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

December 2019
Edition 175

The Clay Research Group

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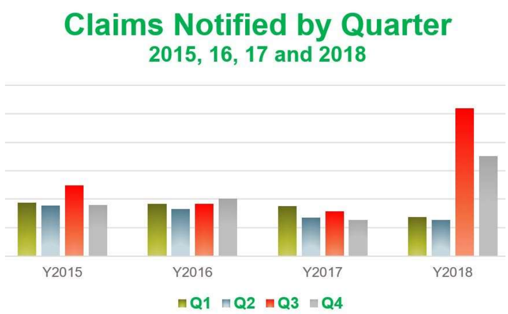
Issue 175, December 2019

2018 Surge

We won't know the industry claim numbers for 2019 until the end of the first quarter in 2020, but reflecting on 2018, in what sense was 2018 a surge, what did the weather have to do with it and is there a predictive element?

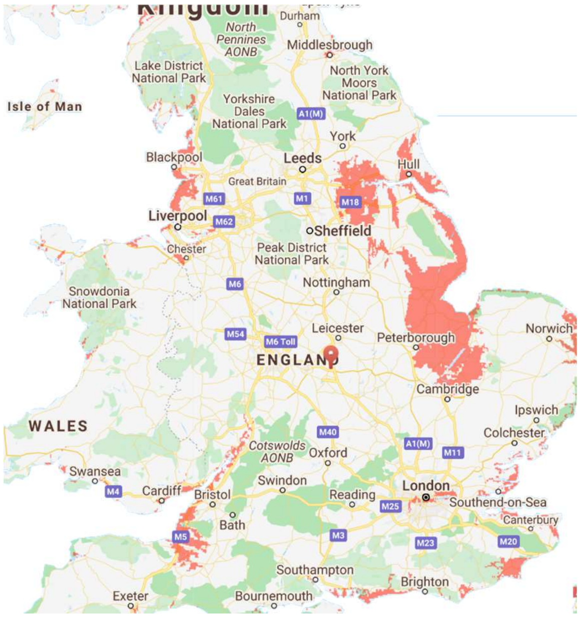
The graph below illustrates the nature of the surge. The third quarter of 2018 saw an increase exceeding 300% on the previous quarter. More inside.



Modelled Flood Plain Increase

Below, a map of areas that may be below the flood plain in 2050.

See Kulp, S.A., Strauss, B.H. "New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding." Nature Communications (2019).

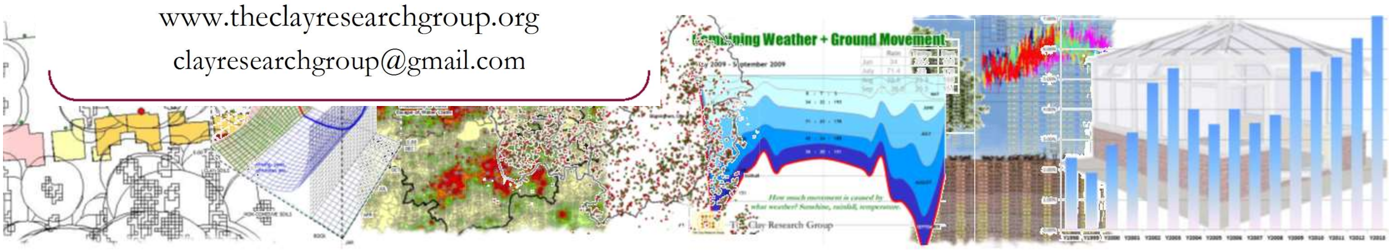


Visit the site at https://coastal.climatecentral.org

Contributions Welcome

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

Please Email us at clayresearchgroup@gmail.com.



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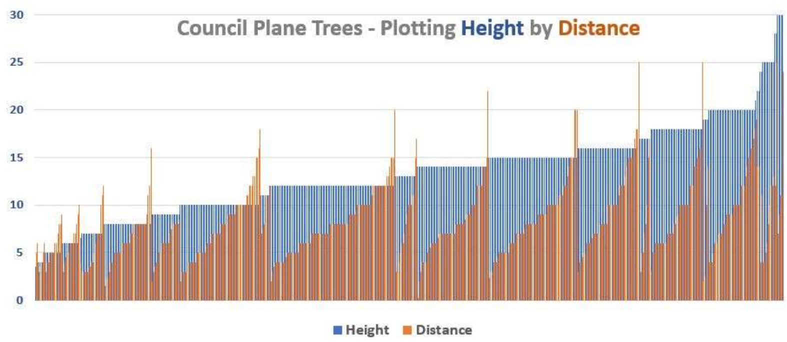
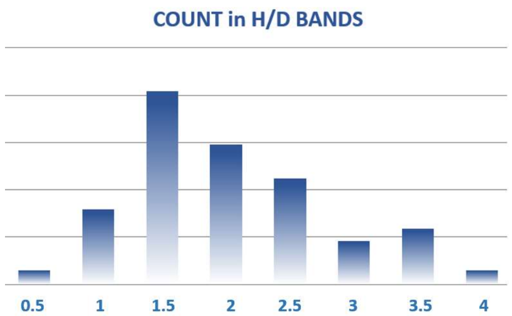
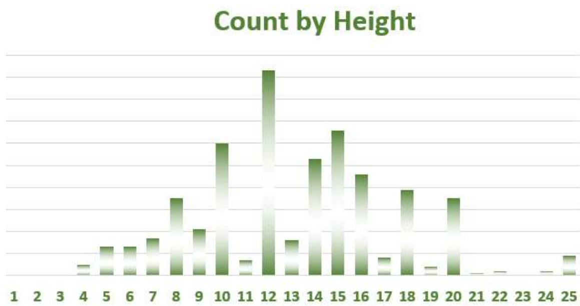
Council Plane Trees Involved with Subsidence Damage

Whether the trees rated as presenting a higher risk of causing subsidence damage reflects their population (i.e. more claims are involved with Plane trees that are 12mtrs tall due to the fact there are more of them) or their physiology – or a mixture of the two - is unknown but it is hoped that the following details may assist council arboricultural officers when planning their maintenance programs.



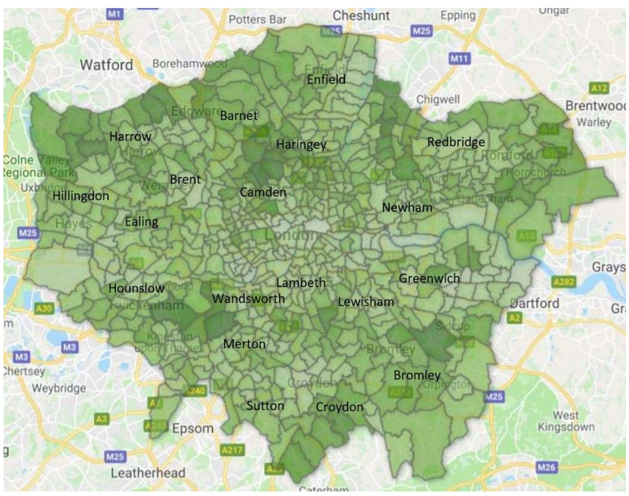
Left, taking the Plane as an example, the distribution by height (blue) and then by distance to the damaged property (brown) reveals a fairly regular profile. Below, left, a broad distribution plotting the H/D ratios and below right, the count by height.



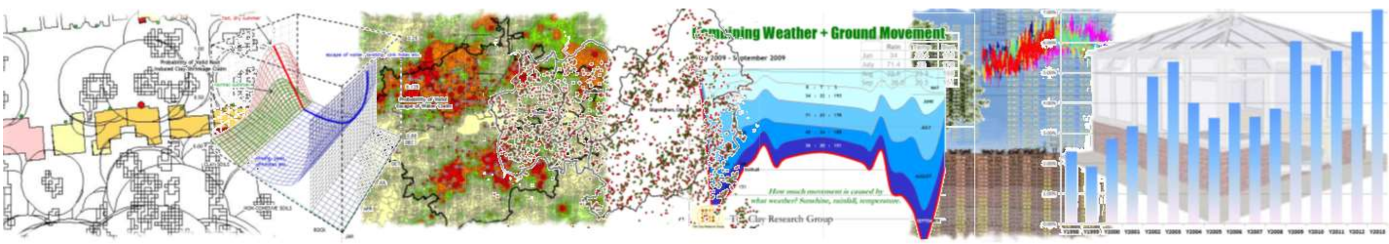


In summary, 12m tall Plane trees appear to be involved in more claims than those that are shorter or taller, and the H/D risk indicator is a value of 2, suggesting that councils might be helped, at least in the case of Plane trees, identifying those with a height of 12mtrs, 6mtrs distant from domestic properties.

On a different but related topic, canopy cover in London has been plotted in a document entitled "Tree Canopy Cover Methodology" by the GLA. See right.



Visit: -https://data.london.gov.uk/dataset/curio-canopy



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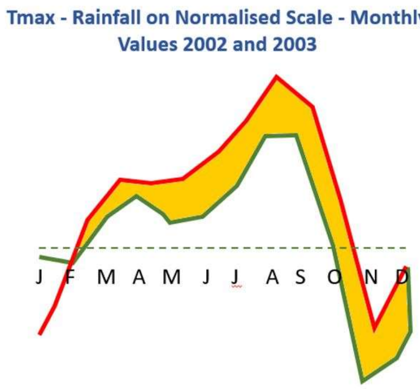
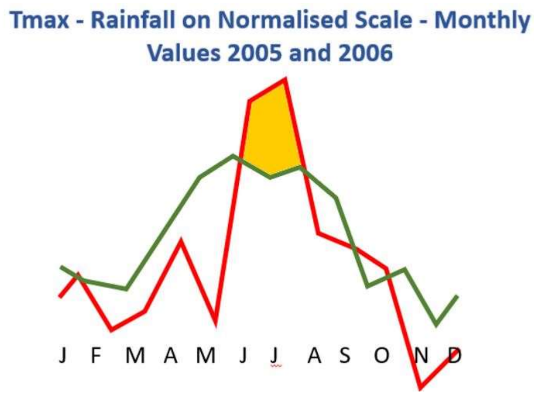
Weather Profiles -v- Claims

Can we forecast the likelihood of a subsidence claims surge year based on the weather, and if so, how far in advance and what are the indicators? First, some comparisons between surge and normal years using normalised weather data from the Heathrow weather station.



Weather data has been normalised on a 0 – 1 scale to allow comparisons between disparate elements including rainfall, temperature and hours of sunshine. In the examples on this page, the formula *Tmax – Rainfall* has been used, identifying rainfall deficits extending from March through to December.

Left, the difference between temperature and rainfall in the years 2002 (a normal claim year) and 2003 (a surge year).

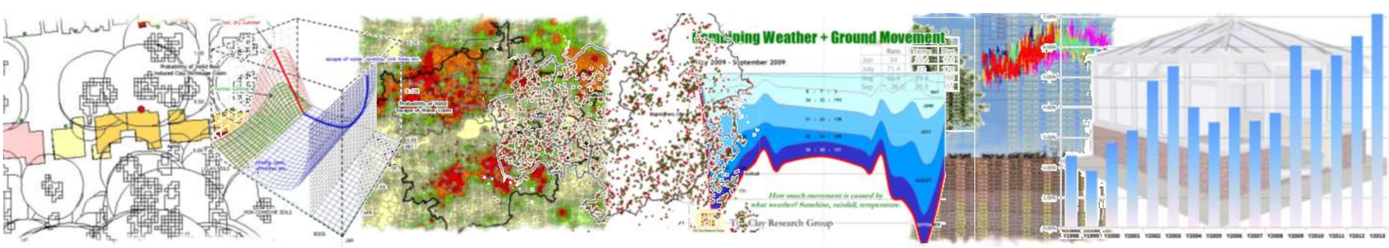


The yellow shaded zone represents the difference (i.e. reduced rainfall) between the years.

Right, the same exercise comparing 2005 (another normal year) and 2006 (surge) revealing a difference lasting a far shorter time – from June through to August. For all remaining months 2005 was dryer than 2006.

The implication, reinforced by previous studies looking at water uptake by the Aldenham willow and oak trees, is that July is perhaps a significant month in terms of tree physiology. In 2003 the ground was dry when the trees came into leaf, and the deficit maintained throughout the summer. The normalised deficit in July was 0.519. The deficit sum for June through to October (inclusive) was 2.37. In 2006, the deficit for July was 0.662 and the sum for June through to October was 1.825.

In summary, 2003 had a higher deficit that lasted longer, delivering more claims than 2006. Both of these surge years had higher deficits than 2002 (0.245 in July and sum of 1.377) and 2007 (-0.055 – i.e. a much wetter year than either of the surge years with a sum of 1.23).



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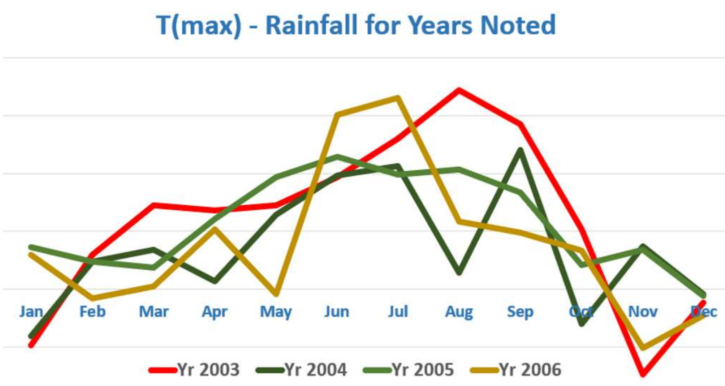
Weather -v- Claims

Comparing weather profiles using *T(max) - rainfall* profiles reveals the relationship with claim numbers in these graphs.

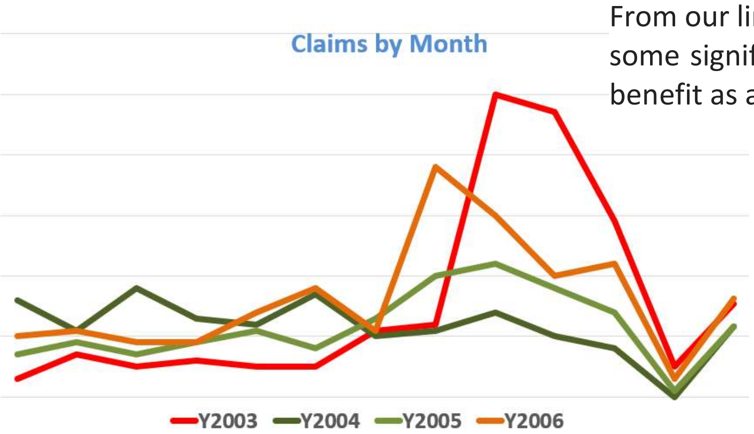
Right, the weather profiles show a summer deficit for the two surge years, peaking in August for 2003 June and July in 2006.

Below, the difference between 2005 and 2006 was reversed and there was no identifiable pattern to suggest that 2006 would deliver over 10,000 more claims than 2005.



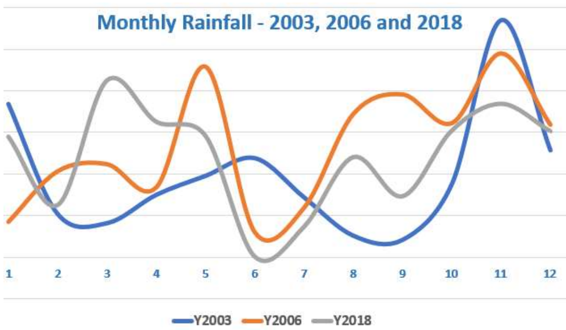
Clearly there is no reliable means of predicting what the summer holds.

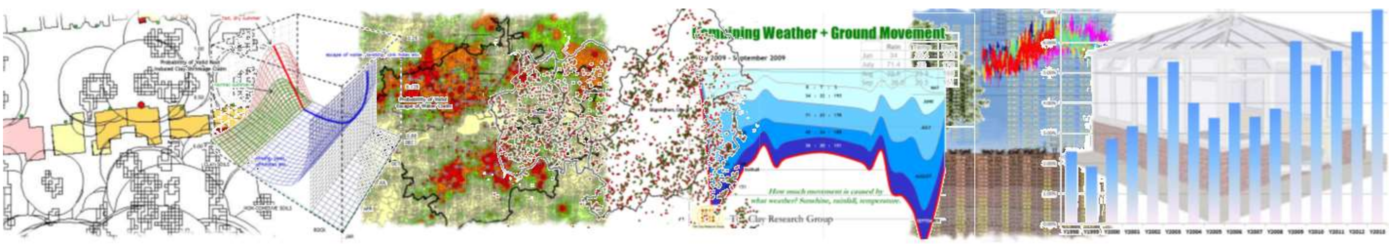
From our limited study it does appear that July has some significance, but too late to deliver any real benefit as a predictive element.



This reinforces the view expressed by Dr. Richard Pugh in his paper *"Some observations on recent climate change on the subsidence of shallow foundations"*. Proc. Of the Institution of Civil Engineers, Geotechnical Engineering. January 2002

Right, comparing rainfall in 2018 with the earlier surge years of 2003 and 2006 reveals the relationship between claim numbers and weather. In 2003 and 2006 rainfall dipped around June, and 2018 between August and September so whilst rainfall is closely linked to claim numbers, it has no role in building a predictive algorithm.





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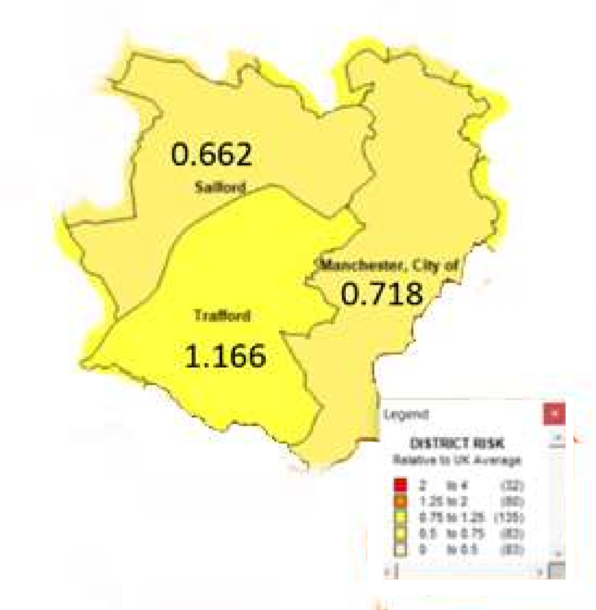
Subsidence Risk Analysis – Manchester, Trafford and Salford

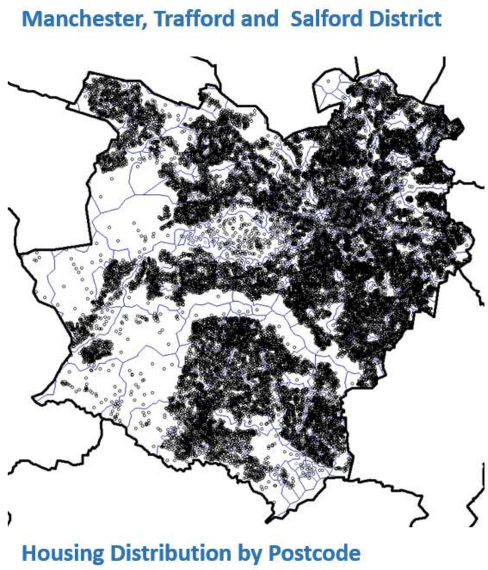
The three districts have a combined area of around 318km^2 and population of around 765,000.



Layout of the districts above. They have a combined estimated population of around 123,000 and an area of 129.6km^2.

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?

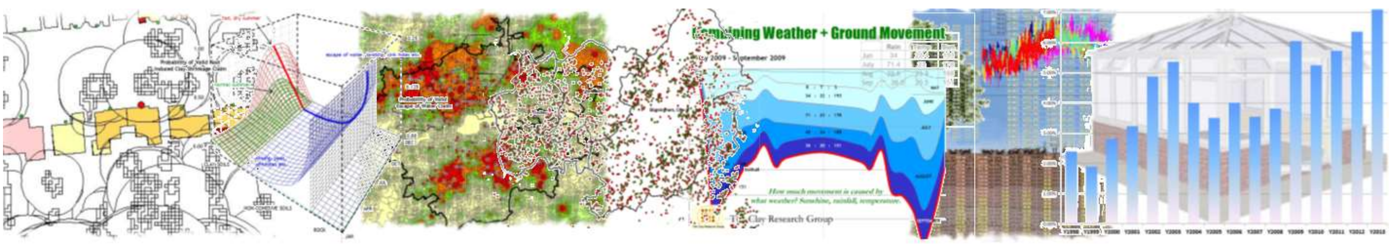
Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than an absolute 'count of claim' value.



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.

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.

Trafford has the highest risk of the three districts (from our sample) coming around 130th out of 413 UK districts in our 'rank order of risk' table for claims frequency. Manchester comes second at 259 and Salford appears to be the safest of the three, taking 260th place.



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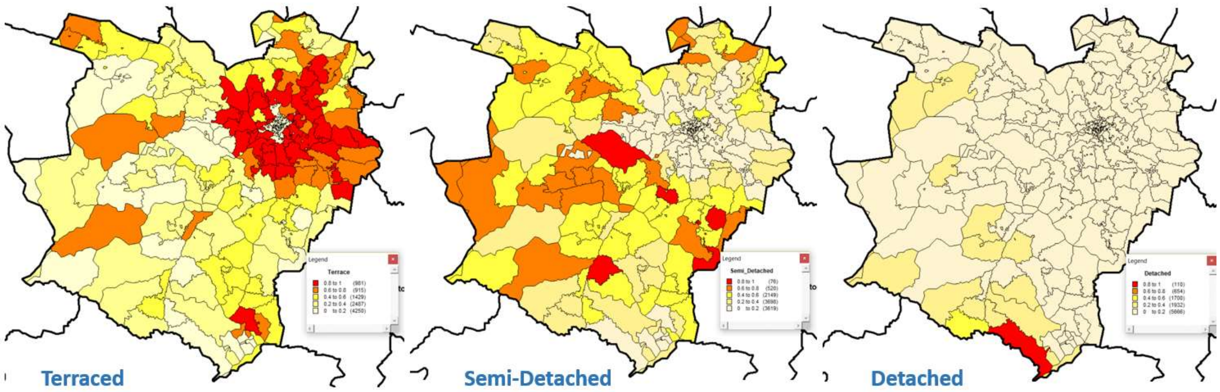
Manchester, Trafford and Salford - Properties by Style and Ownership

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.

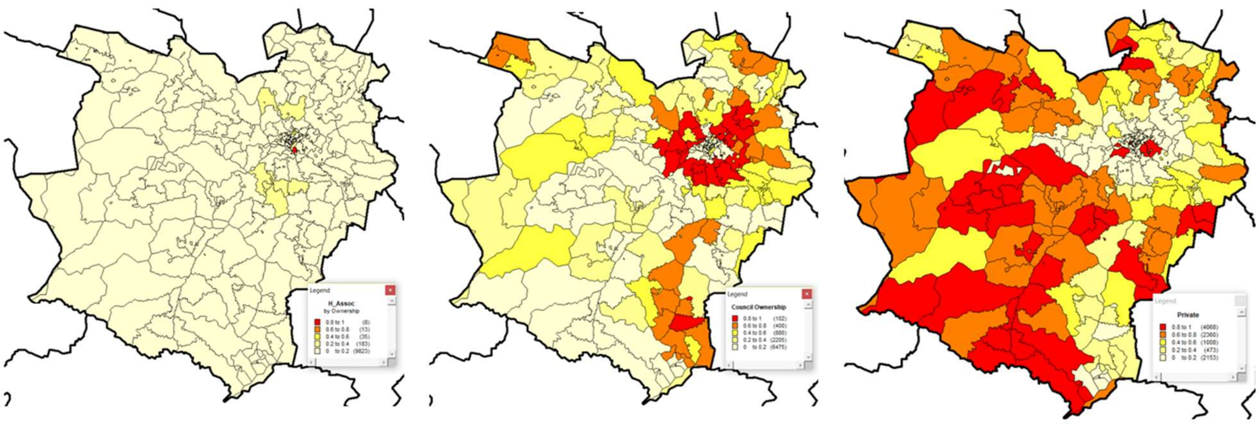
Distribution by House Type



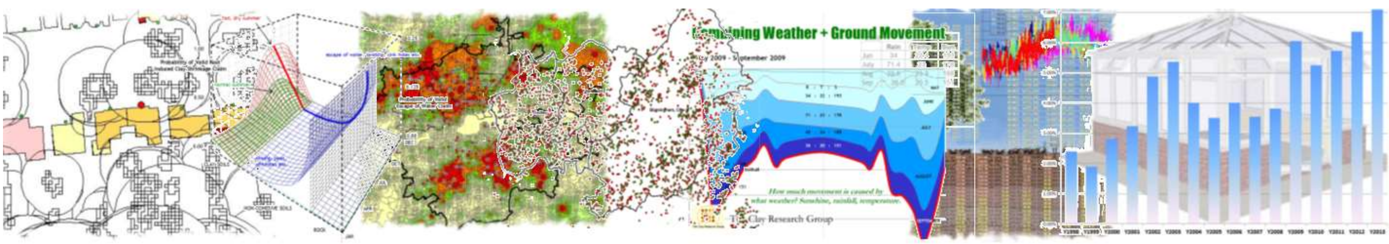
Terraced Semi-Detached Detached

Distribution by ownership is shown below, revealing a high population of privately-owned properties across the borough and a high concentration of terraced houses in council ownership towards the town centre.

Distribution by Ownership



Housing Association Council Ownership Private Ownership



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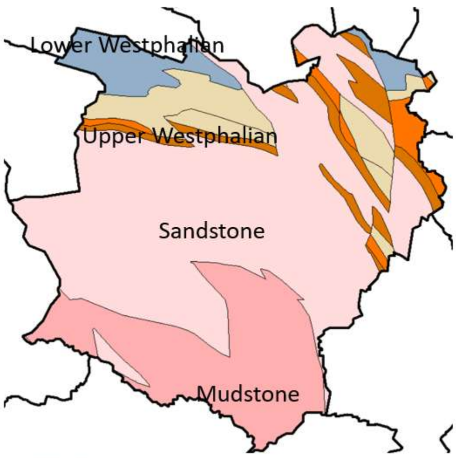
Subsidence Risk Analysis - Manchester, Trafford and Salford

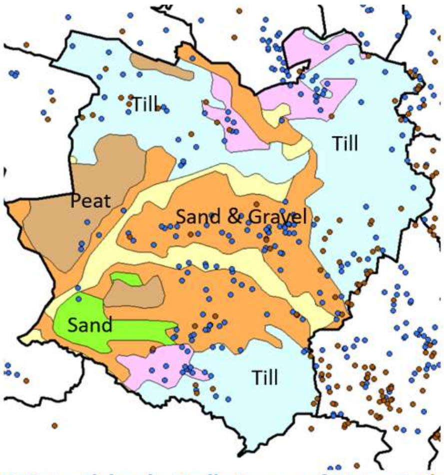
Below, extracts from the British Geological Survey maps showing the solid and drift series. View at:

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

Manchester, Trafford and Salford District District : BGS Geology – 1:625,000 scale low resolution mapping



SOLID

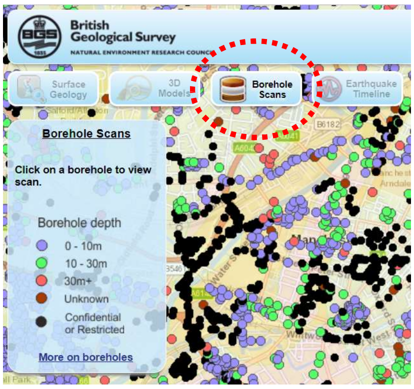


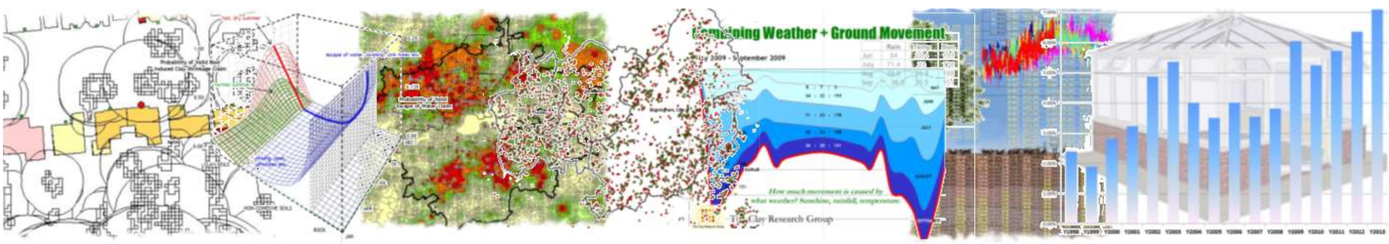
DRIFT - Claims by Peril - Escape of Water & Clay Shrinkage

See page 12 for a seasonal analysis, which reveals that the probability of a claim being due to clay shrinkage in the summer is slightly less than due to an escape of water, falling further in the winter. Throughout the year the probability of a claim being declined is higher in the summer.

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

The colour of the dot relates to the depth of borehole and selecting one returns a pdf of the original log.





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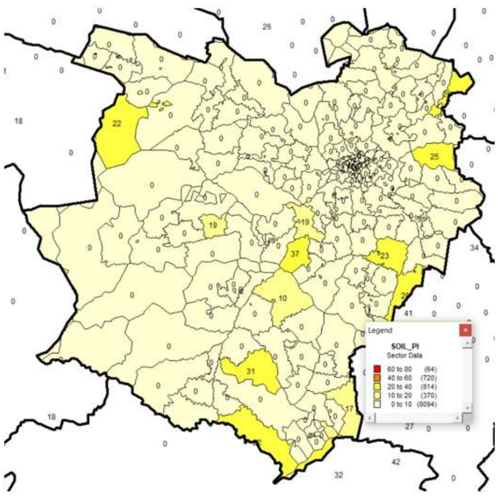
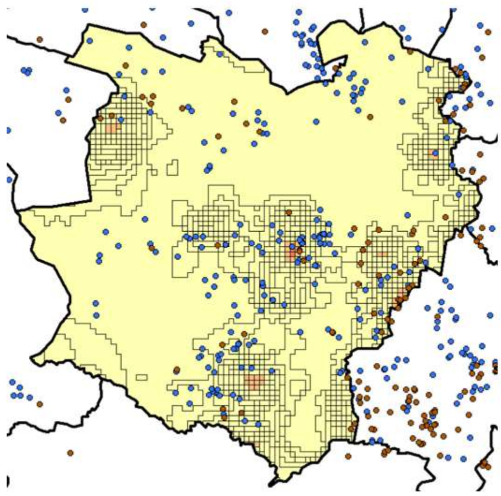
Liability by Season and Geology

Below, determining if there is a link with the underlying geology by making reference to the CRG 250m grid (below, right) plotting soil by PI obtained when investigating claims.

Manchester, Trafford and Salford District District – Soil Plasticity Index



Soil PI Averaged by Sector



PI Interpolated on 250m CRG grid

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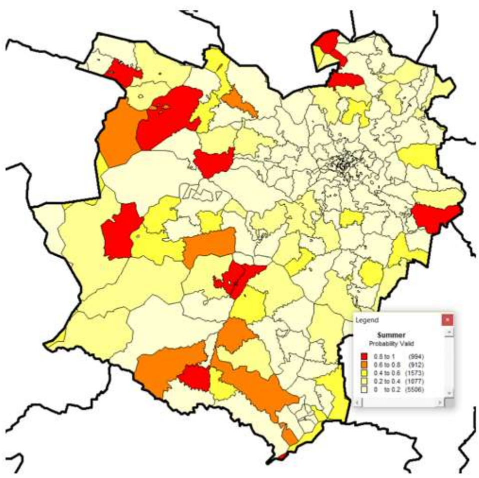
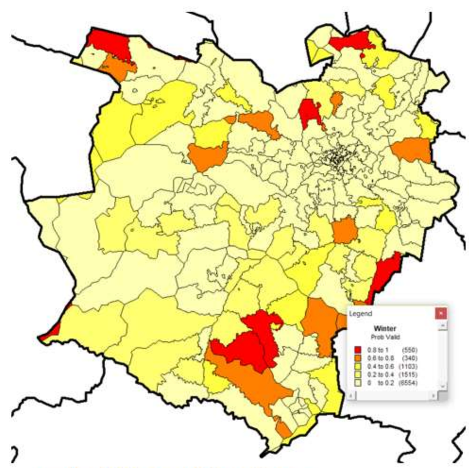
Below, the probability of whether a claim is likely to be valid or declined by season. It can be seen there is little to distinguish between them.

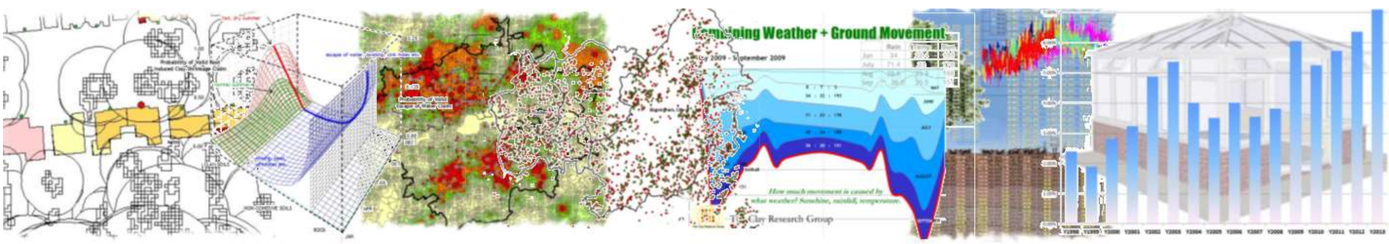
Manchester, Trafford and Salford District



Probability Valid, Summer



Probability Valid, Winter



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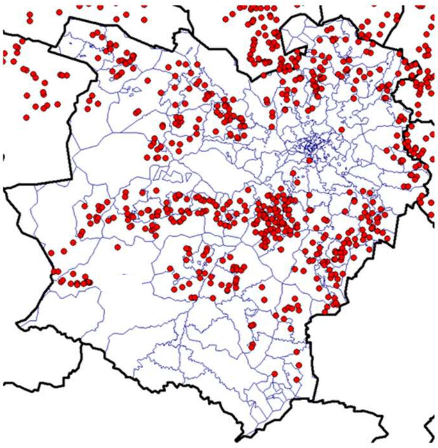
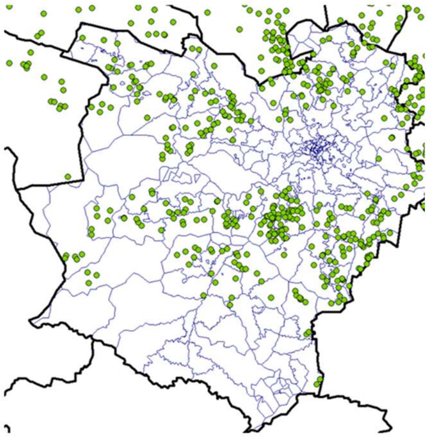
Liability by Sector. Escape of Water and Council Tree Claims Distribution

Manchester, Trafford and Salford District District – Liability Distribution



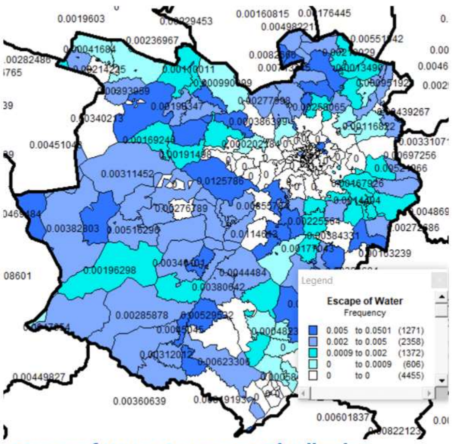
Declinatures



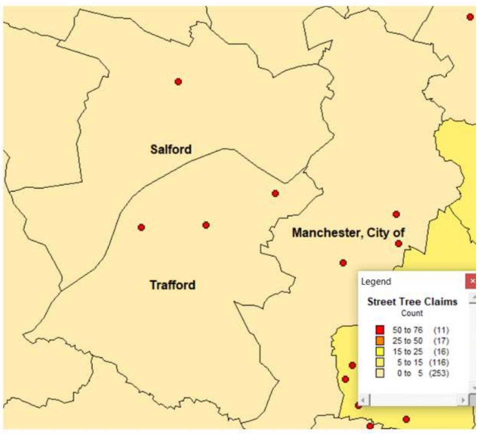
Valid Claims

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 reflects the primarily non-cohesive drift deposits – Till, sand and sandy gravels. 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 termed a 'hot spot'. The low numbers in the sample we hold reflects the variable, predominantly non-cohesive, geology.

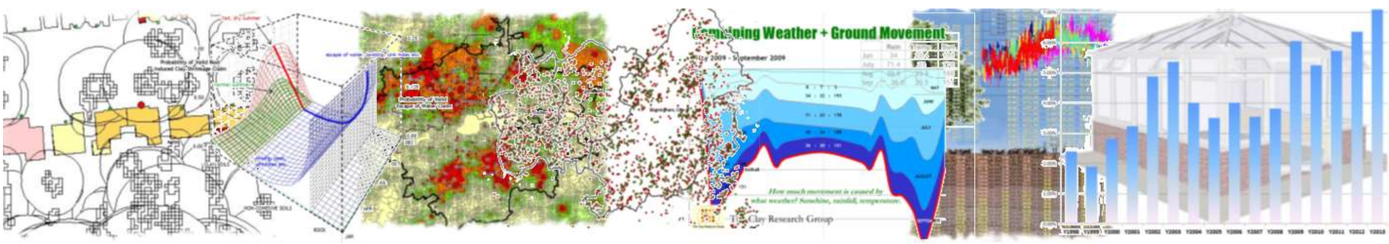
Manchester, Trafford and Salford District District – Postcode Distribution



Escape of Water Frequency Distribution



Street Tree Claims



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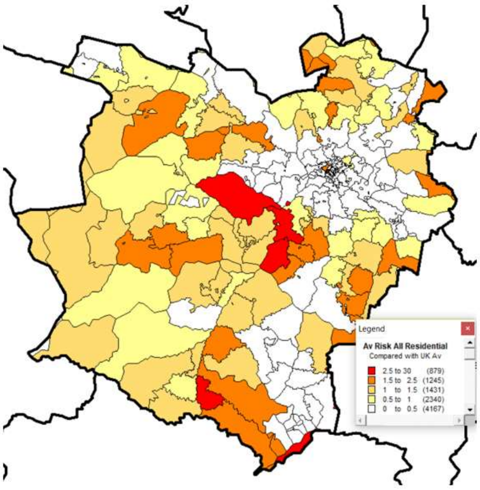
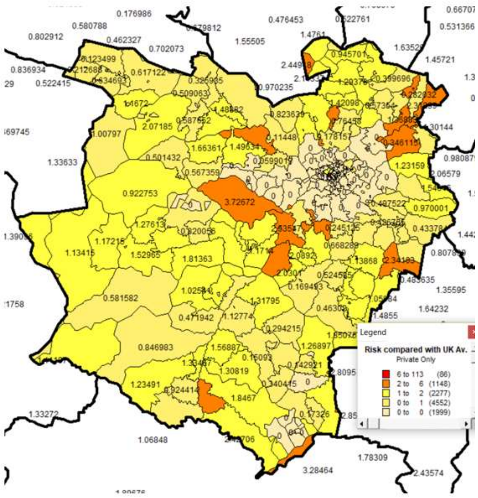
Manchester, Trafford and Salford - Frequencies, Count & Probabilities

Manchester, Trafford and Salford District



Combined Public and Private Frequency



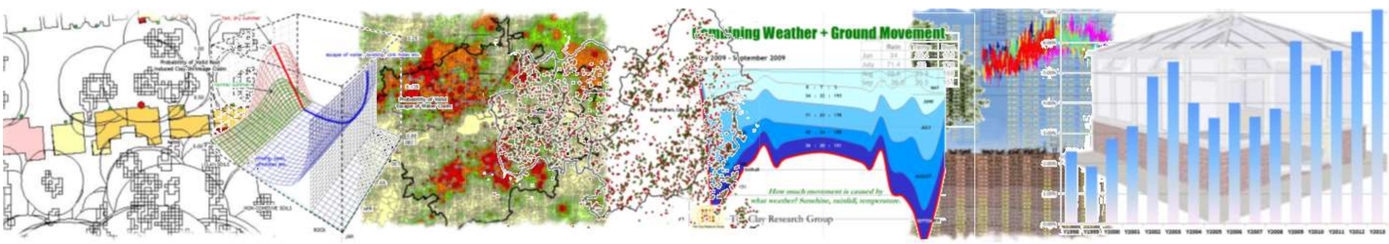
Private Only

Above, private housing plot links risk with the CRG geological map on page 8. Below, the figures reveal a borough with a modest seasonal risk. The chances of a claim being declined in the summer are just over 40%, reaching 70% in Trafford, and if it is valid, there is a higher than average probability that the cause will be water related. In the winter, the repudiation rate is slightly lower and if the claim is valid, again there is a high probability the cause will be water related.

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 - Manchester, Trafford and Salford District

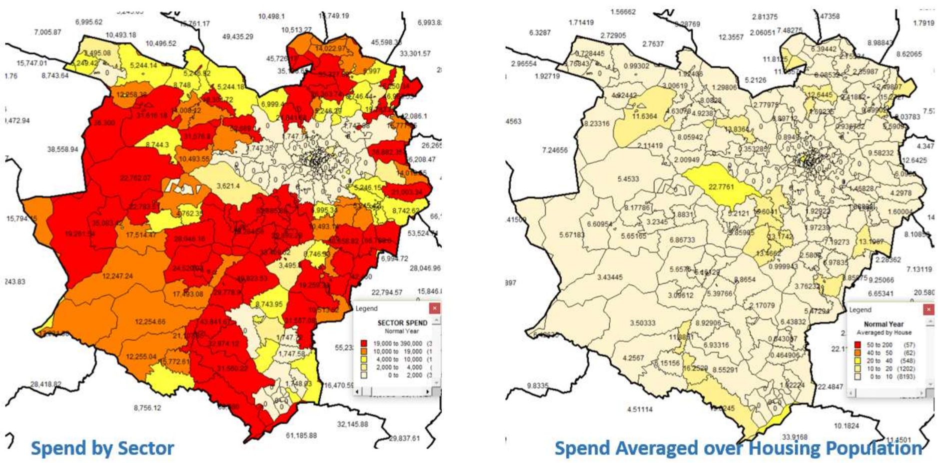
District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Manchester, City of	0.257	0.342	0.401	0.30	0.40	0.302
Trafford	0.053	0.257	0.69	0.13	0.64	0.233
Salford	0.143	0.307	0.55	0.24	0.52	0.238



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 normal (top) and surge (bottom) years. The figures reflect the study sample and will vary by the insurer's exposure and distribution.

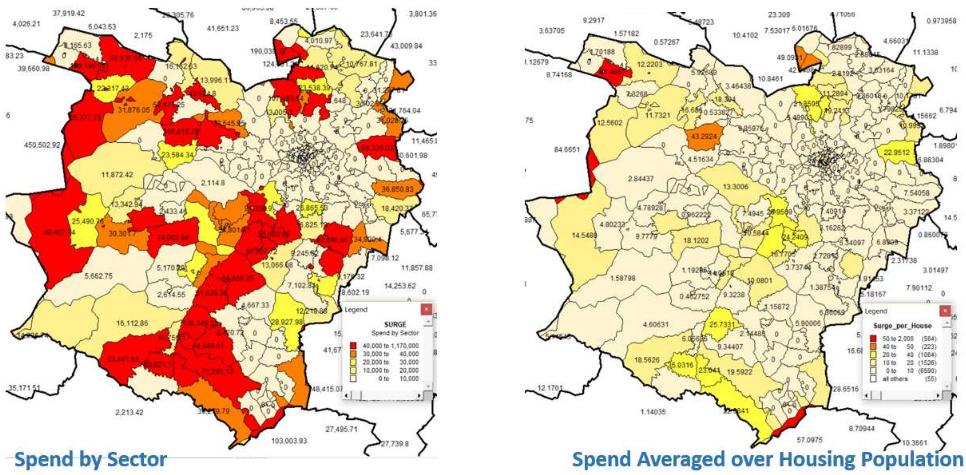
NORMAL YEAR SPEND - Manchester, Trafford and Salford District



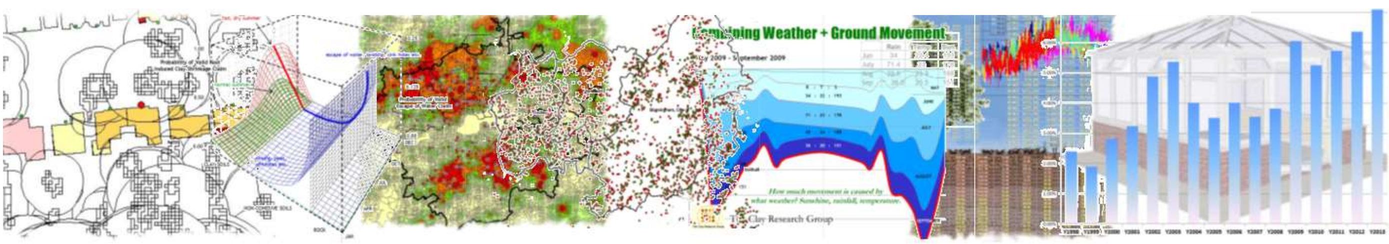
Spend by Sector — Spend Averaged over Housing Population

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. 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 cost per house.

SPEND in SURGE - Manchester, Trafford and Salford District



Spend by Sector — Spend Averaged over Housing Population



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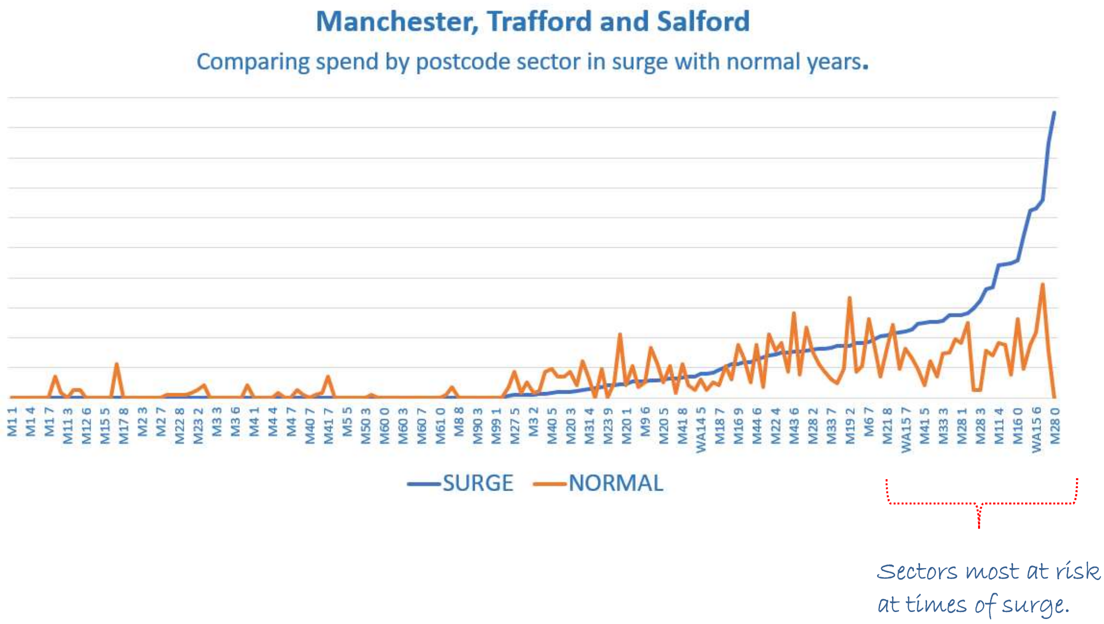

Identifying the variable risk across the district between normal and surge years by postcode sector. Divergence between the plots indicates those sectors most at risk at times of surge.

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.