

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



August 2022
Issue 207

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District and Sector Risk

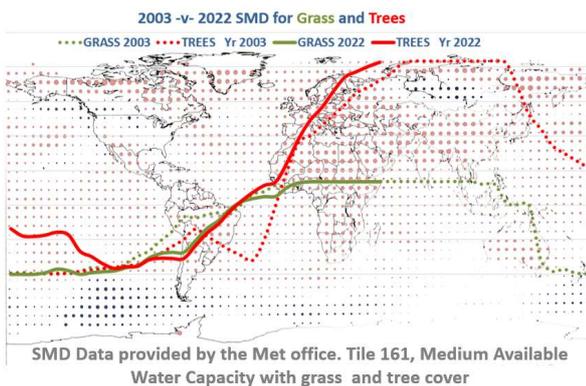
Bedford is the topic of the District Risk series in this month's edition and increased resolution is provided with examples at postcode sector level.

The study includes a review of cause and liability by season, providing a useful reference for underwriters, engineers and claim handlers.



Soil Moisture Deficit

Below, current SMD values provided by the Met Office from the Heathrow weather station, for both grass and tree cover, comparing them with the 2003 event year (dotted lines).



The profiles for both tree and grass cover continue to follow the 2003 event year.

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BGS Geology of Britain

The BGS 'retired' their Geology of Britain map viewer on 1 August 2022. This was a useful site giving access to 1:50,000 and 1:625,000 scale geological maps describing the solid and drift geology, as well as providing access to borehole data. Their updated site can be accessed at: <https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/>

Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at:

clayresearchgroup@gmail.com

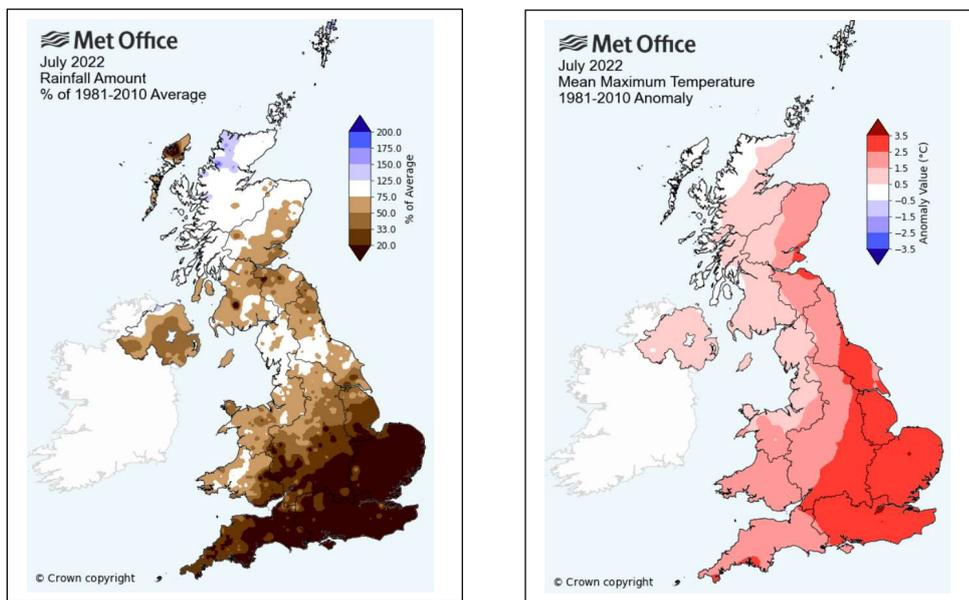


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Warmer and Drier

The Met Office report that July 2022 was the driest since 1935. For some parts of the country, it has been the driest since records began in 1836. Below, Met Office anomaly maps for July showing rainfall (left) and mean maximum temperature (right).

The south east has been around 20% drier and between 2.5 – 3.5 degC warmer this year than the 1981 – 2010 average and early reports suggest an associated increase in claim numbers.



Reducing CO2 Emissions. Fell the tree or underpin?

Richard Rollit, Technical Director of Innovation Group has been looking at research undertaken on the topic of tree removal, and whether underpinning is a better environmental solution. The following quote is of interest:

One tonne of reinforced concrete can generate 180kg of CO2 and in contrast a tree sequestrates about 22kg of CO2 a year. An underpinning scheme might use 25m³ of concrete (which is approximately 60 tonnes = 10,800 kg of CO2) or about 2 acres of new forest for a year.

Perhaps surprisingly, it would seem that removing the tree may be the better of the two options from an environmental viewpoint.

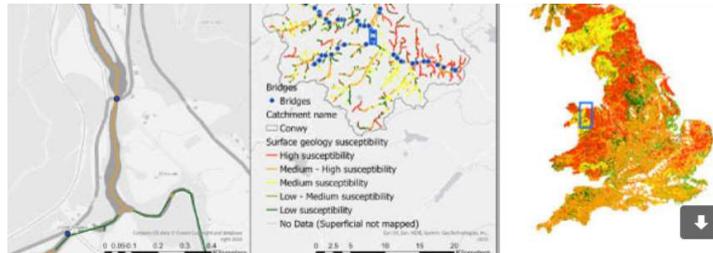
Carbon absorption capacity varies by species and age, and of course, some trees grow more quickly than others and therefore absorb CO2 faster, as is the case with the eucalyptus. In contrast, other tree species grow slower but also live longer and therefore absorb more CO2 over the long term, such as oak or beech.



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British Geological Survey GeoScour Dataset

The BGS have released a new dataset covering river scour – “BGS GeoScour Open datasets provide a generalised overview of the natural characteristics and properties of catchment and riverine environments for the assessment of river scour in Great Britain.”



Register for a half hour webinar scheduled for Thursday, 8th September commencing at 1pm. Go to: https://ukri.zoom.us/webinar/register/WN_a4ypNqerSfacpaWwUCUx1w

Street Trees Research Project

Laura McKechnie is studying for an MSc in Planning and Urban Leadership at the University of the West of England and has requested help in obtaining as much background information as possible. Laura explains “the research relates to my dissertation on the subject of delivering street trees in new developments. I have prepared a questionnaire seeking views on the opportunities and constraints relating to street tree provision within new development projects in the UK. The questionnaire should take 20-30 minutes to complete and I would be very grateful if people feel able to take the time to assist my research.”

If you are able to offer any assistance, log into the web site at to complete a questionnaire:

https://uwe.eu.qualtrics.com/jfe/form/SV_cZnDeGAuIMx7it0

Tree Design Action Group Updates

For updates on the events scheduled and recording of past events visit: <https://www.tdag.org.uk/events.html>

UKCRIC Newsletter

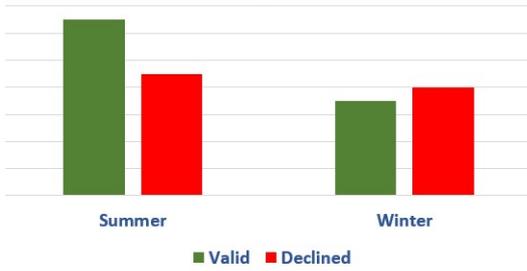
Sign up for the UKCRIC newsletter by visiting <https://www.ukcric.com/>. Enter details at the foot of the page and receive regular updates of current research. Scheduled events can be accessed at: <https://www.ukcric.com/events/>



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

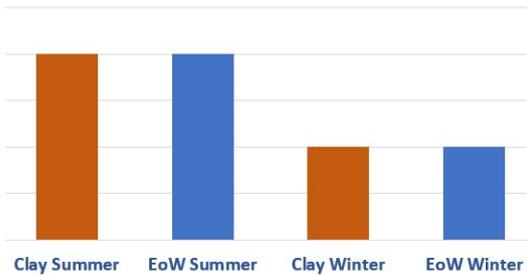
Liability Analysis



MK41 7 – 60% of claims accepted in the summer and slightly less than 50% in the winter. It is rated 3.2 times the UK average risk.

The cause of subsidence in the sector is equally balanced between clay shrinkage and escape of water in both summer and winter months.

Cause Analysis (valid)



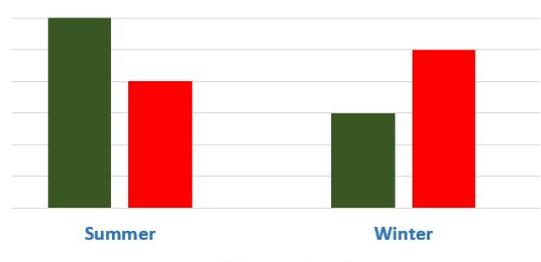
Site investigations undertaken in connection with claims revealed made ground to a depth of 500mm overlying a stiff brown/grey clay subsoil with fine gravel and a Plasticity Index of around 40%.

MK43 7 – Situated to the centre of the district, this is another high-risk sector with predominantly clay shrinkage claims throughout the year.

69% of claims were determined as valid in the summer and 50% in the winter. Spend exceeded a quarter of a million pounds. The sector is rated 3 times the risk of the national average.

Investigations revealed similar soil conditions to those described above, the clay soil having similar PI.

Liability Analysis



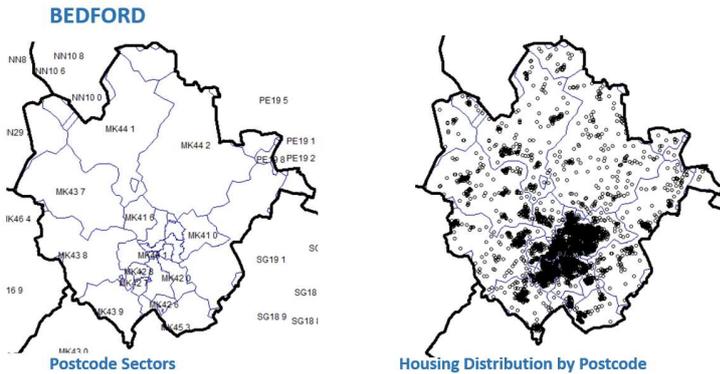
Cause Analysis (valid)



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Subsidence Risk Analysis – BEDFORD

Bedford occupies an area of 474km² and has a population of around 170,000.



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.

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?

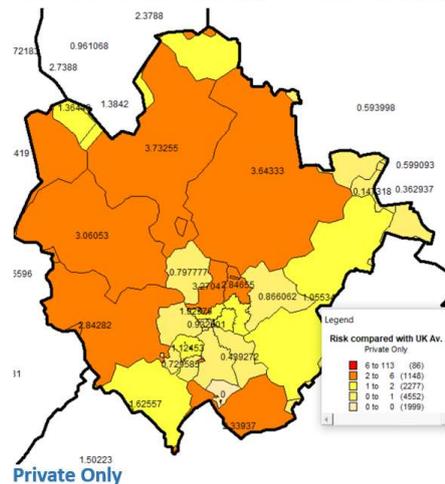
Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than a 'claim count' value.

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

Bedford is rated 62nd out of 413 districts in the UK from the sample analysed and is around 1.62x the risk of the UK average, or 0.42 on a normalised scale.

There is an increased risk to the north west of the borough as can be seen from the sector map, right.

BEDFORD - Sector Risk Compared with UK Average



Bedford district is rated around 1.62 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.

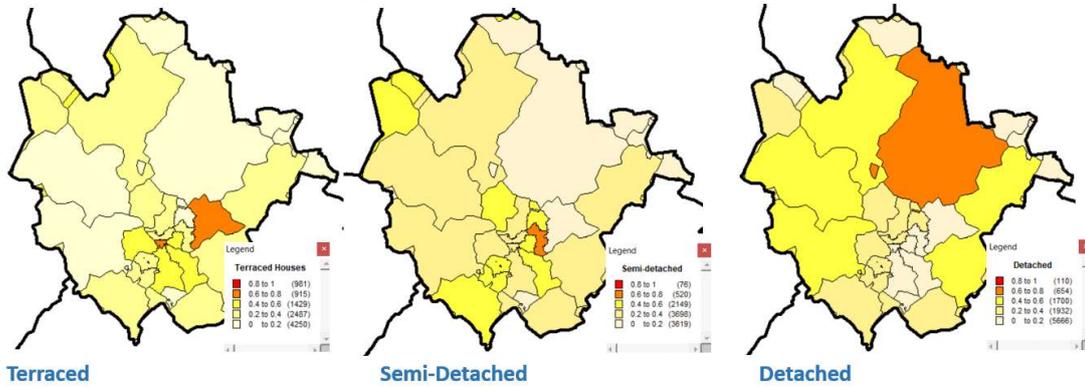


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BEDFORD - Properties by Style and Ownership

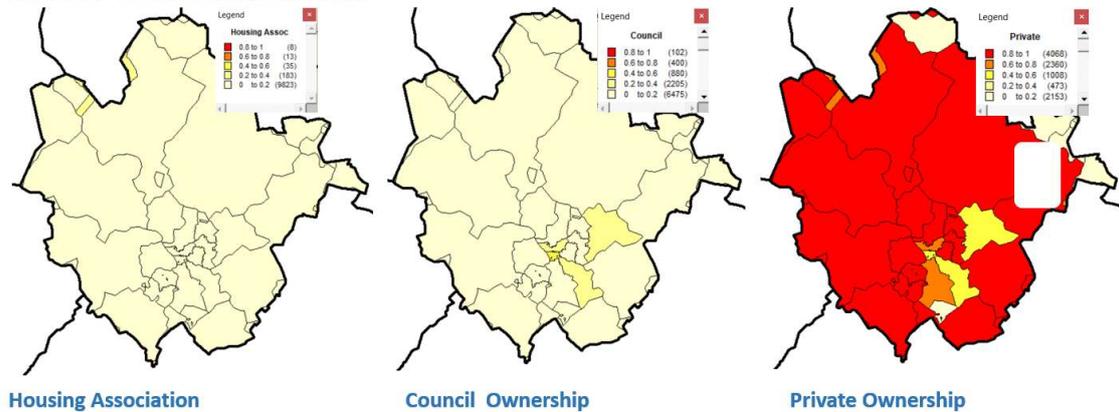
Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of application.

BEDFORD - Distribution by House Type



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

BEDFORD - Distribution by Ownership



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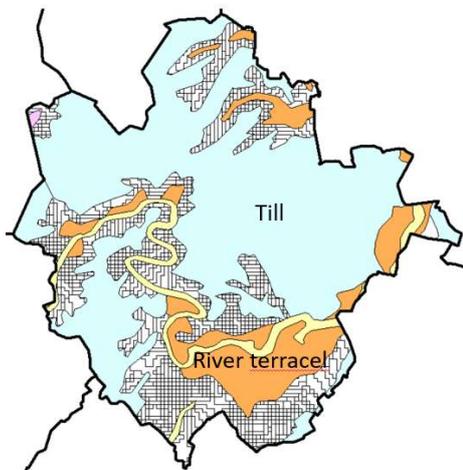
Subsidence Risk Analysis – BEDFORD

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.

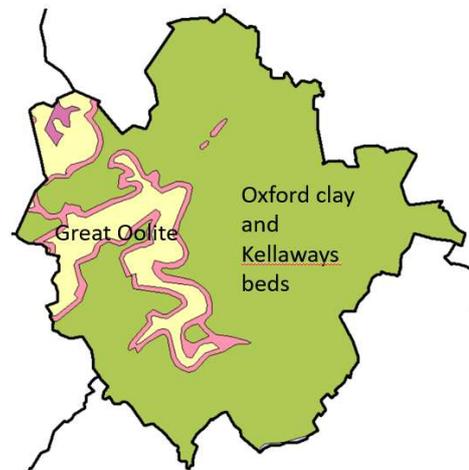
See page 10 for a seasonal analysis of the sample we hold which reveals that in the summer there is slightly less than 80% probability of a claim being valid, and of the valid claims, there is a high probability (around 85% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid is less than 20% - and if valid, there is around an 90% probability the cause will be due to an escape of water. Maps at the foot of the following page plot the seasonal distribution.

BEDFORD : BGS Geology – 1:625,000 scale



DRIFT DEPOSITS



SOLID GEOLOGY

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 in the summer, and escape of water in the winter months.

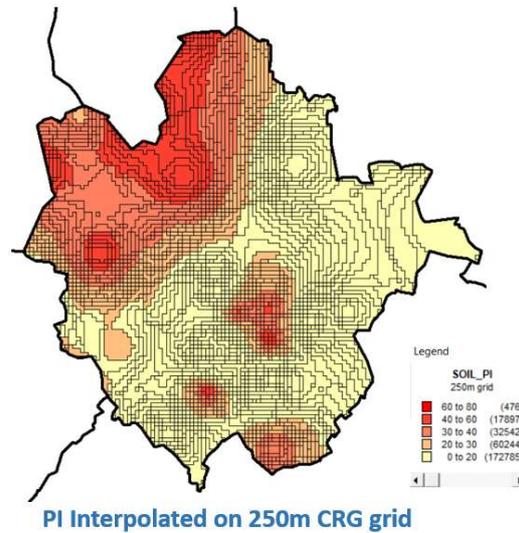
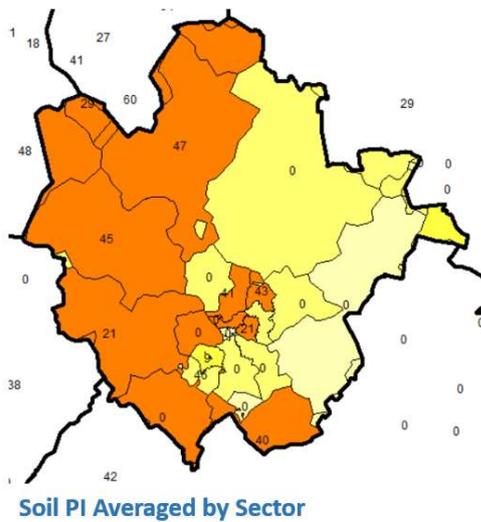


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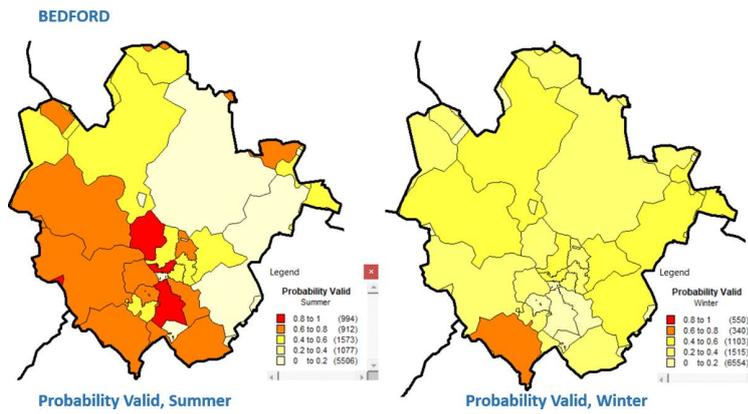
Liability by Geology and Season

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. The general pattern agrees with the BGS maps on the previous page.

BEDFORD – Soil Plasticity Index



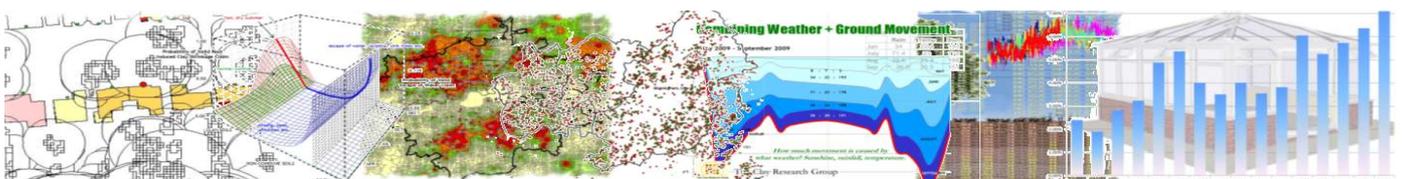
Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. A single claim in an area with low population can raise the risk as a result of using frequency estimates.



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

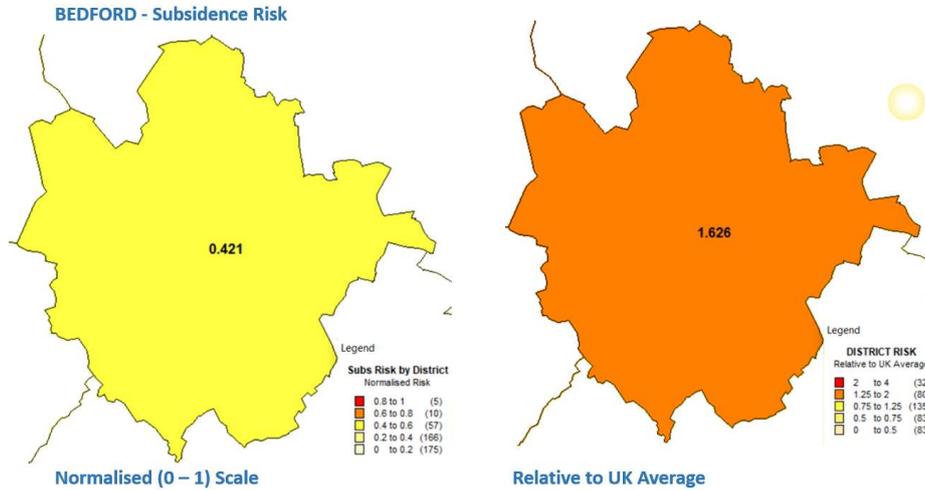
Combining the risk maps by season combined with the table on page 10 is perhaps the most useful way of assessing the likely cause, potential liability and geology using the values listed.

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.



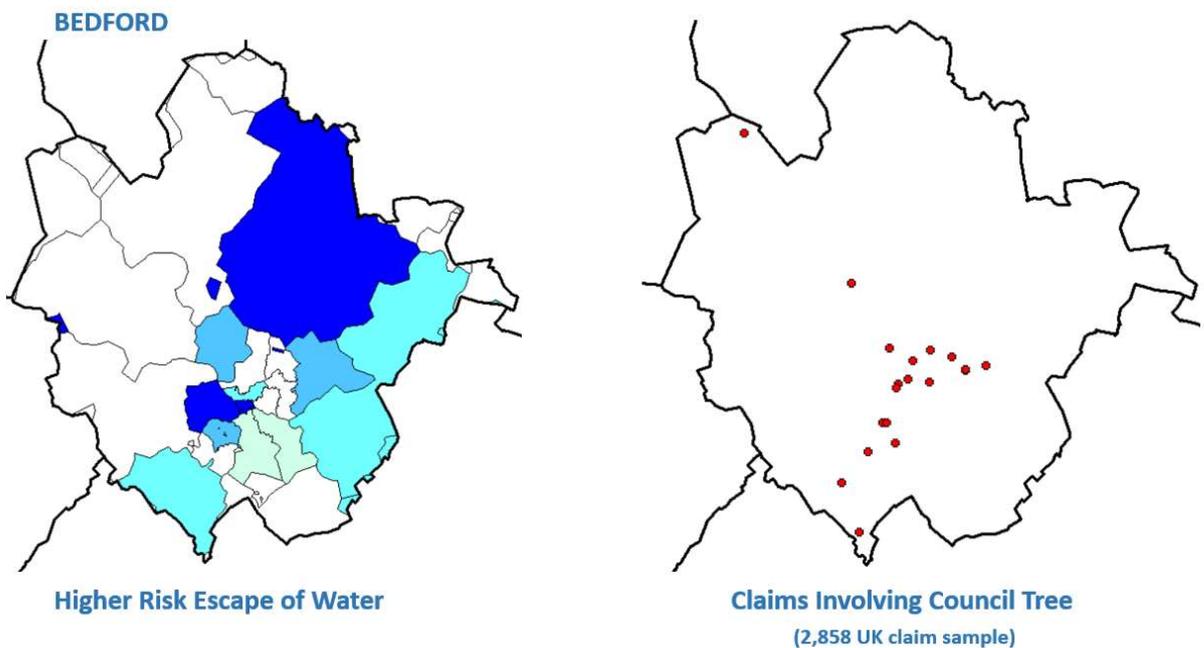
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District Risk -v- UK Average. EoW and Council Tree Risk.



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

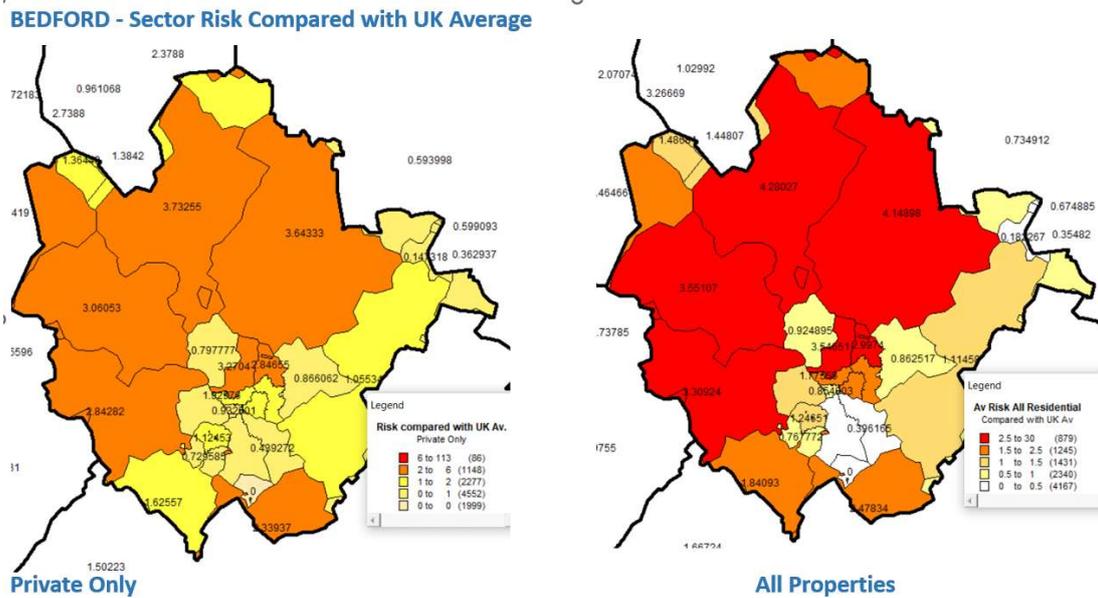
Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. The location coincides the presence of shrinkable clay soils – see both BGS (page 7) and CRG (page 8).



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BEDFORD - 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.



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 steady throughout the year.

Liability by Season - BEDFORD

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Bedford	0.729	0.056	0.215	0.01	0.16	0.83

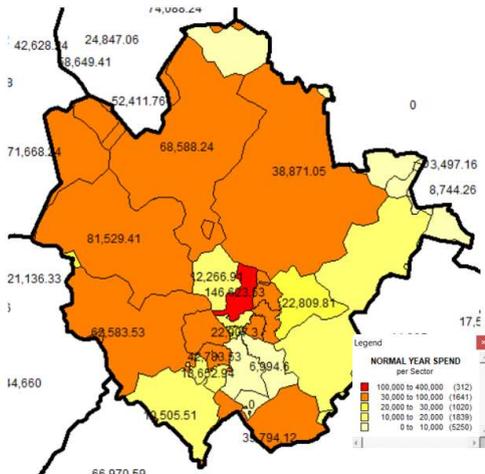


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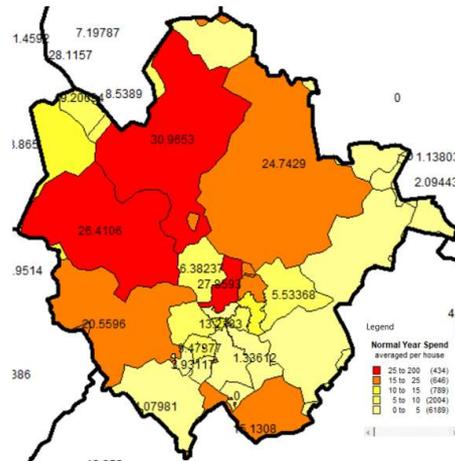
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 – BEDFORD



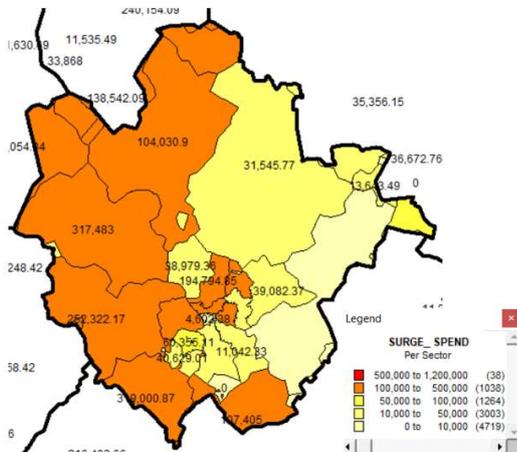
Spend by Sector



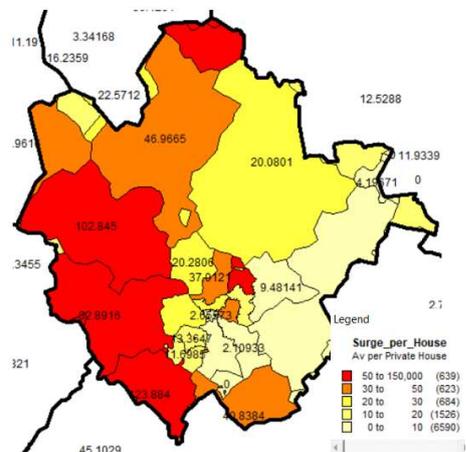
Spend Averaged over Housing Population

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 – BEDFORD



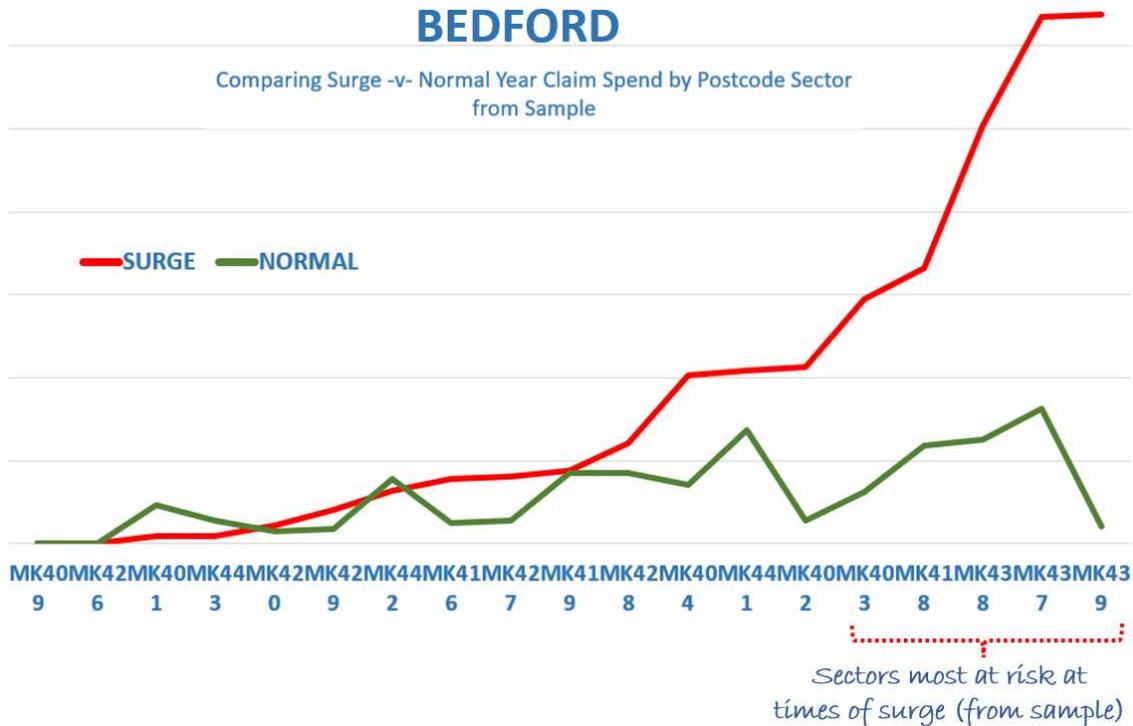
Spend by Sector



Spend Averaged over Housing Population



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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.

