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

April 2020
Edition 179

The Clay Research Group

CONTENTS

Issue 179, April 2020

District Risk Modelling

This month continues the series of mapping the risk of subsidence across the UK, looking at each district at postcode sector level and comparing the geology with claim frequency and cost, all by season. In this edition, several districts are compared (see pages 2 & 3) to determine the use of such an approach in terms of underwriting and claims handling.

More districts will be added over time. This month, the district under consideration is Northampton (pages 6 – 13).

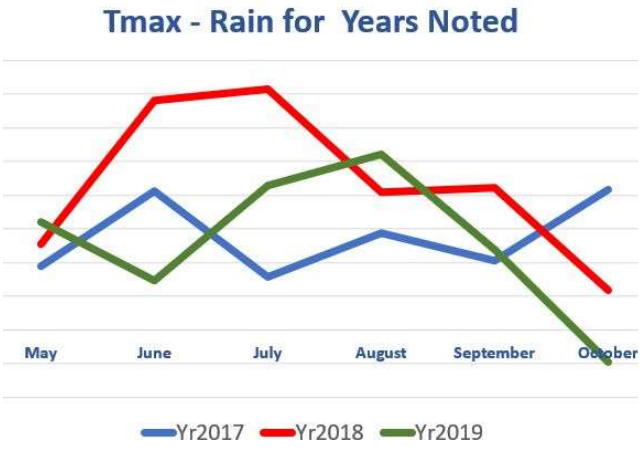
Tree Risk Algorithm

Predicting which tree will cause damage and when is of course impossible. However, there does appear to be a strong indicator using tree metrics which appears to be shared across species. See page 4.

Predicting Surge?

Issue 175 explored the link between weather to see if a predictive element could be identified. How did the proposed *Tmax – Rainfall* equation (using normalised weather data) perform in 2018? Was there any suggestion that the third quarter of that year would see a surge in claims?

Below, the equation applied to years 2017, 2018 and 2019 reveals a potential indicator as can be seen by the red line. Whether that indicator has any value as a predictor is the issue. Yes, it may link weather and claims, but is a warning in June/July too late to be of use?



Contributions Welcome

Thanks to contributors who have spent time putting together articles on a range of subjects. Updates, articles and comments etc., are welcome.

Please Email us at clayresearchgroup@gmail.com.

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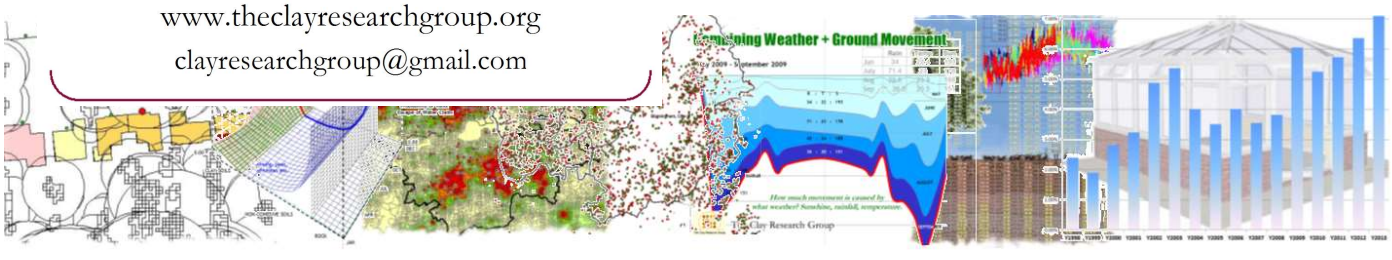

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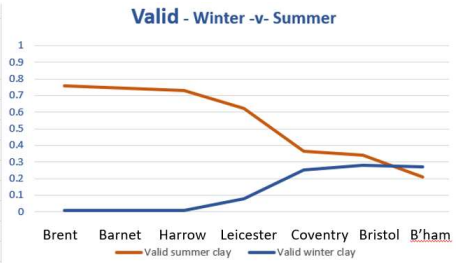
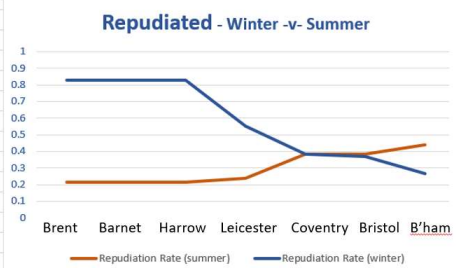
'Risk by District' Model Examined

Below, an extract from our study showing how a small selection of districts compare and how the output is used in triage and to rate risk. From the sample it can be seen that, on clay soils, there is a high probability that a claim notified in the summer months on a clay soil has a slightly greater than 70% probability of being valid, and the cause is likely to be root induced clay shrinkage whereas the probability of a valid claim being due to an escape of water is very low – less than 1%.

DISTRICT	Valid summer clay	Valid Summer EoW	Repudiation Rate (summer)	Valid winter clay	Valid winter EoW	Repudiation Rate (winter)
Brent	0.76	0.026	0.214	0.01	0.16	0.83
Barnet	0.746	0.039	0.215	0.01	0.16	0.83
Harrow	0.728	0.057	0.215	0.01	0.16	0.83
Leicester	0.621	0.141	0.238	0.08	0.37	0.55
Coventry	0.366	0.252	0.382	0.25	0.37	0.382
Bristol	0.341	0.277	0.382	0.28	0.35	0.37
Birmingham	0.208	0.352	0.44	0.27	0.46	0.267

In contrast, the variable geology beneath Birmingham delivers different outcomes. There is a greater probability of a valid claim being due to an escape of water than clay shrinkage in the both the summer and winter months. The figures reflect the risk reflects the Mercia mudstones to the south east of the district and the variable drift deposits elsewhere, illustrating the benefit of higher resolution postcode sector data over district data.

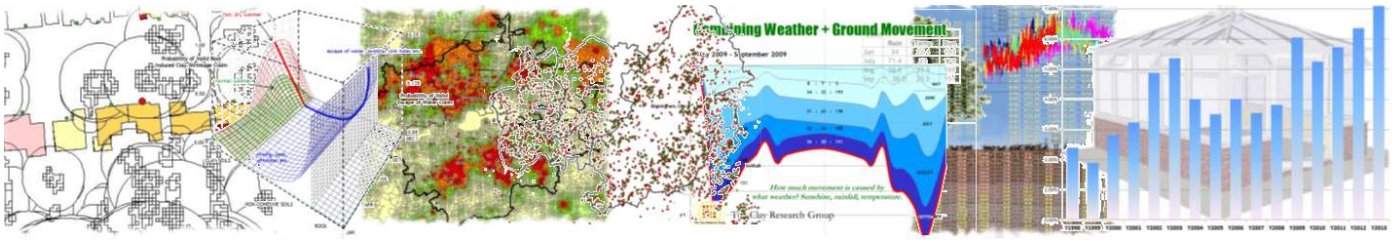




Graphing the above data (left) illustrates the difference between the selected districts. Top, the probability of a claim being valid and bottom, declined, showing the difference between summer and winter notifications.

Where the underlying geology is predominantly London clay, the seasonal differences are quite marked, whereas districts on more variable geological deposits fluctuates less, which is itself an indicator.

Next month, returning to postcode sector data to show the refinement within these districts when higher resolution data is used.



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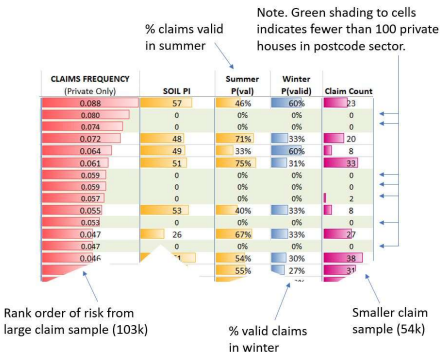
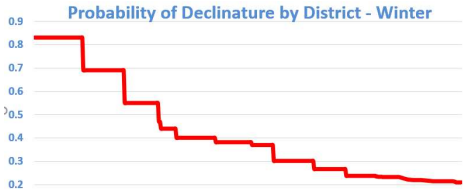
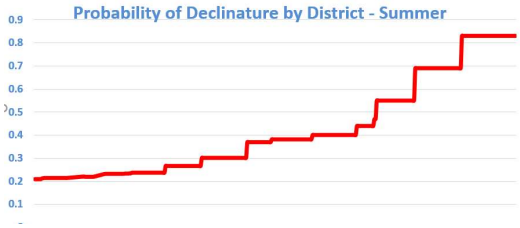
'Risk by District' Model Explored

Below, similar graphs to those on the previous page but covering the UK, plotting the probability of declinatures by season. In examples on both pages, risk rating can be skewed using frequency data. A record of the count of claims and housing population running alongside is essential – see snapshot right.



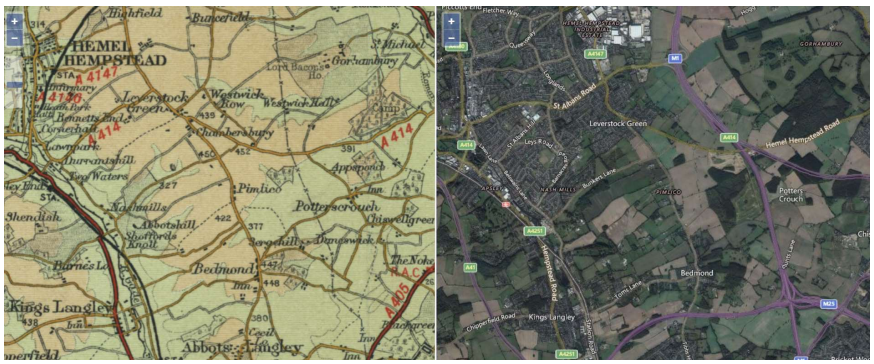


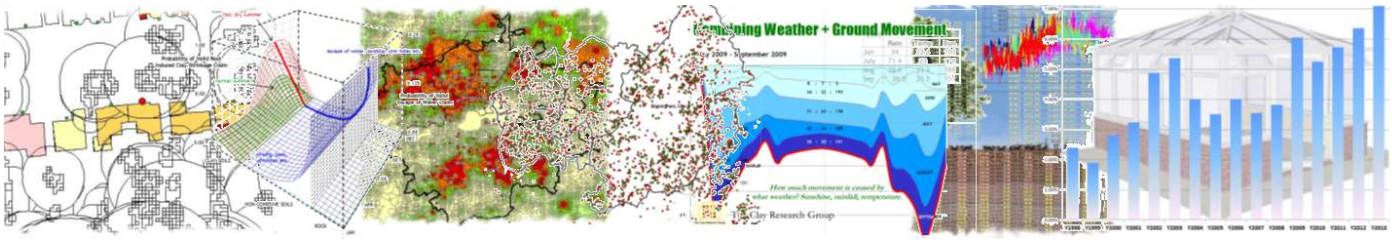


Maps – Now and Then

https://maps.nls.uk/geo/explore/side-by-side/?fbclid=IwAR0QfppxLH3sSqYifU-WggN2p5gg5wo-nIgNn6nYM5CsjjbEc_aksime37c#zoom=14.99591206647567&lat=50.26485&lon=-5.08081&layers=171&right=BingHyb

This web site provides a range of maps comparing current aerial imagery with a range of maps from the past. The range includes roads (below), geology, railways, population, iron and steel, limestone, rainfall, land use etc., dating back to 1885. The imagery options include LiDAR, Bing, ESMI, OSM





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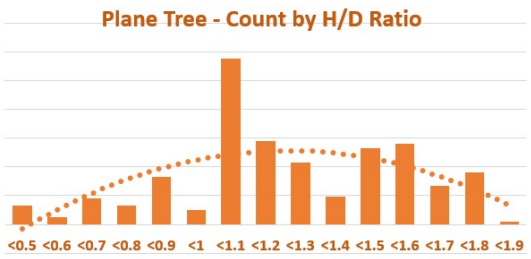
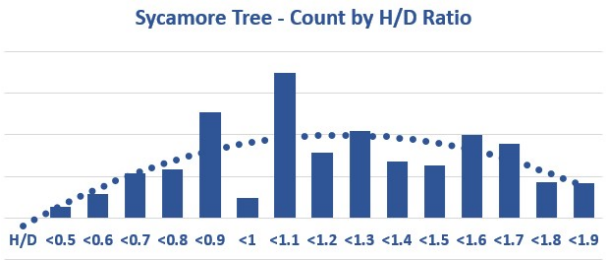
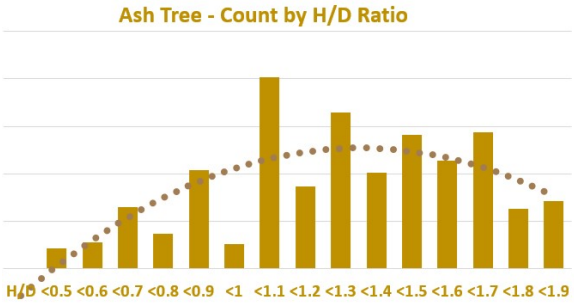
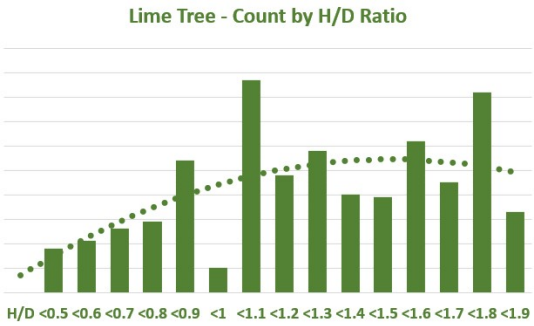
Revisiting Tree Risk *... continued*

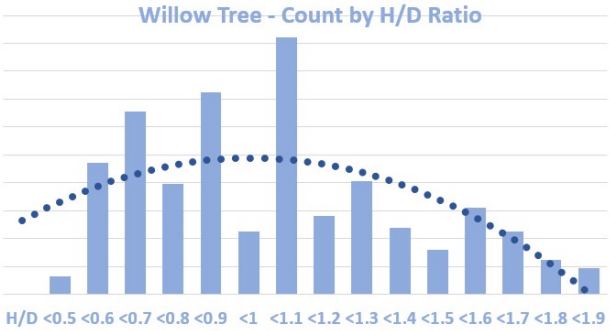
The graphs below, built from data gathered relating to trees that have caused subsidence damage to buildings, illustrate that the majority have an H/D ratio of 1.1. The polynomial trendlines show a gradual increase towards this figure, but the value itself stands out as a risk indicator.

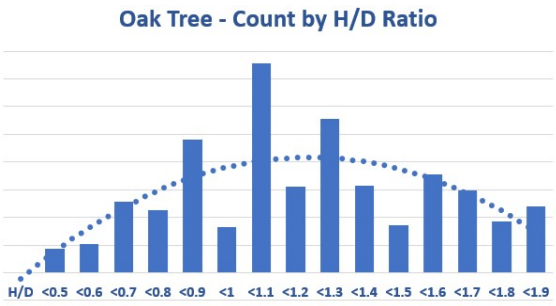




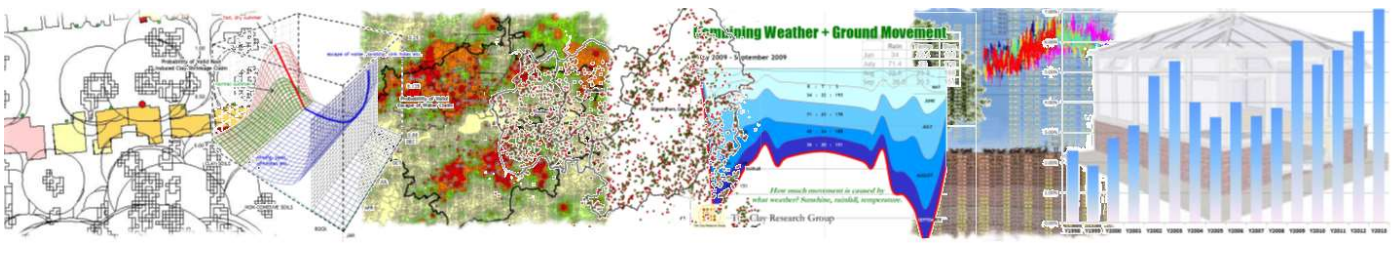








Is it the case there are simply more trees that fall into this category and the 'risk indicator' is reflecting commonly encountered situations? If it is proven to be valid then it may be useful to local authority arboricultural officers in directing spend when resources are limited. More examples in next month's issue.



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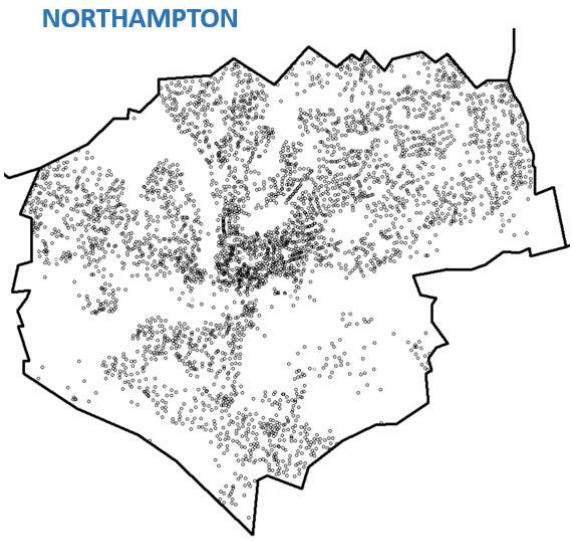
Subsidence Risk Analysis – Northampton

Northampton occupies an area of nearly 81km^2 with a population of around 215,000.



Housing Distribution by Postcode

Distribution of housing stock using full postcode as a proxy. Each postcode in the UK covers on average 15 houses, although there are large variations.

Districts are rated for the risk of domestic subsidence compared with the UK average – see map, right.

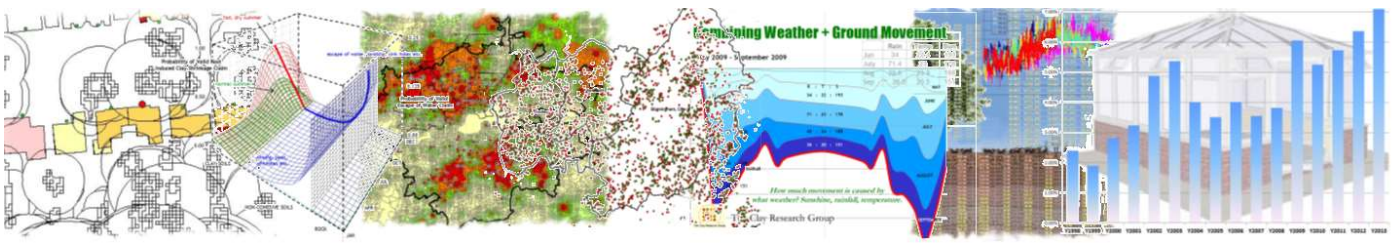
The highest risk rating is a value of 4 and Northampton is rated as being 1.218 times the UK average risk, ranked in 119th place.

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 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.

Risk Compared with UK Average

Layout of the district used for risk analysis above. Northampton has an estimated population of around 215,000 and an area of 81km^2.



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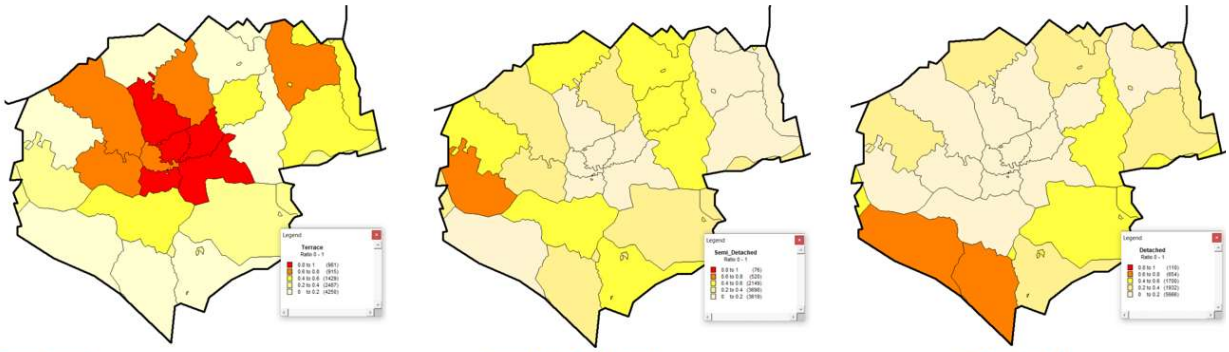
Northampton - Properties by Style and Ownership

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 – the age of the property. Risk increases with age of property and from a visual assessment using Google Street View, we rate Northampton district at around 0.5 on a scale of 0 – 1. This assessment could be refined using insurer's portfolio data.

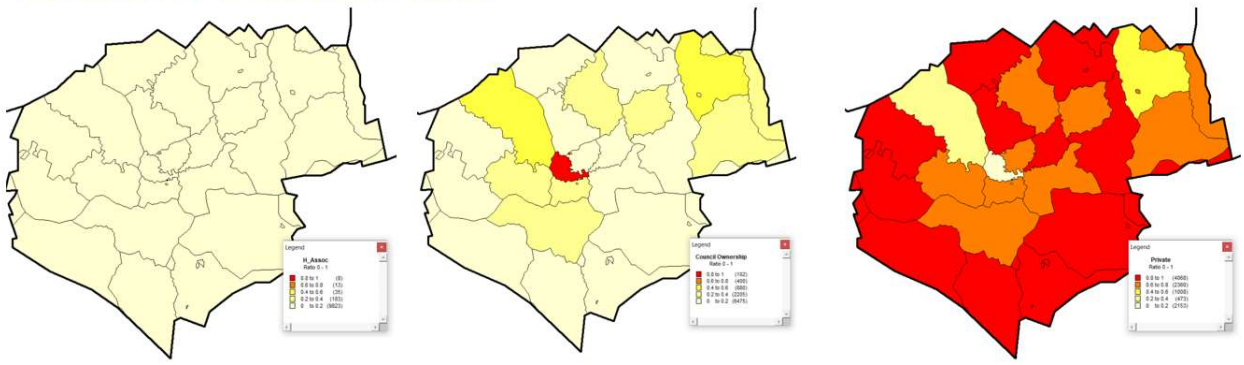
NORTHAMPTON - Distribution by House Type



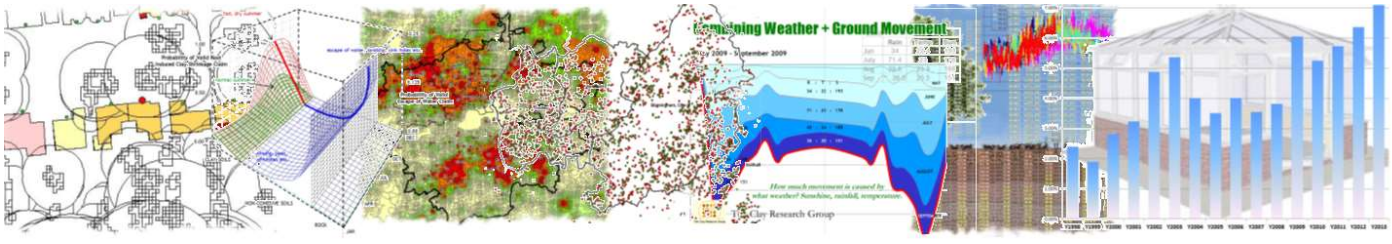
Terraced | Semi-Detached | Detached

Distribution by ownership is shown below. The maps reveal predominantly privately-owned properties across the borough, which will influence the risk rating.

NORTHAMPTON - Distribution by Ownership



Housing Association | Council Ownership | Private Ownership



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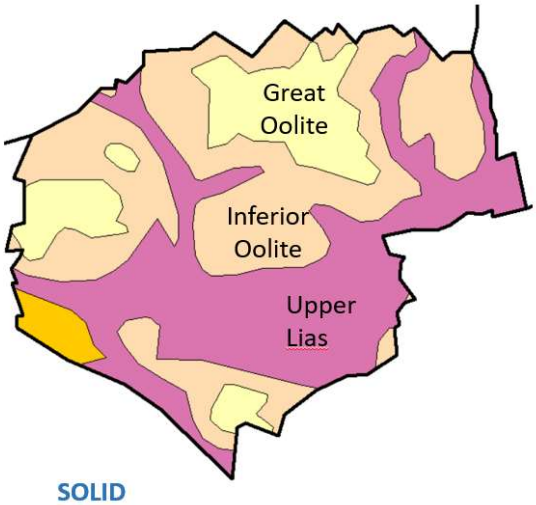
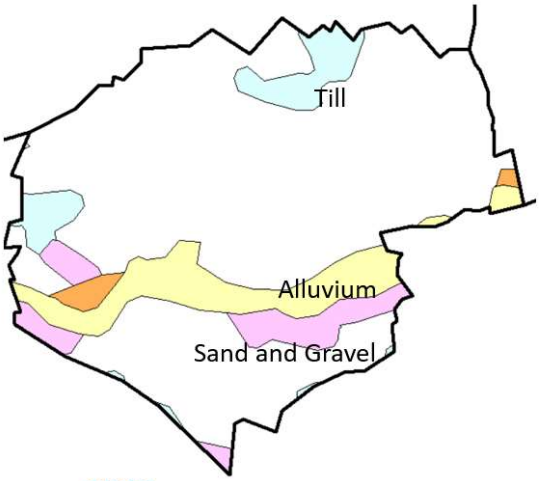
Subsidence Risk Analysis - Northampton

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

NORTHAMPTON : BGS Geology – 1:625,000 scale low resolution mapping



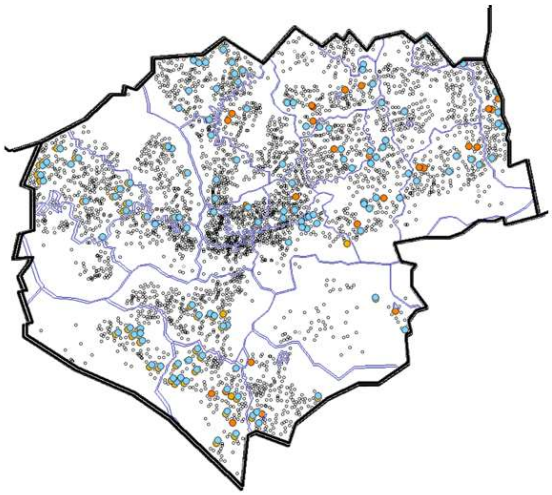
SOLID



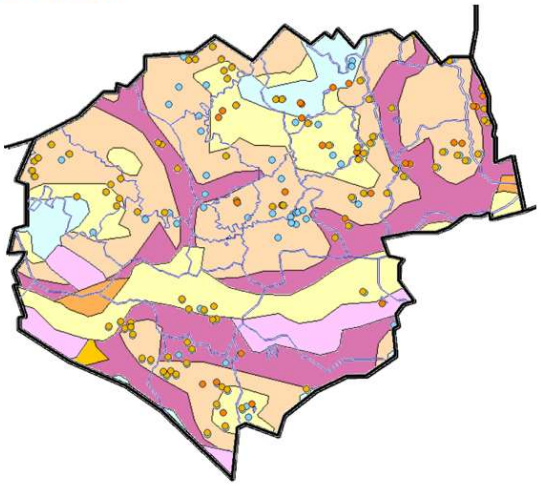
DRIFT

See page 10 for a seasonal analysis, which reveals a fairly balanced number of valid claims in the summer and winter, reflecting the variable geology.

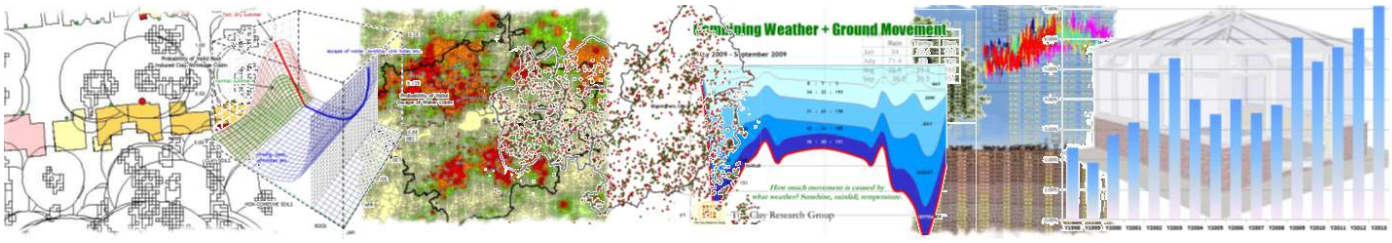
NORTHAMPTON : Mapping claims by peril by population and geology



Claims on Population Map



Claims on Geological Map



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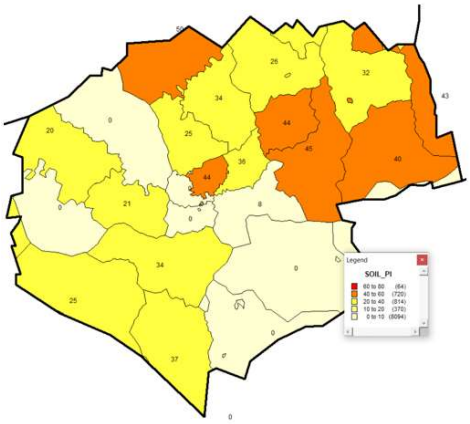
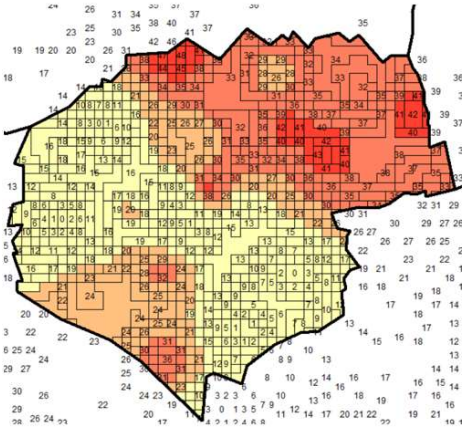
Liability by Season and Geology

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m model grid (right). The presence of a shrinkable clay in the model and the sparsity of clay in the BGS maps is a function of interpolation and variable composition of the drift which contains a clay fraction as confirmed in some of the BGS borehole logs. The higher the PI values, the darker red the CRG grid and the more likely the values are linked to actual results from claims. The variable soil type is itself a risk indicator when used by district, as seen in Coventry, Bristol and Birmingham etc., on page 2.

NORTHAMPTON – Soil Plasticity Index



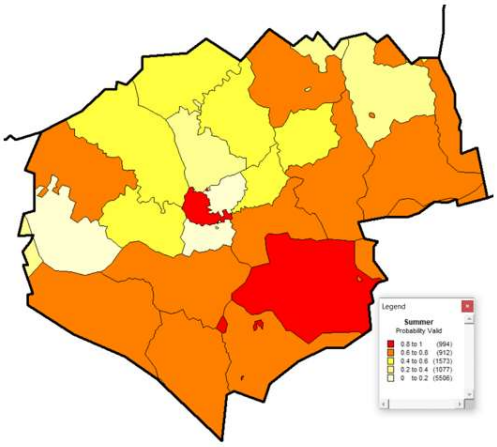
Soil PI Averaged by Sector



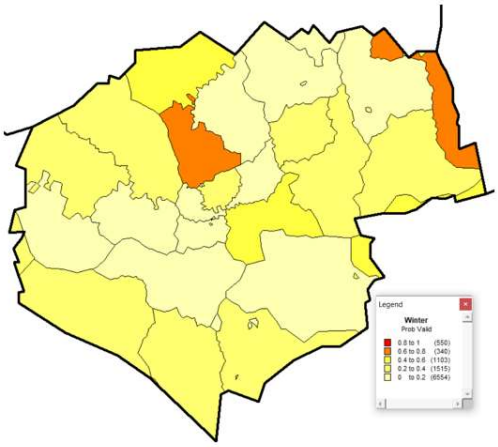
PI Interpolated on 250m CRG grid

Below, the probability of whether a claim is likely to be valid or declined by season. The high-risk sector to the south east corner reflects an issue with using frequency data. A single claim in an area with low population can raise the risk as a result of using frequency estimates – note low density housing in this sector from map on previous page.

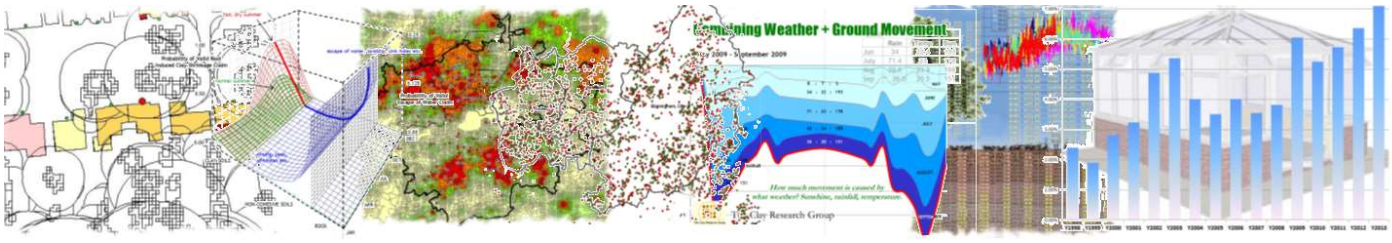
NORTHAMPTON



Probability Valid, Summer



Probability Valid, Winter



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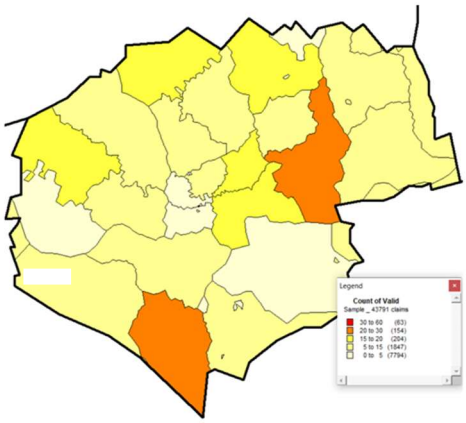
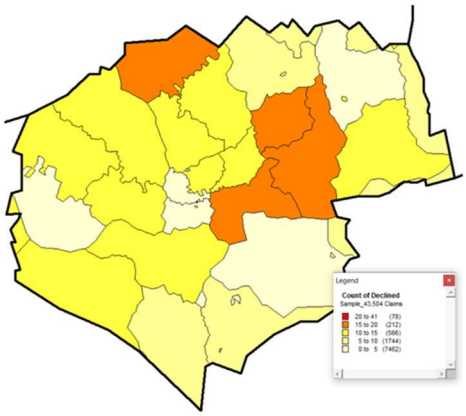
Liability by Sector. All Perils

NORTHAMPTON



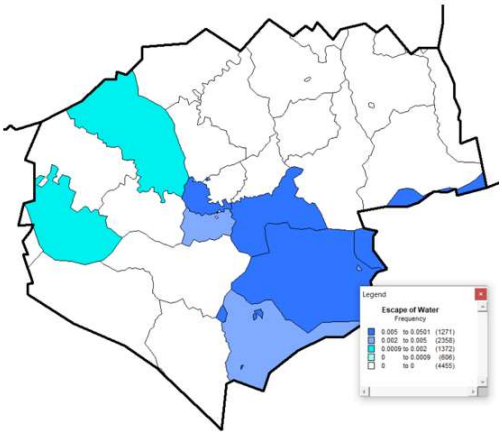
Count Valid



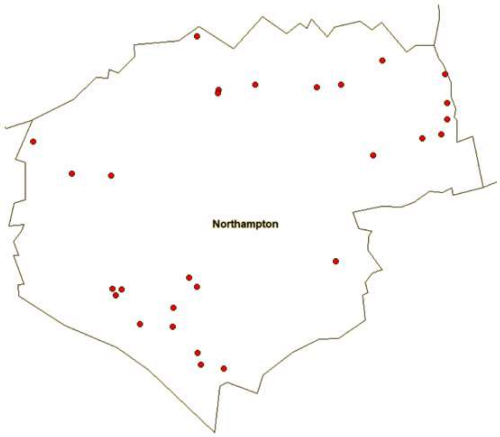
Count Declined

Above, mapping liability and plotting count of valid and declined claims from the sample, not taking into account any seasonal influence. The postcode sector to the south east, rated high risk on the previous page using frequency data, appears low risk when using count. Below left, mapping the frequency of Escape of Water claims from the sample reflects the presence of shallow non-cohesive drift deposits to the south east of the district. Below, right, dots on the 'Council Tree Claims' map, represent properties where damage has been attributable to vegetation in the ownership of the local authority which coincide with the clay formation.

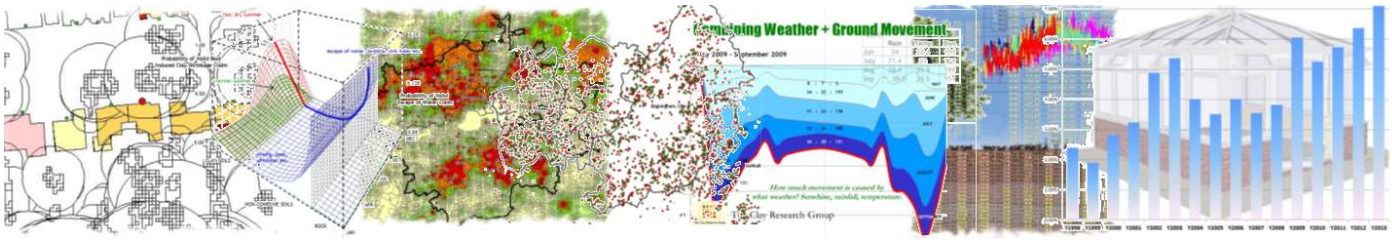
NORTHAMPTON



Escape of Water Frequency Distribution



Local Authority Street Tree Claims



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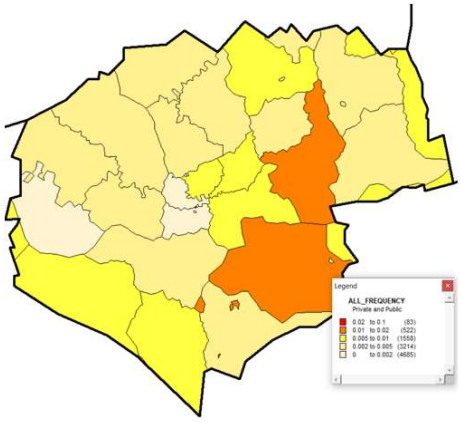
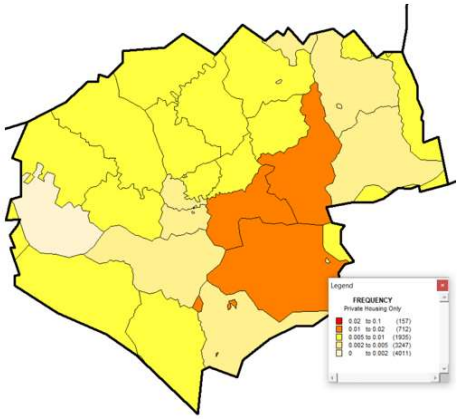
Northampton - Frequencies & Probabilities

NORTHAMPTON - Postcode Sector Subsidence Risk (frequency) by Ownership



Combined Public and Private Frequency



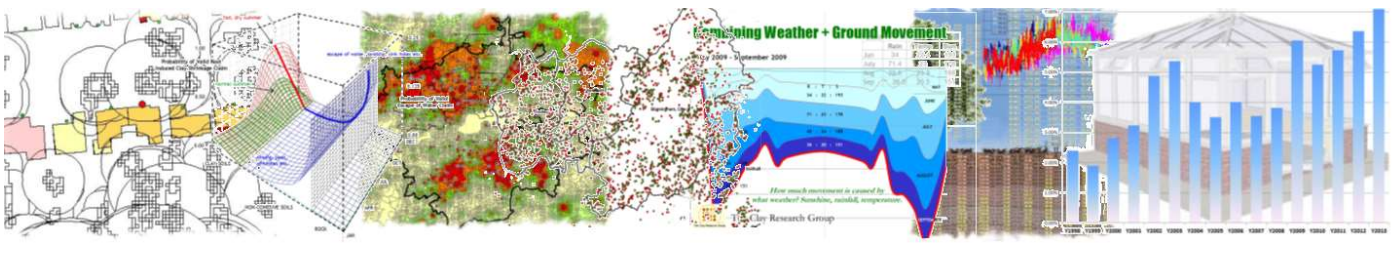
Private Only

The maps and figures reveal a borough with a fairly balanced seasonal risk, reflecting the variable geology. The chances of a claim being declined in the summer are just over 25% and if it is valid, there is a higher probability that the cause will be clay shrinkage. In the winter, the repudiation rate increase - around 44% for our sample - and if the claim is valid, there is a higher probability the cause will be water related. The probabilities of causation reverse between the seasons.

To improve our understanding a postcode sector analysis is far more useful.

Liability by Season - NORTHAMPTON

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Northampton	0.559	0.174	0.267	0.13	0.43	0.44



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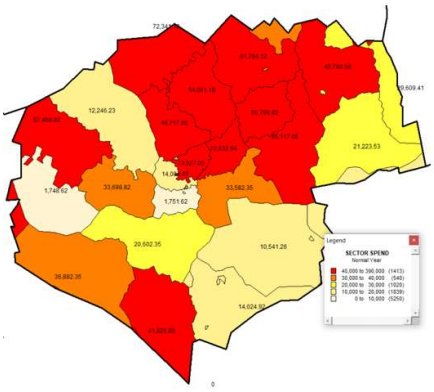
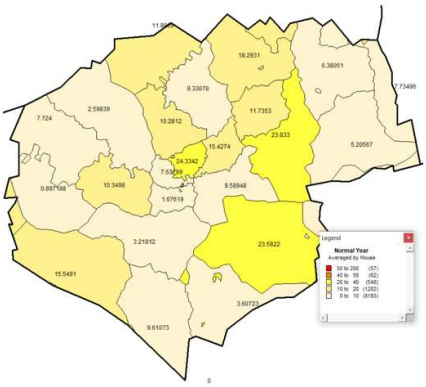
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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

NORMAL YEAR SPEND - NORTHAMPTON



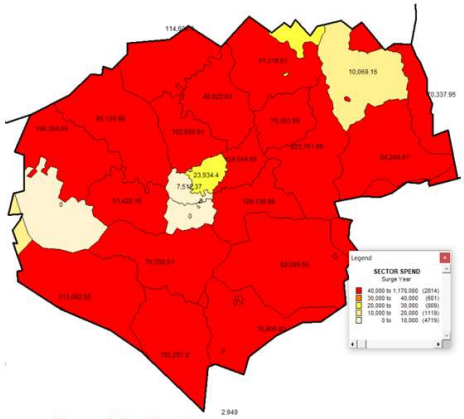
Spend by Sector



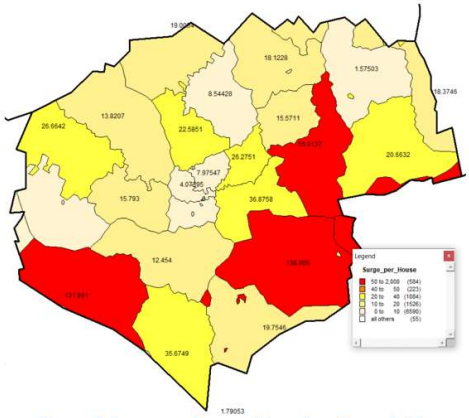
Spend Averaged over Housing Population

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 cost per house.

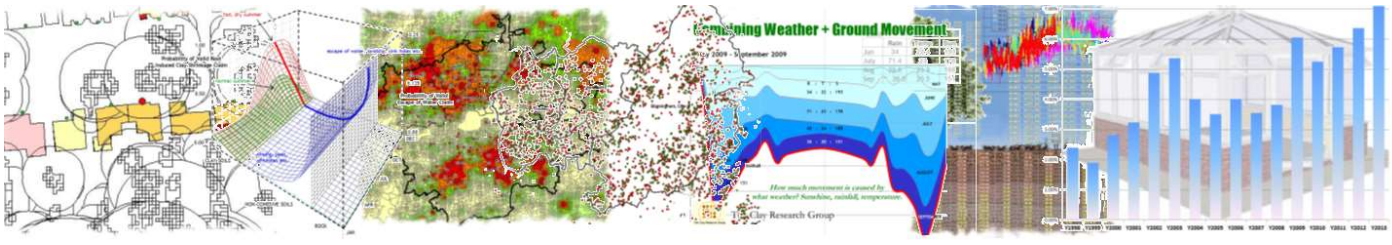
SPEND in SURGE - NORTHAMPTON



Spend by Sector



Spend Averaged over Housing Population



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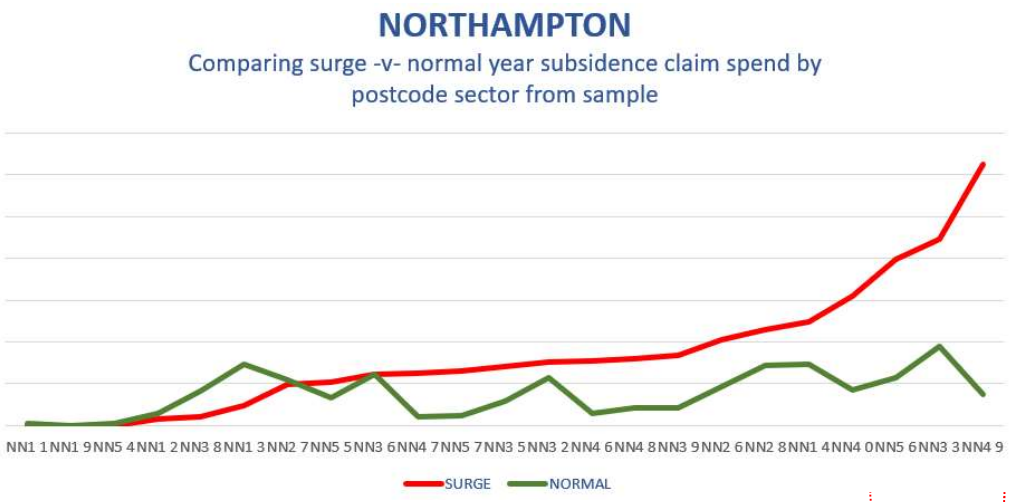

Sectors most at risk at times of surge.

Identifying the variable risk across the district distinguishing between normal and surge years by postcode sector. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

In making an assessment of risk, housing distribution and count by postcode sector plays a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count can 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.