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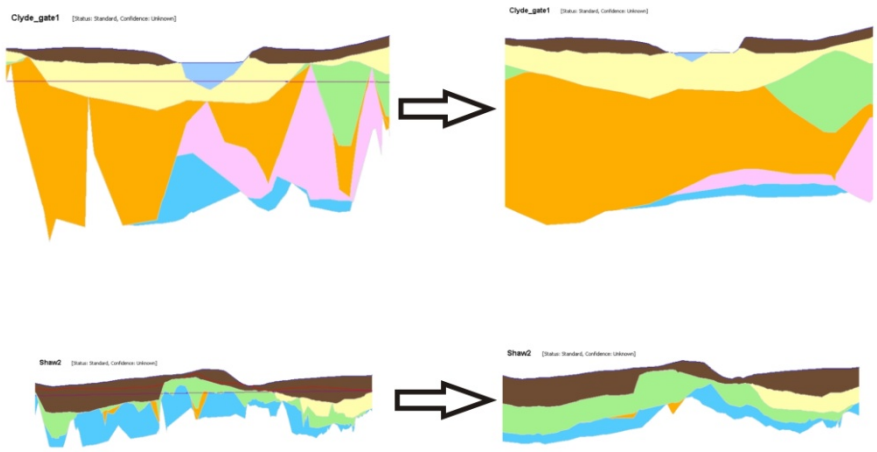
Post-Calculation Checking of GSI3D Models

Geology and Landscape Programme

Internal Report IR/11/057



BRITISH GEOLOGICAL SURVEY

GEOLOGY AND LANDSCAPE PROGRAMME

INTERNAL REPORT IR/11/057

Post-Calculation Checking of GSI3D Models

R L Terrington

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Summary

This report describes methods for checking and remediating problems within GSI3D models post calculation for non-faulted models. These checks are particularly concerned with how the geometry of units have calculated and if they are a true resemblance of what has been drawn in cross-section. These issues include:

- Missing Envelopes or cross-section correlations
- Lack of correlation nodes on cross-section lines
- Wrongly attributed correlation lines in cross-section

1 Introduction

One of the most important parts of the model checking process is done in post calculation. This allows you to see whether the 2D and 3D distribution of geological has been calculated correctly. This is very important when making volumetric calculations and assessing the distribution of these units. Please refer to the GSI3D 2011 manual (Mathers *et al* 2011) for related information regarding the checking of models.

All of the cross-sections in this document have been generated from calculating the model and looking at the synthetic outputs from the calculation. The snapping functionality has now made some of these problems easier to avoid but for older models or models that pre-date this functionality the following checks should be made to improve the calculation of the model and the surface triangulation.

Before checking the model, you must calculate it by doing the following: ***Calculate – NonFaulted – Calculate All units from Sections and envelopes***

Once the model has been calculated do the following to view the 'calculated' or synthetic output of each of the existing sections: ***Right click in the Cross-section window – Window Properties – Click off Polygons under Correlated section rendering – Click On Polygons for Synthetic section rendering*** (**Figure 1**).

The next stage is to **go through every cross-section** to see if any of the calculated units are missing/have a spiked triangulation or have a peculiar geometry compared to the original correlation lines. In the following pages there are examples of the kinds of issues to look for in post calculation and how to remediate these to improve the calculation of the units.

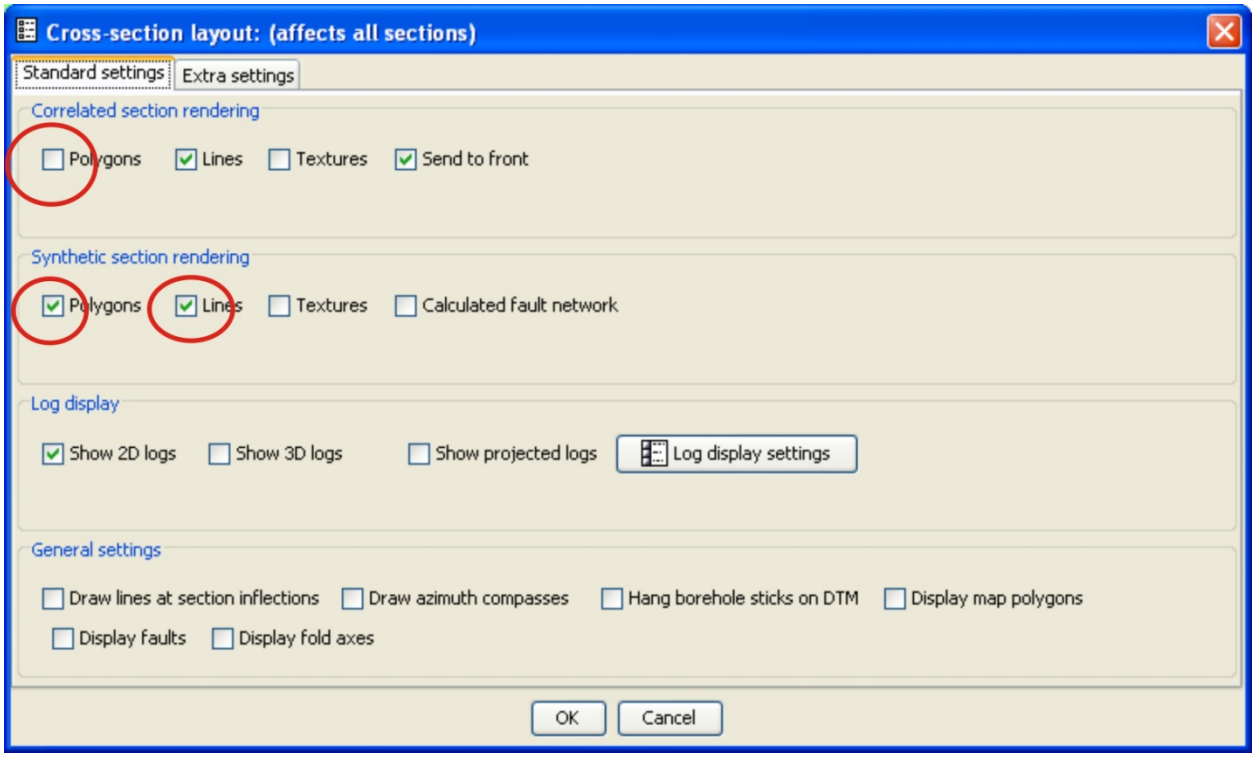

Figure 1 – Setup for checking calculated sections in cross-section

2 Post-Calculation Checks and Remediation

2.1 GENERAL CALCULATION ISSUES

Check the calculation does not take overly long or does not finish – occasionally this can be seen if the certain units are not calculated or take a very long time to calculate (successful calculation indicated by aterisk * in top left corner of geological unit and a pop-up box indicating the calculation has finished). **Figure 2** indicates where the calculation progress can be monitored.

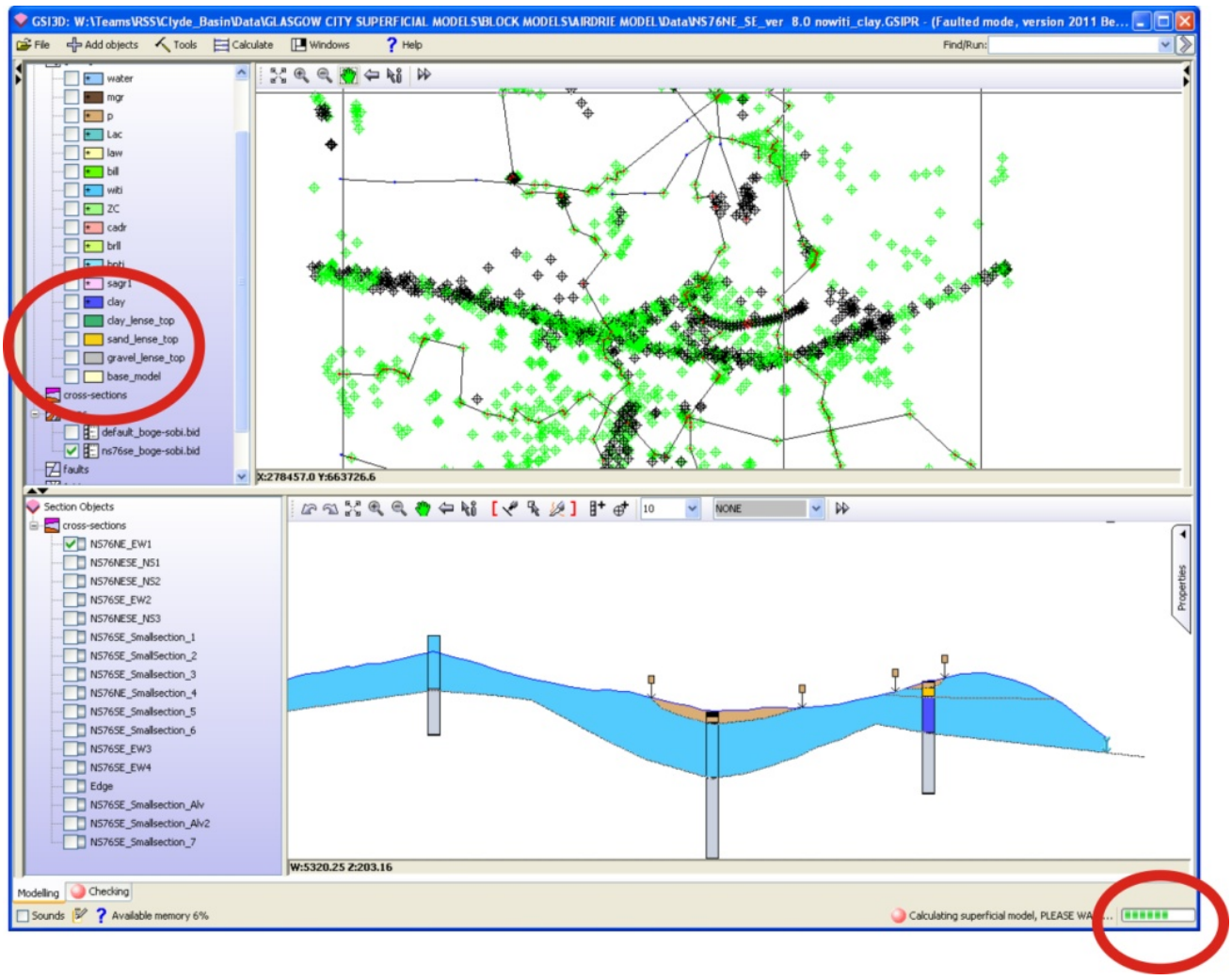

Figure 2 - Calculation Progress Monitoring

A number of factors could contribute to the unsuccessful calculation of a model. These include:

- Wrongly attributed units in the ID GVS column (e.g. the numbering order has been corrupted or is no longer sequential)
- Java Memory runs out (Check Java console for an indication of this). This could be due to large DTM sizes (generally those above 10mb) or large image sizes within the project (those above 2mb)

2.2 WRONGLY ATTRIBUTED LINES AND MISSING ENVELOPES

If when viewing the calculated cross-section, the correlation line exists but does not appear to be forming a calculated unit in cross-section then it is probably one of the factors below:

- The correlation line could be unattributed with anything from the GVS list and will appear to be attributed with **NN** (no name) or wrongly named as in **Figure 3**. Please re-name the line as applicable from the GVS
- The correlation line could be wrongly attributed from the list in the GVS and therefore not match the envelope defining its 2D distribution. Please re-name as applicable
- The envelope for the correlated line could be missing as in **Figure 4**. Please draw the necessary envelope required to match the correlation line in the cross-section

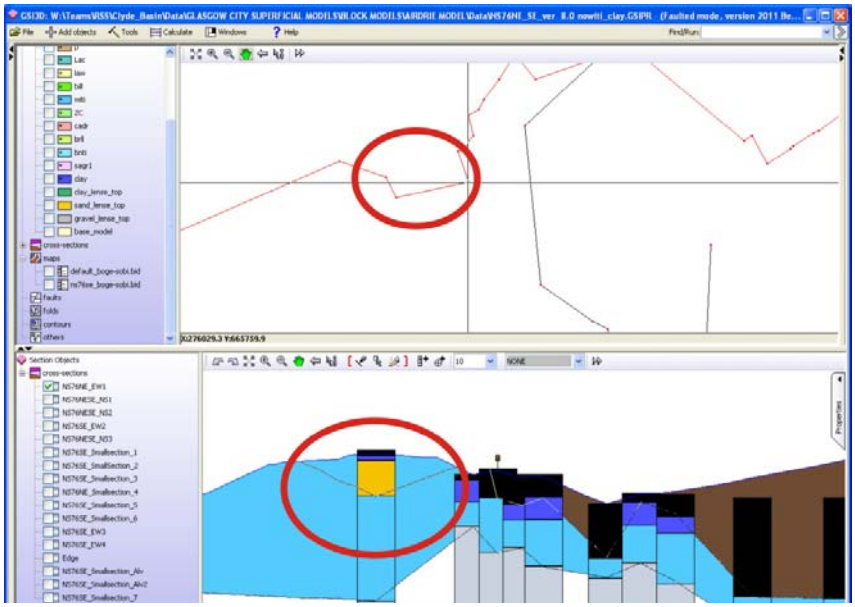

Figure 3 - Wrongly named Correlation Lines

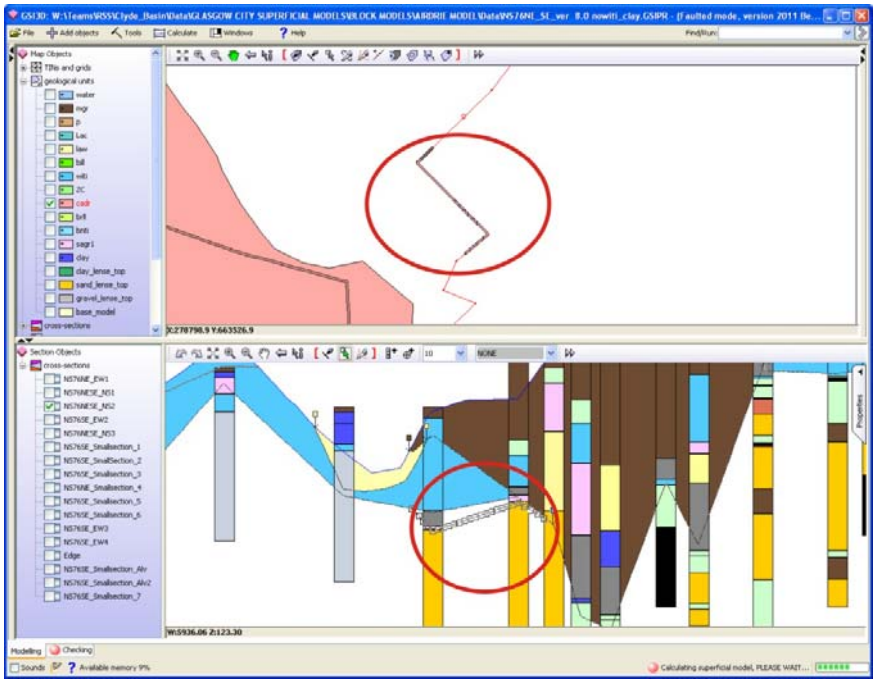

Figure 4 - Missing envelopes for correlated lines

2.3 ENVELOPES NOT FULLY EXTENDED

For each of the units the cross-section correlations must be covered by an envelope for it to calculate and form a surface. **Figure 5** shows an example where the geological unit has not been calculated to its full extent on the cross-section. Where this occurs, envelopes must be extended to cover the extent of the correlation on cross-section or the cross-section must be investigated to see if the correlation should actually exist there.

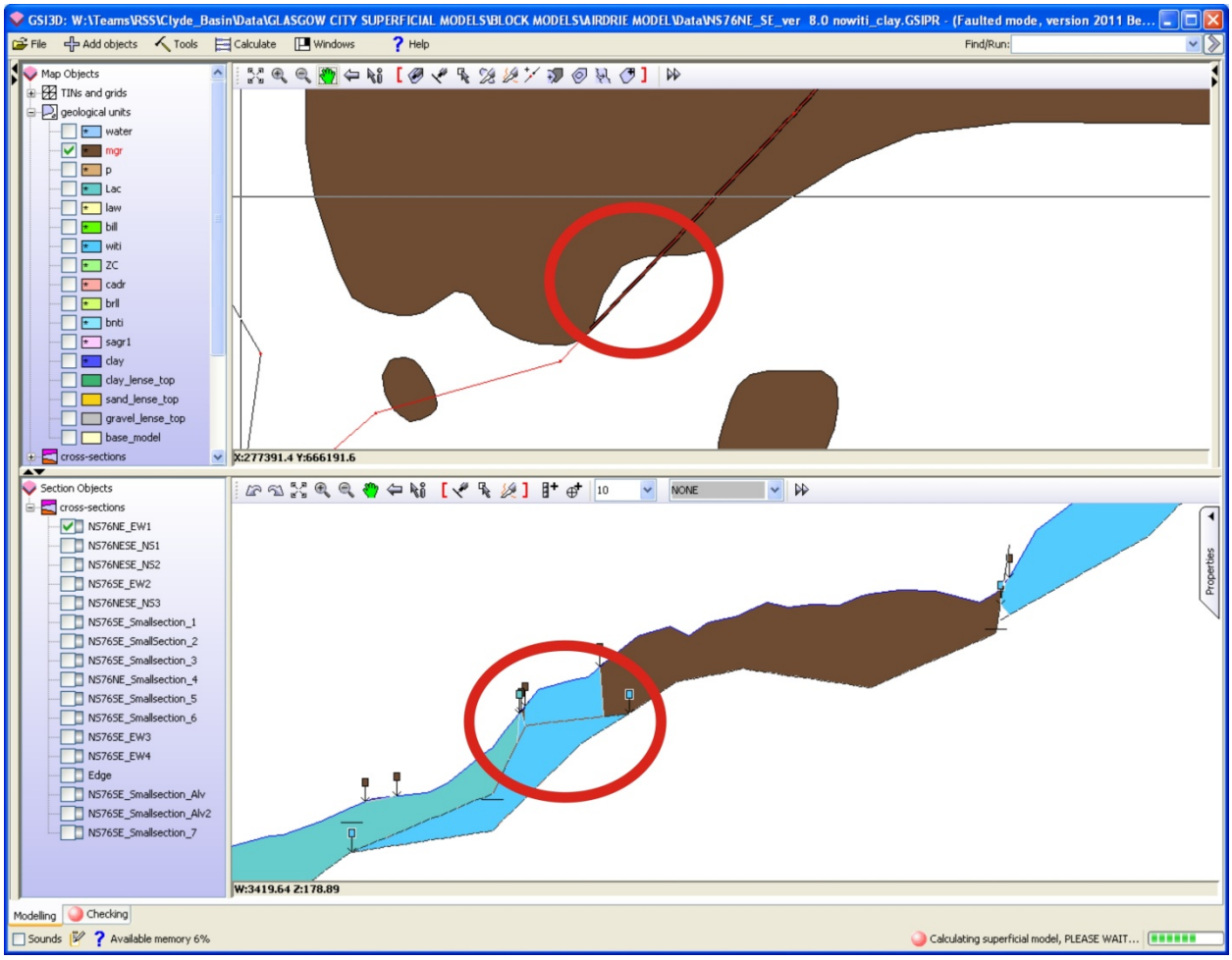

Figure 5 - Cross-section envelope missing full extent of envelope

2.4 LENSE ISSUES

Lenses must have a base and top correlated in cross-section for the calculation. Only the Top lense needs to exist in the list of the geological units and have the envelopes drawn for it. A reason why a lense will not calculate is because the correlation lines are not tightly linked together in cross-section (i.e. the area in which the top lense line meets the base lense line). The envelope for the lense must also be tightly wrapped around the cross-section correlations. The snapping functions in GSI3D do not exist at present for snapping lense to cross-sections to lense outcrops so this must be done eye.

If the lense still does not calculate please check the GVS to make sure the top has a negative ID and the base a positive ID with the same number (e.g. Top Silt lense = -450, base silt lense = 450)

Below is an example of a calculated model section showing a lense that hasn't been calculated correctly (**Figure 6**) and the areas in the map window and cross-section window to check the tightness of the correlation lines.

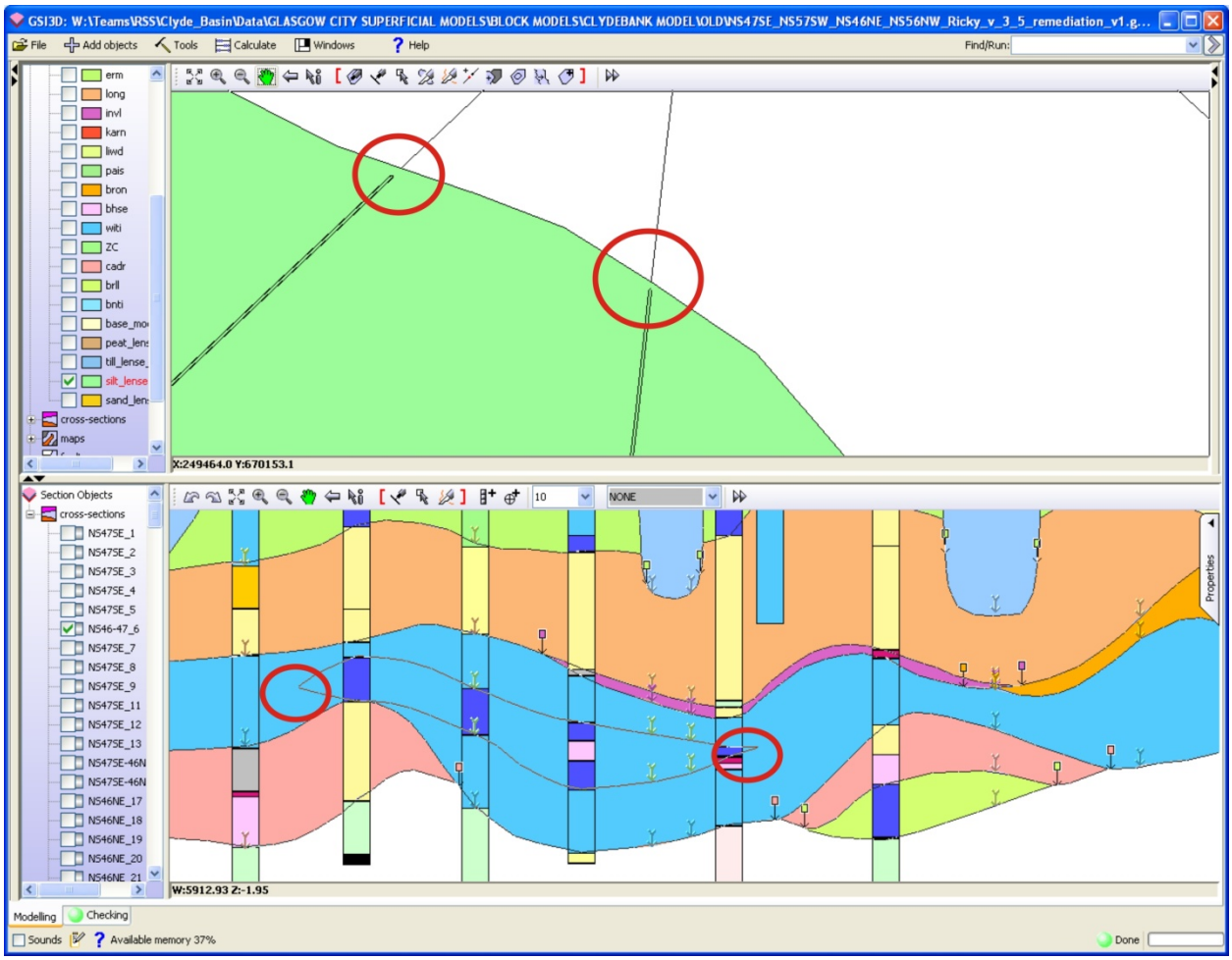

Figure 6 - Incorrectly calculated lenses

2.5 MISSING ENVELOPE EXTENSIONS

A common error that occurs is where the envelope has not been extended far enough to the end of where it has been correlated in cross-section. **Figure 7** shows an example where the blue (water) envelope needs to be extended so the unit is calculated to its correct extent. This can be remediated by simply extending the envelope over the area of correlated section or changing the extent of the correlation in section

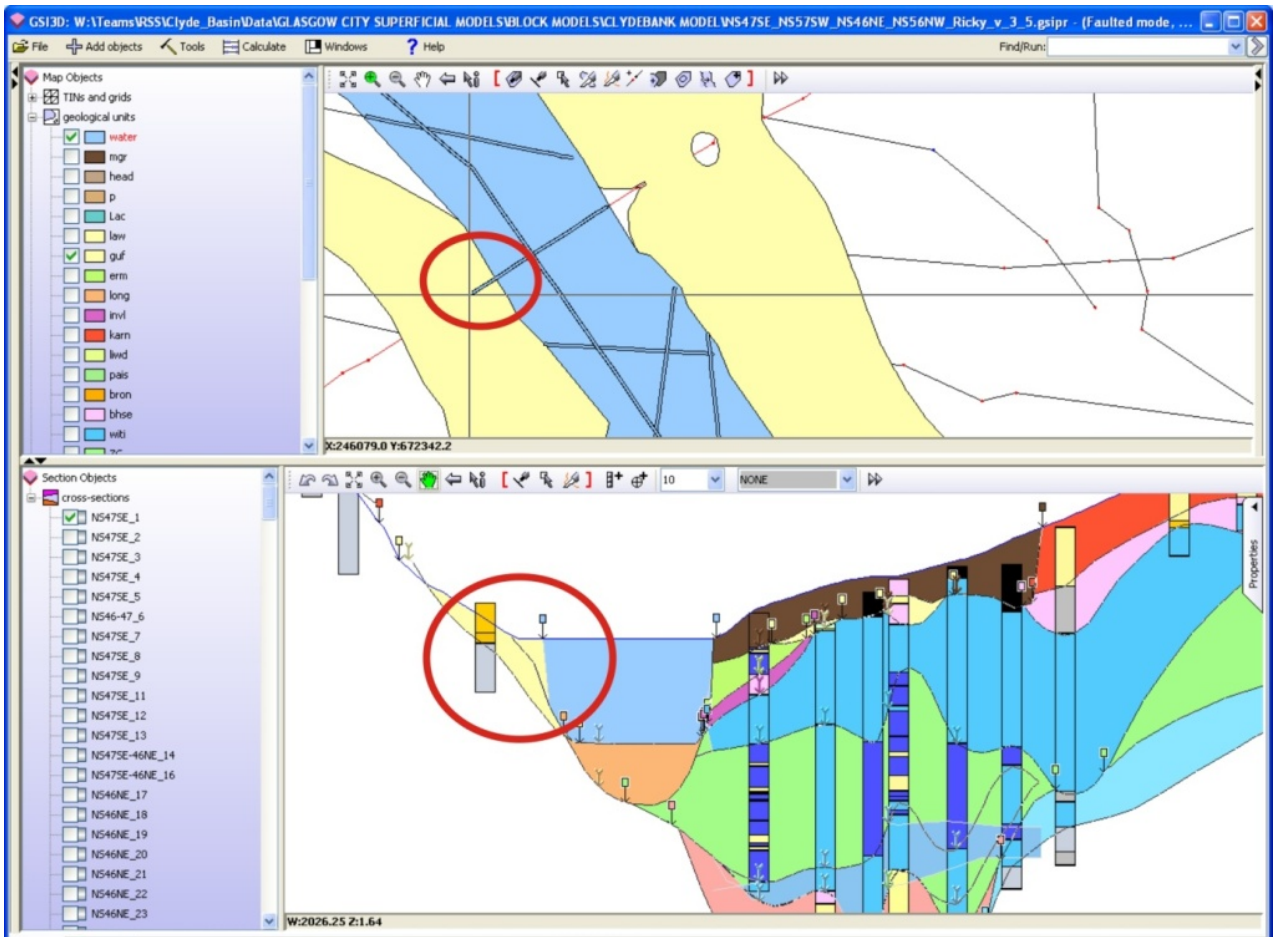

Figure 7 - Envelope extensions needed

2.6 MISSING CORRELATION LINES ON SECTION OR MISSING 'HOLES' IN THE ENVELOPE

In some of the cross-sections, the geological unit may appear to be incorrectly calculated or have an incorrect geometry due to a correlation line not actually existing for that unit in cross-section but where an envelope does exist for that unit. The reasons for this include:

- Missing 'holes' in the envelope where the correlation has stopped mid-way through the section but the envelope still exists over this area **Figure 8**
- An envelope has been extended too far beyond the end of the section as in **Figure 9**
- The correlation needs to be added to the cross-section where the envelope exists in that area **Figure 8 and 9**

To remediate this issue, the surrounding geological data must be assessed and that is why either of these scenarios could exist as seen in figures below**.**

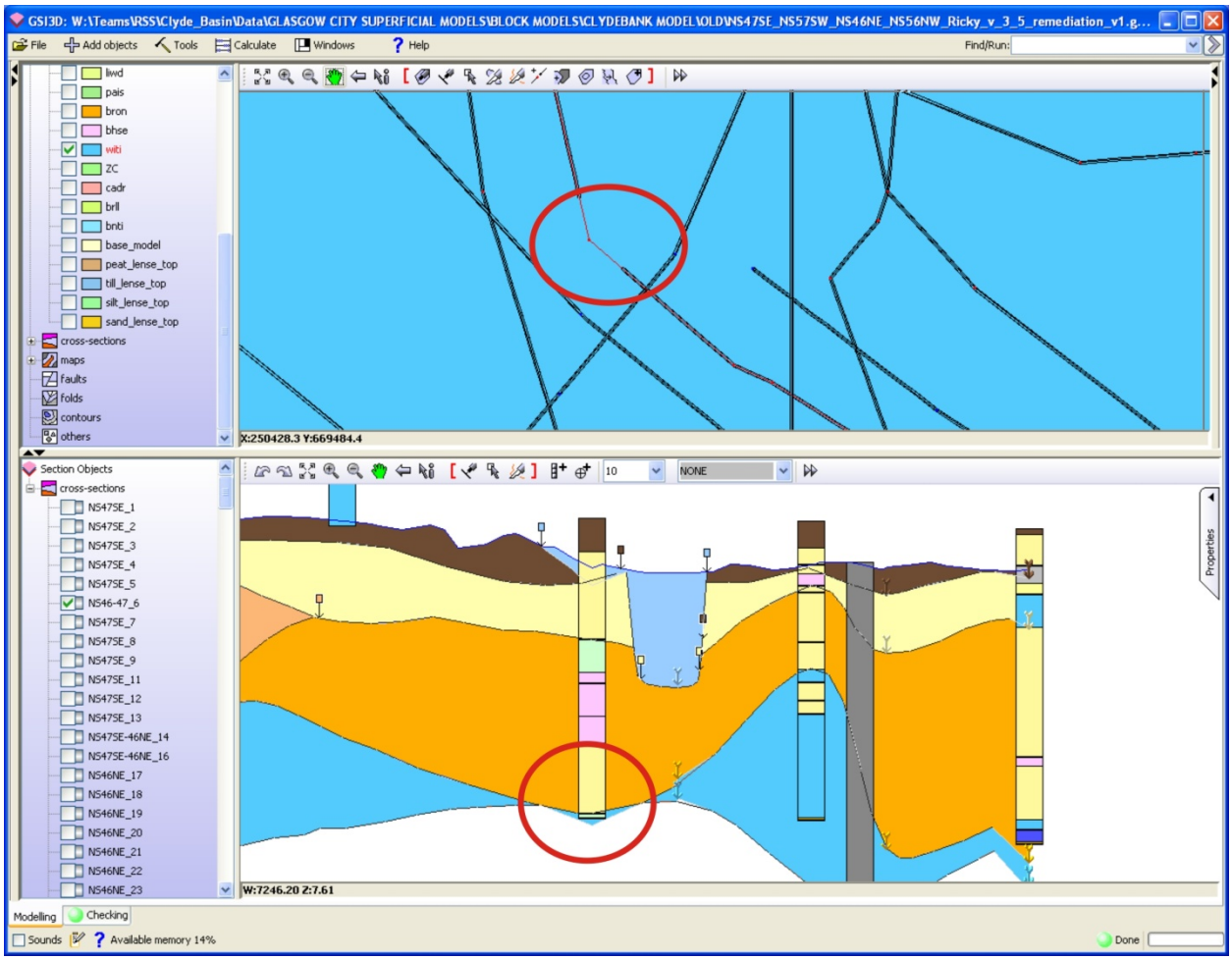

Figure 8 - Missing hole in envelope

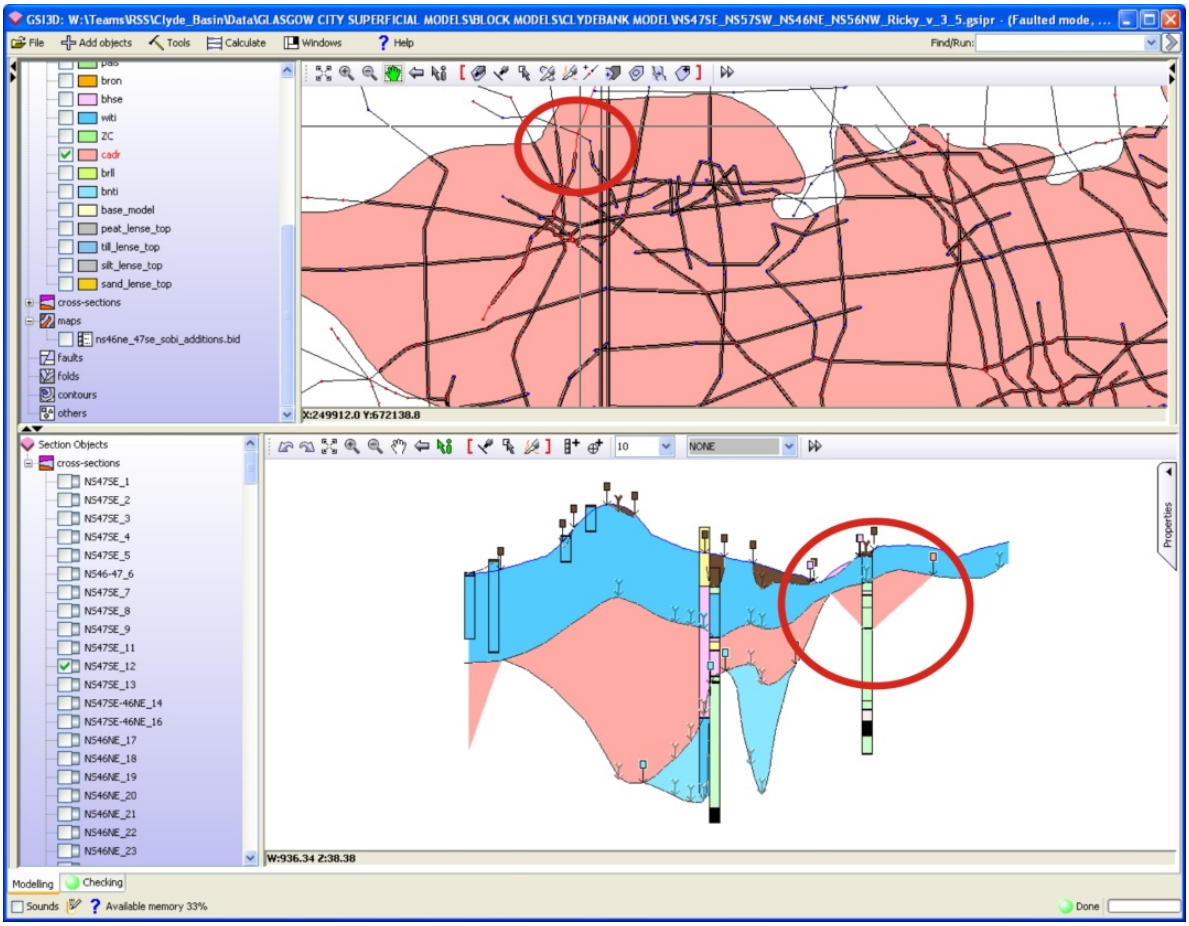

Figure 9 - Envelope or cross-section correlation needs editing

2.7 NOT ENOUGH NODES ADDED TO CORRELATED LINES

A common problem with thinner geological units (e.g. head, alluvium) is where there are not enough nodes on the cross-section correlation for the triangulation to calculate a full distribution of the unit. This will be shown in cross-section as ‘spiked’ triangular projections where the unit should be flat and continuous (**Figure 10**).

This can be remediated by adding nodes on the correlation line at the base of the spike/triangle where it spikes upwards as shown by the arrows in **Figure 10**. There is a *Densify Line* tool in GSI3D that can help you fix this quickly but this should be used with care as it makes future editing cumbersome and makes calculations take longer.

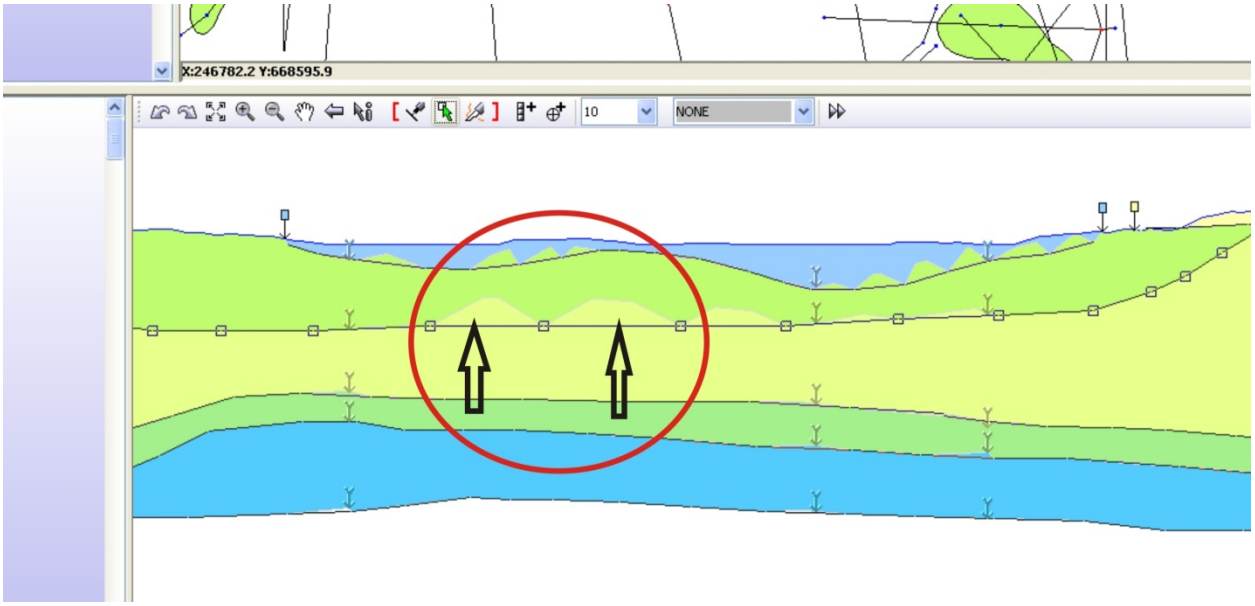

Figure 10 - Adding nodes to improve triangulation

Further testing of the model the model triangulation can be achieved by creating new sections in the model and viewing the synthetic outputs. This will help indicate where 'Helper' sections might need adding, or where the calculation is poorly constrained.

Glossary

Envelope	Defined here as the extent of a geological deposit in plan view (2D): forming a distribution map of the particular unit, a presence – absence map. May include an area of outcrop, subcrop or a combination of both
GSI3D	The Geological Surveying and Investigation in 3-D software and methodology
Helper	A sections used to constrain the calculation in areas of few sections or thin units such as Alluvium or Head.
Section	Defined here as a vertical x, z plane attributed with correlation lines
Surface	Base or top of a geological unit exported as a grid or TIN
TIN	Triangular Irregular Network. GSI3D exports TINs in Indexed Triangle Mesh format (VRML97).
Triangulation	A form of interpolation (Delauney) that uses TINS in GSI3D to form the base and top surfaces of a unit
Unit	A geological unit is a particular geological deposit that has been identified and mapped out during a GSI3D project. A unit is defined by its basal surface in sections and an envelope of its lateral extent. The top of the unit is back calculated during calculation of the model stack

References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

Mathers, S, J., Wood, B., Kessler, H., 2011. GSI3D 2011 software manual and methodology. *British Geological Survey Open Report*, OR/11/020.