12d Solutions Pty Ltd

Civil and Surveying Software

Version 9 Course Notes

12dModel

STORMWATER DESIGN - Part 2

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12d Stormwater Course - Part 2 Notes

These course notes assume that the trainee has the basic 12d Model skills usually obtained from the "**12d Model Training Manual**"

These notes are intended to cover basic Stormwater Design. For more information regarding training courses contact 12d Solutions Training Manager.

These notes were prepared by
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Civil and Surveying Software

COURSE NOTES

STORMWATER DESIGN - Part 2

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1.0 Stormwater Design Part 2- Introduction

The **Stormwater Design Course Part 1** and this manual, the **Stormwater Design Part ,** describe the functions and processes of the 12d drainage module. In these documents, the generic term **pit** refers manholes inlets, catch basin and manholes.

The **Stormwater Design Course - Part 1 Notes** contain**:**

- create a super tin for pipe cover and pit cover levels,
- set drainage defaults and layout a drainage network from CAD and in 12d,
- use the 12d drainage network editor to assign names to the pit/pipes, avoid service clashes, grade pipes, align obverts, minimise depth and many other design tools,
- designate catchment areas and produce catchment plans,
- run the 12d storm rational hydrology and hydraulics engine,
- transfer data to and from electronic spreadsheets to enable the user to easily review the data and add user defined data to the 12d pipe network. This data may include such data as pipe bedding types and trench width,
- create a drainage template containing customised default design parameters,
- create pit setout schedules to export to spreadsheets or word processors for final formatting,
- produce long section drainage profiles including HGL data, flows, invert levels and service crossings,
- create plan drawings with pipe sizes, flows, pit symbols, linestyles for pipe sizes, design parameters for pit and pipes and user defined data,
- locate pits/manholes at exact chainage and offset locations.

This manual, the **Stormwater Design Course - Part 2,** is intended to describe the additional features of 12d model drainage and discuss the customisation of the package. This will include

- customising the drainage.4d file,
- 12d storm analysis with inlet capacity calculations and bypass flow,
- flooded width analysis and flooding at SAG pits,
- drainage trench excavation volume calculations,
- pipe and pit quantity calculations/reports,
- open channel calculations,
- adjusting pit locations for changes in horiz road geometry
- analysing the major flood events,
- design or evaluate the drainage system using by creating input files for the xpswmm/ xprat-hgl, Windes, Drains and PCdrain drainage design packages,
- read the output from the drainage design packages and update the drainage network plus storing the hydraulic data, such as hgl (hydraulic grade line) levels, peak pipe flows and

pipe capacities,

- creating drainage symbols with grates and upstream side inlets,
- detailed drainage plan labelling and long sections with hatching under roads.

2.0 Starting with a Basic Drainage Network

In this document, the generic term **pit** refers to manholes, inlets, catch basin and manholes. When the term **manhole** is used on the 12d menu system it refers to any type of pit. Pit types, dimensions and inlet capacities of the pits are set in the drainage.4d file.

These course notes assume that you have completed the Stormwater Design Course and that you have experience creating 12d model drainage networks with catchments areas. You may continue this project or begin with a completed drainage design found in the directory

\12d\9.00\Courses\Drainage_Analysis

The project name is Local Road Complete.

3.0 Setup Filesnd Their Locations

The drainage module consists of the optional 12d Drainage Analysis, utilities, startup configuration files for RAT2000, XP SWMM and the 12d drainage configuration file (drainage.4d).

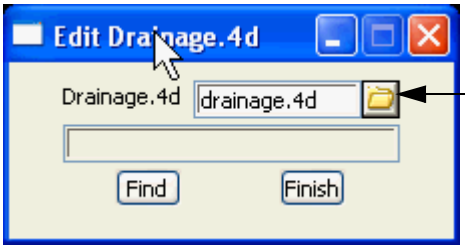
All setup files have been configured for the training version. However, when you start working on real projects you may want customise the drainage module. **More - Customising the drainage module**

The **drainage.4d** file contains pipe types (RCP, Class 2 etc.) and example pit inlet capacites for inlet pits. Detailed pit type descriptions and internal pit dimensions can be included in this file to be inserted into your pit schedules. For PCdrain and Drains users there are routines to read your gully pit/database files and create the drainage.4d file **More**.

REVIEW THIS DATA CAREFULLY! The **drainage.4d** file may be customised for any additional inlet capacity data you may have.

To edit the **drainage.4d** file, from the main menu select

Design->Drainage-Sewer->More->Edit drainage.4d



Select the **Find** button to search the 12d path for the current **drainage.4d** file. If the file is found in the **set-ups** folder, it should be copied to the user folder or your current working folder before editting it (see below).

Select the **More info** button (the folder) and then **Open** to edit the file.

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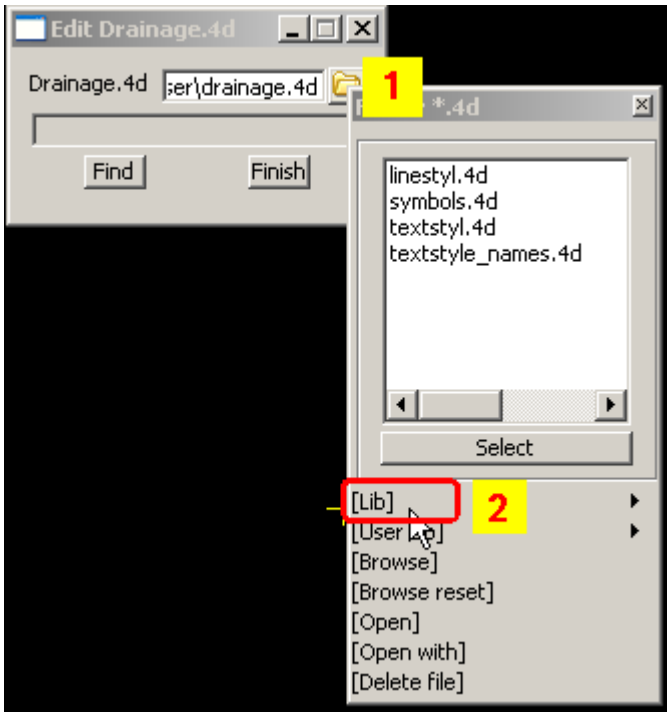
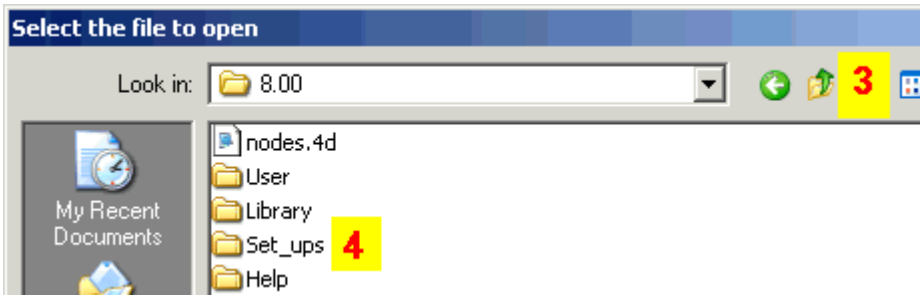
Copying the drainage.4d files

If the drainage.4d file is found in the 12d setups folder or if other drainage.4d files are to be used they can be copied from setups folder.



1. Select the **More info** button (the folder)
2. select **lib** to open the windows browse panel**.**



3. Select the up level icon.
4. Select the **Set_ups** folder. Now we are ready to copy the desired drainage.4d file.

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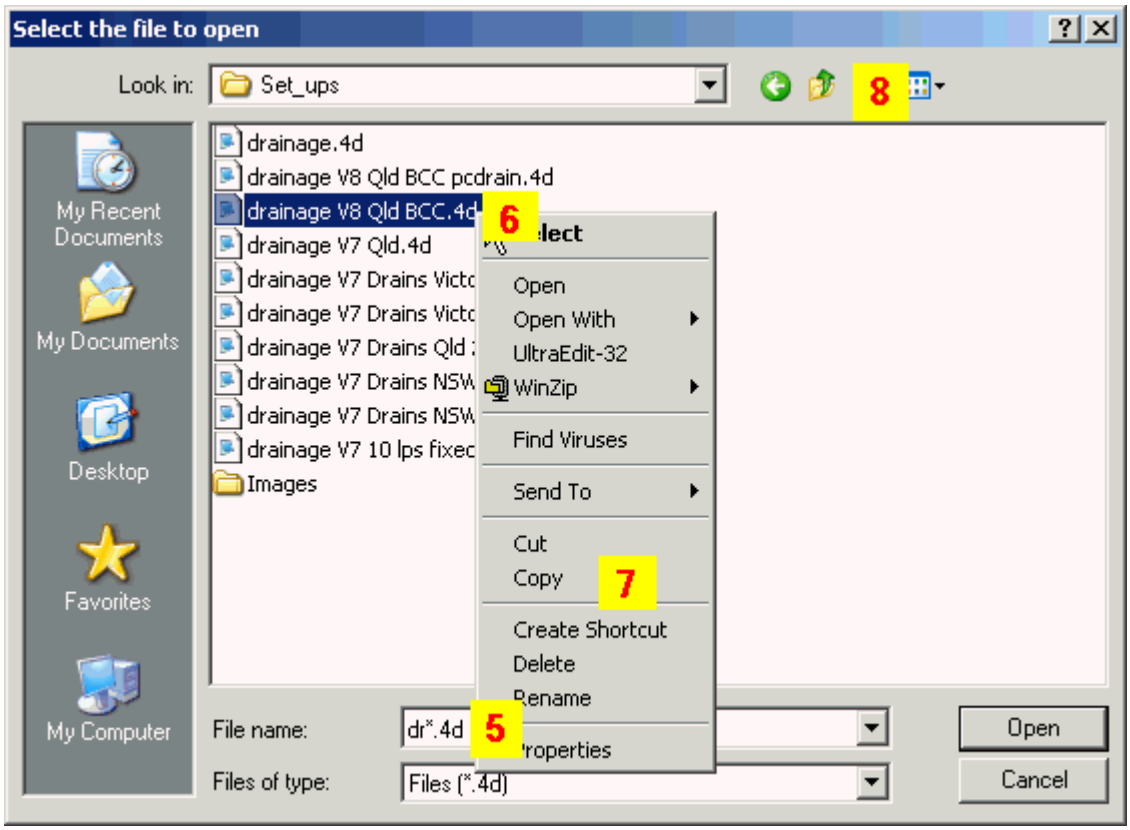
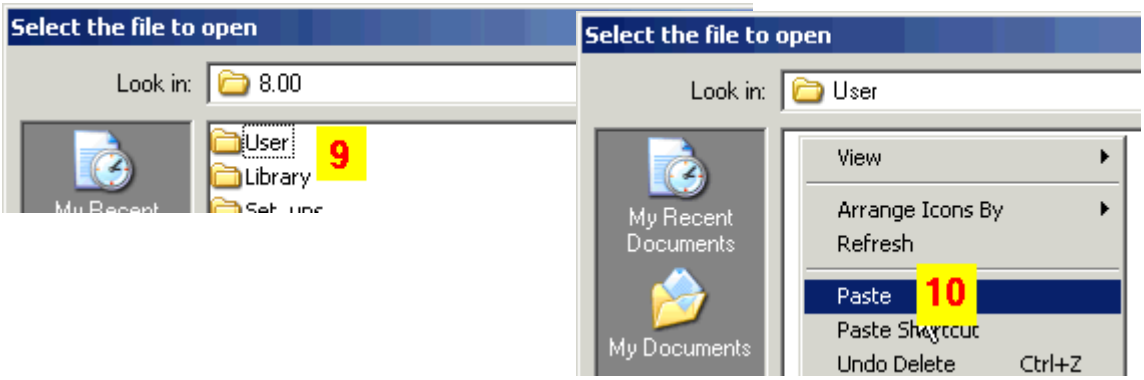


5. type **dr*.4d** and press **Enter** to get a list of the drainage.4d files.
6. RB the desired file
7. Select **Copy** to place the file on the clipboard.
8. select the **Up level** icon to move back up a level
9. Select the **User** folder
10. RB in the white space and then select **Paste.**
11. The file can now be renamed **drainage.4d** if it had another name.



You must restart 12d for these changes to become active. Select Project->Restart!

At startup, if there are significant errors in the file, refer to the output window where 12d will print the line number where it give up. When looking in the long list of files, the drainage.4d file is loaded after the shp files.

See “The drainage.4d file” on page 19.

REVIEW THIS DATA CAREFULLY! A detailed description of the pit inlet capacity tables in this file is given in “Pit Inlet Capacities” on page 26. The **drainage.4d** file may be customised for any additional inlet capacity data you may have.

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4.0 Bypass Flow

Bypass flow strings are used to trigger the bypass calculations in the network editor and are used as a centre line for flooded width calculations.

The 12d storm analysis, and many of the design programs 12d exports to, allow for bypass flow. Bypass flow involves the calculation of pit inlet capacity for on-grade or sag pits. These capacities are based on the pit type and may use either ponding depths (sag pits) or on the road grade and/or crossfall upstream of the inlet.

Key Points

1. Draw an bypass flow string in the direction of flow so that it passes within 1 pit diameter of an inlet. At sag locations the string should show the direction of flow during bypass conditions. When bypass flow strings join they must join within 1 pit diameter of an inlet (pits with **inlet config** set to **Manhole** are not considered inlets). If flooded with calculations are to calculated the string should located in the flow channel.
   Enter the model name in the **Bypass flow model** field on the **Global->Utility Models** tab.

   Note: if there is no bypass flow string within 1 pit diameter then 100% of the approach flow will enter into the pit.
2. Many bypass strings may join at an inlet but only one bypass string should leave each inlet.
3. Set the pit type. (**Pit Type** on the **Pit** tab). With a bypass string within 1 pit diameter of the pit centre, no water will enter the pit unless the pit type has inlet capacity data defined in the drainage.4d file.
4. Set the **Inlet config** on the **Pit->Main** tab (Manhole, On-grade or Sag pit). This selection will be disabled if cap_config parameter sets the inlet type in the drainage.4d file. Manholes have no inlet capacity and are not considered inlets, on-grade inlets capture the water as it passes the inlet while SAG inlets trap the water flowing in from all directions (until the pond depth overflows at the low point of the catchment string).
5. On grade pits may require road grade and/or crossfall data for inlet capacity. They may be entered manually or calculated using the road strings. A setout string link is required to measure road grade. If road crossfall measurement is needed then the centre string is also required. These strings are specified using the **Road design file** on the **Global->Utility Models** tab (see Stormwater Part 1 manual).
6. Sag inlets require a pond depth either manually entered or calculated by 12d. Pond depth calculations require a link to a catchment string to locate the overflow point and correct grate level (**Grate rl mode**).
7. Press the **Set Pit Details** button. Road grades, crossfalls, pond depths and bypass pits will now be found on the **Pit->Bypass** tab of the **Network Editor**. Measurement markers are created in the **construction drainage data** model.
8. Bypass pits may be cleared using **Clear Bypass Links** on the **Globals->Utility Models** tab
9. **Storm Analysis** must have **Consider Bypass Flows** selected on the **Main** tab.
10. **Calculate overland flood extents** is optional on the **Flood Extents** tab of **Storm Analysis**.

4.1 Drawing Bypass Flow Strings

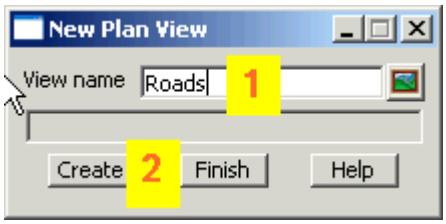
The bypass flow string must be within 1. pit diameter of the drainage pit in be considered on the bypass flow path. If the bypass flow string is to be used for flooded width calculations in the future, the string must also be drawn in the main flow area of the cross section. At sag locations the bypass flow strings indicate the direction the water flows when it overtops the overflow point. This string usually goes uphill to this overflow point.

For a project with roads it is easiest to copy a road string (invert strings are usually the best) into the flow model and then check the string to see if it flows down hill. You may be required reverse the direction of some strings, split some strings at major crests, join some strings that do not meet at inlets and finally add some flow lines where flow crosses the road.

Copying the Invert strings into the bypass model

First we will create a new view for just the road strings.

View->Create->Plan view



11.Type **Roads**

12.Select **Create**

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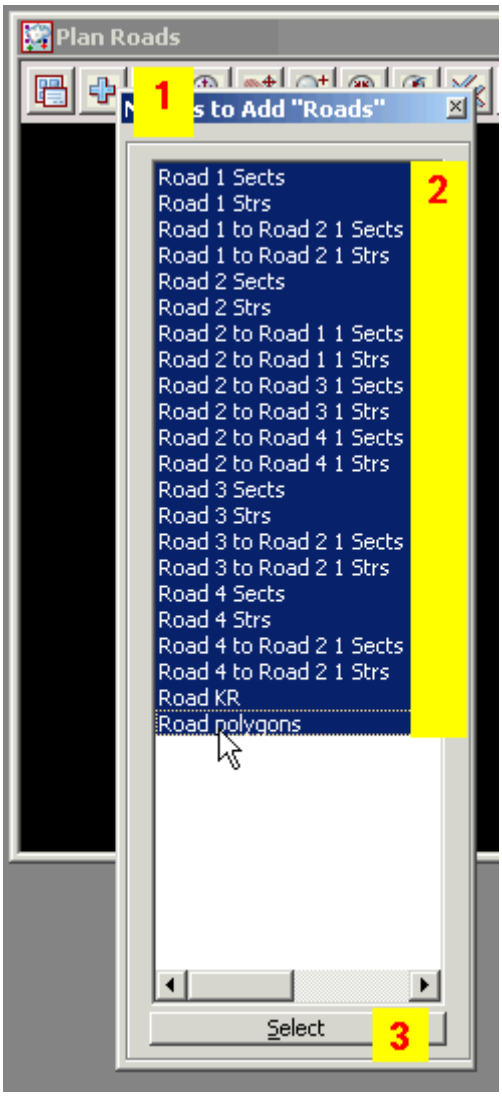
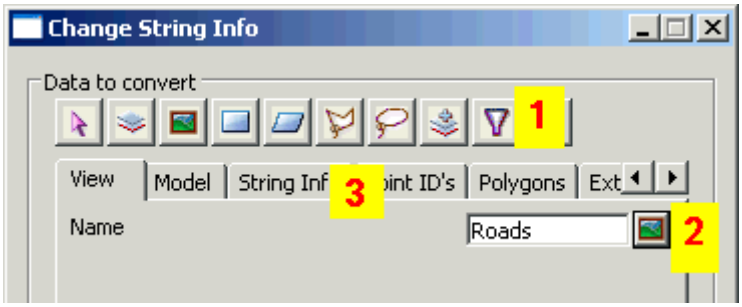


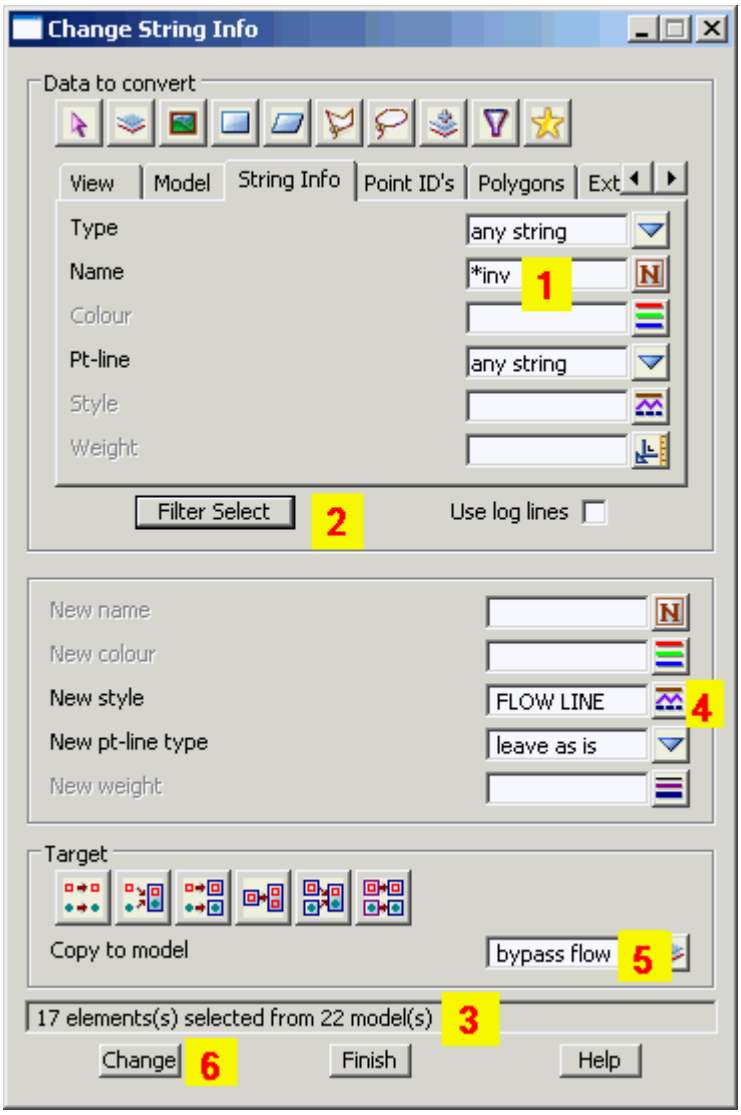
1. Place your point over the + button and press **Shift+r** to display all of the models starting with R.
2. Drag your pointer across all of the road models to select them
3. Lb the **Select** button to add them to the view.

From the main menu select

Utilities->A-G->Change



1. Select the filter button
2. Select the View button and then select the **Roads** view
3. Select the **String Info** tab.



1. Type ***inv** to select the rinv and linv strings.
2. Select **Filter Select** to select the ***inv** strings from the **Roads** view.
3. Note that 17 strings have been selected from the roads models.
4. Enter a **New name** so that the string will not be confused with the road invert strings in the future.
5. Either type **FLOW LINE** or select the line style button, then select the group **Drainage 12d** and finally **FLOW LINE** line-style.
6. type **bypass flow,1** for the new model. The **,1** will add the model to view 1 for you.
7. select **Change** to copy the strings to the new model with the new line style.

Splitting the Strings at Major Crests

If the roads contain a major crest that defines a separate catchment then the flow lines will need to be split so that one segment can be reversed.

If you have labelled the crests and sag points then you can use these labels to quickly identify the crests.

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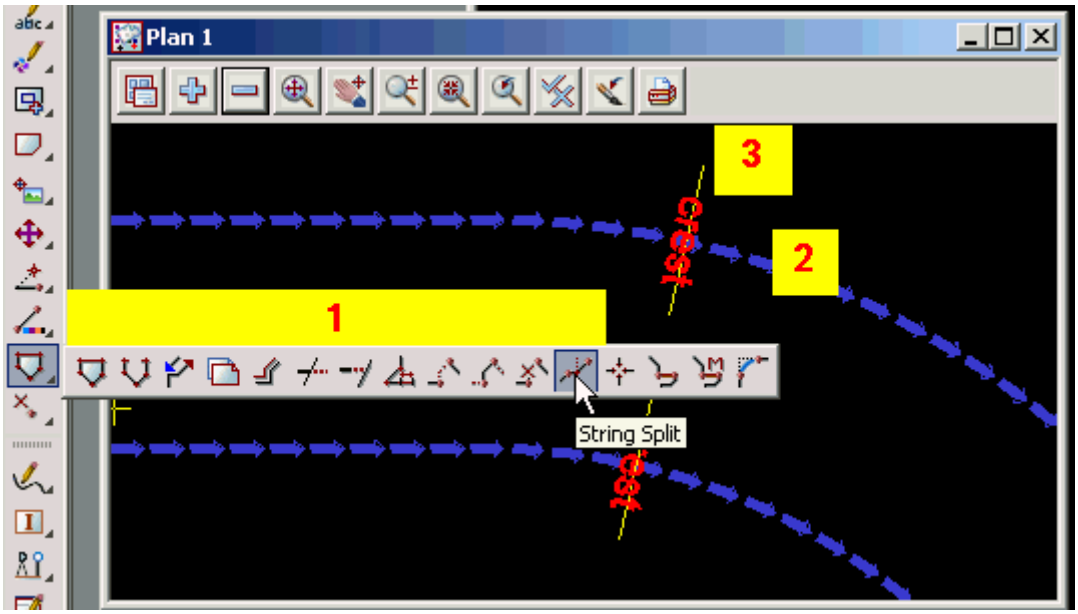

1. Drag out the **CAD string** toolbar and select the **String split** icon.
2. Instructions will be given in the 12d message area (bottom left corner of the screen). Pick and accept the string to be split.
3. Pick and accept the split point or if you have them the crest marker. The string will now be split.
   repeat steps 2 and 3 for all strings to be split. Press **ESC** when finished.

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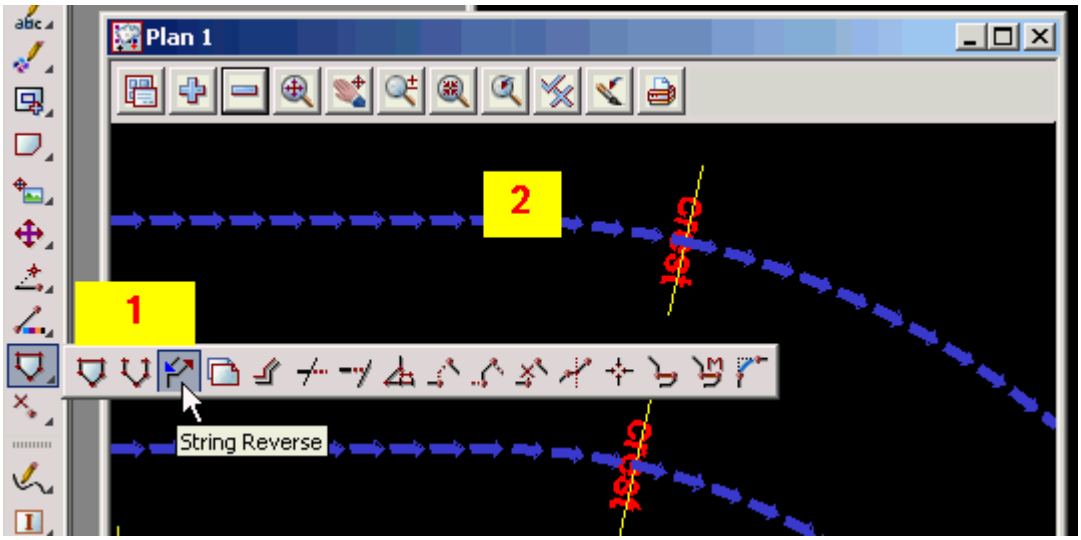
Reversing the Strings if they flow in the wrong direction

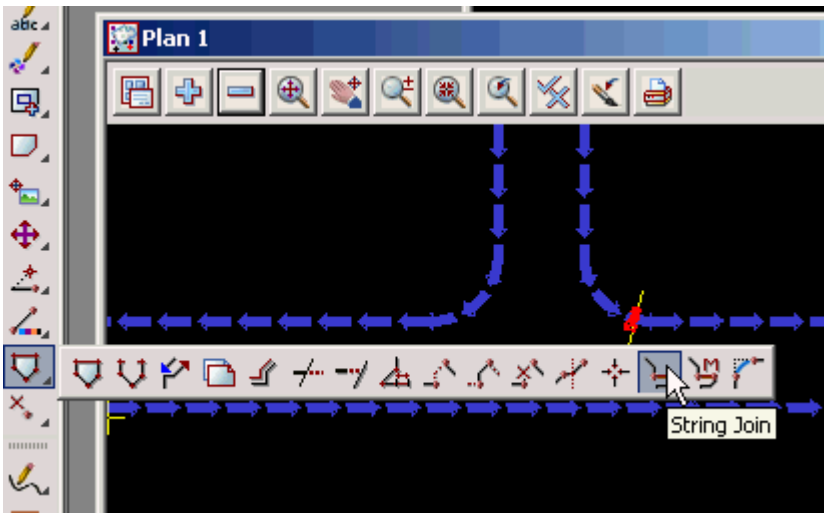


1. Drag out the **CAD string** toolbar and select the **String Reverse** icon.
2. Instructions will be given in the 12d message area (bottom left corner of the screen). Pick and accept the string to reverse.

   continue selecting strings to be reversed. Press **ESC** when finished.

Joining Flow Lines Together

If the flow lines join each other within 1 pit diameter of an inlet (not a manhole) then they do not need to be joined (but they can if desired). If there is no inlet at the join then you will have to join the strings together.



1. Drag out the **CAD string** toolbar and select the **String Join** icon.
2. Instructions will be given in the 12d message area (bottom left corner of the screen). Pick and accept the upstream string then pick and accept the downstream string. Since they are already drawn in the same direction you will not have to use a directional pick.

   continue selecting strings to be joined. Press **ESC** when finished.

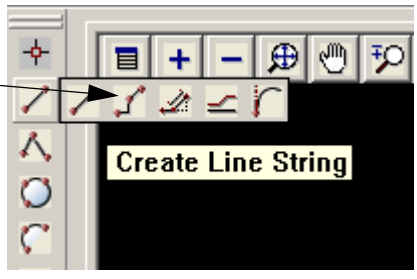
Adding additional flow lines where the flow cross the road

Use the **CAD toolbar** to create the bypass flow paths.

To use the **CAD toolbar** go to the **CAD data bar** and enter a string name and model name. Select the line style (optional).

DRAG the **Create line** button and release at the **Create Line String** button.

When finished drawing the string press **ESC.**

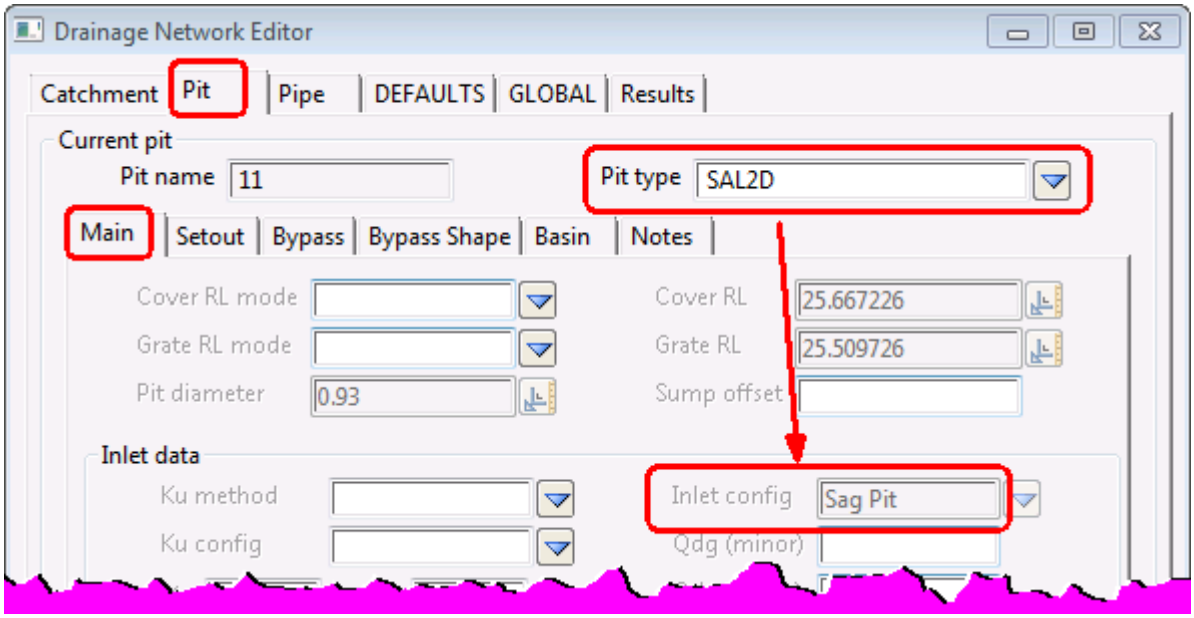


Starting at the upstream end. LB select an insertion point and MB or press return to accept the selection. Continue this until you reach the end of the flow path. The string will not be shown in the new linestyle until the screen is redrawn. Press **ESC** to finish drawing the string. MB on the plan view title area to redraw the screen. The correct linestyle will now appear.

If you reach a sag pit location you may terminate the string or continue defining the bypass flow path for a surcharging event out of the sag location.

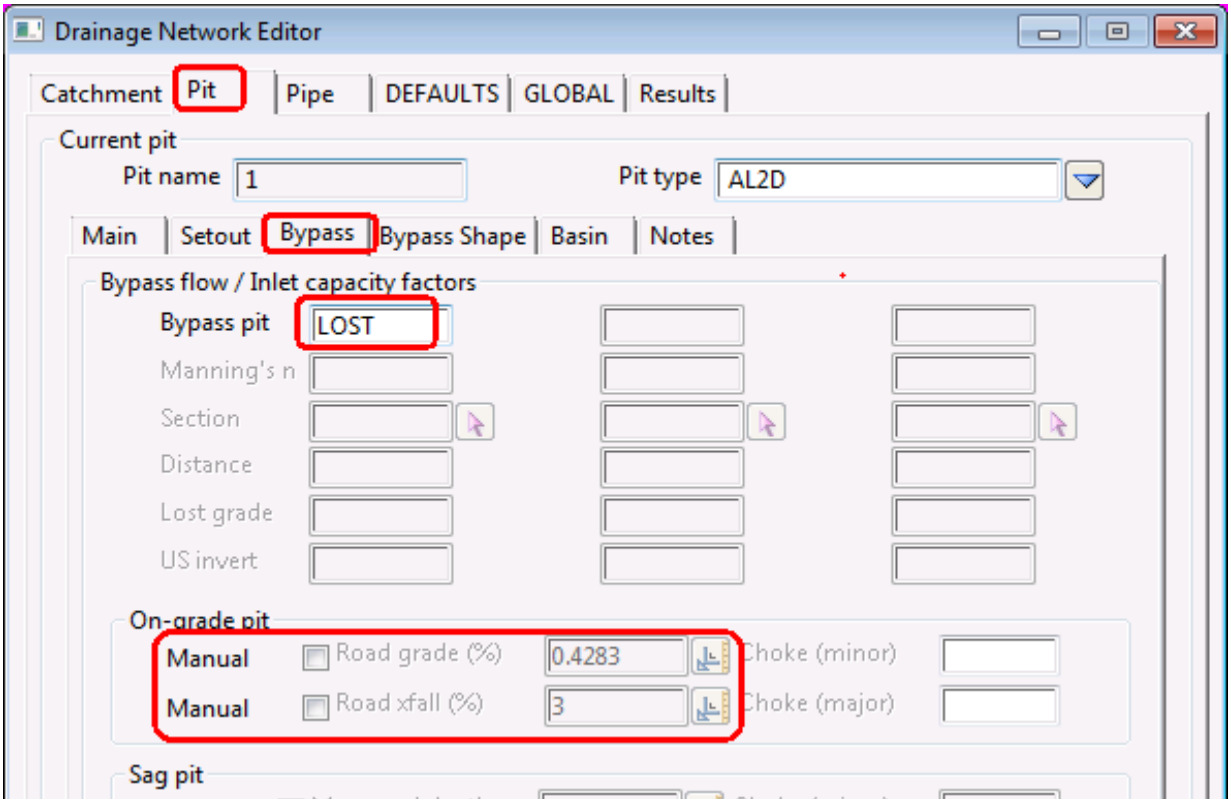
4.2 Set Pit Details - Calculate the Bypass Flow Data

Once the first Key points of bypass flow (listed above) are complete, you are ready to calculate the bypass flow data. Select **Set Pit Details** and then select a pit on a bypass flow string. The bypass data is found on the **Pit->Bypass** and **Pit Main** tabs.



12d supports Manhole, on-grade and SAG configurations. The **inlet configuration** is set on the **Pit->Main**. This settings can be locked to the **Pit type** in the drainage.4d file using the cap_config command (discussed later but shown above). Pits with **Inlet config** set to **Manholes** will not receive bypass flow and cannot have catchments assigned to them. On-grade pits are pit where the water will flow passed the pit if not captured and Sag pits are located at sag locations where the water will pond around the pit if there is not enough inlet capacity.

The remaining bypass data is found on the **Pit->Bypass** tab.

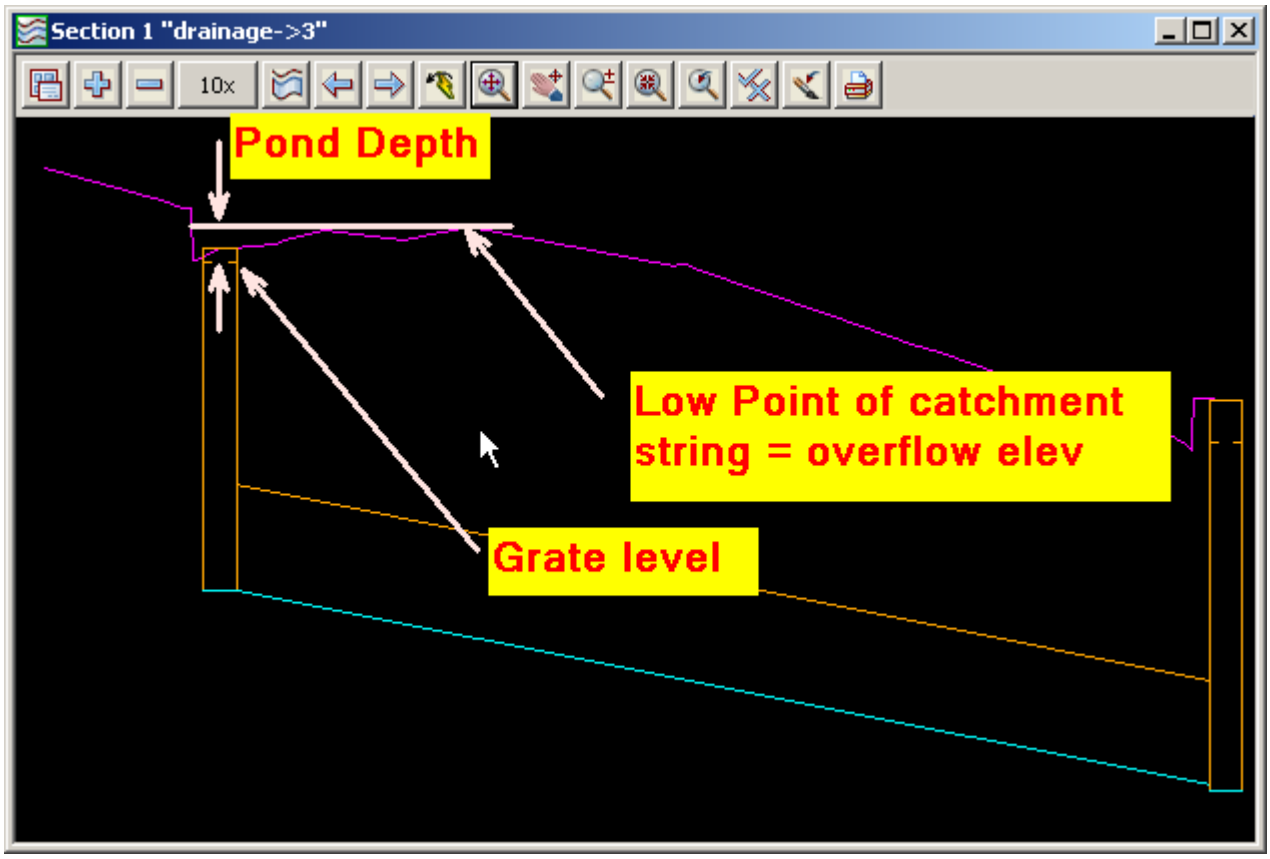


The downstream pit will now show in the **Bypass pit** field. If the bypass string does not go to another inlet (the network outlet is never an inlet) then the **Bypass pit** will be marked as **LOST**.

If **Pit on grade** is selected and a setout string was found (see **Pit->Setout** tab), the **Road grade** will appear in grey. You may override this value by selecting the **Manual** tick box beside the value and entering your own value. If a road centre string was selected, the **Road xfall** field will also have a value.

If **Sag pit** was selected and a catchment string was selected, the **Max pond depth** will be displayed. The catchment strings from all 3 sets are draped onto the finish surface tin and the low point located. The **Max pond depth** is calculated as

Max pond depth = catchment string low point - Grate RL.

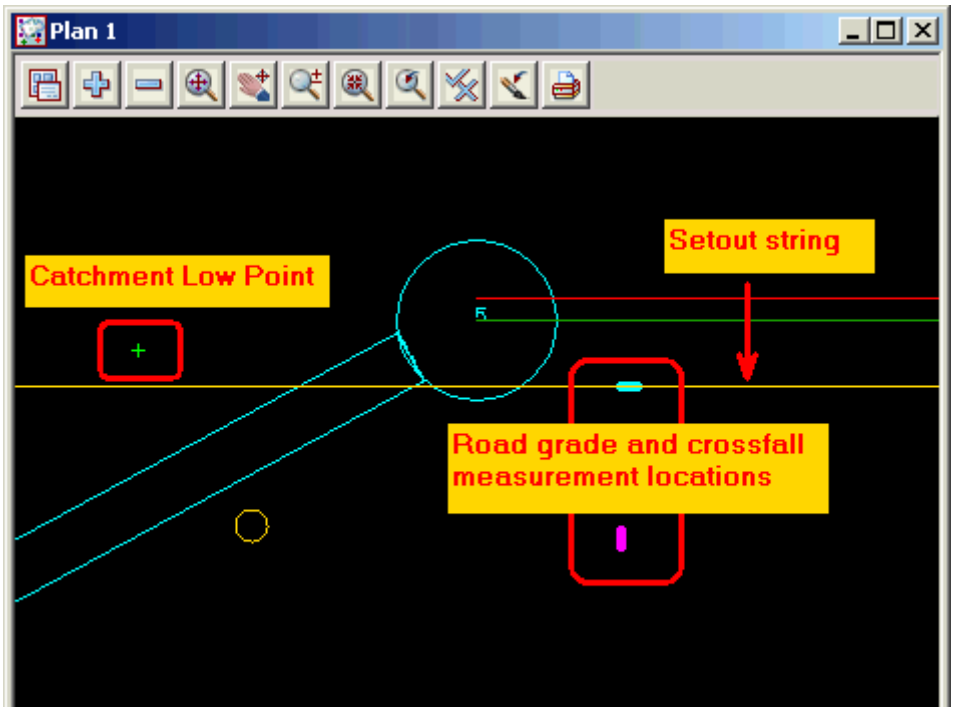


Negative Pond Depths

Negative pond depths are usually caused by one of two errors in input. The first may be that the grate level is too high. Often this happens when the Grate RL mode on the **Pit->Main** tab has not be set correctly or if **Sz + setout string** option is used the **Sz** value on the **Pit->Setout** tab has been entered correctly.

The second common error is that the catchment string has not been drawn around the crest of the catchment. The lowest section of the catchment string must be drawn carefully because it is the lowest point on the string that determines the overflow elevation. If in doubt, profile the catchment string with the design tin shown in the section view. Double check were the low point is. The location of the low point is also shown as a green vertex (plus sign) in **construction drainage data** model.

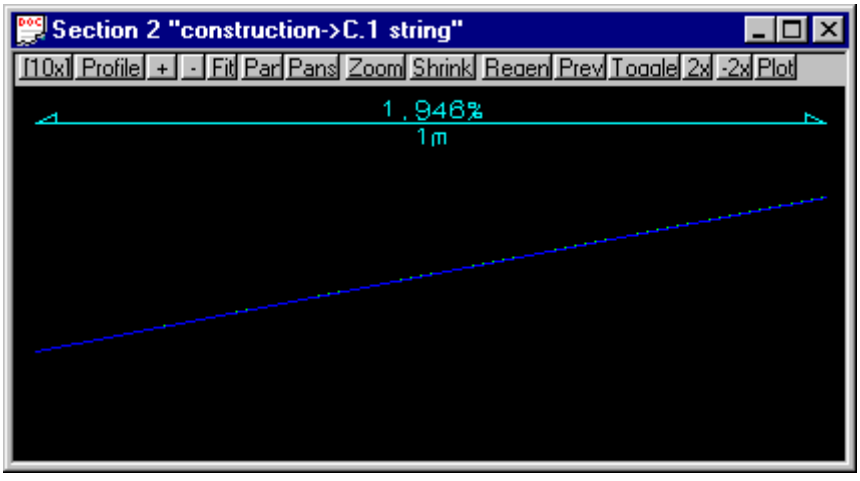
Verification strings in the same model confirm the locations where the road grade and crossfall have been measured. To check these strings add the **construction drainage data** model to the plan view. The following image shows a close up of the verification strings at a pit.



The green line indicates where road grade was measured and the magenta line indicates where the road cross fall was measured.

The default location of the road grade measurement is one pit diameter upstream of the setout point, along the setout string. The road crossfall is measure one pit diameter away from the setout point towards the road centreline. These are 3d super strings and therefore you may profile them in the section view. With the grades toggled on (check under **Toggle**) you can verify the slopes.

The location of the road grade and crossfall measurements can be changed in the **road design file**. The distance upstream to measure the road grade is controlled by the **Grade offset** column one the rows where the setout strings are defined. The road crossfall is controlled by the **Xfall offset** column on the rows where the road centre lines are defined. The distance the measurements are taken is controlled by the **Slope measurement distance**.



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Important Notes

1. Pits with a bypass pit entered but no inlet capacity defined in the drainge.4d file will have a zero inlet capacity.
2. With **Inlet config** set to **Manhole**, the pit has no inlet capacity.
3. If no bypass flow string is supplied for a pit, the inlet capacity is set to 100%.
4. If you have a problem with the inlet capacity calculations, check the **Storm Analysis** hydrology report for details.

5.0 The drainage.4d file

The drainage.4d file controls many of the settings for the pit and pipes types inside 12d. This section details the format of the drainage.4d file. Changes to this model take effect only after 12dmodel has been restarted. If there are any errors in the drainage.4d file they will be listed in the output window at startup (just after the shp file listing). The error in the drainage.4d file is generally located just above the line indicated in the output window.

All text to the right of the // is ignored by 12d (comments). There are pit and pipe type definitions. Because of historic reasons the pit types are defined using a **Manhole** command.

Many of the settings in the drainage network editor (DNE) can be controlled by the pit types and the pipe types defined in the drainage.4d file. The **special manhole attributes** defined below control these fields.

The original **drainage.4d** file is found in the “program files\12d\12dmodel\9.00\set_ups” directory. **Do NOT** change this file. Copy it into your user folder “\12d\9.00\User” and edit it there. Files in the user directory are used by preference and they are never over written by a 12d update.

5.1 Pit Type definitions

The order of the pit type definitions controls the order of the pit types in the DNE drop down list. The minimum requirement for a pit type definition is

```
Mnahole “name” {
}
```

The name must be unique and the braces {} cannot be () or [].

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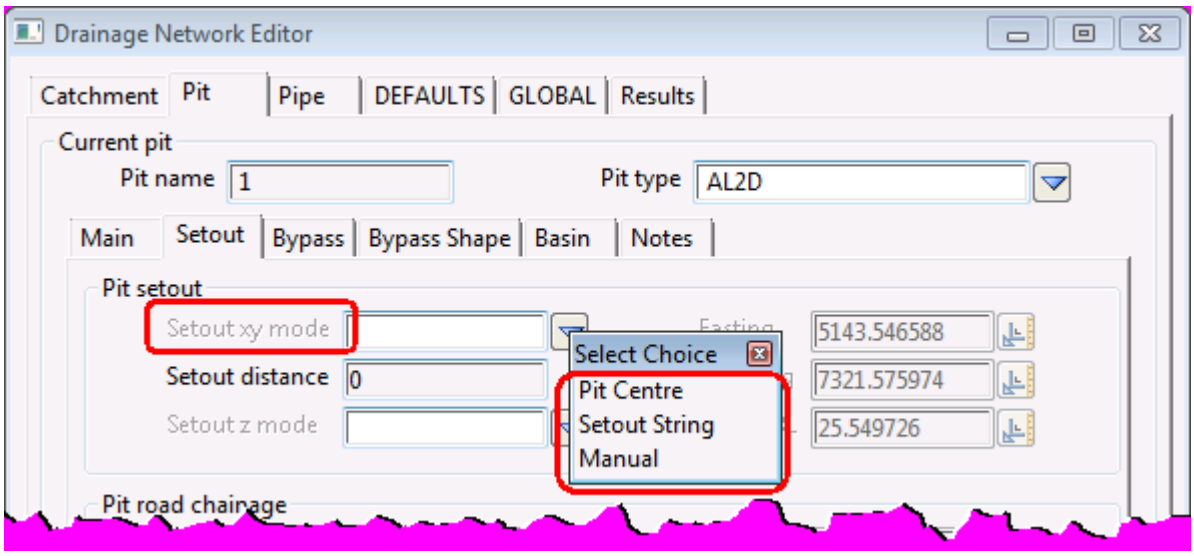
Example:

The setout xy mode controls the following on the DNE.

```
attribute_integer "setout xy mode" 0 //[0,1,2] Pit=>Setout=>Setout xy mode
```

The 0,1,2 are the values to be used. The order of the numbers [0,1,2] is the same as the order in the DNE drop down list. The numbers are not always in sequential order.

0	Pit centre
1	Setout string
2	Manual



The following example of a channel ip point is given below. The setout modes are set, the cover and grate level modes are set and the ku (losses) are set. Finally, the inlet capacity is set to an on-grade pit with200% inlet capacity so that even in a major storm with a choke factor of 0.5 it will still have 100% inlet capacity.

```
Manhole "CHNL auto" {

  mhdesc  "channel hip-vip"
  attribute_text "lplot description1"  "OPEN CHANNEL"

  mhsize  0.0
  mhdiam  0.0
  attribute_integer "setout xy mode"  0 // centre of the channel
  attribute_integer "setout z mode"   6 // sump invert is the bottom of the chan-
nel
  attribute_integer "cover rl mode"   4 // max obvert - top of the channel
  attribute_integer "grate rl mode"   4 // max obvert - top of the channel
  attribute_integer "ku method"       0    // direct
  attribute_real    "ku"              0.0  // zero unless interested in bend
losses
```

```
  cap_config G

  cap_percent 200 // if a choke factor of 0.5 is applied then it will still
have 100% inlet capacity
}
```

Manhole Commands

```
//
=============================================================================
// Rules for manhole/pipe attributes in the drainage.4d file:
//
=============================================================================
//  From V9, bothpit the Manhole and Pipe entries support attribute entries based on
manhole/pipe type:
//
//  attribute_integer "attribute name1" <Integer value>
//  attribute_real    "attribute name2" <Real value>
//  attribute_text    "attribute name3" "Text value"
//
//  The following manhole & pipe attribute names are recognised as special by 12d, and
may be used to take
//  control of the matching fields in the Drainage Network Editor for the applicable
manhole/pipe types:
//
//  ---------------------------------------------------------------------------
//  Special manhole attributes              Valid values          DNE field
//  ---------------------------------------------------------------------------
//  attribute_integer "cover rl mode"       [0,3,1,8,4,2] Pit=>Main=>Cover RL mode
//  attribute_integer "grate rl mode"       [7,0,3,1,8,4,2] Pit=>Main=>Grate RL mode
//  attribute_real    "sump offset"                          Pit=>Main=>Sump offset
//  attribute_integer "ku method"           [0-3,101-110,201-223] Pit=>Main=>Ku method
//  attribute_real    "ku"                                   Pit=>Main=>Ku
//  attribute_real    "kw"                                   Pit=>Main=>Kw
//  attribute_integer "setout xy mode"      [0,1,2] Pit=>Setout=>Setout xy mode
//  attribute_integer "setout z mode"       [7,0,3,1,8,4,5,6,2]
                                                 Pit=>Setout=>Setout z mode
//  attribute_integer "road chainage mode"  [0,1,2] Pit=>Setout=>Chainage mode
//  attribute_real    "setout adjustment"                    Pit=>Setout=>Sxy
//  attribute_real    "setout adjustment z"                  Pit=>Setout=>Sz
//  attribute_real    "design freeboard"  Pipe=>Design=>Freeboard limit at US pit

//  Any other manhole/pipe attribute name may be specified, apart from those documented
in:
//  http://www.forums.12dmodel.com/downloads/Owen.Thornton/12d_Drainage_Attributes.pdf
//  which are reserved for use by the 12d 'Drainage' and/or 'Drainage Analysis' modules.
//
//  NB1: If a non-special attribute name is set for some, but not all Manhole types,
then that attribute
//         will be deleted on all manholes with types where the attribute is not set.
//  NB2: If a non-special attribute name is set for some, but not all Pipe types, then
that attribute
//         will be deleted on all pipes with types where the attribute is not set.
//
=============================================================================
```

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==

```
//=============================================================================
// Manhole Format:
//=============================================================================
//Manhole "manhole type" {
//
//  //All entries inside a Manhole entry are optional.
//
//  attribute_integer "attribute name1" <Integer value>
//  attribute_real    "attribute name2" <Real value>
//  attribute_text    "attribute name3" "Text value"
//
//  mhsize  <x.x> [<x.x>]  //Nominal Length [and optional Width] in <base units>
//  mhdiam  <x.x>          //controls drawn MH diam on Drainage string (omit mhdiam entry
to specify independent of manhole type)
//
//  mhdesc  "verbose description of the manhole type"
//  mhnotes "extra remarks about this manhole type"
//  mhgroup "manhole group to which the type belongs"
//
//  //Capacity configurations (omit cap_config entry to specify independent of manhole
type):
//  //  "cap_config G" = on-grade pit ... OR
//  //  "cap_config S" = sag pit      ... OR
//  //  "cap_config M" = manhole (sealed pit)
//
//  cap_config G
//
//  //Inlet capacity data for G and S configs (generic):
//
//  cap_multi   <x.x>
//  cap_fixed   <x.x>
//  cap_percent <x.x>
//  cap_coeff   <x.x>
//  cap_power   <x.x>
//
//  //Inlet capacity data for G config (by road grade & xfall):
//
//  cap_curve_grade "curve 1" {
//    road_grade  <x.x>
//    road_xfall  <x.x>
//    cap_multi   <x.x>
//    cap_fixed   <x.x>
//    cap_percent <x.x>
//    cap_coeff   <x.x>
//    cap_power   <x.x>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//  }
//  cap_curve_grade "curve 2" {
//    road_grade  <x.x>
//    road_xfall  <x.x>
//    cap_multi   <x.x>
//    cap_fixed   <x.x>
```

```
//    cap_percent <x.x>
//    cap_coeff   <x.x>
//    cap_power   <x.x>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//  }
//  cap_curve_grade "curve n" {
//    road_grade  <x.x>
//    road_xfall  <x.x>
//    cap_multi   <x.x>
//    cap_fixed   <x.x>
//    cap_percent <x.x>
//    cap_coeff   <x.x>
//    cap_power   <x.x>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//    coord <Qa> <Qin>
//  }
//
//  //Inlet capacity data for S config:
//
//  cap_curve_sag "curve sag" {
//    cap_multi   <x.x>
//    cap_fixed   <x.x>
//    cap_percent <x.x>
//    cap_coeff   <x.x>
//    cap_power   <x.x>
//    coord <Depth> <Qin>
//    coord <Depth> <Qin>
//    coord <Depth> <Qin>
//  }
//}
//-------------------------------------------------------------------------------
// Rules for Pit Inlet Capacity Data
//-------------------------------------------------------------------------------
//
//Qa  = pit approach flow rate
//Qin = pit inflow rate
//Qb  = bypass flow rate = Qa - Qin
//
//If pit is sealed (i.e. a manhole)   : Qin = 0
//If no bypass pit (i.e. 100% capture): Qin = Qa
//
//Else: Qa >= Qin = choke*cap_multi*(  cap_fixed
//                                   + cap_percent*0.01*Qa
//                                   + cap_coeff*Qa^cap_power
//                                   + cap_curve_? {
//                                       cap_multi*(  cap_fixed
//                                                  + cap_percent*0.01*Qa
//                                                  + cap_coeff*Qa^cap_power
//                                                  + [Qin via coord lookup] )
//                                     }
//                                  )
//
//                  where: 'cap_curve_?' is the applicable curve data
//
//Default values for unspecified entries:
//  cap_multi   = 1.0
```

```
//  cap_fixed   = 0.0
//  cap_percent = 0.0
//  cap_coeff   = 0.0
//  cap_power   = 1.0
//
//Rules for 'cap_curve_grade' entries:
//  *Only applicable to on-grade pits.
//  *All cap_curve_grade entries must be uniquely named within a pit.
//  *The 'road_grade' and 'road_xfall' entries are both optional, but their
//     use must be consistent across all cap_curve_grade entries within a pit.
//  *If both 'road_grade' and 'road_xfall' entries are omitted, only one
//     cap_curve_grade entry is allowed within a pit.
//  *The 'road_grade' and 'road_xfall' entries must be specified in %, and are
//     interpreted as minimum threshold values.
//  *The cap_curve_grade 'coord' entries (if used) must be in order of
//     increasing Qa.
//
//Rules for 'cap_curve_sag' entries:
//  *Only applicable to sag pits.
//  *Only one cap_curve_sag entry is allowed within a pit, and it must have
//     a valid name.
//  *The cap_curve_sag 'coord' entries (if used) must be in order of
//     increasing Depth.
//  *It is recommended that all sag pits have 'coord' entries, because even
//     if there is no bypass pit (100% capture), the 'coord' entries are used
//     to reverse-calculate the flooded depth at the sag inlet, based on Qin.
//
//NB1: Flow rates must be specified in "cubic <base units> per second".
//NB2: Depths must be specified in <base units>.
//NB3: For choke factors: 0.0 means blocked, 1.0 means unblocked.
//
//=============================================================================
=============================================================================
```

5.2 Pipe Type Definitions

The order of the pipe type definitions controls the order of the pipe types in the DNE drop down list. The minimum requirement for a pipe type definition is

```
Pipe “name” {
}
```

The name must be unique and the braces {} cannot be () or [].

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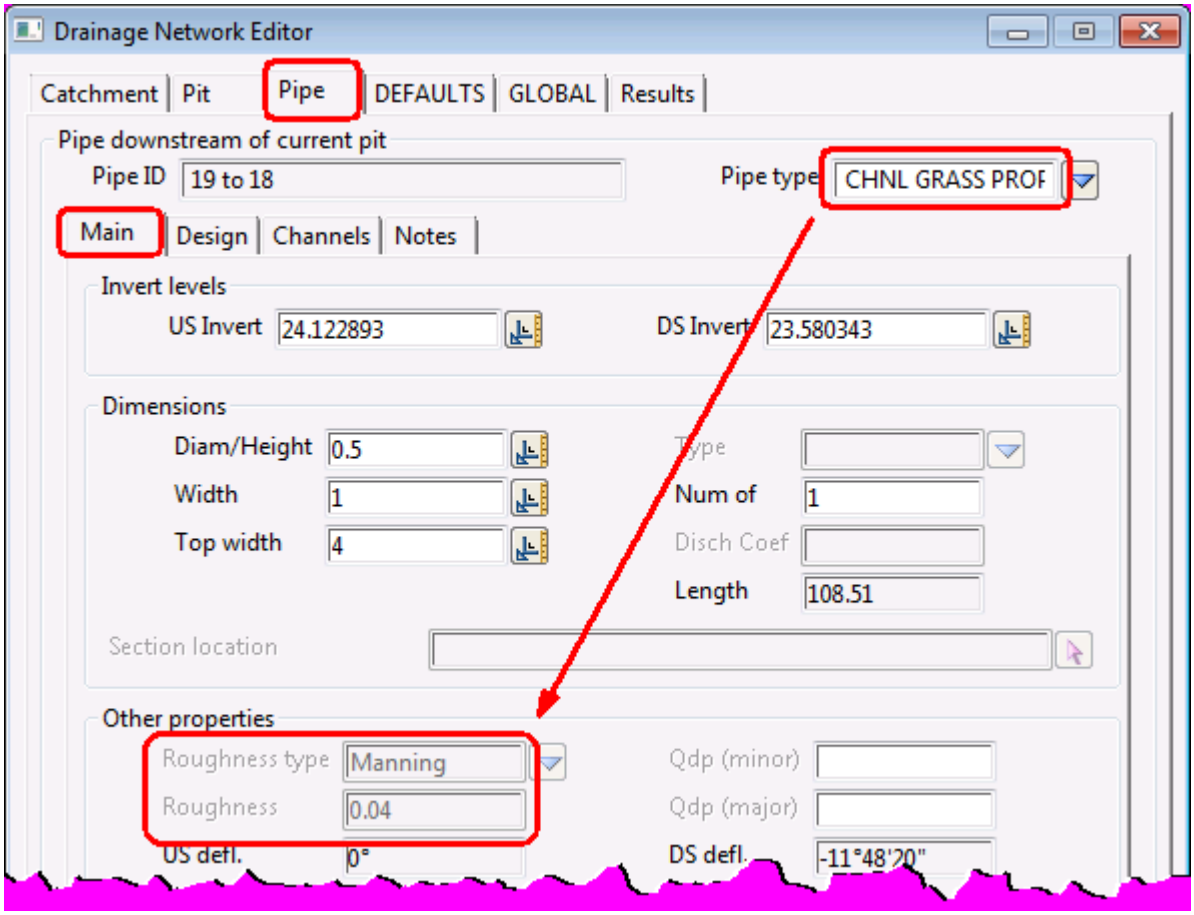
Example:

The roughness type and value types can be set in the DNE.

```
roughness_n 0.040
```



Example:

```
Pipe "CHNL GRASS PROPOSED" {  //Open Channel created below the tin. cover set
in cover file to 0.0
  roughness_n 0.040
  attribute_integer "design size mode"     3  // open channel mode
}
```

Pipe Commands

```
//=============================================================================
// Pipe Format:
//=============================================================================
//Pipe "pipe type" {
//
//  //All entries inside a Pipe entry are optional.
//
//  attribute_integer "pipe attribute name1" <Integer value>
//  attribute_real    "pipe attribute name2" <Real value>
//  attribute_text    "pipe attribute name3" "Text value"
//
//  //Pipe roughness ... n or k (omit roughness entry to specify independent of
pipe type):
//
//  roughness_n <Manning n roughness value>
//  roughness_k <Colebrook k roughness value> //in millimetres
//  ---------------------------------------------------------------------------
//  Special pipe attributes                Valid values         DNE field
//  ---------------------------------------------------------------------------
//  attribute_real    "min height"          [> 0.0]              Pipe=>Design=>Min pipe
height
//  attribute_integer "design size mode"     [0,1,2,3]            Pipe=>Design=>Design
mode
//  attribute_real   "design percent depth" [> 0.0]             Pipe=>Design=>Flow-depth
at pipe entrance
//  ---------------------------------------------------------------------------
//

//}
//=============================================================================
```

5.3 Pit Inlet Capacities

The pit inlet capacity tables contained within the **drainage.4d** file are used by the drainage design packages in different ways but with a common philosophy.

5.3.1 On grade pits

The grade and crossfall values for the tables are threshold values, i.e. the next set of capacity factors will not be used until the crossfall and grade are equal to or exceed the values for the curves. The curves are not interpolated!

12d Storm Analysis

Some sample Pit definitions follow to demonstrate how the pit inlet capacities are calculated.

```
Manhole "SEP 25" {

  mhsize  1.200 0.900
  mhdesc  "SEP with 25 l/s"
```

```
  mhnotes ""
  mhgroup "SA"

  cap_multi   1.0
  cap_fixed   0.025

}

Manhole "SEP 50 percent" {

  mhsize  1.200 0.900
  mhdesc  "SEP with 50%"
  mhnotes ""
  mhgroup "SA"

  cap_multi   1.0
  cap_percent 50.

}

Manhole "SEP Grade x 10" {

  mhsize  1.200 0.900
  mhdesc  "SEP with 25 l/s"
  mhnotes ""
  mhgroup "SA"

  cap_curve_grade "curve 1" {
    road_grade  1
    cap_multi   1.0
    cap_fixed   0.010
  }

  cap_curve_grade "curve 2" {
    road_grade  2
    cap_multi   1.0
    cap_fixed   0.020
  }

  cap_curve_grade "curve 3" {
    road_grade  3
    cap_multi   1.0
    cap_fixed   0.030
  }

  cap_curve_sag "curve sag" {
    cap_multi   1.0
    coord 0.0  0.000
    coord 0.1  0.010
  }
```

}

Drains Version 1 and ILSAX

The cap1, cap2, cap3 and cap4 values are used to describe the inlet capacity of the pit as described in their user manuals.

Drains Version +

The 12d inlet curve names are exported to Drains as the pit family.

xpswmm, xpstorm and RAT-HGL

If cap2, cap3 and cap4 are all equal to zero then a fixed inlet capacity equal to cap1 will be exported to RAT-HGL. If the sum of these three values is greater than zero then a pit type will be created in the format of **pit_type-crossfall-roadgrade**. For example SA2-3-2 for a SA2 pit with a road crossfall of 3% and a road grade of 2%. A rating curve with this name will have to exist inside RAT-HGL. 12d has no way of transferring the rating curve itself into RAT-HGL.

PC Drain

Similar to RAT-HGL, PC Drain has it own rating curves defined internally. The road grade is sent as a separate piece of data to PC Drain so that the pit inlet capacity may be determined.

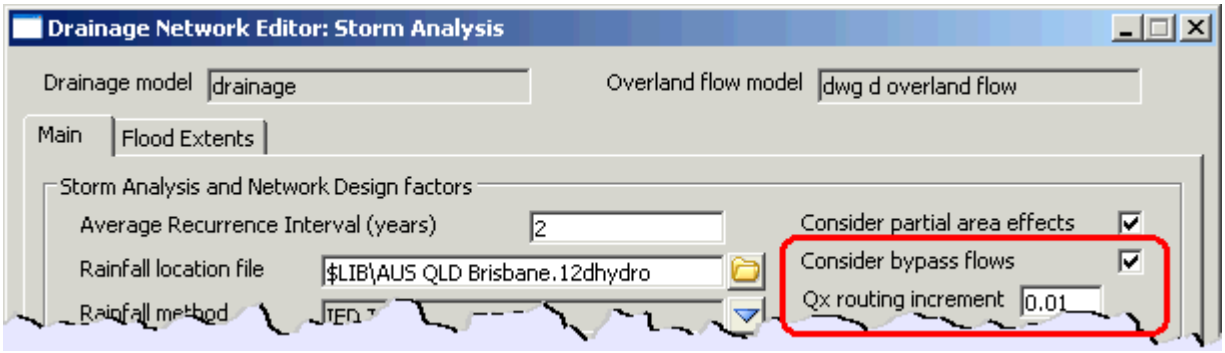
5.3.2 SAG Inlets

PC Drain

PC Drain places a suffix code in the pit type to specify that the pit is a SAG pit. For example an 9S.03 indicates that pit type 9 is a sag pit and the maximum depth before bypassing is 30mm.

6.0 12d Storm Analysis Bypass and Flooded Width Calculations

Once the bypass pits are selected and the drainage.4d file has been setup for bypass flow the storm analysis engine must have this feature enabled. Select **Consider bypass flow**.



Excess Flow

The **Qx** value controls how excess flow is handled in the bypass flow calculations. If the hgl at the pit reaches the grate level then no more water can enter the pit even if there is inlet capacity. The flow that will not enter the pit is considered excess flow. When a value greater than zero is entered here, the inlet will initially have its inlet capacity restricted by this value. Upstream inlets are done first as this may reduce the hgl in the downstream system. The system is automatically rerun adjusting the flows by this amount each time.

If the inlet capacity is reduced to zero and the hgl is still above the pit then water is removed from the pit and considered as Qs (surcharge flow). In the hydraulic reports this value is found as a negative **Inlet Flow Qi**.

Overland Flow Calculations

The storm analysis engine will calculated flooded widths from normal depths along the flow path and ponding extents at SAG inlets. A bypass flow model (**Global-Utility Models** tab) is required for these calculations.

The **Utility String Editor** should be used where bypass flow strings combine at a pit. Without using this editor it is assumed that 100% of the catchment flow flows down each bypass flow string thereby overestimating the flooded widths.

The **Utility String Editor** could be used to change the Manning's along the string (approach channels to culvert for example) or the maximum flooded width warning limit (before a pedestrian crossing or a highway off-ramp).

The models and the default input data for these calculations are entered on the **Flood Extents** tab.

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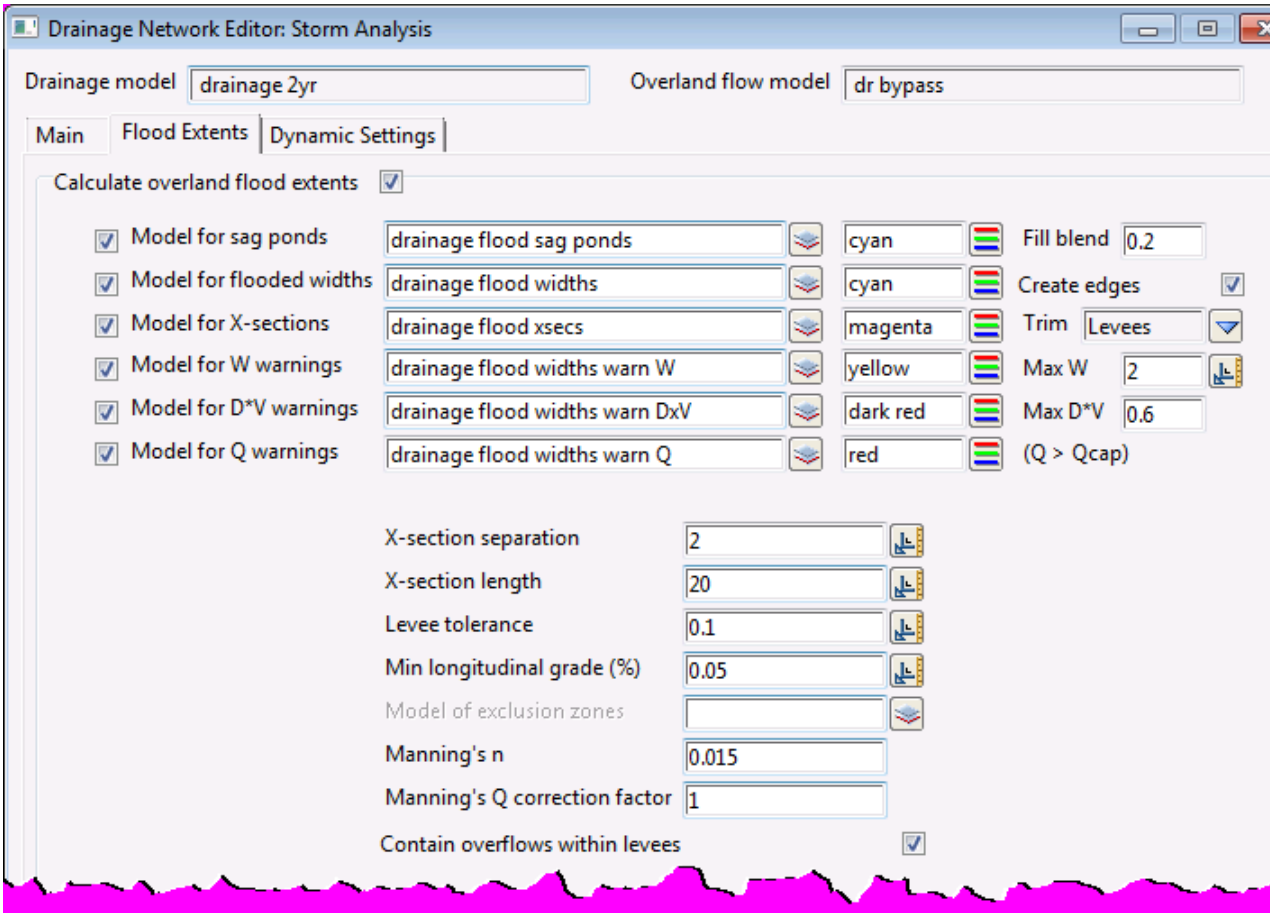

Select **Calculate overland flooded extents** to active the fields on the panel.

Model for sag ponds is used to hold strings that indicate the extent of flooding at the pits marked as SAG inlets. The total approach flow is used with the cap_curve_sag in the drainage.4d file to determine the depth of flooding above the grate level. A closed contour at this flood elevation is then selected near the centre of the inlet. A super string is then created at this level with the colour and **fill blend** transparency selected (1.0 is solid).

Model for flooded width holds the strings indicating the normal depth - flooded width calculation results. These strings are created with a fixed elevation of the flood level. The strings will have string attributes with all of the calculations details.

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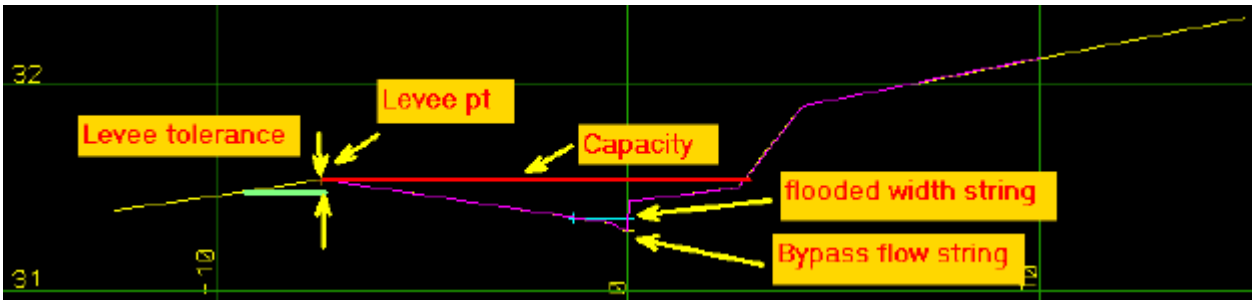
Calculations



1. Cross sections are cut perpendicular to the overland flow string at the interval **X-section separation** with a length of **X-section length**. No calculations are done for sect of the bypass flow string with in **Model of exclusion zones** polygon.
2. The x-section string is then trimmed using the **Trim** settings.The section above had a x-section length of 20 and was trimmed at the levee. The **levees** setting has the routine search for levee (high points) on either side of the low point near the bypass flow string. The levee points are found if sections drops more than the **Levee tolerance** value after the high point is found.
3. The flow for the section is calculated using the bypass flow string chainage to interpolate between the upstream bypass flow and the downstream approach flow. The percentage of catchment flow used in the calculation of the approach flow for this bypass string may be changed using the **Utility String Editor.**
4. The slope of the surface near the bypass flow line is measured for each section. If the slope is less than **Min longitudinal grade (%)** then this cross section is skipped in the calculations.
5. **Manning n** value is the default roughness used in the calculations. This value may be changed at any vertex along the bypass flow string using the **Utility String Editor**.
6. The flow's calculated at the indicated level are multiplied by the **Manning's Q correction factor**. A factor of 0.8 would cause the flooded widths to increase and the road capacity to decrease.
7. The maximum depth calculated will be at the point where water overflows the edges of the section (**Road capacity)** unless **Contain overflow within levees** is selected. This will cause frictionless vertical walls to be placed at the ends of the section so that higher water level may be calculated when the flow is greater that the road capacity.

Warning Models

Model for W warnings will contain copies of the flooded width strings with the colour selected if the flooded width is greater than the default **Max W** value.

Model for D*V warnings will contain copies of the flooded width strings with the colour selected if the depth * velocity is greater than the **Max D*V** value.

Model for Q warnings will contain copies of the flooded width strings with the colour selected if the flow is greater than the capacity of the section. The capacity is the flow where the water over tops one of the sides of the section.

7.0 Drainage Utility String Editor

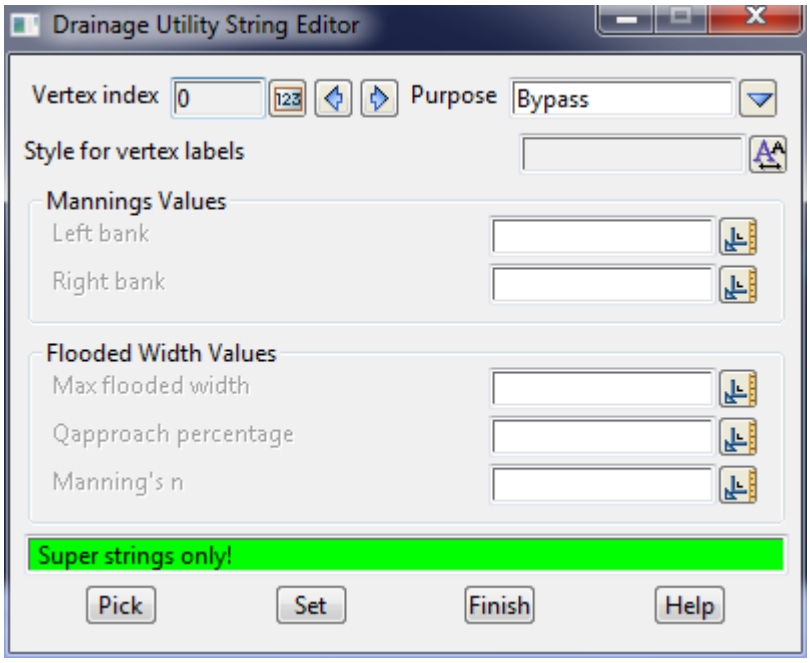
Drainage_utility_string_editor

Position of option on menu: Design =>Drainage-Sewer =>Utility String Editor

The drainage utility editor is used to assign left and right bank roughness to cross section shape strings and to change the default values used for flooded width calculations along a bypass string.

First the string is selected at the vertex where the values are to be assigned. Next select the purpose of the string (cross section or bypass) to unlock the appropriate fields. A textstyle favourite is required as the vertex is labelled with the assigned values. Enter the values into the fields and then select Set to set the values as vertex attributes and create the label as a vertex annotation.

On selecting the utility string editor option, the utility string editor panel is displayed.



The fields and buttons used in this panel have the following functions.

Field Description Type Defaults Pop-Up

Vertex index vertex selected vertex

Once the string is selected use this to move between vertices

Style for Vertex Labelstextstyle favouritetextstyles

A label is created on the vertex using this textstyle favourite

Left bank Input

mannings n value, to delete clear and select set

Right bank Input

mannings n value, to delete clear and select set

Max Flooded with Input

This changes the threshold were warning bars are created during flooded width calculations. It remains in effect till the next change or the end of the bypass flow string.

Qdc percentage Input

This changes the percentage of the Qdirect+Qcatchment that is used to interpolate the discharges during flooded width calculations. It is generally set on the first vertex past upstream pit and remains in effect till the next change or the end of the bypass flow string. The flow changes from the bypass flow at the upstream pit to this value/100(Qdirect+Qcatchment).*

Manning's n Input

This changes the Manning's n value used for during flooded width calculations. It remains in effect till the next change or the end of the bypass flow string.

Pick button

Use this button to select the string. Select near the vertex you want assign the values to.

Set button

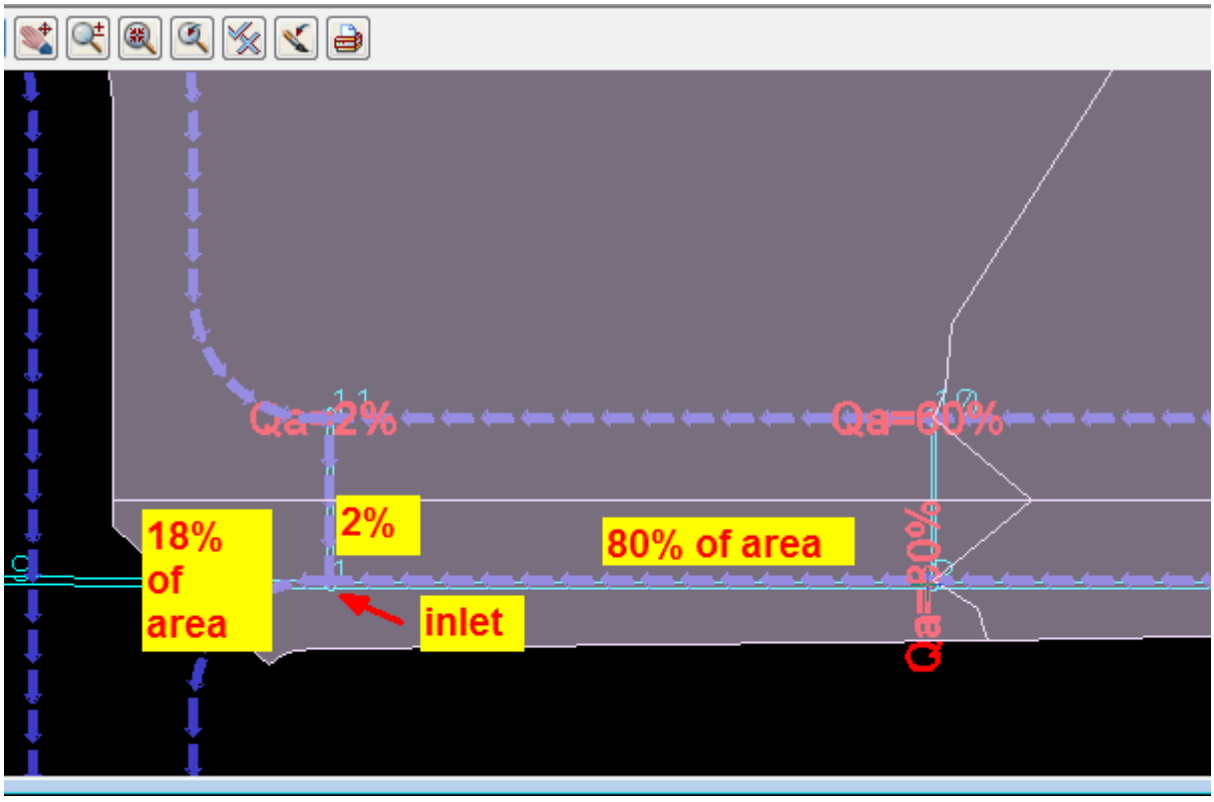
Creates the attributes and the label on the vertex.

Finish button

Removes the panel from the screen.

Help button

Launches the 12d help



In the example above, The Qdc is set to 80% at the eastern end of the catchment. The Qdc is set to 2% for the water overtopping the road. The 18% of the area is not considered large enough to do the flooded width calculation for. If desired, another bypass flow string approaching from the east could be drawn but the final bypass string to the west (direction during bypass should remain).

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8.0 Open Channel Flow

12d can model flow in open channels a trapezoidal sections. Suggestions for drainage network editor settings are listed below.

Generally, simple channels leading into a pipe network are often not modelled as open channels. The flooded width calculations can perform flooded width calcs (normal depth however) along the channel and the depth at the headwall is calculated using the headwall ku method.

If gradually varied depth/backwater calculations are desired then the channel will need to be modelled as a drainage string. Also if the pipes discharge into a channel then this channel will also need to be modelled as a drainage string.

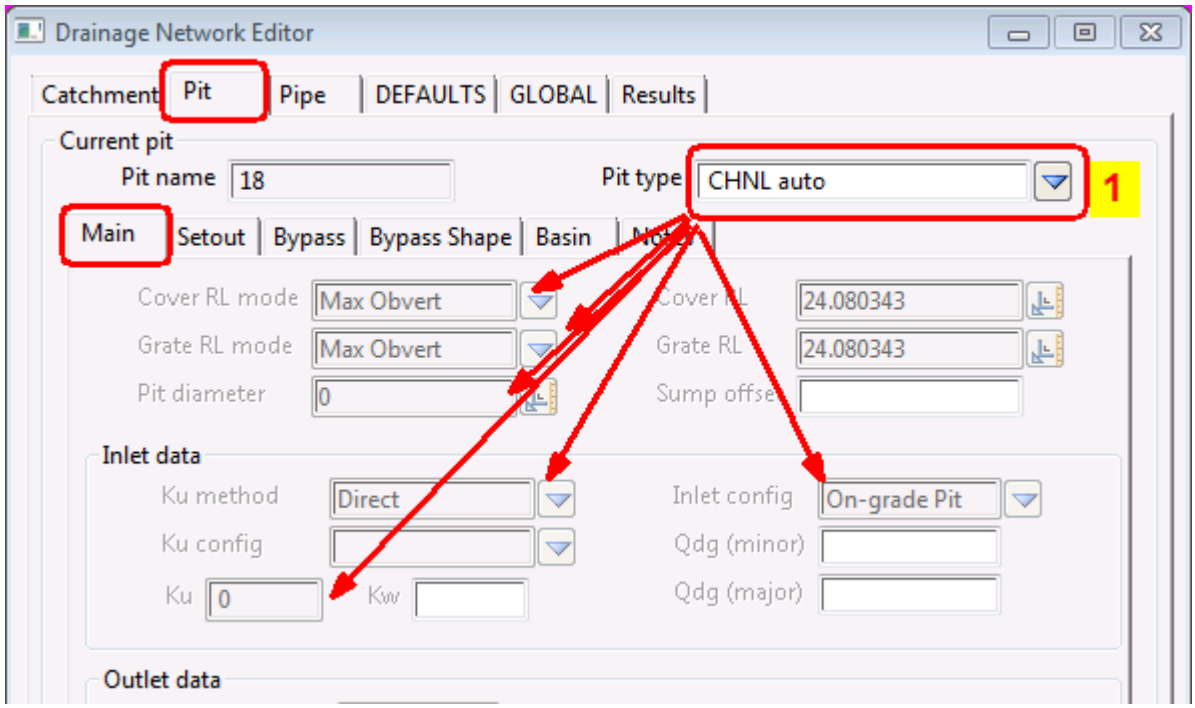
Key points

The pit grate level must always be at or above the top of the open channel conduit.

Changes in vertical grade and horizontal alignment require a pit in the drainage string. The pit diameter is usually set to zero.

Channels may exist in the tin or you may be proposing a channel to be cut into the tin. The grading and grate level modes will be different for each case. These channel type will be referred to as “Existing” or “Proposed”

Pit-Main Tab

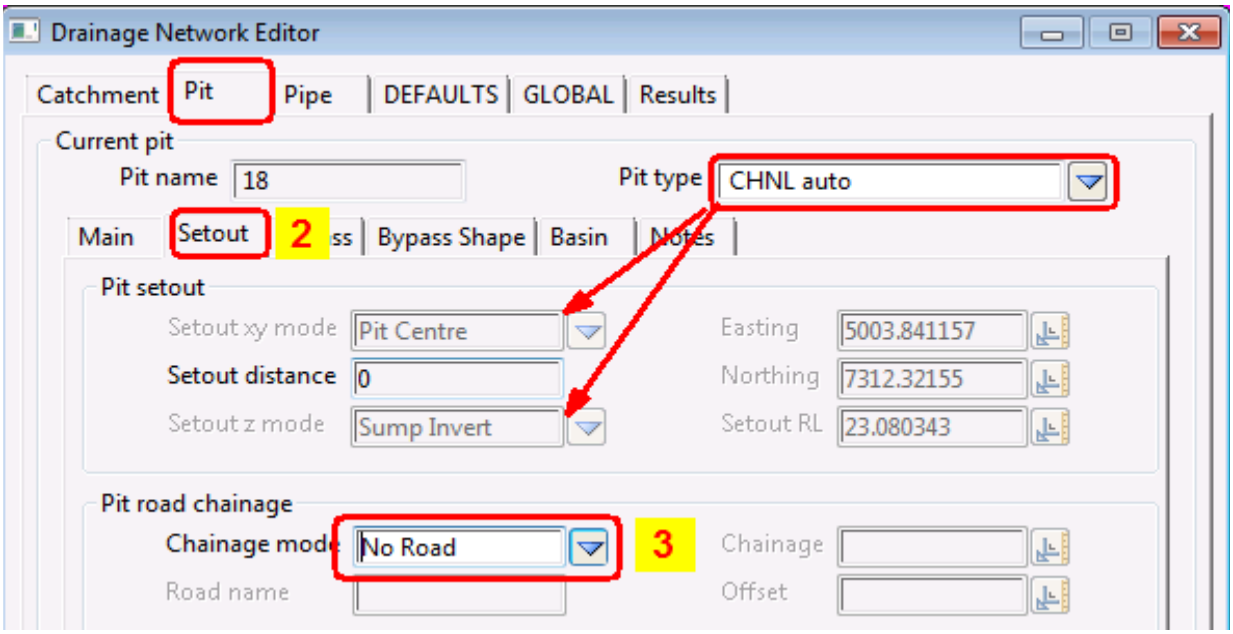


1. Selecting the **CHNL auto** pit typechanges many setting in the DNE.
   Cover RL mode is changed to **Max obvert**.
   Grate RL mode is changed to **Max obvert**.
   Pit diameter of diameter of zero. This will result in a single line on the drainage long sections

instead of a pit.
Ku method is set to **Direct** and a **Ku** of 0 for the channel change of grade points (pits).
Inlet config - On-grade pit - it has a 200% inlet capacity. The 200% inlet capacity is in case a choke factor is accidentally applied.

2. Select the Pit Setout tab

Pit-Setout Tab



Setout xy mode is set to **Pit centre**
Setout z mode is set to **Sump Invert** which is the lowest of the channel inverts if **Sump offset** = 0(Main tab).

3. The **Chainage mode** may be be changed to **No Road** if the channel centre line is not to be used for setout.If the default was **Centre string** this will stop the Problem message saying the centreline string is not found.

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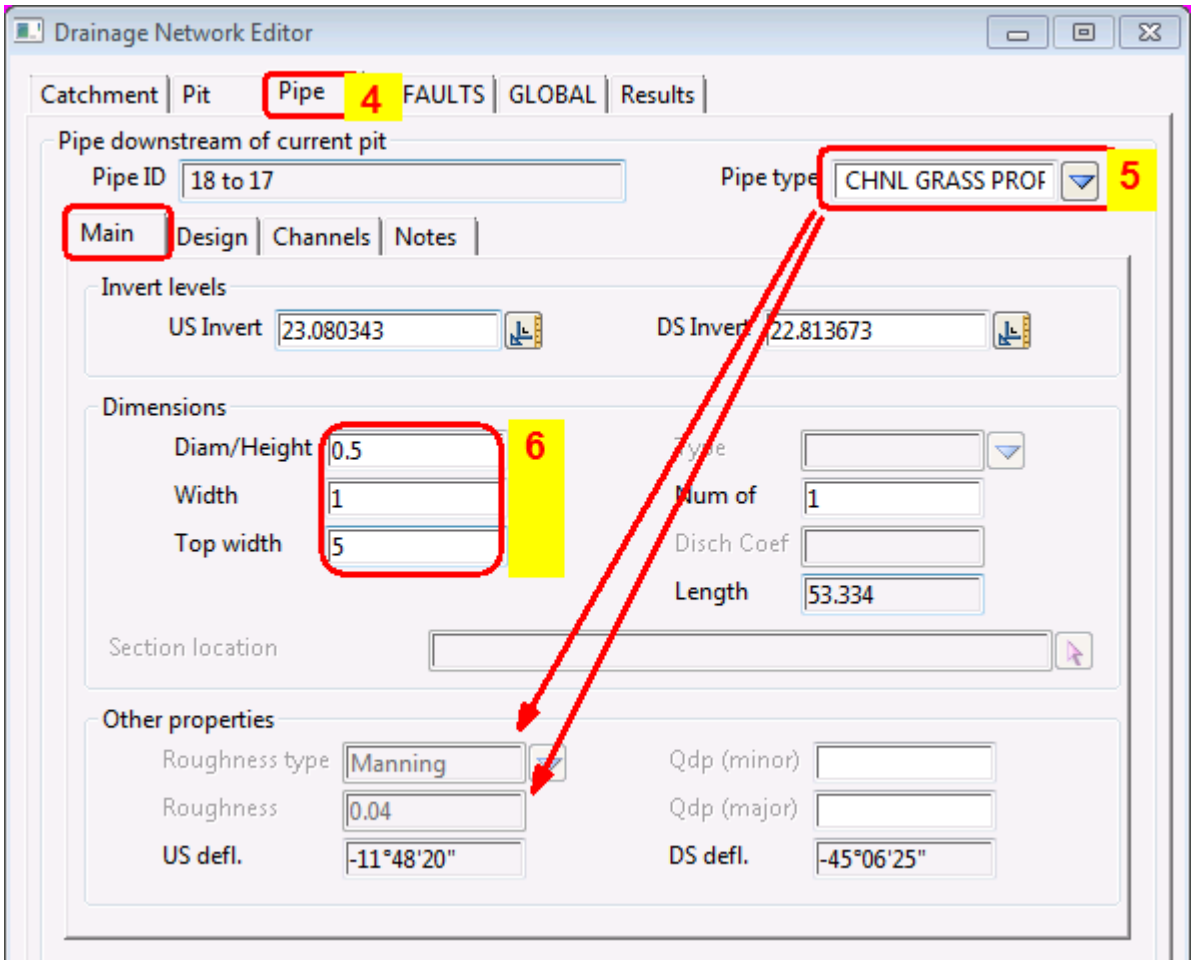
Pipe-Main Tab



4. Change to the **Pipe->Main** tab
5. Change the **Pipe type** to **CHNL GRASS PROPOSED**. This changes the following:
   the **Roughness type** to **Manning**
   the **roughness** for the open channel to 0.040
6. Set the **Height, Top width** and **Bottom width** of the channel.

Note: The pipe type can now be changed back to channel if you needed to alter any of the locked settings. Selecting the **CHNL GRASS PROPOSED** first set most of the setting correctly as a good starting point.

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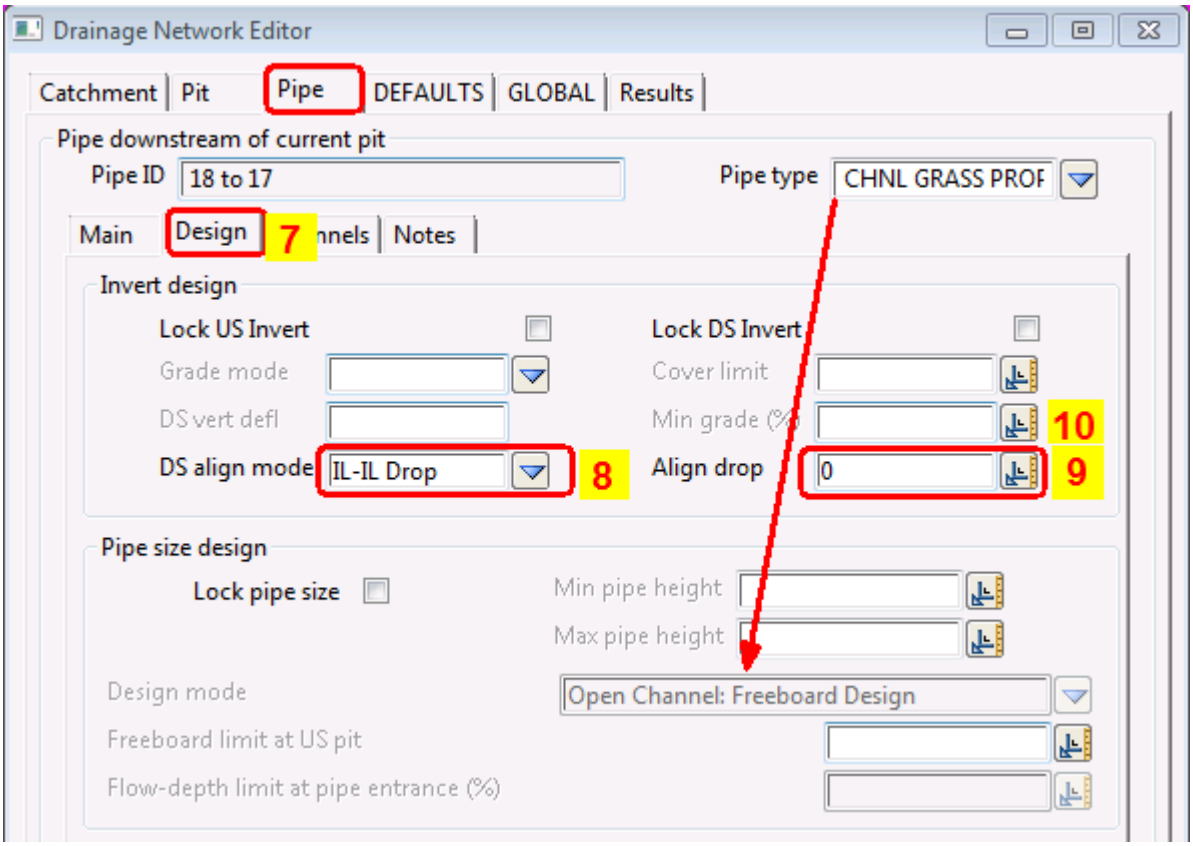
Pipe-Design Tab



7. Change to the **Pipe->Design** tab
8. Set the **Align mode** to “IL-IL drop”
9. Set the **Align drop** value to 0 (unless you are designing drop structures for your channel.
10. **Min Grade %** for open channels is usually much less than pipes.

Note: The **Design mode** has been changed to “**Open Channel: Freeboard Design**”. This will allow supercritical flow to continue through the channel junctions. Often the Freeboard limit will be different for a channel than the pipe system.

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STORMWATER DESIGN - Part 2

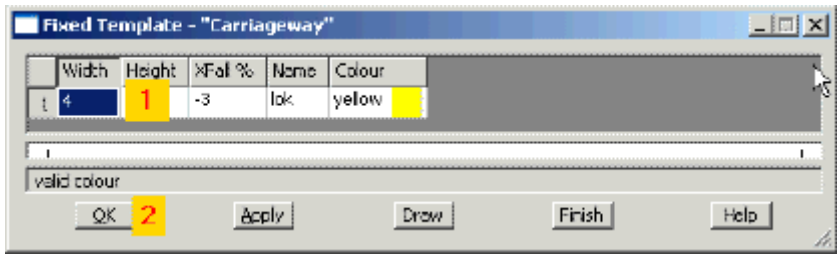
9.0 Horizontal Change in Road Alignment (Adjust Pit Locations)

It is advised that you have a link in your road template that is used for setting out the centre of the drainage pits. This make the job of placing the pits much quicker and if the road alignment moves horizontally the pits can be moved back onto these strings (moved perpendicular to the road string).

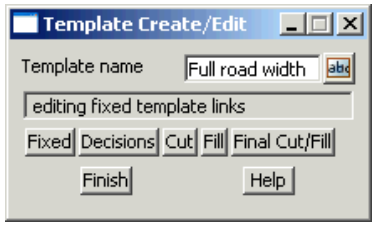
First we will widen the road using the templates. From the main menu select

Design->Template->Create Edit

1. Select the **Carriageway** template
2. Lb the **Fixed** button.



1. Change the **Width** to **4.**
2. Lb the **OK** button.



1. Select the **Full road width** template
2. Lb the **Fixed** button.

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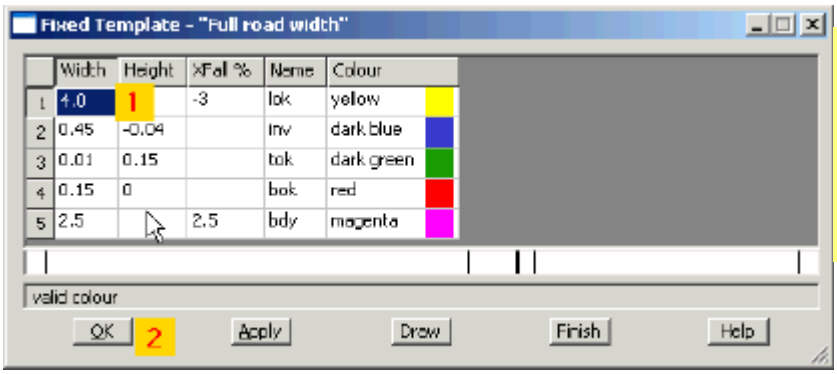
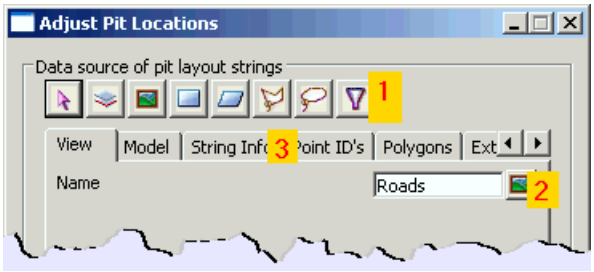


1. Change the **Width** to **4.**
2. Lb the **OK** button.

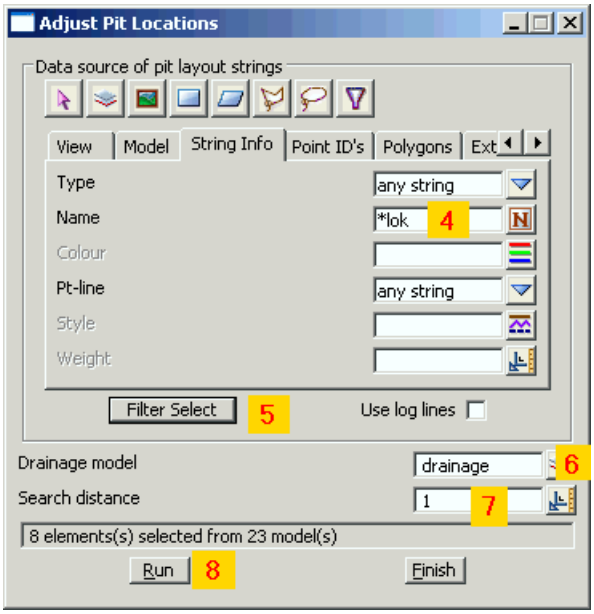
Utilities->Functions->Recalc->Recalc->design

Now we can move the pits back onto the lok string. From the main menu select,

Design->Drainage-Sewer->More Drainage->Adjust pit locations



1. LB the **filter** button
2. Lb more info **View** button and select the Roads view that holds all of the road strings.
3. LB the **String Info** tab



4. type ***lok** to select both the llok and rlok strings.
5. Lb **Filter Select** button to see how many strings are selected.
6. LB the **Drainage model more info** button ans select the **drainage** model.
7. Leave the default **search distance** as 1.
8. Lb **Run** to move the pits.

There is an undo for this operation.

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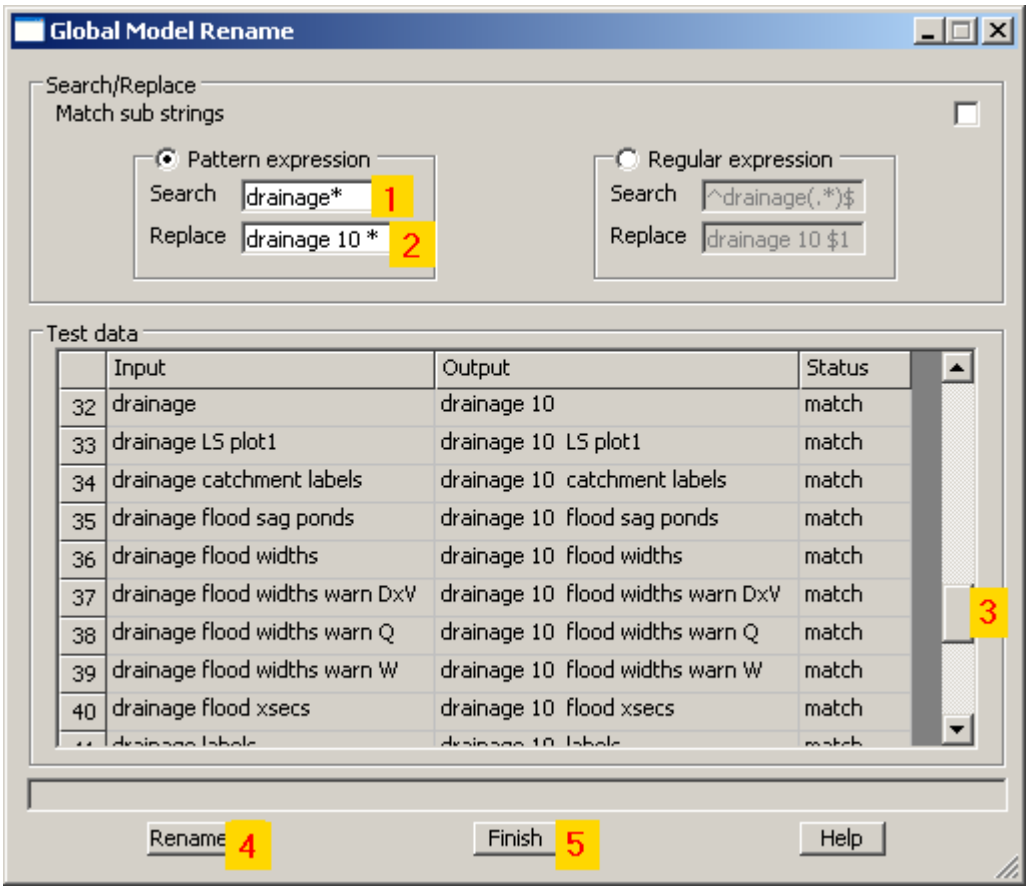
STORMWATER DESIGN - Part 2

10.0 Major Flood Events

To keep the results file from the minor event rename the drainage models using

Models->Global Rename



1. Type the **Search** criteria to select the drainage models
2. Type the **Replace** criteria. Note the 10 has been added.
3. Scroll down to see the new model names.
4. Lb **Rename** button
5. Lb the **Finish** button.

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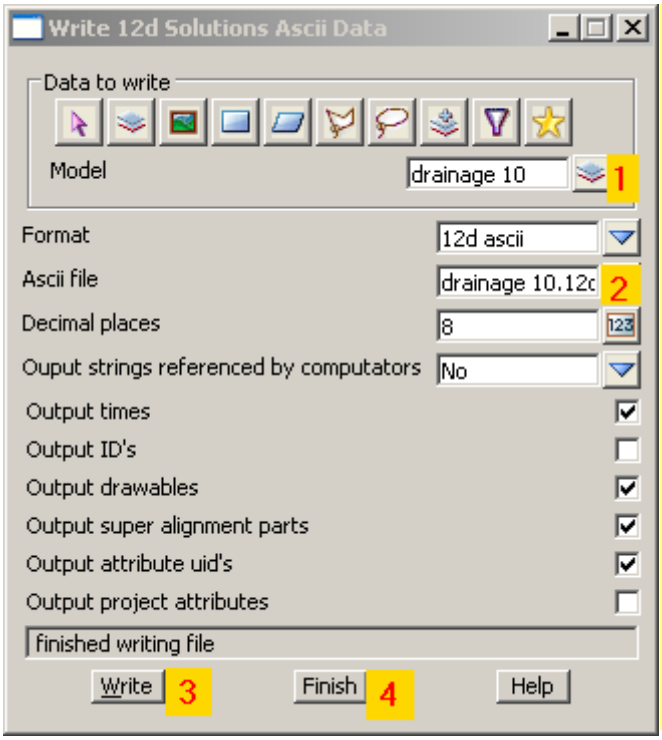
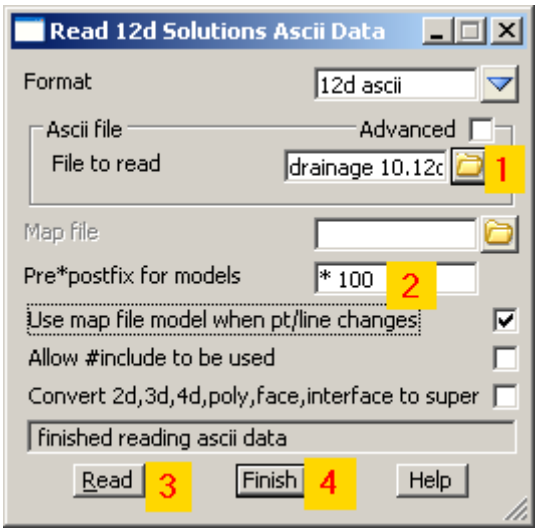
Next, create a copy of your drainage network and add a suffix to the model name. Select **File IO->Data Output->12da/4da data.**



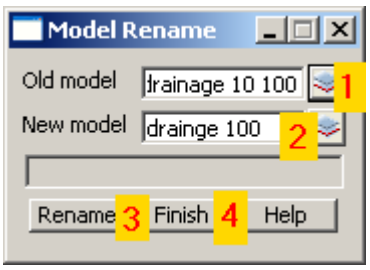
1. Select the drainage model
2. Type the name of the 12da file **drainage 10**
3. Lb the **Write** button
4. Lb the **Finish** button.

Now read the same file into 12d using a suffix 10. Select File IO->Data Input->12da/4da data.



1. **Select** the file written above
2. Type the postfix "*** 100**".
3. Lb the **Read** button
4. Lb the **Finish** button.

Lastly, rename the imported file to remove the **10** from the name.



1. **Select** the model created above **drainage 10 100**
2. Type the new name **drainage 100**
3. Lb the **Rename** button
4. Lb the **Finish** button.

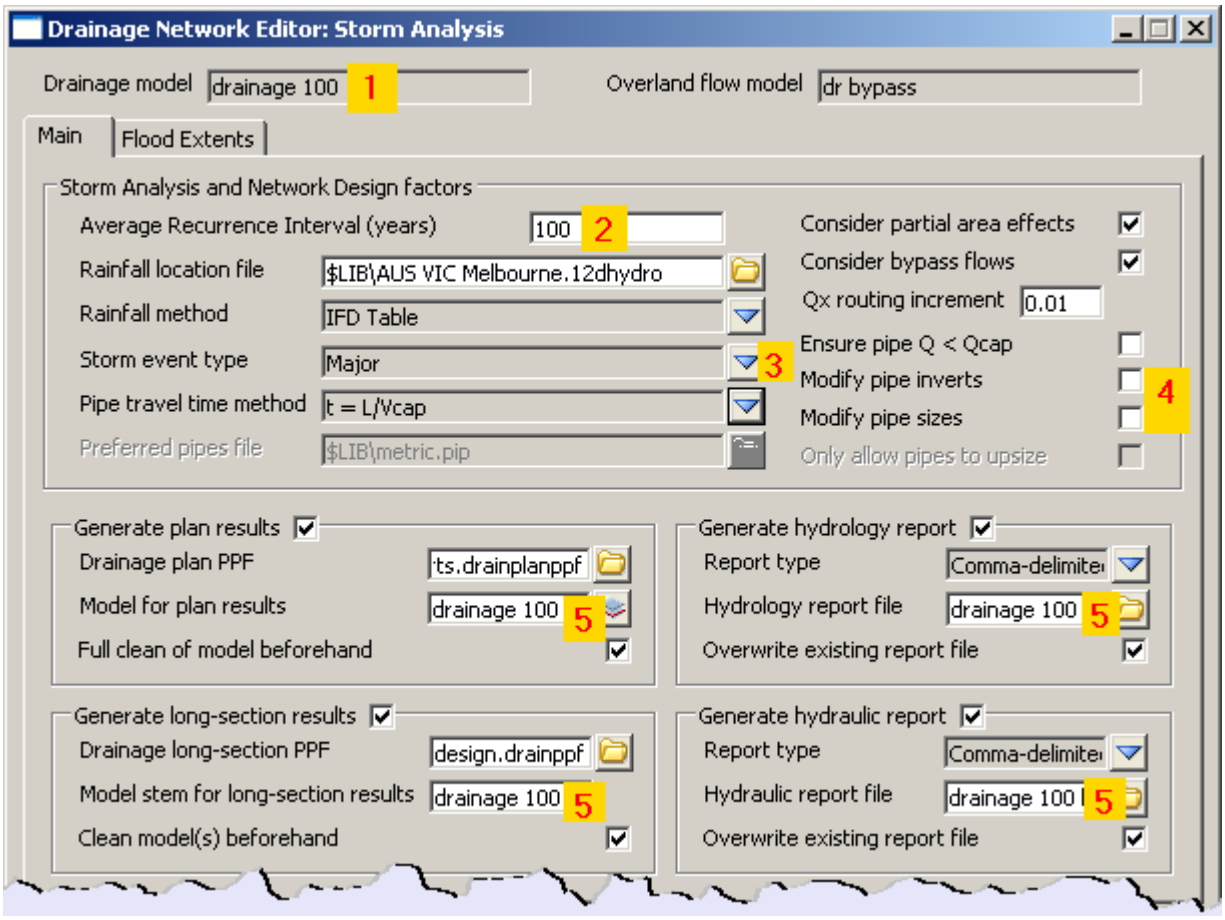
COURSE NOTES

STORMWATER DESIGN - Part 2

For major flood events the user may desire to use an alternative set of values for

Catchment tc,
Catchment C,
Pit direct inflow (Qdi),
Pipe direct inflow (Qpi),
Pit choke factor for ongrade inlets,
Pit choke factor for SAG inlets,
Outlet tailwater levels.

These controls are found on the Storm Analysis Panel, **Main** tab.



1. Ensure you have selected the **drainage 100** model.
2. Type the new return period.
3. Select the **major** storm setting.
4. turn off the **Modify pipe inverts** and **Modify pipe sizes**.
5. Change the name of your report files by adding **100** after drainage.

11.0 Excavation Quantities

Sample templates are included in the 12d library (pipe template.tpl). The templates from this template library may be added to your project using

Design=>Templates=>Utilities=>Input.

This routine uses 12d templates to calculate the excavation volume for all of the drainage strings in a model. An option to create section for a tin on top of the pipe is also available so that the drainage long sections can include hatching between the obvert of the pipe and the design tin under roads.

Templates with names set to the pipe diameters (times 1000) are used for the calculations, thus trench shapes can be customised and over excavation for bedding materials can be included. Net area calculations to exclude pipe area are not supported.

Key points

1. One template for each pipe size (mm)
2. If obvert templates are used, add the prefix “obvert “ to the pipe size
3. Carefully consider the tin selected.

A template must exist for each pipe size in the model (pipe size x 1000). For example a 0.3m pipe will require a template to exist named 300. A 0.5ft pipe would require a template named 500. Sample templates are included in the courses section of 12djobs (\12djobs\courses\7.00\drainage). These may be copied to your *.project directory and then added to your project using **Design=>Templates=>Utilities=>Add=>All all to project.**

The templates are run along the strings and the total volumes are reported. Volumes for each strings are given in the report file. An example follows.

COURSE NOTES

STORMWATER DESIGN - Part 2

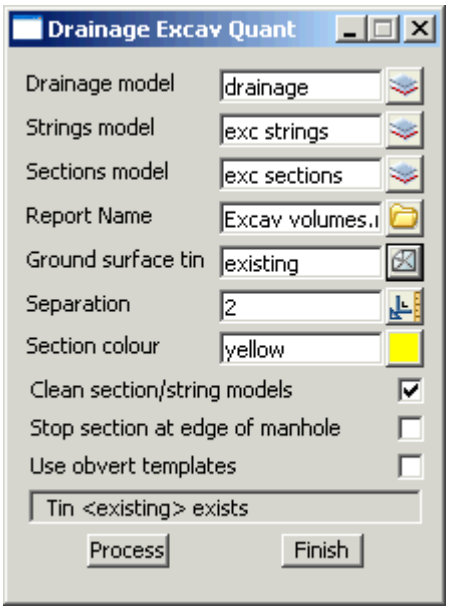
```
---------------------------- BEGIN APPLY TEMPLATE REPORT ----------------------------

 apply template to string report -

   string         E
   tin            design
   separation         10.000
   left template  375
   right template 375
   cut volumes and areas are negative
   fill volumes and areas are positive


chainage- ------sectional  information------  ------intermediate  information----    ---------accumulative  information-------
          ---------- ---cut area --fill area ------------ ----cut vol ---fill vol    -cut volume-- -fill volume- ---balance---


    0.000                -1.434       0.000                                              0.000         0.000         0.000
                                                             -0.771       0.000
    0.550                -1.367       0.000                                             -0.771         0.000        -0.771
                                                            -14.222       0.000
   10.000                -1.642       0.000                                            -14.992         0.000       -14.992
                                                            -15.293       0.000
   20.000                -1.416       0.000                                            -30.286         0.000       -30.286
                                                             -1.845       0.000
   21.313                -1.393       0.000                                            -32.130         0.000       -32.130
                                                             -0.794       0.000
   21.863                -1.493       0.000                                            -32.924         0.000       -32.924

total cut                        -32.924
total fill                         0.000
balance                          -32.924
ie excess of cut over fill        32.924


---------------------------- END APPLY TEMPLATE REPORT ----------------------------
```

If a tin is created from these strings then volumes by depth can be determined using **Design=>Volumes=>Exact=>Tin to tin**

Usage

Access this panel from the menu selection

Design => Drainage => Reports => Excavation Quantities



The fields and buttons used in this panel have the following functions.

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Field Description	Type	Defaults	Pop-Up

Drainage model input box

Model to contain all of the pit and pipe network to be worked on.

Strings model model box

Strings generated from the templates will be stored in this model

Sections model model box

Sections generated from the templates will be stored in this model

Report name input box

cut and fill volumes will ne sent to this report

Ground Surface Tin tin box

tins from which the volumes will be calculated

Separation real box

distance between the sections

Sections colour colour box

Sections generated from the templates will be assigned this colour (strings colours are defined in the templates)

Clean section/strings model tick box

Delete the strings in these models before processing.

Stop section at edge of pit tick box

Template are run from pit centre to centre if this is not selected. The templates stop at the edge of the pit if selected. This is often selected with the following option ***Use obvert templates.***

Use obvert templates tick box

Templates must be named with the prefix "obvert". i.e. ***obvert 300.*** *The template is still run along the invert of the pipe but the user now has a section "set" of templates that can be used to create a tin on top of the pipe as well as below.*

12.0 Network Quantities Report

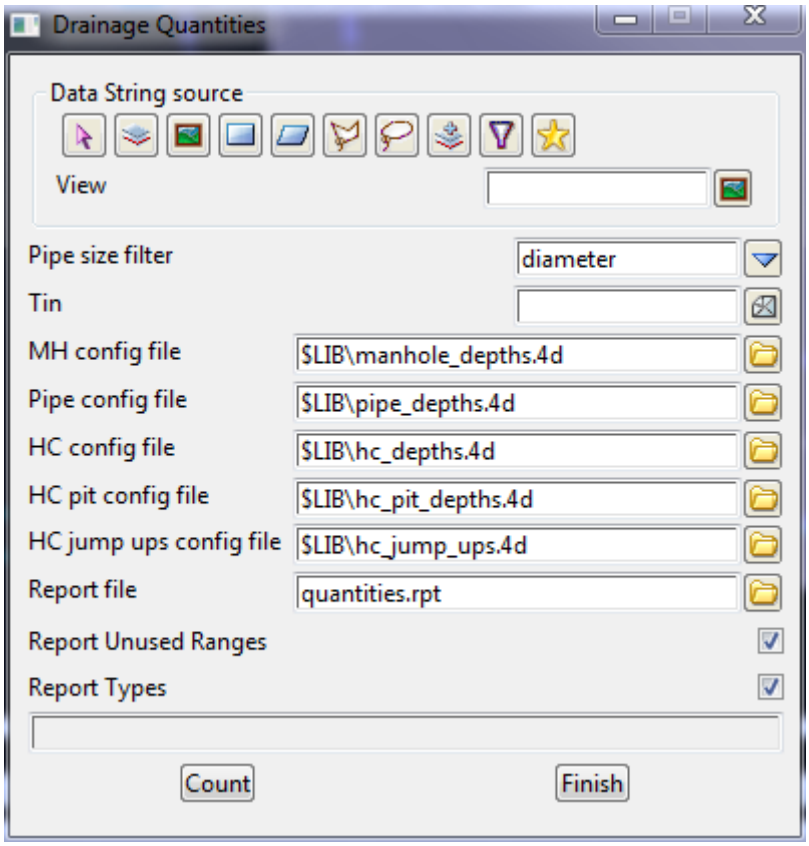
This panel is accessed from the menu selection

Design => Drainage Sewer => Reports=> Network Quantities

Key points

1. Items are counted/totalled by depth and optionally type.

1. The routine will not "double count" items even if the ranges overlap.
2. Types are case sensitive, types with spaces in the name must be enclosed in quotes and the wild card * may be used.
3. Use vertically offset tins and "banded" depth ranges to get quantities under roads, foot paths etc. This is discussed later in detail.
4. Erase count file fields if the items are not to be counted.



The fields and buttons used in this panel have the following functions.

Field Description	Type	Defaults	Pop-Up
Data String Source	Choice		

usually the entire model is selected but view is also available for combining models

Pipe size filter Choice diameter or pipe size attribute

*The second item in a count line is used to filter by **diameter** (in meters/ft) or the **pipe size attribute**. The **diameter** can only be used when no box culverts or trapazoidal channels are used. The **pipe size attribute** is the label genrally used in the plan plots. This is the pipe size in mm/inches (375), for box culverts width x height (750x375) and for trapazoidal channels TopwidthBottomwidthxHeight (T5000B1000x500).*

Tin tin box

This tin will be used for the pipe and pit depths.

MH config file file box

This file specifies the types and depth ranges for the pits. Details of this file are contained below.

Pipe config file file box

This file specifies the types and depth ranges for the pipes. Details of this file are contained below.

HC config file file box

This file specifies the types and depth ranges for the house connections. Details of this file are contained below.

HC pit config file file box

This file specifies the types and depth ranges for the HC pits. Details of this file are contained below.

HC jump ups file file box

This file specifies the types and depth ranges for the house connections jump ups. Details of this file are contained below.

Report file file box

a sample report file is given below.

Report unused ranges tick box

*the depth ranges for the pit/pipe/house connections are defined in the *.4d files. Selecting this option will cause the depth ranges in the file to be printed even if there are no pit/pipe/house connections in these depth ranges (zero quantity values will be shown).*

Report types tick box

*Selecting this option will cause the pit/pipe/house connection types used in the model types to be listed (even if quantities are not requested in the *.4d files). Since this is a complete of the type used in the model, the list informs the user what types have not been included in the quantity calculation.*

Count button

executes the option.

Finish button

removes the dialogue from the screen

The *.4d files listed above are contained in the 12d **library** directory. Each line is the file performs a count (count lines). No items are counted twice. Therefore, if an item is counted its type and then a count line is found the wild card is used for the type, the type already counted will not be included in the count.

The format for a count line is three or four values (space delimited) per line. Size is optional.

```
<type (from drainage.4d)>  <size> <starting depth>   <ending depth>
```

Notes:

All **types** with spaces in the name must be enclosed in quotes The wild card * may be used.

The **size** is optional and if omitted the all sizes will be counted in this group (do not use the * for a wild card).

The **starting depth** and **ending depth** are required for all count lines.

Quantities Under Roads and Footpaths

By creating super tins with vertically offset sections, quantities under roads, footpaths etc. can be determined. for example.

Offset your road design tin up by 1000m **(Tins->Utility->Translate/Copy)** and then use the depth range 1000-1999 for pipes under roads.

Create a tin from the footpaths only, null by angle length with a small length to remove the road and then offset it vertically by 2000m. the depth range 2000-2999 is not the quantities under the footpath.

Sample count lines

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```
// sum concrete cover manholes is various ranges

"CONC COVER" 0.0 1.6
"CONC COVER" 1.5 3.0
"CONC COVER" 3.0 999.9  // this is expected to be zero
"CONC COVER" -999.0 0.0 // trap errors

// any that are not Concrete cover will be counted here

* 0.0 1.6
* 1.6 3.0
* 3.0 999.9
```

```
Manhole Quantities
==================================


CONC COVER          0.00    1.60    13      16.506
CONC COVER          1.60    3.00     1       1.510
CONC COVER          3.00   999.9     0       0.000
CONC COVER        -999.0     0.0     0       0.000

*                   0.00    1.60     0       0.000
*                   1.60    3.00     0       0.000
*                   3.00   999.9     0       0.000

  total length = 18.016


  Types Used
  ----------

  CONC COVER

  Diameters Used
  ----------

  1.100
```

Since the **Report unused ranges** tick box was selected, these lines were printed even though there were no pits in the data ranges.

This data results from selecting the **Report types** tick box.

Sample count lines for pipes follow.

```
// sum class 2 pipes by diameter and for various ranges

// count 375

2 0.375 0.0 2.0
2 0.375 2.0 5.0
2 0.375 5.0 999.

// count 450

2 0.450 0.0 2.0
2 0.450 2.0 5.0
2 0.450 5.0 999.

// count 525

2 0.525 0.0 2.0
2 0.525 2.0 5.0
2 0.525 5.0 999.

// count pipe sizes that were missed

2 * 0.0 2.0
2 * 2.0 5.0
2 * 5.0 999.

// count all other missed pipes

* 0.0 999.
```

13.0 Exporting to Drainage Design Software Packages

12d contains most of the data required for your drainage design packages. However, each packages has specific design variables that 12d does not have access too. The design process is intended to export your data from 12d to the design package, design the drainage system and then read the results back into 12d for your long sections.

If pits/pipes are to be added/deleted from your network during the design process you are safest to add/delete the pit/pipe to 12d and to your design package separately.

Not recommended and as a poor alternative, you have the option of reading the results back into 12d, adding/deleting the pits/pipes and then exporting the data to a new drainage project in your drainage design software. **As 12d does not have access to all of the data in the design packages this method is not recommended!**

Some of the drainage design programs offer a third option that allows you to import data “on top of” an existing project thereby merging and over writing the existing data. Be sure to contact the drainage software supplier to obtain exact details of how the merging process is performed.

The interface is run by selecting **Import/Export** from the **Drainage Network Editor**

Design->Drainage-Sewer->Network Editor

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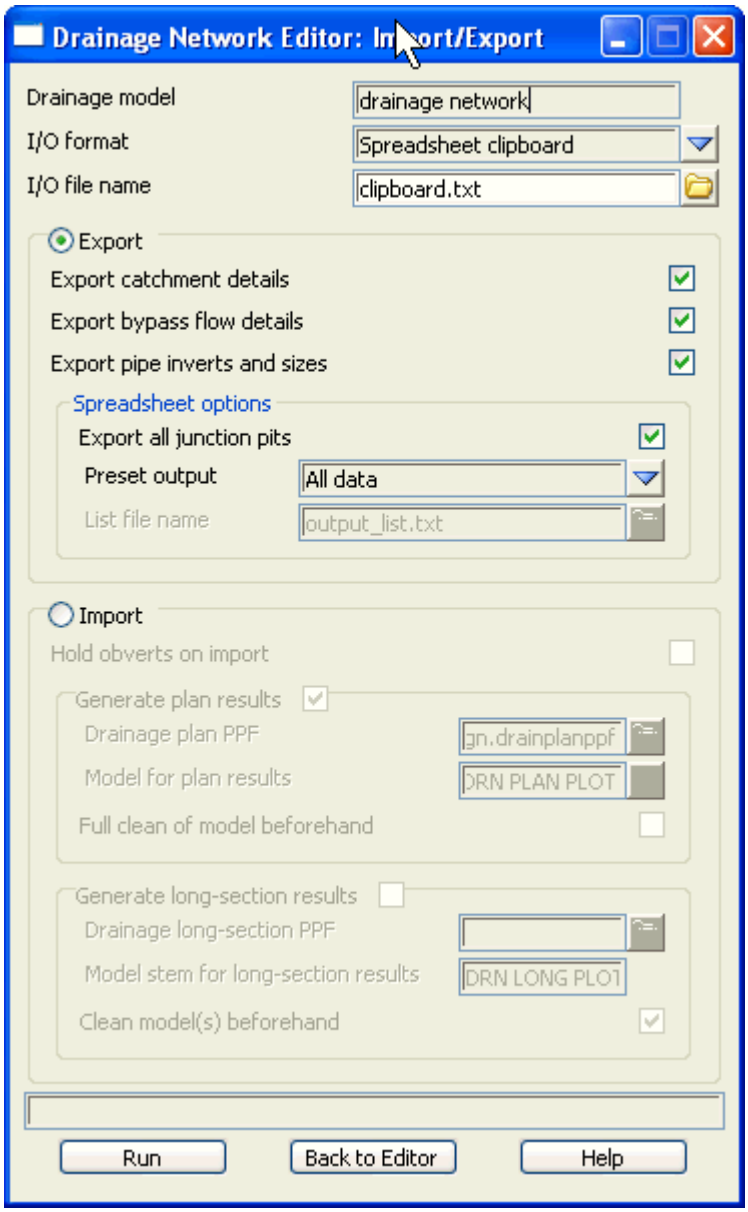


The **Drainage model** is the model currently being edited.

The **I/O format** selects which external program the 12d is interfacing with. Some programs use the windows clipboard and others use files. If the clipboard is used the data will also be written to a file by 12d in case you need to take the data to another computer.

Export enables the export fields below and exports when **Run** is selected.

The **Export options** have slightly different effects depending on the **I/O format** (program) selected above. Therefore they will be discussed later with the various formats.

Export pipe diameters and inverts is generally select for existing systems only. If your design program will set invert levels and pipe sizes then turn this tick box off for new systems.Some design programs will require initial inverts and pipe sizes. In this case this box should be selected on the first export.

Export default catchment/pit parameters is generally selected for the first export. For subsequent exports turn this selection off and then only the catchment areas (if the model is supplied above) will be exported.

14.0 Drainage Data Input and Output to Spreadsheets

Spreadsheets are an effective method to manage the numerous variables urban drainage designers create in the modelling process. Spreadsheet data can be transferred to and from 12d in tab delimited files and stored within 12d as “user definable attributes”. These attributes are linked to the pit and pipes within a network. Drainage long section plots can display the pipe attributes in the “arrows” data area and pit attributes in the bubbles area. Drainage plan drawing can also show these pit and pipe attributes.

Drainage strings will be created if they do not exist in the model but pits cannot be added to existing strings.

See also

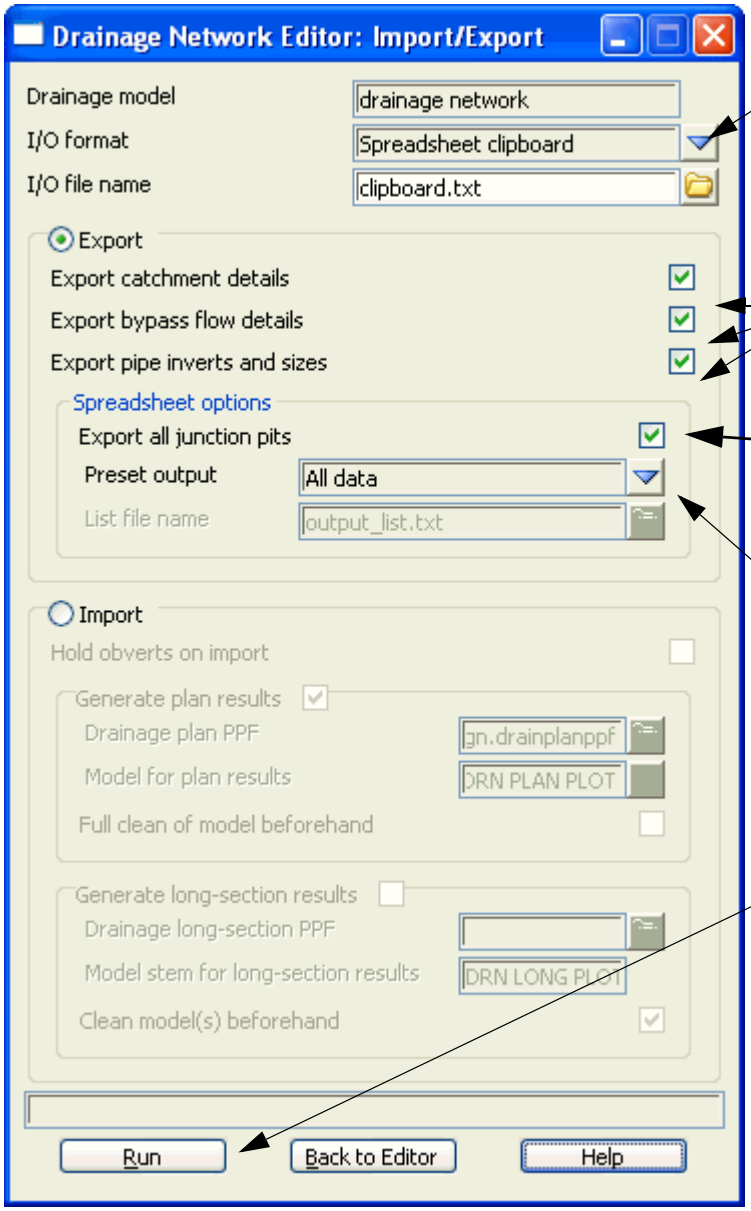
12d to spreadsheet transfers

Spreadsheet to 12d update and create

Spreadsheet options

14.1 12d to spreadsheet transfers

This interface is accessed the **Import/Export** button on the Drainage **Network Editor**.



Select **Spreadsheet clipboard**

These options are not used for spreadsheet export.

Usually leave this off! Select to export the junction pit at the end of all drainage lines (very rarely needed).

You may also select to limit the output if desired. If you like using spreadsheets for data entry, the PCdrain data and ILSAX data formats are useful for adding data for the first time for either program.

Select **Run** to place the data on the clipboard.

14.1.1 Options

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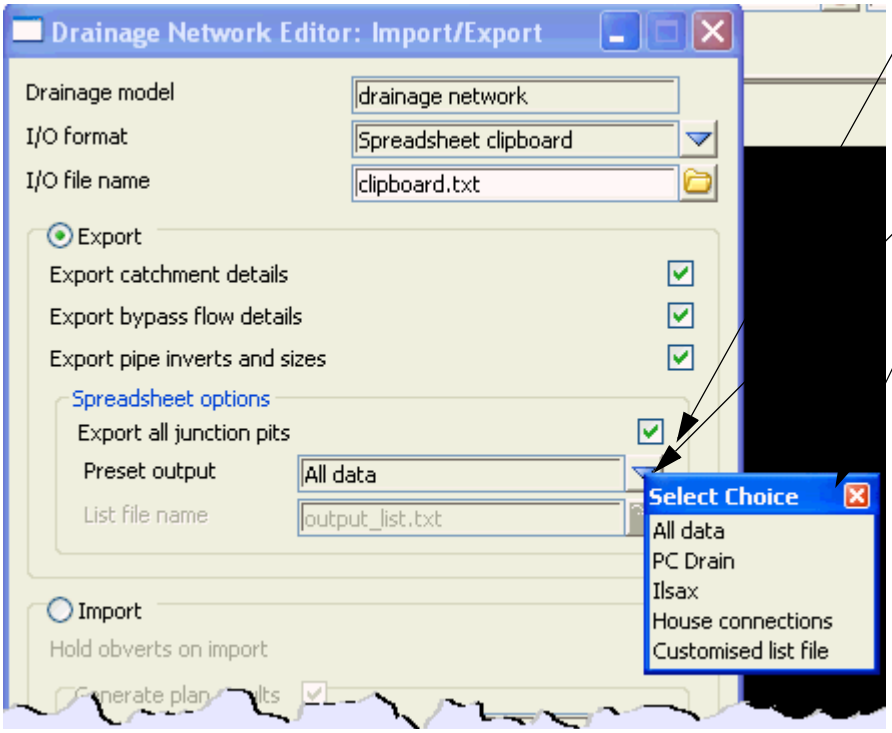
The **Spreadsheet Options** section allows the user to define the amount of data exported.



Export all junction pits when selected will repeat the data for the junction pit at the end of each branch line.

Preset Output this choice box offers the following choices:

All Data: All of the 12d drainage string data and the user defined attributes will be exported to the clipboard in a tab delimited format. The 12d data names and the user defined attribute names will appear at the top of the spreadsheets columns.

ILSAX: For the ILSAX program, the spreadsheet column headings will change depending on the pipe and catchment indicators (P2 card) and the inlet type (P3 card). Therefore, use the ILSAX pipe editor macro to set up one pit/catchment for the type of data you wish to enter. Now when you export the pipe network data the column headings will include the names of the relevant parameters.

User defined below: The **Customised list file name** is used to define the drainage values, their order and format you desire.

The **customised list file** is a text file where each line contains a drainage variable or a spreadsheet IO command (blank lines are ignored unless preceded by the header command). The spreadsheet IO commands are all lower case and listed below:

header	to define a line of text to be exported
blank	to leave a blank column in the output
pit data	the following attributes are for the pit.
downstream pit data	the following attributes are for the downstream pit.
upstream pit data	the following attributes are for the upstream pit(s).
pipe data	the following attributes are for the pit's outlet pipe
downstream pipe data	the following attributes are for the downstream pipe(s)
upstream pipe data	the following attributes are for the upstream pipe(s)
variable name	a 12d drainage variable names
factor	the following variable is multiplied by this factor
decimals	the following variable will export with these decimal places

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The simplest way to create your own customised tab delimited file is to set the **Preset Output** field to **All data** and leave the **customised list file name** field blank. Selecting **Set**, **Finish** and then **Copy** from the main dialogue. The data will be placed on the clipboard and a **customised list file**, named **output_list.txt** will be created containing the names of all of the drainage variables in the 12d model. Use a text editor to add/or delete the variable names, change their order and/or add spreadsheet IO commands. **Save the file with a new name!** The **output_list.txt** file is overwritten on every export.

A listing of a customised list file follows. Note the words in the header file have a “tab” between them so that they will be spaces across the spreadsheet columns.

```
header
Pipe Details
    header
    Name Length   U/S IL   D/S IL   Slope(%)   Class   Dia I.D.   Rough   Pipe Is   No. Pipes

    pit data
    *pit name

    pipe data
    *length
    low ch invert
    high ch invert

    factor
    100
    *grade

    pipe type

    factor
    1000
    diameter
```

After creating your customised list file, select **Options** again and change the **Preset Output** field to **User Defined below** and enter the new **customised list file** name that you saved above. Select **Set** then **Finish** and finally **Copy** to put the formatted data onto the clipboard.

The data can be pasted into a spreadsheet program for checking or additional formatting.

CUSTOM FORMATED DATA MIGHT NOT BE PASTED BACK INTO 12d!

The data must be in the “12d drainage spreadsheet” format to be read into 12d.

Caution with pit names in the form 1-1 or 1/1. Some spreadsheets will interpret these values as dates. If you use these formats for your pit names you will have to paste command them in once, format the columns that contain the pits names as text data and then paste the information in again.

One final word on using the copy/paste commands in the Microsoft Excel program. The Paste Special command using the “Skip Blanks” option will allow you to copy a large block of 12d data (with blanks in it) on top your data so that your data is preserved where it coincides with the blanks. To use this option paste the data into a blank spreadsheet and then select copy again. The Paste special option with “Skip Blanks” will now be available.

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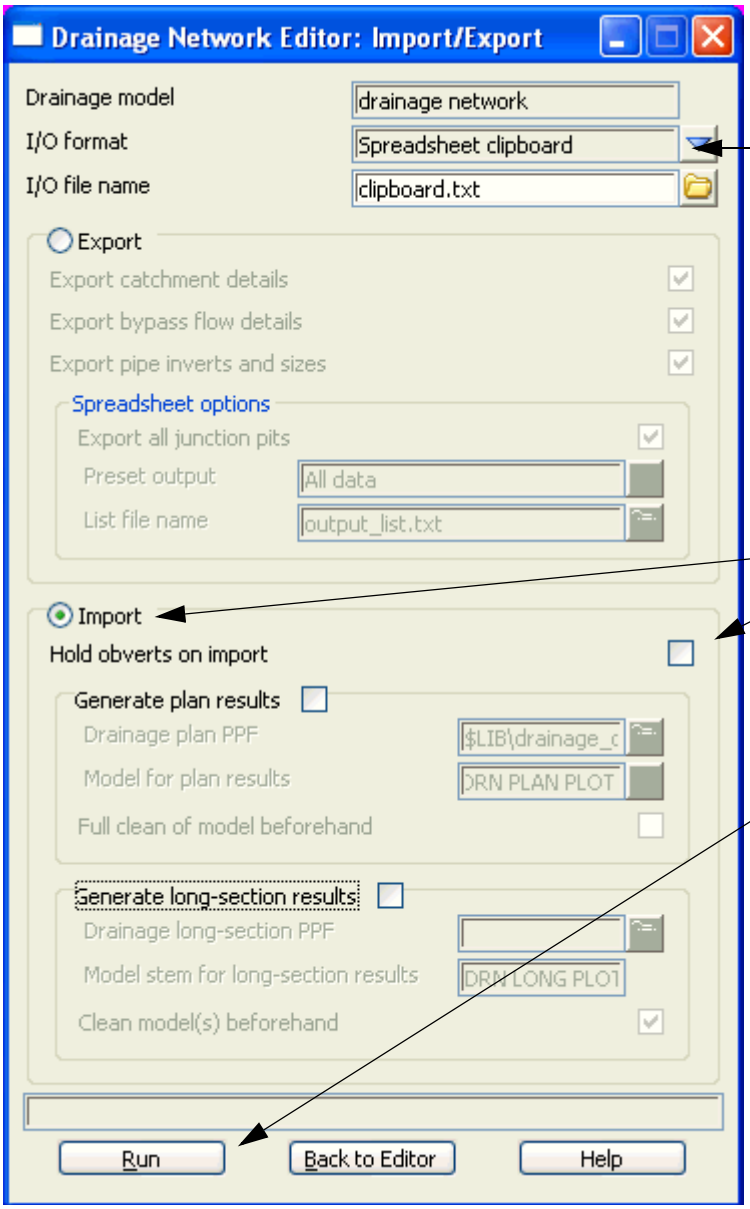
14.1.2 Spreadsheet to 12d transfers

This item is accessed from the **Import/Export** button on the **Drainage Network Editor**.

The following panel will appear.



Select the **Spreadsheet clipboard** format.

Select **Import**

This is ignored on spreadsheet imports.

Select **Run** to update the drainage model.

Tab delimited, “12d drainage spreadsheet” format or “from to” format data must be on the clip-board in order to update a 12d drainage model or create a new model. These format are described below.

14.1.3 Updating an Existing Model

The data usually is generated by 12d using the **Export** option, pasted into a spreadsheet and then copied back to the clipboard so that 12d can be updated.

When 12d exports the drainage model to a spreadsheet it includes a column for the unique string

identifier and a unique pit identifier (unique to the drainage model not the 12d project). The names of the strings and pits may be changed via the spreadsheet if these columns are present at import time.

If the pit id column is not present, 12d will search the drainage model for a matching pit name. When the pit is a junction between drainage lines, only the trunk line will be the data updated.

14.1.4 Creating a New Model

It is possible to create a new string or an entire drainage network using this format. However, pits cannot be added to an existing string. The entire drainage string must be created at once. Two formats are available, the “from-to pit” format and the “12d drainage spreadsheet” format.

At present the network editor must select a drainage string to become active. Therefore, if you are not adding strings to a network, you will have to great a drainage network with one “dummy” pit. Select this one “dummy” pit to activate the editor. After importing the data and the new drainage lines are created the “dummy” pit may be deleted.

12d drainage spreadsheet Format

The top left cell in the clipboard data must be the text “12d” to specify this format. The minimum amount of data required to create a new string is the string name, pit name, x and y coordinates. You can add as much additional data as you have available. This would include pipe diameters inverts etc. The pits must be listed from upstream to downstream order. If the string is to join a trunk line, the junction pit must be included for both the tributary and the trunk line.

An example file exists called **new_network.txt** is supplied in the library. Open this file in a spreadsheet or a text editor and copy it to the clipboard. Set the **I/O Action** to **Import** and select **Run**. The new drainage lines will exist in the model currently being edited.

From-to Pit Format

The top left cell in the clipboard data must be the text “from to” to specify this format. The minimum amount of data required to create a new string is the upstream pit name "*pit name), the downstream pit name (*ds pit name) and the x(x location) and y(y location) coordinates of the upstream pit. If the string is to join a trunk line, the junction pit must be included for both the tributary and the trunk line.

An optional column for the pit cover elev (cover elev) may be specified. Once the network has been created additional pipe and pit data may be added using the “12d drainage spreadsheet” format described above.

An example file exists called **new_from_to_network.txt** is supplied in the library. It is shown below. Open this file in a spreadsheet or a text editor and copy it to the clipboard. Enter a new model name in the **Drainage model** field and select paste. The new drainage model will now exist.

from to	pit	pit	pit	pit
*pit name	*ds pit name	x location	y location	cover elev
text	text	real	real	real
E/1	A/3	5309.458	7336.935993	29.2173
D/1	A/4	5277.189	7336.935989	28.5071
C/1	B/3	5251.238738	7423.99485	31.5257
A/1	A/2	5354.629222	7336.935998	30.2115
A/2	A/3	5340.019987	7322.035996	29.89
A/3	A/4	5293.458002	7322.035991	28.8652
A/4	A/5	5250.182625	7322.035986	27.9127
A/5	A/6	5217.194202	7322.035983	27.1867
A/6	A/7	5183.458002	7322.035979	26.4442
A/7		5152.698693	7322.035975	25.7672
B/1	B/2	5289.42875	7422.289079	32.7197
B/2	B/3	5264.638564	7393.947083	30.7948
B/3	B/4	5249.738564	7384.207593	30.4187
B/4	B/5	5249.738564	7351.201545	29.1444
B/5	A/5	5233.426685	7336.935984	27.544

14.2 “12d drainage spreadsheet” Format

Each column of data is used for a 12d drainage variable or a user defined attribute. Each row represents a pit and the downstream pipe (controlled by the direction of flow variable) within the drainage network. A sample is shown below.

12d	pit	pit	pit	pit	pit	pit
*string Name	*pit name	pit type	pit low ch invert	pit high ch invert	pit id	string id
text	text	text	real	real	integer	integer
E	E/1	SA2	28.108	28.108	1	67389
E	A/3	SA2	27.7559	27.7559	2	67389
D	D/1	SA2	27.3961	27.3961	3	68100
D	A/4	SA2	26.8018	26.8018	4	68100
C	C/1	SA2	30.67	30.67	5	72072
C	B/3	SA2	29.563	29.563	6	72072
A	A/1	SA2	29.1026	29.1026	7	82469
A	A/2	SA2	28.7811	28.7311	8	82469
A	A/3	SA2	27.7652	27.7059	9	82469
A	A/4	SA2	26.8127	26.7518	10	82469
A	A/5	SA2	26.0867	26.0244	11	82469
A	A/6	SA2	25.3442	25.2942	12	82469
A	A/7	SA2	24.6672	24.6672	13	82469
B	B/1	SA2	31.2759	31.2759	14	192066
B	B/2	SA2	29.351	29.301	15	192066
B	B/3	SA2	29.123	29.073	16	192066
B	B/4	SA2	28.0444	27.8951	17	192066
B	B/5	SA2	26.3447	26.2947	18	192066
B	A/5	SA2	26.0744	26.0744	19	192066

Duplicate Definitions

Strings Variables such as “direction” are may be defined for numerous pits on the same string. Searching in a top down direction through the file, the last definition found for the string will be set.

Invert levels may be set via pipe data or pit data or combined. It is recommended that the user only use one method and not combine them. Both are exported so delete the ones you are not going to use. The variables are processed from left to right, so if duplicate definitions of an invert level or found the right most data will be set.

The format definition

1. Row1, column 1 must contain either “12d”, or “from to”. Therefore, the first column must be a 12d drainage variable (cannot be a user defined attribute).
2. Row 1. The text <pit> at the top of the column indicates the column contains a user defined pit attribute and similarly <pipe> indicates a user defined pipe attribute.
3. Row 2. This row contains the names of the 12d drainage variable names and the pit/pipe attributes. All names are case sensitive so be careful where you use capital letters. A list of 12d drainage variables is found below.

   Names beginning with an asterix (*) will not be processed (except pit/string names when unique identifiers are present in the data). 12d drainage variables names beginning with an asterix indicate that this data was calculated at export time and cannot be read back into 12d (for example, pipe length, pipe grade and deflection angle).

Prefixing an user defined attribute name with “DELETE ” (no quotes, note the space after the DELETE) will cause the attribute to be deleted from all pits/pipes within the model.

4. Row 3. The text in this row define the type of attribute to be stored within 12d. The only valid choices are;

   integer
   real
   text

   If you want to change an attribute type you must delete the attribute and create it again. If you simply change the attribute type in the third row then that attribute will not be updated.

5. Blank lines may be inserted as desired.

6. You are not required to fill in all of the cells in the spreadsheets. Blank cells are ignored (you must use a space to remove all data from text attributes (the space will not be stored).

7. Pipe names are included in the data so that they can be changed but they are **not** used to identify the pipe. Pipe data will always be assigned to the pipe following the pit in the direction of **ascending** chainage. If flow directions is ascending then the pipe data will be for the downstream pipe. If the flow direction is descending then the pipe data will apply to the upstream pipe.

14.3 12d Drainage Variable Names

Manhole Variables	Pipe Variables	String Variables
*string Name	pipe name	direction
*pit name	pipe type	
pit type	low ch invert	
pit diameter	high ch invert	string id
pit low ch invert	diameter	
pit high ch invert	*length	
pit road chainage	*grade	
pit road name	low hgl	
*pit angle	high hgl	
*pit drop	pit hgl	
*pit depth	flow	
*pit chainage	velocity	
x location		
y location		
cover elev		
*fs elev		
*ns elev		
pit id		

COURSE NOTES

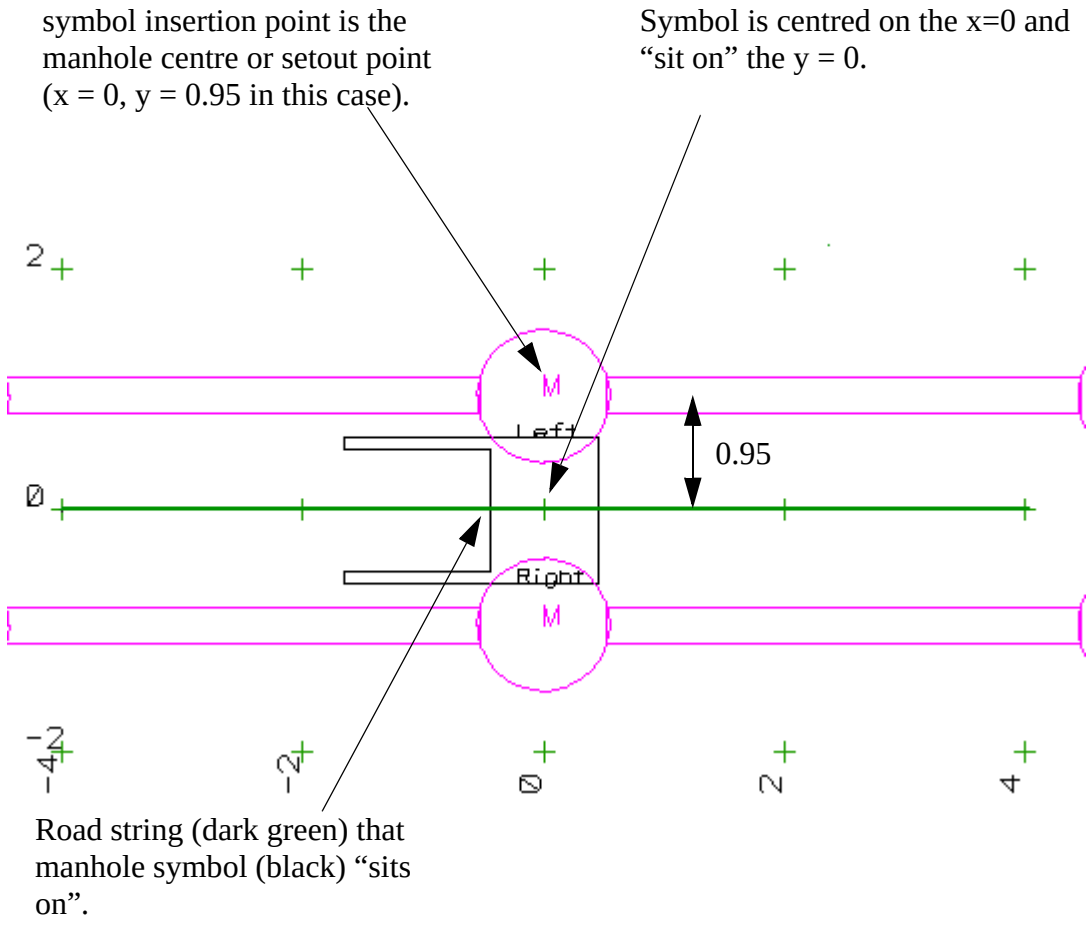
STORMWATER DESIGN - Part 2

15.0 Detailed Drainage Plan Drawing - Creating MH Symbols

There are many methods to create the drainage symbols and one is presented here. The pit symbol is drawn so that the symbol "sits on" the road string that it aligns with (the road string is the y reference). For drawing lintels and grates, assume the road is downhill to the right. See diagram below.

Two symbols are required, one for the left side of the road and one for the right side (referred to as the mirror symbol in the plan ppf). 12d checks the downhill direction of the road strings when using these symbols to determine which is the left and right side of the road.

Either draw your own symbol or import the symbols using **File IO->Data Input->4ds/12da data** and selecting the file **inlet symbols.12da**



To create the symbol in 12d draw the left pit symbol in a model by itself. The pit should "sit on" the zero "y" grid line. A 900 wide by 600 long inlet with a 1.2m lintel is shown above.

From the main menu, select

Project->Tree

Expand **Project** then expand **Symbols** and finally select **Create Symbol**.

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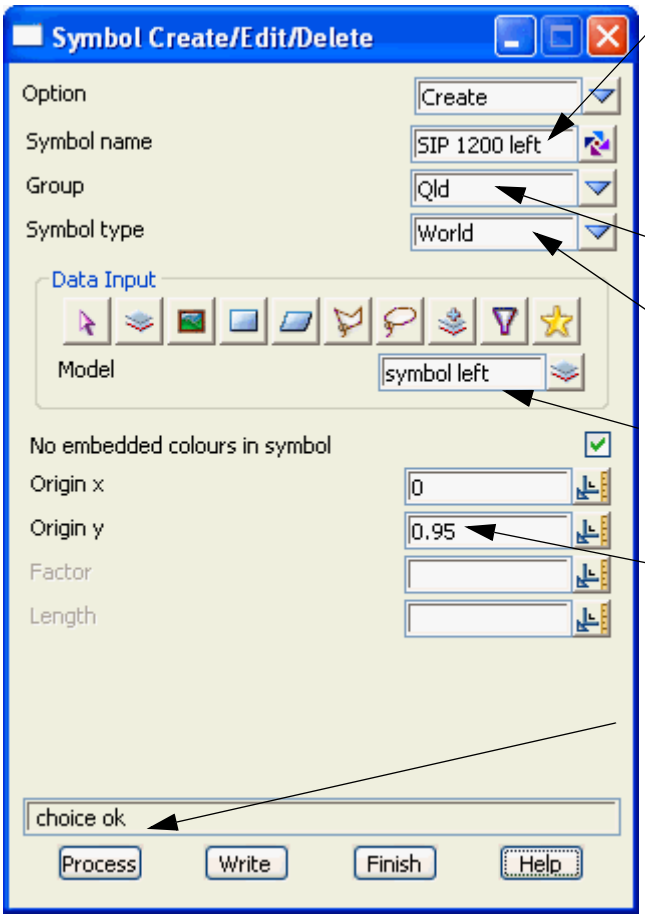


Enter the **Symbol Name**. Usually the name includes the size.

Select the **Group** the symbol is to appear in the symbol drop down menu and select **World** as the symbol type.

Select the **model** that contains the manhole drawing.

Enter the x,y location of the manhole centre in your drawing (0 is different then

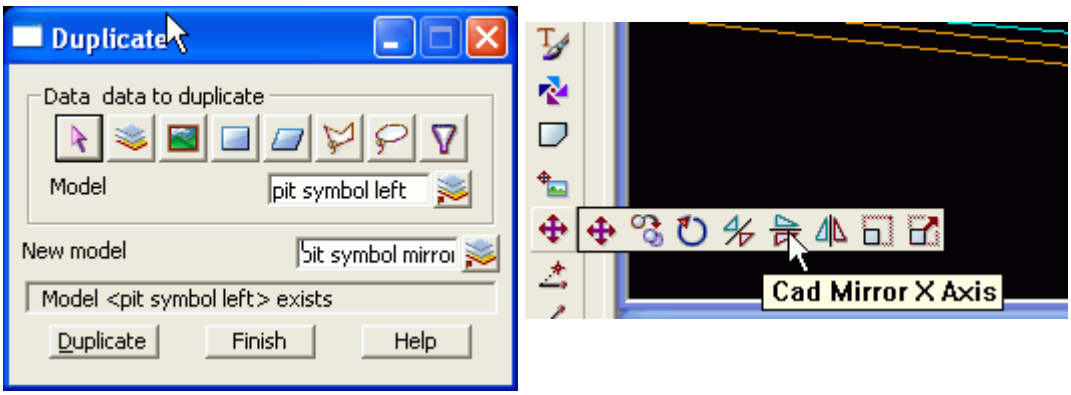
Process will create the symbol in the project.

Change the **symbol name**, **origin y** and

Write will add the new symbols to the symbols.4d file so that they will be available to other projects.

Leave this panel open as we will need it after we create the mirror image of the pit.

To create the mirror image of the symbol about the x axis use the CAD mirror about X axis command. 12d will require you do this one string at a time. Version 7 does not mirror into a new model so you will want to duplicate the pit symbol model first using **Utilities->A-G->Duplicate.**



Now repeat the process of creating the right side mirrored symbol. Note that the location of the pit

centre is now **negative** and add the suffix **mirrored** to the symbol name.

Do not forget to select **Write** again to save the symbols to the symbols.4d file.

These symbols can now be used in the **Maintenance hole** tab of the Drainage Plan Plot ppf editor. If your version of 12d supports, **native-size symbol**, in the ppf editor then use this mode. If not, select scalable symbol and enter the size equal to the full width of the symbol (height if it is greater).

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STORMWATER DESIGN - Part 2

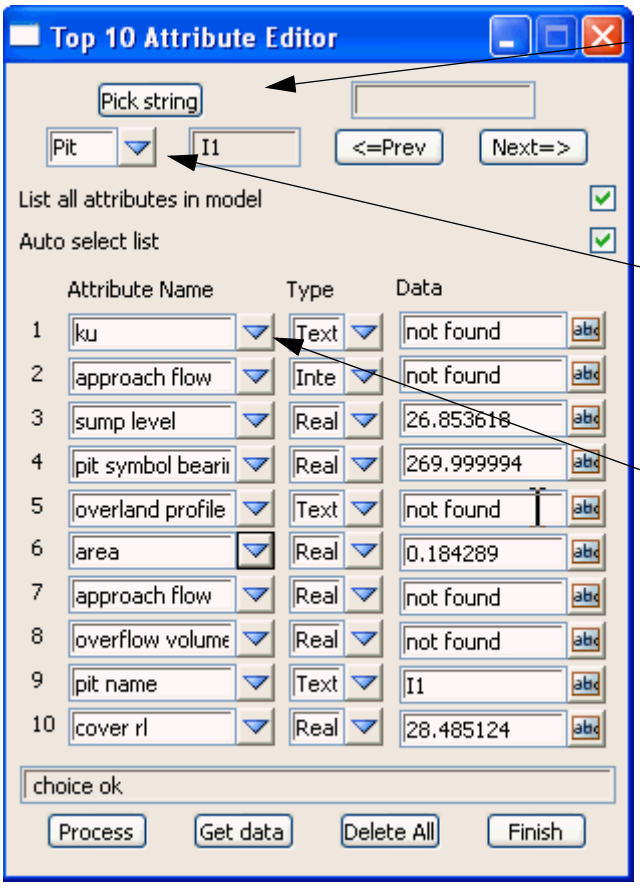
16.0 User Defined Attributes

These drainage attributes are automatically created by 12d when required but you are free to change them or add more as desired. The attributes may be exported to a spreadsheet and edited and then imported back into 12d. To edit/add the user defined attributes within 12d select either

Strings=>Properties=>Attributes or

Strings=>User=>Attribute Editor. This second editor is described below.

.



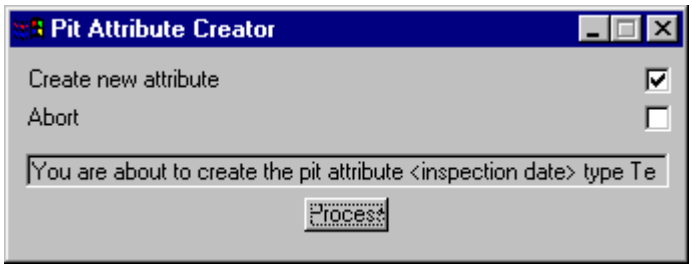
First **S**elect **Pick** to select the string that contains the user attributes (the drainage string). The strings will be highlighted in white when they are selected.

All catchment data is store with the pits in drainage strings. To access the pit attributes, select the drop down icon and then select **pit**. A circle will be drawn around the pit selected. **Next** and **Prev** will now move you from pit to pit.

Select the drop down icon and then select the **Attribute Name** from the list of existing user defined attributes. These attributes include all of the attributes in the model that the string exists in.

They may not be defined for the pit you are editing. **Not found** will be displayed in the **Data** field if the pit does not have that attribute defined.

To change the value for the attribute enter the new value in the **data** field. If the attribute does not exist, deleting the **not found** text and adding data will create it. The message on the right will be displayed whenever you are creating a new attribute.



16.1 Drainage Pit attributes

Pit attributes are created and/or updated when the user selects **Set Pit Details.**

pit length	real	0	mhsize (first value) from drainage.4d file
pit width	real	0	mhsize (second value) from drainage.4d file
pit group	text		mhgroup from drainage.4d file
cover rl	real	446.685248	
grate level	real	446.685248	
setout z	real	446.685248	
setout x	real	299643.648	
setout y	real	6563620.716	
setout distance	real	0	
pit name	text	1-3	
pit type	text	SA2	
pit diameter	real	1.1	
pit chainage	real	118.61441375	
pit centre x	real	299643.648	
pit centre y	real	6563620.716	
pit centre fs level	real	446.685248	
pit centre ns level	real	446.685248	
ds invert	real	445.307	upstream invert level of exit pipe
ds pit	text	1-2	ds pit along the pipe network
sump level	real	445.307	
pit depth	real	1.378	

Extra Atttributes from Pit - Main Tab

cover rl mode	integer	1
design freeboard	real	0.4
direct flow	real	0.02
grate rl mode	integer	1
inlet type	integer	0
ku	real	0.2
ku config	integer	1
ku method	integer	1
kw	real	0.22
sump offset	real	-0.2

Extra Attributes from Pit-Setout Tab

road chainage	real	10
road chainage mode	integer	2
road name	text	My Road
road offset	real	12

setout adjustment	real	-1
setout adjustment z	real	0.045
setout xy mode	integer	0
setout z mode	integer	8

Extra Attributes from Pit-Bypass Tab

bypass pit	text	12.4P
choke major	real	0.8
choke minor	real	0.7
choke pog major	real	0.8
choke pog minor	real	0.7
inlet capacity curve	text	Sutherland - 3% crossfall
manual pit grade	integer	1
manual pit xfall	integer	1
pit grade	real	1
pit xfall	real	3

Extra Attributes from Pit-Notes Tab

reamrks	text	constructed by others

Setout string selected

design model id	uid	52	
design string id	uid	61	
pit symbol angle	real	81.48609728	
pit symbol bearing	real	8.51390272	
pit symbol bearing dms	text	8°30'50"	
pit grade	real	4.00	if bypass pit present

Centre line string selected (with bypass and setout)

pit xfall	real	3.00	if bypass pit present
centre model id	uid	52	
centre string id	uid	92	
mirror pit	integer	1	mirror symbol required for plotting

Bypass Pit entered

bypass pit	text	1-2	next pit along bypass string
inlet type	integer	1	
choke major	real	0.8	ongrade or sag choke (see sag setting)
choke minor	real	1	ongrade or sag choke (see sag setting)
inlet capacity curve	text	SA2 3% Grade	
			calculate if pit grade and/or pit xfall present

			(pit type - inlet cap curves determines which are required)
pit grade	real	4.00	if setout string selected
pit xfall	real	3.00	if centre line string selected

The following require the bypass string (manual entry of bypass pit is not enough).

bypass distance	real	33.995	distance to bypass pit
gutter length	real	99.79	dist. up the bypass string to next pit or end of string (longest bypass route if multiple)
gutter grade	real	2.70	(us pit fs levels - ds pit fs levels) / gutter length)

Catchment Tab data

area	real	0.1
percent imperviousreal		60

Pervious Area only

c major pervious	real	0.9
c minor pervious	real	0.8

For both pervious and impervious (change pervious to impervious)

catchment grade perviousreal		1
catchment length perviousreal		900
catchment roughness perviousreal		0.1
tc major perviousreal		5
tc method pervioustext		Kinematic Wave
tc method pervioustext		Direct
tc minor perviousreal		5

Export Pit Atttributes (calculated when Export selected on Import/Export button))

inlet type	integer	updated to include 5 for headwalls
ds pit string id	uid	drainage string id for the ds pit
ds pit index	integer	index number of the ds pit (counter along the string)
area impervious	real	%impervious * area for set 1
area pervious	real	%pervious * area for set 1
area impervious2	real	%impervious * area for set 2
area pervious2	real	%pervious * area for set 2
area impervious3	real	%impervious * area for set 3
area pervious3	real	%pervious * area for set 3
pcdrain pit type	type	pit type with the pcdrain suffix (S + pond depth)

Export Pipe Atttributes (calculated when Export selected on Import/Export button))

locked diameter	real	pipe diameter (exists only if pipe locked)
locked invert us	real	pipe us invert (exists only if us invert locked)
locked invert ds	real	pipe ds invert (exists only if ds invert locked)
windes diameter	real	if pipe type is WINDES, value is neg diameter
roughness n	real	if “roughness type” is Manning then roughness value otherwise it is 0
roughness k	real	if “roughness type” is Colebrook then roughness value otherwise it is 0

16.2 Drainage Pipe attributes

Set Pit Details

invert us	real	28.47
invert ds	real	28.422
diameter	real	0.225
pipe size	text	225
pipe type	text	2
roughness text	text	n=0.010
calculated pipe length	real	9.58175349
calculated pipe grade	real	0.50095215
calculated pipe grade 1 in	real	199.6198644
calculated us deflection	real	71.75414547
calculated ds deflection	real	-36.3032794
pipe name	text	12.5P to 12.4P
minimum cover	real	1.04113728
calculated drop	real	0.03

Additional Pipe Attributes created via Pipe Tab setting

design alignment mode	integer	0
design cover	real	0.4
design cover mode	integer	0
design drop	real	0.03
design grade	real	0.1
design size mode	integer	0
diameter	real	0.225
direct pipe flow	real	0.01
lock ds il	integer	1
lock size	integer	1
lock us il	integer	1

max height	real	0.6
min height	real	0.3
remarks	text	extra pipe notes
roughness	real	0.012
roughness type	text	Manning
width	real	0.225
width top	real	6

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17.0 Detailed Drainage Plan Drawing

12d drainage has the capability to create detailed drainage plan drawings with the following features:

screate symbols at the inlets and the type of symbol is controlled by the inlet type (given when you create the inlet).

screate text labels for inlet types and user defined pit attributes

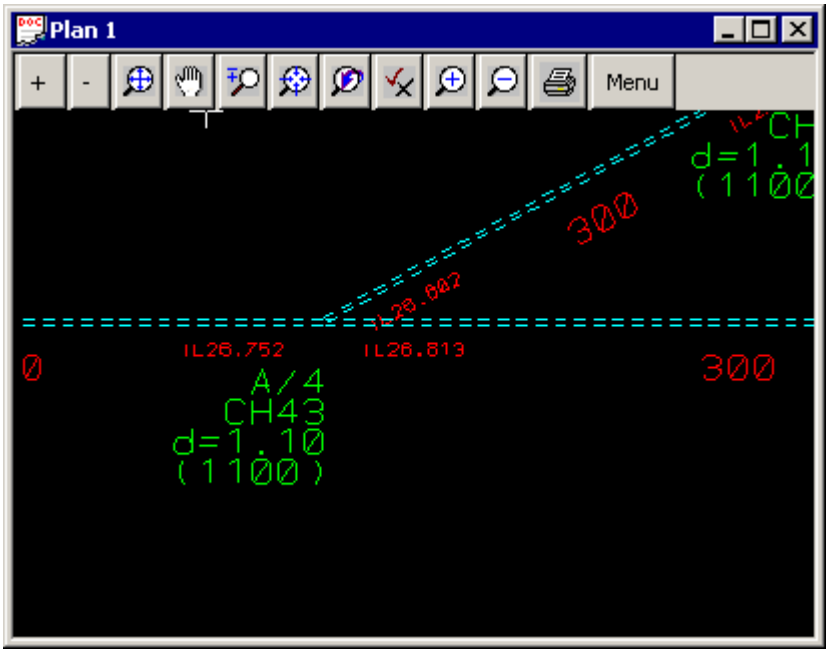
sdraw lines with line styles and colours to represent pipe sizes

screate text labels for pipe diameters, inverts and user defined pipe attributes

screate text labels for house connection types, invert levels and chainages

sindicate direction of flow on pipes.

An example is shown below



Usage

This option is accessed from the menu selection

Design => Drainage-Sewer => Plots => Plan Annotations

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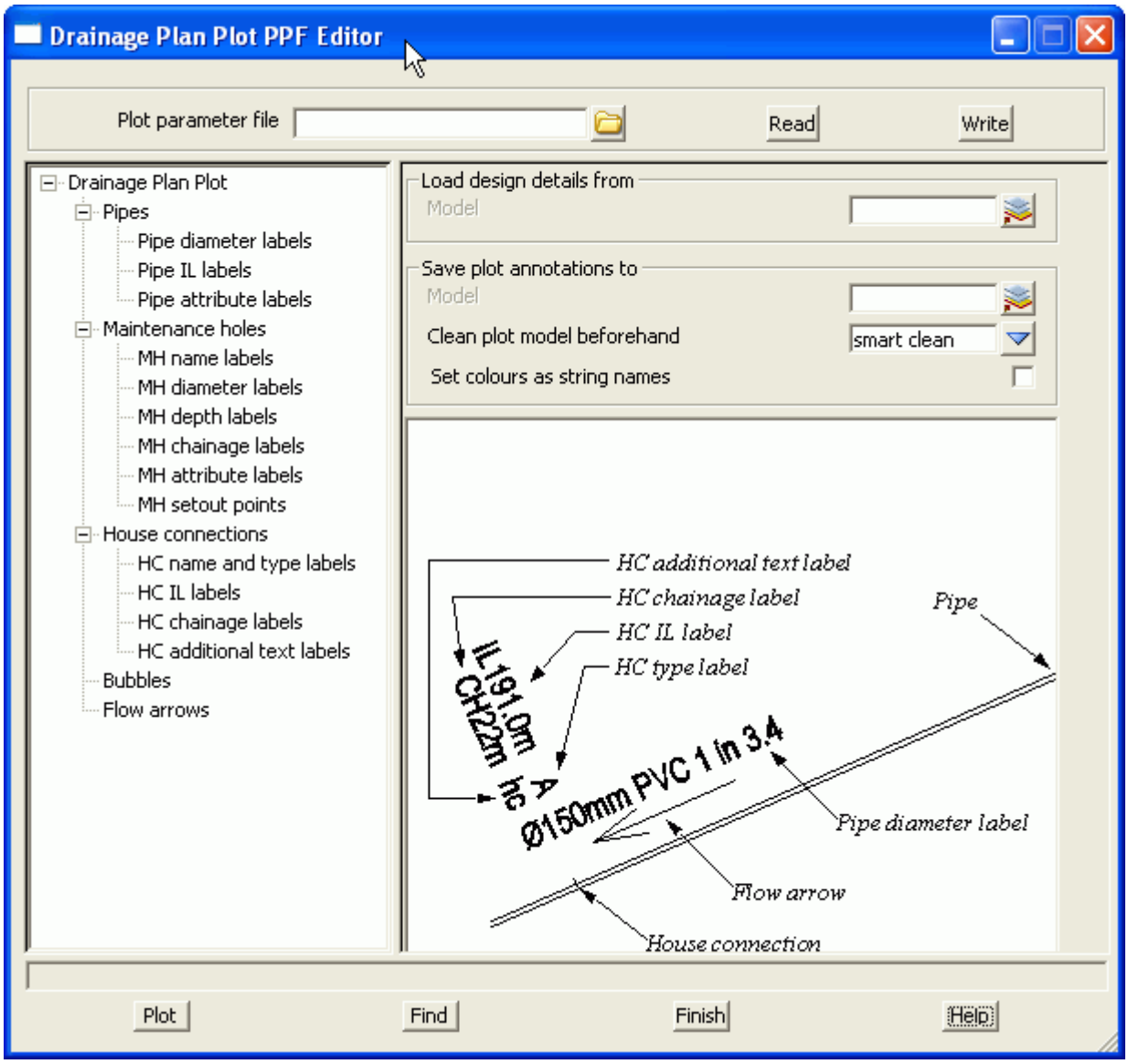


The fields and buttons used in this panel have the following functions.

Field Description	Type	Defaults	Pop-Up

Plot parameter file file box

Optional - no dpf is required. The default settings will create a schematic drainage drawing. A custom dpf may be selected if desired.

Load design details from model box

data source for drainage strings to be labelled

Save plot annotations to modelmodel box

labels to be created are stored here, Undo will remove the labels created

Clean plot model before hand choice box

smart clean will update text that has been moved and clean the rest. Full clean will all text from the plan annotations model.

Set colour as string name tick box

when selected the string colour will be used for the string name (to be used for DWG/DXF export using map files)

Plot button

Creates the labels in the model specified

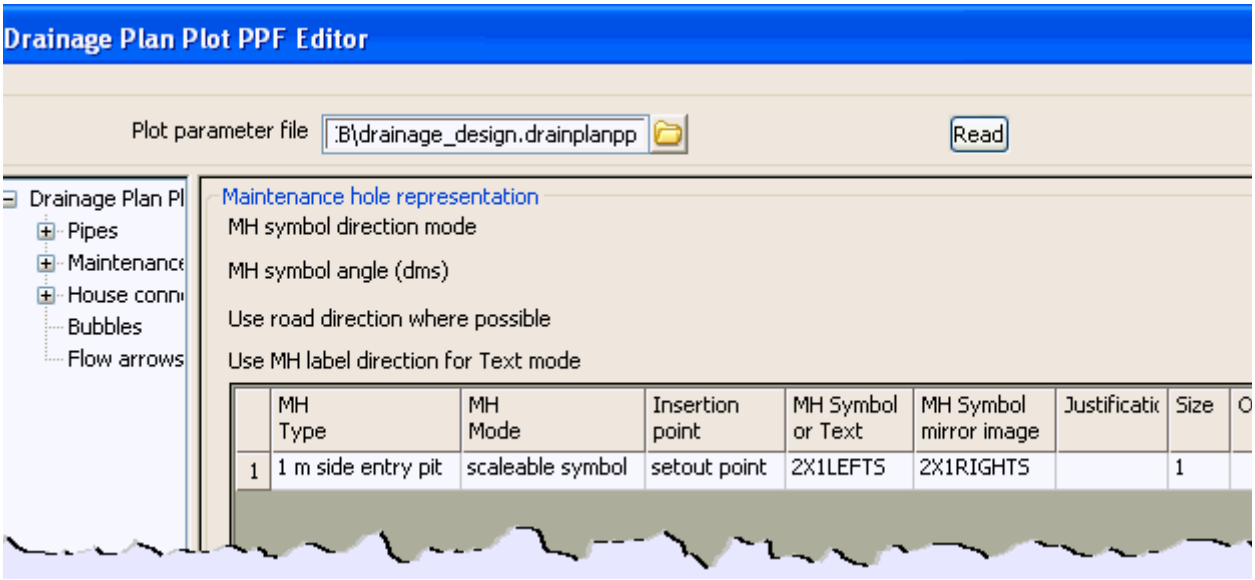
Find button

used to locate plot parameter input boxes using Version 5 plot parameter names

IMPORTANT! to turn off any data change the text height to zero.

Select **Maintenance holes** from the tree to set the symbols to be used for the various pit types.

Select the MH type as desired and use **scalable symbol** and **setout point**. For the symbols enter the names that you used when you created the symbols.



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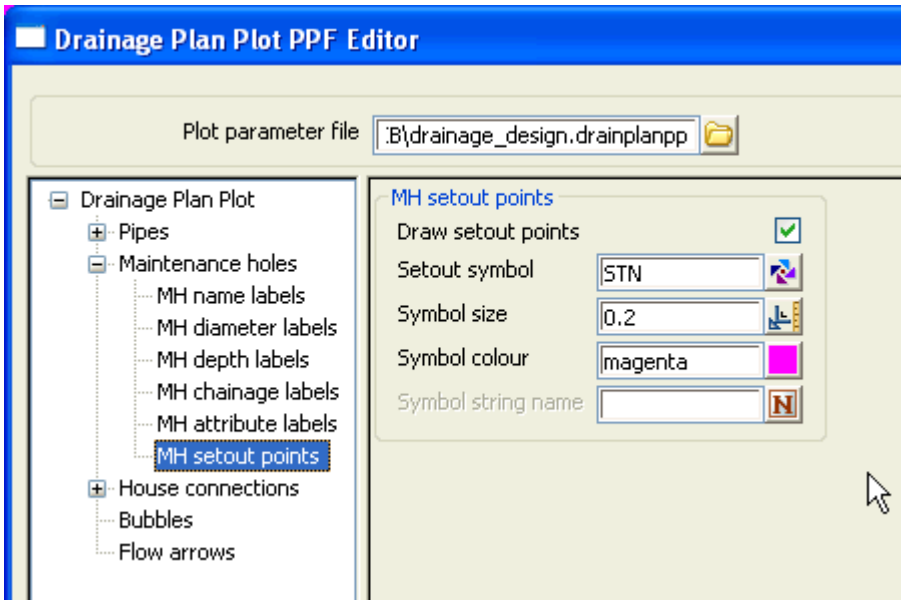

Plotting a symbol at the pit setout point is a good confirmation of the data printed in the setout reports. The settings to create this symbol are shown on the left.

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18.0 Drainage Long Section Plotting - Hatching Under Roads

The drainage long section plotting has been discussed in the Intro Drainage Course. Here we will discuss the technique for hatching under roads and/or footpaths.

The following steps are required.

1. Run the Excavation volumes routine using the obvert templates to create sections and strings for a tin on top of the pipe (obvert tin). Select **Stop section at end of manhole** to prevent the pits from being hatched
2. Create the obvert tin from the strings and sections then and null by angle length with a small length value so that the tin is nulled near the pits.
3. Create a design tin that extends to the limit of the roads.
4. Use the hatching section of the drainage long section plot to select the hatching style.

18.1 Creating the Obvert strings.

Run the Drainage Plan Plot by selecting Plot from the Drainage Network Editor.

Select the drainage_design ppf file from the library.

Select the folder icon then **Open** the ppf.

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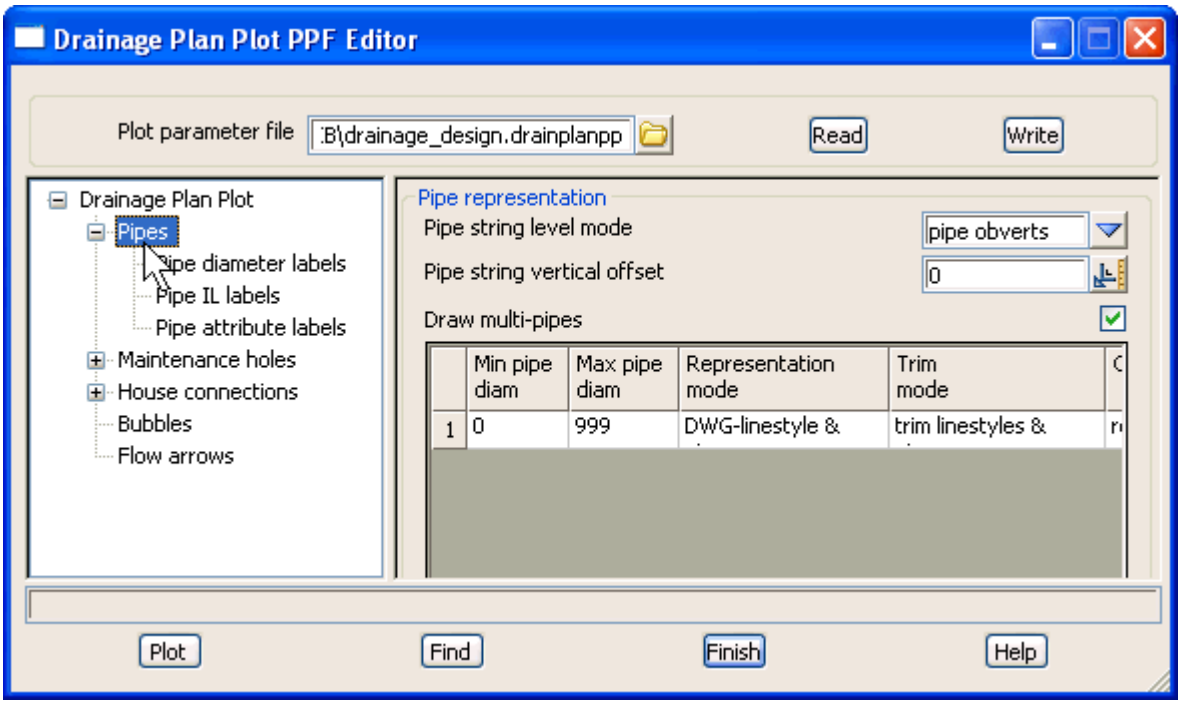
STORMWATER DESIGN - Part 2



Confirm that the **Pipe string level mode** is set to **pipe obverts** and that all symbols with elevations are not used. This include:

- MH setout points,
- Flow arrows,
- pit symbols

Now plot the drawing and we will use the pipe strings at the obvert level to create a tin.

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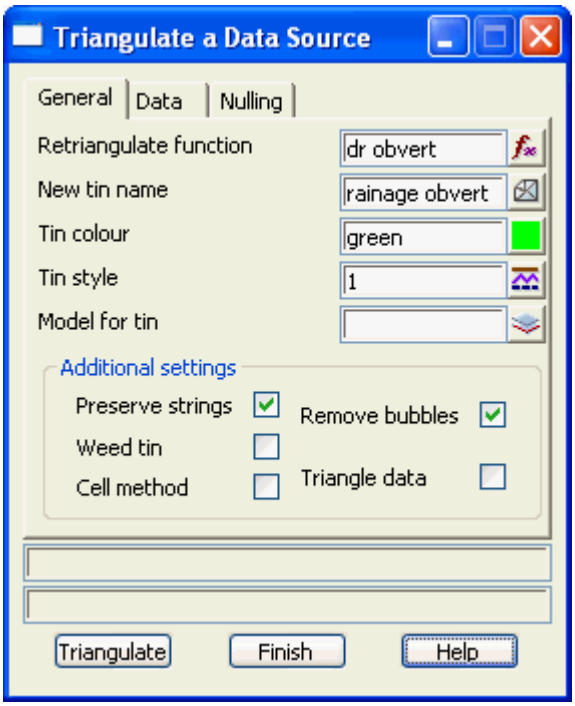
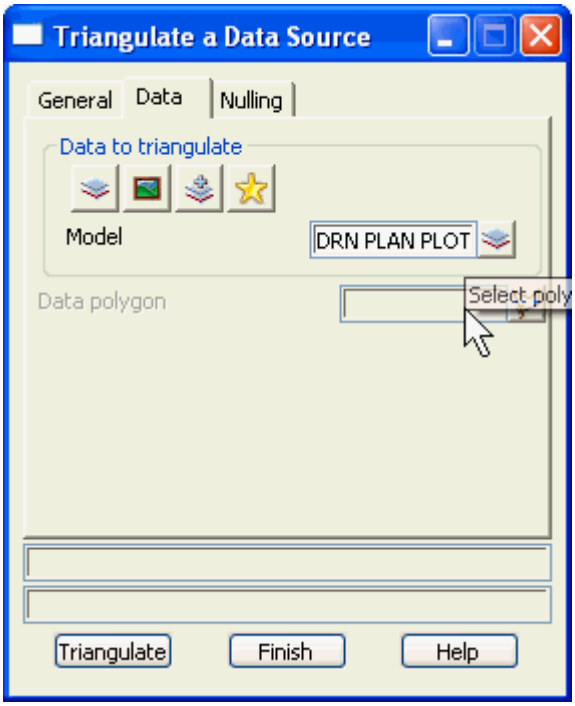
18.2 Create and Null the Obvert tin



To create the obvert tin select.

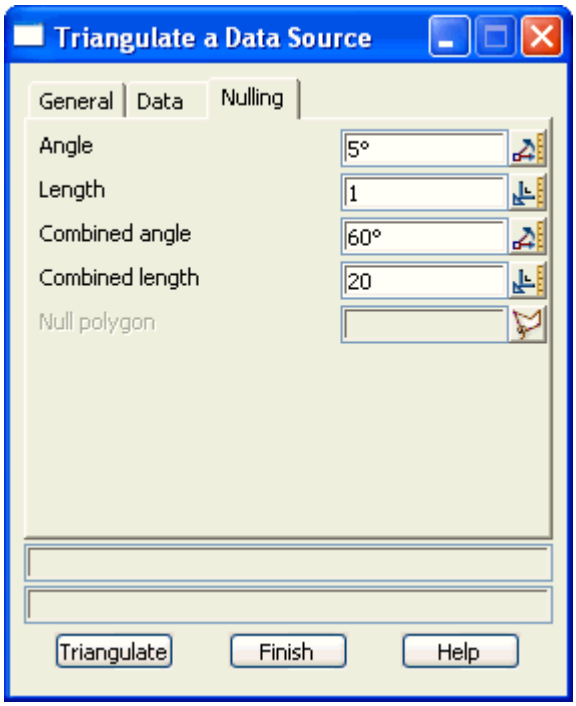
Tins->Create->Triangulate Data

Enter a **New tin name** as desired.



Select the **Data** tab.

Select the plot model created above.



Select the Nulling tab

Enter a **Length** that is less than the pit diameter and greater than the largest pipe.

Select **Triangulate**

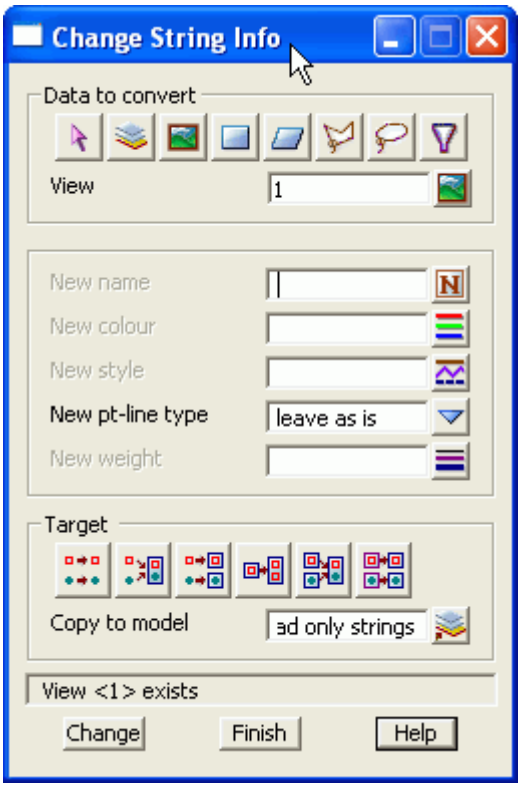
The tin will now only exist on top of the pipe and it is ready to use for hatching.

18.3 Create a Roads Only Tin

The design tin is already nulled to remove the long triangles. If the footpaths were to be excluded from the tin then they should be removed from the road design strings. You could run a template that did not include the footpath and has a **Final Maximum slope width** of zero or just copy the desired road strings to one model and remove unwanted strings. We will use the later techniques.

Add all of the road string and kerb return models onto one view and then select

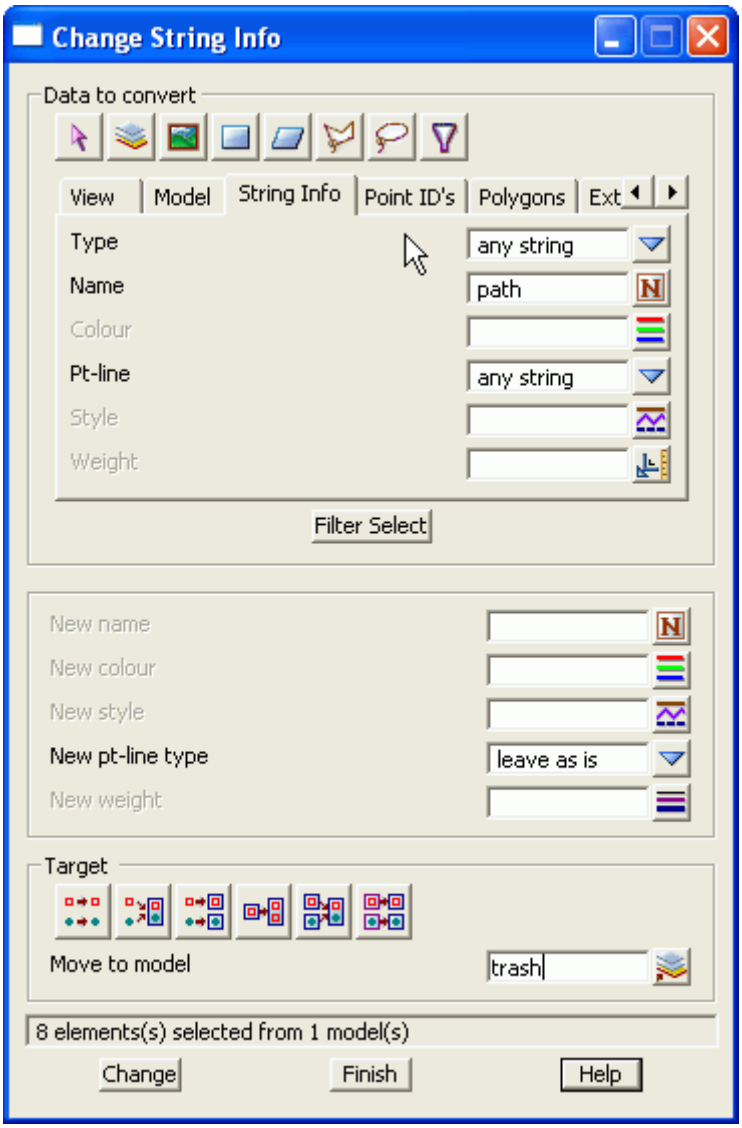
Utilities->A-G->Change



View select the view that contains all of the road strings

Copy to model type the name of a model for all of the road strings.

Select **Change** copy the strings.



Select the **Filter** icon at the end of the selection strip. Now select the **Model** tab and select the **Name** of the model that holds all of your road and kerb strings **road strings only** (tab not shown here).

Select the **String Info** tab and enter the name of the strings that you want to remove from the road only model. In this case it is **path.**

Select **Filter Select** to select these strings.

Select the second **Target** button **Move to model** and select the model **trash** and then select **Change**.

Repeat this for string names **int.**

We are now ready to triangulate the road only tin.

Now to create the tin select **Tins->Create->Triangulate data**

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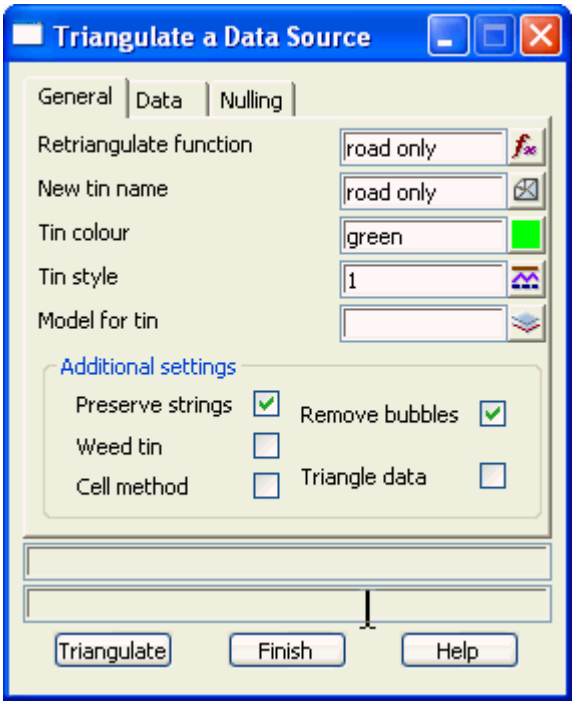
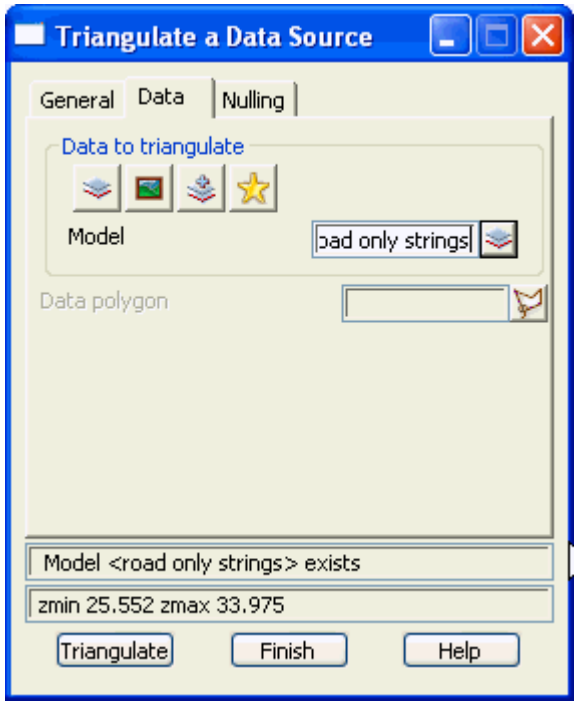
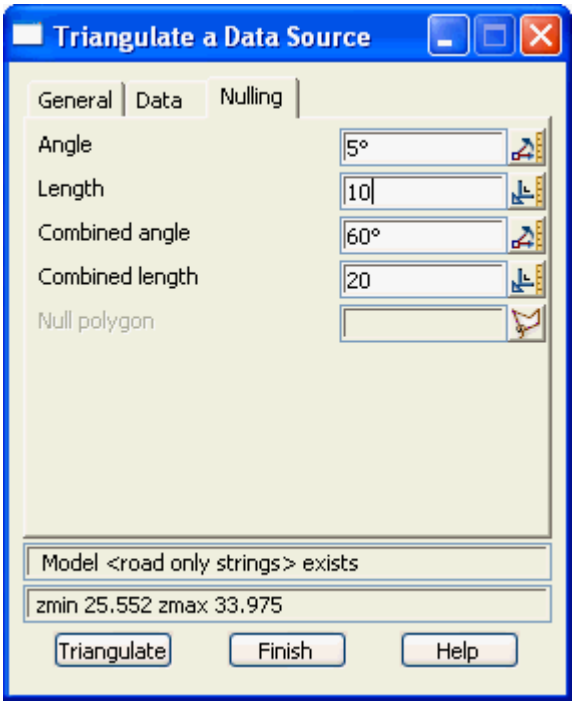


Enter a function name (optional) and **New tin name** and then select the **Data** tab.



Model - Select the model containing the road only strings.



Length - Select a length just greater than the width of half the road so that the tin will not be nulled from the end of the roads.

Select **Triangulate.**.

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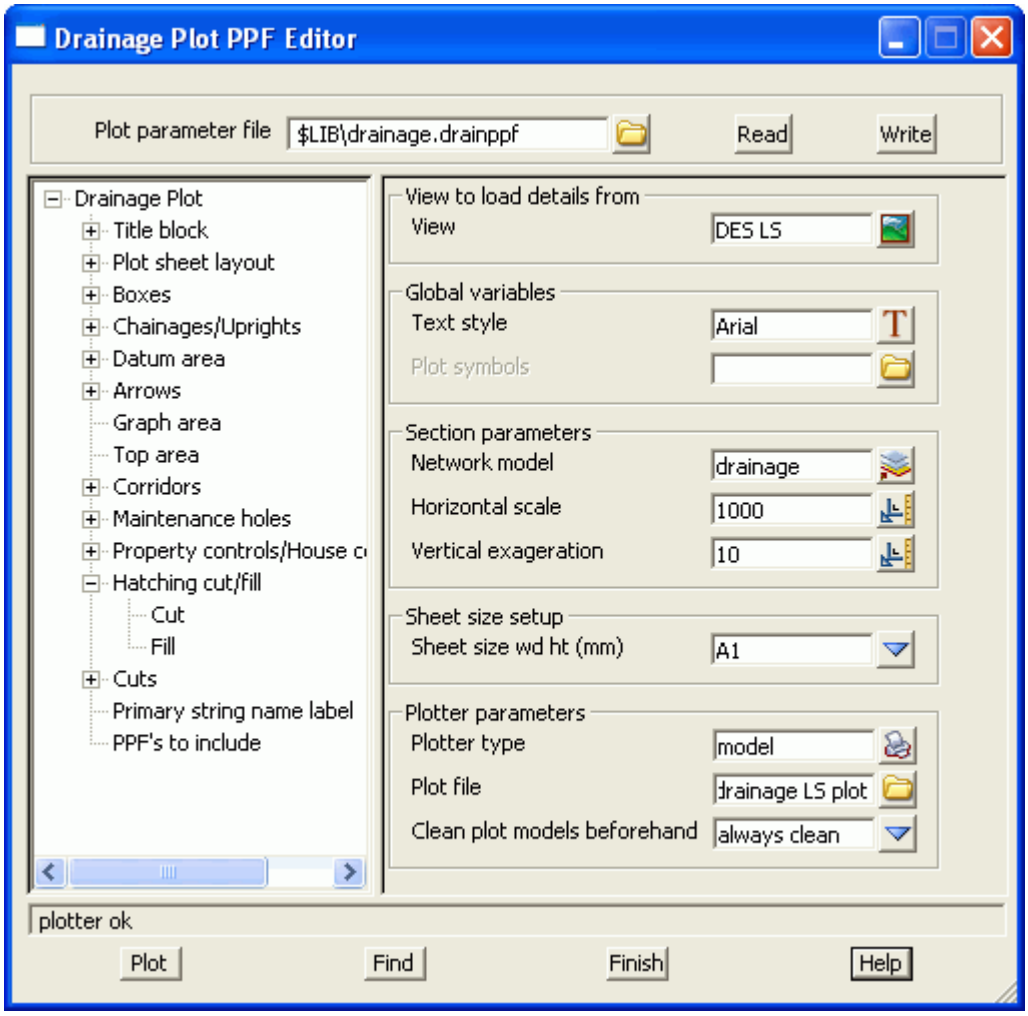
18.4 Use the Hatching Feature in Drainage Longsections

We are now ready to create the drainage longsection plots. Set up a section view with the a string in the drainage model profiled, the vertical exaggeration set, the desired tins displayed and the service models added. From the main menu select,

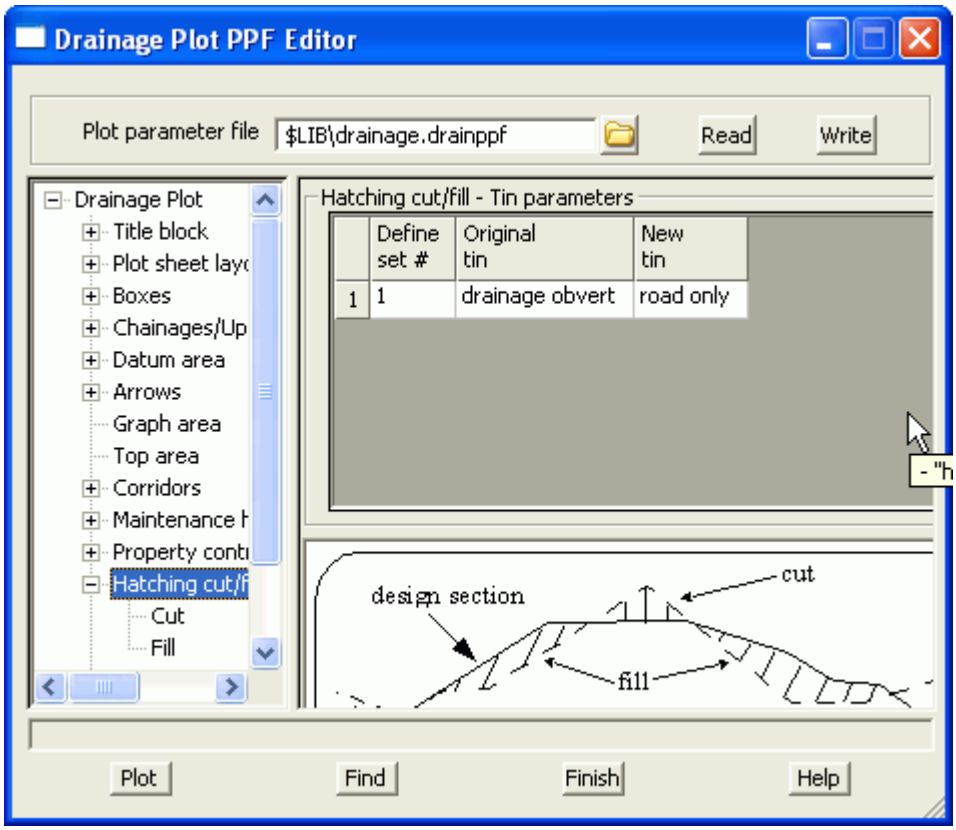
Design->Drainage-Sewer->Plots->Longsections



From the **Plot parameter file** field select a drainage longsection ppf from the library and then select **Read.**

In the **View to load details from** field select the section view you have setup for the drainage long section.

Now select **Hatching cut/fill**



Define set is set to 1.

Original tin is set to the obvert tin.

New tin is set to the road only tin.

Now select the + beside the **Hatching cut/fill** and then select **fill.**

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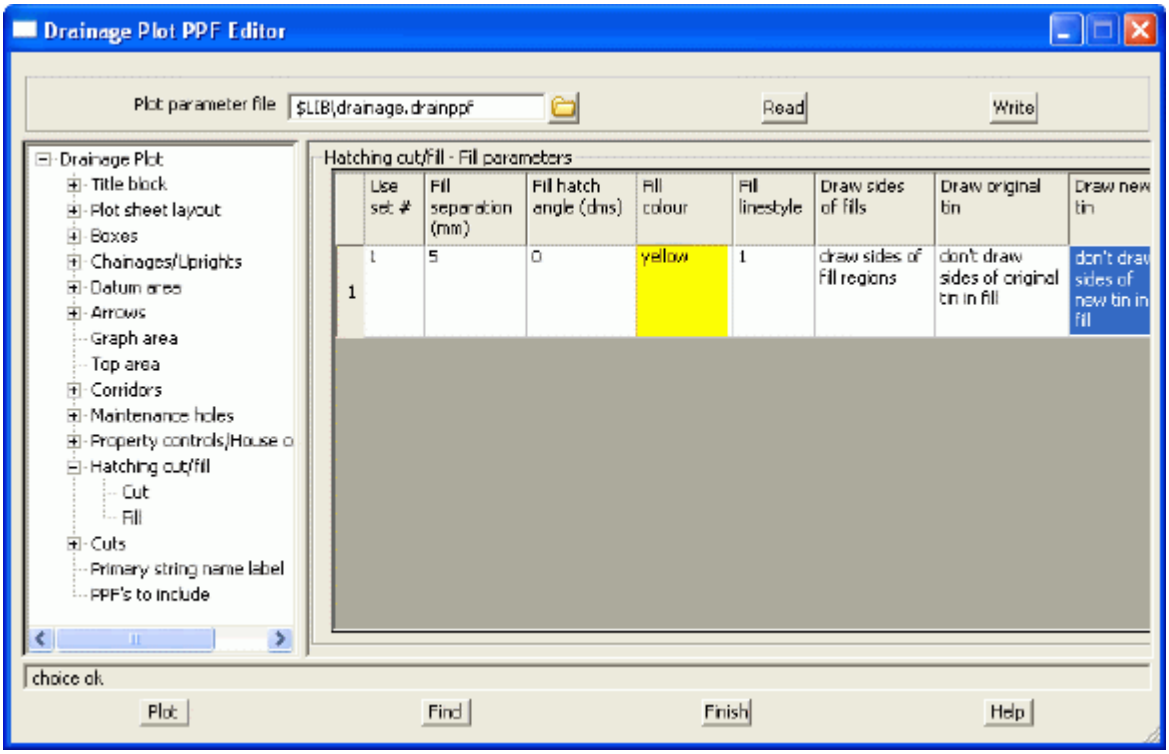
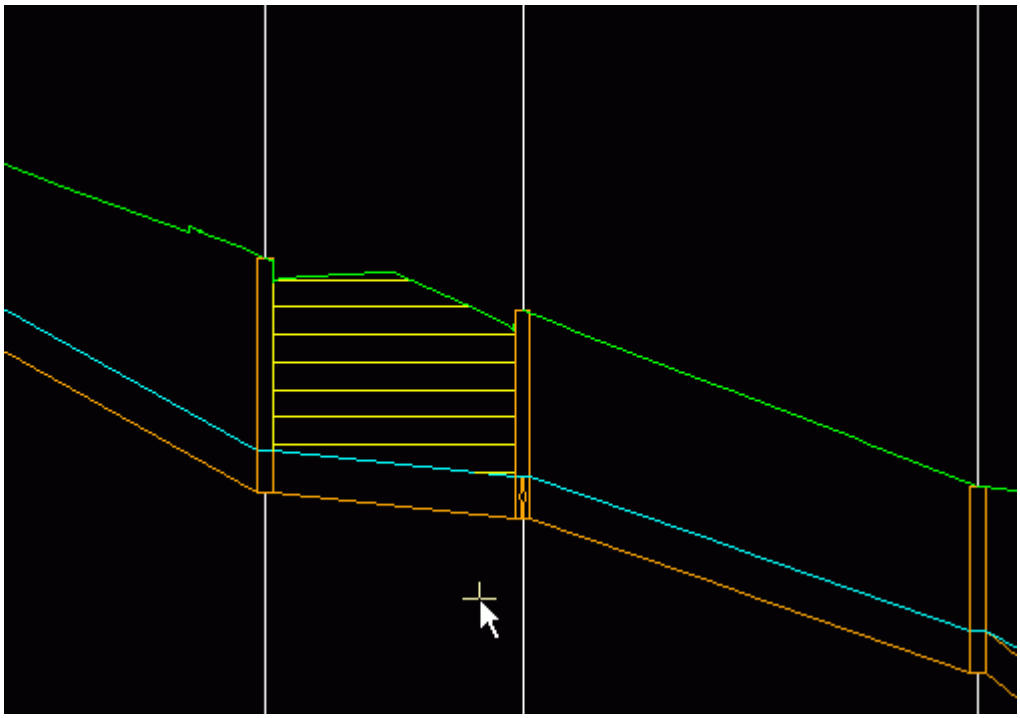


Use set # is entered as 1. **Fill separation, hatch angle, colour and linestyle** selected as desired. **Draw sides of tin, Draw original tin** and **Draw new tin** are not required unless you want these extra line in the drawing.

Select **Plot** and add the plot model **drainage LS plot1** onto a PLAN view to preview the drawing.



The hatching is shown to the left at a 2mm spacing with the tins and sides not drawn.

19.0 Flooded Width Analysis and HEC RAS

There are 2 flooded width methods in the drainage module. The first can be used with any of the external drainage packages and the second is part of the 12d storm analysis. The first is found on the main menu

Design->Drainage-Sewer->Calc flooded widths

The name of the overland flow string becomes the name of the HECRAS project.

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