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

August 2019
Edition 171

The Clay Research Group

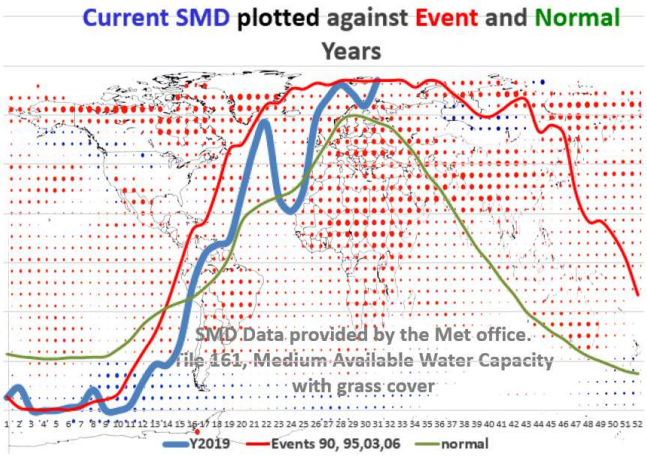
CONTENTS

Issue 171, August 2019

Page 2
Remote monitoring of moisture change
Page 3
Using Past Claims Data to Model Probability of Liability, Cause and Geology
Page 4
Count -v- Frequency
Page 5
Geology -v- Claims -v- Spend -v- Peril
Pages 6 - 10
Subsidence Risk Analysis – BIRMINGHAM
Page 11
SMD Profiling – is there a predictive value?

2019 Surge?

The SMD continues to fluctuate by month as can be seen in the graph below. After steady drying up to the end of May, heavy rainfall in June reduced the deficit significantly, reducing the prospect of a surge.



Soil Moisture Deficit data from tile 161, supplied by the Met Office for grass cover, medium available water capacity soils.

Record July Temperature

The Met Office have confirmed the 38.7°C temperature recorded in Cambridge Botanic Garden on 25 July as being the highest ever recorded in the UK.

National records have been set across Europe, including Germany, Belgium, Luxembourg and the Netherlands.

Feedback

We welcome feedback, contributions, updates and/or articles from readers relating to domestic subsidence – please contact us at the Email address below.

Next month - looking at spend by geological series and postcode sector

To supplement the ongoing analysis of subsidence risk across the UK, future editions will review claim spend at postcode sector level, comparing event and normal years.

The event year dataset models 2003, with a gross claim value of £410m, delivering an average cost per claim of over £10k. The 'normal' year dataset models 2004 and has a total claim cost of just over £190m.

The output provides thematically plotted maps of total spend by sector, and average cost by housing population.

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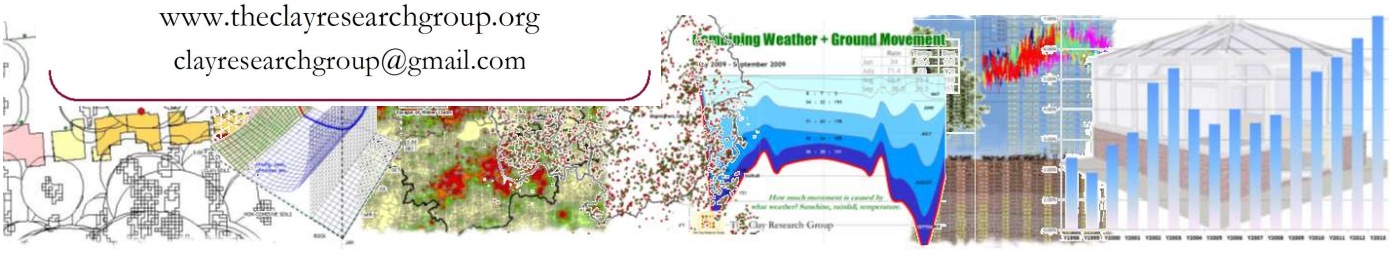

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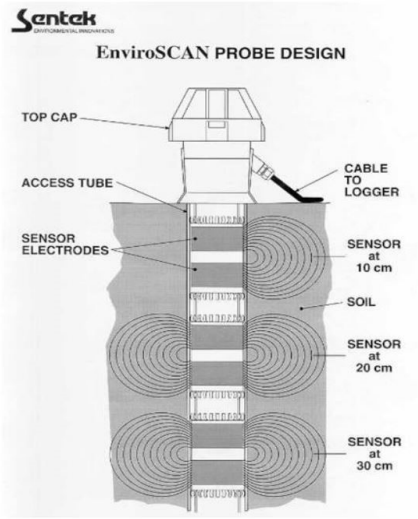
Remote Monitoring of Moisture Change

Jon Heuch attended the annual East Malling Fruit Day and came across the Soil Moisture Sense Limited stand who, as the name suggests, specialise in measuring moisture change in relation to irrigation scheduling and monitoring. The company is based in Aldringham, Leiston.



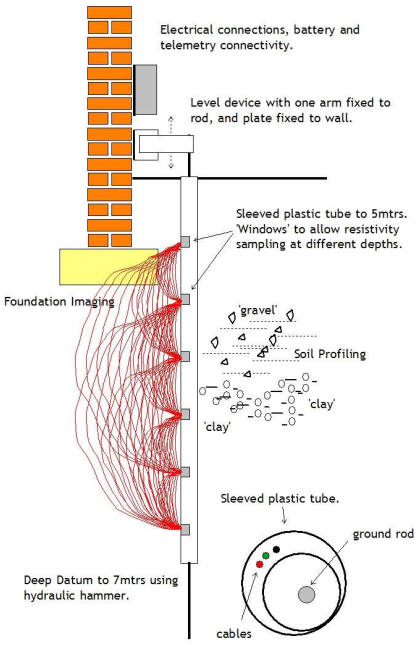
Soil Moisture Sense Limited are agents for the EnviroSCAN probe, pictured left and manufactured by an Australian company. It is used to measures moisture content at 100, 200 and 300mm centres and can go to a maximum depth of 1.5mtrs below ground level in its present form, but the company would be willing to explore developing a device that could go deeper.

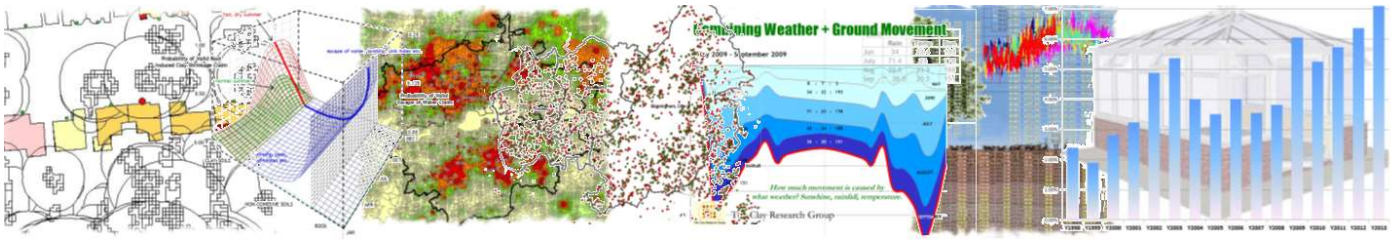
Jon reports that the probe costs £1,500, with a £250 annual charge for relaying the readings via a dedicated web site.

Jon explains that the graph on their web site (https://www.soilmoisturesense.com/index.php?pid=278) reveals a dry July followed by rain during August which percolated down to the top 4 layers but didn't affect the bottom two layers.

Right, a sketch from an earlier copy of the CRG Newsletter illustrating a similar idea for a probe that could take moisture measurements at intervals, incorporating a level device to monitor building movement.

Jon welcomes hearing from anyone who may be interested in funding a test site and perhaps extending the technology.





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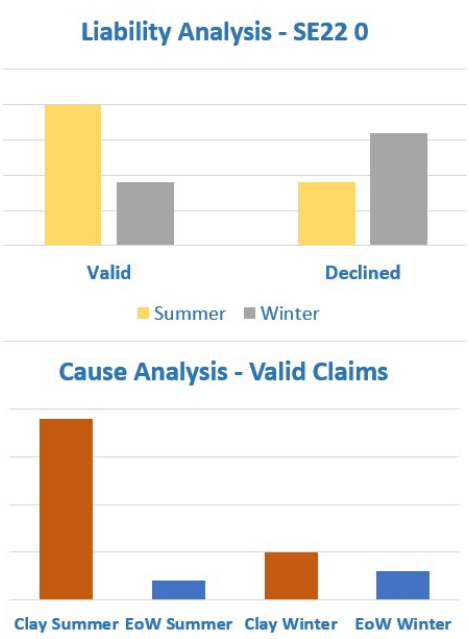
Using Past Claims Data to infer Geology and Derive Probability of Liability and Cause *... cont. from previous editions*



SE22 0 – This is a high-risk sector with a predominantly clay shrinkage claim population as can be seen from the lower of the two graphs (left). There is a higher probability of a claim being valid than declined in the summer, and in the winter the prospect of a claim being declined increases as a proportion of the total.

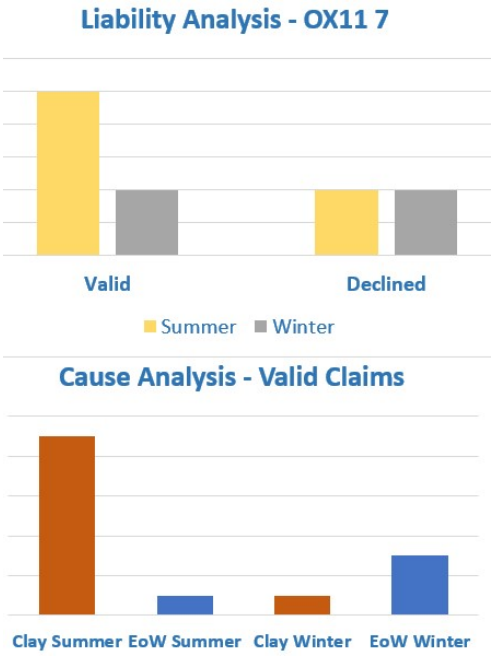
The chance of a valid claim being due to clay shrinkage is nearly five times that of the cause being an escape of water. Referring to the BGS 1:50,000 series maps reveals the solid geology to be predominantly London clay and Lambeth group.

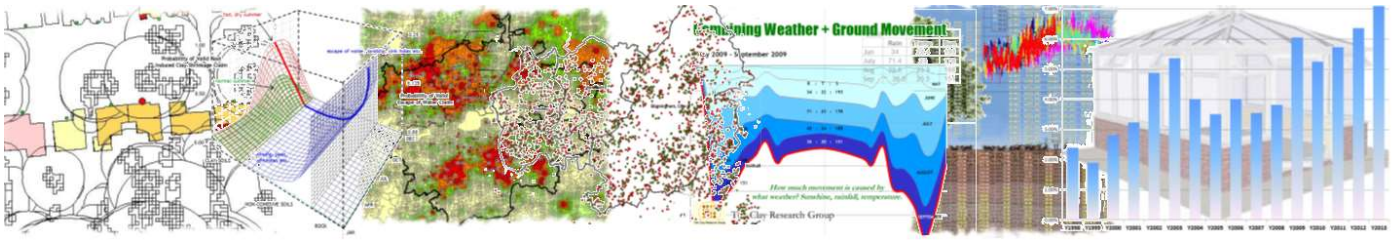
Total spend on valid claims from sample in this postcode sector exceeds £284k.

OX11 7 – From our sample this postcode has around a quarter the number of subsidence claims recorded in SE22 0 but the dominant cause remains clay shrinkage which accounts for the rise in numbers in the summer.

Reference to the BGS 1:50,000 scale map reveals a variable geology comprising the Gault, Upper greensand formations and chalk.

Total spend on valid claims from this sector = £92k





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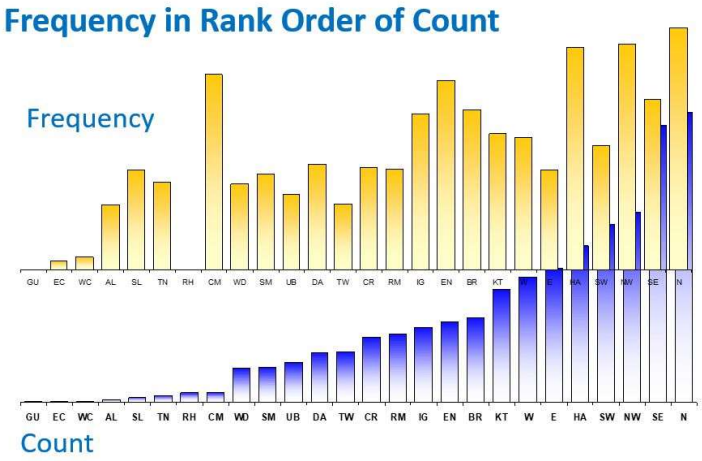
Count -v- Frequency

The graph below reveals the difference between claim count by area, and claim frequency - that is, the number of claims divided by the insured housing population. The N postcode area achieves first place in both instances, and NW and HA areas maintain their position in the frequency table, but most others see a reduction.

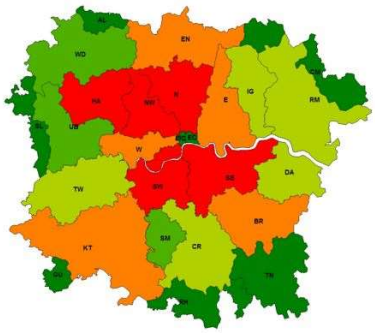


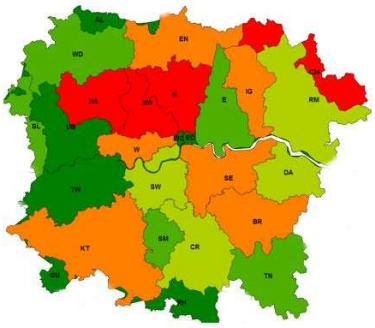
For example, SE, SW and E have a reduced risk using the frequency calculation, suggesting a large housing population in these areas.

The CM area – Chelmsford - is an exception, showing an increase in risk when plotted as frequency. This will form the subject of next month's edition looking at risk by district at postcode sector level.

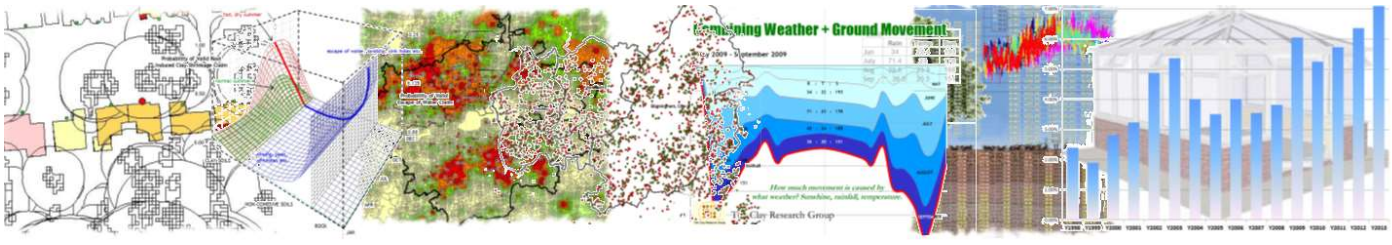
Right, relative risk by both count and frequency for London districts, reflecting the graphs above.

On the following page, the spend by postcode sector is explored and in a future edition, we shall be looking at the spend in terms of frequency to see the impact on premium variations across the UK.





Relative risk of subsidence for London area postcodes using count (left) and frequency (right) calculations. The HA, NW and N areas remain high risk in both examples. SW, SE and E, along with several others areas, have a reduced risk using a frequency approach due to an increased housing population relative to the claim count. The outcome varies by year and season.



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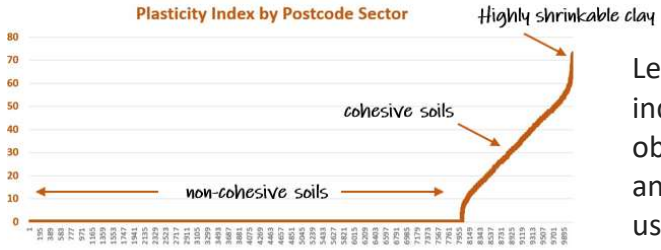
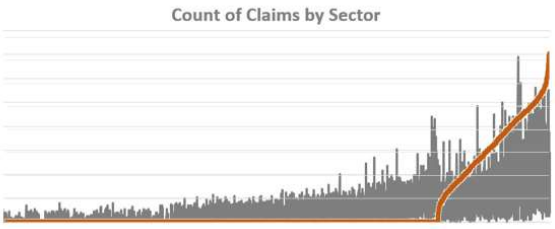
Geology -v- Claims -v- Spend -v- Peril

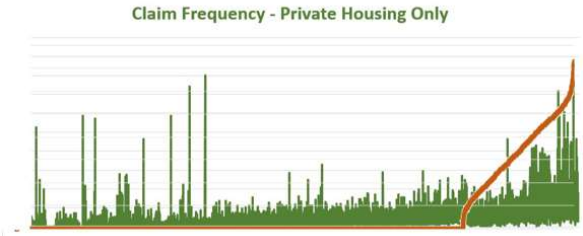
A brief study showing the relationship between geology (cohesive -v- non-cohesive) and subsidence perils, including claims frequency and cost.



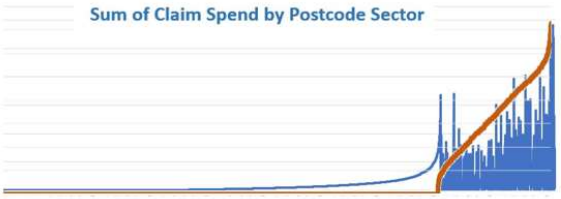


Left, a graph plotting soil plasticity index by postcode sector with data obtained from site investigations and interpolated across the UK using a GIS.

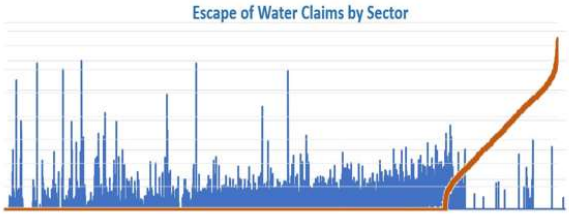
The soils graph superimposed onto a 'claim count by postcode sector' graph, revealing the increase in claims on the clay belt, reflecting the increase in population to the southeast.



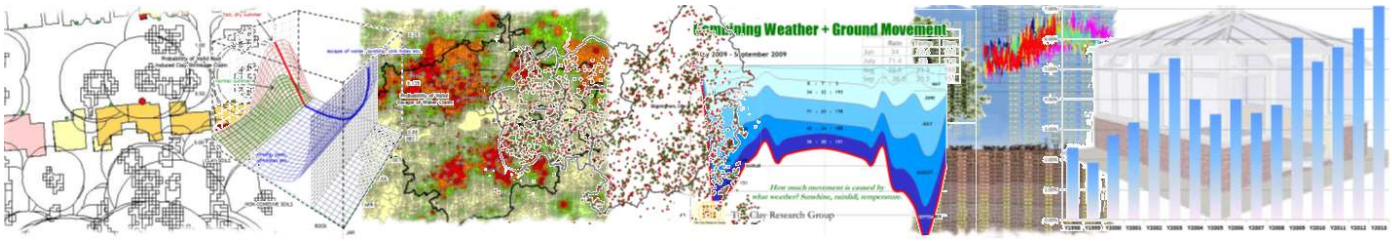
Re-plotting the above claims data as frequency reveals an increased risk on non-cohesive soils (sands and gravels etc) reflecting fewer claims and a lower housing population to the left of the graph.



Aggregating the spend on subsidence claims from our sample illustrates the increased cost of damage to houses on clay soils. This graph plots the total spend at sector level, and not frequency spend – i.e. claim cost per insured proeprty.



The sum of claims (not cost) related to damage caused by leaking drains, water services or 'other', such as landslip, sinkholes etc.



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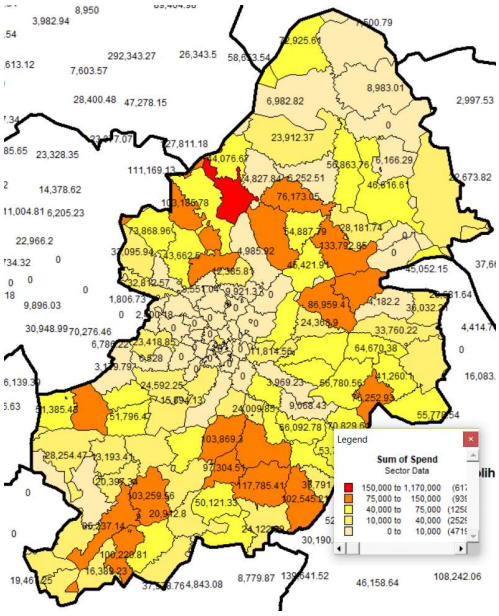
Subsidence Risk Analysis - BIRMINGHAM

Birmingham has around 425,000 houses, a population of around 1.3m and an area of 268km^2.

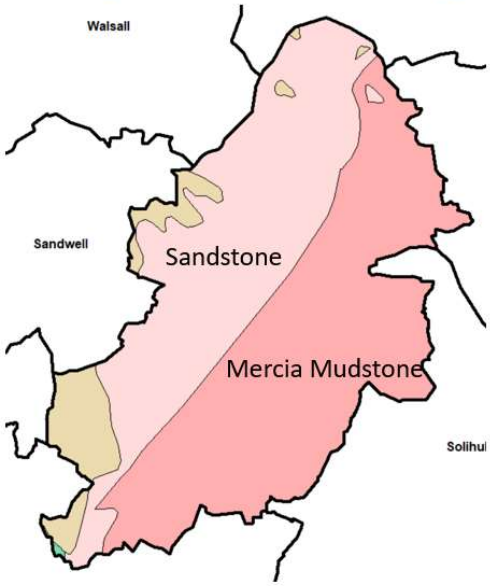


It comes 103rd out of 414 districts in our 'rank order of risk' table, with a risk rated at around the UK average. It accounts for around 1% of the total UK spend on subsidence claims for the sample held.

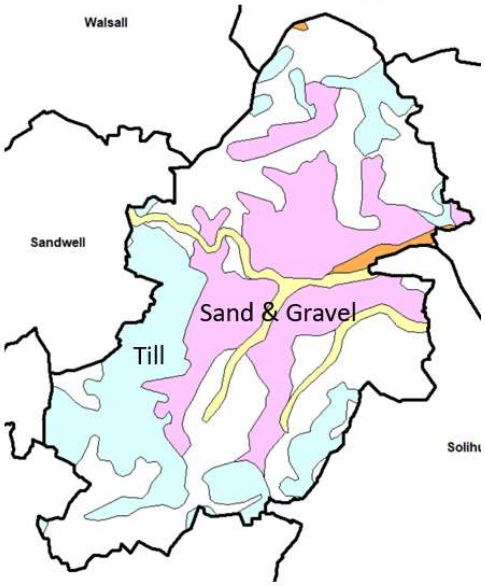
The spend per sector in surge (based on 2003 figures) is shown left.

Below, extracts from the British Geological Survey maps showing the solid and drift series, with an extensive covering of drift deposits (sand, gravel and till) with outcropping sandstone to the north and Mercia mudstone to the southeast.

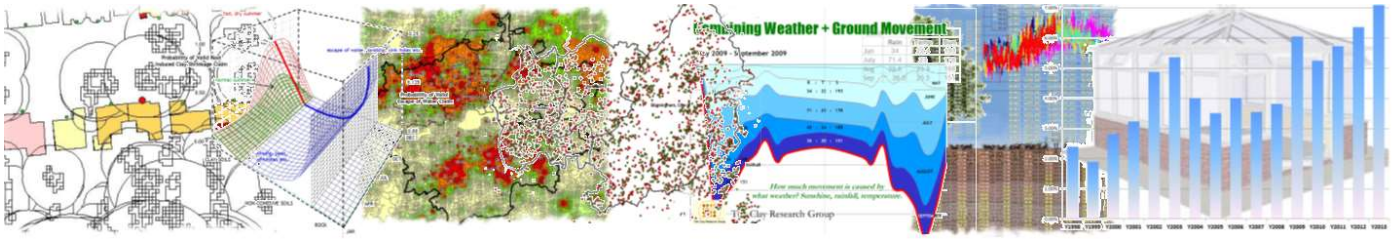
Birmingham District - BGS Geology – 1:625,000 scale low resolution mapping



SOLID



DRIFT



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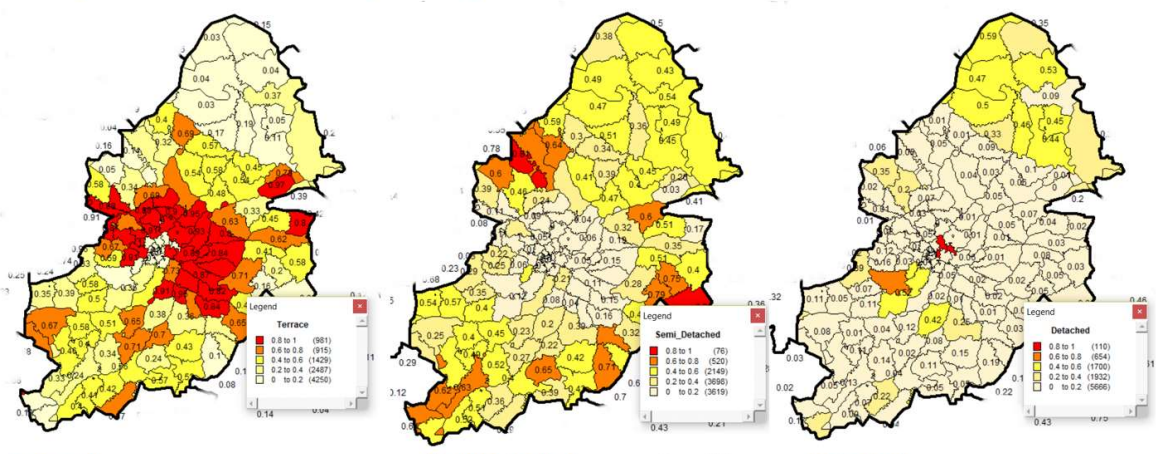
BIRMINGHAM - Properties by Style and Ownership

Birmingham District - Distribution by House Type

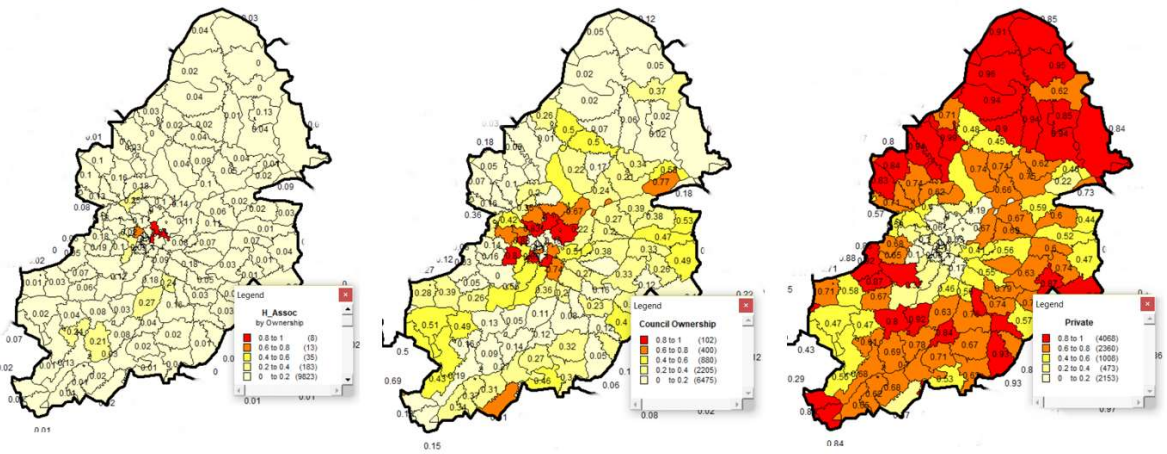


Terraced **Semi-Detached** **Detached**

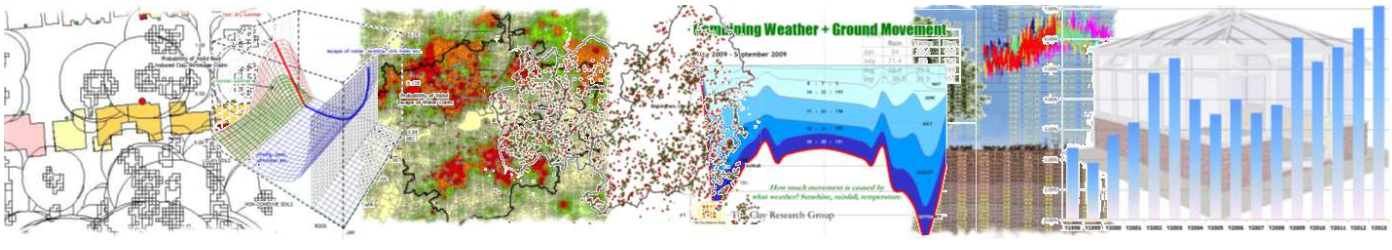
Above, the frequency distribution of differing house styles at postcode sector level showing the concentration of each style in relation to the total housing stock. The 2018 census lists 46,450 detached, 147,400 semi-detached and 125,000 terraced properties (all figures rounded). The balance consists of flats, maisonettes and bungalows.

Distribution by ownership is shown below, revealing a high number of privately-owned properties across the borough.

Birmingham District - Distribution by Ownership



Housing Association **Council Ownership** **Private Ownership**



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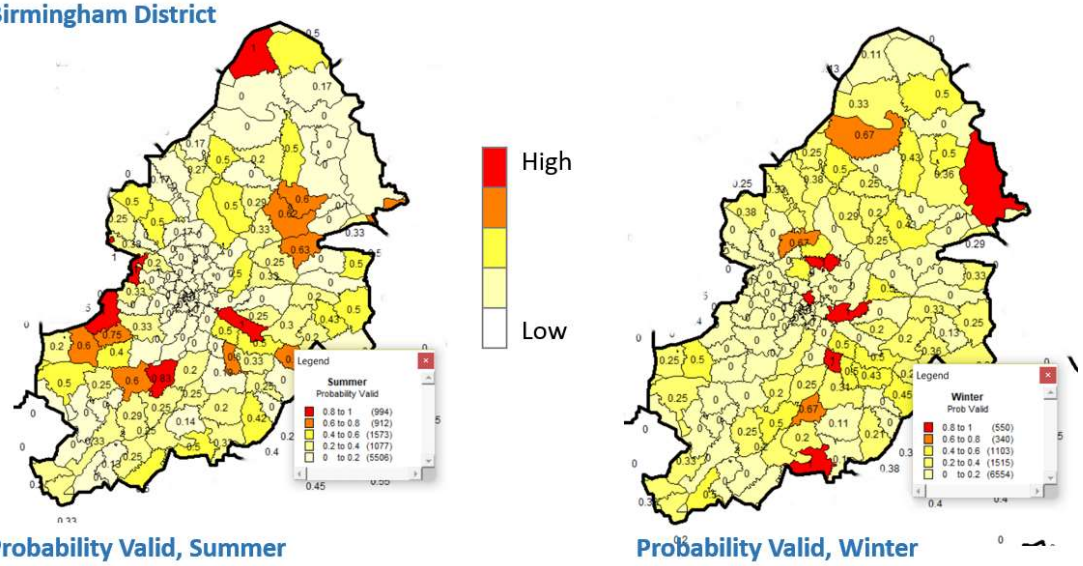
BIRMINGHAM - Liability by Season and Geology

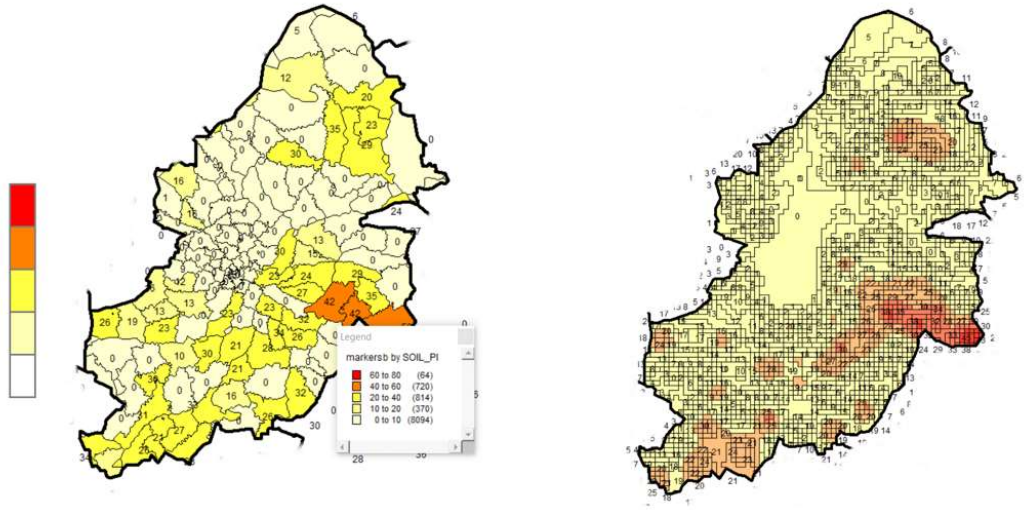
Birmingham District



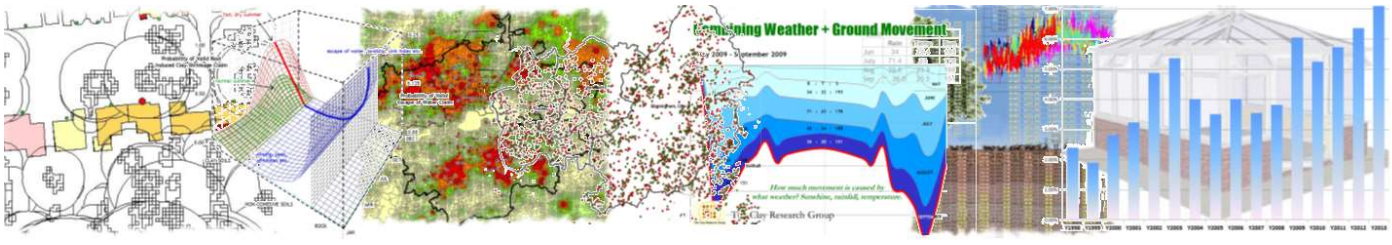
Probability Valid, Summer **Probability Valid, Winter**

Above, the probability of whether a claim is likely to be valid or declined by season, and below, seeing if there is a link with the underlying geology making reference to the CRG 250m grid plotting soil by PI. Claim frequency data by season and peril can be used to infer the nature of the underlying soil (i.e. either cohesive or non-cohesive) and its relationship with the weather. Clay soils respond to warm, dry summers, but deliver far fewer claims in the winter months. Houses on non-cohesive soils tend to deliver fewer claims overall, but with little change by season. The shrinkable clay series, where present to the south east of the district, has a variable PI reaching a maximum of 42% but generally closer to the mid-twenties.

Birmingham District – Soil Plasticity Index



Soil PI Averaged by Sector **PI plotted on 250m CRG grid**



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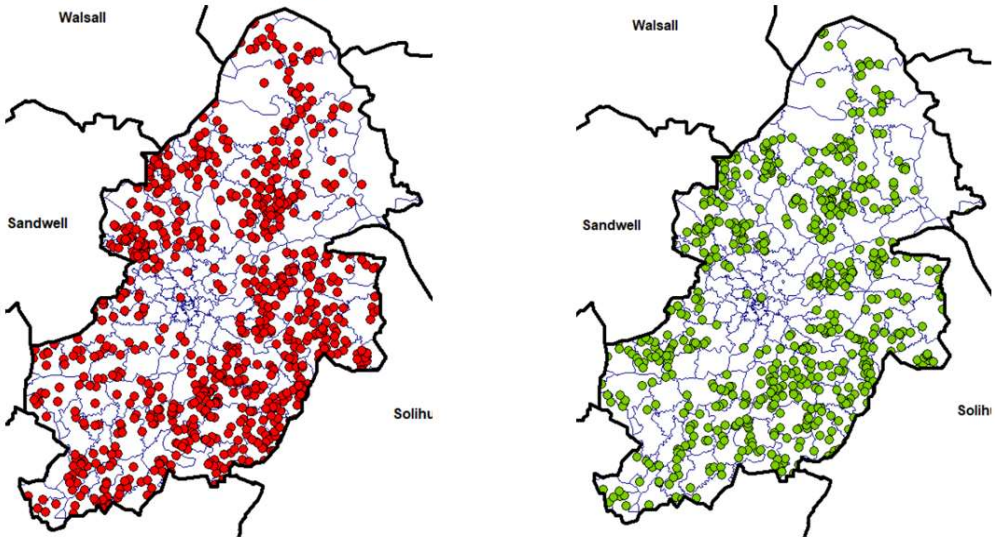
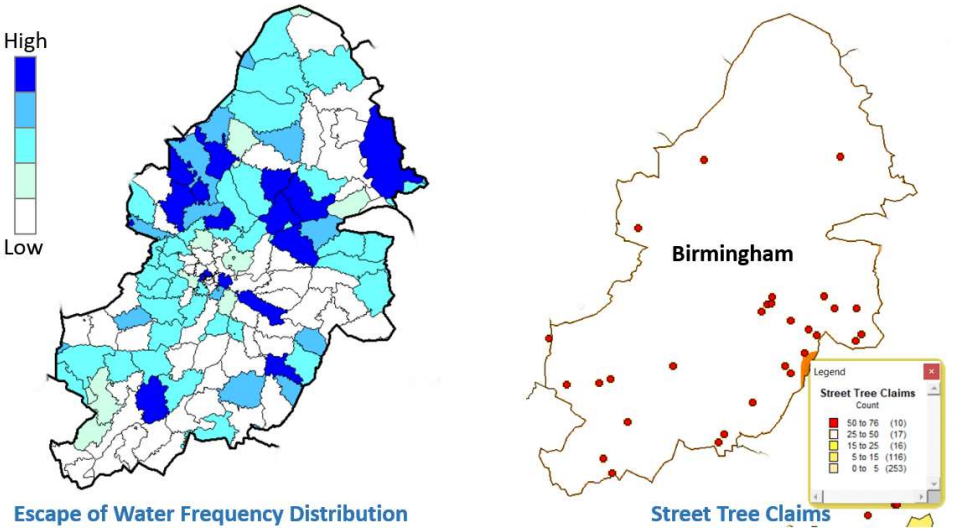
BIRMINGHAM – Liability by Sector. Escape of Water and Council Tree Claims Distribution

Birmingham District – Liability Distribution

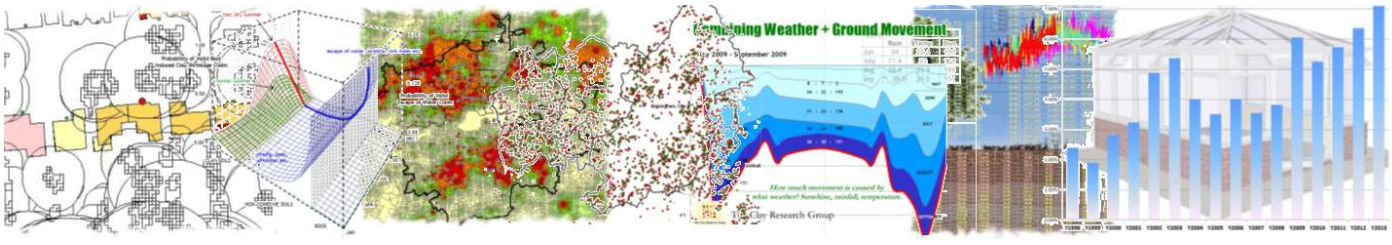


Declinatures **Valid Claims**

Above, mapping liability and plotting declined (red) and valid (green) claims throughout the year, not taking into account any seasonal influence. Below left, mapping the frequency of Escape of Water claims from the sample, reflecting the variable geology and presence of drift deposits. 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 with a concentration to the SE of the borough, coincident with the outcropping Mercia mudstone.



Escape of Water Frequency Distribution **Street Tree Claims**



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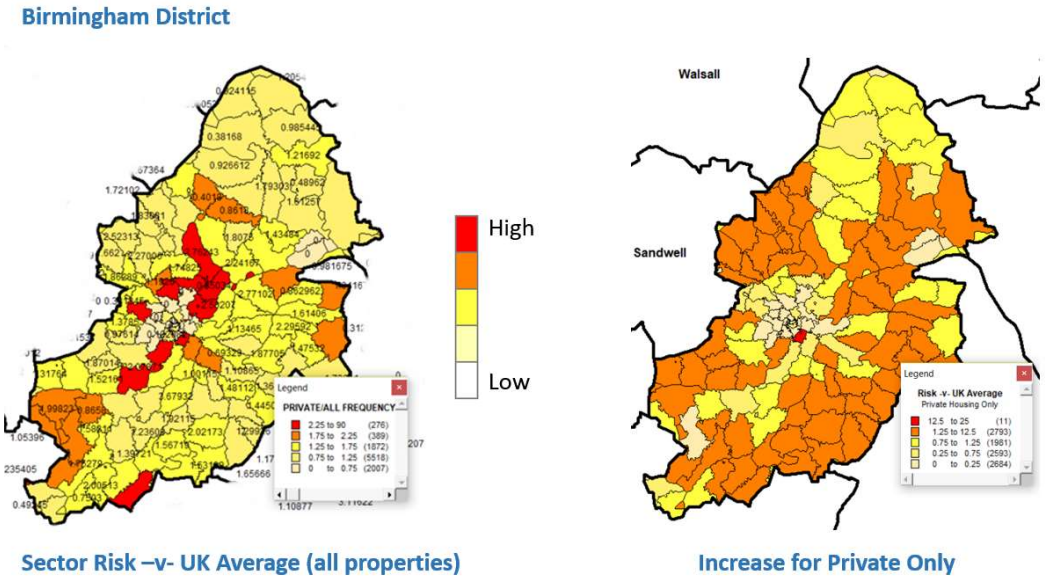
BIRMINGHAM – Frequencies, Count & Probabilities



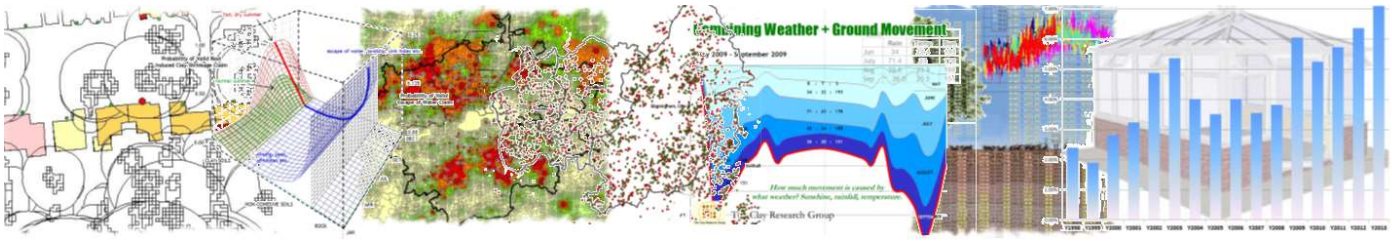
Sector Risk –v- UK Average (all properties)

Increase for Private Only

Below, the figures reveal a borough with a more variable risk than those to the north west of London in terms of subsidence, and by season. The chances of a claim being declined in the summer are around 44%, and if it is valid, the chances of it being due to clay shrinkage will be around 36% and escape of water, 64%. of all claims. In the winter, the repudiation rate is around 27%, and if it is valid, the chance of a claim being due to an escape of water is 63%.

The figures reflect the variable geology. By contrast, a borough like Harrow with a large coverage of outcropping London clay, has a likelihood of a valid claim being due to clay shrinkage of around 70% in the summer, falling dramatically in the winter months. Data is of course less reliable when there is geological variability across the district, as is the case here, when sector level analysis is preferable.

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Birmingham	0.208	0.352	0.44	0.27	0.46	0.267



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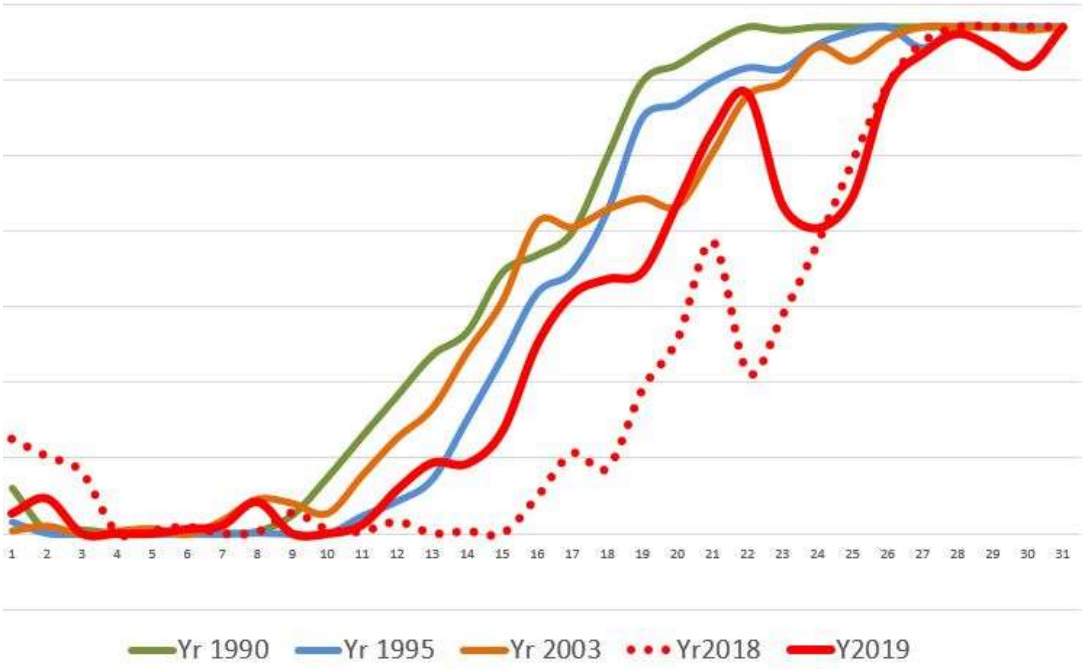
SMD Profiling - is there a predictive value?

Updated yesterday (7th August), the current Soil Moisture Deficit (SMD) profile is shown below as a solid red line. For comparison purposes, the profiles for surge years 1990, 1995 and 2003 are shown, all of which exceed (are drier than) the current levels.



The point of interest is matching current levels with 2018. As we know, the third quarter of 2018 delivered a surge in claims – will we see something similar this year?

The 2019 profile is drier than the 2018 from week 12. There is a noticeable dip in 2018 around week 21 and weeks 23 and 24 in 2019, and then the profiles merge. Will 2019 deliver a higher number of claims in the third quarter than 2018 – or does the steep gradient of the 2018 profile heading towards July distinguish them? Our experience at Aldenham suggests that July is a significant month for water uptake although perhaps a little too late in the year to be regarded as having a predictive element.

It may be that comparisons between the SMD and claim numbers over these two years reveals its value.