

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



October 2024

Issue 233

The Clay Research Group

CONTENTS

Issue 233, October 2024

Page 2

Weather and Surge

Page 3

ChatGPT. Does Rain = Sinkholes?

Page 4

UK Met Office Anomaly Maps, September

Pages 5 - 12

Subsidence Risk Analysis by District

Tunbridge Wells

District and Sector Risk

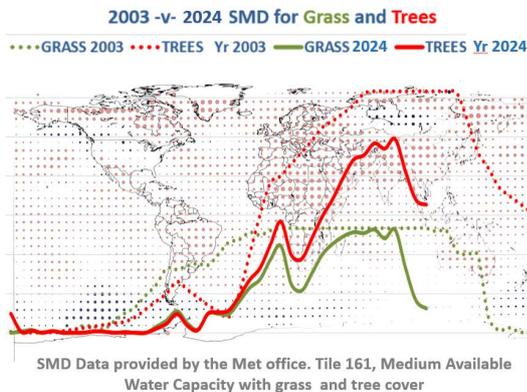
Tunbridge Wells, Kent, is the subject of the 'Risk by District' series in this month's edition. Its geology is predominantly outcropping Hastings beds – see Page 7.



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

SMD

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



Updates

TDAG and the Arboricultural Association are working with the NHBC on a review of foundation design for low rise buildings on shrinkable soils with a view to updating NHBC Standards, Chapter 4.2.

Visit the TDAG web site at <https://www.tdag.org.uk/> and sign up for regular monthly NHBC updates at:

<https://www.nhbc.co.uk/builders/products-and-services/techzone/nhbc-standards>

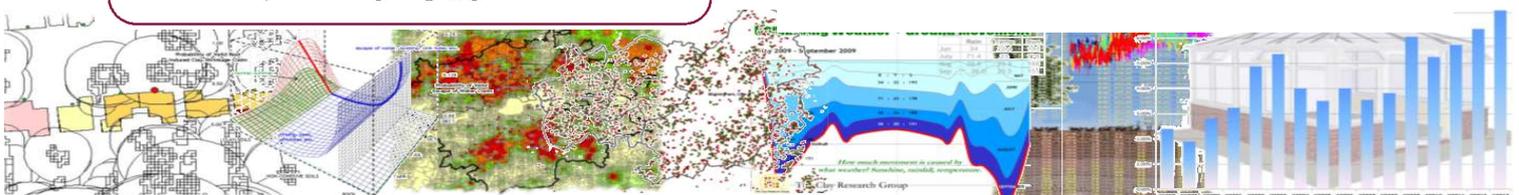
Contributions Welcome

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

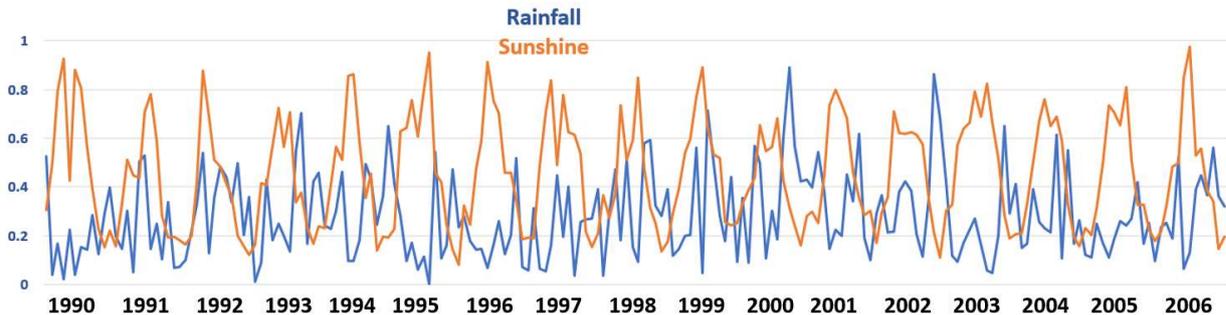
clayresearchgroup@gmail.com



The Clay Research Group

Weather and Surge

The graph below plots rainfall and sunshine from Met Office data recorded at the Heathrow weather station. Values for each have been plotted on a normalised 0 – 1 scale. It is interesting (but not surprising) to see high values for sunshine and low values for rainfall coincident with subsidence surge years 1990, 1995 2003 and 2006.

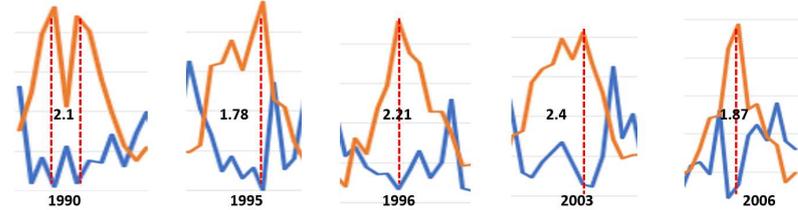


The following extracts illustrate the difference between surge and normal years, marking the most extreme differences between hours of sunshine and rainfall per month by a red dotted line. Values indicate *sunshine-rainfall* for the months June to September, inclusive.

With the exception of 2006, all have significant profiles over several months.

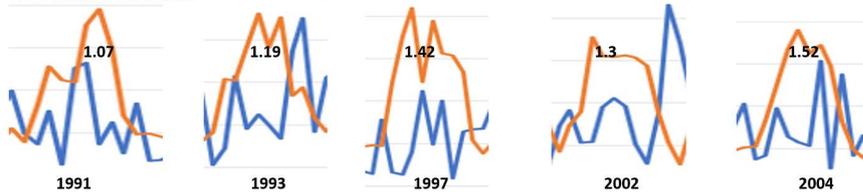
2006 had fewer months with higher-than-average values. Nonetheless, it still delivered a significant *sunshine-rainfall* value.

SURGE YEARS



Sunshine-rainfall values in the range 5.26 – 5.8 for surge years.

NORMAL YEARS



Sunshine-rainfall values in the range 4.08 – 4.65 for normal years.

For normal years, the difference between values for sunshine and rainfall are less than for surge years, with moisture values interrupting the risk.

Unfortunately. The exercise doesn't deliver a predictive function but it does extend our knowledge of the interaction between the elements. More next month.



The Clay Research Group

ChatGPT – Risk of Sinkholes



QUESTION to ChatGPT:

Are we likely to see an increase in sinkhole claims following the heavy rainfall over the last 12 months?

ChatGPT RESPONSE:

Yes, it's highly likely that we will see an increase in sinkhole claims following the heavy rainfall experienced over the last 12 months. Sinkholes are often triggered by a combination of natural geological processes and external factors like excessive rain, flooding, or storms. Here's why:

1. Water-Induced Erosion:

Heavy rainfall can cause water to seep into the ground, especially in areas where the subsurface contains soluble rocks like limestone, gypsum, or salt. This leads to **erosion of underground cavities**, which may eventually collapse and form sinkholes. The more rainfall, the more erosion, and the higher the chance of a sinkhole forming.

2. Destabilization of Soil:

Rainwater can saturate the soil, causing it to lose its ability to support the ground above it. If the bedrock below dissolves due to rainwater (often acidic from atmospheric CO₂), it can leave voids that are prone to collapse. When soil becomes overly saturated from prolonged or heavy rain, the risk of destabilization and sinkhole formation rises significantly.

3. Increased Groundwater Levels:

In some regions, the **fluctuation of groundwater levels** can contribute to sinkhole formation. Heavy rain may cause a temporary rise in groundwater levels, which in turn can contribute to both the formation and collapse of voids in susceptible geological areas.

4. Drainage System Overload:

Poor drainage or overwhelmed drainage systems during intense rain events can exacerbate water pooling and soil saturation, which can further contribute to sinkhole formation in both urban and rural areas.

5. History and Geography:

Certain regions are more prone to sinkholes due to their underlying geology, particularly areas with karst terrain (regions with easily dissolved rocks). If these areas have experienced **above-average rainfall**, the likelihood of sinkhole formation increases, and thus claims related to property damage from these phenomena are expected to rise.



The Clay Research Group

Potential for Increased Claims:

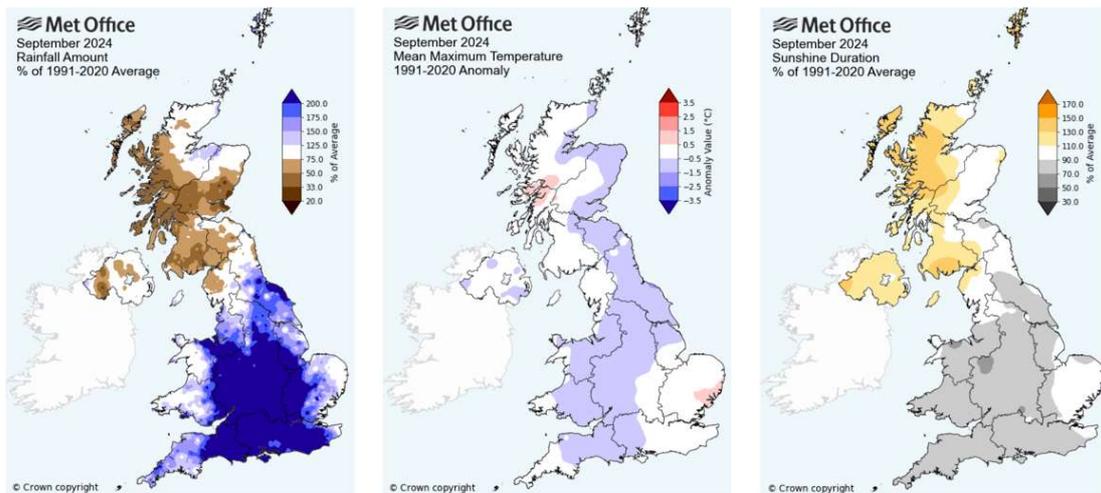
- **Insurance Impact:** As sinkholes cause damage to homes, roads, and infrastructure, insurance claims for sinkhole damage are likely to surge. This is particularly true in areas where sinkhole insurance is common, such as Florida and other sinkhole-prone states.
- **Delayed Effects:** While some sinkholes form quickly after heavy rains, others may develop over time. This means claims may continue to rise even months after the most intense rainfall events.

Overall, the combination of geological susceptibility and unusually heavy or prolonged rainfall creates conditions ripe for increased sinkhole activity and the associated insurance claims.

Met Office Anomaly Maps for September 2024

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

The month can be summed up as being wetter in the south and a little drier to the north west, a little cooler with slightly lower sunshine duration to the south, and higher to the north west when compared with the 1991 – 2020 average.



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

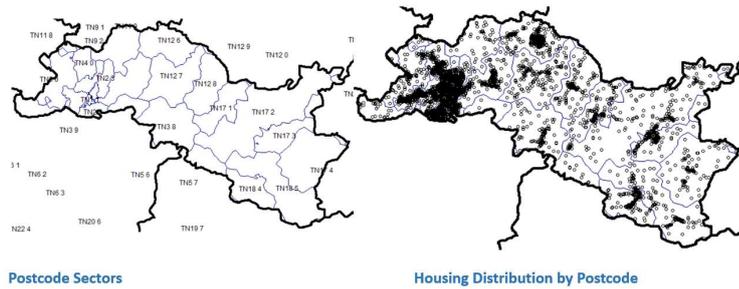


The Clay Research Group

Subsidence Risk Analysis – Tunbridge Wells

Tunbridge Wells is located in Kent and occupies an area of 331km² with a population of around 60,000.

Tunbridge Wells



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.

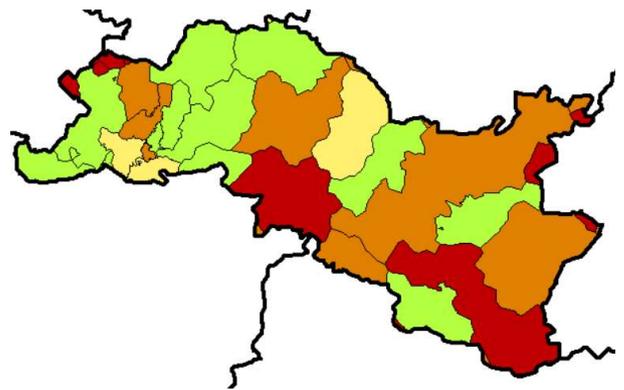
From the sample we hold sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Tunbridge Wells is rated 116th out of 413 districts in the UK from the sample analysed and is around 1.234x the risk of the UK average, or 0.32 on a normalised 0 - 1 scale.

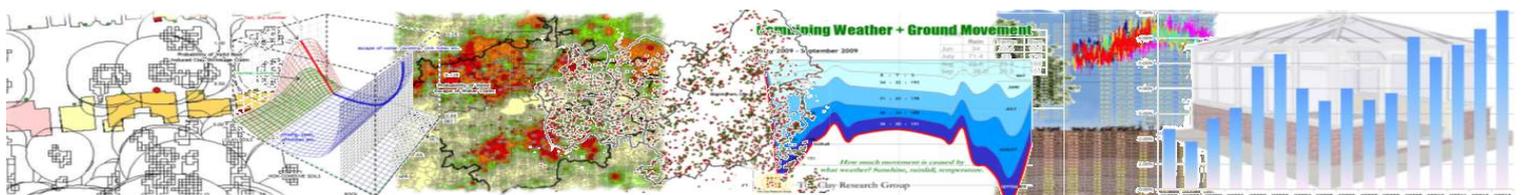
There is a slightly greater than average risk across the district as can be seen from the sector map, right.

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 only.

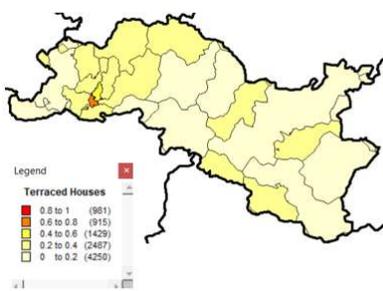


The Clay Research Group

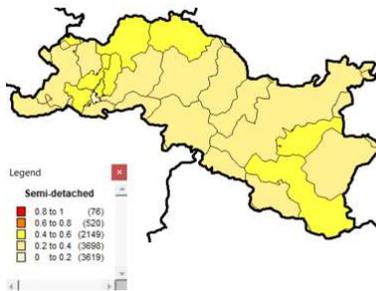
Tunbridge Wells. Properties by Style and Ownership

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.

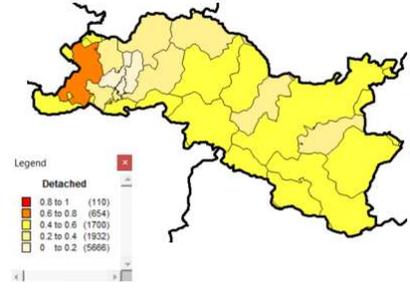
Tunbridge Wells - Distribution by House Type



Terraced



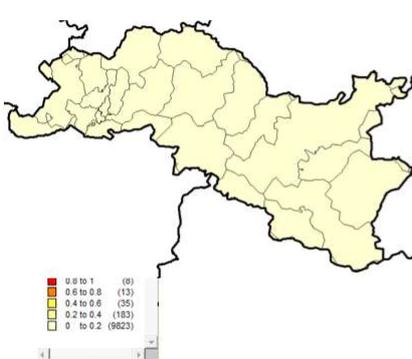
Semi-Detached



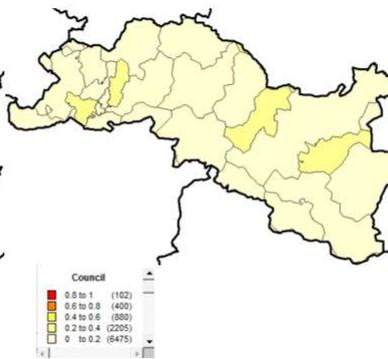
Detached

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

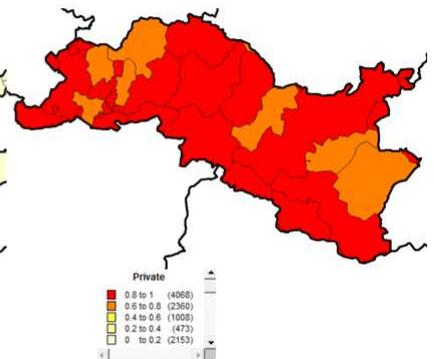
Tunbridge Wells - Distribution by Ownership



Housing Association



Council Ownership



Private Ownership



The Clay Research Group

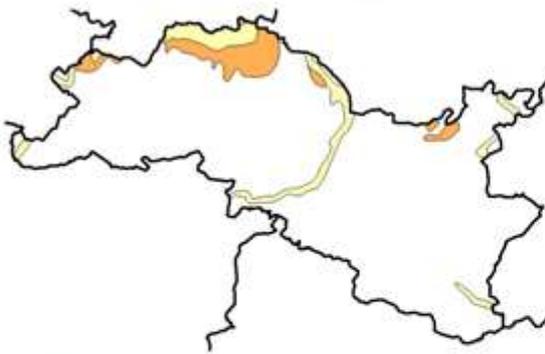
Subsidence Risk Analysis – Tunbridge Wells

Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is around an 80% probability of a claim being valid in the summer and, of the valid claims, there is a similar probability that the damage will have been caused by clay shrinkage. In the winter, the likelihood of a claim being valid drops to around 20% and of the valid claims escape of water is the most likely cause.

A postcode sector map on the following page records the PI of soils retrieved following site investigations from the claims associated with the data held.

Tunbridge Wells : BGS Geology – 1:625,000 scale

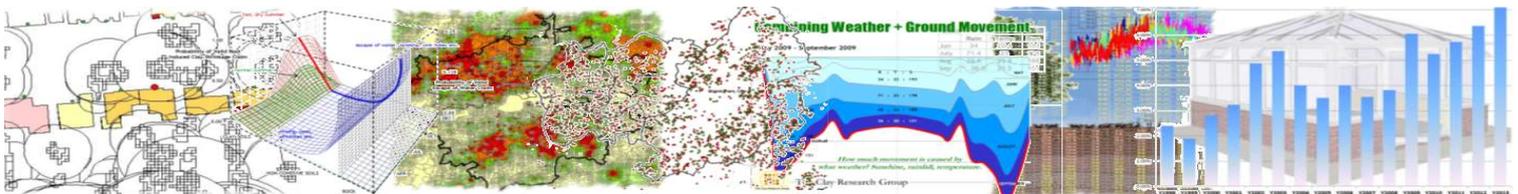


DRIFT DEPOSITS



SOLID GEOLOGY

Above, extracts from the 1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series delivers far greater benefit when assessing risk.

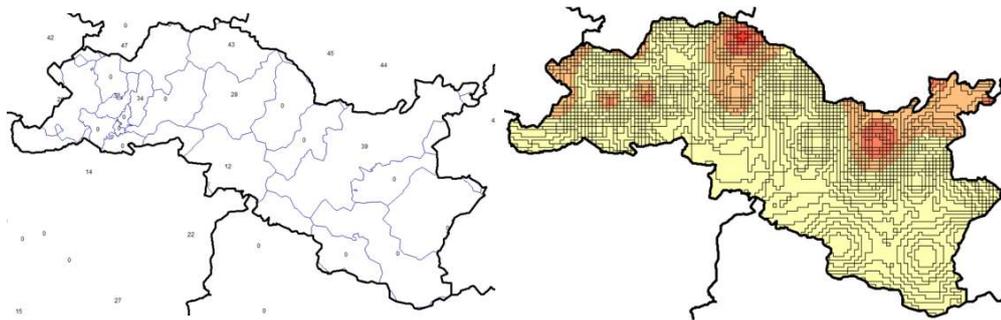


The Clay Research Group

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.

Tunbridge Wells – Soil Plasticity Index

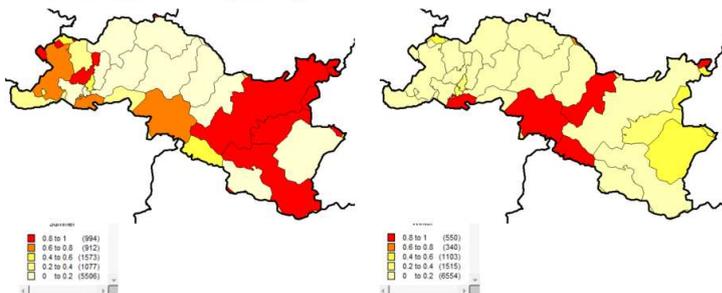


Soil PI Averaged by Sector

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.

Tunbridge Wells – by season



Probability Valid, Summer

Probability Valid, Winter

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

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

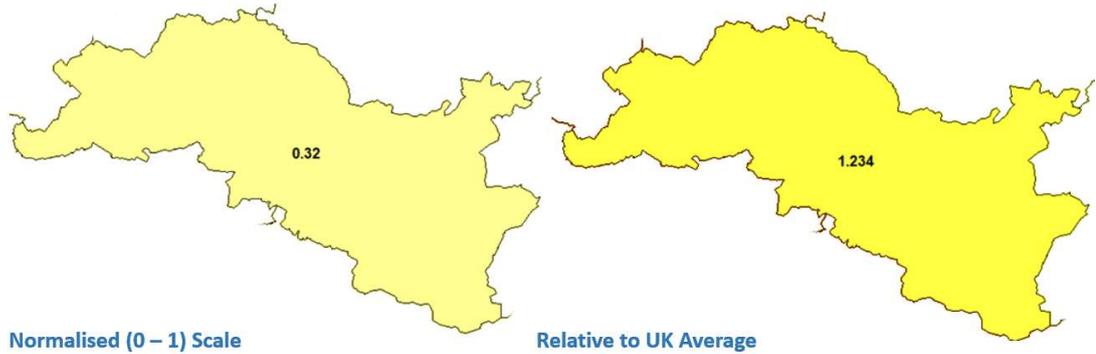
The 'claim by cause' distribution and the risk posed by the soil types is illustrated at the foot of the following page. A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



The Clay Research Group

District Risk. EoW and Council Tree Risk.

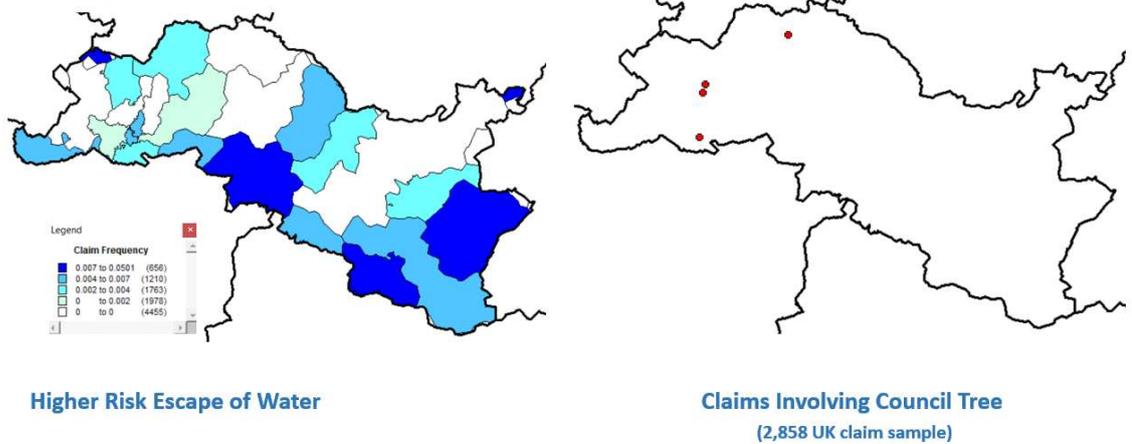
Tunbridge Wells - Subsidence Risk Relative to UK



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.

Tunbridge Wells

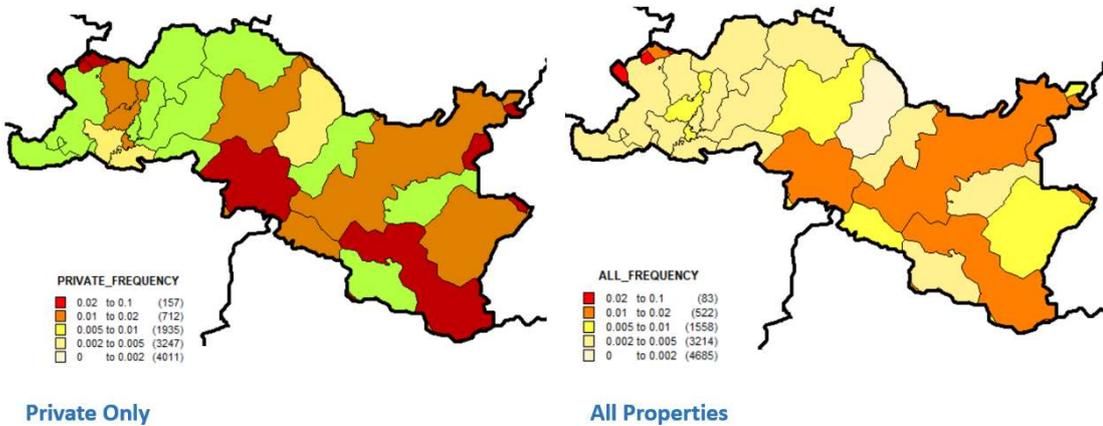


The Clay Research Group

Tunbridge Wells - 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.

Tunbridge Wells - Sector Risk Compared with UK Average



On a general note, a reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is usually low, and in the winter, it is high.

Valid claims in the summer 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 - Tunbridge Wells

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Tunbridge Wells	0.727	0.058	0.215	0.01	0.16	0.83

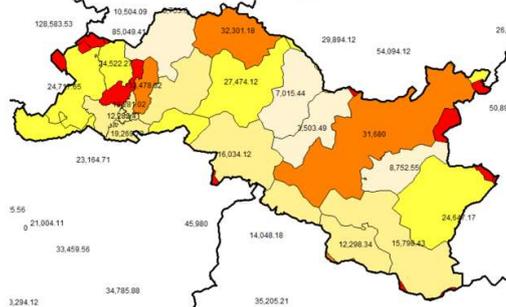


The Clay Research Group

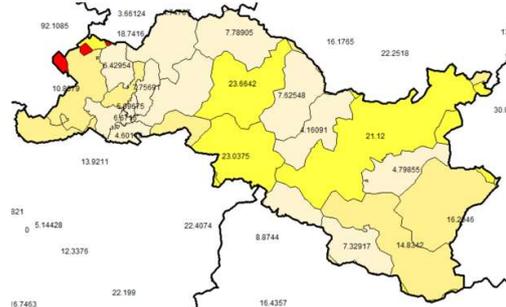
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Normal & Surge Years

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 – Tunbridge Wells



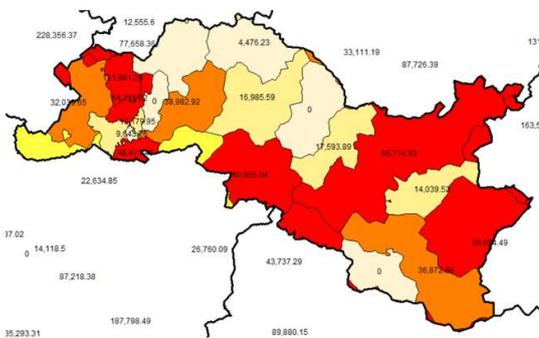
Spend by Sector



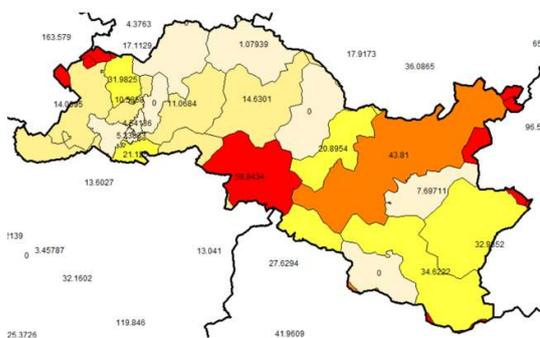
Spend Averaged Over Private Housing Population

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 – Tunbridge Wells



Spend by Sector



Spend Averaged over Private Housing Population



The Clay Research Group

Tunbridge Wells

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.

