

Introduction

In the previous paper site specific details were strategically analysed.

This paper covers the detailed design of an integrated SUDS system.

Detailed Design Process

The work process comprises of five stages;

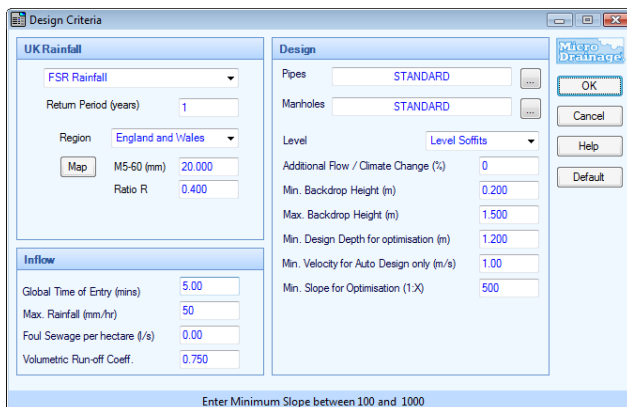
- 1) Design the surface water flow conveyance network
- 2) Design the 'appropriate' structures for each sub-catchment
- 3) Develop the optimum SUDS train for the project
- 4) Test the SUDS train for hydraulic and water quality performance
- 5) Model an integrated SUDS system

1) Design the surface water flow conveyance network

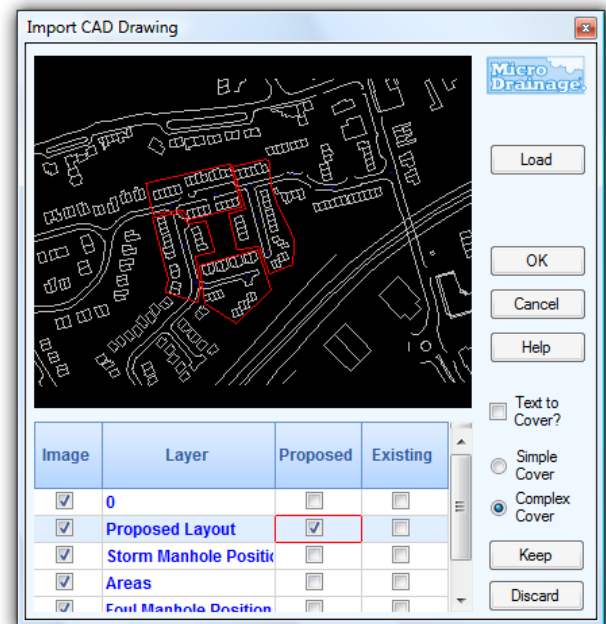
There are two ways to design the SW network, either in a graphical or spreadsheet format. The most productive method would be to use an electronic drawing, or work in conjunction with GIS data, in a graphical format.

The drainage layout can be drawn on plan and auto designed to comply with local standards. Typically the flow conveyance system would be designed for a relatively frequent return period of 1, 2 or 5 years.

Details are input as 'Design Criteria' to ensure the network is auto designed in accordance with local requirements.

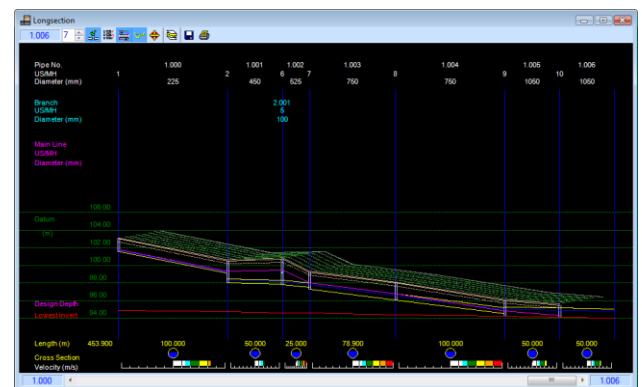


A CAD drawing of the infrastructure layout is then imported, in 2D or 3D format.



The amount of detail imported will depend upon the CAD drawing. Text, Simple or Complex Cover levels can be loaded and triangulated.

Design of the flow conveyance system can be completed with pipes, swales, ditches and culverts. The capacity of each element is optimised as the impermeable areas are input.



The outfall details may be included to ensure the system meets the correct discharge point.

2) Design 'appropriate' structures for each sub-catchment

The benefit of planning out the SUDS system may now be fully realised as structures for each of the sub-catchments can be developed into a SUDS train, using a 'Design Guide'.

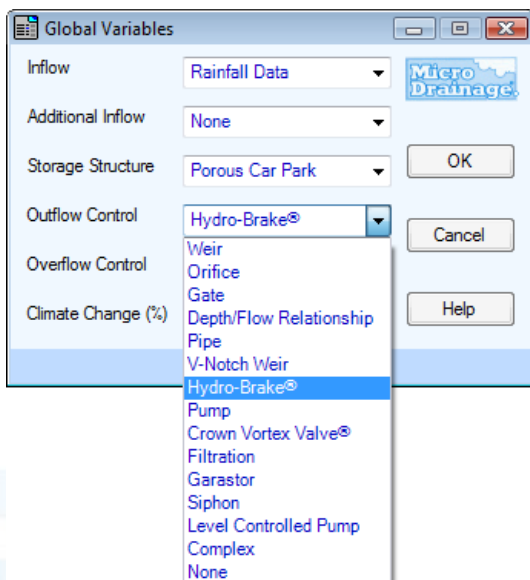
The Design Guide is a tool developed to simplify the complex process of designing the optimum solution for a project that incorporates the use of infiltration techniques.



The Quick Storage Estimate confirms the feasibility of using infiltration and provides a target volume required for the whole project. An allowance for climate change may be included throughout the process.

Quick Design produces optional structure sizes for a sub-catchment, to ensure that any limitations on the plan or depth of a structure are taken into consideration and engineered out.

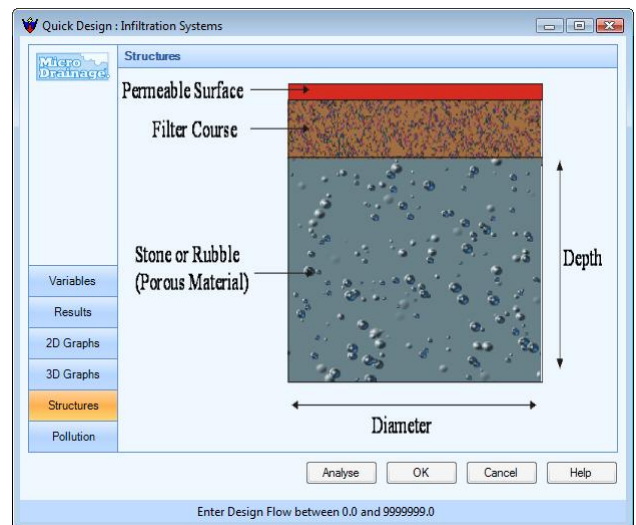
Detailed Design enables a structure to be designed for each sub-catchment. A complete range of structures are supported as well as a range of online and offline controls.



3) Develop the optimum SUDS train for the project

The optimum structure for each sub-catchment is initially designed in isolation, prior to cascading together into a SUDS train.

An appropriate structure is chosen and designed in a logical workflow that enables the engineer to incorporate online flow controls to limit the offsite discharge and maximise the upstream storage available.



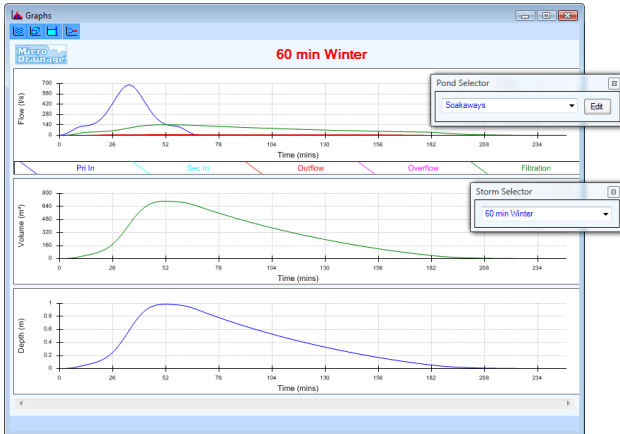
Overflow controls may also be included for each individual structure to manage extreme rainfall events beyond the design criteria.

An increasingly popular form of SUDS structure being used on high density developments is a green roof.

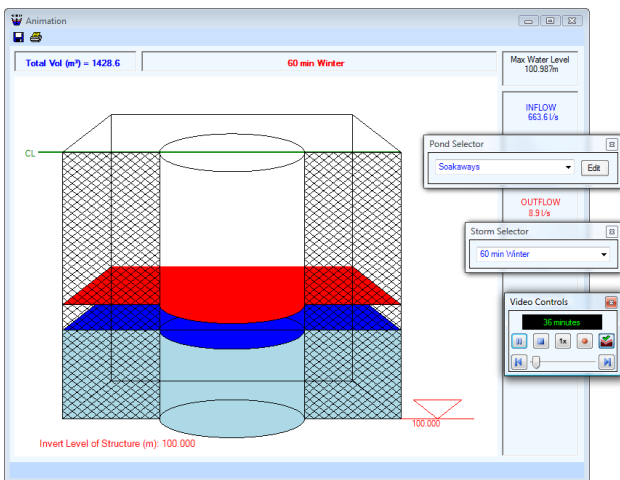


A range of outputs are available to ensure that each structure is providing peak performance. Results are provided that automatically identify the critical storm duration.

Graphs are generated to assess the inflow/outflow hydrographs, volume and depth of water within the structure throughout the event.



2D and 3D animations of the structure for all events is available to help visualise the hydraulic characteristics.

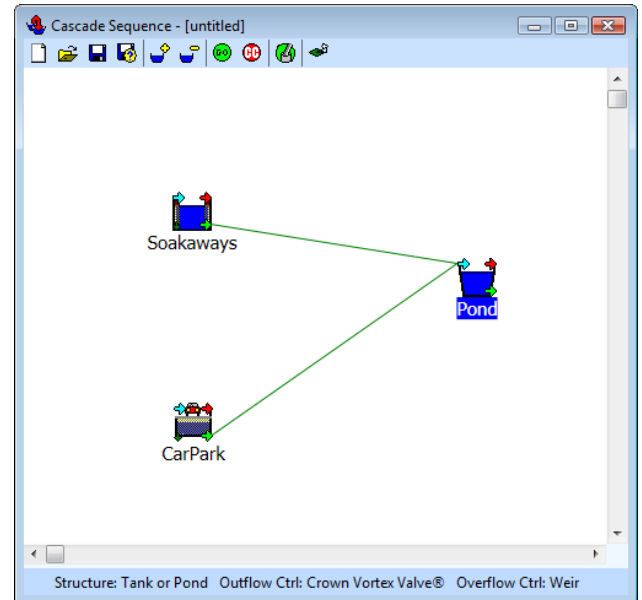


4) Test the SUDS train for hydraulic and water quality performance

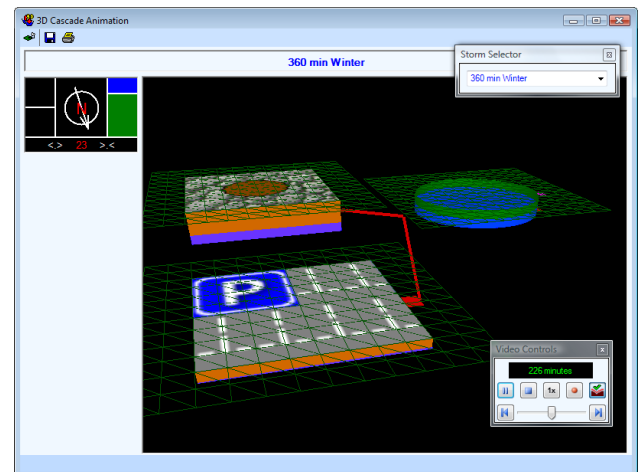
The optimum design for each structure is important but it is essential to test the complete SUDS train for hydraulic and treatment performance.

The latest technology has the ability to model the structures as a SUDS train.

The file structures for each sub-catchment are Cascaded together.



The SUDS train can then be analysed for hydraulic performance for the whole development. The results and outputs are utilised to identify any areas where refinement is required.

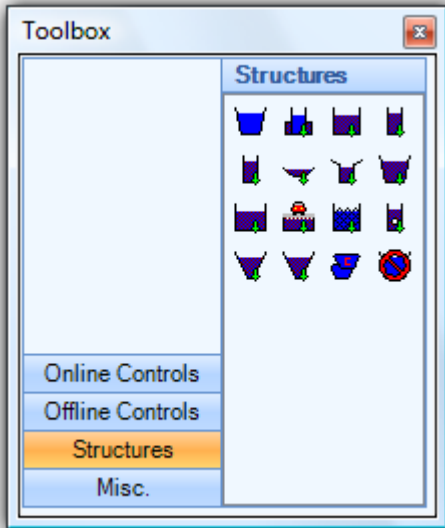


When the hydraulic aspects have been optimised a check on pollution removal can be undertaken on the same model.

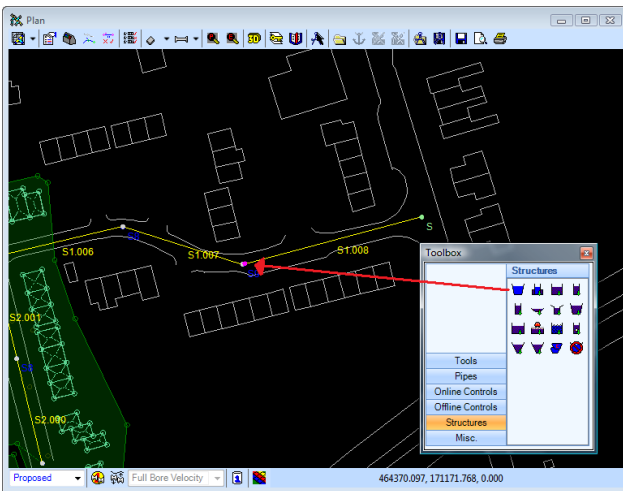
A range of percentage pollution removal results are provided for TSS, Hydrocarbons, Phosphorous, Nitrogen, Faecal Coli Forms and Heavy Metals.

5) Model an integrated SUDS system

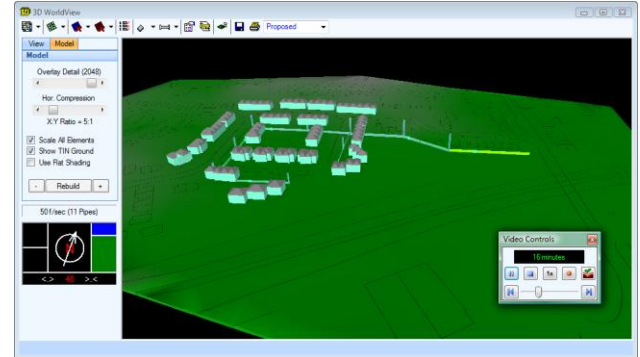
When the performance of the SUDS train has been refined, the final model of an integrated SUDS system can be produced. The model should include the flow conveyance system, attenuation and infiltration structures, online and offline controls.



All of the structures and controls can be incorporated into the model through a simple drag and drop routine.



The complete integrated network is tested in accordance with local standards.



Summary

A systematic approach to SUDS design can be applied using the latest software technology. This will ensure that the optimum solutions are provided for both hydraulic and water treatment performance.

SUDS Series of Papers

The final SUDS paper will be published on the subject of auditing.

The complete series will comprise of the following papers;

- ☉ Legislation for SUDS Implementation
- ☉ Planning for SUDS
- ☉ Preliminary Design for SUDS
- ☉ Detailed Design for SUDS
- ☉ Auditing SUDS for extreme rainfall

Contact Details

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To share your views, keep abreast of legislation and research visit Piped Up! The Micro Drainage blog at <http://pipedup.wordpress.com>