Riodesk

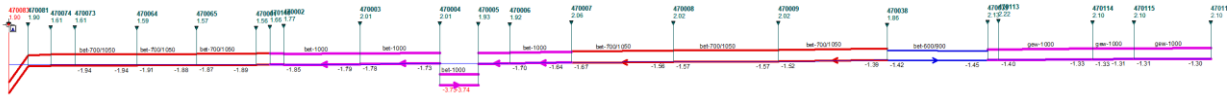
SCOPE
Assessment and Planning Guide

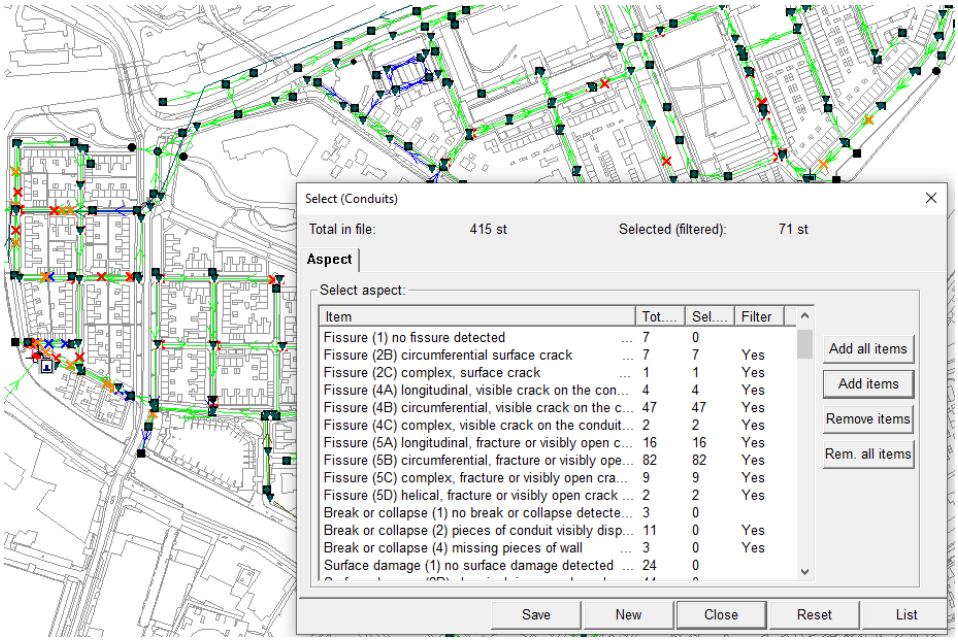
BRUTIS

Best Rational Urban Tech Information System

Urban Drainage and Sewer Management

Assessment and Planning Guide





Phnom Penh, November 2023
Manual for investigate conditions, perform assessments, plan, implement and improve drain and sewer systems with BRUTIS
Version 6.3

Foreword:

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Appendix A **Breakdown of the BRUTIS replacement cost calculation**

Appendix B **Decision support model for the assessment of sewerage**

1 Introduction

Welcome to the Urban Drainage Management System BRUTIS, developed by https://www.riodesk.com, based on the best management practice of sewage and drainage professionals in the Netherlands.

BRUTIS is an abbreviation for **B**est **R**ational **U**rban **T**ech **I**nformation **S**ystem. In BRUTIS is drain and sewer management an integral part of the management of all other objects in the urban space.

This software allows you to collect data, investigate conditions, perform assessments, plan, implement and improve drain and sewer systems. Based on the European Standard EN 13508-2

Contents

- Assessment and Planning
- Scope
- Overview of this manual

1.1 Assessment and Planning

In addition to data collection, assessment and planning are fundamentals of urban asset management.

Assessment involves considering which measures are necessary to maintain the functioning of the sewer system. Based on inspection data and benchmarks.

Planning takes place at strategic, tactical and operational levels.

Strategically based on a DSS decision support system to calculate global long-term costs and to establish benchmarks for assessment at the tactical level. Different benchmarks are determined for the critical asset and the non-critical asset, so that the critical assets receive a measure earlier than the non-critical assets.

Tactical to determine the measures needed (assessment). Based on inspection data, the hydraulic capabilities, the critical status of the asset and strategically determined benchmarks.

Operational planning comes into the picture once budgets and green light have been obtained to implement measures.

1.2 Scope

This Assessment and Planning Guide shows you how to use BRUTIS to learn: How does the sewerage work? Where are the strengths and weaknesses. What is needed to maintain and improve functioning?

As described in the User's manual the most important data input for the management system is:

- What do we have (urban drainage system)
- What is the performance (does it meet design standards)
- What is the level of physic condition (damages)
- What is the level of maintenance (sedimentation)

In addition to this data input, we need to get available budgets, agreed service levels and design standards for assessment and to plan measures.

1.3 BRUTIS Documentation

The BRUTIS documentation is arranged in the following two categories:

Documentation	Description
User's Manual	This manual provides installation instructions on how to get started and collect data with BRUTIS.
Assessment and Planning Guide	This manual is guide to using BRUTIS for Analyses the performance, check the physic condition and the level of maintenance, and perform costing and planning.

1.4 Overview of this Manual

This Assessment and Planning guide is the primary piece of documentation on how to use BRUTIS for:

- Selecting conduits and nodes for cost calculating, reporting, performing calculations and planning.
- Analysing the physic condition and the level of maintenance, with:
  - DSS Assessment based on inspection data;
  - Flow and lost storage calculation;
  - Export to hydraulic calculation program.
- Perform replacement and maintenance cost calculation.
- Strategically, tactical and operational planning of measurements.
- Reporting and creating drawings and pictures.

In the text the user is asked to click on BRUTIS buttons, items and objects. Clicking is placing the mouse pointer on the centre of the desired area. Then press down on the left mouse button and release the button.

A breakdown of the BRUTIS unit prices is documented in appendix A.

Decision support model for the assessment of sewerage is schematized in in Appendix B.

2 Selection

The selection tools in BRUTIS enable users to perform cost calculating, reporting, performing calculations and planning on a collection of nodes and conduits.

After selecting conduits and nodes BRUTIS colours them orange. Users are then able to:

- copy them,
- start a new window and
- paste them in the new window.

To perform the desired action.

This chapter only describes the most important selection methods. All methods are displayed in the menu depicted in figure 2.1.

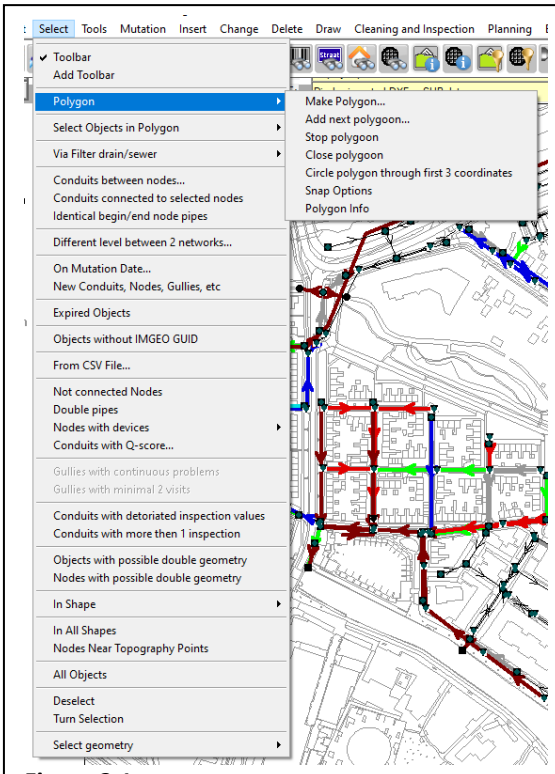


Figure 2.1

Contents

- Selecting a single conduit and nodes
- Selection of a number of conduits with a polygon
- Selection of conduits and nodes with the filter options

2.1 Single conduits and nodes

After starting menu option: **Consult -> Conduit data**, a user can click on a conduit. A dialog will appear with the data of the conduit. With the [Log] button in the lower left corner you can start a window with a [Select] button on the lower right corner, to select the conduit with both nodes. Pressing [Select] again deselects the conduit.

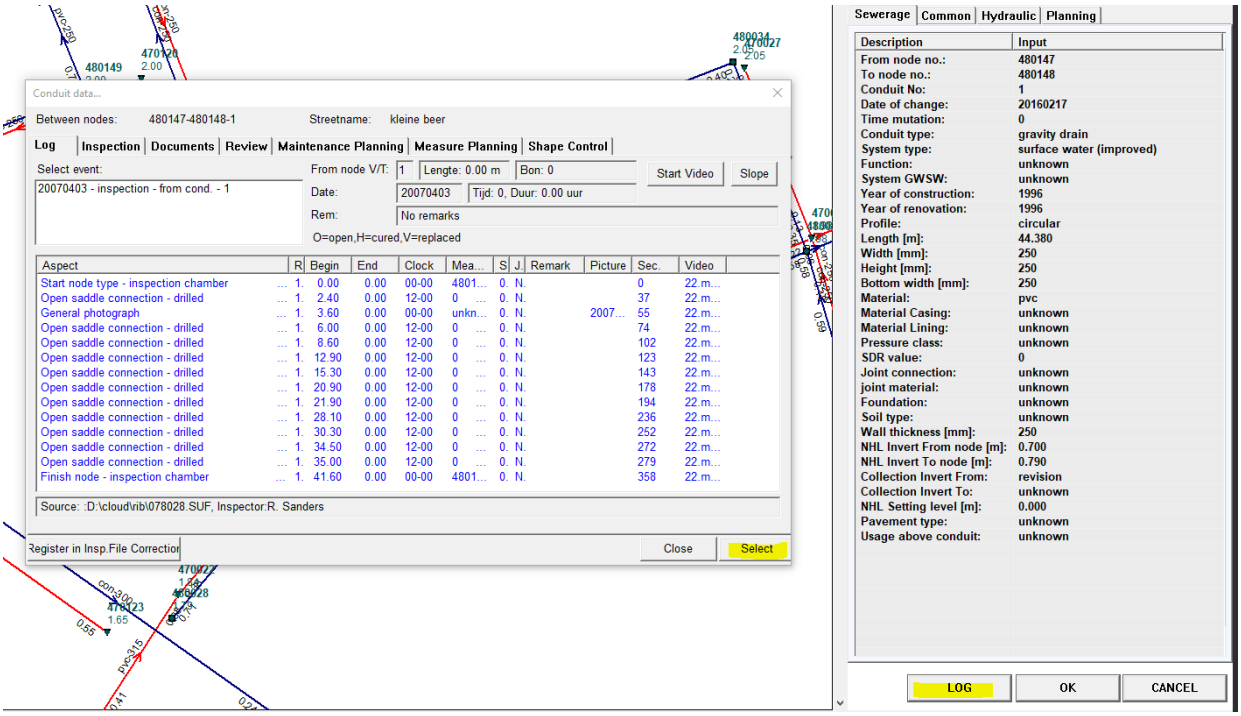


Figure 2.1.1

2.2 Number of conduits with a polygon

After drawing a polygon (a closed line) it is possible to selects the conduits and nodes in the polygon.

Start drawing a polygon with the **Make Polygon…** menu option depicted in figure 2.1, in the popup menu which appears if the user does a right mouse click in the graphical window. Or with button: , in the toolbar.

Draw the polygon by clicking an imaginary fence around the conduits. BRUTIS paints the polygon with a blue line. The last clicked coordinate is painted as a blue cross.

Before closing the fence manually, the user should close the polygon (fence) with the **Close polygo**n menu option depicted in figure 2.1, or in the popup menu which appears if the user does a right mouse click in the graphical window. Or with button: , in the toolbar. It is also possible to close the polygon by double clicking on the last point before closing.

The user can select the conduits and nodes with the menu option depicted in figure 2.2.1, or in the popup menu which appears if the user does a right mouse click in the graphical window.

BRUTIS selects all conduits and nodes in the imaginary fence, including all conduits which are partly in the fence.

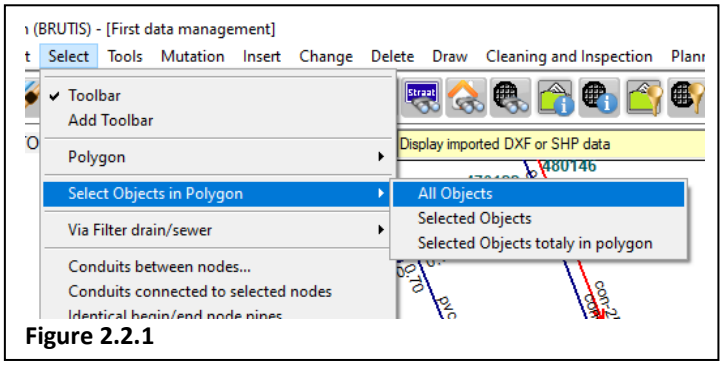


Figure 2.2.1

2.3 Number of conduits with the filter options

To select conduits and nodes on certain features BRUTIS has filter options. Those filter options are located behind the buttons: and in the button bar above the graphical window. Or with the options in menu: **Select -> Filter drain/sewer**

After menu option: **Select -> Filter drain/sewer -> Conduits..** , a tabbed selection dialog will appear as depicted in figure 2.3.1.

The user can select on various data via separate tabs. Between tabs there is an: ”**and**” relationship. Between the data in the list-view there is a: “**or**” relationship.

In the selection dialog a list-view, with on the left side a list of items with the columns:

- Item: A value to select conduits
- Tot.[st] : The number of conduits with the value
- Sel.[st]: The number of selected conduits with the value
- Filter: Indicator if the vlaue is used for the selection of conduits.

On the right side of the list-view there are 4 buttons and a check box. The 4 buttons can be used to add or remove items from the selection filter after clicking on an item in the list. The check box allows the user to change the display from number to length or from length to number.

Click on an item in the list-view to add it to the selection set with button: [**Add selected items to filter**].

Via button: [**New**] BRUTIS copies the selection to a new window.

Click [**Reset**] to remove all items from the filter.

Click [**Close**] to close the selection dialog.

Button **[List]** saves the list in a file, and opens the file with notepad.

To select conduits, add items to the selection filter.

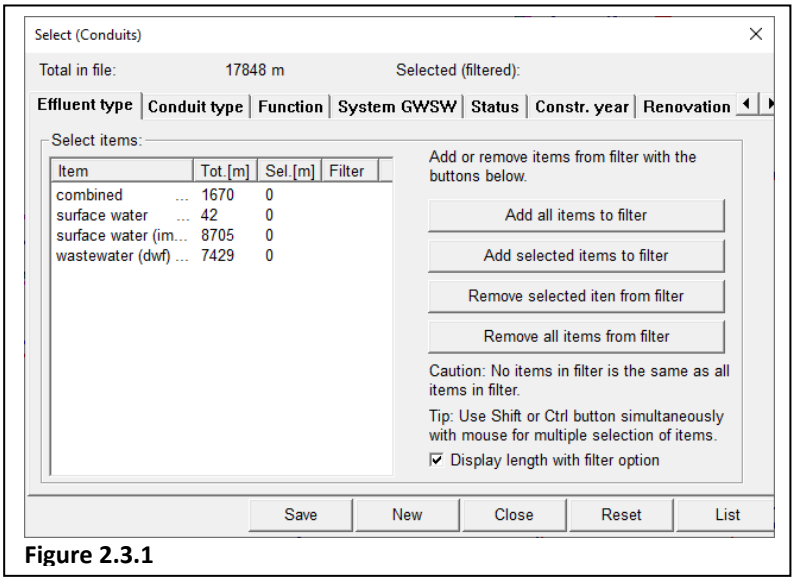


Figure 2.3.1

Add single items by:

1. Clicking on an item in the list. The item background colours blue.
2. Click on the: Add selected item to filter, button.

Add multiple items by:

1. Clicking on the top most item in the list.
2. Clicking on the bottom most item in the list, while pressing the Shift key. Or clicking on items while pressing the [Ctrl key]. The background of the selected items colours blue.
3. Click on the: Add selected item to filter, button.

On an identical way the user is able to remove items from the selection filter using the: Remove selected items from filter, button.

While adding and removing items from the selection filter BRUTIS selects directly the conduits matching the filter, and colours them orange in the graphical window.

Multiple items in one guide card are “or” related. For example, if items: concrete and pvc are selected all conduits with concrete or pvc material are selected.

Between list-views the items are “and” related. For example, if item: concrete is selected in the material guide card and dimension 400 is selected in the dimension guide card all conduits with concrete material and 400 dimensions are selected.

After clicking on button: , a similar dialog will appear as depicted in figure 2.3.1 for the selection of nodes. If a selection filter is active in the conduit filter dialog it effects the selection of items in the node filter dialog. For example, if item: “combined”, is selected in the conduit filter dialog effluent type list-view and item: pumping station is selected in the node filter dialog node list-view all pumping station node types are selected in the combined sewer systems.

3 Analyses

In this chapter the analyses of the physic condition and the level of maintenance of urban drainage (conduits) is described.

The physic condition of conduits is about damages affecting the purpose of the conduits and eventually the condition of the infrastructure on top or along the conduit. All conduits in a basin form a system. The physic condition of a system is about capacity affecting the drainage purpose to keep dry feats and sanitation.

If the physic condition has reached an unacceptable level conduit have to be rehabilitated, replaced or improved.

The level of maintenance is about cleaning and repairing. The physical condition can have an effect on the cleaning frequency of drainage systems.

Contents

- Flow and lost storage calculation
- Filter observations
- Combine the data with background drawings from DXF/SHP/GML, Web Map Services (WMS) and or aerial photographs from ECW files.

3.1 Flow and lost storage calculation

The physic condition of the system is judged by testing the drainage of the drainage- and sewer system. After all the most important job of the system is to drain.

Bad drainage can cause remaining stagnant water. Stagnant water can cause:

- sedimentation and block the system
- a mosquito source, causing malaria.

To determine the drain of the system BRUTIS can perform storage and flow calculation. This calculation:

1. Fills the whole system, to top level, with water.
2. Drains the system via the pump discharge levels, weir crest levels, orifice invert levels and node top levels.
3. The remaining water cannot drain and is the amount off lost storage.
4. The flow direction is based on the remaining water levels.

To get a quick impression of discharge directions, you can use the menu option: **Display -> Display options**, tab: **Conduit**, checkbox: **Flow** as depicted in figure 3.1.1.

The menu options for storage and flow calculation are found behind menu option: **Tools -> Calculate Storage and flow**. The user can calculate the flow from node, to node and for the whole drainage system. Whit the option: **Block Conduit…** the user can block a conduit and calculate the flow.

All options are based on the same calculation, the display is different:

- Using the flow from node option the user can click on a node and display the flow from that point to the point where the water leaves the system.
- Using the flow to node option the user can click on a node and display the basin of the node. This option is very helpful to trace polluted water.

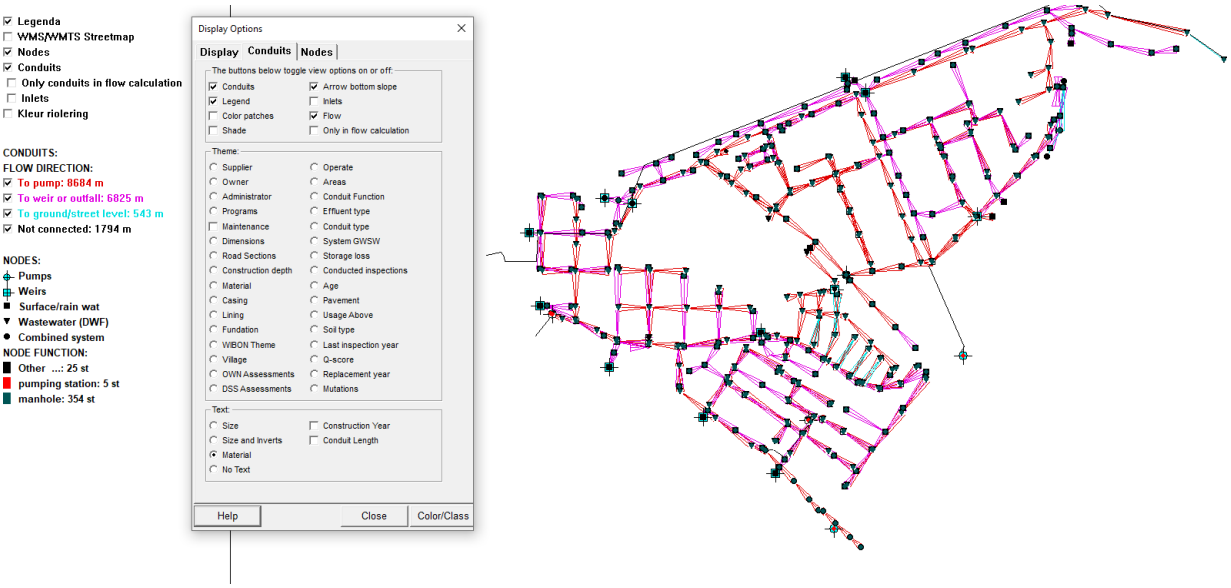


Figure 3.1.1

Example:

After starting option: **Tools -> Calculate Storage and Flow -> From node**, a user can click on a node. A dialog will appear as depicted in figure 3.1.2 the flow is displayed with arrows along the conduits from the node to the point where the water leaves the system. In the dialog the calculated storage characteristics are displayed.

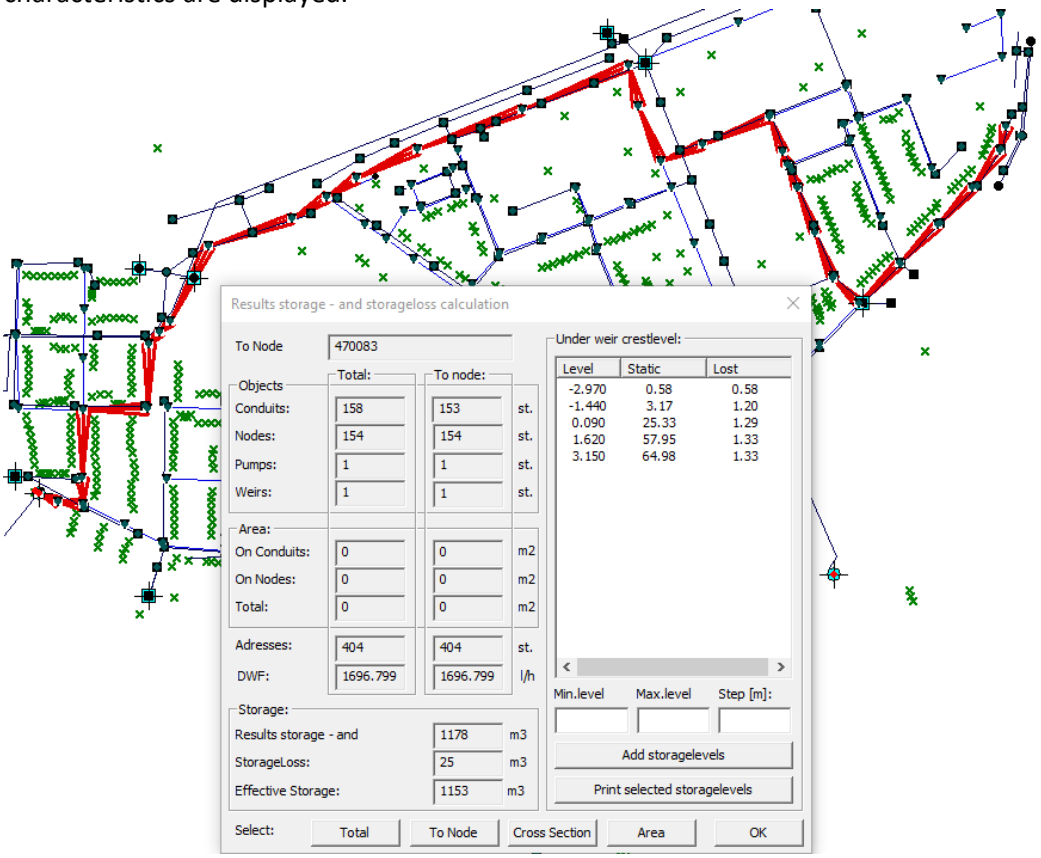


Figure 3.1.2

If addresses are available, the total number of addresses connected to the outflow is displayed. If catchment the total catchment area.

The dialog depicted in figure 3.1.2 has the following buttons:

- [Total]: to select all connecting nodes and conduits
- [To Node]: to select the nodes and conduits in the flow direction
- [Cross Section]: to open a new window with the connecting conduits in longitudinal display. As depicted in figure 3.1.3
- [Add storage levels]: to perform a new storage calculation based on the levels defined in the fields above this button. In figure 3.1.2 the to be calculated storage levels begin at -2.97 m and end at a level of 3.15 m and have steps of 1.53 m. In the list the results are summarized per level. The Static column shows the drained volume below the weir crest levels and node top levels. The Lost column shows the remaining volume.
- [Print selected storage levels]: to start the notepad editor to display the detailed results per node and conduit for the last level shown in the list.
- [Area]: this button is used after performing a “flow to node” calculation to draw a fence around the catchment area of all connecting nodes.
- [OK]: to close the dialog

The location of the remaining water levels can be displayed in situation on the map with thematic colours and in a longitudinal display as depicted in figure 3.1.3

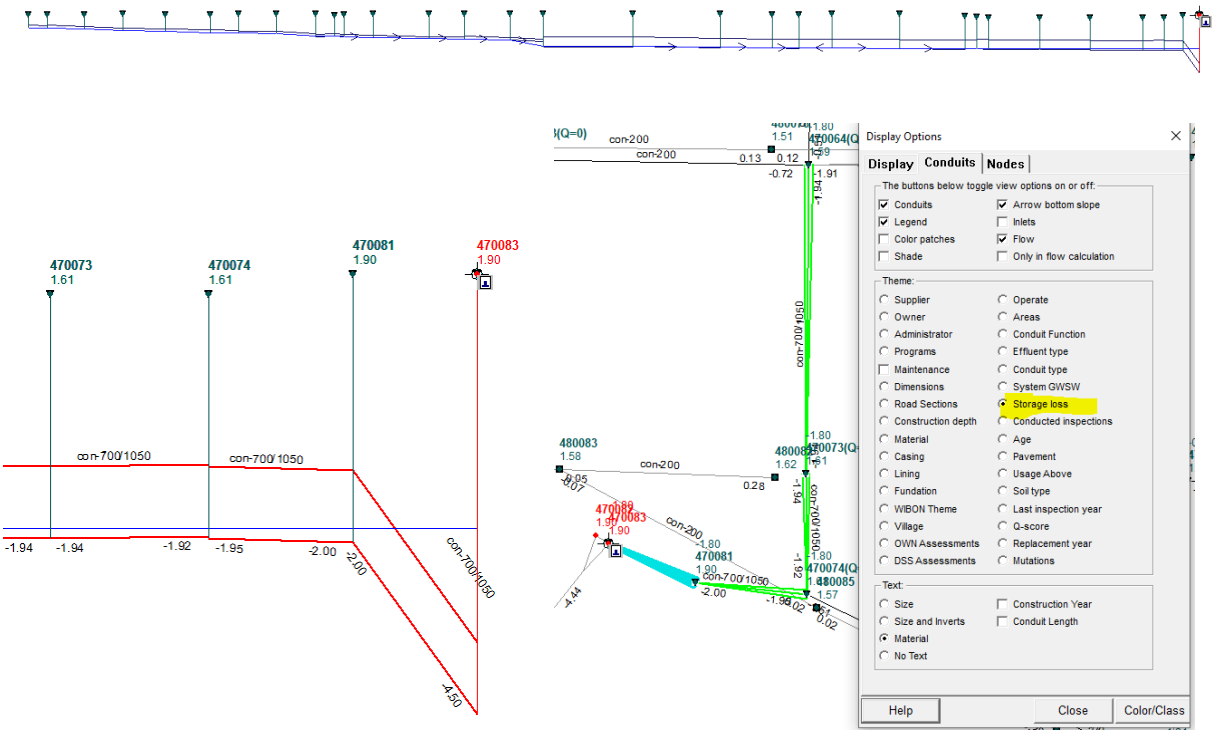


Figure 3.1.3

To display the thematic situation the user can click on the “Storage loss”, radio button in the “Conduits” tab in the Display Options dialog.

To prevent making a longitudinal display of the whole system it is better to select first the conduit and nodes in the flow, with the described: To Node, button. Copy the selection and past the selection in a new window.

To display the longitudinal sections the user can check the "Longitudinal profiles" check-Box in the "Display" tab in the Display Options dialog, as depicted in figure 3.1.4.

Remark:
The storage and flow calculation are a good tool to check the levelling and the connections of the system.

Determine the remaining water levels (blue line) with the BRUTIS zoom and pan options. In figure 3.1.5 the results are shown with:

- Node and conduit text.
- The inspection data.

To review the inspection data start option: Conduit Info and click on a conduit. The conduit info dialog will appear. Click on the Logbook guide card and the inspection results will appear as depicted in figure 3.5.

Check the calculated remaining water levels with the inspection results. There must be a match. If the results do not match, it is probably the network data of the drainage system is not correct and has to be improved.

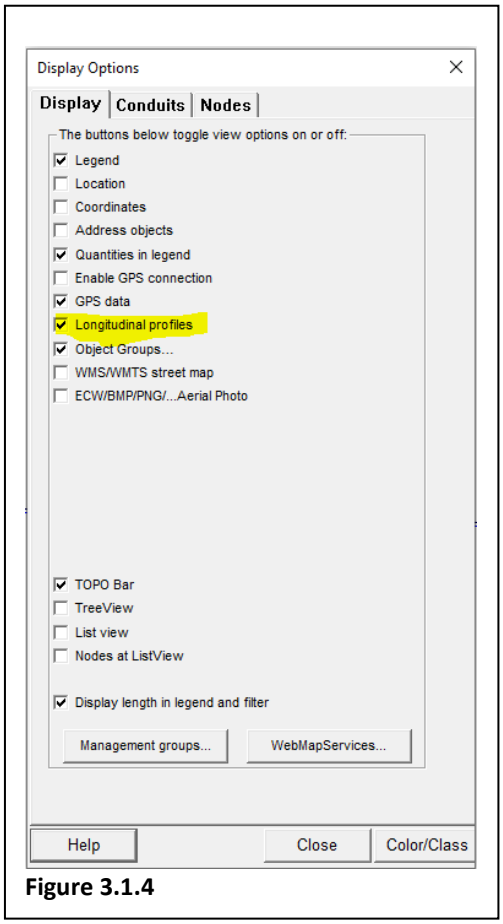


Figure 3.1.4

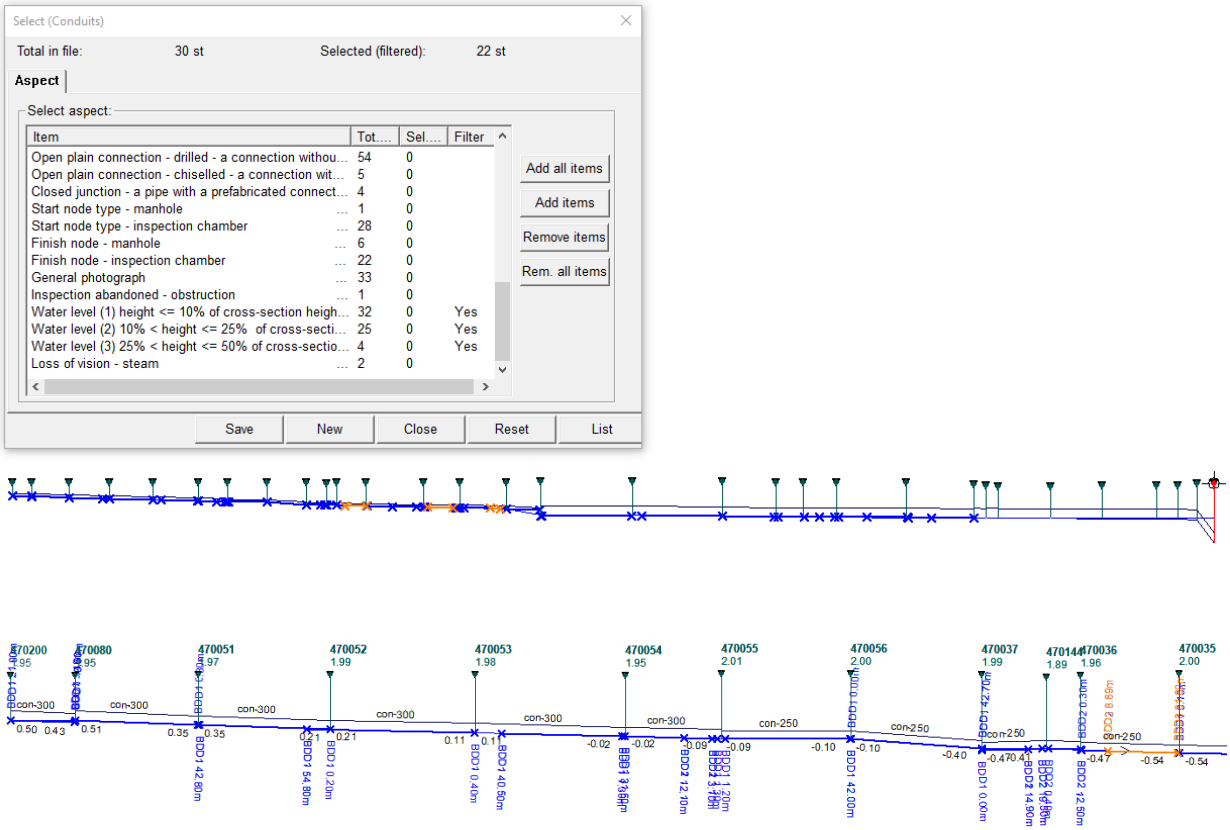


Figure 3.1.5

3.2 Select and display observations

The physic condition of the conduits is judged by making reports off the damage and maintenance problem locations.

Damages and maintenance problems can block the system causing flooding areas because the hydraulic capacity is blocked.

To determine the blocking of drainage systems BRUTIS is able to display the location of certain observations. For example: the observation of damages and maintenance problems blocking the system.

The user displays the locations when the dialog for selecting conduits is opened. Start this dialog whit menu option: **Select -> Via filter drain/sewer -> Observations**. A dialog will appear as depicted in figure 3.1.5. and 3.1.6

In section 2.3 is explained how to select conduits with a selection filter. Follow the next steps for displaying observation type locations.

Add single observation types (items) by:

1. Clicking on an item in the list. The item background colours blue.
2. Click on the: Add selected item to filter, button.

Add multiple observation types by:

- Clicking on the top most item in the list.
- Clicking on the bottom most item in the list, while pressing the Shift key. Or clicking on items while pressing the Ctrl key. The background of the selected items colours blue.
- Click on the: Add selected item to filter, button.

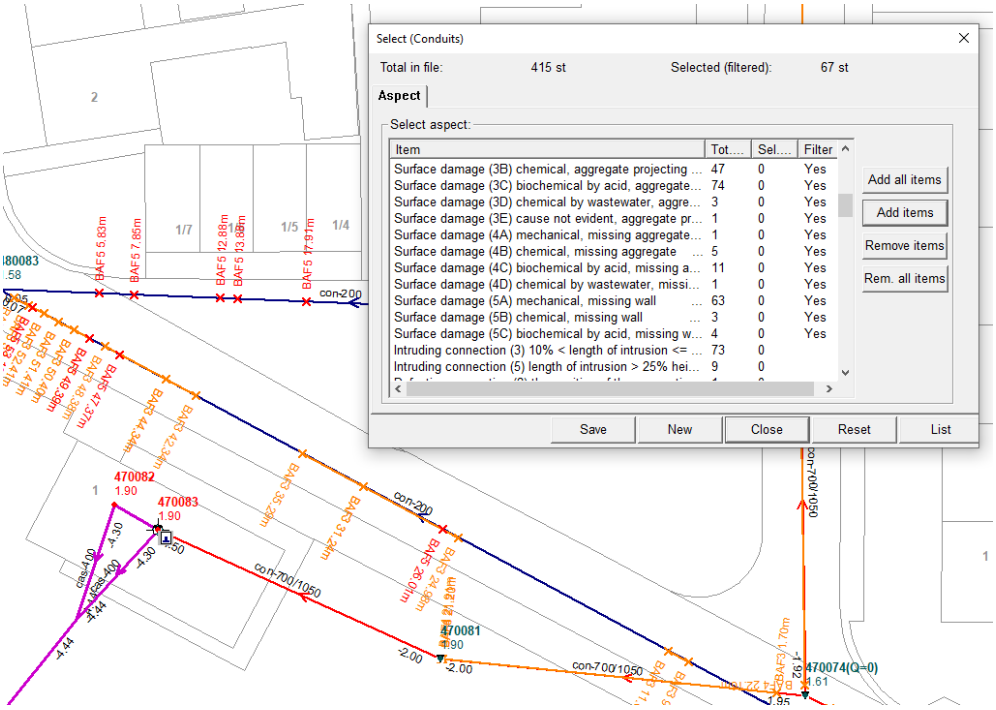


Figure 3.1.6

On an identical way the user is able to remove items from the selection filter using the: [Remove items], button.

While adding and removing items from the selection filter BRUTIS paints directly the observations matching the filter, and marks them with blue crosses. A location with an extend is displayed as a blue line between 2 blue crosses.

When the user zooms in also the observation code and distance from the node are displayed, as depicted in figure 3.1.6

For making exports of the observations to DXF, SHP file or making drawings and pictures with the observation locations the dialog for selecting the observations must kept open!

3.3 Combine with background data

Combine the data with background drawings from DXF/SHP/GML, Web Map Services (WMS) and or aerial photographs from ECW files.

See section 5.2 in the BRUTIS User's Manual.

For very large topographies, building the display can take a very long time. This can be accelerated by giving the "slowtopo" option a zoom factor between 0.1 and 2, via the menu option: **Tools -> Start options**. For example, slowtopo=1. This option only displays the topography at the specified zoom factor.

By clicking on the [Save] button in the line below the toolbar you ensure that the program will automatically start with the background maps during the next session.

Use menu option: **Import -> Working file**, to add data from other working files, such as the data from road management to the sewerage management data, as shown in figure 3.3.

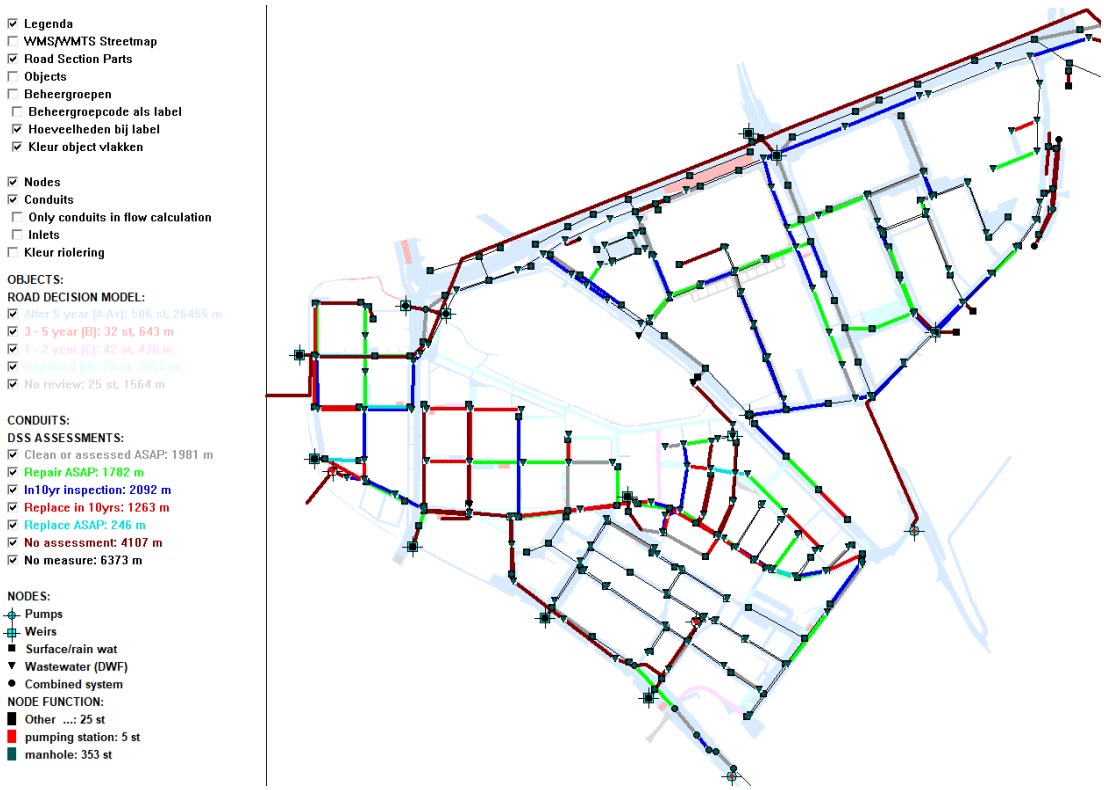


Figure 3.3

4 Export data, printing and plotting

In this chapter the export of data to different file formats and the plotting and printing of drawings is described.

Contents

- Export data to different file formats
- Printing and plotting

You can also import exported data again with the options under the import menu. For example, you can export to CSV. Mutate in this format and with the option under menu: **Import -> CSV Object data**, add and mutate data.

4.1 Export data to different file formats

Under menu: Export, you will find all options to export the data to certain file formats.

If a data type is present. The option to export is also enabled.

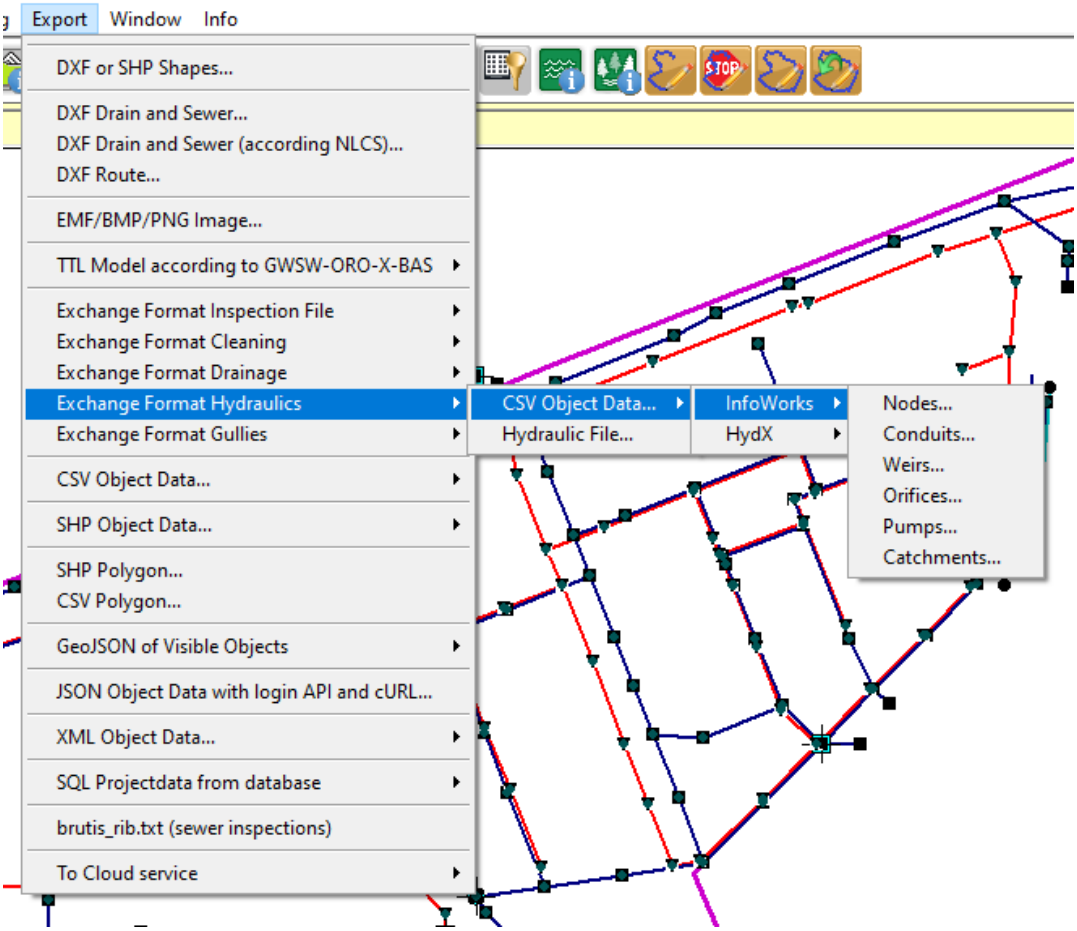


Figure 4.1

4.1.1 DXF for Computer-aided design like AutoCAD

Depending on the settings of the display options, you can create a “drawing exchange format” (DXF) of the current display via the menu option: **Export -> DXF Drain and Sewer**. Situation or longitudinal profile display with layer names depending on the chosen theme.

4.1.2 hydrology-hydraulic water simulation model

To test the drainage capacity of the sewerage system, you can export the data to a hydraulic calculation file, via the options under menu: Export -> Exchange Format Hydraulics. You can export to CSV and formats established by the various suppliers. See figure 4.1.1 and 4.1.2 for the possibilities.

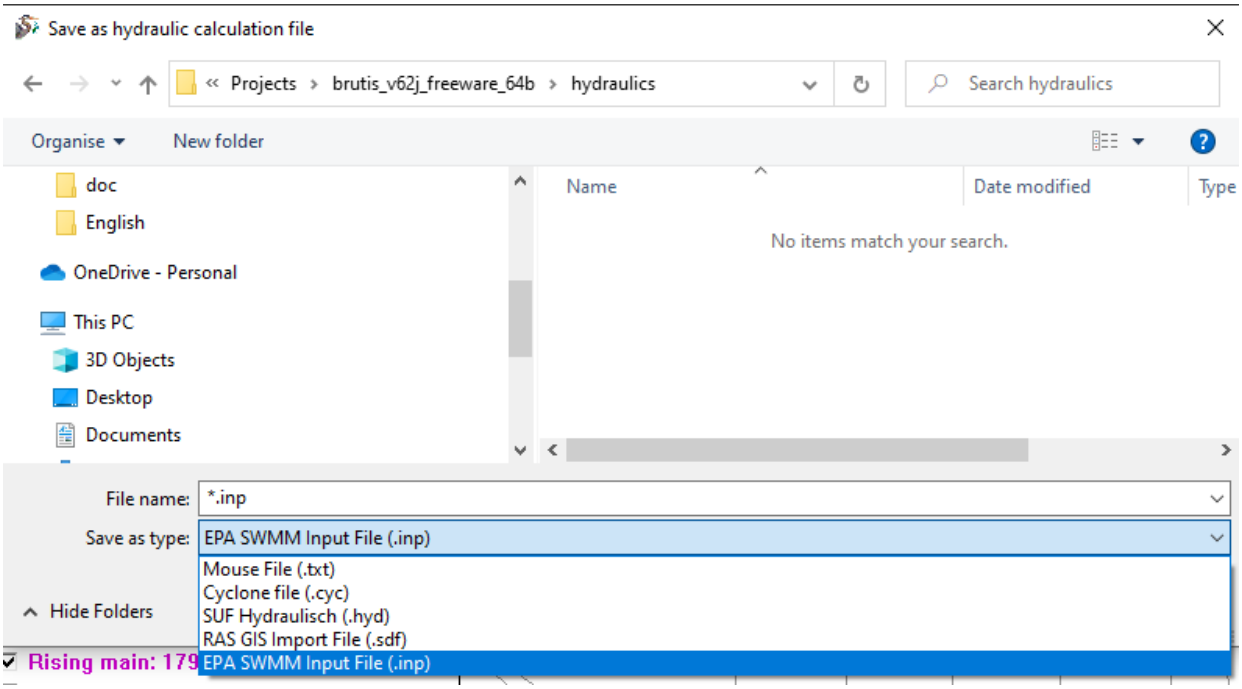


Figure 4.1.2

4.1.3 CSV Object data

Use the export to “Comma Separated Values” (CSV), If you want to present overviews of the data in a spreadsheet, like MS Excel.

With the options under menu: **Export -> CSV Object Data**, you can literally export all data.

Depending on the regional settings, a comma is not always the separator in MS Excel. If not, you are ferry happy because all data will be imported in 1 column. So, you will have the possibility to mark all columns as text using the “Text to Columns” function in MS Excel. MS Excel has the habit to convert data to date formats, leading zeros in codes and misinterpretation of decimal characters.

4.1.4 SHP for Geographical Information Systems

With the options under menu: **Export -> SHP Object Data**, you can export the data of all objects, such as nodes, conduits, pumps, overflows, etc., to shape format. 3 files are then created, with the extension **.shp**, **.shx** and **.dbf**

You can create SHP files with BRUTIS from the command line as follows:

If you want to use the data from the database, provide the following start options:

- **expshp**, make a node and conduit SHP-file
- **expdxf,** make a DXF-file
- **batchmode**, do it without GUI
- **username**, username
- **password**, password
- **datasource**, ODBC source name

Example:
BRUTIS.exe expshp,batchmode,username=myname,password=mypass,datasource=mydatabase

If you provide the name of the BRUTIS DBB work file, BRUTIS will use this work file.

Example:
BRUTIS.exe BRUTIS.dbb,expshp,batchmode

4.1.5 KML, GeoJSON,XML,BMP

Also possible via the options under menu: **Export**

4.2 Printing and plotting

Here you can read about changing plot settings, such as paper size, and plotting.

4.2.1 Change plot settings

Setting the paper size for plotting.

Operation:

1. Click on **File->Plot parameters...** or button: , in the button bar;
2. The "Plot settings" window opens, see figure 4.1.2.
3. Here you can check and/or change the settings.
4. Click [OK] to apply the settings.

Remark:
Before printing or plotting it is advisable that you first check the settings below because these settings are not saved when you exit BRUTIS.

The default settings are:

- Scale = 1:1000
- Paper size = A4 297 x 210 mm
- Orientation = Portrait
- Margin Left/Right = 20 mm
- Margin Top/Bottom = 20 mm

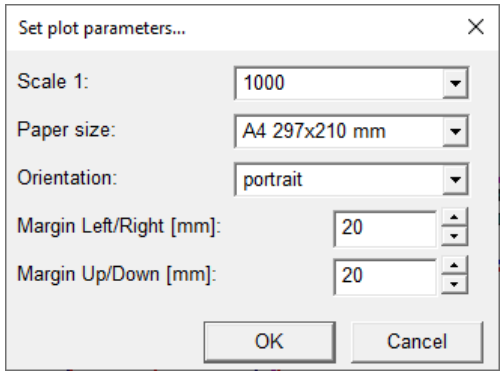


Figure 4.1.2

4.2.2 Making a plot

Printing the pipe system, of the current window, on a printer, plotter or PDF-creator.

Operation:

1. Make sure that the entire part to be plotted is visible in BRUTIS.
2. If necessary, first click on **File->Plot settings**, which will display the "Plot settings" window. This allows you to set the desired scale, paper size and orientation of the print;
3. Click **File -> Plot**, or button: . BRUTIS then asks via the window in figure 4.2.2 whether you also want to print the bitmap measures from the assessment. Click on [Yes] or [No] button, then left-click in the graphical view and hold down the mouse button. BRUTIS then draws the paper size to the size that BRUTIS will have it printed.
4. By holding down the left mouse button and moving the mouse, move the print to the desired position and release the mouse button;
5. The Windows "Print" window will be displayed, allowing you to select the desired printer, plotter or PDF creator;
6. If necessary, click [Settings] to set the correct paper size and orientation, as depicted in figure 4.2.3.
7. Click [Print] to print the selected section of the piping system.

If you have also printed the maintenance advice, notepad will also be started with a list of all these measures.

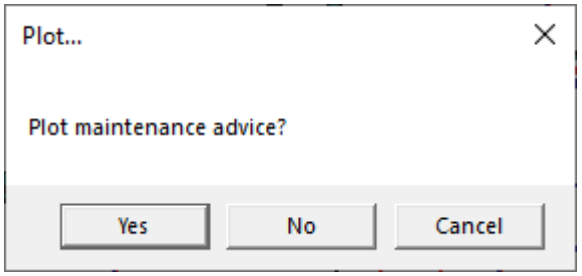


Figure 4.2.2

Remark:
When plotting, the selected portion of the display is printed. It is therefore necessary that the display is sufficiently reduced or enlarged to accurately place the frame of the paper size. The settings of the theme and the captions (labels) such as manhole number, manhole cover height, BOB, flow direction, size, material, etc. are taken from the Display options. This means that the print can be adjusted to your own insight and purpose.

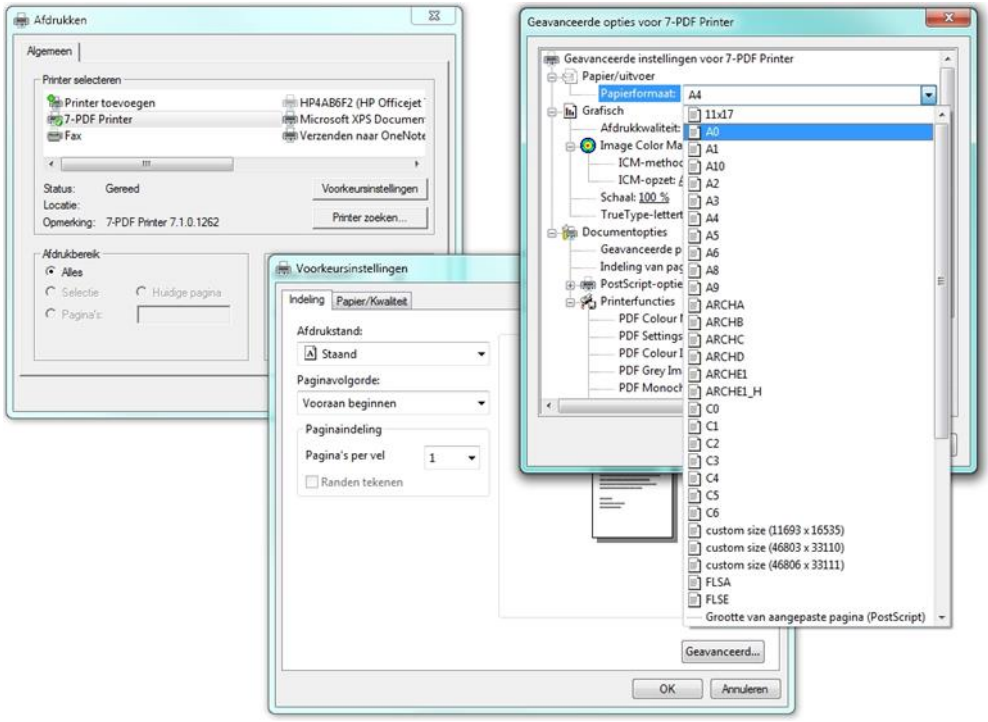


Figure 4.2.3

4.2.3 Plotting an entire area

Printing a portion of the piping system specified by the user on a printer, plotter or PDF-creator.

Make sure that the entire part to be plotted is visible in BRUTIS.

Operation:

1. Set the desired scale, paper size and orientation of the print, according section 4.1.2.
2. Click File -> Plot Window, or button: . BRUTIS then asks via the window in figure 4.2.2 whether you also want to print the bitmap measures from the assessment. If this question is answered with [Yes], a separate drawing will be made of each measure in A4 format on which the location of the measure is indicated. These images can then be included in specifications.
3. If this question is answered with [No], the active theme is plotted.
4. Click on the first vertex of the section to be printed. Hold down the mouse button and move the mouse so that the drawn rectangle frames the portion of the objects to be printed.
5. The Windows "Print" window will be displayed. Select the desired printer, plotter or PDF maker.
6. Press the [Preference Settings] button
7. Set the desired scale, paper size and orientation of the print according to the settings specified under point 2.
8. Press the [Print] button to print the selected portion of the objects.

Remark:
When plotting, the selected portion of the objects is printed. It is therefore necessary that the objects are sufficiently reduced or enlarged to allow the frame to be placed accurately.
The theme and captions (labels) settings are taken from the Display options. This allows the print to be set according to your own insight and purpose.

4.2.4 Printing

Make sure that the part to be printed is visible in BRUTIS.

1. Click on menu option: **File -> Print…**
2. The Windows "Print" window will be displayed, allowing you to select the desired printer, plotter or PDF creator.
3. Press the [Preference Settings] button.
4. Set the desired scale, paper size and orientation of the print according to point 3 of Plot settings.
5. Press the [Print] button to print the selected portion of the objects.

5 Cost Calculation

In this chapter the costing of replacement and cleaning of urban drainage (conduits) is described.

Contents

- Replacement, renovation and inspection costs calculation
- Maintenance cost calculation

5.1 Replacement, renovation and inspection cost calculation

BRUTIS calculates the costs for replacement and renovation based on the key cost figures and principles in the overview that you can create via: **Consult -> Report prices**. Figure 5.1.1 shows an example of the overview.

BRUTIS has a standard set of cost figures. The substantiation of these cost figures can be requested from Riodesk.

You can change the cost figures by:

6. exporting to a CSV file with the options under menu: **Export -> CSV Object data -> Costs**;
7. then change the contents with a spreadsheet program or word processor such as Notepad;
8. save and import the file via**: Import -> CSV Object data -> Start.**

The CSV file contains the cost figures for the most important material types, dimensions and profiles. BRUTIS interpolates the cost figures for the missing types.

BRUTIS always starts with the desired cost figures from the CSV file above, if you save the status aspects in the file: "brutis.csv", in the program folder.

5.1.1 Determining replacement costs

An example of the calculation of the replacement costs of the sewer system in this window can be found under the menu option**: Planning -> Calculate and display of replacement costs -> Urban drainage**. BRUTIS then displays a window that allows you to specify the name of the file and the desired output format:

- XML for display with MS-Excel or
- ASCII for notepad display.

In Figure 5.1.2. you see an example of a cost calculation via the menu option above. The calculation consists of:

1. A list of sewer lines for which costs have been calculated. The costs depend on:
    a. Soil type, size and trench depth of the string. In Figure 5.1.2 you see in red that BRUTIS interpolates an amount from the list of unit prices based on the trench depth based on these criteria.
    b. Function system, for calculating costs for house and gully connections
    c. Paving, for calculating costs for replacing the overlying pavement based on trench width and conduit length. BRUTIS calculates the slot width based on the diameter, wall thickness and top width of the pavement from the list of exit points.
2. The calculation of surcharges on the subtotal of € 298.193,-

APPLIED PRICES AND STORAGES: Prices excl.VAT, price level 2022

Number [st]	Dim [cm]	Soil srt.	Material	Prizes in [€] per [m] 1.0 m	1.5 m	2.0 m	2.5 m	3.0 m	3.5 m	4.0 m	4.5 m	5.0 m	Construction depth Insp.	Reno.	Wall
105	30	sand	concrete	156.38	174.20	192.01	209.83	267.71	285.53	303.33	321.15	338.96	6.17	461.01	0.13
105	30	clay	concrete	156.38	174.20	192.01	209.83	267.71	285.53	303.33	321.15	338.96	6.17	461.01	0.13
105	30	peat	concrete	156.38	174.20	192.01	209.83	267.71	285.53	303.33	321.15	338.96	6.17	461.01	0.13
64	25	sand	concrete	146.06	162.70	179.34	195.98	250.04	266.69	283.33	299.96	316.60	5.15	432.20	0.13
64	25	clay	concrete	146.06	162.70	179.34	195.98	250.04	266.69	283.33	299.96	316.60	5.15	432.20	0.13
64	25	peat	concrete	146.06	162.70	179.34	195.98	250.04	266.69	283.33	299.96	316.60	5.15	432.20	0.13
1	40	sand	pvc	81.99	98.93	98.93	98.93	98.93	98.93	98.93	98.93	98.93	9.60	0.00	0.00
1	40	clay	pvc	88.11	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12	9.60	0.00	0.00
1	40	peat	pvc	100.36	126.47	126.47	126.47	126.47	126.47	126.47	126.47	126.47	9.60	0.00	0.00
29	20	sand	pvc	88.77	105.72	105.72	105.72	105.72	105.72	105.72	105.72	105.72	4.12	0.00	0.00
29	20	clay	pvc	94.89	114.90	114.90	114.90	114.90	114.90	114.90	114.90	114.90	4.12	0.00	0.00

Etc…

OTHER PRICES:

House connections / m sewer	[€]:	67.61
Gully connections / m sewer	[€]:	40.48
Brick pavement / m2	[€]:	36.66
Asphalt pavement / m2	[€]:	86.83
Well point system / m sewer	[€]:	20.00

STORAGE: (if prices are exclusive then there is no storage counted for cost below)

Description	Storage perc.	When costs (exclusive) From [€]	To [€]
Cable&Pipe :	25	0	50000
Cable&Pipe :	20	50000	250000
Cable&Pipe :	15	250000	0
Environmnt :	15	0	50000
Environmnt :	15	50000	250000
Environmnt :	15	250000	0
Supervisor :	25	0	150000
Supervisor :	20	150000	450000
Supervisor :	15	450000	0
Contracter :	20	0	150000
Contracter :	15	150000	450000
Contracter :	10	450000	0
Contingenc :	0	0	150000
Contingenc :	0	150000	450000
Contingenc :	0	450000	0

BASIC ASSUMPTIONS:

Construction depth is lower side conduit minus:	0.00 m
Excavation width in sand when depth is 1.5 m :	3.80 m
Excavation width in sand when depth is 2.0 m :	3.40 m
Excavation width in sand when depth is 2.5 m :	3.40 m
Excavation width in sand when depth is 3.0 m :	3.40 m
Excavation width in sand when depth is 3.5 m :	3.40 m
Excavation width in sand when depth is 4.0 m :	3.40 m
Excavation width in sand when depth is 4.5 m :	3.40 m
Excavation width in sand when depth is 5.0 m :	3.40 m
Excavation width in clay when depth is 1.5 m :	3.80 m
Excavation width in clay when depth is 2.0 m :	3.40 m
Excavation width in clay when depth is 2.5 m :	3.40 m
Excavation width in clay when depth is 3.0 m :	3.40 m
Excavation width in clay when depth is 3.5 m :	3.40 m
Excavation width in clay when depth is 4.0 m :	3.40 m
Excavation width in clay when depth is 4.5 m :	3.40 m
Excavation width in clay when depth is 5.0 m :	3.40 m
Excavation width in peat when depth is 1.5 m :	3.80 m
Excavation width in peat when depth is 2.0 m :	3.40 m
Excavation width in peat when depth is 2.5 m :	3.40 m
Excavation width in peat when depth is 3.0 m :	3.40 m
Excavation width in peat when depth is 3.5 m :	3.40 m
Excavation width in peat when depth is 4.0 m :	3.40 m
Excavation width in peat when depth is 4.5 m :	3.00 m
Excavation width in peat when depth is 5.0 m :	3.40 m

Excavation width above is exclusive conduit width!!!

Prices are inclusive:
- cleaning, transport of silt and inspection;
- well point system from a depth of 2.5m;
- casing of trench;
- removing old conduits (pipes) and nodes;
- dig, fill and ground improvement;
- construct new conduits and nodes.
- storage of 34 procent when working in old town center of shopping area
- storage of 22 procent when working in a business area
- storage of 10 procent when workjing in a residential area

Prices are exclusive:
- reconstruction of kerbstones;
- taxes.

Figure 5.1.1

REPLACEMENTCOST CALCULATION dated 7-11-2023 : (See for basic prizes and basic assumptions, the option in the menu)

Replacementcosts:

Conduit id. From-To node	Soil	System type	Dim cm	Material	Ditch dep/wid	Con & Node	Connections house	Gully	Well	Length [m]	Cost exclusive [€] reno	unpav	bricks	asphal	cost
470005-470019	sand	wastewate	25	concrete	2.43 3.65	193.81	67.61	0.00	0.00	39.4	0	10300	15572	22787	22787
470019-470117	sand	wastewate	25	concrete	2.18 3.65	185.50	67.61	0.00	0.00	22.0	0	5568	8512	12540	12540
470020-470117	sand	wastewate	25	concrete	2.18 3.65	185.33	67.61	0.00	0.00	30.0	0	7588	11602	17096	17096
470020-470123	sand	wastewate	20	pvc	1.15 4.00	77.08	67.61	0.00	0.00	48.0	0	6947	13987	23621	23621
480021-480022	sand	surface w	40	pvc	1.46 4.20	80.63	67.61	40.48	0.00	42.4	0	8009	14543	23486	23486
480022-480026	sand	surface w	25	concrete	1.59 3.97	165.86	67.61	40.48	0.00	60.2	0	16497	25270	37276	37276
480026-480027	sand	surface w	30	concrete	1.67 3.96	180.26	67.61	40.48	0.00	61.0	0	17597	26466	38603	38603
Subtotal replacementcosts (exclusive) :			303			0	72506		115952	175407	72506				

Open water course dimension w1/h/w2:
w1=width toplevel
h =height
w2=width invert level

Storage :	Storag Perc.	Costs [€] renovatie	unpaved	bricks	asphalt	cost
Subtotal replacementcosts (exclusive)		0	72506	115952	175407	175407
Cable&Pipe with subtotal < 50000	25	0	0	0	0	0
Cable&Pipe with 50000 < subtotal < 250000	20	0	14501	23190	35081	35081
Cable&Pipe with subtotal > 250000	15	0	0	0	0	0
Environmnt with subtotal < 50000	15	0	0	0	0	0
Environmnt with 50000 < subtotal < 250000	15	0	10876	17393	26311	26311
Environmnt with subtotal > 250000	15	0	0	0	0	0
Supervisor with subtotal < 150000	25	0	18127	28988	0	0
Supervisor with 150000 < subtotal < 450000	20	0	0	0	35081	35081
Supervisor with subtotal > 450000	15	0	0	0	0	0
Contracter with subtotal < 150000	20	0	14501	23190	0	0
Contracter with 150000 < subtotal < 450000	15	0	0	0	26311	26311
Contracter with subtotal > 450000	10	0	0	0	0	0
Contingenc with subtotal < 150000	0	0	0	0	0	0
Contingenc with 150000 < subtotal < 450000	0	0	0	0	0	0
Contingenc with subtotal > 450000	0	0	0	0	0	0
Total replacementcosts incl. storage, excl. taxes :		0	130511	208714	298193	298193
Storage with old towncenter or shoppingmal :	34	0	44374	70963	101386	101386
Total incl. difficulty storage, excl. taxes :		0	174885	279676	399578	399578
Storage with business areas :	22	0	28712	45917	65602	65602
Total incl. difficulty storage, excl. taxes :		0	159223	254630	363795	363795
Storage with residential area:	10	0	13051	20871	29819	29819
Total incl. difficulty storage, excl. taxes :		0	143562	229585	328012	328012

Figure 5.1.2

5.2 Maintenance cost calculation

You can display and change the unit prices for calculating maintenance costs via the menu option: **Planning -> Change sewer maintenance unit prices**.

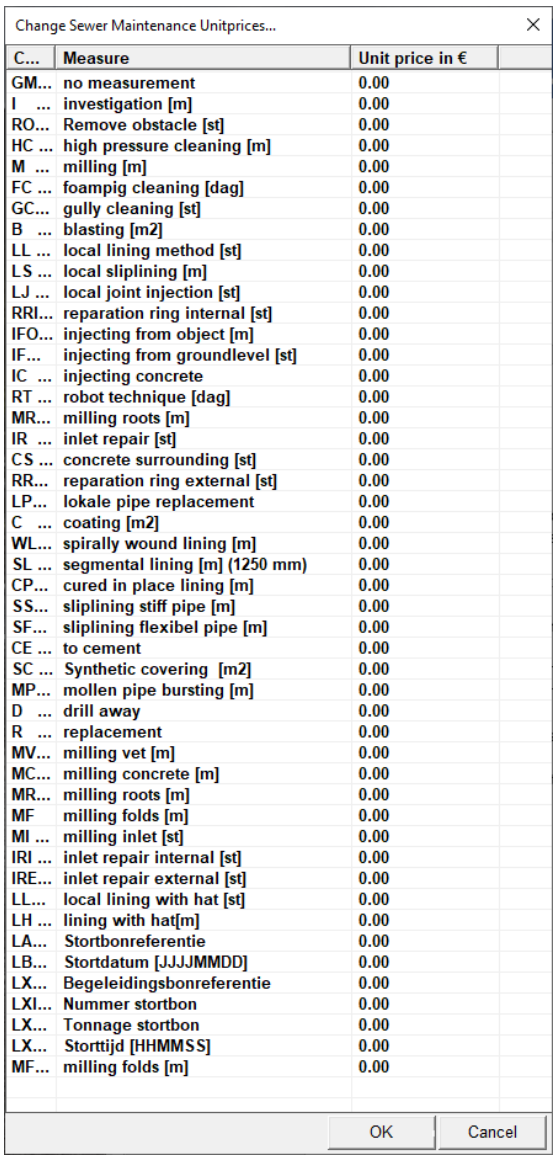
BRUTIS then shows the window according to Figure 5.2

BRUTIS uses these unit prices in the maintenance assessment.

Carrying out maintenance involves an enormous number of environmental variables, making it almost impossible to properly substantiate unit prices.

In the window you can only enter 1 price per measure.

We recommend contacting an advisor in this area to definitively determine the maintenance measure costs.



C...	Measure	Unit price in €
GM...	no measurement	0.00
I ...	investigation [m]	0.00
RO...	Remove obstacle [st]	0.00
HC ...	high pressure cleaning [m]	0.00
M ...	milling [m]	0.00
FC ...	foampig cleaning [dag]	0.00
GC...	gully cleaning [st]	0.00
B ...	blasting [m2]	0.00
LL ...	local lining method [st]	0.00
LS ...	local sliplining [m]	0.00
LJ ...	local joint injection [st]	0.00
RRI...	reparation ring internal [st]	0.00
IFO...	injecting from object [m]	0.00
IF...	injecting from groundlevel [st]	0.00
IC ...	injecting concrete	0.00
RT ...	robot technique [dag]	0.00
MR...	milling roots [m]	0.00
IR ...	inlet repair [st]	0.00
CS ...	concrete surrounding [st]	0.00
RR...	reparation ring external [st]	0.00
LP...	lokale pipe replacement	0.00
C ...	coating [m2]	0.00
WL...	spirally wound lining [m]	0.00
SL ...	segmental lining [m] (1250 mm)	0.00
CP...	cured in place lining [m]	0.00
SS...	sliplining stiff pipe [m]	0.00
SF...	sliplining flexibel pipe [m]	0.00
CE ...	to cement	0.00
SC ...	Synthetic covering [m2]	0.00
MP...	mollen pipe bursting [m]	0.00
D ...	drill away	0.00
R ...	replacement	0.00
MV...	milling vet [m]	0.00
MC...	milling concrete [m]	0.00
MR...	milling roots [m]	0.00
MF	milling folds [m]	0.00
MI ...	milling inlet [st]	0.00
IRI ...	inlet repair internal [st]	0.00
IRE...	inlet repair external [st]	0.00
LL...	local lining with hat [st]	0.00
LH ...	lining with hat[m]	0.00
LA...	Stortbonreferentie	0.00
LB...	Stortdatum [JJJJMMDD]	0.00
LX...	Begeleidingsbonreferentie	0.00
LXI...	Nummer stortbon	0.00
LX...	Tonnage stortbon	0.00
LX...	Storttijd [HHMMSS]	0.00
MF...	milling folds [m]	0.00

Figure 5.2

6 Assessment and planning

BRUTIS carries out sewerage management at strategic, tactical and operational level:

- the strategic level directs the tactical level and
- the tactical level in turn controls the operational level.

At the strategic level, you establish the principles for the tactical level by drawing up a multi-year budget. At the tactical level you use the principles to obtain a need for measures. The measure requirement is the source for obtaining planning and projects at the operational level.

Determining the principles for the tactical level is a cost/quality assessment process. You keep adjusting the starting points until you have found an acceptable multi-year budget. This process often takes place when drawing up the municipal sewerage plan, whereby the municipal council determines the policy (the principles) to be followed to maintain the functioning of the sewerage system.

As standard, BRUTIS includes all components in the multi-year budget and cost calculation. Also, the pressure pipes, drains, connections, low voltage, etc. You can leave these strands out of the display and calculations via the menu options:

1. **Tools -> Database tools -> Register conduit types for flow calculation**. You will then receive a window in which you indicate which conduit types are not allowed to participate;
2. **Display -> Display options**. Tab: **Conduits**, you can check the option: “only conduit types in flow calculation”.

But you can of course also make a selection of the sewer lines for which you want to calculate the multi-year budget by selecting, copying and pasting in a new window.

To prevent BRUTIS from displaying amounts twice, BRUTIS does not include the replacement costs of sewer lines for which a replacement, renovation or improvement measure is planned at operational level in the multi-year budget!

Contents

- Strategic planning (getting benchmark numbers for the assessment)
- Tactical planning (assessment of inspections, getting the needs for operational planning)
- Operational planning

6.1 Strategic planning

Here you can read how BRUTIS determines the residual life of sewerage for the multi-year budget. The multi-year budget contains the costs per year for replacing and renovating sewerage.

With the standard principles and cost figures in BRUTIS you can create a multi-year budget almost immediately. But because your management situation may deviate from the standard based on quality and budget, testing and possible adjustment of the principles and cost figures is necessary.

You can see these steps in the following: “Decision support model for the assessment of sewerage”, in figure 6.1.1. Testing against the warning and intervention standards takes place in the top half of the scheme. Determining the year of replacement is done in the bottom half of the scheme.

Remark:
According to the “Decision support model for the assessment of sewerage”, the extend criterion influences the choice of measures in the short term and the calculation of the year of replacement in the long term.

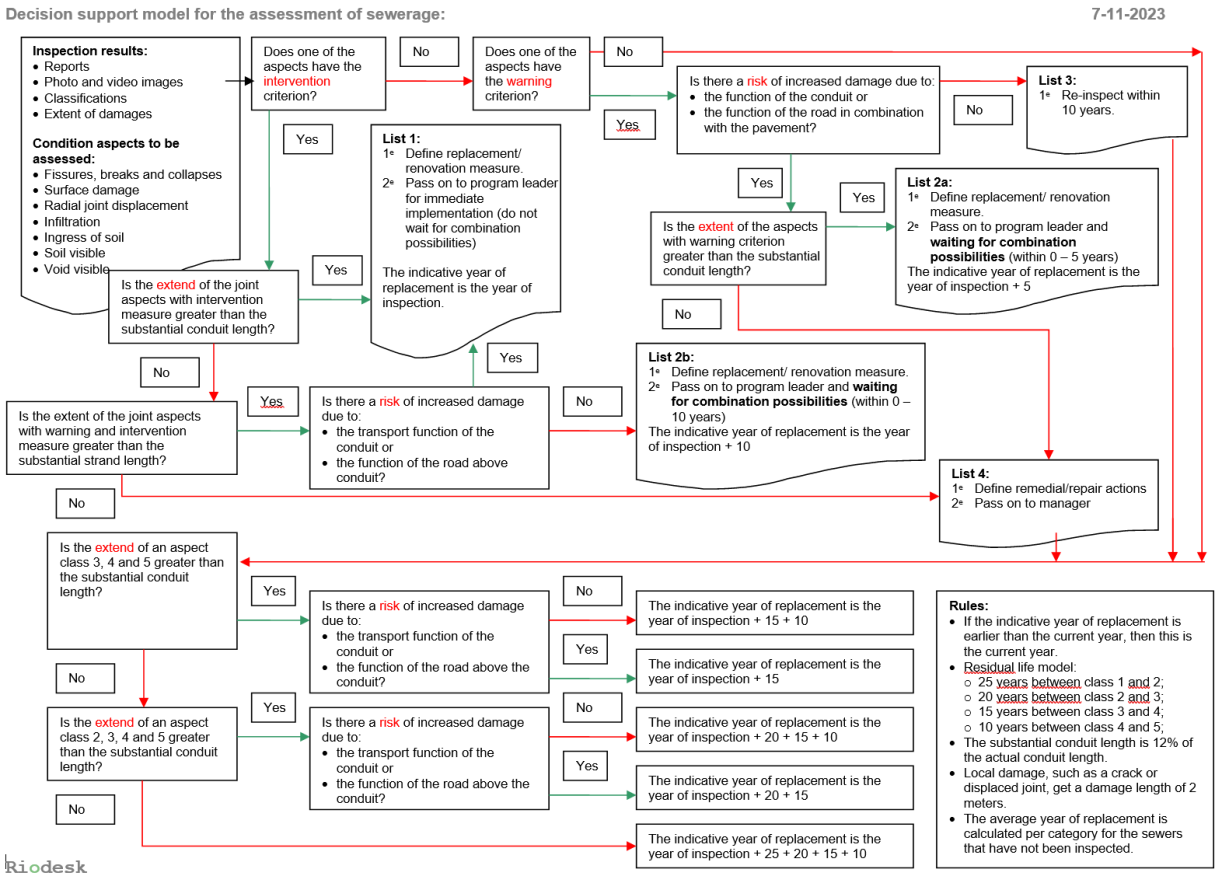


Figure 6.1.1

Operation:

BRUTIS carries out the following steps to arrive at a multi-year budget (basic planning and budget):

1. test against the extend, warning and intervention criterions/benchmarks;
2. determine the year of replacement and costs;

6.1.1 Test against the extend, warning and intervention criterions

Based on the extend, warning and intervention criteria and the condition aspects from inspection, BRUTIS determines which measures are necessary and when. BRUTIS uses the following criteria:

- If the intervention criterion has been reached, a measure is necessary.
- If the size of the condition aspect is smaller than the size criterion, this is a repair measure. If greater or equal, a replacement or renovation measure.
- If only the warning benchmark has been reached or if there are many other status aspects that have not reached the benchmark (high Q score), BRUTIS advises to monitor the status aspects.
- If there is a risk of: "the sewer system no longer functioning", or of: "traffic nuisance due to collapse of the sewer line", BRUTIS can advise a more stringent measure with more priority.
- BRUTIS consciously does not take into account aspects of the situation that only relate to runoff, such as sedimentation and water level. These aspects are often caused by the sewer system as a whole and not by the condition of the object: sewer line. These aspects, together with the drainage and storage capacity calculation, deserve attention in the basic sewerage plan (BRP) and are discussed at the tactical level.
- BRUTIS only considers the condition aspects that strongly determine the residual life of a sewer line. These are condition aspects that indicate the structural stability of the sewer line and are shown in the table below.

At a **tactical** level, BRUTIS presents the above measures and priorities as an assessment advice. You can adopt or adjust this advice via tab: “own assessment”, in the conduit Log. See figure 6.2.1

Code	Condition aspect	Benchmark numbers
BAB	Fissure	Warning = 4, Intervene = 5
BAC	Break/Collapse	Warning = 2, Intervene = 2
BAFA	Surface damage, mechanical	Warning = 4, Intervene = 5
BAFB	Surface damage, chemical - general	Warning = 4, Intervene = 5
BAFC	Surface damage chemical – damage in upper par	Warning = 4, Intervene = 5
BAFD	Surface damage, chemical – damage in lower part	Warning = 4, Intervene = 5
BAJ	Displaced joint	Warning = 4, Intervene = 5
BBD	Ingress of soil	Warning = 4, Intervene = 5
BBF	Infiltration (Water ingress)	Warning = 4, Intervene = 5
BAO	Soil visible through defect	Warning = 4, Intervene = 5
BAP	Void visible through defect	Warning = 4, Intervene = 5

The benchmark numbers in the table above indicate the severity class of the condition aspect. From 1 = not detected or new to 5 = most serious condition.
Comparing classes between state aspects is not possible. For example, a class 2 crack is more serious than a class 5 crack.

You can change the warning and intervention criteria by:

1. Export the benchmark numbers with option: **Export -> CSV Object data -> DSS parameters**, to a CSV file, with filename: **brutis.csv**[1], in the program directory;
2. then change the numbers in this file with a spreadsheet program or word processor such as Notepad;
3. save the file and import it with option: **Import -> CSV Object data -> Start**

The extend criteria is a percentage of the total conduit length. By default, BRUTIS uses a value of 12%

You can change the size criteria via:

1. menu option: **Planning -> Strategic Decision Support System -> Urban drainage -> Set DSS parameters**, BRUTIS displays a window with the size measure percentage for risk and non-risk sewer lines. You can change this percentage if you have connected to a database. For example, via menu option: **File -> Connect with database**.
2. start option: “**replen**”, where you do not need a connection to the database.

You can indicate the risk sewer conduits per conduit type and road type, via the menu options:

1. **Planning -> Priorities -> Register Conduit types with fail risk**;
2. **Planning -> Priorities -> Register Road types with fail risk**.

Via the menu options above, BRUTIS displays windows in which you can mark conduit types and road types as high-risk.

[1] If saved in file: brutis.csv, in the program directory the settings are automatically adapted when starting BRUTIS.

You can consult the results of the DSS via menu option: **Display -> Display Options**, tab: **Conduits**, checkbox: **DSS Assessment**. As shown in figure: 6.1.2

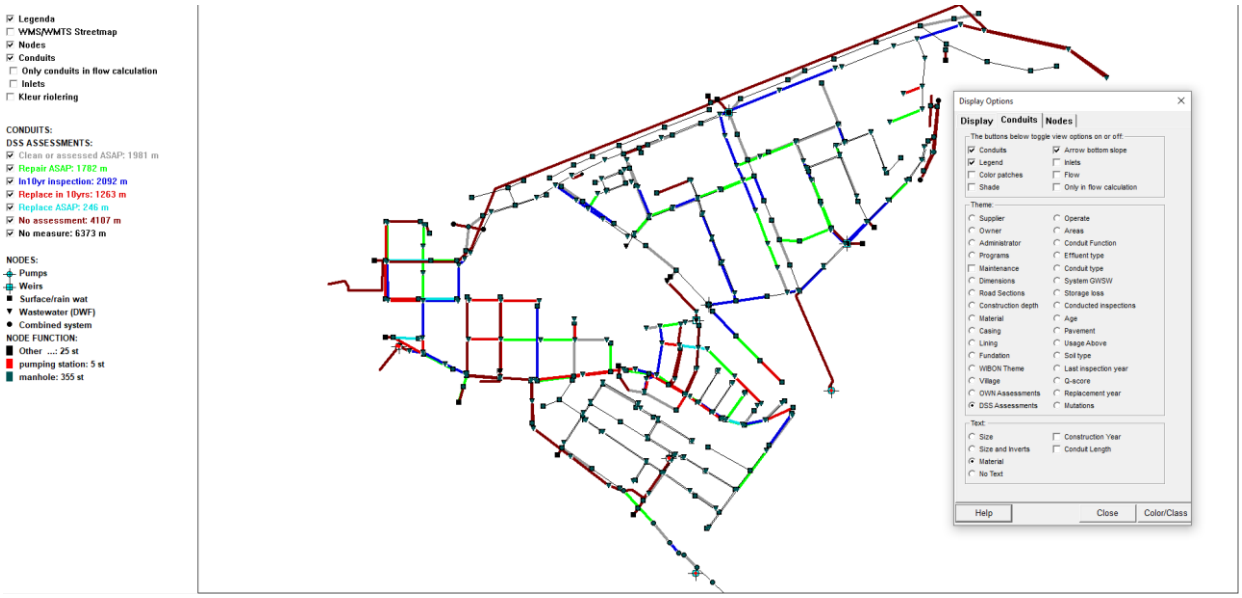


Figure 6.1.2

6.1.2 Determine the year of replacement and costs

See section 4 for the replacement cost calculation.

BRUTIS uses the following to determine the year of replacement:

1. Models for inspected sewer lines.
2. For the non-inspected sewer lines, the average year of replacement of the inspected sewers belonging to the same category.

BRUTIS displays the above data via menu option: **Planning -> Strategic Decision Support System -> Standard models**. First the models per condition aspect and category, then a list with the calculated year of replacement per sewer line and finally the average year of replacement per category.

Models for inspected sewer lines

To determine the year of replacement of the inspected sewer lines, BRUTIS uses the model: 25-20-15-10 in all situations. This means that it takes 25 years for an aspect to deteriorate from class 1 to 2, 20 years from 2 to 3, 15 years from 3 to 4 and 10 years from 4 to 5.

BRUTIS therefore uses a standard lifespan of 70 years (25+20+15+10).

If your sewer system has a shorter or longer lifespan on average, you can change the lifespan with menu option: **Tools -> Start options**, option "lifespan=".

For example: **lifespan=40**, where BRUTIS shortens the periods to: (15+12+8+5)

BRUTIS first calculates the year of replacement per condition aspect. Based on a lifespan of 70 years, this happens as follows:

1. If length classes 3, 4 and 5 together are greater than or equal to the size criterion, the year of replacement is:
    a. the inspection year + 15 + 10, if no risk.
    b. the inspection year + 15, if there is a risk of extended damage beyond the conduit.

2. If length classes 2, 3, 4 and 5 are jointly greater than or equal to the size criterion, the year of replacement is:
    a. the inspection year + 20 + 15 + 10, if no risk.
    b. the inspection year + 20 + 15, if there is a risk of extended damage beyond the conduit.
3. If the total is not greater than or equal to the size criterion, the year of replacement is:
    a. the inspection year + 25 + 20 + 15 + 10, if no risk.
    b. the inspection year + 25 + 20 + 15, if there is a risk of extended damage beyond the conduit.

Remark:

1. Only condition aspects with a sufficiently large extend are taken into account in the above consideration! If a condition aspect is less extensive than the size criterion, an aspect is not included in the calculation of the year of replacement.
2. According to the above calculations of the year of replacement, a risky sewer line will last 10 years less! 60 years instead of the standard 70 years.

BRUTIS carries out the above calculation for each condition aspect and uses the earliest year of replacement in the multi-year budget and other representations.

<u>Models for not inspected sewer lines</u>

For the non-inspected sewer lines, BRUTIS uses the average year of replacement of the inspected sewer lines mentioned above. BRUTIS calculates the average year of replacement per category. Non-inspected sewer lines within the category are assigned the average year of replacement. If no inspected sewer lines are present, BRUTIS will calculate one year of replacement

- the current year plus the standard 70 years, if no year of construction is recorded;
- the year of construction plus the standard 70 years (where the year of replacement cannot be lower than the current year), if the year of construction is registered.

BRUTIS divides the categories by:

- Year of construction:
    - older than 1941
    - between 1941 and 1966
    - between 1966 and 1990
    - younger than 1990
- Dimension:
    - smaller than 315mm
    - between 315mm and 600mm
    - greater than 600mm
- Type of discharge (system type):
    - mixed
    - dwf
    - surface/rain water
- Soil type:
    - sand
    - clay
    - peat
- Material type:
    - concrete
    - plastic
    - clay

Remark:

1. When determining the residual lifespan, the year of construction is only a criteria for the category classification, for which BRUTIS calculates an average year of replacement.
2. You can consult the calculated residual lifespans per category via menu option: **Consult -> Dashboard -> Indicator**. In addition to the basic principles, the dashboard also displays the average residual lifespan as a whole and per category, based on the residual lifespan calculation.

6.2 Tactical planning (assessment)

Tactical planning is in fact assessing sewerage.

Assessing sewerage consists of:

1. An automated tactical assessment advice from the BRUTIS program based on the inspection results, the scope, intervention and warning criteria and the residual life calculation describes in the previous section 6.1.
2. A manual own-assessment with which you check and correct the tactical assessment advice of the BRUTIS program.
3. An automatic/manual maintenance advice for planning maintenance based on the intervention and warning criteria.

This section concerns the tactical assessment advice and your own assessment. The strategic multi-year budget in BRUTIS is based on the advice of BRUTIS according to the principles in section 6.1 and your own assessment!

For example: If according to paragraph 6.1 a string “as soon as needs to be replaced” you can overrule this with your own assessment: “No measure”, so that the implementation ends up in the multi-year budget 10 years later.

BRUTIS stores your own assessment in the **database**. In order to take into account, display and register these assessments, it is therefore necessary to connect to the **database**, for example via the menu option: **File -> Connect to database**.

You can display the tactical assessment advice and your own assessment thematically via menu option: **Display -> Display Options**, tab: **Conduits**, checkboxes:

- **OWN Assessment** (the checked and corrected assessment)
- **DSS Assessment** (assessment advice from BRUTIS)

As shown in figure: 6.1.2.

6.2.1 Manual own-assessment to check/correct the strategic planning

The substantiation of the assessment advice and the management of your own assessment takes place in the tab: “Assessment”, in the “LOG”, window. See figure 6.2.1.

This tab consists of the following parts:

- Name and current date. Enter your name here. Registers name and date if you enter a review.
- The automated advice from BRUTIS based on the inspection results, the scope, intervention and warning criteria.
- The report of your own assessment in which you substantiate how you arrived at the quality figure and measures. You can change this report.
- The quality figure with Q-score and Indication year of replacement based on the calculation in section 6.1. You must indicate the quality rating in order to rigorously present your own assessment.
- Measures from your own assessment. These measures override any measures from the maintenance advice described in section 6.2.2
- The [Commit] button, which registers a “own assessment” in the database.
- History of your own assessments.

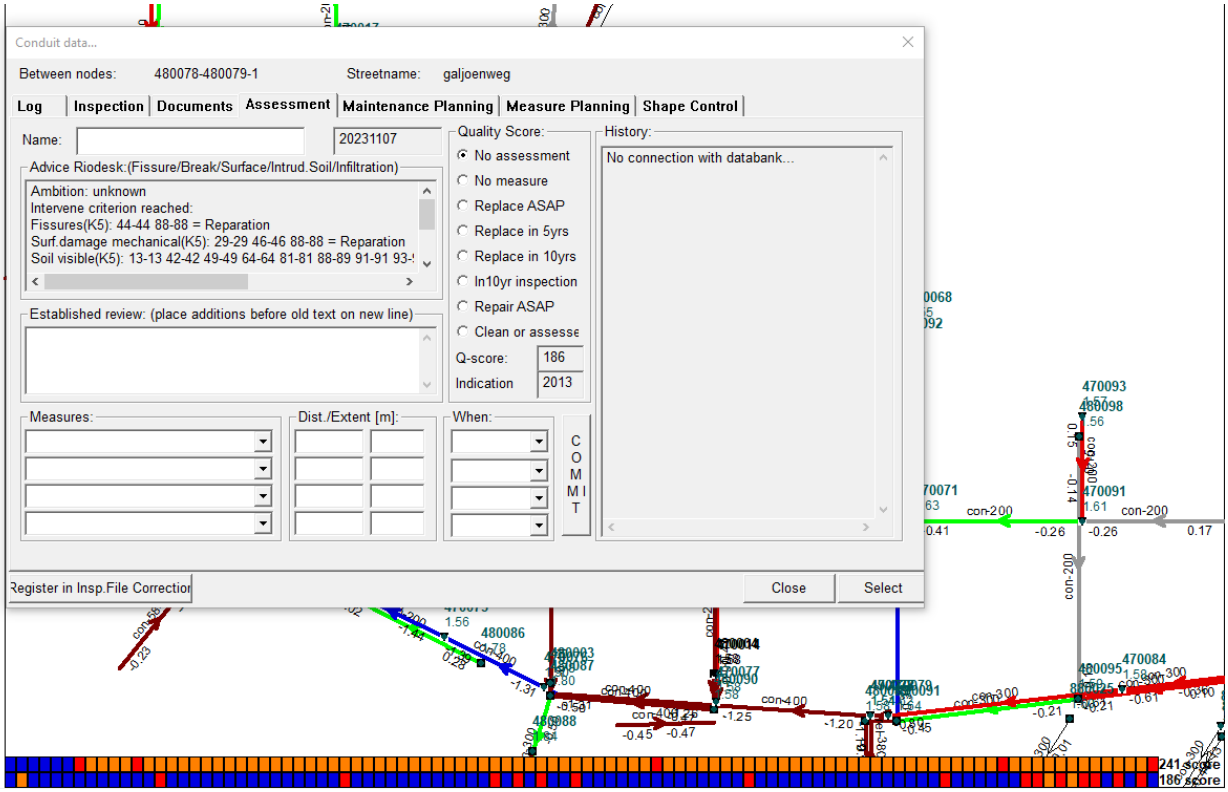


Figure 6.2.1

6.2.2 Manual own-assessment to plan maintenance

The assessment for maintenance takes place in the tab: “Log”, in the “LOG”, window. See figure 6.2.2.

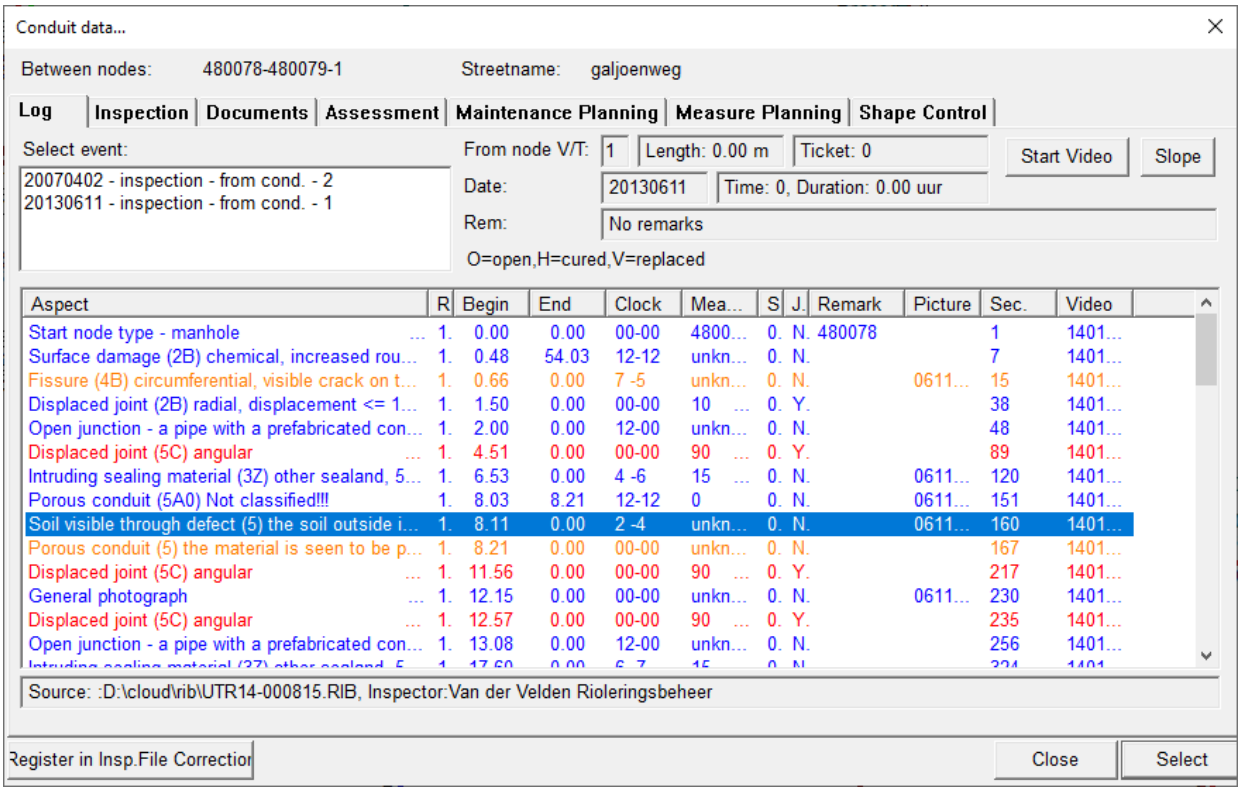


Figure 6.2.2

Steps to assess a conduit for maintenance:

1. Menu: Consult -> Conduit data, or press the button .
2. Click on an inspected conduit with the left mouse button
3. The "Conduit data" window is now displayed on the right side, as shown in figure: 6.2.3.
4. In the drawing, the automatically calculated advice measures on the conduit, are displayed with a symbol.
5. Click in the “Conduit data” window on the [Log] button.
6. The condition aspects for which BRUTIS recommends maintenance advice are marked in the “Status” column with the letter “A” (Advisory measure).
7. A definitive measure from own assessment are marked with the “B” (Assessed measure).
8. Click, with the right mouse button on the condition aspect for which you want to define a measure.
9. The window according to figure 6.2.4. appears. In this window you register:
    - the priority
    - the desired measure by choosing a measure from the list. (Symbol field fills automatically, with symbol number)
    - Description of obstacles.
    - Yes, if the measure is executed
    - Cost
    - Symbol and location are automatically filled
10. Click on [OK] to save the measure
11. If video images are linked and no photo has been taken of this damage image, the program will ask whether a photo can be taken from the video images.
12. Steps 8 to 11 can be repeated for each aspect.
13. When all measures have been taken, press the [Close] button in the “Conduit data…” Log-window.
14. If definitive measures have been taken, the message, in figure 6.2.5. will be displayed. Press [Yes] If you want to save the data with the original inspection file.

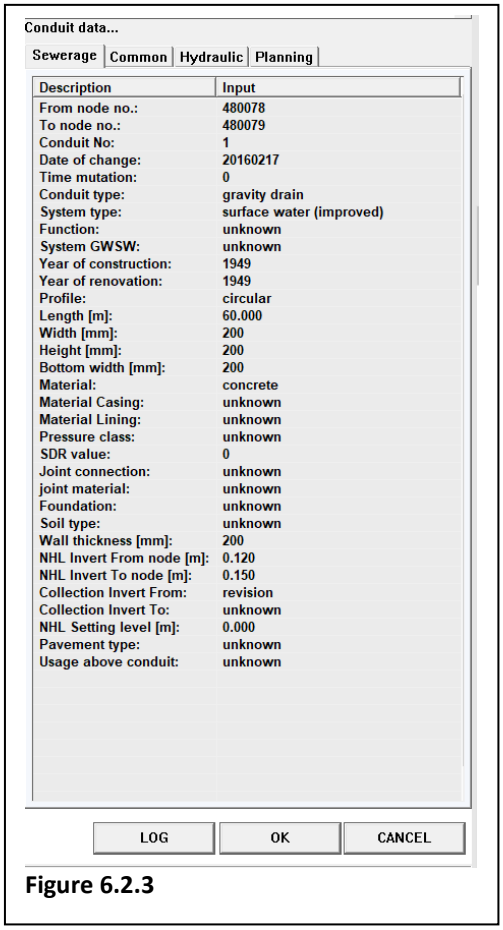


Figure 6.2.3

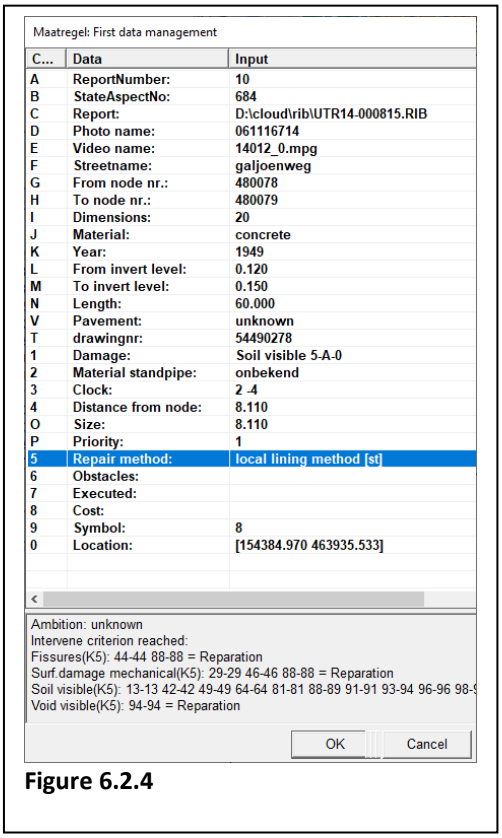


Figure 6.2.4

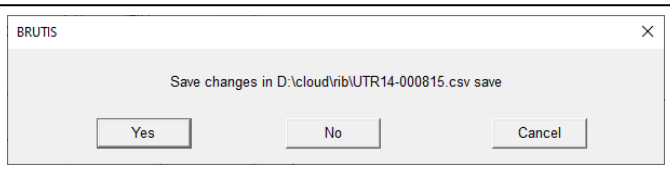


Figure 6.2.5

When consulting a conduit and plotting the data the measures are shown with the symbols in the table below:

Measurement	Symbol 1:1	Symbol 2:1	Symbol nr.	Abbrev.
Investigation [m]			1	NO
Remove obstacle [st]			2	OV
High pressure cleaning [m]			3	HR
Milling [m]			4	F
Foam-pig cleaning [day]			5	FR
Gully cleaning [st]			6	KZ
Blasting [m2]			7	S
Local lining method [st]			8	LK
Local slip lining [m]			9	LS
Local joint injection [st]			10	LV
Reparation ring internal [st]			11	RRI
Injecting from object [m]			12	IVO
injecting from ground level [st]			13	IVM
injecting in concrete [st]			14	IB
Robot technique [day]			15	RT
Manual repair			16	HR
Inlet repair [st]			17	IR
Concrete surrounding [st]			18	BO
Reparation ring external [st]			19	RRU
Local pipe replacement			20	LBV
Coating [m2]			21	C
Spirally wound lining [m]			22	WB
segmental lining [m] (1250 mm pipe)			23	SD
Cured in place lining [m]			24	K
Sliplining stiff pipe [m]			25	SSP
Sliplining flexibel pipe [m]			26	SFB

Measurement	Symbol 1:1	Symbol 2:1	Symbol nr.	Abbrev.
To cement			27	CE
Synthetic covering [m2]			28	KB
Mollen pipe bursting			29	MPB
Drill away			30	B
Replacement			31	V
Milling grease [m]			32	FV
Milling concrete [m]			33	FB
Milling roots [m]			34	FW
Milling folds in lining [m]			35	FP
Milling inlet [st]			36	FI
Inlet repair internal [st]			37	IRI
Inlet repair external [st]			38	IRU
Local lining with hat [st]			39	LKH
Lining with hat [m]			40	KH
Re-inspect and clean			41	OI
Drill core research			42	BK
Part liner and milling [m]			43	DF
Reopen inlet			44	IH

The measure symbols are drawn along the conduit, when consulting a conduit or plotting a drawing.

When entering the figure 6.2.4 window, it is possible to locate the symbol whit a leader along the pipe line, by drawing the leader with help of the button.

The status aspects with a priority greater than 0 are marked with a coloured square around the symbol.

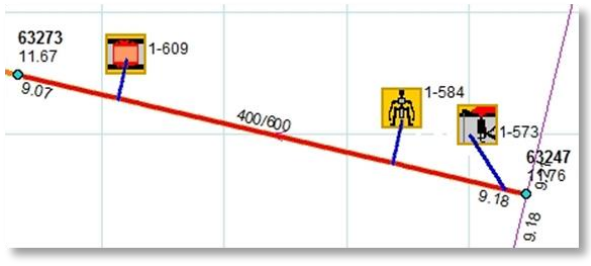


Figure 6.2.6

Prioriteit	Symbool	Toelichting
0	no	Default, not given
1		High
2		Average
3		Low

Figure 6.2.7

6.3 Operational planning

The operational planning is in fact a project registration that consists of:

- the registration of the project data
- linking conduits and nodes to projects before implementing a measure.

The operational planning distinguishes between maintenance and measure projects. In principle, maintenance includes: inspection, cleaning and repair. In principle, measures include: renovation, replacement and improvement. But in fact, you can choose all options.

You can link a conduit or node to 1 maintenance project and to 1 measure project.

BRUTIS stores the operational planning in the database. To take into account, display and register this planning, it is therefore necessary to connect to the database, for example with menu option: **File -> Connect to database**.

You create an annual program of measures based on the linked measures and project: “annual increments”. You can make selections and create reports here, among other things. In Figure 6.3 you see the tab: Measures program (next to Maintenance program), of the window which can be started via menu option: **Select -> Via filter -> Conduits**.

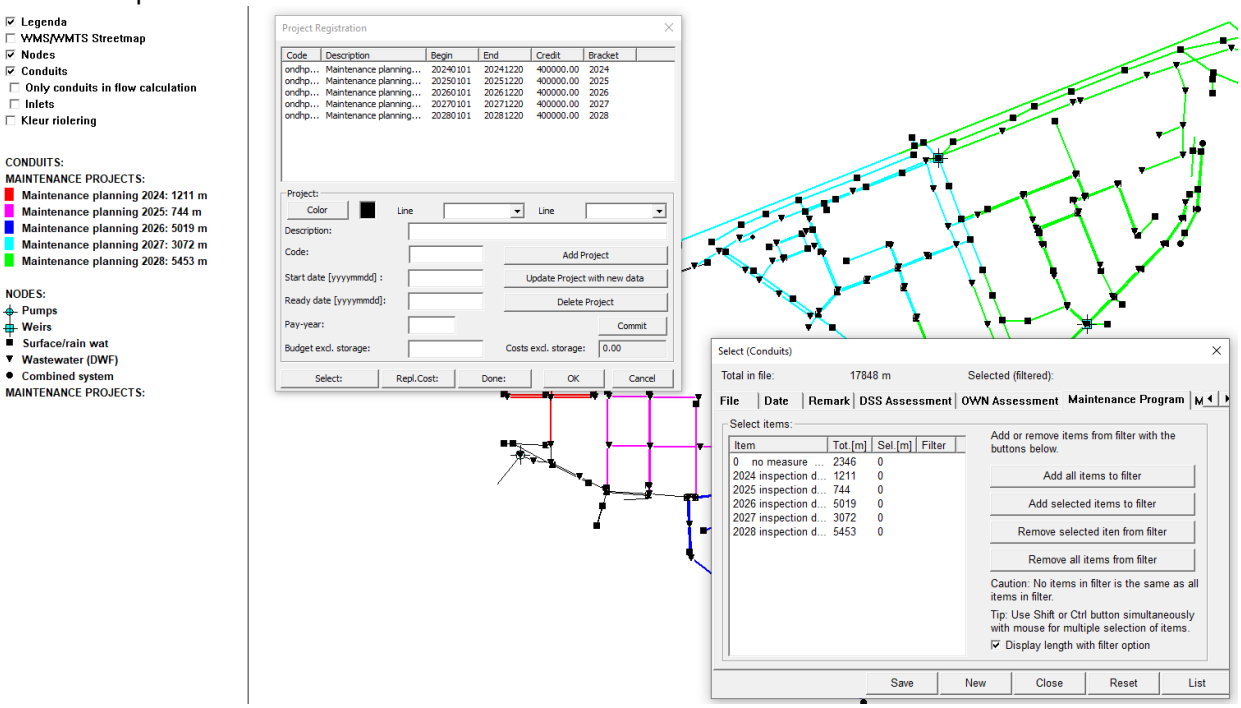


Figure 6.3

6.3.1 Registration of projects

Figure 6.3.1 shows the both project registration windows. As soon as you display this window, BRUTIS changes the display theme to measure or maintenance projects.

Figure 6.3 in combination with the legenda and data.

You start the windows with the options under menu: **Planning -> Planning operational measures and projects -> Project registration**:

- **Maintenance sewers…**
- **Measure sewers…**
- **Maintenance nodes** (to register nodes to a measures program.)

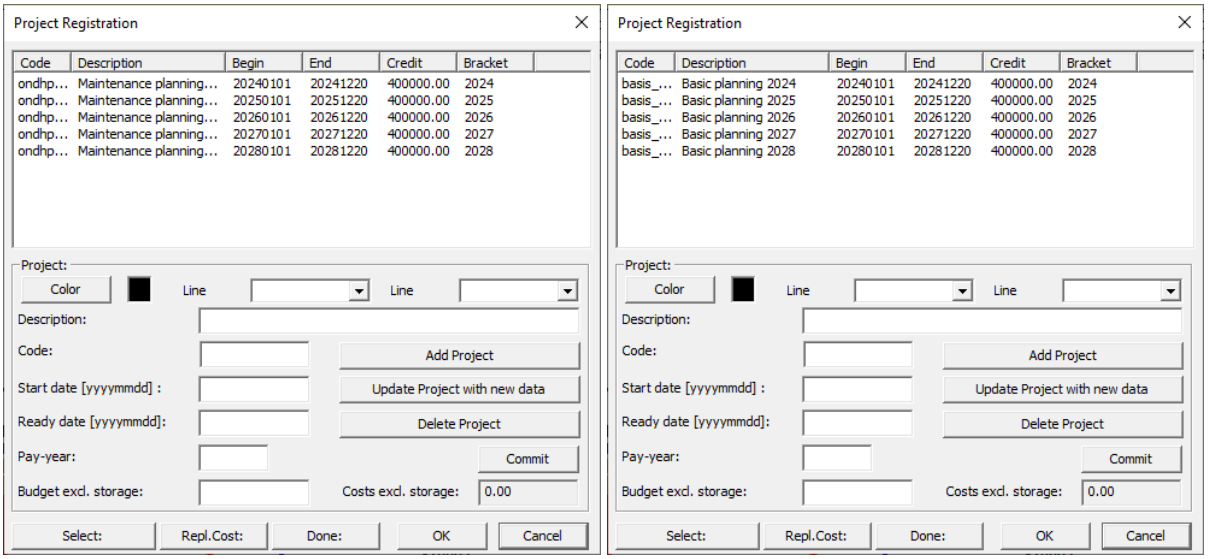


Figure 6.3.1

If you are not yet connected to the database, BRUTIS will first display the: “Log in to the database window”. After successful registration, BRUTIS shows the operational planning data from the database.

In the window, click on a project to display the project's details in the: “Project” section.

Change projects:
Once the data has been displayed, you can edit it and save it in the window above via the button: [Update project with new data].

Delete projects:
Once the details of a project have been displayed, you can delete it via the [Delete project] button, after which it will also be removed from the list above.

You add a project by:

1. choose a colour,
2. enter a description,
3. enter a unique code of up to 10 characters,
4. Enter a start date and finished date, always in the format: YYYYMMDD
5. the annual instalment from which the project is paid,
6. and enter a credit excluding surcharges.

After which you click on the [Add project] button. The project is then added to the list above.

You can save the changes in the meantime via the [Commit] button.

Use the [Select] button to select the strands and knots linked to the project.

Use the [Cancel] button to close the window without saving. Via the [OK] button, BRUTIS closes the window with the question whether you want to save the changes.

The user can easily add a next project by changing the remaining text in the registration fields and add the data via step 2 in the previous session.

The user can change projects by clicking on a project in the list. BRUTIS copies the to be changed project data in the registration fields. Update the project in the list with the data in the registration fields with the Update data with new data button.

6.3.2 Linking conduits to projects an define measurements

Now it is time to register the conduits belonging to the project.

You can attach or unlink strands or nodes to a project in 2 ways:

- By adding or removing via a selection.
- By adding or removing them one by one via the “Conduit data” and “Node data” Log windows.

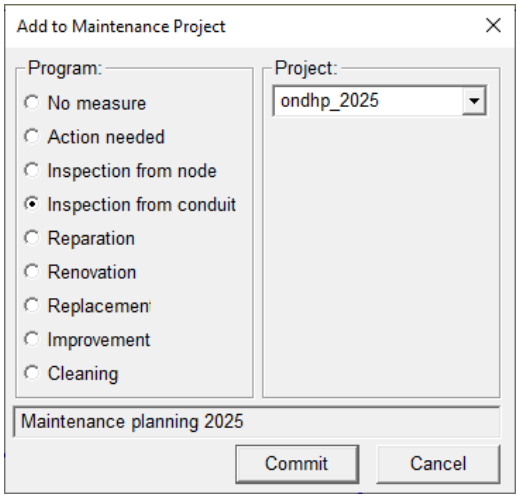


Figure 6.3.2

6.3.3 Adding or removing via a selection

See section 2 for selecting conduits. Selected conduits can be added via the options under menu: **Planning -> Planning operational measures and projects -> Add selection to project and measure program**.

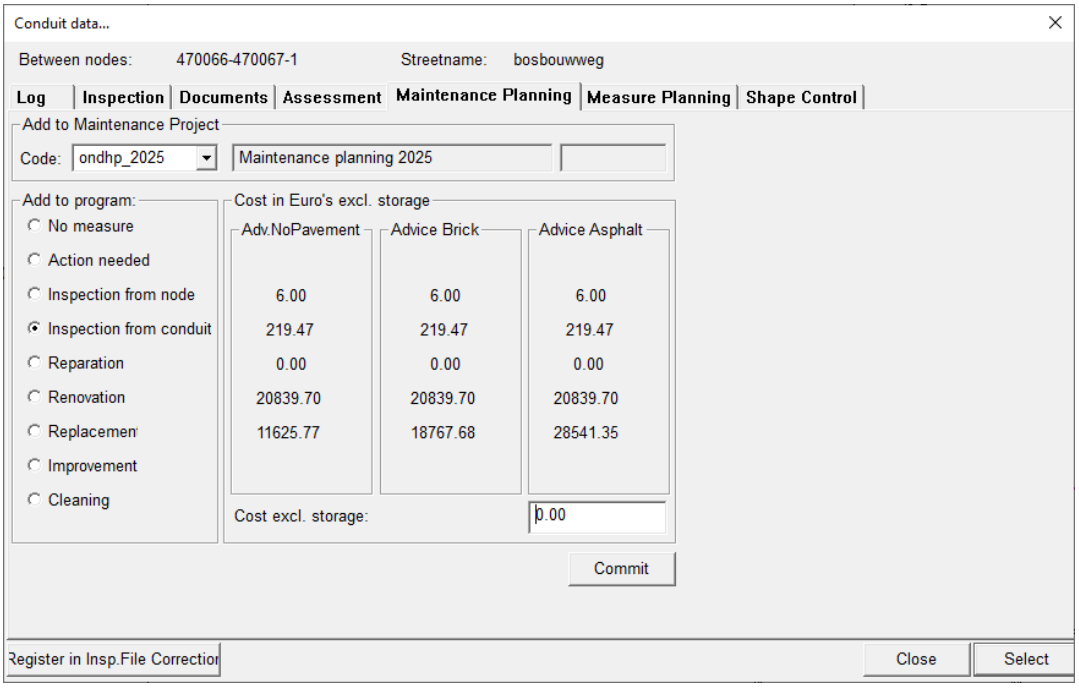
See figure 6.3.2.

In this window you first choose a project code and then a program of measures.

You finalize the recording by clicking on the [Commit] button.

BRUTIS only links the conduits to the project.

Adding or removing them one by one via the “Conduit data” and “Node data” Log windows
You can link the selected node or conduit in the “Conduit data” and “Node data” Log windows with the tabs: “Maintenance Planning” and “Measure Planning”.



In this window you first choose a project code and then a program of measures.

You finalize the recording by clicking on the [Commit] button.
You remove a conduit or node from a project by choosing project code: “0” and “No action”.

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Appendix A Breakdown of the BRUTIS replacement cost calculation

REPLACEMENTCOST CALCULATION dated 26-2-2009 : (See for basic prizes and basic assumptions, the option in the menu)

Replacementcosts:

Conduit id. From node -To node	Soil	Effluent type	Conduit type	Dimension [mm]	Material	Constr depth	Ditch width	Con & Node [Rp]	Connections hous [Rp]	Connections Gul [Rp]	Length [m]	Cost exclusive [Rp*1000] unpaved	bricks	asphalt	cost
5021 0002 -50210003	sand	unknown	closed	70/60/55	masonry c	0.74	2.50	***483.13***	0.00	0.00	4.4	2116	3496	6387	6387
5021 0007 -50210008	sand	unknown	open	70/60/60	masonry c	0.60	1.80	***492.76***	0.00	0.00	10.6	5248	7663	12724	12724
5021 0012 -50210013	sand	unknown	closed	70/60/65	masonry c	0.73	2.50	502.39	0.00	0.00	4.2	2130	3466	6264	6264
50210001 -5021 0002	sand	unknown	open	70/60/55	masonry c	0.81	1.80	483.13	0.00	0.00	2.3	1111	1633	2726	2726
50210003 -50210004	sand	unknown	open	70/60/55	masonry c	0.63	1.80	483.13	0.00	0.00	6.7	3222	4735	7905	7905
50210004 -50210005	sand	unknown	closed	63/40/53	masonry c	0.53	2.43	391.29	0.00	0.00	3.0	1174	2092	4017	4017
50210005 -50210006	sand	unknown	open	63/55/53	masonry c	0.58	1.80	447.16	0.00	0.00	3.6	1601	2413	4114	4114
50210006 -5021 0007	sand	unknown	closed	63/45/53	masonry c	0.60	2.43	409.92	0.00	0.00	3.1	1267	2213	4195	4195
50210008 -50210009	sand	unknown	closed	70/50/60	masonry c	0.63	2.50	451.02	0.00	0.00	4.0	1813	3079	5733	5733
50210009 -50210010	sand	unknown	open	70/60/60	masonry c	0.60	1.80	492.76	0.00	0.00	19.8	9732	14211	23597	23597
50210010 -50210011	sand	unknown	closed	65/45/55	masonry c	0.61	2.45	415.70	0.00	0.00	4.0	1671	2912	5512	5512
50210011 -5021 0012	sand	unknown	open	65/60/55	masonry c	0.68	1.80	473.49	0.00	0.00	1.5	710	1050	1763	1763
50210013 -50210014	sand	unknown	open	65/80/55	masonry c	0.76	1.80	550.56	0.00	0.00	10.1	5550	7836	12626	12626
50210014 -50210015	sand	unknown	open	65/65/55	masonry c	0.76	1.80	492.76	0.00	0.00	7.6	3725	5440	9032	9032
50210015 -50210016	sand	unknown	closed	70/50/60	masonry c	0.68	2.50	451.02	0.00	0.00	7.4	3347	5684	10581	10581
50210016 -50210017	sand	unknown	open	70/60/60	masonry c	0.71	1.80	492.76	0.00	0.00	6.0	2961	4325	7181	7181
50210017 -50210018	sand	unknown	closed	70/65/60	masonry c	0.81	2.50	513.63	0.00	0.00	3.7	1906	3074	5523	5523
50210018 -50210019	sand	unknown	open	70/70/60	masonry c	0.83	1.80	534.50	0.00	0.00	13.3	7087	10095	16396	16396
50211001 -50211002	sand	unknown	open	70/50/50	masonry c	0.67	1.80	434.96	0.00	0.00	51.1	22222	33809	58087	58087
50211002 -50211003	sand	unknown	closed	70/40/50	masonry c	0.53	2.50	396.43	0.00	0.00	4.2	1665	2988	5760	5760
50211003 -50211004	sand	unknown	open	70/50/50	masonry c	0.63	1.80	434.96	0.00	0.00	15.9	6938	10555	18135	18135
50211004 -50211005	sand	unknown	closed	70/50/50	masonry c	0.68	2.50	434.96	0.00	0.00	28.5	12418	21411	40254	40254
50211005 -50211006	sand	unknown	open	70/60/60	masonry c	0.78	1.80	492.76	0.00	0.00	18.0	8884	12974	21542	21542
								Subtotal replacementcosts		(exclusive) :	233	108499	167155	290052	290052

Figure A.1 (page 1/2)

Number [st]	Dimension [cm]	Soil srt.	Material	Prizes in [Rp*1000] per [m] 1.5 m	2.0 m	2.5 m	3.0 m	Construction depth 3.5 m
5	70/60/55	sand	masonry coursed	***483.13***	483.13	483.13	483.13	483.13
5	70/60/55	clay	masonry coursed	487.97	487.97	487.97	487.97	487.97
5	70/60/55	peat	masonry coursed	490.00	490.00	490.00	490.00	490.00
23	70/60/60	sand	masonry coursed	***492.76***	492.76	492.76	492.76	492.76
23	70/60/60	clay	masonry coursed	497.85	497.85	497.85	497.85	497.85
23	70/60/60	peat	masonry coursed	500.00	500.00	500.00	500.00	500.00

Figure A.2 (part 1/4)

OTHER PRICES:
House connections / m sewer [Rp*1000]: 0.00
Gully connections / m sewer [Rp*1000]: 0.00
Brick pavement / m2 [Rp*1000]: 126.00
Asphalt pavement / m2 [Rp*1000]: 390.00

2116 = 483.13 x 4.38
3496 = 483.13 x 4.38 + 126.00 x 4.38 x 2.50
6387 = 483.13 x 4.38 + 390.00 x 4.38 x 2.50

Remarks:
4.38 is length in report displayed as 4.4
When conduit type is open, ditch width is excl. width of conduit

Figure A.2 (part 2/4)

Appendix A Breakdown of the BRUTIS replacement cost calculation

Storage :	Storag Perc.	Costs [Rp*1000] unpaved	bricks	asphalt	cost
Subtotal replacementcosts (exclusive)		108499	167155	290052	290052
Cable&Pipe with subtotal < 50000	0	0	0	0	0
Cable&Pipe with 50000 < subtotal < 250000	0	0	0	0	0
Cable&Pipe with subtotal > 250000	0	0	0	0	0
Environmnt with subtotal < 50000	0	0	0	0	0
Environmnt with 50000 < subtotal < 250000	0	0	0	0	0
Environmnt with subtotal > 250000	0	0	0	0	0
Supervisor with subtotal < 150000	0	0	0	0	0
Supervisor with 150000 < subtotal < 450000	0	0	0	0	0
Supervisor with subtotal > 450000	0	0	0	0	0
Contracter with subtotal < 150000	5	5425	0	0	0
Contracter with 150000 < subtotal < 450000	5	0	8358	14503	14503
Contracter with subtotal > 450000	5	0	0	0	0
Contingenc with subtotal < 150000	6	6510	0	0	0
Contingenc with 150000 < subtotal < 450000	6	0	10029	17403	17403
Contingenc with subtotal > 450000	6	0	0	0	0
Total replacementcosts incl. storage, excl. taxes :		120434	185542	321958	**321958**
Storage with old towncenter or shoppingmal :	34	40948	63084	109466	109466
Total incl. difficulty storage, excl. taxes :		161381	248626	431424	**431424**
Storage with business areas :	22	26495	40819	70831	70831
Total incl. difficulty storage, excl. taxes :		146929	226361	392789	**392789**
Storage with residential area:	10	12043	18554	32196	32196
Total incl. difficulty storage, excl. taxes :		132477	204096	354154	**354154**

Figure A.1 (page 2/2)

Prices are inclusive:
- cleaning, transport of silt and inspection;
- well point system and casing of trench from a depth of 2.5m;
- removing old conduits (pipes) and nodes;
- dig, fill and ground improvement;
- construct new conduits and nodes.
- storage of 34 procent when working in old town center of shopping area
- storage of 21 procent when working in a business area
- storage of 10 procent when workjing in a residential area

Prices are exclusive:
- reconstruction of kerbstones;
- taxes.

Figure A.2 (page 4/4)

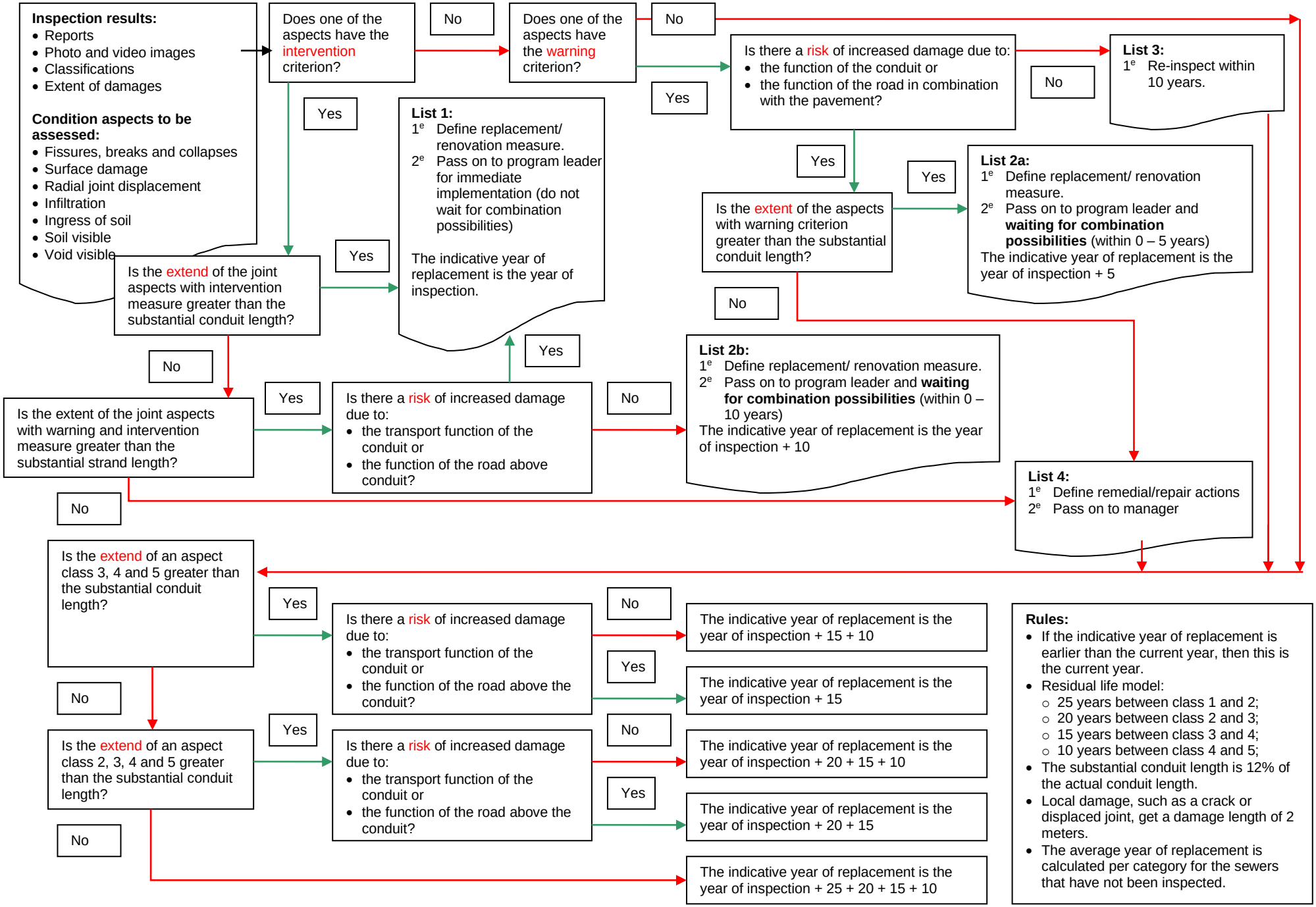
STORAGE: (if prices are exclusive then there is no storage counted for cost below)

Description	Storage perc.	When costs (exclusive) From [Rp]	To [Rp]
Cable&Pipe :	0	0	50000
Cable&Pipe :	0	50000	250000
Cable&Pipe :	0	250000	0
Environmnt :	0	0	50000
Environmnt :	0	50000	250000
Environmnt :	0	250000	0
Supervisor :	0	0	150000
Supervisor :	0	150000	450000
Supervisor :	0	450000	0
Contracter :	5	0	150000
Contracter :	5	150000	450000
Contracter :	5	450000	0
Contingenc :	6	0	150000
Contingenc :	6	150000	450000
Contingenc :	6	450000	0

BASIC ASSUMPTIONS:

Construction depth is lower side conduit minus:	0.00 m
Excavation width in sand when depth is 1.5 m :	1.80 m
Excavation width in sand when depth is 2.0 m :	3.47 m
Excavation width in sand when depth is 2.5 m :	4.13 m
Excavation width in sand when depth is 3.0 m :	2.00 m
Excavation width in sand when depth is 3.5 m :	2.00 m
Excavation width in sand when depth is 4.0 m :	2.00 m
Excavation width in sand when depth is 4.5 m :	2.00 m
Excavation width in sand when depth is 5.0 m :	2.00 m
Excavation width in clay when depth is 1.5 m :	1.80 m
Excavation width in clay when depth is 2.0 m :	3.47 m
Excavation width in clay when depth is 2.5 m :	4.13 m
Excavation width in clay when depth is 3.0 m :	2.00 m
Excavation width in clay when depth is 3.5 m :	2.00 m
Excavation width in clay when depth is 4.0 m :	2.00 m
Excavation width in clay when depth is 4.5 m :	2.00 m
Excavation width in clay when depth is 5.0 m :	2.00 m
Excavation width in peat when depth is 1.5 m :	0.00 m
Excavation width in peat when depth is 2.0 m :	0.00 m
Excavation width in peat when depth is 2.5 m :	1.00 m
Excavation width in peat when depth is 3.0 m :	0.00 m
Excavation width in peat when depth is 3.5 m :	0.00 m
Excavation width in peat when depth is 4.0 m :	0.00 m
Excavation width in peat when depth is 4.5 m :	0.00 m
Excavation width in peat when depth is 5.0 m :	0.00 m

Excavation width above is exclusive conduit width!!!

Figure A.2 (page 3/4)

Appendix B Decision support model for the assessment of sewerage: