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

February 2020
Edition 177

The Clay Research Group

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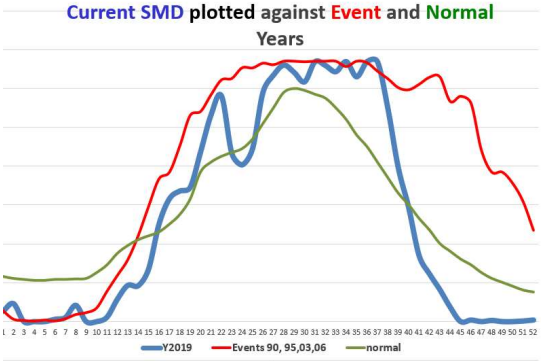
Issue 177, February 2020

2019 SMD Graph

We won't know the industry claim numbers for 2019 until the end of the first quarter in 2020, but the intermittent rainfall at the end of May/beginning of June and rapid falloff at the end of September suggests numbers of around 18k or perhaps slightly less.



That said, the profile is more 'aggressive' than 2006, so we look forward with interest to see the ABI figures.

District Risk Modelling

Continuing the study of the risk of domestic subsidence by district, this month's edition looks at Chelmsford. It has outcropping London clay formation to the south and superficial deposits of Till to the north. The CRG geology model suggests that these superficial deposits of Till have a high clay content with a recorded plasticity index of around 30%. Analysis of claims by season reveals a significantly higher number of valid claims in the summer than the winter, suggesting clay shrinkage to be the dominant peril.

OS Grid -v- Postcode Sectors

Would a risk model using OS grid system deliver an improved idea of risk when compared with the current postcode sector approach because of the higher resolution in built-up areas? With a GIS system, the two approaches could be integrated, using the OS grid for towns and built-up areas, and sector data elsewhere.

Contributions Welcome

Thanks to contributors who have spent time putting together articles on a range of subjects. Articles, updates and comments etc., are welcome.

Please Email us at clayresearchgroup@gmail.com.

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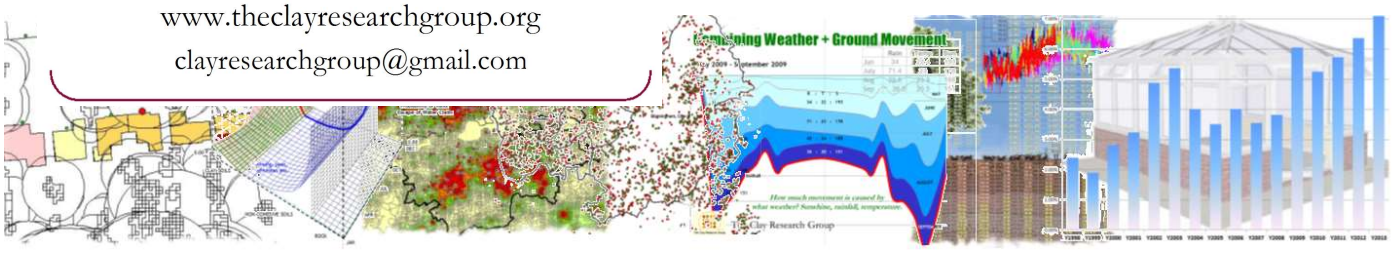

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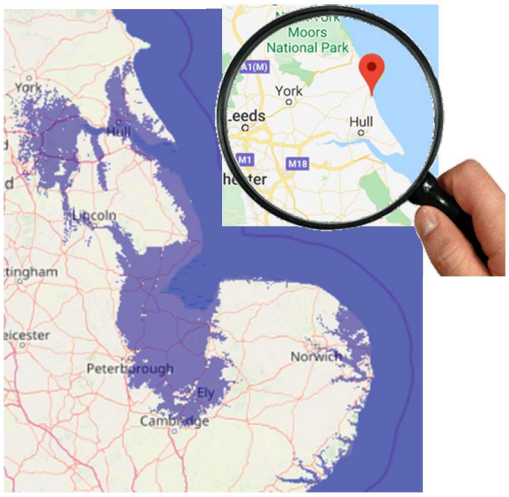


Modelling Coastal Erosion

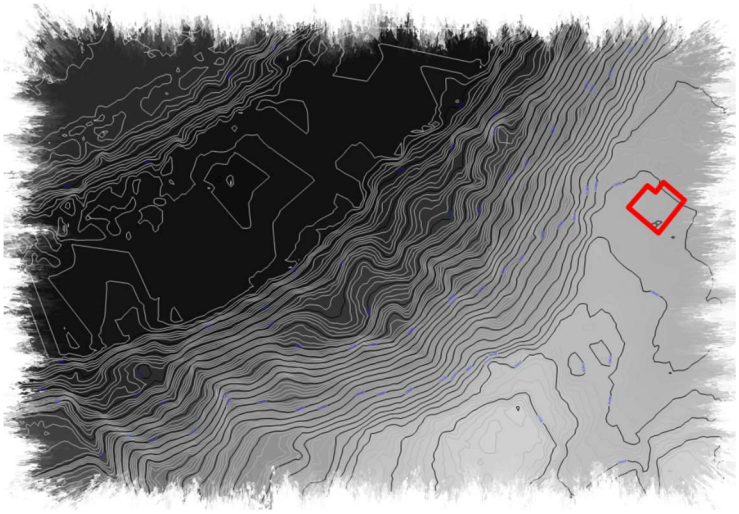
The area (Skipsea) is just north of Hull - see inset map. Areas at risk from rising sea levels can be viewed at http://flood.firetree.net. A recent article in the Sunday Times explored the problem facing homeowners in such circumstances relating to insurance cover. The FOS supported an insurer's decision to decline payment:

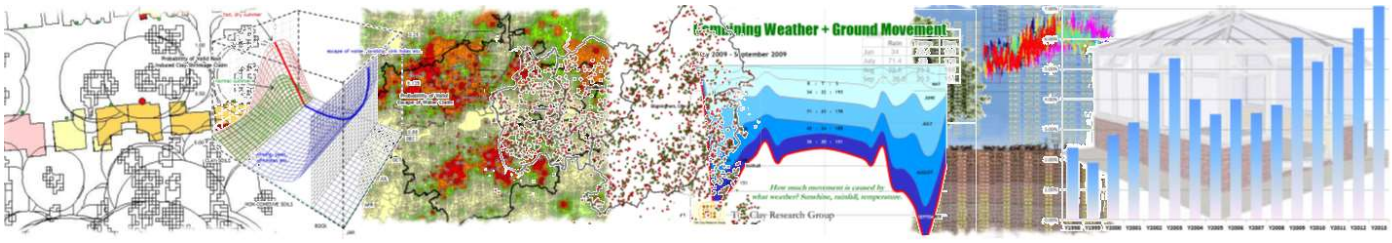
https://www.thetimes.co.uk/edition/money/our-house-fell-off-a-cliff-but-the-insurer-wont-pay-5xkhqkhnn

Contour Maps

An example of contour mapping from a site being investigated by Geotechnical Consulting Group.

The subject property is shown as a red outline and the ground contours can be clearly seen with the land sloping down towards a nearby river with the steepness of the slope evident from the proximity of the contour lines.





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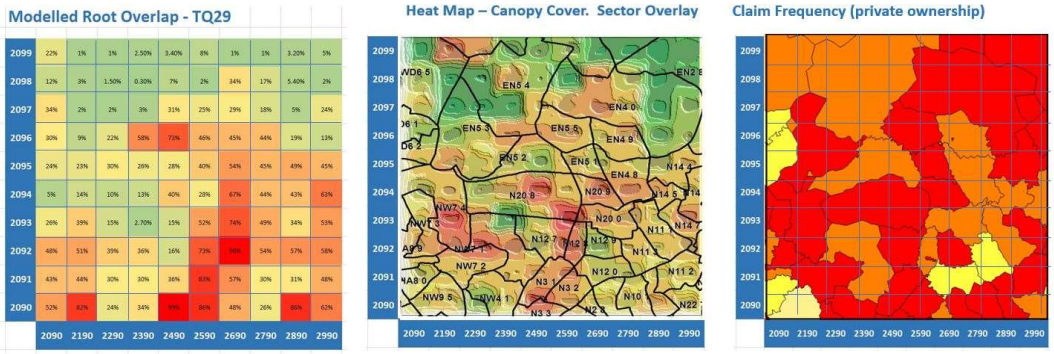
Postcode Sectors or OS Tiles?

Some time ago we mapped the tree canopy in OS tile TQ29 (Barnet district) and the exercise was useful in terms of comparing postcode sector mapping with the more regular grid of the OS system.

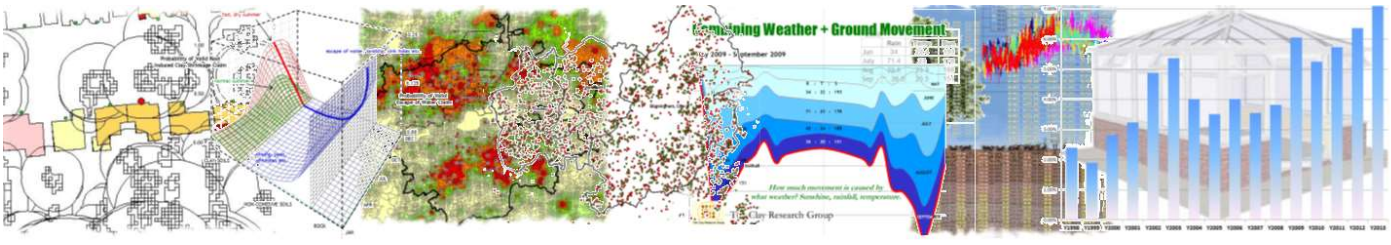


As the above examples reveal, OS tiles cover a smaller and more regular area than postcode sectors, and may be easier to integrate into an Ai system. For example, there are nearly 10 OS tiles in one of the sectors above, which increases the definition of the model whilst still allowing grouping for area factors like the geology, tree density, claim frequency and house type etc. Whilst a sector may contain say 2,000 houses, the OS tile might contain 200. Sufficient for our needs but with enhanced resolution.

In terms of ease of use (i.e. locating in which tile the house is situated using the full postcode) a basic GIS application can resolve this without any problems.

The centre tile from the above shows how some degree of fuzziness can be introduced to resolve the otherwise binary nature of such models and we believe it may be the beginning of an improved approach to modelling the risk posed by all perils, not just subsidence.

The approach would involve producing two versions of each grid to take account of summer and winter notifications – at least for the subsidence peril. See following page. The operator would enter the claim address and date the damage was noticed. The system would deliver the appropriate risk data including historic claims by peril and liability, geology, tree metrics before opening Google Earth and Street View imagery to prompt appropriate questions. The claims handler would be prompted to ask the location of the damage and if the geology was indicated as being a clay subsoil, then they might ask the homeowner if they could identify the tree species or the presence of any nearby vegetation.



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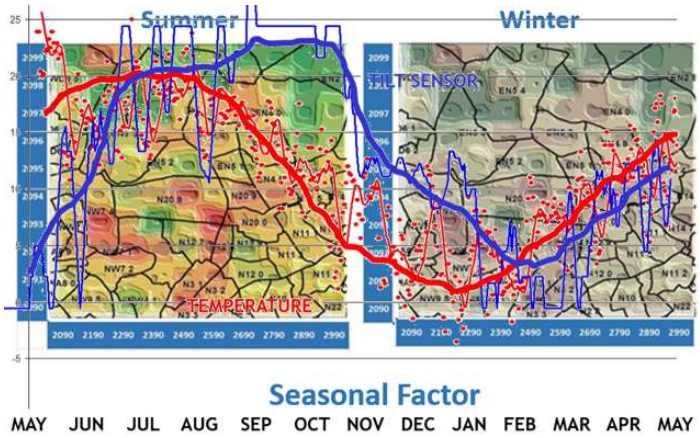
Triage and Embracing Ai

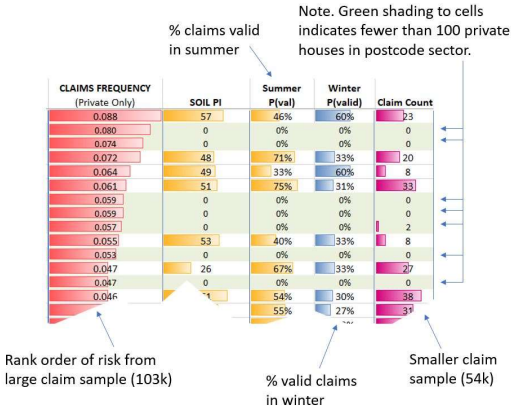


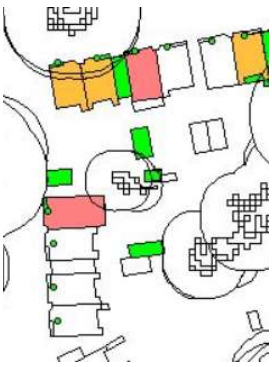
Taking account of seasonal changes in risk is relatively easy as can be seen on the following pages relating to the Chelmsford study area.

The image left shows a reduced risk in the winter months on clay soils related to temperature and rainfall.

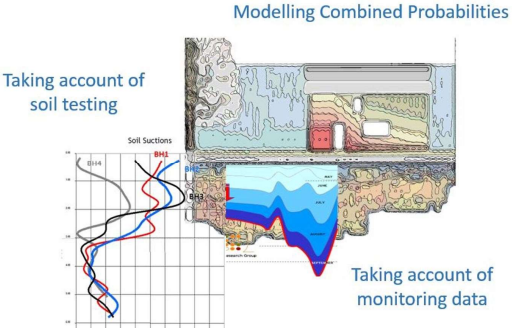
This analysis can be stored in a database providing all of the information required for detailed Triage.

Past claims experience, including both peril and liability provide an insight into the likely risk, taking into account housing population, geology and seasonal changes.

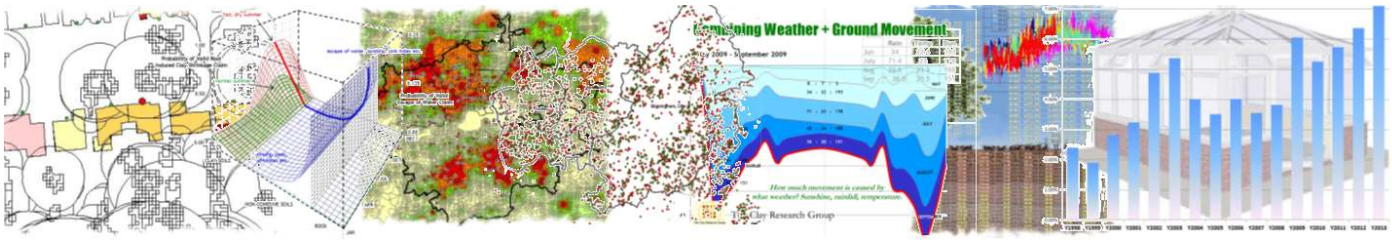




LiDAR tree mapping helps to identify risk in relation to areas of reported damage on clay sites, and the output can be modelled using a range of applications. Right, plotting the likely zone of influence of a nearby tree and building movement.



The outcome of the above analysis can determine the next step. Should site investigations be instructed and if so, what form should they take? What sort of soil tests are required? Should drains be looked at? When the results become available, can the system carry out meaningful interpretation? Faster and cheaper with improved customer care is the objective.



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Aldenham Site – Layout of EKO pad and Levels

When Tom Clinton was carrying out research towards obtaining his PhD, he arranged for an area of ground to be treated at the site of the Aldenham willow. The location is shown left - see 'EKO PAD'.

Level arrays (green) are also indicated, along with level stations around the perimeter of the headmaster's house.

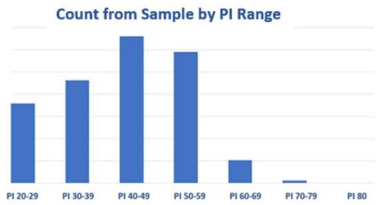
Risk of Subsidence by Clay Plasticity Index

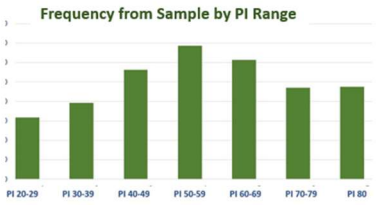
The graphs, right, reveal the risk of subsidence on clay soils in relation to their plasticity index (PI).

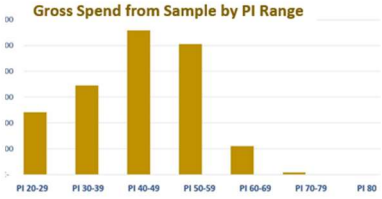
Of the three graphs, the top one represents the count of claims, the middle claim frequency (count of claims divided by the housing count) and at the bottom the gross spend (including investigations, fees and repairs), all rated by PI.

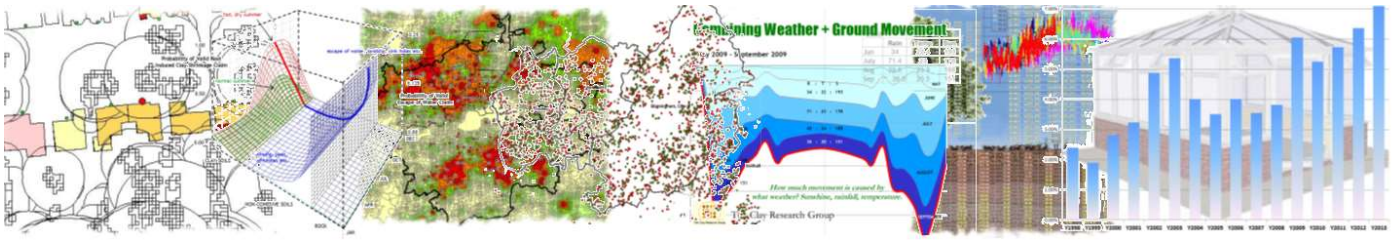
Not surprisingly, gross spend corresponds to the claim count and frequency peaks just to the right of the two other graphs on the x axis but the analysis, when combined with the CRG 250m soils grid, helps to improve our understanding of risk.

Clay shrinkage related claims cost around 20% more than their counterparts on non-cohesive soils in average years.









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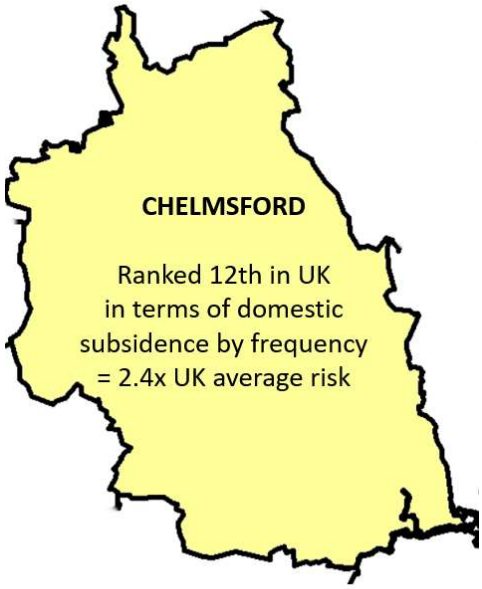
Subsidence Risk Analysis – Chelmsford

Chelmsford is situated in Essex and occupies an area of around 342km^2 with a population of around 170,000.



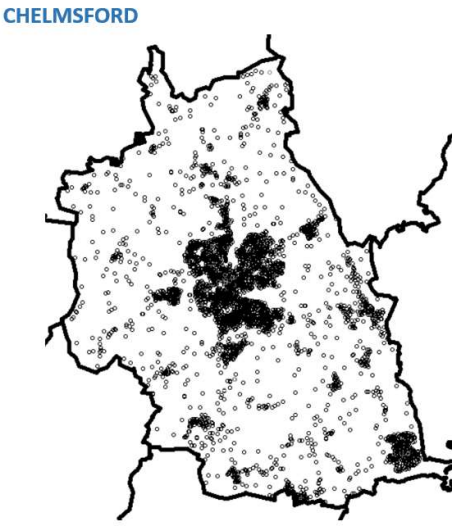
Risk Compared with UK Average

Layout of the districts above. They have a combined estimated population of around 170,000 and an area of 342km^2.

The areas are rated for the risk of domestic subsidence as shown on the above map in relation to the UK district average. The highest risk rating on rating scale is a value of 4.

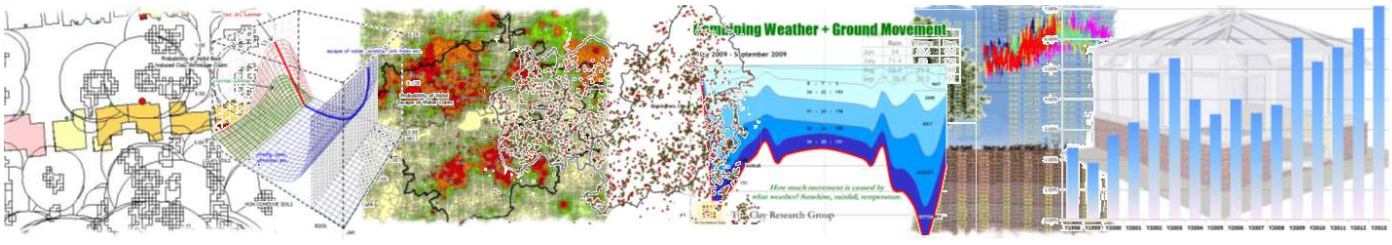
Mapping housing distribution across the districts (below, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims because there are more houses?

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 an absolute 'count of claim' value.



Housing Distribution by Postcode

Distribution of housing stock using full postcode as a proxy. Each postcode in the UK covers on average 15 houses, although there is significant variation.



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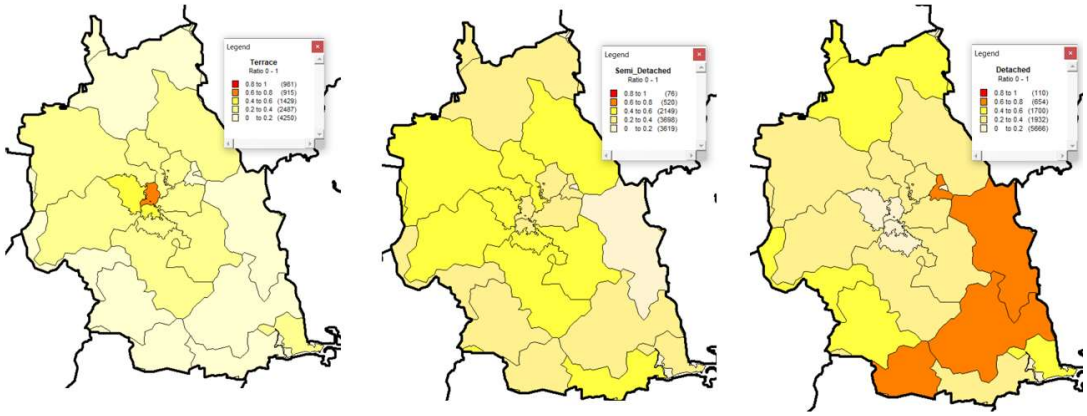
Chelmsford - Properties by Style and Ownership

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 – the age of the property. As we have seen before, risk increases with age.

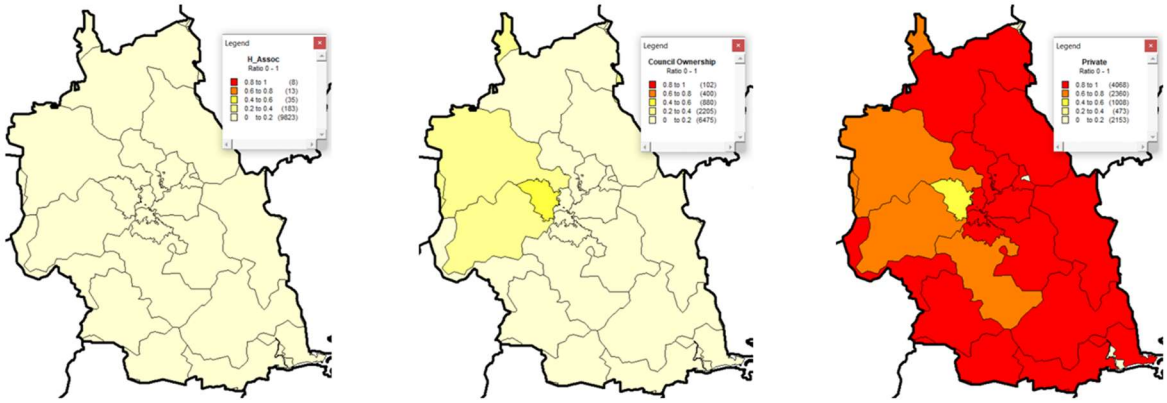
CHELMSFORD - Distribution by House Type



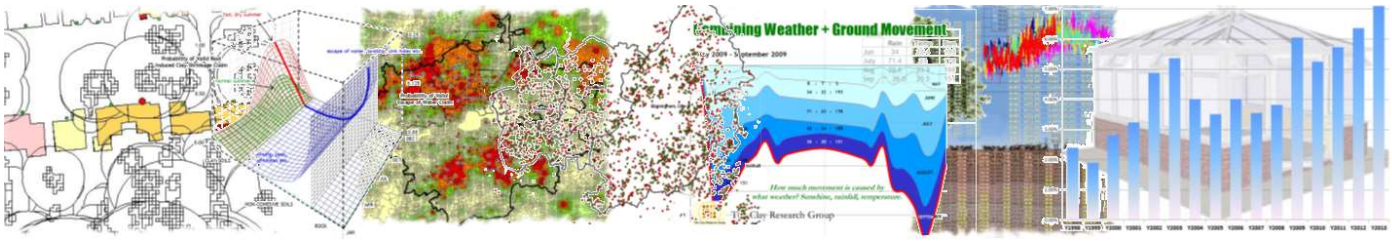
Terraced **Semi-Detached** **Detached**

Distribution by ownership is shown below. The maps reveal predominantly privately-owned, detached properties across the borough, which will influence the risk distribution.

CHELMSFORD - Distribution by Ownership



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



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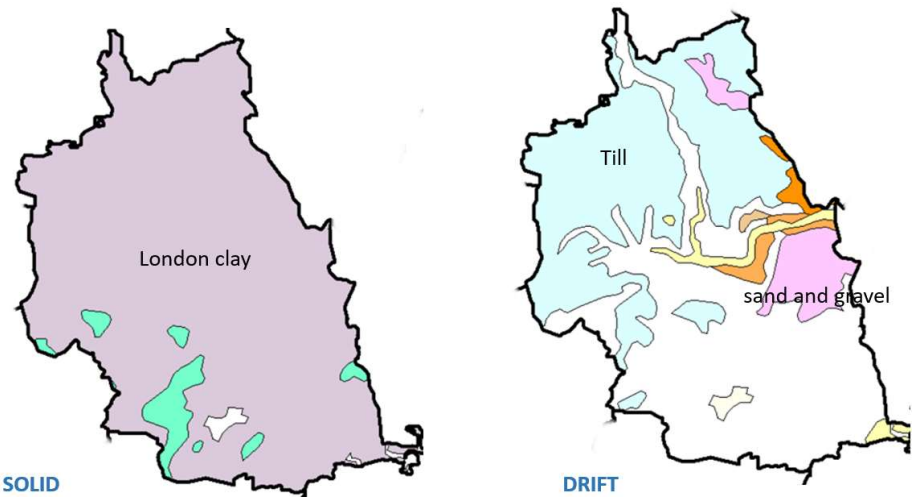
Subsidence Risk Analysis - Chelmsford

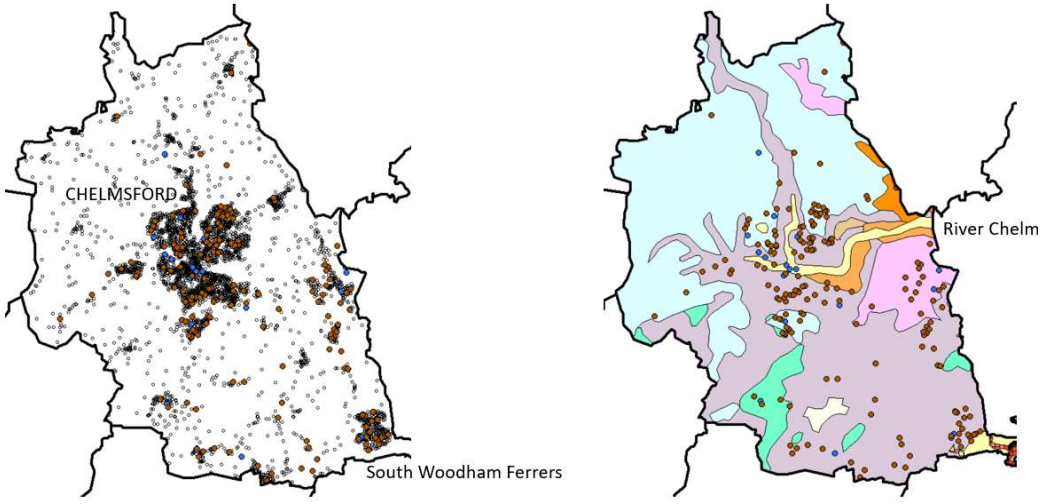
Below, extracts from the British Geological Survey maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html

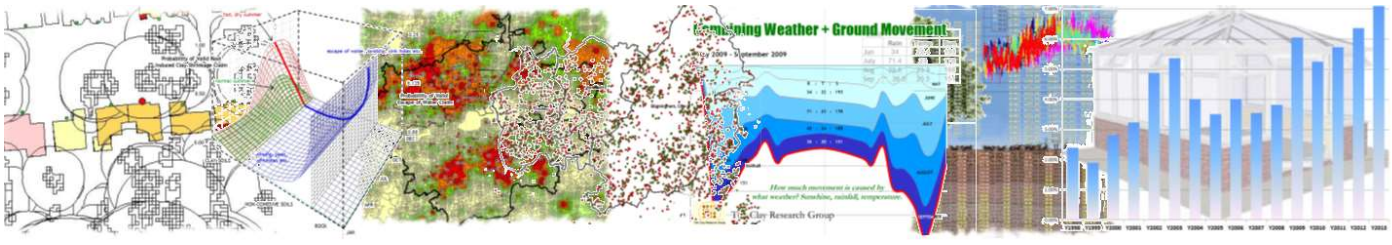
CHELMSFORD : BGS Geology – 1:625,000 scale low resolution mapping



See page 12 for a seasonal analysis, which reveals a high percentage of valid claims in the summer and a high probability that of those, many will be due to clay shrinkage – a function of the underlying London clay. The probability of a claim being declined in the winter is high.

CHELMSFORD : Mapping claims by peril by population and geology





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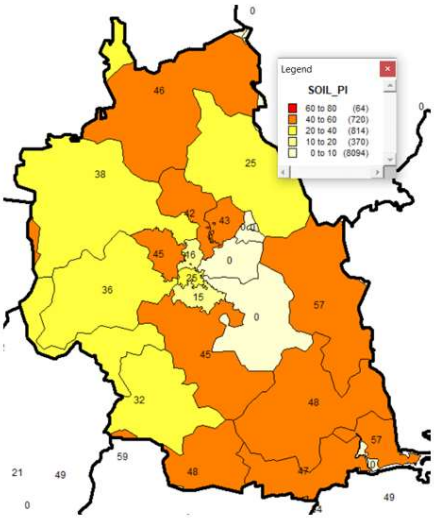
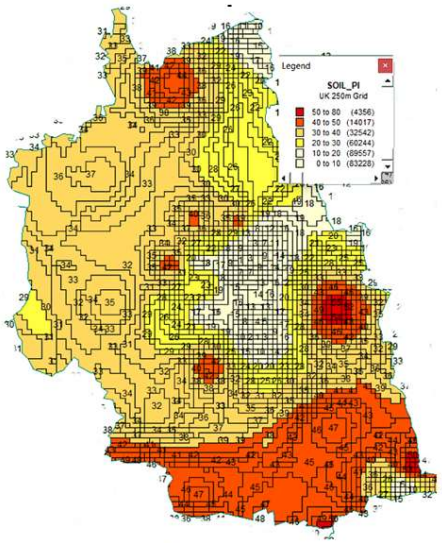
Liability by Season and Geology

Below, the average PI derived from site investigations by postcode sector (left) and interpolated to develop the CRG 250m model grid (right). The presence of a shrinkable clay to the north of the district suggests the superficial Till deposits have a high clay content.

CHELMSFORD – Soil Plasticity Index



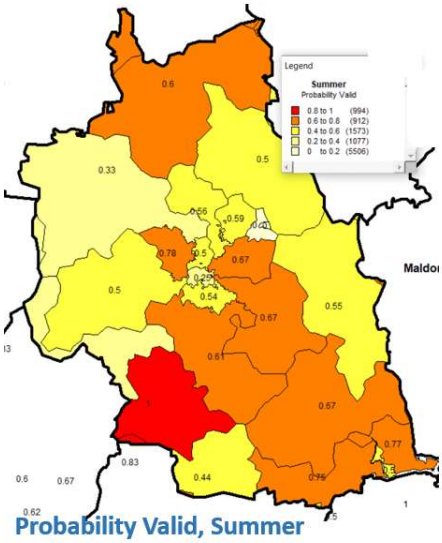
Soil PI Averaged by Sector



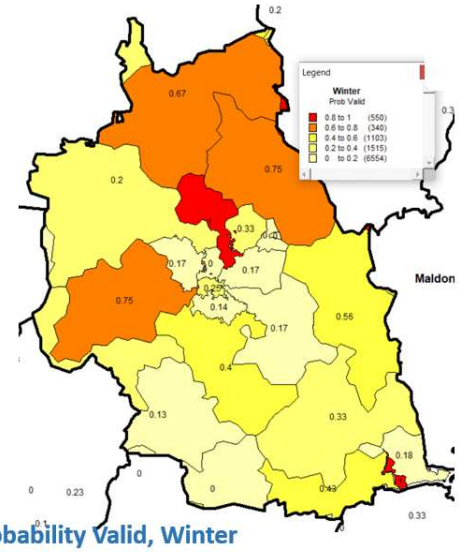
PI Interpolated on 250m CRG grid

Below, the probability of whether a claim is likely to be valid or declined by season. Analysis suggests that claims are more likely to be valid in the summer months and less likely in the winter, reinforcing the influence of the underlying clay deposits.

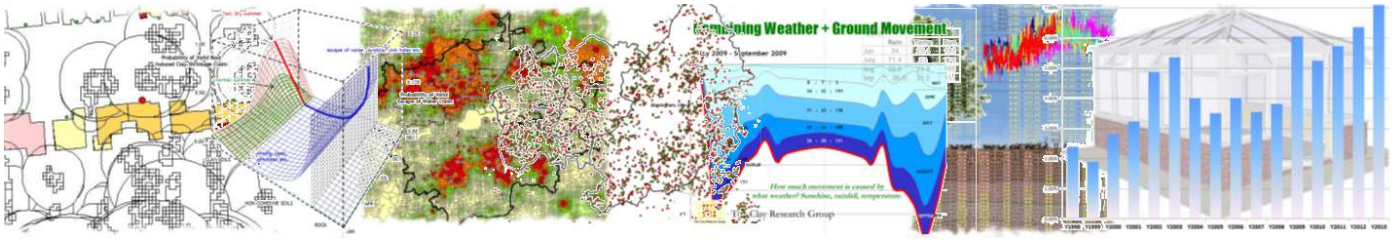
CHELMSFORD



Probability Valid, Summer



Probability Valid, Winter



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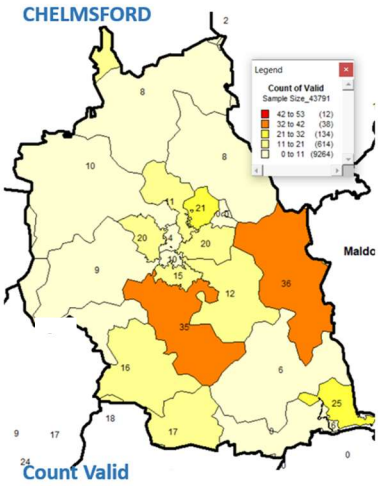
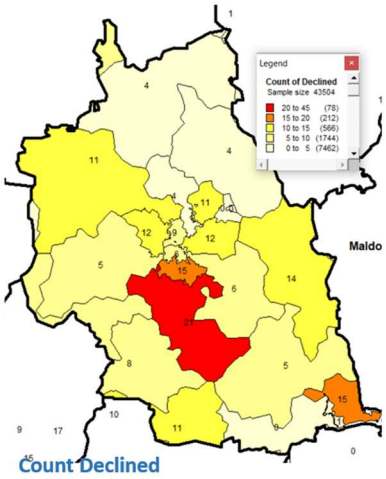
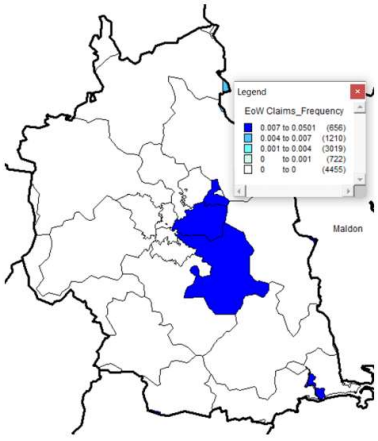
Liability by Sector. All Perils

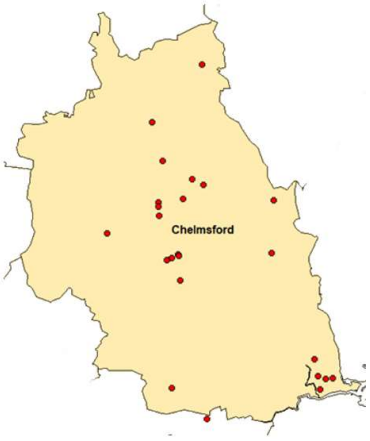


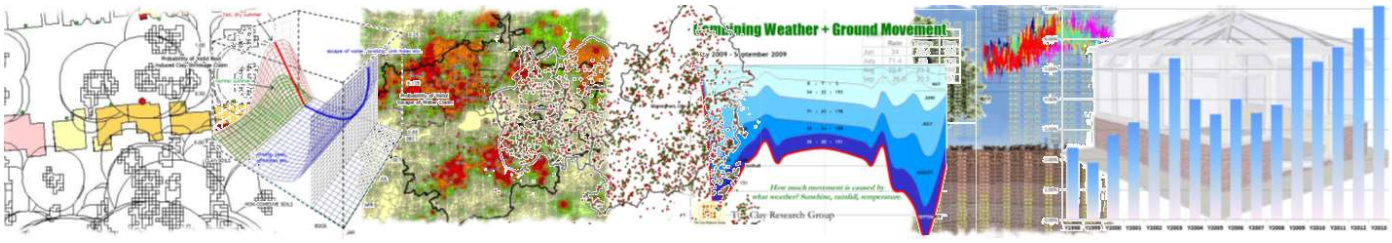


Above, mapping liability and plotting distribution of valid and declined claims for the sample size shown, not taking into account any seasonal influence. Below left, mapping the frequency of Escape of Water claims from the sample reflects the primarily non-cohesive drift deposits in the vicinity – Till, sand, sandy gravels and alluvial soils – and the population density. 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.

CHELMSFORD – Postcode Distribution







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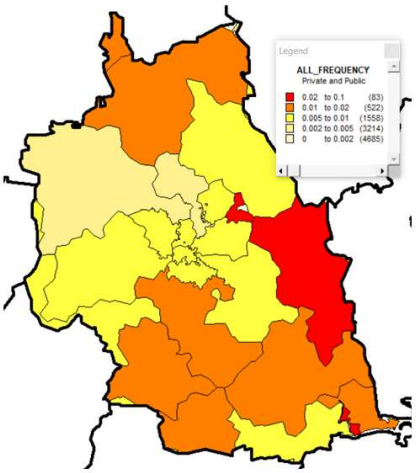
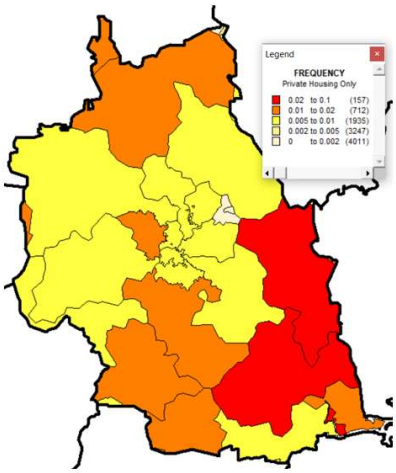
Chelmsford - Frequencies & Probabilities

CHELMSFORD - Postcode Sector Subsidence Risk (frequency) by Ownership



Combined Public and Private Frequency



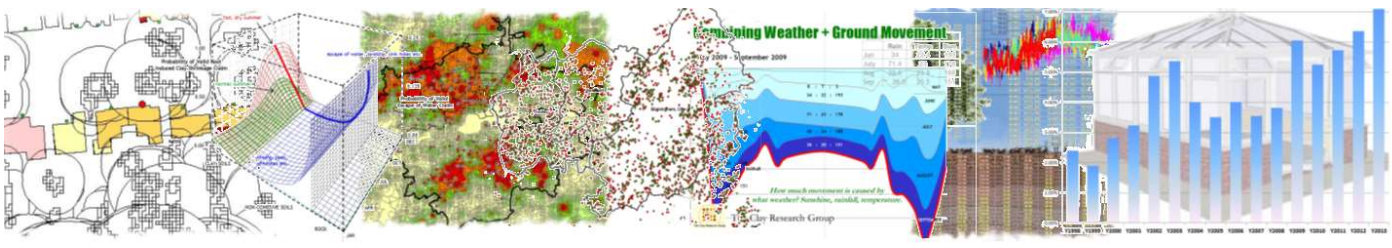
Private Only

Above, private housing map links risk with the CRG geological map on page 8. Below, the figures reveal a borough with a high seasonal risk. The chances of a claim being declined in the summer are just over 20% and if it is valid, there is a 90% probability that the cause will be clay shrinkage. In the winter, the repudiation rate is high at over 80% and if the claim is valid, there is a high probability the cause will be water related.

The district illustrates the importance of taking note of the underlying geology.

Liability by Season - CHELMSFORD

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Chelmsford	0.735	0.050	0.215	0.01	0.16	0.83



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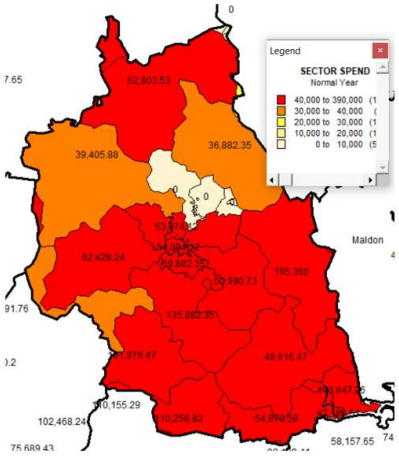
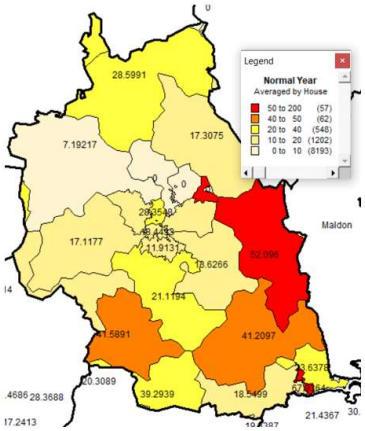
Aggregate Subsidence Claim Spend by Postcode Sector and Household to Derive Risk and Premium in Surge & Normal Years

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

NORMAL YEAR SPEND - CHELMSFORD



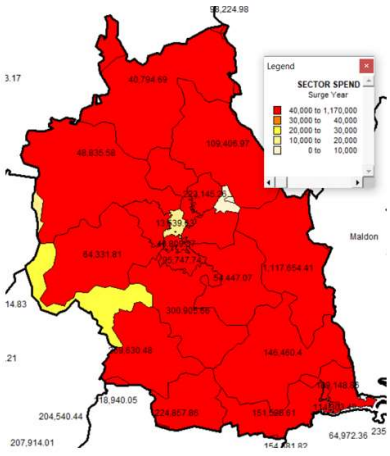
Spend by Sector



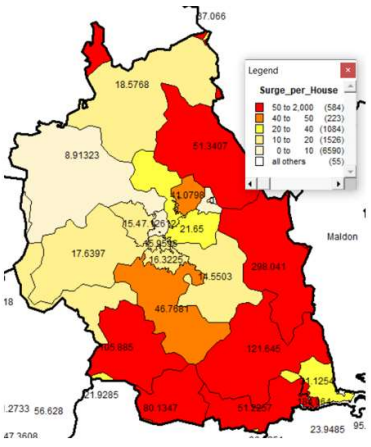
Spend Averaged over Housing Population

It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. The image to the left in both examples represents sector spend and the figures to the right, sector spend averaged across housing population to derive a notional cost per house.

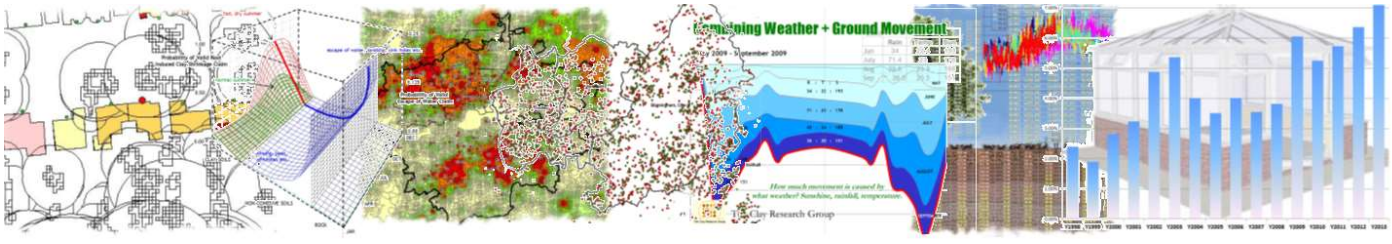
SPEND in SURGE - CHELMSFORD



Spend by Sector



Spend Averaged over Housing Population



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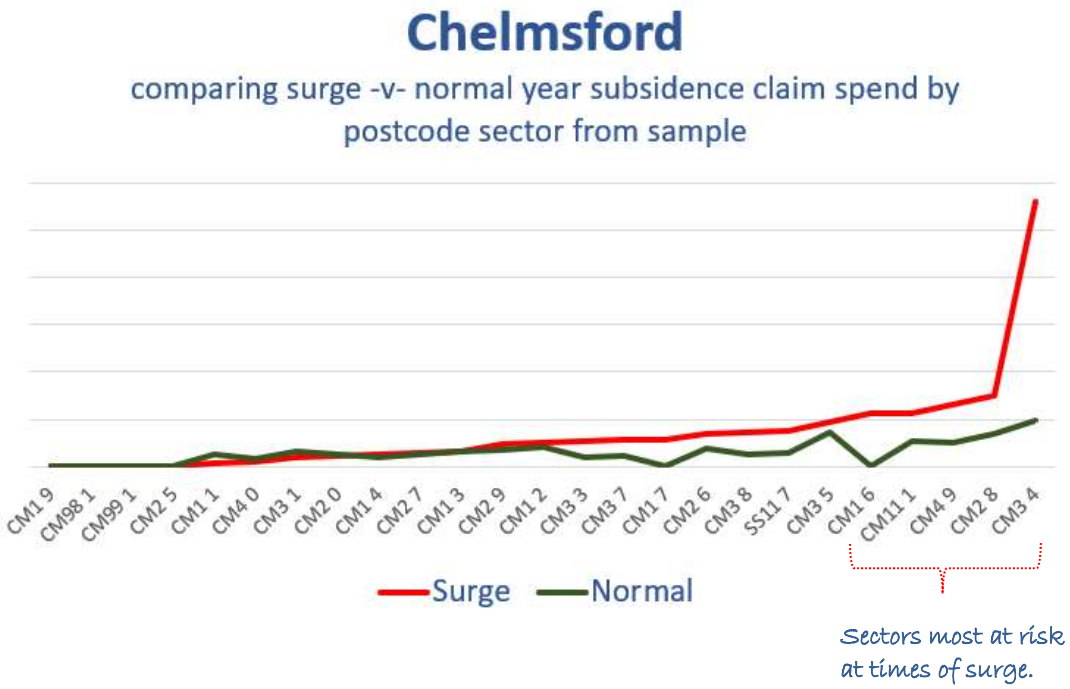

Identifying the variable risk across the district between normal and surge years by postcode sector. Divergence between the plots indicates those sectors most at risk at times of surge.

In making an assessment of risk, housing distribution and count by postcode sector plays a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count might 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 appear less of a threat than it actually is.