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

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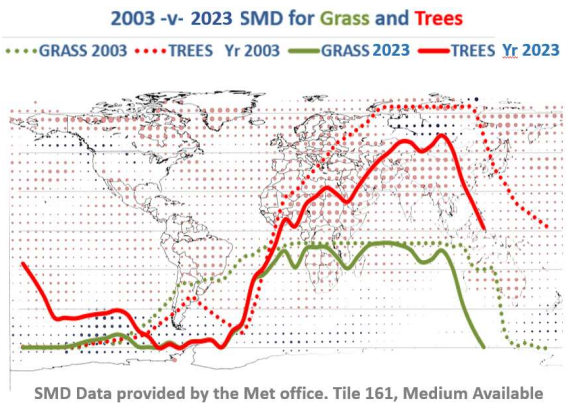
The Clay Research Group

CONTENTS

Soil Moisture Deficit Update

Soil Moisture Deficit readings reflect the spell of wetter weather in October.



SMD Data provided by the Met office. Tile 161, Medium Available Water Capacity with grass and tree cover

Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at: *clayresearchgroup@gmail.com*

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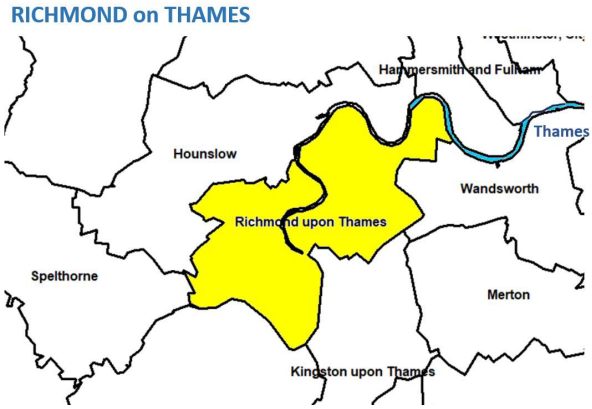
District and Sector Risk

Richmond on Thames is the topic of the 'Risk by District' series in this month's edition. Situated in south west London, it has a geology consisting of superficial deposits of sand, gravel and alluvium overlying London clay.



The risk maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

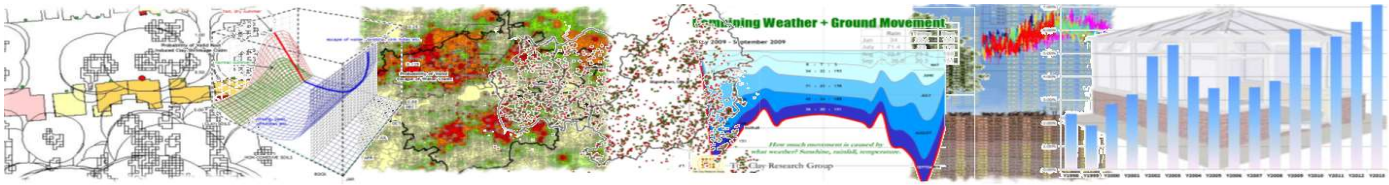
TDAG Update

Presentations from past TDAG events can be viewed at https://www.tdag.org.uk/past-events.html.

All are of interest but in particular perhaps Keith Sacre's *"How do we close the performance gap and enable 'establishment'?"* and David Winlo of Mapscape, hosting a YouTube presentation, *"Tree Management with Carbon Dioxide Uptake Calculations"*, reviewing the use of GIS to estimate carbon uptake by vegetation.

Keith also provides a view in *"Root barriers – when to use, when not to use and long-term ineffectiveness"* which is interesting.

The sessions on the 9th May 2023 were of particular interest to the subsidence community.



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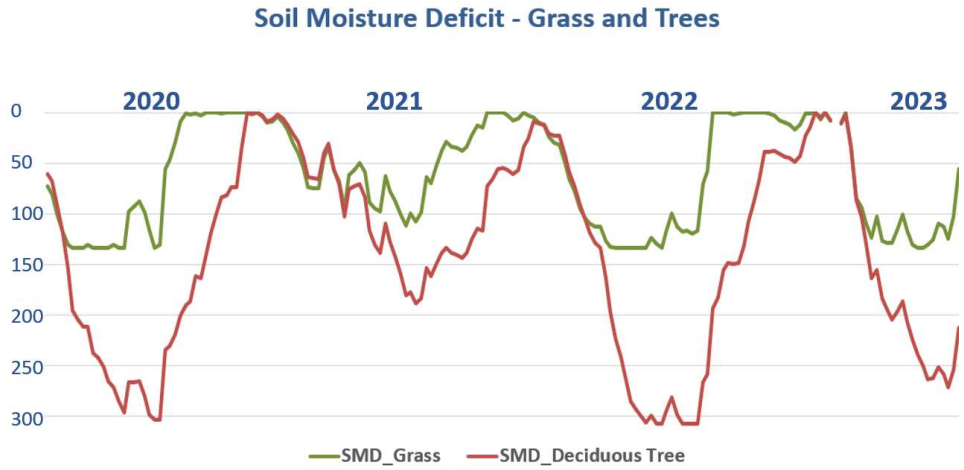
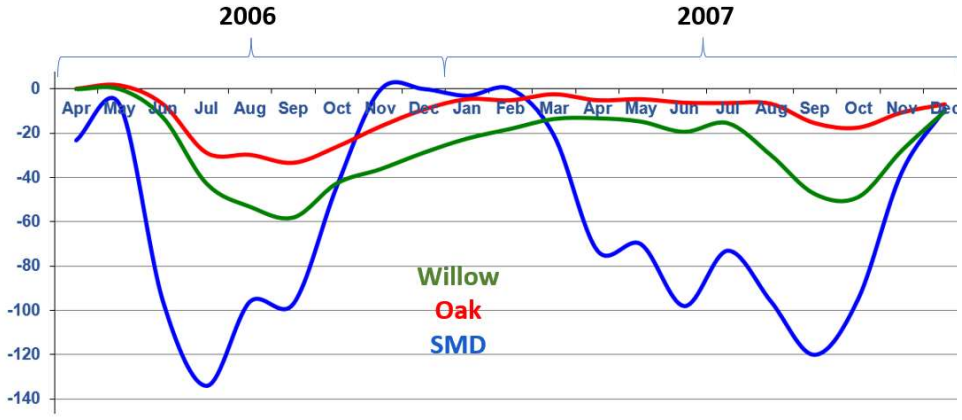
Soil Moisture Deficit and Ground Movement

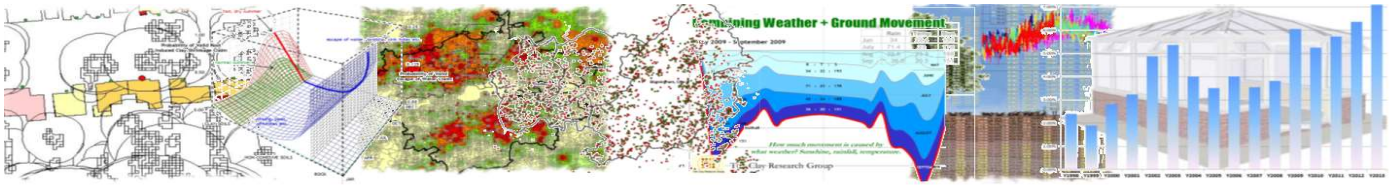
Below, graphs showing the Soil Moisture Deficit supplied by the Met Office for grid 161 for both grass (green) and trees (red) for the years noted. Peak values are 134mm for grass and 308mm for trees, calculated to account for moisture deficit in the top 1m of soil. We tend to favour using the grass values as a 'datum' due to the variability when considering trees.



Below, the correlation between ground movement measured at the Aldenham Research Site for both the willow and oak trees and SMD. The two trees deliver similar patterns of ground movement by month and the interesting element is the link between ground movement and the SMD profile.



Ground movement follows the SMD profile with a variable delay of between one and two months. Moving the ground movement profile back a month delivers a correlation exceeding 0.7 – significant given the variable nature of the elements involved – i.e. soil, climate and vegetation.



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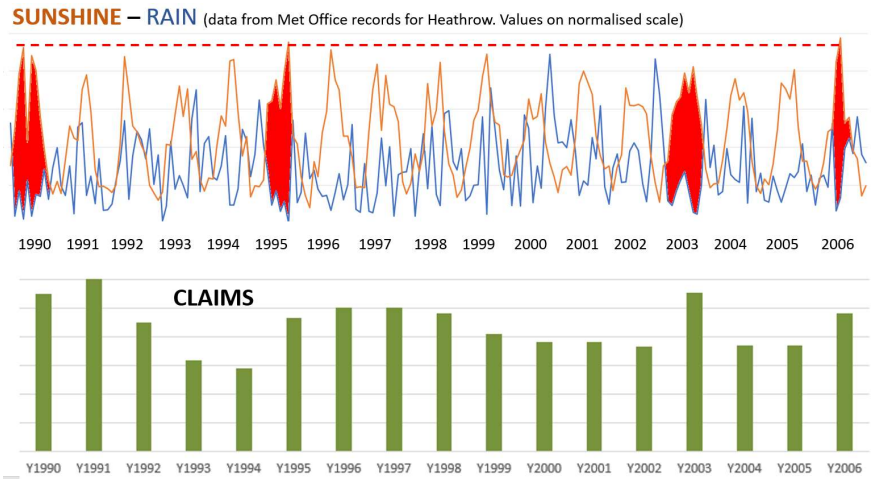
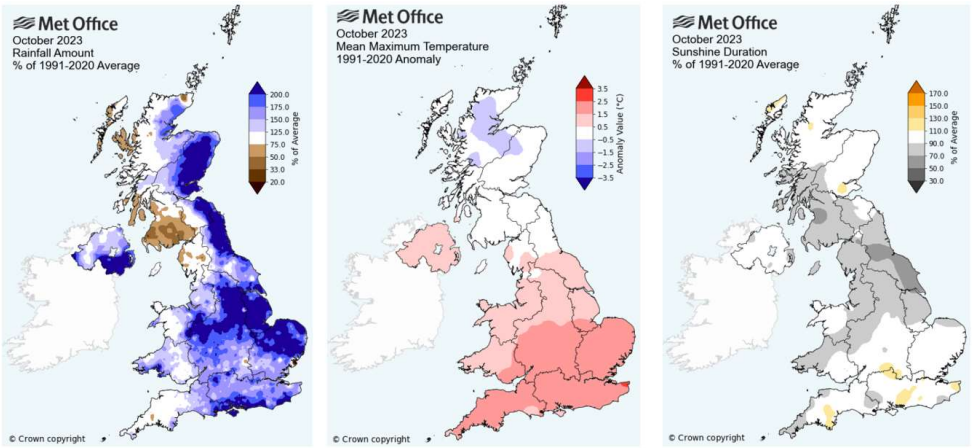
Weather Elements and Surge

Following on from last month's edition, below are graphs showing the relationship between subsidence claim numbers (green bar graph) and weather elements – sunshine and rain. The red shaded areas show the difference between normalised values for the two elements and the relationship with surges in subsidence claims.

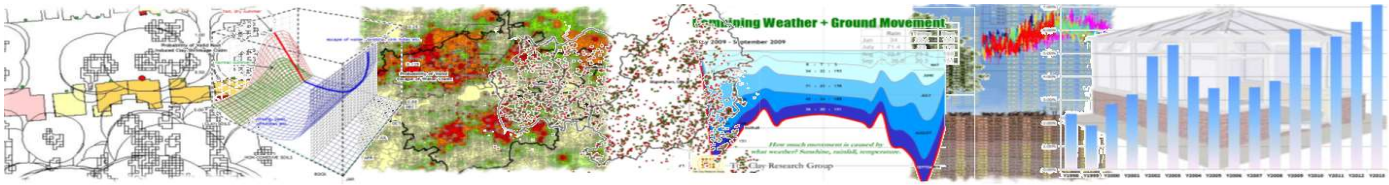


Met Office October 2023 Update. Anomaly Data, 1991 – 2020

Anomaly maps from the Met Office web site reproduced below. October 2023 was warmer than the 1991-2020 average, with increased rainfall and fairly average hours of sunshine for the south east, the area with the highest number of subsidence claims and vulnerability to surge.



https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps



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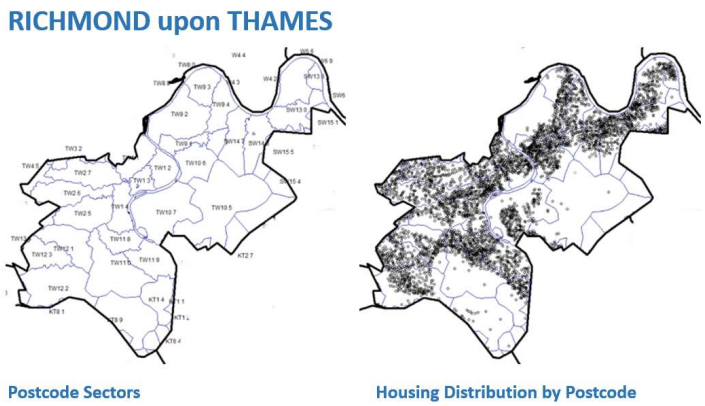
Subsidence Risk Analysis – RICHMOND upon THAMES

Richmond upon Thames is located in south west London, occupying an area of 57.4km^2 with a population of around 195,000.



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

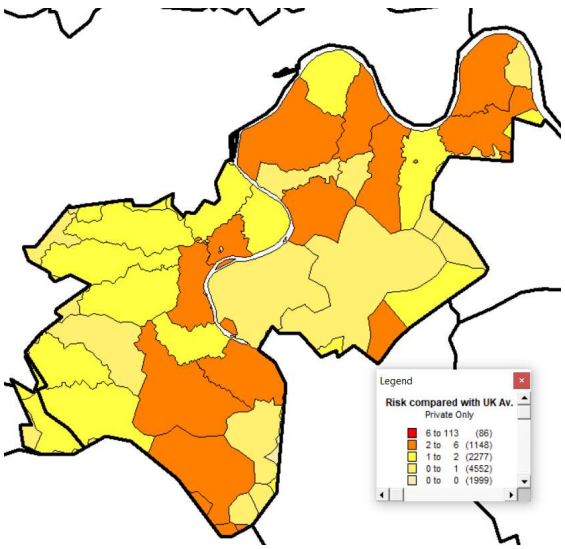
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

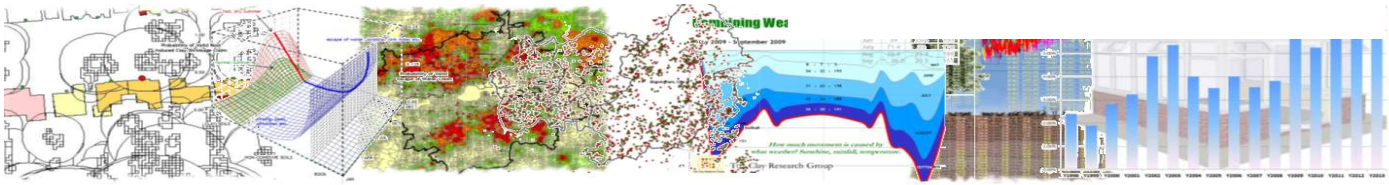
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Richmond upon Thames is rated 46th out of 413 districts in the UK from the sample analysed and is around 1.751x the risk of the UK average, or 0.454 on a normalised 0 - 1 scale.

There is a varied risk across the borough as can be seen from the sector map, right, which reflects the varied geology with non-cohesive drift deposits overlying London clay.



Postcode sectors compared with the UK average risk for domestic subsidence claims from the sample analysed.



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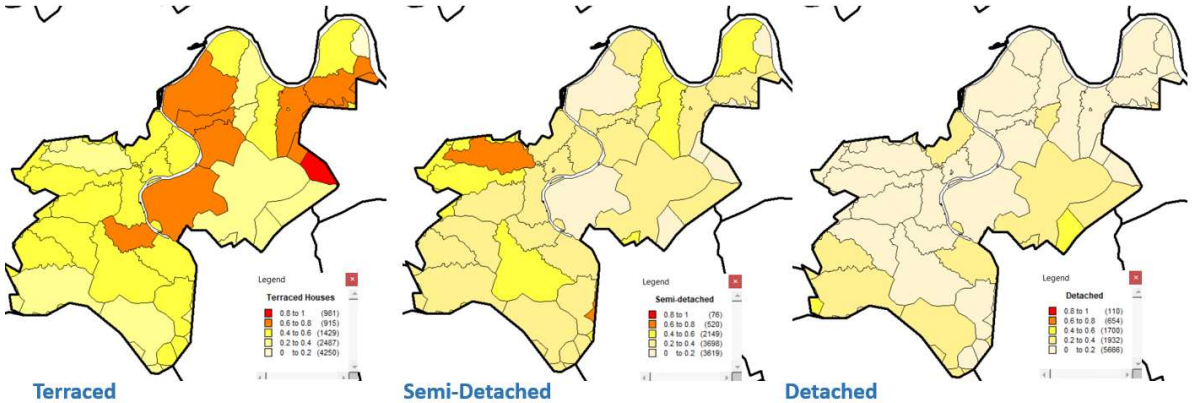
RICHMOND on THAMES - Properties by Style and Ownership

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 taking out the policy.

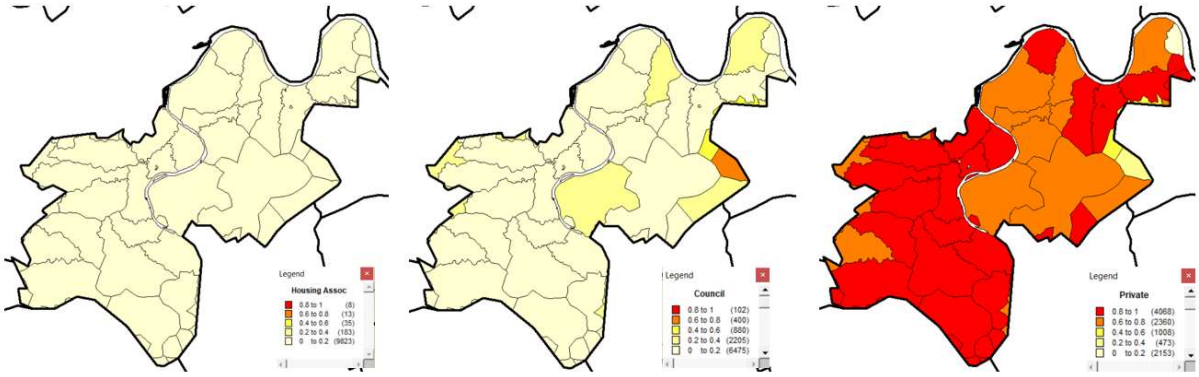
RICHMOND upon THAMES - Distribution by House Type



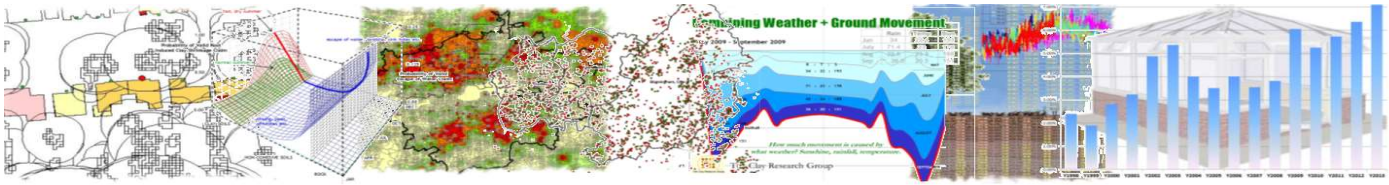
Terraced Semi-Detached Detached

Distribution by ownership is shown below. Private properties are the dominant class ownership across the borough.

RICHMOND upon THAMES - Distribution by Ownership



Housing Association Council Ownership Private Ownership



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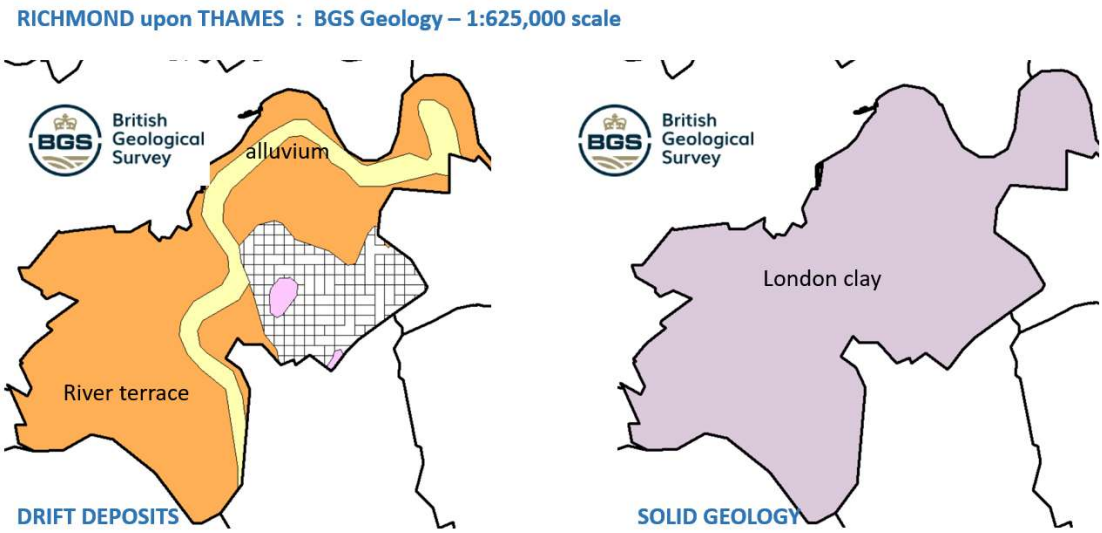
Subsidence Risk Analysis – RICHMOND on THAMES

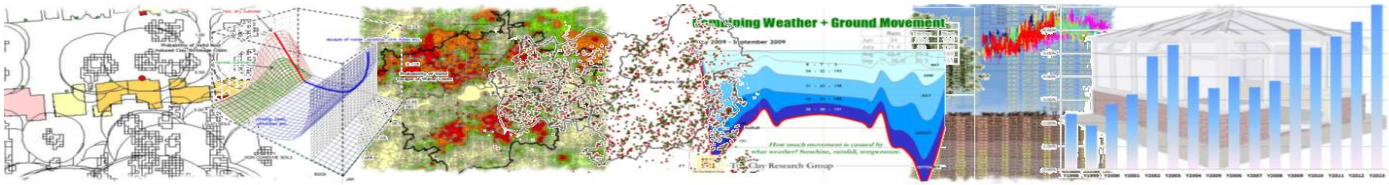
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 9 for a seasonal analysis of the sample which reveals that, at district level, there is around a 56% probability of a claim being valid in the summer and, of the valid claims, there is around a 37% chance that the damage will have been caused by clay shrinkage, with escape of water accounting for the remaining 63%. In the winter the likelihood of a claim being valid is higher at around 73%. Of the valid claims there is a 37% chance of the cause being clay shrinkage and 74% chance of the cause being an escape of water.

Maps at the foot of the following page plot the seasonal distribution with shrinkable deposits encountered following investigations associated with claims.



Above, extracts from the 1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series delivers far greater benefit when assessing risk.



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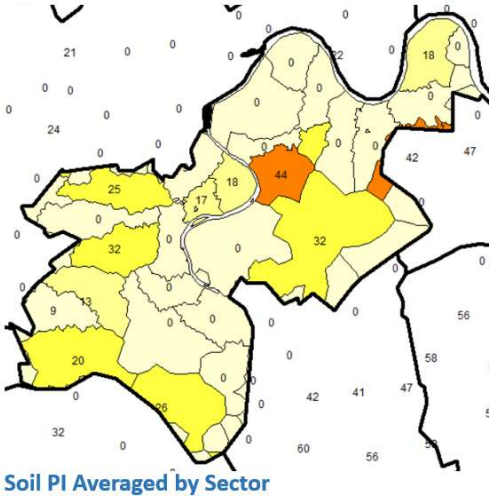
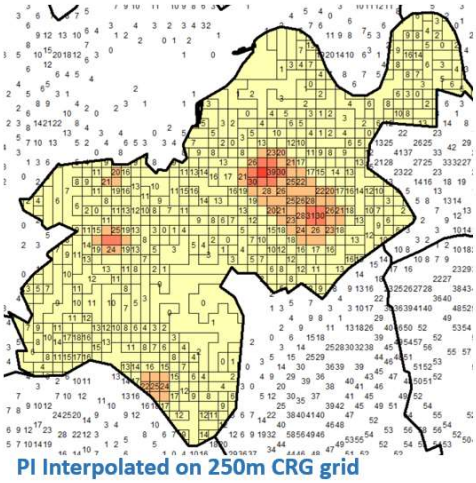
Liability by Geology and Season

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.

RICHMOND upon THAMES – Soil Plasticity Index



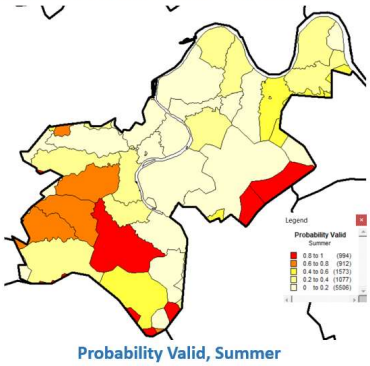
Soil PI Averaged by Sector



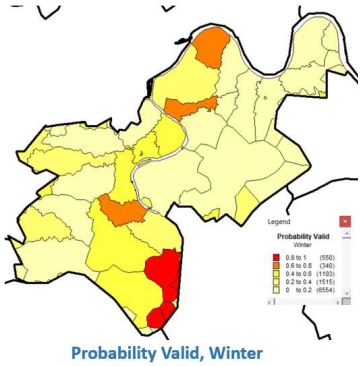
PI Interpolated on 250m CRG grid

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.

RICHMOND upon THAMES – by season



Probability Valid, Summer



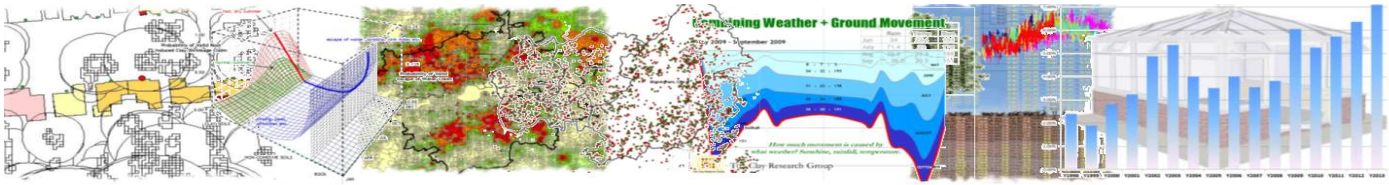
Probability Valid, Winter

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

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

This approach seems less useful in this instance as clay is recorded as a significant cause of subsidence in the summer months and yet the geological series are, in the main, non-shrinkable.

The 'claim by cause' distribution and the risk posed by the soil types is illustrated at the foot of the following page. 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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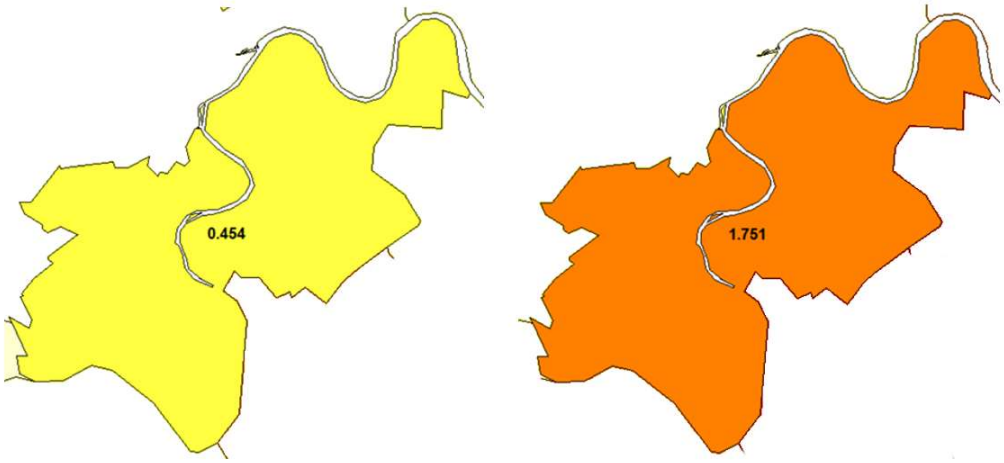
District Risk -v- UK Average. EoW and Council Tree Risk.

RICHMOND upon THAMES - Subsidence Risk Relative to UK



Normalised (0 – 1) Scale

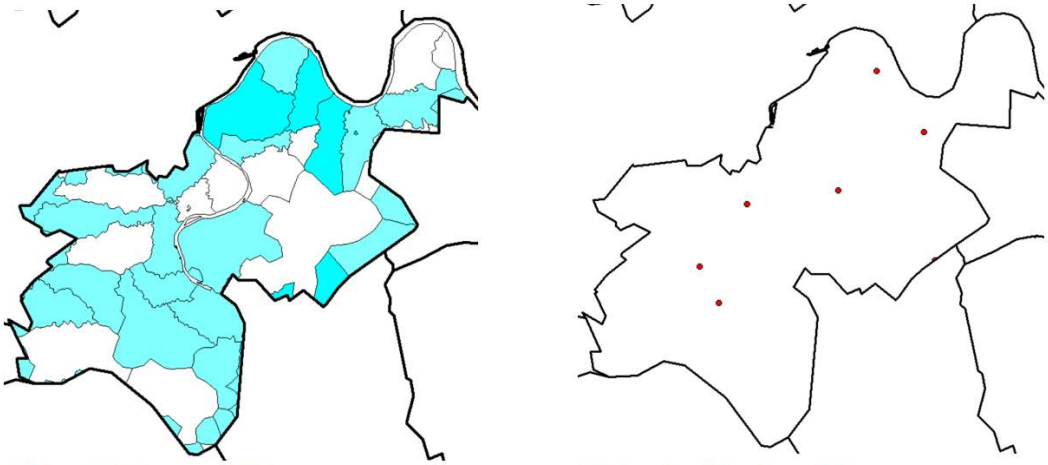
Relative to UK Average

Below, left, mapping the frequency of escape of water claims confirms the presence of non-cohesive soils. As we would expect, the 50,000 scale BGS map provides a more detailed picture.

The CRG 1:250 grid reflects claims experience.

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 low numbers are attributable to the superficial geology being largely non-cohesive.

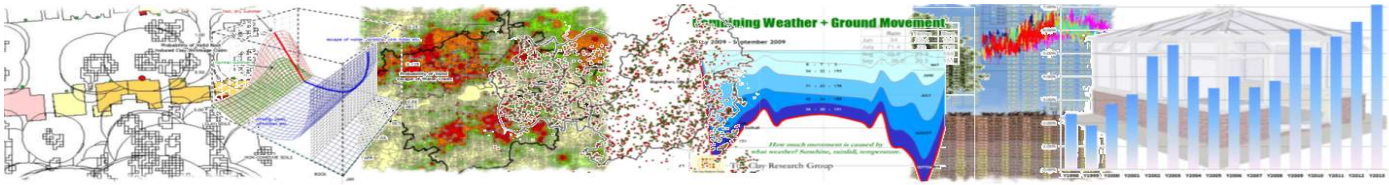
RICHMOND upon THAMES



Higher Risk Escape of Water

Claims Involving Council Tree

(2,858 UK claim sample)



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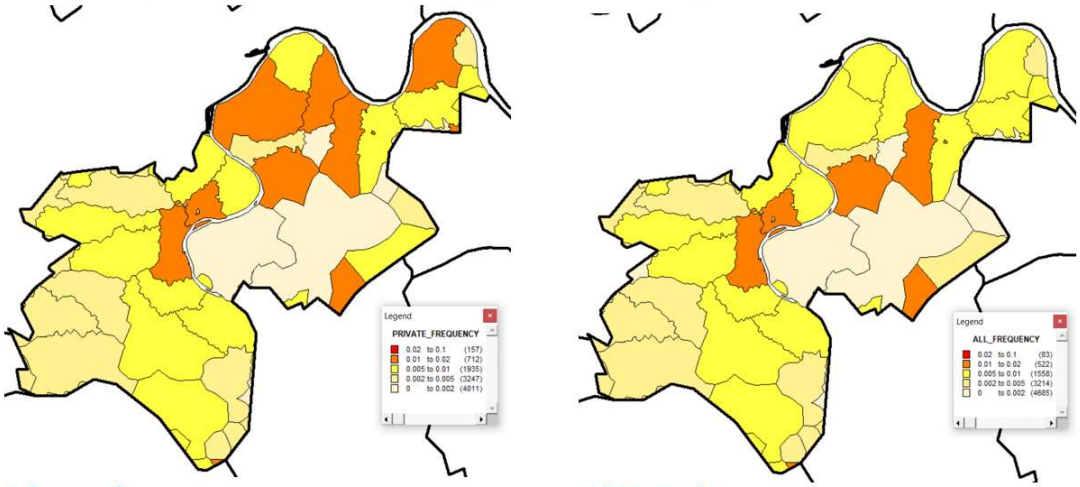
RICHMOND on THAMES - Frequencies & Probabilities

Below, mapping the risk of subsidence by ownership. Claims frequency including council and housing association properties delivers a misleading value of risk as they tend to self-insure. The following show the normalised risk, taking account of the private housing population.

RICHMOND upon THAMES - Sector Risk Compared with UK Average



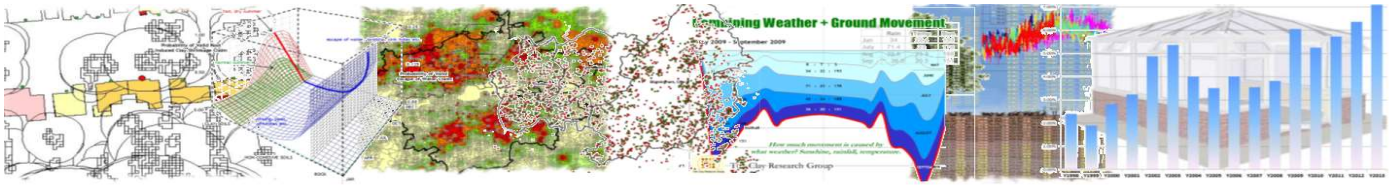
Private Only **All Properties**

On a general note, a 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 usually 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 fairly steady throughout the year.

Liability by Season - RICHMOND upon THAMES

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Richmond upon Thames	0.212	0.348	0.44	0.28	0.46	0.267



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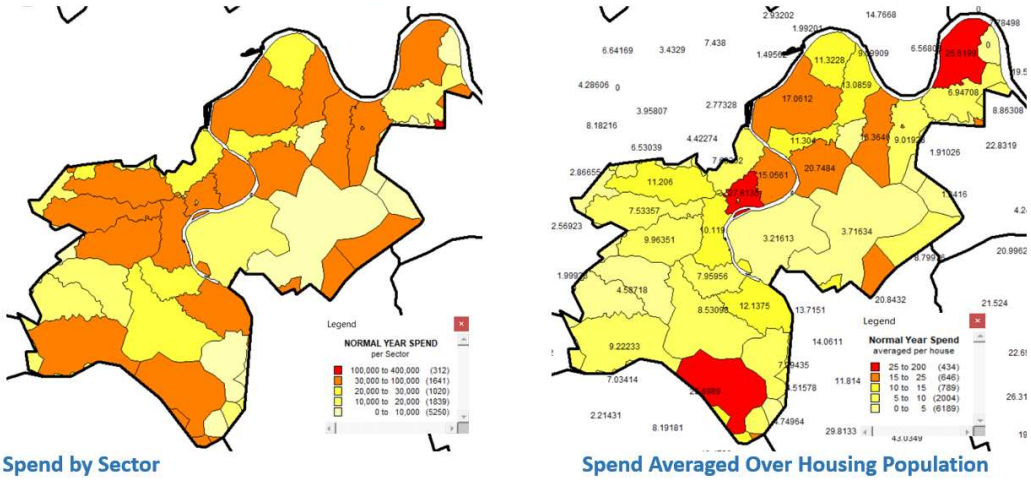
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 of course.

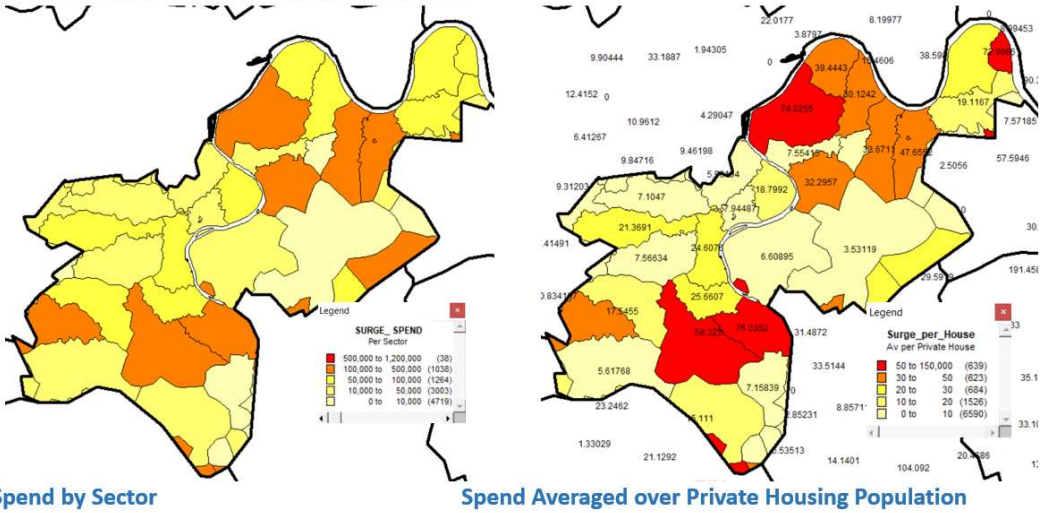
NORMAL YEAR SPEND – RICHMOND upon THAMES



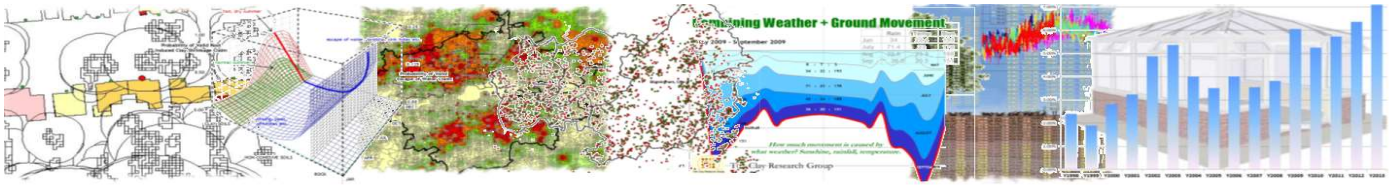
Spend by Sector | Spend Averaged Over Housing Population

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 – RICHMOND upon THAMES



Spend by Sector | Spend Averaged over Private Housing Population



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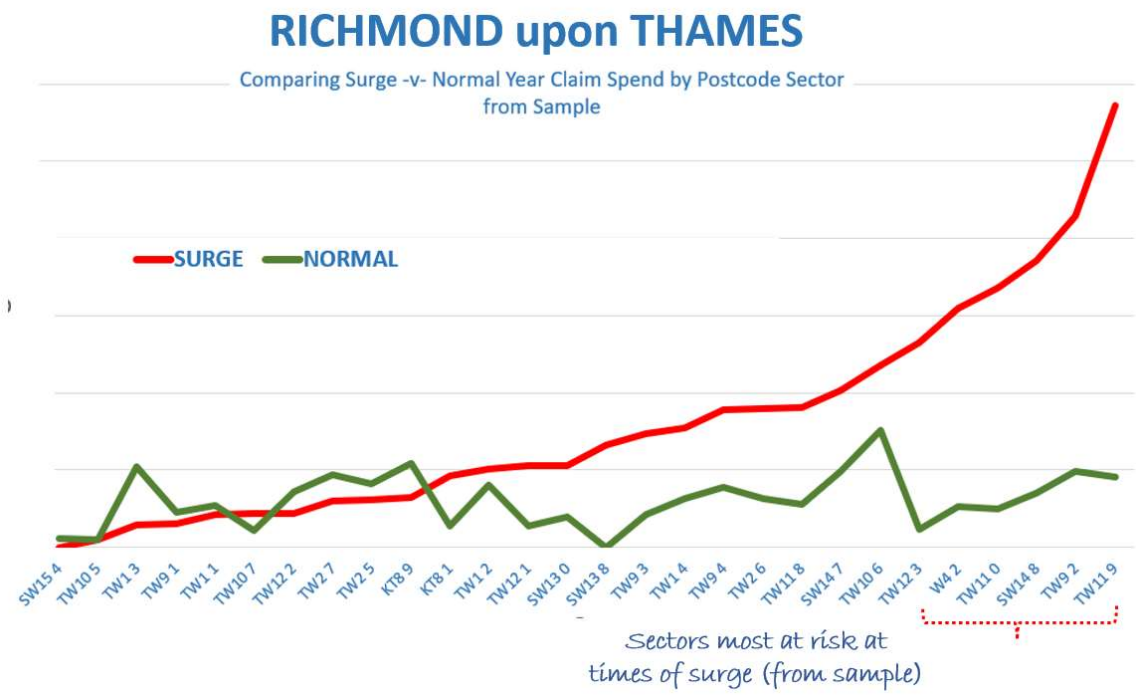

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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 are based on losses for surge of just over £400m, and for normal years, £200m.