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

July 2023
Issue 218

The Clay Research Group

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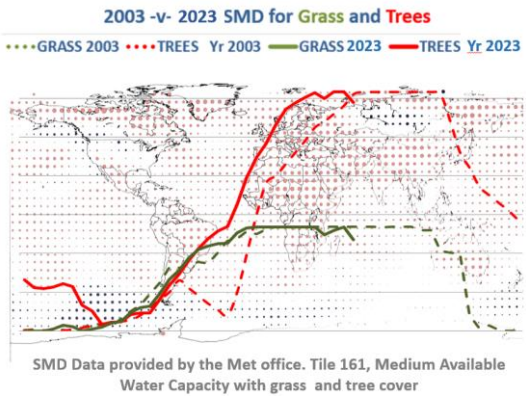
Issue 218, July 2023

Soil Moisture Deficit Update

The Soil Moisture Deficit for both grass and trees are exceeding those of 2003, an event year, with an increase in the risk of subsidence following a warm June.



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

The London Borough of Newham is the topic of the 'Risk by District' series in this month's edition. Newham is situated north of the Thames and has superficial deposits of River Terrace with alluvium bordering the Thames overlying predominantly London clay.

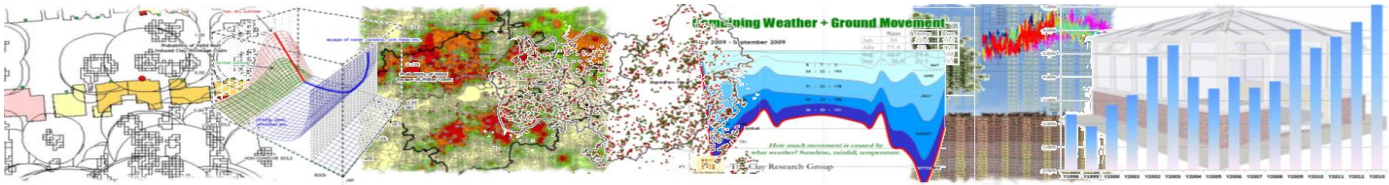
The risk maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

Claim Cost Increase

According to ABI data, in Q1 of 2023 there were 4,296 claims, similar to Q1 of 2019 when there were 4,467 claims but the average costs have jumped significantly by over 80% from £6,283/claim to £11,383/claim.

In contrast during the same period all other claims (excluding subsidence) have increased 35% suggesting there is some unusual inflationary pressure with subsidence.

We have looked in detail at this in the past and we believe it is linked to the increased difficulty in removing trees causing subsidence, particularly third-party trees.



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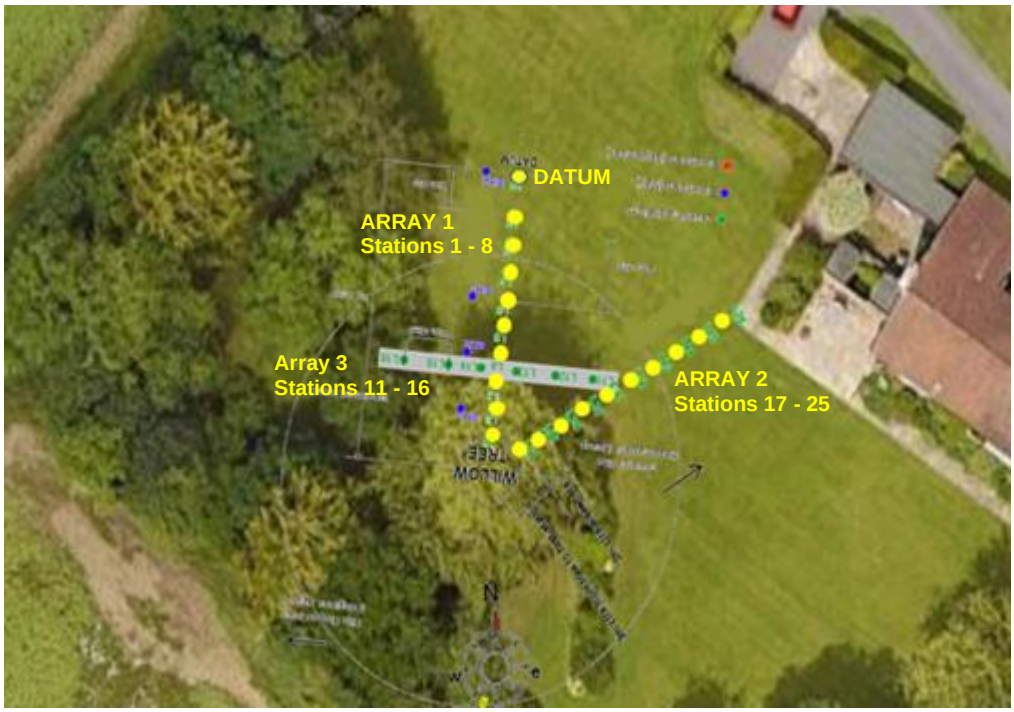
Level Station Layout
Aldenham

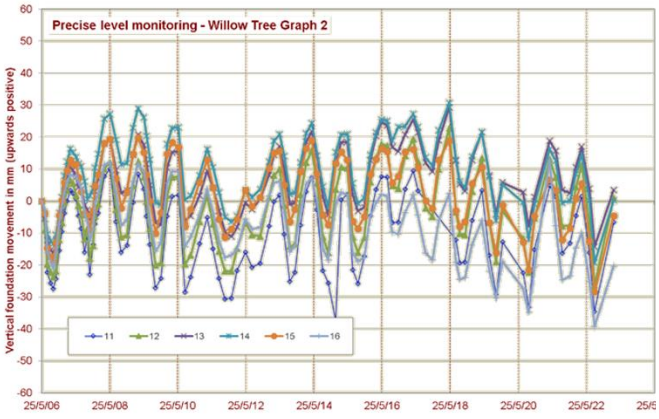
Below, an aerial photograph of the site of the Aldenham willow from Google Earth with the level stations superimposed. Array 1 includes stations 1 – 8 and array 2, stations 17 – 25. Levels were also taken from intermediate stations (11 – 16), crossing Array 1 between stations 3 and 4.

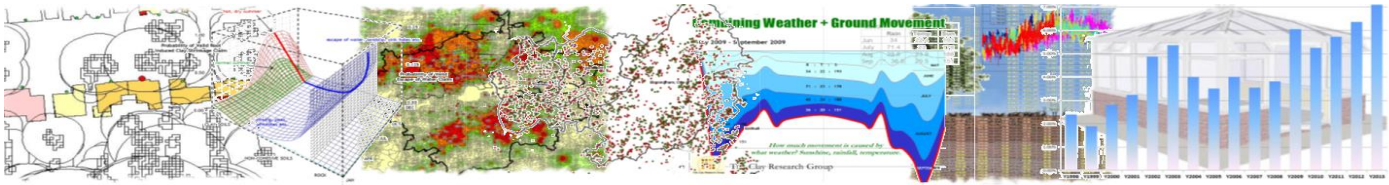


Right, levels from Array 3, Stations 11 – 16, crossing Array 1 at 90 degrees between Stations 3 and 4.

A regular seasonal pattern reveals movement in the range of 30mm of recovery in the summer at Station 14 and peak subsidence of 40mm in the winter at Station 16.

The average seasonal movement is around 40mm.





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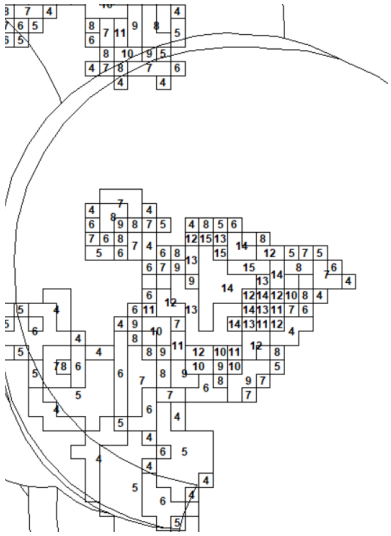
Our first involvement was in 1996 when we commissioned a flight over London to take aerial pictures. Experts were engaged to measure tree heights using stereoscopic imagery. It was a lengthy manual exercise.

In 2006 we had London overflown again, but this time using LiDAR. This allowed accurate plotting of tree location, but also tree heights across the canopy.

An approximation of the root zone was added to try to estimate the risk posed to individual buildings.

Right, tree heights across the crown plotted on a 1m square grid.

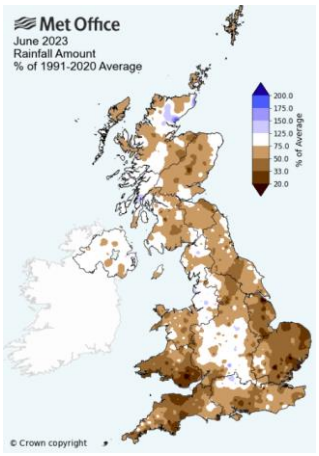


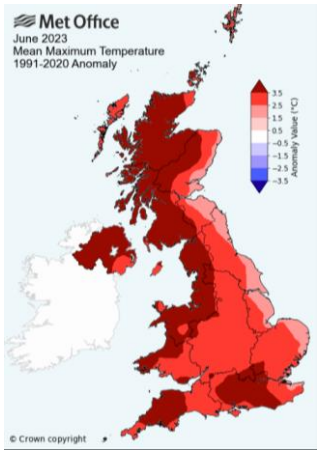
Met Office June 2023 Update.
Anomaly Data, 1991 – 2020

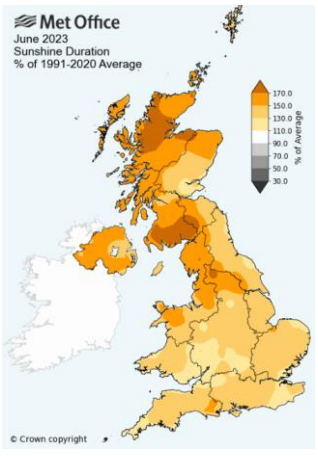
According to the Met Office, June 2023 was the warmest on record for both mean and maximum average, beating the previous years of 1940 and 1976. Below, anomaly data comparing June averages in 1991 – 2020 with June 2023.

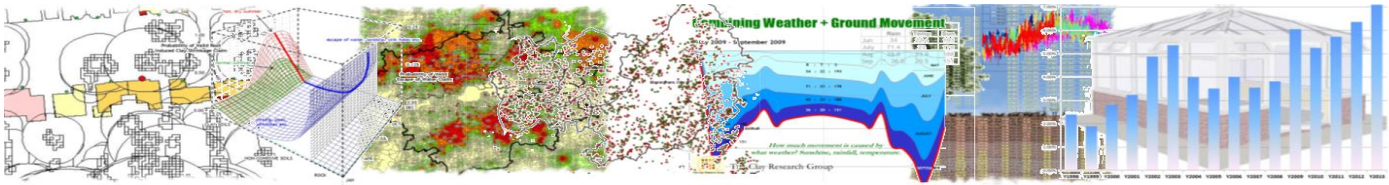
Large areas of the country received reduced rainfall, higher temperatures and longer sunshine duration. The Met Office have confirmed that June 2023 was the warmest on record with temperatures exceeding those of the previous warmest years, 1976 and 1940.

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









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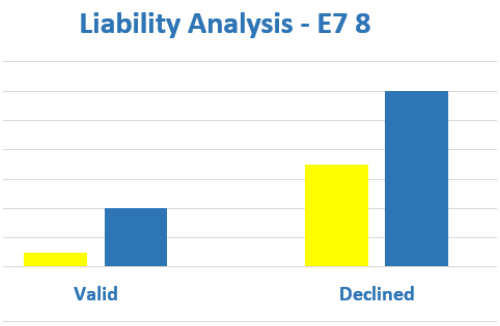
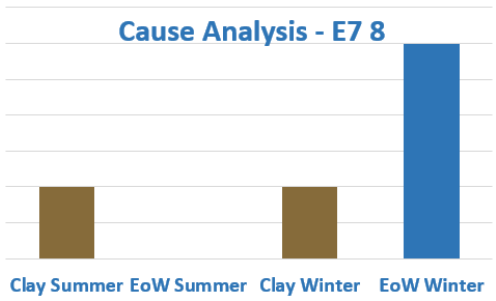
NEWHAM Area Sector Level Sample. Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability





E7 8 – The cause and claim liability data reflect the geology in the sector - River Terrace overlying London clay. From the sample we hold, only 25% of claims notified in the winter were accepted as being valid and predominantly due to escape of water.

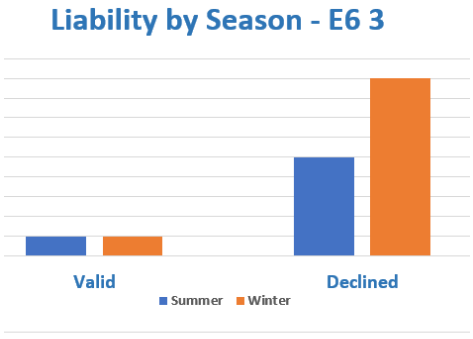
District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
DA2 7	0.25	0.25	0.5	0.13	0.38	0.5

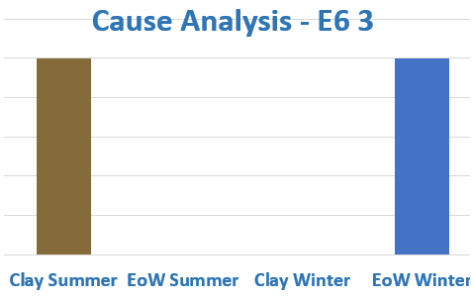
In the summer claim numbers were low. Only 13% were accepted as being valid with the most likely cause being clay shrinkage.

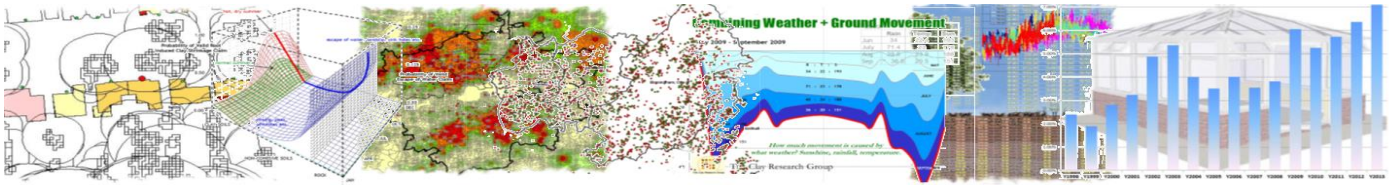
E6 3 – As above, and again reflecting the geology, escape of water is the dominant cause in the winter and clay shrinkage in the summer.

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
DA1 2	0.00	0.80	0.2	0.14	0.28	0.57

There is a higher-than-average rate of declinatures from the sample held for some undetermined reason.







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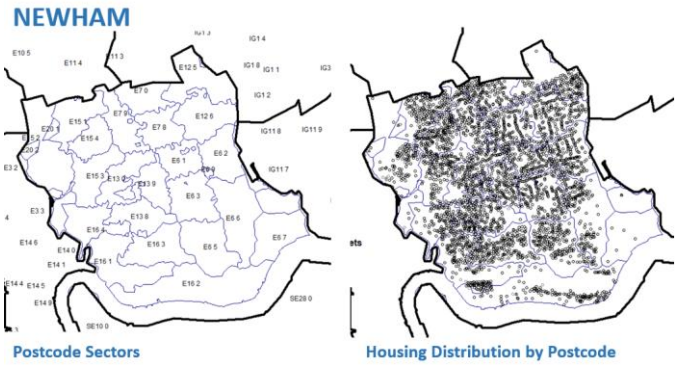
Subsidence Risk Analysis – NEWHAM

Newham is a London borough occupying an area of 36.22km^2 with a population of around 380,000.



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.

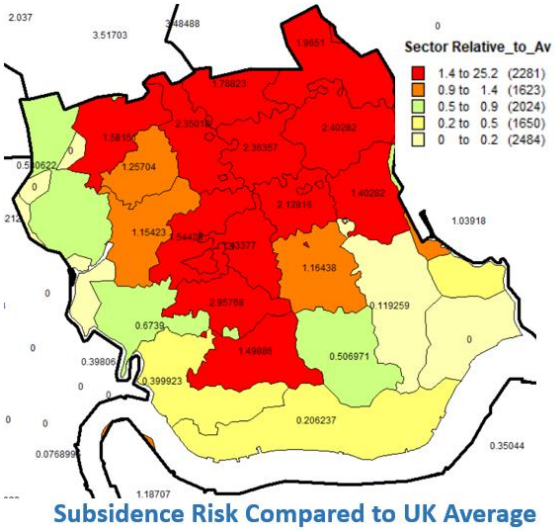
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

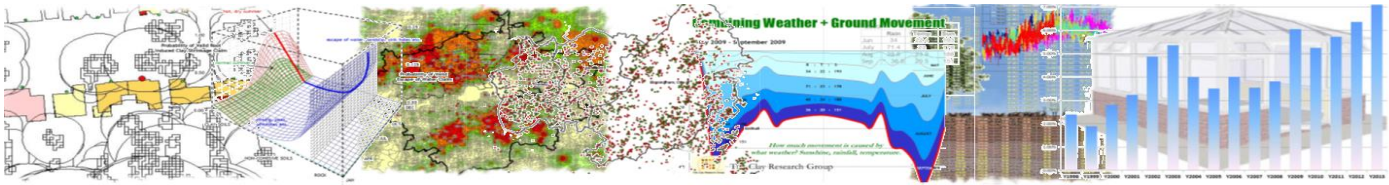
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Newham is rated 128th out of 413 districts in the UK from the sample analysed and is around 1.167x the risk of the UK average, or 0.302 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 predominantly London clay.



Newham district is rated around 1.167 times the UK average risk for domestic subsidence claims from the sample analysed. Above, normalised risk by sector.



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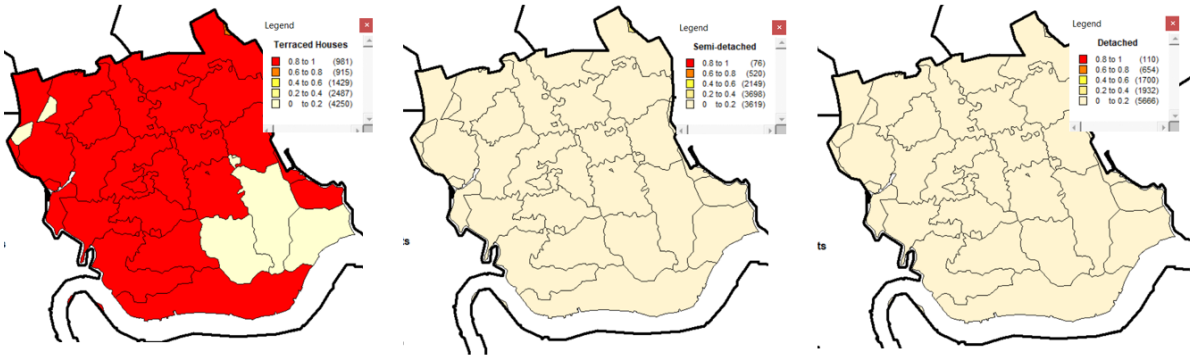
NEWHAM - Properties by Style and Ownership

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.

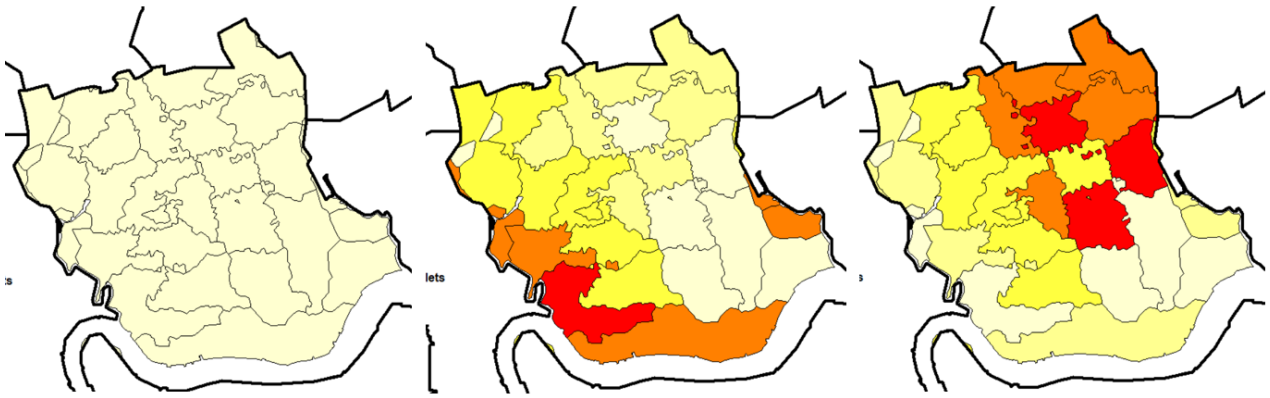
NEWHAM - Distribution by House Type



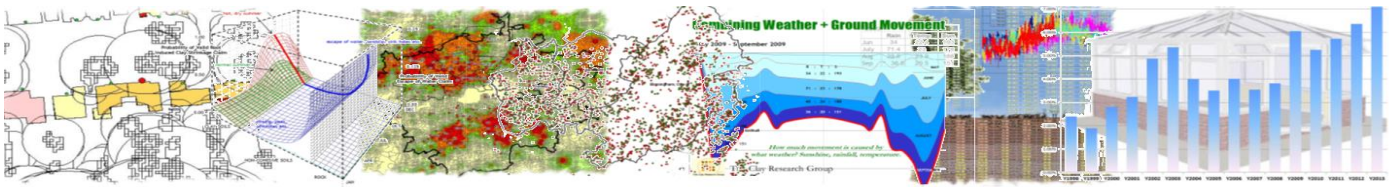
Terraced **Semi-Detached** **Detached**

Distribution by ownership is shown below. Terraced properties are the dominant class with private ownership increasing to the south of the borough. See page 10 for distribution of risk by ownership.

NEWHAM - Distribution by Ownership



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



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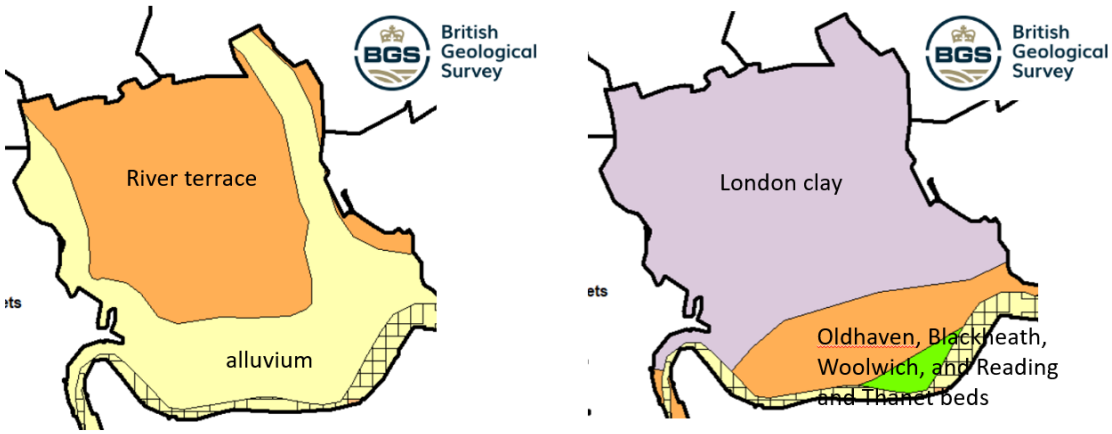
Subsidence Risk Analysis – NEWHAM

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 which reveals that, at district level, there is a slightly higher than 50% probability of a claim being valid in the summer and of the valid claims, there is around a 65% chance that the damage will have been caused by an escape of water – leaking drains etc., with clay shrinkage accounting for the balance. In the winter the likelihood of a claim being valid is higher at around 30% - and if valid, there is a higher than 70% probability the cause will be due to an escape of water. This reflects the geology – alluvium and outcropping chalk.

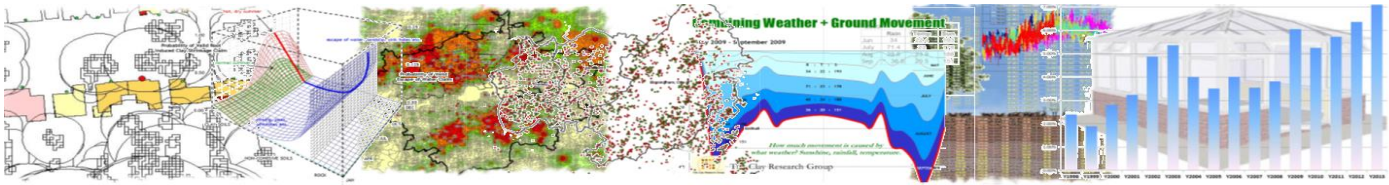
Maps at the foot of the following page plot the seasonal distribution.

NEWHAM : BGS Geology – 1:625,000 scale



DRIFT DEPOSITS **SOLID GEOLOGY**

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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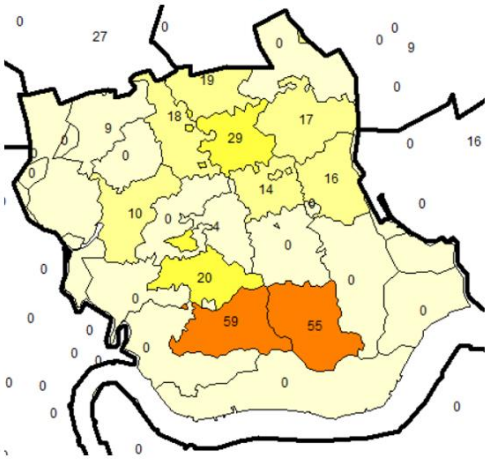
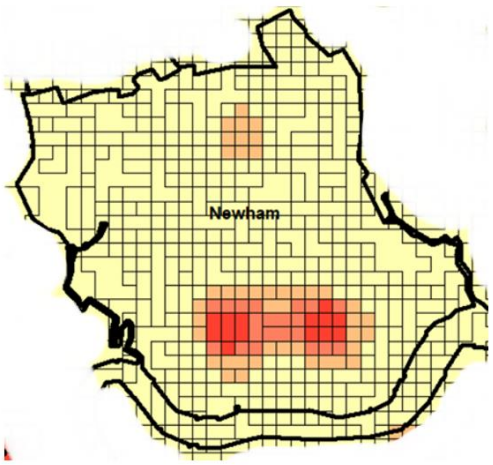
Liability by Geology and Season

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.

NEWHAM – Soil Plasticity Index



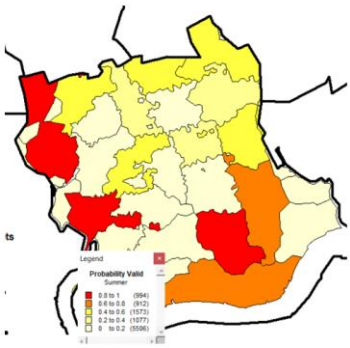
Soil PI Averaged by Sector



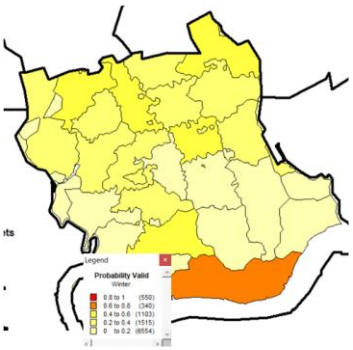
PI Interpolated on 250m CRG grid

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.

NEWHAM – by season



Probability Valid, Summer

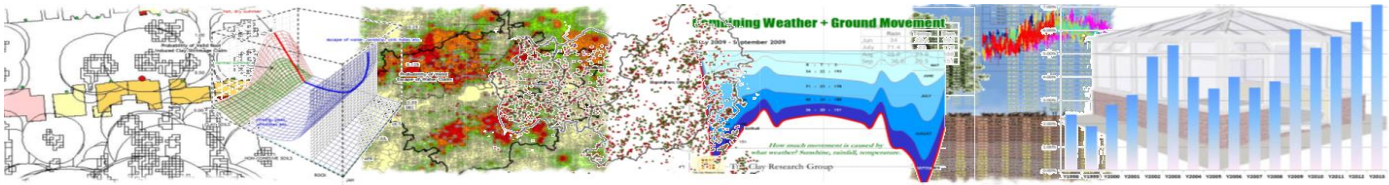


Probability Valid, Winter

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

Combining the risk maps by season and reviewing the table on page 10 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.

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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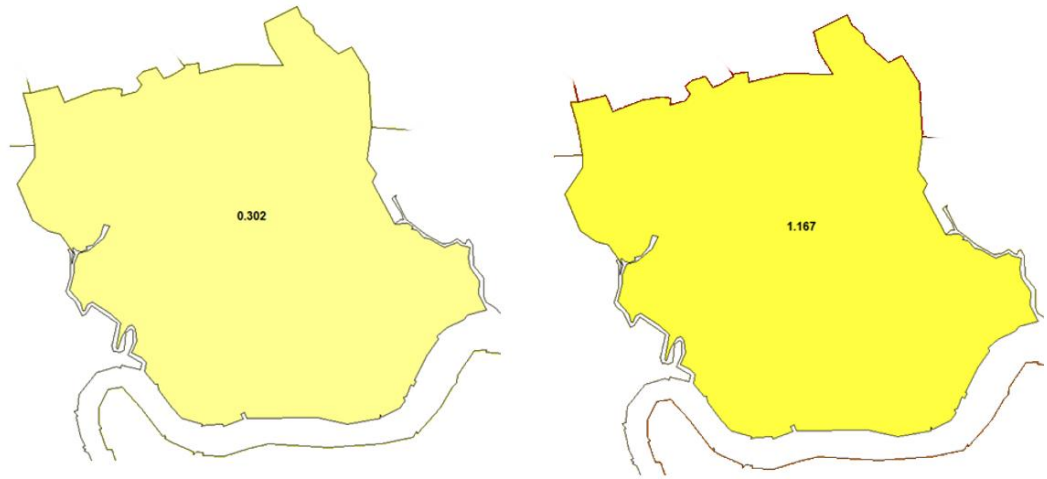
District Risk -v- UK Average. EoW and Council Tree Risk.

NEWHAM - Subsidence Risk Relative to UK

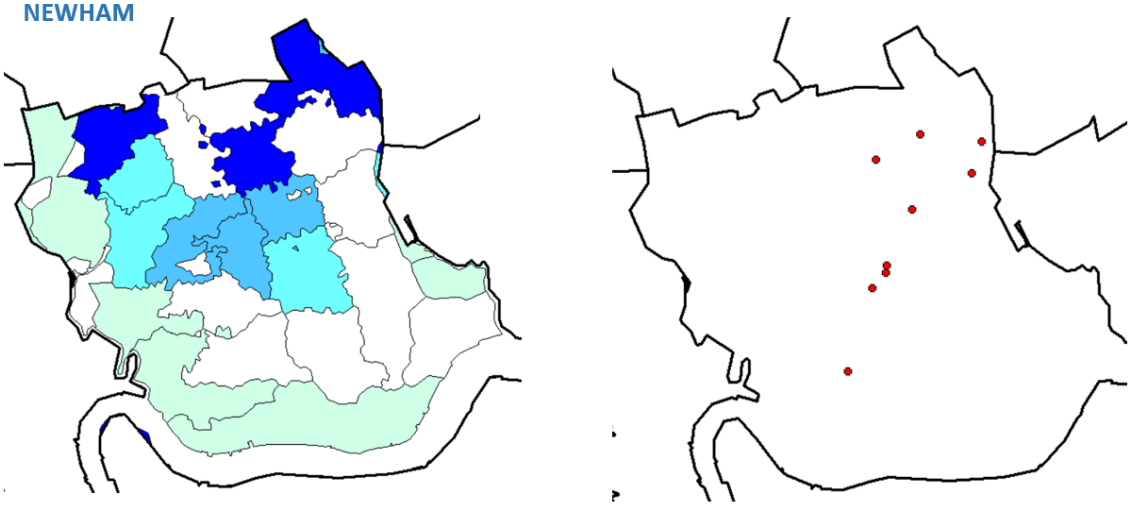


Normalised (0 – 1) Scale **Relative to UK Average**

Below, left, mapping the frequency of escape of water claims confirms the presence of non-cohesive soils bordering the Thames - deposits of River Terrace and alluvium, sands and gravels etc. As we would expect, the 50,000 scale BGS map provides a more detailed picture. The CRG 1:250 grid reflects claims experience.

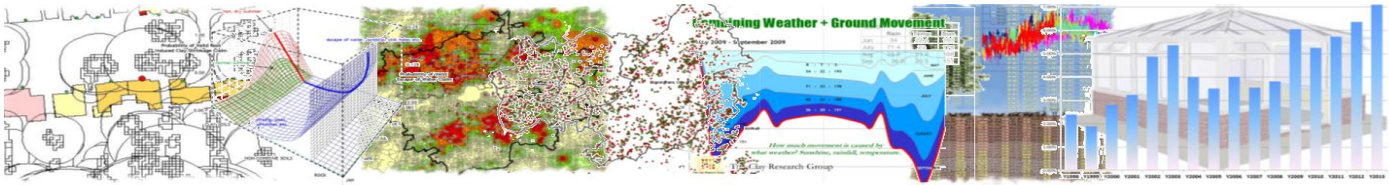
Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. Although the superficial geology is largely non-cohesive, claims suggest shallow deposits in these locations.

NEWHAM



Higher Risk Escape of Water **Claims Involving Council Tree**

(2,858 UK claim sample)



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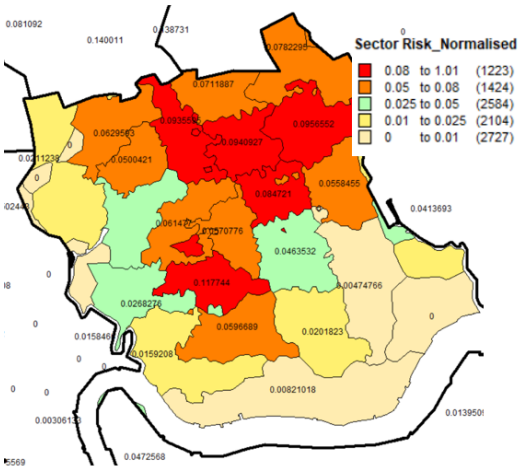
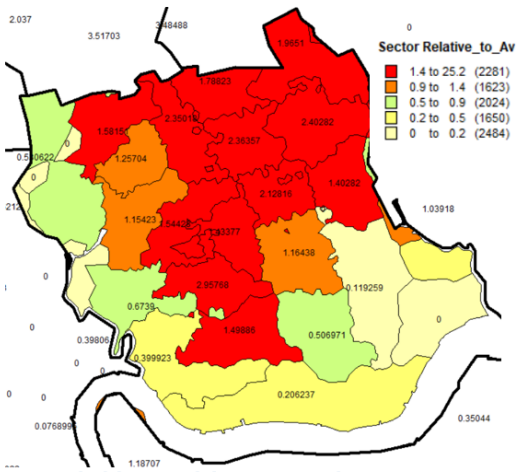
NEWHAM - Frequencies & Probabilities

Below, mapping the total housing stock by ownership. Claims frequency including council and housing association properties delivers a misleading value of risk as they tend to self-insure.

Normalised Risk by Sector – NEWHAM



Normalised Subsidence Risk – scale 0 – 1



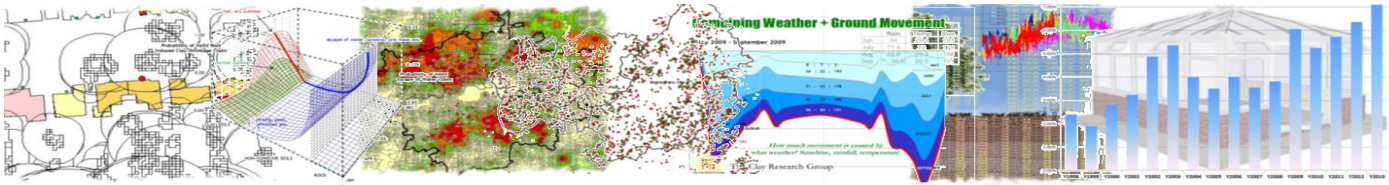
Subsidence Risk Compared to UK Average

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 - NEWHAM

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Newham	0.150	0.300	0.55	0.24	0.49	0.267



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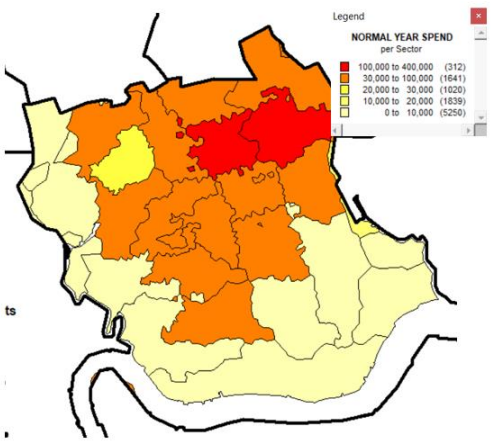
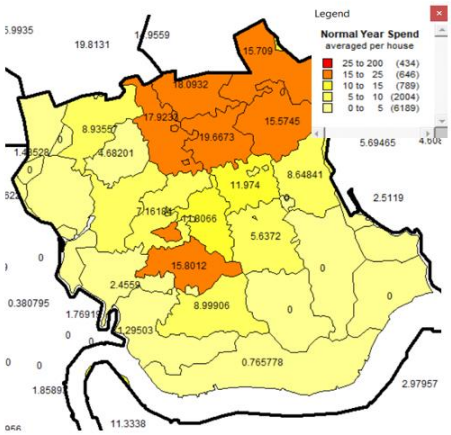
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 – NEWHAM



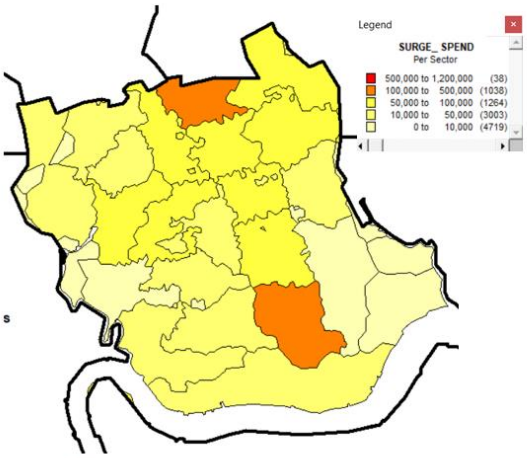
Spend by Sector



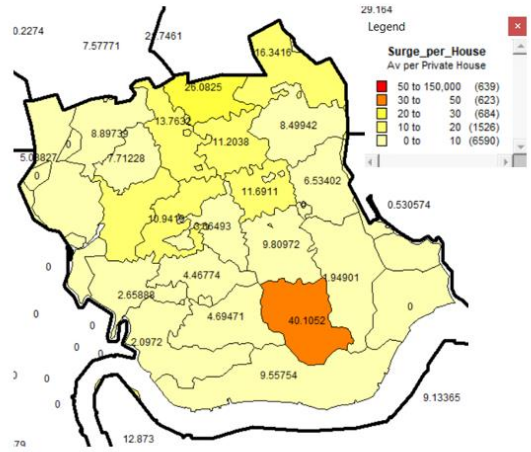
Spend Averaged over Housing Population

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.

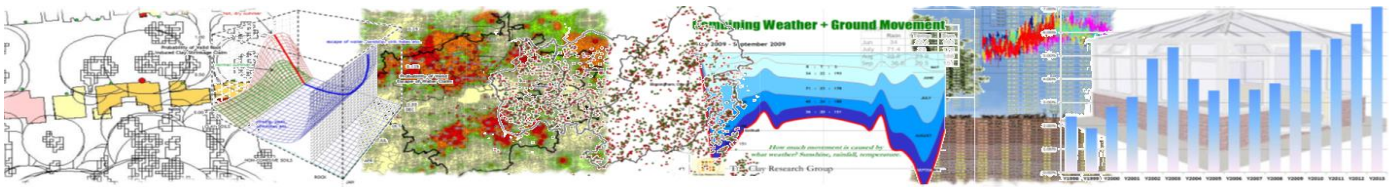
SPEND in SURGE – NEWHAM



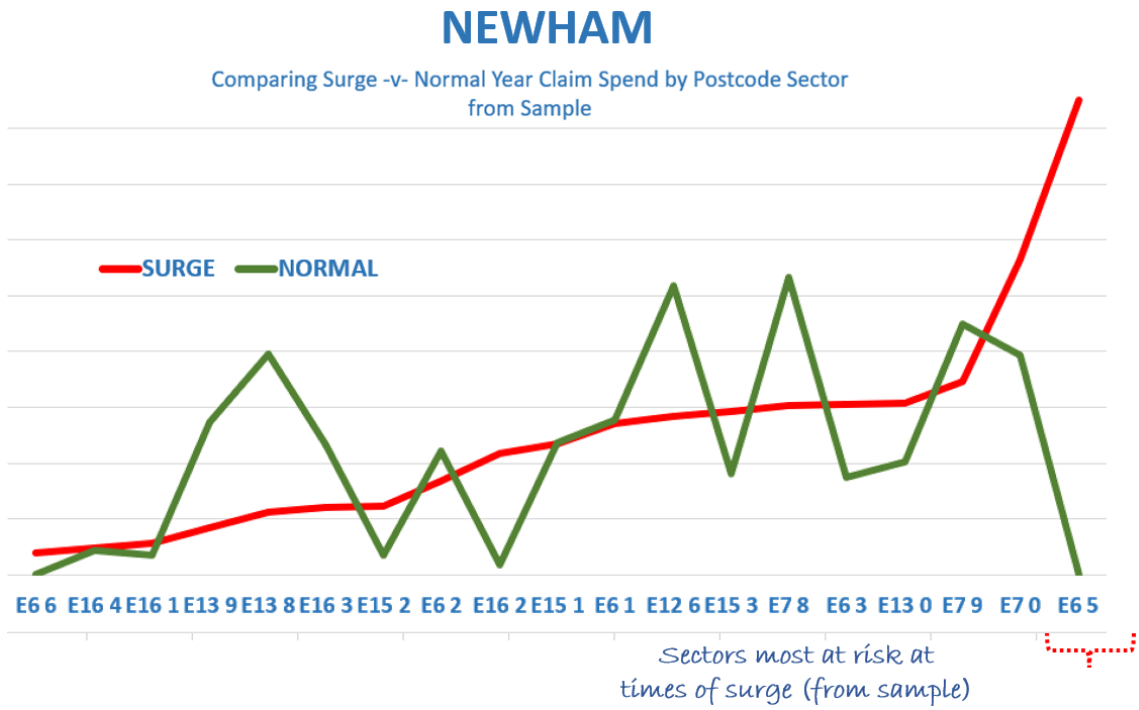
Spend by Sector



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