- A tool to check house connections against authority standards (branch rise, covers, safety requirement, boundary traps, etc.).
- A tool to automatically adjust connection levels to match acceptable branch rises and apply an acceptable type relative to the branch rise.



12d International Innovation Awards

Outputs Tab

Input

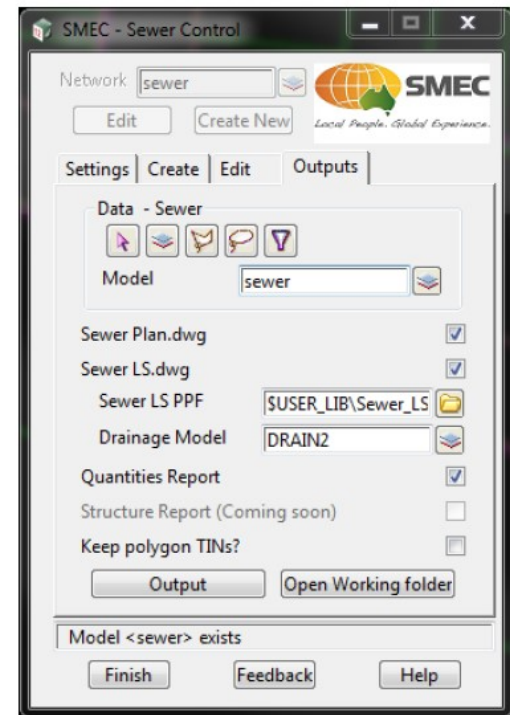
Data

- This will initially default to the model of the chosen network.
- However if only part of a network is required to be output the other widgets can be utilised.
- Note: please only select data from one sewer network.

Output

Sewer Plan

- If ticked the “Sewer_Base_MRWA.drainplanppf” will be run on the selected data.
- The rotated property branches will also be output along with custom labels (detailed in the video).
- “sewer - Sewer Base.dwg” will be output to the working folder



Sewer Long Sections

- If ticked the long sections will be output as per the PPF specified.
- Where the attribute polygons cut the sewer string a chainage will be output.
- The Drainage model will be added to the long section to show where it crosses or runs alongside the sewer network.

Quantities

- If ticked a quantities report (sewer – Sewer Quantities.csv) will be output into the working folder with the following information:
 - Pit Quantities: Type, Size, Depth Range.
 - Pipe Quantities: Size, Type, Backfill, Depth Range, Length.
- The quantities will be broken into areas where the network’s “Attribute” Polygons are used.

Structures Report

- Coming soon

Keep polygon TINs

- If this is ticked, the “Attribute” Polygon TINs will not be deleted after outputting the data.