The Clay Research Group

RESEARCH AREAS

Climate Change ◆ Data Analysis ◆ Electrical Resistivity Tomography
Time Domain Reflectometry ◆ BioSciences ◆ Ground Movement
Soil Testing Techniques ◆ Telemetry ◆ Numerical Modelling
Ground Remediation Techniques ◆ Risk Analysis
Mapping ◆ Software Analysis Tools
Artificial Intelligence

May 2022
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The Clay Research Group

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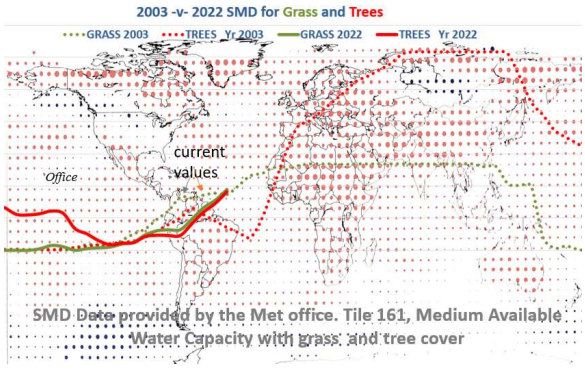
Soil Moisture Deficit

Below, the SMD values provided by the Met Office for both grass and tree cover, comparing them with the 2003 event year.



Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at:

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Risk by District – and Sector

In this edition we refine the analysis of subsidence risk by looking at some postcode sectors within the district covered – Horsham this month.

The study includes a review of cause and liability by season, providing a useful reference for underwriters, engineers and claims handlers.

Changing Risk

In last month's edition we looked briefly at the change in risk both in terms of cause (sulphate and heave claims for example) and count (diminishing numbers since 2006). How can an A*i* system deal with this?

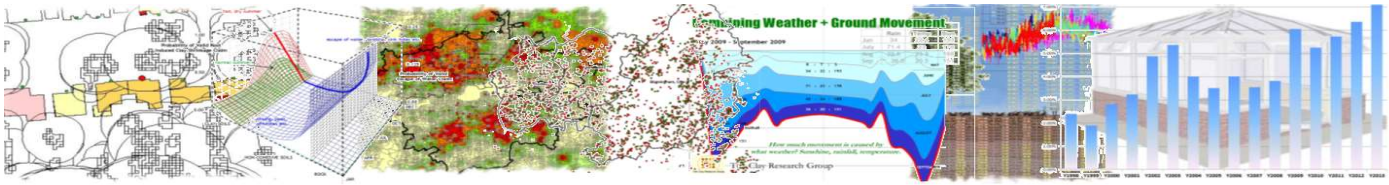
On page 2 we look at how sigmoid learning systems read distribution curves and make changes to the output gradually when the change is minor and short-lived, and quickly when claim frequency increases for a defined period.

TDAG Diary Dates

Several meetings and workshops planned for the coming year, but perhaps of particular interest are the following:

16th June TDAG have partnered with Forest Research and the Birmingham Institute of Forest Research delivering a conference on Tree Maps and Mapping Technology taking place from 9.00 – 13.00. Link for free tickets:
https://www.eventbrite.co.uk/e/tree-mapping-workshop-tickets-335853425637

13th September, looking at subsidence issues and involving the Institution of Structural Engineers.



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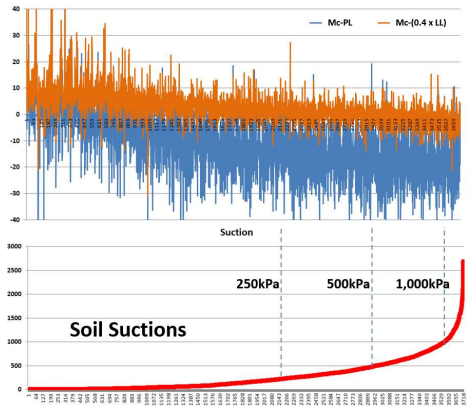
Suctions -v- Plasticity Indices

The graph below plots soils data provided by Clive Bennet from samples tested by MatLab Ltd. The profiles compare results from the same samples (3,720 in total) when using three tests.



The base line (red) plots the soil suction test results. The orange line plots data using 0.4 x LL and the blue line the Mc compared with the PL. Although there is very broad agreement, the amplitude of desiccation is best revealed by the suction test - both comparisons with the PI tests show increasing desiccation in a linear fashion and there is substantial scatter which renders them less reliable than the suction test.

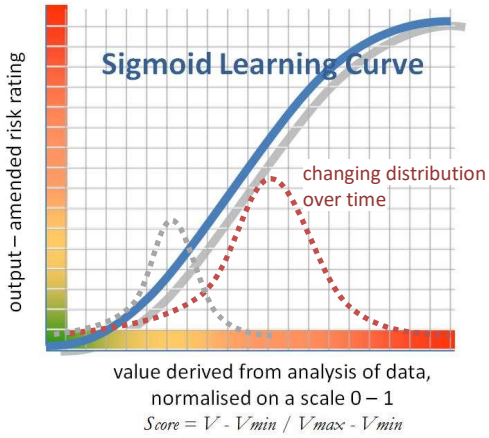
Of course, one could argue that this calls into question the suction test, but most experts would agree that relying on the results of the PI tests alone doesn't always reveal the full story.

Accounting for Change

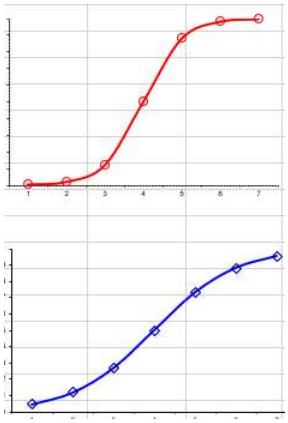
The graphs on the following page provide data from two sectors from this month's study district, Horsham. A more recent claims dataset has been used to reflect the reducing risk of domestic subsidence since 2006.

Accounting for change over time using an A*i* system involves measuring trends. Is one quiet year sufficient to trigger a premium reduction, or should the underwriter base his calculations on a minimum term of say 5 low risk years or more?

The answer will vary by insurer of course and their exposure (insurers with high exposure to properties in the north of the UK will likely record lower amplitude fluctuations), but the use of the sigmoid curve can be useful, building rules that take into account current trends and exposure.

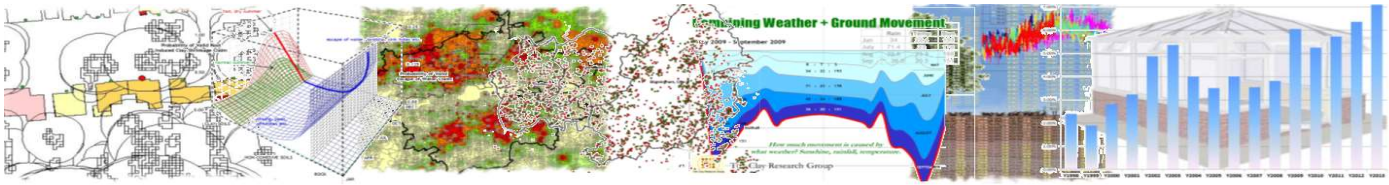


In the above graph, the x axis plots the claim frequency by sector, and the 'y' axis, the amended rating. Each sector has its own module.



The sector rating is determined by the claim distribution (red dotted line in the above graph), which is built from live data tables.

Similar modules exist for claim components - trees, soils etc.



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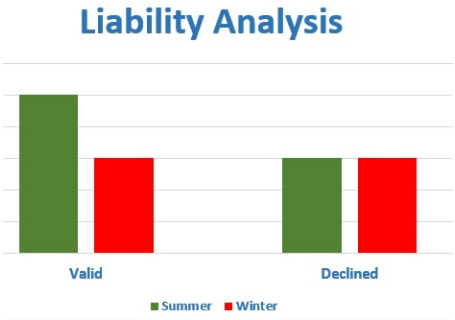
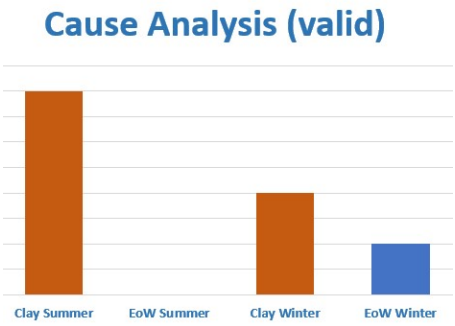
Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability – Sector Level Analysis





RH13 8 – This is a high-risk sector from the claim sample with a predominantly clay shrinkage claim population as can be seen from the lower of the two graphs (left). The probability of claims being valid or declined by season is shown below.

Clay Valid Summer	EoW Valid Summer	Declined Summer	Clay Valid Winter	EoW Valid Winter	Declined Winter
0.50	0.00	0.50	0.33	0.17	0.50

The chance of a valid claim being due to clay shrinkage is high throughout the year. Referring to the BGS 1:50,000 series map reveals the solid geology to be predominantly outcropping Weald clay.

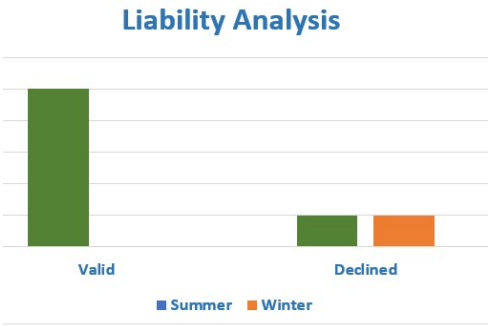
The average spend on valid claims from the sample in this postcode sector was £12,000.

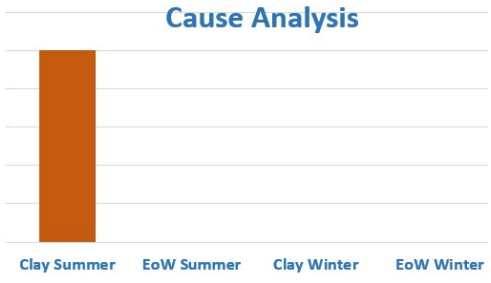
RH13 0 – A lower risk sector with a rating of 0.49 times the national average. As with the postcode sector above, the dominant risk is clay shrinkage in the summer months.

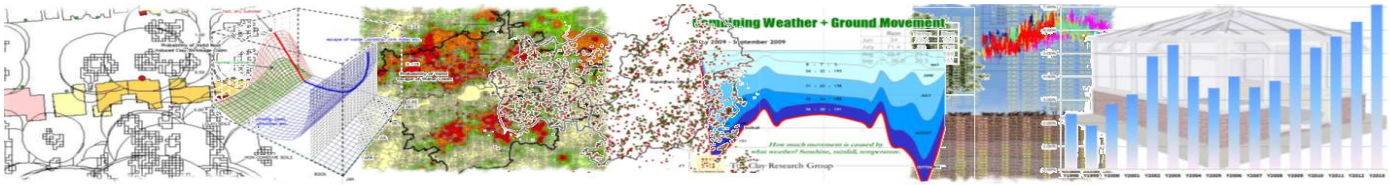
Seasonal probabilities are shown in the table below.

Clay Valid Summer	EoW Valid Summer	Declined Summer	Clay Valid Winter	EoW Valid Winter	Declined Winter
0.83	0.00	0.17	0.00	0.00	1.00

The probability of a claim being valid in the summer months (from the sample) is 83% of the total notified and valid claims are predominantly related to incidence of clay shrinkage whereas in the winter, the chance of a valid claim is very low – zero in the sample. The average cost of valid claims is £10,800.







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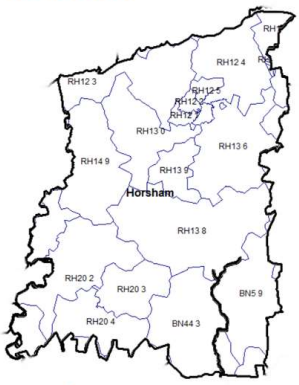
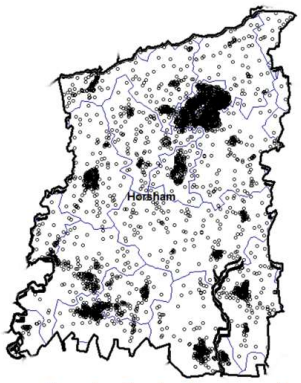
Subsidence Risk Analysis – HORSHAM

The Horsham district is situated in West Sussex and occupies an area of 11.8km^2 with a population of around 51,000.

HORSHAM



Postcode Sectors



Housing Distribution by Postcode

Distribution of housing stock using full postcode as a proxy. Each sector covers around 2,000 houses and full postcodes include around 15 – 20 houses on average, although there are large variations.

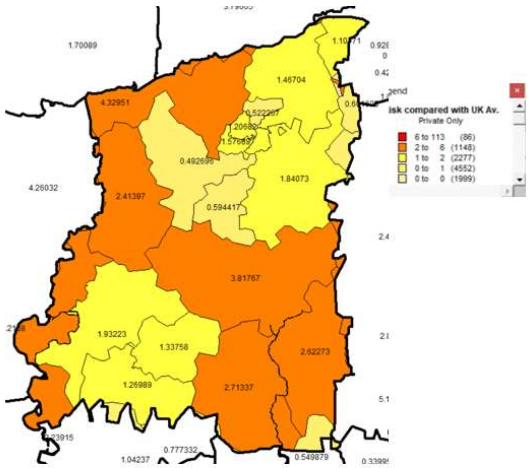
Housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than a 'claim count' value.

From the sample we have, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

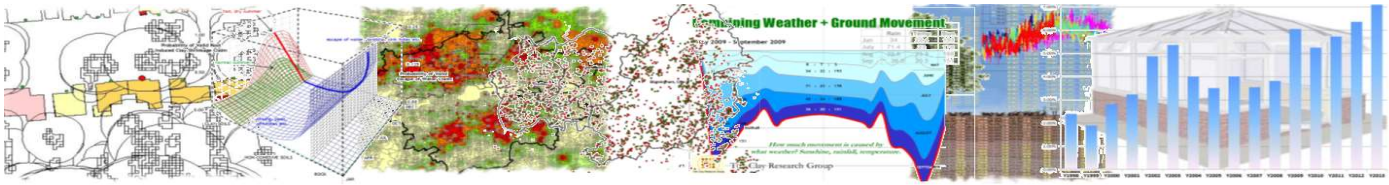
Horsham is rated 69th out of 413 districts in the UK from the sample analysed and is around 1.57x the risk of the UK average, or 0.4 on a normalised scale.

The distribution varies considerably across the borough as can be seen from the sector map.



Sector Risk Compared with UK Average

Horsham district is rated around 1.57 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.



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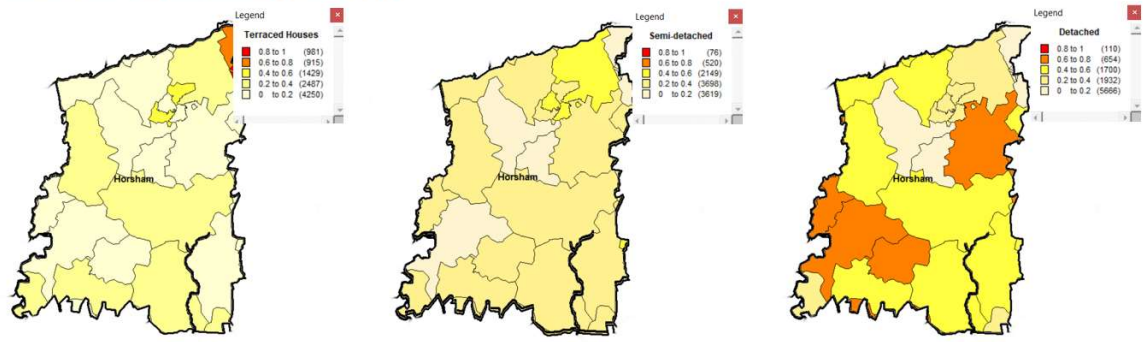
HORSHAM - Properties by Style and Ownership

Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of application.

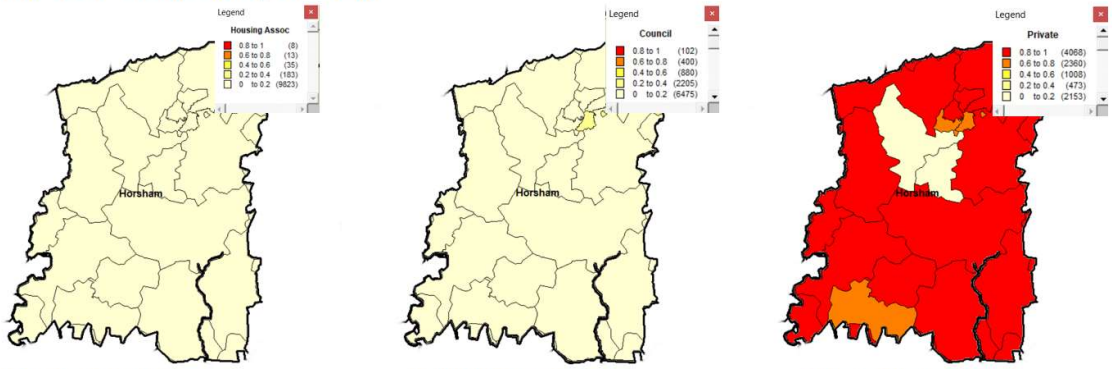
HORSHAM - Distribution by House Type



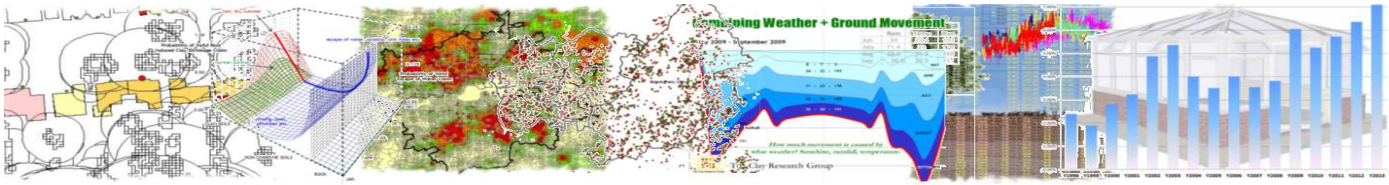
Terraced Semi-Detached Detached

Distribution by ownership is shown below. Privately owned properties are the dominant class and are spread across the borough.

HORSHAM - Distribution by Ownership



Housing Association Council Ownership Private Ownership



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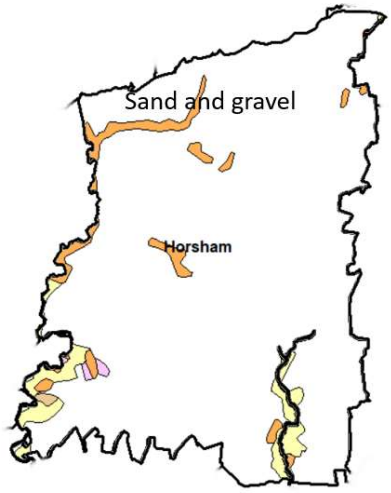
Subsidence Risk Analysis – HORSHAM

Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

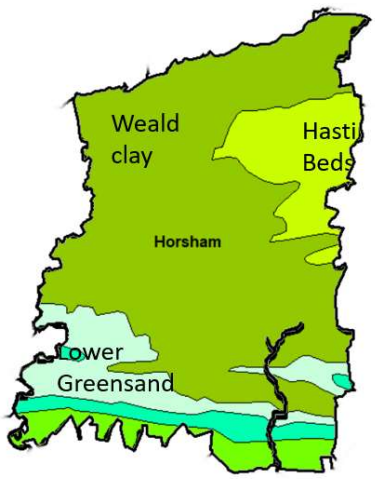
See page 9 for a seasonal analysis of the sample we hold which reveals that in the summer there is a greater than 75% probability of a claim being valid, and of the valid claims, there is a high probability (around 88% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid is much lower - around 20% - and if valid, there is nearly 90% probability the cause will be due to an escape of water. Maps at the foot of the following page plot the seasonal distribution.

HORSHAM : BGS Geology – 1:625,000 scale

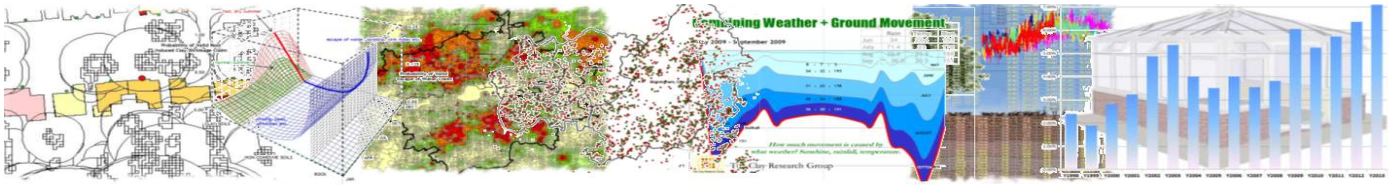


DRIFT DEPOSITS



SOLID GEOLOGY

1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series maps deliver far greater benefit when assessing risk. Clay shrinkage is the dominant cause in the summer, and declinatures are more likely in the winter months.



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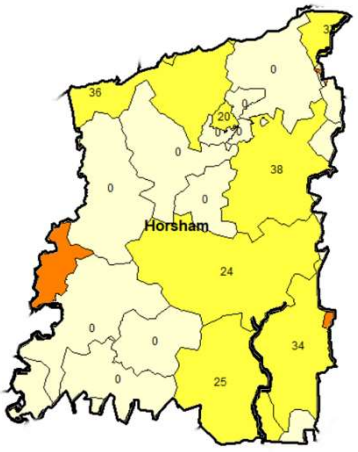
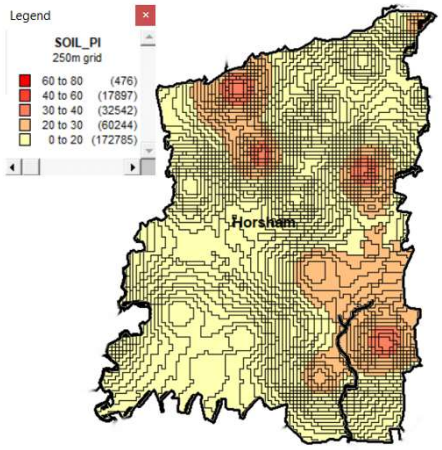
Liability by Geology and Season

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The higher the PI values, the darker red the CRG grid. The general pattern agrees with the BGS maps on the previous page.

HORSHAM – Soil Plasticity Index



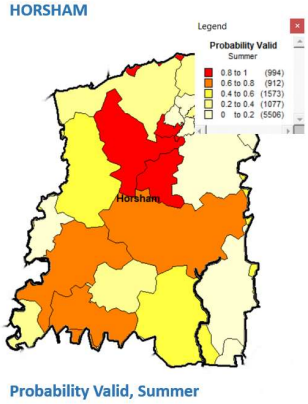
Soil PI Averaged by Sector



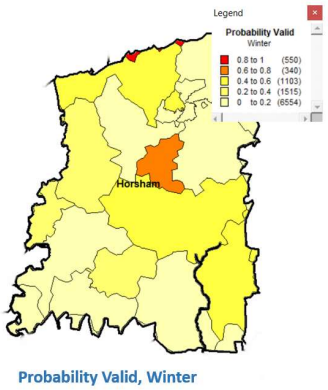
PI Interpolated on 250m CRG grid

Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. A single claim in an area with low population can raise the risk as a result of using frequency estimates.

HORSHAM



Probability Valid, Summer

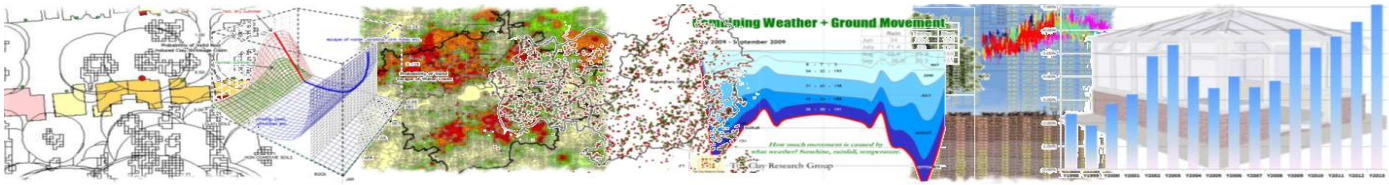


Probability Valid, Winter

The maps, left, show the seasonal difference from the sample used.

Combining the risk maps by season combined with the table on page 9 is perhaps the most useful way of assessing the likely cause, potential liability and geology using the values listed.

The claim distribution and the risk posed by the soil types is illustrated at the foot of the following page. Escape of water related claims are associated with the superficial deposits or simply shallow foundations on poor ground and the dominant clay shrinkage claim, the outcropping Weald clay. A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



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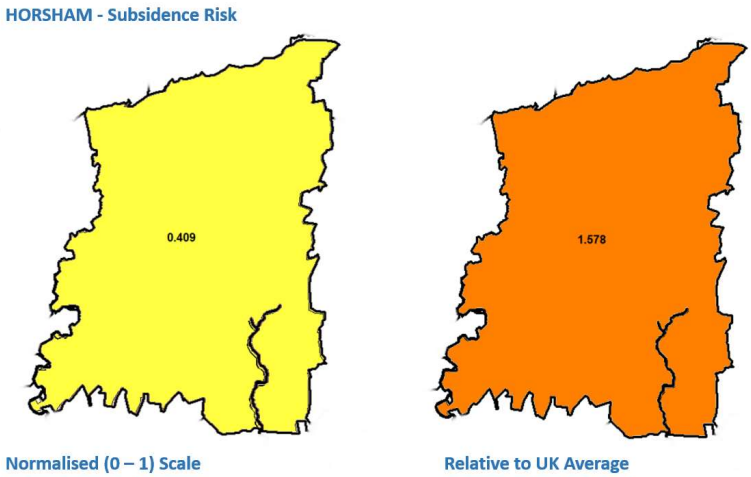
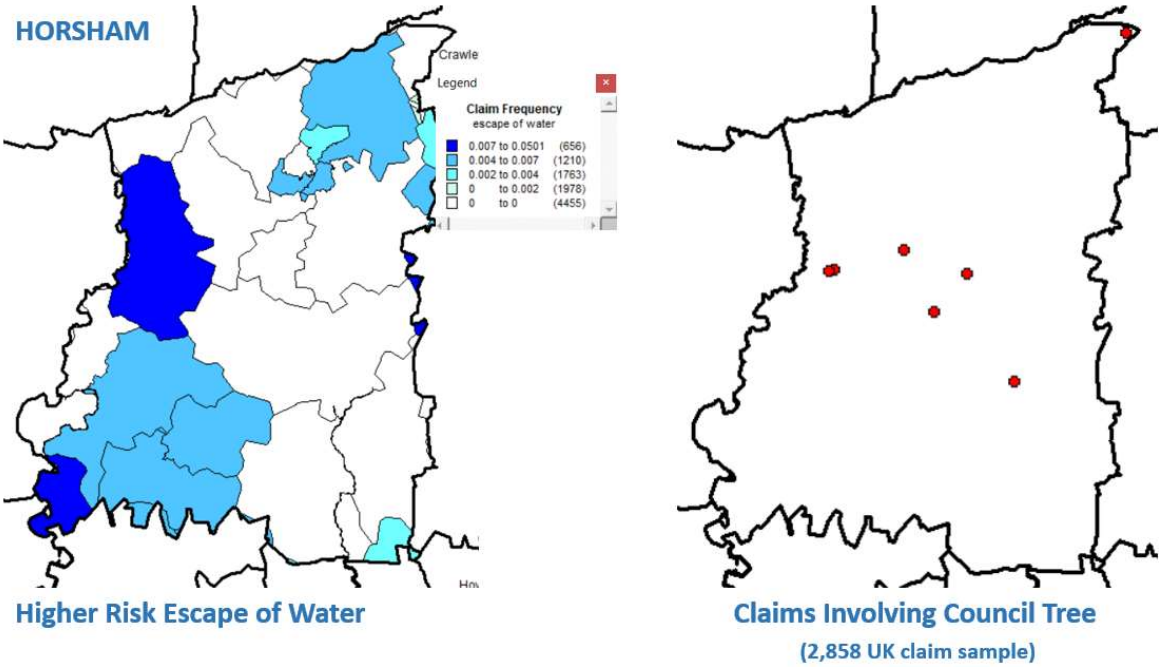
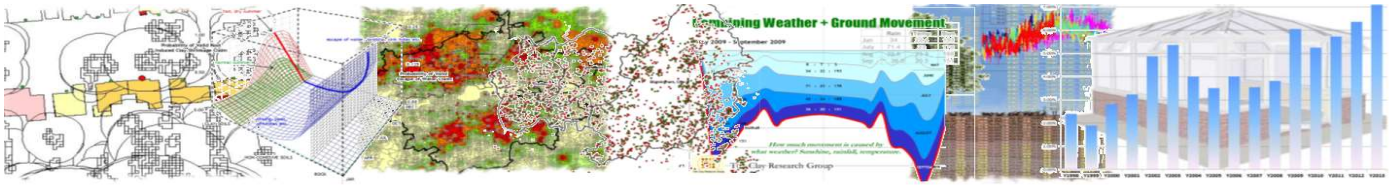
District Risk -v- UK Average. EoW and Council Tree Risk.



Below, left, mapping the frequency of escape of water claims reflects the presence of, non-cohesive soils – alluvium, sands and gravels etc. The absence of shading can indicate a low frequency rather than the absence of claims.

Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. The location coincides the presence of shrinkable clay soils – see both BGS (page 6) and CRG (page 7).





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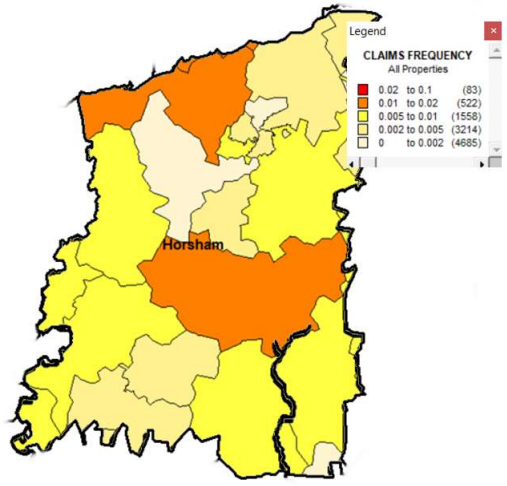
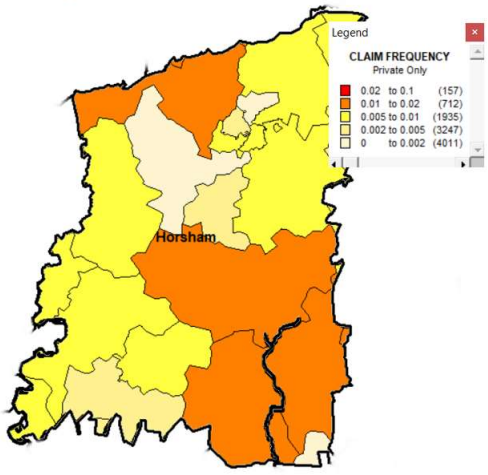
HORSHAM - Frequencies & Probabilities

Mapping claims frequency against the total housing stock by ownership (left, private, council and housing association combined and right, private ownership only), reveals the importance of understanding properties at risk by portfolio.

HORSHAM - Postcode Sector Subsidence Risk (frequency) by Ownership



Combined Public and Private Frequency

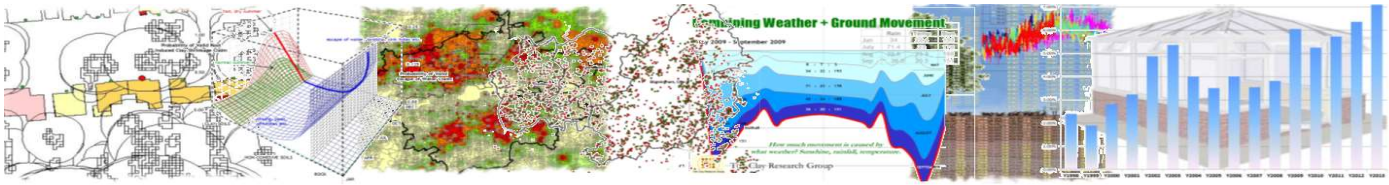


Private Only

On a general note, the reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is low, and in the winter, it is high. Valid claims in the summer are likely to be due to clay shrinkage, and in the winter, escape of water. For non-cohesive soils, sands gravels etc., the numbers tend to be lower throughout the year.

Liability by Season - HORSHAM

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Horsham	0.692	0.087	0.221	0.02	0.15	0.83



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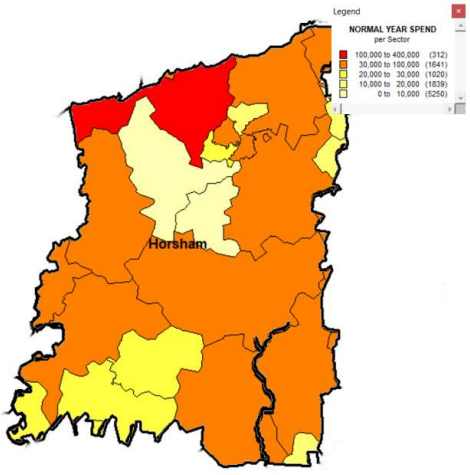
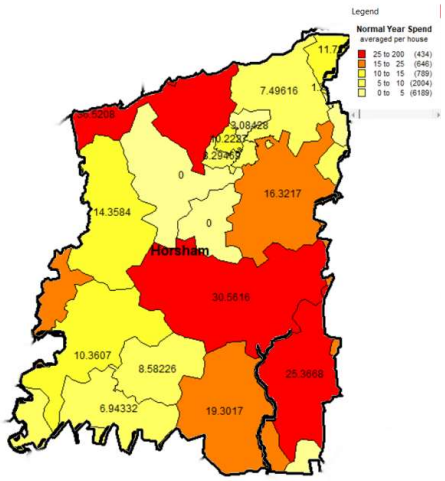
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

The maps below show the aggregated claim cost from the sample per postcode sector for both normal (top) and surge (bottom) years. The figures will vary by the insurer's exposure, claim sample and distribution.

NORMAL YEAR SPEND – HORSHAM



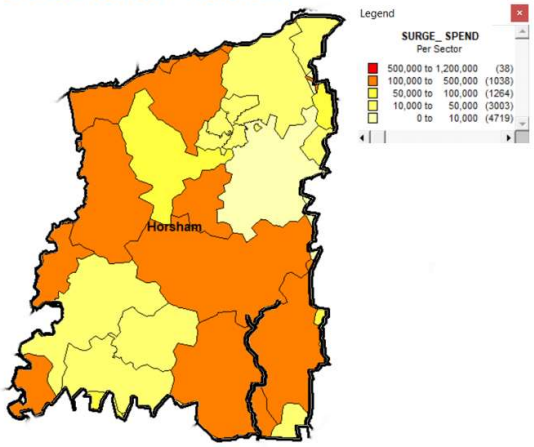
Spend by Sector



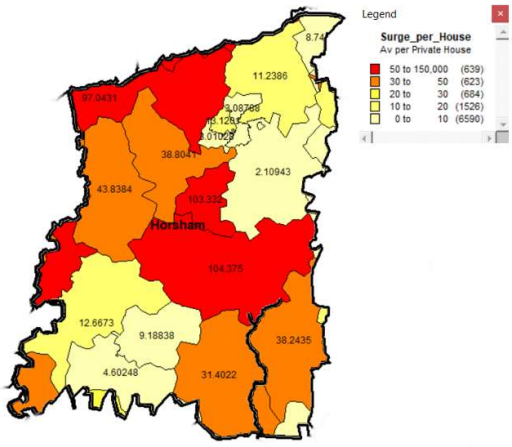
Spend Averaged over Housing Population

It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. The images to the left in both examples (above and below) represent gross sector spend and those to the right, sector spend averaged across housing population to derive a notional premium per house for the subsidence peril. The figures can be distorted by a small number of high value claims.

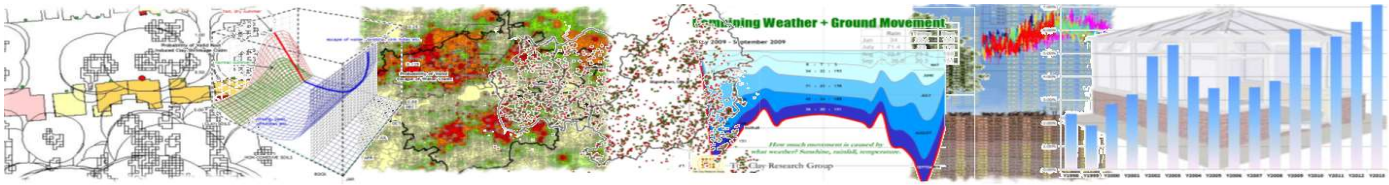
SPEND in SURGE – HORSHAM



Spend by Sector



Spend Averaged over Housing Population



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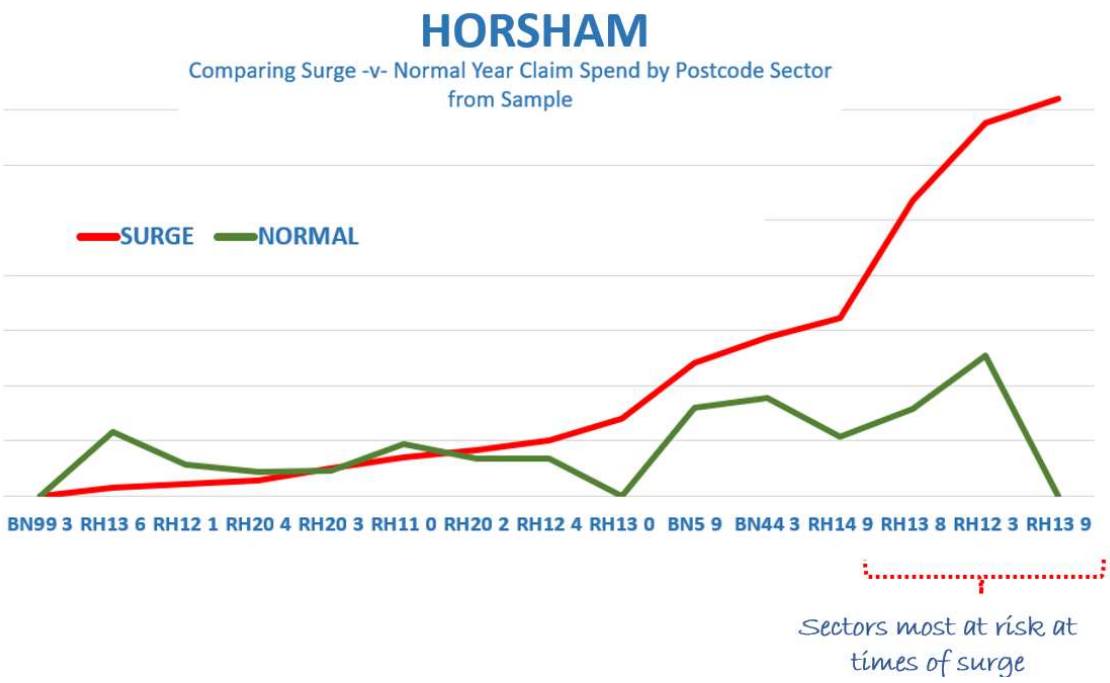

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

It is of course the case that a single expensive claim (a sinkhole for example) can distort the outcome using the above approach. With sufficient data it would be possible to build a street level model.

In making an assessment of risk, housing distribution and count by postcode sector play a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count may deliver a different outcome. This can also skew the assessment of risk related to the geology, making what appears to be a high-risk series less or more of a threat than it actually is.

The models comparing the cost of surge and normal years is based on losses for surge of just over £400m, and for normal years, £200m.