Department for Transport

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Structures Asset Management Planning Toolkit

User Guide to the Computerised Model

Version 2.01

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Haydn Davies	Department for Transport
Steve Berry	Department for Transport
Chris Allen-Smith (Chair)	Hertfordshire County Council
Mandy Bretherton	Chartered Institute of Public Finance and Accountancy
Chris Brain	Chartered Institute of Public Finance and Accountancy
Shaun Darcy	Bournemouth Borough Council
Steve Mead	Derbyshire County Council
Clive Griffiths	Hampshire County Council
Geoff Lewis	Hertfordshire County Council
Keith Harwood	Hertfordshire County Council
Harry Godwin	Leicestershire County Council
Neil Eglintine	Newcastle City Council
Paul Boss	Staffordshire County Council
Colin Jenkins	Warrington Borough Council
Graeme Ferguson	SCOTS/SRMCS/Perth & Kinross
Duro Basic	Transport for London
Lila Tachtsi	Atkins
Andy Woolley	Atkins
Dr Ray Hickey	Atkins
Pat Haley	Atkins
John Paterson	Atkins

Project Team

Lila Tachtsi	Atkins
Andy Woolley	Atkins
Dr Ray Hickey	Atkins
Oriana Hesketh	Atkins
Pat Haley	Atkins
John Paterson	Atkins
Sergey Mikhaylov	Atkins
Jonathan Gamble	Atkins

Contents

Section		Page
1.	**Introduction**	**3**
1.1	General	3
1.2	Background Information	3
1.3	Layout of the User Guide	3
1.4	Important Notes for the User	4
2.	**Overview of the Model**	**5**
2.1	General	5
2.2	Creating a New Copy of the Blank Model	5
2.3	Considerations before and while Using the Model	7
2.4	Opening the SAMPt Model	9
2.5	Clear the Model	11
2.6	View/Enter Essential Data	12
2.7	Analyse New Scenario	13
2.8	Show/Hide Worksheets with Reference Data	15
3.	**Essential Input Data**	**18**
3.1	General	18
3.2	Data on (Groups of) Structures: ‘Structure Database’ Worksheet	18
3.3	Data on Elements: ‘Element Database’ Worksheet	20
3.4	Data on Programmes of Work: ‘Upgrades, Improvements & LCPs’ Worksheet	21
3.5	Data on Regular Maintenance: ‘Rtn Mntnce, Inspctns & Assmnts’ Worksheet	21
4.	**Outputs of the Model**	**23**
4.1	General	23
4.2	Output Charts and Data Tables of Asset Management Planning Analysis	23
4.3	Output data of HAMFIG DRC Analysis	24
5.	**References**	**25**
Appendix A : Interpretation of Output Charts		**26**
A.1	General	27
A.2	Chart01 - Work,Shortfall&Cond	27
A.3	Chart02 - SSCIav by Type	28
A.4	Chart03 - SSCIcrit by Type	29
A.5	Chart04 - Expenditure by Type	30
A.6	Chart05 - Expenditure by Life	31
A.7	Chart06 – Shortfall	32
A.8	Chart07 - Risk & Traffic Delay	33
A.9	Chart08 - Condition Bands	34
Appendix B : Default Information		**35**
B.1	General	36
B.2	‘Reference_03&04_i’ Worksheet	36
B.3	‘Reference_03&04_ii’ Worksheet	37
B.4	‘Reference_05&07’ Worksheet	38
B.5	‘Reference_06’ Worksheet	39

B.6 ‘Reference_08’ Worksheet 40
B.7 ‘Reference_09’ Worksheet 40
B.8 ‘Reference_10’ Worksheet 41
B.9 ‘Reference_11_i’ Worksheet 41
B.10 ‘Reference_12’ Worksheet 41
B.11 ‘Reference_14’ Worksheet 42

List of Tables

Table 1: Layout of the User Guide 3
Table 2: Colour Coding in the Model 7
Table 3: Content of Worksheets with Reference Data 16
Table 4: Output Charts of the SAMPt Model 23
Table 5: Acceptable Locations for Traffic Management Arrangements 40

List of Figures

Figure 01: Copying the SAMPt Model 5
Figure 02: Pasting the SAMPt Model 6
Figure 03: Renaming the SAMPt Model 6
Figure 04: Displaying Progress on Tasks 8
Figure 05: Saving the Model 9
Figure 06: Opening the SAMPt Model in Microsoft Excel 2007 9
Figure 07: Main Menu of the SAMPt Model 10
Figure 08: Accessing the Main Menu 11
Figure 09: Selecting Which Parts of the Model should be Cleared 11
Figure 10: Viewing and Entering Essential Input Data 12
Figure 11: Enabling Automatic Calculations 12
Figure 12: Viewing the Results from the Last Analysis 12
Figure 13: Selecting the Type of Analysis to be Performed 13
Figure 14: Calculating DRC Valid for 2014/2015 13
Figure 15: Viewing Results of Scenario where DRC is Valid for 2014/2015 14
Figure 16: Developing Asset Management Plans and Calculating DRC Not Valid for 2014/2015 14
Figure 17: Restrictions on Copying and Pasting Data in the ‘Structure Database’ Worksheet 19
Figure 18: Potential for Additional Adjustment Factors for the GRC 19
Figure 19: Applying a Global Reduction Factor to the Mean Times to Failure 22
Figure 20: Example of Output Chart 01 27
Figure 21: Example of Output Chart 02 28
Figure 22: Example of Output Chart 03 29
Figure 23: Example of Output Chart 04 30
Figure 24: Example of Output Chart 05 31
Figure 25: Example of Output Chart 06 32
Figure 26: Example of Output Chart 07 33
Figure 27: Example of Output Chart 08 34
Figure 28: Adding Additional Component/Material Types 36
Figure 29: Indicating Which Component/Material Types are Appropriate for Elements 37
Figure 30: Indicating that a Functioning Finish Freezes Deterioration of the Component/Material Type 37
Figure 31: Defining the Condition Deterioration Profile of a Component/Material Type 37
Figure 32: Adding New Adjustment Factors 41

1. Introduction

1.1 General

1.1.1 This document is the user guide to the proof-of-concept Excel model for the *Structures Asset Management Planning Toolkit* (SAMPt).

1.1.2 Two versions of the proof-of-concept model have been developed:

- The full version of the model, allowing for a maximum of 2,500 individual – or groups of – structures and 30,000 elements on those structures (*SAMPt_Model_v02-01_BLANK.xlsm*)
- The small version of the model, having the same functionality as the full version but allowing for a maximum of 250 individual – or groups of – structures and 3,750 elements on those structures (*SAMPt_Model_v02-01_small_BLANK.xlsm*)

1.1.3 Unless clearly stated otherwise, the guidance in this document applies to both versions of the proof-of-concept model.

1.1.4 This user guide should be read in conjunction with the following:

- Part A: Methodology
- Part C: Supporting Information

1.2 Background Information

1.2.1 The *Structures Asset Management Planning Toolkit* supports bridge engineers and managers in their management and other related activities, for example, financial planning, prioritisation of needs, lifecycle planning and asset valuation.

1.2.2 This version of the toolkit (Version 2.01, March 2015) focuses on long-term asset management and financial planning and asset valuation/depreciation for highway structures. The valuation module has been updated from the previous version.

1.3 Layout of the User Guide

1.3.1 The layout of this user guide is summarised in Table 1.

Table 1: Layout of the User Guide

Section	Description
2. Overview of the Model	Presents an overview of the SAMPt model, including general guidance that should be considered before and while using the model.
3. Essential Input Data	Describes what data sets are required to run the model and how to enter the data.
4. Outputs of the Model	Provides details of the model outputs.
5. References	Lists relevant documents that may need to be read in conjunction with this user guide to fully understand the model.
Appendix A: Interpretation of Output	Describes how the output charts may be interpreted.
Appendix B: Default Information	Explains the default information in the model.

1.4 Important Notes for the User

1.4.1 Important notes that require the user's particular attention are highlighted with the use of a box around the text.

2. Overview of the Model

2.1 General

2.1.1 This section presents an overview of the SAMPt model, including general guidance that should be considered before and while using the model.

2.2 Creating a New Copy of the Blank Model

2.2.1 It is recommended that a copy of the blank model is retained and that a separate copy of the blank model is created for analysis.

i. In Windows Explorer, right-click on the file name.

ii. Select **Copy** on the menu that appears (shown in the red box in Figure 01).

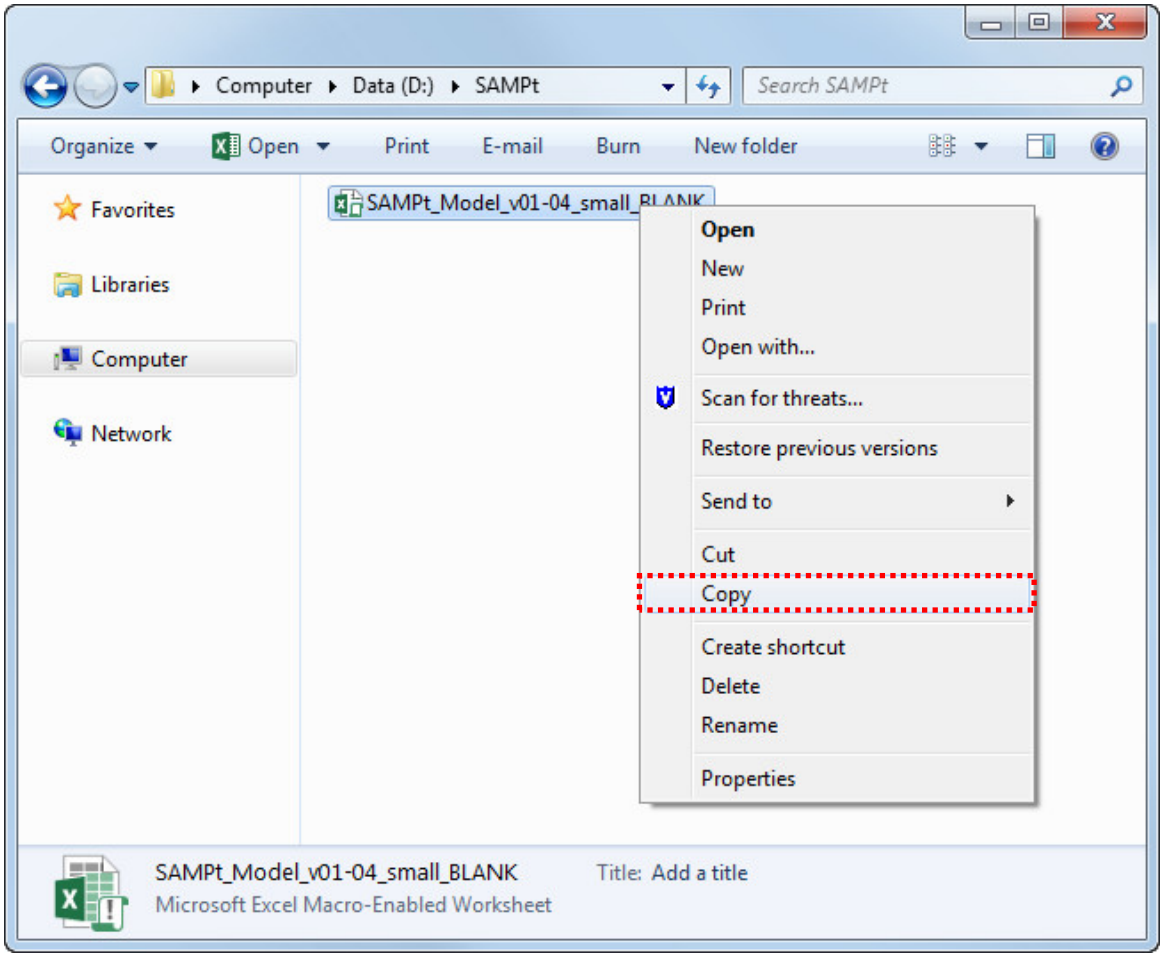


Figure 01: Copying the SAMPt Model

iii. Choose the appropriate folder to which the copy of the model should be saved.

iv. Right-click in Windows Explorer.

v. Select **Paste** on the menu that appears (shown in the red box in Figure 02).

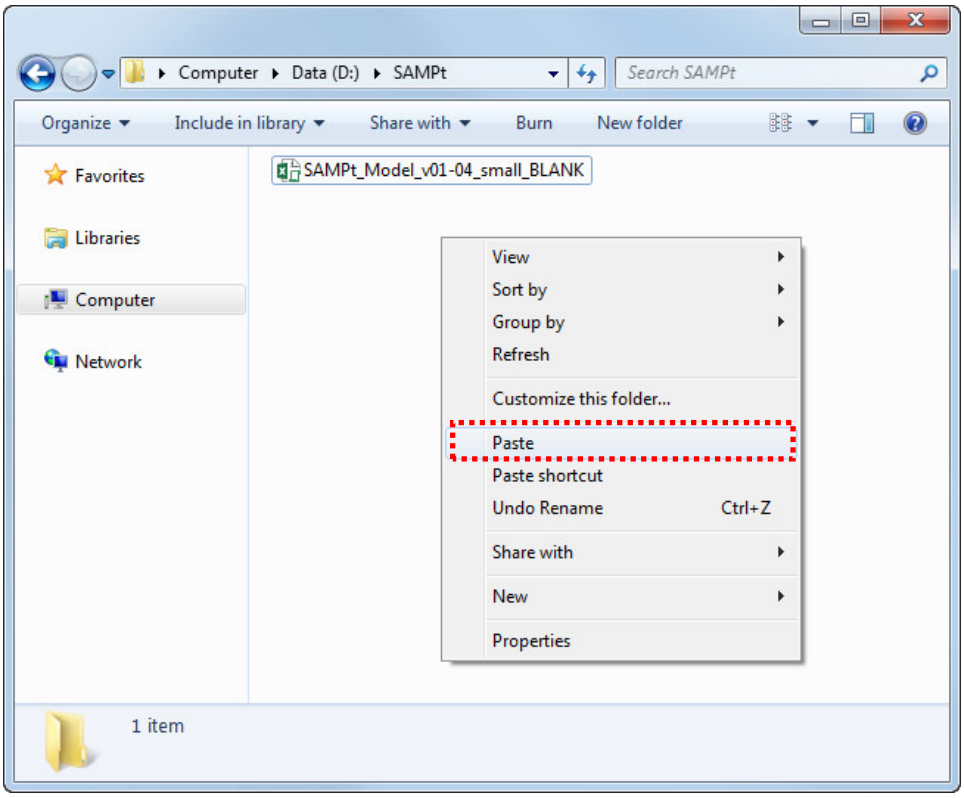


Figure 02: Pasting the SAMPt Model

vi. Rename the copy of the blank model by right-clicking on its filename and selecting **Rename** from the menu that appears (shown in the red box in Figure 03). Replace the previous file name with an appropriate new file name.

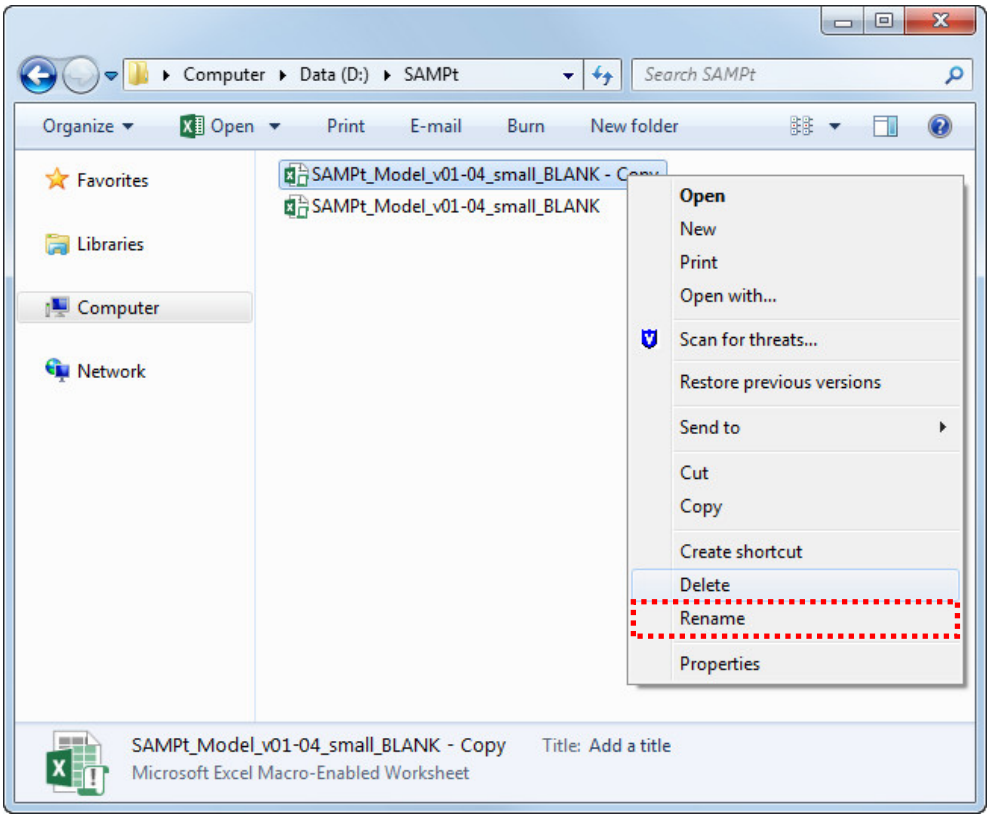


Figure 03: Renaming the SAMPt Model

2.3 Considerations before and while Using the Model

2.3.1 The user should bear the following in mind before and while operating the SAMPt model:

The computerised proof-of-concept model has been developed in Microsoft Excel 2013 and is compatible with 2007 and 2010 versions.

> The model must NOT be opened in earlier versions of Excel, e.g. Microsoft Excel 2003.
>
> Also, users may experience differing performance levels when using different versions of Microsoft Excel, such as 2013.

- It may take the full version of the model two minutes or more to open, depending on the specification of the computer hardware.

> To keep run-times to a minimum, close all other computer programs before using the model.

- Microsoft Excel's **Cut** and **Paste** functionality must NOT be used in the model, as this could – obviously or subtly – corrupt the model. Instead, the **Copy** and **Paste Special** -- **Values** functionality may be used.

- Table 2 describes the colour coding used in the model.

Table 2: Colour Coding in the Model

Colour of Cell Background and Format of Text	Data Type	Description
XXXXXXXXXXX	Hints and Tips	Cells containing table headings with hints and tips for the user, e.g. exceptions where 'Essential Input Data' are not required or suggested assumptions that can be made in the absence of better information.
XXXXXXXXXXX	Essential Input Data	Cells where it is essential that, where appropriate (see data type 'Hints and Tips' above), input data be entered by the user. 'Essential' means that data entry is required for the model to run correctly. In the absence of better information, essential input data may be based on engineering judgement and expert opinion.
XXXXXXXXXXX	Amendable Default Information **OR** Desirable Information	Cells containing default data that can be changed by the user **OR** Cells where it is desirable that input data be entered.
XXXXXXXXXXX	Non-Amendable Default Information **OR** Model Output	Cells containing default data that cannot be changed by the user **OR** Cells evaluated by the model.
XXXXXXXXXXX	**Warnings or Error Messages**	**Cells containing warnings or error messages, as evaluated by the model, for the user to address, as appropriate.**

- It may take the full version of the SAMPt model a significant amount of time to analyse a new scenario, depending on the volume of essential data entered, the type of analysis to be run (i.e. with or without evaluation of Depreciated Replacement Cost (DRC) over the 30-year analysis period) and the specification of the computer hardware. A message showing progress will be displayed in the status bar at the foot of the spreadsheet (see the red boxes in Figure 04 for two examples).

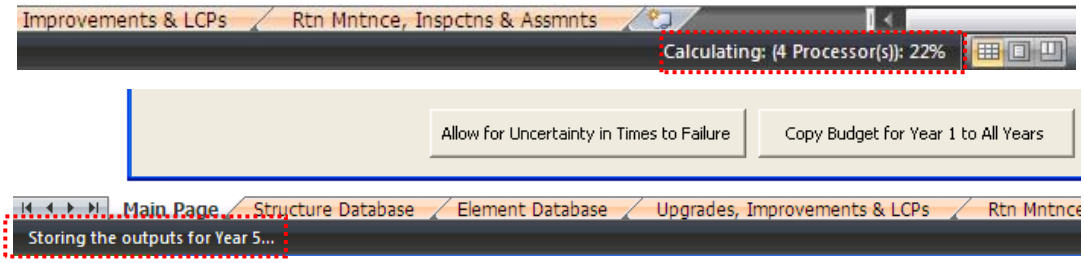


Figure 04: Displaying Progress on Tasks

- It may take the small version of the SAMPt model between several minutes and several hours to analyse a new scenario, depending on the volume of essential data entered, the type of analysis to be run (i.e. with or without evaluation of DRC over the 30-year analysis period) and the specification of the computer hardware. Again, a message showing progress will be displayed in the status bar at the foot of the spreadsheet (see Figure 04).

For the purposes of for Asset Management Planning a stock of structures must be analysed in a single model. This constraint does not exist for HAMFIG DRC.

For example, four or more copies of the small version of the SAMPt model (*SAMPt_Model_v02-01_small_BLANK.xlsm*) should not be used to analyse a stock of 1,000 structures. This is to ensure that the in-built prioritisation of maintenance requirements is unbiased.

- The model – and particularly the full version of the SAMPt model – should be saved regularly to avoid data loss. This can be achieved by clicking on the Office button on the menu bar in the top left corner of the model (Figure 05).

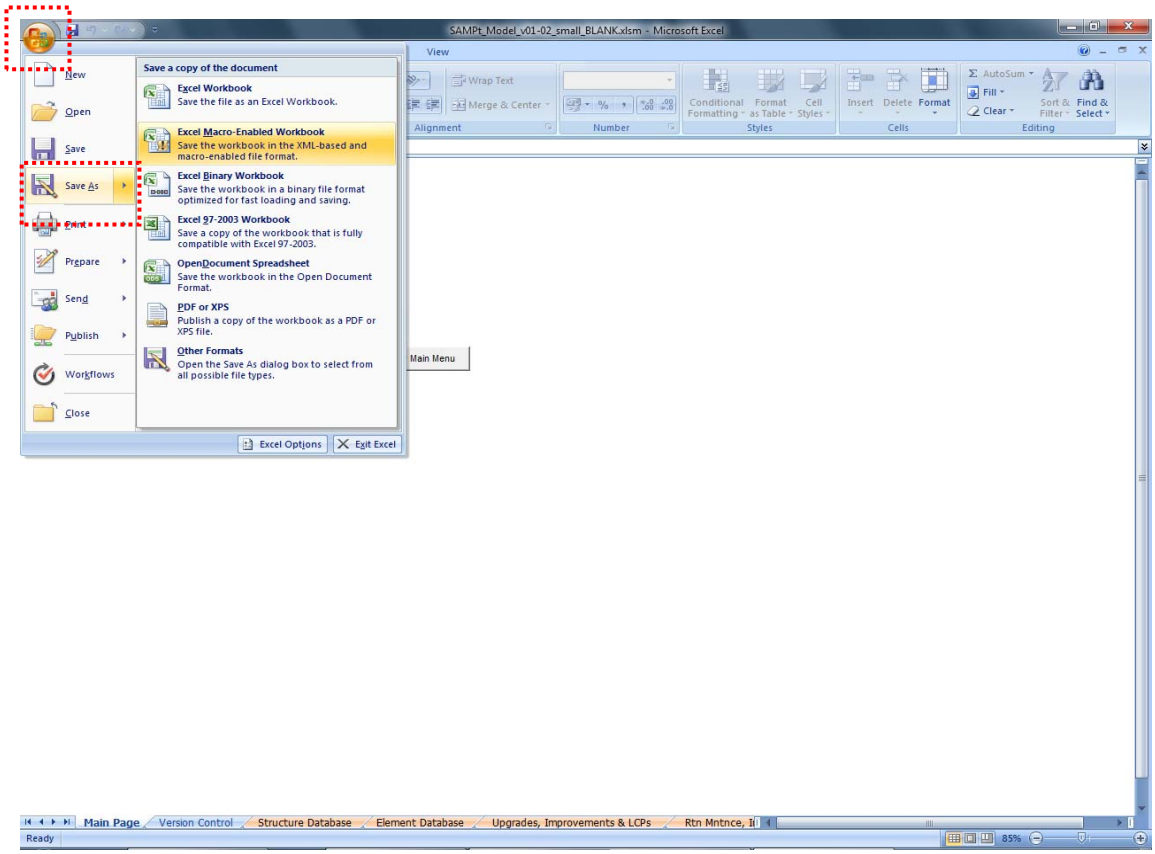


Figure 05: Saving the Model

2.4 Opening the SAMPt Model

2.4.1 Macros must be enabled to allow the model to run.

i. Open the SAMPt model.

ii. Click **Options…** near the security warning, as shown in the red box in Figure 06.

iii. Click **Enable this content** on the pop-up that appears, as shown in the blue box in Figure 06.

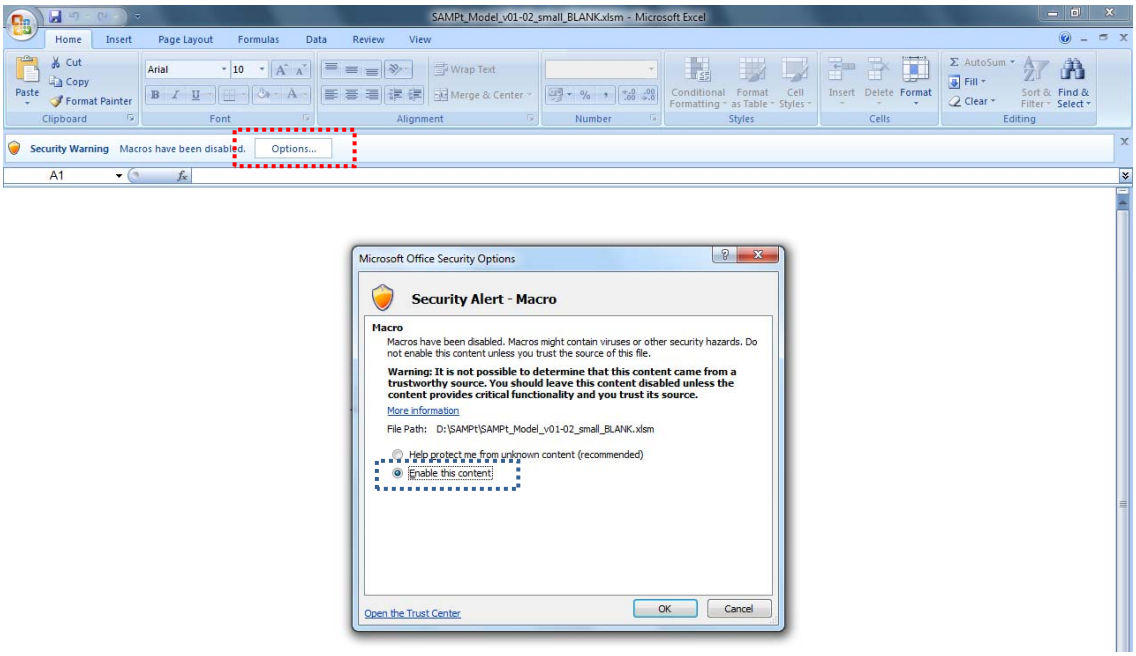


Figure 06: Opening the SAMPt Model in Microsoft Excel 2007

2.4.2 Click **OK**. The Main Menu of the SAMPt model (Figure 07) appears.

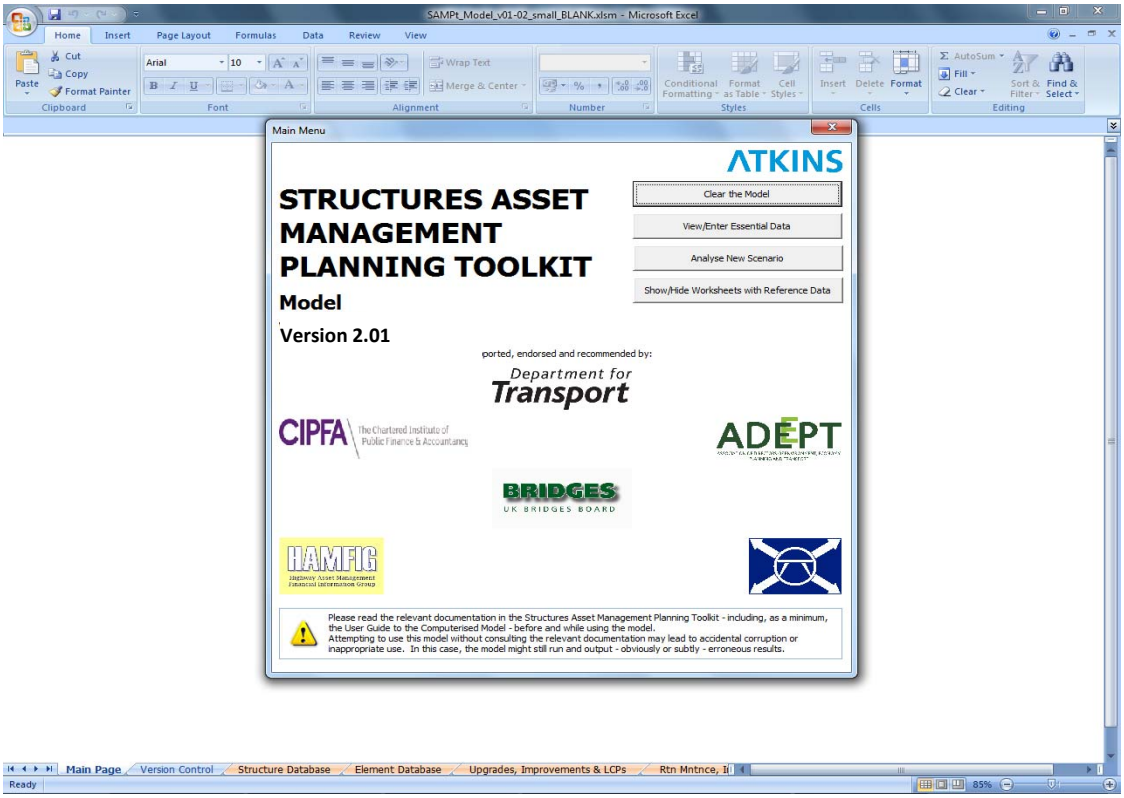


Figure 07: Main Menu of the SAMPt Model

2.4.3 Between four and five buttons are available to the user. These buttons and the model functionality accessed through them are described in Sections 2.5 to 2.8.

2.4.4 The Main Menu can be accessed at any time. On the 'Main Page' worksheet (see the red box in Figure 08), click **Show Main Menu** (shown in the blue box in Figure 08).

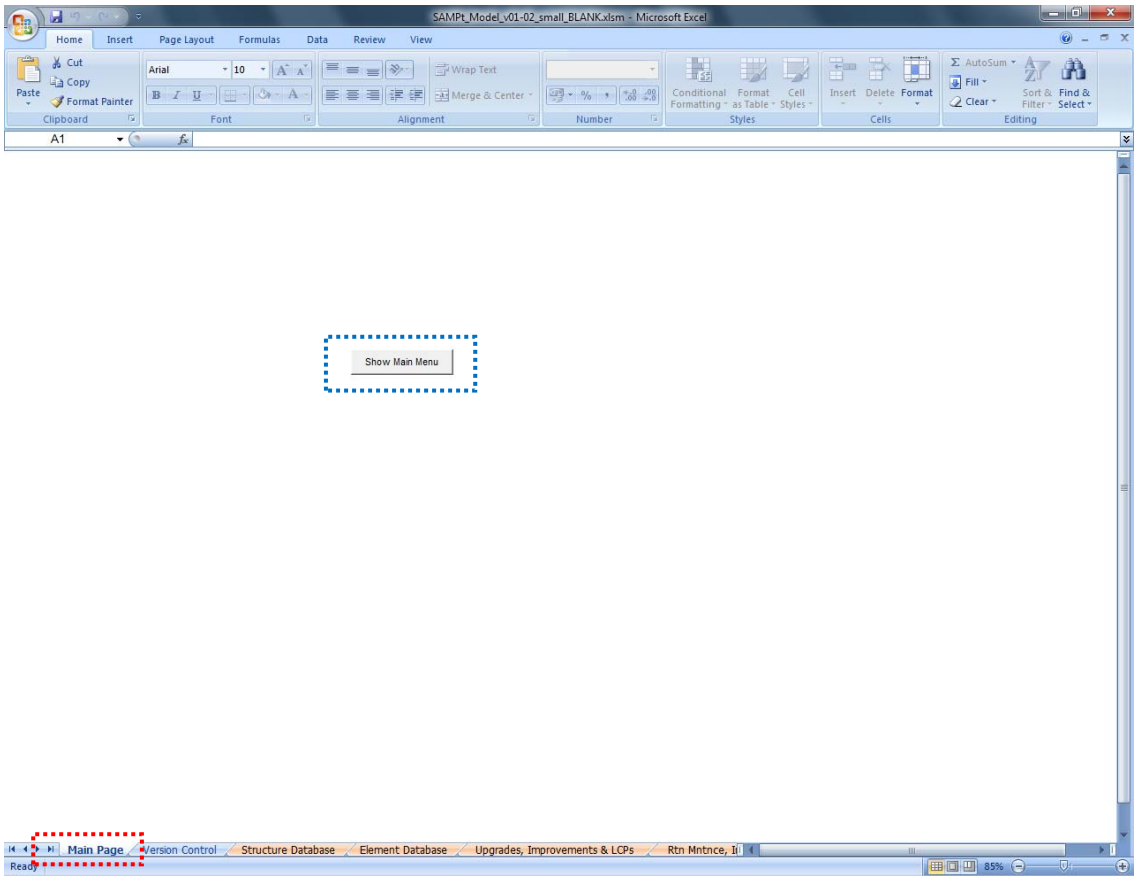


Figure 08: Accessing the Main Menu

2.5 Clear the Model

2.5.1 Input data that have been entered in the SAMPt model can be deleted in bulk by clicking **Clear the Model** on the Main Menu (Figure 07). The following pop-up appears.

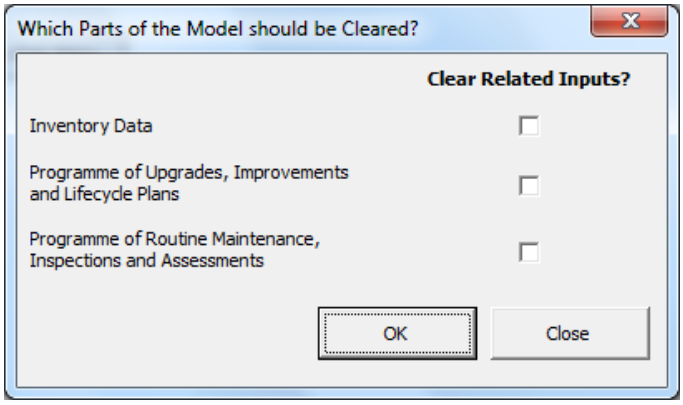


Figure 09: Selecting Which Parts of the Model should be Cleared

2.5.2 Select the parts of the model that should be cleared and click **OK**.

- Inventory Data: If this checkbox is ticked, then all inventory data in the 'Structure Database' (Section 3.2) and 'Element Database' (Section 3.3) worksheets will be deleted.
- Programme of Upgrades, Improvements and Lifecycle Plans: If this checkbox is ticked, then all input data in the 'Upgrades, Improvements & LCPs' worksheet (Section 3.4) will be deleted.
- Programme of Routine Maintenance, Inspections and Assessments: If this checkbox is ticked, then all input data in the 'Rtn Mntnce, Inspctns & Assmnts' worksheet (Section 3.5) will be deleted.

2.5.3 If no data needs to be cleared, then click **Close**.

2.6 View/Enter Essential Data

2.6.1 **View/Enter Essential Data** on the Main Menu (Figure 07) enables the user to view and enter essential inventory data on individual structures or groups of structures and their elements.

2.6.2 A complete set of essential input data must be entered in the model before a scenario is analysed.

2.6.3 When **View/Enter Essential Data** is clicked on the Main Menu, the pop-up shown in Figure 10 appears.

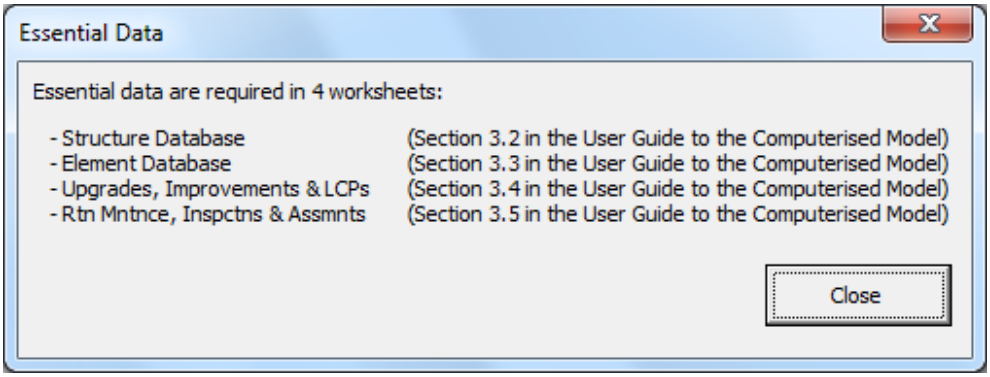


Figure 10: Viewing and Entering Essential Input Data

2.6.4 Click **Close**.

2.6.5 Enter the essential input data in the appropriate worksheets (Section 3).

2.6.6 When entering data one cell at a time, ensure that the calculation mode is set to automatic. This ensures that the drop-down lists that are available to the user, the results from interim calculations and any warnings are up-to-date and appropriate.

2.6.7 On the menu bar, select **Formulas** -- **Calculation Options** -- **Automatic**, so that a ✓ appears next to **Automatic** (Figure 11).

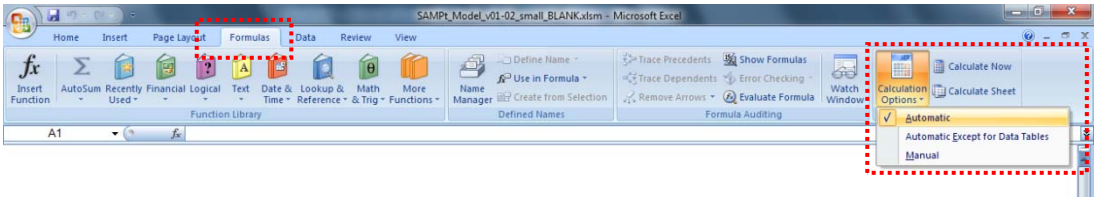


Figure 11: Enabling Automatic Calculations

2.6.8 When entering data in bulk (e.g. by copying data from another spreadsheet and pasting values in the model), the calculation mode can temporarily be set to manual. This can speed up the transfer of data. Once the data transfer is complete, the calculation mode should be reset to automatic (Section 2.6.7). This is necessary to validate the input data and update any warnings, as appropriate.

2.6.9 To set the calculation mode to manual, select **Formulas** -- **Calculation Options** -- **Manual** on the menu bar, so that a ✓ appears next to **Manual**.

2.6.10 To avoid unlikely crash of the toolkit during the analysis, it must be ensured that the data entered in 'Structure Database' and 'Element Database' worksheets is valid by confirming that the entries in 'Checks' columns of the worksheets show Valid. If shown otherwise, the data entered in relevant row must be reviewed and re-entered in the correct format.

2.6.11 Appendix A outlines how the model's results can be interpreted.

2.7 Analyse New Scenario

2.7.1 After entering a complete set of essential input data and ensuring that the calculation mode is set to automatic, click **Analyse New Scenario** on the Main Menu (Figure 07). The pop-up shown in Figure 12 appears.

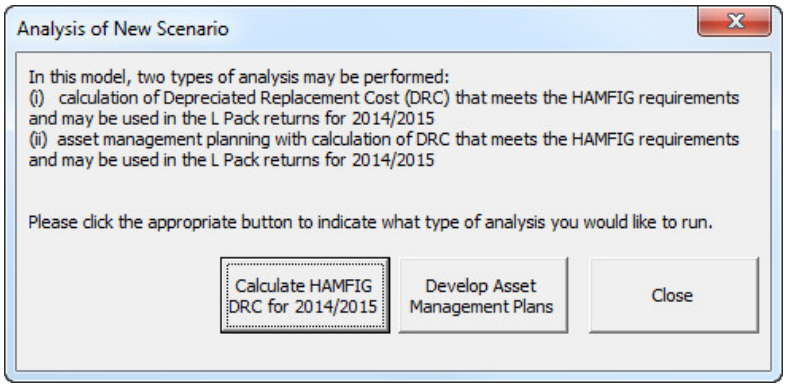


Figure 12: Selecting the Type of Analysis to be Performed

Calculating DRC Valid for 2014/2015

2.7.2 Click **Calculate HAMFIG DRC for 2014/2015**. The pop-up shown in Figure 13 appears.

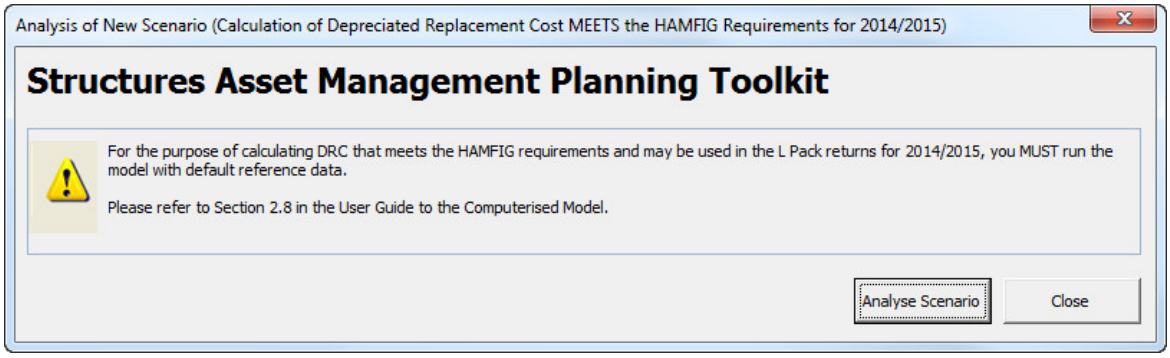


Figure 13: Calculating DRC Valid for 2014/2015

2.7.3 For the purposes of Whole of Government Accounts (WGA) returns for 2014/2015, the model automatically:

- uses one specific intervention strategy - 'Unplanned Reactive' - for all elements
- ignores the uncertainty in the times to failure for all elements
- assumes that the annual budget is unlimited (therefore, maintenance is not postponed or carried forward to later years)

2.7.4 The user is NOT required to change the intervention strategy to 'Unplanned Reactive' for all elements.

2.7.5 The user is NOT required to start again from a blank copy of the model, if uncertainty in the times to failure has already been allowed for (Section 2.7.12).

2.7.6 For the purpose of calculating DRC for 2014/2015, the user MUST run the model with default reference data. This includes using the default service lives and deterioration rates, thereby assuming that an appropriate routine maintenance regime is in place.

2.7.7 Click **Analyse Scenario**.

2.7.8 Once the scenario has been analysed, the pop-up notifying of successful analysis completion appears. Click on ‘OK’ button to bring the ‘Valuation Results’ worksheet on the screen as shown in Figure 14.

Date of analysis	31-Mar-2015 17:24
Valuation Date	31-Mar-2015

Distribution of average condition across the stock

Condition Band	No. of assets
Very Good	0
Good	733
Fair	173
Poor	543
Very Poor	10
Total	**1,459**

Structure Stock Condition Indices (SSCI)

Asset Type	SSCI Average	SSCI Critical
Bridges	69	87
Retaining Walls	80	95
Culverts	63	91
Sign/Signal Gantries	0	0
High Mast Lighting	0	0
Underpasses	0	0
Stock	**70.3**	**88.4**

N.B. The BCI values for multi-span structures are estimated and differ from the published BCI methodology. This estimate is necessary as Toolkit input data does not include lengths of individual spans.

Valuation results

Asset Type	GRC	DRC	DRC as % of GRC	Acc. Depreciation
Bridge: Vehicular (single span)	£ 234,158,242	£ 167,102,171	**71.4%**	£ 67,056,071
Bridge: Vehicular (2 or 3 spans)	£ 366,500,359	£ 258,730,400	**70.6%**	£ 107,769,960
Bridge: Vehicular (4 or more spans)	£ -	£ -		£ -
Bridge: Pedestrian/Cycle (single span)	£ 25,622,650	£ 18,043,371	**70.4%**	£ 7,579,280
Bridge: Pedestrian/Cycle (multi-span)	£ 487,011	£ 118,088	**24.2%**	£ 368,924
Cantilever Road Sign	£ -	£ -		£ -
Chamber/Cellar/Vault	£ -	£ -		£ -
Culvert (single cell)	£ 38,079,711	£ 26,301,602	**69.1%**	£ 11,778,110
Culvert (multi-cell)	£ 22,606,424	£ 13,755,029	**60.8%**	£ 8,851,395
High Mast Lighting	£ -	£ -		£ -
Retaining Wall (height > 3m)	£ 26,124,080	£ 21,967,595	**84.1%**	£ 4,156,485
Retaining Wall (height ≤ 3m)	£ -	£ -		£ -
Sign/Signal Gantry [cantilever]	£ -	£ -		£ -
Sign/Signal Gantry [spanning]	£ -	£ -		£ -
Structural Earthworks - (height > 3m)	£ -	£ -		£ -
Structural Earthworks - (height ≤ 3m)	£ -	£ -		£ -
Underpass: Vehicular	£ -	£ -		£ -
Underpass (or Subway): Pedestrian	£ 47,483,684	£ 24,487,545	**51.6%**	£ 22,996,139
Subway: Pipe	£ -	£ -		£ -
Tunnel (bored)	£ -	£ -		£ -
Tunnel (cut and cover)	£ -	£ -		£ -
Total	**£ 761,062,163**	**£ 530,505,800**	**69.7%**	**£ 230,556,363**

Annual Depreciation	**£ 5,898,190**

N.B. The annual depreciation figure is based on the current structures stock and current condition. It does not take into account any addition, detrunking, dimensional changes or any intervention that may have taken place in year.

Figure 14: Viewing Results of Scenario where DRC is Valid for 2014/2015

2.7.9 Appendix A outlines how the model's results can be interpreted.

2.7.10 Once the scenario has been analysed, the model automatically restores for all elements the intervention strategy previously specified by the user and the uncertainty in the times to failure.

Developing Asset Management

2.7.11 To develop asset management plans (with or without calculating a value for DRC that can be submitted as part of the WGA returns in 2014/2015), click **Develop Asset Management Plans**. The pop-up shown in Figure 15 appears.

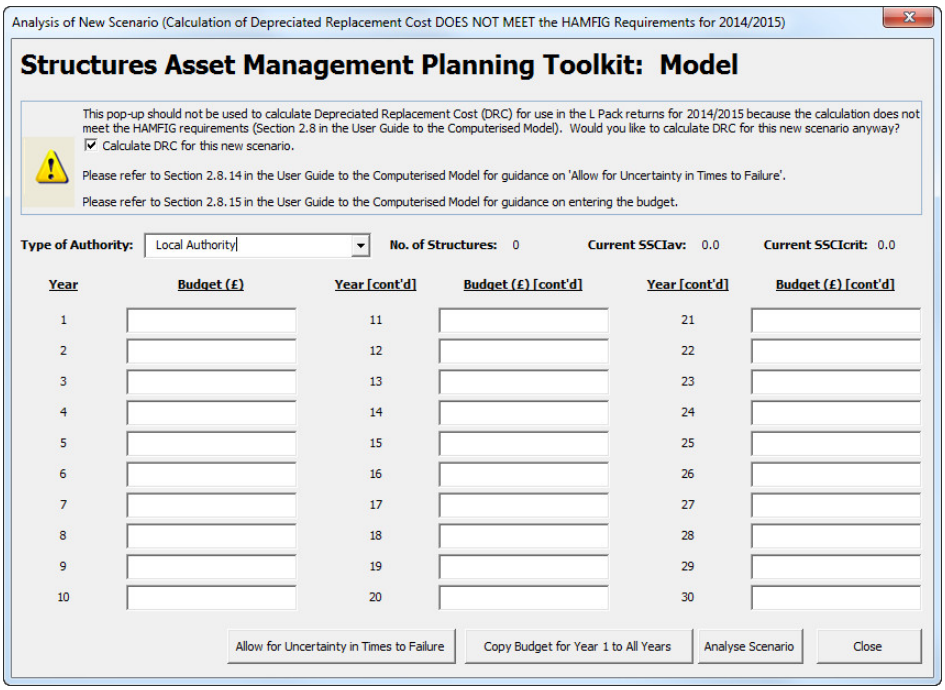


Figure 15: Developing Asset Management Plans and Calculating DRC Not Valid for 2014/2015

2.7.12 Experience indicates that diverse deterioration rates and service lives occur across a network due to the wide range of exposure environments and construction qualities present. **Allow for**

Uncertainty in Times to Failure should therefore be clicked at least once after all the structure and element information has been entered in the model. This allows for uncertainty in the model's deterioration service lives and deterioration rates (Section 2.13 of *Structures Asset Management Planning Toolkit, Part A: Methodology*[1]).

It is recommended that **Allow for Uncertainty in Times to Failure** is NOT clicked between analyses of the same structure and element information. Effects from changes in the budget or changes in strategies will then be more recognisable.

2.7.13 The following details need to be provided on the pop-up:

- Type of Authority: Select the appropriate authority. Two options are provided in the drop-down list – Local Authority or Overseeing (Trunk Road) Authority. This is required to select the appropriate weighting coefficients for the evaluation of structure stock condition.
- Budget: Enter a budget for each year in the 30-year analysis period. If the same budget is to be entered for all (or most) years, enter the budget in the textbox for Year 1 and click **Copy Budget for Year 1 to All Years**. The model will automatically populate the textboxes for all 30 years with the budget specified for Year 1. The user can then overwrite the automatically populated values, as required.

Do NOT leave any of the textboxes for the budget blank. If you wish to enter a zero-budget, please enter '0'.

The budget should - as a minimum - cover the costs identified in the 'Upgrades, Improvements & LCPs' and 'Rtn Mntnce, Inspctns & Assmnts' worksheets. The model spends the budget on these items first, before allocating the remaining funding to condition-triggered maintenance.

Any available funding not used in a given year is not carried forward to later years in the SAMPt model.

2.7.14 Click **Analyse Scenario**.

2.7.15 Once the scenario has been analysed, the pop-up window with a timer appears. Click **OK.**

2.8 Show/Hide Worksheets with Reference Data

2.8.1 The model uses the default assumptions and data provided in *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

2.8.2 The model can be operated without reviewing the default information.

2.8.3 To show or hide the default information that can be modified in the model to suit a user's particular needs, click **Show/Hide Worksheets with Reference Data** on the Main Menu (Figure 07).

2.8.4 The default information that can be modified in the model is contained in cells highlighted in blue (Section 2.3) in worksheets where the name starts with 'Reference_' (e.g. 'Reference_03&04_i', 'Reference_03&04_ii', 'Reference_05&07', etc.). The number after 'Reference_' in the name of the worksheet is the number of the relevant section in *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2]. For example, information presented in the 'Reference_03&04_i' worksheet is based on Sections 3 and 4 of *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2]. Table 3 outlines the content of each worksheet with default information.

Table 3: Content of Worksheets with Reference Data

Worksheet	Corresponding Sections and Tables in *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2]
Reference_03&04_i	Section 3: Default Deterioration Profiles for Components Table C.3.A: Deterioration Profile for Components Section 4a: Default Deterioration Profiles for Materials Table C.4.A: Deterioration Profiles for Materials Section 4b. Default Deterioration Profiles for Groups/Structures Table C.4.B: Deterioration Profiles for Groups/Structures
Reference_03&04_ii	Section 3: Default Deterioration Profiles for Components Table C.3.A: Deterioration Profile for Components Section 4a: Default Deterioration Profiles for Materials Table C.4.A: Deterioration Profiles for Materials Section 4b. Default Deterioration Profiles for Groups/Structures Table C.4.B: Deterioration Profiles for Groups/Structures
Reference_05&07	Section 5: Maintenance Options Table C.5.A: Maintenance Options Section 7: Base Unit Rates Table C.7.A: Base Unit Rates (2Q 2010 indexed to 2Q 2012 using Road Project Index for 2014/2015 prices)
Reference_06	Section 6a: Default Intervention Levels and Effects for Materials and Components Table C.6.A: Intervention Levels and Effects for Materials and Components Section 6b: Default Intervention Levels and Effects for Groups/Structures Table C.6.B: Intervention Levels and Effects for Groups/Structures
Reference_08	Section 8: Element or Structure Size Formulae Table C.8.A: Size Formulae for Bridge Elements Table C.8.B: Size Formulae for Retaining Wall Elements Table C.8.C: Size Formulae for Sign/Signal Gantry Elements Table C.8.D: Size Formulae for Groups/Structures

Worksheet	Corresponding Sections and Tables in *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2]
Reference_09	Section 9: Add-ons Table C.9.A: Preliminaries Table C.9.B: Other Costs Table C.9.D: Design Costs Table C.9.C: Traffic Management Costs Table C.9.E: Bridge - Works Location and TM Arrangements Table C.9.F: Retaining Wall - Works Location and TM Arrangements Table C.9.G: Sign/Signal Gantry - Works Location and TM Arrangements Table C.9.H: Groups/Structures - Works Location and TM Arrangements
Reference_10	Section 10: Penalties Table C.10.A: Traffic Restrictions Table C.10.B: Traffic Delay Costs
Reference_11i	Section 11: Prioritisation Table C.11.A: Priority Weighting Coefficients Table C.11.B: Factor based on Traffic Table C.11.C: Factor based on Obstacle Crossed OR For Retaining Walls / Structural Earthworks, Route Adjacent to the Foot of the Wall/Earthworks Table C.11.D: Factor based on Route Supported by or Adjacent to a Structure OR For Retaining Walls / Structural Earthworks, Route Adjacent to the Top of the Wall/Earthworks OR For Spanning Sign/Signal Gantries, Route Crossed Table C.11.E: Factor based on Structure Type
Reference_12	Section 12: Gross Replacement Cost Table C.12.A: Replacement Unit Rates Table C.12.B: Adjustment Factors
Reference_14	Section 14: Element Codes Definition of Element Codes

2.8.5 Appendix B describes the worksheets with default information in more detail.

2.8.6 When modifying the default information, ensure that the calculation mode is set to automatic (Section 2.6.7). This is necessary to validate the data and update any warnings, as appropriate.

3. Essential Input Data

3.1 General

3.1.1 This section describes what data sets are required to run the model and how to enter the data.

3.1.2 Essential input data needs to be entered in the following four worksheets:

- 'Structure Database' worksheet (Section 3.2)
- 'Element Database' worksheet (Section 3.3)
- 'Upgrades, Improvements & LCPs' worksheet (Section 3.4)
- 'Rtn Mntnce, Inspctns & Assmnts' worksheet (Section 3.5)

3.2 Data on (Groups of) Structures: 'Structure Database' Worksheet

3.2.1 A summary of the essential input data to be entered in the 'Structure Database' worksheet is provided in Section 15 of *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

3.2.2 The first entry in the 'Structure Database' worksheet should be made in row 5. There must be NO blank rows between entries.

3.2.3 If a cell is populated then, as a minimum, all relevant Essential Input Data (Table 2) must be provided for the row of that cell.

3.2.4 Care should be taken when defining groups of structures. For groups with a large number of structures, the expenditure profile over the analysis period may include some extreme values. The model will maintain/replace an element on either all or none of the structures belonging to the group in a year.

For example, suppose that a group of 50 bridges is defined with waterproofing in condition 3E at the start of the analysis period and under a Planned Targeted maintenance strategy. The waterproofing on all 50 bridges has exceeded its intervention threshold condition. In the model, either all or none of the waterproofing on these 50 bridges will be replaced in one year, depending on the funding available. In reality, the waterproofing would be replaced over a number of years. This can be modelled by splitting the group of 50 bridges into several groups with fewer bridges. Alternatively, the user could leave the group of 50 bridges as it is and keep in mind the fact that all or none of the waterproofing will be replaced in one year when defining the budget and interpreting the model's outputs.

3.2.5 Data may be copied and pasted in cells with a tan or blue background in the 'Structure Database' worksheet, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality. The model does not allow data to be copied and pasted in other cells, including cells that are hidden.

For example, all data in row 5 cannot be copied and pasted simultaneously to another row in the 'Structure Database' worksheet because columns Q to X are hidden (Figure 16).

		Additional Facto [Prese				
Obstacle Crossed, if appropriate OR For Retaining Walls / Structural Earthworks, Route Type Adjacent to the Foot of the Wall/Earthworks [please select from drop-down menu; not appropriate for cantilever road signs, high mast lighting and sign/signal gantries; essential for all other structure types]	Is Obstacle Crossed OR For Retaining Walls / Structural Earthworks, Route Type Adjacent to the Foot of the Wall/Earthworks salted (gritted)? [Yes = 1; No or Not Applicable = 0 or (Blank)]	Heritage	Conservation Area	Environmentally Sensitive	River, Coastal etc. Walls	Substandard Structure
Watercourse - navigable	0	0	0	0	0	0
Local Road - C class	1	0	0	0	0	0
Local Road - unclassified	0	0	0	0	0	0
Watercourse - navigable	0	0	0	0	0	0
Local Road - B class	1	0	0	0	0	0
Local Road - A class	1	0	0	0	0	0
Watercourse - navigable	0	0	0	0	0	0
Local Road - A class	1	0	0	0	0	0
Railway: Inter-City Line	0	0	0	0	0	0
Watercourse - navigable	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Watercourse - navigable	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0

e | Structure Database | Element Database | Upgrades, Improvements & LCPs | ...

Figure 16: Restrictions on Copying and Pasting Data in the 'Structure Database' Worksheet

3.2.6 Columns AD to AI (Figure 17) in the 'Structure Database' worksheet are currently not used. They are available for use if the list of adjustment factors for the GRC is extended beyond the list in *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2]. The list of adjustment factors for the GRC can be modified in the 'Reference_12' worksheet (Section 2.8).

B	AA	AB	AC	AD	AE	AF	AG	AH	AI
	Additional Factors Affecting Gross Replacement Cost [Present = 1; Not Present = 0 or (Blank)]								
Identifier of Structure or Group of Structures [must be unique in this model]	Environmentally Sensitive	River, Coastal etc. Walls	Substandard Structure	[Spare Adjustment Factor 1]	[Spare Adjustment Factor 2]	[Spare Adjustment Factor 3]	[Spare Adjustment Factor 4]	[Spare Adjustment Factor 5]	[Spare Adjustment Factor 6]
1	0	0	0						
2	0	0	0						
3	0	0	0						
4	0	0	0						
5	0	0	0						
6	0	0	0						
7	0	0	0						
8	0	0	0						
9	0	0	0						
10	0	0	0						
11	0	0	0						
12	0	0	0						
13	0	0	0						
14	0	0	0						
15	0	0	0						
16	0	0	0						
17	0	0	0						
18	0	0	0						
19	0	0	0						
20	0	0	0						
21	0	0	0						
22	0	0	0						

Main Page | Structure Database | Element Database | Upgrades, Improvements & LCPs | Rtn Mntnce, Inspctns & Assr ...

Figure 17: Potential for Additional Adjustment Factors for the GRC

3.3 Data on Elements: 'Element Database' Worksheet

3.3.1 A summary of the essential input data to be entered in the 'Element Database' worksheet is provided in Section 15 of *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

3.3.2 Data on elements must NOT be entered in the 'Element Database' worksheet until after all required data on the associated structure or group of structures have been entered in the 'Structure Database' worksheet.

This ensures that the drop-down lists that are available to the user, the results from interim calculations and any warnings are up-to-date and appropriate.

3.3.3 The first entry in the 'Element Database' worksheet should be made in row 2. There must be NO blank rows between entries.

3.3.4 If a cell is populated then, as a minimum, all relevant Essential Input Data (Table 2) must be provided for the row of that cell.

3.3.5 Cells in columns B to D must be populated from left to right (i.e. data must be entered in column B, then in column C and finally in column D).

Following this sequence ensures that the drop-down lists that are available to the user, the results from interim calculations and any warnings are up-to-date and appropriate.

The items that appear in the drop-down lists for 'Identifier of Structure or Group of Structures' in column B of the 'Element Database' worksheet are based on the entries in column B of the 'Structure Database' worksheet.

The drop-down lists for 'Full Name of Element' in column C are based on the CSS Structure Inspection Elements[3]. As such, '**Br09**. Abutments (incl. Arch Springing)' means CSS **Br**idge Inspection Element **09**, which is 'Abutments (incl. Arch Springing)'. It does NOT refer to the abutments on the ninth bridge entered in the 'Structure Database' worksheet. Column B in the 'Element Database' worksheet identifies the structure or group of structures to which the element belongs.

3.3.6 Data may be copied and pasted in cells with a tan background in the 'Element Database' worksheet, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality. The model does not allow data to be copied and pasted in other cells, including cells that are hidden.

3.3.7 'Condition at last inspection' in column F of the 'Element Database' worksheet refers to the condition recorded for the element when it was last inspected. The date of last inspection can be entered in column E and if left blank then the condition data is assumed current.

3.3.8 If the error message 'The structure or group of structures is not recognised.' appears in column I of the 'Element Database' worksheet, then the data values entered in column B are invalid. Select an appropriate item from the drop-down list in column B.

3.3.9 If the error message 'The element is not recognised.' appears in column J of the 'Element Database' worksheet, then the data values entered in column C are invalid. Select an appropriate item from the drop-down list in column C.

3.3.10 If the error message 'The component/material type is not recognised.' appears in column K of the 'Element Database' worksheet, then the data entered in column D are invalid. Select an appropriate item from the drop-down list in column D.

3.3.11 If the error message 'The element condition is not recognised.' appears in column W of the 'Element Database' worksheet, then the data values entered in column F are invalid. Select an appropriate item from the drop-down list in column F.

3.4 Data on Programmes of Work: 'Upgrades, Improvements & LCPs' Worksheet

3.4.1 A summary of the essential input data to be entered in the 'Upgrades, Improvements & LCPs' worksheet is provided in Section 15 of *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

3.4.2 Data on programmes of work must NOT be entered in the 'Upgrades, Improvements & LCPs' worksheet until after all required data on the associated structure or group of structures and its elements have been entered in the 'Structure Database' and 'Element Database' worksheets.

This ensures that the drop-down lists that are available to the user, the results from interim calculations and any warnings are up-to-date and appropriate.

3.4.3 Programmes of work (Section 2.7 of *Structures Asset Management Planning Toolkit, Part A: Methodology*[1]) should only be entered in the 'Upgrades, Improvements & LCPs' worksheet if (i) schemes are scheduled to take place in the future, (ii) schemes are Capital, and (iii) funding is secured (i.e. the schemes are certain to be commissioned).

This is because the model deteriorates the condition of elements but does not schedule any condition-triggered maintenance or renewal works until after the last scheme for the element defined in the 'Upgrades, Improvements & LCPs' worksheet has been completed. Furthermore, the model spends the budget on items in the 'Upgrades, Improvements & LCPs' worksheet before allocating funding to condition-triggered maintenance (Section 2.7.13). Therefore, if schemes are not certain to be commissioned, no data should be entered in the 'Upgrades, Improvements & LCPs' worksheet. This enables the model to predict and prioritise maintenance and funding needs appropriately.

3.4.4 The first entry in the 'Upgrades, Improvements & LCPs' worksheet should be made in row 2. There must be NO blank rows between entries.

3.4.5 If a cell is populated then, as a minimum, all relevant Essential Input Data (Table 2) must be provided for the row of that cell.

3.4.6 'Element ID' in column A of the 'Upgrades, Improvements & LCPs' worksheet refers to the 'Element ID' in column A of the 'Element Database' worksheet for the relevant element.

3.4.7 The items that appear in the drop-down list for 'Maintenance Action' in column G of the 'Upgrades, Improvements & LCPs' worksheet are based on the list of maintenance activities in Section 7 of the Structures Asset Management Planning Toolkit, Part C: Supporting Information[2]. The list of maintenance activities in the model can be modified in the 'Reference_05&07' worksheet (Section 2.8).

3.4.8 Data may be copied and pasted in cells with a tan or blue background in the 'Upgrades, Improvements & LCPs' worksheet, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality. The model does not allow data to be copied and pasted in other cells, including cells that are hidden.

3.5 Data on Regular Maintenance: 'Rtn Mntnce, Inspctns & Assmnts' Worksheet

3.5.1 A summary of the essential input data to be entered in the 'Rtn Mntnce, Inspctns & Assmnts' worksheet is provided in Section 15 of *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

3.5.2 This worksheet is used to record data on the planned future expenditure on regular or Revenue maintenance of the entire structure stock over the analysis period. The default deterioration profiles provided in the model are based on the assumption that routine maintenance is carried out.

3.5.3 To analyse a scenario in which limited or no routine maintenance is carried out, the mean times to failure should be adjusted.

This can be achieved either by applying a global reduction factor to the mean times to failure for all component/material types, or by applying reduction factors selectively in column V in the 'Reference_03&04_ii' worksheet.

3.5.4 To apply a global reduction factor to the mean times to failure for all component/material types, click **Apply a Global Reduction Factor to Mean Times to Failure**. The pop-up shown in Figure 18 appears.

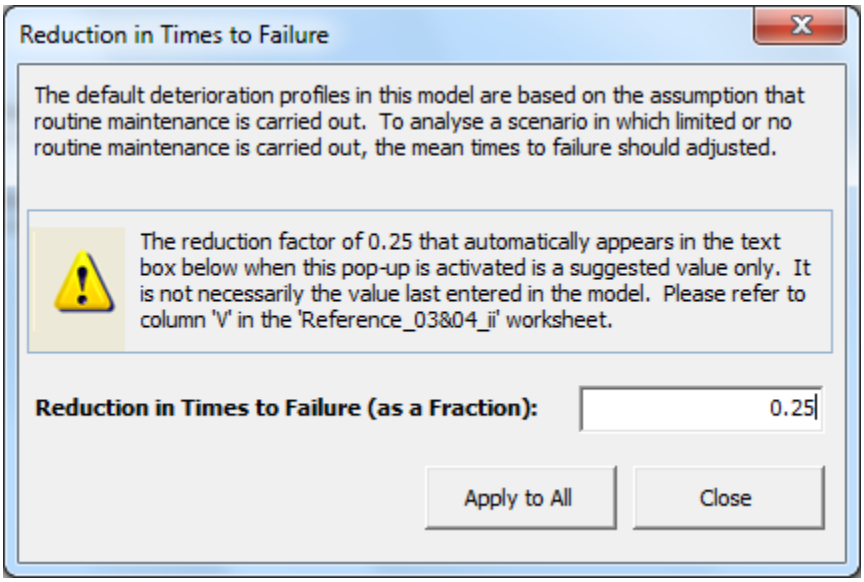


Figure 18: Applying a Global Reduction Factor to the Mean Times to Failure

3.5.5 The reduction factor of 0.25 that automatically appears in the text box when the pop-up in Figure 18 is activated is a suggested value only. It is not necessarily the value last entered in the model or the current value in column V in the 'Reference_03&04_ii' worksheet.

3.5.6 Enter the global reduction factor to be applied to the mean times to failure for all component/material types.

3.5.7 Click **Apply to All**.

3.5.8 Other than the effect on the deterioration profiles of component/material types, regular or Revenue maintenance does not impact DRC, Accumulated Depreciation or the overall condition of the structure stock in the model – provided that the budget covers the costs identified in the 'Rtn Mntnce, Inspctns & Assmnts' worksheet.

The model spends the budget on items in the 'Rtn Mntnce, Inspctns & Assmnts' worksheet before allocating funding to condition-triggered maintenance (Section 2.7.13).

3.5.9 Data may be copied and pasted in cells with a tan background in the 'Rtn Mntnce, Inspctns & Assmnts' worksheet, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality.

3.5.10 Data may be copied and pasted in cells with a blue background in the 'Reference_03&04_ii' worksheet, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality. The model does not allow data to be copied and pasted in other cells, including cells that are hidden.

4. Outputs of the Model

4.1 General

4.1.1 This section describes the outputs of the model.

4.1.2 Appendix A outlines how the model's results can be interpreted.

4.2 Output Charts and Data Tables of Asset Management Planning Analysis

4.2.1 The model outputs up to 8 charts (Section 0 and Section 2.7) and supporting data tables in the spreadsheet. Table 4 describes each chart.

Table 4: Output Charts of the SAMPt Model

Chart	Description
Chart01 - Work,Shortfall&Cond	Profiles of budget, expenditure, shortfall, and the average and critical Structure Stock Condition Indicators ($SSCI_{av}$ and $SSCI_{crit}$, respectively) over the analysis period
Chart02 - SSCIav by Type	Profiles of average condition over the analysis period, broken down by structure type: • Bridges • Retaining walls • Culverts • Sign/signal gantries • High mast lighting • Tunnel and vehicular underpasses
Chart03 - SSCIcrit by Type	Profiles of critical condition over the analysis period, broken down by structure type: • Bridges • Retaining walls • Culverts • Sign/signal gantries • High mast lighting • Tunnel and vehicular underpasses
Chart04 - Expenditure by Type	Profiles of expenditure over the analysis period, broken down into: • **Regular maintenance (Revenue**) • **Upgrades, improvements and lifecycle plans (Capital)** • **Condition-triggered maintenance (Capital)**

Chart	Description
Chart05 - Expenditure by Life	Profiles of expenditure over the analysis period, broken down into: • **Cost of condition-triggered maintenance for elements with a finite life** • **Cost of upgrades, improvements and lifecycle plans for elements with a finite life** • **Cost of condition-triggered maintenance for elements with an indefinite life** • **Cost of upgrades, improvements and lifecycle plans for elements with an indefinite life**
Chart06 – Shortfall	Profile of shortfall for condition-triggered maintenance over the analysis period
Chart07 - Risk & Traffic Delay	Number of structures with Safety or Performance at Risk, and the associated traffic delay cost over the analysis period
Chart08 - Condition Bands	Number of structures in different condition bands (i.e. Very Good, Good, Fair, Poor and Very Poor) over the analysis period

4.2.2 The ‘Results Summary’ worksheet contains the data tables for the 8 charts described in Table 4.

4.2.3 The ‘ECS Profile’ worksheet shows how the Element Condition Score (ECS) of each element changes over the analysis period.

4.2.4 The ‘Total Capital Work Profile’ shows the cost profile of Capital works (from defined upgrades, improvements and lifecycle plans and from condition-triggered maintenance) for each element over the analysis period.

4.2.5 Data in the ‘Results Summary’, ‘ECS Profile’ and ‘Total Capital Work Profile’ worksheets may be copied and pasted in another spreadsheet, using Microsoft Excel’s **Copy** and **Paste Special** – **Values** functionality.

This allows for further analysis of the output data outside the SAMPt model.

4.3 Output data of HAMFIG DRC Analysis

4.3.1 The model outputs a worksheet of the valuation results, where the following data sets are summarised and presented in the tabular format:

- Distribution of average condition across the stock.
- Structure Stock Condition Indices.
- Valuation results, including GRCs and DRCs for each structure type.
- Annual depreciation (forecast).

5. References

1. Structures Asset Management Planning Toolkit, Part A: Methodology, Version 2.01, 2015.
2. Structures Asset Management Planning Toolkit, Part C: Supporting Information, Version 2.01, 2015.
3. Inspection Manual for Highway Structures, Volume 1: Reference Manual, TSO, 2007.

Appendix A : Interpretation of Output Charts

A.1 General

A.1.1 This appendix outlines how the model's results can be interpreted. The charts used for this purpose are outputs from an analysis of dummy data, representing a fictional authority's network.

A.2 Chart01 - Work,Shortfall&Cond

A.2.1 An example of this chart is shown in Figure 19.

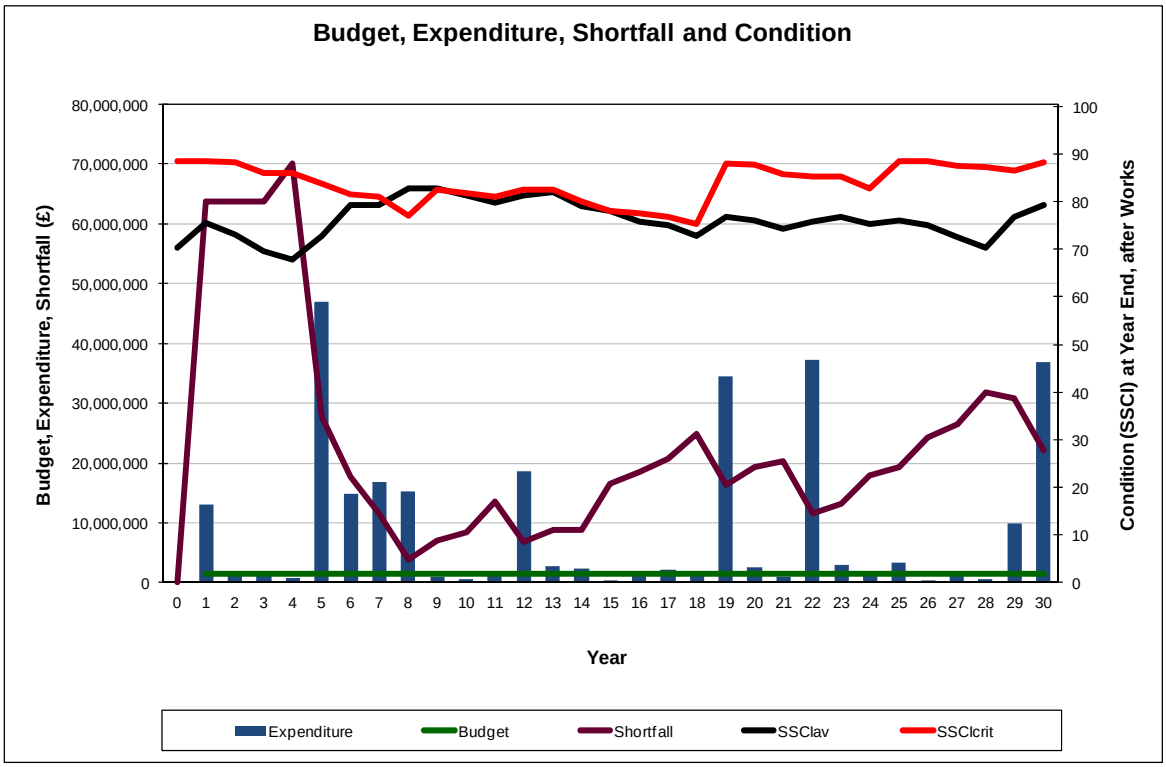


Figure 19: Example of Output Chart 01

A.2.2 In Figure 19, the predicted expenditure exceeds the specified budget in a number of years. This is predominantly caused by the specified budget that does not cover the costs identified in the 'Upgrades, Improvements & LCPs' and 'Rtn Mntnce, Inspctns & Assmnts' worksheets. The model assumes that these costs will be incurred regardless of the specified budget because the works are certain to be commissioned.

This trend suggests that the specified budget is insufficient for the maintenance needs of the structure stock.

Section A.5 helps to clarify which of the two possible explanations above applies.

A.2.3 The large differences between minimum and maximum annual expenditure and between minimum and maximum shortfall seen over the analysis period suggest that a number of elements reach or exceed their intervention threshold condition in the same year. This may be because groups with a large number of structures have been defined (Section 3.2.4). For example, the large expenditure in Year 5 is mostly on the replacement of waterproofing on two groups of structures, with 45 and 44 structures each. Therefore, in reality the expenditure would be spread over a number of years and would not all be incurred in Year 5. The model may reflect this better if the two groups are broken down into more groups with fewer structures.

A.2.4 There is significant variation in the average Structure Stock Condition Indicator over the analysis period, with a notably low value in Year 4. This suggests that the specified budget is insufficient for the maintenance needs of the structure stock under the current maintenance strategies.

A.2.5 There is a significant shortfall over the analysis period. This implies that the funding is not sufficient to carry out works on a number of elements that have reached or exceeded their

intervention threshold. This suggests that the funding should be increased or the maintenance strategies for the elements should be revised.

A.3 Chart02 - SSClav by Type

A.3.1 An example of this chart is shown in Figure 20.

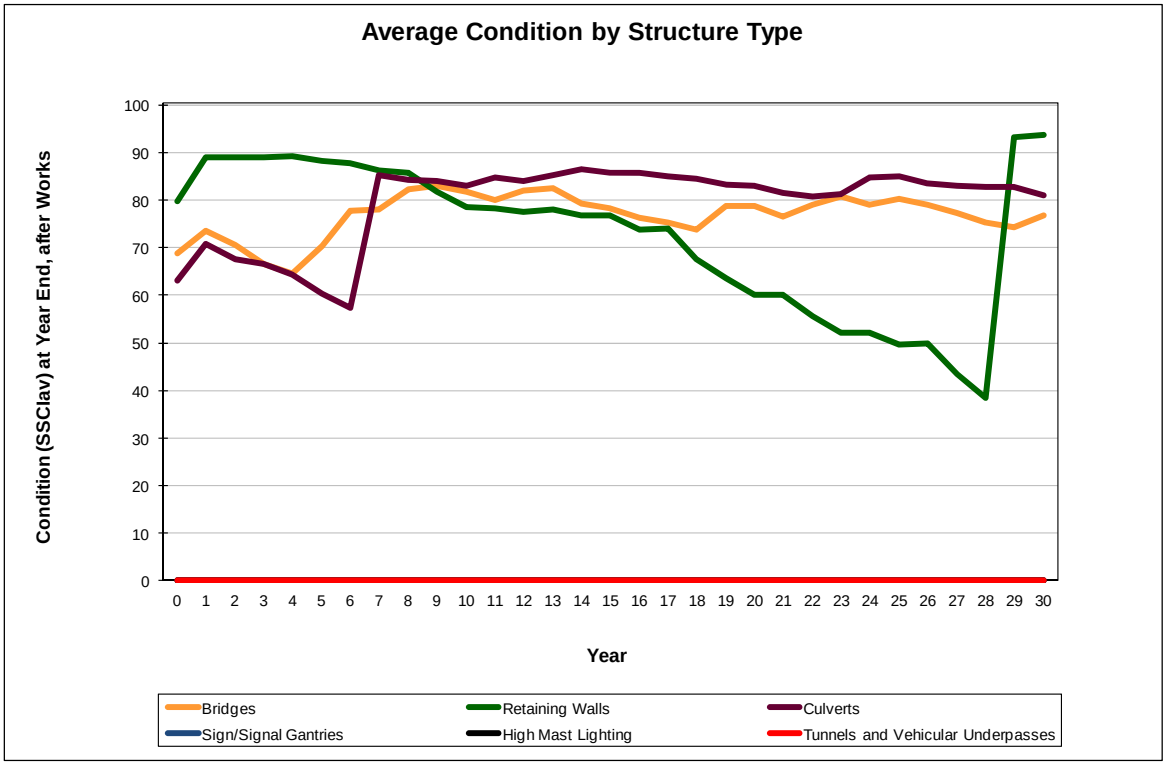


Figure 20: Example of Output Chart 02

A.3.2 Figure 20 shows that no sign/signal gantries, no high mast lighting and no tunnels or vehicular underpasses have been defined as being part of the structure stock.

A.3.3 There is significant variation in the average condition of bridges, retaining walls and culverts over the analysis period. In Year 28, the average condition of retaining walls is notably low – in the

Very Poor condition band. This supports the conclusion that the specified budget is insufficient for the maintenance needs of the structure stock under the current maintenance strategies.

A.4 Chart03 - SSCIcrit by Type

A.4.1 An example of this chart is shown in Figure 21.

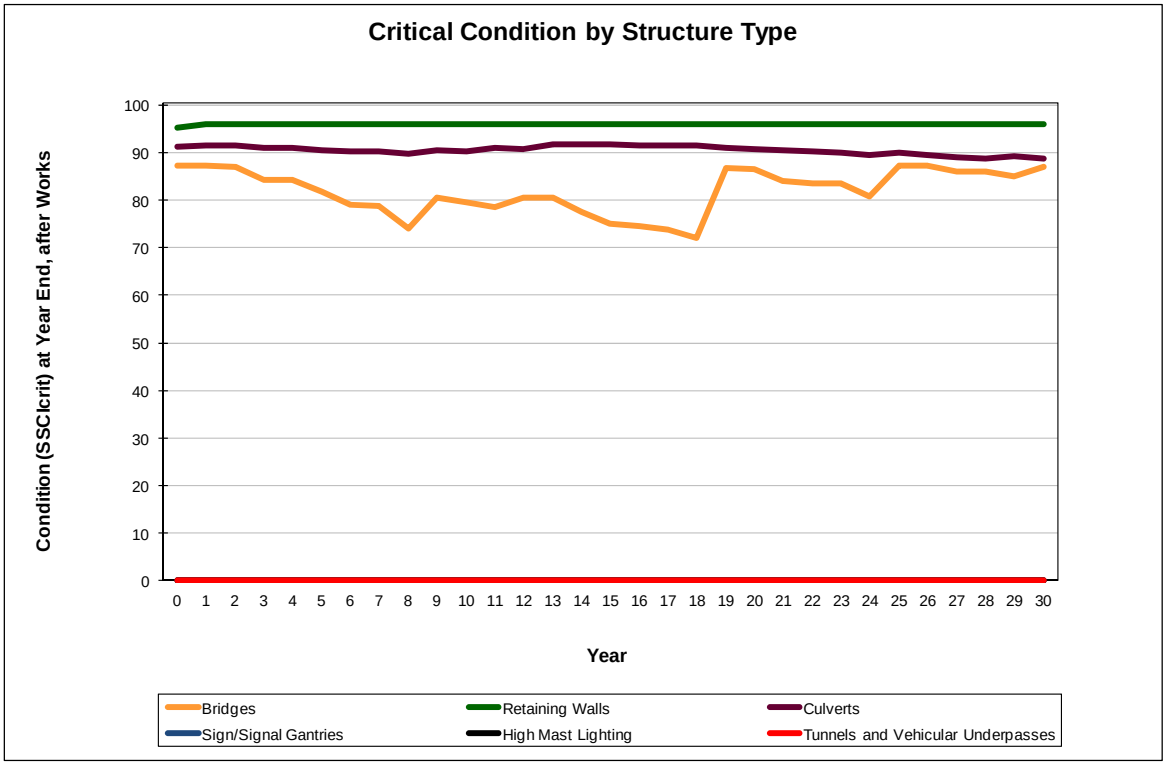


Figure 21: Example of Output Chart 03

A.4.2 Figure 21 shows that no sign/signal gantries, no high mast lighting and no tunnels or vehicular underpasses have been defined as being part of the structure stock.

A.4.3 The critical condition of bridges, retaining walls and culverts is better and varies less than the average condition of these structures over the analysis period. This suggests that the low values

and the variation in average condition of the structures are mainly due to elements that are not critical to structural integrity.

A.5 Chart04 - Expenditure by Type

A.5.1 An example of this chart is shown in Figure 22.

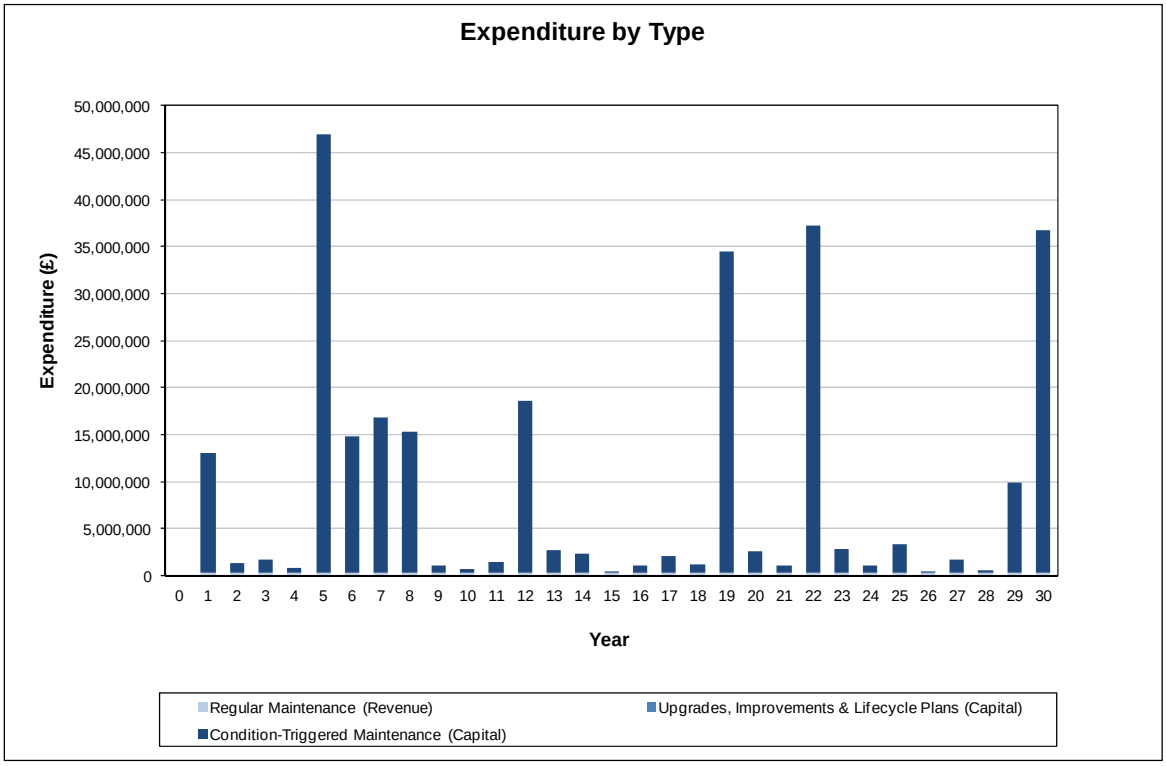


Figure 22: Example of Output Chart 04

A.5.2 The total expenditure profile in Figure 22 is the same as that in Figure 19.

A.5.3 Figure 22 shows that most of the expenditure is on condition-triggered works.

A.6 Chart05 - Expenditure by Life

A.6.1 An example of this chart is shown in Figure 23.

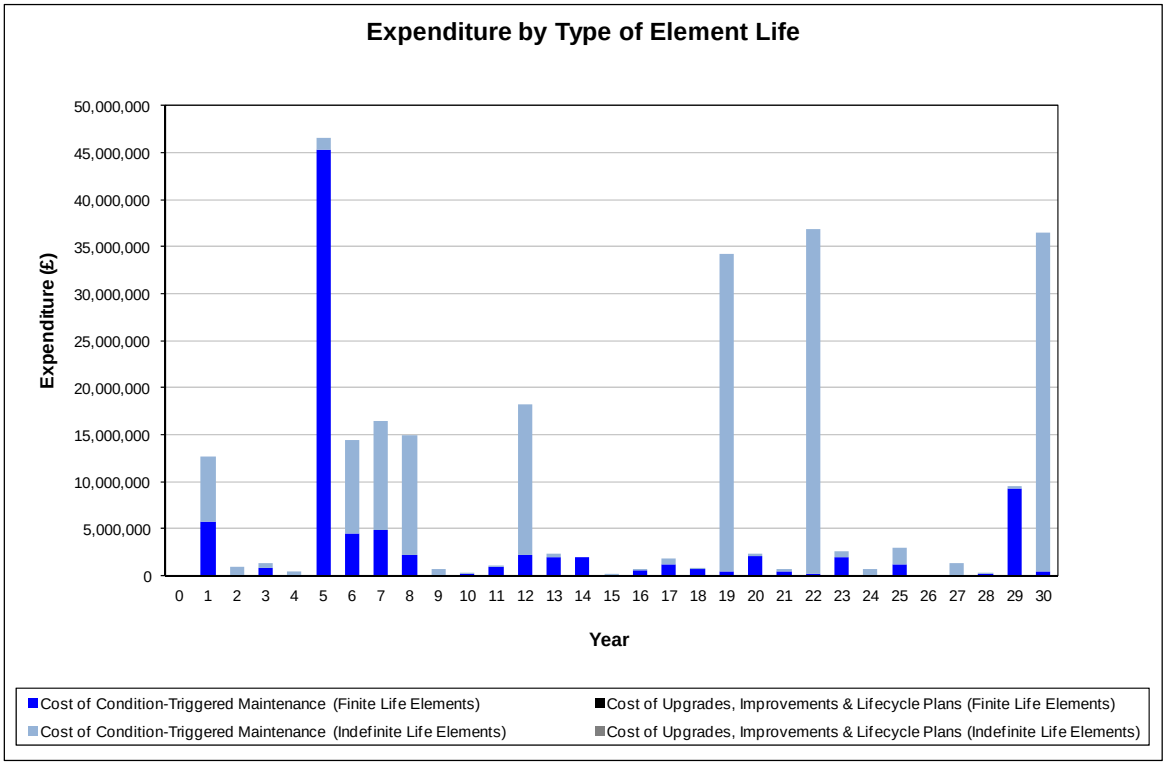


Figure 23: Example of Output Chart 05

A.6.2 Figure 23 shows that more money is spent on maintaining indefinite life elements than on maintaining/replacing finite life elements. This may be surprising at first. The reason for this trend may be that the maintenance strategies specified for the indefinite life elements are not appropriate, leading to an unnecessarily high frequency of works. Furthermore, the under-funding in works may be creating a severe exposure environment for a number of indefinite life elements, thereby increasing the frequency of necessary maintenance. For example, if the waterproofing on a bridge fails (i.e. reaches or exceeds condition 4B) and is not replaced, then the exposure

environment of the bridge's deck elements and abutments will be severe and the condition of these elements will deteriorate faster.

A.7 Chart06 – Shortfall

A.7.1 An example of this chart is shown in Figure 24.

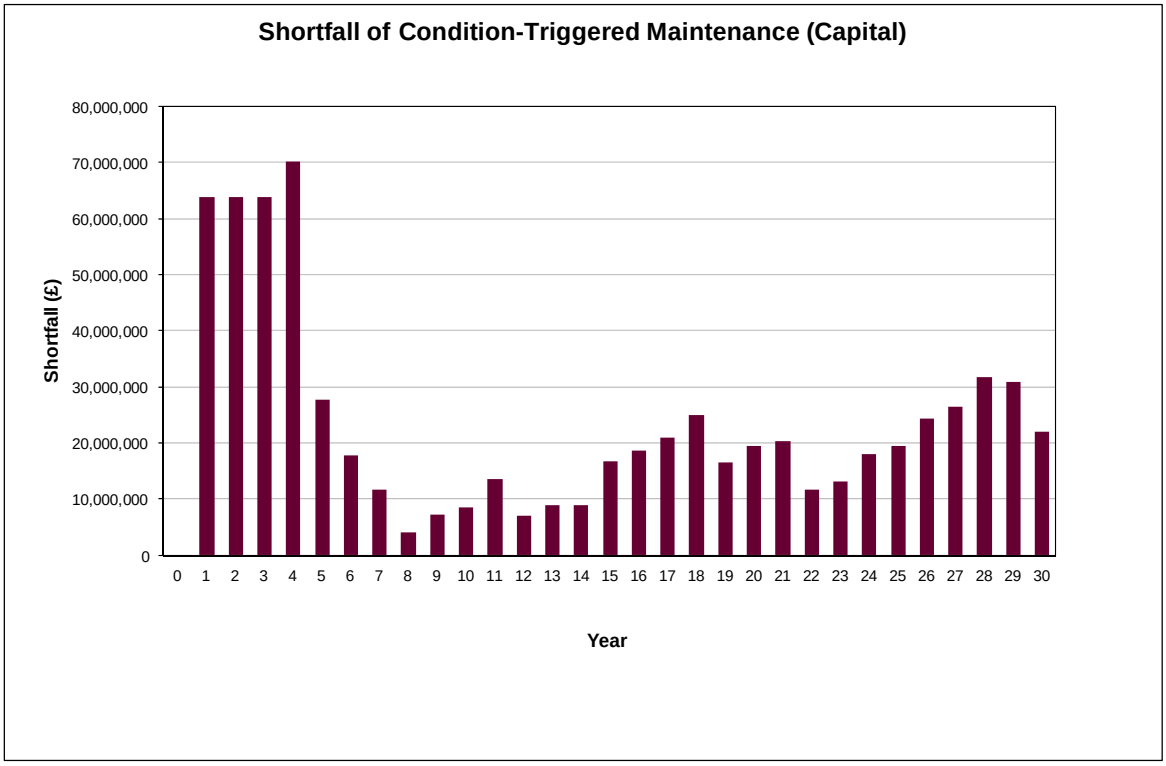


Figure 24: Example of Output Chart 06

A.7.2 Figure 24 repeats the shortfall profile in Figure 19.

A.7.3 Shortfall is carried forward from one year to the next until the required work can be undertaken. The shortfall associated with a particular element may increase over time if the element continues to deteriorate and the value of work required to restore it to "as-new" condition increases as a result.

A.7.4 The large difference between minimum and maximum shortfall seen over the analysis period suggests that a number of elements reach or exceed their intervention threshold condition in the same year. This may be because groups with a large number of structures have been defined (Section 3.2.4).

A.7.5 There is a significant shortfall over the analysis period. This implies that the funding is not sufficient to carry out works on a number of elements that have reached or exceeded their

intervention threshold. This suggests that the funding should be increased or the maintenance strategies for the elements should be revised.

A.8 Chart07 - Risk & Traffic Delay

A.8.1 An example of this chart is shown in Figure 25.

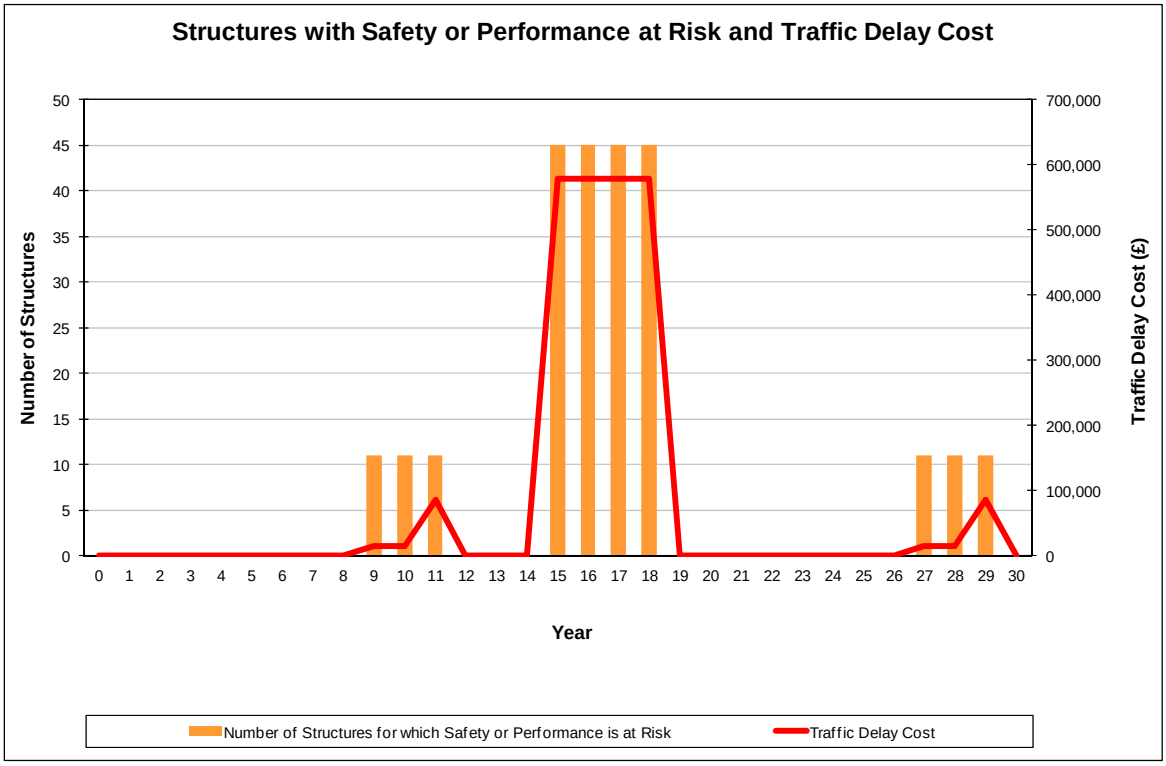


Figure 25: Example of Output Chart 07

A.8.2 Figure 25 shows the number of structures with safety or performance at risk, and the associated traffic delay cost over the analysis period.

A.8.3 A structure's safety or performance is considered to be at risk if at least one element with a Very High importance rating has reached or exceeded condition 4B.

A.8.4 Where the number of structures with safety or performance at risk remains the same but the associated traffic delay cost increases (e.g. Years 10 and 11 and Years 28 and 29), this may because elements with a Very High importance rating have deteriorated from a condition with a Severity of 4 to a condition with a Severity of 5. Alternatively, the set of structures for which safety or performance are at risk in Years 10 and 28 may be different to the set of structures in Years 11 and 29. The traffic delay cost would be higher in Years 11 and 29 if the set of affected structures

in these years have a greater length or carry more traffic (leading to more onerous traffic restrictions) than the affected structures in Years 10 and 28.

A.9 Chart08 - Condition Bands

A.9.1 An example of this chart is shown in Figure 26.

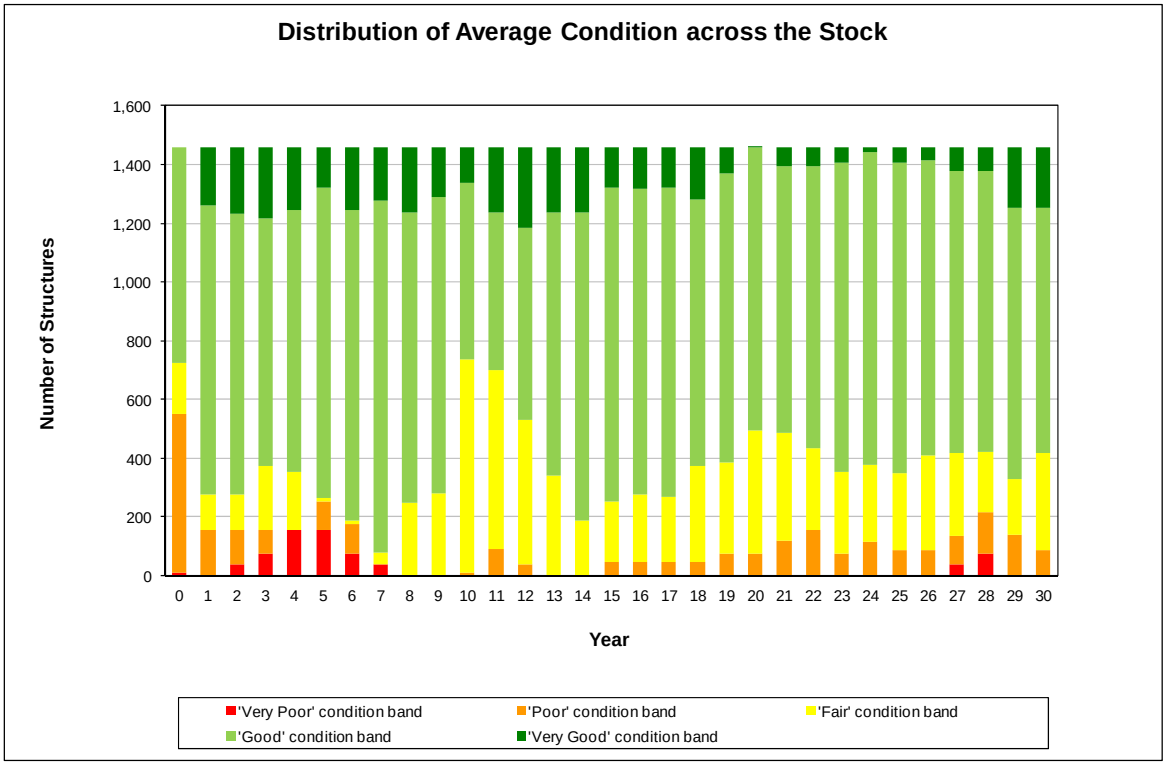


Figure 26: Example of Output Chart 08

A.9.2 Figure 26 shows that most of the structures are in Very Good or Good condition over the analysis period. Structures in Very Poor condition over the analysis period imply that the funding should be increased or the maintenance strategies for the elements should be revised.

Appendix B : Default Information

B.1 General

B.1.1 This appendix explains the default information in the model.

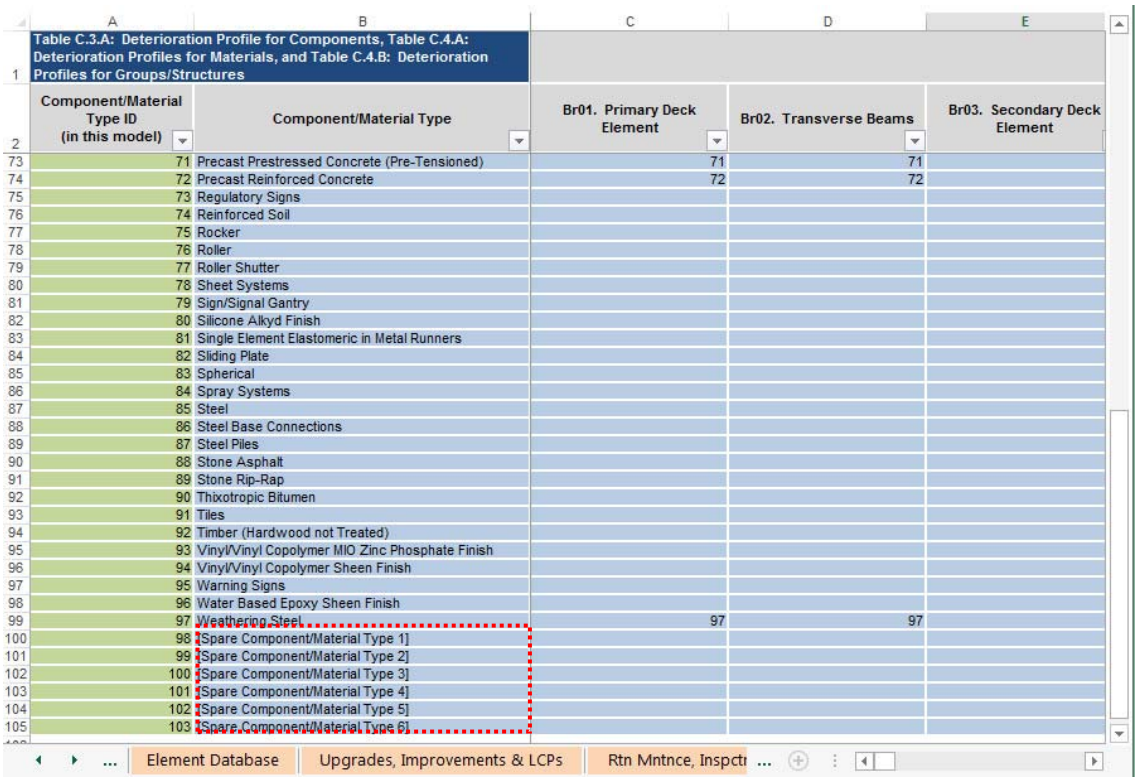
5.1.1 Data may be copied and pasted in cells with a blue background in the worksheets described in this appendix, using Microsoft Excel's **Copy** and **Paste Special** – **Values** functionality. The model does not allow data to be copied and pasted in other cells, including cells that are hidden.

B.2 'Reference_03&04_i' Worksheet

B.2.1 This worksheet lists the possible component/material types for each element.

B.2.2 Common component/material types are listed in column B of the 'Reference_03&04_i' worksheet.

B.2.3 New component/material types may be defined in cells B100 to B105 (Figure 27).



	A	B	C	D	E
1	Table C.3.A: Deterioration Profile for Components, Table C.4.A: Deterioration Profiles for Materials, and Table C.4.B: Deterioration Profiles for Groups/Structures				
2	Component/Material Type ID (in this model)	Component/Material Type	Br01. Primary Deck Element	Br02. Transverse Beams	Br03. Secondary Deck Element
73	71	Precast Prestressed Concrete (Pre-Tensioned)	71	71	
74	72	Precast Reinforced Concrete	72	72	
75	73	Regulatory Signs			
76	74	Reinforced Soil			
77	75	Rocker			
78	76	Roller			
79	77	Roller Shutter			
80	78	Sheet Systems			
81	79	Sign/Signal Gantry			
82	80	Silicone Alkyd Finish			
83	81	Single Element Elastomeric in Metal Runners			
84	82	Sliding Plate			
85	83	Spherical			
86	84	Spray Systems			
87	85	Steel			
88	86	Steel Base Connections			
89	87	Steel Piles			
90	88	Stone Asphalt			
91	89	Stone Rip-Rap			
92	90	Thixotropic Bitumen			
93	91	Tiles			
94	92	Timber (Hardwood not Treated)			
95	93	Vinyl/Vinyl Copolymer MIO Zinc Phosphate Finish			
96	94	Vinyl/Vinyl Copolymer Sheen Finish			
97	95	Warning Signs			
98	96	Water Based Epoxy Sheen Finish			
99	97	Weathering Steel	97	97	
100	98	[Spare Component/Material Type 1]			
101	99	[Spare Component/Material Type 2]			
102	100	[Spare Component/Material Type 3]			
103	101	[Spare Component/Material Type 4]			
104	102	[Spare Component/Material Type 5]			
105	103	[Spare Component/Material Type 6]			

Figure 27: Adding Additional Component/Material Types

B.2.4 To indicate if a component/material type applies to an element, complete cells C3 to BN105. For example, 'Blockwork, i.e. Masonry or Stone' is appropriate for 'Br01. Primary Deck Element'. To indicate this, the 'Component/Material Type ID' in cell A6 for 'Blockwork, i.e. Masonry or Stone' should be given in cell C6 for 'Br01. Primary Deck Element' (see the red box in Figure 28). On the other hand, 'Asphaltic Plug Joint' is not appropriate for 'Br01. Primary Deck Element'. Therefore,

cell C5 does not contain the 'Component/Material Type ID' from cell A5 and is left blank instead (see the yellow box in Figure 28).

	A	B	C
1	Table C.3.A: Deterioration Profile for Components, Table C.4.A: Deterioration Profiles for Materials, and Table C.4.B: Deterioration Profiles for Groups/Structures		
2	Component/Material Type ID (in this model)	Component/Material Type	Br01. Primary Deck Element
3	1	Aluminium	
4	2	Anti-Graffiti Paint	
5	3	Asphaltic Plug Joint	
6	4	Blockwork, i.e. Masonry or Stone	4
7	5	Boarded Systems	
8	6	Brickwork	6
9	7	Buried Joint	

Figure 28: Indicating Which Component/Material Types are Appropriate for Elements

B.2.5 'Functioning Finishes Protect Component/Material Type from Deterioration?' in column BO of the 'Reference_03&04_i' worksheet indicates if a functioning finish freezes the deterioration of the component/material type. For example, deterioration of 'Cast Iron or Wrought Iron' is assumed to be frozen if it has a functioning finish. Therefore, '100' is entered in cell BO13 (see the red box in Figure 29). On the other hand, deterioration of 'Clay Pipe' is assumed not to be frozen if the component has a functioning finish. Therefore, '0' is entered in cell BO15 (see the yellow box in Figure 29).

	B	BM	BN	BO
	ration Profile for Components, Table C.4.A: s for Materials, and Table C.4.B: Deterioration Structures			[Yes = 100; No = 0]
	al Component/Material Type	St07. Structural Earthworks - Reinforced/Strengthened Soil/Fill Structure	St08. Subway: Pipe	Functioning Finishes Protect Component/Material Type from Deterioration?
11	Cast Iron or Wrought Iron			100
12	Cladding			0
13	Clay Pipe			0
14	Concrete			0
15	Concrete Insitu Slabs			0

Figure 29: Indicating that a Functioning Finish Freezes Deterioration of the Component/Material Type

B.3 'Reference_03&04_ii' Worksheet

B.3.1 This worksheet presents the service life and deterioration rates for each component/material type in different exposure environments.

B.3.2 Columns C to S in the 'Reference_03&04_ii' worksheet show the time taken (as fractions of the mean time to failure) for a component/material type to deteriorate from condition 1A to other conditions if no maintenance/replacement is carried out. For example, aluminium in a mild exposure environment is expected to reach condition 3B in 80% of the mean time to failure from condition 1A if no maintenance/replacement is carried out (see the red box in Figure 30).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Table C.3.A: Deterioration Profile for Components, Table C.4.A: Deterioration Profiles for Materials, and Table C.4.B: Deterioration Profiles for Groups/Structures		Fraction of Time to Failure to Reach Condition...										
2	Component/Material Type	Exposure	1A	2B	2C	2D	2E	3B	3C	3D	3E	4B	4C
3	Aluminium	Mild	0.000	0.533	0.667	0.711	0.756	0.800	0.867	0.889	0.911	0.933	0.967
4	Aluminium	Moderate	0.000	0.500	0.667	0.722	0.778	0.833	0.892	0.911	0.931	0.950	0.975
5	Aluminium	Severe	0.000	0.532	0.691	0.745	0.798	0.851	0.904	0.922	0.940	0.957	0.979
6	Anti-Graffiti Paint	Mild	0.000	0.250	0.375	0.417	0.458	0.500	0.625	0.667	0.708	0.750	0.875
7	Anti-Graffiti Paint	Moderate	0.000	0.250	0.375	0.417	0.458	0.500	0.625	0.667	0.708	0.750	0.875
8	Anti-Graffiti Paint	Severe	0.000	0.250	0.375	0.417	0.458	0.500	0.625	0.667	0.708	0.750	0.875
9	Asphaltic Plug Joint	Mild	0.000	0.533	0.667	0.711	0.756	0.800	0.867	0.889	0.911	0.933	0.967
10	Asphaltic Plug Joint	Moderate	0.000	0.500	0.625	0.667	0.708	0.750	0.833	0.861	0.889	0.917	0.958
11	Asphaltic Plug Joint	Severe	0.000	0.400	0.500	0.533	0.567	0.600	0.700	0.733	0.767	0.800	0.900
12	Blockwork, i.e. Masonry or Stone	Mild	0.000	0.167	0.333	0.389	0.444	0.500	0.667	0.722	0.778	0.833	0.917
13	Blockwork, i.e. Masonry or Stone	Moderate	0.000	0.400	0.550	0.600	0.650	0.700	0.800	0.833	0.867	0.900	0.950
14	Blockwork, i.e. Masonry or Stone	Severe	0.000	0.400	0.550	0.600	0.650	0.700	0.800	0.833	0.867	0.900	0.950

Figure 30: Defining the Condition Deterioration Profile of a Component/Material Type

B.3.3 Column T in the ‘Reference_03&04_ii’ worksheet gives the mean time to failure of a component/material type if routine maintenance takes place.

B.3.4 If limited or no routine maintenance takes place, the mean times to failure should be adjusted. Column V in the ‘Reference_03&04_ii’ worksheet should be used to give the appropriate reduction factor.

B.3.5 If new component/material types have been defined (Section B.2.3), then it is necessary to define appropriate deterioration profiles for them in rows 317 to 414.

B.3.6 The following must be followed when defining new or modifying existing deterioration profiles in the proof-of-concept model:

- For consistency with the default exposure rules in the proof-of-concept model, NO exposure classification should be specified for any type of waterproofing (e.g. mastic asphalt, boarded systems, sheet systems, spray systems, other/unknown waterproofing, etc.).
- For all other component/material types, an exposure classification must be specified for each deterioration profile. At least three deterioration profiles should be defined for each component/material type – for Mild, Moderate and Severe exposure environments. A deterioration profile for a Protected exposure environment should only be defined if a functioning finish freezes the deterioration of the component/material type.

B.3.7 If the error message ‘The component/material type is not recognised.’ appears in column X of the ‘Reference_03&04_ii’ worksheet, then the data entered in column A are invalid. Enter an appropriate component/material type in column A. The component/material type in column A of the ‘Reference_03&04_ii’ worksheet should appear in column B of the ‘Reference_03&04_i’ worksheet.

It is only acceptable for this error message not to be addressed in rows that do not contain defined deterioration profiles.

B.3.8 If the error message ‘This is an ambiguous deterioration rule.’ appears in column Y of the ‘Reference_03&04_ii’ worksheet, then two or more deterioration profiles have been defined for the same combination of component/material type and exposure. Only one deterioration profile is permitted for each combination of component/material type and exposure.

B.4 ‘Reference_05&07’ Worksheet

B.4.1 The unit costs of works and the work rates for different maintenance/renewal activities are provided in this worksheet.

B.4.2 Details of new maintenance/renewal activities can be defined in rows 72 to 209.

B.4.3 Data may be added to or modified in cells with a blue background in the 'Reference_05&07' worksheet. No other cells should be changed. Entering a ‘Cost Type’ in column D of the

'Reference_05&07' worksheet changes the background colour of cells in columns E to J to indicate which cells need to be populated.

B.5 'Reference_06' Worksheet

B.5.1 This worksheet presents the intervention levels and effects for each component/material type in different exposure environments.

B.5.2 If new component/material types have been defined (Section B.2.3), then it is necessary to define appropriate intervention levels and effects for them in rows 3275 to 3402.

B.5.3 The following must be followed when defining new or modifying existing intervention levels and effects in the proof-of-concept model:

- For consistency with the default exposure rules in the proof-of-concept model, NO exposure classification should be specified for any type of waterproofing (e.g. mastic asphalt, boarded systems, sheet systems, spray systems, other/unknown waterproofing, etc.).
- For all other component/material types, an exposure classification must be specified for each intervention rule. Three intervention rules should be defined for each component/material type – for Mild, Moderate and Severe exposure environments.
- Intervention profiles for a Protected exposure environment need not be defined. It is assumed that a Protected exposure environment means that deterioration of the component/material type is frozen. Furthermore, it is assumed that a finish cannot be maintained/replaced without the component/material type that it is protecting being maintained/replaced as well if the component/material type has reached or exceeded its intervention threshold condition.

B.5.4 If the error message 'The maintenance action is not recognised.' appears in column J of the 'Reference_06' worksheet, then the data entered in column H are invalid. Select an appropriate item from the drop-down list in column H.

It is only acceptable for this error message not to be addressed in rows that do not contain defined intervention rules.

B.5.5 If the error message 'The component/material type is not recognised.' appears in column K of the 'Reference_06' worksheet, then the data entered in column F are invalid. Enter an appropriate component/material type in column F. The component/material type in column F of the 'Reference_06' worksheet should appear in column B of the 'Reference_03&04_i' worksheet.

It is only acceptable for this error message not to be addressed in rows that do not contain defined intervention rules.

B.5.6 If the error message 'This is an ambiguous intervention rule.' appears in column L of the 'Reference_06' worksheet, then two or more intervention rules have been defined for the same combination of strategy, condition, component/material type and exposure. Only one intervention rule is permitted for each combination of strategy, condition, component/material type and exposure.

B.5.7 In columns B to E of the 'Reference_06' worksheet, enter all the conditions of the component/material type at which maintenance/renewal works may be carried out under Planned Preventive, Planned Targeted, Planned Do Minimum and Unplanned Reactive strategies, respectively. Enter 'N/A' in columns B to E if the intervention rule (i.e. combination of condition, component/material type, exposure, maintenance action and condition after application) does not apply under one or more strategies.

B.5.8 For each combination of strategy, component/material type and exposure, an intervention rule must be defined for conditions 5B, 5C, 5D and 5E.

This is for consistency with the SAMPt's assumption that works must be undertaken on an element that has reached or exceeded condition 5B, regardless of the budget.

B.6 'Reference_08' Worksheet

B.6.1 This worksheet presents the size formulae for each element from *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

B.6.2 Column B of the 'Reference_08' worksheet provides the element size formulae in a format that is easily understood by a user. Columns E to K of the 'Reference_08' worksheet are used to translate the element size formulae to a format that can be easily understood by the proof-of-concept model.

B.6.3 If the element size formulae in the 'Reference_08' worksheet are modified, then the unit costs of works and the work rates in the 'Reference_05&07' worksheet may also need to be revised.

B.7 'Reference_09' Worksheet

B.7.1 This worksheet contains the formulae for calculating preliminaries cost, design cost and other costs.

B.7.2 The 'Reference_09' worksheet also gives the permissible traffic management arrangements for each element, the corresponding unit costs of traffic management and the location of traffic management arrangements.

The only acceptable combinations for traffic management arrangement and location of traffic management arrangement are given in Table 5.

Table 5: Acceptable Locations for Traffic Management Arrangements

Location of Traffic Management Arrangement	Traffic Management Arrangement
RouteAndObstacle	• Retaining Wall Traffic Management
Route	• Contraflow • Shuttle Working / Lane Closure • Hardshoulder Closure
Obstacle	• Contraflow • Shuttle Working / Lane Closure • Hardshoulder Closure • Waterway Possession • Railway Possession

B.8 'Reference_10' Worksheet

B.8.1 This worksheet contains the formulae to calculate traffic delay costs from *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

B.9 'Reference_11_i' Worksheet

B.9.1 This worksheet contains the prioritisation algorithm from *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2], used to prioritise condition-triggered maintenance/renewal works.

B.9.2 The prioritisation algorithm includes priority weighting coefficients; the factors for different traffic categories, the factors for different routes supported and for different routes and obstacles adjacent to or crossed by the structure, and the factors for different structure types.

B.9.3 The 'Reference_11_i' worksheet also gives the permissible traffic management arrangement for different structure types, different routes supported and different routes and obstacles adjacent to or crossed by the structure.

B.9.4 Finally, the 'Reference_11_i' worksheet provides the asset value factor (AVF) for different structure types and authority types and the structure size formulae associated with the AVFs. These are used to weight the condition of individual structures to determine the overall condition of the structure stock.

B.9.5 There are two ways to ensure that the condition of a structure type has no impact on the overall condition of the structure stock:

- In cells D49 to D69 of the 'Reference_11_i' worksheet, do NOT assign an AVF structure type to the structure type for Modern Equivalent Asset given in cells B49 to B69.
- In cells C73 to D78 of the 'Reference_11_i' worksheet, set the appropriate AVF to a very small non-zero value (e.g. 0.000000000001). Do NOT set an AVF to zero as this will corrupt the model.

B.10 'Reference_12' Worksheet

B.10.1 This worksheet contains the formulae for calculating GRC, including the basic unit rates of GRC for different structure types and the adjustment factors for different criteria, from *Structures Asset Management Planning Toolkit, Part C: Supporting Information*[2].

B.10.2 New adjustment factors can be added in cells B42 to D47 (see the red box in Figure 31) of the 'Reference_12' worksheet.

	A	B	C	D
27		Table C.12.B: Adjustment Factors		
28		Factor Affecting Unit Cost	Factor	Notes
29		Tunnel (> 400m)	1.25	Based on engineering judgement
30		Location - Rural	0.70	Based on scheme data and engineering judgement
31		Route Supported - Unclassified	0.80	Based on scheme data and engineering judgement
32		Obstacle (Footway/Cycleway)	0.75	Based on engineering judgement
33		Obstacle (Watercourse - Non-Navigable)	0.90	Based on scheme data and engineering judgement
34		Obstacle (Land/Disused)	0.90	Based on scheme data and engineering judgement
35		Obstacle (Railway)	2.00	Based on scheme data and engineering judgement
36		Obstacle (Tenanted/Business)	1.10	Based on engineering judgement
37		Heritage	2.00	Based on engineering judgement
38		Conservation Area	1.25	Based on engineering judgement
39		Environmentally Sensitive	1.40	Based on engineering judgement
40		River, Coastal etc. Walls	1.60	Based on engineering judgement
41		Substandard Structure	0.85	Based on engineering judgement
42		[Spare Adjustment Factor 1]	1.00	Available for definition by the user
43		[Spare Adjustment Factor 2]	1.00	Available for definition by the user
44		[Spare Adjustment Factor 3]	1.00	Available for definition by the user
45		[Spare Adjustment Factor 4]	1.00	Available for definition by the user
46		[Spare Adjustment Factor 5]	1.00	Available for definition by the user
47		[Spare Adjustment Factor 6]	1.00	Available for definition by the user

Figure 31: Adding New Adjustment Factors

B.11 'Reference_14' Worksheet

B.11.1 This worksheet presents the importance of each element to the integrity of the overall structure and the type of life of each element as either finite or indefinite life.