# 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


November 2022
Issue 210

# The Clay Research Group

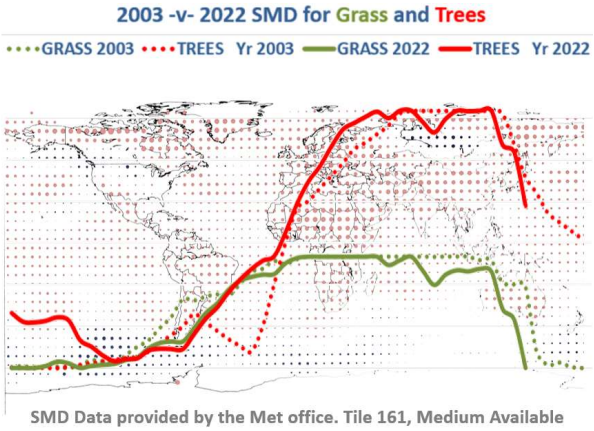
## CONTENTS

Issue 210, November 2022



## Soil Moisture Deficit

Below, SMD values provided by the Met Office from the Heathrow weather station for both grass and tree cover.




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

The 2022 profiles follow the 2003 event year profiles. Claim numbers at the moment appear to be close to those of 2018.

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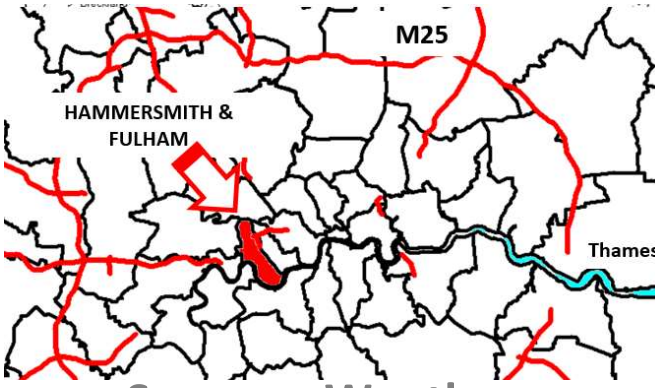
## District and Sector Risk

Hammersmith and Fulham is the topic of the District Risk series in this month's edition and increased resolution is provided with examples at postcode sector level.




## Summer Weather

The Met Office report the summer months (June, July and August) were warmer by 1.1deg, had far less rainfall (62%) and longer hours of sunshine (115%) than the 1991 – 2020 average. Download their report from the CRG website by selecting the Monthly Newsletter tab and then 'Met Office Data – Summer Averages'.

## TDAG Events Diary

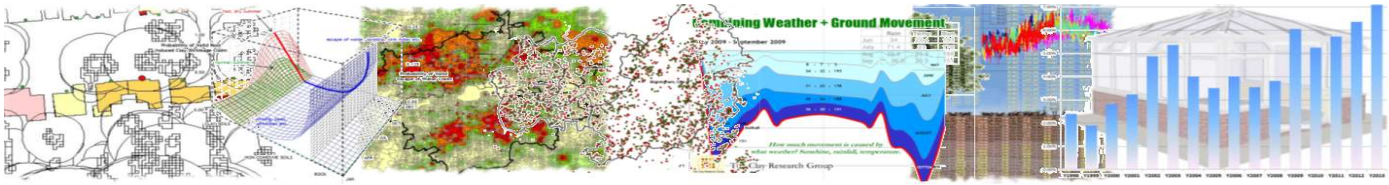
Two TDAG meetings scheduled in 2022. The first on the 22nd November from 2-4pm delivering updates on projects currently underway.

The last TDAG seminar in 2022 takes place on the 7th December on the important topic of soil – recognising its value and caring for it.

Links to register are available on the TDAG web site at: https://www.tdag.org.uk/

## 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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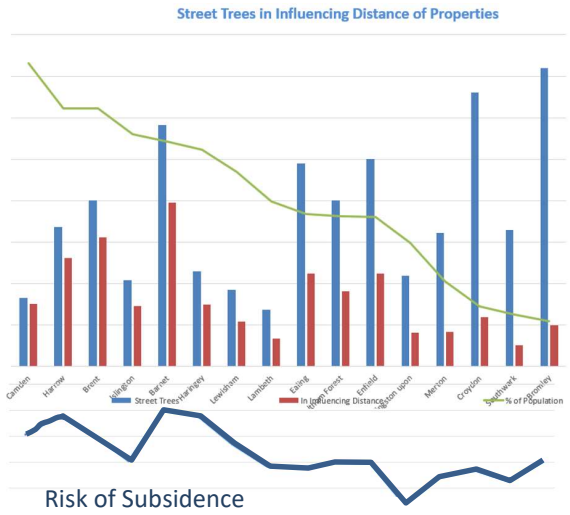
## Trees, Houses and Root Overlap

Borough by borough, which presents the highest risk in terms of root induced clay shrinkage? Clearly not something that can be calculated with any degree of accuracy, but an approximate estimate based on a root zone of 1.2 x tree height has been used as a starting point. For this preliminary exercise no account has been taken of species - this is a significant omission but something that can be corrected as more boroughs publish relevant data.




Left, a chart plotting the count of street trees by borough (blue) and those modelled as being within influencing distance (red). A serious omission is the degree of modelled overlap. Is it 5%, or 100%? Once the species has been identified, the root zone can perhaps be estimated with greater accuracy, although it is accepted that the term 'accuracy' isn't appropriate.

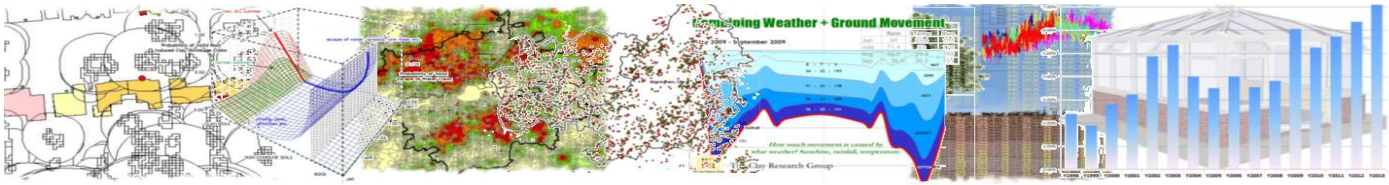
The blue line beneath the bar graph ranks the boroughs by risk in terms of claims experience.

Again, there are problems refining the risk model without identifying tree species, age and type of property, but this information is available, either from the boroughs (tree species) or insurer (style and age of property).

From an initial appraisal and bearing in mind the above reservations, there appears to be a large difference between the boroughs. For example, Barnet is rated high risk and has a high count of trees and a high number with root zones that may extend beneath houses. Southwark is rated medium risk with far fewer trees and far fewer estimated to be within influencing distance.

Account has to be taken that the risk model uses frequency data. It is quite possible that a borough with few trees can be high risk if there is a low-density housing population.

The project doesn't seek to identify individual trees for removal or retention, but to improve our understanding of the various factors going forward. Is there a way to reduce the conflict between councils and insurers that benefits the environment and reduces cost for all parties?



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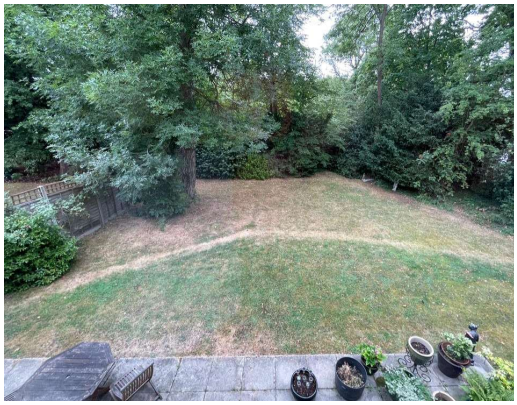
## Intervention Quiz

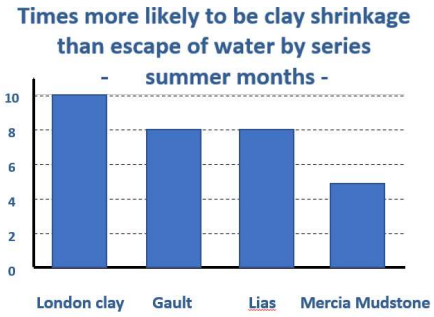
Thanks to Allan Tew of Innovation Group for sending the pictures below. Innovation holds the patent for the Intervention Technique – a method of triggering the production of Abscisic Acid in trees to reduce their water uptake whilst leaving them in good health.

They have been using the technique for the last 5 years to resolve claims where root induced clay shrinkage has been the cause of damage with the benefit that the property has been stabilised and the tree retained.

The quiz is, can you spot the location of the trench?



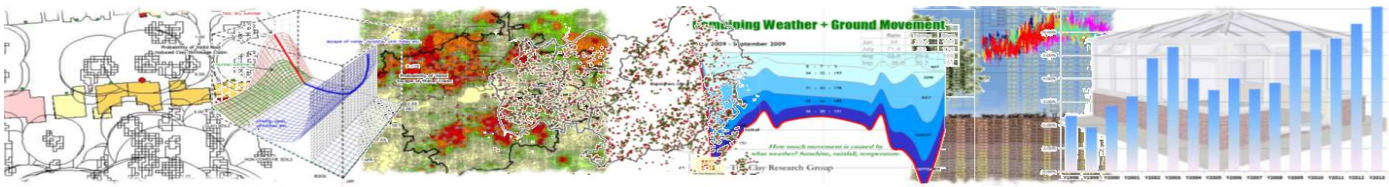
## Summer Risk by Soil Type - clay




The probability table on page 10 is derived from claims experience and provides an idea of the likelihood of a subsidence claim being valid and if it is, the most likely cause (clay shrinkage or escape of water) by season.

Left, a sample of the most likely cause by soil type in the summer months. A claim notified on London clay might be 10 times more likely to have been caused by root induced clay shrinkage than an escape of water.

Gault and Lias follow with a rating of 8. Mercia mudstone has a rating of 4.2 from the sample analysed. Needless to say, the values change by year and climate at the time of making the assessment.



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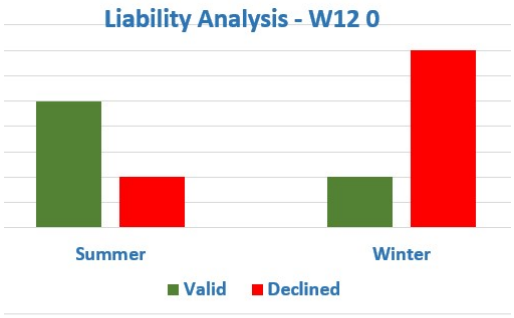
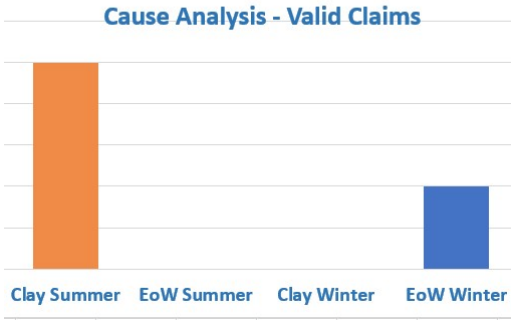
## Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability
## Sample Sector Level Analysis




**W12 0** – from the sample we hold, 70% of subsidence claims were accepted as valid in the summer and around 20% in the winter.

It is rated 6.6 times the UK average risk at postcode sector level and 0.3 on a normalised scale.

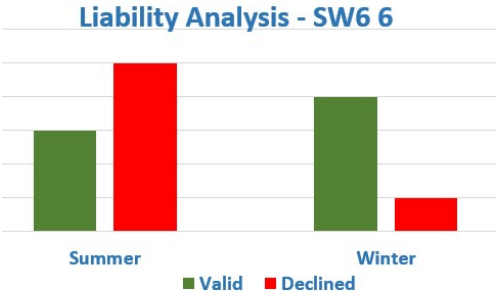
The BGS maps on page 7 show a solid geology of outcropping London clay to the north of the borough and drift deposits of River Terrace to the south. W12 0 is situated on London clay.

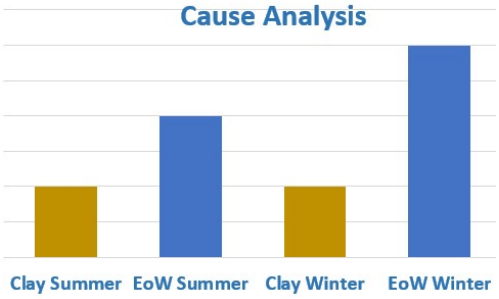
As might be expected from the geology, clay shrinkage is the dominant cause of subsidence in the sector.

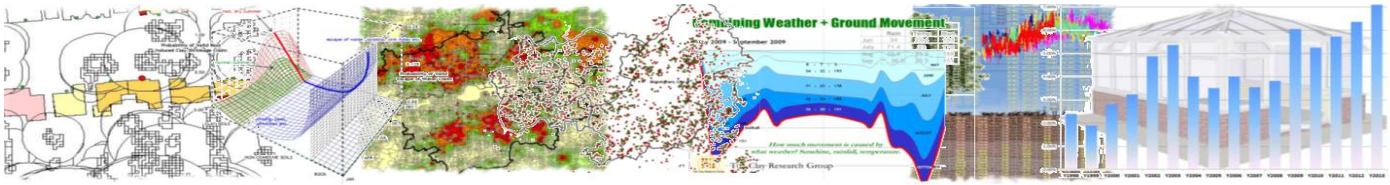
**SW6 6 –** Situated to the south west of the district with predominantly escape of water claims in the summer and winter, reflecting the influence of drift deposits of River Terrace – sandy gravels with some clay content.

Site investigations undertaken confirm the presence of River Terrace deposits.

The sector is rated 4.5 times the risk of the national average with a normalised value of 0.21.



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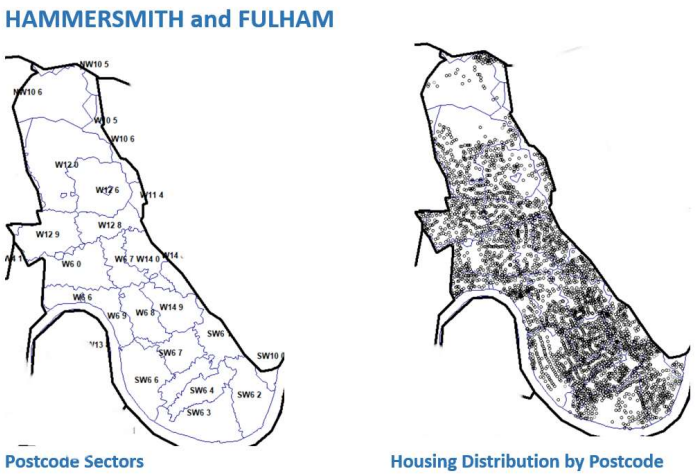
## Subsidence Risk Analysis – HAMMERSMITH AND FULHAM

Hammersmith and Fulham is situated on the north bank of the Thames and occupies an area of 16.39km$^2$ with a population of around 185,150.




*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.*

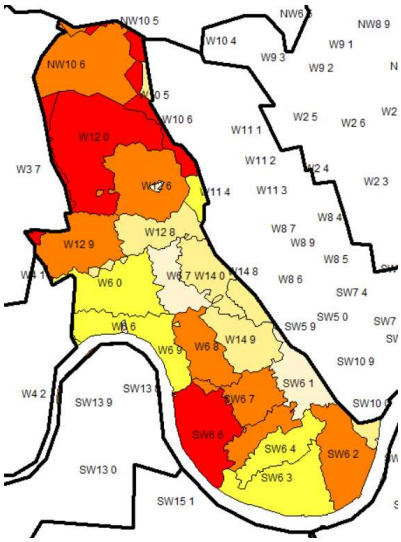
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

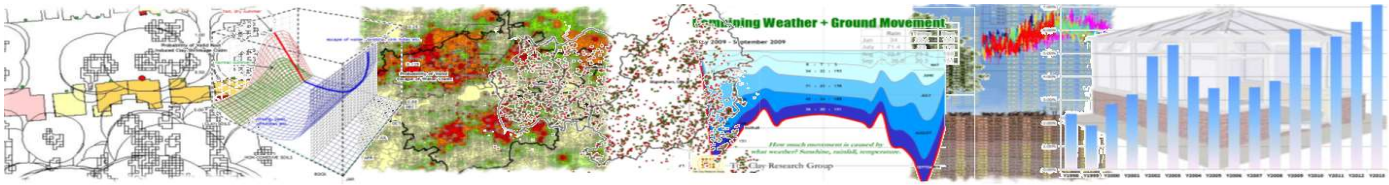
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Hammersmith and Fulham is rated 65th out of 413 districts in the UK from the sample analysed and is around 1.8x the risk of the UK average, or 0.46 on a normalised scale.

There is an increased risk to the north of the borough as can be seen from the sector map, which broadly corresponds with outcropping London clay.




*Hammersmith and Fulham district is rated around 1.8 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.*



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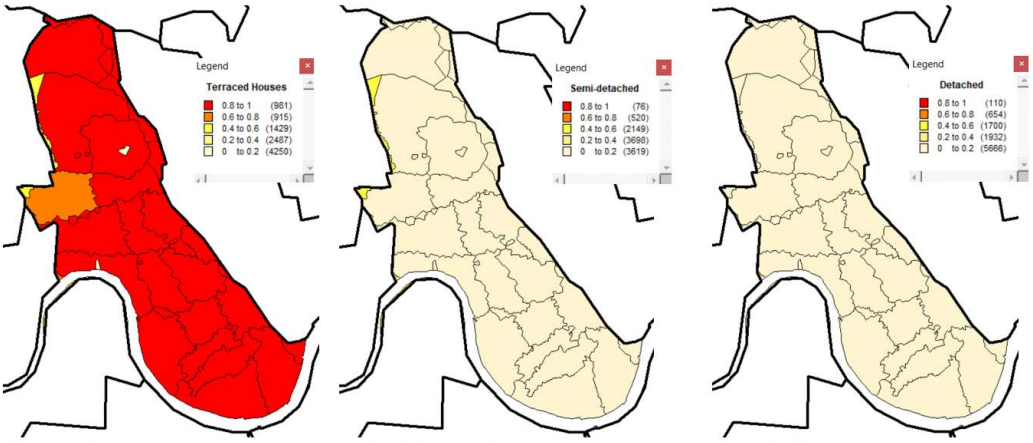
## HAMMERSMITH AND FULHAM - Properties by Style and Ownership

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.

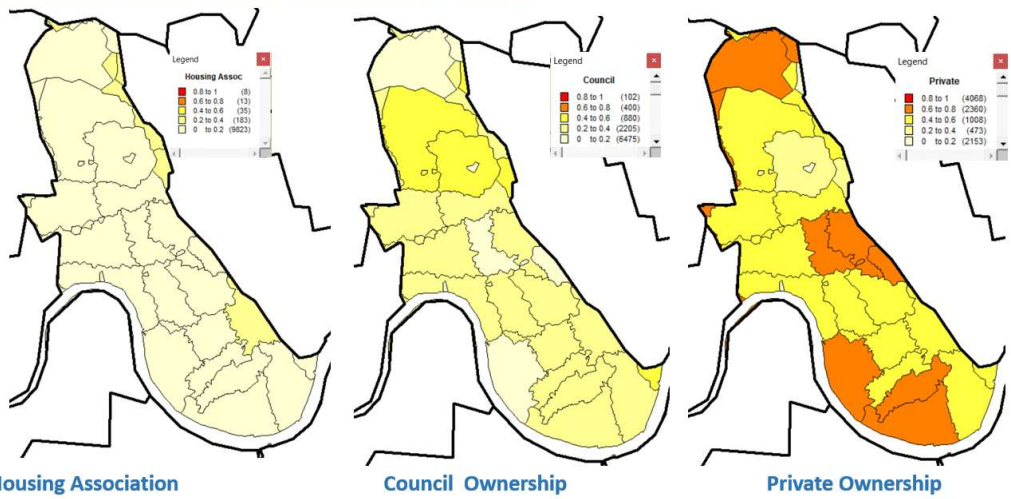
**HAMMERSMITH and FULHAM - Distribution by House Type**



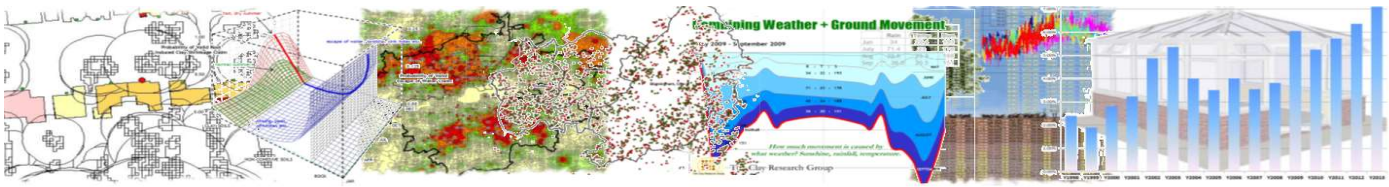

Terraced Semi-Detached Detached

Distribution by ownership is shown below. Privately owned, terraced properties are the dominant class and are spread across the borough. See page 10 for distribution of risk by ownership.

**HAMMERSMITH and FULHAM - Distribution by Ownership**




Housing Association Council Ownership Private Ownership



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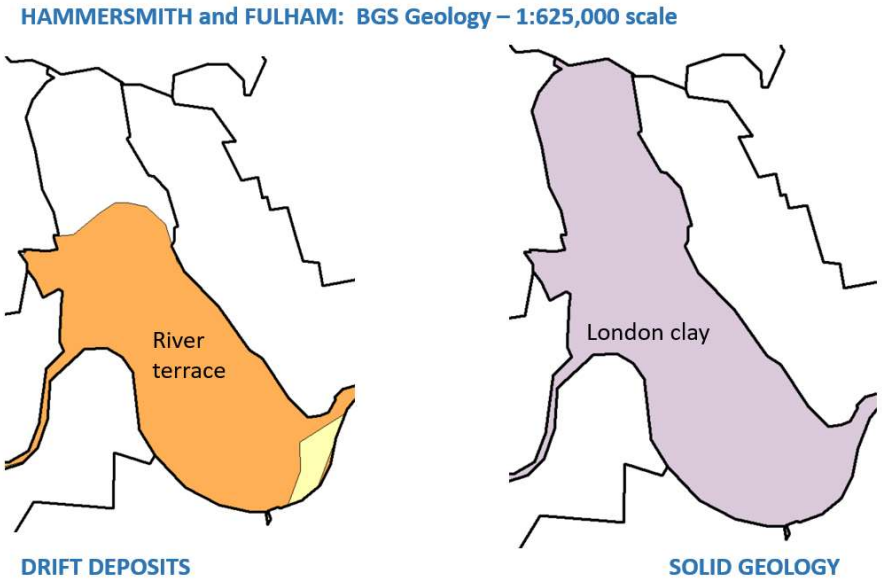
## Subsidence Risk Analysis – HAMMERSMITH AND FULHAM

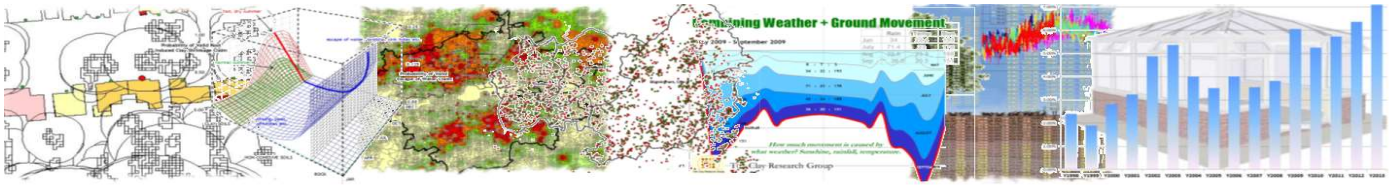
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample we hold which reveals that, at district level, there is a greater than 60% probability of a claim being valid in the summer and of the valid claims, there is a high probability (around 60% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid remains at around 60% - and if valid, there is an 60% probability the cause will be due to an escape of water. Maps at the foot of the following page plot the seasonal distribution.




*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 of valid claims in the summer and escape of water is the dominant peril in the winter months.*



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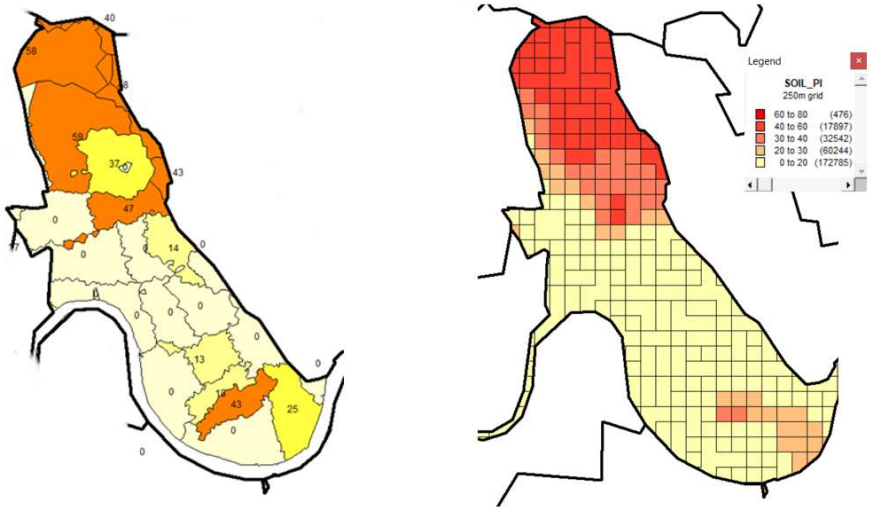
## Liability by Geology and Season

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. Claim investigations reveal a small zone of clay to the south of the borough which we assume relates to a shallow depth of drift deposits in the area.

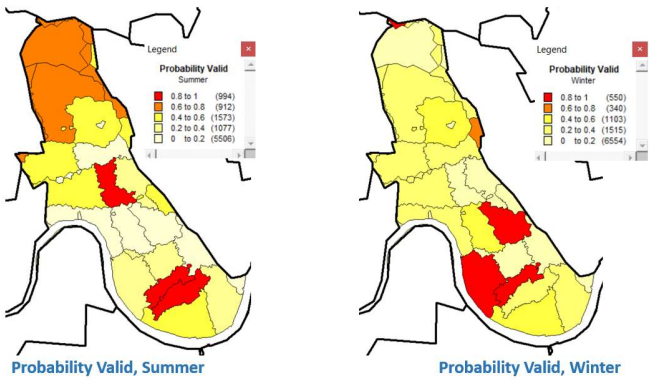
**HAMMERSMITH and FULHAM – Soil Plasticity Index**




**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.

**HAMMERSMITH and FULHAM – by season**

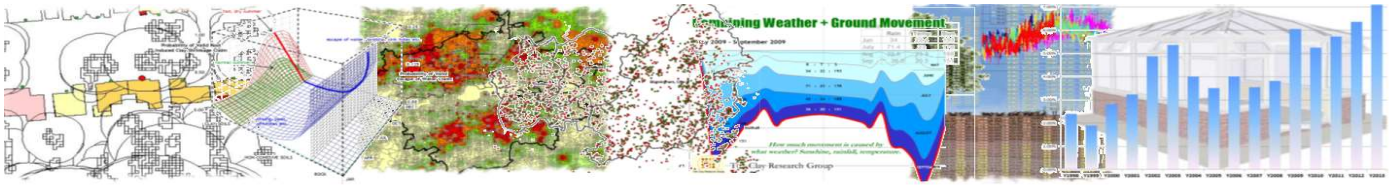



**Probability Valid, Summer** **Probability Valid, Winter**

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

Combining the risk maps by season combined with the table on page 10 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 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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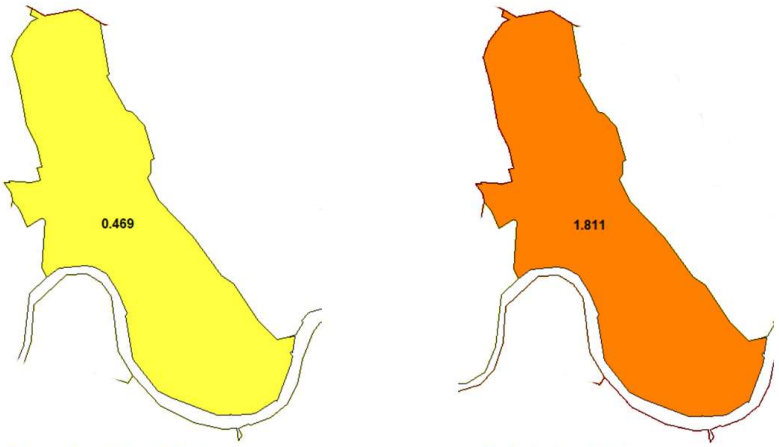
## District Risk -v- UK Average. EoW and Council Tree Risk.

HAMMERSMITH and FULHAM - Subsidence Risk Relative to UK



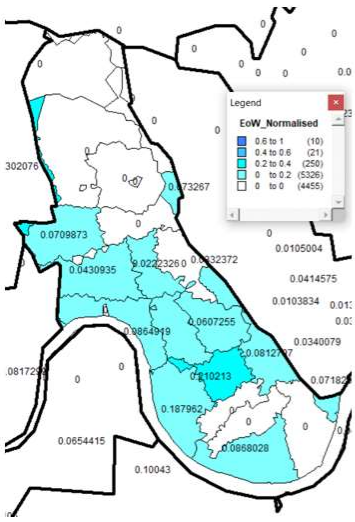

Normalised (0 – 1) Scale

Relative to UK Average

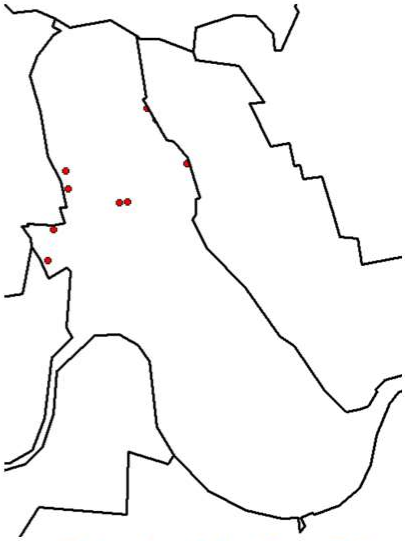
Below, left, mapping the frequency of escape of water claims reflects the presence of non-cohesive soils – River Terrace deposits of alluvium, sands and gravels etc. The absence of shading can indicate a low frequency rather than the absence of claims.

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 corresponds with the presence of outcropping London clay soil.

HAMMERSMITH and FULHAM

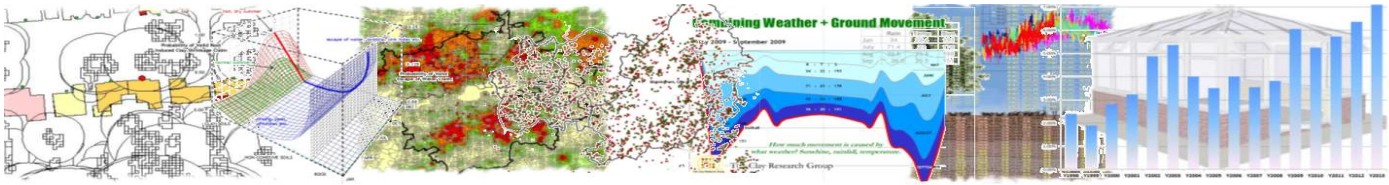



Higher Risk Escape of Water



Claims Involving Council Tree

(2,858 UK claim sample)



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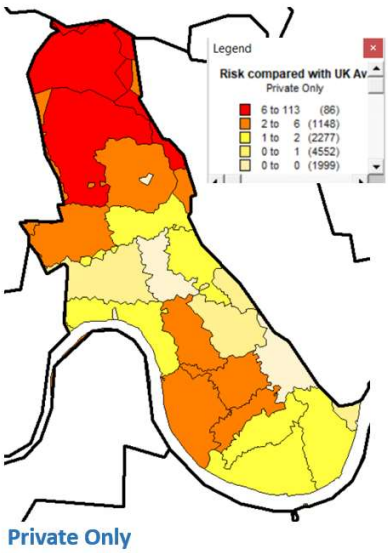
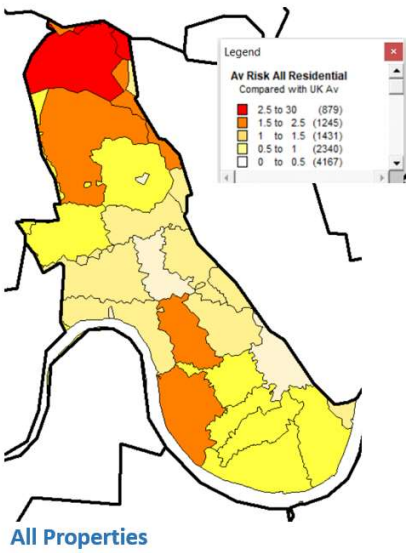
## HAMMERSMITH AND FULHAM - Frequencies & Probabilities

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

**HAMMERSMITH and FULHAM - Sector Risk Compared with UK Average**




Private Only

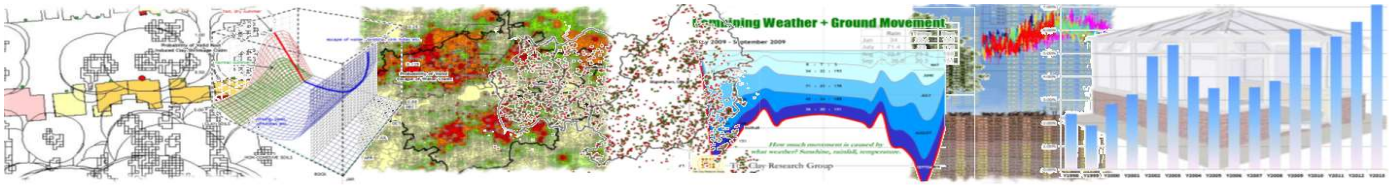



All Properties

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 fairly steady throughout the year.

**Liability by Season - HAMMERSMITH and FULHAM**

| District | valid summer clay | valid summer EoW | Repudiation Rate (summer) | valid winter clay | valid winter EoW | Repudiation Rate (winter) |
|---|---|---|---|---|---|---|
| Hammersmith and Fulham | 0.353 | 0.265 | 0.382 | 0.27 | 0.36 | 0.37 |



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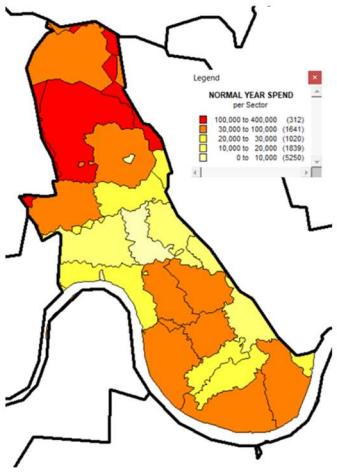
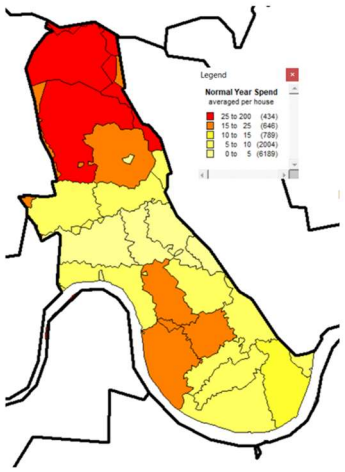
## Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 – HAMMERSMITH and FULHAM**



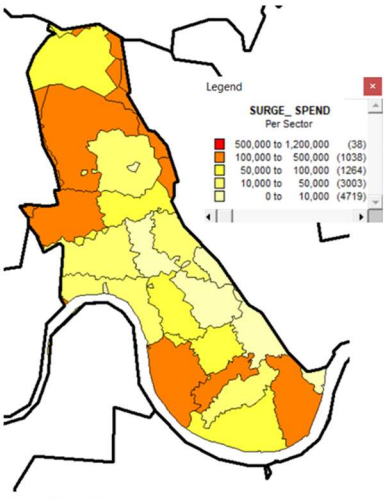

Spend by Sector



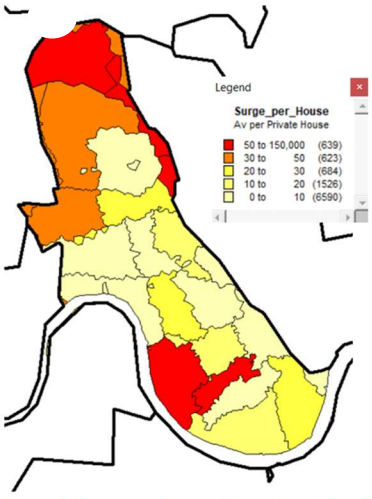

Spend Averaged over Housing Population

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.

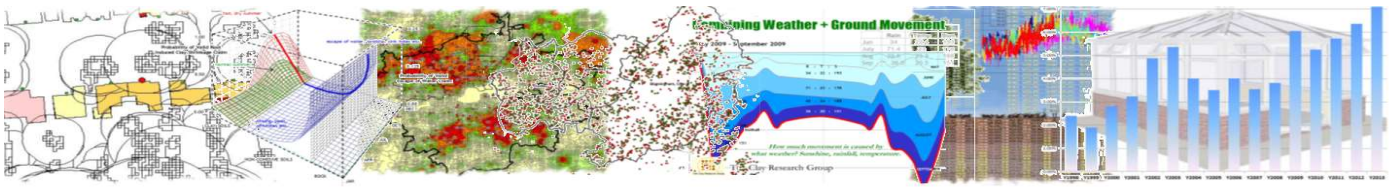
**SPEND in SURGE – HAMMERSMITH and FULHAM**



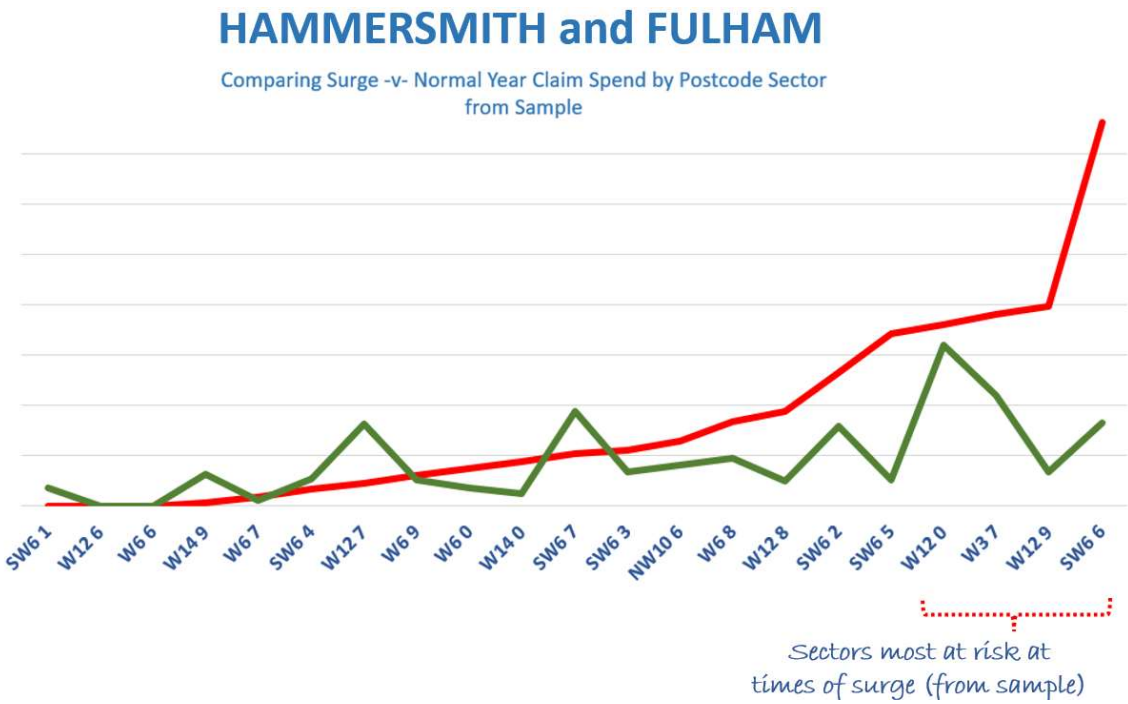

Spend by Sector




Spend Averaged over Housing Population



# The Clay Research Group




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.