

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



September 2024

Issue 232

The Clay Research Group

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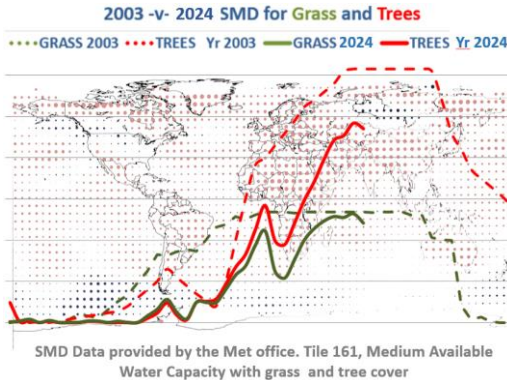
UK Met Office Anomaly Maps, August Electrical Resistivity Tomography

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Subsidence Risk Analysis by District
Chester

SMD

The SMD for both trees and grass remains well below values recorded in a surge year (2003 in this example) suggesting a surge is unlikely.



Contributions Welcome

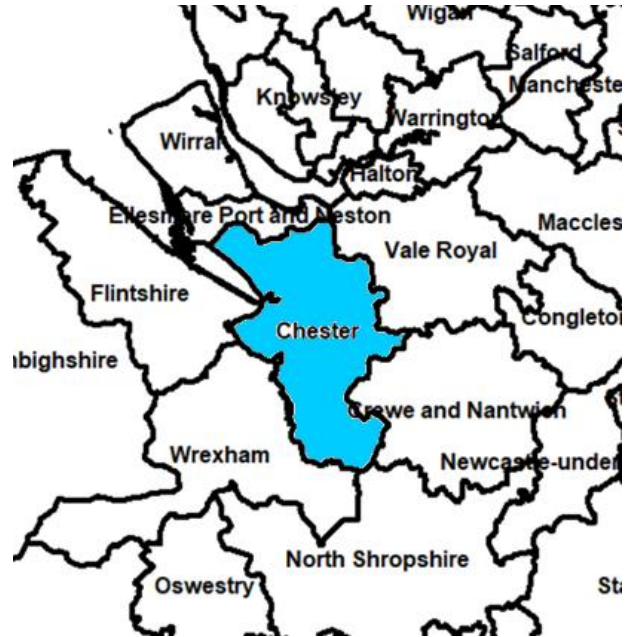
We welcome articles and comments from readers. If you have a contribution, please Email us at: clayresearchgroup@gmail.com

THE CLAY RESEARCH GROUP

www.theclayresearchgroup.org
clayresearchgroup@gmail.com

District and Sector Risk

Chester is the subject of the 'Risk by District' series in this month's edition. Its geology is predominantly till overlying sandstone – see Page 8.



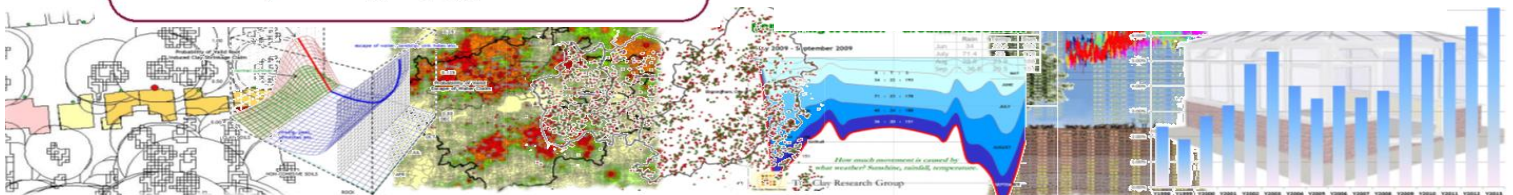
The risk maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

Updates

Subsidence Forum training day is scheduled to take place at Mythe Barn, Warwickshire on 3rd October 2024. <https://www.subsidenceforum.org.uk/>

DAFNI roadshows have been arranged at Swansea, Glasgow and Belfast - <https://www.dafni.ac.uk/>.

Sue James has requested information from anyone exploring the way in which designing with trees can support quality placemaking etc. and "has anyone worked on a project using trees for noise mitigation?". Contact Sue at sue.jamesriba@gmail.com



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Should councils introduce a charge to consider work required to trees in a conservation area or subject of a TPO?

Thanks to Keiron Hart of TAMLA Trees Ltd., for drawing attention the following.

The Ministry of Housing, Communities and Local Government has issued a consultation paper entitled “Proposed reforms to the National Planning Policy Framework and other changes to the planning system” which seeks views on a range of topics, some relating to trees. The following extract questions whether it would be appropriate to make a charge to take account of the costs involved when councils are required to consider applications to undertake work to trees in a conservation area or are the subject of a Tree Preservation Order.

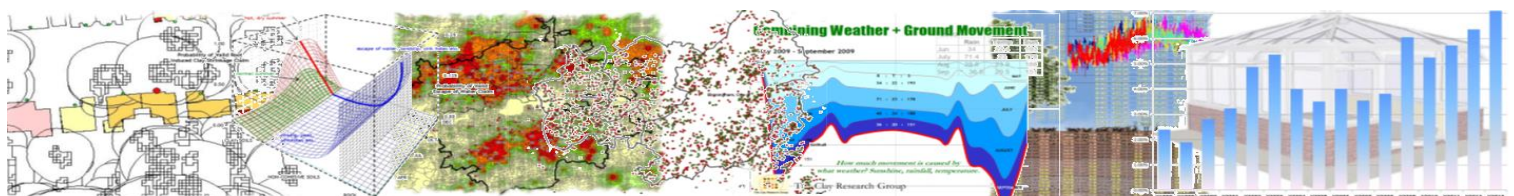
Fees for applications where there is currently no charge

14. There are some applications which are not currently subject to fees. These include listed building consents, consent to undertake relevant demolition in a conservation area, and works to trees that are protected because they are located in a conservation area or by a Tree Preservation Order. Fees are not charged for these applications, principally for the reason that owners cannot opt out of these designations and such designations confer burdens with regard to preservation and maintenance that are in the public interest. However, each of these applications incurs costs to local planning authorities. They often require additional publicity, and consideration by technical experts such as heritage and conservation or tree officers. This cost burden is felt most strongly in local planning authorities with a high proportion of these applications.

15. We are interested in views on whether a fee should be charged for any of these applications, or any other applications which do not currently charge a fee. This could be to cover the full cost or a small flat administration fee only to cover the administration, consultation and publicity costs of applications.

The opportunity to add your views to this, and related topics, closes on 24th September, 2024. The above issue is dealt with in Question 93 of the publication.

<https://www.gov.uk/government/consultations/proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system/proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system>



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ChatGPT – Identifying Heave

QUESTION to ChatGPT:

What are the indicators of heave damage to a property?

ChatGPT RESPONSE:

Heave damage in a property occurs when the ground beneath a building swells, usually due to an increase in moisture content. This can cause significant structural problems. Identifying the signs of heave damage early is crucial to prevent further deterioration and costly repairs. Here are the key indicators of heave damage:

1. Cracks in Walls and Floors

- **Vertical Cracks:** These are common in internal and external walls, especially in brickwork or plaster. They can also appear in concrete floors.
- **Stair-Step Cracks:** Cracks that follow the mortar joints in brick walls, often resembling a staircase.
- **Widening or Tapering Cracks:** Cracks that widen towards the top or bottom of a wall suggest differential movement due to heave.

2. Doors and Windows Misalignment

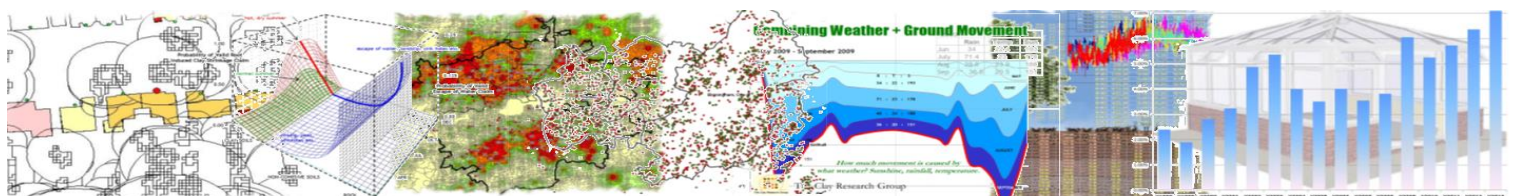
- **Sticking or Jamming:** Doors and windows may become difficult to open or close as the frames become misaligned due to the shifting foundation.
- **Gaps:** Visible gaps around door or window frames, often on one side, indicate that one part of the structure has moved more than the other.

3. Uneven Floors

- **Raised or Bulging Floors:** Heave can cause parts of the floor to rise, creating a noticeable slope or bulge.
- **Cracks in Floor Tiles or Concrete:** As the ground swells and pushes the floor upwards, it can lead to cracks, particularly in rigid materials like concrete or tiles.

4. Changes in Foundation or External Structure

- **Foundation Heave:** Visible upward movement of the foundation or parts of the structure, sometimes noticeable around the perimeter of the building.
- **Bulging or Bowing of Walls:** External walls may appear to bulge outward due to the pressure exerted by the heave.



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5. Damage to External Features

- **Movement in Paths or Driveways:** Paths, patios, or driveways that are close to the property may also show signs of heave, with sections rising or becoming uneven.
- **Detached or Misaligned Structures:** Outbuildings, fences, or walls attached to the main property may become misaligned.

6. Roof Distortion

- **Sagging or Warping:** The roofline may appear uneven, with sagging or distortion as the structure underneath shifts due to heave.

7. Plumbing Issues

- **Leaking Pipes:** Heave can cause plumbing pipes, particularly those beneath the foundation, to crack or rupture.
- **Drainage Problems:** Improper drainage or slow-draining fixtures may occur if pipes have been dislodged or blocked due to ground movement.

8. Visible Ground Changes

- **Swelling Soil:** The soil around the property may appear raised or swollen, particularly in clay-rich areas.
- **Surface Water Pooling:** If the ground has swelled unevenly, water may start to pool in areas that previously drained well.

9. Gaps between Structure and Ground

- **Separation from Ground:** In extreme cases, parts of the building may appear to lift off the ground, creating visible gaps between the foundation and the soil.

10. Roof and Chimney Cracks

- **Chimney Movement:** Chimneys, which are often more rigid, may develop cracks or separate from the main structure as the foundation shifts.

Recognizing these signs early is essential for addressing heave damage. If multiple indicators are present, it is advisable to consult a structural engineer or a professional surveyor to assess the extent of the damage and recommend appropriate remedial actions.

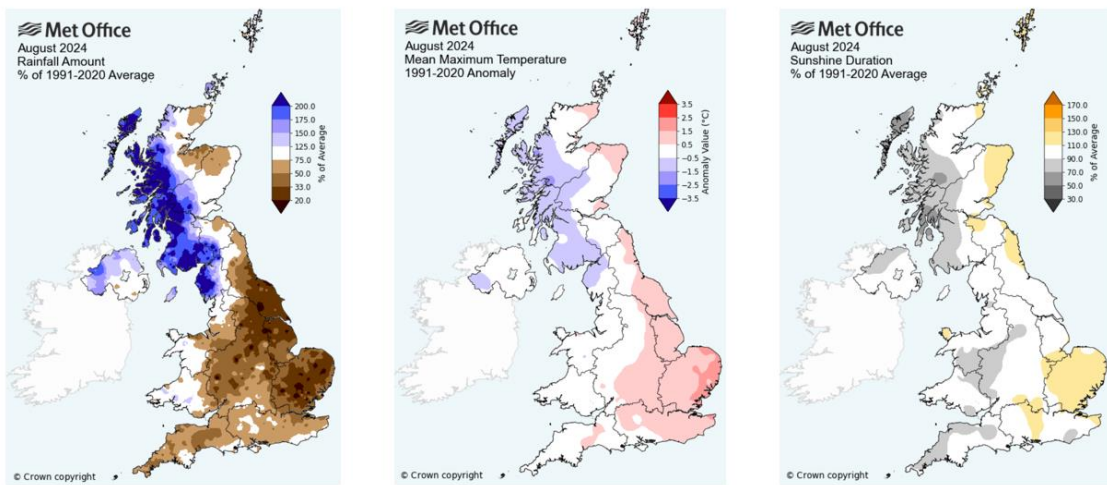


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Met Office Anomaly Maps for August 2024

Anomaly maps from the Met Office web site for the month of August 2024 reproduced below.

The month can be summed up as being drier and slightly warmer in the south-east and wetter and a little cooler to the north west, with below average sunshine to the west much of the UK and slightly more sunshine to areas along to the east coast than the average for July when compared with the 1991 – 2020 average.

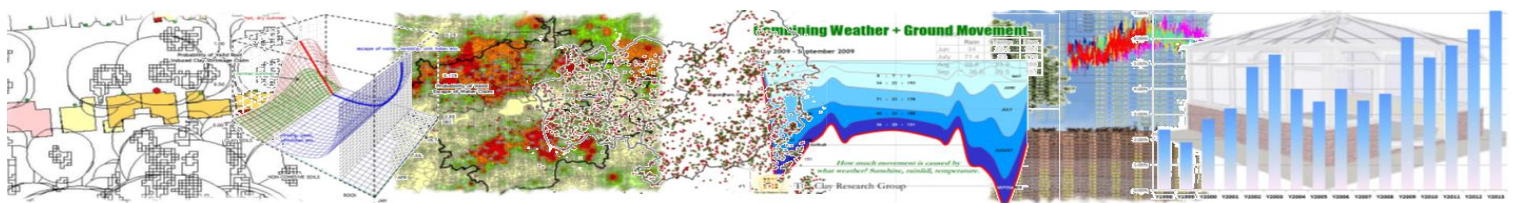
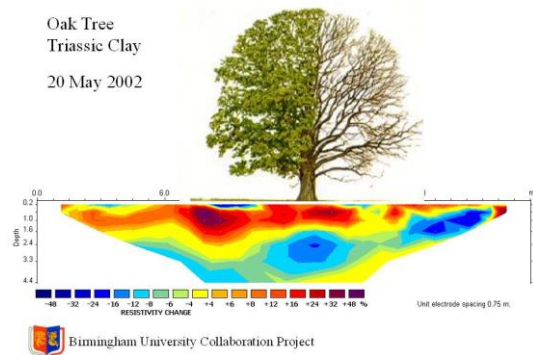


<https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps>

Electrical Resistivity Tomography

Allan Tew, Head of Engineering at Innovation, is putting together a team to look into the benefits of using Electrical Resistivity Tomography to detect changes in the moisture content of clay soils associated with root activity, along with several related fields of research.

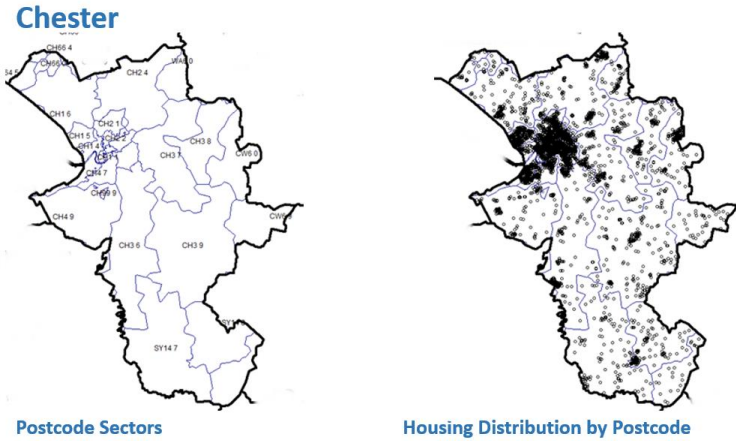
Work should start shortly with guidance from Professor Ian Jefferson, Birmingham University, who, along with Prof. Nigel Cassidy, was involved with work at the Aldenham research site over several years, guiding students towards their PhD's.



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Subsidence Risk Analysis – Chester

Chester is located close to the Welsh border and occupies an area of 448km² with a population of around 93,000.



Distribution of housing stock using full postcode as a proxy. Each sector covers around 3,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

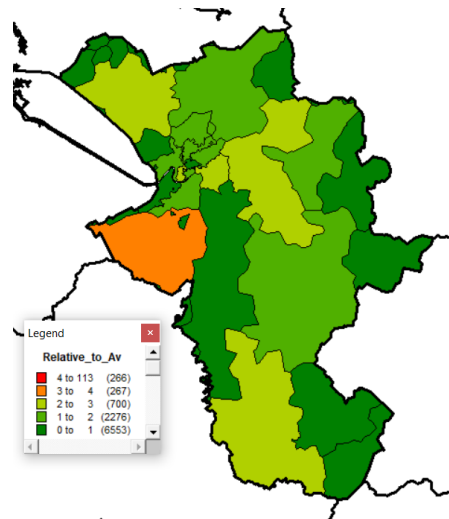
From the sample we hold sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Chester is rated 91st out of 413 districts in the UK from the sample analysed and is around 1.383x the risk of the UK average, or 0.358 on a normalised 0 - 1 scale.

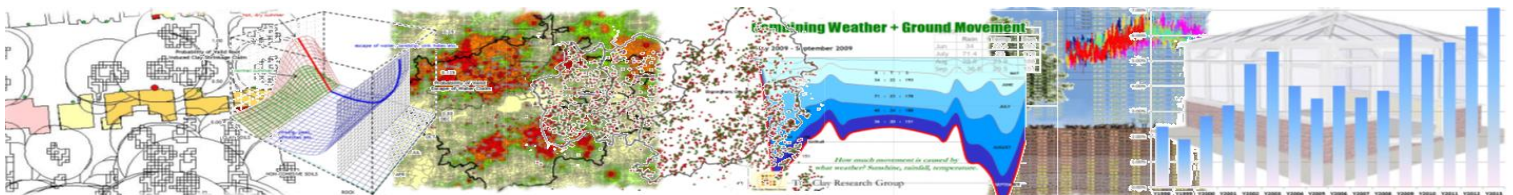
There is a slightly greater than average risk across the district as can be seen from the sector map, right. The geology (see pages 8 and 9) no doubt accounts for this with non-cohesive soils overlying sandstone.

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.



Sector risk compared to UK average from the sample analysed. Private ownership.

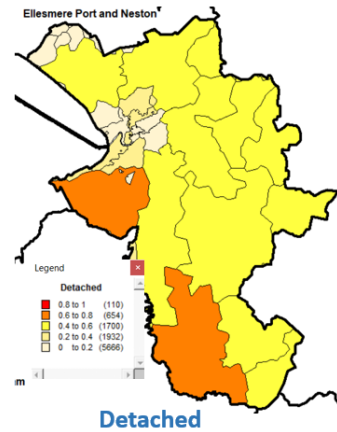
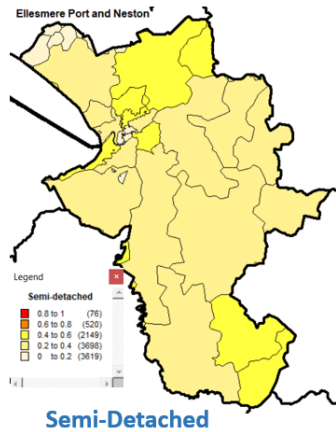
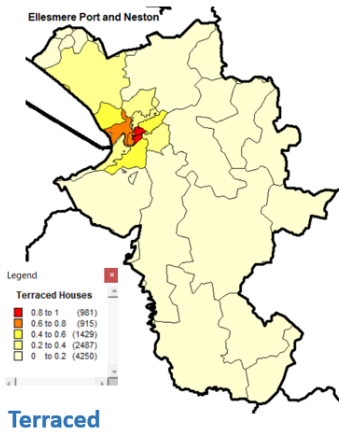


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Chester. Properties by Style and Ownership

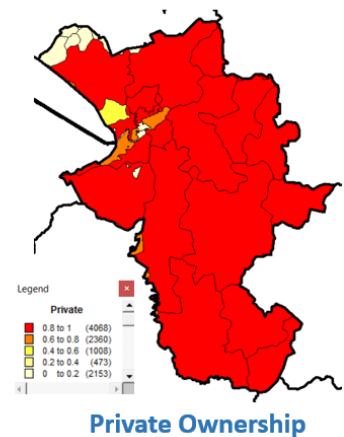
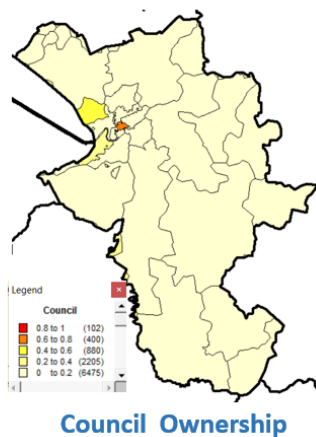
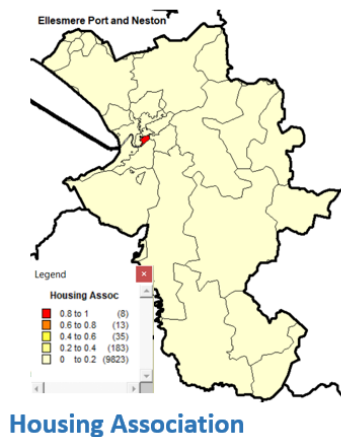
Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information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

Chester - Distribution by House Type



Distribution by ownership is shown below. Detached, private properties are the dominant class across the district.

Chester - Distribution by Ownership



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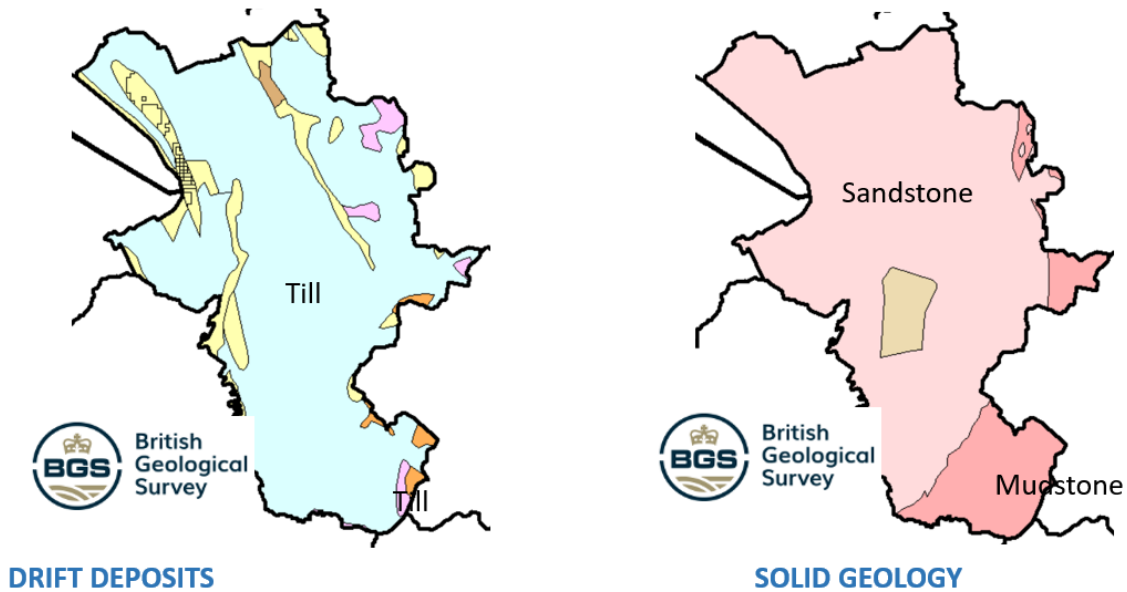
Subsidence Risk Analysis – Chester

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.

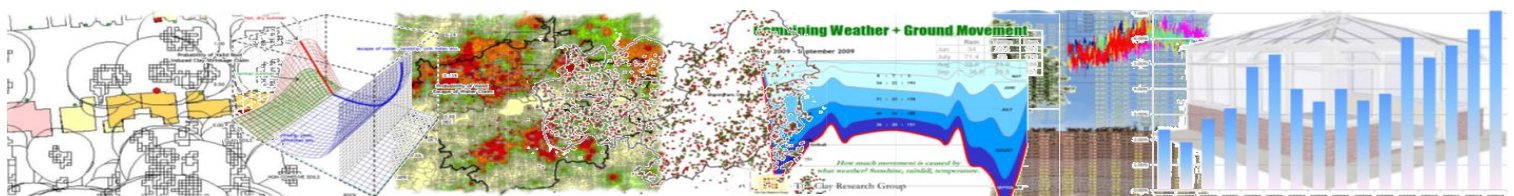
See page 11 for a seasonal analysis of the sample which reveals that, at district level, there is around a 60% probability of a claim being valid in the summer and, of the valid claims, there is around a 50% chance that the damage will have been caused by clay shrinkage or escape of water. In the winter, the likelihood of a claim being valid is around 70% and of the valid claims there is a 50% chance of the cause being clay shrinkage or escape of water.

Maps at the foot of the following page plot the seasonal distribution and provide an indication of risk by geological series.

Chester : BGS Geology – 1:625,000 scale



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.

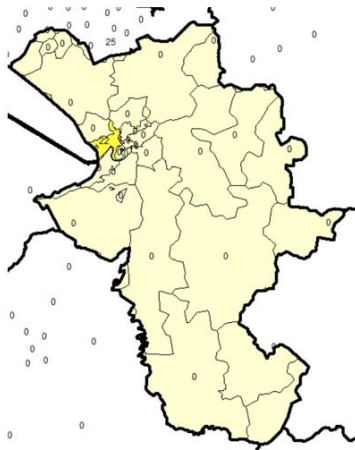


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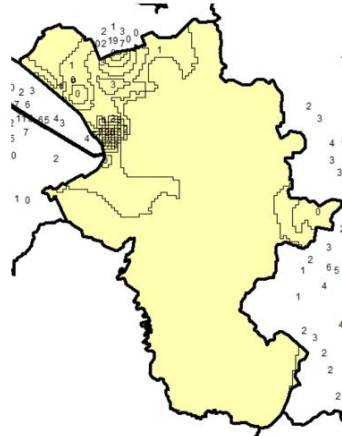
Liability by Geology and Season

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.

Chester – Soil Plasticity Index



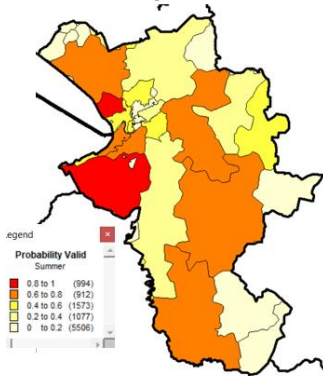
Soil PI Averaged by Sector



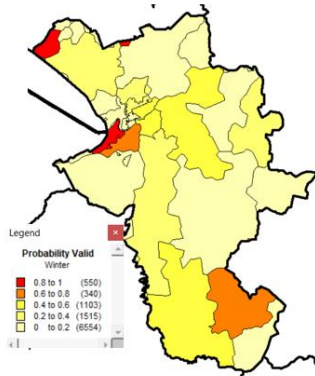
PI Interpolated on 250m CRG grid

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.

Chester – by season



Probability Valid, Summer

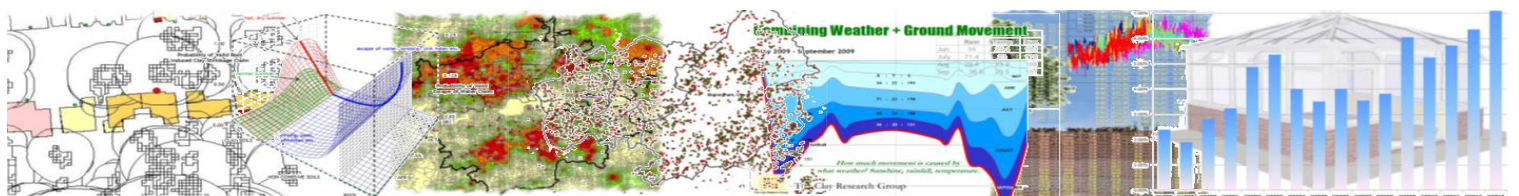


Probability Valid, Winter

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

Combining the risk maps by season and reviewing the table on page 11 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.

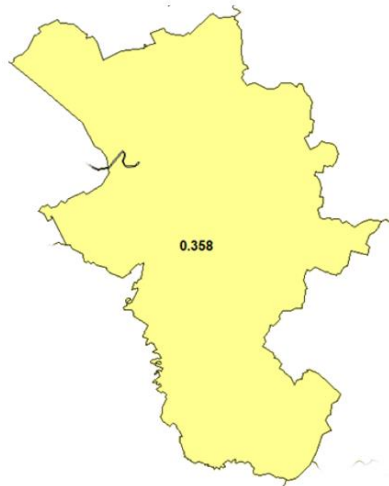
The 'claim by cause' distribution and the risk posed by the soil types is illustrated at the foot of the following page. A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



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District Risk. EoW and Council Tree Risk.

Chester - Subsidence Risk Relative to UK



Normalised (0 – 1) Scale

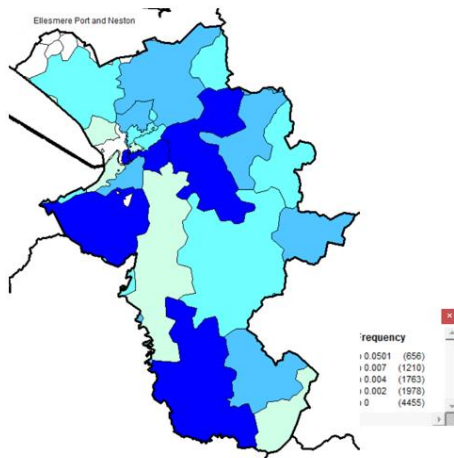


Relative to UK Average

Below, left, mapping the frequency of escape of water claims confirms the presence of non-cohesive soils. The distribution on the map reflects the presence of non-cohesive drift deposits. 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.

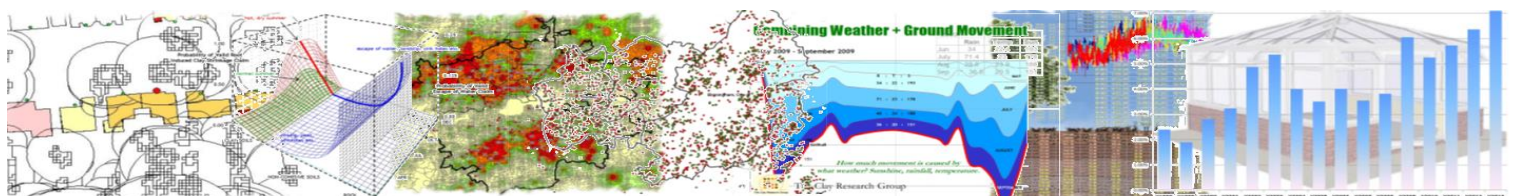
Chester



Higher Risk Escape of Water



Claims Involving Council Tree
(2,858 UK claim sample)

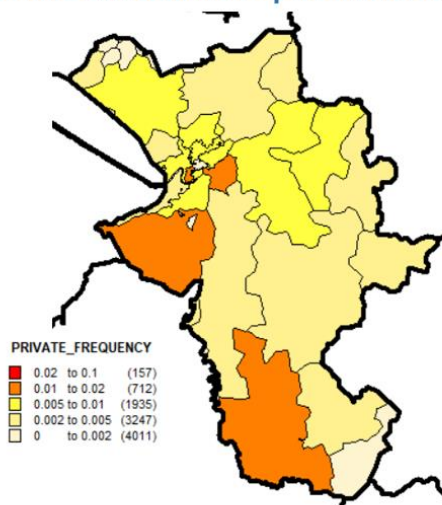


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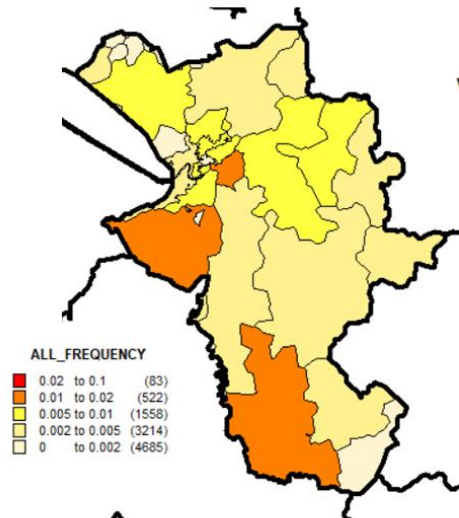
Chester - Frequencies & Probabilities

Below, mapping the risk of subsidence by ownership. Claims frequency that includes council and housing association properties delivers a misleading value of risk as they tend to self-insure. The following show the normalised risk, taking account of the private housing population – that is, the rating compared with the average value for each category.

Chester - Sector Risk Compared with UK Average



Private Only



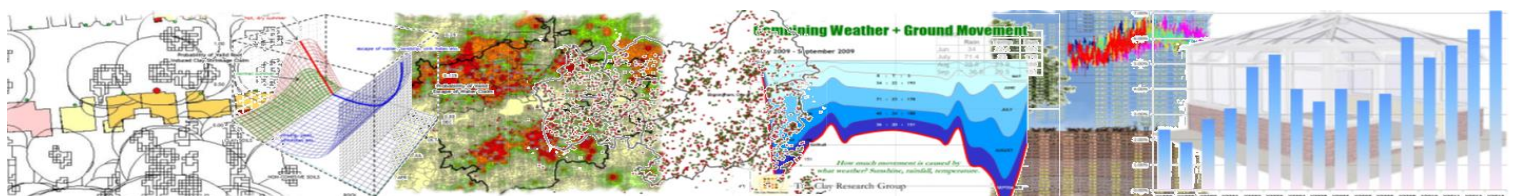
All Properties

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 have a higher probability of being 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 - Chester

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Chester	0.292	0.307	0.401	0.34	0.36	0.302

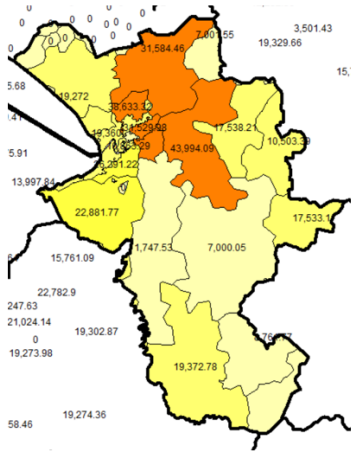


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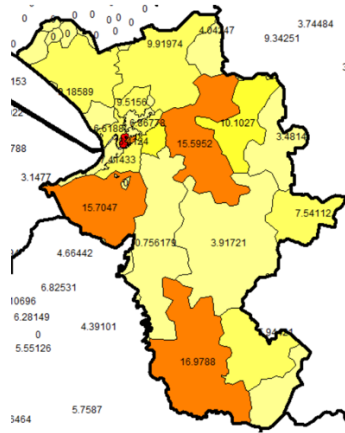
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Normal & Surge Years

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 – Chester



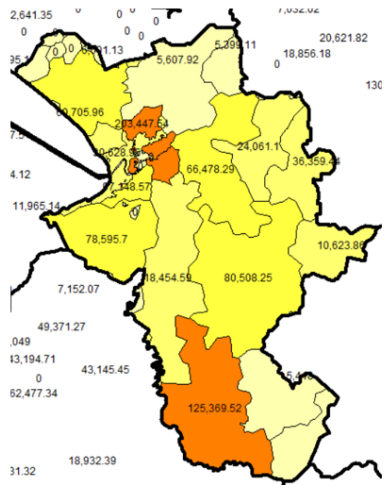
Spend by Sector



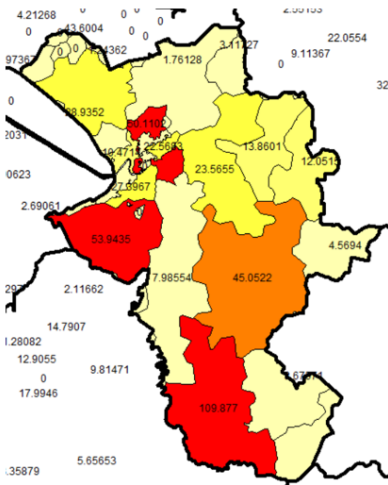
Spend Averaged Over Private Housing Population

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 private 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.

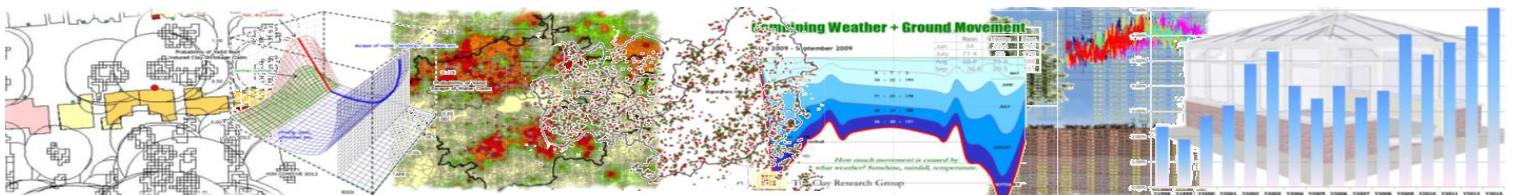
SPEND in SURGE – Chester



Spend by Sector



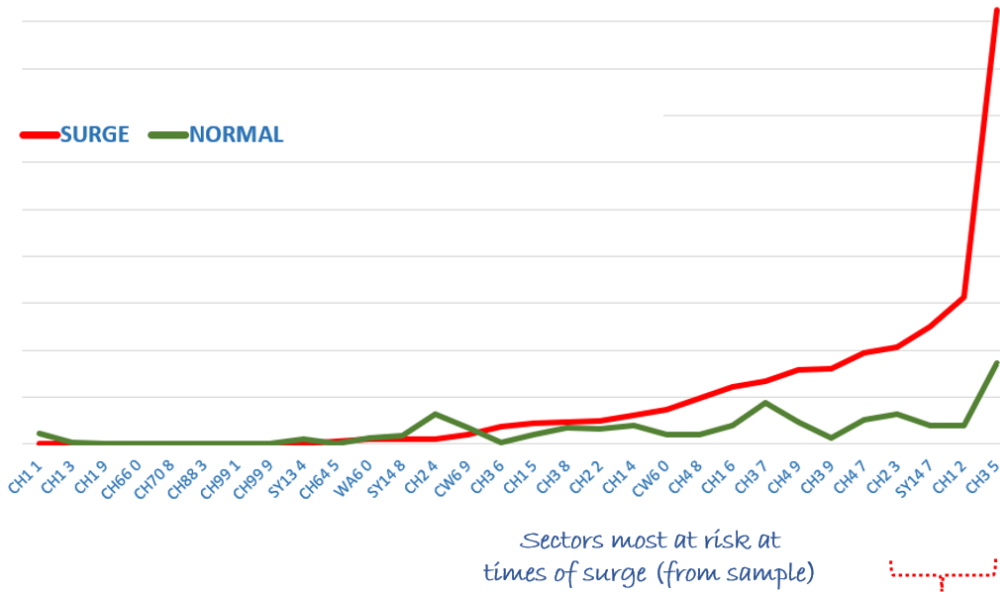
Spend Averaged over Private Housing Population



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Chester

Comparing Surge -v- Normal Year Claim Spend by Postcode Sector from Sample



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.

