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

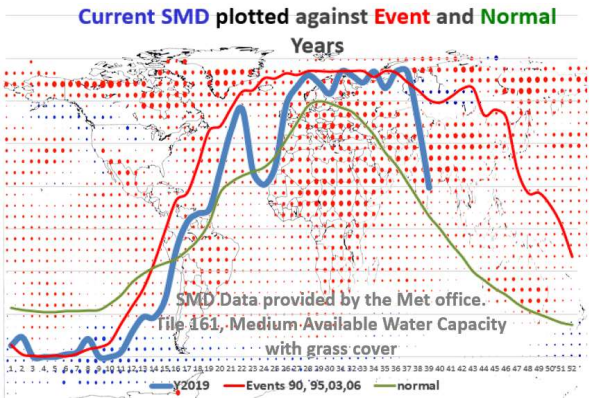
October 2019
Edition 173

The Clay Research Group

CONTENTS

2019 Surge?

The SMD continues to fluctuate by month as can be seen in the graph below.



The Met Office confirm the summer of 2019 was the twelfth hottest on record and the seventh wettest since 1910. Hours of sunshine were close to average. In terms of overall claim numbers, we expect the total for 2019 to be between 15,000 and 20,000.

Study Area - Braintree

Braintree in Essex is the study area this month, and much of the text is repeated from the last edition, listing claim frequency, cost per sector, extrapolated by house to derive an idea of premium, calculated for both surge and normal years etc.

The study uses a data sample that may not reflect the experience of all insurers and adjusters due to distribution channels etc., but it does provide a methodology for those interested in developing their own models.

Building Research Establishment

The work of the BRE in the early 1990s changed the way that domestic subsidence claims are handled and delivered considerable savings to insurers.

The team at the time - Richard Driscoll, Tim Freeman and Mike Crilly - published a series of Digests and Information Papers that provided practical engineering guidance on identifying causation, the appropriate level of investigations, soil testing and monitoring etc., as well as producing a table linking crack damage to appropriate repair.

Over the next few months we shall be re-visiting their work in the context of what had gone before.

Diary Dates

The Subsidence Forum hold their annual training day at Tewin Bury Farm, Hertford Road, Welwyn, AL6 0JB on the 17th October. For details of this popular event contact them via their web site at https://www.subsidenceforum.org.uk/

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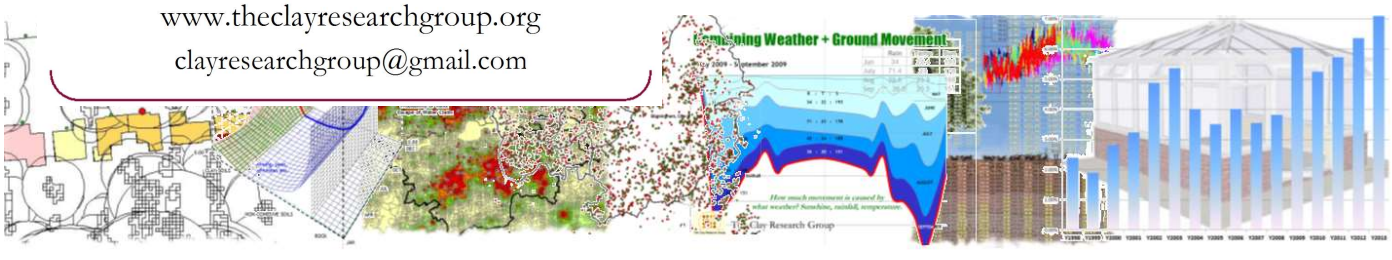

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The Intervention Technique

Related Research Notes

Different taxa of tree respond differently to watering in trenches according to a recent study by a team of researchers based at Temple University, Philadelphia, USA. Their paper, Water Relations of Street Trees in Green Infrastructure Tree Trench Systems by Joshua S.Caplan *et al.,* is published in the journal, Urban Forestry & Urban Greening, Vol 41, May 2019. Link below.

https://www.sciencedirect.com/science/article/pii/S1618866718305910?via%3Dihub

The paper confirms the environmental benefit of using rehydration trenches to manage stormwater.

The abstract points out "*However, tree trenches are designed to infiltrate rapidly, which could limit water availability in trenches and soil pits, thereby restricting transpiration between storms and eventually impacting tree health and survival*."

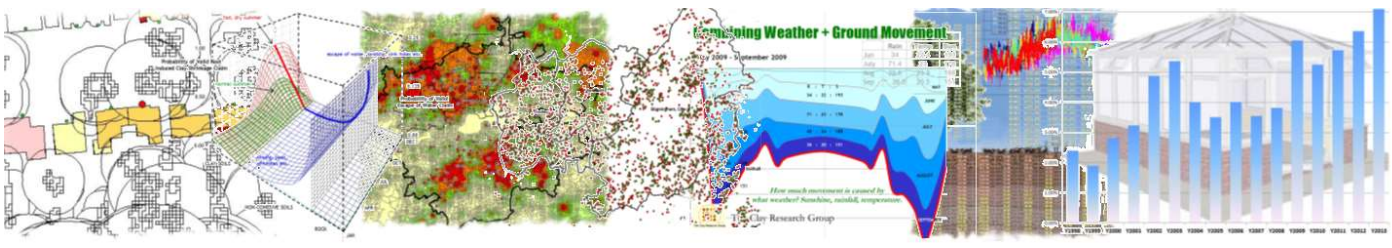
Over 100 claims have been resolved using the Intervention Technique since a patent was granted to Innovation Group and so far, there have been no failures. The technique does not flood the chamber, but allows gradual and controlled filtration using a chamber filled with sand and minerals to rehydrate clay soil in which the roots are established – or more likely, reduce the degree of desiccation to an acceptable level in terms of building movement.

In another paper in the same journal (Responses of Mature Roadside Trees to Root Severance Treatments. Andrew R. Benson et al.), the research team explored the effect of root pruning, something linked to the Intervention Technique and of interest when installing the treatment trench.

The team arrived at the conclusion "*To avoid sustained water stress symptoms, linear root cutting on Q. virginiana should not be undertaken closer to trees than six times DBH, equating to ≈ 25% root system loss.*" DBH – trunk diameter at 1.37mtrs above ground level.

https://www.sciencedirect.com/science/article/pii/S1618866718308094

With regard to the Intervention Technique understanding which trees respond to treatment and which don't is of interest going forward, as are the findings relating to the amount of root loss that can be safely sustained.



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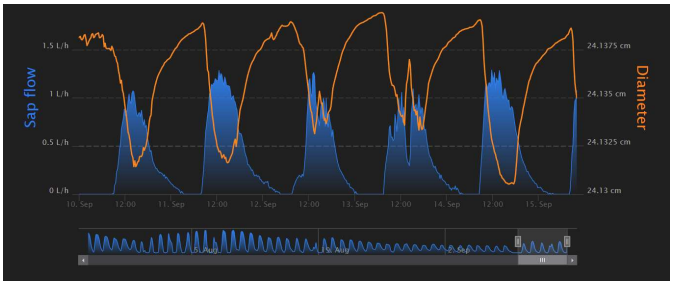
Trunk Diameter -v- Sap Flow

Back in October 2016 (Newsletter 137) Dr. Jon Heuch alerted us to research being undertaken into tree water uptake and associated changes in trunk diameter at a site in Germany. A team from the Thunen Institute are monitoring pine, beech, larch and fir trees and provide live access to their findings at the following web site:



https://treewatch.net/thunen-institute-forest-ecoystems/

We weren't sure how to interpret the graphs (brown line trunk diameter and blue line, sap flow) and Jon provided the following explanation.

"Loss of water from the leaves doesn't lead to instantaneous uptake of water in the roots. The easiest part of the tree to monitor is around chest height on the main stem so that is where the monitoring equipment tends to go, or slightly higher to prevent looting of expensive equipment.

At equilibrium we imagine roots, stem and leaves all have adequate water content without any excessive stresses or strains; in the absence of drought this is likely to occur at, or just before, dawn. As sun rises the tree requires carbon dioxide from the atmosphere so opens the stomata on the leaves; water promptly is lost from the leaves leading to a suction effect from all the leaves onto the main "storage" area i.e. the main conduits for water – the xylem. The suction leads to the xylem loosing water and thus overall the stem shrinks slightly. That suction is transferred down to the roots and the roots slowly suck up water and nutrients.

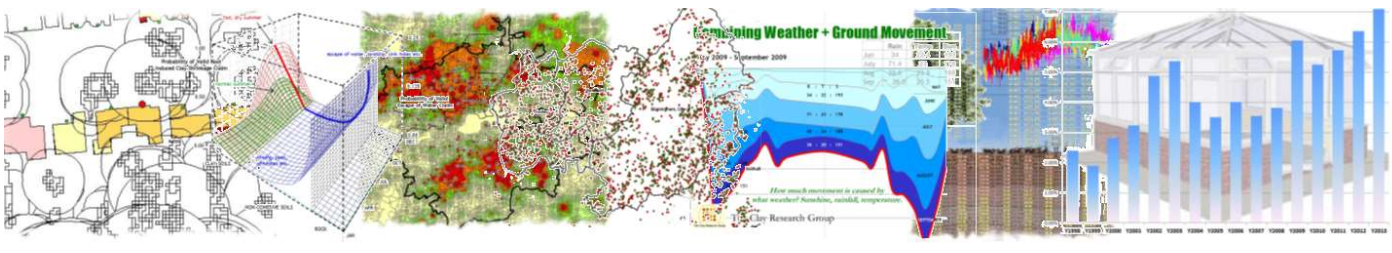
The suction from the leaves subsides in later afternoon and as darkness starts but the roots keep "pumping" to rectify the loss encountered in the xylem. As a result the xylem heads toward equilibrium during darkness … the stem slowly swells."

Jon has provided the following link:

https://www.scientificamerican.com/article/how-do-large-trees-such-a/ (old)

And this one which he thinks may be more fun:

https://www.youtube.com/watch?v=BickMFHAZR0



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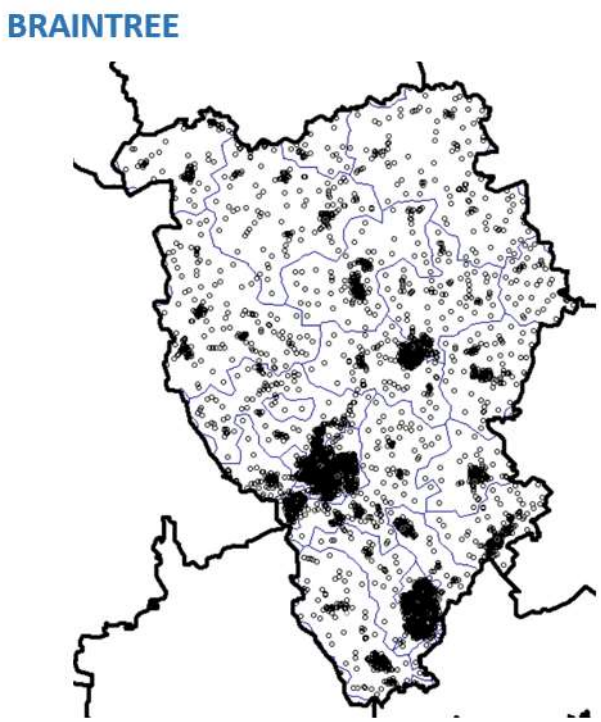
Subsidence Risk Analysis – BRAINTREE



Braintree is rated as being 1.26 times the risk of subsidence in terms of claims frequency compared with the UK average and is ranked 109th out of 413 districts in our 'rank order of risk' table for claims frequency.

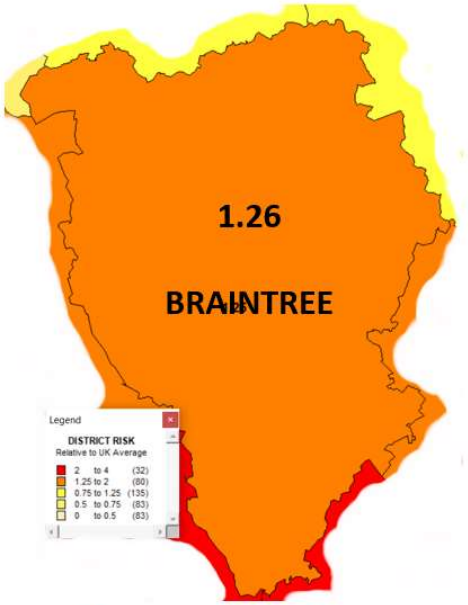
Its standing reflects the large number of districts rated as being low risk. The highest risk rating is a value of 4.

Where high risk sectors are indicated this reflects frequency (rather than count) of claims.

Mapping housing distribution across the districts clarifies the risk maps on the following pages.

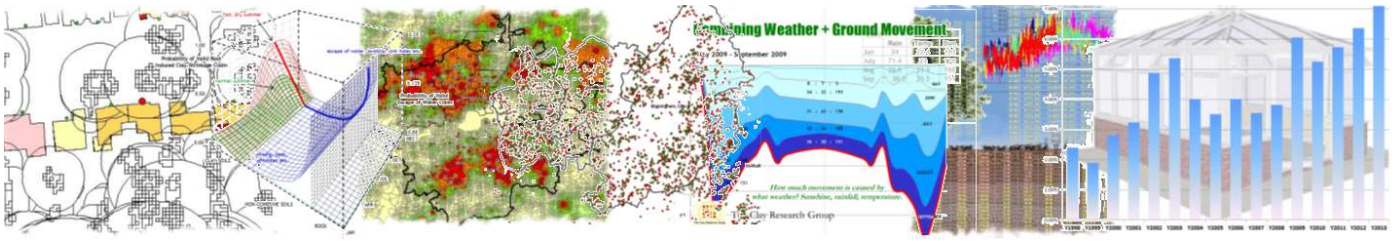
Some areas are indicated as low risk due to low density housing population, and others a high risk due to housing density. Whilst frequency estimates help to resolve this, large differences of the sort seen here can influence the output.

Below, a map ranking district according to their standing in relation to the UK average.



Risk Compared with UK Average

Braintree is rated 1.26 times the risk of subsidence compared with the UK average at district level.



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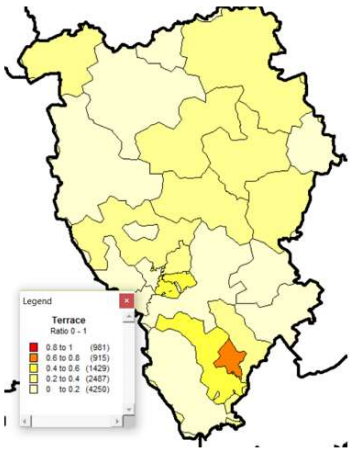
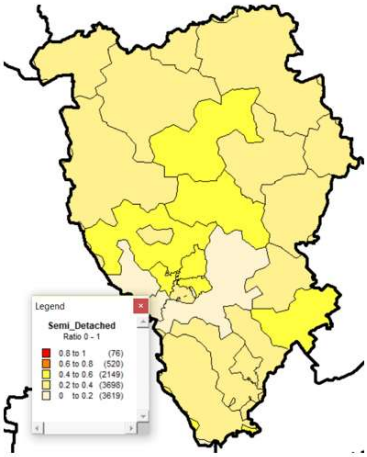
BRAINTREE - Properties by Style and Ownership

Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached.

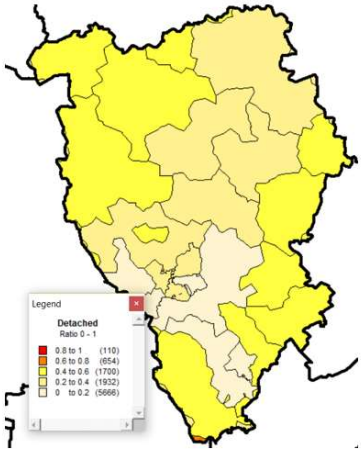
BRAINTREE District - Distribution by House Type



Terraced



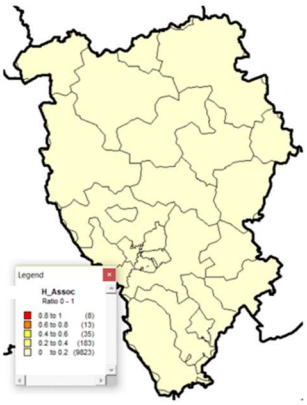
Semi-Detached



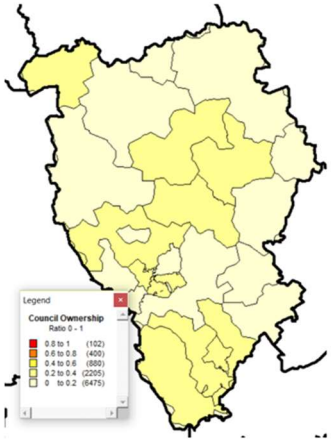
Detached

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

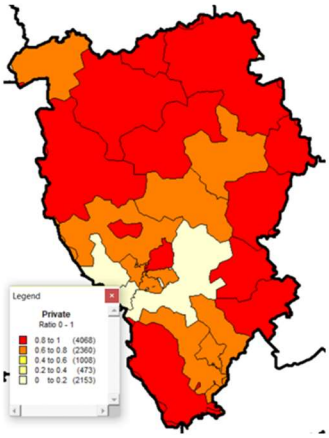
BRAINTREE District - Distribution by Ownership



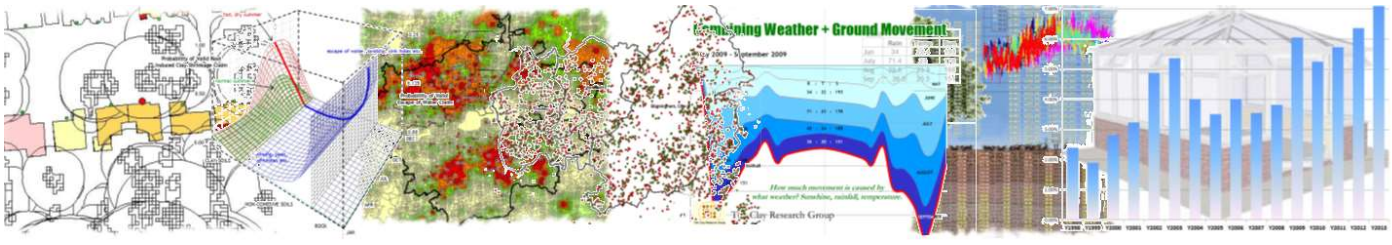
Housing Association



Council Ownership



Private Ownership



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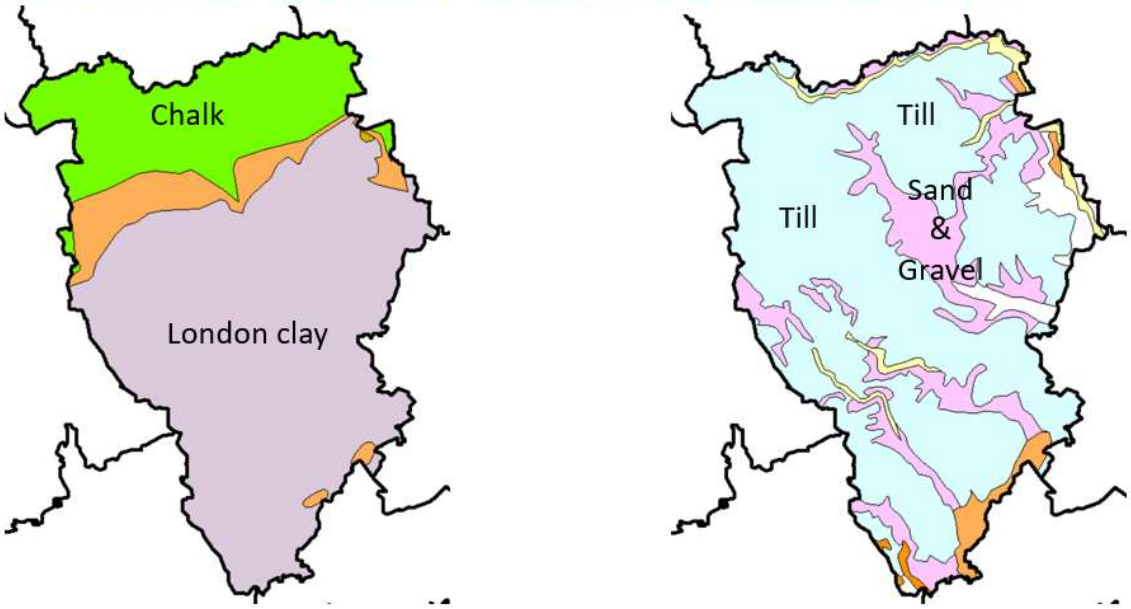
Subsidence Risk Analysis - BRAINTREE

Below, extracts from the British Geological Survey maps showing the solid and drift series. Go to:

http://mapapps.bgs.ac.uk/geologyofbritain/home.html?

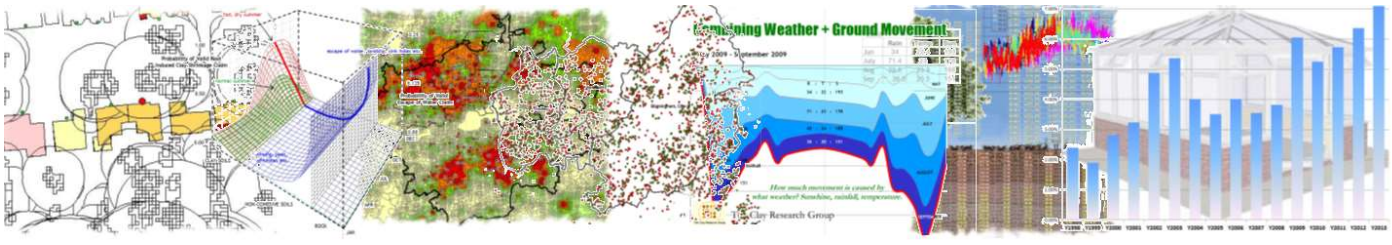
BRAINTREE District - BGS Geology – 1:625,000 scale low resolution mapping



SOLID **DRIFT**

The drift deposits (predominantly till), appear to be relatively shallow given the apparent sensitivity to surge. See page 12 for a seasonal analysis, which reveals that the probability of a claim being due to clay shrinkage in the summer is high.

The above BGS web site also provides access to borehole data providing information on the depth and thickness of the strata.



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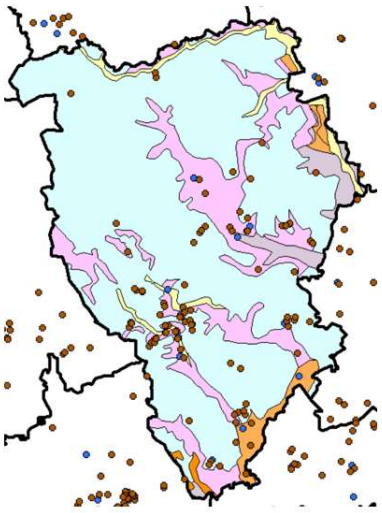
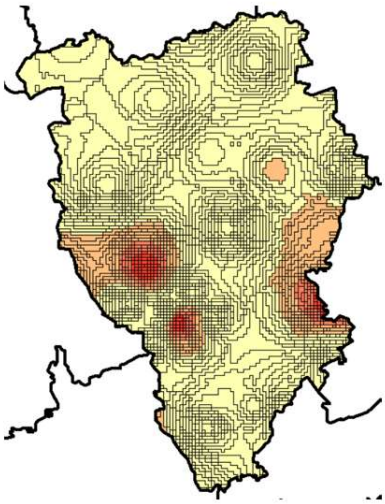
Liability by Season and Geology

Below, determining if there is a link with the underlying geology by making reference to the CRG 250m grid plotting soil by PI.

BRAINTREE District – Claims by Peril Distribution



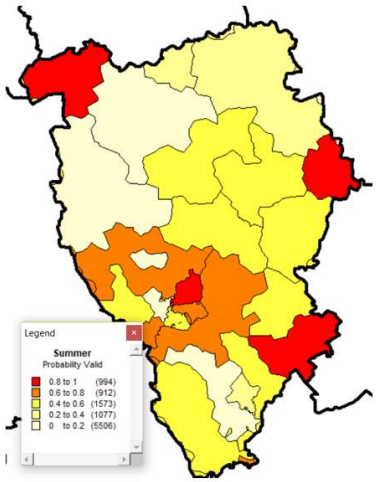
Escape of Water & Clay Shrinkage



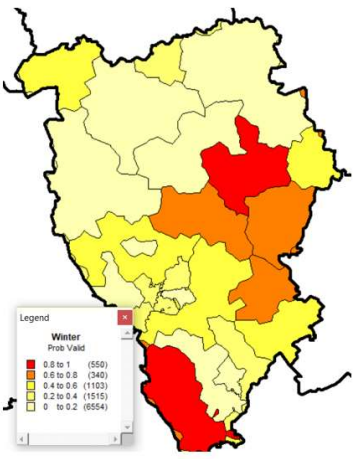
PI Interpolated on 250m CRG grid

Below, the probability of whether a claim is likely to be valid or declined by season.

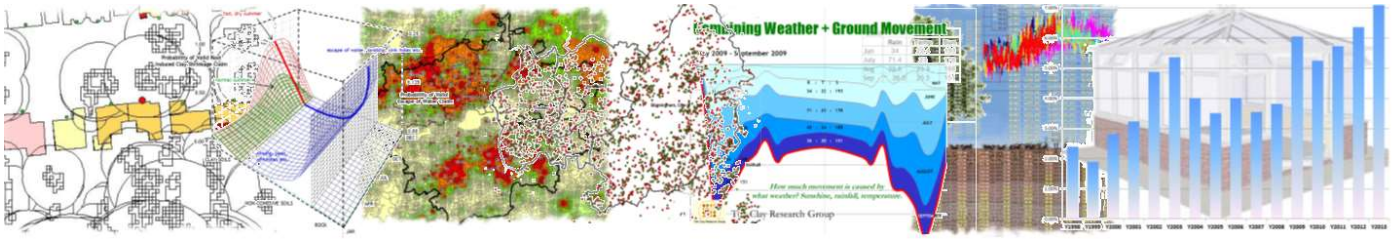
BRAINTREE District



Probability Valid, Summer



Probability Valid, Winter



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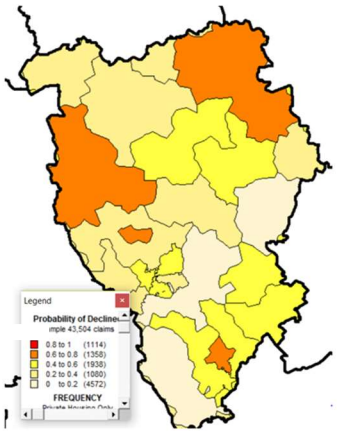
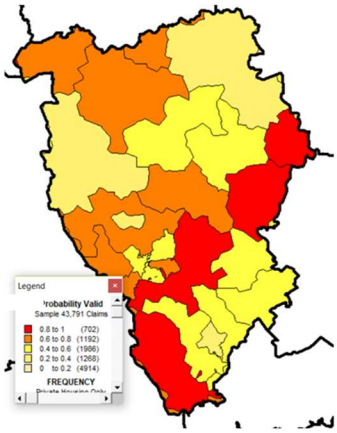
Liability by Sector. Escape of Water and Council Tree Claims Distribution

BRAINTREE District – Liability Distribution



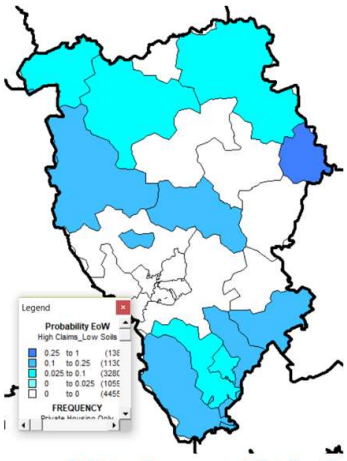
Declinatures



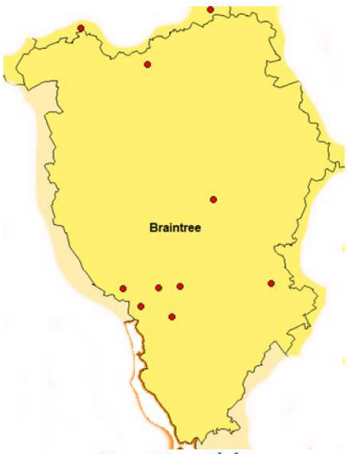
Valid Claims

Above, mapping liability and plotting distribution of valid and declined claims for the sample size shown, not taking into account any seasonal influence. Below left, mapping the frequency of Escape of Water claims from the sample. 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 to determine if there is what is known as a 'hot spot'. The low numbers – and consequentially the absence of a hot spot – appears to reflect the low count of street trees.

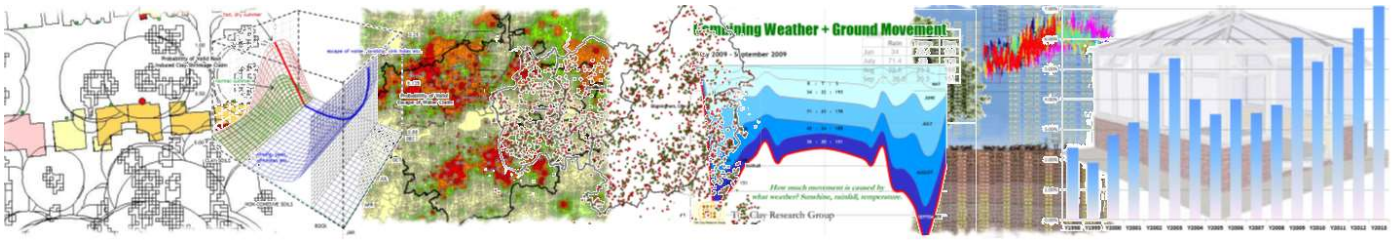
BRAINTREE District – Postcode Distribution



Escape of Water Frequency Distribution



Street Tree Claims



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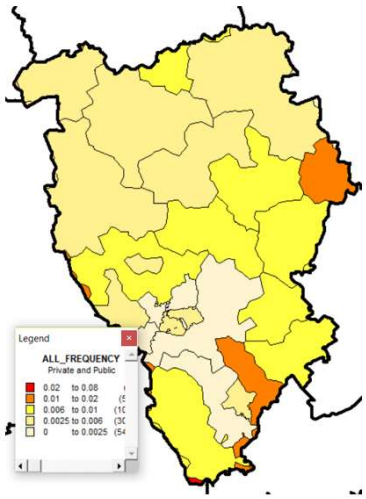
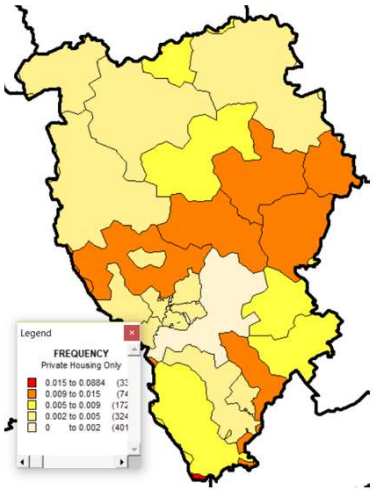
BRAINTREE - Frequencies, Count & Probabilities

BRAINTREE District



Sector Risk - All Housing



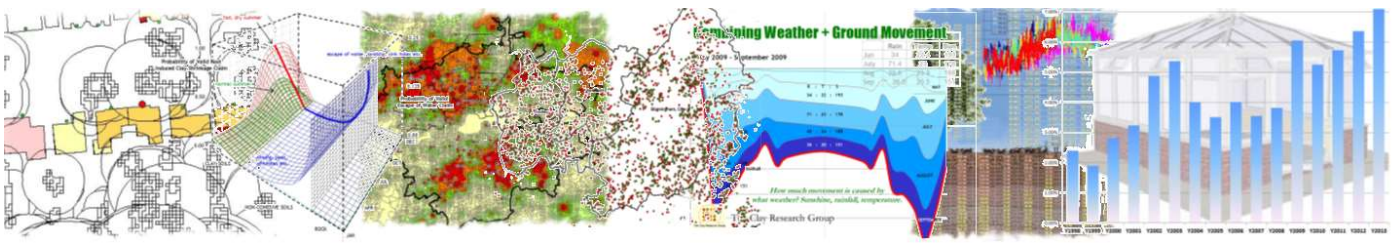
Sector Risk - Private Housing Only

Below, the figures reveal a borough with a variable seasonal risk. The chances of a claim being declined in the summer are just over 20%, and if it is valid, there is a greater than 90% chance (from the sample) of the cause being clay shrinkage. In the winter, the repudiation rate is around 80%, and if it is valid, the chance of a claim being due to clay shrinkage falls to around 6%.

The district illustrates the significant differences between boroughs, dependent on their geology. In this case, where the superficial drift deposits dominate, it gives a valuable clue to (a) their composition and (b) their thickness.

Liability by Season - BRAINTREE District

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Braintree	0.750	0.035	0.215	0.01	0.16	0.83



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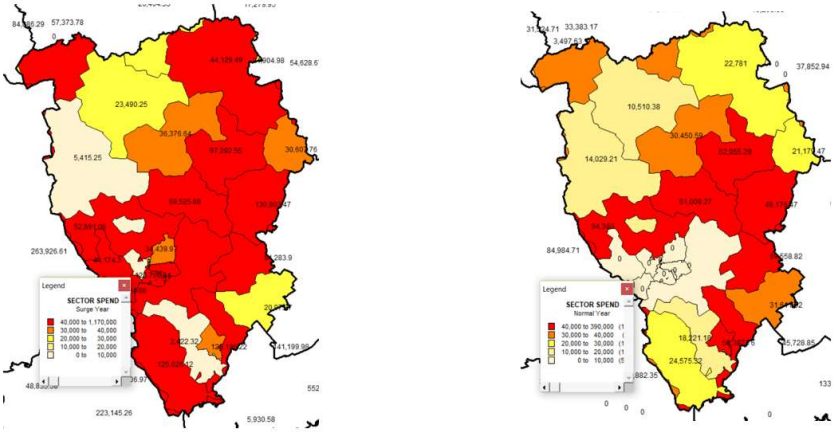
Aggregate Subsidence Claim Spend by Postcode Sector and Household to Derive Risk and Premium in Surge & Normal Years *...continued*

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

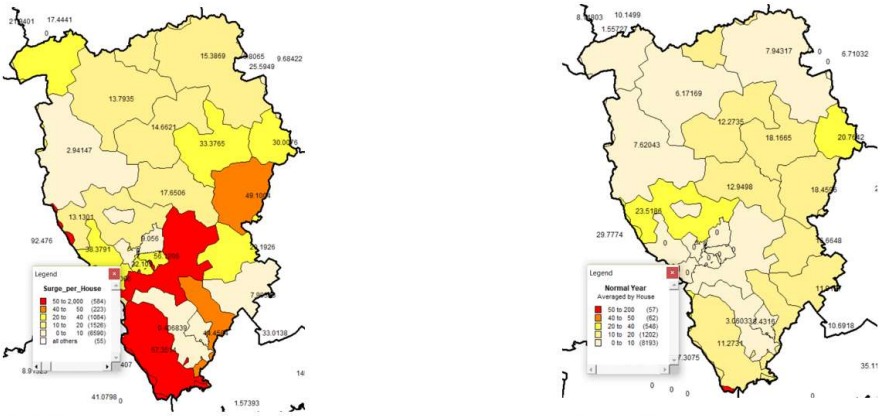
SECTOR COMPARISON – BRAINTREE



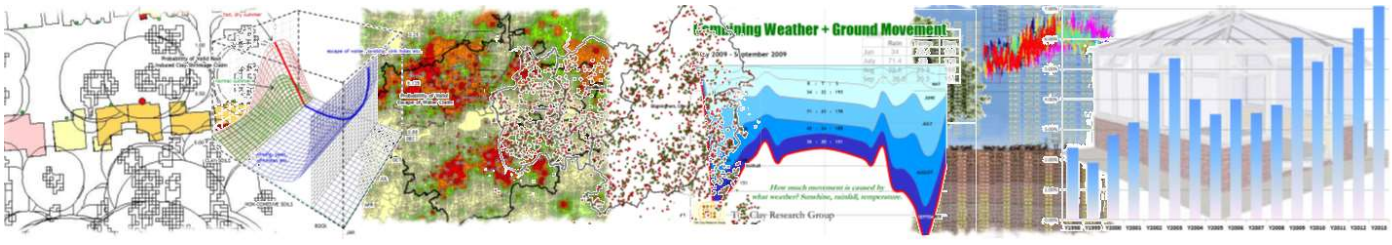
SURGE **NORMAL**

As mentioned in previous editions, not all areas see an increase in cost associated with surge, reflecting the variable geology. It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. Below, sector spend averaged across housing population to derive a cost per house. Figures published by the ABI suggest that the average sum spent on subsidence in normal years is around 4% of total spend.

HOUSEHOLD COMPARISON – BRAINTREE



SURGE **NORMAL**



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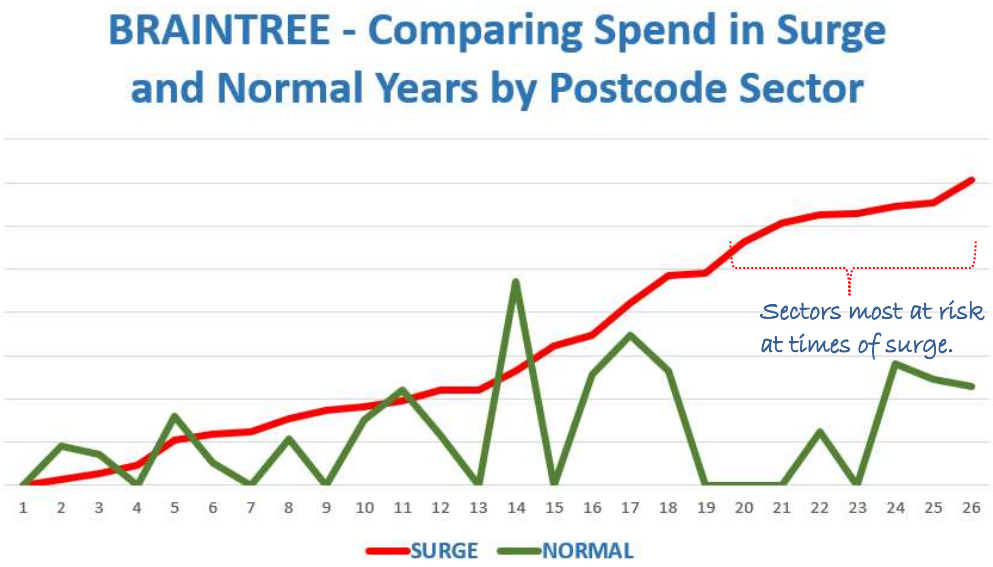

Identifying the variable risk across the district between normal and surge years by postcode sector.